IBM Corp.

IBM eServer BladeCenter with Nortel Networks Layer 2-7 Gigabit Ethernet Switching Module
Price/Performance of Integrated vs. External Switching

Test
Summary

Premise: Companies are adopting blade computing to provide a reliable, available and secure computing environment. Integrating high-performance Layer2-Layer 7 switching improves system reliability, enhances performance and scalability, eases deployment, improves manageability and security, and reduces Total Cost-of-Ownership compared with external switch solutions.
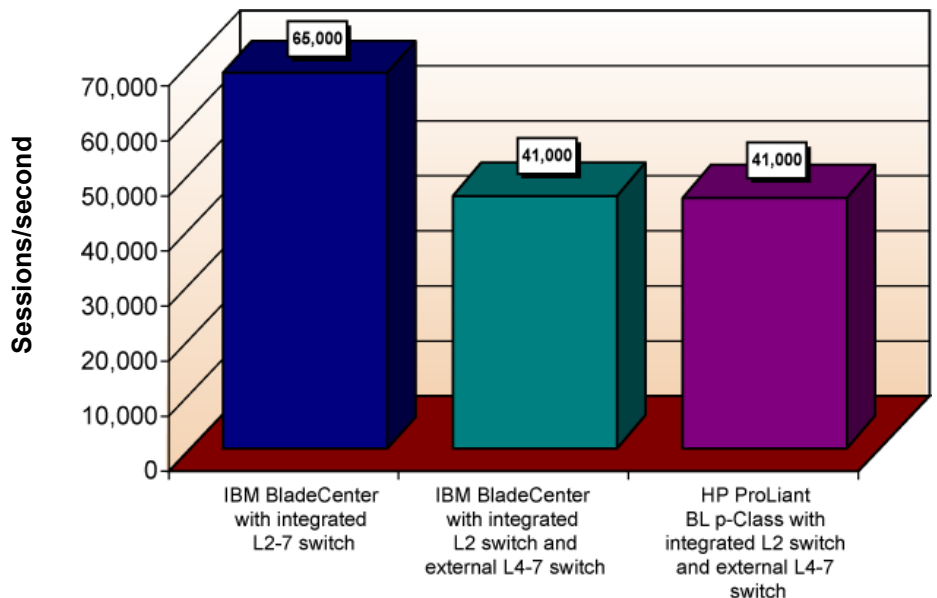
IBM commissioned The Tolly Group to evaluate the competitive price/performance of its IBM eServer BladeCenter outfitted with eight 2.0-GHz server blades and an integrated Nortel Networks Layer 2-7 Ethernet switch module.

The Tolly Group compared the price/performance of the eServer BladeCenter with integrated Layer 2-7 switch module (hereafter IBM Integrated) against two other blade server solutions: the IBM eServer BladeCenter with an integrated Layer 2 switch module and an external Nortel Networks Alteon Application Switch 2216 (hereafter IBM External), and an HP ProLiant BL p-Class blade server solution outfitted with eight 2.8-GHz server blades, an integrated Layer 2 switch module, and an external Nortel Networks Alteon Application Switch 2216 (hereafter HP External).

Test Highlights

❍ IBM BladeCenter with integrated Layer 2-7 LAN switching delivers over 60% greater Layer 4 session performance than either BladeCenter or ProLiant BL with an external Layer 4-7 switch

❍ Costs almost 40% less than an HP ProLiant BL-class blade server outfitted with an external Layer 4-7 switch

❍ Achieves a price-performance that is 60% better than a HP ProLiant BL-class blade server with an external Layer 4-7 switch

❍ Establishes that a blade server with integrated Layer 2-7 switching offers significant (40%) performance and price-performance (60%) advantage over a blade server with integrated Layer 2 switching and external Layer 3-7 switching

Layer 4 Gigabit Ethernet Throughput for Blade Servers
Gigabit Session Rate with GET (66-Byte Object) using Two GbE Links as Reported by IXIA IxWeb

Source: The Tolly Group, November 2003   *Figure 1*

Price Summary					
Description	**Price**				
	Internal switch	**External switch (with warranty)**	**Total switch cost**	**Eight blades & chassis (with warranty)**	**Total solution cost**
	(A)	**(B)**	**(C) = (A+B)**	**(D)**	**(C+D)**
IBM BladeCenter with integrated L2-7 switch	$8,999	$0	$8,999	$34,054	**$43,053**
IBM BladeCenter with integrated L2 switch and external L4-7 switch	$2,199	$30,335	$32,534	$34,054	**$66,588**
HP ProLiant BL p-Class with integrated L2 switch and external L4-7 switch	$4,500	$30,335	$34,835	$34,402	**$69,237**

Note: Pricing obtained in January 2004; list prices in U.S. dollars; Pricing information came from IBM and HP Web sites; Nortel pricing obtained from a corporate sales representative. Prices include 24x7x4 three-year warranty (Although IBM blade servers tested were outfitted with 2.0-GHz processors, all products were priced according to 2.8-GHz prices to provide a fair 'apples-to-apples' comparison with the 2.8-GHz HP equipment.).

Source: The Tolly Group, November 2003   *Figure 2*

All solutions were running Windows Server 2000 with Service Pack 4 and IIS5.

Engineers generated Layer 4 traffic to measure the maximum session-per-second rate for all the solutions under test. The performance results and the total cost per solution were used to quantify each solution's session-rate, price-performance value. Testing was performed in November 2003.

Tests show that the IBM Integrated solution significantly outperforms both the IBM and HP External solutions, and does so at significantly lower cost.

RESULTS

LAYER 4 SESSION THROUGHPUT

Engineers set out to measure the Layer 4 performance of the IBM Integrated solution, versus the performance of the other systems tested with an external Layer 4-7 switch. To quantify their session-processing performance, The Tolly Group measured the maximum number of sessions per second that each configuration could sustain without errors. This zero-error parameter ensured that reliable performance was measured. A session is defined

by a three-way handshake (to establish the connection), an HTTP GET request (requesting a 66-byte object size), a server response, and a two-way TCP teardown.

The IBM Integrated switch achieved a maximum sustained session-per-second rate of 65,000 sessions/second, or about 63% greater than the other solutions. (See Figure 1.) Both the IBM External and the HP External, each with the external Layer 4-7 switch, had session rates measured at 41,000 sessions/second.

Price/Performance

Since an eight-server complex (as in all the systems under test) is likely for eCommerce or a high-end corporate Web or Enterprise application, an applicable metric for this test is maximum sustained session-rate. Additionally, incorporating the total solution cost with the session-rate, delivers a price-performance metric – cost-per-sessions-per-second. Although no formal metric is defined in the industry, using such an approach provides useful insights. Specifically, it allows the reader to make fine comparisons between solutions when both performance results and system prices differ.

With performance numbers in hand, Tolly Group engineers sought out system pricing information to use in establishing a metric that identified the effective "session-per-second" cost of the systems under test then investigated the common market price for the equipment tested. Prices were list U.S. dollars for single systems (meaning no volume discounts) and were current as of 08 January 2004. Both the IBM and HP pricing information was gathered from the respective vendor Web sites, and the Nortel pricing information was gathered from a marketing representative at its corporate headquarters. Product pricing includes a three-year 24x7 warranty with a four-hour response (24x7x4). The Nortel Networks Alteon Application Switch 2216 external Layer 4-7 switch had only a one-year 24x7 warranty, and this value was multiplied by three as to equal all other product warranties.

The IBM Integrated solution carried the lowest overall price at $43,053 – some 40% less than the HP External solution, which was priced at $69,237. (See Figure 2.) A large portion of that pricing delta can be found in the switching cost, where the IBM Integrated solution's switch costs 64% less than the switches that make up the HP External solution (excluding warranty costs).

Next, engineers divided the total system price of each solution by the Layer 4 session rate to determine the session-rate price/performance – or the cost to achieve the per-second session rate described in the Layer 4 throughput test. Here the IBM Integrated solution posted a session-rate price/performance of $0.66 — meaning it costs 66 cents to process each session per second, which is considerably less than half the cost of the HP External solution which has a session-rate price/performance of $1.69 for each session per second. (See Figure 3.)

Analysis

The IBM BladeCenter with its integrated Layer 2-7 GbE switch module offers a far better session-rate price/performance than both the IBM BladeCenter with its integrated Layer 2 GbE switch module and an external Nortel Networks Alteon Application Switch 2216 Layer 4-7 switch, and the HP ProLiant p-Class with its integrated Layer 2 GbE switch module and an external Nortel Networks Alteon Application Switch 2216.

IBM Corp.

IBM eServer BladeCenter with integrated Layer 2-7 switch

Layer 4 Price/Performance

IBM Corp.
eServer BladeCenter
Layer 2-7 Gigabit Ethernet Switching Module
Product Specifications*

Technical Specifications
- 18 Gigabit Ethernet ports plus two Fast Ethernet management ports
- Line rate Layer 2 and Layer 3
- 300,000 concurrent sessions
- 65,000 Layer 4 sessions per second
- 28,000 Layer 7 sessions per second
- 128 IP routing interfaces
- 64 virtual server support
- 1,024 policy filters
- 128 VLANs
- 255 default gateways

Protocol and Standards Compatibility
- IEEE 802.3-2000, 802.1d, 802.2, 802.3x, 802.3z, 802.1Q
- RFC 1213 MIB-II, RFC 1493 Bridge MIB, RFC 1398, RFC 1757 RMON1, RFC 1573 and Alteon Enterprise MIB
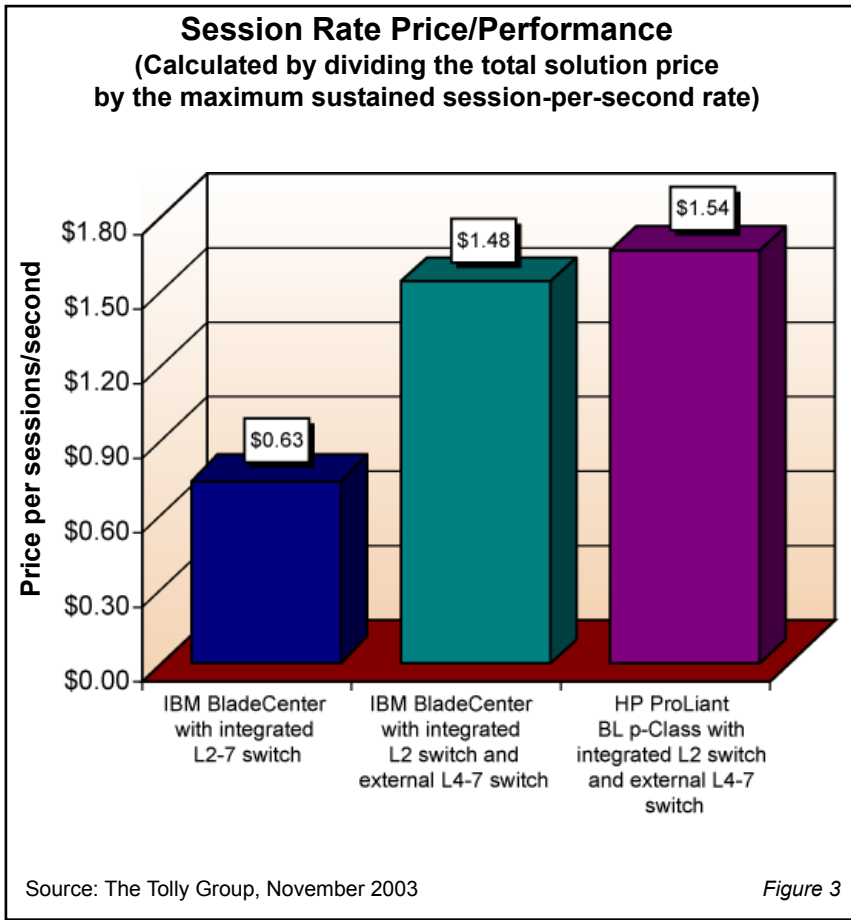
Major Applications
- Load balancing
  - Local server load balancing
  - Application health checks
  - IP, FTP, LDAP, DNS, RTSP and others
  - VPN, Intrusion Detection, WAP, SSL, others
- Redirection
  - SSL, streaming media, cache
- Filtering/Security
  - Layer 2-7
  - VLAN
  - Accept, deny, NAT, redirect
  - Access control
  - DoS attack prevention
- Layer 7 (Content) inspection

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center/blade_servers/

*Vendor-supplied information not verified by The Tolly Group

Session Rate Price/Performance
(Calculated by dividing the total solution price by the maximum sustained session-per-second rate)

Source: The Tolly Group, November 2003   *Figure 3*

Test Configuration and Methodology

For the IBM Integrated solution, The Tolly Group tested an IBM eServer BladeCenter version 8677-1XX outfitted with eight Intel Xeon 2.0-GHz/512 KB (uniprocessor) server blades (for price comparisons the IBM 2.8-GHz prices were used so as not to put HP at an unfair disadvantage), each with 512 MB RAM per blade, 20 GB ATA-100 HD per blade, two Broadcom NetXtreme Gigabit Adapters per blade, and one Gigabit Ethernet expansion card. The BladeCenter chassis was capable of supporting up to 14 server blades, but only eight server blades were used for comparative purposes (the HP ProLiant BL p-Class chassis only holds eight server blades). The IBM eServer BladeCenter also utilized an integrated Nortel Networks Layer 2-7 Ethernet Switch Module ver. 20.0.1.2. An IXIA 400T connected directly to two Gigabit Ethernet (fiber) ports on the integrated Layer 2-7 switch module.

The IBM External solution consisted of the same components and configuration as the IBM Integrated solution, minus the Nortel Networks integrated switch. Instead, this eServer BladeCenter solution consisted of an internal D-Link Systems Layer 2 Ethernet Switch Module rev. 2, and an external Nortel Networks Alteon Application Switch 2216 Layer 4-7 switch ver. 21.0.0.20.

IBM is one of the first, if not the first vendor, to market with this blade-server solution with an integrated Layer 2-7 switch module, which offers a price/performance that will be compelling to many users. Tests show that users can purchase a BladeCenter server that performs very well from a Layer 4 GbE switching perspective without having to make a sizable investment to obtain performance.

While HP or other vendors may argue that they can bolt on a different external Layer 4-7 GbE switch and outperform the IBM BladeCenter integrated solution tested, those companies would be hard pressed to do so and maintain the same price/performance offered by the IBM integrated solution. This is due to the fact that IBM offers the Nortel integrated Layer 2-7 switch module (which is cheaper than most high-performance external Layer 4-7 switches) and you can dispense with the IBM integrated Layer 2 switch. On the other hand, in other vendors' blade server solutions, you still have to pay for the integrated Layer 2 switch and an external Layer 4-7 switch. For sake of completeness, it must be noted that the HP GbE switch offering for the P-Class blade server is upgradeable in future, via mezzanine adapter, to support the full complement of Layer 2-7 switching. In addition, the HP GbE switch offers a choice of fiber and copper GbE uplinks and a future option for 10-Gbps uplinks.

The HP ProLiant BL p-Class blade server came with eight Intel Xeon 2.8-GHz/512 KB (uniprocessor) server blades, each with 512 MB RAM per blade, 36.4 GB SCSI storage per blade, three NC7781 PCI-X Gigabit network adapters, and one 10/100 Mbps network adapter. The HP External solution includes an HP ProLiant BL p-Class Integrated Layer 2 Gigabit EtherSwitch (GbE2) ver. 1.0.1 and an external Nortel Networks Alteon Application Switch 2216 Layer 4-7 switch ver. 21.0.0.20.

The Nortel external Layer 4-7 switch was chosen because HP does not manufacture a Layer 4-7 switch, Nortel is considered a leading player in Layer 4-7 switching, and the use of all Nortel equipment for the Layer 4-7 switching component allows for an easier 'apples-to-apples' comparison of Layer 4-7 switching capabilities.

For both solutions using the external Layer 4-7 switch, the switch was configured to load-balance (using round-robin) the HTTP requests from IXIA IxWeb and direct traffic to the eight servers. The switch's Spanning Tree feature was turned off.

The eight server blades for all solutions tested were running Microsoft Windows 2000 Server ver. 5.0.2195 with Service Pack 4 and Microsoft IIS 5. The Spanning Tree feature on each of the switches was disabled for the test. All Gigabit Ethernet ports were set to 1000-Mbps full duplex and the Fast Ethernet ports were set to 100-Mbps full duplex.

Price/Performance Summary	
Competitive configuration	**Price/performance advantage of IBM BladeCenter Integrated solution over competitive configurations**
IBM BladeCenter with integrated L2 switch and external L4-7 switch	**135%**
HP ProLiant BL p-Class with integrated L2 switch and external L4-7 switch	**144%**

Source: The Tolly Group, November 2003   *Figure 4*

To quantify the price/performance of the blade server solutions, engineers performed a Layer 4 test to measure the maximum session/second rate for each device; results were recorded along with the system's total cost. Ixia's IxWeb was used to generate real HTTP 1.0 sessions, which were processed by actual blade servers resident in each system under test using a round-robin algorithm. HTTP 1.0 was used because it stresses the session capacity more (since there are more session setups/teardowns) and it is still the more common HTTP session protocol used. A session was defined by a three-way handshake (to establish the connection), an HTTP GET request, a server response, and a two-way TCP teardown. The object requested by the HTTP GET requests was a 66-byte object (a graphics interchange format file — .gif).
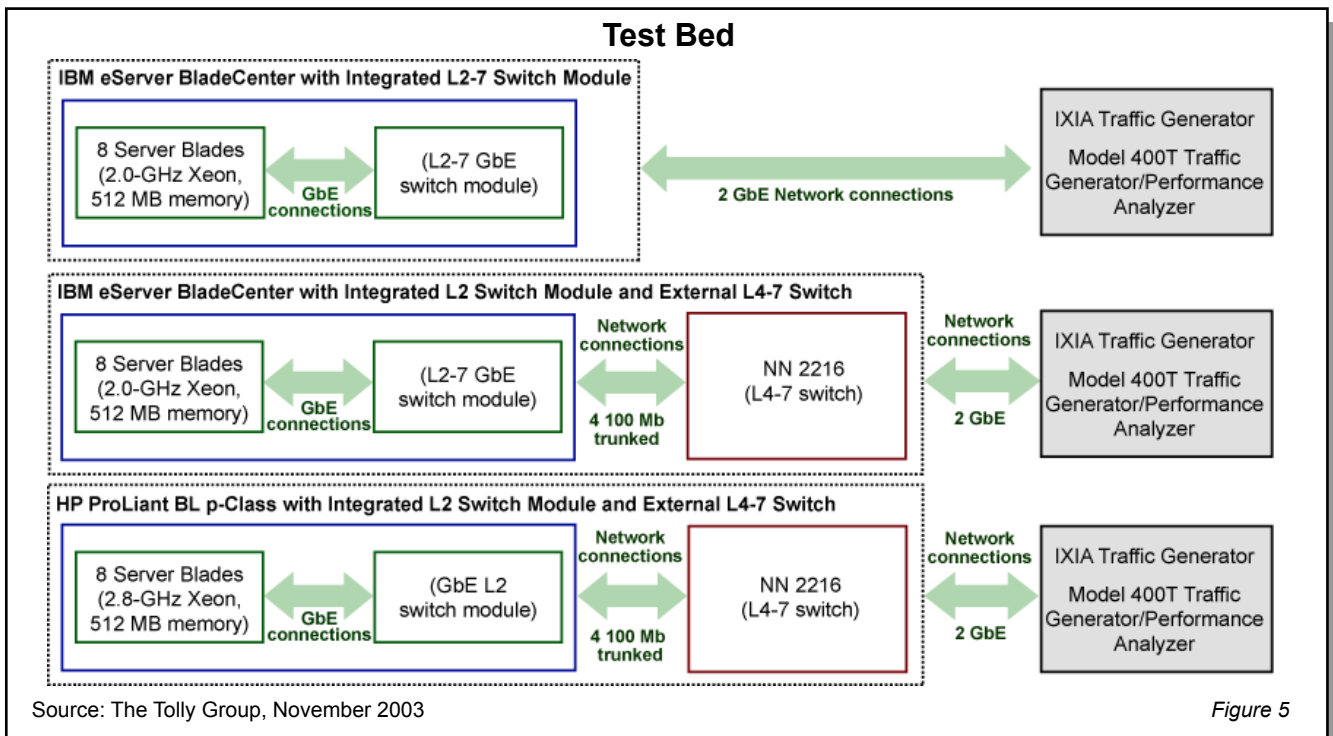
The maximum sessions/second for the devices tested was determined by the maximum rate at

which the tested device was able to respond to the HTTP requests without errors.

Equipment Acquisition and Support

The IBM eServer BladeCenter and integrated Nortel Networks switch were provided by IBM for testing purposes, along with the HP ProLiant BL p-Class blade server and the external Nortel Networks Alteon Application Switch 2216 Layer 4-7 switch.

The Tolly Group verified product release levels and shared test configurations with HP in order to give the company an opportunity to optimize its devices for the tests. The Tolly Group shared the test methodology with HP and also furnished HP with results of the company's product tested. HP executives elected not to comment on the test results in the allotted timeframe.
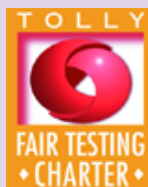
Test Bed

IBM eServer BladeCenter with Integrated L2-7 Switch Module

8 Server Blades (2.0-GHz Xeon, 512 MB memory) — GbE connections → (L2-7 GbE switch module) — 2 GbE Network connections ↔ IXIA Traffic Generator Model 400T Traffic Generator/Performance Analyzer

IBM eServer BladeCenter with Integrated L2 Switch Module and External L4-7 Switch

8 Server Blades (2.0-GHz Xeon, 512 MB memory) — GbE connections → (L2-7 GbE switch module) — Network connections / 4 100 Mb trunked → NN 2216 (L4-7 switch) — Network connections / 2 GbE ↔ IXIA Traffic Generator Model 400T Traffic Generator/Performance Analyzer

HP ProLiant BL p-Class with Integrated L2 Switch Module and External L4-7 Switch

8 Server Blades (2.8-GHz Xeon, 512 MB memory) — GbE connections → (GbE L2 switch module) — Network connections / 4 100 Mb trunked → NN 2216 (L4-7 switch) — Network connections / 2 GbE ↔ IXIA Traffic Generator Model 400T Traffic Generator/Performance Analyzer

Source: The Tolly Group, November 2003

Figure 5

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

Vendor	Product	Web address
Ethereal	Ethereal Traffic Capture	http://www.ethereal.com
Ixia	IXIA 400T Traffic Generator	http://www.ixiacom.com
Ixia	IxWeb	http://www.ixiacom.com

PERFORMANCE VERIFIED By IXIA

Tolly Group Services

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For info on the Fair Testing Charter, visit: http://www.tolly.com/Corporate/FTC.aspx

Project Profile

Sponsor: IBM Corp.
Document number: 204104
Product class: Blade server with integrated switching
Products under test:
- IBM eServer BladeCenter Ver. 8677-1XX with integrated Nortel Networks Layer 2-7 Ethernet Switch Module ver. 20.0.1.2
- IBM eServer BladeCenter Ver. 8677-1XX with internal: D-Link Systems Layer 2 Ethernet Switch Module ver. 21.0.0.20 and external Nortel Networks Alteon Application Switch 2216
- HP ProLiant BL p-Class with Integrated Layer 2 Gigabit Switch ver. 1.0.1 and external Nortel Networks Alteon Application Switch 2216

Testing window: November 2003
Software status:
- Generally available

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