THE TOLLY GROUP

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NETGEAR™ Inc.

ProSafe® GSM7224R Managed Switch

Competitive Performance Evaluation and "Tolly Verified" Validation vs. HP ProCurve Switch 2824 and Linksys SGE2000

TOLLY Up to Spec CERTIFIED Test Summary

Premise: When considering the purchase of fixed-port standalone Ethernet switches in small- to medium-businesses (SMBs), entry-level enterprise, mid-market and branch office networks, IT decision makers need to know the bidirectional Layer 2 throughput, energy usage, total cost of ownership and feature/functionalities that prospective switches offer.

NETGEAR commissioned The Tolly Group to evaluate its fully managed 24-port ProSafe® GSM7224R Gigabit Ethernet Switch to quantify its Layer 2, zero-loss, bidirectional throughput, evaluate the cost of ownership and verify key features and functions.

Tolly Group engineers compared the performance of the NETGEAR switch against an HP ProCurve Switch 2824 and a Linksys SGE2000.

In addition to measuring zero-loss throughput, Tolly Group engineers validated a wide array of features covering Layer 2 functions, management, security, Quality of Service (QoS), routing and multicast capabilities.

Features and functions were validated under the auspices of The Tolly Group's Tolly Verified (TV) program. In all, the NETGEAR earned more than a dozen TV certifications. Tests were conducted in August 2008.

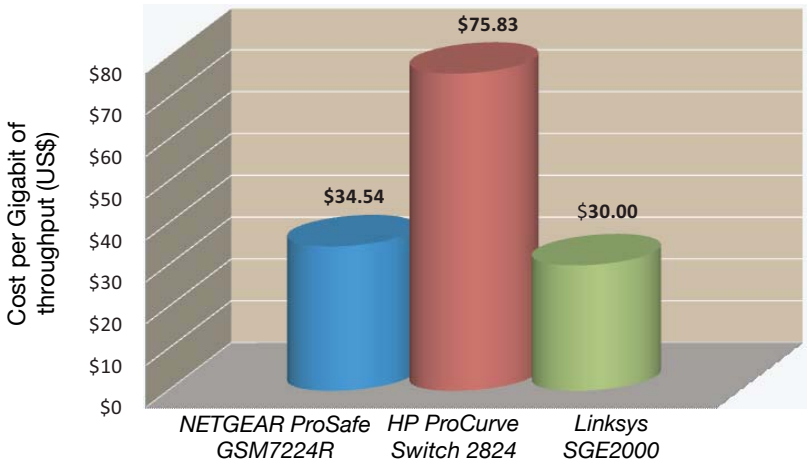
Test Highlights

- GSM7224R fully managed switch offers a comprehensive Layer 2 feature set with static routing (Layer 3) as an add-on value
- Costs half as much to deliver a Gigabit of throughput than the HP ProCurve Switch 2824
- Uses 13% to 38% less energy than the Linksys SGE2000 or the HP ProCurve Switch 2824
- Offers superior scalability and a broader feature set than the HP and Linksys switches tested

Cost of Delivering Gigabit Throughput

Using performance data from Ixia Optixia XM2 and IxNetwork

Lower bars are better



Note: Cost per Gigabit of throughput was derived by taking the average throughput of all frame sizes tested and dividing it into the retail cost of the three products tested. Prices were obtained from cdw.com during the week of 18 August 2008.

Source: The Tolly Group, August 2008

Figure 1

Executive Summary

Tests show that NETGEAR's GSM7224R fully managed switch costs half as much as the HP switch to deliver a Gigabit of throughput, while also using 13% to 38% less energy than Linksys and HP switches tested, respectively, while delivering a broad set of features/functionality.

Tolly Group tests show that NETGEAR's GSM7224R 24-port managed switch should be especially appealing to small and medium businesses (SMBs), and to small and medium enterprises, since it delivers line-rate, zero-loss throughput of 24 Gbps, while also consuming less power compared to HP and Linksys switches tested.

Tests show that to deliver just a Gigabit of throughput, the NETGEAR GSM7224R and Linksys SGE2000 switches cost almost the same. However, the GSM7224R offers a cost-per-Gigabit of throughput that is half as much as the HP ProCurve Switch 2824.

For cost-conscious network managers, this shows that the NETGEAR switch not only offers optimal performance, but does so at a price point either on par with, or less than, rival products.

But performance is only part of the overall total cost of ownership picture.

Tolly Group tests show that the GSM7224R uses 13% to 38% less power, which translates into lower overall operational costs to power the switch and for associated cooling costs.

Finally, The Tolly Group's hands-on evaluation showed the NETGEAR offers a broad set of features and functions that were validated under Tolly Verified certification program.

Inclusion of management, advanced security, Quality of Service (QoS), static routing and multicast snooping capabilities reveals that the GSM7224R delivers an expansive set of capabilities to help SMB-class users manage and secure their networks.

The support of eight traffic queues when using QoS, versus just four queues with the HP and Linksys devices, means that users have greater flexibility to guarantee bandwidth to strategic applications during congestion situations.

Support for access control lists (ACLs) and storm control (broadcast, multicast and unknown-unicast) gives users the type of capabilities normally reserved for medium- and large-scale businesses.

Support for Spanning Tree, Rapid Spanning Tree, Multiple Spanning Tree protocols means that users will be able to guard against network failures and rebound quickly from link outages.

Further, support link aggregation allows users to bundle multiple physical ports into high-bandwidth uplinks.

Performance

Layer 2 Bidirectional Zero-loss Throughput

The Tolly Group validated Layer 2 zero-loss throughput on the NETGEAR GSM7224R switch for frame sizes of 64, 512, and 1,518 bytes.

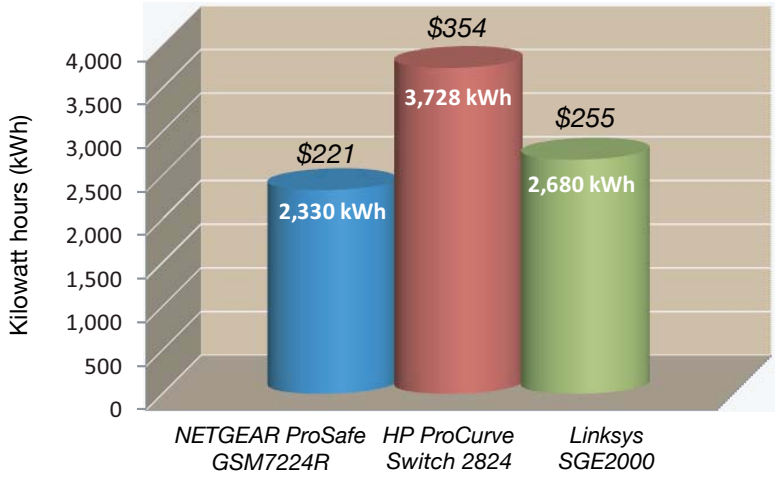
Measurements were taken across 24 GbE ports on the switches under test configured in a full-mesh scenario with an Ixia Optixia XM2.

In every instance, the NETGEAR switch achieved 100% of the theoretical maximum zero-loss throughput, delivering 24 Gbps of throughput. The HP ProCurve and the Linksys switches also achieved 100% of zero-loss throughput, as well.

However, where the products begin to diverge is when users look at the cost

Switch Power Consumption and Operational Cost Forecast Over a Five-Year Period

Lower bars are better



Note: Five-year operational costs shown above bars. Engineers multiplied the total watts over the five-year period by the U.S. national average price of $0.095 per kilowatt hour (taken from the U.S. Energy Information Administration). Total operational cost includes power for switch operation and for cooling.

Source: The Tolly Group, August 2008

Figure 2

of delivering a Gigabit of throughput. Engineers divided the street price of each switch into the aggregate throughput result to achieve a cost per Gigabit of throughput delivered. Prices for the NETGEAR, HP and Linksys switches were derived from Web retailer cdw.com (CDW Corp.) the week of 18 August 2008.

The NETGEAR GSM7224R cost $35 to deliver a Gigabit of throughput, which was on par with the Linksys SGE2000 that cost $30 to deliver the same throughput. (See Figure 1.)

The HP ProCurve Switch 2824 cost almost 2X more to deliver one Gigabit of throughput — at a cost of $76.

Power Consumption

Tolly Group engineers measured the total power consumed (watts) by each of the three switches while handling line-rate traffic.

Tests show that the NETGEAR GSM7224R used the least amount of power of the three switches tested — just 40 watts during a one-minute traffic snapshot.

By comparison, the Linksys SGE2000 consumed 13% more power (46 watts), while the HP ProCurve Switch 2824 consumed 38% more power (64 watts).

Engineers then converted the power consumption results to kilowatt hours and projected the five-year cost to power and cool the switches. (See Figure 2.)

Tolly Group engineers then computed the cost of operating each of the switches over a five-year period. Engineers multiplied the energy consumed (in kWh) over the five-year period by the U.S. national average industrial retail price of $0.095 per kilowatt hour (taken from the U.S. Energy Information Administration).

Forecasts show that to power and cool the NETGEAR GSM7224R users would spend $221 over the five-year period.

By contrast, the Linksys SGE2000 would cost $255 over five years to power the switch and to cool it, while the HP ProCurve Switch 2824 would cost $354.

Functionality Evaluation

Rapid Spanning Tree Support (802.1w) (TV 10507)

This certification verifies that the NETGEAR GSM7224R can reconfigure its Layer 2 Spanning Tree tables using the IEEE 802.1w "rapid" option.

Tests show that the GSM7224R demonstrated the ability to detect a failure of the Layer 2 Spanning Tree via the Rapid Spanning Tree protocol and established a new Layer 2 "tree."

This approach provides a quicker re-establishment of traffic paths in networks where multiple data paths exist, and dramatically reduces user downtime when compared with the recovery mechanism of traditional 802.1D spanning tree devices.

Multiple Spanning Tree Protocol Support (IEEE 802.1s) (TV 10834)

This verifies that the GSM7224R implements the IEEE 802.1s Multiple Spanning Tree protocol to implement multiple Spanning Tree instances on the same switch to eliminate loops and reconverge the network following a link failure.

Medium and large business networks employing a large number of virtual LANs (VLANs) benefit from the implementation of separate Spanning Tree instances to selectively allow or block multiple VLANs on a switch port, without blocking the entire traffic on a switch port.

Spanning Tree Protocol Support (TV 10833)

This certification verifies that the device tested implements the IEEE

NETGEAR Inc.

GSM7224R

Layer 2, Zero-loss Throughput and Feature/ Functionality Verification

Product Specifications

Vendor-supplied information not necessarily verified by The Tolly Group

NETGEAR, Inc.

GSM7224R

Benefits:

- Fully managed Gigabit Ethernet switch
- 24x10/100/1000 copper + four 1GbE SFP fiber ports
- Comprehensive Layer 2 feature and static route
- Full lifetime warranty

Feature & Performance:

- 48 Gbps switching capacity and 35.7 Mpps throughput
- 32 static routes supported
- 8K MAC and 512 VLANs
- Advanced QoS with eight priority queues, 802.1p, ToS and DiffServ
- High availability with 802.1d, RSTP and MSTP
- Static and dynamic LAGs with LACP (802.3ad)
- Layer 2 (IGMP Snooping) and Layer 3 (IGMP Querier) multicast

Security:

- Advanced Security with Access Control Lists and Broadcast Storm Control
- SSLv3/SSH v1.3, v2
- SNMP v1, v2 and v3

Management:

- Industry-standard comprehensive command line interface (CLI)
- Industry-leading ProSafe Control Center Web-based GUI

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802.1D Spanning Tree protocol. Tests show that the NETGEAR GSM7224R switch successfully blocked redundant links to an adjacent switch, and could reconfigure the network in the event of a failure of the active link.

Switch Management Interfaces (TV 10572 , 10843)

For fully managed switching products, it is very critical for customers to know if the switch supports a standards- based comprehensive command line interface (CLI). It is also very critical that a fully managed switch provides options to manage the device from a Web-based interface.

Engineers verified that the NETGEAR GSM7224R and HP ProCurve 2824 supported both CLI and Web-based GUI options. However, the Linksys SGE2000 switch doesn't have a CLI interface. Instead, customers must use a menu-driven interface that has limited configuration capabilities, or use the Web-based GUI.

QoS - Eight Traffic Queues(TV 10587)

This certification verifies that a device is capable of segmenting QoS traffic into eight unique and separate queues.

Tests show that the NETGEAR GSM7224R supports eight QoS traffic queues, while the HP and Linksys devices tested support just four traffic queues each.

The greater number of traffic queues means that NETGEAR can offer a more granular level of traffic prioritization, so latency-sensitive applications such as voice and video are guaranteed the bandwidth they need even during periods of congestion.

Link Aggregation (TV 10835)

This certification verifies that

Feature Comparison Chart

	NETGEAR GSM7224R	HP ProCurve 2824	Linksys SGE2000
Management			
Web	✓	✓	✓
CLI	✓	✓	X
Layer 2			
Number of VLANs	512	256	256
802.1d Spanning Tree	✓	✓	✓
802.1w (RSTP)	✓	✓	✓
802.1s (MSTP)	✓	✓	✓
802.3ad (LACP)	✓	✓	✓
Security			
Access control lists (ACLs)	✓	Port-filtering only	✓
Storm control	✓	Broadcast-limiting only	✓
QoS			
Number of QoS queues	8	4	4
Routing			
Static routes supported	32	16	128*
Multicast			
IGMP snooping	✓	✓	✓
IGMP Querier	✓	✓	X

Note: * Due to test time constraints, Tolly Group engineers validated 20 static routes for the Linksys SGE2000; vendor data sheets indicate the product can support up to 128 static routes.

Source: The Tolly Group, August 2008

Figure 3

the NETGEAR GSM7224R implements standards-based link aggregation (IEEE 802.3ad), thus providing the ability to increase the switch-to-switch throughput by aggregating multiple links into one logical interface. In the test, Tolly Group personnel verified that traffic was distributed evenly over the aggregated links.

IGMP Snooping (TV 10786)

This certification verifies that the NETGEAR GSM7224R implements IGMP snooping allowing it to monitor IGMP traffic to keep track of the nodes on the network joining and leaving IGMP Multicast Groups.

This means that the switch can direct multicast traffic only to the members of the appropriate multicast group instead of broadcasting it to all ports. This makes a more efficient use of the bandwidth in a network and minimize congestion.

IGMP Querier (TV 11114)

This test verified that the NETGEAR GSM7224R can be configured as the IGMP Querier. This means that the switch can act as the IGMP Querier on a VLAN that does not require multicast traffic to be routed, thereby eliminating the need to have a multicast router or configure any multicast routing protocols (PIM SM, DVMRP, etc.) in that switch. This feature is particularly useful for smaller networks by giving the administrator more flexibility in configuring multicast traffic.

IPv4 - Static Route Support (TV 10881)

This test verified that the GSM7224R allows users to define static IPv4 routes manually. Tests show the NETGEAR device supports up to 32 static routes, versus 16 routes for the ProCurve Switch 2824.

Test Setup & Methodology

Tolly Group engineers tested the NETGEAR GSM7224R, a 24-port managed GbE switch supporting software version 7.2.0.5. Engineers also tested an HP ProCurve Switch 2824 supporting software version I.10.43, and a Linksys SGE2000 supporting software version 1.0.0.45.

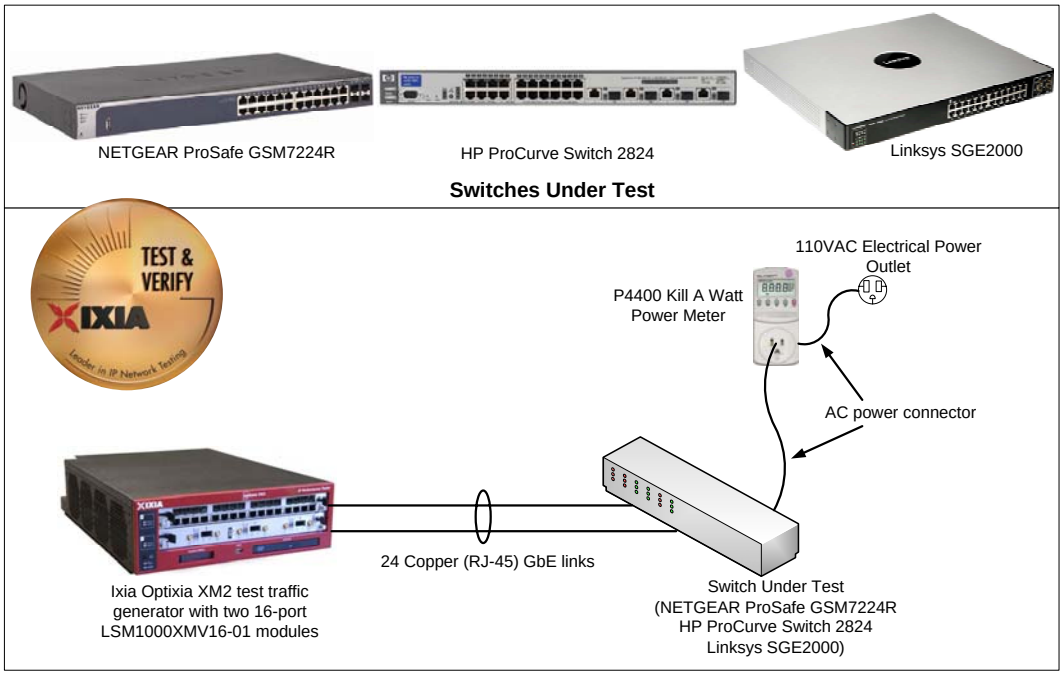
For the purposes of testing, the GSM7224R and other switches tested were connected to an IXIA Optixia XM2 using 24 10/100/ 1000 BASE-T ports to measure throughput.

For the zero-loss throughput testing, engineers sent bidirectional Layer 2 unicast streams at full line rate from the 24 GbE test ports using 64, 512, and 1,518-byte frames. Engineers configured the test ports in a full-mesh topology, meaning every switch port sent and received traffic from every other port.

Throughput tests were run three times each, and the results averaged to obtain the final result.

Engineers attached a P3 International P4400 Kill a Watt power meter to the test network (inline between the switch and the power source) and measured the watts used by the devices under test during a one-minute snapshot of line-rate traffic being passed through the device.

Test Bed Diagram



Source: The Tolly Group, August 2008

Figure 4

Engineers measured the power consumption (watts) over a one minute duration. This measurement was converted into kWh using the formula kWh=W/1000, assuming that the power consumption W was constant over a one-hour duration. The cost of one kWh in the state of California was obtained as $0.095 from the U.S. Dept. of Energy, Energy Information Administration site:

http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html.

The cost of cooling a server was assumed to be one-third of the power required to operate the switch.

The five-year operating expense to operate and cool the switch was calculated using the formula:

(0.095*(kWh*24*5*365 + 0.33*kWh *24*5*365))

For details on the methodology used for any of the TV certifications, visit The Tolly Group's TV Web page at:

http://www.tolly.com/TV_Home.aspx.

Fair Testing Charter™
Interaction with Competitors

The Tolly Group reached out to Linksys, a division of Cisco; and HP ProCurve Networking, with an invitation to participate in the testing, under the auspices of The Tolly Group's Fair Testing Charter (http://www.tolly.com/FTC.aspx). As part of the interaction, they were provided with the test plan and device software/hardware version information. Linksys and ProCurve responded with suggested switch software levels to be used for testing. HP ProCurve also suggested to enable "qos-passthrough-mode" on its switch for optimal performance, and Tolly Group engineers implemented the suggestion. Test results for their respective devices were shared with Linksys and ProCurve for their review and comments. Linksys and HP ProCurve representatives indicated that they did not have any comments on the results.

Test Equipment Summary

Vendor	Product	Web URL:
Ixia	IxNetwork, Optixia	http://www.ixiacom.com
P3 International	P4400 Kill a Watt	http://www.p3international.com

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