EXECUTIVE SUMMARY

Stackable L2/L3 managed switches provide scalability and flexibility in a compact form factor. While high-performance is mandatory for such devices, acquisition costs and power efficiency are important considerations as well.

D-Link Systems commissioned Tolly to evaluate its xStack DGS-3620-52P switch running the Enhanced Image and compare that to a Cisco Systems Catalyst 3560-X switch. Tests were conducted using 48 Gigabit Ethernet ports at both layer 2 and layer 3 and included ATIS power consumption measurements.

The D-Link Systems switch matched the performance of the Cisco Systems Catalyst across all the performance tests. In addition, the D-Link DGS-3620 has a significantly lower purchase price and consumes much less power than the Cisco Systems Catalyst 3560-X. ...<continued on next page>

THE BOTTOM LINE

The D-Link DGS-3620 delivers:

1. Line-rate throughput across all 48 ports – equivalent to the Cisco Systems Catalyst 3560
2. Latency that is comparable to or lower than the Cisco Systems switch
3. Cost-per-Gigabit that is 28% lower than the Cisco Systems switch
4. Power consumption that is 45% lower than the Cisco Systems switch using the ATIS model
Both switches under test provide fixed configurations of 48 Gigabit Ethernet ports. The D-Link also offers support for four Gigabit SFP or 10GbE SFP+ ports. While switches were tested with single power supply, both supported a second power supply. While both switches provide Power over Ethernet (PoE), that feature was not tested. See The Test Methodology section for additional details about the systems under test and the specifics of the tests.

L2 Throughput and Latency

Industry-standard RFC 2544 Throughput tests of multiple frame sizes, from 64-bytes to 1518-bytes, proved that the D-Link DGS-3620 switch delivers the same line-rate L2 throughput as the competing switch. See Figure 1.

Similarly, latency tests showed that the D-Link switch delivered better or equivalent latency when compared with the Cisco Systems switch. See Figure 2.

L3 Throughput and Latency

Industry-standard RFC 2544 Throughput tests of multiple frame sizes, from 64-bytes to 1518-bytes, proved that the D-Link switch delivers the same line-rate L3 throughput as the competing switch. See Figure 3.

Similarly, latency tests showed that the D-Link switch delivered better or equivalent latency when compared with the Cisco Systems switch. See Figure 4.

Cost Per Gigabit

Tolly engineers also evaluated the relative cost of the switches by calculating the cost-per-gigabit-per-second of throughput.

As tested, the D-Link switch had a cost of $6,589.98 while the Cisco Systems switch had a cost of $9,209.99. This cost did not include any additional features or maintenance.

Dividing each of these values by the 48 wire-speed ports gave a cost per Gigabit per second of throughput value of $191.87 for Cisco Systems and $137.29 for D-Link - The D-Link cost being 28% lower than the Cisco Systems Catalyst switch. See Table 1.

In addition to the 48 ports, the D-Link switch provides 4 10GbE slots that can be used for stacking or aggregation.
Layer 3 IPv4 Gigabit Ethernet Switch Throughput
Across 48 Ports in a Full-Mesh Configuration
(as reported by Ixia IxNetwork 7.40)

![Throughput Chart]

Source: Tolly, January 2015

Figure 3

Layer 3 IPv4 Gigabit Ethernet Switch Average Latency (μsec)
Across 48 Ports in a Full-Mesh Configuration
(Lower numbers are better)
(as reported by Ixia IxNetwork 7.40)

![Latency Chart]

Source: Tolly, January 2015

Figure 4
ATIS Power Consumption

Finally, Tolly engineers evaluated the power consumption of the two switches. The ATIS approach dictates that the power consumption of the switch be measured at different levels of activity. A lower ATIS value is a better result indicating lower power consumption.

The ATIS value for the Cisco Systems Catalyst switch was 128.03 compared to only 70.88 for the D-Link DGS-3620. This represents 45% lower power consumption for the D-Link switch. The lower power consumption of the D-Link switch provides long-term benefits to the total cost of ownership for the system.

Test Setup & Methodology

Switches under test were managed L2/L3 switches and provided at least 48 ports of Gigabit Ethernet (1000Base-T) connectivity. See Table 2.

All performance testing used 48 ports. Default device configurations were used as the basis for all tests. L3 test required basic IPv4 routing configurations for each device.

Performance

All tests were run using Ixia’s IxNetwork 7.40 running on a Microsoft Windows 7 system. Two Ixia Optixia XM2 chassis were outfitted with copper Gigabit Ethernet ports. The Optixia chassis ran IxServer 6.8.

L2/L3 Throughput & Latency Tests

The Ixia RFC 2544 templates were used for all throughput and latency tests. All tests were run using the following frame sizes: 64-, 256-, 512-, 1024-, 1280-, and 1518-bytes of full-mesh layer 2 or layer 3 traffic as appropriate. All tests were run three times for a duration of one minute each. The average of the three runs was reported.

For the throughput test, the constant loading traffic profile was used with a loss tolerance of zero percent.

For the latency test, the constant loading traffic profile was used and the rate was set to 100%. Store and forward latency was measured.

Cost Per Gigabit

Cost per gigabit per second of throughput was calculated by taking price of the system and dividing it by the system throughput. Since both devices delivered wire-speed throughput at all frame/packet sizes, the throughput value was 48 Gbps.

No maintenance, power, taxes or other costs were included in the calculation. For the cost listed, D-Link includes a lifetime, next-business-day warranty. Prices as listed at PC Mall website as of February 5, 2015.

Power Consumption

ATIS

Tolly engineers benchmarked the power consumption of each solution using 48 Gigabit Ethernet ports and one power supply. PoE was not tested.

Testing was conducted in accordance with ATIS document ATIS-0600015.03.2009 - Energy Efficiency for Telecommunication Equipment: Methodology for Measurement and Reporting for Router and Ethernet Switch Products. In the ATIS calculation, a lower value is better.
Power was measured using a WattsUp Pro power meter.

**Relative Performance Calculation**

To calculate how much better one solution is than another, the formula used is 1 - (N1/N2) where N1 is the better result and N2 is the worse result. This is multiplied by 100 to give the percentage benefit.

### Managed, L2/L3 Gigabit Ethernet Switches Under Test

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
<th>Description</th>
<th>Vendor SKU</th>
<th>PC Mall Part #</th>
<th>PC Mall Price</th>
<th>Firmware</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-Link Systems</td>
<td>xStack DGS-3620-52P</td>
<td>52-port Gigabit Ethernet PoE Managed Switch</td>
<td>DGS-3620-52P with Enhanced Image(EI) upgrade</td>
<td>Switch: 8843747, EI upgrade: 9285361</td>
<td>$6,589.98</td>
<td>2.60.016 (Hardware version B1)</td>
<td>One power supply. Tested with 48 ports.</td>
</tr>
<tr>
<td>Cisco Systems</td>
<td>Catalyst 3560X-48P-E</td>
<td>48-Port Gigabit Ethernet PoE Managed Switch</td>
<td>WS-C3560X-48P-E</td>
<td>9107763</td>
<td>$9,209.99</td>
<td>12.2 (Hardware V06)</td>
<td>One power supply. Tested with 48 ports.</td>
</tr>
</tbody>
</table>

Note: PC Mall (pcm.com) price as of 2015-02-05. Pricing for unit as listed only, no additional maintenance. For the price above, D-Link provides a lifetime/next-business-day warranty. Both switches support an additional power supply and provide PoE (not tested).

Source: Tolly, January/February 2015

### Test Equipment Summary

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

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
<th>Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemon</td>
<td>Cable Infrastructure</td>
<td><a href="http://www.siemon.com">http://www.siemon.com</a></td>
</tr>
</tbody>
</table>
About Tolly
The Tolly Group companies have been delivering world-class IT services for more than 25 years. Tolly is a leading global provider of third-party validation services for vendors of IT products, components and services.

You can reach the company by E-mail at sales@tolly.com, or by telephone at +1 561.391.5610.

Visit Tolly on the Internet at: http://www.tolly.com

Interaction with Competitors
In accordance with Tolly's Fair Testing Charter, Tolly personnel invited representatives from Cisco Systems to participate in the testing. Cisco Systems did respond to the invitation.

For more information on the Tolly Fair Testing Charter, visit: http://www.tolly.com/FTC.aspx

Terms of Usage
This document is provided, free-of-charge, to help you understand whether a given product, technology or service merits additional investigation for your particular needs. Any decision to purchase a product must be based on your own assessment of suitability based on your needs. The document should never be used as a substitute for advice from a qualified IT or business professional. This evaluation was focused on illustrating specific features and/or performance of the product(s) and was conducted under controlled, laboratory conditions. Certain tests may have been tailored to reflect performance under ideal conditions; performance may vary under real-world conditions. Users should run tests based on their own real-world scenarios to validate performance for their own networks.

Reasonable efforts were made to ensure the accuracy of the data contained herein but errors and/or oversights can occur. The test/audit documented herein may also rely on various test tools the accuracy of which is beyond our control. Furthermore, the document relies on certain representations by the sponsor that are beyond our control to verify. Among these is that the software/hardware tested is production or production track and is, or will be, available in equivalent or better form to commercial customers. Accordingly, this document is provided “as is,” and Tolly Enterprises, LLC (Tolly) gives no warranty, representation or undertaking, whether express or implied, and accepts no legal responsibility, whether direct or indirect, for the accuracy, completeness, usefulness or suitability of any information contained herein. By reviewing this document, you agree that your use of any information contained herein is at your own risk, and you accept all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from any information or material available on it. Tolly is not responsible for, and you agree to hold Tolly and its related affiliates harmless from any loss, harm, injury or damage resulting from or arising out of your use of or reliance on any of the information provided herein.

Tolly makes no claim as to whether any product or company described herein is suitable for investment. You should obtain your own independent professional advice, whether legal, accounting or otherwise, before proceeding with any investment or project related to any information, products or companies described herein. When foreign translations exist, the English document is considered authoritative. To assure accuracy, only use documents downloaded directly from Tolly.com. No part of any document may be reproduced, in whole or in part, without the specific written permission of Tolly. All trademarks used in the document are owned by their respective owners. You agree not to use any trademark in or as the whole or part of your own trademarks in connection with any activities, products or services which are not ours, or in a manner which may be confusing, misleading or deceptive or in a manner that disparages us or our information, projects or developments.