networktest

Netgear XSM7224S

Switch Assessment

January 2011

Executive Summary

Netgear commissioned Network Test to assess the performance of its **Netgear XSM7224S** 10G Ethernet top-of-rack switch.

Test areas included MAC address capacity; forward pressure; layer-2 unicast and multicast throughput and latency; layer-3 unicast throughput and latency; IGMP multicast group capacity; multicast group join/leave delay; and power consumption.

Among the key test results:

- ✓ The XSM7224S has a MAC address capacity of nearly 29,000 addresses, a key capability for virtualization applications
- ✓ The XSM7224S delivered line-rate throughput in all unicast and multicast tests
- ✓ Average latency is around 1.6 to 1.7 usec for all frame sizes, including jumbo frames
- ✓ Layer-2 and Layer-3 unicast throughput and latency are virtually identical; there is no performance penalty for layer-3 forwarding
- ✓ With IGMP snooping enabled, the switch can forward traffic to more than 1,500 multicast groups
- ✓ The XSM7224S offers consistent times in joining and leaving IGMP groups
- ✓ Power consumption is less than 140 watts, even when fully loaded

The remainder of this document discusses the test results in more detail. Besides presenting the test results, each section describes the test objective and procedure, as well as its meaning for network architects and network managers.

MAC Address Capacity

As defined in RFCs 2285 and 2889, the goal of the MAC address capacity test is to determine the maximum number of Ethernet addresses to which a switch will forward traffic without flooding. A large MAC address table is desirable in a top-of-rack data-center switch, especially where virtualization is involved. Virtualization may require network designs with very large broadcast domains encompassing thousands or tens of thousands of MAC addresses.

In assessing the switch's MAC address capacity, we used the pseudorandom MAC address pattern described in RFC 4814. Working with these pseudorandom addresses, this test involves a binary search to determine the maximum number of addresses the switch will learn without flooding. The test was run with five times, with five different sets of pseudorandom addresses. The best and worst results were discarded, and the test result is the average of the remaining three results.

In the MAC address tests, the Netgear XSM7224S learned 28,819 addresses.

Forward Pressure

As described in RFC 2889, the forward pressure test determines if a switch uses an illegally small interframe gap that could cause congestion for attached devices.

Normally, the gap between Ethernet frames is 12 bytes long. In this test, the Spirent TestCenter traffic generator offers frames to the XSM7224S at illegally high rates by using interframe gaps of 11 and then 10 bytes. Spirent TestCenter then measures the rate at which the XSM7224S forwards traffic on egress ports.

The hardware clock on the XSM7224S unit tested is about 22 parts per million above nominal Ethernet line rate, well within the 100-ppm clock tolerance allowed by the IEEE 802.3 Ethernet specification.

Table 1 summarizes results from the forward pressure tests.

	Observed forwarding rate (fps)
Line rate - 100 ppm	14,879,464
Line rate	14,880,952
Netgear XSM7224S	14,880,987
Line rate + 100 ppm	14,882,440

Table 1: Forward Pressure Rates

Layer 2 Unicast Throughput

This test measures throughput for layer-2 unicast traffic, as defined in RFCs 1242, 2285, 2544, and 2889. Tests involved a fully-meshed pattern of traffic between all 24 switch ports, for a duration of 60 seconds per iteration. In all layer-2 and layer-3 unicast performance tests, the Spirent TestCenter test instrument emulated 25 hosts per port, for a total of 600 hosts.

Separate tests were run with 64, 65, 108, 256, 1518, and 9216-byte frames. *Throughput* describes the highest rate at which the switch forwards traffic with zero frame loss.

The XSM7224S exhibited line-rate throughput for all frame sizes. In every single test, the Netgear switch never dropped a frame. Table 2 summarizes throughput results for the Netgear switch.

	64-byte	65-byte	108-byte	256-byte	1518-byte	9216-byte
Theoretical line rate (fps)	**357,142,857**	352,941,176	234,375,000	108,695,652	19,505,852	3,248,159
Netgear XSM7224S (fps)	357,142,855	352,941,174	234,374,999	108,695,652	19,505,852	3,248,160

Table 2: Layer-2 Unicast Throughput

Layer-2 Unicast Latency

Latency describes the delay introduced by the switch at the throughput rate. Because the Spirent TestCenter test instrument records the latency of every frame, measurements of average and maximum latency are possible. The Netgear XSM7224S is a "store-and-forward" device, meaning it caches all of each incoming frame before making a forwarding decision. Accordingly, RFC 1242 specifies that latency be measured on a "last in, first out" (LIFO) basis – from the end of the incoming frame on the ingress port to the beginning of the outgoing frame on the egress port.

The Netgear XSM7224S exhibited average latency of around 1.7 to 1.8 microseconds regardless of frame length. Maximum latency was around 2.2 usec for smaller frames and 1.9 usec for larger frames.

Table 3 summarizes average and maximum layer-2 unicast latency, respectively, for the XSM7224S.

	64-byte	65-byte	108-byte	256-byte	1518-byte	9216-byte
Average latency (usec)	1.78	1.78	1.79	1.78	1.74	1.73
Maximum latency (usec)	2.14	2.18	2.23	2.14	1.91	1.91

Table 3: Layer-2 Unicast Latency

Layer-3 Unicast Performance

Network Test also assessed throughput and latency of the XSM7224S when configured as a layer-3 device, with different IPv4 subnets configured on each port. **Layer-3 throughput and latency were virtually identical to the layer-2 results, suggesting there is no performance penalty for operating in layer-3 mode.**

Table 4 compares layer-2 and layer-3 throughput and latency for the Netgear XSM7224S.

	64-byte	65-byte	108-byte	256-byte	1518-byte	9216-byte
L2 throughput (fps)	357,142,855	352,941,174	234,374,999	108,695,652	19,505,852	3,248,160
L3 throughput (fps)	357,142,855	352,941,175	234,374,999	108,695,652	19,505,852	3,248,160
L2 average latency (usec)	1.78	1.78	1.79	1.78	1.74	1.73
L3 average latency (usec)	1.77	1.77	1.78	1.76	1.72	1.71
L2 maximum latency (usec)	2.14	2.18	2.23	2.14	1.91	1.91
L3 maximum latency (usec)	2.04	2.10	2.02	1.92	1.88	1.88

Table 4: Layer-2 and Layer-3 Unicast Performance Compared

Layer-2 Multicast Throughput

A separate set of tests focused on layer-2 multicast performance, using the aggregated multicast throughput and latency tests described in RFC 3918. Here, the focus was on multicast performance when the XSM7224S is configured in IGMP snooping mode. Tests used IGMPv2. One Spirent TestCenter port acted as a multicast transmitter, and the remaining 23 ports acted as multicast receivers, each subscribed to the same 989 IP multicast groups.

As in the unicast tests, the Netgear XSM7224S delivered line-rate throughput for all multicast traffic.

Table 5 summarizes multicast throughput results for the Netgear XSM7224S.

	64-byte	65-byte	108-byte	256-byte	1518-byte	9216-byte
Theoretical line rate (fps)	342,261,905	338,235,294	224,609,375	104,166,667	18,693,108	3,112,819
Netgear XSM7224S (fps)	342,261,903	338,235,293	224,609,374	104,166,667	18,693,108	3,112,820

Table 5: Layer-2 Multicast Throughput

Layer-2 Multicast Latency

The multicast latency tests described in RFC 3918 are conceptually similar to those in RFC 2544: Spirent TestCenter measures the latency of every frame received, and we present average and maximum latency results.

Layer-2 average multicast latency is in line with unicast results, and maximum latency is slightly lower. Table 6 compares average and maximum layer-2 multicast latency.

	64-byte	65-byte	108-byte	256-byte	1518-byte	9216-byte
Average latency (usec)	1.67	1.68	1.70	1.61	1.60	1.60
Maximum latency (usec)	1.81	1.87	1.84	1.75	1.75	1.75

Table 6: Layer-2 Multicast Latency

IGMP Group Capacity

The RFC 3918 multicast group capacity test determines the size of a switch's IGMP snooping table by finding the maximum number of groups to which the switch will forward traffic without flooding. Like the MAC address test, this involves a binary search in which the Spirent TestCenter test instrument joins some number of groups; offers traffic to all groups; and determines if one or more frames is received in each group.

For some vertical industries (especially financial services and streaming media providers), multicast group capacity is a key metric in assessing switch performance. For these users, multicast scalability is at least as important as throughput and latency.

The Netgear XSM7224S learned 1,508 multicast groups using IGMP snooping.

Multicast Join/Leave Delay

The multicast join/leave delay (JLD) test in RFC 3918 measures the average and maximum time required for a switch to join and leave a set of multicast groups. Join and leave times are especially meaningful for financial services and streaming media applications.

In the JLD test, one transmit port on Spirent TestCenter begins by offering traffic to 989 multicast groups even though no receiver test ports have yet subscribed to any groups. The test instrument then sends IGMP reports to join all the groups; Spirent TestCenter measures the interval between the first report and the switch forwarding traffic to the last port per group as the join delay. After a 120-second delay, the receiver ports on Spirent TestCenter then send more IGMP reports to leave all multicast groups.

Leave delay is measured as the interval between the first leave message and the cessation of all multicast traffic forwarding. Spirent TestCenter performs JLD measurements for each group, and calculates average and maximum values at the end of the test.

Table 7 summarizes results from the JLD tests.

	Average join latency (ms)	Maximum join latency (ms)	Average leave latency (ms)	Maximum leave latency (ms)
Netgear XSM7224S	2.20	426.30	0.21	37.43

Table 7: Multicast Join/Leave Delay

Power Consumption

The power consumption tests measure wattage under four conditions: With 12 ports populated while idle and fully loaded; and with 24 ports populated and fully loaded. For this test, “fully loaded” refers to the data plane and uses the same traffic as in the layer-2 throughput and latency tests. “Ports populated” refers to the number of interfaces with 10GBase-SR optic transceivers installed.

We derive wattage by measuring voltage at the power outlet and AC amperage at the power supply. The test instrument is a Fluke TrueRMS 335 clamp meter.

Table 8 summarizes power consumption for the Netgear XSM7224S in the various test cases.

	Netgear XSM7224S
12 ports idle	119
12 ports loaded	126
24 ports idle	135
24 ports loaded	138

Table 8: Power Consumption

Appendix A: About Network Test

Network Test is an independent third-party test lab and engineering services consultancy. Our core competencies are performance, security, and conformance assessment of networking equipment and live networks. Our clients include equipment manufacturers, large enterprises, service providers, industry consortia, and trade publications.

Appendix B: Hardware and Software Releases Tested

This appendix describes the software versions used on test bed infrastructure.

Component	Version
Netgear XSM7224S	9.0.0.12
Spirent TestCenter	3.55.5086
Fluke TrueRMS 335 clamp meter	NA

Appendix C: Disclaimer

Network Test Inc. has made every attempt to ensure that all test procedures were conducted with the utmost precision and accuracy, but acknowledges that errors do occur. Network Test Inc. shall not be held liable for damages which may result for the use of information contained in this document. All trademarks mentioned in this document are property of their respective owners.

Network Test Inc.
31324 Via Colinas, Suite 113
Westlake Village, CA 91362-6761
USA
+1-818-889-0011
http://networktest.com
info@networktest.com