INFINITE SUMMIT

Enterasys S-Series
Test Verification and Validation

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Enterasys S-Series Performance Testing

Introduction

This paper is an independent verification and validation of the testing of the Enterasys S-Series switch family describing the tests performed, the results of the tests, and the implications of those results.

Enterasys describes their S-Series switch family as a "Terabit-class, convergence-ready, modular switch family for edge-to-core and data center deployments." Enterasys designed the S-Series switch family to be both comprehensive and flexible for deployment as a high-density network edge access device, a high performance distribution layer switch, a enterprise core router, a storage switch and as a data center virtualization solution.

Figure 1. The Enterasys S-Series

As you look at options for edge-to-core and data center switches, it is critical to consider a wide range of issues, including manageability, visibility, and control. In addition, you need to understand the real performance of the systems in use.

Choosing from among the enterprise switches available today is no easy task, and understanding the performance distinctions between them requires both a grasp of how switches are tested and the implications of the results—together with trusting both the results and the organization doing the testing. The independent verification and validation of those test results can be very helpful in understanding the results, their meaning, and also in having trust in their accuracy.

This independent analysis of testing performed on the Enterasys S-Series enterprise switch gives you the information you need to make an informed decision.

Enterasys says that the "highly available architecture makes forwarding decisions, and enforces security policies and roles while classifying/prioritizing traffic at wire speed."

The test results demonstrate whether or not the S-Series will meet your needs for an enterprise switch.

Testing of Ethernet switches is governed by a series of Internet RFCs (standards) that define both the methods and the semantics of the tests. These tests were performed on the Enterasys S-Series family and the tests were observed and validated as being performed properly and the results were validated to ensure that they were produced from these particular tests.

Infinite Summit certifies the results of the tests described in this report.

The Tests

The tests performed on the S-Series switches using 1Gb port speeds on the XM12 and XL10 chassis were the following:

- Back-to-Back (RFC 2544)
- Full Mesh (RFC 2889)
- Frame Loss (RFC 2544)
- Mant-to-Many Mesh (RFCs 2285 and 2889)
- Latency (RFC 2544)
- Head-of-Line Blocking

Each of these tests has specific setup and functional requirements. There are aspects of each test that underscore capabilities and limitations of the device under test. The following sections briefly describe the tests and what the results show.

Back-to-Back

RFC 2544 defines the back-to-back test this way:

> Send a burst of frames with minimum inter-frame gaps to the DUT [device under test] and count the number of frames forwarded by the DUT. If the count of transmitted frames is equal to the number of frames forwarded the length of the burst is increased and the test is rerun. If the number of forwarded frames is less than the number transmitted, the length of the burst is reduced and the test is rerun.
>
> The back-to-back value is the number of frames in the longest burst that the DUT will handle without the loss of any frames.

Back-to-Back	Back-to-Back Frames
64	1,071,428,400
128	608,108,400
256	326,087,280

The Enterasys S-Series passes the maximum possible back-to-back frames with no loss giving the S-Series the best possible results.

Full Mesh

RFC 2285 defines "fully meshed" and testing of the switch in "full mesh" as:

> every interface forwards frames to and receives frames from every other interface.
>
> …
>
> Each port should receive the same number of test frames that it transmitted.

The Enterasys S-Series performed flawlessly in the full mesh test, passing 100% of frames at the maximum throughput possible for each frame size.

Fully Meshed	Tx Rate %	Fr Loss %
64	100	0.00
128	100	0.00
256	100	0.00

Frame Loss

RFC 2544 also defines the methodology for frame loss testing.

While speed and latency numbers often get all the attention, frame loss is actually the most important of all measurements. If a switch drops frames under normal usage, you are very likely to have issues in day-to-day operation of the system.

Frame Loss	Agg Rate %	Max Rate (fps)
64	100	1,488,095.24
128	100	844,594.59
256	100	452,898.55

At full speed, the S-Series has no frame loss at any frame size tested. This is superlative performance.

Many-to-Many Mesh

The many-to-many mesh test is defined in RFC 2285 and RFC 2889. This test, determines the frame loss from the total number of frames transmitted from all the ports and the total number of frames received on all the ports.

Many-to-Many	Tx Rate %	Fr Loss %
64	100	0.06
128	100	0.00
256	100	0.00

In this test, the Enterasys S-Series passed the maximum possible number of frames without loss for frame sizes of 128, 256, 512, 1024, 1280. The 64-byte frames had frame loss of 0.06%. The 1518-byte frames had frame loss of 4.37%.

The many-to-many mesh test shows the impact of buffering on the switch's ability to forward frames of various sizes. Given the results, you can be confident that, even at volumes higher than will ever be reached with real network loads, the Enterasys S-Series is able to pass virtually every frame all the time.

Latency

According to RFC 2544, "The latency is timestamp B minus timestamp A as per the relevant definition from RFC 1242, namely latency as defined for store and forward devices or latency as defined for bit forwarding devices."

As specified by RFC 2544, this test is done using frame sizes of 64, 128, 256, 512, 1024, 1280, 1518 bytes.

Latency	Frame Loss	Avg Latency
64	0.00	9.7 μs
128	0.00	10.2 μs
256	0.00	10.7 μs

In the latency test for the Enterasys S-Series, there was no packet loss. Latency ranged from 9.7 μs for 64-byte frames to 10.7 μs for 256-byte frames.

This is "low latency" for a higher-reliability store-and-forward switch. Cut-through switching is a design that begins forwarding the frame before the entire frame has been received and often has lower latency than store-and-forward. However, it also has lower reliability due to its inability to examine the entire frame before forwarding it.

This test shows that the S-Series delivers store-and-forward reliability at rates that approach those of cut-through switching.

Head-of-Line Blocking

Head-of-Line Blocking occurs when there are more frames needing to be sent out a single port than the speed of the port can handle. Waiting frames are then blocked from being sent by the other frames in front of them, effectively being blocked by the frame that's at the head of the line.

Since buffers are not infinitely large, at some point, outbound frames will be blocked long enough that some frames will be dropped.

In these tests, the switch was offered 50% greater frame rates than the output ports could handle at full wire speed. However, frame losses were less than 17 percent. This means that a major portion of the overage frames were buffered and forwarded on the network.

Head of Line	Tx Frames	Fr Loss %
64	2,000,000	15.16
128	2,000,000	15.76
256	2,000,000	16.15

The Enterasys S-Series performs at a very high level of reliability even in the most intense frame forwarding tests.

Interpretation of Results

The test results indicate that the Enterasys S-Series has the performance capabilities for deployment as a high-density network edge access device, high performance distribution layer switch, resilient enterprise class multi-terabit core router, high-end storage switch and as a data center virtualization solution.

As results of the Head-of-Line blocking test show, the S-Series switches minimize the impact of contention with characteristics and volume that is far beyond real-world network traffic.

This is further illustrated by the other tests, showing little to no frame loss.

It is important in your analysis of test results to recognize that a real-world Ethernet network is unable to maintain the consistent intense traffic levels of the test systems for two reasons. First, in a real network environment, systems are contending for access to the network and each other, introducing a randomness to the transmissions that has the effect of reducing the network utilization. Second, the vast majority of applications and the systems supporting them are unable to maintain a constant stream of frames due to everything else they are doing simultaneously.

You may want to measure Ethernet traffic between your systems to get a clearer idea of its nature and the characteristics of switches that will be most important for your particular systems and applications.

Given this distinction between real-world Ethernet traffic and test traffic, it is also vital to understand the design trade-offs within the switches that cause different characteristics. For example, as mentioned within the latency test above, a store-and-forward design can have better forwarding reliability and be able to do analysis that allows for the application of policies, filters, and other decisions before the frame is forwarded. Cut-through switching will reduce the latency to very low levels since the frames can be forwarded as soon as the destination address is read, but without the ability to make those decisions.

For most uses of edge access, distribution, core routing, and data center switching, the ability to make decisions about forwarding at wire speed is more important than reducing latency by a few μs.

Inherent Test Anomalies

One of the challenges introduced in testing of Ethernet devices is the issue of clock skew or clock tolerance. Given that the device under test (the Enterasys S-Series) and the testing device (an IXIA test frame using IxAutomate 6.90.93.14) use independent clocks, getting the clocks into sync during the course of the test presents a challenge. Furthermore, if they are not 100% in sync, the testing device will see differences in the clocks as issues with the frames.

Because of the standard approaches to testing and the wide use of test results, it is difficult to make the necessary test adjustments to eliminate clock skew as an issue, especially for smaller packets. In the case of these tests, clock skew is a factor in the Many-to-Many Mesh test, increasing the measured frame loss, most notably for the 64-byte frames.

Validation and Verification

Infinite Summit Principal Stephen Hultquist observed these tests at the Enterasys test lab in Andover, Massachusetts. During setup, operation, analysis, and reporting, we verified that the tests were run as appropriate and that the reported results matched what the IXIA test system reported at the time of the test.

We therefore verified and validated the test results.

Conclusions and Recommendations

The Enterasys S-Series fulfills its design criteria as an exemplary offering for data center and storage switching, core routing, distribution switching, and edge access. Furthermore, due to the focus on policy management that Enterasys has demonstrated for many years, the S-Series performs its functions at wire speed even when routing and applying policy.

This report shows that the Enterasys policy capabilities enable a granular depth of control without negatively impacting the test results. With S-Series switches, you can design and administer your infrastructure to address the performance requirements of your applications and systems without being concerned that doing so will reduce the overall performance of your infrastructure.

Therefore, whether you choose to take advantage of the benefits of policy or simply deploy a terabit-class modular switch with very little management, the Enterasys S-Series should be on your short list.

About Infinite Summit

Infinite Summit is an independent business and technology consultancy serving both business and non-profit organizations. With a commitment to finding effective approaches to addressing organizational needs, Infinite Summit offers on-demand services to address both CIO and CTO services.

Principal Stephen Hultquist has a broad background both in business and in engineering, rising to the level of Senior Engineer at IBM within 10 years, and then fulfilling the roles of CTO, CIO, and CEO of various small and midsize firms.

Mr. Hultquist is also a Contributing Editor to InfoWorld magazine, for whom he has conducted tests of network equipment including policy-based networking (often called NAC) and switching systems.

This independent verification and validation of Enterasys S-Series testing is done under the Terms outlined on the Infinite Summit web site: http://infinitesummit.com/terms.html.