Lab Testing Summary Report

March 2012

Report SR120122B

Product Category:

Carrier-Class Ethernet Switch

Vendor Tested:

HUAWEI

Product Tested:

S9306 Switch

Key findings and conclusions:

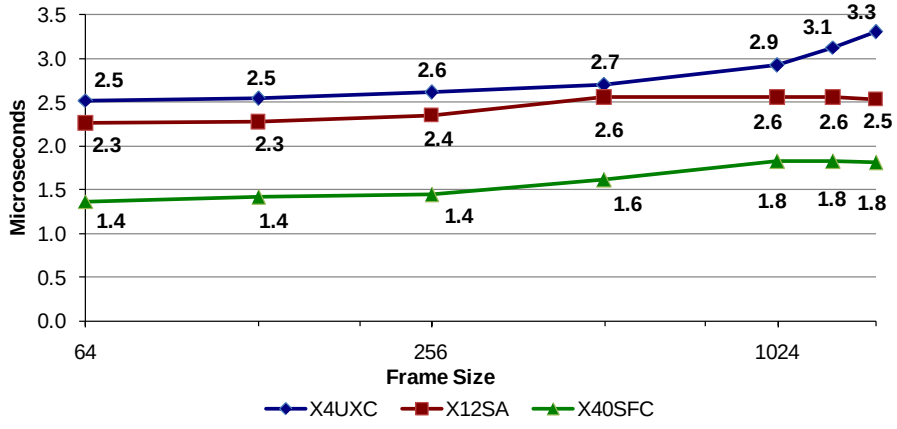
- **Huawei S9306 switch supports patented Cluster Switching System (CSS) technology for high availability**
- **Smart Ethernet Protection (SEP) protocol is supported with highly advanced capabilities**
- **Low forwarding latency of 10G port at full load**
- **Proven interoperability in tests with Cisco switches**
- **Supports hot swapping for power and fan modules as well as backup routing units**

Huawei Technologies engaged Miercom to evaluate the S9300 Series of terabit routing switches. The S9300 series contains the S9303, S9306 and S9312 models, which have similar functions. The S9306 is a carrier-class chassis switch with six service slots. It is highly redundant to meet carrier class requirements for high availability.

Miercom testing focused on the redundancy, latency, and throughput capabilities for three different blade types. The 12-port 10GE optical LPU is called the X12XSA. The X4UXC blade is a 4-Port 10GBASE-X interface card. The high density 40-port 10GE optical interface blade is called the X40SFC. The X12XSA, X4UXC, and X40SFC blades were all tested, along with testing of the backplane chassis. Feature testing was performed to show interoperability and extensive capability of the switch and the blades installed.

In addition to proving the switch chassis and installed blades are capable of achieving benchmarks and standards expected of a carrier class system, the S9306 proved itself to be more resilient and redundant than other switches of its grade.

Figure 1: Huawei S9300 Series Carrier-Class Switch
RFC 2544 Latency of Huawei S9306 Cards



Source: Miercom, March 2012

Huawei S9300 Series switch had low latency at line rate. The X4UXC cards displayed a minimum latency of 2.44 microseconds. Average latency of 2.82 microseconds was seen across all frame sizes.

Performance

By showcasing its high throughput of 6 Tbps backplane capacity and forwarding of 1,152 Mpps, the S9306 has proved to be a next generation terabit class routing switch. The S9300 supports 40*10GE (non wire-speed) high density blades as well as 12*10GE (wire-speed) blades.

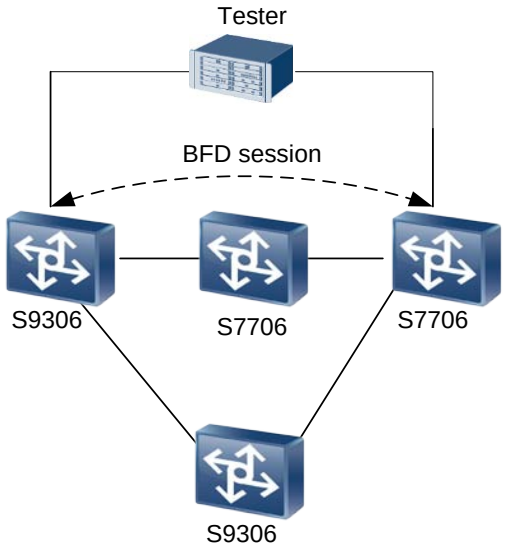
The S9306 LACP feature shows Ethernet trunking with nominal convergence. The switch chassis is capable of, and was tested for, up to 128 Ethernet trunk groups across fiber, copper, and combination connections, demonstrating its diversity and use cases. Conducting RFC 2544 benchmarking tests showed that all blades maintained low latency under line rate. The X4UXC blades exhibited a minimum latency of 2.44 microseconds, and averaged 2.82 microseconds across all frame sizes as shown in *Figure 1* on *page 1*. Both the X12XSA and X40SFC showcased even lower average latency at 2.44 and 1.61 microseconds respectively.

High Availability

The S9306 chassis supports hot-swappable power and fan modules. One of these modules can be replaced without having to shut down the system and reboot. This feature can save on total network downtime and enable a business to keep running efficiently. In addition to fan and power modules, entire switch routing units can be replaced or swapped without having to shut down the switch. With proper Ethernet trunking and spanning trees in place, the system should experience no downtime whatsoever.

During recovery after a power failure, the system fails over to a new power supply flawlessly with no packet loss or abnormal operation. Power over Ethernet (PoE) redundancy works equally as well as the power supply redundancy without any packet loss.

Figure 2: Huawei S9306 Switch
BFD OSPF Topology



Source: Miercom, March 2012

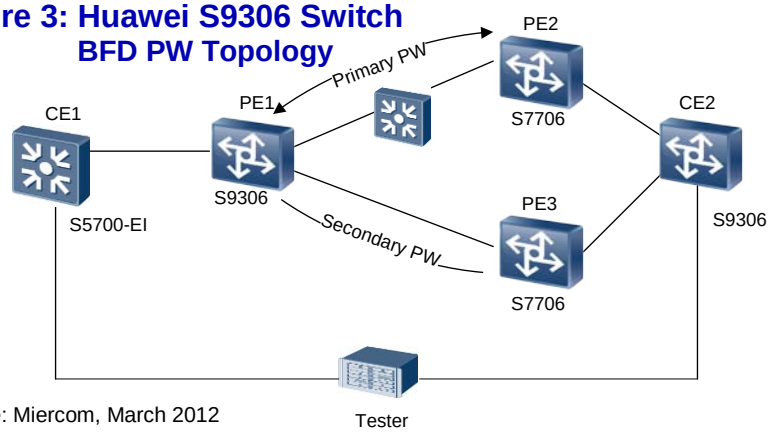
Open Shortest Path First protocol was tested by creating a more direct path that excluded DUT-2 in order to ensure that the BFD could recognize and re-route for complex systems properly.

Features

Hardware BFD and OAM Huawei S9300 series supports Bidirectional Forwarding Detection (BFD) and Operations, Administration and Maintenance (OAM) hardware.

Hardware BFD and OAM exhibited perfect performance in fault detection and switchover with 3.3ms trouble detection and 50ms convergence. This allows the switch to detect a fault and switch

Figure 3: Huawei S9306 Switch
BFD PW Topology



Source: Miercom, March 2012

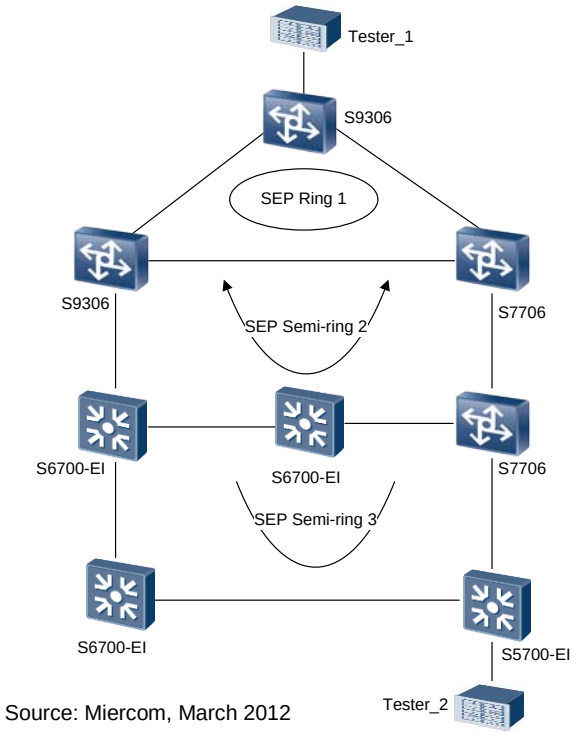
Pseudo Wire configuration for testing BFD uses multiple kinds of switches with the outer switches being the Devices Under Test (S9306) and the inner switches being set to pass through traffic accordingly. All BFD is performed by the S9306, as well as convergence and resolution.

over to another blade or network path with very minimal packet loss incurred.

To test this feature, we associated the BFD with many different protocols, such as OSPF, BGP, LSP, PW, and VRRP, which all achieved trouble protection of end-to-end in 200ms. OSPF BFD and PW BFD topologies are shown in *Figures 2* and *3* on *page 2*, respectively. These tests were conducted by setting up a network with the BFD associated to one protocol at a time. A network cable was unplugged, and by using a traffic tester, we measured the total packets that were dropped and the amount of time it took for the BFD to detect the fault and switch over to a valid path.

BFD technology senses the cut or pulled cable and re-routes traffic around another path in order to reach the destination device. There were minimal dropped packets when the cable pull was performed. One device is master and the other is secondary. When pulling a cable on the master device, the second device automatically switches to master to handle traffic. When plugging the cable back in, the first device switches back to master and the second resumes secondary functions.

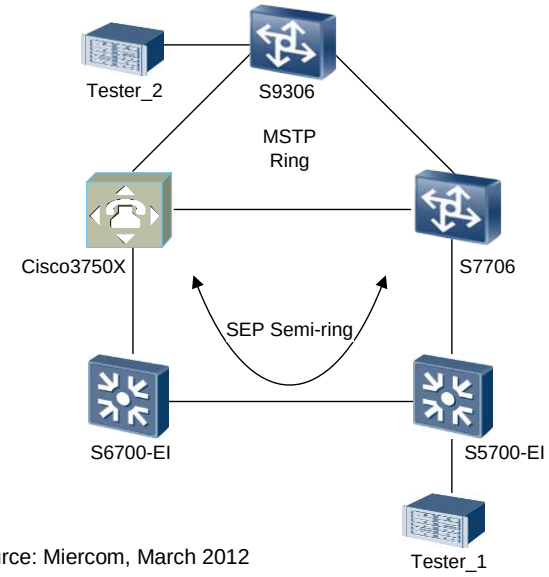
Figure 5: Huawei S9306 Switch
SEP Multi-Ring Topology



Source: Miercom, March 2012

SEP ring network stacked on top of two SEP semi-ring networks for redundant network performance.

Figure 4: Huawei S9306 Switch
MSTP Ring Topology



Source: Miercom, March 2012

A complex MSTP and semi-ring topology unique to Huawei switch infrastructure is displayed.

Figure 2 on *page 2* displays the OSPF topology. We had intentionally created a shortest path and a longer path, and through specific load testing, we observed that OSPF validated the shortest path and delivered traffic properly. Additionally, *Figure 3* on *page 2* provides insight into the Pseudo Wire configuration used to test PW BFD.

Hardware ETH OAM maintained under SLA of 10ms for detection of faults, and under 50ms for identification and convergence handling. The S9300 series systems proved to be resilient and fast-responding to any issues that may arise during normal operation.

CSS Technology Huawei S9300 supports patented Cluster Switching System (CSS) technology. CSS enables a higher level of redundancy not possible in link teaming, trunking, or spanning trees. The cluster can support 256G bandwidth between chassis to ensure that no traffic will be lost when there is a fault in either uplink or downlink connections. The S9306 is ideal in scenarios where low latency but high redundancy and high throughput are required in the terabit routing class. The CSS link is shown in *Figure 6* on *page 4*, and indicates how the synchronization layer is connected. By keeping a common synchronization across devices in the Ethernet trunk, we observed minimal packet loss after disabling a link. Typically, a CSS requires multiple

switching processes and tends to lower switch performance at the exchange of raising its resiliency. We found in the S9300 cluster, the CSS allowed for not only saving on card slots, but 256 Gbps bandwidth, a throughput higher than any switch of this class tested to date.

Interoperability

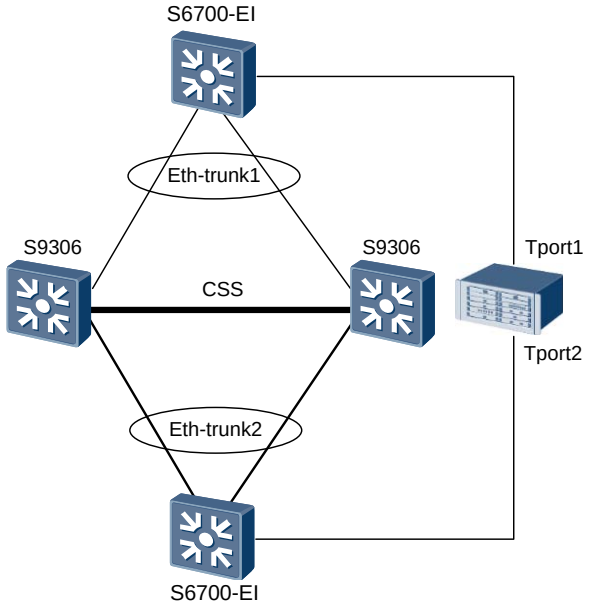
LACP Interoperability with other vendor products and special protocols functioned properly. Link teaming with Cisco 7609 switch functioned fully. After manually performing a link failure, the system detected and rerouted packets with a loss of only 1.8K frames, where traffic was set to send at 422K fps. The convergence of the LACP fault detection took 4.2 ms while interoperating with the Cisco 7609 switch. When the connection was restored, 7.5K packets were lost and trunk load balancing was immediately and automatically re-enabled.

OSPF Routing through the switches using the Cisco 7609 switch with Huawei S5700-EI proved to be fully functional as well. Both Cisco and Huawei console outputs indicated the OSPF route had been established and the test center verified the results.

Ring Topology Huawei supports several kinds of different ring networks. Standard ring networks were tested by disconnecting and reconnecting each link in succession and checking packet loss and connectivity in between trials. For interoperability, a SEP and MSTP with S9306 and Cisco's C3750X switch was also verified to be fully functional with a Huawei ring setup. This demonstrates very high level interoperability and functionality between Huawei and other vendors. For the SEP and MSTP ring networks, an MSTP ring was set up using two Huawei switches and a Cisco switch. Next, a SEP semi-ring was connected and network traffic was verified. *Figure 4* on *page 3* displays the ring topology with other vendor products in place.

In the setup of the topology, one port on the MSTP ring was set to discard packets (block) and one port on the SEP ring was also set to discard packets. Traffic was still able to pass from Tester 1 to Tester 2, using the unblocked path automatically discovered and utilized due to the nature of the ring network. To test convergence of the rings, one cable was manually pulled from the MSTP ring, severing the connection to one device completely and abruptly. It was noted that once the device noticed a pulled cable, the blocked port was immediately unblocked to allow traffic to be

Figure 6: Huawei S9306 Switch Cluster Switching System



Source: Miercom, March 2012

CSS connects devices within an Ethernet trunk, enabling a higher level of connectivity and lower loss on a broken link.

delivered between testers. Testing a redundant system should adjust itself as necessary without link teaming. Next, a cable was pulled from the SEP ring and again the unblocked port on the device was enabled so that traffic could make it from end to end.

Also tested were SEP open rings that can be stacked into complex, highly redundant, multi-ring configurations. This type of setup allows for large, redundant networks across several kinds of switches with complicated and varying configurations. Aside from standard ring protocols features unique to this system were also enabled, such as the Rapid Ring Protection Protocol (RRPP) and Semi-ring configuration. *Figure 5* on *page 3* shows one of the test scenarios used to verify operation of the rings and displays accurately the configuration of the rings under test.

This ring topology was tested using the same methodology as the previous rings. All rings tested were proved to work and to converge in a minimal amount of time with low packet loss.

BGP By adding the appropriate ports to a set VLAN and IP addresses on the opposing switch, we verified the functionality of BGP between the

Table 1: Chart of Features of the S9300 Series of Switches

Model	S9312	S9306 ✱	S9303
Features			
LPU Slots	12 slots	6 slots	3 slots
Backplane Capacity	12Tbps	6Tbps	3Tbps
Netstream	✓	✓	✓
LLDP	✓	✓	✓
NAT	✓	✓	✓
Firewall	✓	✓	✓
VRRP	✓	✓	✓
Multicast	✓	✓	✓
QoS/ACL	✓	✓	✓
PoE	✓	✓	✓
Wireless Access Controller	✓	✓	✓
Advanced Security Features	✓	✓	✓
SNMP Management	✓	✓	✓
802.3az Energy Efficient Ethernet	✓	✓	✓
IPv6 Support	✓	✓	✓

Source: Miercom, March 2012 ✱ - Tested Model

S9306 and Cisco's 7609. We validated the test bed by using an ICMP echo request.

Rich Authentication Huawei S9300 series of switches works with Huawei and other third party 802.1x RADIUS authentication servers. These servers authenticate devices on the network and initiate the permissions allowed for each switch. Verification of interoperability was done with the connection of a Cisco RADIUS server to the S9300 switch. Authentication was correct and no issues occurred with the switch.

STP/MSTP Miercom tested the STP and MSTP network shown in *Figure 5* on *page 3* by weighting the branches of the trees differently. While monitoring traffic and utilization on the switches, we intentionally broke the links individually to assess the resiliency of the STP and MSTP across vendor switches. The diagram below shows the STP and MSTP test bed. The system was validated and did not drop packets when shutting down the higher priority port. When the link was brought back, online traffic was immediately re-routed. Loss of the lower priority link in both cases did not affect the network.

VRRP Routing through VLANs and with different vendor products is a key feature required to increase reliability and availability of routing paths. We successfully configured the Cisco 7609 as secondary and the S9306 as the primary, and validated the configuration using a test center to send virtually routed traffic through the tunnel with no packet loss.

Advanced Functionality Using a test center, one Huawei switch, and one Cisco switch, we configured and tested a VLL tunnel. The VLL functionality was validated and exhibited no packet loss. A VPLS routing table was established properly and indicated as such on both switches. Verification of tunnel was conducted by the test center transmitting traffic through the proper VLANs. CDP (Cisco's proprietary nearest neighbor detection) works flawlessly through the Huawei switch. Similarly, LLDP, which is Huawei's own nearest neighbor detection system, found and identified Cisco products without error. The most advanced feature, however, is in the design and complexity of the open ring and semi ring redundancies.

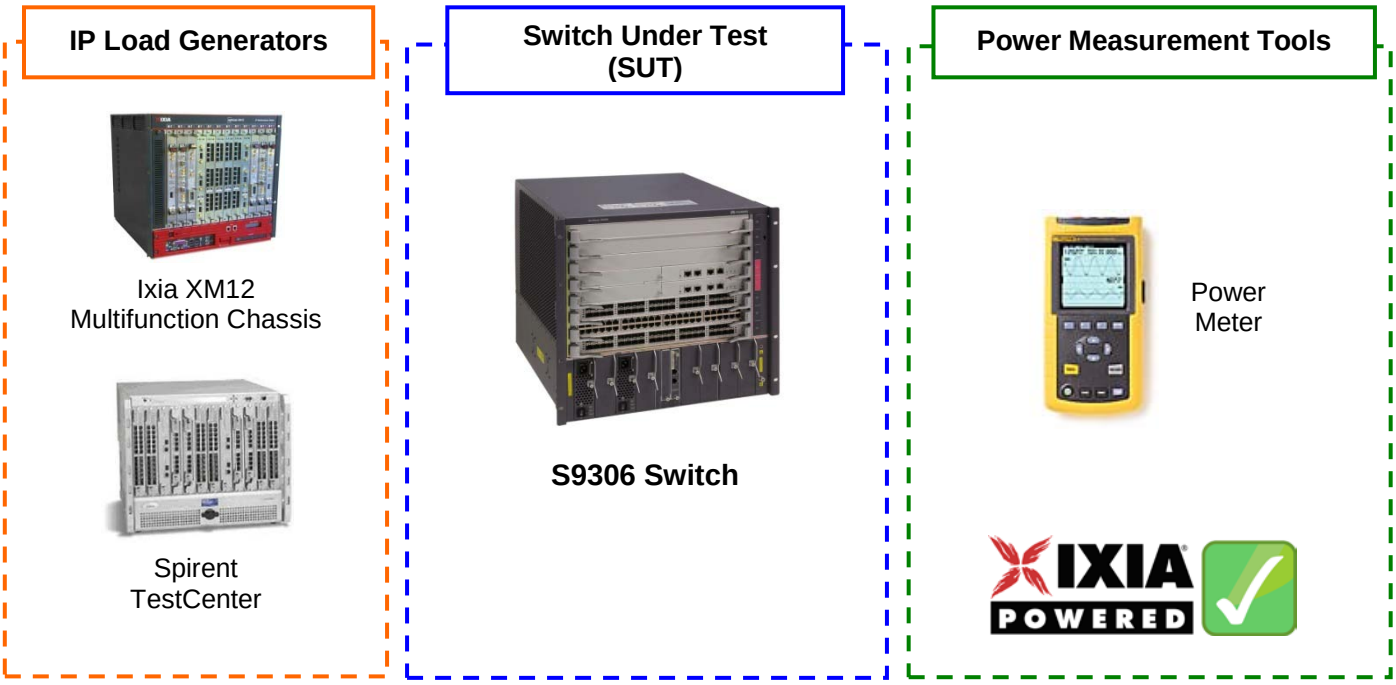
Bottom Line

The switch chassis displays high versatility with its different blades, so deploying this chassis makes it flexible for upgrades and different use cases. In addition to physical configurability, the software configuration is flexible. By using a complex network of clusters, spanning trees and rings, one could create a highly redundant system that is highly resistant to being broken by a single-link, or even a double-link failure. Combined with power and blade redundancy, this switch chassis paves the way for a High Availability network.

The switch displayed strong interoperability when working with other vendor products, indicating it would be ideal for piecewise or full scale deployment into existing network infrastructures.

Overall, we found the Huawei S9306 to be a very feature-rich, resilient switch capable of being deployed in both carrier class network settings and enterprise environments.

Test Bed Diagram



Source: Miercom, March 2012

How We Did It

The Huawei S9306 switch was evaluated for performance, reliability, and enriching features. Testing was conducted to verify that each of the features outlined in this report operated as advertised. Energy efficiency was evaluated by measuring energy consumption without any energy saving features enabled and then repeating the testing with these features turned on to compare savings. Miercom and Huawei engineers used load generators to ensure that the maximum potential of the switch was revealed. The load generators were configured for feature testing to specifically test certain functionalities to verify they were working appropriately and routing correctly.

The Huawei S9306 switch chassis evaluated was running firmware version 5.7 OS. This was the latest firmware version available for this device. Two different traffic generators were used during the course of the tests, Ixia XM12 running IxNetwork version 5.50.121.48 and Spirent TestCenter running version 3.76.0076.

Utilizing RFC 2544, RFC 3918, and RFC 2889 standards for load testing, Miercom was able to obtain industry applicable metrics for latency, throughput, and other statistical measurements such as out of sequence errors and jitter to ensure validity of the metrics observed. Analyzing the statistics, we were able to produce accurate results for public distribution.

Miercom recognizes Ixia (www.ixiacom.com) as an industry leader in energy efficiency testing of networking equipment. Ixia's unique approach utilizes coordination of energy measurements with network traffic load – allowing energy consumption to be graphed against network traffic volume. Real-world traffic is generated by Ixia's test platform and test applications, principally IxNetwork for Layer 2-3 routing and switching traffic and IxLoad for Layer 4-7 application traffic.

The tests in this report are intended to be reproducible for customers who wish to recreate them with the appropriate test and measurement equipment. Current or prospective customers interested in repeating these results may contact reviews@miercom.com for details on the configurations applied to the Switch Under Test and test tools used in this evaluation. Miercom recommends customers conduct their own needs analysis study and test specifically for the expected environment for product deployment before making a product selection.

Miercom Performance Verified

The performance of Huawei S9306 Terabit routing switch was verified by Miercom. In hands-on testing, Huawei demonstrated advanced performance features such as:

- Competitively low latency on all cards
- Interoperability with other vendor products
- Highly redundant and diverse SEP configurations, including unique semi rings and stacking rings
- Extensive BFD feature functionality and clustering capability

S9306 Switch

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