Miercom

LAB TESTING SUMMARY REPORT

September 2003
Report 240903

Product Category:

Internet Gateway Router

Vendor Tested:

Cisco Systems

Products Tested:

Cisco 7304 router with NSE-100 Routing Engine

MIER Communications
Performance Verified

Key findings and conclusions:

- **Cisco 7304 with NSE-100 routing engine scales to 1,000 Virtual Routing Forwardings (VRFs) in MPLS VPN while forwarding MPLS packets at line rate**
- **Demonstrated a Route Processor failover time of only 0.4 seconds on average**
- **Delivered OC-12 line-rate performance for 128-byte and higher packet sizes with multiple services enabled**

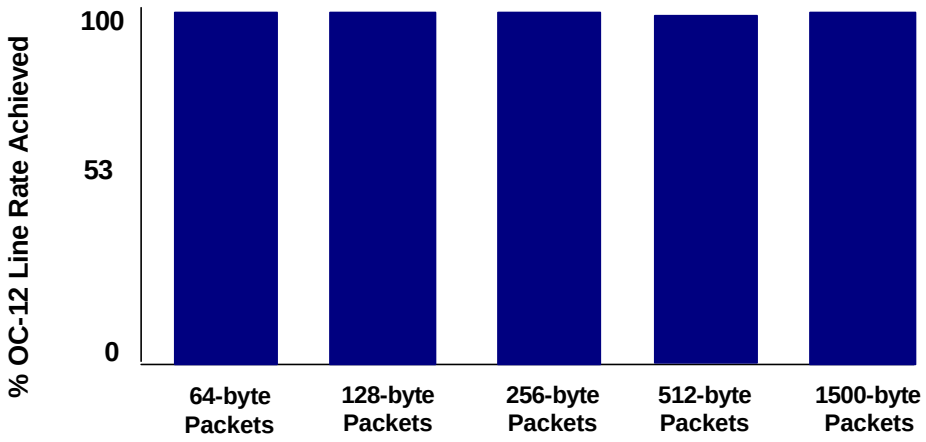
Cisco Systems contracted Miercom to test the Cisco 7304 Series router with the new NSE-100 routing engine. We evaluated the products at Cisco's laboratories in San Jose, CA. Testing and observation were based on a test bed and methodology co-developed by Cisco and Miercom. Testing was conducted on Cisco 7304 Series routers running IOS™ 12.2(20)S.

The purpose of testing was to demonstrate the 7304's ability to forward IPv4 and MPLS packets at OC-12 line rate; to forward 128-byte packets at OC-12 line rate with services, such as access control list (ACL), Modular Quality of Service (MQC) Policing, unicast Reverse Path Forwarding (uRPF) Check, Weighted Random Early Detection (WRED) and NetFlow; to show support of 1,000 VRFs with 200,000 VPN routes; and to evaluate failover times with traffic passing.

Performance and Scalability Results

The Cisco 7304 proved itself a high-performance edge device making it an ideal platform for enterprise Internet Gateway applications or as a high-end CPE router with high-speed optical interfaces for

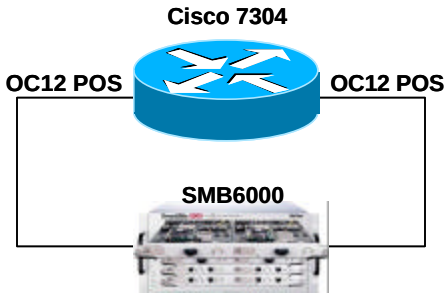
100 Percent of Line Rate Achieved on MPLS VPN*



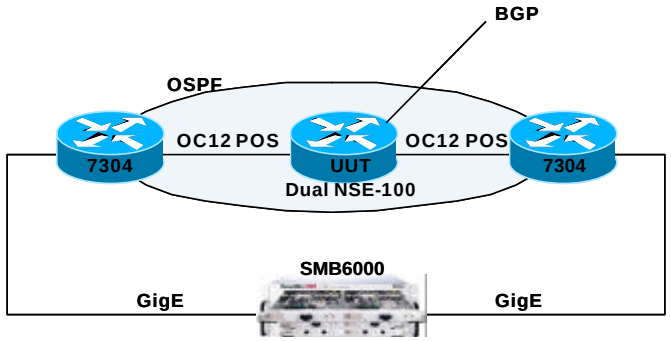
**Line rates pertain to both provider edge and provider core routers.*

Test-bed Setups

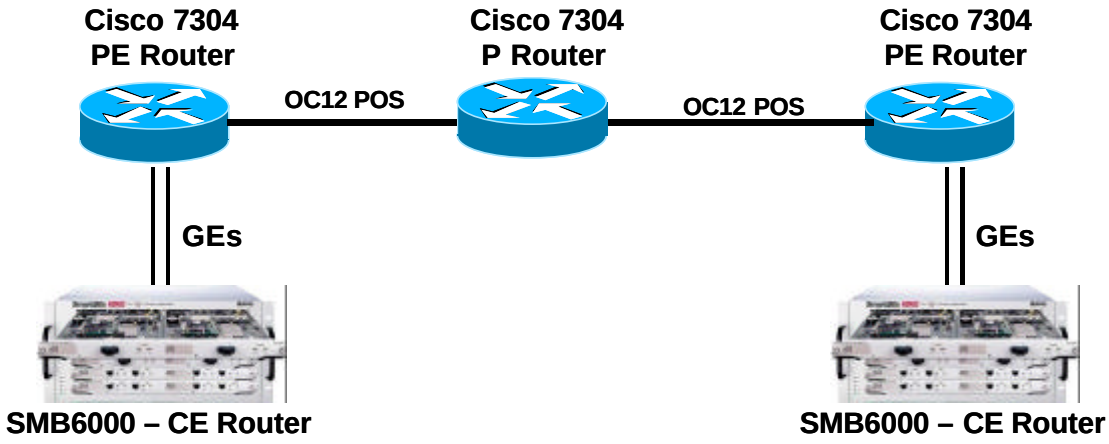
Test 1 - IPv4 Performance:



Test 2 - Failover:



Test 3 - MPLS VPN Scalability:



About the testing…We conducted three tests to determine IPv4 performance with and without services, failover and time required for resumption of traffic, and MPLS VPN scalability. Testing was conducted using a Spirent SmartBits SMB6000, version 7.70, load generator to simulate all data traffic. The system under test (SUT) was a Cisco 7304 Series router running IOS 12.2(20)S and supporting two OC-12 POS line cards.

Test 1—IPv4 Performance: The SmartBits SMB6000 was configured to send one million packets bi-directionally. For testing with services, the configuration was modified to enable a list of services including input extended ACL with 1,000 rules, unicast Reverse Path Forwarding Check (uRPF), Modular Quality of Service (MQC) policing, Weighted Random Early Detection (WRED) and NetFlow. Each of these services was applied to each OC-12 on the router. In addition, 350,000 Border Gateway Protocol (BGP) routes were injected into the SUT using a second router. We repeated each test three times for each packet size (40-, 128-, 256-, 517- and 1500-bytes), with and without services.

Test 2—Failover Time: The SmartBits SMB6000 was configured to send four million packets bi-directionally at 100,000 packets per second. In addition, 150,000 BGP routes and 500 Open Shortest Path First (OSPF) routes were injected in the SUT via a second Cisco 7304 router. Service disruption was measured by the number of packets dropped during failover and calculation of the time based on the packet rate.

Test 3—MPLS VPN Scalability: Traffic was generated via the SmartBits SMB6000. The SmartBits, acting as CEs, were configured with 1,000 BGP peers to each Cisco 7304 provider edge (PE) router. Each PE was configured with 1,000 VRFs, and each of these VRFs receives 200 routes in its routing table for a total of 200,000 VPN routes per PE. The SmartBits passed traffic bi-directionally over 20,000 routes at full line rate via dual Gigabit Ethernet links to the PE routers. These were linked to the SUT, which simulated a provider's core network (P) via OC-12 connections.

service providers. A compact, modular router with integrated Gigabit Ethernet interfaces, the Cisco 7304 provides flexibility and scalability features to enable new applications and services, such as voice-over-IP (VoIP), while delivering security and resilience.

Test 1 – IPv4 Performance: The objective of testing was to determine the throughput of the 7304 with five different packet sizes (40-, 128-, 256-, 517- and 1500-byte packets) and with various services (ACLs, uRPF, MQC Policing, WRED and NetFlow) simultaneously active on the router.

Results, depicted in the table below, show that the Cisco 7304 could handle full line rate when services and routes were not enabled. When services were added to the router, it still maintained line-rate performance for packets that were 128-bytes and larger.

Packet Size (bytes)*	% of line rate	
	No services	With services and routes
40	100	36
128	100	100
256	100	100
517	100	100
1500	100	100

**The packet size shown in results files are IP packets and do not include Layer 2 headers, such as 5 bytes for POS header and 2 bytes for cyclic redundancy check (CRC).*

Test 2 – Failover Time: The objective of testing was to determine the time required for traffic to resume when there is a failure in the primary processor.

The first method that we used to test Route Processor fail over was to issue the command 'redundancy force-switchover' on the primary processor. This command executes an orderly shutdown and transfer from the primary to the secondary processor; therefore, it might not be truly indicative of the speed at which the controllers would fail over in an emergency.

We next conducted an online insertion and removal (OIR) test in which the primary processor, on which power was enabled and traffic was passing, was extracted to simulate a real-life scenario. We did so to evaluate whether the 7304 could handle a fail over under adverse conditions.

Last, we induced a fatal memory error in the primary processor in iterations 3 and 4 (most likely what would happen should this type of error occur in the "real" world). In all cases, failure caused only 0.51 seconds or less of down time. See the table below for specific failover results.

Iteration	Failure Type	Packets Lost		Sec.
		A → B	B → A	
1	Force Failover	34,315	34,316	0.34
2	Force Failover	36,871	36,864	0.37
3	Memory Error	3,166	3,164	0.03
4	Memory Error	3,135	3,143	0.03
5	OIR	51,378	51,380	0.51
6	OIR	51,471	51,474	0.51

Test 3 – MPLS VPN Scalability: The objective of testing was to evaluate the label forwarding, label imposition and disposition throughput and scalability of MPLS VPNs. (Note: When an IP packet goes through a provider edge [PE] router to the MPLS network, the PE router adds, or "imposes," an MPLS label on top of that packet. When an MPLS packet goes through a PE router to an IP network, the PE router has to remove, or "dispose" the MPLS label.)

Results showed that the Cisco 7304 could handle 1,000 MPLS VPN VRFs and 200,000 VPN routers, while still maintaining OC-12 line-rate traffic flows. Further, the test showed that the Cisco 7304 could impose and dispose MPLS labels at line rate.

This MPLS scalability test also showed that MPLS packets were forwarded through the provider core router at line rate, as well.

Conclusions

Miercom recently conducted tests to assess the overall scalability, functionality and performance of the Cisco 7304 Series router equipped with the NSE-100 routing engine. Results showed that the Cisco 7304 could scale up to 1,000 Virtual Routing Forwardings (VRFs) in an MPLS virtual private network while forwarding MPLS packets at an OC-12 line rate. The Cisco 7304 also forwards 40-byte packets at line rate with no services and 128-byte IP packets with services turned on. In addition, the 7304 demonstrated an average failover rate of only 0.4 seconds, a downtime that would be imperceptible to an end user attempting to access the network. The Cisco 7304 is a compact, modular router with integrated Gigabit Ethernet interfaces, offering IP/MPLS services and OC-48 connectivity at the network edge.

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About Miercom's Product Testing Services…

With hundreds of its product-comparison analyses published over the years in such leading network trade periodicals as *Business Communications Review* and *Network World,* Miercom's (formerly Mier Communications) reputation as the leading, independent product test center is unquestioned. Founded in 1988, the company has pioneered the comparative assessment of networking hardware and software, having developed methodologies for testing products from ATM switches to VoIP gateways and IP PBX's. Miercom's private test services include competitive product analyses, as well as individual product evaluations. Products submitted for review are typically evaluated under the "Net**WORKS** As Advertised™" or "Performance Verified™" programs, in which networking-related products must endure a comprehensive, independent assessment of the products' usability and performance. Products that meet the appropriate criteria and performance levels receive Miercom's endorsement.

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