CHAPTER 4

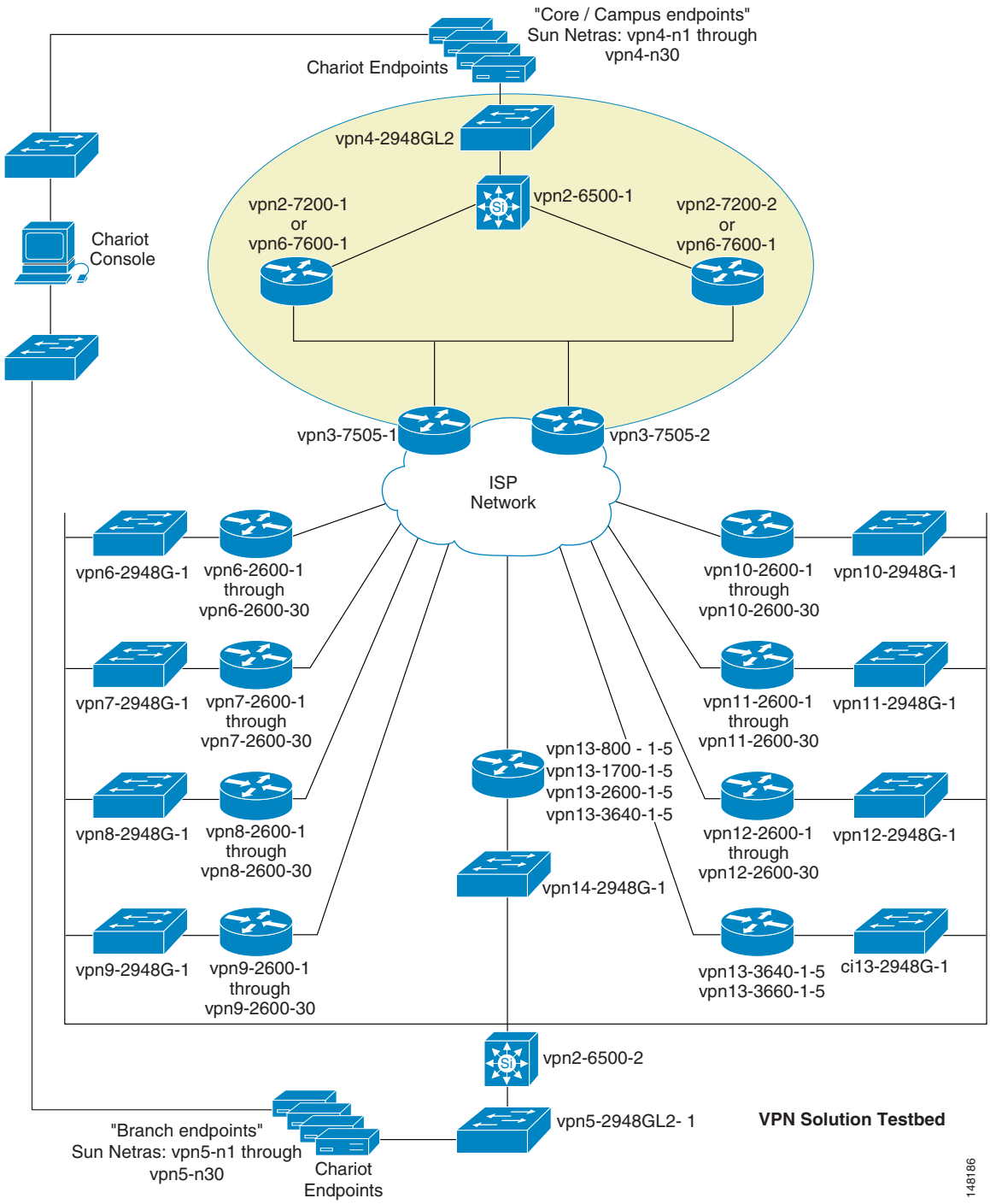
Scalability Test Results (Unicast Only)

This chapter provides Cisco test results to provide design guidance on the scalability of various platforms in DMVPN configurations.

Note IP multicast (IPmc) results are not included.

Figure 4-1 shows the scalability test bed network diagram.

Figure 4-1 DMVPN Hub-And-Spoke Mode Test Bed



Scalability Test Methodology

The headend scalability test bed consists of a number of Cisco branch routers (various types, including the 1700, 2600, 3600, 3700, 1800, 2800, and 3800 Series) homed to various types of headends. For most of the traffic sent through the network, flows are established using the Ixia Chariot testing tool. The bps mix of traffic is approximately 35 percent UDP and 65 percent TCP; application types represented in the mix include the following: VoIP, FTP, DNS, HTTP, POP3, and TN3270. The average packet size is 188 bytes, from headend to branch, and 144 bytes from branch to headend. This relatively small average packet size ensures that the scalability results presented support a converged network design, and tends to be fairly conservative. A network carrying data-only traffic, with a larger average packet size, may achieve better bps performance than that listed here. However, the pps performance given a specific CPU value should be the same.

Some traffic is also generated by the Cisco IP SLA feature in Cisco IOS, formerly known as Cisco Service Assurance Agent (SAA), using the HTTP Get script, with the branch routers making an HTTP Get call to an HTTP server in the core. Testing was conducted without fragmentation occurring in the network by setting the MTU to 1300 bytes on the test endpoints.

The following tables show results for testing with a configuration for the DMVPN tunnel aggregation. The routing protocol used during testing was EIGRP unless otherwise stated. The traffic mix used, as stated earlier, is converged data and g.729 VoIP.

DMVPN—Hub-and-Spoke Deployment Model

Headend Scalability Test Results

Table 4-1 shows results for scalability testing with a configuration for the DMVPN hub-and-spoke deployment model. QoS is not enabled on the DMVPN head-end hub router, but rather on the WAN routers.

Table 4-1 Headend Scalability Results—DMVPN Hub-and-Spoke Model

Platform	# of Tunnels	# Voice Calls	Throughput (kpps)	Throughput (Mbps)	CPU%
Cisco 7200VXR NPE-G1 Dual SA-VAM2	400 (1 mGRE)	285	47.5	106.3	80%
	800 (2 mGRE)	250	45.2	104.3	82%
Cisco 7200VXR NPE-G2 with VPN Services Adapter	600 (1 mGRE)	600	122	416	75%
Cisco ASR 1004 with RP1 and ESP 10	1000 (1 mGRE)	2570	545	1.2 Gbps	N/A

Table 4-1 Headend Scalability Results—DMVPN Hub-and-Spoke Model (continued)

Cisco 7600 Sup720 VPN SPA	1000 (2 mGRE)	4137	515.4	1.09 Gbps	N/A
Cisco 7200VXR/ Cisco 7600 Dual Tier architecture	3000 (1000 p2p GRE tunnels on each of three Cisco 7200VXR with IPsec tunnels on VPN SPA)	est. 4000	601 in total Up to 203 Kpps on each of three 7200VXR	-	N/A

Note No CPU numbers are reported for the Cisco ASR 1000 and Cisco 7600 because, for these case, encryption is done in hardware and has no impact on the main processor.

Table 4-2 shows results for scalability testing with a configuration for the DMVPN hub-and-spoke deployment model. QoS is enabled on the DMVPN headend hub router on the outside physical interface; a GigEthernet in this test. A shaper is configured per branch, *qos pre-classify* is enabled on the tunnel interface, and the service policy on the outside physical interface matches on the destination IP address. Each branch is therefore identified by the network address of the inside LAN network address. The shaped rate is 85 percent of 1.54 Mbps, or 1,310,000 bps.

Table 4-2 Headend Scalability Results—DMVPN Hub-and-Spoke Model with per Branch QoS Enabled

Platform 7200VXR NPE G2	Number of IPsec Tunnels	Tunnels w/ active traffic	Tunnels w/ EMIX traffic	Number of G.729 Calls	Throughput (Kpps)	Throughput (Mbps	CPU %
VAM2+	40	25	25	160	26.4	69	74
VSA	40	40	40	280	40	104.6	75

Branch Office Scalability Test Results

Table 4-3 shows results for testing with a configuration for the DMVPN hub-and-spoke deployment model. A single tunnel was configured to the aggregation headend. Cisco IOS-FW and NAT services were also engaged during the test.

Table 4-3 Branch Office Scalability Results—DMVPN Hub-and-Spoke Model

Platform	HW Encryption	# Voice Calls	Throughput (kpps)	Throughput (Mbps)	CPU%
Cisco 3845 ISR	On-board	187	24.0	48.8	81%
	AIM-VPN/HPII-Plus	420	27.1	50.1	80%
Cisco 3825 ISR	On-board	143	18.2	36.6	81%
	AIM-VPN/EPII-Plus	156	20.1	42.8	79%

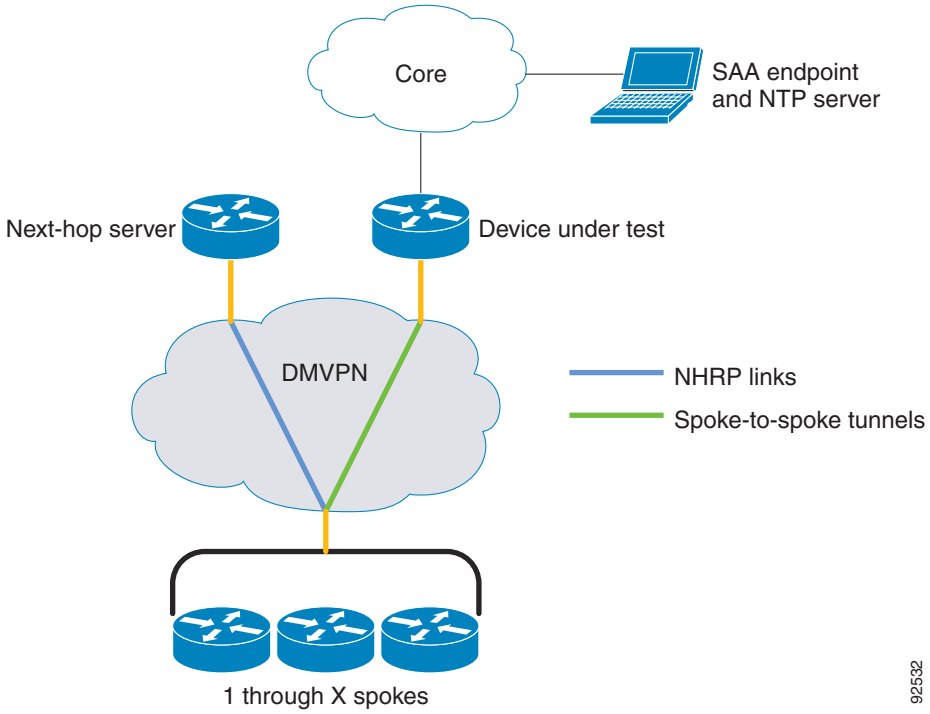
Table 4-3 Branch Office Scalability Results—DMVPN Hub-and-Spoke Model (continued)

Cisco 2851 ISR	On-board	90	11.4	23.8	79%
	AIM-VPN/EPII-Plus	120	14.9	30.8	80%
Cisco 2821 ISR	On-board	45	6.0	13.6	53%
	AIM-VPN/EPII-Plus	97	12.3	25.9	78%
Cisco 2811 ISR	On-board	19	2.6	5.8	79%
	AIM-VPN/EPII-Plus	27	3.6	8.0	80%
Cisco 2801 ISR	On-board	19	2.6	5.8	83%
	AIM-VPN/EPII-Plus	30	3.9	8.4	79%
Cisco 1841 ISR	On-board	19	2.5	5.7	82%
	AIM-VPN/BPII-Plus	30	3.9	8.8	80%
Cisco 1811W with no BVI configured	On-board	33	7.6	16.0	81%
Cisco 1811W with BVI configured	On-board	60	4.3	9.3	82%
Cisco 871W with no BVI configured	On-board	8	2.0	4.4	85%
Cisco 871W with BVI configured	On-board	15	1.1	2.4	84%

DMVPN—Spoke-to-Spoke Deployment Model

The spoke scalability test bed is shown in Figure 4-2.

Figure 4-2 DMVPN Spoke-to-Spoke Test Bed



The routers tested range from Cisco 831s to 3845s, and are inserted in turn into the "Device Under Test" spot. Various numbers of "1 through X" spokes are brought into the test bed. These routers each open one IPsec SA (or tunnel) to the next-hop server, which supplies them the NBMA address of the device under test (DUT). Each spoke opens a spoke-to-spoke tunnel to the DUT. Tunnels are kept alive via Cisco IP SLA and Network Time Protocol (NTP). Traffic is then generated through a certain number of these tunnels to assess the DUT router performance in terms of pps and bps, as it maintains what is considered its "safe maximum" number of tunnels. The outside interface (other than the DUT) of each spoke router is shaped to 192 Kbps; it is then known that the DUT is aggregating (192 Kbps x the number of tunnels shown). The traffic profile includes one voice call (G.729 codec) per tunnel. VoIP quality metrics are tracked during the test. Test results are not valid (or displayed) unless adequate VoIP quality is maintained during the tests.

Because spoke routers are exposed to various security risks (especially if they are connected to the Internet), and spoke sites are rarely large enough to justify the installation of dedicated security appliances, a spoke router normally has to perform some scrutiny of the incoming packets. Therefore, in addition to DMVPN, all testing is performed with the following features enabled:

- Outbound firewall inspection
- Inbound and outbound access control lists
- NAT

The new Cisco ISR platforms (1841, 2801, 2811, 2821, 2851, 3825, and 3845) are delivered with integrated encryption hardware, with an option to purchase an encryption/compression Advanced Integration Module (AIM) card for more encryption power. Results for these platforms are shown both ways; with the onboard encryption card and with the AIMs.

Table 4-4 shows the test results for the DMVPN spoke-to-spoke deployment.

Table 4-4 DMVPN Spoke-to-Spoke Deployment Model—Test Results

Platform	# Tunnels	# Voice Calls	Throughput (kpps)	Throughput (Mbps)	CPU%
Cisco 871W On-Board no BVI configured	1	15	2.0	4.4	85%
	5	14	1.6	3.8	82%
	9	13	1.9	3.9	85%
Cisco 871W On-Board with BVI configured	1	8	1.1	2.4	84%
	5	7	1.0	2.1	84%
	9	6	0.9	1.9	81%
Cisco 1811W On-Board no BVI configured	1	60	7.6	16.0	81%
	25	49	6.8	14.1	80%
	50	44	6.8	13.7	82%
Cisco 1811W On-Board with BVI configured	1	33	4.3	9.3	82%
	25	23	3.2	6.9	81%
	50	22	3.4	6.9	81%

Table 4-4 DMVPN Spoke-to-Spoke Deployment Model—Test Results (continued)

Cisco 1841 On-Board	1	19	2.5	5.7	82%
	25	14	2.2	4.7	81%
	50	13	2.1	4.1	79%
Cisco 1841 AIM-VPN/BPII-Plus	1	30	4.0	8.8	80%
	25	20	3.1	6.8	79%
	50	20	3.1	6.8	79%
Cisco 2801 ISR On-Board	1	19	2.6	5.8	83%
	25	14	2.2	4.7	83%
	50	13	2.1	4.5	81%
Cisco 2801 ISR AIM-VPN/EPII-Plus	1	30	3.9	8.4	79%
	25	20	3.1	6.8	79%
	50	20	3.1	6.8	81%
Cisco 2811 ISR On-Board	1	19	2.6	5.8	79%
	25	14	2.2	4.8	80%
	50	14	2.2	4.8	83%
Cisco 2811 ISR AIM-VPN/EPII-Plus	1	27	3.6	8.0	80%
	25	18	2.8	6.1	79%
	50	18	2.8	6.1	82%
Cisco 2821 ISR On-Board	1	45	6.0	13.6	53%
	50	50	7.8	17.0	79%
	100	50	7.8	17.0	80%
Cisco 2821 ISR AIM-VPN/EPII-Plus	1	97	12.3	25.9	78%
	100	59	9.2	20.1	80%
	200	55	8.8	18.9	80%
Cisco 2851 ISR On-Board	1	90	11.4	23.8	79%
	55	55	8.5	18.6	81%
	100	54	8.5	18.5	80%
Cisco 2851 ISR AIM-VPN/EPII-Plus	1	120	14.9	30.8	80%
	100	72	11.2	24.5	80%
	200	71	11.2	24.3	87%
Cisco 3825 ISR On-Board	1	143	18.2	36.6	81%
	150	91	14.2	29.0	80%
	300	89	14.2	28.8	80%
Cisco 3825 ISR AIM-VPN/EPII-Plus	1	156	20.1	42.8	79%
	150	108	16.8	35.7	80%
	300	104	16.5	34.8	80%

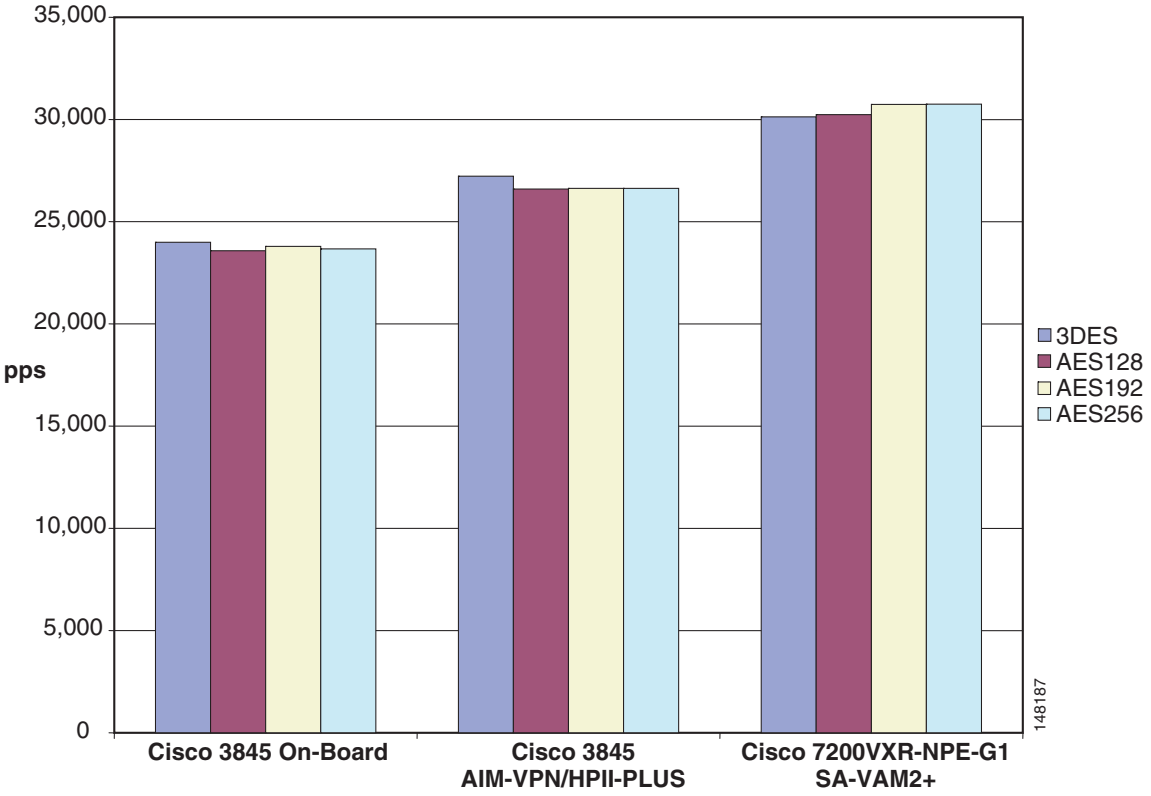
Table 4-4 DMVPN Spoke-to-Spoke Deployment Model—Test Results (continued)

Cisco 3845 ISR	1	187	24.0	48.8	81%
On-Board	200	118	18.4	37.7	80%
	400	114	18.1	36.7	80%
Cisco 3845 ISR	1	420	27.1	58.1	80%
AIM-VPN/HPII-Plus	200	280	21.7	46.3	80%
	400	270	21.4	45.2	80%
Cisco 7200VXR	1	480	30.4	63.1	79%
NPE-G1	200	340	26.4	56.2	79%
Dual SA-VAM2	400	320	25.2	53.3	80%
Cisco 7301	1	240	31.0	66.1	80%
SA-VAM2	200	160	24.7	50.1	79%
	400	150	23.6	47.6	79%

AES versus 3DES Scalability Test Results

Both 3DES and AES encryption are available in all products shown here, including hardware-accelerated IPsec. Not every test was executed with both 3DES and AES; however, several snapshot tests were performed to compare performance. As can be seen in the chart in Figure 4-3, results are fairly comparable, with little to no variation in performance, even for AES with wider key lengths.

Figure 4-3 Comparison of 3DES and AES Performance



Software Releases Evaluated

The software releases shown in Table 4-5 were used in the scalability testing:

Table 4-5 Software Releases Evaluated

Cisco Product Family	SW Release
Cisco ASR 1000	12.2(33)XNA
Cisco 7600	IOS 12.2(18)SXE2
Cisco 6500 VPNSM	IOS 12.2(18)SXE2
Cisco 7200VXR	IOS 12.2(11)T2 IOS 12.3(5)
Cisco 7200VXR NPE-G2 with VPN Services Adapter	IOS 124-4.XD-0629
Cisco branch office routers (17xx, 26xx, 36xx, 37xx)	IOS 12.3(8)T5

Table 4-5 Software Releases Evaluated

Cisco branch office ISRs (1841, 28xx, 38xx)	IOS 12.3(8)T5 IOS 12.3(11)T2
Cisco remote office routers (831, 871W, and 1811W)	831—IOS 12.3(8)T5 871W—IOS 12.3(8)Y1 1811W—IOS 12.3(14)YT1

As always, before selecting Cisco IOS software, perform the appropriate research. It is also important to have an understanding of issues in those levels of code that may affect other features configured on routers.