



Benchmark Performance Report

January 2016

Accelerated SDN

9400-SD

Table of Contents

Overview	3
Preliminary Benchmark Framework.....	3
Standalone Firewall.....	4
Standalone Firewall with IPsec.....	5
One Virtual Machine Running Firewall.....	6
Two Virtual Machines Running Firewall.....	7
Three Virtual Machines Running Firewall.....	8
Virtual Machine Running Firewall with IPsec.....	9
Appendix A: Testing Notes	10

Overview

This document provides a summary of the preliminary performance results for the Accelerated Concepts 9400-SD Universal Customer Premise Equipment (uCPE).

The 9400-SD is still in active development, therefore performance tests will be repeated on a regular basis with these preliminary results providing a benchmark of performance that Accelerated Concepts will use to monitor performance through the product development lifecycle as well as measure efficacy of development targeted to improve performance.

Preliminary Benchmark Framework

Several scenarios have been benchmarked to provide scaling data suitable for extrapolating to more precise customer requirements. A list of the resources used for testing is provided in the Appendix to help with reproduction of these results.

All tests operated with a full stateful firewall on all systems (physical and virtual).

All configuration was provided to the devices using central management and no local customization or optimizations were applied

All tests were performed using high performance desktop computers¹.

¹ The specifications for the high performance computers used for this benchmark are as follows:

PC A: Pentium i7-4790K - 8 core @ 4.0GHz (IPsec end-point), 32GB RAM, Intel Gb NICs

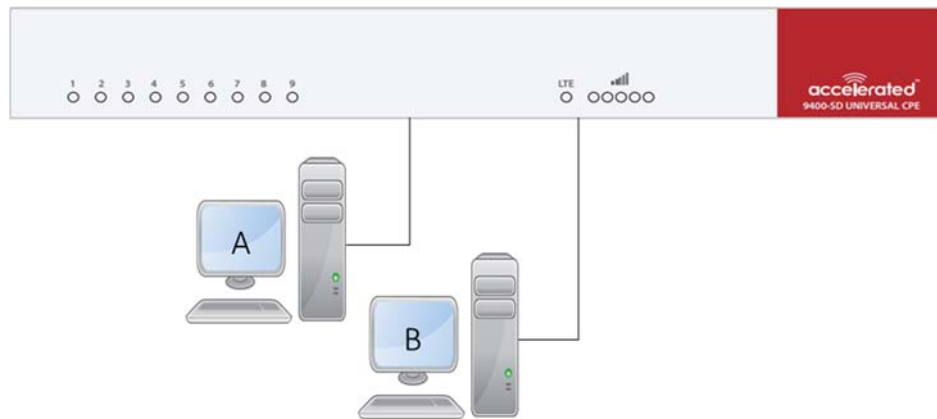
PC B: Intel Core2-6700 Duo @ 2GHz, 8GB RAM, Intel Gb NICs

PC C: Intel Xeon(R) E5420 4 core @ 2.5GHz, 8GB RAM, Broadcom NetXtreme II BCM5708 1000Base-T NIC

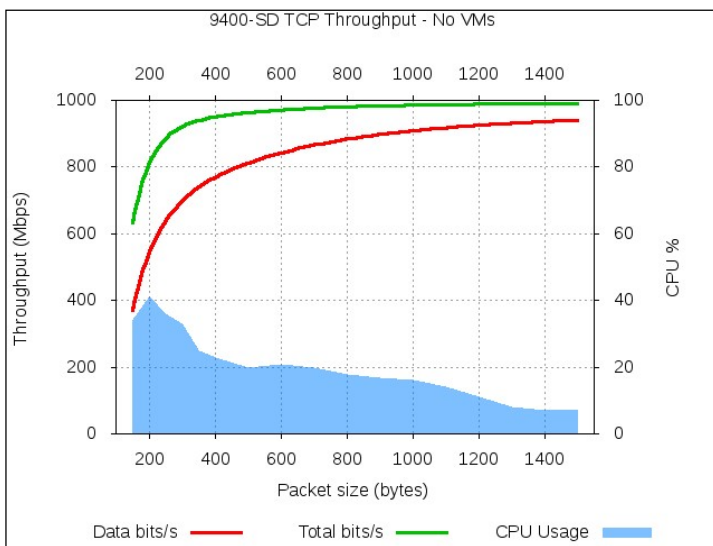
Standalone Firewall

Test Conditions

- For this test, two high performance desktop computers were connected to the 9400-SD on network ports ETH1 and ETH2 using the gigabit copper interface.
- The device was configured to NAT IPv4 traffic from A to B.
- The test utilized TCP connections using MSS clamping to provide the packet sizes under test.
- The TCP data throughput (payload throughput) and the raw copper throughput are shown along with the average 9400-SD CPU utilization while testing.



Results



Packet Size	Data Mbps	Total Mbps	CPU%
150	370.501109	633.22	34
200	595.601805	885.958	41
250	671.505166	920.921	36
300	722.195121	938.854	33
350	759.330233	950.388	25
400	787.70692	958.377	23
500	828.215373	968.652	20
600	855.73757	974.93	21
700	875.658763	979.146	20
800	890.740783	982.159	18
900	902.564098	984.425	17
1000	912.073507	986.179	16
1100	919.894321	987.585	14
1200	926.393824	988.686	11
1300	931.988197	989.683	8
1400	936.759773	990.486	7
1500	940.90284	991.17	7

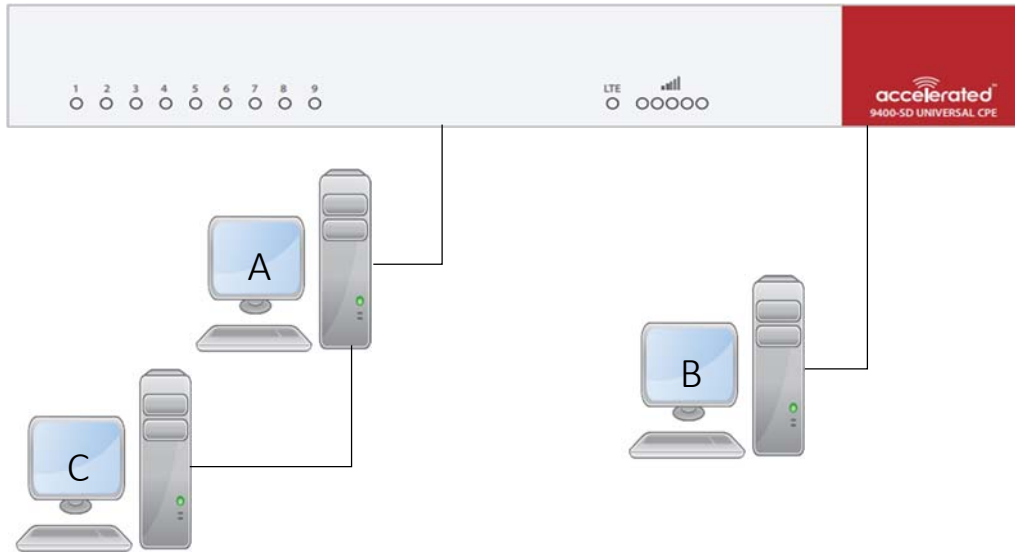
Results Analysis

The 9400-SD shows line rate performance for most packets sizes, the CPU utilization is low. Further investigation is required to determine why more CPU cannot be utilized to increase small packet performance.

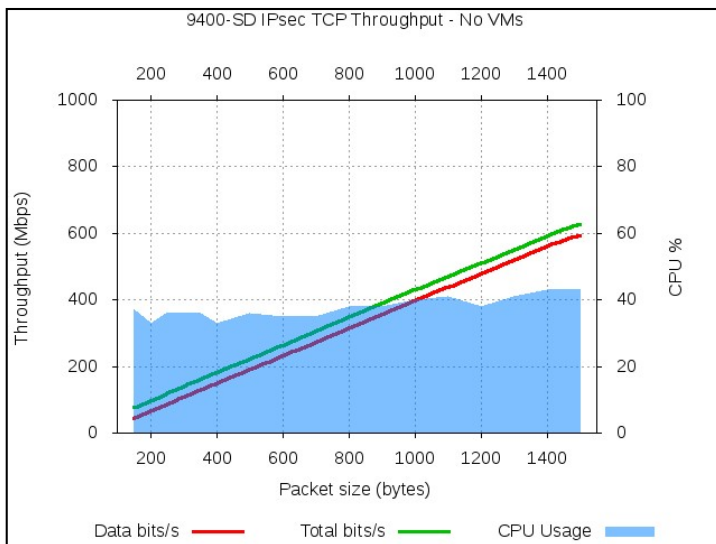
Standalone Firewall with IPsec

Test Conditions

- This test used three high performance desktops computers.
- The test was performed between C and B.
- An AES128-SHA1-MODP1024 IPsec tunnel was established between A and the 9400-SD to carry the traffic between C and B.



Results



Packet Size	Data Mbps	Total Mbps	CPU%
150	45.010871	76.9277	37
200	58.541569	87.0806	33
250	88.16662	120.914	36
300	110.129398	143.168	36
350	132.386236	165.696	36
400	141.96837	172.728	33
500	195.469301	228.614	36
600	227.685131	259.398	35
700	266.060272	297.504	35
800	317.387059	349.961	38
900	356.957033	389.332	38
1000	398.528077	430.908	40
1100	454.064481	487.477	41
1200	456.753227	487.466	38
1300	520.851844	553.095	41
1400	568.250595	600.841	43
1500	594.190726	625.935	43

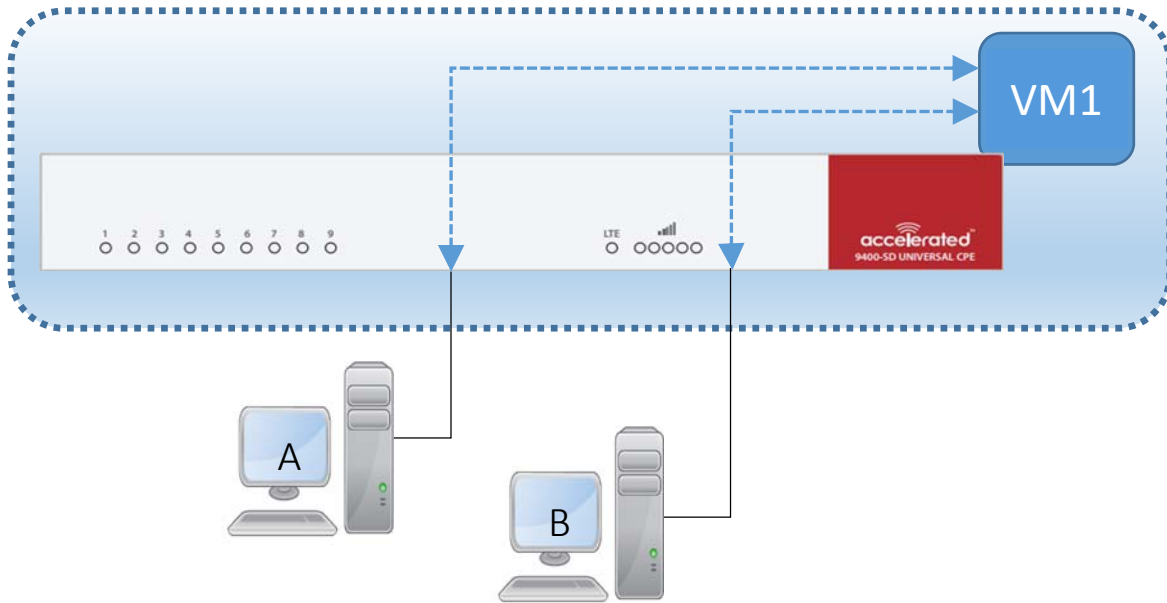
Results Analysis

The design of the Linux IPsec stack provided serialization of all packets. This prevents a higher CPU utilization. More investigation is required on the possibility of improving this, however, the additional CPU time is readily available for more intensive network processing options.

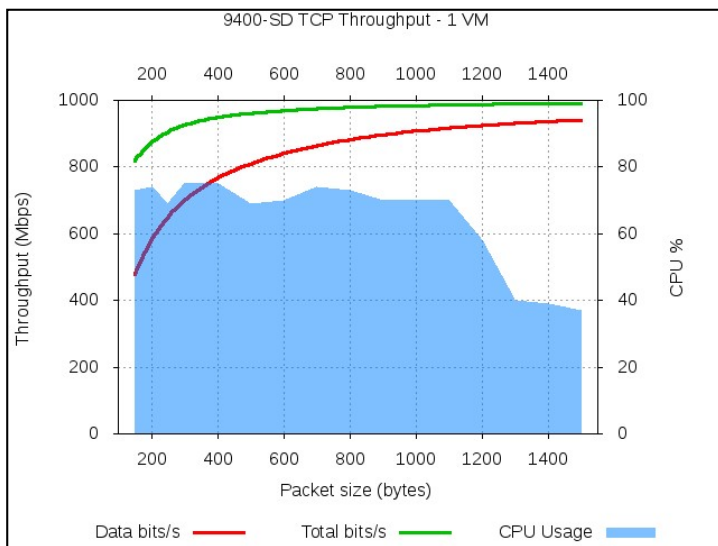
One Virtual Machine Running Firewall

Test Conditions

- This benchmark involved running a single instance of the 9400-SD as a Virtual Machine (VM) within the 9400-SD.
- For this test, VM1 was given exclusive access to the physical Ethernet ports ETH1 and ETH2.
- The throughput was tested exactly as per the "Standalone firewall" test with all the networking functions (stateful NAT firewall) run within VM1.



Results

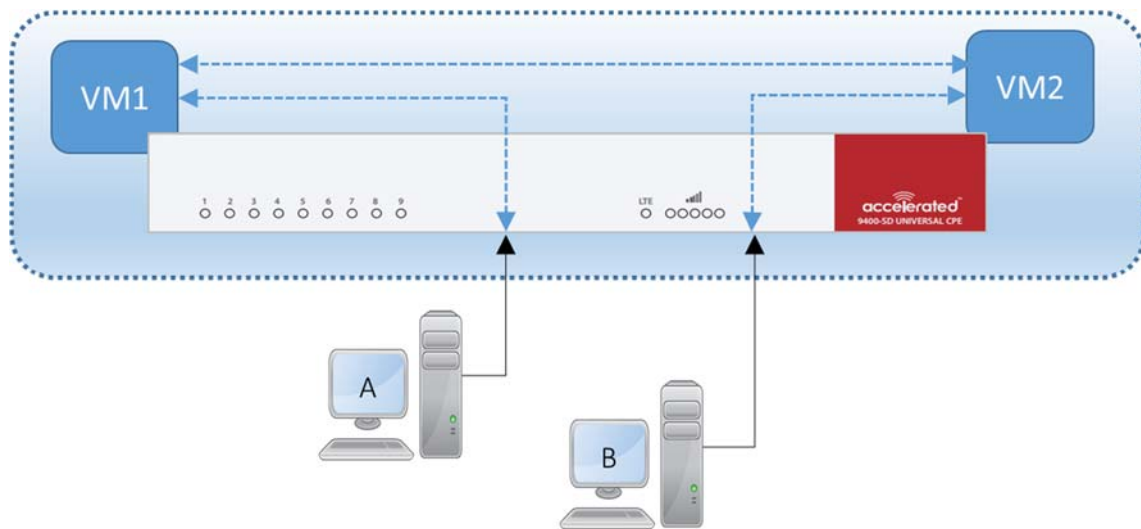


Packet Size	Data Mbps	Total Mbps	CPU%
150	479.677969	819.813	73
200	595.738512	886.161	74
250	669.309989	917.911	69
300	718.965003	934.655	75
350	756.647805	947.03	75
400	785.335295	955.491	75
500	826.294855	966.406	69
600	854.118458	973.085	70
700	874.674897	978.046	74
800	889.492955	980.783	73
900	901.385236	983.139	70
1000	910.760257	984.76	70
1100	918.52697	986.117	70
1200	925.692044	987.937	58
1300	931.670173	989.345	40
1400	936.515281	990.227	39
1500	940.60356	990.855	37

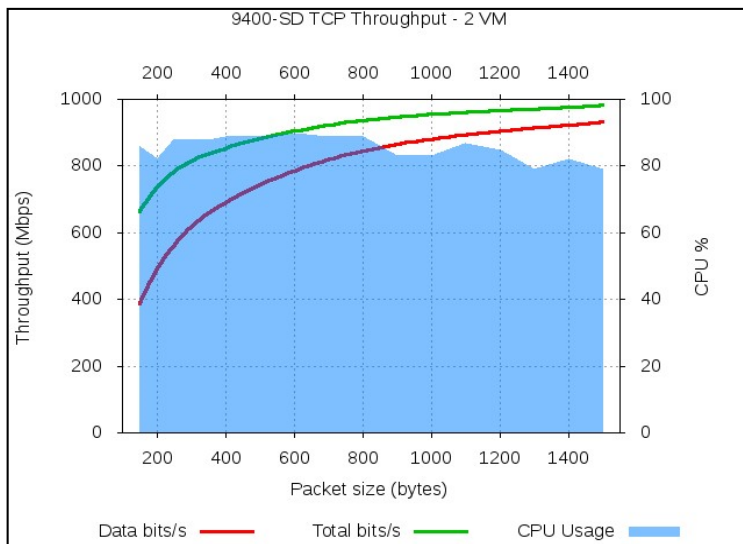
Two Virtual Machines Running Firewall

Test Conditions

- This benchmark involved running two instances of the 9400-SD as a Virtual Machine (VM) within the 9400-SD.
- For this test, VM1 was given exclusive access to ETH1, VM2 was given exclusive access to ETH2 and VM1 and VM2 were chained together (Virtual network between Virtual Machines).
- Both VM1 and VM2 were running full stateful NAT firewall configurations.
- The benchmark was run between A and B with all packets traversing through VM1 and VM2 in route to their destination.



Results

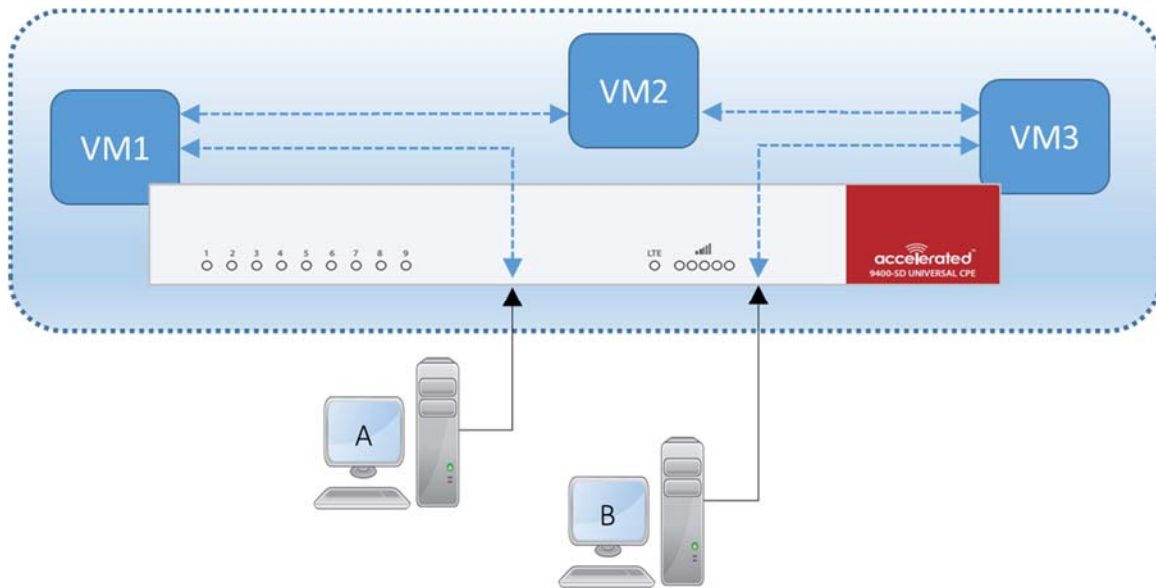


Packet Size	Data Mbps	Total Mbps	CPU%
150	388.751353	664.411	86
200	498.899572	742.113	82
250	590.763012	810.189	88
300	639.718653	831.634	88
350	671.83282	840.875	88
400	705.748834	858.661	89
500	752.139317	879.676	89
600	803.154359	915.022	90
700	836.505627	935.365	89
800	861.187803	949.573	89
900	874.046285	953.32	83
1000	874.721363	945.792	83
1100	900.882577	967.174	87
1200	907.091096	968.085	85
1300	914.315531	970.916	79
1400	920.633367	973.434	82
1500	931.734645	981.512	79

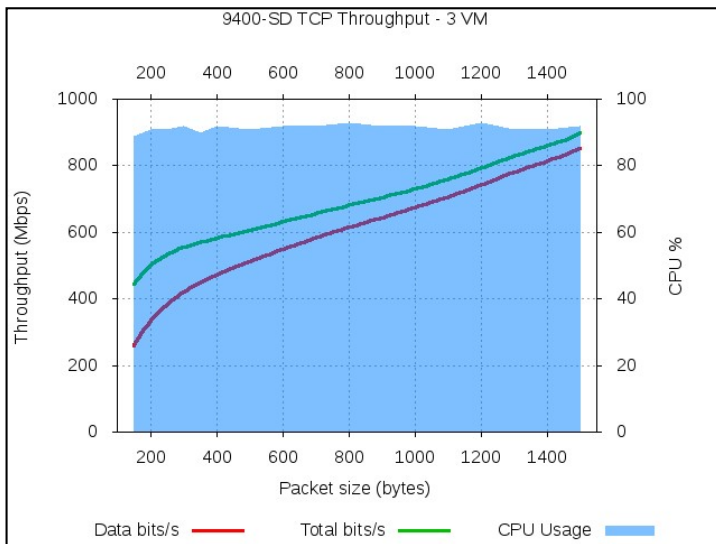
Three Virtual Machines Running Firewall

Test Conditions

- This benchmark involved running three instances of the 9400-SD as Virtual Machines within the 9400-SD.
- For this test, VM1 was given exclusive access to ETH1, VM3 was given exclusive access to ETH2. VM1/VM2 and VM2/VM3 were chained together.
- VM1, VM2 and VM3 were running full stateful NAT firewall configurations.
- The benchmark was run between A and B with all packets traversing through VM1, VM2 and VM3 in-route to their destination



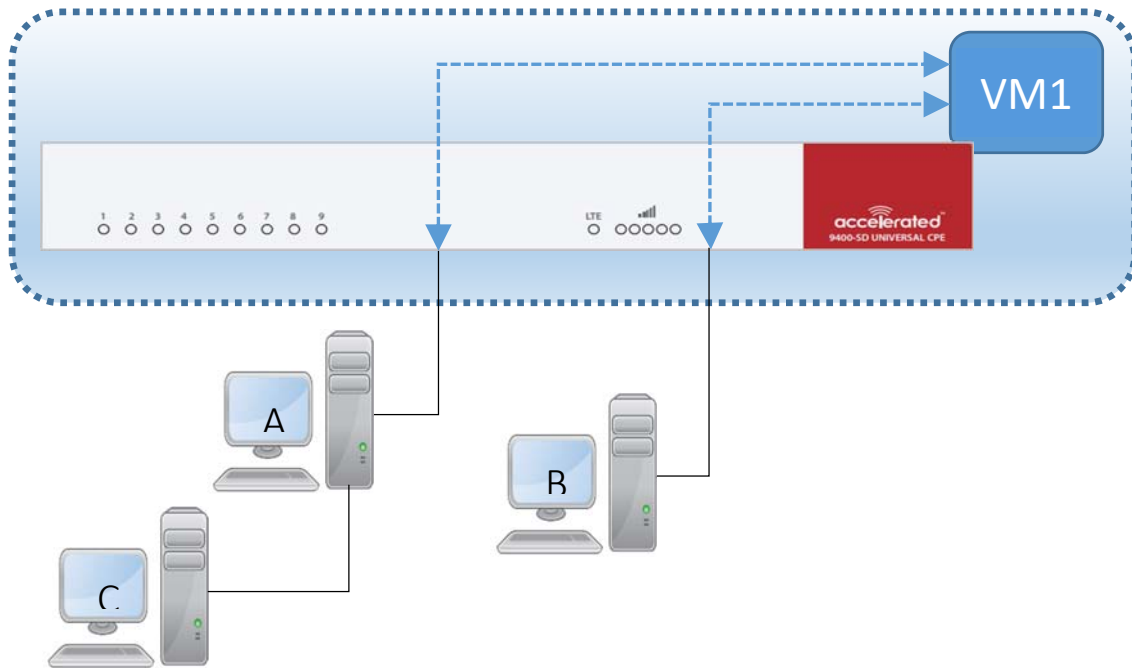
Results



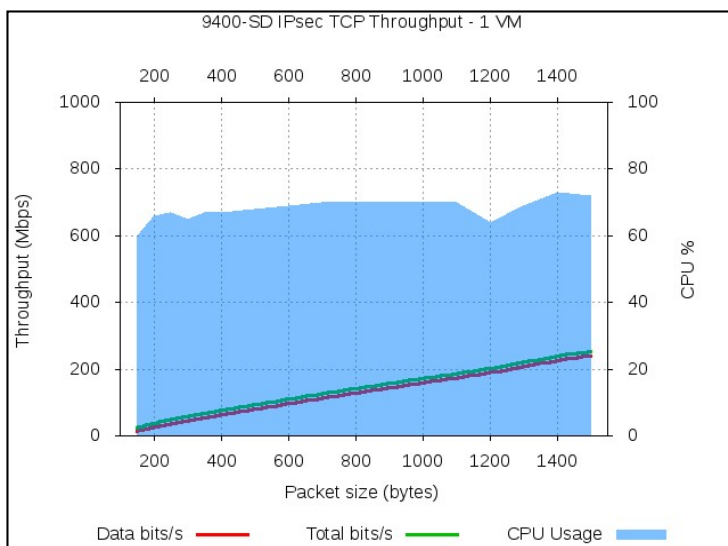
Packet Size	Data Mbps	Total Mbps	CPU%
150	260.782466	445.701	89
200	343.991588	511.687	91
250	397.477656	545.112	91
300	436.965621	568.055	92
350	457.877589	573.085	90
400	476.92908	580.264	92
500	510.742983	597.347	91
600	552.478172	629.43	92
700	589.362724	659.015	92
800	626.833415	691.166	93
900	645.868225	704.447	92
1000	672.431993	727.067	92
1100	674.321412	723.941	91
1200	743.009361	792.97	93
1300	806.5794	856.511	91
1400	798.324131	844.11	91
1500	852.189958	897.718	92

Virtual Machine Running Firewall with IPsec

- This benchmark involved running a single instance of the 9400-SD as a Virtual Machine (VM) within the 9400-SD.
- For this test, VM1 was given exclusive access to the physical Ethernet ports ETH1 and ETH2.
- The throughput was tested exactly as per the “Standalone firewall with IPsec” test with all the networking functions (stateful NAT firewall and IPsec) run within VM1.



Results



Packet Size	Data Bps	Total Mbps	CPU%
150	14.124628	24.1403	60
200	25.796246	38.3719	66
250	36.03353	49.4174	67
300	45.247137	58.8213	65
350	53.847875	67.3967	67
400	62.91714	76.5492	67
500	79.015176	92.4134	68
600	95.810654	109.156	69
700	114.934959	128.518	70
800	127.409112	140.485	70
900	143.793246	156.835	70
1000	161.848211	174.998	70
1100	179.026079	192.2	70
1200	171.369934	182.893	64
1300	212.304781	225.447	69
1400	229.440749	242.6	73
1500	239.684726	252.49	72

Appendix A: Testing Notes

- All testing was conducted using Ubuntu Linux desktop systems running version 12.04 or 14.04.
- The “hpcbench” tools were utilized for TCP throughput testing (<http://hpcbench.sourceforge.net/>).
- The “hpcbench” MSS clamping option was used to limit TCP packet sizes in a predictable way suitable for presentation.
- The throughput totals represented in these tests do not include retransmissions, ACKs or other traffic not directly related to the data carrying packets involved in the testing. This method of testing and reporting will not be able to report a full 1Gbps throughput result due to this unaccounted bandwidth and as such, full line rate utilization will show as slightly less than 1Gbps.
- 9400-SD firmware version 16.1.59 with parallel encryption options enabled was utilized for this testing.