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Performance Testing of Gigabit Ethernet Adapters in DEC Alpha Computers Running Linux

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Performance Testing of Gigabit Ethernet Adapters in DEC Alpha Computers Running Linux

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Abstract

This report describes performance testing of Gigabit Ethernet adapters from Alteon and SysKonnnect under the Linux operating system on DEC Alpha host computers. The testing measured performance on both the UDP and TCP networking protocols, as well as the load imposed on the host computer.

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Executive Summary

This report describes performance testing of Gigabit Ethernet adapters from Alteon and SysKonnnect under the Linux operating system on DEC Alpha host computers. The testing was motivated by poor performance of an NFS-based I/O aggregation application for Cplant. Data collected from the testing reported here played a role in correcting that performance problem.

The testing reported here measured performance on both the UDP and TCP networking protocols, as well as the load imposed on the host computer. The purpose of this report is simply to record the results of the testing in a form that can be referenced. Any analysis of the test results is beyond the scope of this document.

The Alteon ACEnic PCI gigabit Ethernet card was tested under versions 2.2.14 and 2.2.16 of the Linux kernel. Version 0.41 of the ACEnic driver was used for the 2.2.14 testing. Version 0.44 of the driver, which was included in the 2.2.16 Linux distribution, was used for the 2.2.16 testing.

The SysKonnnect SK-9843 gigabit Ethernet card was only tested under version 2.2.16 of the Linux kernel. The driver version distributed with that kernel was tested, rather than the driver found on the CD that shipped with the card, because the former had newer versions of several driver files.

The results reported here for the Alteon ACEnic under Linux 2.2.14, using driver version 0.41, are included only for the sake of completeness. The testing indicated no reason that driver version 0.41 should be preferred over version 0.44 (and by implication, any later version).

Using the ACEnic driver version 0.44, the Alteon achieved the following peak performance:

- UDP stream test:
 - 450 Mb/s (1500 byte MTU)
 - 650 Mb/s (9000 byte MTU)
- TCP stream test
 - 400 Mb/s (1500 byte MTU)
 - 660 Mb/s (9000 byte MTU)
- UDP request/response test
 - ~3970 transactions/s (1500 byte MTU)
 - ~3730 transactions/s (9000 byte MTU)
- TCP request/response test
 - ~6250 transactions/s (1500 byte MTU)
 - ~5500 transactions/s (9000 byte MTU)

The SysKonnnect achieved the following peak performance:

- UDP stream test:
 - 220 Mb/s (1500 byte MTU)
 - 670 Mb/s (9000 byte MTU)
- TCP stream test
 - 300 Mb/s (1500 byte MTU)
 - 620 Mb/s (9000 byte MTU)
- UDP request/response test
 - ~10,000 transactions/s (1500 byte MTU)
 - ~10,000 transactions/s (9000 byte MTU)
- TCP request/response test
 - ~8000 transactions/s (1500 byte MTU)
 - ~8000 transactions/s (9000 byte MTU)

Test Hardware and Software

Hardware

The testing reported here was conducted using two model 500au DEC Personal Workstations, also known as Dec Miatas. The DEC 500au uses a 500 MHz EV56 Alpha processor, and employs a PCI bus with two 64-bit, 33 MHz slots in addition to three 32-bit, 33 MHz slots.

Gigabit Ethernet cards from two different vendors were tested. These cards were the Alteon ACEnic and the SysKonnnect SK-9843. Both cards have features that attempt to mitigate the high interrupt rate that would occur if the host CPU were interrupted for each packet. In theory, this should increase the bandwidth available through the interface. In addition, both cards support jumbo Ethernet frames.

The Alteon ACEnic uses tuning parameters to control how many packets are sent or received before an interrupt is generated. The two basic tuning parameters are the number of packets to process before interrupting the host (maximum coalesced packets), and the maximum time to wait for that number of packets to be processed before interrupting the host anyway. The timeout parameter is needed to provide a guaranteed maximum latency for packets traversing the card. These two parameters can be set independently for sent and received packets. The Alteon document Host/NIC Software Interface Definition [1] has more information on these parameters.

The SysKonnnect SK-9843 addresses this problem with a feature that SysKonnnect calls PacedPacketBatch (sic) technology. It is not clear from the available SysKonnnect documentation [2,3] just how this works, but the documentation claims it dynamically adjusts the interrupt grouping based on traffic conditions. It also supports an interrupt moderation parameter that provides the means to limit the maximum rate of interrupts generated by the card.

One card of each type was installed in each of the two DEC Miatas. The cards were connected to an Alteon ACEswitch 180 gigabit Ethernet switch, which supports jumbo frames. The switch was configured so that the Alteon cards were in one VLAN and the SysKonnnect cards were in a separate VLAN.

Software

The first series of tests, on the Alteon ACEnic interface, were conducted in March 2000, when version 2.2.14 of the Linux kernel was current. At that time the driver for the ACEnic was undergoing rapid development, so the version of the driver that was distributed with that kernel, 0.33a, was considerably older than the newest version available, 0.41. Thus, that series of tests was run using the 2.2.14 kernel with version 0.41 of the ACEnic driver.

By July 2000, when the second series of tests for the Alteon and SysKonnnect cards were run, the current Linux kernel was 2.2.16, which included version 0.44 of the ACEnic driver. By that time the driver was much more mature and the pace of its development had slowed considerably, so the latest version (0.45, as of this writing) was not used for that series of tests.

It is difficult to determine a version number for the SysKonnnect driver, as the source consists of multiple files, each with its own revision number. Several of the files comprising the SysKonnnect driver had higher revisions in the 2.2.16 kernel source than in the driver source on the CD shipped with the card. Thus, the driver as distributed with version 2.2.16 of the Linux kernel was used for these tests.

The network performance testing used the netperf program [4], version 2.1. Netperf was designed to test both bulk data transfer rates (through its stream tests) and latency performance (through its request/response tests) for the UDP and TCP protocols. Its most useful options allow the data buffer size, socket buffer size, and test duration to be set, independently if necessary, for the send and receive processes.

During the testing a minor bug was discovered in netperf, which prevents UDP request/response tests from running. See Appendix A for a patch that corrects the bug.

Note that on Linux, the default maximum socket buffer size, and hence the maximum TCP window size, is 65536 bytes. This can be changed, to 256 KB, for example, using the commands

```
echo 262144 > /proc/sys/net/core/rmem_max
echo 262144 > /proc/sys/net/core/wmem_max
```

The load placed on the systems by the netperf testing was determined using the Linux/Unix utility vmstat, sampling every two seconds. System load for both the sending and receiving hosts was captured. The duration of each netperf test was twenty seconds. Five instances of each test were run, and the results were averaged over the five tests.

Because of the number of parameter combinations used in the testing, running all of the tests manually would have been error-prone. Instead, a simple shell script was written to automate the testing. This script, along with a sample input file, is presented in Appendix A. Also, because of the volume of output generated by the tests, some automated post-processing was required. A script for the utility awk was written to reduce the data into tabular form, such as the tables presented in Appendix B. This awk script is also presented in Appendix A.

Results

The following parameter ranges were explored in the testing:

Tests:	stream (measures throughput) request/response (measures latency)
IP Protocols:	UDP, TCP
MTU size (bytes):	1500, 9000
Socket buffer size (bytes):	64K, 128K, 256K
Data buffer size (bytes):	32, 64, 128, 256, 512, 1K, 2K, 4K, 8K, 16K, 32K

Recall that for the TCP protocol, the socket buffer size is also the TCP window size. The data buffer size specifies the buffer size used to pass data to/from the socket send/rcv calls.

Results from the testing include either received data rate (stream tests) or transaction rate (request/response tests), CPU interrupt rate, CPU context switching rate, and CPU utilization. The CPU statistics are reported for both sending and receiving hosts. Received data rate is reported because the UDP protocol does not guarantee delivery, and delivered throughput is most relevant to applications. A complete set of results in tabular form is presented in Appendix B.

Results are presented here in graphical form for those cases where a visual representation will speed assimilation. Note that for the vertical axis on the graphs showing data rate, the scale (Mb/s) is 10^6 bits/second, not 2^{20} bits/second.

The interrupt rates presented in Appendix B are those reported by vmstat, and thus include all the interrupts for the system during the testing, not just the interrupts which could be attributed to the network testing. Thus, to interpret the reported interrupt rate it is important to know that the interrupt rate on an idle Linux-based Alpha is ~1000 interrupts/second.

Tests Using Linux Kernel Version 2.2.14

Alteon ACEnic, 1000 Microsecond Interrupt Coalesce Timeout

As discussed previously, the Alteon ACEnic supports tunable parameters to mitigate interrupt rate. These parameters can be set either when the driver is compiled, or, if the driver is compiled as an insertable module, at module insertion time. These four module parameters are: max_tx_desc, max_rx_desc, tx_coal_tick, and rx_coal_tick. The first two parameters specify the number of transmit and receive descriptors (packets), respectively, to process before interrupting the host to notify it the packets have been serviced. The second two parameters are the number of microsecond clock ticks to wait before interrupting the host if the specified number of transmit and receive descriptors, respectively, haven't been processed.

The default values of these parameters in version 0.41 of the ACEnic driver are:

```
max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 996
rx_coal_tick: 1000
```

Full results for testing using these values for the tuning parameters can be found in Appendix B, in Table B-1 through Table B-24. Results for received bit rate and CPU utilization for the stream tests are presented graphically in Figure 1 through Figure 8.

From Figure 1, which shows the received data rate for the UDP stream test with a 1500 byte MTU, we see that throughput increases smoothly to ~500 Mb/s at a data buffer size of 1024 bytes. Then, it drops off precipitously to ~10 Mb/s for 2048 byte data buffers. Since these two data buffer sizes bracket the MTU size, IP fragmentation of the UDP packets is probably involved. Examining the traffic through the Ethernet interface with a program like tcpdump verifies that IP fragmentation is occurring for data buffer sizes greater than the MTU size. Figure 5 shows that the receiving CPU is not saturated until the 2048 byte data buffer size, supporting the hypothesis that the large drop in throughput is due to the overhead of IP fragment re-assembly on the receiving host.

It is not clear why the sending host CPU utilization drops off for data buffers greater than 1024 bytes. Since UDP does not have guaranteed delivery, the sender should be sending packets as fast as possible regardless of what is occurring on the receiving side. Clearly some other kernel resource is being over-subscribed, but the available data gives no indication what it might be. It is not likely related to MTU size, since CPU utilization data for the same test with a 9000 byte MTU and a 64 KB socket buffer (Figure 7) show the same drop-off for the sender at the same data buffer size, 1024 bytes. Tables B-14 and B-15 in Appendix B show that the same reduction in CPU utilization for the receiving host occurs for 128 KB and 256 KB socket buffers, as well.

Figure 2 shows the received data rate for the TCP stream test with a 1500 byte MTU. For 128 KB and 256 KB socket buffers, the throughput levels off at ~390 Mb/s for data buffer sizes equal to or greater than 2048 bytes. For 64 KB socket buffers, throughput levels off at ~250 Mb/s for data buffers equal to or greater than 512 bytes. CPU utilization for the various socket buffer sizes (Figure 8, Tables B-4 through B-6, Appendix B) shows that the 64 KB socket buffer case uses significantly fewer CPU cycles, even though it has less throughput.

This reduction in throughput for a 64 KB socket buffer may be related to the interrupt mitigation tuning parameters. Note that transmitting 64 KB at the 10^9 bit/second line rate with a 1500 byte MTU takes 0.66 ms and 44 packets. Possibly the sending host has to wait for ACK packets sent by the receiver to time out on the card before the sender can advance its TCP window. However, further speculation on the cause of this anomalous behavior is beyond the scope of this report.

Throughput results for UDP and TCP stream tests with a 9000-byte MTU are shown in Figures 3 and 4, respectively. The received bit rate for the UDP stream test with a 64 KB

socket buffer shows some anomalous results which cannot be explained from data gathered in this testing. However, for 128 KB and 256 KB socket buffers, the throughput increases smoothly up to ~650 Mb/s at a data buffer size of 8192 bytes.

The TCP stream test shows significant dependence of data rate on socket buffer size. For a 64 KB socket buffer, peak throughput of ~220 Mb/s is attained for data buffer 128 bytes and larger. Peak throughput for a 128 KB socket buffer is ~420 Mb/s for data buffers 512 bytes and larger. Finally, for 256 KB socket buffers we see the peak throughput of ~640 Mb/s only at the largest data buffer size, 32 KB. Tables B-16 through B-18 show that the increase in throughput with socket buffer size correlates with increasing CPU utilization. The mechanism described above for the 1500 byte MTU case, i.e., ACK packet delivery to the sending host being delayed by the interrupt mitigation strategy, may also be at work here.

For request/response results in tabular form, see Appendix B, Table B-7 through B-12, and B-19 through B-24. Results for the request/response tests were not graphed, as they showed no variation with MTU size, data buffer size, or socket buffer size. This is as expected, since the request/response test primarily measures network latency, not throughput.

For the test parameters of this section, the ACEnic delivered ~920 transactions per second.

Figure 1. Data rate for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 2. Data rate for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 3. Data rate for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 4. Data rate for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 5. CPU utilization for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 6. CPU utilization for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 7. CPU utilization for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Figure 8. CPU utilization for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 1.0 ms interrupt coalesce timeout.

Alteon ACEnic, 250 Microsecond Interrupt Coalesce Timeout

The impact of the interrupt coalesce timeout tuning parameters for the Alteon ACEnic was determined by running the tests again with smaller values of the parameters. The hope was to obtain much better results for the request/response tests, which are network latency sensitive, without a significant adverse impact on throughput results. Two sets of tests were run, one with a 500 microsecond interrupt coalesce timeout and one with a 250 microsecond interrupt coalesce timeout. Since the 500 microsecond timeout results are in every respect intermediate between the default timeout results of the previous section and the 250 microsecond timeout results presented here, only the latter will be shown.

For this series of tests, the values of the tuning parameters used with version 0.41 of the ACEnic driver were:

```
max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 250
rx_coal_tick: 250
```

Full results for testing using these values for the tuning parameters can be found in Appendix B, in Table B-25 through Table B-48. Results for received bit rate and CPU utilization for the stream tests are presented graphically in Figure 9 through Figure 16.

Comparing Figure 9 with Figure 1, we see that for the UDP stream test with a 1500 byte MTU, throughput is only slightly reduced for an interrupt coalesce timeout of 250 microseconds. Throughput for the TCP stream test (Figure 10 vs. Figure 2) is essentially unchanged for 128 KB and 256 KB socket buffers, while throughput for 64 KB socket buffers now essentially matches the larger buffer sizes. This increased TCP stream throughput for the 64 KB socket buffer case corresponds to increased CPU utilization (compare Figure 14 with Figure 6). This supports the speculation made in the previous section that the reduced TCP throughput with a 64 KB socket buffer was related to the interrupt coalesce tuning parameters.

For 9000 byte MTU size, the UDP stream throughput (Figure 11 vs. Figure 3) is again essentially unchanged. Once again, the anomalous results for a 64 KB socket buffer for a 1000 microsecond timeout disappear when the timeout is reduced to 250 microseconds.

The TCP stream throughput for a 9000 byte MTU (Figure 12 vs. Figure 4) with a 256 KB socket buffer is slightly higher with a 250 microsecond interrupt coalesce timeout, and the peak is broader. Also, the 128 KB socket buffer results now essentially match the 256 KB socket buffer results, and the throughput for a 64KB socket buffer have increased substantially. Now, we see a peak throughput of ~660 Mb/s for 128 KB and 256 KB socket buffers and a peak throughput of ~500 Mb/s for 64 KB socket buffers. Also, for larger data buffer sizes we see a significant increase in CPU utilization in the 64 KB socket buffer case (compare Figure 16 with Figure 8).

For request/response results in tabular form, see Appendix B, Table B-31 through B-36, and B-43 through B-48. Once again, results for the request/response tests were not graphed, as they showed no variation with MTU size, data buffer size, or socket buffer size. For the test

parameters of this section, the ACEnic delivered ~2900 transactions per second for UDP and ~2750 transactions per second for TCP. This compares very favorably with the ~920 transactions per second measured with the 1000 microsecond interrupt coalesce timeout.

Figure 9. Data rate for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 10. Data rate for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 11. Data rate for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 12. Data rate for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 13. CPU utilization for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 14. CPU utilization for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 15. CPU utilization for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Figure 16. CPU utilization for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.14, using driver version 0.41 and a 0.25 ms interrupt coalesce timeout.

Tests Using Linux Kernel Version 2.2.16

Alteon ACEnic, MTU-Dependent Interrupt Coalesce Timeout

The 2.2.16 version of the Linux kernel uses version 0.44 of the ACEnic driver. Among the many changes to the driver were changes to the default values of the interrupt coalesce tuning parameters. The default values of the tuning parameters were made dependent on the MTU size, and the default values of the interrupt coalesce timeout were significantly reduced.

The default values of the tuning parameters for version 0.44 of the ACEnic driver for a normal (1500 byte) MTU size are:

```
max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 400
rx_coal_tick: 120
```

The default values of the tuning parameters for version 0.44 of the ACEnic driver for a jumbo (9000 byte) MTU size are:

```
max_tx_desc: 60
max_rx_desc: 6
tx_coal_tick: 20
rx_coal_tick: 30
```

In the discussion to follow, we will compare results for the ACEnic driver version 0.44 with version 0.41 using a 250 microsecond interrupt coalesce timeout, since that combination had the best overall performance for driver version 0.41.

From Figure 17 we see that the maximum received bit rate for the UDP stream test with a 1500 byte MTU is ~450 Mb/s, a slight reduction from that achieved using driver version 0.41 (Figure 9). Also, we see that the CPU utilization for data buffer sizes where the CPU is not fully consumed is somewhat higher for driver version 0.44 (Figure 21 vs. Figure 13).

A similar situation holds for the TCP stream test with a 1500 byte MTU. Throughput is slightly reduced, and CPU utilization is slightly higher. Compare Figure 18 to Figure 10, and Figure 22 with Figure 14.

For the UDP stream test with a 9000 byte MTU, peak throughput is essentially unchanged at ~650 Mb/s for the three socket buffer sizes tested (Figure 19 vs. Figure 11). However, with version 0.44 of the driver, throughput at intermediate data buffer sizes is significantly reduced. For example, with 1024 byte data buffers, received bit rate dropped from ~500 Mb/s to ~275 Mb/s.

TCP stream performance with a 9000 byte MTU remained essentially unchanged at ~650 Mb/s, as compared to the ~660 Mb/s achieved by version 0.41 of the driver (Figure 20 vs. Figure 12). The notable exception to this is for the 64 KB socket buffer case. With version

0.44 of the driver throughput at larger data buffer sizes has increased by ~100 Mb/s to ~600 Mb/s, and now is much closer to that obtained using larger socket buffer sizes.

For request/response results in tabular form, see Appendix B, Table B-55 through B-60, and B-67 through B-72. Once again, results for the request/response tests were not graphed, as they showed no variation with data buffer size, or socket buffer size. However, there is a dependence on MTU size for this version of the ACEnic driver. This is most likely due to the effect on latency caused by the driver using different interrupt coalesce timeout values for regular and jumbo frames.

For the test parameters of this section and a 1500 byte MTU, the ACEnic delivered ~3970 transactions per second for UDP and 3730 transactions for TCP. With a 9000 byte MTU, the ACEnic delivered ~6250 transactions per second for UDP, and ~5500 transactions per second for TCP. These results compare favorably with the ~2900 transactions per second for UDP and ~2750 transactions per second for TCP, which were measured with version 0.41 driver using a 250 microsecond interrupt coalesce timeout.

Figure 17. Data rate for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 18. Data rate for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 19. Data rate for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 20. Data rate for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 21. CPU utilization for UDP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 22. CPU utilization for TCP stream test using 1500 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 23. CPU utilization for UDP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

Figure 24. CPU utilization for TCP stream test using 9000 byte MTU, for Alteon ACEnic PCI GigE card under Linux version 2.2.16.

SysKonnnect SK-9843

The testing described here was performed with the version of the SysKonnnect driver distributed with version 2.2.16 of the Linux kernel, not the driver shipped with the card on CDROM. As mentioned earlier, some versions of files for the driver distributed with 2.2.16 were newer than those on the CDROM.

In the discussion that follows, we will compare the performance of the SysKonnnect card with that of the Alteon card using version 0.44 of the ACEnic driver under Linux 2.2.16.

The peak received bit rate for the UDP stream test with a 1500 byte MTU (Figure 25) was only ~200 Mb/s for the SysKonnnect, as compared to ~450 Mb/s for the Alteon (Figure 17). In fact, for this test the SysKonnnect had less than half the throughput of the Alteon for any data buffer size tested (compare Tables B-73 through B-75 with Tables B-49 through B-51). In addition, the CPUs of both the sending and receiving hosts are completely consumed when driving the SysKonnnect to this level of performance (Figure 29). However, when driving the Alteon some CPU cycles are available on the receiving host at smaller data buffer sizes.

At this point it is also pertinent to mention interrupt rate results. For this test the SysKonnnect is interrupting both the sending and receiving hosts at a rate of 40,000–60,000 interrupts a second! In comparison, the Alteon is interrupting the sending host 3500–6000 times per second, and the receiving host 9000–11,000 times per second.

The SysKonnnect also suffers in comparison with the Alteon on the TCP stream test with a 1500 byte MTU, although not as much as in the UDP stream test. In the TCP stream test the SysKonnnect delivers a peak throughput of ~300 Mb/s (Figure 26), compared to ~380 Mb/s for the Alteon. Again, the Alteon has higher performance at all data buffer sizes tested, although the advantage is slight at smaller data buffer sizes (compare Tables B-76 through B-78 with Tables B-52 through B-54).

The SysKonnnect again generates a higher interrupt rate in this test, 15,000–35,000 interrupts per second vs. 8500–10,500 interrupts per second for the Alteon.

When using jumbo frames, the SysKonnnect has performance more on par with the Alteon. For the UDP stream test with a 9000 byte MTU, the SysKonnnect attains a peak received bit rate of ~650 Mb/s (Figure 27), the same as that of the Alteon (Figure 19). Away from the peak, however, the SysKonnnect is somewhat outperformed by the Alteon. For example, at a data buffer size of 1024 bytes, throughput for the SysKonnnect is ~220 Mb/s, vs. ~280 Mb/s for the Alteon.

Comparison of interrupt rates for this test again reveals more parity than in the 1500 byte MTU tests. The SysKonnnect generates 11,000–60,000 interrupts per second for this test, with the higher interrupt rates corresponding to smaller data buffer sizes (see Tables B-85 through B-87). The Alteon generates 3000–45,000 interrupts per second on the sending host, and 10,000–35,000 interrupts per second on the receiving host (Tables B-61 through B-63).

For the TCP stream test with a 9000 byte MTU, the SysKonnnect card achieves a peak throughput of ~620 Mb/s. This compares well with the 600–650 Mb/s achieved by the ACEnic (compare Figure 28 vs. Figure 20). However, the SysKonnnect requires a few more CPU cycles than the Alteon to send data at those rates (compare Figure 32 vs. Figure 24). From Tables B–88 through B–90 and B–64 through B–66, we see that for this test the SysKonnnect and the Alteon interrupt the receiving host at about the same rate. However, the SysKonnnect interrupts the sending host at a higher rate than the Alteon, 3500–13,000 interrupts per second vs. 3500–8000 interrupts per second.

For request/response results in tabular form, see Table B–79 through Table B–84, and Table B–91 through Table B–96. For both 1500 and 9000 byte MTU sizes, the SysKonnnect attains ~10,000 transactions per second using UDP and ~8000 transactions per second using TCP. Note that this is significantly better performance than the Alteon NIC can achieve on these tests.

Figure 25. Data rate for UDP stream test using 1500 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 26. Data rate for TCP stream test using 1500 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 27. Data rate for UDP stream test using 9000 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 28. Data rate for TCP stream test using 9000 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 29. CPU utilization for UDP stream test using 1500 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 30. CPU utilization for TCP stream test using 1500 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 31. CPU utilization for UDP stream test using 9000 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

Figure 32. CPU utilization for TCP stream test using 9000 byte MTU, for SysKonnnect SK-9843 PCI GigE card under Linux version 2.2.16.

References

1. Alteon Networks, *Gigabit Ethernet/PCI Network Interface Card Host/NIC Software Interface Definition, Revision 12.1.11*. P/N 010001. Alteon Networks, Inc., 50 Great Oaks Blvd., San Jose, CA, June 1999.
2. SysKonnnect, *SK-NET GE Gigabit Ethernet Server Adapter*. SysKonnnect, Inc., 1922 Zanker Road, San Jose, CA, 1999.
3. SysKonnnect, *SK-NET GENESIS Technical Manual*, Version 1.0. SysKonnnect, Inc., 1922 Zanker Road, San Jose, CA, November 6, 1998.
4. Hewlett-Packard, *Netperf: A Network Performance Benchmark, Revision 2.0*. Hewlett-Packard, 1995.

Appendix A: Scripts

Netperf Patch for UDP_RR Bug

The following patch corrects a bug which prevents the UDP request/response test from running:

```
diff -Naur netperf-2.1pl3/nettest_bsd.c my-netperf-2.1pl3/nettest_bsd.c
--- netperf-2.1pl3/nettest_bsd.c Wed Apr  9 12:02:16 1997
+++ my-netperf-2.1pl3/nettest_bsd.c Thu Sep 21 14:53:10 2000
@@ -4121,8 +4121,10 @@
     udp_rr_response->data_port_number = (int) ntohs(myaddr_in.sin_port);
     netperf_response.content.serv_errno = 0;

-    fprintf(where,"recv port number %d\n",myaddr_in.sin_port);
-    fflush(where);
+    if (debug) {
+        fprintf(where,"recv port number %d\n",myaddr_in.sin_port);
+        fflush(where);
+    }

    /* But wait, there's more. If the initiator wanted cpu measurements, */
    /* then we must call the calibrate routine, which will return the max */
```

Netperf Driver Script

The driver script for netperf used to automate the network interface testing follows. Note that the script accepts as a parameter the name of a file containing the parameter values which describe the test. An example input file follows the driver script.

```
#!/bin/bash

myname=ip_test

usage="
$myname -i test_parms
```

This script will invoke 'netperf' repeatedly, based on the test description in the file 'test_parms', to test the performance of an IP connection between two hosts. At the same time, it runs 'vmstat' on both the remote and local hosts, to record the load on both hosts during each test. Both hosts need to have netperf available. Output from the testing is written to standard out.

Since this script uses 'rsh' to start processes on the remote host, the user running the test should have the appropriate '.rhosts' files to allow access between the hosts being tested. Also, netperf needs to be available on both hosts, and netserver needs to be running on both hosts.

'test_parms' is a file containing a bash script which defines the following shell variables. The default parameter values assumed by

\$myname are shown in parentheses.

```
comment
    A description of the test, which will be echoed (echo "$comment")
    to stdout before testing begins.
loc_if (eth0)
rem_if (eth0)
    The local/remote interfaces over which the test will be conducted.
rem_host
    The host name or IP address of the host for the remote end of
    the test. Note that the IP address that rem_host resolves to
    does not have to be the same as that assigned to rem_if, as long
    as 1) loc_if and rem_if are on the same subnet, and 2) the
    remote host can be reached via 'rsh rem_host'.
mtu_sizes (1500)
    A list of MTU sizes to be tested. This assumes that a suid
    executable named 'set_mtu' is available on each machine, which
    can be used to change the MTU size of the tested interface. If
    'set_mtu' is not available, the tests will be run for the current
    MTU of the interface, if it is in this list.
test_types (TCP_STREAM)
    A list of netperf test types to run, from the following choices:
    TCP_STREAM UDP_STREAM TCP_RR UDP_RR
skbuf_sizes (65536)
    A list of socket buffer sizes, in bytes, to test. This is also
    the TCP window size for TCP tests. Remember that on Linux, the
    maximum read/write socket buffer sizes need to be increased
    using, e.g.:
        echo 524288 > /proc/sys/net/core/rmem_max
        echo 524288 > /proc/sys/net/core/wmem_max
    $myname will check these values, and warn if they are not large
    enough.
tcp_data_sizes (256 512 1024)
udp_data_sizes (256 512 1024)
    A list of data buffer sizes to use for the TCP and UCP tests,
    respectively.
bidirectional
    If this parameter has a non-null value, a bidirectional test will
    be run; i.e., netperf will be started on both the local host
    (sending to the remote host) and on the remote host (sending to
    the local host). This is useful to test aggregate throughput in
    those cases where send/receive processing are not balanced.
test_len (10)
    The length of time, in seconds, for each invocation of netperf to
    run.
repeat (1)
    The number of times to repeat each individual test.
vmstat_args (2 6)
    Arguments to vmstat; i.e. the interval (in seconds) between
    reports, and the number of reports. if the output of $myname is
    to be post-processed with the awk script 'reduce.awk', vmstat
    should be run for just slightly longer than vmstat, to avoid
    averaging in vmstat results when netperf is not running.

ifconfig (/sbin/ifconfig)
netperf (/opt/netperf/netperf)
vmstat (/usr/bin/vmstat)
rsh (/usr/bin/rsh)
sed (/bin/sed)
set_mtu (./set_mtu)
    The paths to these commands, in the event they are in an unusual
    place. $myname assumes these paths are the same on both hosts.
    set_mtu is a suid executable which can be used to set the mtu
```

size on an interface (set_mtu if size), so that \$myname does not have to be run as root (which would require root to have a .rhosts file, which would be very, very bad).

"

```
if [ "$#" -eq 0 ] ; then
    echo "$usage"
    exit 0
fi
```

```
ifconfig=/sbin/ifconfig
netperf=/opt/netperf/netperf
vmstat=/usr/bin/vmstat
rsh=/usr/bin/rsh
sed=/bin/sed
set_mtu=./set_mtu
```

```
comment=
rem_host=
loc_if=eth0
rem_if=eth0
mtu_sizes=1500
test_types=TCP_STREAM
skbuf_sizes=65536
tcp_data_sizes="256 512 1024"
udp_data_sizes="256 512 1024"
bidirectional=
test_len=10
repeat=1
vmstat_args="2 6"
parm_file=
```

based on example code in /usr/lib/getopt:

```
# Note that we use '$@' to let each command-line parameter expand to a
# separate word. The quotes around '$@' are essential!
# We need TEMP as the 'eval set --' would nuke the return value of getopt.
TEMP=`getopt -o i: -n $myname -- "$@"`
```

```
case "$?" in
    0) ;;
    1) exit 1 ;;
    2) echo -e "$myname: bad parameters for getopt..." >&2 ; exit 1 ;;
    3) echo -e "$myname: Internal getopt errors..." >&2 ; exit 1 ;;
    *) echo -e "$myname: unknown getopt error..." >&2 ; exit 1 ;;
esac
```

```
# Note the quotes around '$TEMP': they are essential!
eval set -- "$TEMP"
```

```
while true ; do
    case "$1" in
        -i) parm_file="$2"
            shift 2 ;;
        --) shift
            break ;;
        *) echo "$myname: unexpected parameter: '$1'"
            exit 1 ;;
    esac
done
if [ -z "$parm_file" ] ; then
    echo "$myname: test parameter file not specified."
    exit 1
fi
```

```

fi
if [ "$#" -ne 0 ] ; then
    echo -n "$myname: unexpected argument(s):"
    for arg do echo -n " '$arg' " ; done
    echo
    exit 1
fi
if [ ! -f "$parm_file" ] ; then
    echo "$myname: test parameter file '$parm_file' does not exist."
    exit 1
fi
. "$parm_file"
if [ -z "$rem_host" ] ; then
    echo "$myname: remote host not specified in test parameter file."
    exit 1
fi

loc_skbuf_rmax=`cat /proc/sys/net/core/rmem_max`
loc_skbuf_wmax=`cat /proc/sys/net/core/wmem_max`

rem_skbuf_rmax=`$rsh -n $rem_host cat /proc/sys/net/core/rmem_max`
rem_skbuf_wmax=`$rsh -n $rem_host cat /proc/sys/net/core/wmem_max`

tmp_skbuf=
for sz in $skbuf_sizes ; do
    too_big=""
    if [ "$sz" -gt "$loc_skbuf_rmax" ] ; then
        echo "For a $sz byte socket buffer, /proc/sys/net/core/rmem_max"
        echo "on the local host must be at least $sz, not $loc_skbuf_rmax"
        too_big=yes
    fi
    if [ "$sz" -gt "$loc_skbuf_wmax" ] ; then
        echo "For a $sz byte socket buffer, /proc/sys/net/core/wmem_max"
        echo "on the local host must be at least $sz, not $loc_skbuf_wmax"
        too_big=yes
    fi
    if [ "$sz" -gt "$rem_skbuf_rmax" ] ; then
        echo "For a $sz byte socket buffer, /proc/sys/net/core/rmem_max"
        echo "on the remote host must be at least $sz, not $rem_skbuf_rmax"
        too_big=yes
    fi
    if [ "$sz" -gt "$rem_skbuf_wmax" ] ; then
        echo "For a $sz byte socket buffer, /proc/sys/net/core/wmem_max"
        echo "on the remote host must be at least $sz, not $rem_skbuf_wmax"
        too_big=yes
    fi
    if [ -z "$too_big" ] ; then
        tmp_skbuf="$tmp_skbuf $sz"
    else
        echo
    fi
fi
done
skbuf_sizes="$tmp_skbuf"

[ -n "$comment" ] && echo "$comment"

loc_ip=`$ifconfig $loc_if | \
    $sed -n 's/.*inet addr:([0-9.]*\).*\/\1/p'`

rem_ip=`$rsh -n $rem_host "$ifconfig $rem_if" | \
    $sed -n 's/.*inet addr:([0-9.]*\).*\/\1/p'`

vmstat_loc_logfile="/tmp/vmstat_${loc_ip}_log"

```

```

vmstat_rem_logfile="/tmp/vmstat_${rem_ip}_log"

netperf_to_loc_logfile="/tmp/netperf_to_${loc_ip}_log"
netperf_to_rem_logfile="/tmp/netperf_to_${rem_ip}_log"

l="-l $test_len"
lh="-H $loc_ip"
rh="-H $rem_ip"

divider="*****
*****"
at_least_one_test_ran=

get_loc_mtu ()
{
    echo '$ifconfig $loc_if | $sed -n 's/. *MTU: \([0-9.]*\) .*/\1/p'`
}
get_rem_mtu ()
{
    echo '$rsh -n $rem_host "$ifconfig $rem_if" | \
    $sed -n 's/. *MTU: \([0-9.]*\) .*/\1/p'`
}

for mtu in $mtu_sizes; do

    loc_mtu=`get_loc_mtu`
    rem_mtu=`get_rem_mtu`

    bad_mtu=
    if [ "$loc_mtu" -ne "$mtu" ] ; then
        $set_mtu $loc_if $mtu
        loc_mtu=`get_loc_mtu`
        if [ "$loc_mtu" -ne "$mtu" ] ; then
            echo "Requested MTU ($mtu) does not match MTU ($loc_mtu) on"
            echo "local interface $loc_if ($loc_ip).\"
            bad_mtu=yes
        fi
    fi
    if [ "$rem_mtu" -ne "$mtu" ] ; then
        $rsh -n $rem_host "$set_mtu $rem_if $mtu"
        rem_mtu=`get_rem_mtu`
        if [ "$rem_mtu" -ne "$mtu" ] ; then
            echo "Requested MTU ($mtu) does not match MTU ($rem_mtu) on"
            echo "remote interface $loc_if ($loc_ip).\"
            bad_mtu=yes
        fi
    fi
    if [ -n "$bad_mtu" ] ; then
        echo
        continue
    fi

    for type in $test_types; do

        t="-t $type"

        if echo $type | grep TCP > /dev/null ; then
            data_sizes=$tcp_data_sizes
        else
            data_sizes=$udp_data_sizes
        fi

        for buf in $skbuf_sizes; do

```

```

s="-s $buf -S $buf"

echo -e "\n$divider\n$divider\n"
echo -n "  test:      "
if [ -n "$bidirectional" ] ; then
echo -n bi
else
echo -n uni
fi
echo "directional $type"
echo "  MTU (bytes):      $mtu"
echo "  socket buffer (bytes): $buf"
echo "  data buffer (bytes):  $data_sizes"
echo -e "\n$divider\n$divider\n"

for dlen in $data_sizes; do

d="-m $dlen -M $dlen"

i=0
while [ $i -lt $repeat ] ; do

loc_netperf="$netperf $l $rh $t -- $s $d"
rem_netperf="$netperf $l $lh $t -- $s $d"

$srsh -e $rem_host \
"echo -e $rem_ip vmstat':\n'; date; \
$vmstat $vmstat_args" \
2>&1 > $vmstat_rem_logfile &

(echo -e $loc_ip vmstat':\n'; date; \
$vmstat $vmstat_args) \
2>&1 > $vmstat_loc_logfile &

# need to give vmstat a chance to start, before we
# start pounding with netperf
sleep 1

if [ -n "$bidirectional" ] ; then
$srsh -n $rem_ip "date; $rem_netperf" 2>&1 > \
$netperf_to_loc_logfile &
fi

(date; $loc_netperf) 2>&1 > \
$netperf_to_rem_logfile &

wait

echo -e "${divider}\n\ncommand:\n"
echo $loc_netperf
if [ -n "$bidirectional" ] ; then
echo $rem_netperf
fi
echo -e "\nresult:\n"

cat $netperf_to_rem_logfile
if [ -n "$bidirectional" ] ; then
echo
cat $netperf_to_loc_logfile
fi
echo

```

```

        cat $vmstat_loc_logfile
        echo
        cat $vmstat_rem_logfile
        echo
        at_least_one_test_ran=yes
        let i+=1
    done

done
done
done
done
[ -n "$at_least_one_test_ran" ] && echo -e "\n$divider\n$divider\n"

```

Example Driver Script Input File

An example input file for the driver script follows. This is the input file used to generate the results found in Table B-1 through Table B-24.

```

#!/bin/bash

comment="
Linux: v2.2.14
acenic: v0.41
driver parameters:
    tx_coal_tick: 996
    rx_coal_tick: 1000
    max_tx_desc: 40
    max_rx_desc: 25
"

rem_host=134.253.4.76

mtu_sizes="1500 9000"
test_types="UDP_STREAM TCP_STREAM UDP_RR TCP_RR"

skbuf_sizes="65536 131072 262144"

tcp_data_sizes="32 64 128 256 512 1024 2048 4096 8192 16384 32768"
udp_data_sizes="32 64 128 256 512 1024 2048 4096 8192 16384 32768"

bidirectional=
test_len=20
repeat=5
vmstat_args="2 11"

```

Data Reduction Awk Script

Shown below is the awk script used to automate data reduction for results generated by the previously shown netperf driver script. The command

```
awk -f reduce.awk < test.log > test.res
```

would read the results of a series of tests run by the netperf driver script from *test.log*, reduce them, and save the output in the file *test.res*, assuming the awk script below was in the file *reduce.awk*.

```
BEGIN \
{ # these are variables that control the state
STATE_CONFIG = 0;
STATE_TEST_DESC = 0;
STATE_CMD = 0;
STATE_RES = 0;
STATE_VMSTAT = 0;
STATE_DEL1 = 0;
STATE_DEL2 = 0;
STATE_UNKNOWN = 1;
OPEN_DEL_EXPECTED = 1;

# these are variables used to process data

HOST = 0;
SEND SOCK_BUFLen = 0;
RECV SOCK_BUFLen = 0;
SEND DATA_BUFLen = 0;
RECV DATA_BUFLen = 0;
HOST1 = "";
HOST2 = "";
}

# state diagram:
```

```

#                                     |          6          |          13
#                                     |          |          |
#                                     |          |          |
#          STATE_CONFIG <-10-- STATE_CONFIG +-----14----- STATE_VMSTAT
#          !OPEN_DEL_EXPECTED   OPEN_DEL_EXPECTED               OPEN_DEL_EXPECTED
#
#
# all of the state-transition patterns go here.
# NOTE: ordering of transition rules is IMPORTANT!
#
# transition 1
STATE_UNKNOWN && OPEN_DEL_EXPECTED && /\^*+$/ \
{ STATE_DEL1 = 1;
  STATE_UNKNOWN = 0;
  next;
}
# transition 2
STATE_UNKNOWN && /\^command:[      ]*$/ \
{ STATE_CMD = 1;
  STATE_UNKNOWN = 0;
  next;
}
# transition 3
STATE_DEL1 && OPEN_DEL_EXPECTED && /\^*+$/ \
{ STATE_TEST_DESC = 1;
  STATE_DEL1 = 0;
  compute_ave();
  reset_ave(0,0,0,0);
  TEST_TYPE = "";
}

printf("\n*****\n\n");
next;
}
# transition 4
STATE_DEL1 && OPEN_DEL_EXPECTED \
{ STATE_UNKNOWN = 1;
  STATE_DEL1 = 0;
  next;
}
# transition 5:
STATE_DEL1 && !OPEN_DEL_EXPECTED && /\^*+$/ \
{ STATE_UNKNOWN = 1;
  STATE_DEL1 = 0;
  OPEN_DEL_EXPECTED = 1;
  next;
}
# transition 6:
STATE_TEST_DESC && OPEN_DEL_EXPECTED && /\^*+$/ \
{ STATE_CONFIG = 1;
  STATE_TEST_DESC = 0;
  next;
}
# transition 7:
STATE_TEST_DESC && !OPEN_DEL_EXPECTED && /\^*+$/ \
{ STATE_DEL1 = 1;
  STATE_TEST_DESC = 0;

# hit the end of the test description state, so need to print out headings for
# report for this test

if( index(TEST_TYPE,"STREAM") && index(TEST_TYPE,"uni") ) {
  printf("\n          data   received\n");
}

```



```

        printf("      buf    bit rate\n");
        printf("    num    len    10^6                host 1                host 2\n");
        printf("  trials  bytes  bits/sec    in/sec  cs/sec  %% cpu    in/sec  cs/sec\n");
        printf("%% cpu \n\n");
    } else if( index(TEST_TYPE,"STREAM") && index(TEST_TYPE,"bi") ) {
        printf("\n      combined\n");
        printf("      data    received\n");
        printf("      buf    bit rate\n");
        printf("    num    len    10^6                host 1                host 2\n");
        printf("\n");
        printf("  trials  bytes  bits/sec    in/sec  cs/sec  %% cpu    in/sec  cs/sec\n");
        printf("%% cpu \n\n");
    } else if( index(TEST_TYPE,"RR") ) {
        printf("\n      data\n");
        printf("      buf    transaction\n");
        printf("    num    len    rate                host 1                host 2\n");
        printf("\n");
        printf("  trials  bytes  trans/sec    in/sec  cs/sec  %% cpu    in/sec  cs/sec\n");
        printf("%% cpu \n\n");
    }
    next;
}
# transition 8:
# transition delimiter state, but don't skip to next record; will process it below
STATE_TEST_DESC \
{ if( OPEN_DEL_EXPECTED ) OPEN_DEL_EXPECTED = 0;
}
# transition 9:
STATE_CONFIG && !OPEN_DEL_EXPECTED && /^\\*+$/ \
{ STATE_DEL2 = 1;
  STATE_CONFIG = 0;
  next;
}
# transition 10:
# transition DELiter state, but don't skip to next record; will process it below
STATE_CONFIG \
{ if( OPEN_DEL_EXPECTED ) OPEN_DEL_EXPECTED = 0;
}
# transition 11:
STATE_DEL2 && !OPEN_DEL_EXPECTED && /^\\*+$/ \
{ STATE_DEL1 = 1;
  STATE_DEL2 = 0;
}
# transition 12:
STATE_CMD && /^result:[    ]*$/ \
{ STATE_RES = 1;
  STATE_CMD = 0;
  next;
}
# transition 13:
STATE_RES && /vmstat:[    ]*$/ \
{ STATE_VMSTAT = 1;
  STATE_RES = 0;
  if( NF == 2 ) {
    HOST = $1;
    if( !length(HOST1) ) HOST1 = HOST;
  } else {
    printf("Found vmstat results, but host specification is garbled.\n");
    HOST = 0;
  }
  SKIP_VMSTAT = 1;
}

```

```

    next;
}
# transition 14:
STATE_VMSTAT && /\^*+$/ \
{ STATE_DEL1 = 1;
  STATE_VMSTAT = 0;
  next;
}

# functions used to process go here

function compute_ave() {

    if( length(TEST_TYPE) != 0 &&
        SEND SOCK_BUFLen != 0 &&
        RECV SOCK_BUFLen != 0 &&
        SEND DATA_BUFLen != 0 &&
        RECV DATA_BUFLen != 0 ) {

        if( index(TEST_TYPE,"STREAM") ) {
            AVE_BIT_RATE1 /= NUM_TRIALS;
            rate = AVE_BIT_RATE1;
        } else if( index(TEST_TYPE,"RR") ) {
            AVE_TRANS_RATE /= NUM_TRIALS;
            rate = AVE_TRANS_RATE;
        }
        rate += 0.5;

        AVE_INT_RATE1 /= NUM_PERF_SAMPLES1;
        AVE_CS_RATE1  /= NUM_PERF_SAMPLES1;
        AVE_IDLE1     /= NUM_PERF_SAMPLES1;

        AVE_INT_RATE2 /= NUM_PERF_SAMPLES2;
        AVE_CS_RATE2  /= NUM_PERF_SAMPLES2;
        AVE_IDLE2     /= NUM_PERF_SAMPLES2;

        # print results, rounded off to nearest integer (in conjunction
        # with print format)

        AVE_INT_RATE1 += 0.5;
        AVE_INT_RATE2 += 0.5;
        AVE_CS_RATE1  += 0.5;
        AVE_CS_RATE2  += 0.5;
        AVE_IDLE1     += 0.5;
        AVE_IDLE2     += 0.5;

        printf("%4d%9d%8d%13d%8d%7d%10d%8d%7d\n",
            NUM_TRIALS,
            SEND_DATA_BUFLen,
            rate,
            AVE_INT_RATE1 + 0.5,
            AVE_CS_RATE1 + 0.5,
            100 - AVE_IDLE1 + 0.5,
            AVE_INT_RATE2 + 0.5,
            AVE_CS_RATE2 + 0.5,
            100 - AVE_IDLE2 + 0.5);
    }
}

function reset_ave(ssbl,rsbl,sdbl,rdbl) {
    SEND SOCK_BUFLen = ssbl;
    RECV SOCK_BUFLen = rsbl;

```

```

SEND_DATA_BUFLen = sdbl;
RECV_DATA_BUFLen = rdbl;
AVE_BIT_RATE1 = 0;
AVE_BIT_RATE2 = 0;
AVE_TRANS_RATE = 0;
AVE_INT_RATE1 = 0;
AVE_INT_RATE2 = 0;
AVE_CS_RATE1 = 0;
AVE_CS_RATE2 = 0;
AVE_IDLE1 = 0;
AVE_IDLE2 = 0;
NUM_PERF_SAMPLES1 = 0;
NUM_PERF_SAMPLES2 = 0;
NUM_TRIALS = 0;
}

# all of the processing for various states go here

STATE_CONFIG \
{ print $0;
  next;
}

STATE_TEST_DESC && /test:/ \
{ TEST_TYPE = substr($0,index($0,"test:")+6);
# printf("Found new test type '%s'\n",TEST_TYPE);
}

STATE_TEST_DESC \
{ print $0;
  next;
}

STATE_CMD && NF > 0 \
{ # print $0

# read the test command; if the test has changed, we need to compute our
# averages for the last test and print them out, and reset for the new test

send_sock_bufLen = 0;
recv_sock_bufLen = 0;
send_data_bufLen = 0;
recv_data_bufLen = 0;
test_type = "";

for( i=1; i<=NF; i++ ) {
  if( $i ~ "-s" ) {
    i++;
    send_sock_bufLen = $i;
  } else if ( $i ~ "-S" ) {
    i++;
    recv_sock_bufLen = $i;
  } else if ( $i ~ "-m" ) {
    i++;
    send_data_bufLen = $i;
  } else if ( $i ~ "-M" ) {
    i++;
    recv_data_bufLen = $i;
  } else if ( $i ~ "-r" ) {
    i++;
    send_data_bufLen = $i;
    recv_data_bufLen = $i;
  } else if ( $i ~ "-t" ) {

```

```

        i++;
        test_type = $i;
    }
}

if( !index(TEST_TYPE,test_type) ) {
    printf("Error: Test type of test\n  '%s'\n", $0);
    printf("does not match test section heading test type: '%s'\n\n", TEST_TYPE);
    STATE_CMD=0;
    STATE_UNKNOWN=1;
    next;
}

if( send_sock_bufalen != SEND SOCK_BUFLLEN ||
    recv_sock_bufalen != RECV SOCK_BUFLLEN ||
    send_data_bufalen != SEND DATA_BUFLLEN ||
    recv_data_bufalen != RECV DATA_BUFLLEN ) {

    compute_ave();
    reset_ave(send_sock_bufalen,recv_sock_bufalen,send_data_bufalen,recv_data_bufalen);
}
# if this is a bidirectional test, there will be two test commands in data file,
# one for each host.  only counts as one trial, though.
INCR = 1;
if( index(TEST_TYPE,"bi") ) INCR = 0.5;
NUM_TRIALS += INCR;

if( send_sock_bufalen != recv_sock_bufalen ) {
    printf("Warning: send/receive socket buffers have different lengths:\n
%s\n\n", $0);
    printf("send_sock_bufalen: %d\nrecv_sock_bufalen:
%d\n", send_sock_bufalen, recv_sock_bufalen);
}
if( send_data_bufalen != recv_data_bufalen ) {
    printf("Warning: send/receive data buffers have different lengths:\n
%s\n\n", $0);
    printf("send_data_bufalen: %d\nrecv_data_bufalen:
%d\n", send_data_bufalen, recv_data_bufalen);
}
next;
}

# note ugly hack to determine if first field is string or numeric
STATE_RES && NF > 0 && ($1+0) != 0 \
{ if( index(TEST_TYPE,"UDP_STREAM") ) {
# UDP stream results have two lines; we want field 4 from first line
    if( UDPS_RECV ) {
        UDPS_RECV = 0;
        AVE_BIT_RATE1 += $4;
#         printf("adding %f to bit rate ave; ave = %f\n", $4, AVE_BIT_RATE1);
    } else {
        UDPS_RECV = 1;
    }
} else if( index(TEST_TYPE,"TCP_STREAM") ) {
# TCP stream results have just one line; we want field 4
    AVE_BIT_RATE1 += $5;
#     printf("adding %f to bit rate ave; ave = %f\n", $5, AVE_BIT_RATE1);
} else if( index(TEST_TYPE,"UDP_RR") || index(TEST_TYPE,"TCP_RR") ) {
# request/response results have two lines; we want field 6 from first line.
    if( !RR_RECV ) {
        RR_RECV = 0;
        AVE_TRANS_RATE += $6;
#         printf("adding %f to trans rate ave; ave = %f\n", $6, AVE_TRANS_RATE);
    }
}
}

```

```

    } else {
        RR = 1;
    }
}

STATE_VMSTAT && /vmstat:[ ]*$/ \
{ if( NF == 2 ) {
    HOST = $1;
    if( !length(HOST1) ) HOST1 = HOST;
} else {
    printf("Found vmstat results, but host specification is garbled.\n");
    HOST = 0;
}
    SKIP_VMSTAT = 1;
    next;
}

# want to skip first vmstat report, since test program usually hasn't
# started up yet.

STATE_VMSTAT &&
($1 == 1 || $1 == 2) && NF == 16 \
{ if( !SKIP_VMSTAT ) {
    if( HOST ~ HOST1 ) {
        AVE_INT_RATE1 += $12;
        AVE_CS_RATE1  += $13;
        AVE_IDLE1     += $16;
        NUM_PERF_SAMPLES1++;
    } else if( HOST ~ HOST2 ) {
        AVE_INT_RATE2 += $12;
        AVE_CS_RATE2  += $13;
        AVE_IDLE2     += $16;
        NUM_PERF_SAMPLES2++;
    }
}
    SKIP_VMSTAT = 0;
    next;
}

STATE_UNKNOWN { next }

```

Appendix B: Results Data

Here we present the reduced data from a series of tests for various versions of the Linux kernel and kernel drivers for the gigabit Ethernet cards tested. The following parameter ranges were explored in the testing:

Tests:	stream (measures throughput) request/response (measures latency)
IP Protocols:	UDP, TCP
MTU size (bytes):	1500, 9000
Socket buffer size (bytes):	64K, 128K, 256K
Data buffer size (bytes):	32, 64, 128, 256, 512, 1K, 2K, 4K, 8K, 16K, 32K

Recall that for the TCP protocol, the socket buffer size is also the TCP window size. The data buffer size specifies the buffer size used to pass data to/from the socket send/recv calls.

Results from the testing include either received data rate (stream tests) or transaction rate (request/response tests), CPU interrupt rate, CPU context switching rate, and CPU utilization. The CPU statistics are reported for both sending and receiving hosts. Received data rate is reported because the UDP protocol does not guarantee delivery, and delivered throughput is most relevant to applications.

The interrupt rates presented here are those reported by vmstat, and thus include all the interrupts for the system during the testing, not just the interrupts which could be attributed to the network testing. Thus, to interpret the reported interrupt rate it is important to know that the interrupt rate on an idle Linux-based Alpha is ~1000 interrupts/second.

Tests Using Linux Kernel Version 2.2.14

The tests on the Alteon ACEnic for this version of the Linux kernel were performed using version 0.41 of the ACEnic driver. The Alteon ACEnic supports tunable parameters to mitigate interrupt rate. These four module parameters are: max_tx_desc, max_rx_desc, tx_coal_tick, and rx_coal_tick. The first two parameters specify the number of transmit and receive descriptors (packets), respectively, to process before interrupting the host to notify it the packets have been serviced. The second two parameters are the number microsecond clock ticks to wait before interrupting the host if the specified number of transmit and receive descriptors, respectively, haven't been processed.

The default values of these parameters in version 0.41 of the ACEnic driver are:

max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 996
rx_coal_tick: 1000

These are the values used in the first series of tests reported in this section. A second series of tests were performed using the following values of the tuning parameters:

max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 250
rx_coal_tick: 250

Alteon ACEnic, 1000 Microsecond Interrupt Coalesce Timeout

Table B-1.							
UDP stream test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	3960	6	100	4971	5776	29
64	40	3948	6	100	4960	5801	35
128	80	3915	7	100	4971	5816	38
256	160	3919	6	100	4978	5823	42
512	312	3107	6	100	4964	4185	64
1024	505	2997	7	98	4040	1825	83
2048	12	3009	7	100	4448	6	99
4096	15	2574	1151	87	4155	6	99
8192	19	2595	1850	78	4182	6	99
16384	51	2620	1966	68	4292	7	99
32768	83	2520	1949	60	3949	30	97

Table B-2.							
UDP stream test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4004	6	100	4978	5730	30
64	40	3927	7	98	4960	5798	33
128	80	3874	7	98	4972	5809	37
256	160	3920	6	100	4979	5804	44
512	312	3285	7	100	4982	4338	64
1024	506	2994	7	98	4041	1262	88
2048	12	3007	7	100	4476	6	99
4096	19	2654	7	100	4061	6	99
8192	26	2595	7	100	4059	6	99
16384	50	2459	8	97	4008	6	99
32768	81	2378	143	92	3837	6	99

Table B-3.
UDP stream test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	3974	6	100	4984	5704	29
64	40	3952	6	100	4961	5789	33
128	80	3873	7	98	4973	5803	36
256	160	3888	7	98	4980	5788	43
512	316	3352	7	98	4986	5072	58
1024	494	2973	7	97	4043	1361	87
2048	13	3010	7	100	4489	6	99
4096	16	2793	7	100	4063	6	99
8192	26	2718	7	100	4063	6	99
16384	49	2507	7	100	4037	6	99
32768	82	2353	7	98	3828	6	99

Table B-4.
TCP stream test with 1500 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	82	2036	905	85	2054	6	100
64	137	2033	1233	77	2050	8	99
128	182	2040	1013	79	2352	954	82
256	178	2189	1543	61	2689	1562	57
512	231	2002	1738	40	2172	1895	45
1024	241	2032	1864	35	2214	1962	40
2048	256	2029	1963	29	2227	2000	32
4096	255	2029	1978	27	2195	2002	31
8192	255	2030	1974	27	2206	2001	29
16384	255	2033	1980	23	2191	2002	29
32768	256	2031	1980	21	2206	2002	28

Table B-5.
TCP stream test with 1500 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	81	2042	1178	81	2058	5	100
64	137	2036	1181	79	2053	5	100
128	209	2033	1066	77	2094	16	99
256	275	2058	845	77	2365	37	98
512	303	2110	338	89	2889	637	84
1024	315	2315	236	90	2925	787	79
2048	382	2242	385	85	2883	589	84
4096	390	2278	548	78	2866	634	81
8192	389	2291	635	73	2860	675	80
16384	395	2314	971	63	2864	661	81
32768	401	2363	1116	58	2863	740	79

Table B-6.
TCP stream test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	71	2041	872	85	2059	404	90
64	132	2043	1223	78	2056	4	100
128	198	2039	1159	76	2087	5	100
256	261	2056	817	79	2256	33	99
512	309	2093	452	86	2660	113	97
1024	339	2157	376	87	2761	131	95
2048	375	2162	69	97	2917	557	86
4096	391	2242	90	96	2906	341	91
8192	388	2258	82	96	2889	350	90
16384	387	2309	557	78	2839	141	95
32768	388	2363	772	68	2804	210	93

Table B-7.							
UDP request/response test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	929	2018	1972	2	2050	2037	2
64	931	2018	1973	2	2051	2038	2
128	929	2029	1995	2	2051	2038	2
256	929	2029	1995	2	2050	2037	2
512	930	2029	1995	2	2051	2038	2
1024	930	2018	1973	2	2051	2037	2
2048	931	2029	1995	2	2051	2038	2
4096	930	2029	1995	2	2051	2038	2
8192	929	2018	1973	2	2051	2038	1
16384	929	2029	1995	2	2050	2037	2
32768	928	2029	1994	2	2051	2038	2

Table B-8.							
UDP request/response test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	930	2019	1974	2	2050	2037	2
64	929	2029	1995	2	2051	2038	2
128	928	2029	1995	2	2051	2038	2
256	929	2008	1952	2	2050	2037	2
512	929	2029	1995	2	2051	2038	2
1024	930	2029	1994	2	2051	2037	2
2048	928	2029	1995	2	2051	2038	2
4096	928	2029	1995	2	2051	2037	2
8192	928	2018	1973	2	2050	2037	2
16384	928	2029	1995	2	2051	2038	2
32768	929	2029	1995	2	2050	2038	2

Table B-9.
UDP request/response test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	930	2029	1995	2	2051	2038	2
64	927	2029	1995	2	2051	2038	2
128	931	2029	1995	2	2051	2037	2
256	931	2029	1995	2	2051	2038	2
512	928	2029	1994	2	2050	2037	2
1024	929	2029	1995	2	2051	2038	2
2048	929	2029	1995	2	2051	2038	2
4096	928	2029	1994	2	2050	2037	2
8192	930	2029	1994	2	2051	2038	2
16384	929	2029	1995	2	2051	2037	2
32768	929	2018	1973	2	2051	2038	2

Table B-10.
TCP request/response test with 1500 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	916	2030	1995	2	2053	2039	2
64	916	2030	1995	2	2053	2039	2
128	916	2030	1995	2	2053	2038	2
256	916	2030	1996	2	2053	2039	2
512	916	2030	1995	2	2053	2039	2
1024	917	2030	1995	2	2053	2039	2
2048	916	2030	1995	2	2053	2039	2
4096	916	2019	1974	2	2053	2038	2
8192	917	2030	1995	2	2053	2039	2
16384	916	2031	1995	2	2053	2039	2
32768	916	2030	1995	2	2053	2039	2

Table B-11.							
TCP request/response test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	917	2030	1995	2	2053	2038	2
64	917	2030	1995	2	2053	2038	2
128	917	2030	1995	2	2053	2039	2
256	916	2030	1995	2	2053	2039	2
512	917	2031	1995	2	2052	2038	2
1024	916	2030	1995	2	2053	2039	2
2048	917	2030	1995	2	2053	2038	2
4096	916	2030	1995	2	2053	2039	2
8192	916	2030	1995	2	2053	2038	2
16384	916	2030	1995	2	2053	2038	2
32768	917	2030	1995	2	2053	2039	2

Table B-12.							
TCP request/response test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	916	2030	1995	2	2052	2038	2
64	916	2030	1995	2	2053	2039	2
128	916	2019	1973	2	2053	2039	2
256	916	2019	1973	2	2053	2039	2
512	916	2019	1973	2	2053	2039	2
1024	917	2030	1995	2	2053	2039	2
2048	916	2030	1995	2	2053	2039	2
4096	917	2030	1995	2	2053	2039	2
8192	916	2030	1995	2	2053	2039	2
16384	916	2019	1974	2	2052	2038	2
32768	917	2030	1995	2	2053	2039	2

Table B-13.
UDP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4452	7	98	4976	5775	29
64	40	4159	7	98	4959	5801	33
128	80	4095	6	100	4973	5816	36
256	160	3921	6	100	4979	5793	43
512	317	3642	7	100	4983	5535	54
1024	517	3012	7	100	4037	1440	86
2048	392	2032	1175	68	2921	2414	47
4096	434	2031	1328	62	2055	2021	38
8192	516	1538	1004	43	2057	2028	41
16384	478	1543	1004	40	2087	801	65
32768	447	1533	993	31	2085	1478	38

Table B-14.
UDP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4208	6	100	4985	5731	29
64	40	3987	6	100	4961	5798	33
128	80	3984	6	100	4973	5813	36
256	160	3918	6	100	4979	5815	42
512	316	3550	7	100	4983	5406	55
1024	498	2992	7	98	4040	423	95
2048	605	2030	125	92	3056	2000	67
4096	640	2034	270	83	2055	2019	56
8192	675	2036	535	64	2058	2026	55
16384	206	2037	583	62	2122	6	99
32768	215	2036	763	48	2135	7	99

Table B-15.							
UDP stream test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4334	6	100	4986	5704	30
64	40	4209	6	100	4961	5789	33
128	80	3998	6	100	4973	5802	36
256	160	3887	7	98	4978	5798	42
512	317	3479	7	98	4984	5390	55
1024	483	2992	7	98	4040	527	94
2048	599	2020	7	98	3056	1997	66
4096	629	2036	109	87	2055	2018	55
8192	640	2039	118	83	2059	2024	51
16384	194	2038	213	70	2121	6	99
32768	232	2039	269	61	2124	7	99

Table B-16.							
TCP stream test with 9000 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	97	2035	98	98	2055	8	99
64	171	2035	309	94	2057	115	98
128	223	2036	1715	66	2057	1550	72
256	227	2036	1981	42	2057	2034	45
512	227	2035	1994	30	2057	2035	33
1024	227	2036	1995	24	2057	2036	26
2048	227	2036	1996	21	2058	2036	24
4096	227	2036	1995	19	2058	2036	22
8192	227	2036	1995	18	2057	2036	21
16384	227	2035	1995	15	2057	2036	20
32768	227	2035	1995	13	2058	2036	20

Table B-17.
TCP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	93	2040	111	98	2060	5	100
64	162	2039	655	90	2060	5	100
128	258	2037	1010	84	2058	7	99
256	356	2015	1276	76	2034	50	96
512	409	2022	1746	61	2048	1511	75
1024	416	2028	1849	51	2049	1832	64
2048	422	2025	1923	43	2046	1995	50
4096	423	2025	1921	39	2046	2007	45
8192	428	2035	1940	39	2057	2026	46
16384	429	2035	1980	31	2057	2029	44
32768	430	2035	1992	27	2057	2030	43

Table B-18.
TCP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	88	2040	485	91	2061	4	100
64	136	2041	1183	79	2062	5	100
128	213	2041	818	84	2062	397	94
256	329	2036	1275	78	2061	6	100
512	445	2036	758	87	2058	12	99
1024	531	2035	208	94	2055	233	95
2048	565	2035	444	88	2057	11	99
4096	593	2036	518	86	2058	13	99
8192	606	2036	498	86	2057	33	98
16384	624	2037	1073	72	2057	483	92
32768	628	2035	1484	57	2057	350	94

Table B-19.
UDP request/response test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	930	2029	1995	2	2050	2038	2
64	929	2029	1994	2	2051	2038	2
128	929	2029	1995	2	2051	2038	2
256	931	2029	1994	1	2051	2038	2
512	930	2018	1972	2	2050	2037	2
1024	930	2029	1995	2	2051	2037	2
2048	930	2018	1973	2	2051	2038	2
4096	930	2029	1995	2	2050	2038	2
8192	929	2029	1995	2	2051	2038	2
16384	929	2029	1995	2	2051	2038	2
32768	928	2018	1973	2	2051	2038	2

Table B-20.
UDP request/response test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	931	2029	1995	2	2051	2038	2
64	930	2029	1995	2	2051	2038	2
128	929	2018	1973	2	2051	2038	2
256	930	2029	1995	2	2051	2038	2
512	930	2029	1994	2	2051	2038	2
1024	929	2029	1995	2	2051	2038	2
2048	930	2029	1995	2	2051	2038	2
4096	930	2029	1995	2	2051	2038	2
8192	928	2029	1994	2	2051	2038	2
16384	930	2029	1995	1	2051	2038	2
32768	925	2029	1995	2	2051	2037	2

Table B-21.
UDP request/response test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	929	2029	1995	2	2050	2037	2
64	929	2029	1994	2	2051	2038	2
128	929	2029	1994	2	2051	2038	2
256	930	2029	1995	2	2051	2038	2
512	930	2029	1995	2	2051	2038	2
1024	929	2029	1994	2	2051	2038	2
2048	929	2029	1994	2	2050	2037	2
4096	929	2029	1995	1	2051	2038	2
8192	930	2029	1995	2	2050	2038	2
16384	930	2029	1995	2	2051	2038	2
32768	930	2029	1995	2	2051	2038	2

Table B-22.
TCP request/response test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	915	2009	1953	2	2053	2038	2
64	917	2030	1995	2	2053	2039	2
128	917	2030	1995	2	2053	2039	2
256	916	2030	1995	2	2053	2039	2
512	916	2030	1995	2	2053	2039	2
1024	916	2030	1994	2	2053	2038	2
2048	916	2030	1995	2	2053	2039	2
4096	916	2030	1995	2	2054	2039	2
8192	917	2030	1995	2	2053	2038	2
16384	916	2019	1973	2	2053	2039	2
32768	916	2019	1973	2	2053	2038	2

Table B-23.							
TCP request/response test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	916	2030	1995	2	2053	2039	2
64	917	2020	1975	2	2053	2039	2
128	917	2030	1995	2	2053	2038	2
256	916	2030	1995	2	2054	2039	2
512	917	2030	1995	2	2054	2039	2
1024	917	2030	1995	2	2053	2038	2
2048	916	2030	1995	2	2053	2038	2
4096	916	2030	1994	2	2053	2038	2
8192	916	2030	1995	2	2054	2039	2
16384	916	2019	1973	2	2054	2039	2
32768	916	2030	1995	2	2054	2039	2

Table B-24.							
TCP request/response test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	917	2019	1974	2	2053	2039	2
64	916	2030	1995	2	2053	2038	2
128	916	2030	1995	2	2053	2039	2
256	916	2030	1995	2	2053	2039	2
512	916	2019	1973	2	2053	2039	2
1024	917	2030	1995	2	2054	2039	2
2048	916	2030	1995	2	2053	2039	2
4096	916	2019	1973	2	2053	2038	2
8192	916	2030	1995	2	2053	2039	2
16384	917	2030	1995	2	2053	2039	2
32768	916	2030	1995	2	2053	2039	2

Alteon ACEnic, 250 Microsecond Interrupt Coalesce Timeout

Table B-25.							
UDP stream test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4814	6	100	4973	7692	28
64	38	4814	6	100	4974	7758	30
128	80	4777	7	100	4976	7747	35
256	151	4890	6	100	4983	7768	39
512	293	4922	7	100	5004	7338	51
1024	471	4977	7	100	5032	10	99
2048	9	4927	8	98	6103	7	99
4096	12	4706	82	97	6148	7	99
8192	20	4549	224	91	6020	7	99
16384	30	4590	475	83	6164	7	99
32768	53	4414	749	72	6010	16	98

Table B-26.							
UDP stream test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4792	6	100	4980	7637	29
64	38	4797	7	100	4975	7756	30
128	79	4772	7	100	4972	7740	36
256	158	4871	7	100	4978	7726	44
512	313	4893	7	98	4996	7340	55
1024	498	4985	7	100	5035	1131	92
2048	11	4979	7	100	6120	7	99
4096	17	4751	7	100	6111	7	99
8192	19	4657	7	100	6235	8	99
16384	35	4502	7	100	6245	7	99
32768	52	4291	18	97	6110	7	99

Table B-27.							
UDP stream test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	19	4830	7	98	4998	7661	28
64	40	4768	6	100	4955	7700	32
128	80	4745	7	98	4971	7726	34
256	158	4870	6	100	4979	7721	41
512	291	4932	6	100	5003	6409	57
1024	475	4978	6	100	5044	93	98
2048	11	4970	7	100	6118	7	99
4096	15	4643	7	100	6131	7	99
8192	25	4564	7	100	6118	7	99
16384	35	4520	7	100	6214	7	99
32768	47	4371	7	100	6299	7	99

Table B-28.							
TCP stream test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	81	5018	1354	91	5049	5	98
64	112	4995	1094	94	5067	3360	79
128	193	4694	1901	80	4762	31	92
256	248	4719	1074	85	4887	1089	87
512	279	4763	253	92	4838	2917	67
1024	305	4946	19	98	5011	4527	62
2048	400	4958	24	99	4973	3597	74
4096	420	4954	23	99	4930	3746	73
8192	425	4950	25	99	4960	2465	80
16384	434	4942	88	98	4993	1274	86
32768	415	4898	648	91	4953	2201	78

Table B-29.
TCP stream test with 1500 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	79	5035	1924	89	5106	4	100
64	128	5023	3466	81	5086	4	100
128	197	4965	3436	77	5051	8	99
256	244	4910	1702	86	5036	1520	87
512	318	4927	1062	89	5022	19	99
1024	353	4957	624	93	5014	162	98
2048	379	4920	217	96	5019	2417	83
4096	392	4955	213	97	4971	1045	90
8192	395	4946	470	94	5008	374	96
16384	396	4899	1017	86	5003	694	92
32768	410	4520	1905	67	4961	310	96

Table B-30.
TCP stream test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	79	5035	1388	92	5105	4	100
64	129	5030	3010	84	5092	5	100
128	192	4978	2619	83	5065	4	100
256	261	4918	434	96	5054	27	99
512	312	4941	117	98	5039	245	97
1024	344	4958	24	99	5029	41	99
2048	374	4964	16	99	5026	430	96
4096	385	4962	19	99	5020	124	98
8192	388	4939	16	99	5022	264	96
16384	391	4875	424	94	5012	230	97
32768	400	4506	1057	81	4941	268	96

Table B-31.							
UDP request/response test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2928	4998	7931	5	5085	8106	5
64	2922	4999	7932	5	5085	8106	5
128	2940	4997	7930	5	5084	8104	5
256	2936	5057	7931	5	5085	8107	5
512	2934	4998	7932	5	5085	8106	5
1024	2920	4999	7931	5	5085	8106	5
2048	2937	4987	7909	4	5073	8082	5
4096	2943	4998	7931	5	5085	8105	5
8192	2943	4998	7931	5	5086	8106	5
16384	2926	4998	7931	5	5086	8107	5
32768	2928	4997	7929	5	5085	8104	5

Table B-32.							
UDP request/response test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2940	4997	7930	5	5086	8107	5
64	2936	4997	7929	5	5084	8104	5
128	2935	4998	7931	4	5085	8106	5
256	2942	4998	7931	5	5085	8106	5
512	2931	4998	7932	5	5085	8106	5
1024	2935	4985	7906	5	5071	8078	5
2048	2927	4997	7929	5	5085	8105	5
4096	2941	4997	7928	5	5084	8104	5
8192	2944	5002	7937	4	5085	8104	5
16384	2925	4997	7928	5	5085	8105	5
32768	2926	4999	7931	5	5085	8106	5

Table B-33.							
UDP request/response test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2943	4997	7929	4	5086	8106	5
64	2948	4998	7931	5	5085	8106	5
128	2930	4997	7929	5	5086	8107	5
256	2942	4999	7931	5	5085	8105	5
512	2936	4954	7844	5	5085	8105	5
1024	2947	4998	7931	5	5085	8106	5
2048	2940	4998	7930	5	5085	8106	5
4096	2934	4998	7930	5	5085	8106	5
8192	2891	4963	7861	5	5035	8006	5
16384	2949	4998	7931	5	5085	8106	5
32768	2937	4991	7916	5	5076	8088	5

Table B-34.							
TCP request/response test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2778	4999	7931	6	5086	8106	6
64	2757	4956	7846	7	5087	8109	6
128	2768	5000	7934	6	5087	8108	6
256	2766	5000	7933	6	5087	8109	7
512	2735	5000	7933	7	5087	8109	6
1024	2768	4999	7931	6	5086	8106	6
2048	2775	5000	7933	6	5087	8109	6
4096	2768	5000	7934	6	5087	8109	6
8192	2765	4999	7933	6	5087	8109	6
16384	2765	5000	7933	6	5087	8109	6
32768	2771	4998	7930	6	5086	8106	6

Table B-35.
TCP request/response test with 1500 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2772	4998	7929	6	5084	8102	6
64	2735	5000	7935	7	5087	8109	6
128	2773	5000	7934	6	5087	8108	6
256	2784	5000	7933	5	5087	8109	6
512	2769	4999	7931	6	5085	8106	6
1024	2778	4955	7843	6	5086	8107	6
2048	2781	5000	7933	6	5087	8109	6
4096	2784	4999	7933	6	5087	8109	5
8192	2782	5000	7933	6	5087	8109	6
16384	2781	5000	7933	5	5087	8109	6
32768	2770	4954	7843	5	5086	8106	6

Table B-36.
TCP request/response test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2756	5000	7933	6	5087	8109	6
64	2767	5000	7934	6	5087	8108	6
128	2757	5000	7933	6	5087	8108	6
256	2768	5000	7933	6	5087	8108	6
512	2765	4999	7932	6	5086	8106	6
1024	2756	5000	7933	6	5087	8108	6
2048	2773	5000	7933	6	5087	8109	6
4096	2769	5000	7934	6	5087	8108	6
8192	2768	5000	7933	6	5087	8109	6
16384	2763	4955	7844	6	5086	8106	6
32768	2767	4991	7916	6	5077	8089	6

Table B-37.
UDP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4826	6	100	4971	7699	28
64	40	4803	6	100	4954	7721	31
128	80	4778	7	100	4970	7751	34
256	158	4873	6	100	4984	7757	41
512	314	4913	7	100	4996	7323	55
1024	511	4981	7	100	5034	1041	92
2048	630	3499	922	80	5067	7408	64
4096	663	3238	836	64	5101	8009	59
8192	590	1623	1146	48	4928	7684	48
16384	330	1685	1138	40	5002	8	99
32768	378	1616	1146	37	4990	146	94

Table B-38.
UDP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4846	6	100	4977	7651	28
64	40	4770	7	100	4952	7714	31
128	80	4793	6	100	4970	7743	34
256	158	4872	6	100	4976	7741	41
512	314	4929	6	100	4994	7389	54
1024	495	4984	6	100	5032	151	98
2048	632	3505	267	83	5067	7390	65
4096	666	2520	426	67	5106	8008	60
8192	666	2763	501	69	5113	8026	55
16384	142	2797	687	57	5241	6	99
32768	146	2802	832	49	5315	6	99

Table B-39.
UDP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	20	4800	6	100	4981	7628	28
64	40	4836	6	98	4954	7705	31
128	80	4778	6	100	4970	7730	34
256	159	4870	6	100	4976	7725	41
512	314	4915	7	100	4995	7077	55
1024	475	4977	6	100	5032	222	97
2048	608	3387	7	98	5068	7632	62
4096	653	2492	179	75	5104	8028	58
8192	659	2724	184	72	5120	8032	55
16384	165	2768	245	64	5305	6	99
32768	172	2755	287	58	5350	6	99

Table B-40.
TCP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	91	3775	699	97	3784	413	98
64	154	5003	1366	93	4498	2711	92
128	268	4295	1659	90	4666	578	95
256	383	4699	586	91	4989	1969	89
512	443	4498	2774	70	5050	3821	73
1024	473	4602	5843	52	5058	6759	59
2048	494	4728	6879	47	5086	7795	52
4096	491	4723	6803	45	5086	7913	49
8192	499	4759	7216	40	5086	7994	47
16384	501	4762	7272	35	5086	8002	48
32768	500	4756	7296	31	5086	8002	47

Table B-41.
TCP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	93	3771	467	98	3830	266	98
64	157	4928	586	97	4584	2015	94
128	263	4460	434	96	4732	361	98
256	385	4652	745	93	4978	250	98
512	489	4748	224	96	5074	1102	93
1024	530	4984	34	98	5074	2786	84
2048	603	4968	811	94	5075	2414	85
4096	660	4876	1133	89	5087	4388	78
8192	661	4877	1738	84	5086	5547	73
16384	661	4886	3285	69	5088	6033	71
32768	665	4899	4403	55	5087	6426	69

Table B-42.
TCP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	88	3615	632	97	3671	388	97
64	155	5025	1499	93	4285	1223	96
128	264	4346	587	95	4672	116	99
256	378	4737	185	98	4994	539	97
512	503	4564	149	98	4993	166	96
1024	564	4869	105	98	5002	1056	92
2048	621	4925	114	97	5083	1383	92
4096	653	4882	1026	90	5091	2940	84
8192	657	4841	1949	82	5051	4234	77
16384	658	4842	2940	71	5096	5515	74
32768	659	4871	3982	59	5095	5866	72

Table B-43.							
UDP request/response test with 9000 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2952	4997	7930	5	5086	8108	5
64	2944	4998	7932	5	5088	8111	5
128	2942	4998	7931	5	5087	8110	5
256	2929	4997	7929	5	5086	8108	5
512	2927	4998	7933	5	5088	8112	5
1024	2948	4995	7926	5	5084	8103	5
2048	2952	4998	7932	5	5087	8111	5
4096	2930	4998	7932	5	5088	8111	5
8192	2914	4999	7933	5	5088	8111	5
16384	2952	4999	7934	5	5087	8111	5
32768	2938	4999	7933	5	5088	8111	5

Table B-44.							
UDP request/response test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2952	4998	7932	5	5087	8109	5
64	2936	4999	7933	5	5088	8111	5
128	2920	4960	7856	5	5029	7994	5
256	2955	4999	7933	5	5088	8112	5
512	2935	4999	7933	4	5088	8111	5
1024	2954	4998	7932	5	5087	8109	5
2048	2954	4998	7932	5	5088	8112	5
4096	2933	4998	7933	5	5088	8111	5
8192	2950	4998	7932	5	5088	8112	5
16384	2947	4999	7933	5	5088	8111	5
32768	2953	4998	7931	5	5086	8109	5

Table B-45.							
UDP request/response test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2948	4991	7919	5	5079	8095	5
64	2938	4999	7933	5	5088	8112	5
128	2947	4990	7916	5	5078	8091	5
256	2954	4999	7934	5	5087	8111	5
512	2952	4998	7932	5	5087	8110	5
1024	2954	4999	7933	5	5088	8111	5
2048	2945	4998	7932	5	5088	8112	5
4096	2953	4995	7926	4	5083	8102	5
8192	2936	4999	7934	5	5088	8110	5
16384	2954	4999	7934	4	5088	8111	5
32768	2938	4998	7931	5	5087	8109	6

Table B-46.							
TCP request/response test with 9000 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2784	5000	7935	6	5090	8114	6
64	2747	4982	7900	6	5070	8075	6
128	2783	5000	7935	6	5090	8114	5
256	2789	5000	7934	6	5089	8113	6
512	2766	5000	7935	6	5090	8114	6
1024	2753	5000	7935	6	5090	8114	6
2048	2792	5000	7935	6	5090	8114	6
4096	2729	4998	7931	6	5088	8110	6
8192	2762	4992	7918	6	5080	8095	6
16384	2784	4993	7921	6	5089	8114	6
32768	2794	5000	7935	6	5090	8114	6

Table B-47.							
TCP request/response test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2760	4999	7933	6	5090	8113	7
64	2775	5000	7935	6	5090	8114	6
128	2772	4992	7918	6	5080	8094	6
256	2785	5000	7935	6	5090	8114	5
512	2785	4995	7924	6	5084	8102	6
1024	2781	5000	7935	6	5089	8113	6
2048	2794	5000	7935	6	5090	8115	6
4096	2767	5000	7935	6	5090	8114	6
8192	2759	4999	7933	6	5089	8113	6
16384	2794	5000	7934	6	5090	8114	6
32768	2789	4999	7933	6	5089	8114	6

Table B-48.							
TCP request/response test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	2799	5000	7935	6	5090	8114	6
64	2795	4956	7847	6	5090	8114	5
128	2763	5000	7936	6	5090	8114	6
256	2754	5000	7934	6	5090	8114	6
512	2762	5000	7935	6	5090	8115	6
1024	2791	4999	7934	6	5089	8113	6
2048	2747	5000	7935	6	5090	8114	6
4096	2785	5000	7935	6	5090	8114	5
8192	2777	5000	7934	6	5089	8113	5
16384	2790	5000	7935	6	5090	8115	6
32768	2789	4999	7932	6	5089	8112	6

Tests Using Linux Kernel Version 2.2.16

The 2.2.16 version of the Linux kernel uses version 0.44 of the ACEnic driver. Among the many changes to the driver were changes to the default values of the interrupt coalesce tuning parameters. The default values of the tuning parameters were made dependent on the MTU size, and the default values of the interrupt coalesce timeout were significantly reduced.

The default values of the tuning parameters for version 0.44 of the ACEnic driver for a normal (1500 byte) MTU size are:

```
max_tx_desc: 40
max_rx_desc: 25
tx_coal_tick: 400
rx_coal_tick: 120
```

The default values of the tuning parameters for version 0.44 of the ACEnic driver for a jumbo (9000 byte) MTU size are:

```
max_tx_desc: 60
max_rx_desc: 6
tx_coal_tick: 20
rx_coal_tick: 30
```

The SysKconnect card was shipped with a CDROM that contained driver source. Since several files were newer in the driver version distributed with Linux 2.2.16 than in the version on the CDROM, the SysKconnect NIC was tested using the driver code distributed with version 2.2.16 of the Linux kernel.

Alteon ACEnic, MTU-Dependent Interrupt Coalesce Timeout

Table B-49.							
UDP stream test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	19	5756	7	100	9278	15794	35
64	39	5752	7	100	9229	13568	46
128	77	5754	8	100	9260	14288	45
256	151	4366	8	100	9275	12681	51
512	294	3660	7	100	9329	3240	86
1024	442	3521	8	100	9359	10	99
2048	6	3511	8	100	10469	6	99
4096	11	3522	107	97	10849	7	99
8192	16	3521	34	99	12004	7	99
16384	20	3521	203	94	10648	6	99
32768	37	3521	534	85	10253	15	98

Table B-50.							
UDP stream test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	19	4743	8	98	9284	15573	36
64	39	5722	7	100	9221	15594	37
128	77	5728	8	100	9245	13484	47
256	148	4072	7	100	9261	8999	65
512	283	3730	7	100	9319	3883	84
1024	432	3494	8	98	9393	3226	89
2048	6	3510	8	100	11381	7	99
4096	9	3529	7	100	11111	6	99
8192	17	3523	8	100	10301	6	99
16384	20	3526	8	100	11155	7	99
32768	28	3505	8	98	11461	7	99

Table B-51.
UDP stream test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	19	4778	7	100	9308	15274	37
64	39	5676	8	98	9224	13608	44
128	78	5739	7	100	9244	15201	40
256	149	4622	8	100	9258	10601	60
512	282	3693	7	100	9301	4611	81
1024	395	3519	7	100	9376	9	99
2048	7	3511	8	100	10600	6	99
4096	9	3527	8	100	10598	6	99
8192	13	3523	8	100	10675	6	99
16384	20	3526	8	100	11185	6	99
32768	27	3531	8	100	11349	6	99

Table B-52.
TCP stream test with 1500 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	73	8589	1346	94	8638	9	100
64	122	8391	2241	89	8537	10	99
128	167	8518	4283	76	9242	10	99
256	230	8941	3864	78	9657	14	99
512	262	9731	912	93	10401	3362	84
1024	297	9817	1162	90	10550	1829	90
2048	355	9696	457	95	10642	1337	94
4096	377	9605	190	97	10692	1313	93
8192	372	9633	235	97	10747	2864	83
16384	382	8382	589	94	10173	2291	86
32768	394	8534	686	93	10418	2168	88

Table B-53.							
TCP stream test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	61	8077	4080	79	8159	4	100
64	115	7630	3161	84	8413	5	100
128	161	8889	3391	81	9562	1820	91
256	226	9308	716	94	9984	1117	95
512	278	9494	235	97	10227	795	96
1024	312	9345	785	92	10199	74	98
2048	336	9236	845	90	10318	135	98
4096	350	9591	546	94	10649	2173	90
8192	357	9242	197	97	10583	1570	92
16384	371	7788	425	95	9976	1338	90
32768	372	6390	1429	76	9192	338	96

Table B-54.							
TCP stream test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	47	7242	7827	54	7289	4	100
64	81	8357	7738	59	8456	4	100
128	131	8580	7962	59	8954	4	100
256	196	8682	5518	68	9266	5	100
512	260	9204	2487	84	9960	9	99
1024	300	9432	1054	91	10193	13	99
2048	319	9355	637	93	10290	15	99
4096	337	9136	285	96	10303	114	98
8192	345	8457	525	94	10135	192	98
16384	361	7261	308	95	9809	605	94
32768	368	6336	811	87	9198	500	95

Table B-55.
UDP request/response test with 1500 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	4000	7156	12173	8	7216	12238	8
64	3998	7180	12221	8	7218	12281	8
128	3986	7157	12174	8	7192	12189	9
256	3993	7161	12184	8	7214	12222	9
512	3987	7163	12186	7	7193	12206	8
1024	3974	7121	12102	8	7190	12149	8
2048	4004	7167	12196	8	7209	12259	8
4096	3993	7159	12179	8	7212	12264	8
8192	3977	7141	12112	8	7174	12187	8
16384	4003	7161	12183	8	7353	12245	8
32768	3984	7151	12163	7	7183	12198	9

Table B-56.
UDP request/response test with 1500 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	3992	7171	12201	8	7211	12218	8
64	3966	7127	12110	8	7187	12132	9
128	3992	7158	12176	8	7207	12237	9
256	4008	7175	12209	7	7214	12269	8
512	4000	7163	12185	8	7237	12264	8
1024	3991	7157	12173	8	7204	12203	10
2048	4010	7184	12227	8	7221	12285	8
4096	3986	7141	12142	7	7184	12208	8
8192	3997	7160	12179	8	7221	12230	8
16384	4000	7164	12187	8	7205	12250	8
32768	3994	7158	12175	7	7235	12224	8

Table B-57.							
UDP request/response test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	4000	7168	12194	8	7208	12256	8
64	3986	7157	12175	8	7214	12211	9
128	4005	7114	12087	8	7257	12266	8
256	3912	7139	12140	8	7093	12026	8
512	3962	7156	12173	8	7203	12241	8
1024	3962	7099	12058	8	7169	12168	8
2048	3977	7132	12117	8	7207	12252	8
4096	4002	7161	12181	8	7215	12272	8
8192	3948	7149	12160	8	7106	12058	8
16384	3981	7131	12123	8	7171	12169	9
32768	3951	7116	12094	7	7110	12058	8

Table B-58.							
TCP request/response test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	3724	6919	11259	9	6952	11036	11
64	3711	6888	11165	9	6963	10980	10
128	3745	6940	11294	9	6995	11088	10
256	3734	6858	11242	9	6956	11044	10
512	3738	6939	11254	9	6983	11061	10
1024	3723	6912	11260	9	6938	11022	11
2048	3734	6932	11329	9	6982	11062	10
4096	3698	6884	11114	9	6895	10962	10
8192	3713	6898	11248	9	6953	10980	10
16384	3743	6935	11345	9	6991	11085	10
32768	3745	6942	11265	9	6970	11077	10

Table B-59.
TCP request/response test with 1500 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	3720	6913	11211	9	6938	11041	10
64	3745	6932	11347	9	6964	11075	10
128	3739	6931	11329	9	6969	11066	10
256	3752	6940	11371	8	6977	11102	9
512	3743	6939	11337	9	6961	11066	10
1024	3726	6912	11214	9	6942	11022	10
2048	3742	6940	11299	9	6963	11088	10
4096	3733	6932	11247	9	6954	11051	10
8192	3754	6945	11408	9	6984	11117	10
16384	3741	6923	11351	9	6956	11047	10
32768	3754	6943	11413	9	6972	11111	10

Table B-60.
TCP request/response test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	3706	6897	11193	9	6902	10974	11
64	3724	6918	11270	9	6940	11055	11
128	3745	6943	11244	9	6972	11085	10
256	3750	6944	11308	9	6974	11087	10
512	3721	6848	11041	9	6932	11023	10
1024	3734	6926	11302	9	6985	11052	10
2048	3722	6913	11125	9	6934	11022	10
4096	3737	6932	11209	10	6974	11071	9
8192	3728	6860	10971	9	6978	11045	10
16384	3739	6924	11326	8	6957	11043	10
32768	3722	6914	11129	9	6938	11020	10

Table B-61.
UDP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	16	45277	7	100	34568	35552	56
64	32	45346	7	100	34707	40000	50
128	65	43279	7	100	34708	33452	58
256	129	35141	7	100	34625	29993	63
512	228	40455	7	100	34382	1447	96
1024	280	15952	8	100	34665	12	98
2048	447	3486	411	88	34382	15	99
4096	644	3019	619	77	15571	12669	75
8192	629	1835	1213	56	11133	18099	58
16384	151	1836	1198	57	9651	6	99
32768	209	1850	1249	47	10222	6	99

Table B-62.
UDP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	16	44663	7	100	34666	34542	58
64	32	46213	7	100	34674	39829	51
128	65	43844	8	100	34668	30819	61
256	129	34613	7	100	34663	24958	68
512	214	40511	7	100	34405	603	98
1024	283	17589	7	100	34669	13	99
2048	436	3450	138	90	34449	12	99
4096	634	2713	296	80	15606	13348	74
8192	653	3090	328	74	11385	18395	61
16384	85	3110	406	68	10116	6	99
32768	83	3132	536	58	11071	6	99

Table B-63.
UDP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	15	44648	7	100	34718	31712	61
64	33	45622	7	100	34655	41459	49
128	65	44240	7	100	34661	39429	52
256	129	39522	7	100	34622	28236	65
512	200	39819	7	100	34572	19040	73
1024	259	15354	8	98	34733	11	99
2048	433	3418	8	100	34362	12	99
4096	634	2712	125	82	15731	14166	72
8192	650	3077	129	82	11493	18854	61
16384	84	3111	210	70	10074	6	99
32768	108	3095	229	67	10952	5	99

Table B-64.
TCP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	76	3675	1077	95	3642	1142	92
64	147	5538	1588	89	5425	1195	95
128	242	8404	4666	90	8442	1818	93
256	380	6957	4163	83	9255	12	98
512	502	6651	2382	82	10775	185	98
1024	552	7389	3096	76	11804	1265	92
2048	584	7691	2722	76	12415	3515	84
4096	590	7517	2529	79	11954	5880	78
8192	598	7600	3592	72	12200	8277	72
16384	594	7375	4801	59	12157	9345	70
32768	582	7135	5450	49	11984	10970	66

Table B-65.							
TCP stream test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	80	3302	2396	84	3298	4	100
64	143	5137	2628	84	5039	5	100
128	195	7465	3832	85	7216	2761	85
256	345	6368	2976	79	8211	8	99
512	441	7966	2160	84	11045	879	96
1024	536	7534	1543	86	11667	345	97
2048	569	8240	1137	89	12377	1447	93
4096	633	7098	1648	85	12384	26	98
8192	659	7048	1988	85	12585	340	97
16384	656	6728	2526	81	12433	1274	94
32768	660	6891	5070	66	12562	2408	90

Table B-66.							
TCP stream test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	80	3309	2317	84	3302	4	100
64	143	5097	2590	83	4870	5	100
128	227	7353	2759	87	7320	13	99
256	349	7595	1576	93	9605	999	97
512	444	6323	1957	86	9972	11	99
1024	522	7114	700	93	11113	389	97
2048	579	7141	527	94	11717	56	98
4096	609	6730	607	94	12028	182	98
8192	618	6852	418	95	12031	234	98
16384	642	6562	1434	87	12185	554	96
32768	650	6474	3910	69	12256	1896	92

Table B-67.
UDP request/response test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	6319	13678	25266	11	13806	25525	14
64	6292	13804	25521	12	13819	25552	14
128	6329	13850	25612	11	13797	25508	13
256	6181	13535	24980	12	13616	25145	13
512	6334	13849	25608	11	13843	25600	13
1024	6263	13696	25303	12	13648	25208	14
2048	6300	13777	25464	12	13740	25392	13
4096	6363	13941	25793	12	13911	25736	12
8192	6306	13791	25494	12	13750	25413	14
16384	6196	13812	25535	12	13478	24870	12
32768	6308	13787	25484	12	13737	25388	12

Table B-68.
UDP request/response test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	6344	13880	25670	12	13847	25606	12
64	6311	13798	25507	12	13755	25422	14
128	6372	13971	25853	12	13894	25703	12
256	6284	13738	25386	12	13819	25551	14
512	6262	13572	25056	12	13642	25197	13
1024	6265	13700	25312	13	13776	25466	13
2048	6346	13869	25649	12	13826	25565	12
4096	6274	13771	25452	12	13746	25406	15
8192	6336	13848	25608	11	13810	25533	13
16384	6353	13894	25700	12	13867	25646	13
32768	6261	13846	25602	12	13630	25174	13

Table B-69.							
UDP request/response test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	6311	13804	25521	12	13772	25459	14
64	6265	13777	25463	12	13743	25398	13
128	6253	13690	25293	11	13646	25205	13
256	6330	13839	25590	12	13841	25597	13
512	6226	13754	25419	11	13560	25032	13
1024	6313	13803	25517	12	13865	25642	13
2048	6294	13756	25424	12	13768	25450	13
4096	6195	13615	25142	12	13598	25110	13
8192	6330	13700	25312	12	13800	25514	12
16384	6327	13846	25605	11	13806	25526	13
32768	6310	13800	25512	11	13802	25510	13

Table B-70.							
TCP request/response test with 9000 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	5479	12125	22162	14	12103	22118	14
64	5512	12194	22299	12	12155	22223	13
128	5466	12103	22115	13	12077	22062	15
256	5472	12105	22120	12	12068	22048	14
512	5437	12033	21977	13	12054	22022	14
1024	5534	12238	22385	12	12210	22331	13
2048	5502	12170	22250	13	12170	22254	13
4096	5479	12128	22167	13	12107	22127	14
8192	5484	12135	22180	13	12114	22140	14
16384	5519	12208	22327	12	12182	22277	14
32768	5465	12093	22098	13	12064	22040	14

Table B-71.
TCP request/response test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	5483	12135	22180	14	12114	22139	15
64	5487	12144	22200	13	12125	22158	14
128	5515	12199	22310	12	12180	22273	15
256	5528	12228	22367	13	12201	22315	13
512	5453	12074	22059	13	12046	22004	16
1024	5501	12195	22300	13	12166	22246	14
2048	5491	12148	22206	13	12128	22168	14
4096	5502	12183	22277	13	12159	22230	14
8192	5507	12179	22270	12	12150	22213	14
16384	5503	12188	22287	13	12160	22233	13
32768	5460	12087	22084	13	12059	22030	14

Table B-72.
TCP request/response test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	5472	12109	22129	13	12079	22068	14
64	5503	12175	22260	12	12145	22201	15
128	5478	12123	22157	12	12115	22144	14
256	5477	12121	22153	13	12092	22097	14
512	5518	12205	22321	12	12178	22270	14
1024	5511	12188	22288	13	12159	22231	13
2048	5479	12123	22157	12	12094	22101	14
4096	5509	12191	22292	13	12163	22238	14
8192	5527	12228	22368	13	12201	22315	14
16384	5518	12204	22319	13	12174	22261	14
32768	5505	12174	22258	13	12145	22202	13

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Table B-73.							
UDP stream test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	8	54889	7	100	56490	4632	96
64	11	52965	7	98	55689	6	99
128	25	48219	6	100	49995	2138	97
256	45	42940	7	100	44379	7	99
512	104	37245	7	99	38723	446	98
1024	219	46786	7	100	44620	10	99
2048	2	33972	6	98	47723	9	98
4096	2	43619	7	99	73424	11	100
8192	4	41216	6	98	65180	10	99
16384	6	43400	7	97	69226	9	98
32768	9	47131	6	98	64800	8	96

Table B-74.							
UDP stream test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	7	56610	6	100	58279	5	100
64	11	55280	7	100	57149	6	99
128	16	47945	6	100	51157	6	100
256	38	41082	7	98	43272	7	98
512	78	34497	6	100	41890	8	99
1024	229	45954	7	100	41562	12	99
2048	3	34127	6	99	51704	11	99
4096	3	43372	6	99	70583	10	99
8192	3	42651	7	100	69463	9	100
16384	6	45831	7	99	70963	8	99
32768	9	47639	7	99	73019	9	99

Table B-75.
UDP stream test with 1500 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	5	54780	6	100	56972	5	100
64	10	56364	6	100	58243	5	100
128	22	48466	6	100	52939	1658	98
256	34	41529	6	100	43011	6	99
512	93	33776	7	100	35302	7	98
1024	208	47830	6	100	44221	9	99
2048	3	33370	7	100	50265	10	99
4096	3	43752	7	98	67151	9	99
8192	5	41279	6	100	69900	10	100
16384	7	44216	7	100	66884	9	95
32768	9	48044	7	100	74136	8	99

Table B-76.
TCP stream test with 1500 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	65	13525	7480	85	13941	1062	98
64	101	18753	11941	83	13206	9	99
128	138	25179	8653	93	24787	9	99
256	189	26095	5152	84	27504	10	98
512	217	27613	4170	86	29495	65	98
1024	241	28903	3604	86	31984	25	98
2048	267	29932	687	93	30673	722	95
4096	280	32102	438	93	32686	257	97
8192	290	32518	50	96	32492	459	96
16384	295	35897	580	86	35991	86	98
32768	297	34654	995	58	36692	21	98

Table B-77.**TCP stream test with 1500 byte MTU and 131072 byte socket buffer.**

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	62	12606	14320	77	12611	1815	96
64	97	17995	16262	68	12974	5	100
128	129	23695	15939	88	22491	7	100
256	170	25026	8223	79	26476	8	100
512	213	27662	3485	87	28016	8	99
1024	234	28502	1522	93	30909	74	98
2048	253	29824	564	93	31002	79	98
4096	269	32143	186	97	32353	12	99
8192	280	33262	27	98	32980	320	96
16384	289	35324	259	94	35443	28	98
32768	288	33296	1010	59	35261	17	98

Table B-78.**TCP stream test with 1500 byte MTU and 262144 byte socket buffer.**

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	66	12647	14290	80	12630	5	100
64	98	18697	12746	83	13683	5	100
128	132	24076	9982	83	23109	5	100
256	172	25105	7174	86	26538	5	100
512	213	27605	2180	89	28116	6	99
1024	232	28580	1856	91	30682	7	100
2048	250	30238	544	95	31099	15	99
4096	260	32134	63	98	31894	8	98
8192	262	32392	76	94	32358	70	95
16384	273	33808	1425	73	35044	8	98
32768	279	32205	1174	52	34228	8	98

Table B-79.							
UDP request/response test with 1500 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	8108	21343	40275	21	21328	40457	21
64	10116	21467	40780	17	21447	40746	18
128	10123	21483	40809	19	21465	40774	19
256	10202	21646	41126	22	21631	41093	20
512	10080	21396	40628	17	21367	40407	18
1024	10112	21464	40786	15	21441	40719	18
2048	10169	21582	41005	20	21569	40928	21
4096	10222	21689	41211	21	21667	41161	21
8192	10201	21652	41141	19	21647	41114	19
16384	10073	21378	40430	21	21357	40562	16
32768	10243	21484	40798	22	21697	41203	25

Table B-80.							
UDP request/response test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	10204	21635	41094	23	21622	41053	25
64	10054	21341	40522	17	21323	40500	15
128	10147	21523	40900	19	21513	40799	24
256	9972	21181	40201	16	21165	40118	21
512	10129	21490	40832	17	21477	40791	18
1024	10110	21456	40760	17	21439	40714	17
2048	9958	21138	39821	20	21129	39872	16
4096	10008	21251	40356	12	21241	40320	17
8192	10079	21396	40629	18	21382	40603	15
16384	9999	21224	40299	15	21208	40191	18
32768	9977	21188	39532	14	21170	40159	14

Table B-81.**UDP request/response test with 1500 byte MTU and 262144 byte socket buffer.**

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	10033	21070	40016	11	21285	40135	17
64	10055	21345	40525	19	21328	40461	23
128	10072	21380	40617	14	21364	40550	17
256	10096	21435	40734	15	21416	40690	15
512	10178	21591	41025	21	21586	40969	23
1024	10048	21331	40502	18	21311	40434	16
2048	10033	21296	40432	16	21284	40406	16
4096	9913	21060	39391	21	21049	38598	21
8192	9856	20944	39246	16	20937	39605	21
16384	10049	21331	40515	15	21318	40464	17
32768	10075	21385	40584	21	21367	40541	19

Table B-82.**TCP request/response test with 1500 byte MTU and 65536 byte socket buffer.**

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	7913	16832	27813	21	17012	29566	26
64	8041	17276	31437	16	17263	30959	17
128	8005	17216	29284	20	17206	29513	22
256	8081	17392	31521	20	17381	30487	25
512	8129	17457	31936	19	17441	31447	19
1024	8068	17335	31932	18	17317	30340	15
2048	8111	17428	31134	22	17412	30962	23
4096	8182	17567	32427	23	17553	30847	27
8192	8136	17473	31847	26	17461	31793	24
16384	8123	17448	30148	26	17430	31258	23
32768	8142	17477	31796	26	17468	32157	23

Table B-83.							
TCP request/response test with 1500 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	8058	17311	31023	22	17292	29880	26
64	8173	17546	31916	24	17539	32162	26
128	8163	17524	31605	26	17510	31982	24
256	8103	17408	31370	22	17392	31039	24
512	8197	17598	32242	26	17580	31576	24
1024	8189	17580	31150	27	17561	31847	24
2048	8114	17431	31536	18	17419	31605	20
4096	8204	17610	32104	26	17603	32063	23
8192	8089	17374	31272	24	17364	30983	21
16384	8068	17332	31909	21	17312	31533	19
32768	7970	17131	29429	28	17123	30496	25

Table B-84.							
TCP request/response test with 1500 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	8015	17235	31182	22	17221	30655	22
64	8061	17330	30994	25	17313	30666	23
128	8102	17399	32115	23	17384	31793	19
256	8154	17523	31354	22	17492	31626	22
512	8095	17385	31021	19	17383	31151	20
1024	8096	17391	31708	22	17373	30745	23
2048	8087	17377	31649	20	17370	30300	19
4096	8216	17650	32078	26	17643	32410	26
8192	8162	17531	32253	26	17518	31838	26
16384	8133	17460	31836	25	17461	31227	23
32768	7897	16987	31112	25	16986	29888	27

Table B-85.							
UDP stream test with 9000 byte MTU and 65536 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	5	57975	6	100	60886	6	99
64	9	52745	6	100	55079	6	99
128	11	47254	7	100	50957	6	99
256	41	42422	7	100	43657	9	98
512	87	35855	6	99	38594	9	98
1024	206	48730	7	99	44580	9	98
2048	350	36883	7	99	37242	10	98
4096	644	21175	235	89	21259	5510	93
8192	671	11493	865	64	11518	20356	63
16384	62	11506	995	59	12423	6	99
32768	62	11516	1170	52	12710	6	99

Table B-86.							
UDP stream test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	4	56662	6	100	59939	5	100
64	9	52516	6	100	55127	6	100
128	17	46742	6	100	48572	7599	93
256	42	42890	6	100	44885	7	99
512	72	35688	6	100	36805	7	98
1024	225	47629	7	100	44157	10	99
2048	362	36106	7	99	36523	1361	96
4096	640	21045	102	91	21111	11293	84
8192	651	11176	299	76	11188	19722	61
16384	37	11361	439	66	14529	7	99
32768	54	11414	553	58	14126	6	99

Table B-87.
UDP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	4	57188	6	100	61884	5	100
64	7	51438	6	100	55275	5	100
128	15	46987	6	100	50144	6	100
256	41	42322	7	100	43313	7	99
512	88	34859	7	100	36113	7	98
1024	214	47094	7	98	43535	9	98
2048	349	37573	7	99	37934	9	98
4096	592	19267	7	98	19576	17540	76
8192	633	10880	73	89	10888	19291	57
16384	60	11106	153	78	12949	6	99
32768	87	11222	230	66	12500	6	99

Table B-88.
TCP stream test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	80	3617	2266	87	3615	634	96
64	141	5282	3086	87	5327	910	94
128	228	7508	5191	86	7346	8	99
256	347	9610	4707	84	9750	10	99
512	453	10701	3084	88	12090	11	99
1024	492	12005	965	95	15368	2847	92
2048	562	12796	1226	93	14544	3008	89
4096	613	13651	4387	85	13997	4430	87
8192	583	12825	2832	87	13473	7530	78
16384	605	13198	10174	61	13775	9533	76
32768	603	13467	11586	59	13811	13656	66

Table B-89.
TCP stream test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	85	3440	3183	83	3436	5	100
64	151	5329	3814	89	5327	5	100
128	224	7406	4348	89	7884	1571	95
256	357	8876	2074	91	9186	8	99
512	430	10710	975	95	12313	444	98
1024	518	10446	880	95	12871	55	98
2048	517	12649	26	98	15424	1753	91
4096	581	12434	153	98	14138	2792	90
8192	588	12998	575	96	13943	5253	85
16384	615	12948	11530	54	13845	4736	86
32768	620	13753	14672	45	14100	7624	80

Table B-90.
TCP stream test with 9000 byte MTU and 262144 byte socket buffer.

data buffer length (bytes)	received bit rate (10 ⁶ bits per second)	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	83	3402	2303	88	3391	4	100
64	139	5277	3255	89	5271	890	95
128	226	7464	4906	87	7372	4	100
256	345	9172	1936	94	9478	140	99
512	420	10368	1445	94	11457	468	98
1024	504	9976	1106	95	12677	294	98
2048	544	11035	4748	82	12778	173	98
4096	572	11846	1759	91	13211	149	98
8192	565	11773	220	98	13350	3364	89
16384	609	13004	7917	69	13737	4446	87
32768	613	13635	12287	55	13965	7516	80

Table B-91.
UDP request/response test with 9000 byte MTU and 65536 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	9959	21160	40169	13	21149	40137	15
64	10029	21301	40460	13	21283	40397	18
128	10103	21446	40735	19	21431	40673	21
256	10081	21394	40642	13	21376	40575	16
512	10102	21444	40751	16	21425	40697	15
1024	10056	21358	40042	24	21339	40507	20
2048	10097	21428	40722	14	21397	40614	19
4096	10009	21265	40363	18	21255	40066	24
8192	10043	21332	40525	15	21313	40416	17
16384	9915	21064	39943	17	21037	39909	17
32768	10006	21243	40304	15	21234	40316	12

Table B-92.
UDP request/response test with 9000 byte MTU and 131072 byte socket buffer.

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	9972	21181	40207	14	21167	40166	17
64	10022	21285	40389	20	21269	40376	17
128	9894	21021	39800	20	21039	39928	13
256	10120	21484	40816	21	21476	40791	19
512	10049	21347	40481	13	21340	40526	16
1024	10161	21331	40494	19	21564	40964	18
2048	10191	21637	41078	25	21623	41065	22
4096	8119	21281	40383	13	21271	40365	18
8192	9842	20932	38000	25	20915	39528	23
16384	9845	20940	38954	20	20922	39557	22
32768	7881	20857	37356	26	20848	38811	28

Table B-93.**UDP request/response test with 9000 byte MTU and 262144 byte socket buffer.**

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	9778	20564	36934	23	20778	39213	19
64	9998	21242	40265	22	21228	39753	22
128	10035	21319	40381	18	21306	40413	19
256	10119	21484	40815	18	21467	40544	17
512	10057	21363	40589	14	21351	40499	15
1024	10006	21258	40314	15	21239	40291	14
2048	10076	21393	40636	14	21375	40552	15
4096	9883	21012	39834	19	20987	39787	18
8192	9946	21131	40073	16	21114	40071	15
16384	9236	21154	40154	13	21133	40053	14
32768	9984	21200	40165	23	21187	40209	16

Table B-94.**TCP request/response test with 9000 byte MTU and 65536 byte socket buffer.**

data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	8032	17268	30429	21	17255	31383	16
64	7984	17176	29397	18	17168	30694	19
128	8014	17232	28410	17	17224	30812	22
256	8036	17282	28409	19	17272	31676	13
512	8098	17403	30167	24	17392	31619	18
1024	8118	17448	31051	21	17432	31206	23
2048	8089	17390	28674	19	17370	31364	19
4096	8165	17541	30961	23	17534	31966	23
8192	8093	17395	29722	21	17382	31779	21
16384	7918	16851	25529	26	17020	31250	20
32768	7831	16869	28976	20	16866	30297	22

Table B-95.							
TCP request/response test with 9000 byte MTU and 131072 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	7918	17048	30077	27	17034	31389	21
64	8030	17266	28809	25	17241	31147	23
128	7885	16975	30303	19	16963	31169	16
256	7934	17052	28368	25	17030	30555	22
512	7995	17204	30656	17	17201	30775	17
1024	8074	17161	30662	21	17337	30751	19
2048	8070	17353	30650	24	17337	31716	18
4096	8088	17379	32103	18	17371	30890	19
8192	7852	16906	31119	24	16901	29736	20
16384	8049	17297	31203	19	17287	30409	18
32768	7868	16931	30152	20	16914	30566	16

Table B-96.							
TCP request/response test with 9000 byte MTU and 262144 byte socket buffer.							
data buffer length (bytes)	transactions per second	Sending Host			Receiving Host		
		interrupts per second	context switches per second	% CPU use	interrupts per second	context switches per second	% CPU use
32	7966	16959	31061	17	17126	30989	15
64	8028	17273	31787	18	17262	30836	14
128	8033	17280	31991	20	17274	31687	17
256	7985	17172	31695	19	17165	31275	21
512	8067	17361	31656	22	17353	32065	19
1024	8110	17426	31764	21	17410	32263	19
2048	8062	17333	31398	18	17315	31355	19
4096	8055	17322	30721	18	17310	31955	16
8192	7855	16693	28866	25	16848	30408	24
16384	7879	16910	30818	22	16934	30711	21
32768	7841	16886	30281	20	16868	30593	16

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