VeriTest®

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Comtrol Corporation: Latency Performance Testing of Network Device Servers

Test report prepared under contract from Comtrol Corporation

Executive summary

Comtrol Corporation commissioned VeriTest, a division of Lionbridge Technologies, Inc., to execute a benchmark comparing the overall latency of device server products when performing network to serial communications. Additionally, as a baseline, VeriTest executed the same benchmark against a Native PC serial port.

The test compared single and multiple serial port to Ethernet device servers from three vendors. In addition to testing the performance of the products using industry standard TCP/IP protocol, the tests were repeated with three Comtrol products using their Rapid Transport Service™ (RTS) network protocol, to determine if latency improvements could be obtained if RTS replaced TCP/IP.

Key findings

- Native PC serial port latency was 5.67 ms versus 4.075 ms on the DeviceMaster RTS 16RM (RTS protocol) and 7.13 ms (TCP/IP protocol)
- Overall, our testing showed that the Comtrol device servers generated significantly lower latencies compared to other competitors' device servers
- The Comtrol DeviceMaster RTS RM16 has the lowest latency of any product tested
- Comtrol's products, on average, performed approximately 10 to 50 times faster than Digi or Lantronix in our test configurations.
- The latency differences observed across the nine products tested ranged from 4.075 ms to a high of 562.595 ms

The following device servers were included in the test:

- Comtrol DeviceMaster PRIMO
- Comtrol DeviceMaster RTS 1 Port
- Comtrol RocketPort Serial Hub ia
- Comtrol DeviceMaster RTS 16RM
- Digi One IA RealPort
- Digi PortServer TS 16
- Lantronix MSS4
- Lantronix UDS-10
- Lantronix UDS100

The device servers listed above connect one or more serial devices and move data to and from the connected device over an Ethernet network that is configured with vendor specific Driver or COM port

redirector software. The COM port redirection software associates an IP or MAC address with a COM port identifier. It is the function of the device server and related software/drivers to convert data from a serial based system into data that can be delivered to an Ethernet based client system.

The test objective was to measure the average round-trip latency required to send a stream of single 8-bit characters from a host PC across a network to the test device server's serial port and receive the same data echoed back to the host PC. The echoing of data was accomplished by attaching a loop back plug to the device server's serial port. The lower the round-trip latency, the faster the device server and associated driver or COM port redirection software processed and moved the data.

Comtrol Corporation provided VeriTest with all the device servers and associated software. Comtrol also provided a custom Python-based test program to be executed on a personal computer. The program generated the load for testing, controlled the execution of the test and measured the latency during testing. Please refer to the Test Methodology section for complete details on how the tests were conducted and our review of the benchmark program used for these tests.

A single iteration of the test consists of the benchmark program sending a single 8-bit character from the Ethernet port of the host PC to the serial port of the device server being tested, and then having the character echoed back to the host PC. The benchmark program recorded the elapsed time from when the character was sent until the time it was received back. This elapsed time is the latency required to send a single character to a device server and get a response back.

For each device server tested, we configured the benchmark program to complete 10,000 iterations of the test described above. For all device servers tested, the benchmark program sent data at 9600 baud with 8 data bits, 1 stop bit and no parity. We conducted two tests using 10,000 iterations for each device server tested to ensure the repeatability and accuracy of the test results. We then computed an average based on the two sets of latency results for inclusion in this report. Please refer to the Test Methodology section for complete details and configuration information.

Latency results from the testing are shown in Figure 1 below. For these tests, lower numbers mean less latency. The benchmark program was completed for all device server products using the TCP/IP protocol. Please note that for three of the Comtrol products, we also performed the testing using Comtrol's proprietary RTS protocol. Our testing showed that Comtrol device servers running under RTS incurred up to a 52 percent decrease in latency compared to the same product running TCP/IP.

In our testing, the Comtrol DeviceMaster RTS 16RM device server generated the lowest average round-trip latencies compared to all other device servers regardless of the network protocol. The RTS 16RM required, on average, 7.13 milliseconds to complete each of the 10,000 iterations included in each test using TCP/IP and 4.075 milliseconds to complete each of the 10,000 iterations using RTS. These results are significantly better than the 110.055 milliseconds required when testing the next best performing competitors' product, namely the Digi One IA RealPort 1- port device server. The Digi PortServer TS 16, required on average, 120.005 milliseconds to complete each of the 10,000 iterations. Finally, the Lantronix products generated significantly higher latencies than any other vendor's devices in our testing. Specifically the Lantronix MSS4 required, on average, 562.595 milliseconds to complete each of the 10,000 iterations included in each test. Other Lantronix products faired slightly better than the MSS4, with both the UDS-10 and UDS 100 each generating average latencies of 529.36 milliseconds. Overall, the Comtrol product line produced significantly lower latencies than any other competitor's products tested, regardless of the protocol used.

Product	Driver/Driver Rev.	Network Protocol	Avg. Latency (ms)
Native PC Serial Port	Win2K		5.67
Comtrol DeviceMaster PRIMO	W2K/1.5.0.0	TCP/IP	10.65
Comtrol DeviceMaster RTS 1 Port	W2K/6.5.0.0	TCP/IP	15.855
Comtrol DeviceMaster RTS 1 Port	W2K/6.5.0.0	Rapid Transport Service™	9.47
Comtrol RocketPort Serial Hub ia	W2K/6.5.0.0	TCP/IP	19.1
Comtrol RocketPort Serial Hub ia	W2K/6.5.0.0	Rapid Transport Service™	9.165
Comtrol DeviceMaster RTS 16RM	W2K/6.5.0.0	TCP/IP	7.13
Comtrol DeviceMaster RTS 16RM	W2K/6.5.0.0	Rapid Transport Service™	4.075
Digi One IA RealPort	W2K/2.6.82.0	TCP/IP	110.055
Digi PortServer TS 16	W2K/2.6.82.0	TCP/IP	120.005
Lantronix MSS4	W2K/Dev Com 1.0 Build 117	TCP/IP	562.595
Lantronix UDS -100	W2K/Dev Com 1.0 Build 117	TCP/IP	529.36
Lantronix UDS -10	W2K/Dev Com 1.0 Build 117	TCP/IP	529.36

Figure 1. Device Server Average Latencies

Testing methodology

Comtrol Corporation commissioned VeriTest, a division of Lionbridge Technologies, Inc., to execute a predefined benchmark test provided by Comtrol that measured the performance of a native PC serial port and compared the performance of the following device servers moving a stream of single 8-bit character data:

- Comtrol DeviceMaster PRIMO
- Comtrol DeviceMaster RTS 1 Port
- Comtrol RocketPort Serial Hub ia
- Comtrol DeviceMaster RTS 16RM
- Digi One IA RealPort
- Digi PortServer TS 16
- Lantronix MSS4
- Lantronix UDS-10
- Lantronix UDS100

The device servers listed above allow serial devices to connect to and move data to and from a device on an Ethernet network configured with vendor specific COM port driver or redirection software. The COM port driver or redirection software associates an IP or MAC address with a COM port identifier. It is the function of the device server and related software/drivers to convert data from a serial based system into data that can be delivered to an Ethernet based client system.

The goal of the testing was to measure the average round trip-latency required to send a stream of single 8-bit characters from a host PC across a network to the test device server's serial port and receive the same data echoed back to the host PC. The echoing of data was accomplished by attaching a loop back plug to the device server's serial port. The lower the latency for this round-trip, the faster the device server and associated COM port redirection software processed and moved the data.

To provide a basis for comparison, the latency test was also performed on the host PC, sending the same stream of single 8 bit characters out of the native, onboard serial port. A loop back plug was attached to the onboard serial port to echo back the character.

The equipment and topology used for the test is shown in Figure 2 below. Each of the device servers used a 100 Mbps Ethernet port (except the Lantronix UDS-10 which had a 10Mbps port) and was equipped with one or more serial ports. We used a Dell Dimension 8100 configured with a 1.5 GHz Pentium 4 processor and 256MB of RAM, running Windows 2000 Professional/SP3 as our host PC. We connected the host PC to a 3Com 10/100 Mbps hub using a Cat 5 Ethernet cable. Next, we connected the Ethernet port on the device server under test to the 3Com hub using a Cat 5 Ethernet cable. A loop back plug was placed on the device server's serial port to redirect the character stream back to the host PC.

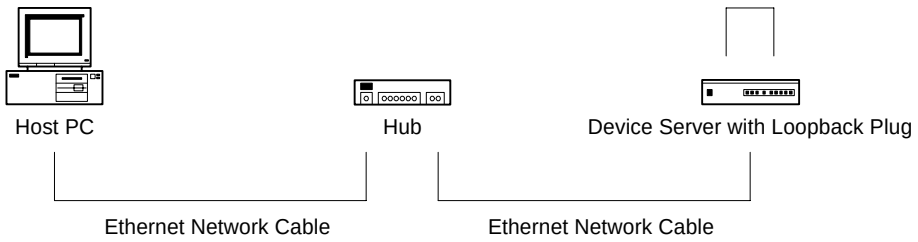

Figure 2. Device Server Interconnect Diagram

Comtrol Corporation provided VeriTest with a custom Python script, referred to as the "benchmark program" in this document, to measure the latency for each of the devices tested. To run the Python script, we downloaded ActivePython-2.2.2-224-win32-ix86.msi from ActiveState's website and installed it on the host PC using the "typical installation" option. We then installed the benchmark program by copying the custom Comtrol provided Python files to the host PC. We ran the benchmark program from a command prompt on the host PC as follows:

C:\> bench.bat –c10000 com#

- the designated COM port number assigned to the device servers serial port.

When executed, the benchmark program writes a stream of single 8 bit characters from the host PC using an Ethernet connection to the device under test. The device under test then echoes that same 8 bit character back to the host PC. The echoing of data was accomplished using a loop back plug that connected the RS-232 Tx data pin to the Rx data pin. The benchmark program recorded the time that elapsed from when it initially sent the character to when it received the character back. This elapsed time is the latency required to send a single character to the device server's serial port and get a response back.

A single iteration of this test is defined as the sending of one 8 bit character of data from the host PC to the device server under test and then back to the host PC. For these tests, we instructed the benchmark program to perform 10,000 iterations of the test. When the specific test was completed the benchmark program computed and displayed the min, mean, max and standard deviation of the results recorded during the testing. For our reporting, we used the mean to produce our results. The test results from this benchmark were obtained using the following parameters:

inter-character timeout:	2ms
total read timeout:	2000ms
iteration delay:	100ms
baud rate:	9,600bps
block size:	1 byte
number of iterations:	10,000

[All parameters are default values of the benchmark program except iteration count]

We reviewed and evaluated the Comtrol supplied Python language source code to ensure that the program code matched the observed operation of the applications during testing. During our analysis we verified the following characteristics of the benchmark program:

- the program flow of the application seemed reasonable and fair for all products tested
- the layout of the test data was a 256 byte repeating set of ASCII characters
- the program sent a single ASCII character by default
- the program received a single ASCII character by default
- the program would terminate with an error if the received character did not match the send character
- the timing values printed as output matched the output of the time.clock( ) system call
- that the min, max, and mean results were calculated properly for an iteration count of 10
- the com port functions issued matched the Win32 parameter definitions for those calls

Given our investigation of the Python script, we are satisfied that the benchmark program operated as intended and generated a valid set of test results.

Comtrol provided all the device servers as well as the products' software/drivers. To be certain we were using the most current version of each device servers' software/driver, we visited each vendor's website and performed any necessary updating. Listed in figure 3 below are the vendor specific COM port driver or redirection software versions we used for this testing.

Product	Driver/Driver Rev.
Comtrol DeviceMaster PRIMO	W2K/1.5.0.0
Comtrol DeviceMaster RTS 1 Port	W2K/6.5.0.0
Comtrol RocketPort Serial Hub ia	W2K/6.5.0.0
Comtrol DeviceMaster RTS 16RM	W2K/6.5.0.0
Digi One IA RealPort	W2K/2.6.82.0
Digi PortServer TS 16	W2K/2.6.82.0
Lantronix MSS4	W2K/Dev Com 1.0 Build 117
Lantronix UDS 100	W2K/Dev Com 1.0 Build 117
Lantronix UDS -10	W2K/Dev Com 1.0 Build 117

Figure 3. Device Server Driver Information

We used the following procedure for testing each device server:

- Connect the host PC and device server to the 3Com hub using Cat 5 Ethernet Cable
- Power up the Device Sever under test, place the loop back plug on a serial port on the device server
- Power up the host PC
- Install and configure the vendor specific COM port redirection software and drivers specifying the IP and in some cases the MAC (Comtrol devices only) address of the Ethernet interface of the device server under test. The appropriate COM port was also defined as the interface through which the device server and the host PC communicate
- Reboot the host PC again and recycle the power on the test device server
- Start the benchmark script on the host PC by entering the command line entry - C:\> bench.bat –c10000 com# and specifying the appropriate COM port number for #
- Once the command is executed, visually monitor the test until complete and save the test results
- Cycle power on both the host PC and device server
- Perform the second 10,000 iteration of the test

Test results

This section describes the results of the device server testing. The goal of the testing was to measure the average round-trip latency required to send a stream of single 8-bit characters from a host PC over a local Ethernet network to a test device server's serial port and have it echo back the stream to the host PC. The lower the latency for this round-trip, the faster the device server was able to process and move the data. Please refer to the Test Methodology section for complete details and configuration information.

In our testing, the Comtrol DeviceMaster RTS 16RM device server generated the lowest average round-trip latencies compared to all other devices regardless of the network protocol. The RTS 16RM required, on average, 7.13 milliseconds to complete each of the 10,000 iterations included in each test using TCP/IP and 4.075 milliseconds to complete each of the 10,000 iterations using RTS. These results are significantly better than the 110.055 milliseconds required when testing the next best performing competitors' product, namely the Digi One IA RealPort 1- port device server. The Digi PortServer TS 16, required on average, 120.005 milliseconds to complete each of the 10,000 iterations. Finally, the Lantronix products generated significantly higher latencies than any other vendor's devices in our testing. Specifically the Lantronix MSS4 required, on average, 562.595 milliseconds to complete each of the 10,000 iterations included in each test. Other Lantronix products faired slightly better than the MSS4, with both the UDS-10 and UDS 100 each generating average latencies of 529.36 milliseconds. Overall, the Comtrol product line produced significantly lower latencies than any other competitor's products tested, regardless of the protocol used.

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Lantronix UDS 100	W2K/Dev Com 1.0 Build 117	TCP/IP	529.36
Lantronix UDS -10	W2K/Dev Com 1.0 Build 117	TCP/IP	529.36

Figure 4. Device Server Average Latencies

Appendix

A. System disclosures

Dell Dimension (Host PC)	
Processor/Speed/Number Of	P4/1.5 GHz
System RAM/Type/Slots	256 MB
Motherboard Manufacturer	INTEL
Motherboard Chipset/Model	82850
Main Bus Type	PCI
L2 Cache	256 KB
BIOS	DELL AO2
HD Model # / Size	38 GB
HD Controller	INTEL 82801BA Ultra ATA Storage Controller
Graphics Adapter	NVIDA DDR GEFORCE 2GTS
Graphics Driver & Version	NVDISP.DRV/4.12.01.0634
Graphics Memory (MB type)	32 MB
Graphics Chip Type	GEFORCE 2
NIC (Driver)	3Com 3C920 (3C9050 – TX Compatible)
USB Chipset	USB 1.0

Figure 5. Host PC System Configuration Information

VeriTest (www.veritest.com), the testing division of Lionbridge Technologies, Inc., provides outsourced testing solutions that maximize revenue and reduce costs for our clients. For companies who use high-tech products as well as those who produce them, smoothly functioning technology is essential to business success. VeriTest helps our clients identify and correct technology problems in their products and in their line of business applications by providing the widest range of testing services available.

VeriTest created the suite of industry-standard benchmark software that includes WebBench, NetBench, Winstone, and WinBench. We've distributed over 20 million copies of these tools, which are in use at every one of the 2001 Fortune 100 companies. Our Internet BenchMark service provides the definitive ratings for Internet Service Providers in the US, Canada, and the UK.

Under our former names of ZD Labs and eTesting Labs, and as part of VeriTest since July of 2002, we have delivered rigorous, objective, independent testing and analysis for over a decade. With the most knowledgeable staff in the business, testing facilities around the world, and almost 1,600 dedicated network PCs, VeriTest offers our clients the expertise and equipment necessary to meet all their testing needs.

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