MIPS® R4400/R4600 Microprocessors
Windows NT™ Performance Brief

The Fastest Processors on the Planet™

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Mountain View, CA 94043

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Introduction

MIPS designs high performance microprocessors used in PCs, workstations, servers, minicomputers, supercomputers and consumer devices. The Microsoft Windows NT™ operating system is a portable 32-bit operating system supporting multiple CPU architectures. In addition to being portable, Windows NT features: the familiar Windows 3.1 user interface, secure and robust environment, multitasking and multithreading capabilities, built-in symmetric multiprocessing support, integrated networking and DOS/Windows application compatibility.

Currently, computer systems based on Intel x86, Pentium, MIPS R4x00 and Digital Alpha microprocessors are supported by Windows NT (version 3.1). This performance brief shows the performance differences among commercially available personal computer systems based on these three types of microprocessors.

Summary

This report demonstrates the price/performance advantages of computers based on MIPS microprocessors using real world 32-bit applications for Windows NT. Computer systems based on Intel Pentium, Digital Alpha AXP 21064 and MIPS R4400 microprocessors are compared. These systems are currently considered to be the best in their class.

The MIPS R4400SC (200 MHz) based computer system is up to three times as fast as the computer system based on the Pentium (90 MHz) processor and is up to 1.67 times faster than the system based on the Alpha AXP 21064 (200 MHz) microprocessor.

Overview and Methodology

This document is divided into two sections: 32-bit application benchmarks and low-level processor benchmarks. The first section presents the results of 32-bit application benchmark tests on computer systems incorporating Intel 486DX2 (66 MHz), Intel Pentium (90 MHz), Digital Alpha AXP 21064 (200 MHz) and MIPS R4400SC (200 MHz) microprocessors under Windows NT. Effort has been taken to minimize the disk and video activity while devising the benchmark cases so as to show the comparison of the CPU (both integer and floating point) and memory subsystem performance. Most of the benchmarks are devised in such a way that no system benefits by having a large secondary cache. Applications and tools used for this report are all either released or in advanced stages of beta testing. Windows NT version 3.1 (1.528) is used on all the platforms for benchmark testing.

Data presented here is normalized to a 486-66 machine, where applicable. Thus, a large bar indicates the number of times (given at the top of the column) a particular benchmark runs faster than the 486-66 machine used for comparison. Summary of total elapsed times and relative performance advantage of the MIPS based system for these benchmarks is given in appendix-A. Detailed configurations of these systems is presented in appendix-B. Contact information for application vendors is provided in appendix-C.

The MIPS systems used in this benchmarking report are representative systems from MIPS and partners. MIPS based systems are manufactured by multiple systems vendors as listed in appendix-D. MIPS microprocessors are manufactured by multiple semiconductor partners as listed in appendix-E.

R4600 Performance

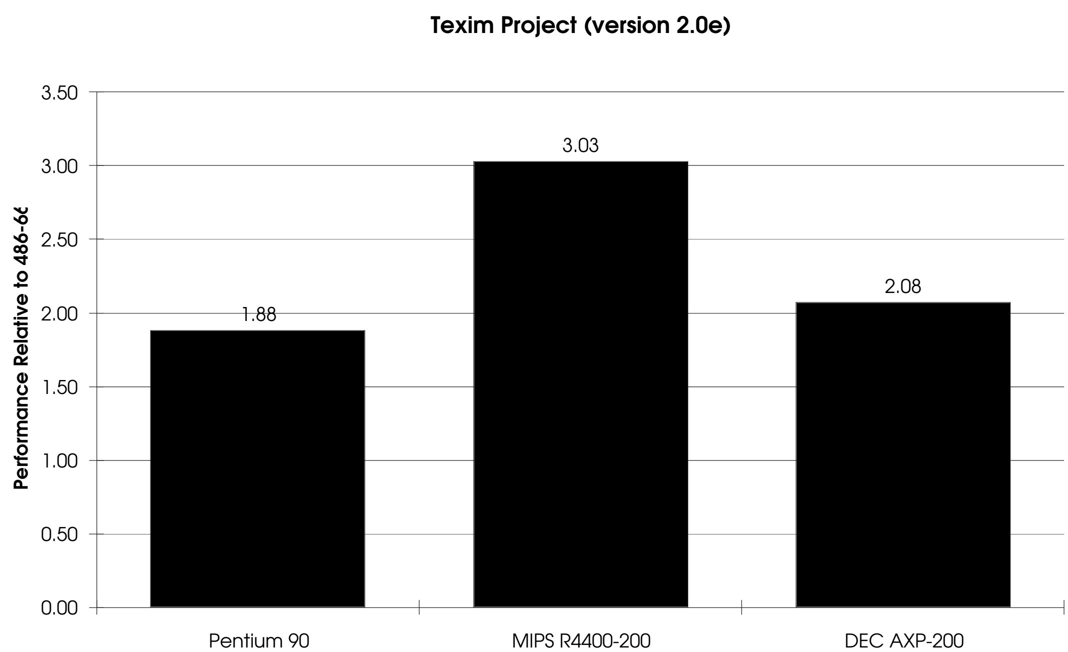
MIPS R4600 (150 Mhz) microprocessor based system performance results including system configuration, is given in an addendum to this document.

SECTION 1 - 32 bit Application Benchmarks

Texim Project

Texim Project is a comprehensive project management application for Windows NT from Welcom Software Technology Corporation. Version 2.0e of Texim Project is used for this benchmark. There are two tests in this benchmark. The first test measures the time it takes to perform time analysis on a small (~70K) project file for 100 repetitions and the second measures the time it takes to perform resource leveling on a large (~1M) project file for 50 repetitions. The cumulative time for the two benchmarks is the time of comparison. There is minimal disk activity and negligible video activity.

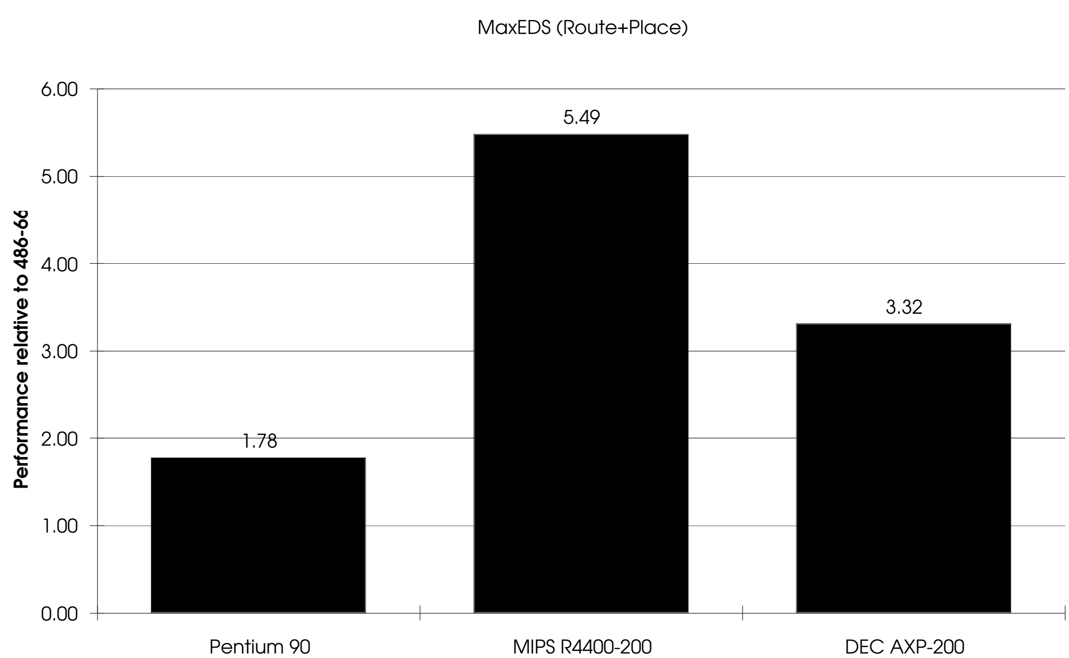
Larger bar is better.



MaxEDS

MaxEDS is a printed circuit board (PCB) placement and routing package for Windows NT from Massteck Ltd. Released version (5.10) of this product is used for benchmarking. There are two tests in this benchmark and the cumulative of the two is the benchmark time. These two benchmarks show the two major areas of the application's uses - routing and placement. The first test measures the time it takes to auto route a PCB with 20 components (file size ~70K). The second test measures the time it takes to auto place a PCB with 30 components (file size ~110K). The video subsystem affects the first benchmark but does not have any measurable impact on the second test. The first test contributes about 1/3 of the test total so the video effect on the total time is relatively minor.

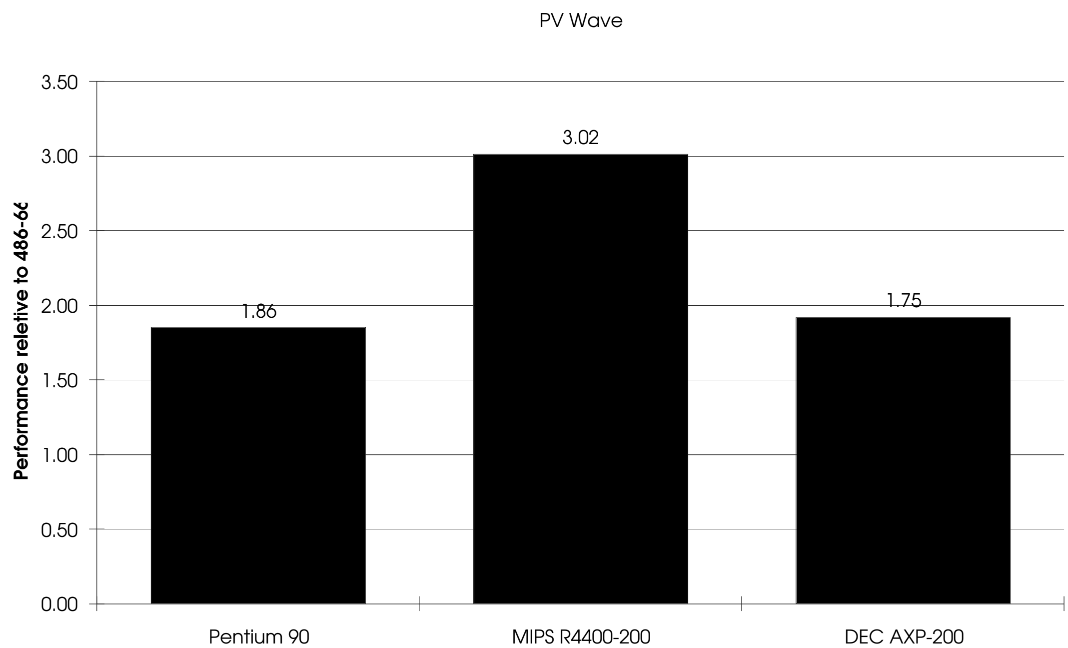
Larger bar is better.



PV-Wave Advantage

PV-Wave Advantage is an interactive data analysis and visualization application from Visual Numerics, Inc. Released version (4.20) is used for comparison. Volumetric rendering of a cut away section of a cube from the Advanced Rendering Library of PV-Wave is used as the benchmark for this application. Even though this test measures the time it takes to render three views of the cube, video subsystem does not contribute significantly to the time to complete the test. This test shows the combined integer and floating point performance of the CPU.

Larger bar is better.



Hamilton C Shell

Hamilton C Shell is a programmer's tool kit with an alternative command shell and UNIX style utilities for Windows NT developers from Hamilton Laboratories. There are two tests for this application. The first test is a shell script to generate calendar for 20 years for every month. Since the goal of this performance brief is to compare mainly the CPU performance, the result of this calendar shell script is piped to nul so that the console video performance does not play a role. The second test encrypts a binary data file (~512K) and pipes the output to the decrypt option of the "des" command multiple times (14). The total of the two tests is the benchmark time.

Larger bar is better.

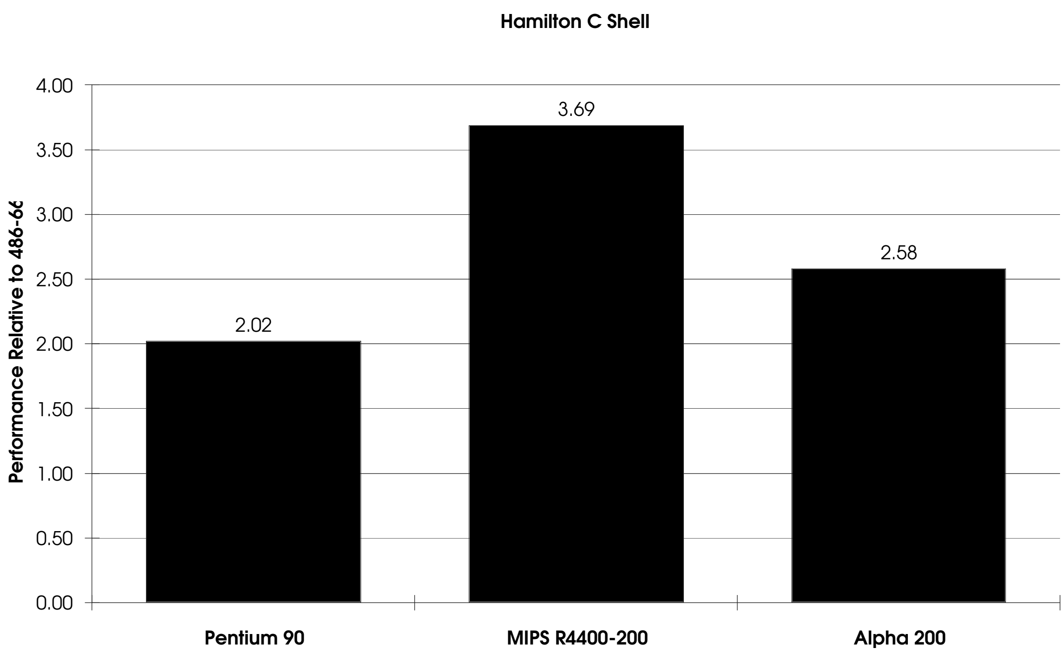
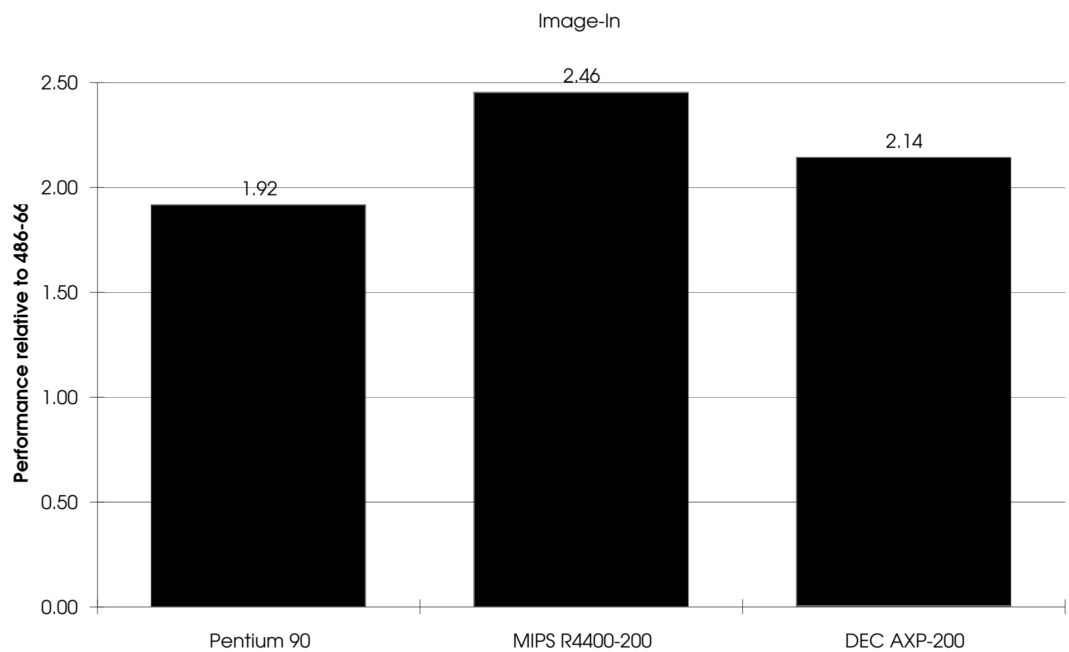


Image-In

Image-In is an image processing package for Windows NT from CPI Inc. Engineering release version of Image-In is used for testing. Benchmark tests for this application are three discrete filter operations on a 24-bit compressed JPEG image file (110 Kb file expands to about 4Mb). These filters are Emboss, Ripples and Waves. Cumulative time of these operations on this image file is the benchmark time. This benchmark showcases both integer and floating point performance of the CPU. A small amount of time is spent in the video subsystem in this test.

Larger bar is better.

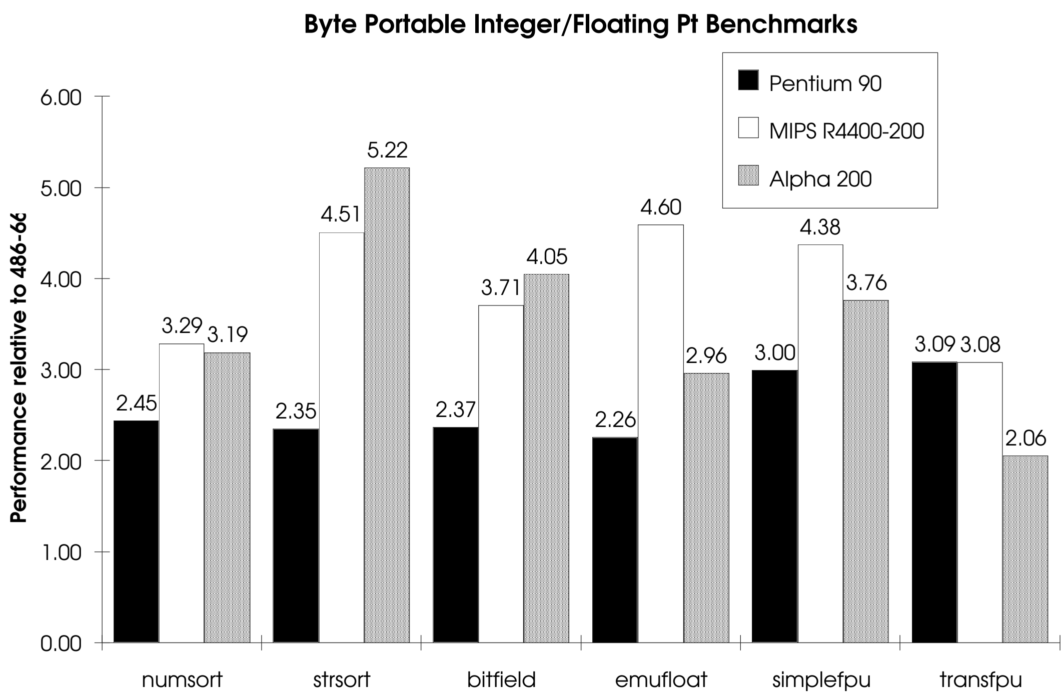


SECTION 2 - Low-level processor benchmarks

Byte Portable CPU/FPU Benchmarks

Byte Magazine has devised a set of portable benchmarks to measure the CPU performance, both integer and floating point. There are six tests in this suite - 3 integer and 3 floating point. Results of these tests are normalized to the 486-66 system. These benchmarks are compiled with both -ot and -ox and /or with -o2 and the best result of the three is taken for comparison.

Larger bar is better.

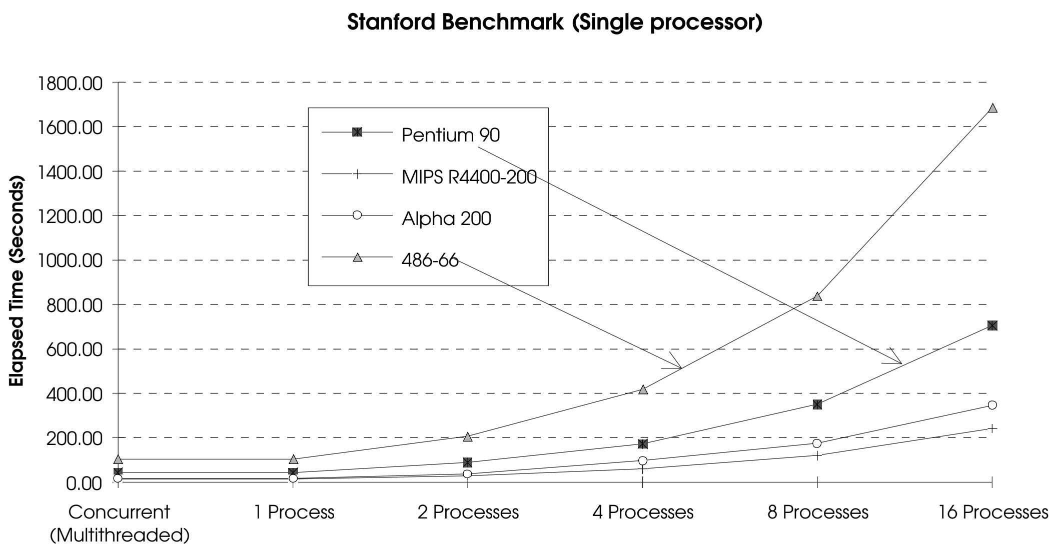


Stanford Benchmark

Stanford benchmark consists of ten processor intensive tests. These tests fall into three general categories - integer, floating point and recursive type.

First the tests were run sequentially in a single process and then multiple instances of the same process is started to see the degradation of the system performance while running multiple processes.

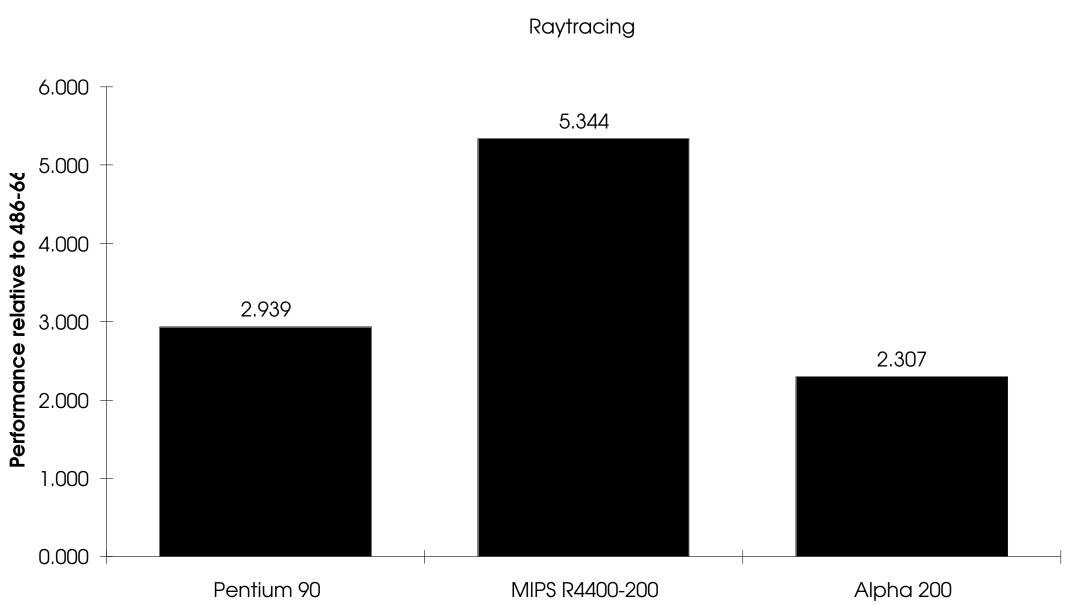
All these tests were started simultaneously in the concurrent mode so the effects of multithreading on the system performance could be measured. The graphs below show the number of processes against the elapsed time for the Stanford test suite to complete on the platforms under comparison. Complete timing information is provided in appendix-A.



Raytracing

Raytracing is a CPU intensive operation used in 3D graphics and image processing applications. The multithreaded application used in this benchmark has been developed by a research scientist to investigate the multiprocessing capabilities of Windows NT in computation intensive areas. The time to generate a 600x600 pixel raytraced image is the benchmark time. Graph below shows the relative performance of each system compared to the 486-66 system. Complete timing information is given in appendix-A.

Larger bar is better.



Appendix-A

SUMMARY OF BENCHMARK TIMES (Absolute and Relative)

Elapsed Total Time (seconds)

Application/System	Pentium 90	MIPS R4400-200	Alpha200	486-66
Texim Project	98.00	60.87	88.9	184.50
MaxEDS	383.50	124.65	206.00	684.00
PV-Wave Advantage	79.17	48.74	76.5	147.00
Hamilton C Shell	104.5	57.38	82	211.60
Image-In	53.8	41.9	48.0	102.9

Relative to Pentium 90

Application/System	Pentium 90	MIPS R4400-200	MIPS advantage
Texim Project	98.00	60.87	1.61
MaxEDS	383.50	124.65	3.08
PV-Wave Advantage	79.17	48.74	1.62
Hamilton C Shell	104.5	57.38	1.82
Image-In	53.8	41.9	1.28

Relative to Alpha 200

Application/System	Alpha 200	MIPS R4400-200	MIPS advantage
Texim Project	88.9	60.87	1.46
MaxEDS	206.00	124.65	1.65
PV-Wave Advantage	76.5	48.74	1.57
Hamilton C Shell	82	57.38	1.43
Image-In	48.0	41.9	1.15

Stanford Benchmark
(Elapsed time in seconds)

	Pentium 90	MIPS R4400-200	Alpha 200	486-66
Concurrent (Multithreaded)	42.0	14.50	17.00	104.00
1 Process	43.0	14.50	17.00	104.00
2 Processes	88.0	29.00	36.00	207.00
4 Processes	172.0	59.00	96.00	417.00
8 Processes	350.0	120.00	175.00	839.00
16 Processes	705.0	243.00	345.00	1685.00

Raytracing - Elapsed time in seconds

	Pentium 90	MIPS R4400-200	Alpha 200	486-66
Raytracing (1Thread)	39.1	21.5	49.8	114.9

Appendix - B

System Configurations

486-66 System

System Vendor:	Dell Computer Corporation
Model Number:	466DE
Processor:	Intel i486DX2
Speed:	33/66Mhz
Primary Cache:	I&D-8K
Secondary Cache:	128K
Memory:	32Mb
Bus:	EISA
Disk Controller:	Adaptec 1742
Disk:	200Mb (formatted)
Drive Type:	Quantum ProDrive LPS240
File System:	FAT/NTFS
CD-ROM:	Built-in
Video:	ATI Ultra
Resolution:	1024 x 768 x 256 colors
Monitor:	17" Ultrasync

Pentium 90 System

System Vendor:	Dell Computer Corporation
Model Number:	Omniplex SP90
Processor:	Intel Pentium-90
Speed:	90MHz
Primary Cache:	I-8K/D-8K
Secondary Cache:	256K
Memory:	32Mb
Bus:	PCI/EISA
Disk:	1Gb
Drive Type:	Digital
Disk Controller:	On board NCR PCI Controller
File System:	FAT/NTFS
Network Adapter:	SMC EtherCard
Video:	ATI PCI
Resolution:	1024 x 768 x 256 colors
Monitor:	17” Dell VS 17 Monitor

Alpha 200 System

Company:	Carrera Computers
System/Model:	Hercules 200
Processor:	21064
Speed:	200 MHz
Primary Cache:	I-8K/D-8K
Secondary Cache:	512K
Memory:	32Mb
Bus:	EISA
Disk:	500Mb
Drive Type:	Digital 94002-035
Disk Controller:	Adaptec 1742 SCSI Adapter
CD-ROM:	Built-in
Network Adapter:	Built-in
File System:	NTFS
Video:	Compaq Qvision
Resolution:	1024 x 768 x 256 colors
Monitor:	17" DEC Monitor

MIPS R4400-200 System

System Vendor:	NEC Technologies
System/Model:	NEC RISCstation
Processor:	MIPS R4400SC
Speed:	200 MHz
Primary Cache:	I-16K/D-16K
Secondary Cache:	1Mb
Memory:	32Mb
Bus:	EISA
Disk Controller:	Integrated SCSI Controller
Disk:	500Mb
Drive Type:	Maxtor LXT 535SY
File System:	FAT/NTFS
CD-ROM:	Built-in
Network Adapter:	Built-in
Video:	Frame Buffer G364
Resolution:	1280 x 1024 x 256 colors
Monitor:	19" Monitor

Appendix - C

Software Vendors Contact Information:

Texim Project - Project management software

Company: Welcom Software Technology Corporation
Address: 15995 N. Barkers Landing Road, Suite 275, Houston, TX 77079
Tel: (713) 558-0514
Fax: (713) 584-7828

MaxEDS - PCB routing and placement software

Company: Massteck Ltd.
Address: PO Box 1130, 95 Russell Street, Littleton, MA 01460
Tel: (508) 486-0197
Fax: (508) 486-1084

Image-In - Image processing software

Company: CPI Inc.
Address: 1953 Landings Drive, Mtn.View, CA 94043
Tel: (415) 961-6556
Fax: (415) 961-6456

PV-Wave Advantage - Visualization package

Company: Visual Numerics, Inc.
Address: 6230 Lookout Road, Boulder, CO 80301
Tel: (303) 530-9000x433
Fax: (303) 530-9286

Hamilton C Shell - Unix style utilities and command shell

Company: Hamilton Laboratories
Address: 13 Old Farm Road, Wayland, MA 01788-3117
Tel: (508) 358-5715
Fax: (508) 358-1113

Appendix - D

MIPS Systems Providers:

Acer America Corporation
2641 Orchard Parkway
San Jose, CA 95134
Tel: (800) SEE-ACER
Fax: (408) 922-2933

DeskStation Technology
13256 West 98th Street
Lenexa, KS 66215
Tel: (800) 793-3375
Fax: (913) 599-4024

NEC Technologies, Inc.
1414 Massachusetts Avenue
Boxborough, MA 01719
Tel: (800) NEC-INFO
Fax: (508) 264-8488

NeTpower, Inc.
545 Oakmead Parkway
Sunnyvale, CA 94086
Tel: (408) 522-9999
Fax: (408) 720-8558

Shuttle Computers International Inc.
1161 Cadillac Court
Milpitas, CA 94035
Tel: (408) 945-1480
Fax: (408) 945-1481

ShaBLAMM! Computer Corporation
21040 Homestead Road Suite 201
Cupertino, CA 95014-0238
Tel: (408) 730-9696
Fax: (408) 730-4940

Siemens Nixdorf Information Systems, Inc.
15305 NE 40th Street, Suite 302
Redmond, WA 98052
Tel: (206) 867-1939
Fax: (206) 867-1939

UniMicro Systems, Inc
44382 South Grimmer Blvd.
Fremont, CA 94538
Tel: (510) 659-9010
Fax: (510) 659-8749

Appendix-E

MIPS Semiconductor Partners:

NEC Electronics, Inc.
401 Ellis Street, P.O Box 7421
Mountain View, CA 94039
Tel: (415) 960-6000
Fax: (415) 965-6131

Toshiba Corporation
1-1, Shibura 1-chrome, Minto-ku
Tokyo 105-01, Japan
Tel: (03) 3457-3423, (714) 455-2000
Fax: (03) 3457-4858

Integrated Device Technology, Inc.
3236 Scott Blvd. P.O Box 58015
Santa Clara, CA 95054
Tel: (408) 727-6116
Fax: (408) 492-8674

LSI Logic Corporation
1551 McCarthy Blvd.
Milpitas, CA 95035-7447
Tel: (408) 433-8000
Fax: (408) 433-7447

Siemens Components, Inc.
10950 North Tantau Avenue
Cupertino, CA 95014
Tel: (408) 777-4500
Fax: (408) 777-4910

NKK Corporation
LSI Division
1-1-2, Marunouchi, 14F, East
Chiyoda-Ku, Tokyo 100 Japan
Tel: 81-217-3110
Fax: 81-217-3148

Disclaimers:

The information provided in this document is subject to change without notice.

MIPS Technologies, Inc. assumes no responsibility for any errors that may appear in this performance brief.

All the applications used in the benchmark tests are either released or the latest beta versions obtained from application vendors as available at the time of this publication.

Windows NT Version 3.1(Final release) is used in all the benchmarking with CSD 001 applied (Winver - 1.528).

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MaxEDS is a trademark of Massteck Ltd.
PV-WAVE Advantage is a trademark of Visual Numerics, Inc.
Hamilton C Shell is a trademark of Hamilton Laboratories.
Image-In is a registered trademark of CPI, Inc.
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MIPS R4600 Performance Addendum

This addendum presents benchmark data for a MIPS R4600 microprocessor based system. The 32-bit application benchmark data is given first, followed by the low-level benchmark results and the configuration of the system. Note that beta Windows NT 3.5 (build 612 - debug) is used to measure the performance of this machine.

SUMMARY OF 32- BIT APPLICATION BENCHMARK TIMES (MIPS R4600-150) (Absolute and Relative)

Elapsed Total Time (seconds)

Application/System	Pentium 90	MIPS R4600-150	Alpha 200	486-66
Texim Project	98.00	76.25	88.9	184.50
MaxEDS	383.50	121.60	206.00	684.00
PV-Wave Advantage	79.17	68.70	76.5	147.00
Hamilton C Shell	104.5	64.60	82.0	211.60
Image-In	53.8	39.47	48.0	102.90

Relative to 486-66

Application/System	Pentium 90	MIPS R4600-150	Alpha 200	486-66
Texim Project	1.88	2.42	2.08	1.00
MaxEDS	1.78	5.63	3.32	1.00
PV-Wave Advantage	1.86	2.14	1.92	1.00
Hamilton C Shell	2.02	3.28	2.58	1.00
Image-In	1.91	2.61	2.14	1.00

Relative to Pentium 90

Application/System	Pentium 90	MIPS R4600-150	MIPS advantage
Texim Project	98.00	76.25	1.29
MaxEDS	383.50	121.60	3.15
PV-Wave Advantage	79.17	68.70	1.15
Hamilton C Shell	104.5	64.60	1.62
Image-In	53.8	39.47	1.36

Relative to Alpha 200

Application/System	Alpha 200	MIPS R4600-150	MIPS advantage
Texim Project	88.9	76.25	1.17
MaxEDS	206.00	121.60	1.69
PV-Wave Advantage	76.50	68.70	1.11
Hamilton C Shell	82.00	64.60	1.27
Image-In	48.00	39.47	1.22

SUMMARY OF LOW-LEVEL BENCHMARKS (MIPS R4600-150)

Byte Portable Benchmarks

	486-66	Pentium 90	MIPS R4600-150	Alpha 200
numsort	1.00	2.45	2.98	3.19
strsort	1.00	2.35	4.38	5.22
bitfield	1.00	2.37	3.61	4.05
emufloat	1.00	2.26	4.92	2.96
simplefpu	1.00	3.00	2.89	3.76
transfpu	1.00	3.09	2.59	2.06

Stanford Benchmark (Elapsed time in seconds)

	Pentium 90	MIPS R4600-150	Alpha 200	486-66
Concurrent(Multithreaded)	42.00	15.00	17.00	104.00
1 Process	43.00	15.00	17.00	104.00
2 Processes	88.00	30.00	36.00	207.00
4 Processes	172.00	79.50	96.00	417.00
8 Processes	350.00	180.00	189.00	839.00

Raytracing (Elapsed time in seconds)

	Pentium 90	MIPS R4600-150	Alpha 200
Raytracing (1 Thread)	39.1	21.5	49.8

Configuration of the MIPS R4600-150 based system

System Vendor:	ShaBlamm! Computers Inc.
System/Model:	NiTro VLB (4600) in a Gateway2000 486-66Mz machine
Processor:	R4600
Speed:	150 MHz
Primary Cache:	I-16K/D-16K
Memory:	32Mb TrueCache
Bus:	EISA / VLB
Disk Controller:	IDE/SCSI Controller
Disk:	520Mb
Drive Type:	Maxtor
File System:	FAT/NTFS
CD-ROM:	Built-in
Video:	VESA SVGA Adapter - Orchid VLB
Resolution:	1024 x 768 x 256 colors
Monitor:	17" CrystalScan Monitor