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Using NVAX Performance Monitoring Tools running SPEC benchmarks on The VAX 4000

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NOTE

CONTENTS

1 INTRODUCTION

Below are the results of the NVAX performance monitor tools run during each of the individual SPEC tests on a standard KA680 module (14ns clock, 128KB cache, 1 slip cycle on cache reads/writes), and a KA690 module (12ns, 512KB cache, 0 and 1 slip cycle data taken.) Data was also taken on a KA690 using the Kuck precompiler optimizing code for the SPEC benchmark suite.

The NVAX CPU chip contains a facility by which privileged software may obtain performance information about the dynamic behavior of the CPU. The facility is implemented with a combination of hardware and microcode, and controlled by software using privileged instructions. Two 64-bit performance counters called PMCTR0 and PMCTR1 are maintained in memory for each CPU in the system. The lower 16 bits of each counter are implemented in hardware in the CPU, and at specified points, microcode updates the quadwords in memory with the contents of the hardware counters. The performance monitoring facility may be configured by privileged software to count a number of events in the system, from which performance analysis data such as cache and TB hit rates, cycles-per-instruction, and stall frequencies may be calculated.

The SPAG performance monitoring tools make use of the NVAX performance monitoring facility created by SEG in Hudson to record requested events. Each of the separate SPEC tests were run 16 times; each time a different performance parameter was measured, each parameter measured for 5 seconds/sample. The results are recorded below.

The SPEC Benchmarking Suite is a collection of ten portable programs, which are samples of applications that perform integer and floating-point computations in a technical computing environment. Integer computation manipulates positive or negative whole numbers without fractions. Floating-point computation manipulates positive or negative real numbers including fractions. The programs are written in either FORTRAN or C. They are described before each test summary. (SPEC test descriptions adapted from "THE JOY OF SPEC's" an article by Kaivalya Dixit, written for the December 1991 SPECNewsletter, and "VAX Systems Performance Summary Featuring VAX 4000 Model 300 Systems", Digital Equipment Corp. July 1990.)

2 PERFORMANCE PARAMETERS

Below is a description of the performance parameters measured during the SPECmark tests.

Box	PMCTR0 Input	PMCTR1 Input	Description; use test_result name
Ibox	VIC access	VIC hit	VIC hits compared to total VIC accesses; VIC hit ratio {specmark_name}_vic.npm
Ebox	Cycles	S3 Stall	S3 stalls (source queue, MD, Wn, Fbox scoreboard hit, Fbox input) compared to total cycles; S3 stalls per unit time {specmark_name}_S3_stall.npm
Ebox	Cycles	Instruction retire	Ebox and Fbox instructions retired compared to total cycles; CPI {specmark_name}_cpi.npm. Invert %age and multiply by 100 for CPI
Ebox	Cycles	Total stall	Total Ebox stalls compared to total cycles; Stalls per unit time {specmark_name}_total_stall.npm
Ebox	Total stall	S3 stall	S3 stalls compared to total stalls; S3 stalls as a %age of all stalls {specmark_name}_s3_stall_per.npm
Ebox	S5 µword event	S5 µword event	Number of times a µintstruction whose MISC field contained INCR_PERF.COUNT reached S5. By using the patchable control store, one may count µword events by setting the MISC field of selected µwords to this value. If event is selected, writing to the PMFCNT processor register will increment the counters via the MISC field decode; number of context switches {specmark_name}_s5_microword_per.npm
Mbox	P0/P1 I-stream TB accesses	P0/P1 I-stream TB hits	TB hits for P0 and P1 I-stream references compared to total TB accesses for P0 and P1 I-stream references; P0/P1 I-stream TB hit ratio {specmark_name}_p0_p1_i_tb.npm

Mbox	P0/P1 D-stream TB accesses	P0/P1 D-stream TB hits	TB hits for P0 and P1 D-stream references compared to total TB accesses for P0 and P1 D-stream references; P0/P1 D-stream TB hit ratio {specmark_name}_p0_p1_d_tb.npm
Mbox	S0 I-stream TB accesses	S0 I-stream TB hits	TB hits for S0 I-stream references compared to total TB accesses for S0 I-stream references; S0 I-stream TB hit ratio {specmark_name}_s0_i_tb.npm
Mbox	S0 D-stream TB accesses	S0 D-stream TB hits	TB hits for S0 D-stream references compared to total TB accesses for S0 D-stream references; S0 D-stream TB hit ratio {specmark_name}_s0_d_tb.npm
Mbox	I-stream PCache accesses	I-stream PCache hits	PCache hits for I-stream references compared to total PCache references; I-stream PCache hit ratio {specmark_name}_i_pcache.npm
Mbox	D-stream PCache accesses	D-stream PCache hits	PCache hits for D-stream references compared to total PCache references; D-stream PCache hit ratio {specmark_name}_d_pcache.npm
Cbox	BCache CPU accesses	BCache hits	BCache CPU hits compared to total BCache references; BCache hit ratio {specmark_name}_all_bcache.npm
Cbox	BCache CPU IREAD accesses	BCache hits	BCache CPU hits compared to IREAD BCache references; BCache IREAD hit ratio {specmark_name}_i_bcache.npm
Cbox	BCache CPU DREAD accesses	BCache hits	BCache CPU hits compared to DREAD BCache references; BCache DREAD hit ratio {specmark_name}_d_bcache.npm
Cbox	BCache CPU OREAD accesses	BCache hits	BCache CPU hits compared to OREAD BCache references; BCache OREAD hit ratio {specmark_name}_oread_pcache.npm

3 RUNNING THE TOOLS

The following is brief summary of how the performance monitoring tools are run with the SPEC benchmarks. The tools and benchmarks are run from either hard disk or memory (RAM) disk.

First, the batch queue and some logicals for running SPECmarks are set up. Then the performance monitor logicals are defined, and the pass 1 NVAX is patched. The version of the tools used required pass 1 NVAX. Next, the RAM disk is set up if the performance tools are run from memory instead of disk. The RAM disk is initialized, contents of the hard disk are backed up to the memory disk, and the default directory is changed to the RAM disk. A command file initializes the performance monitoring environment and then runs each of the SPEC benchmarks once for each performance parameter. The benchmarks are run consecutively. Each parameter for each benchmark is run for 7 seconds and sampled for 5 seconds. After the sample is taken, the subprocess that is used to run the benchmark is stopped.

4 DATA ANALYSIS

Some caveats about the data:

1. Given that the sample rates are small compared to the length of most of the benchmarks, it is difficult to know if the monitoring occurs during steady state benchmark operation. Full-length data is provided for KA690 testing.

2. There may be differences between running the benchmarks from hard disk and from RAM disk, as far as what is left in the cache between consecutive runs. Most likely the benchmark will be reloaded from disk and thus will not be in the cache. If the benchmark is on RAM disk, then every load will start with a 'hot' cache.

3. Data for each benchmark from parameter to parameter will not be completely consistent since each parameter was sampled on separate runs.

4. There are some anomalies to the data; these are noted. We are in the process of trying to explain them. For example, we would expect Kuck data to be more consistent with the RAMdisk results, and in fact better because of the cache blocking. This doesn't appear to be the case throughout all the tests.

5. Results for longer tests (MATRIX, NASKER, SPICE, TOMCATV, XLISP) would be closer to valid for the full-length cases.

5 GENERAL EXPECTATIONS FROM SPEEDUPS

- KA680 -> KA690: most tests should show significant improvement due to:
  - faster BCache: fewer cache slips should improve CPI
  - larger cache: should improve miss rates for data intensive tests
- 1 slip -> No slips: cuts down on cache access times, improves CPI for BCache intensive tests
- RAMdisk: reduces I/O wait time for QIOs, decreases CPI for tests with frequent disk accesses.
- Kuck: optimizes cache blocking. Should improve BCache, PCache data miss rates on tests (EQNTOTT, TOMCATV, MATRIX, NASKER, SPICE) with regular cache accesses.

6 SPECMARK SUMMARY

This summary is a comparison of SPEC results for each test on standard KA680 and KA690, for SPEC benchmarks Release 1 and with Kuck Associates Preprocessor (KAP).

	KA680			KA690			%Improvement	
	REL.1	KAP	%gain	REL.1	KAP	%gain	REL.1	KAP
DODUC	28.0	31.5	12.6%	37.2	39.1	5.1%	32.9%	24.0%
EQNTOTT	20.8	25.6	23.4%	26.4	32.9	24.7%	27.2%	40.8%
ESPRESSO	21.5	22.1	2.5%	27.2	27.6	1.3%	26.3%	24.8%
FPPP	37.0	38.7	4.6%	46.5	50.5	8.7%	25.7%	30.5%
GCC	22.9	23.3	1.7%	32.4	32.9	1.7%	41.5%	41.2%
MATRIX	19.2	95.8	399.0%	29.2	118.4	305.5%	52.1%	23.6%
NASKER	18.0	25.5	42.2%	28.3	50.8	79.8%	57.2%	99.2%
SPICE	17.1	18.3	6.5%	24.8	26.6	7.4%	45.0%	45.4%
TOMCATV	31.6	36.6	15.6%	40.0	45.2	13.1%	26.6%	23.5%
XLISP	24.2	26.4	9.2%	30.5	32.1	5.4%	26.0%	21.6%

7 SUMMARIZED DATA

7.1 DODUC:

015.doduc is a Monte Carlo simulation of the time evolution of a thermo-hydraulical model ("hydrocode") for a nuclear reactor's component. It is an intensive double-precision floating point test. This large kernel represents ECAD and high-energy physics applications. It is a non-vectorizable FORTRAN benchmark. The kernel executes an abundance of short branches, loops and code spread over many subroutines. Tests FORTRAN compiler, machine speed, and cache memory effectiveness.

Results: RAM disk helped PCache Istream, and the larger BCache on the KA690. KAP improves VIC miss rate.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	7.86 CPI	7.84 CPI	6.87 CPI	7.27 CPI
VIC	7.70% (1,169,585)	9.60% (1,280,603)	5.05% (1,020,383)	6.98% (1,290,623)
I_PCACHE	71.36% (1,463,390)	61.30% (1,156,802)	49.86% (764,457)	69.43% (1,610,650)
D_PCACHE	4.53% (635,706)	4.73% (674,362)	4.14% (770,963)	4.26% (780,520)
I_BCACHE	9.98% (63,242)	15.60% (96.579)	1.48% (9,044)	3.62% (24,985)
D_BCACHE	7.27% (38,285)	15.86% (94,345)	2.93% (18,032)	11.63% (68,831)
All BCACHE	6.02% (188,088)	6.76% (237,750)	2.98% (119,790)	2.12% (83,552)
P0_P1_I_TB	0.21% (2,124)	0.31% (1,951)	3.77% (2,142)	0.24% (2,327)
P0_P1_D_TB	0.17% (6,160)	0.28% (5,968)	0.16% (6,694)	0.16% (6,782)
S0_I_TB	0.82% (9,217)	0.82% (10,719)	0.85% (12,833)	0.84% (12,401)
S0_D_TB	0.16% (17,810)	0.16% (19,360)	0.16% (23,464)	0.16% (22,852)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	6.87 CPI	6.81 CPI	7.52 CPI	6.9 CPI
VIC	5.05% (1,020,383)	5.40% (1,055,017)	1.37% (393,154)	9.4% (1.03e6)
I_PCACHE	49.86% (764,457)	40.51% (644,449)	80.55% (458,374)	42.4% (5.45e5)
D_PCACHE	4.14% (770,963)	4.28% (821,804)	2.25% (324,944)	5.1% (6.85e5)
I_BCACHE	1.48% (9,044)	0.81% (5,904)	9.92% (31,051)	7.9% (4.44e4)
D_BCACHE	2.93% (18,032)	1.12% (7,650)	9.23% (26,106)	1.8% (9.34e3)
All BCACHE	2.98% (119,790)	0.93% (37,671)	5.90% (69,482)	1.2% (4.58e4)
P0_P1_I_TB	3.77% (2,142)	5.08% (2,601)	5.29% (28,557)	4.9% (7.50e2)
P0_P1_D_TB	0.16% (6,694)	0.18% (6,884)	0.53% (69,886)	0.8% (4.22e3)
S0_I_TB	0.85% (12,833)	0.86% (13,334)	4.57% (8,905)	0.9% (1.10e4)
S0_D_TB	0.16% (23,464)	0.16% (24,305)	2.17% (16,515)	0.2% (1.98e4)

7.2 EQNTOTT:

023.eqntott is a CPU-intensive integer benchmark written in C. Translates a boolean equations into a truth table through heavy usage of the Qsort (quick sort) utility.

Results: RAM disk increases BCache activity. KAP increases PCache Istream activity.

Anomalies: CPI for RAMdisk goes way down.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	7.51 CPI	3.90 CPI	7.51 CPI	7.51 CPI
VIC	0.02% (4,635)	0.91% (230,366)	0.02% (6,322)	0.02% (5,984)
I_PCACHE	92.92% (3,674,408)	90.48% (911,256)	94.75% (56,806)	99.75% (1,081,830)
D_PCACHE	0.01% (1,662)	2.83% (354,537)	0.01% (2,043)	0.02% (2,374)
I_BCACHE	22.13% (321)	15.05% (12,157)	17.15% (299)	7.49% (77)
D_BCACHE	27.97% (451)	41.26% (145,917)	8.92% (160)	11.73% (220)
All BCACHE	15.07% (1,243)	12.04% (201,786)	7.80% (522)	9.60% (933)
P0_P1_I_TB	0.01% (289)	0.74% (7,158)	0.56% (236)	0.03% (281)
P0_P1_D_TB	0.00% (472)	0.46% (18,723)	0.00% (507)	0.00% (357)
S0_I_TB	8.16% (6)	1.41% (2,308)	9.12% (7)	6.80% (21)
S0_D_TB	2.43% (55)	0.61% (50,789)	2.51% (60)	3.97% (27)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.51 CPI	3.85 CPI	7.53 CPI	7.5 CPI
VIC	0.02% (6,322)	0.55% (172,893)	1.63% (461,462)	0.0% (3.37e3)
I_PCACHE	94.75% (56,806)	57.48% (140,580)	80.34% (517,437)	93.5% (3.07e4)
D_PCACHE	0.01% (2,043)	2.37% (363,783)	2.36% (340,270)	0.0% (1.56e3)
I_BCACHE	17.15% (299)	8.12% (5,824)	10.09% (29,230)	11.1% (1.10e2)
D_BCACHE	8.92% (160)	16.51% (59,895)	8.06% (25,458)	8.0% (1.02e2)
All BCACHE	7.80% (522)	5.45% (95,076)	5.05% (61,708)	5.3% (2.75e2)
P0_P1_I_TB	0.56% (236)	2.95% (6,688)	5.99% (27,499)	0.3% (1.45e2)
P0_P1_D_TB	0.00% (507)	0.27% (16,935)	0.49% (65,760)	0.0% (3.40e2)
S0_I_TB	9.12% (7)	1.74% (2,947)	4.53% (9,224)	6.6% (9.67e0)
S0_D_TB	2.51% (60)	0.63% (56,632)	2.09% (16,996)	2.9% (2.92e1)

7.3 ESPRESSO:

008.espresso is an integer intensive benchmark written in C. It performs heuristic boolean function minimization as part of the process of generating and optimizing Programmable Logic Arrays. Provides information on system performance for simulation and routing algorithms. It characterizes work done in the EDA market and Logic-Simulation and Routing-Algorithm applications.

Results: Larger BCache improves Istream performance.

Anomalies: KAP CPI inconsistent.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	4.98 CPI	4.18 CPI	4.32 CPI	4.39 CPI
VIC	1.64% (393,072)	1.63% (367,085)	1.03% (290,556)	1.23% (341,102)
I_PCACHE	89.12% (1,364,784)	84.24% (936,856)	63.05% (366,136)	89.23% (1,504,534)
D_PCACHE	2.88% (407,532)	3.41% (495,177)	2.79% (482,498)	2.68% (456,189)
I_BCACHE	13.23% (12,684)	8.36% (7,755)	2.63% (2,345)	3.41% (3,366)
D_BCACHE	8.70% (35,140)	10.53% (49,417)	0.92% (4,369)	3.31% (13,405)
All BCACHE	2.25% (60,277)	2.82% (100,689)	0.24% (8,500)	0.48% (16,750)
P0_P1_I_TB	0.34% (2,733)	0.60% (2,416)	5.69% (2,879)	0.30% (2,817)
P0_P1_D_TB	0.12% (4,065)	0.25% (3,745)	0.10% (3,989)	0.12% (4,690)
S0_I_TB	0.06% (560)	0.09% (586)	0.10% (659)	0.07% (596)
S0_D_TB	0.02% (2,265)	0.03% (3,561)	0.04% (5,847)	0.03% (3,450)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	4.32 CPI	4.30 CPI	7.55 CPI	5.0 CPI
VIC	1.03% (290,556)	1.33% (368,776)	1.81% (509,484)	3.0% (6.10e5)
I_PCACHE	63.05% (366,136)	65.30% (409,476)	83.69% (642,298)	58.6% (3.85e5)
D_PCACHE	2.79% (482,498)	3.47% (601,706)	2.37% (341,679)	3.5% (3.84e5)
I_BCACHE	2.63% (2,345)	4.97% (4,592)	9.50% (29,688)	3.1% (7.42e3)
D_BCACHE	0.92% (4,369)	4.71% (24,850)	8.46% (24,537)	4.3% (1.50e4)
All BCACHE	0.24% (8,500)	1.05% (39,513)	5.54% (64,147)	1.6% (2.89e4)
P0_P1_I_TB	5.69% (2,879)	4.56% (2,828)	5.43% (27,859)	11.7% (2.77e4)
P0_P1_D_TB	0.10% (3,989)	0.16% (4,946)	0.50% (67,695)	0.4% (2.09e4)
S0_I_TB	0.10% (659)	0.12% (861)	4.54% (9,157)	0.9% (4.30e3)
S0_D_TB	0.04% (5,847)	0.08% (11,550)	2.15% (16,716)	0.3% (1.49e4)

7.4 FPPP:

042.fpppp is a double-precision, floating-point FORTRAN benchmark with a large basic block. It is a quantum chemistry benchmark that measures performance on one style of computation (two electron integral derivative) which occurs in the Gaussian series of programs.

Results: Larger BCache, KAP improves VIC and Istream cache hit rates. VIC miss rate go up, BCache miss rates go down for full test case.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	9.06 CPI	9.38 CPI	7.58 CPI	8.34 CPI
VIC	21.17% (2,663,667)	30.57% (3,223,383)	12.72% (2,418,509)	21.36% (3,368,939)
I_PCACHE	88.57% (2,302,432)	84.67% (1,988,211)	82.17% (2,235,685)	88.41% (2,863,524)
D_PCACHE	4.33% (785,132)	5.26% (1,004,100)	5.74% (1,574,747)	4.86% (1,233,884)
I_BCACHE	18.16% (265,685)	18.09% (268,150)	2.03% (49,132)	4.93% (104,202)
D_BCACHE	23.74% (189,336)	7.14% (84,274)	19.30% (217,096)	2.46% (31,848)
All BCACHE	12.86% (448,594)	9.76% (415,874)	1.43% (84,510)	0.25% (13,971)
P0_P1_I_TB	0.30% (9,541)	0.38% (1,816)	7.11% (2,211)	0.26% (2,166)
P0_P1_D_TB	0.23% (2,038)	0.59% (10,415)	0.33% (11,960)	0.34% (11,058)
S0_I_TB	1.87% (29,316)	1.95% (36,547)	1.97% (52,377)	2.02% (50,141)
S0_D_TB	0.23% (35,562)	0.23% (31,643)	0.22% (53,493)	0.22% (46,117)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.58 CPI	7.62 CPI	7.55 CPI	8.1 CPI
VIC	12.72% (2,418,509)	15.04% (2,612,192)	2.01% (556,405)	23.2% (2.33e6)
I_PCACHE	82.17% (2,235,685)	84.24% (2,136,887)	80.03% (452,216)	88.9% (1.99e6)
D_PCACHE	5.74% (1,574,747)	5.00% (1,381,170)	2.37% (342,323)	5.0% (1.02e6)
I_BCACHE	2.03% (49,132)	1.35% (30,973)	10.03% (27,905)	4.7% (9.29e4)
D_BCACHE	19.30% (217,096)	2.41% (31,685)	8.30% (23,737)	2.9% (2.91e4)
All BCACHE	1.43% (84,510)	13.31% (593,501)	5.91% (68,610)	0.3% (1.55e4)
P0_P1_I_TB	7.11% (2,211)	5.25% (2,137)	7.28% (28,996)	5.3% (6.71e2)
P0_P1_D_TB	0.33% (11,960)	0.37% (12,402)	0.51% (68,601)	1.3% (8.87e3)
S0_I_TB	1.97% (52,377)	1.96% (52,022)	4.57% (8,857)	2.1% (4.79e4)
S0_D_TB	0.22% (53,493)	0.22% (53,251)	2.13% (16,709)	0.2% (4.11e4)

7.5 GCC:

001.gcc is a CPU intensive, mainly integer computation benchmark written in C. It measures the time the GNU C compiler version 1.35 takes to convert 19 preprocessed source files into Sun-3 assembly language output. This benchmark spends about 10% of its total execution time performing disk I/O. GCC shows the highest cache misses amongst all four integer benchmarks.

Results: RAM disk, larger BCache improves BCache hit rates. BCache rates also improve with full test.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	7.68 CPI	7.68 CPI	7.54 CPI	7.58 CPI
VIC	0.65% (165,474)	12.33% (1,996,551)	0.40% (120,112)	0.53% (161,172)
I_PCACHE	98.72% (2,688,201)	69.54% (1,656,133)	86.11% (249,097)	98.72% (2,989,582)
D_PCACHE	0.52% (67,362)	6.29% (624,659)	0.45% (68,408)	0.46% (69,659)
I_BCACHE	26.51% (17,547)	17.73% (119,635)	11.58% (7,472)	11.53% (7,556)
D_BCACHE	25.63% (16,364)	25.13% (137,707)	8.99% (5,370)	9.77% (5,602)
All BCACHE	16.37% (45,717)	8.73% (352,496)	6.49% (17,997)	6.83% (19,647)
P0_P1_I_TB	0.30% (7,798)	2.30% (27,862)	4.95% (7,725)	0.25% (7,943)
P0_P1_D_TB	0.11% (14,468)	1.32% (57,537)	0.09% (13,503)	0.10% (14,495)
S0_I_TB	5.13% (1,352)	1.83% (24,569)	4.95% (1,427)	5.05% (1,415)
S0_D_TB	1.95% (3,596)	1.26% (70,834)	1.92% (3,531)	1.92% (3,152)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.54 CPI	6.59 CPI	7.56 CPI	7.0 CPI
VIC	0.40% (120,112)	8.82% (2,008,686)	1.89% (528,756)	2.7% (5.50e5)
I_PCACHE	86.11% (249,097)	50.14% (1,016,365)	80.20% (472,320)	63.2% (4.83e5)
D_PCACHE	0,45% (68,408)	5.38% (737,235)	2.27% (329,008)	1.9% (2.05e5)
I_BCACHE	11.58% (7,472)	7.94% (64,347)	9.60% (30,323)	6.4% (1.40e4)
D_BCACHE	8.99% (5,370)	10.16% (69,528)	9.10% (26,679)	6.9% (1.25e4)
All BCACHE	6.49% (17,997)	3.66% (186,608)	5.54% (66,513)	2.7% (3.72e4)
P0_P1_I_TB	4.95% (7,725)	6.63% (30,339)	6.87% (30,638)	2.5% (7.17e3)
P0_P1_D_TB	0.09% (13,503)	1.01% (62,146)	0.53% (70,598)	0.2% (1.56e4)
S0_I_TB	4.95% (1,427)	1.96% (34,092)	4.58% (8,311)	1.9% (2.05e5)
S0_D_TB	1.92% (3,531)	1.28% (97,868)	2.03% (17,823)	1.3% (2.79e4)

7.6 MATRIX:

030.matrix300 is a double-precision floating point intensive kernel that characterizes scientific applications. It is vectorizable and even though the code is highly localized, data accesses can cause significant cache misses. Recent development in smart preprocessors have significantly reduced both memory traffic and cache misses.

Results: Larger BCache greatly improves hit rates, KAP increases PCache, BCache activity.

Anomalies: Full test case shows increased miss rates, CPI.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	7.74 CPI	7.84 CPI	7.01 CPI	7.25 CPI
VIC	0.63% (86,741)	0.80% (97,247)	0.41% (70,855)	0.54% (95,745)
I_PCACHE	94.87% (833,255)	93.43% (518,987)	65.63% (85,514)	94.88% (863,133)
D_PCACHE	4.47% (733,711)	4.76% (804,516)	4.39% (935,620)	4.38% (907,117)
I_BCACHE	31.46% (7,800)	25.83% (5,531)	12.74% (2,544)	10.02% (3,290)
D_BCACHE	70.47% (512,448)	70.65% (567,486)	51.97% (481,940)	53.60% (472,619)
All BCACHE	17.82% (531,554)	17.96% (593,710)	13.03% (502,445)	13.15% (492,450)
P0_P1_I_TB	0.28% (2,289)	0.46% (1,967)	3.47% (2,339)	0.27% (2,413)
P0_P1_D_TB	0.34% (9,527)	0.59% (9,585)	0.30% (9,785)	0.24% (10,171)
S0_I_TB	2.37% (760)	2.22% (773)	2.17% (863)	2.28% (939)
S0_D_TB	0.25% (33,372)	0.25% (36,275)	0.25% (44,890)	0.25% (43,131)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.01 CPI	6.99 CPI	7.56 CPI	10.9 CPI
VIC	0.41% (70,855)	0.44% (74,200)	1.77% (498,417)	0.2% (1.52e4)
I_PCACHE	65.63% (85,514)	61.45% (73,847)	81.05% (475,949)	87.3% (2.22e4)
D_PCACHE	4.39% (935,620)	4.37% (933,404)	2.27% (328,757)	21.8% (2.50e6)
I_BCACHE	12.74% (2,544)	14.71% (2,850)	9.78% (30,742)	21.1% (9.67e2)
D_BCACHE	51.97% (481,940)	51.49% (491,799)	8.83% (27,650)	13.5% (3.36e5)
All BCACHE	13.03% (502,445)	12.88% (504,689)	5.21% (61,504)	8.6% (3.43e5)
P0_P1_I_TB	3.47% (2,339)	3.14% (2,234)	6.25% (31,487)	6.5% (5.52e2)
P0_P1_D_TB	0.30% (9,785)	0.32% (9,844)	0.48% (64,897)	4.7% (8.05e4)
S0_I_TB	2.17% (863)	1.95% (852)	4.58% (8,731)	18.8% (3.98e3)
S0_D_TB	0.25% (44,890)	0.25% (45,390)	1.99% (18,237)	14.4% (1.40e6)

7.7 NASKER:

020.nasa7 is an intensive double-precision floating-point synthetic benchmark that represents scientific computations performed in many of NASA's scientific programs. It is a collection of seven floating-point intensive kernels written in FORTRAN . Each program generates its own input data, performs the kernel, and compares the result against an expected result. The data accesses cause a high cache miss rate.

Results: KAP improves PCache hit rates, larger BCache improves BCache hit rates.

Anomalies: Data cache miss rates, CPI increase with full test.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	9.37 CPI	9.51 CPI	7.95 CPI	8.16 CPI
VIC	0.67% (74,721)	0.71% (65,717)	0.44% (64,448)	0.53% (74,274)
I_PCACHE	96.82% (1,183,049)	96.11% (883,208)	93.78% (607,378)	97.01% (1,291,650)
D_PCACHE	6.91% (1,252,049)	7.78% (1,442,965)	6.80% (1,677,188)	5.77% (1,363,564)
I_BCACHE	10.64% (4,086)	6.81% (4,258)	0.55% (2,665)	4.04% (1,832)
D_BCACHE	22.34% (228,840)	22.22% (245,231)	6.34% (86,675)	7.37% (93,576)
All BCACHE	17.76% (348,736)	17.19% (376,675)	5.50% (159,043)	5.98% (148,393)
P0_P1_I_TB	0.28% (1,908)	0.33% (1,595)	2.32% (2,022)	0.28% (2,205)
P0_P1_D_TB	0.18% (4,866)	0.30% (4,666)	0.16% (4,977)	0.17% (5,521)
S0_I_TB	0.06% (257)	0.05% (229)	0.05% (293)	0.07% (377)
S0_D_TB	0.02% (3,493)	0.02% (3,721)	0.02% (4,662)	0.02% (4,755)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.95 CPI	7.84 CPI	7.54 CPI	12.2 CPI
VIC	0.44% (64,448)	0.45% (63,274)	1.78% (499,707)	12.9% (1.31e6)
I_PCACHE	93.78% (607,378)	94.05% (643,279)	80.93% (473,901)	74.1% (2.14e5)
D_PCACHE	6.80% (1,677,188)	6.19% (1,523,430)	2.23% (322,916)	19.8% (5.54e6)
I_BCACHE	0.55% (2,665)	0.37% (1,867)	9.30% (27,683)	2.0% (2.81e3)
D_BCACHE	6.34% (86,675)	6.99% (85,087)	8.89% (27,543)	22.5% (8.85e5)
All BCACHE	5.50% (159,043)	5.59% (162,257)	5.45% (67,433)	12.9% (1.31e6)
P0_P1_I_TB	2.32% (2,022)	3.68% (1,874)	6.57% (30,848)	10.5% (1.11e3)
P0_P1_D_TB	0.16% (4,977)	0.17% (5,114)	0.53% (70,172)	6.2% (8.84e4)
S0_I_TB	0.05% (293)	0.04% (268)	4.59% (8,142)	1.9% (4.92e3)
S0_D_TB	0.02% (4,662)	0.02% (4,704)	2.09% (17,178)	4.5% (1.20e6)

7.8 SPICE:

013.spice2g6 is an analog circuit simulation tool. It is written mostly in FORTRAN. It is a real application used in EDA markets. It is a CPU intensive program (integer and double-precision floating point) for the current input circuit model. It stresses the data cache.

Results: Faster processor, larger BCache improve BCache, PCache performance.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	7.60 CPI	7.62 CPI	7.55 CPI	7.55 CPI
VIC	0.45% (116,239)	0.44% (115,646)	0.28% (84,776)	0.35% (108,267)
I_PCACHE	99.06% (3,811,606)	99.07% (3,950,606)	65.76% (75,462)	99.10% (4,088,744)
D_PCACHE	0.27% (35,247)	0.33% (43,776)	0.24% (36,755)	0.22% (34,696)
I_BCACHE	16.49% (7,402)	17.82% (8,383)	6.68% (2,556)	6.37% (2,714)
D_BCACHE	25.45% (8,795)	24.82% (9,226)	7.01% (2,280)	7.36% (2,343)
All BCACHE	9.68% (21,186)	8.79% (22,048)	3.47% (7,518)	4.02% (8,318)
P0_P1_I_TB	0.10% (4,055)	0.11% (4,179)	2.51% (4,011)	0.10% (4,169)
P0_P1_D_TB	0.04% (4,850)	0.03% (4,453)	0.03% (4,529)	0.03% (4,508)
S0_I_TB	14.04% (3,565)	14.45% (4,507)	14.85% (3,694)	14.20% (3,634)
S0_D_TB	1.17% (2,949)	1.14% (3,438)	1.16% (3,041)	1.18% (3,133)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	7.55 CPI	7.54 CPI	7.56 CPI	7.3 CPI
VIC	0.28% (84,776)	0.28% (84,865)	1.88% (527,442)	2.4% (2.49e6)
I_PCACHE	65.76% (75,462)	56.39% (54,791)	81.01% (494,439)	58.5% (1.82e6)
D_PCACHE	0.24% (36,755)	0.23% (35,535)	2.11% (307,284)	16.9% (1.94e7)
I_BCACHE	6.68% (2,556)	7.26% (2,996)	9.61% (28,105)	1.7% (2.54e4)
D_BCACHE	7.01% (2,280)	11.44% (3,932)	8.67% (25,446)	14.3% (2.66e6)
All BCACHE	3.47% (7,518)	7.71% (17,475)	5.37% (66,541)	9.4% (2.96e6)
P0_P1_I_TB	2.51% (4,011)	4.66% (4,223)	6.95% (31,011)	9.8% (4.80e3)
P0_P1_D_TB	0.03% (4,529)	0.03% (4,638)	0.51% (68,360)	9.0% (8.46e5)
S0_I_TB	14.85% (3,694)	14.79% (3,979)	4.53% (8,932)	2.3% (7.10e4)
S0_D_TB	1.16% (3,041)	1.15% (3,075)	2.05% (17,716)	5.6% (5.86e6)

7.9 TOMCATV:

047.tomcatv is a highly vectorizable mesh generation program. It is floating point (double-precision) intensive and causes high data cache misses. This benchmark has both scalar and vector operations and a mix of integer and floating point operations.

Results: data intensive test is BCache sensitive, KAP and larger BCache improve performance.

Anomalies: Istream cache miss rates, CPI decrease with full test.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	8.95 CPI	9.07 CPI	8.50 CPI	8.46 CPI
VIC	1.69% (255,578)	1.97% (268,934)	1.07% (200,695)	1.28% (238,287)
I_PCACHE	94.46% (1,233,304)	92.89% (908,792)	67.67% (147,226)	94.52% (1,308,291)
D_PCACHE	4.24% (742,336)	4.49% (795,311)	3.77% (825,540)	3.93% (813,156)
I_BCACHE	10.24% (7,141)	11.40% (6,811)	8.73% (3,601)	8.18% (4,289)
D_BCACHE	48.87% (336,555)	48.60% (375,292)	40.78% (335,024)	40.44% (328,110)
All BCACHE	17.45% (496,209)	17.57% (549,614)	14.57% (505,023)	14.62% (449,173)
P0_P1_I_TB	0.32% (3,564)	0.35% (3,205)	2.89% (3,264)	0.33% (3,930)
P0_P1_D_TB	0.29% (13,519)	0.40% (13,820)	0.24% (13,123)	0.22% (14,150)
S0_I_TB	0.90% (1,606)	0.88% (1,775)	1.08% (1,498)	0.73% (1,678)
S0_D_TB	0.16% (19,909)	0.15% (21,710)	0.14% (23,565)	0.15% (23,414)

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	8.50 CPI	8.26 CPI	7.55 CPI	8.5 CPI
VIC	1.07% (200,695)	1.02% (188,511)	1.80% (505,577)	1.0% (1.10e5)
I_PCACHE	67.67% (147,226)	62.66% (132,157)	84.73% (652,982)	92.8% (1.04e5)
D_PCACHE	3.77% (825,540)	3.85% (839,218)	2.13% (308,777)	4.6% (7.80e5)
I_BCACHE	8.73% (3,601)	9.66% (3,359)	9.35% (27,549)	28.0% (1.93e3)
D_BCACHE	40.78% (335,024)	40.47% (336,942)	9.01% (27,602)	43.8% (3.40e5)
All BCACHE	14.57% (505,023)	14.46% (504,558)	5.43% (68,093)	15.6% (4.84e5)
P0_P1_I_TB	2.89% (3,264)	2.91% (3,263)	6.42% (29,934)	3.4% (6.72e2)
P0_P1_D_TB	0.24% (13,123)	0.24% (12,981)	0.53% (70,600)	0.2% (3.83e3)
S0_I_TB	1.08% (1,498)	1.13% (1,532)	4.60% (7,883)	0.8% (1.04e3)
S0_D_TB	0.14% (23,565)	0.15% (23,921)	1.99% (18,409)	0.1% (2.18e4)

7.10 XLISP:

022.li is a CPU-intensive integer benchmark. It is a LISP interpreter implemented in C that measures the time li takes to solve the 8-queens problem. The backtracking algorithm is recursive and represents object oriented programming applications. The principal computation is searching for an item in a linked list.

Results: Faster processor shows improved Istream hit rates.

	KA680 harddisk %misses (miss/sec)	KA680 RAMdisk %misses (miss/sec)	KA690(0slip) harddisk %misses (miss/sec)	KA690(1slip) harddisk %misses (miss/sec)
CPI	5.56 CPI	5.39 CPI	5.17 CPI	5.33 CPI
VIC	6.65% (1,299,886)	8.15% (1,514,006)	6.27% (1,535,428)	6.14% (1,483.391)
I_PCACHE	62.44% (1,380,913)	48.29% (989,392)	28.11% (499,303)	59.86% (1,457,726)
D_PCACHE	3.80% (552,546)	3.97% (593,063)	3.50% (643,943)	2.97% (532,895)
I_BCACHE	5.79% (26,214)	6.99% (26,121)	1.32% (6,134)	2.09% (7,104)
D_BCACHE	15.68% (64,840)	9.11% (45,840)	4.94% (24,882)	13.67% (69,469)
All BCACHE	1.93% (104,753)	2.06% (128,899)	0.64% (43,223)	0.43% (28,749)
P0_P1_I_TB	1.00% (9,193)	1.95% (10,972)	5.33% (11,855)	1.23% (12,439)
P0_P1_D_TB	0.28% (10,365)	0.49% (11,043)	0.28% (12,934)	0.28% (12,796)
S0_I_TB	0.45% (5,491)	0.43% (6,344)	0.42% (6,984)	0.44% (6,236)
S0_D_TB	0.41% (44,955)	0.41% (53,536)	0.41% (53,711)	0.41% (55,106)

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SUMMARIZED DATA

	KA690(0slip) harddisk %misses (miss/sec)	KA690(0slip) RAMdisk %misses (miss/sec)	KA690(0slip) RAMdisk KAP %misses (miss/sec)	KA690(0slip) hdisk full %misses (miss/sec)
CPI	5.17 CPI	5.06 CPI	7.53 CPI	4.9 CPI
VIC	6.27% (1,535,428)	6.06% (1,467,679)	2.01% (557,829)	7.4% (1.21e6)
I_PCACHE	28.11% (499,303)	31.60% (531,626)	80.81% (491,060)	39.4% (5.95e5)
D_PCACHE	3.50% (643,943)	2.89% (538,500)	2.27% (327,968)	3.5% (4.84e5)
I_BCACHE	1.32% (6,134)	1.61% (7,854)	8.93% (23,943)	2.4% (7.97e3)
D_BCACHE	4.94% (24,882)	1.86% (8,646)	10.25% (31,483)	2.2% (1.17e4)
All BCACHE	0.64% (43,223)	0.61% (42,556)	5.19% (62,299)	0.2% (1.38e4)
P0_P1_I_TB	5.33% (11,855)	5.71% (12,966)	6.53% (30,784)	6.5% (1.03e4)
P0_P1_D_TB	0.28% (12,934)	0.33% (13,908)	0.50% (66,891)	0.9% (1.01e4)
S0_I_TB	0.42% (6,984)	0.43% (7,409)	4.51% (8,993)	0.4% (6.61e3)
S0_D_TB	0.41% (53,711)	0.41% (58,459)	2.12% (16,646)	0.4% (5.07e4)

8 DATA FROM TEST RUNS

Finally, the data itself. Right now I have data for hard disk and RAM disk for the pre-Kuck nonoptimized SPEC benchmarks for the KA680, and pre-Kuck nonoptimized SPEC benchmarks and the Kuck optimized benchmarks for the KA690. I have full benchmark sample tests for KA690 harddisk case only. Also discussed were trying to run the performance monitoring tools during TPS runs, and long DECSIM runs. (Data below is 132 characters wide.)

DODUC: KA680 hard disk	PMCTR0 (total events)	PMCTR1 (total hits)	PMCTR0 - PMCTR1 (total misses)
doduc_all_bcache.npm	15628158(3125631.6/s)	14687719(2937543.8/s 93.98%)	940439(188087.8/s 6.02%)
doduc_cpi.npm	501523543(100304710.4/s)	63843419(12768684.0/s 12.73%)	437680124(87536025.6/s 87.27%)
doduc_d_bcache.npm	2632526(526505.2/s)	2441099(488219.8/s 92.73%)	191427(38285.4/s 7.27%)
doduc_d_pcache.npm	70164597(14032920.0/s)	66986069(13397213.6/s 95.47%)	3178528(635705.6/s 4.53%)
doduc_i_bcache.npm	3169106(633821.2/s)	2852894(570578.8/s 90.02%)	316212(63242.4/s 9.98%)
doduc_i_pcache.npm	10253316(2050663.2/s)	2936367(587273.4/s 28.64%)	7316949(1463389.8/s 71.36%)
doduc_oread_bcache.npm	10138484(2027696.8/s)	9806725(1961345.0/s 96.73%)	331759(66351.8/s 3.27%)
doduc_p0_p1_d_tb.npm	18016925(3603385.2/s)	17986127(3597225.6/s 99.83%)	30798(6159.6/s 0.17%)
doduc_po_p1_i_tb.npm	5153488(1030697.6/s)	5142869(1028573.8/s 99.79%)	10619(2123.8/s 0.21%)
doduc_s0_d_tb.npm	54871007(10974201.6/s)	54781955(10956391.2/s 99.84%)	89052(17810.4/s 0.16%)
doduc_s0_i_tb.npm	5636716(1127343.2/s)	5590631(1118126.2/s 99.18%)	46085(9217.0/s 0.82%)
doduc_s3_stall.npm	501386975(100277395.2/s)	228980578(45796115.2/s 45.67%)	272406397(54481280.0/s 54.33%)
doduc_s3_stall_per.npm	279292708(55858540.8/s)	239867523(47973504.0/s 85.88%)	39425185(7885036.8/s 14.12%)
doduc_s5_microword_per.npm	194(38.8/s)	194(38.8/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	501511442(100302291.2/s)	278843059(55768614.4/s 55.60%)	222668383(44533676.8/s 44.40%)
doduc_vic.npm	75898126(15179625.6/s)	70050201(14010040.0/s 92.30%)	5847925(1169585.0/s 7.70%)

DODUC: KA680 RAM disk			
doduc_all_bcache.npm	17591625(3518325.2/s)	16402876(3280575.2/s 93.24%)	1188749(237749.8/s 6.76%)
doduc_cpi.npm	501477459(100295494.4/s)	63928776(12785755.2/s 12.75%)	437548683(87509734.4/s 87.25%)
doduc_d_bcache.npm	2975180(595036.0/s)	2503453(500690.6/s 84.14%)	471727(94345.4/s 15.86%)
doduc_d_pcache.npm	71359797(14271960.0/s)	67987985(13597596.8/s 95.27%)	3371812(674362.4/s 4.73%)
doduc_i_bcache.npm	3095453(619090.6/s)	2612559(522511.8/s 84.40%)	482894(96578.8/s 15.60%)
doduc_i_pcache.npm	9436143(1887228.6/s)	3652131(730426.2/s 38.70%)	5784012(1156802.4/s 61.30%)
doduc_oread_bcache.npm	11906500(2381300.0/s)	11650057(2330011.4/s 97.85%)	256443(51288.6/s 2.15%)
doduc_p0_p1_d_tb.npm	10501013(2100202.6/s)	10471174(2094234.8/s 99.72%)	29839(5967.8/s 0.28%)
doduc_po_p1_i_tb.npm	3105883(621176.6/s)	3096128(619225.6/s 99.69%)	9755(1951.0/s 0.31%)
doduc_s0_d_tb.npm	59336562(11867312.8/s)	59239762(11847952.8/s 99.84%)	96800(19360.0/s 0.16%)
doduc_s0_i_tb.npm	6519707(1303941.4/s)	6466112(1293222.4/s 99.18%)	53595(10719.0/s 0.82%)
doduc_s3_stall.npm	501313107(100262624.0/s)	248511964(49702393.6/s 49.57%)	252801143(50560227.2/s 50.43%)
doduc_s3_stall_per.npm	288617588(57723520.0/s)	241802643(48360528.0/s 83.78%)	46814945(9362988.8/s 16.22%)
doduc_s5_microword_per.npm	203(40.6/s)	203(40.6/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	501034224(100206848.0/s)	297178361(59435673.6/s 59.31%)	203855863(40771171.2/s 40.69%)
doduc_vic.npm	66713194(13342639.2/s)	60310175(12062035.2/s 90.40%)	6403019(1280603.8/s 9.60%)

DODUC: ka690 harddisk (0slip)			
doduc_all_bcache.npm	20088895(4017779.2/s)	19489944(3897988.8/s 97.02%)	598951(119790.2/s 2.98%)
doduc_cpi.npm	584255767(116851148.8/s)	84991431(16998286.4/s 14.55%)	499264336(99852870.4/s 85.45%)
doduc_d_bcache.npm	3073731(614746.2/s)	2983570(596714.0/s 97.07%)	90161(18032.2/s 2.93%)
doduc_d_pcache.npm	93202375(18640475.2/s)	89347561(17869512.0/s 95.86%)	3854814(770962.8/s 4.14%)
doduc_i_bcache.npm	3046459(609291.8/s)	3001239(600247.8/s 98.52%)	45220(9044.0/s 1.48%)
doduc_i_pcache.npm	7665684(1533136.8/s)	3843400(768680.0/s 50.14%)	3822284(764456.8/s 49.86%)
doduc_oread_bcache.npm	13849305(2769861.0/s)	13767534(2753506.8/s 99.41%)	81771(16354.2/s 0.59%)
doduc_p0_p1_d_tb.npm	21057077(4211415.4/s)	21023608(4204721.6/s 99.84%)	33469(6693.8/s 0.16%)
doduc_po_p1_i_tb.npm	283861(56772.2/s)	273152(54630.4/s 96.23%)	10709(2141.8/s 3.77%)
doduc_s0_d_tb.npm	73614024(14722804.8/s)	73496704(14699340.8/s 99.84%)	117320(23464.0/s 0.16%)
doduc_s0_i_tb.npm	7577489(1515497.8/s)	7513324(1502664.8/s 99.15%)	64165(12833.0/s 0.85%)
doduc_s3_stall.npm	583680960(116736166.4/s)	254725079(50945014.4/s 43.64%)	328955781(65791155.2/s 56.36%)
doduc_s3_stall_per.npm	303164442(60632889.6/s)	256076415(51215283.2/s 84.47%)	47088027(9417605.6/s 15.53%)
doduc_s5_microword_per.npm	199(39.8/s)	199(39.8/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	584213437(116842688.0/s)	303486386(60697280.0/s 51.95%)	280727051(56145408.0/s 48.05%)
doduc_vic.npm	101036000(20207200.0/s)	95934083(19186816.0/s 94.95%)	5101917(1020383.4/s 5.05%)

DODUC: ka690 harddisk (1slip)			
doduc_all_bcache.npm	19744831(3948966.4/s)	19327070(3865414.0/s 97.88%)	417761(83552.2/s 2.12%)
doduc_cpi.npm	584246916(116849382.4/s)	80403273(16080654.4/s 13.76%)	503843643(100768729.6/s 86.24%)
doduc_d_bcache.npm	2959320(591864.0/s)	2615162(523032.4/s 88.37%)	344158(68831.6/s 11.63%)
doduc_d_pcache.npm	91560073(18312014.4/s)	87657473(17531494.4/s 95.74%)	3902600(780520.0/s 4.26%)
doduc_i_bcache.npm	3449979(689995.8/s)	3325056(665011.2/s 96.38%)	124923(24984.6/s 3.62%)
doduc_i_pcache.npm	11599652(2319930.4/s)	3546402(709280.4/s 30.57%)	8053250(1610650.0/s 69.43%)
doduc_oread_bcache.npm	13000185(2600037.0/s)	12922997(2584599.4/s 99.41%)	77188(15437.6/s 0.59%)
doduc_p0_p1_d_tb.npm	21041410(4208282.0/s)	21007499(4201500.0/s 99.84%)	33911(6782.2/s 0.16%)
doduc_po_p1_i_tb.npm	4829905(965981.0/s)	4818270(963654.0/s 99.76%)	11635(2327.0/s 0.24%)
doduc_s0_d_tb.npm	71356626(14271324.8/s)	71242362(14248472.0/s 99.84%)	114264(22852.8/s 0.16%)
doduc_s0_i_tb.npm	7378021(1475604.2/s)	7316016(1463203.2/s 99.16%)	62005(12401.0/s 0.84%)
doduc_s3_stall.npm	584217876(116843575.2/s)	259729733(51945945.6/s 44.46%)	324488143(64897625.6/s 55.54%)
doduc_s3_stall_per.npm	311167387(62233478.4/s)	262292458(52458492.8/s 84.29%)	48874929(9774985.6/s 15.71%)
doduc_s5_microword_per.npm	196(39.2/s)	196(39.2/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	584014883(116802982.4/s)	314475828(62895168.0/s 53.85%)	269539055(53907808.0/s 46.15%)
doduc_vic.npm	92483069(18496614.4/s)	86029953(17205990.4/s 93.02%)	6453116(1290623.2/s 6.98%)

DODUC: KA690(0slip) RAM			
doduc_all_bcache.npm	20213864(4042772.8/s)	20025509(4005102.0/s 99.07%)	188355(37671.0/s 0.93%)
doduc_cpi.npm	583675950(116735193.6/s)	85681512(17136302.4/s 14.68%)	497994438(99598886.4/s 85.32%)
doduc_d_bcache.npm	3402377(680475.4/s)	3364129(672825.8/s 98.88%)	38248(7649.6/s 1.12%)
doduc_d_pcache.npm	95910259(19182051.2/s)	91801240(18360248.0/s 95.72%)	4109019(821803.8/s 4.28%)
doduc_i_bcache.npm	3624602(724920.4/s)	3595082(719016.4/s 99.19%)	29520(5904.0/s 0.81%)
doduc_i_pcache.npm	7953652(1590730.4/s)	4731406(946281.2/s 59.49%)	3222246(644449.2/s 40.51%)
doduc_oread_bcache.npm	14096798(2819359.6/s)	13965679(2793135.8/s 99.07%)	131119(26223.8/s 0.93%)
doduc_p0_p1_d_tb.npm	18900745(3780149.2/s)	18866326(3773265.2/s 99.82%)	34419(6883.8/s 0.18%)
doduc_po_p1_i_tb.npm	256212(51242.4/s)	243206(48641.2/s 94.92%)	13006(2601.2/s 5.08%)
doduc_s0_d_tb.npm	75503531(15100705.6/s)	75382006(15076401.6/s 99.84%)	121525(24305.0/s 0.16%)
doduc_s0_i_tb.npm	7772657(1554531.4/s)	7705986(1541197.2/s 99.14%)	66671(13334.2/s 0.86%)
doduc_s3_stall.npm	583980817(116796160.0/s)	257475227(51495046.4/s 44.09%)	326505590(65301120.0/s 55.91%)
doduc_s3_stall_per.npm	310801502(62160300.8/s)	261183733(52236745.6/s 84.04%)	49617769(9923553.6/s 15.96%)
doduc_s5_microword_per.npm	210(42.0/s)	210(42.0/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	583939173(116787840.0/s)	308386000(61677203.2/s 52.81%)	275553173(55110636.8/s 47.19%)
doduc_vic.npm	97637765(19527553.6/s)	92362682(18472536.0/s 94.60%)	5275083(1055016.6/s 5.40%)

DODUC: KA690(0slip) KAP			
doduc_all_bcache.npm	5892104(1178420.8/s)	5544694(1108938.8/s 94.10%)	347410(69482.0/s 5.90%)
doduc_cpi.npm	584554189(116910835.2/s)	77664614(15532923.2/s 13.29%)	506889575(101377913.6/s 86.71%)
doduc_d_bcache.npm	1413814(282762.8/s)	1283281(256656.2/s 90.77%)	130533(26106.6/s 9.23%)
doduc_d_pcache.npm	72328203(14465640.0/s)	70703483(14140696.0/s 97.75%)	1624720(324944.0/s 2.25%)
doduc_i_bcache.npm	1564766(312953.2/s)	1409511(281902.2/s 90.08%)	155255(31051.0/s 9.92%)
doduc_i_pcache.npm	2845260(569052.0/s)	553390(110678.0/s 19.45%)	2291870(458374.0/s 80.55%)
doduc_oread_bcache.npm	2706715(541343.0/s)	2653328(530665.6/s 98.03%)	53387(10677.4/s 1.97%)
doduc_p0_p1_d_tb.npm	66540721(13308144.0/s)	66191291(13238258.4/s 99.47%)	349430(69886.0/s 0.53%)
doduc_po_p1_i_tb.npm	2698362(539672.4/s)	2555579(511115.8/s 94.71%)	142783(28556.6/s 5.29%)
doduc_s0_d_tb.npm	3811420(762284.0/s)	3728845(745769.0/s 97.83%)	82575(16515.0/s 2.17%)
doduc_s0_i_tb.npm	974488(194897.6/s)	929964(185992.8/s 95.43%)	44524(8904.8/s 4.57%)
doduc_s3_stall.npm	584386790(116877363.2/s)	165523910(33104780.8/s 28.32%)	418862880(83772576.0/s 71.68%)
doduc_s3_stall_per.npm	174636498(34927299.2/s)	165368011(33073603.2/s 94.69%)	9268487(1853697.4/s 5.31%)
doduc_s5_microword_per.npm	320(64.0/s)	320(64.0/s 100.00%)	0(0.0/s 0.00%)
doduc_total_stall.npm	583752919(116750579.2/s)	174636062(34927212.8/s 29.92%)	409116857(81823372.8/s 70.08%)
doduc_vic.npm	143305768(28661155.2/s)	141339997(28268000.0/s 98.63%)	1965771(393154.2/s 1.37%)

DODUC: KA690(0slip) full	smple (secs)	PMCTR0 (total events)	PMCTR1 (total hits)	PMCTR0 - PMCTR1 (total misses)
doduc_all_bcache.npm	55.0	2.02e+08 (3.67e+06/s)	1.99e+08 (3.62e+06/s 98.8%)	2.52e+06 (4.59e+04/s 1.2%)
doduc_cpi.npm	55.0	4.46e+09 (8.11e+07/s)	6.41e+08 (1.17e+07/s 14.4%)	3.82e+09 (6.94e+07/s 85.6%)
doduc_d_bcache.npm	55.0	2.93e+07 (5.33e+05/s)	2.88e+07 (5.24e+05/s 98.2%)	5.14e+05 (9.34e+03/s 1.8%)
doduc_d_pcache.npm	55.0	7.42e+08 (1.35e+07/s)	7.05e+08 (1.28e+07/s 94.9%)	3.77e+07 (6.85e+05/s 5.1%)
doduc_i_bcache.npm	55.0	3.08e+07 (5.59e+05/s)	2.83e+07 (5.15e+05/s 92.1%)	2.44e+06 (4.44e+04/s 7.9%)
doduc_i_pcache.npm	55.0	7.07e+07 (1.29e+06/s)	4.07e+07 (7.40e+05/s 57.6%)	3.00e+07 (5.45e+05/s 42.4%)
doduc_oread_bcache.npm	55.0	1.29e+08 (2.34e+06/s)	1.28e+08 (2.32e+06/s 99.3%)	8.42e+05 (1.53e+04/s 0.7%)
doduc_p0_p1_d_tb.npm	55.0	2.84e+07 (5.16e+05/s)	2.81e+07 (5.12e+05/s 99.2%)	2.32e+05 (4.22e+03/s 0.8%)
doduc_po_p1_i_tb.npm	55.0	8.50e+05 (1.55e+04/s)	8.09e+05 (1.47e+04/s 95.1%)	4.12e+04 (7.50e+02/s 4.9%)
doduc_s0_d_tb.npm	55.0	6.95e+08 (1.26e+07/s)	6.93e+08 (1.26e+07/s 99.8%)	1.09e+06 (1.98e+04/s 0.2%)
doduc_s0_i_tb.npm	55.0	6.99e+07 (1.27e+06/s)	6.93e+07 (1.26e+06/s 99.1%)	6.03e+05 (1.10e+04/s 0.9%)
doduc_s3_stall.npm	55.0	4.49e+09 (8.17e+07/s)	2.23e+09 (4.05e+07/s 49.6%)	2.26e+09 (4.12e+07/s 50.4%)
doduc_s3_stall_per.npm	55.0	2.76e+09 (5.01e+07/s)	2.28e+09 (4.15e+07/s 82.9%)	4.72e+08 (8.58e+06/s 17.1%)
doduc_s5_microword_per.npm	55.0	6.87e+02 (1.25e+01/s)	6.87e+02 (1.25e+01/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
doduc_total_stall.npm	55.0	4.42e+09 (8.04e+07/s)	2.61e+09 (4.74e+07/s 58.9%)	1.82e+09 (3.30e+07/s 41.1%)
doduc_vic.npm	55.0	6.03e+08 (1.10e+07/s)	5.47e+08 (9.94e+06/s 90.6%)	5.65e+07 (1.03e+06/s 9.4%)

EQNTOTT: KA680 hard disk

eqnt_all_bcache.npm	41256(8251.2/s)	35040(7008.0/s 84.93%)	6216(1243.2/s 15.07%)
eqnt_cpi.npm	501747806(100349561.6/s)	66767571(13353514.4/s 13.31%)	434980235(86996044.8/s 86.69%)
eqnt_d_bcache.npm	8070(1614.0/s)	5813(1162.6/s 72.03%)	2257(451.4/s 27.97%)
eqnt_d_pcache.npm	66883669(13376733.6/s)	66875360(13375072.0/s 99.99%)	8309(1661.8/s 0.01%)
eqnt_i_bcache.npm	7252(1450.4/s)	5647(1129.4/s 77.87%)	1605(321.0/s 22.13%)
eqnt_i_pcache.npm	18387049(3677410.0/s)	15008(3001.6/s 0.08%)	18372041(3674408.4/s 99.92%)
eqnt_oread_bcache.npm	23594(4718.8/s)	22092(4418.4/s 93.63%)	1502(300.4/s 6.37%)
eqnt_p0_p1_d_tb.npm	66810434(13362087.2/s)	66808063(13361612.8/s 100.00%)	2371(474.2/s 0.00%)
eqnt_po_p1_i_tb.npm	15147488(3029497.6/s)	15146044(3029208.8/s 99.99%)	1444(288.8/s 0.01%)
eqnt_s0_d_tb.npm	11404(2280.8/s)	11127(2225.4/s 97.57%)	277(55.4/s 2.43%)
eqnt_s0_i_tb.npm	343(68.6/s)	315(63.0/s 91.84%)	28(5.6/s 8.16%)
eqnt_s3_stall.npm	502192551(100438508.8/s)	164274098(32854819.2/s 32.71%)	337918453(67583692.8/s 67.29%)
eqnt_s3_stall_per.npm	134133368(26826673.6/s)	134003978(26800795.2/s 99.90%)	129390(25878.0/s 0.10%)
eqnt_s5_microword_per.npm	13(2.6/s)	13(2.6/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	501937787(100387558.4/s)	134062269(26812454.4/s 26.71%)	367875518(73575104.0/s 73.29%)
eqnt_vic.npm	133705135(26741027.2/s)	133681957(26736392.0/s 99.98%)	23178(4635.6/s 0.02%)

EQNTOTT: KA680 RAM disk

eqnt_all_bcache.npm	8379736(1675947.2/s)	7370806(1474161.2/s 87.96%)	1008930(201786.0/s 12.04%)
eqnt_cpi.npm	501770371(100354073.6/s)	128739484(25747897.6/s 25.66%)	373030887(74606176.0/s 74.34%)
eqnt_d_bcache.npm	1768353(353670.6/s)	1038769(207753.8/s 58.74%)	729584(145916.8/s 41.26%)
eqnt_d_pcache.npm	62669813(12533962.4/s)	60897130(12179426.4/s 97.17%)	1772683(354536.6/s 2.83%)
eqnt_i_bcache.npm	403928(80785.6/s)	343145(68629.0/s 84.95%)	60783(12156.6/s 15.05%)
eqnt_i_pcache.npm	5035406(1007081.2/s)	479127(95825.4/s 9.52%)	4556279(911255.8/s 90.48%)
eqnt_oread_bcache.npm	6230119(1246023.8/s)	5998879(1199775.8/s 96.29%)	231240(46248.0/s 3.71%)
eqnt_p0_p1_d_tb.npm	20573738(4114747.6/s)	20480124(4096024.8/s 99.54%)	93614(18722.8/s 0.46%)
eqnt_po_p1_i_tb.npm	4833232(966646.4/s)	4797442(959488.4/s 99.26%)	35790(7158.0/s 0.74%)
eqnt_s0_d_tb.npm	41365298(8273060.0/s)	41111352(8222270.4/s 99.39%)	253946(50789.2/s 0.61%)
eqnt_s0_i_tb.npm	816567(163313.4/s)	805025(161005.0/s 98.59%)	11542(2308.4/s 1.41%)
eqnt_s3_stall.npm	501509117(100301824.0/s)	169576506(33915302.4/s 33.81%)	331932611(66386521.6/s 66.19%)
eqnt_s3_stall_per.npm	186145455(37229091.2/s)	170625301(34125059.2/s 91.66%)	15520154(3104030.8/s 8.34%)
eqnt_s5_microword_per.npm	214(42.8/s)	214(42.8/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	501280287(100256057.6/s)	186073440(37214688.0/s 37.12%)	315206847(63041369.6/s 62.88%)
eqnt_vic.npm	127097294(25419459.2/s)	125945464(25189092.8/s 99.09%)	1151830(230366.0/s 0.91%)

EQNTOTT: ka690 harddisk (0slip)

eqnt_all_bcache.npm	33463(6692.6/s)	30854(6170.8/s 92.20%)	2609(521.8/s 7.80%)
eqnt_cpi.npm	584431966(116886387.2/s)	77796278(15559256.0/s 13.31%)	506635688(101327136.0/s 86.69%)
eqnt_d_bcache.npm	8950(1790.0/s)	8152(1630.4/s 91.08%)	798(159.6/s 8.92%)
eqnt_d_pcache.npm	77909881(15581976.0/s)	77899668(15579934.4/s 99.99%)	10213(2042.6/s 0.01%)
eqnt_i_bcache.npm	8713(1742.6/s)	7219(1443.8/s 82.85%)	1494(298.8/s 17.15%)
eqnt_i_pcache.npm	299780(59956.0/s)	15748(3149.6/s 5.25%)	284032(56806.4/s 94.75%)
eqnt_oread_bcache.npm	22552(4510.4/s)	21827(4365.4/s 96.79%)	725(145.0/s 3.21%)
eqnt_p0_p1_d_tb.npm	77878444(15575689.6/s)	77875911(15575182.4/s 100.00%)	2533(506.6/s 0.00%)
eqnt_po_p1_i_tb.npm	212265(42453.0/s)	211085(42217.0/s 99.44%)	1180(236.0/s 0.56%)
eqnt_s0_d_tb.npm	11916(2383.2/s)	11617(2323.4/s 97.49%)	299(59.8/s 2.51%)
eqnt_s0_i_tb.npm	362(72.4/s)	329(65.8/s 90.88%)	33(6.6/s 9.12%)
eqnt_s3_stall.npm	583802252(116760448.0/s)	172468233(34493648.0/s 29.54%)	411334019(82266803.2/s 70.46%)
eqnt_s3_stall_per.npm	156007649(31201529.6/s)	155886931(31177385.6/s 99.92%)	120718(24143.6/s 0.08%)
eqnt_s5_microword_per.npm	14(2.8/s)	14(2.8/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	584019994(116803993.6/s)	155883990(31176796.8/s 26.69%)	428136004(85627200.0/s 73.31%)
eqnt_vic.npm	155786475(31157296.0/s)	155754863(31150972.8/s 99.98%)	31612(6322.4/s 0.02%)

EQNTOTT: ka690 harddisk (1slip)

eqnt_all_bcache.npm	48564(9712.8/s)	43901(8780.2/s 90.40%)	4663(932.6/s 9.60%)
eqnt_cpi.npm	583847816(116769561.6/s)	77726828(15545366.4/s 13.31%)	506120988(101224198.4/s 86.69%)
eqnt_d_bcache.npm	9383(1876.6/s)	8282(1656.4/s 88.27%)	1101(220.2/s 11.73%)
eqnt_d_pcache.npm	77913555(15582710.4/s)	77901683(15580336.0/s 99.98%)	11872(2374.4/s 0.02%)
eqnt_i_bcache.npm	5246(1049.2/s)	4853(970.6/s 92.51%)	393(78.6/s 7.49%)
eqnt_i_pcache.npm	5422453(1084490.6/s)	13305(2661.0/s 0.25%)	5409148(1081829.6/s 99.75%)
eqnt_oread_bcache.npm	16270(3254.0/s)	15722(3144.4/s 96.63%)	548(109.6/s 3.37%)
eqnt_p0_p1_d_tb.npm	77860767(15572153.6/s)	77858981(15571796.8/s 100.00%)	1786(357.2/s 0.00%)
eqnt_po_p1_i_tb.npm	5443704(1088740.8/s)	5442297(1088459.4/s 99.97%)	1407(281.4/s 0.03%)
eqnt_s0_d_tb.npm	3397(679.4/s)	3262(652.4/s 96.03%)	135(27.0/s 3.97%)
eqnt_s0_i_tb.npm	1544(308.8/s)	1439(287.8/s 93.20%)	105(21.0/s 6.80%)
eqnt_s3_stall.npm	584433410(116886681.6/s)	178302993(35660598.4/s 30.51%)	406130417(81226086.4/s 69.49%)
eqnt_s3_stall_per.npm	156205357(31241072.0/s)	156082348(31216470.4/s 99.92%)	123009(24601.8/s 0.08%)
eqnt_s5_microword_per.npm	11(2.2/s)	11(2.2/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	584137865(116827571.2/s)	155957235(31191446.4/s 26.70%)	428180630(85636128.0/s 73.30%)
eqnt_vic.npm	155594420(31118883.2/s)	155564502(31112899.2/s 99.98%)	29918(5983.6/s 0.02%)

EQNTOTT: KA690(0slip) RAM

eqnt_all_bcache.npm	8727323(1745464.6/s)	8251943(1650388.6/s 94.55%)	475380(95076.0/s 5.45%)
eqnt_cpi.npm	584053562(116810712.4/s)	151719597(30343920.0/s 25.98%)	432333965(86466790.4/s 74.02%)
eqnt_d_bcache.npm	1814400(362880.0/s)	1514924(302984.8/s 83.49%)	299476(59895.2/s 16.51%)
eqnt_d_pcache.npm	76688725(15337745.6/s)	74869810(14973961.6/s 97.63%)	1818915(363783.0/s 2.37%)
eqnt_i_bcache.npm	358691(71738.2/s)	329569(65913.8/s 91.88%)	29122(5824.4/s 8.12%)
eqnt_i_pcache.npm	1222783(244556.6/s)	519884(103976.8/s 42.52%)	702900(140580.0/s 57.48%)
eqnt_oread_bcache.npm	6594016(1318803.2/s)	6450051(1290010.2/s 97.82%)	143965(28793.0/s 2.18%)
eqnt_p0_p1_d_tb.npm	31295415(6259083.2/s)	31210738(6242147.6/s 99.73%)	84677(16935.4/s 0.27%)
eqnt_po_p1_i_tb.npm	1133420(226684.0/s)	1099981(219996.2/s 97.05%)	33439(6687.8/s 2.95%)
eqnt_s0_d_tb.npm	44932612(8986522.4/s)	44649462(8929892.4/s 99.37%)	283160(56632.0/s 0.63%)
eqnt_s0_i_tb.npm	846433(169286.6/s)	831695(166339.0/s 98.26%)	14738(2947.6/s 1.74%)
eqnt_s3_stall.npm	583996791(116799360.0/s)	173695965(34739193.6/s 29.74%)	410300826(82060166.4/s 70.26%)
eqnt_s3_stall_per.npm	189416493(37883299.2/s)	175095202(35019040.0/s 92.44%)	14321291(2864258.2/s 7.56%)
eqnt_s5_microword_per.npm	235(47.0/s)	235(47.0/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	584521854(116904371.2/s)	188738757(37747750.4/s 32.29%)	395783097(79156620.8/s 67.71%)
eqnt_vic.npm	158483536(31696707.2/s)	157619071(31523814.4/s 99.45%)	864465(172893.0/s 0.55%)

EQNTOTT: KA690(0slip) KAP

eqnt_all_bcache.npm	6106895(1221379.0/s)	5798356(1159671.2/s 94.95%)	308539(61707.8/s 5.05%)
eqnt_cpi.npm	583819354(116763865.6/s)	77521242(15504248.0/s 13.28%)	506298112(101259622.4/s 86.72%)
eqnt_d_bcache.npm	1579296(315859.2/s)	1452005(290401.0/s 91.94%)	127291(25458.2/s 8.06%)
eqnt_d_pcache.npm	71961496(14392299.2/s)	70260147(14052029.4/s 97.64%)	1701349(340269.8/s 2.36%)
eqnt_i_bcache.npm	1448783(289756.6/s)	1302631(260526.2/s 89.91%)	146152(29230.4/s 10.09%)
eqnt_i_pcache.npm	3220343(644068.6/s)	633156(126631.2/s 19.66%)	2587187(517437.4/s 80.34%)
eqnt_oread_bcache.npm	2915878(583175.6/s)	2857665(571533.0/s 98.00%)	58213(11642.6/s 2.00%)
eqnt_p0_p1_d_tb.npm	67648542(13529708.8/s)	67319743(13463948.6/s 99.51%)	328799(65759.8/s 0.49%)
eqnt_po_p1_i_tb.npm	2295316(459063.2/s)	2157819(431563.8/s 94.01%)	137497(27499.4/s 5.99%)
eqnt_s0_d_tb.npm	4070165(814033.0/s)	3985185(797037.0/s 97.91%)	84980(16996.0/s 2.09%)
eqnt_s0_i_tb.npm	1017692(203538.4/s)	971574(194314.8/s 95.47%)	46118(9223.6/s 4.53%)
eqnt_s3_stall.npm	583814969(116762993.8/s)	164842480(32968496.0/s 28.24%)	418972489(83794496.0/s 71.76%)
eqnt_s3_stall_per.npm	172698109(34539622.4/s)	164655386(32931078.4/s 95.34%)	8042723(1608544.6/s 4.66%)
eqnt_s5_microword_per.npm	318(63.6/s)	318(63.6/s 100.00%)	0(0.0/s 0.00%)
eqnt_total_stall.npm	583833876(116766775.2/s)	173463075(34692614.4/s 29.71%)	410370801(82074160.2/s 70.29%)
eqnt_vic.npm	141915335(28383065.6/s)	139608026(27921606.4/s 98.37%)	2307309(461461.8/s 1.63%)

EQNTOTT: KA690(0slip) full

eqnt_all_bcache.npm	45.0	2.35e+05 (5.23e+03/s)	2.23e+05 (4.96e+03/s 94.7%)	1.24e+04 (2.75e+02/s 5.3%)
eqnt_cpi.npm	45.0	3.74e+09 (8.32e+07/s)	4.99e+08 (1.11e+07/s 13.3%)	3.25e+09 (7.22e+07/s 86.7%)
eqnt_d_bcache.npm	45.0	5.73e+04 (1.27e+03/s)	5.27e+04 (1.17e+03/s 92.0%)	4.60e+03 (1.02e+02/s 8.0%)
eqnt_d_pcache.npm	45.0	4.99e+08 (1.11e+07/s)	4.99e+08 (1.11e+07/s 100.0%)	7.00e+04 (1.56e+03/s 0.0%)
eqnt_i_bcache.npm	45.0	4.47e+04 (9.93e+02/s)	3.97e+04 (8.82e+02/s 88.9%)	4.97e+03 (1.10e+02/s 11.1%)
eqnt_i_pcache.npm	45.0	1.48e+06 (3.28e+04/s)	9.56e+04 (2.12e+03/s 6.5%)	1.38e+06 (3.07e+04/s 93.5%)
eqnt_oread_bcache.npm	45.0	1.47e+05 (3.26e+03/s)	1.43e+05 (3.18e+03/s 97.5%)	3.73e+03 (8.28e+01/s 2.5%)
eqnt_p0_p1_d_tb.npm	45.0	4.99e+08 (1.11e+07/s)	4.99e+08 (1.11e+07/s 100.0%)	1.53e+04 (3.40e+02/s 0.0%)
eqnt_po_p1_i_tb.npm	45.0	1.91e+06 (4.24e+04/s)	1.90e+06 (4.22e+04/s 99.7%)	6.54e+03 (1.45e+02/s 0.3%)
eqnt_s0_d_tb.npm	45.0	4.47e+04 (9.93e+02/s)	4.34e+04 (9.64e+02/s 97.1%)	1.31e+03 (2.92e+01/s 2.9%)
eqnt_s0_i_tb.npm	45.0	6.62e+03 (1.47e+02/s)	6.19e+03 (1.37e+02/s 93.4%)	4.35e+02 (9.67e+00/s 6.6%)
eqnt_s3_stall.npm	45.0	3.75e+09 (8.32e+07/s)	1.17e+09 (2.59e+07/s 31.1%)	2.58e+09 (5.73e+07/s 68.9%)
eqnt_s3_stall_per.npm	45.0	1.00e+09 (2.22e+07/s)	1.00e+09 (2.22e+07/s 100.0%)	3.85e+05 (8.56e+03/s 0.0%)
eqnt_s5_microword_per.npm	45.0	7.10e+01 (1.58e+00/s)	7.10e+01 (1.58e+00/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
eqnt_total_stall.npm	45.0	3.75e+09 (8.32e+07/s)	9.99e+08 (2.22e+07/s 26.7%)	2.75e+09 (6.10e+07/s 73.3%)
eqnt_vic.npm	45.0	9.98e+08 (2.22e+07/s)	9.98e+08 (2.22e+07/s 100.0%)	1.52e+05 (3.37e+03/s 0.0%)

ESPRESSO: KA680 hard disk

espr_all_bcache.npm	13378459(2675691.8/s)	13077075(2615415.0/s 97.75%)	301384(60276.8/s 2.25%)
espr_cpi.npm	501815053(100363008.0/s)	100869654(20173931.2/s 20.10%)	400945399(80189081.6/s 79.90%)
espr_d_bcache.npm	2018583(403716.6/s)	1842883(368576.6/s 91.30%)	175700(35140.0/s 8.70%)
espr_d_pcache.npm	70844766(14168953.6/s)	68807104(13761420.8/s 97.12%)	2037662(407532.4/s 2.88%)
espr_i_bcache.npm	479291(95858.2/s)	415869(83173.8/s 86.77%)	63422(12684.4/s 13.23%)
espr_i_pcache.npm	7656926(1531385.2/s)	833004(166600.8/s 10.88%)	6823922(1364784.4/s 89.12%)
espr_oread_bcache.npm	11283982(2256796.4/s)	11244591(2248918.2/s 99.65%)	39391(7878.2/s 0.35%)
espr_p0_p1_d_tb.npm	17449522(3489904.4/s)	17429199(3485840.0/s 99.88%)	20323(4064.6/s 0.12%)
espr_po_p1_i_tb.npm	4058950(811790.0/s)	4045285(809057.0/s 99.66%)	13665(2733.0/s 0.34%)
espr_s0_d_tb.npm	51900446(10380089.6/s)	51889123(10377824.8/s 99.98%)	11323(2264.6/s 0.02%)
espr_s0_i_tb.npm	4333939(866787.8/s)	4331138(866227.6/s 99.94%)	2801(560.2/s 0.06%)
espr_s3_stall.npm	501451997(100290400.0/s)	163471391(32694278.4/s 32.60%)	337980606(67596121.6/s 67.40%)
espr_s3_stall_per.npm	165475463(33095091.2/s)	158672218(31734444.8/s 95.89%)	6803245(1360649.0/s 4.11%)
espr_s5_microword_per.npm	120(24.0/s)	120(24.0/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	501335648(100267129.6/s)	169367139(33873427.2/s 33.78%)	331968509(66393702.4/s 66.22%)
espr_vic.npm	120062502(24012500.8/s)	118097142(23619428.8/s 98.36%)	1965360(393072.0/s 1.64%)

ESPRESSO: KA680 RAM disk

espr_all_bcache.npm	17805300(3561060.0/s)	17301854(3460370.8/s 97.17%)	503446(100689.2/s 2.83%)
espr_cpi.npm	501811216(100362246.4/s)	119994252(23998851.2/s 23.91%)	381816964(76363392.0/s 76.09%)
espr_d_bcache.npm	2347278(469455.6/s)	2100195(420039.0/s 89.47%)	247083(49416.6/s 10.53%)
espr_d_pcache.npm	72611818(14522363.2/s)	70135932(14027187.2/s 96.59%)	2475886(495177.2/s 3.41%)
espr_i_bcache.npm	463670(92734.0/s)	424895(84979.0/s 91.64%)	38775(7755.0/s 8.36%)
espr_i_pcache.npm	5721192(1144238.4/s)	901914(180382.8/s 15.76%)	4819278(963855.6/s 84.24%)
espr_oread_bcache.npm	14927714(2985542.8/s)	14842263(2968452.6/s 99.43%)	85451(17090.2/s 0.57%)
espr_p0_p1_d_tb.npm	7507200(1501440.0/s)	7488474(1497694.8/s 99.75%)	18726(3745.2/s 0.25%)
espr_po_p1_i_tb.npm	2027925(405585.0/s)	2015846(403169.2/s 99.40%)	12079(2415.8/s 0.60%)
espr_s0_d_tb.npm	64738543(12947708.8/s)	64720740(12944148.0/s 99.97%)	17803(3560.6/s 0.03%)
espr_s0_i_tb.npm	3411259(682251.8/s)	3408331(681666.2/s 99.91%)	2928(585.6/s 0.09%)
espr_s3_stall.npm	501365889(100273177.6/s)	157130497(31426099.2/s 31.34%)	344235392(68847078.4/s 68.66%)
espr_s3_stall_per.npm	164532931(32906585.6/s)	156814087(31362816.0/s 95.31%)	7718844(1543768.8/s 4.69%)
espr_s5_microword_per.npm	59(11.8/s)	59(11.8/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	501480574(100296115.2/s)	166616209(33323241.6/s 33.22%)	334864365(66972870.4/s 66.78%)
espr_vic.npm	112565306(22513060.8/s)	110729879(22145976.0/s 98.37%)	1835427(367085.4/s 1.63%)

VAX 4000 SPECmarks Performance Analysis - For Internal Use Only
DATA FROM TEST RUNS

ESPRESSO: ka690 harddisk (0slip)

espr_all_bcache.npm	17663162(3532632.4/s)	17620660(3524132.0/s 99.76%)	42502(8500.4/s 0.24%)
espr_cpi.npm	583963979(116792793.6/s)	135133558(27026710.4/s 23.14%)	448830421(89766086.4/s 76.86%)
espr_d_bcache.npm	2368870(473774.0/s)	2347026(469405.2/s 99.08%)	21844(4368.8/s 0.92%)
espr_d_pcache.npm	86564096(17312819.2/s)	84151605(16830321.6/s 97.21%)	2412491(482498.2/s 2.79%)
espr_i_bcache.npm	445956(89191.2/s)	434233(86846.6/s 97.37%)	11723(2344.6/s 2.63%)
espr_i_pcache.npm	2903741(580748.2/s)	1073059(214611.8/s 36.95%)	1830682(366136.4/s 63.05%)
espr_oread_bcache.npm	15039462(3007892.4/s)	15022030(3004406.0/s 99.88%)	17432(3486.4/s 0.12%)
espr_p0_p1_d_tb.npm	20166360(4033272.0/s)	20146413(4029282.8/s 99.90%)	19947(3989.4/s 0.10%)
espr_po_p1_i_tb.npm	253034(50606.8/s)	238637(47727.4/s 94.31%)	14397(2879.4/s 5.69%)
espr_s0_d_tb.npm	66160711(13232142.4/s)	66131475(13226295.2/s 99.96%)	29236(5847.2/s 0.04%)
espr_s0_i_tb.npm	3334742(666948.4/s)	3331446(666289.2/s 99.90%)	3296(659.2/s 0.10%)
espr_s3_stall.npm	584195005(116839001.6/s)	167123638(33424726.4/s 28.61%)	417071367(83414272.0/s 71.39%)
espr_s3_stall_per.npm	173793775(34758755.2/s)	167778823(33555763.2/s 96.54%)	6014952(1202990.4/s 3.46%)
espr_s5_microword_per.npm	117(23.4/s)	117(23.4/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	583713620(116742720.0/s)	173472593(34694518.4/s 29.72%)	410241027(82048204.8/s 70.28%)
espr_vic.npm	140377457(28075491.2/s)	138924676(27784934.4/s 98.97%)	1452781(290556.2/s 1.03%)

ESPRESSO: ka690 harddisk (1slip)

espr_all_bcache.npm	17607784(3521556.8/s)	17524034(3504806.8/s 99.52%)	83750(16750.0/s 0.48%)
espr_cpi.npm	583943725(116788748.8/s)	132926900(26585380.8/s 22.76%)	451016825(90203366.4/s 77.24%)
espr_d_bcache.npm	2025636(405127.2/s)	1958613(391722.6/s 96.69%)	67023(13404.6/s 3.31%)
espr_d_pcache.npm	85203623(17040724.8/s)	82922678(16584536.0/s 97.32%)	2280945(456189.0/s 2.68%)
espr_i_bcache.npm	493153(98630.6/s)	476322(95264.4/s 96.59%)	16831(3366.2/s 3.41%)
espr_i_pcache.npm	8430590(1686118.0/s)	907920(181584.0/s 10.77%)	7522670(1504534.0/s 89.23%)
espr_oread_bcache.npm	14942730(2988546.0/s)	14907107(2981421.4/s 99.76%)	35623(7124.6/s 0.24%)
espr_p0_p1_d_tb.npm	20330394(4066078.8/s)	20306945(4061389.2/s 99.88%)	23449(4689.8/s 0.12%)
espr_po_p1_i_tb.npm	4618647(923729.4/s)	4604561(920912.2/s 99.70%)	14086(2817.2/s 0.30%)
espr_s0_d_tb.npm	64438478(12887696.0/s)	64421224(12884244.8/s 99.97%)	17254(3450.8/s 0.03%)
espr_s0_i_tb.npm	4083664(816732.8/s)	4080682(816136.4/s 99.93%)	2982(596.4/s 0.07%)
espr_s3_stall.npm	583995330(116799065.6/s)	174358036(34871606.4/s 29.86%)	409637294(81927456.0/s 70.14%)
espr_s3_stall_per.npm	178449960(35689993.6/s)	171089318(34217862.4/s 95.88%)	7360642(1472128.4/s 4.12%)
espr_s5_microword_per.npm	120(24.0/s)	120(24.0/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	584207304(116841459.2/s)	178441297(35688259.2/s 30.54%)	405766007(81153203.2/s 69.46%)
espr_vic.npm	138512548(27702508.8/s)	136807039(27361408.0/s 98.77%)	1705509(341101.8/s 1.23%)

VAX 4000 SPECmarks Performance Analysis - For Internal Use Only
DATA FROM TEST RUNS

ESPRESSO: KA690(0slip) RAM

espr_all_bcache.npm	18763713(3752742.6/s)	18566146(3713229.2/s 98.95%)	197567(39513.4/s 1.05%)
espr_cpi.npm	584439401(116887880.2/s)	135884202(27176840.4/s 23.25%)	448555040(89711008.0/s 76.75%)
espr_d_bcache.npm	2640702(528140.4/s)	2516454(503290.8/s 95.29%)	124248(24849.6/s 4.71%)
espr_d_pcache.npm	86697400(17339480.0/s)	83688869(16737774.4/s 96.53%)	3008531(601706.2/s 3.47%)
espr_i_bcache.npm	461857(92371.4/s)	438898(87779.6/s 95.03%)	22959(4591.8/s 4.97%)
espr_i_pcache.npm	3135393(627078.6/s)	1088015(217603.0/s 34.70%)	2047378(409475.6/s 65.30%)
espr_oread_bcache.npm	15589648(3117929.6/s)	15548287(3109657.4/s 99.73%)	41361(8272.2/s 0.27%)
espr_p0_p1_d_tb.npm	15436391(3087278.2/s)	15411660(3082332.0/s 99.84%)	24731(4946.2/s 0.16%)
espr_po_p1_i_tb.npm	309902(61980.4/s)	295763(59152.6/s 95.44%)	14139(2827.8/s 4.56%)
espr_s0_d_tb.npm	70953150(14190630.0/s)	70895399(14179079.8/s 99.92%)	57751(11550.2/s 0.08%)
espr_s0_i_tb.npm	3455211(691042.2/s)	3450908(690181.6/s 99.88%)	4303(860.6/s 0.12%)
espr_s3_stall.npm	583714979(116743001.6/s)	171711380(34342275.2/s 29.42%)	412003599(82400718.8/s 70.58%)
espr_s3_stall_per.npm	181795106(36359020.8/s)	175063113(35012624.0/s 96.30%)	6731993(1346398.6/s 3.70%)
espr_s5_microword_per.npm	74(14.8/s)	74(14.8/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	584003605(116800716.8/s)	178937643(35787529.6/s 30.64%)	405065962(81013190.4/s 69.36%)
espr_vic.npm	138224374(27644873.6/s)	136380493(27276099.2/s 98.67%)	1843881(368776.2/s 1.33%)

ESPRESSO: KA690(0slip) KAP

espr_all_bcache.npm	5785742(1157148.4/s)	5465008(1093001.6/s 94.46%)	320734(64146.8/s 5.54%)
espr_cpi.npm	583794938(116758988.8/s)	77332050(15466409.6/s 13.25%)	506462888(101292576.0/s 86.75%)
espr_d_bcache.npm	1449657(289931.4/s)	1326970(265394.0/s 91.54%)	122687(24537.4/s 8.46%)
espr_d_pcache.npm	72015606(14403121.6/s)	70307210(14061441.6/s 97.63%)	1708396(341679.2/s 2.37%)
espr_i_bcache.npm	1562856(312571.2/s)	1414416(282883.2/s 90.50%)	148440(29688.0/s 9.50%)
espr_i_pcache.npm	3837299(767459.8/s)	625808(125161.6/s 16.31%)	3211491(642298.2/s 83.69%)
espr_oread_bcache.npm	3184746(636949.2/s)	3123973(624794.6/s 98.09%)	60773(12154.6/s 1.91%)
espr_p0_p1_d_tb.npm	68932484(13786496.8/s)	68593009(13718601.8/s 99.50%)	339475(67895.0/s 0.50%)
espr_po_p1_i_tb.npm	2563149(512629.8/s)	2423855(484771.0/s 94.57%)	139294(27858.8/s 5.43%)
espr_s0_d_tb.npm	3885872(777174.4/s)	3802291(760458.2/s 97.85%)	83581(16716.2/s 2.15%)
espr_s0_i_tb.npm	1008065(201613.0/s)	962279(192455.8/s 95.46%)	45786(9157.2/s 4.54%)
espr_s3_stall.npm	584131160(116826232.0/s)	165763018(33152603.6/s 28.38%)	418368142(83673628.4/s 71.62%)
espr_s3_stall_per.npm	175145707(35029141.4/s)	165746486(33149296.0/s 94.63%)	9399221(1879844.2/s 5.37%)
espr_s5_microword_per.npm	314(62.8/s)	314(62.8/s 100.00%)	0(0.0/s 0.00%)
espr_total_stall.npm	583939684(116787942.4/s)	174858668(34971734.4/s 29.94%)	409081016(81816204.8/s 70.06%)
espr_vic.npm	140408727(28081744.0/s)	137861304(27572262.4/s 98.19%)	2547423(509484.6/s 1.81%)

VAX 4000 SPECmarks Performance Analysis - For Internal Use Only
DATA FROM TEST RUNS

ESPRESSO: KA690(0slip) full

espr_all_bcache.npm	85.0	1.58e+08 (1.85e+06/s)	1.55e+08 (1.82e+06/s 98.4%)	2.46e+06 (2.89e+04/s 1.6%)
espr_cpi.npm	85.0	7.07e+09 (8.32e+07/s)	1.42e+09 (1.67e+07/s 20.1%)	5.65e+09 (6.65e+07/s 79.9%)
espr_d_bcache.npm	85.0	2.99e+07 (3.52e+05/s)	2.86e+07 (3.37e+05/s 95.7%)	1.27e+06 (1.50e+04/s 4.3%)
espr_d_pcache.npm	85.0	9.25e+08 (1.09e+07/s)	8.93e+08 (1.05e+07/s 96.5%)	3.27e+07 (3.84e+05/s 3.5%)
espr_i_bcache.npm	85.0	2.06e+07 (2.43e+05/s)	2.00e+07 (2.35e+05/s 96.9%)	6.31e+05 (7.42e+03/s 3.1%)
espr_i_pcache.npm	85.0	5.58e+07 (6.57e+05/s)	2.31e+07 (2.72e+05/s 41.4%)	3.27e+07 (3.85e+05/s 58.6%)
espr_oread_bcache.npm	85.0	1.07e+08 (1.26e+06/s)	1.07e+08 (1.26e+06/s 99.5%)	5.22e+05 (6.15e+03/s 0.5%)
espr_p0_p1_d_tb.npm	85.0	4.67e+08 (5.50e+06/s)	4.65e+08 (5.47e+06/s 99.6%)	1.78e+06 (2.09e+04/s 0.4%)
espr_po_p1_i_tb.npm	85.0	2.01e+07 (2.36e+05/s)	1.77e+07 (2.08e+05/s 88.3%)	2.35e+06 (2.77e+04/s 11.7%)
espr_s0_d_tb.npm	85.0	4.55e+08 (5.36e+06/s)	4.54e+08 (5.34e+06/s 99.7%)	1.27e+06 (1.49e+04/s 0.3%)
espr_s0_i_tb.npm	85.0	4.23e+07 (4.98e+05/s)	4.20e+07 (4.94e+05/s 99.1%)	3.65e+05 (4.30e+03/s 0.9%)
espr_s3_stall.npm	85.0	7.07e+09 (8.32e+07/s)	2.04e+09 (2.40e+07/s 28.9%)	5.03e+09 (5.92e+07/s 71.1%)
espr_s3_stall_per.npm	85.0	2.23e+09 (2.62e+07/s)	2.08e+09 (2.44e+07/s 93.3%)	1.49e+08 (1.75e+06/s 6.7%)
espr_s5_microword_per.npm	85.0	3.60e+04 (4.23e+02/s)	3.60e+04 (4.23e+02/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
espr_total_stall.npm	85.0	7.07e+09 (8.32e+07/s)	2.20e+09 (2.59e+07/s 31.1%)	4.87e+09 (5.73e+07/s 68.9%)
espr_vic.npm	85.0	1.72e+09 (2.02e+07/s)	1.66e+09 (1.96e+07/s 97.0%)	5.18e+07 (6.10e+05/s 3.0%)

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FPPP: KA680 hard disk
          fppp_all_bcache.npm    17447805( 3489561.2/s)     15204836( 3040967.2/s  87.14%)     2242969(  448593.8/s  12.86%)
                 fppp_cpi.npm   501852168(100370432.0/s)    55414175( 11082835.2/s  11.04%)   446437993( 89287596.8/s  88.96%)
            fppp_d_bcache.npm     3987762(  797552.4/s)      3041082(  608216.4/s  76.26%)      946680(  189336.0/s  23.74%)
            fppp_d_pcache.npm    90694542( 18138908.8/s)    86768884( 17353777.6/s  95.67%)     3925658(  785131.6/s   4.33%)
            fppp_i_bcache.npm     7316828( 1463365.6/s)      5988402( 1197680.4/s  81.84%)     1328426(  265685.2/s  18.16%)
            fppp_i_pcache.npm    12998468( 2599693.6/s)      1486308(  297261.6/s  11.43%)    11512160( 2302432.0/s  88.57%)
        fppp_oread_bcache.npm     6672043( 1334408.6/s)      6478089( 1295617.8/s  97.09%)      193954(   38790.8/s   2.91%)
         fppp_p0_p1_d_tb.npm     15721931( 3144386.2/s)     15674228( 3134845.6/s  99.70%)       47703(    9540.6/s   0.30%)
         fppp_po_p1_i_tb.npm      4382033(  876406.6/s)      4371843(  874368.6/s  99.77%)       10190(    2038.0/s   0.23%)
            fppp_s0_d_tb.npm     78349899( 15669979.2/s)    78172090( 15634417.6/s  99.77%)      177809(   35561.8/s   0.23%)
            fppp_s0_i_tb.npm      7855894( 1571178.8/s)      7709312( 1541862.4/s  98.13%)      146582(   29316.4/s   1.87%)
           fppp_s3_stall.npm    501711471(100342291.2/s)   289135066( 57827014.4/s  57.63%)   212576405( 42515280.0/s  42.37%)
       fppp_s3_stall_per.npm    325776758( 65155353.6/s)   298344560( 59668915.2/s  91.58%)    27432198(  5486439.6/s   8.42%)
  fppp_s5_microword_per.npm            70(      14.0/s)           70(       14.0/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    501863690(100372736.0/s)   314317701( 62863539.2/s  62.63%)   187545989( 37509196.8/s  37.37%)
                fppp_vic.npm     62902391( 12580478.4/s)    49584055(  9916811.2/s  78.83%)    13318336(  2663667.2/s  21.17%)

FPPP: KA680 RAM disk
          fppp_all_bcache.npm    21305498( 4261099.6/s)     19226127( 3845225.6/s  90.24%)     2079371(  415874.2/s   9.76%)
                 fppp_cpi.npm   501551175(100310233.6/s)    53488829( 10697765.6/s  10.66%)   448062346( 89612467.2/s  89.34%)
            fppp_d_bcache.npm     5903618( 1180723.6/s)      5482246( 1096449.2/s  92.86%)      421372(   84274.4/s   7.14%)
            fppp_d_pcache.npm    95508161( 19101632.0/s)    90487661( 18097532.8/s  94.74%)     5020500( 1004100.0/s   5.26%)
            fppp_i_bcache.npm     7411099( 1482219.8/s)      6070348( 1214069.6/s  81.91%)     1340751(  268150.2/s  18.09%)
            fppp_i_pcache.npm    11741472( 2348294.4/s)      1800416(  360083.2/s  15.33%)     9941056( 1988211.2/s  84.67%)
        fppp_oread_bcache.npm     8903269( 1780653.8/s)      8824348( 1764869.6/s  99.11%)       78921(   15784.2/s   0.89%)
         fppp_p0_p1_d_tb.npm      8844211( 1768842.2/s)      8792136( 1758427.2/s  99.41%)       52075(   10415.0/s   0.59%)
         fppp_po_p1_i_tb.npm      2418767(  483753.4/s)      2409686(  481937.2/s  99.62%)        9081(    1816.2/s   0.38%)
            fppp_s0_d_tb.npm     68974187( 13794836.8/s)    68815970( 13763193.6/s  99.77%)      158217(   31643.4/s   0.23%)
            fppp_s0_i_tb.npm      9367840( 1873568.0/s)      9185105( 1837021.0/s  98.05%)      182735(   36547.0/s   1.95%)
           fppp_s3_stall.npm    501504118(100300825.6/s)   303118826( 60623763.2/s  60.44%)   198385292( 39677059.2/s  39.56%)
       fppp_s3_stall_per.npm    345678051( 69135609.6/s)   318917391( 63783475.2/s  92.26%)    26760660(  5352132.0/s   7.74%)
  fppp_s5_microword_per.npm            55(      11.0/s)           55(       11.0/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    501127234(100225446.4/s)   342701926( 68540384.0/s  68.39%)   158425308( 31685062.4/s  31.61%)
                fppp_vic.npm     52725179( 10545036.0/s)    36608262(  7321652.8/s  69.43%)    16116917(  3223383.4/s  30.57%)
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FPPP: ka690 harddisk (0slip)
          fppp_all_bcache.npm    29566389( 5913278.0/s)     29143838( 5828767.6/s  98.57%)      422551(   84510.2/s   1.43%)
                 fppp_cpi.npm   584044924(116808985.6/s)    77039759( 15407952.0/s  13.19%)   507005165(101401030.4/s  86.81%)
            fppp_d_bcache.npm     5625120( 1125024.0/s)      4539638(  907927.6/s  80.70%)     1085482(  217096.4/s  19.30%)
            fppp_d_pcache.npm   137253584( 27450716.8/s)   129379847( 25875969.6/s  94.26%)     7873737( 1574747.4/s   5.74%)
            fppp_i_bcache.npm    12102811( 2420562.2/s)     11857151( 2371430.2/s  97.97%)      245660(   49132.0/s   2.03%)
            fppp_i_pcache.npm    13603861( 2720772.2/s)      2425434(  485086.8/s  17.83%)    11178427( 2235685.4/s  82.17%)
        fppp_oread_bcache.npm    10845100( 2169020.0/s)     10808662( 2161732.4/s  99.66%)       36438(    7287.6/s   0.34%)
         fppp_p0_p1_d_tb.npm     18328992( 3665798.4/s)     18269190( 3653838.0/s  99.67%)       59802(   11960.4/s   0.33%)
         fppp_po_p1_i_tb.npm       155560(   31112.0/s)       144504(   28900.8/s  92.89%)       11056(    2211.2/s   7.11%)
            fppp_s0_d_tb.npm    119529332( 23905867.2/s)   119261865( 23852372.8/s  99.78%)      267467(   53493.4/s   0.22%)
            fppp_s0_i_tb.npm     13323907( 2664781.4/s)     13062020( 2612404.0/s  98.03%)      261887(   52377.4/s   1.97%)
           fppp_s3_stall.npm    583764699(116752934.4/s)   318735778( 63747155.2/s  54.60%)   265028921( 53005785.6/s  45.40%)
       fppp_s3_stall_per.npm    341089617( 68217926.4/s)   315466644( 63093331.2/s  92.49%)    25622973(  5124594.8/s   7.51%)
  fppp_s5_microword_per.npm            72(      14.4/s)           72(       14.4/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    584091662(116818329.6/s)   347114200( 69422841.6/s  59.43%)   236977462( 47395491.2/s  40.57%)
                fppp_vic.npm     95032379( 19006475.2/s)    82939835( 16587966.4/s  87.28%)    12092544(  2418508.8/s  12.72%)

FPPP: ka690 harddisk (1slip)
          fppp_all_bcache.npm    28240529( 5648106.0/s)     28170674( 5634134.8/s  99.75%)       69855(   13971.0/s   0.25%)
                 fppp_cpi.npm   583912888(116782579.2/s)    70008161( 14001632.0/s  11.99%)   513904727(102780947.2/s  88.01%)
            fppp_d_bcache.npm     6474215( 1294843.0/s)      6314974( 1262994.8/s  97.54%)      159241(   31848.2/s   2.46%)
            fppp_d_pcache.npm   127056370( 25411273.6/s)   120886948( 24177390.4/s  95.14%)     6169422( 1233884.4/s   4.86%)
            fppp_i_bcache.npm    10572053( 2114410.6/s)     10051043( 2010208.6/s  95.07%)      521010(  104202.0/s   4.93%)
            fppp_i_pcache.npm    16195110( 3239022.0/s)      1877489(  375497.8/s  11.59%)    14317621( 2863524.2/s  88.41%)
        fppp_oread_bcache.npm    10259718( 2051943.6/s)     10246778( 2049355.6/s  99.87%)       12940(    2588.0/s   0.13%)
         fppp_p0_p1_d_tb.npm     16166956( 3233391.2/s)     16111668( 3222333.6/s  99.66%)       55288(   11057.6/s   0.34%)
         fppp_po_p1_i_tb.npm      4188304(  837660.8/s)      4177472(  835494.4/s  99.74%)       10832(    2166.4/s   0.26%)
            fppp_s0_d_tb.npm    103420466( 20684092.8/s)   103189879( 20637976.0/s  99.78%)      230587(   46117.4/s   0.22%)
            fppp_s0_i_tb.npm     12402215( 2480443.0/s)     12151508( 2430301.6/s  97.98%)      250707(   50141.4/s   2.02%)
           fppp_s3_stall.npm    583596362(116719270.4/s)   333302293( 66660460.8/s  57.11%)   250294069( 50058812.8/s  42.89%)
       fppp_s3_stall_per.npm    361465745( 72293152.0/s)   332433641( 66486726.4/s  91.97%)    29032104(  5806420.8/s   8.03%)
  fppp_s5_microword_per.npm            65(      13.0/s)           65(       13.0/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    584252196(116850444.8/s)   354382825( 70876563.2/s  60.66%)   229869371( 45973875.2/s  39.34%)
                fppp_vic.npm     78852500( 15770500.8/s)    62007807( 12401561.6/s  78.64%)    16844693(  3368938.8/s  21.36%)
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FPPP: KA690(0slip) RAM
          fppp_all_bcache.npm    22303386( 4460677.2/s)     19335883( 3867176.8/s  86.69%)     2967503(  593500.6/s  13.31%)
                 fppp_cpi.npm   583765183(116753036.8/s)    76611776( 15322355.2/s  13.12%)   507153407(101430681.6/s  86.88%)
            fppp_d_bcache.npm     6560989( 1312197.8/s)      6402566( 1280513.2/s  97.59%)      158423(   31684.6/s   2.41%)
            fppp_d_pcache.npm   138177961( 27635593.6/s)   131272113( 26254422.4/s  95.00%)     6905848( 1381169.6/s   5.00%)
            fppp_i_bcache.npm    11481777( 2296355.4/s)     11326912( 2265382.4/s  98.65%)      154865(   30973.0/s   1.35%)
            fppp_i_pcache.npm    12683028( 2536605.6/s)      1998594(  399718.8/s  15.76%)    10684434( 2136886.8/s  84.24%)
        fppp_oread_bcache.npm    10688701( 2137740.2/s)     10671340( 2134268.0/s  99.84%)       17361(    3472.2/s   0.16%)
         fppp_p0_p1_d_tb.npm     16809428( 3361885.6/s)     16747419( 3349483.8/s  99.63%)       62009(   12401.8/s   0.37%)
         fppp_po_p1_i_tb.npm       203656(   40731.2/s)       192969(   38593.8/s  94.75%)       10687(    2137.4/s   5.25%)
            fppp_s0_d_tb.npm    118890716( 23778144.0/s)   118624461( 23724892.8/s  99.78%)      266255(   53251.0/s   0.22%)
            fppp_s0_i_tb.npm     13258775( 2651755.0/s)     12998667( 2599733.4/s  98.04%)      260108(   52021.6/s   1.96%)
           fppp_s3_stall.npm    583746456(116749286.4/s)   377258145( 75451628.8/s  64.63%)   206488311( 41297660.8/s  35.37%)
       fppp_s3_stall_per.npm    346420722( 69284147.2/s)   322112417( 64422483.2/s  92.98%)    24308305(  4861661.2/s   7.02%)
  fppp_s5_microword_per.npm            68(      13.6/s)           68(       13.6/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    583776339(116755264.0/s)   351921328( 70384268.8/s  60.28%)   231855011( 46371001.6/s  39.72%)
                fppp_vic.npm     86864192( 17372838.4/s)    73803233( 14760646.4/s  84.96%)    13060959(  2612191.8/s  15.04%)

FPPP: KA690(0slip) KAP
          fppp_all_bcache.npm     5805886( 1161177.2/s)      5462834( 1092566.8/s  94.09%)      343052(   68610.4/s   5.91%)
                 fppp_cpi.npm   584006650(116801331.2/s)    77381104( 15476220.8/s  13.25%)   506625546(101325107.2/s  86.75%)
            fppp_d_bcache.npm     1430142(  286028.4/s)      1311459(  262291.8/s  91.70%)      118683(   23736.6/s   8.30%)
            fppp_d_pcache.npm    72136019( 14427203.2/s)    70424406( 14084881.6/s  97.63%)     1711613(  342322.6/s   2.37%)
            fppp_i_bcache.npm     1390481(  278096.2/s)      1250955(  250191.0/s  89.97%)      139526(   27905.2/s  10.03%)
            fppp_i_pcache.npm     2825296(  565059.2/s)       564216(  112843.2/s  19.97%)     2261080(  452216.0/s  80.03%)
        fppp_oread_bcache.npm     3160281(  632056.2/s)      3090961(  618192.2/s  97.81%)       69320(   13864.0/s   2.19%)
         fppp_p0_p1_d_tb.npm     66929863( 13385972.8/s)    66586858( 13317372.0/s  99.49%)      343005(   68601.0/s   0.51%)
         fppp_po_p1_i_tb.npm      1992333(  398466.6/s)      1847351(  369470.2/s  92.72%)      144982(   28996.4/s   7.28%)
            fppp_s0_d_tb.npm      3913581(  782716.2/s)      3830034(  766006.8/s  97.87%)       83547(   16709.4/s   2.13%)
            fppp_s0_i_tb.npm       968240(  193648.0/s)       923955(  184791.0/s  95.43%)       44285(    8857.0/s   4.57%)
           fppp_s3_stall.npm    584020628(116804121.6/s)   166020750( 33204150.4/s  28.43%)   417999878( 83599974.4/s  71.57%)
       fppp_s3_stall_per.npm    172488533( 34497705.6/s)   164772718( 32954544.0/s  95.53%)     7715815(  1543163.0/s   4.47%)
  fppp_s5_microword_per.npm           363(      72.6/s)          363(       72.6/s 100.00%)           0(        0.0/s   0.00%)
        fppp_total_stall.npm    583765925(116753190.4/s)   175359955( 35071990.4/s  30.04%)   408405970( 81681196.8/s  69.96%)
                fppp_vic.npm    138736450( 27747289.6/s)   135954425( 27190886.4/s  97.99%)     2782025(   556405.0/s   2.01%)
```



```
FPPP: KA690(0slip) full
          fppp_all_bcache.npm   70.0  3.36e+08 (4.80e+06/s)  3.35e+08 (4.78e+06/s  99.7%)  1.08e+06 (1.55e+04/s   0.3%)
                 fppp_cpi.npm   70.0  5.78e+09 (8.25e+07/s)  7.11e+08 (1.02e+07/s  12.3%)  5.07e+09 (7.24e+07/s  87.7%)
            fppp_d_bcache.npm   70.0  7.08e+07 (1.01e+06/s)  6.87e+07 (9.82e+05/s  97.1%)  2.04e+06 (2.91e+04/s   2.9%)
            fppp_d_pcache.npm   70.0  1.42e+09 (2.02e+07/s)  1.35e+09 (1.92e+07/s  95.0%)  7.11e+07 (1.02e+06/s   5.0%)
            fppp_i_bcache.npm   70.0  1.38e+08 (1.97e+06/s)  1.32e+08 (1.88e+06/s  95.3%)  6.50e+06 (9.29e+04/s   4.7%)
            fppp_i_pcache.npm   70.0  1.56e+08 (2.24e+06/s)  1.74e+07 (2.49e+05/s  11.1%)  1.39e+08 (1.99e+06/s  88.9%)
        fppp_oread_bcache.npm   70.0  1.22e+08 (1.74e+06/s)  1.20e+08 (1.71e+06/s  98.6%)  1.75e+06 (2.51e+04/s   1.4%)
         fppp_p0_p1_d_tb.npm    70.0  4.82e+07 (6.89e+05/s)  4.76e+07 (6.80e+05/s  98.7%)  6.21e+05 (8.87e+03/s   1.3%)
         fppp_po_p1_i_tb.npm    70.0  8.81e+05 (1.26e+04/s)  8.34e+05 (1.19e+04/s  94.7%)  4.69e+04 (6.71e+02/s   5.3%)
            fppp_s0_d_tb.npm    70.0  1.37e+09 (1.96e+07/s)  1.37e+09 (1.95e+07/s  99.8%)  2.88e+06 (4.11e+04/s   0.2%)
            fppp_s0_i_tb.npm    70.0  1.56e+08 (2.23e+06/s)  1.53e+08 (2.19e+06/s  97.9%)  3.35e+06 (4.79e+04/s   2.1%)
           fppp_s3_stall.npm    70.0  5.82e+09 (8.32e+07/s)  3.72e+09 (5.31e+07/s  63.9%)  2.10e+09 (3.00e+07/s  36.1%)
       fppp_s3_stall_per.npm    70.0  3.95e+09 (5.64e+07/s)  3.63e+09 (5.18e+07/s  91.8%)  3.23e+08 (4.62e+06/s   8.2%)
  fppp_s5_microword_per.npm     70.0  3.02e+02 (4.31e+00/s)  3.02e+02 (4.31e+00/s 100.0%)  0.00e+00 (0.00e+00/s   0.0%)
        fppp_total_stall.npm    70.0  5.54e+09 (7.91e+07/s)  3.70e+09 (5.29e+07/s  66.8%)  1.84e+09 (2.62e+07/s  33.2%)
                fppp_vic.npm    70.0  7.03e+08 (1.00e+07/s)  5.39e+08 (7.71e+06/s  76.8%)  1.63e+08 (2.33e+06/s  23.2%)
```

GCC: KA680 hard disk

gcc_all_bcache.npm	1396731(279346.2/s)	1168145(233629.0/s 83.63%)	228586(45717.2/s 16.37%)
gcc_cpi.npm	502026995(100405401.6/s)	65367990(13073598.4/s 13.02%)	436659005(87331801.6/s 86.98%)
gcc_d_bcache.npm	319170(63834.0/s)	237351(47470.2/s 74.37%)	81819(16363.8/s 25.63%)
gcc_d_pcache.npm	64502794(12900559.2/s)	64165982(12833196.8/s 99.48%)	336812(67362.4/s 0.52%)
gcc_i_bcache.npm	330986(66197.2/s)	243252(48650.4/s 73.49%)	87734(17546.8/s 26.51%)
gcc_i_pcache.npm	13615665(2723133.0/s)	174661(34932.2/s 1.28%)	13441004(2688200.8/s 98.72%)
gcc_oread_bcache.npm	740268(148053.6/s)	687585(137517.0/s 92.88%)	52683(10536.6/s 7.12%)
gcc_p0_p1_d_tb.npm	63469114(12693823.2/s)	63396772(12679354.4/s 99.89%)	72342(14468.4/s 0.11%)
gcc_po_p1_i_tb.npm	12848660(2569732.0/s)	12809671(2561934.2/s 99.70%)	38989(7797.8/s 0.30%)
gcc_s0_d_tb.npm	922750(184550.0/s)	904772(180954.4/s 98.05%)	17978(3595.6/s 1.95%)
gcc_s0_i_tb.npm	131712(26342.4/s)	124954(24990.8/s 94.87%)	6758(1351.6/s 5.13%)
gcc_s3_stall.npm	501799941(100359987.2/s)	137877594(27575520.0/s 27.48%)	363922347(72784467.2/s 72.52%)
gcc_s3_stall_per.npm	142282683(28456537.6/s)	138028822(27605763.2/s 97.01%)	4253861(850772.2/s 2.99%)
gcc_s5_microword_per.npm	172(34.4/s)	172(34.4/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	501926937(100385388.8/s)	142254067(28450812.8/s 28.34%)	359672870(71934572.8/s 71.66%)
gcc_vic.npm	127447494(25489499.2/s)	126620122(25324024.0/s 99.35%)	827372(165474.4/s 0.65%)

GCC: KA680 RAM disk

gcc_all_bcache.npm	20189245(4037849.2/s)	18426767(3685353.6/s 91.27%)	1762478(352495.6/s 8.73%)
gcc_cpi.npm	501471182(100294233.6/s)	65294196(13058839.2/s 13.02%)	436176986(87235398.4/s 86.98%)
gcc_d_bcache.npm	2739375(547875.0/s)	2050841(410168.2/s 74.87%)	688534(137706.8/s 25.13%)
gcc_d_pcache.npm	49694423(9938884.8/s)	46571126(9314225.6/s 93.71%)	3123297(624659.4/s 6.29%)
gcc_i_bcache.npm	3373300(674660.0/s)	2775125(555025.0/s 82.27%)	598175(119635.0/s 17.73%)
gcc_i_pcache.npm	11908185(2381637.0/s)	3627518(725503.6/s 30.46%)	8280667(1656133.4/s 69.54%)
gcc_oread_bcache.npm	14060492(2812098.4/s)	13554960(2710992.0/s 96.40%)	505532(101106.4/s 3.60%)
gcc_p0_p1_d_tb.npm	21724885(4344977.2/s)	21437199(4287440.0/s 98.68%)	287686(57537.2/s 1.32%)
gcc_po_p1_i_tb.npm	6060977(1212195.4/s)	5921664(1184332.8/s 97.70%)	139313(27862.6/s 2.30%)
gcc_s0_d_tb.npm	28139370(5627874.0/s)	27785201(5557040.4/s 98.74%)	354169(70833.8/s 1.26%)
gcc_s0_i_tb.npm	6701061(1340212.2/s)	6578216(1315643.2/s 98.17%)	122845(24569.0/s 1.83%)
gcc_s3_stall.npm	501548498(100309702.4/s)	166278113(33255622.4/s 33.15%)	335270385(67054080.0/s 66.85%)
gcc_s3_stall_per.npm	209905468(41981094.4/s)	166102326(33220464.0/s 79.13%)	43803142(8760628.8/s 20.87%)
gcc_s5_microword_per.npm	345(69.0/s)	345(69.0/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	502558080(100511616.0/s)	212045088(42409017.6/s 42.19%)	290512992(58102598.4/s 57.81%)
gcc_vic.npm	80958173(16191635.2/s)	70975418(14195083.2/s 87.67%)	9982755(1996551.0/s 12.33%)

GCC: ka690 harddisk (0slip)

gcc_all_bcache.npm	1385836(277167.2/s)	1295853(259170.6/s 93.51%)	89983(17996.6/s 6.49%)
gcc_cpi.npm	584534300(116906854.4/s)	77511874(15502374.4/s 13.26%)	507022426(101404486.4/s 86.74%)
gcc_d_bcache.npm	298549(59709.8/s)	271699(54339.8/s 91.01%)	26850(5370.0/s 8.99%)
gcc_d_pcache.npm	76389448(15277889.6/s)	76047410(15209481.6/s 99.55%)	342038(68407.6/s 0.45%)
gcc_i_bcache.npm	322517(64503.4/s)	285156(57031.2/s 88.42%)	37361(7472.2/s 11.58%)
gcc_i_pcache.npm	1446392(289278.4/s)	200909(40181.8/s 13.89%)	1245483(249096.6/s 86.11%)
gcc_oread_bcache.npm	744524(148904.8/s)	718567(143713.4/s 96.51%)	25957(5191.4/s 3.49%)
gcc_p0_p1_d_tb.npm	75419163(15083832.0/s)	75351648(15070329.6/s 99.91%)	67515(13503.0/s 0.09%)
gcc_po_p1_i_tb.npm	780451(156090.2/s)	741828(148365.6/s 95.05%)	38623(7724.6/s 4.95%)
gcc_s0_d_tb.npm	921340(184268.0/s)	903686(180737.2/s 98.08%)	17654(3530.8/s 1.92%)
gcc_s0_i_tb.npm	144127(28825.4/s)	136993(27398.6/s 95.05%)	7134(1426.8/s 4.95%)
gcc_s3_stall.npm	584532621(116906521.6/s)	157533275(31506656.0/s 26.95%)	426999346(85399872.0/s 73.05%)
gcc_s3_stall_per.npm	160377811(32075561.6/s)	157521486(31504297.6/s 98.22%)	2856325(571265.0/s 1.78%)
gcc_s5_microword_per.npm	176(35.2/s)	176(35.2/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	584303290(116860659.2/s)	160728279(32145654.4/s 27.51%)	423575011(84715001.6/s 72.49%)
gcc_vic.npm	151951063(30390211.2/s)	151350505(30270102.4/s 99.60%)	600558(120111.6/s 0.40%)

GCC: ka690 harddisk (1slip)

gcc_all_bcache.npm	1437485(287497.0/s)	1339252(267850.4/s 93.17%)	98233(19646.6/s 6.83%)
gcc_cpi.npm	584233815(116846758.4/s)	77104439(15420888.0/s 13.20%)	507129376(101425875.2/s 86.80%)
gcc_d_bcache.npm	286799(57359.8/s)	258791(51758.2/s 90.23%)	28008(5601.6/s 9.77%)
gcc_d_pcache.npm	76148103(15229620.8/s)	75799808(15159961.6/s 99.54%)	348295(69659.0/s 0.46%)
gcc_i_bcache.npm	327746(65549.2/s)	289964(57992.8/s 88.47%)	37782(7556.4/s 11.53%)
gcc_i_pcache.npm	15141023(3028204.6/s)	193113(38622.6/s 1.28%)	14947910(2989582.0/s 98.72%)
gcc_oread_bcache.npm	713665(142733.0/s)	685821(137164.2/s 96.10%)	27844(5568.8/s 3.90%)
gcc_p0_p1_d_tb.npm	75143647(15028729.6/s)	75071174(15014235.2/s 99.90%)	72473(14494.6/s 0.10%)
gcc_po_p1_i_tb.npm	15588109(3117621.8/s)	15548396(3109679.2/s 99.75%)	39713(7942.6/s 0.25%)
gcc_s0_d_tb.npm	912884(182576.8/s)	895324(179064.8/s 98.08%)	17560(3512.0/s 1.92%)
gcc_s0_i_tb.npm	140027(28005.4/s)	132952(26590.4/s 94.95%)	7075(1415.0/s 5.05%)
gcc_s3_stall.npm	583942511(116788505.6/s)	158095538(31619107.2/s 27.07%)	425846973(85169395.2/s 72.93%)
gcc_s3_stall_per.npm	161721524(32344304.0/s)	158527919(31705584.0/s 98.03%)	3193605(638721.0/s 1.97%)
gcc_s5_microword_per.npm	178(35.6/s)	178(35.6/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	583968774(116793753.6/s)	161552461(32310492.8/s 27.66%)	422416313(84483264.0/s 72.34%)
gcc_vic.npm	151481111(30296220.8/s)	150675253(30135049.6/s 99.47%)	805858(161171.6/s 0.53%)

GCC: KA690(0slip) RAM

gcc_all_bcache.npm	25501554(5100310.8/s)	24568516(4913703.2/s 96.34%)	933038(186607.6/s 3.66%)
gcc_cpi.npm	583913260(116782656.0/s)	88580390(17716078.4/s 15.17%)	495332870(99066572.8/s 84.83%)
gcc_d_bcache.npm	3420320(684064.0/s)	3072682(614536.4/s 89.84%)	347638(69527.6/s 10.16%)
gcc_d_pcache.npm	68447338(13689467.6/s)	64761161(12952232.2/s 94.62%)	3686177(737235.4/s 5.38%)
gcc_i_bcache.npm	4050780(810156.0/s)	3729045(745809.0/s 92.06%)	321735(64347.0/s 7.94%)
gcc_i_pcache.npm	10135945(2027189.0/s)	5054119(1010823.8/s 49.86%)	5081826(1016365.2/s 50.14%)
gcc_oread_bcache.npm	18029809(3605961.8/s)	17710939(3542186.0/s 98.23%)	318870(63774.0/s 1.77%)
gcc_p0_p1_d_tb.npm	30735380(6147076.0/s)	30424648(6084929.6/s 98.99%)	310732(62146.4/s 1.01%)
gcc_po_p1_i_tb.npm	2287997(457599.4/s)	2136301(427260.2/s 93.37%)	151696(30339.2/s 6.63%)
gcc_s0_d_tb.npm	38358714(7671743.2/s)	37869373(7573874.6/s 98.72%)	489341(97868.2/s 1.28%)
gcc_s0_i_tb.npm	8698668(1739733.6/s)	8528206(1705641.2/s 98.04%)	170462(34092.4/s 1.96%)
gcc_s3_stall.npm	583859732(116771946.4/s)	169851867(33970374.4/s 29.09%)	414107865(82821574.4/s 70.91%)
gcc_s3_stall_per.npm	207004206(41400841.6/s)	169910190(33982038.4/s 82.08%)	37094008(7418801.6/s 17.92%)
gcc_s5_microword_per.npm	389(77.8/s)	389(77.8/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	584002978(116800601.6/s)	206602847(41320569.4/s 35.38%)	377400131(75480026.2/s 64.62%)
gcc_vic.npm	113899228(22779845.6/s)	103855797(20771160.0/s 91.18%)	10043431(2008686.2/s 8.82%)

GCC: KA690(0slip) RAP

gcc_all_bcache.npm	5998724(1199744.8/s)	5666157(1133231.4/s 94.46%)	332567(66513.4/s 5.54%)
gcc_cpi.npm	584024315(116804864.0/s)	77277322(15455464.0/s 13.23%)	506746993(101349401.6/s 86.77%)
gcc_d_bcache.npm	1466219(293243.8/s)	1332825(266565.0/s 90.90%)	133394(26678.8/s 9.10%)
gcc_d_pcache.npm	72403529(14480705.8/s)	70758490(14151697.6/s 97.73%)	1645039(329007.8/s 2.27%)
gcc_i_bcache.npm	1579504(315900.8/s)	1427890(285578.0/s 90.40%)	151614(30322.8/s 9.60%)
gcc_i_pcache.npm	2944816(588963.2/s)	583215(116643.0/s 19.80%)	2361601(472320.2/s 80.20%)
gcc_oread_bcache.npm	2731968(546393.6/s)	2677482(535496.4/s 98.01%)	54486(10897.2/s 1.99%)
gcc_p0_p1_d_tb.npm	66689389(13337877.6/s)	66336398(13267280.0/s 99.47%)	352991(70598.2/s 0.53%)
gcc_po_p1_i_tb.npm	2229045(445809.0/s)	2075855(415171.0/s 93.13%)	153190(30638.0/s 6.87%)
gcc_s0_d_tb.npm	4387239(877447.8/s)	4298122(859624.4/s 97.97%)	89117(17823.4/s 2.03%)
gcc_s0_i_tb.npm	906996(181399.2/s)	865441(173088.2/s 95.42%)	41555(8311.0/s 4.58%)
gcc_s3_stall.npm	584107656(116821529.6/s)	165670029(33134006.4/s 28.36%)	418437627(83687526.4/s 71.64%)
gcc_s3_stall_per.npm	173586726(34717344.0/s)	164983532(32996707.2/s 95.04%)	8603194(1720638.8/s 4.96%)
gcc_s5_microword_per.npm	365(73.0/s)	365(73.0/s 100.00%)	0(0.0/s 0.00%)
gcc_total_stall.npm	583854354(116770867.2/s)	174811170(34962233.6/s 29.94%)	409043184(81808640.0/s 70.06%)
gcc_vic.npm	139991062(27998211.2/s)	137347280(27469456.0/s 98.11%)	2643782(528756.4/s 1.89%)

GCC: KA690(0slip) full

gcc_all_bcache.npm	50.0	6.97e+07 (1.39e+06/s)	6.78e+07 (1.36e+06/s 97.3%)	1.86e+06 (3.72e+04/s 2.7%)
gcc_cpi.npm	50.0	4.16e+09 (8.32e+07/s)	5.94e+08 (1.19e+07/s 14.3%)	3.57e+09 (7.13e+07/s 85.7%)
gcc_d_bcache.npm	50.0	9.08e+06 (1.82e+05/s)	8.45e+06 (1.69e+05/s 93.1%)	6.26e+05 (1.25e+04/s 6.9%)
gcc_d_pcache.npm	50.0	5.35e+08 (1.07e+07/s)	5.24e+08 (1.05e+07/s 98.1%)	1.02e+07 (2.05e+05/s 1.9%)
gcc_i_bcache.npm	50.0	1.10e+07 (2.20e+05/s)	1.03e+07 (2.06e+05/s 93.6%)	6.98e+05 (1.40e+04/s 6.4%)
gcc_i_pcache.npm	50.0	3.82e+07 (7.64e+05/s)	1.41e+07 (2.81e+05/s 36.8%)	2.42e+07 (4.83e+05/s 63.2%)
gcc_oread_bcache.npm	50.0	4.88e+07 (9.76e+05/s)	4.82e+07 (9.65e+05/s 98.9%)	5.62e+05 (1.12e+04/s 1.1%)
gcc_p0_p1_d_tb.npm	50.0	4.28e+08 (8.56e+06/s)	4.27e+08 (8.55e+06/s 99.8%)	7.80e+05 (1.56e+04/s 0.2%)
gcc_po_p1_i_tb.npm	50.0	1.45e+07 (2.91e+05/s)	1.42e+07 (2.83e+05/s 97.5%)	3.58e+05 (7.17e+03/s 2.5%)
gcc_s0_d_tb.npm	50.0	1.07e+08 (2.14e+06/s)	1.06e+08 (2.11e+06/s 98.7%)	1.40e+06 (2.79e+04/s 1.3%)
gcc_s0_i_tb.npm	50.0	2.50e+07 (4.99e+05/s)	2.45e+07 (4.90e+05/s 98.1%)	4.80e+05 (9.60e+03/s 1.9%)
gcc_s3_stall.npm	50.0	4.16e+09 (8.32e+07/s)	1.14e+09 (2.28e+07/s 27.4%)	3.02e+09 (6.04e+07/s 72.6%)
gcc_s3_stall_per.npm	50.0	1.23e+09 (2.46e+07/s)	1.14e+09 (2.28e+07/s 92.7%)	9.00e+07 (1.80e+06/s 7.3%)
gcc_s5_microword_per.npm	50.0	2.57e+03 (5.15e+01/s)	2.57e+03 (5.15e+01/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
gcc_total_stall.npm	50.0	4.16e+09 (8.32e+07/s)	1.23e+09 (2.46e+07/s 29.5%)	2.93e+09 (5.87e+07/s 70.5%)
gcc_vic.npm	50.0	1.01e+09 (2.02e+07/s)	9.82e+08 (1.96e+07/s 97.3%)	2.75e+07 (5.50e+05/s 2.7%)

MATRIX: KA680 hard disk

matr_all_bcache.npm	14918414(2983682.8/s)	12260643(2452128.6/s 82.18%)	2657771(531554.2/s 17.82%)
matr_cpi.npm	501209012(100241804.8/s)	64776508(12955301.6/s 12.92%)	436432504(87286502.4/s 87.08%)
matr_d_bcache.npm	3635866(727173.2/s)	1073628(214725.6/s 29.53%)	2562238(512447.6/s 70.47%)
matr_d_pcache.npm	82120658(16424131.2/s)	78452101(15690420.8/s 95.53%)	3668557(733711.4/s 4.47%)
matr_i_bcache.npm	123964(24792.8/s)	84962(16992.4/s 68.54%)	39002(7800.4/s 31.46%)
matr_i_pcache.npm	4391650(878330.0/s)	225373(45074.6/s 5.13%)	4166277(833255.4/s 94.87%)
matr_oread_bcache.npm	11137618(2227523.6/s)	11009364(2201872.8/s 98.85%)	128254(25650.8/s 1.15%)
matr_p0_p1_d_tb.npm	14115384(2823076.8/s)	14067750(2813550.0/s 99.66%)	47634(9526.8/s 0.34%)
matr_po_p1_i_tb.npm	4018705(803741.0/s)	4007261(801452.2/s 99.72%)	11444(2288.8/s 0.28%)
matr_s0_d_tb.npm	67122721(13424544.0/s)	66955861(13391172.0/s 99.75%)	166860(33372.0/s 0.25%)
matr_s0_i_tb.npm	160449(32089.8/s)	156647(31329.4/s 97.63%)	3802(760.4/s 2.37%)
matr_s3_stall.npm	501670094(100334016.0/s)	280059663(56011929.6/s 55.83%)	221610431(44322086.4/s 44.17%)
matr_s3_stall_per.npm	328725963(65745190.4/s)	279908067(55981612.8/s 85.15%)	48817896(9763579.2/s 14.85%)
matr_s5_microword_per.npm	59(11.8/s)	59(11.8/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	501639445(100327891.2/s)	328463590(65692716.8/s 65.48%)	173175855(34635171.2/s 34.52%)
matr_vic.npm	68914789(13782958.4/s)	68481082(13696216.0/s 99.37%)	433707(86741.4/s 0.63%)

MATRIX: KA680 RAM disk

matr_all_bcache.npm	16529411(3305882.2/s)	13560860(2712172.0/s 82.04%)	2968551(593710.2/s 17.96%)
matr_cpi.npm	501131576(100226316.8/s)	63892342(12778468.8/s 12.75%)	437239234(87447846.4/s 87.25%)
matr_d_bcache.npm	4016418(803283.6/s)	1178984(235796.8/s 29.35%)	2837434(567486.8/s 70.65%)
matr_d_pcache.npm	84478321(16895664.0/s)	80455740(16091148.8/s 95.24%)	4022581(804516.2/s 4.76%)
matr_i_bcache.npm	107054(21410.8/s)	79401(15880.2/s 74.17%)	27653(5530.6/s 25.83%)
matr_i_pcache.npm	2777556(555511.2/s)	182617(36523.4/s 6.57%)	2594939(518987.8/s 93.43%)
matr_oread_bcache.npm	12429232(2485846.4/s)	12273380(2454676.0/s 98.75%)	155852(31170.4/s 1.25%)
matr_p0_p1_d_tb.npm	8116732(1623346.4/s)	8068806(1613761.2/s 99.41%)	47926(9585.2/s 0.59%)
matr_po_p1_i_tb.npm	2119513(423902.6/s)	2109676(421935.2/s 99.54%)	9837(1967.4/s 0.46%)
matr_s0_d_tb.npm	73144617(14628923.2/s)	72963242(14592648.0/s 99.75%)	181375(36275.0/s 0.25%)
matr_s0_i_tb.npm	174259(34851.8/s)	170392(34078.4/s 97.78%)	3867(773.4/s 2.22%)
matr_s3_stall.npm	501785121(100357024.0/s)	298162136(59632428.8/s 59.42%)	203622985(40724598.4/s 40.58%)
matr_s3_stall_per.npm	352378291(70475660.8/s)	298271531(59654304.0/s 84.65%)	54106760(10821352.0/s 15.35%)
matr_s5_microword_per.npm	46(9.2/s)	46(9.2/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	501426458(100285292.8/s)	351530822(70306163.2/s 70.11%)	149895636(29979126.4/s 29.89%)
matr_vic.npm	60433427(12086685.6/s)	59947191(11989438.4/s 99.20%)	486236(97247.2/s 0.80%)

MATRIX: ka690 harddisk (0slip)

matr_all_bcache.npm	19284728(3856945.6/s)	16772501(3354500.2/s 86.97%)	2512227(502445.4/s 13.03%)
matr_cpi.npm	583734445(116746892.8/s)	83298868(16659774.4/s 14.27%)	500435577(100087116.8/s 85.73%)
matr_d_bcache.npm	4636515(927303.0/s)	2226817(445363.4/s 48.03%)	2409698(481939.6/s 51.97%)
matr_d_pcache.npm	106607411(21321481.6/s)	101929311(20385862.4/s 95.61%)	4678100(935620.0/s 4.39%)
matr_i_bcache.npm	99842(19968.4/s)	87122(17424.4/s 87.26%)	12720(2544.0/s 12.74%)
matr_i_pcache.npm	651515(130303.0/s)	223947(44789.4/s 34.37%)	427568(85513.6/s 65.63%)
matr_oread_bcache.npm	14450503(2890100.6/s)	14344217(2868843.4/s 99.26%)	106286(21257.2/s 0.74%)
matr_p0_p1_d_tb.npm	16447132(3289426.4/s)	16398208(3279641.6/s 99.70%)	48924(9784.8/s 0.30%)
matr_po_p1_i_tb.npm	336942(67388.4/s)	325246(65049.2/s 96.53%)	11696(2339.2/s 3.47%)
matr_s0_d_tb.npm	90570308(18114062.4/s)	90345858(18069171.2/s 99.75%)	224450(44890.0/s 0.25%)
matr_s0_i_tb.npm	199212(39842.4/s)	194896(38979.2/s 97.83%)	4316(863.2/s 2.17%)
matr_s3_stall.npm	583740480(116748096.0/s)	311660606(62332121.6/s 53.39%)	272079874(54415974.4/s 46.61%)
matr_s3_stall_per.npm	369467876(73893574.4/s)	311385267(62277056.0/s 84.28%)	58082609(11616521.6/s 15.72%)
matr_s5_microword_per.npm	60(12.0/s)	60(12.0/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	584046099(116809216.0/s)	369894253(73978848.0/s 63.33%)	214151846(42830368.0/s 36.67%)
matr_vic.npm	86780243(17356048.0/s)	86425967(17285193.6/s 99.59%)	354276(70855.2/s 0.41%)

MATRIX: ka690 harddisk (1slip)

matr_all_bcache.npm	18721528(3744305.6/s)	16259275(3251855.0/s 86.85%)	2462253(492450.6/s 13.15%)
matr_cpi.npm	584200900(116840179.2/s)	80637266(16127452.8/s 13.80%)	503563634(100712729.6/s 86.20%)
matr_d_bcache.npm	4418275(883655.0/s)	2050181(410036.2/s 46.40%)	2368094(473618.8/s 53.60%)
matr_d_pcache.npm	103659321(20731864.0/s)	99123734(19824747.2/s 95.62%)	4535587(907117.4/s 4.38%)
matr_i_bcache.npm	164131(32826.2/s)	147683(29536.6/s 89.98%)	16448(3289.6/s 10.02%)
matr_i_pcache.npm	4548785(909757.0/s)	233116(46623.2/s 5.12%)	4315669(863133.8/s 94.88%)
matr_oread_bcache.npm	14093226(2818645.2/s)	13979438(2795887.6/s 99.19%)	113788(22757.6/s 0.81%)
matr_p0_p1_d_tb.npm	21408962(4281792.4/s)	21358107(4271621.6/s 99.76%)	50855(10171.0/s 0.24%)
matr_po_p1_i_tb.npm	4452108(890421.6/s)	4440045(888009.0/s 99.73%)	12063(2412.6/s 0.27%)
matr_s0_d_tb.npm	86949500(17389900.0/s)	86733845(17346769.6/s 99.75%)	215655(43131.0/s 0.25%)
matr_s0_i_tb.npm	206094(41218.8/s)	201399(40279.8/s 97.72%)	4695(939.0/s 2.28%)
matr_s3_stall.npm	583613664(116722739.2/s)	313605145(62721030.4/s 53.74%)	270008519(54001702.4/s 46.26%)
matr_s3_stall_per.npm	374201310(74840262.4/s)	314665183(62933036.8/s 84.09%)	59536127(11907225.6/s 15.91%)
matr_s5_microword_per.npm	77(15.4/s)	77(15.4/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	583948631(116789721.6/s)	355167423(71033484.8/s 60.82%)	228781208(45756243.2/s 39.18%)
matr_vic.npm	89471344(17894268.8/s)	88992619(17798523.2/s 99.46%)	478725(95745.0/s 0.54%)

MATRIX: KA690(0slip) RAM

matr_all_bcache.npm	19588709(3917742.0/s)	17065262(3413052.4/s 87.12%)	2523447(504689.4/s 12.88%)
matr_cpi.npm	583940254(116788044.8/s)	83559839(16711968.0/s 14.31%)	500380415(100076083.2/s 85.69%)
matr_d_bcache.npm	4775638(955127.6/s)	2316642(463328.4/s 48.51%)	2458996(491799.2/s 51.49%)
matr_d_pcache.npm	106779808(21355961.6/s)	102112787(20422556.8/s 95.63%)	4667021(933404.2/s 4.37%)
matr_i_bcache.npm	98588(19717.6/s)	84058(16811.6/s 85.26%)	14530(2906.0/s 14.74%)
matr_i_pcache.npm	600830(120166.0/s)	231593(46318.6/s 38.55%)	369237(73847.4/s 61.45%)
matr_oread_bcache.npm	14856913(2971382.6/s)	14748249(2949649.8/s 99.27%)	108664(21732.8/s 0.73%)
matr_p0_p1_d_tb.npm	15353225(3070645.0/s)	15304006(3060801.2/s 99.68%)	49219(9843.8/s 0.32%)
matr_po_p1_i_tb.npm	355813(71162.6/s)	344641(68928.2/s 96.86%)	11172(2234.4/s 3.14%)
matr_s0_d_tb.npm	91883412(18376683.2/s)	91656462(18331292.8/s 99.75%)	226950(45390.0/s 0.25%)
matr_s0_i_tb.npm	218157(43631.4/s)	213898(42779.6/s 98.05%)	4259(851.8/s 1.95%)
matr_s3_stall.npm	583904695(116780940.8/s)	314249815(62849964.8/s 53.82%)	269654880(53930976.0/s 46.18%)
matr_s3_stall_per.npm	372622388(74524480.0/s)	314495159(62899031.8/s 84.40%)	58127229(11625445.6/s 15.60%)
matr_s5_microword_per.npm	60(12.0/s)	60(12.0/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	584473308(116894656.0/s)	373703411(74740684.8/s 63.94%)	210769897(42153980.8/s 36.06%)
matr_vic.npm	84311110(16862222.4/s)	83940110(16788022.4/s 99.56%)	371000(74200.0/s 0.44%)

MATRIX: KA690(0slip) KAP

matr_all_bcache.npm	5904312(1180862.4/s)	5596792(1119358.4/s 94.79%)	307520(61504.0/s 5.21%)
matr_cpi.npm	584518336(116903667.2/s)	77328198(15465640.0/s 13.23%)	507190138(101438028.8/s 86.77%)
matr_d_bcache.npm	1565345(313069.0/s)	1428097(285619.4/s 91.23%)	137248(27449.6/s 8.77%)
matr_d_pcache.npm	72255387(14451076.8/s)	70611600(14122320.0/s 97.73%)	1643787(328757.4/s 2.27%)
matr_i_bcache.npm	1572194(314438.8/s)	1418483(283696.6/s 90.22%)	153711(30742.2/s 9.78%)
matr_i_pcache.npm	2936234(587246.8/s)	556487(111297.4/s 18.95%)	2379747(475949.4/s 81.05%)
matr_oread_bcache.npm	2755995(551199.0/s)	2699774(539954.8/s 97.96%)	56221(11244.2/s 2.04%)
matr_p0_p1_d_tb.npm	67532195(13506439.0/s)	67207709(13441541.8/s 99.52%)	324486(64897.2/s 0.48%)
matr_po_p1_i_tb.npm	2520791(504158.2/s)	2363355(472671.0/s 93.75%)	157436(31487.2/s 6.25%)
matr_s0_d_tb.npm	4576193(915238.6/s)	4485009(897001.8/s 98.01%)	91184(18236.8/s 1.99%)
matr_s0_i_tb.npm	953937(190787.4/s)	910281(182056.2/s 95.42%)	43656(8731.2/s 4.58%)
matr_s3_stall.npm	584512941(116902592.0/s)	166212334(33242467.2/s 28.44%)	418300607(83660121.6/s 71.56%)
matr_s3_stall_per.npm	174158692(34831737.6/s)	165593081(33118617.6/s 95.08%)	8565611(1713122.2/s 4.92%)
matr_s5_microword_per.npm	352(70.4/s)	352(70.4/s 100.00%)	0(0.0/s 0.00%)
matr_total_stall.npm	584144114(116828825.6/s)	175978775(35195753.6/s 30.13%)	408165339(81633068.8/s 69.87%)
matr_vic.npm	140417594(28083520.0/s)	137925507(27585100.8/s 98.23%)	2492087(498417.4/s 1.77%)

MATRIX: KA690(0slip) full

matr_all_bcache.npm	160.0	6.36e+08 (3.97e+06/s)	5.81e+08 (3.63e+06/s 91.4%)	5.49e+07 (3.43e+05/s 8.6%)
matr_cpi.npm	160.0	1.29e+10 (8.09e+07/s)	1.18e+09 (7.39e+06/s 9.1%)	1.18e+10 (7.35e+07/s 90.9%)
matr_d_bcache.npm	160.0	3.99e+08 (2.49e+06/s)	3.45e+08 (2.16e+06/s 86.5%)	5.37e+07 (3.36e+05/s 13.5%)
matr_d_pcache.npm	160.0	1.83e+09 (1.15e+07/s)	1.44e+09 (8.97e+06/s 78.2%)	3.99e+08 (2.50e+06/s 21.8%)
matr_i_bcache.npm	160.0	7.31e+05 (4.57e+03/s)	5.77e+05 (3.61e+03/s 78.9%)	1.55e+05 (9.67e+02/s 21.1%)
matr_i_pcache.npm	160.0	4.08e+06 (2.55e+04/s)	5.20e+05 (3.25e+03/s 12.7%)	3.56e+06 (2.22e+04/s 87.3%)
matr_oread_bcache.npm	160.0	2.38e+08 (1.49e+06/s)	2.37e+08 (1.48e+06/s 99.7%)	6.57e+05 (4.10e+03/s 0.3%)
matr_p0_p1_d_tb.npm	160.0	2.72e+08 (1.70e+06/s)	2.59e+08 (1.62e+06/s 95.3%)	1.29e+07 (8.05e+04/s 4.7%)
matr_po_p1_i_tb.npm	160.0	1.37e+06 (8.56e+03/s)	1.28e+06 (8.00e+03/s 93.5%)	8.84e+04 (5.52e+02/s 6.5%)
matr_s0_d_tb.npm	160.0	1.56e+09 (9.76e+06/s)	1.34e+09 (8.36e+06/s 85.6%)	2.24e+08 (1.40e+06/s 14.4%)
matr_s0_i_tb.npm	160.0	3.39e+06 (2.12e+04/s)	2.75e+06 (1.72e+04/s 81.2%)	6.37e+05 (3.98e+03/s 18.8%)
matr_s3_stall.npm	160.0	1.30e+10 (8.14e+07/s)	9.79e+09 (6.12e+07/s 75.2%)	3.23e+09 (2.02e+07/s 24.8%)
matr_s3_stall_per.npm	160.0	1.06e+10 (6.65e+07/s)	9.64e+09 (6.02e+07/s 90.6%)	9.95e+08 (6.22e+06/s 9.4%)
matr_s5_microword_per.npm	160.0	4.86e+02 (3.04e+00/s)	4.86e+02 (3.04e+00/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
matr_total_stall.npm	160.0	1.30e+10 (8.11e+07/s)	1.08e+10 (6.72e+07/s 82.9%)	2.22e+09 (1.39e+07/s 17.1%)
matr_vic.npm	160.0	9.87e+08 (6.17e+06/s)	9.85e+08 (6.16e+06/s 99.8%)	2.43e+06 (1.52e+04/s 0.2%)

NASKER: KA680 hard disk

nask_all_bcache.npm	9819598(1963919.6/s)	8075919(1615183.8/s 82.24%)	1743679(348735.8/s 17.76%)
nask_cpi.npm	501185815(100237164.8/s)	53451637(10690327.2/s 10.67%)	447734178(89546835.2/s 89.33%)
nask_d_bcache.npm	5121699(1024339.8/s)	3977498(795499.6/s 77.66%)	1144201(228840.2/s 22.34%)
nask_d_pcache.npm	90642827(18128564.8/s)	84382581(16876516.8/s 93.09%)	6260246(1252049.2/s 6.91%)
nask_i_bcache.npm	191996(38399.2/s)	171565(34313.0/s 89.36%)	20431(4086.2/s 10.64%)
nask_i_pcache.npm	6109450(1221890.0/s)	194202(38840.4/s 3.18%)	5915248(1183049.6/s 96.82%)
nask_oread_bcache.npm	4778557(955711.4/s)	4208354(841670.8/s 88.07%)	570203(114040.6/s 11.93%)
nask_p0_p1_d_tb.npm	13759412(2751882.4/s)	13735080(2747016.0/s 99.82%)	24332(4866.4/s 0.18%)
nask_po_p1_i_tb.npm	3373192(674638.4/s)	3363651(672730.2/s 99.72%)	9541(1908.2/s 0.28%)
nask_s0_d_tb.npm	76129951(15225990.4/s)	76112484(15222497.6/s 99.98%)	17467(3493.4/s 0.02%)
nask_s0_i_tb.npm	2178523(435704.6/s)	2177237(435447.4/s 99.94%)	1286(257.2/s 0.06%)
nask_s3_stall.npm	501238032(100247609.6/s)	298174346(59634867.2/s 59.49%)	203063686(40612736.0/s 40.51%)
nask_s3_stall_per.npm	351064117(70212825.6/s)	298206805(59641363.2/s 84.94%)	52857312(10571462.4/s 15.06%)
nask_s5_microword_per.npm	65(13.0/s)	65(13.0/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	501390696(100278137.6/s)	352909634(70581926.4/s 70.39%)	148481062(29696211.2/s 29.61%)
nask_vic.npm	56145140(11229028.0/s)	55771533(11154306.4/s 99.33%)	373607(74721.4/s 0.67%)

NASKER: KA680 RAM disk

nask_all_bcache.npm	10954842(2190968.4/s)	9071468(1814293.6/s 82.81%)	1883374(376674.8/s 17.19%)
nask_cpi.npm	501662450(100332492.8/s)	52761627(10552325.6/s 10.52%)	448900823(89780166.4/s 89.48%)
nask_d_bcache.npm	5517125(1103425.0/s)	4290968(858193.6/s 77.78%)	1226157(245231.4/s 22.22%)
nask_d_pcache.npm	92772008(18554401.6/s)	85557185(17111436.8/s 92.22%)	7214823(1442964.6/s 7.78%)
nask_i_bcache.npm	312646(62529.2/s)	291358(58271.6/s 93.19%)	21288(4257.6/s 6.81%)
nask_i_pcache.npm	4594665(918933.0/s)	178626(35725.2/s 3.89%)	4416039(883207.8/s 96.11%)
nask_oread_bcache.npm	5112525(1022505.0/s)	4499571(899914.2/s 88.01%)	612954(122590.8/s 11.99%)
nask_p0_p1_d_tb.npm	7722203(1544440.6/s)	7698874(1539774.8/s 99.70%)	23329(4665.8/s 0.30%)
nask_po_p1_i_tb.npm	2453779(490755.8/s)	2445803(489160.6/s 99.67%)	7976(1595.2/s 0.33%)
nask_s0_d_tb.npm	84862621(16972524.8/s)	84844014(16968803.2/s 99.98%)	18607(3721.4/s 0.02%)
nask_s0_i_tb.npm	2199698(439939.6/s)	2198553(439710.6/s 99.95%)	1145(229.0/s 0.05%)
nask_s3_stall.npm	501729600(100345920.0/s)	320705518(64141100.8/s 63.92%)	181024082(36204816.0/s 36.08%)
nask_s3_stall_per.npm	377331893(75466380.8/s)	319116953(63823392.0/s 84.57%)	58214940(11642988.0/s 15.43%)
nask_s5_microword_per.npm	48(9.6/s)	48(9.6/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	501382749(100276550.4/s)	378067530(75613504.0/s 75.40%)	123315219(24663043.2/s 24.60%)
nask_vic.npm	46330056(9266011.2/s)	46001468(9200293.6/s 99.29%)	328588(65717.6/s 0.71%)

NASKER: ka690 harddisk (0slip)

nask_all_bcache.npm	14451001(2890200.2/s)	13655785(2731157.0/s 94.50%)	795216(159043.2/s 5.50%)
nask_cpi.npm	583817224(116763443.2/s)	73443732(14688747.2/s 12.58%)	510373492(102074700.8/s 87.42%)
nask_d_bcache.npm	6832688(1366537.6/s)	6399314(1279862.8/s 93.66%)	433374(86674.8/s 6.34%)
nask_d_pcache.npm	123239516(24647904.0/s)	114853575(22970715.2/s 93.20%)	8385941(1677188.2/s 6.80%)
nask_i_bcache.npm	2428629(485725.8/s)	2415305(483061.0/s 99.45%)	13324(2664.8/s 0.55%)
nask_i_pcache.npm	3238420(647684.0/s)	201528(40305.6/s 6.22%)	3036892(607378.4/s 93.78%)
nask_oread_bcache.npm	5724673(1144934.6/s)	5447668(1089533.6/s 95.16%)	277005(55401.0/s 4.84%)
nask_p0_p1_d_tb.npm	16052539(3210507.8/s)	16027652(3205530.4/s 99.84%)	24887(4977.4/s 0.16%)
nask_po_p1_i_tb.npm	435971(87194.2/s)	425861(85172.2/s 97.68%)	10110(2022.0/s 2.32%)
nask_s0_d_tb.npm	107385317(21477064.0/s)	107362005(21472401.6/s 99.98%)	23312(4662.4/s 0.02%)
nask_s0_i_tb.npm	2707524(541504.8/s)	2706057(541211.4/s 99.95%)	1467(293.4/s 0.05%)
nask_s3_stall.npm	584349511(116869900.8/s)	323785005(64756998.4/s 55.41%)	260564506(52112902.4/s 44.59%)
nask_s3_stall_per.npm	393881905(78776384.0/s)	322618498(64523699.2/s 81.91%)	71263407(14252681.6/s 18.09%)
nask_s5_microword_per.npm	68(13.6/s)	68(13.6/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	584128812(116825766.4/s)	394849263(78969849.6/s 67.60%)	189279549(37855910.4/s 32.40%)
nask_vic.npm	72425265(14485052.8/s)	72103027(14420604.8/s 99.56%)	322238(64447.6/s 0.44%)

NASKER: ka690 harddisk (1slip)

nask_all_bcache.npm	12397447(2479489.4/s)	11655483(2331096.6/s 94.02%)	741964(148392.8/s 5.98%)
nask_cpi.npm	584029342(116805862.4/s)	71582563(14316512.0/s 12.26%)	512446779(102489356.8/s 87.74%)
nask_d_bcache.npm	6347955(1269591.0/s)	5880073(1176014.6/s 92.63%)	467882(93576.4/s 7.37%)
nask_d_pcache.npm	118247022(23649404.8/s)	111429202(22285840.0/s 94.23%)	6817820(1363564.0/s 5.77%)
nask_i_bcache.npm	226552(45310.4/s)	217392(43478.4/s 95.96%)	9160(1832.0/s 4.04%)
nask_i_pcache.npm	6657130(1331426.0/s)	198877(39775.4/s 2.99%)	6458253(1291650.6/s 97.01%)
nask_oread_bcache.npm	5654947(1130989.4/s)	5365676(1073135.2/s 94.88%)	289271(57854.2/s 5.12%)
nask_p0_p1_d_tb.npm	15991167(3198233.4/s)	15963563(3192712.6/s 99.83%)	27604(5520.8/s 0.17%)
nask_po_p1_i_tb.npm	3952048(790409.6/s)	3941023(788204.6/s 99.72%)	11025(2205.0/s 0.28%)
nask_s0_d_tb.npm	108913534(21782707.2/s)	108889761(21777952.0/s 99.98%)	23773(4754.6/s 0.02%)
nask_s0_i_tb.npm	2875498(575099.6/s)	2873615(574723.0/s 99.93%)	1883(376.6/s 0.07%)
nask_s3_stall.npm	583736124(116747225.6/s)	324819760(64963955.2/s 55.64%)	258916364(51783273.6/s 44.36%)
nask_s3_stall_per.npm	374441642(74888326.4/s)	310018444(62003686.4/s 82.79%)	64423198(12884640.0/s 17.21%)
nask_s5_microword_per.npm	68(13.6/s)	68(13.6/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	583773720(116754739.2/s)	395288144(79057632.0/s 67.71%)	188485576(37697116.8/s 32.29%)
nask_vic.npm	70581416(14116283.2/s)	70210047(14042009.6/s 99.47%)	371369(74273.8/s 0.53%)

NASKER: KA690(0slip) RAM

nask_all_bcache.npm	14523531(2904706.2/s)	13712247(2742449.4/s 94.41%)	811284(162256.8/s 5.59%)
nask_cpi.npm	583746763(116749350.4/s)	74467847(14893569.6/s 12.76%)	509278916(101855782.4/s 87.24%)
nask_d_bcache.npm	6082958(1216591.6/s)	5657523(1131504.6/s 93.01%)	425435(85087.0/s 6.99%)
nask_d_pcache.npm	123006653(24601331.2/s)	115389503(23077900.8/s 93.81%)	7617150(1523430.0/s 6.19%)
nask_i_bcache.npm	2490013(498002.6/s)	2480677(497135.4/s 99.63%)	9336(1866.4/s 0.37%)
nask_i_pcache.npm	3419904(683980.8/s)	203511(40702.2/s 5.95%)	3216393(643278.6/s 94.05%)
nask_oread_bcache.npm	5833882(1166776.4/s)	5507071(1101414.2/s 94.40%)	326811(65362.2/s 5.60%)
nask_p0_p1_d_tb.npm	14836576(2967315.2/s)	14811006(2962201.2/s 99.83%)	25570(5114.0/s 0.17%)
nask_po_p1_i_tb.npm	254758(50951.6/s)	245387(49077.4/s 96.32%)	9371(1874.2/s 3.68%)
nask_s0_d_tb.npm	108529522(21705904.0/s)	108506003(21701200.0/s 99.98%)	23519(4703.8/s 0.02%)
nask_s0_i_tb.npm	3221980(644396.0/s)	3220642(644128.4/s 99.96%)	1338(267.6/s 0.04%)
nask_s3_stall.npm	583781390(116756262.4/s)	326680856(65336171.2/s 55.96%)	257100534(51420106.8/s 44.04%)
nask_s3_stall_per.npm	397986133(79597226.6/s)	324910302(64982060.4/s 81.64%)	73075831(14615166.2/s 18.36%)
nask_s5_microword_per.npm	65(13.0/s)	65(13.0/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	583822126(116764425.2/s)	396879546(79375909.2/s 67.98%)	186942580(37380515.2/s 32.02%)
nask_vic.npm	71038893(14207778.6/s)	70722525(14144505.0/s 99.55%)	316368(63273.6/s 0.45%)

NASKER: KA690(0slip) KAP

nask_all_bcache.npm	6184403(1236880.6/s)	5847236(1169447.2/s 94.55%)	337167(67433.4/s 5.45%)
nask_cpi.npm	584150018(116830003.6/s)	77539400(15507881.0/s 13.27%)	506770218(101358043.6/s 86.73%)
nask_d_bcache.npm	1548547(309709.4/s)	1410834(282166.8/s 91.11%)	137713(27542.6/s 8.89%)
nask_d_pcache.npm	72380673(14476134.6/s)	70766092(14153218.2/s 97.77%)	1614581(322916.2/s 2.23%)
nask_i_bcache.npm	1488736(297747.2/s)	1350322(270064.4/s 90.70%)	138414(27682.8/s 9.30%)
nask_i_pcache.npm	2927760(585552.0/s)	558255(111651.0/s 19.07%)	2369505(473901.0/s 80.93%)
nask_oread_bcache.npm	2999774(599954.8/s)	2936859(587371.8/s 97.90%)	62915(12583.0/s 2.10%)
nask_p0_p1_d_tb.npm	66591578(13318316.0/s)	66240720(13248144.0/s 99.47%)	350858(70171.6/s 0.53%)
nask_po_p1_i_tb.npm	2349324(469864.8/s)	2195086(439017.2/s 93.43%)	154238(30847.6/s 6.57%)
nask_s0_d_tb.npm	4119582(823916.4/s)	4033990(806798.0/s 97.91%)	85592(17118.4/s 2.09%)
nask_s0_i_tb.npm	887932(177586.4/s)	847220(169444.0/s 95.41%)	40712(8142.4/s 4.59%)
nask_s3_stall.npm	584335613(116867122.6/s)	166400866(33280173.2/s 28.48%)	417934747(83586950.4/s 71.52%)
nask_s3_stall_per.npm	176075350(35215070.0/s)	166111007(33222201.4/s 94.34%)	9964343(1992868.6/s 5.66%)
nask_s5_microword_per.npm	325(65.0/s)	325(65.0/s 100.00%)	0(0.0/s 0.00%)
nask_total_stall.npm	584072454(116814490.8/s)	175814246(35162849.2/s 30.10%)	408258208(81651641.6/s 69.90%)
nask_vic.npm	140419756(28083951.2/s)	137921221(27584244.2/s 98.22%)	2498535(499707.0/s 1.78%)

NASKER: KA690(0slip) full

nask_all_bcache.npm	275.5	2.80e+09 (1.02e+07/s)	2.44e+09 (8.86e+06/s 87.1%)	3.61e+08 (1.31e+06/s 12.9%)
nask_cpi.npm	275.5	5.86e+10 (2.13e+08/s)	4.79e+09 (1.74e+07/s 8.2%)	5.38e+10 (1.95e+08/s 91.8%)
nask_d_bcache.npm	275.5	1.08e+09 (3.94e+06/s)	8.41e+08 (3.05e+06/s 77.5%)	2.44e+08 (8.85e+05/s 22.5%)
nask_d_pcache.npm	275.5	7.72e+09 (2.80e+07/s)	6.19e+09 (2.25e+07/s 80.2%)	1.52e+09 (5.54e+06/s 19.8%)
nask_i_bcache.npm	275.5	3.93e+07 (1.43e+05/s)	3.85e+07 (1.40e+05/s 98.0%)	7.74e+05 (2.81e+03/s 2.0%)
nask_i_pcache.npm	275.5	7.97e+07 (2.89e+05/s)	2.06e+07 (7.48e+04/s 25.9%)	5.91e+07 (2.14e+05/s 74.1%)
nask_oread_bcache.npm	275.5	1.69e+09 (6.14e+06/s)	1.57e+09 (5.70e+06/s 93.0%)	1.19e+08 (4.32e+05/s 7.0%)
nask_p0_p1_d_tb.npm	275.5	3.90e+09 (1.42e+07/s)	3.66e+09 (1.33e+07/s 93.8%)	2.44e+08 (8.86e+05/s 6.2%)
nask_po_p1_i_tb.npm	275.5	2.90e+06 (1.05e+04/s)	2.60e+06 (9.42e+03/s 89.5%)	3.05e+05 (1.11e+03/s 10.5%)
nask_s0_d_tb.npm	275.5	7.36e+09 (2.67e+07/s)	7.03e+09 (2.55e+07/s 95.5%)	3.30e+08 (1.20e+06/s 4.5%)
nask_s0_i_tb.npm	275.5	7.19e+07 (2.61e+05/s)	7.05e+07 (2.56e+05/s 98.1%)	1.36e+06 (4.92e+03/s 1.9%)
nask_s3_stall.npm	275.5	5.86e+10 (2.13e+08/s)	4.18e+10 (1.52e+08/s 71.3%)	1.69e+10 (6.12e+07/s 28.7%)
nask_s3_stall_per.npm	275.5	4.68e+10 (1.70e+08/s)	4.17e+10 (1.51e+08/s 89.1%)	5.08e+09 (1.84e+07/s 10.9%)
nask_s5_microword_per.npm	275.5	2.02e+03 (7.31e+00/s)	2.02e+03 (7.31e+00/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
nask_total_stall.npm	275.5	5.86e+10 (2.13e+08/s)	4.68e+10 (1.70e+08/s 79.8%)	1.18e+10 (4.29e+07/s 20.2%)
nask_vic.npm	275.5	3.87e+09 (1.40e+07/s)	3.77e+09 (1.37e+07/s 97.5%)	9.82e+07 (3.56e+05/s 2.5%)

SPICE: KA680 hard disk

spice_all_bcache.npm	1093933(218786.6/s)	988002(197600.4/s 90.32%)	105931(21186.2/s 9.68%)
spice_cpi.npm	503501629(100700326.4/s)	66269126(13253825.6/s 13.16%)	437232503(87446502.4/s 86.84%)
spice_d_bcache.npm	172765(34553.0/s)	128789(25757.8/s 74.55%)	43976(8795.2/s 25.45%)
spice_d_pcache.npm	65970560(13194112.0/s)	65794324(13158864.8/s 99.73%)	176236(35247.2/s 0.27%)
spice_i_bcache.npm	224462(44892.4/s)	187453(37490.6/s 83.51%)	37009(7401.8/s 16.49%)
spice_i_pcache.npm	19239677(3847935.6/s)	181646(36329.2/s 0.94%)	19058031(3811606.4/s 99.06%)
spice_oread_bcache.npm	676486(135297.2/s)	650610(130122.0/s 96.17%)	25876(5175.2/s 3.83%)
spice_p0_p1_d_tb.npm	64482611(12896522.4/s)	64458359(12891672.0/s 99.96%)	24252(4850.4/s 0.04%)
spice_po_p1_i_tb.npm	19959415(3991883.2/s)	19939142(3987828.4/s 99.90%)	20273(4054.6/s 0.10%)
spice_s0_d_tb.npm	1256548(251309.6/s)	1241801(248360.2/s 98.83%)	14747(2949.4/s 1.17%)
spice_s0_i_tb.npm	126929(25385.8/s)	109106(21821.2/s 85.96%)	17823(3564.6/s 14.04%)
spice_s3_stall.npm	502380878(100476172.8/s)	135995081(27199017.6/s 27.07%)	366385797(73277158.4/s 72.93%)
spice_s3_stall_per.npm	275096472(55019296.0/s)	234762032(46952406.4/s 85.34%)	40334440(8066888.0/s 14.66%)
spice_s5_microword_per.npm	198(39.6/s)	198(39.6/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	501252995(100250598.4/s)	276285553(55257113.6/s 55.12%)	224967442(44993488.0/s 44.88%)
spice_vic.npm	130306851(26061369.6/s)	129725654(25945131.2/s 99.55%)	581197(116239.4/s 0.45%)

KA680 RAM disk

spice_all_bcache.npm	1254699(250939.8/s)	1144459(228891.8/s 91.21%)	110240(22048.0/s 8.79%)
spice_cpi.npm	504223335(100844665.6/s)	66174653(13234930.4/s 13.12%)	438048682(87609734.4/s 86.88%)
spice_d_bcache.npm	185893(37178.6/s)	139763(27952.6/s 75.18%)	46130(9226.0/s 24.82%)
spice_d_pcache.npm	65960172(13192034.4/s)	65741293(13148258.4/s 99.67%)	218879(43775.8/s 0.33%)
spice_i_bcache.npm	235195(47039.0/s)	193282(38656.4/s 82.18%)	41913(8382.6/s 17.82%)
spice_i_pcache.npm	19938810(3987762.0/s)	185783(37156.6/s 0.93%)	19753027(3950605.6/s 99.07%)
spice_oread_bcache.npm	797931(159586.2/s)	767752(153550.4/s 96.22%)	30179(6035.8/s 3.78%)
spice_p0_p1_d_tb.npm	64038226(12807645.6/s)	64015960(12803192.0/s 99.97%)	22266(4453.2/s 0.03%)
spice_po_p1_i_tb.npm	19671937(3934387.6/s)	19651042(3930208.4/s 99.89%)	20895(4179.0/s 0.11%)
spice_s0_d_tb.npm	1513103(302620.6/s)	1495912(299182.4/s 98.86%)	17191(3438.2/s 1.14%)
spice_s0_i_tb.npm	155989(31197.8/s)	133453(26690.6/s 85.55%)	22536(4507.2/s 14.45%)
spice_s3_stall.npm	502932874(100586572.8/s)	136481632(27296326.4/s 27.14%)	366451242(73290246.4/s 72.86%)
spice_s3_stall_per.npm	139774617(27954924.8/s)	136805905(27361180.8/s 97.88%)	2968712(593742.4/s 2.12%)
spice_s5_microword_per.npm	205(41.0/s)	205(41.0/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	501853954(100370790.4/s)	138982894(27796579.2/s 27.69%)	362871060(72574214.4/s 72.31%)
spice_vic.npm	130284617(26056923.2/s)	129706386(25941276.8/s 99.56%)	578231(115646.2/s 0.44%)

ka690 harddisk (0slip)

spice_all_bcache.npm	1083713(216742.6/s)	1046124(209224.8/s 96.53%)	37589(7517.8/s 3.47%)
spice_cpi.npm	587304777(117460953.6/s)	77819006(15563801.6/s 13.25%)	509485771(101897152.0/s 86.75%)
spice_d_bcache.npm	162661(32532.2/s)	151261(30252.2/s 92.99%)	11400(2280.0/s 7.01%)
spice_d_pcache.npm	77819066(15563812.8/s)	77635291(15527057.6/s 99.76%)	183775(36755.0/s 0.24%)
spice_i_bcache.npm	191214(38242.8/s)	178432(35686.4/s 93.32%)	12782(2556.4/s 6.68%)
spice_i_pcache.npm	573782(114756.4/s)	196471(39294.2/s 34.24%)	377311(75462.2/s 65.76%)
spice_oread_bcache.npm	685623(137124.6/s)	674447(134889.4/s 98.37%)	11176(2235.2/s 1.63%)
spice_p0_p1_d_tb.npm	76208607(15241721.6/s)	76185962(15237192.0/s 99.97%)	22645(4529.0/s 0.03%)
spice_po_p1_i_tb.npm	799900(159980.0/s)	779845(155969.0/s 97.49%)	20055(4011.0/s 2.51%)
spice_s0_d_tb.npm	1305692(261138.4/s)	1290488(258097.6/s 98.84%)	15204(3040.8/s 1.16%)
spice_s0_i_tb.npm	124376(24875.2/s)	105905(21181.0/s 85.15%)	18471(3694.2/s 14.85%)
spice_s3_stall.npm	584296353(116859276.8/s)	157096727(31419344.0/s 26.89%)	427199626(85439923.2/s 73.11%)
spice_s3_stall_per.npm	303373292(60674656.0/s)	255601908(51120380.8/s 84.25%)	47771384(9554276.8/s 15.75%)
spice_s5_microword_per.npm	194(38.8/s)	194(38.8/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	584486611(116897318.4/s)	300180637(60036128.0/s 51.36%)	284305974(56861196.8/s 48.64%)
spice_vic.npm	153621728(30724345.6/s)	153197850(30639571.2/s 99.72%)	423878(84775.6/s 0.28%)

ka690 harddisk (1slip)

spice_all_bcache.npm	1034549(206909.8/s)	992961(198592.2/s 95.98%)	41588(8317.6/s 4.02%)
spice_cpi.npm	586404873(117280972.8/s)	77619312(15523862.4/s 13.24%)	508785561(101757113.6/s 86.76%)
spice_d_bcache.npm	159206(31841.2/s)	147491(29498.2/s 92.64%)	11715(2343.0/s 7.36%)
spice_d_pcache.npm	77409688(15481937.6/s)	77236206(15447241.6/s 99.78%)	173482(34696.4/s 0.22%)
spice_i_bcache.npm	213095(42619.0/s)	199525(39905.0/s 93.63%)	13570(2714.0/s 6.37%)
spice_i_pcache.npm	20630006(4126001.2/s)	186287(37257.4/s 0.90%)	20443719(4088744.0/s 99.10%)
spice_oread_bcache.npm	662669(132533.8/s)	649053(129810.6/s 97.95%)	13616(2723.2/s 2.05%)
spice_p0_p1_d_tb.npm	76280975(15256195.2/s)	76258435(15251686.4/s 99.97%)	22540(4508.0/s 0.03%)
spice_po_p1_i_tb.npm	20828469(4165694.0/s)	20807625(4161525.2/s 99.90%)	20844(4168.8/s 0.10%)
spice_s0_d_tb.npm	1326842(265368.4/s)	1311176(262235.2/s 98.82%)	15666(3133.2/s 1.18%)
spice_s0_i_tb.npm	127924(25584.8/s)	109754(21950.8/s 85.80%)	18170(3634.0/s 14.20%)
spice_s3_stall.npm	585735141(117147033.6/s)	157354040(31470809.6/s 26.86%)	428381101(85676217.6/s 73.14%)
spice_s3_stall_per.npm	308842570(61768512.0/s)	262446984(52489398.4/s 84.98%)	46395586(9279117.6/s 15.02%)
spice_s5_microword_per.npm	194(38.8/s)	194(38.8/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	584272816(116854566.4/s)	309108177(61821638.4/s 52.90%)	275164639(55032928.0/s 47.10%)
spice_vic.npm	153472058(30694412.8/s)	152930875(30586176.0/s 99.65%)	541183(108236.6/s 0.35%)

SPICE: KA690(0slip) RAM

spice_all_bcache.npm	1133844(226768.8/s)	1046471(209294.2/s 92.29%)	87373(17474.6/s 7.71%)
spice_cpi.npm	585190175(117038028.8/s)	77572365(15514473.6/s 13.26%)	507617810(101523564.8/s 86.74%)
spice_d_bcache.npm	171861(34372.2/s)	152200(30440.0/s 88.56%)	19661(3932.2/s 11.44%)
spice_d_pcache.npm	77360655(15472131.2/s)	77182978(15436595.2/s 99.77%)	177677(35535.4/s 0.23%)
spice_i_bcache.npm	206324(41264.8/s)	191346(38269.2/s 92.74%)	14978(2995.6/s 7.26%)
spice_i_pcache.npm	485833(97166.6/s)	211878(42375.6/s 43.61%)	273955(54791.0/s 56.39%)
spice_oread_bcache.npm	725606(145121.2/s)	709914(141982.8/s 97.84%)	15692(3138.4/s 2.16%)
spice_p0_p1_d_tb.npm	75736576(15147315.2/s)	75713385(15142676.8/s 99.97%)	23191(4638.2/s 0.03%)
spice_po_p1_i_tb.npm	452654(90530.8/s)	431541(86308.2/s 95.34%)	21113(4222.6/s 4.66%)
spice_s0_d_tb.npm	1341912(268382.4/s)	1326535(265307.0/s 98.85%)	15377(3075.4/s 1.15%)
spice_s0_i_tb.npm	134532(26906.4/s)	114635(22927.0/s 85.21%)	19897(3979.4/s 14.79%)
spice_s3_stall.npm	585387383(117077478.4/s)	157159491(31431897.6/s 26.85%)	428227892(85645580.8/s 73.15%)
spice_s3_stall_per.npm	159152188(31830438.4/s)	157259790(31451958.4/s 98.81%)	1892398(378479.6/s 1.19%)
spice_s5_microword_per.npm	200(40.0/s)	200(40.0/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	587003564(117400716.8/s)	159366909(31873382.4/s 27.15%)	427636655(85527328.0/s 72.85%)
spice_vic.npm	153201981(30640396.8/s)	152777655(30555529.6/s 99.72%)	424326(84865.2/s 0.28%)

SPICE: KA690(0slip) KAP

spice_all_bcache.npm	6200476(1240095.2/s)	5867769(1173553.8/s 94.63%)	332707(66541.4/s 5.37%)
spice_cpi.npm	583905969(116781196.8/s)	77276038(15455208.0/s 13.23%)	506629931(101325984.0/s 86.77%)
spice_d_bcache.npm	1467106(293421.2/s)	1339874(267974.8/s 91.33%)	127232(25446.4/s 8.67%)
spice_d_pcache.npm	72654500(14530900.8/s)	71118081(14223616.0/s 97.89%)	1536419(307283.8/s 2.11%)
spice_i_bcache.npm	1462831(292566.2/s)	1322308(264461.6/s 90.39%)	140523(28104.6/s 9.61%)
spice_i_pcache.npm	3051819(610363.8/s)	579623(115924.6/s 18.99%)	2472196(494439.2/s 81.01%)
spice_oread_bcache.npm	3051749(610349.8/s)	2985374(597074.8/s 97.83%)	66375(13275.0/s 2.17%)
spice_p0_p1_d_tb.npm	67105302(13421060.8/s)	66763501(13352700.0/s 99.49%)	341801(68360.2/s 0.51%)
spice_po_p1_i_tb.npm	2230879(446175.8/s)	2075824(415164.8/s 93.05%)	155055(31011.0/s 6.95%)
spice_s0_d_tb.npm	4317938(863587.6/s)	4229357(845871.4/s 97.95%)	88581(17716.2/s 2.05%)
spice_s0_i_tb.npm	985093(197018.6/s)	940433(188086.6/s 95.47%)	44660(8932.0/s 4.53%)
spice_s3_stall.npm	584176177(116835238.4/s)	165476746(33095350.4/s 28.33%)	418699431(83739884.8/s 71.67%)
spice_s3_stall_per.npm	175256353(35051270.4/s)	165770183(33154035.2/s 94.59%)	9486170(1897234.0/s 5.41%)
spice_s5_microword_per.npm	368(73.6/s)	368(73.6/s 100.00%)	0(0.0/s 0.00%)
spice_total_stall.npm	583914198(116782835.2/s)	173879073(34775814.4/s 29.78%)	410035125(82007027.2/s 70.22%)
spice_vic.npm	139938306(27987660.8/s)	137301094(27460217.6/s 98.12%)	2637212(527442.4/s 1.88%)

KA690(0slip) full

spice_all_bcache.npm	96.0	3.02e+09 (3.15e+07/s)	2.74e+09 (2.85e+07/s 90.6%)	2.84e+08 (2.96e+06/s 9.4%)
spice_cpi.npm	96.0	7.94e+10 (8.27e+08/s)	1.09e+10 (1.14e+08/s 13.7%)	6.85e+10 (7.13e+08/s 86.3%)
spice_d_bcache.npm	96.0	1.79e+09 (1.86e+07/s)	1.53e+09 (1.59e+07/s 85.7%)	2.56e+08 (2.66e+06/s 14.3%)
spice_d_pcache.npm	96.0	1.10e+10 (1.14e+08/s)	9.11e+09 (9.49e+07/s 83.1%)	1.86e+09 (1.94e+07/s 16.9%)
spice_i_bcache.npm	96.0	1.41e+08 (1.46e+06/s)	1.38e+08 (1.44e+06/s 98.3%)	2.44e+06 (2.54e+04/s 1.7%)
spice_i_pcache.npm	96.0	2.99e+08 (3.11e+06/s)	1.24e+08 (1.29e+06/s 41.5%)	1.75e+08 (1.82e+06/s 58.5%)
spice_oread_bcache.npm	96.0	1.08e+09 (1.12e+07/s)	1.05e+09 (1.09e+07/s 96.9%)	3.30e+07 (3.44e+05/s 3.1%)
spice_p0_p1_d_tb.npm	96.0	9.04e+08 (9.41e+06/s)	8.23e+08 (8.57e+06/s 91.0%)	8.12e+07 (8.46e+05/s 9.0%)
spice_po_p1_i_tb.npm	96.0	4.70e+06 (4.90e+04/s)	4.24e+06 (4.42e+04/s 90.2%)	4.61e+05 (4.80e+03/s 9.8%)
spice_s0_d_tb.npm	96.0	1.01e+10 (1.05e+08/s)	9.49e+09 (9.88e+07/s 94.4%)	5.62e+08 (5.86e+06/s 5.6%)
spice_s0_i_tb.npm	96.0	3.03e+08 (3.15e+06/s)	2.96e+08 (3.08e+06/s 97.7%)	6.82e+06 (7.10e+04/s 2.3%)
spice_s3_stall.npm	96.0	7.94e+10 (8.27e+08/s)	5.57e+10 (5.80e+08/s 70.1%)	2.37e+10 (2.47e+08/s 29.9%)
spice_s3_stall_per.npm	96.0	2.55e+09 (2.66e+07/s)	2.10e+09 (2.19e+07/s 82.5%)	4.47e+08 (4.66e+06/s 17.5%)
spice_s5_microword_per.npm	96.0	3.19e+03 (3.33e+01/s)	3.19e+03 (3.33e+01/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
spice_total_stall.npm	96.0	4.47e+09 (4.65e+07/s)	2.64e+09 (2.75e+07/s 59.1%)	1.83e+09 (1.90e+07/s 40.9%)
spice_vic.npm	96.0	1.01e+10 (1.06e+08/s)	9.89e+09 (1.03e+08/s 97.6%)	2.39e+08 (2.49e+06/s 2.4%)

TOMCATV: KA680 hard disk

tomc_all_bcache.npm	14216465(2843293.0/s)	11735420(2347084.0/s 82.55%)	2481045(496209.0/s 17.45%)
tomc_cpi.npm	503704924(100740985.6/s)	56243549(11248709.6/s 11.17%)	447461375(89492275.2/s 88.83%)
tomc_d_bcache.npm	3443241(688648.2/s)	1760464(352092.8/s 51.13%)	1682777(336555.4/s 48.87%)
tomc_d_pcache.npm	87637119(17527424.0/s)	83925438(16785088.0/s 95.76%)	3711681(742336.2/s 4.24%)
tomc_i_bcache.npm	348641(69728.2/s)	312936(62587.2/s 89.76%)	35705(7141.0/s 10.24%)
tomc_i_pcache.npm	6528429(1305685.8/s)	361908(72381.6/s 5.54%)	6166521(1233304.2/s 94.46%)
tomc_oread_bcache.npm	10383346(2076669.2/s)	9623380(1924676.0/s 92.68%)	759966(151993.2/s 7.32%)
tomc_p0_p1_d_tb.npm	23357537(4671507.6/s)	23289944(4657988.8/s 99.71%)	67593(13518.6/s 0.29%)
tomc_po_p1_i_tb.npm	5566038(1113207.6/s)	5548216(1109643.2/s 99.68%)	17822(3564.4/s 0.32%)
tomc_s0_d_tb.npm	63021190(12604238.4/s)	62921644(12584328.8/s 99.84%)	99546(19909.2/s 0.16%)
tomc_s0_i_tb.npm	893042(178608.4/s)	885013(177002.6/s 99.10%)	8029(1605.8/s 0.90%)
tomc_s3_stall.npm	504406423(100881286.4/s)	272747494(54549497.6/s 54.07%)	231658929(46331785.6/s 45.93%)
tomc_s3_stall_per.npm	311094499(62218899.2/s)	275711850(55142368.0/s 88.63%)	35382649(7076529.6/s 11.37%)
tomc_s5_microword_per.npm	77(15.4/s)	77(15.4/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	503472201(100694438.4/s)	307009154(61401830.4/s 60.98%)	196463047(39292608.0/s 39.02%)
tomc_vic.npm	75788470(15157694.4/s)	74510579(14902115.2/s 98.31%)	1277891(255578.2/s 1.69%)

TOMCATV: KA680 RAM disk

tomc_all_bcache.npm	15638274(3127654.8/s)	12890202(2578040.4/s 82.43%)	2748072(549614.4/s 17.57%)
tomc_cpi.npm	501174921(100234982.4/s)	55261286(11052257.6/s 11.03%)	445913635(89182726.4/s 88.97%)
tomc_d_bcache.npm	3860988(772197.6/s)	1984528(396905.6/s 51.40%)	1876460(375292.0/s 48.60%)
tomc_d_pcache.npm	88587492(17717499.2/s)	84610935(16922187.2/s 95.51%)	3976557(795311.4/s 4.49%)
tomc_i_bcache.npm	298688(59737.6/s)	264635(52927.0/s 88.60%)	34053(6810.6/s 11.40%)
tomc_i_pcache.npm	4891693(978338.6/s)	347731(69546.2/s 7.11%)	4543962(908792.4/s 92.89%)
tomc_oread_bcache.npm	11468914(2293782.8/s)	10622051(2124410.2/s 92.62%)	846863(169372.6/s 7.38%)
tomc_p0_p1_d_tb.npm	17197019(3439404.0/s)	17127918(3425583.6/s 99.60%)	69101(13820.2/s 0.40%)
tomc_po_p1_i_tb.npm	4577428(915485.6/s)	4561403(912280.6/s 99.65%)	16025(3205.0/s 0.35%)
tomc_s0_d_tb.npm	71377777(14275555.2/s)	71269227(14253844.8/s 99.85%)	108550(21710.0/s 0.15%)
tomc_s0_i_tb.npm	1003238(200647.6/s)	994364(198872.8/s 99.12%)	8874(1774.8/s 0.88%)
tomc_s3_stall.npm	501456358(100291270.4/s)	289698208(57939641.6/s 57.77%)	211758150(42351628.8/s 42.23%)
tomc_s3_stall_per.npm	326668828(65333766.4/s)	288431698(57686342.4/s 88.29%)	38237130(7647426.4/s 11.71%)
tomc_s5_microword_per.npm	59(11.8/s)	59(11.8/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	501532548(100306508.8/s)	326294020(65258803.2/s 65.06%)	175238528(35047705.6/s 34.94%)
tomc_vic.npm	68331916(13666384.0/s)	66987244(13397448.8/s 98.03%)	1344672(268934.4/s 1.97%)

TOMCATV: KA690 harddisk (0slip)

tomc_all_bcache.npm	17325409(3465082.0/s)	14800293(2960058.6/s 85.43%)	2525116(505023.2/s 14.57%)
tomc_cpi.npm	583757173(116751436.8/s)	68714851(13742969.6/s 11.77%)	515042322(103008467.2/s 88.23%)
tomc_d_bcache.npm	4108006(821601.2/s)	2432885(486577.0/s 59.22%)	1675121(335024.2/s 40.78%)
tomc_d_pcache.npm	109392630(21878526.4/s)	105264930(21052985.6/s 96.23%)	4127700(825540.0/s 3.77%)
tomc_i_bcache.npm	206150(41230.0/s)	188144(37628.8/s 91.27%)	18006(3601.2/s 8.73%)
tomc_i_pcache.npm	1087852(217570.4/s)	351721(70344.2/s 32.33%)	736131(147226.2/s 67.67%)
tomc_oread_bcache.npm	12936485(2587297.0/s)	12112430(2422486.0/s 93.63%)	824055(164811.0/s 6.37%)
tomc_p0_p1_d_tb.npm	27149500(5429900.0/s)	27083886(5416777.2/s 99.76%)	65614(13122.8/s 0.24%)
tomc_po_p1_i_tb.npm	564003(112800.6/s)	547680(109536.0/s 97.11%)	16323(3264.6/s 2.89%)
tomc_s0_d_tb.npm	81511345(16302268.8/s)	81393519(16278704.0/s 99.86%)	117826(23565.2/s 0.14%)
tomc_s0_i_tb.npm	692366(138473.2/s)	684874(136974.8/s 98.92%)	7492(1498.4/s 1.08%)
tomc_s3_stall.npm	583977762(116795558.4/s)	308886838(61777369.6/s 52.89%)	275090924(55018182.4/s 47.11%)
tomc_s3_stall_per.npm	350650585(70130118.4/s)	314547762(62909555.2/s 89.70%)	36102823(7220564.8/s 10.30%)
tomc_s5_microword_per.npm	74(14.8/s)	74(14.8/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	584021977(116804390.4/s)	347587564(69517510.4/s 59.52%)	236434413(47286883.2/s 40.48%)
tomc_vic.npm	94108112(18821622.4/s)	93104637(18620928.0/s 98.93%)	1003475(200695.0/s 1.07%)

TOMCATV: ka690 harddisk (1slip)

tomc_all_bcache.npm	15357513(3071502.6/s)	13111646(2622329.2/s 85.38%)	2245867(449173.4/s 14.62%)
tomc_cpi.npm	591010555(118202112.0/s)	69848228(13969646.4/s 11.82%)	521162327(104232467.2/s 88.18%)
tomc_d_bcache.npm	4056438(811287.6/s)	2415889(483177.8/s 59.56%)	1640549(328109.8/s 40.44%)
tomc_d_pcache.npm	103510446(20702089.6/s)	99444664(19888932.8/s 96.07%)	4065782(813156.4/s 3.93%)
tomc_i_bcache.npm	262084(52416.8/s)	240638(48127.6/s 91.82%)	21446(4289.2/s 8.18%)
tomc_i_pcache.npm	6920860(1384172.0/s)	379402(75880.4/s 5.48%)	6541458(1308291.6/s 94.52%)
tomc_oread_bcache.npm	11594460(2318892.0/s)	10830676(2166135.2/s 93.41%)	763784(152756.8/s 6.59%)
tomc_p0_p1_d_tb.npm	31659079(6331816.0/s)	31588328(6317665.6/s 99.78%)	70751(14150.2/s 0.22%)
tomc_po_p1_i_tb.npm	6001019(1200203.8/s)	5981367(1196273.4/s 99.67%)	19652(3930.4/s 0.33%)
tomc_s0_d_tb.npm	79324514(15864902.4/s)	79207444(15841489.6/s 99.85%)	117070(23414.0/s 0.15%)
tomc_s0_i_tb.npm	1161145(232229.0/s)	1152656(230531.2/s 99.27%)	8489(1697.8/s 0.73%)
tomc_s3_stall.npm	583685510(116737100.8/s)	299934892(59986976.0/s 51.39%)	283750618(56750124.8/s 48.61%)
tomc_s3_stall_per.npm	349192573(69838515.2/s)	311374663(62274931.2/s 89.17%)	37817910(7563582.4/s 10.83%)
tomc_s5_microword_per.npm	91(18.2/s)	91(18.2/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	595474045(119094809.6/s)	350065242(70013049.6/s 58.79%)	245408803(49081760.0/s 41.21%)
tomc_vic.npm	93311125(18662225.6/s)	92119690(18423937.6/s 98.72%)	1191435(238287.0/s 1.28%)

TOMCATV: KA690(0slip) RAM

tomc_all_bcache.npm	17447712(3489542.4/s)	14924924(2984984.8/s 85.54%)	2522788(504557.6/s 14.46%)
tomc_cpi.npm	583836689(116767334.4/s)	70668706(14133740.8/s 12.10%)	513167983(102633593.6/s 87.90%)
tomc_d_bcache.npm	4163285(832657.0/s)	2478574(495714.8/s 59.53%)	1684711(336942.2/s 40.47%)
tomc_d_pcache.npm	109007687(21801537.6/s)	104811597(20962320.0/s 96.15%)	4196090(839218.0/s 3.85%)
tomc_i_bcache.npm	173859(34771.8/s)	157063(31412.6/s 90.34%)	16796(3359.2/s 9.66%)
tomc_i_pcache.npm	1054505(210901.0/s)	393718(78743.6/s 37.34%)	660787(132157.4/s 62.66%)
tomc_oread_bcache.npm	13036168(2607233.6/s)	12203759(2440751.8/s 93.61%)	832409(166481.8/s 6.39%)
tomc_p0_p1_d_tb.npm	26655595(5331119.0/s)	26590688(5318137.6/s 99.76%)	64907(12981.4/s 0.24%)
tomc_po_p1_i_tb.npm	560245(112049.0/s)	543930(108786.0/s 97.09%)	16315(3263.0/s 2.91%)
tomc_s0_d_tb.npm	82136027(16427204.4/s)	82016423(16403284.8/s 99.85%)	119604(23920.8/s 0.15%)
tomc_s0_i_tb.npm	675351(135070.2/s)	667692(133538.4/s 98.87%)	7659(1531.8/s 1.13%)
tomc_s3_stall.npm	584341141(116868224.0/s)	307431268(61486252.8/s 52.61%)	276909873(55381977.6/s 47.39%)
tomc_s3_stall_per.npm	347427700(69485542.4/s)	310382258(62076454.4/s 89.34%)	37045442(7409088.8/s 10.66%)
tomc_s5_microword_per.npm	78(15.6/s)	78(15.6/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	584326941(116865382.4/s)	346967400(69393478.4/s 59.38%)	237359541(47471907.2/s 40.62%)
tomc_vic.npm	92499109(18499822.4/s)	91556552(18311310.4/s 98.98%)	942557(188511.4/s 1.02%)

TOMCATV: KA690(0slip) RAP

tomc_all_bcache.npm	6274473(1254894.6/s)	5934007(1186801.4/s 94.57%)	340466(68093.2/s 5.43%)
tomc_cpi.npm	584007767(116801548.8/s)	77365134(15473027.2/s 13.25%)	506642633(101328524.8/s 86.75%)
tomc_d_bcache.npm	1532430(306486.0/s)	1394418(278883.6/s 90.99%)	138012(27602.4/s 9.01%)
tomc_d_pcache.npm	72457198(14491596.8/s)	70914100(14182820.0/s 97.87%)	1543887(308777.4/s 2.13%)
tomc_i_bcache.npm	1473011(294602.2/s)	1335268(267053.6/s 90.65%)	137743(27548.6/s 9.35%)
tomc_i_pcache.npm	3853133(770626.6/s)	588223(117644.6/s 15.27%)	3264910(652982.0/s 84.73%)
tomc_oread_bcache.npm	3051895(610379.0/s)	2974800(594960.0/s 97.47%)	77095(15419.0/s 2.53%)
tomc_p0_p1_d_tb.npm	66243154(13248631.2/s)	65890152(13178030.4/s 99.47%)	353002(70600.4/s 0.53%)
tomc_po_p1_i_tb.npm	2331691(466338.2/s)	2182019(436403.8/s 93.58%)	149672(29934.4/s 6.42%)
tomc_s0_d_tb.npm	4619718(923943.6/s)	4527675(905535.0/s 98.01%)	92043(18408.6/s 1.99%)
tomc_s0_i_tb.npm	857635(171527.0/s)	818221(163644.2/s 95.40%)	39414(7882.8/s 4.60%)
tomc_s3_stall.npm	584284707(116856941.4/s)	166098452(33219690.4/s 28.43%)	418186255(83637251.0/s 71.57%)
tomc_s3_stall_per.npm	175617414(35123482.8/s)	165761135(33152227.2/s 94.39%)	9856279(1971255.8/s 5.61%)
tomc_s5_microword_per.npm	375(75.0/s)	375(75.0/s 100.00%)	0(0.0/s 0.00%)
tomc_total_stall.npm	584306708(116861337.6/s)	175019174(35003833.6/s 29.95%)	409287534(81857504.0/s 70.05%)
tomc_vic.npm	140486499(28097299.2/s)	137958612(27591721.6/s 98.20%)	2527887(505577.4/s 1.80%)

TOMCATV: KA690(0slip) full

tomc_all_bcache.npm	70.0	2.18e+08 (3.11e+06/s)	1.84e+08 (2.63e+06/s 84.4%)	3.39e+07 (4.84e+05/s 15.6%)
tomc_cpi.npm	70.0	5.82e+09 (8.32e+07/s)	6.80e+08 (9.71e+06/s 11.7%)	5.14e+09 (7.35e+07/s 88.3%)
tomc_d_bcache.npm	70.1	5.43e+07 (7.75e+05/s)	3.05e+07 (4.35e+05/s 56.2%)	2.38e+07 (3.40e+05/s 43.8%)
tomc_d_pcache.npm	70.0	1.20e+09 (1.71e+07/s)	1.15e+09 (1.64e+07/s 95.4%)	5.46e+07 (7.80e+05/s 4.6%)
tomc_i_bcache.npm	70.0	4.82e+05 (6.89e+03/s)	3.47e+05 (4.96e+03/s 72.0%)	1.35e+05 (1.93e+03/s 28.0%)
tomc_i_pcache.npm	70.0	7.82e+06 (1.12e+05/s)	5.59e+05 (7.99e+03/s 7.2%)	7.26e+06 (1.04e+05/s 92.8%)
tomc_oread_bcache.npm	70.0	1.62e+08 (2.31e+06/s)	1.51e+08 (2.16e+06/s 93.6%)	1.03e+07 (1.47e+05/s 6.4%)
tomc_p0_p1_d_tb.npm	70.0	1.12e+08 (1.60e+06/s)	1.12e+08 (1.60e+06/s 99.8%)	2.68e+05 (3.83e+03/s 0.2%)
tomc_po_p1_i_tb.npm	70.0	1.39e+06 (1.98e+04/s)	1.34e+06 (1.92e+04/s 96.6%)	4.70e+04 (6.72e+02/s 3.4%)
tomc_s0_d_tb.npm	70.0	1.08e+09 (1.55e+07/s)	1.08e+09 (1.55e+07/s 99.9%)	1.52e+06 (2.18e+04/s 0.1%)
tomc_s0_i_tb.npm	70.0	8.96e+06 (1.28e+05/s)	8.88e+06 (1.27e+05/s 99.2%)	7.29e+04 (1.04e+03/s 0.8%)
tomc_s3_stall.npm	70.0	5.82e+09 (8.32e+07/s)	3.68e+09 (5.25e+07/s 63.1%)	2.15e+09 (3.07e+07/s 36.9%)
tomc_s3_stall_per.npm	70.0	4.08e+09 (5.83e+07/s)	3.67e+09 (5.25e+07/s 90.0%)	4.10e+08 (5.85e+06/s 10.0%)
tomc_s5_microword_per.npm	70.0	3.22e+02 (4.60e+00/s)	3.22e+02 (4.60e+00/s 100.0%)	0.00e+00 (0.00e+00/s 0.0%)
tomc_total_stall.npm	70.0	5.83e+09 (8.33e+07/s)	4.09e+09 (5.84e+07/s 70.1%)	1.74e+09 (2.49e+07/s 29.9%)
tomc_vic.npm	70.0	7.63e+08 (1.09e+07/s)	7.55e+08 (1.08e+07/s 99.0%)	7.70e+06 (1.10e+05/s 1.0%)

XLISP: KA680 hard disk

xlis_all_bcache.npm	27205076	(5441015.2/s)	26681309	(5336262.0/s	98.07%)	523767	(104753.4/s	1.93%)
xlis_cpi.npm	501472352	(100294470.4/s)	90140489	(18028097.6/s	17.98%)	411331863	(82266374.4/s	82.02%)
xlis_d_bcache.npm	2067505	(413501.0/s)	1743304	(348660.8/s	84.32%)	324201	(64840.2/s	15.68%)
xlis_d_pcache.npm	72679067	(14535812.8/s)	69916334	(13983267.2/s	96.20%)	2762733	(552546.6/s	3.80%)
xlis_i_bcache.npm	2260348	(452069.6/s)	2129528	(425905.6/s	94.21%)	130820	(26164.0/s	5.79%)
xlis_i_pcache.npm	11057722	(2211544.4/s)	4153156	(830631.2/s	37.56%)	6904566	(1380913.2/s	62.44%)
xlis_oread_bcache.npm	23377970	(4675594.0/s)	23176716	(4635343.2/s	99.14%)	201254	(40250.8/s	0.86%)
xlis_p0_p1_d_tb.npm	18330683	(3666136.8/s)	18278858	(3655771.6/s	99.72%)	51825	(10365.0/s	0.28%)
xlis_po_p1_i_tb.npm	4585666	(917133.2/s)	4539701	(907940.2/s	99.00%)	45965	(9193.0/s	1.00%)
xlis_s0_d_tb.npm	55191076	(11038215.2/s)	54966301	(10993260.0/s	99.59%)	224775	(44955.0/s	0.41%)
xlis_s0_i_tb.npm	6160919	(1232183.8/s)	6133462	(1226692.4/s	99.55%)	27457	(5491.4/s	0.45%)
xlis_s3_stall.npm	501948623	(100389721.6/s)	155314044	(31062809.6/s	30.94%)	346634579	(69326918.4/s	69.06%)
xlis_s3_stall_per.npm	167008183	(33401635.2/s)	144029835	(28805968.0/s	86.24%)	22978348	(4595669.6/s	13.76%)
xlis_s5_microword_per.npm	377	(75.4/s)	377	(75.4/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	501476814	(100295360.0/s)	160499203	(32099840.0/s	32.01%)	340977611	(68195520.0/s	67.99%)
xlis_vic.npm	97779138	(19555827.2/s)	91279709	(18255942.4/s	93.35%)	6499429	(1299885.8/s	6.65%)

XLISP: KA680 RAM disk

xlis_all_bcache.npm	31356761	(6271352.4/s)	30712266	(6142453.2/s	97.94%)	644495	(128899.0/s	2.06%)
xlis_cpi.npm	501802444	(100360486.4/s)	93202250	(18640449.6/s	18.57%)	408600194	(81720038.4/s	81.43%)
xlis_d_bcache.npm	2514525	(502905.0/s)	2285327	(457065.4/s	90.89%)	229198	(45839.6/s	9.11%)
xlis_d_pcache.npm	74697597	(14939520.0/s)	71732280	(14346456.0/s	96.03%)	2965317	(593063.4/s	3.97%)
xlis_i_bcache.npm	1869239	(373847.8/s)	1738634	(347726.8/s	93.01%)	130605	(26121.0/s	6.99%)
xlis_i_pcache.npm	10244027	(2048805.4/s)	5297067	(1059413.4/s	51.71%)	4946960	(989392.0/s	48.29%)
xlis_oread_bcache.npm	27583989	(5516798.0/s)	27455362	(5491072.4/s	99.53%)	128627	(25725.4/s	0.47%)
xlis_p0_p1_d_tb.npm	11163523	(2232704.6/s)	11108305	(2221661.0/s	99.51%)	55218	(11043.6/s	0.49%)
xlis_po_p1_i_tb.npm	2815893	(563178.6/s)	2761033	(552206.6/s	98.05%)	54860	(10972.0/s	1.95%)
xlis_s0_d_tb.npm	64985147	(12997029.6/s)	64717465	(12943492.8/s	99.59%)	267682	(53536.4/s	0.41%)
xlis_s0_i_tb.npm	7304901	(1460980.2/s)	7273182	(1454636.4/s	99.57%)	31719	(6343.8/s	0.43%)
xlis_s3_stall.npm	501566903	(100313382.4/s)	138271912	(27654384.0/s	27.57%)	363294991	(72658995.2/s	72.43%)
xlis_s3_stall_per.npm	167491950	(33498390.4/s)	142716849	(28543369.6/s	85.21%)	24775101	(4955020.4/s	14.79%)
xlis_s5_microword_per.npm	424	(84.8/s)	424	(84.8/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	501868670	(100373734.4/s)	166364950	(33272988.8/s	33.15%)	335503720	(67100742.4/s	66.85%)
xlis_vic.npm	92894152	(18578830.4/s)	85324124	(17064825.6/s	91.85%)	7570028	(1514005.6/s	8.15%)

XLISP: ka690 harddisk (0slip)

xlis_all_bcache.npm	33805906	(6761181.6/s)	33589792	(6717958.4/s	99.36%)	216114	(43222.8/s	0.64%)
xlis_cpi.npm	584142853	(116828569.6/s)	113020973	(22604195.2/s	19.35%)	471121880	(94224377.6/s	80.65%)
xlis_d_bcache.npm	2517727	(503545.4/s)	2393318	(478663.6/s	95.06%)	124409	(24881.8/s	4.94%)
xlis_d_pcache.npm	91888094	(18377619.2/s)	88673375	(17734675.2/s	96.50%)	3214719	(642943.8/s	3.50%)
xlis_i_bcache.npm	2321860	(464372.0/s)	2291189	(458237.8/s	98.68%)	30671	(6134.2/s	1.32%)
xlis_i_pcache.npm	8881216	(1776243.2/s)	6384699	(1276939.8/s	71.89%)	2496517	(499303.4/s	28.11%)
xlis_oread_bcache.npm	29432326	(5886465.2/s)	29393709	(5878742.0/s	99.87%)	38617	(7723.4/s	0.13%)
xlis_p0_p1_d_tb.npm	22986205	(4597241.2/s)	22921534	(4584306.8/s	99.72%)	64671	(12934.2/s	0.28%)
xlis_po_p1_i_tb.npm	1112149	(222429.8/s)	1052872	(210574.4/s	94.67%)	59277	(11855.4/s	5.33%)
xlis_s0_d_tb.npm	65780170	(13156034.4/s)	65511613	(13102322.4/s	99.59%)	268557	(53711.4/s	0.41%)
xlis_s0_i_tb.npm	8351338	(1670267.6/s)	8316420	(1663284.0/s	99.58%)	34918	(6983.6/s	0.42%)
xlis_s3_stall.npm	583844659	(116768934.4/s)	151208000	(30241600.0/s	25.90%)	432636659	(86527334.4/s	74.10%)
xlis_s3_stall_per.npm	169038464	(33807692.8/s)	150045968	(30009193.6/s	88.76%)	18992496	(3798499.2/s	11.24%)
xlis_s5_microword_per.npm	499	(99.8/s)	499	(99.8/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	584431817	(116886361.6/s)	168186064	(33637212.8/s	28.78%)	416245753	(83249152.0/s	71.22%)
xlis_vic.npm	122433171	(24486633.6/s)	114756030	(22951206.4/s	93.73%)	7677141	(1535428.2/s	6.27%)

XLISP: ka690 harddisk (1slip)

xlis_all_bcache.npm	33245291	(6649058.4/s)	33101546	(6620309.2/s	99.57%)	143745	(28749.0/s	0.43%)
xlis_cpi.npm	583716920	(116743385.6/s)	109577263	(21915452.8/s	18.77%)	474139657	(94827929.6/s	81.23%)
xlis_d_bcache.npm	2541382	(508276.4/s)	2194035	(438807.0/s	86.33%)	347347	(69469.4/s	13.67%)
xlis_d_pcache.npm	89658641	(17931728.0/s)	86994167	(17398833.6/s	97.03%)	2664474	(532894.8/s	2.97%)
xlis_i_bcache.npm	1701312	(340262.4/s)	1665793	(333158.6/s	97.91%)	35519	(7103.8/s	2.09%)
xlis_i_pcache.npm	12176695	(2435339.0/s)	4888063	(977612.6/s	40.14%)	7288632	(1457726.4/s	59.86%)
xlis_oread_bcache.npm	28494119	(5698824.0/s)	28446650	(5689330.0/s	99.83%)	47469	(9493.8/s	0.17%)
xlis_p0_p1_d_tb.npm	22830900	(4566180.0/s)	22766919	(4553384.0/s	99.72%)	63981	(12796.2/s	0.28%)
xlis_po_p1_i_tb.npm	5037909	(1007581.8/s)	4975713	(995142.6/s	98.77%)	62196	(12439.2/s	1.23%)
xlis_s0_d_tb.npm	67220100	(13444020.8/s)	66944568	(13388913.6/s	99.59%)	275532	(55106.4/s	0.41%)
xlis_s0_i_tb.npm	7102584	(1420516.8/s)	7071402	(1414280.4/s	99.56%)	31182	(6236.4/s	0.44%)
xlis_s3_stall.npm	583745717	(116749145.6/s)	154403881	(30880777.6/s	26.45%)	429341836	(85868364.8/s	73.55%)
xlis_s3_stall_per.npm	173914145	(34782828.8/s)	154590601	(30918121.6/s	88.89%)	19323544	(3864708.8/s	11.11%)
xlis_s5_microword_per.npm	505	(101.0/s)	505	(101.0/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	584116754	(116823347.2/s)	177555322	(35511065.6/s	30.40%)	406561432	(81312288.0/s	69.60%)
xlis_vic.npm	120826518	(24165304.0/s)	113409562	(22681912.0/s	93.86%)	7416956	(1483391.2/s	6.14%)

XLISP: KA690(0slip) RAM

xlis_all_bcache.npm	35024679	(7004936.0/s)	34811898	(6962380.0/s	99.39%)	212781	(42556.2/s	0.61%)
xlis_cpi.npm	583858717	(116771737.6/s)	115454961	(23090992.0/s	19.77%)	468403756	(93680748.8/s	80.23%)
xlis_d_bcache.npm	2328513	(465702.6/s)	2285285	(457057.0/s	98.14%)	43228	(8645.6/s	1.86%)
xlis_d_pcache.npm	93057537	(18611507.2/s)	90365039	(18073008.0/s	97.11%)	2692498	(538499.6/s	2.89%)
xlis_i_bcache.npm	2444833	(488966.6/s)	2405562	(481112.4/s	98.39%)	39271	(7854.2/s	1.61%)
xlis_i_pcache.npm	8411621	(1682324.2/s)	5753489	(1150697.8/s	68.40%)	2658132	(531626.4/s	31.60%)
xlis_oread_bcache.npm	30339566	(6067913.2/s)	30300699	(6060140.0/s	99.87%)	38867	(7773.4/s	0.13%)
xlis_p0_p1_d_tb.npm	21075843	(4215168.8/s)	21006304	(4201260.8/s	99.67%)	69539	(13907.8/s	0.33%)
xlis_po_p1_i_tb.npm	1135739	(227147.8/s)	1070908	(214181.6/s	94.29%)	64831	(12966.2/s	5.71%)
xlis_s0_d_tb.npm	71572655	(14314531.2/s)	71280358	(14256072.0/s	99.59%)	292297	(58459.4/s	0.41%)
xlis_s0_i_tb.npm	8612758	(1722551.6/s)	8575715	(1715143.0/s	99.57%)	37043	(7408.6/s	0.43%)
xlis_s3_stall.npm	584107104	(116821427.2/s)	148298154	(29659632.0/s	25.39%)	435808950	(87161792.0/s	74.61%)
xlis_s3_stall_per.npm	177160488	(35432099.2/s)	155977215	(31195443.2/s	88.04%)	21183273	(4236654.8/s	11.96%)
xlis_s5_microword_per.npm	553	(110.6/s)	553	(110.6/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	584129913	(116825984.0/s)	166678184	(33335638.4/s	28.53%)	417451729	(83490348.8/s	71.47%)
xlis_vic.npm	121058279	(24211656.0/s)	113719884	(22743977.6/s	93.94%)	7338395	(1467679.0/s	6.06%)

XLISP: KA690(0slip) KAP

xlis_all_bcache.npm	5997492	(1199498.4/s)	5685996	(1137199.2/s	94.81%)	311496	(62299.2/s	5.19%)
xlis_cpi.npm	583831421	(116766284.8/s)	77524041	(15504808.0/s	13.28%)	506307380	(101261476.0/s	86.72%)
xlis_d_bcache.npm	1535585	(307117.0/s)	1378172	(275634.4/s	89.75%)	157413	(31482.6/s	10.25%)
xlis_d_pcache.npm	72226284	(14445257.6/s)	70586443	(14117288.0/s	97.73%)	1639841	(327968.2/s	2.27%)
xlis_i_bcache.npm	1321335	(264267.0/s)	1221339	(244267.8/s	91.07%)	119716	(23943.2/s	8.93%)
xlis_i_pcache.npm	3038538	(607707.6/s)	583235	(116647.0/s	19.19%)	2455303	(491060.6/s	80.81%)
xlis_oread_bcache.npm	3081954	(616390.8/s)	3026270	(605254.0/s	98.19%)	55684	(11136.8/s	1.81%)
xlis_p0_p1_d_tb.npm	67553310	(13510662.4/s)	67218853	(13443771.2/s	99.50%)	334457	(66891.4/s	0.50%)
xlis_po_p1_i_tb.npm	2358572	(471714.4/s)	2204652	(440930.4/s	93.47%)	153920	(30784.0/s	6.53%)
xlis_s0_d_tb.npm	3923406	(784681.2/s)	3840174	(768034.8/s	97.88%)	83232	(16646.4/s	2.12%)
xlis_s0_i_tb.npm	995919	(199183.8/s)	950954	(190190.8/s	95.49%)	44965	(8993.0/s	4.51%)
xlis_s3_stall.npm	583830852	(116766169.6/s)	165684757	(33136950.4/s	28.38%)	418146095	(83629219.0/s	71.62%)
xlis_s3_stall_per.npm	174637949	(34927590.4/s)	165597859	(33119571.2/s	94.82%)	9040090	(1808018.0/s	5.18%)
xlis_s5_microword_per.npm	372	(74.4/s)	372	(74.4/s	100.00%)	0	(0.0/s	0.00%)
xlis_total_stall.npm	584150512	(116830105.6/s)	174999503	(34999900.8/s	29.96%)	409151009	(81830201.6/s	70.04%)
xlis_vic.npm	139013222	(27802643.2/s)	136224079	(27244816.0/s	97.99%)	2789143	(557828.6/s	2.01%)

XLISP: KA690(0slip) full

xlis_all_bcache.npm	205.0	1.27e+09	(6.17e+06/s)	1.26e+09	(6.16e+06/s	99.8%)	2.82e+06	(1.38e+04/s	0.2%)
xlis_cpi.npm	205.0	1.71e+10	(8.32e+07/s)	3.46e+09	(1.69e+07/s	20.3%)	1.36e+10	(6.63e+07/s	79.7%)
xlis_d_bcache.npm	205.0	1.07e+08	(5.21e+05/s)	1.04e+08	(5.08e+05/s	97.8%)	2.36e+06	(1.15e+04/s	2.2%)
xlis_d_pcache.npm	205.0	2.85e+09	(1.39e+07/s)	2.75e+09	(1.34e+07/s	96.5%)	9.92e+07	(4.84e+05/s	3.5%)
xlis_i_bcache.npm	205.0	6.75e+07	(3.29e+05/s)	6.58e+07	(3.21e+05/s	97.6%)	1.63e+06	(7.97e+03/s	2.4%)
xlis_i_pcache.npm	205.0	3.10e+08	(1.51e+06/s)	1.88e+08	(9.16e+05/s	60.6%)	1.22e+08	(5.95e+05/s	39.4%)
xlis_oread_bcache.npm	205.0	1.08e+09	(5.25e+06/s)	1.08e+09	(5.24e+06/s	99.8%)	2.21e+06	(1.08e+04/s	0.2%)
xlis_p0_p1_d_tb.npm	205.0	2.27e+08	(1.11e+06/s)	2.25e+08	(1.10e+06/s	99.1%)	2.08e+06	(1.01e+04/s	0.9%)
xlis_po_p1_i_tb.npm	205.0	3.26e+07	(1.59e+05/s)	3.05e+07	(1.49e+05/s	93.5%)	2.11e+06	(1.03e+04/s	6.5%)
xlis_s0_d_tb.npm	205.0	2.57e+09	(1.25e+07/s)	2.56e+09	(1.25e+07/s	99.6%)	1.04e+07	(5.07e+04/s	0.4%)
xlis_s0_i_tb.npm	205.0	3.32e+08	(1.62e+06/s)	3.30e+08	(1.61e+06/s	99.6%)	1.36e+06	(6.61e+03/s	0.4%)
xlis_s3_stall.npm	205.0	1.71e+10	(8.32e+07/s)	4.21e+09	(2.06e+07/s	24.7%)	1.28e+10	(6.26e+07/s	75.3%)
xlis_s3_stall_per.npm	205.0	4.93e+09	(2.40e+07/s)	4.25e+09	(2.07e+07/s	86.3%)	6.76e+08	(3.30e+06/s	13.7%)
xlis_s5_microword_per.npm	205.0	1.89e+04	(9.23e+01/s)	1.89e+04	(9.23e+01/s	100.0%)	0.00e+00	(0.00e+00/s	0.0%)
xlis_total_stall.npm	205.0	1.71e+10	(8.32e+07/s)	5.02e+09	(2.45e+07/s	29.5%)	1.20e+10	(5.87e+07/s	70.5%)
xlis_vic.npm	205.0	3.35e+09	(1.63e+07/s)	3.10e+09	(1.51e+07/s	92.6%)	2.48e+08	(1.21e+06/s	7.4%)

6

Rating Processor Performance

This chapter presents the results of a series of single user benchmarks used to evaluate the performance of the VAX 4000 Model 500 and the VAX 6000 Model 600 processors. These benchmarks evaluate the processor efficiency. This data must not be used to make predictions of performance in commercial environments. Sufficient data on performance in commercial environments is provided elsewhere in this Performance Summary. Throughout this chapter, optimizations refer to the use of VAX FORTRAN™ HPO (High Performance Option), VAX BLAS (Basic Linear Algebra Subprograms) libraries, the optimizing preprocessor, and the DECram™ memory disk. Test results are summarized below:

Single User Benchmark System Comparisons

Metric		VAX 4000 Model 500	VAX 6000 Model 610
TPC-A		62.4	83.6
SPEC™ Release 1.0			
	SPECmark	30.5	40.5
	SPECint	24.3	30.9
	SPECfp	35.5	48.6
DR Labs CPU2	µVUPS	50.9	56.0
Single User 99	VUPS	23.8	30.2
—Integer	VUPS	19.6	22.7
—Single	VUPS	26.0	30.9
—Double	VUPS	31.2	37.3
Dhrystone Integer	MIPS	24.7	31.2
Whetstone Single	MIPS	59.5	69.4
Whetstone Double	MIPS	56.9	65.8
LINPACKD (100x100)	MFLOPS	6.9	9.8
LL Loops (L=167)	MFLOPS	6.8	7.4
Perfect	MFLOPS	5.3	6.7
SLALOM	Patches	583	647

VUPS = VAX Units of Performance (relative to VAX 11/780)
µVUPS = VAX Units of Performance (relative to MicroVAX II)
MIPS = Millions of Instructions Per Second (relative to VAX 11/780)
MFLOPS = Millions of Floating-point Operations Per Second
SPECmark = SPEC performance relative to VAX 11/780
Patches = Size of problem solved within 1 minute for SLALOM benchmark

6.1 Introduction

Rating processor speed is becoming more and more difficult, since the rating is very sensitive to the capabilities of the processor cache and the efficiency of the compiler. Every possible effort is used in the industry to optimize this rating. In this chapter, we have used many of the Industry Standard benchmarks, as well as internally used suites, to evaluate the processors from various perspectives. The effects of using various optimizations are also discussed.

6.2 Goal

The goal of the benchmark tests reported in this chapter is to evaluate the performance of VAX 4000 Model 500 and VAX 6000 Model 610 in single-stream compute-intensive application environments. Another goal is to position these products with internal Digital products, particularly the VAX 4000 Model 200, VAX 4000 Model 300, and the VAX 6000 Model 510, as well as recently announced external products with similar price/performance.

Note

Most of these benchmarks do not measure the performance of I/O intensive applications, and these ratings must not be used to assess the performance of commercial applications.

6.3 Methodology

6.3.1 Performance Considerations

With the VAX 4000 Model 500 and VAX 6000 Model 600 systems (both using the new NVAX CPU chip), Digital is delivering leadership performance —the fastest CISC (complex instruction set computing) chip in the industry, and faster than most RISC (reduced instruction set computing) chips. With leadership in CMOS technology and architectural innovation, Digital made the chip run faster and run smarter. The chip takes VAX instructions and then executes them in a very high performance RISC-like pipeline. This means users do not have to sacrifice performance to enjoy the benefits of an established architecture like VAX.

6.3.1.1 Processor

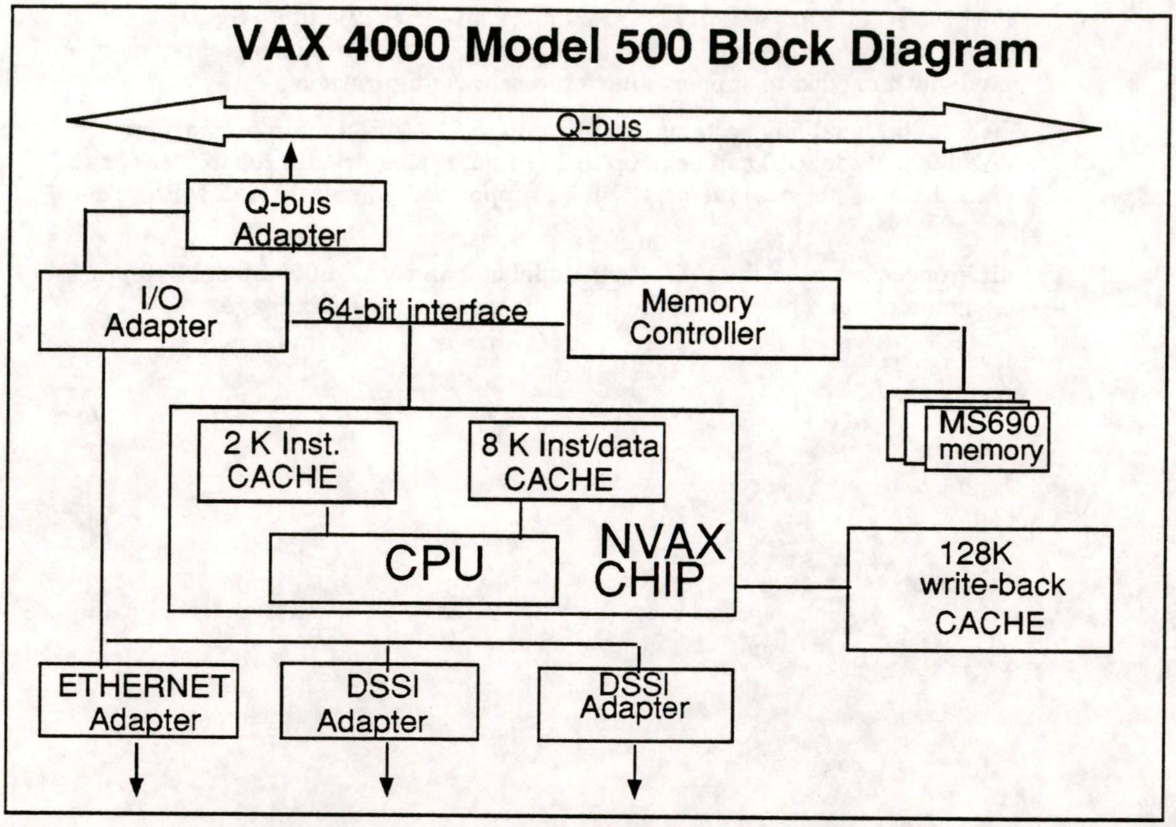
The VAX 4000 Model 500 and VAX 6000 Model 610 processors were packaged with different goals:

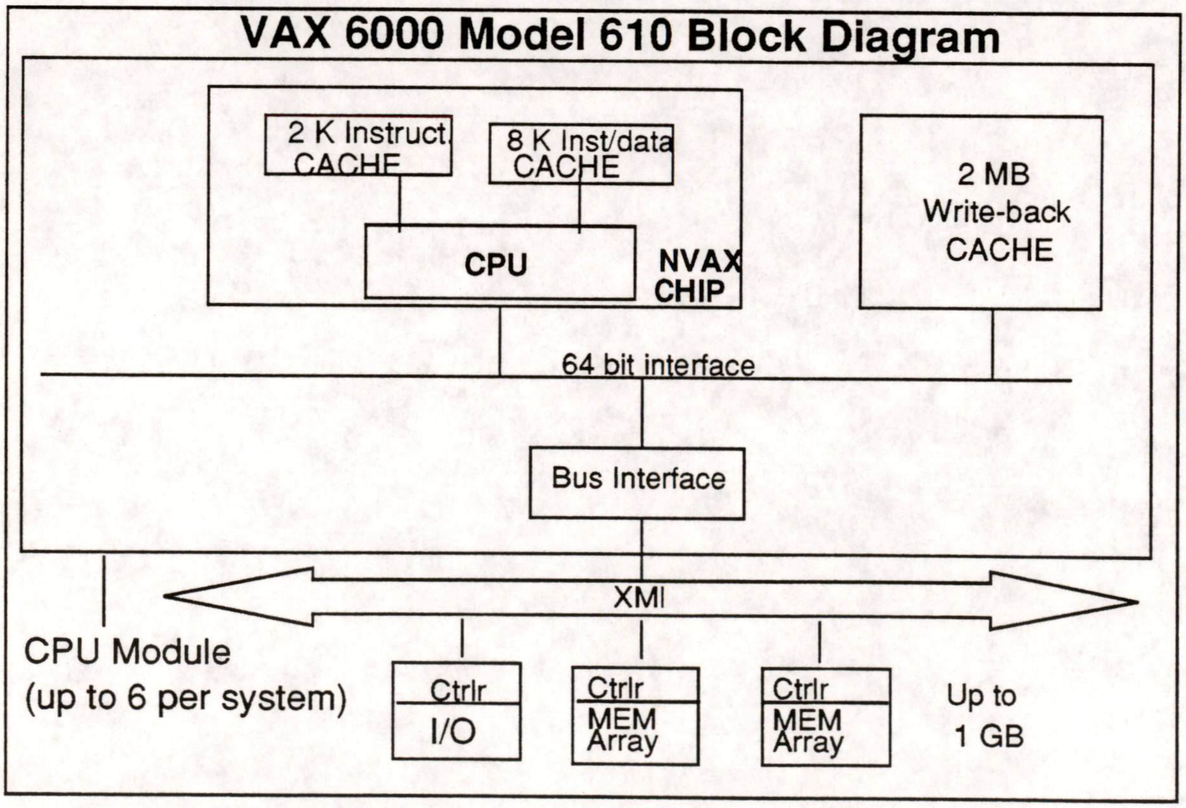
- The VAX 4000 Model 500 is a highly integrated, compact single-processor system targeted to physically reside in distributed computing environments.
- The VAX 6000 Model 610, on the other hand, was developed as an expandable data center system.
- Both systems implement the NVAX chip. The VAX 4000 Model 500 runs at 14ns cycle time, while the VAX 6000 Model 610 runs at 12ns cycle time.
- The VAX 4000 Model 500 has 128 KB write-back cache, while the VAX 6000 Model 610 has 2 MB of write-back cache.
- The VAX 4000 Model 500 has tightly coupled processor to memory interconnect called the NMI™ bus while the VAX 6000 Model 610 accesses memory through

the XMI multiprocessor system bus. When comparing these systems, the VAX 4000 Model 500 has slightly lower memory latencies due to its tightly coupled memory interface, where as the VAX 6000 Model 600 provides greater memory bandwidth needed to support multiprocessor configurations.

- VAX 4000 Model 500 systems can have up to 512 MB of main memory, while the VAX 6000 Model 610 can have up to 1 GB main memory. In future versions of VMS, 1 GB of physical memory will be supported. Currently, 512 MB are supported.

The differences between the VAX 4000 Model 500 and VAX 6000 Model 610 processors and memory can be seen on the block diagrams on the next page.


VAX 4000 Model 500 Block Diagram
Q-bus
Q-bus Adapter
I/O Adapter
64-bit interface
Memory Controller
MS690 memory
2 K Inst. CACHE
8 K Inst/data CACHE
CPU
NVAX CHIP
128K write-back CACHE
ETHERNET Adapter
DSSI Adapter
DSSI Adapter


VAX 6000 Model 610 Block Diagram
2 K Instruct. CACHE
8 K Inst/data CACHE
CPU
NVAX CHIP
2 MB Write-back CACHE
64 bit interface
Bus Interface
XMI
CPU Module
(up to 6 per system)
Ctrlr
I/O
Ctrlr
MEM Array
Ctrlr
MEM Array
Up to 1 GB

6.3.1.2 Cache

Cache size and clock speed play an important role in performance and, therefore, their impact on the performance of these systems must be understood. Table 6-1 summarizes cache capabilities of the VAX 4000 Model 500 and the VAX 6000 Model 600.

Table 6-1 Cache Information

System	Cache Size
VAX 4000 Model 500	2 KB virtual instr, 8 KB inst/data, 128 KB backup
VAX 6000 Model 610	2 KB virtual instr, 8 KB inst/data, 2 MB backup

The NVAX chip has 2 KB virtual instruction cache/8 KB instruction and data cache. Caches internal to the chip are write-thru. In the VAX 4000 Model 500 system there is 128 KB backup cache, while the VAX 6000 Model 610 has 2 MB backup cache. All backup-caches are write-back.

There is one fundamental difference between write-thru and write-back cache. When a write is received by a write-thru cache, the data may be written into the cache and is always written to memory as well. When a write is received by a write-back cache, the write is not necessarily forwarded to memory; the write may be done only into the cache. The data is written back to memory only if another element in the system needs that data, or if the block is displaced (deallocated) from the cache.

During the course of running any given application, the more frequently the required data resides in cache, the more it is possible to take advantage of the added processing power available. Those advantages, from a performance point of view, are the following:

- Reduced processor to memory traffic
- Reduced congestion on the system's bus at heavy loads
- Much faster cache access than memory access and, therefore, improvement in the speed at which a program is completed

6.3.1.3 Processor-Memory Interconnect

Memory access time plays an important role in attaining the best performance on these benchmarks.

The VAX 4000 Model 500 uses a dedicated memory bus called the NMI (NVAX Memory Interconnect), which connects to MS690 RAM modules. The system can have up to 512 MB of memory. The VAX 6000 Model 600 shares its memory interconnect with up to six processors, and up to 1 GB of memory.

6.3.1.4 Tuning/Performance Optimizations

Optimizing Preprocessor

Preprocessor optimizations helped single-user benchmarks achieve significant improvements in performance. Preprocessor optimizations include subroutine inlining, interprocedural dependency analysis (loop interchanging, loop unrolling, loop fusion, loop splitting), 2-D stripmining (cache management), and code scheduling (tree balancing, multiplication and addition splitting for unrolled loops). The preprocessor also has the ability to call standard BLAS routines that are supported in FORTRAN Run-Time Libraries (RTLs), and Digital's eXtended Math Library (DXML).

A most dramatic gain was seen in SPEC's matrix300 benchmark, much like many of our competitors. However, between 10 percent and 30 percent gains on other codes where compute-intensive operations are performed are realized, since the preprocessor can produce code that utilizes the CPU's instruction pipeline better than straight VAX FORTRAN. The C optimizations generally include automatic subroutine inlining and code scheduling. A few of the C programs in the SPEC suite have loops that will benefit from code scheduling, thus most of the C preprocessor's benefit is due to automatic subroutine inlining.

An equally dramatic gain in performance is exhibited by some of the other benchmarks. DR Labs CPU2 and Whetstone performance benefits greatly from using the automatic subroutine inline option of the preprocessor. This is especially apparent in the Whetstone benchmarks because they do a lot of subroutine calls whose performance can be optimized by using an advanced compiler that is capable of auto-inlining.

Minimizing I/O Delays

In most Single-User Benchmarks, the issue of I/O speed is minimized by tuning the systems to allow memory to accommodate the entire test image and all its data structures. No extraneous paging and I/O activity occurs except at the time of image activation or termination. For the SPEC benchmark suite, a RAM disk was used, thereby eliminating I/O latencies. This was necessary, since competitive vendor systems run the suite on UNIX systems and use large buffer caches. This is an attempt to mimic the UNIX environment, which uses buffer caches, to provide an "apples-to-apples" comparison.

6.3.2 Hardware/Software Configurations Used for Testing

Table 6-2 lists the hardware and software configurations for all Single-User Benchmarks.

Table 6-2 Hardware and Software Configuration Information

System	Memory	Disks	Controller
VAX 4000 Model 200	32MB	1 RF31	DSSI
VAX 4000 Model 300	128 MB	1 RF71	DSSI
VAX 4000 Model 500	**128 MB**	**1 RF72**	**DSSI**
VAX 6000 Model 510	256 MB	1 RA90	KDM70
VAX 6000 Model 610	**128 MB**	**1 RA90**	**KDM70**

Software Version

System	VMS	VAX C	VAX FORTRAN	VAX LISP
VAX 4000 Model 200	T5.4-1	3.1	5.4-79	3.0
VAX 4000 Model 300	X5.4-4QN	3.2	5.6	3.1
VAX 4000 Model 500	**T5.5-4Y3**	**3.2**	**5.7, HPOv1.2**	**3.1**
VAX 6000 Model 500	V5.4-4HV	3.1	5.4	3.0
VAX 6000 Model 610	**T5.5-4Y3**	**3.2**	**5.7, HPOv1.2**	**3.1**

Note

The actual memory usage on these benchmarks is very low. Systems happened to be configured with these levels of memory. For example, when running the gcc (SPEC) program, 1.93 MB of memory was used over and above the amount of memory in use when the CPU was idle (that memory usage amounted to 24.8 MB). Therefore, all Single-User Benchmark suites could have been run on systems with 32 MB of memory (or slightly less).

6.3.3 Benchmark Suites Used

The following benchmark suites are summarized in this chapter:

- SPEC Release 1.0
- DR Labs CPU2
- Single-User 99
- Whetstone
- Dhrystone
- LINPACK
- Perfect Benchmark™ Suite
- Lawrence Livermore Loops
- SLALOM

From: TARKIN::GILLETT "RICK -- 293-5788 23-Dec-1991 0119" 23-DEC-1991 01:19:08.14
To: @SPEC_DATA
CC: GILLETT
Subj: End-to-End SPEC Benchmark Statistics on VAX 6610

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+---------------------------+
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i n t e r o f f i c e

m e m o r a n d u m

To: SPEC Interest List

Date: 22-DEC-91
From: Rick Gillett
Dept: VSS/DCSS
DTN: 293-5788
Loc/Mail Stop: BXB2-2/G06
Net mail: TARKIN::GILLETT

Subject: End-to-End SPEC Benchmark Statistics for VAX 6610

We have been working on some standard data analysis tools to use with the NVAX performance monitor. Attached are the data tables which we recently generated for the entire SPEC benchmark suite (running with KAP and DECRAM) on a VAX 6610. A single summary table is followed by one page of detailed information for each benchmark.

To gather this data, the entire benchmark is executed 15 times; once for each parameter we measure. With the exception of TOMCATV (see note at the bottom of the first chart) all SPEC benchmarks run very consistently.

The individual SPEC benchmarks very greatly in how they stress the memory hierarchy. Some interesting observations:

	Minimum	Maximum
Instructions Executed	561M (tomcatv)	11050M (spice)
CPI	3.19 (eqntott)	8.61 (tomcatv)
VIC misses/second	22K (matrix300)	2900K (fpppp)
TB misses/sec	1K (tomcatv)	804K (spice)
Pcache misses/second	2K (tomcatv)	3100K (fpppp)
Bcache misses/second	0.8K (doduc)	315K (tomcatv)

Thanks to John Brown and Reynaldo Cruz for providing the data capture software, and to John Shakshober and Sean Reilly for setting up the SPEC benchmark environment.

Please respond with any comments on the information itself or the way it is presented. I will distribute a set of similar commercial test results after Christmas.

VAX 6610 NVAX Performance Monitor Statistics
22-DEC-1991

anl V0.1

	doduc	eqntott	espresso	fpppp	gcc	li	matrix 300	nasa7	spice	tomcatv	SPEC AVG	SPEC GMEAN
Run Time (sec)	51.6	33.2	84.8	70.4	48	208.4	40	360.7	856.6	58	181.17	96.95
INSTRUCTION STATS												
Instr/Sec	12.	26.1	23.	9.68	14.2	17.4	15.9	10.1	12.9	9.68	15.096	14.25
Total Instr	619	867	1950	681	682	3626	636	3643	11050	561	2432	1382
CPI	6.94	3.19	3.62	8.61	5.87	4.79	5.24	8.25	6.46	8.61	6.16	5.85
VIC (2KB Virtual Instruction Cache)												
Read Refs/Sec	9.8	23.1	19.7	8.55	14.5	15.8	9.68	8.3	11.3	8.66	12.939	12.13
Misses/Sec	0.963	0.144	0.886	2.9	2.54	1.93	0.022	0.143	0.336	0.022	0.989	0.365
Miss %	9.83%	0.62%	4.50%	33.92%	17.52%	12.22%	0.23%	1.72%	2.97%	0.26%	8.38%	3.01%
TB (96-entry fully associative Translation Buffer)												
Refs/Sec	14	11.3	12.6	23.5	12.1	16.4	28	21.9	13.3	0.241	15.334	10.62
Misses/Sec	0.037	0.115	0.164	0.098	0.21	0.055	0.046	0.19	0.804	0.001	0.172	0.075
Miss %	0.27%	1.02%	1.30%	0.42%	1.74%	0.33%	0.16%	0.87%	6.05%	0.45%	1.26%	0.71%
PCACHE (8KB write-through mixed I&D Primary Cache)												
Read Refs/Sec	14.2	11.3	12.5	23.4	12	15.6	27.9	21.3	13.1	0.0536	15.135	9.05
Misses/Sec	1.18	0.492	1.18	3.07	1.86	0.921	0.627	1.32	2.22	0.002	1.287	0.653
Miss %	8.31%	4.35%	9.44%	13.12%	15.50%	5.90%	2.25%	6.20%	16.95%	3.97%	8.60%	7.22%
BCACHE (2MB writeback mixed I&D Backup Cache)												
R+W Refs/Sec	3.78	1.53	3.53	4.89	5.28	6.59	5.16	6.69	3.24	3.21	4.39	4.07
Misses/Sec	0.001	0.005	0.002	0.001	0.025	0.003	0.012	0.071	0.05	0.318	0.049	0.009
Miss %	0.02%	0.35%	0.05%	0.01%	0.48%	0.04%	0.24%	1.06%	1.55%	9.91%	1.37%	0.23%
STALL CYCLES												
%Memory Stalls	52%	31%	32%	66%	29%	25%	53%	68%	68%	70%	49%	46%
%Any Stall	63%	32%	36%	71%	38%	29%	62%	77%	74%	79%	56%	52%
CONTEXT SWITCH STATS												
Switches/Sec	6.9	13	6.9	6.2	81.5	5.2	7.3	4.9	4.7	5.6	14.22	8.29
Sec Between	0.145	0.077	0.145	0.161	0.012	0.192	0.137	0.204	0.213	0.179	0.07	0.121

NOTES
1) Units are millions except for RUN TIME, CPI, and CONTEXT SWITCH stats.
2) All spec benchmarks were run with the KAP preprocessor and DECRAM.
   CPU utilization is >95% on all benchmarks
3) Of the SPEC suite, only TOMCATV shows significant run to run variation.
   Tomcatv sometimes runs up to 20% slower due to cache mapping conflicts.

NVAX Performance Analysis V0.1 (32dua10:[gillett.c]an1.exe;15)

! Benchmark: doduc_kd_top15
! Elapsed Time (sec) - Avg: 51.88 Min: 51.40(0.99) Max: 52.50(1.01)
! Units of Work: 1 entirerun (51.88000)

	/sec	/Unit Work	/Instruction	Total	Percent
Cycles	8.31e+07	4.29e+09	6.91e+00	4.29e+09	
Instructions	1.20e+07	6.21e+08	1.00e+00	6.21e+08	
VIC					
References	9.80e+06	5.11e+08	8.23e-01	5.11e+08	
Misses	9.63e+05	5.02e+07	8.08e-02	5.02e+07	9.82%
TB - ALL					
References	1.40e+07	7.36e+08	1.19e+00	7.36e+08	
Misses	3.72e+04	1.95e+06	3.15e-03	1.95e+06	0.27%
TB - Process I-stream					
References	1.28e+06	6.70e+07	1.08e-01	6.70e+07	
Misses	1.16e+04	6.08e+05	9.80e-04	6.08e+05	0.91%
TB - Process D-stream					
References	1.27e+07	6.56e+08	1.06e+00	6.56e+08	
Misses	2.06e+04	1.06e+06	1.71e-03	1.06e+06	0.16%
TB - System I-stream					
References	1.24e+04	6.40e+05	1.03e-03	6.40e+05	
Misses	8.06e+02	4.16e+04	6.71e-05	4.16e+04	6.51%
TB - System D-stream					
References	2.42e+05	1.24e+07	2.00e-02	1.24e+07	
Misses	4.69e+03	2.41e+05	3.89e-04	2.41e+05	1.94%
Pcache - ALL					
References	1.42e+07	7.35e+08	1.18e+00	7.35e+08	
Misses	1.18e+06	6.08e+07	9.79e-02	6.08e+07	8.27%
Pcache - I-stream					
References	1.27e+06	6.59e+07	1.06e-01	6.59e+07	
Misses	6.26e+05	3.24e+07	5.22e-02	3.24e+07	49.11%
Pcache - D-stream					
References	1.29e+07	6.69e+08	1.08e+00	6.69e+08	
Misses	5.50e+05	2.84e+07	4.58e-02	2.84e+07	4.25%
Bcache - All but writebacks					
References	3.78e+06	1.94e+08	3.13e-01	1.94e+08	
Misses	7.69e+02	3.95e+04	6.36e-05	3.95e+04	0.02%
Bcache - I-stream					
References	5.47e+05	2.81e+07	4.54e-02	2.81e+07	
Misses	2.39e+02	1.23e+04	1.98e-05	1.23e+04	0.04%
Bcache - D-stream					
References	5.81e+05	3.03e+07	4.88e-02	3.03e+07	
Misses	2.07e+03	1.08e+05	1.74e-04	1.08e+05	0.36%
Bcache - Oreads for reads and writes					
References	2.66e+06	1.39e+08	2.24e-01	1.39e+08	
Misses	2.88e+02	1.51e+04	2.43e-05	1.51e+04	0.01%
% Mem Stalls	51.61%				
% Total Stalls	62.59%				
Context Switch	6.91e+00	3.56e+02	5.74e-07	3.56e+02	

! NVAX Performance Analysis V0.1 (32dua10:[gillett.c]an1.exe;15)

! Benchmark: eqntott_top15
! Elapsed Time (sec) - Avg: 33.12 Min: 33.10(1.00) Max: 33.20(1.00)
! Units of Work: 1 entirerun (33.12000)

	/sec	/Unit Work	/Instruction	Total	Percent
Cycles	8.31e+07	2.76e+09	3.18e+00	2.76e+09	
Instructions	2.61e+07	8.68e+08	1.00e+00	8.68e+08	
VIC					
References	2.31e+07	7.64e+08	8.80e-01	7.64e+08	
Misses	1.44e+05	4.78e+06	5.50e-03	4.78e+06	0.63%
TB - ALL					
References	1.13e+07	3.76e+08	4.33e-01	3.76e+08	
Misses	1.15e+05	3.80e+06	4.38e-03	3.80e+06	1.01%
TB - Process I-stream					
References	1.13e+05	3.75e+06	4.32e-03	3.75e+06	
Misses	1.03e+03	3.41e+04	3.93e-05	3.41e+04	0.91%
TB - Process D-stream					
References	1.04e+07	3.44e+08	3.96e-01	3.44e+08	
Misses	9.33e+04	3.09e+06	3.56e-03	3.09e+06	0.90%
TB - System I-stream					
References	5.16e+04	1.71e+06	1.97e-03	1.71e+06	
Misses	3.41e+03	1.13e+05	1.30e-04	1.13e+05	6.59%
TB - System D-stream					
References	7.93e+05	2.62e+07	3.02e-02	2.62e+07	
Misses	1.69e+04	5.61e+05	6.46e-04	5.61e+05	2.14%
Pcache - ALL					
References	1.13e+07	3.75e+08	4.33e-01	3.75e+08	
Misses	4.92e+05	1.63e+07	1.88e-02	1.63e+07	4.34%
Pcache - I-stream					
References	1.66e+05	5.50e+06	6.34e-03	5.50e+06	
Misses	8.78e+04	2.91e+06	3.35e-03	2.91e+06	52.82%
Pcache - D-stream					
References	1.12e+07	3.70e+08	4.26e-01	3.70e+08	
Misses	4.04e+05	1.34e+07	1.54e-02	1.34e+07	3.62%
Bcache - All but writebacks					
References	1.53e+06	5.07e+07	5.84e-02	5.07e+07	
Misses	5.31e+03	1.76e+05	2.02e-04	1.76e+05	0.35%
Bcache - I-stream					
References	3.11e+04	1.03e+06	1.19e-03	1.03e+06	
Misses	7.02e+02	2.32e+04	2.68e-05	2.32e+04	2.25%
Bcache - D-stream					
References	4.01e+05	1.33e+07	1.53e-02	1.33e+07	
Misses	2.46e+03	8.16e+04	9.40e-05	8.16e+04	0.61%
Bcache - Oreads for reads and writes					
References	1.09e+06	3.59e+07	4.14e-02	3.59e+07	
Misses	2.22e+03	7.36e+04	8.48e-05	7.36e+04	0.20%
% Mem Stalls	30.85%				
% Total Stalls	32.00%				
Context Switch	1.30e+01	4.29e+02	4.94e-07	4.29e+02	

```
From:    RICKS::UHLER "Mike Uhler  17-Dec-1991 1326" 17-DEC-1991 13:27:35.60
To:      uhler
CC:
Subj:    Notefile OMEGA Note 207.0


            <<< DIODE::SYS$SYSDEVICE:[NOTES$LIBRARY]OMEGA.NOTE;1 >>>
                               -< Omega Project >-
================================================================================
Note 207.0                    NVAX tools perf. data                  No replies
DIODE::CROWELL "Jon Crowell"                       970 lines  10-DEC-1991 18:54
--------------------------------------------------------------------------------
From:    PHILS::DAVIS          "Todd Davis - MLO5-5/E71 - DTN: 223-5882" 10-DEC-1991 15:04:37.76
To:      CROWELL,KOPEC
CC:
Subj:    Updated KA690 performance monitoring numbers (full length testing)
```

Below is updated KA690 SPEC performance monitoring data. This data is from runs where the full length of each test was monitored. Also, the command files for the test runs were rearranged such that the monitoring does not begin until the actual test begins to run. In previous test runs, data seemed inconsistent, especially the Kuck data. It turns out that the RAM disk is loaded each time each test is run, and the monitoring was turned on during the data transfer from hard disk to RAM disk, skewing the results.

Included is a summary of each SPEC test, showing data for hard disk, RAM disk, and Kuck preprocessor runs. Also included is the raw data from the runs. (Raw data is 132 columns.)

(What else would be interesting? I previously took data for the KA680 hard disk, RAM disk, and KA690 with one slip cycle.)

Todd

DODUC:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	7.09 CPI	6.85 CPI	6.54 CPI
VIC	9.2% (9.33e5)	9.2% (9.35e5)	9.6% (8.26e5)
I_PCACHE	52.2% (6.82e5)	43.9% (5.53e5)	40.0% (4.74e5)
D_PCACHE	5.6% (7.36e5)	5.2% (6.77e5)	4.1% (4.83e5)
I_BCACHE	3.4% (1.80e4)	4.0% (2.04e4)	0.5% (2.37e3)
D_BCACHE	6.3% (4.15e4)	4.2% (2.26e4)	0.4% (1.52e3)
All BCACHE	2.3% (7.99e4)	2.1% (7.35e4)	0.1% (3.89e3)
P0_P1_I_TB	6.9% (6.14e2)	4.8% (6.19e2)	5.0% (4.67e2)
P0_P1_D_TB	0.9% (4.36e3)	0.9% (4.43e3)	3.1% (3.78e3)
S0_I_TB	0.9% (1.10e4)	0.9% (1.09e4)	0.8% (1.02e4)
S0_D_TB	0.2% (1.98e4)	0.2% (1.98e4)	0.2% (1.85e4)

EQNTOTT:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	7.52 CPI	3.19 CPI	3.21 CPI
VIC	0.0% (3.21e3)	0.4% (8.92e4)	0.5% (8.78e4)
I_PCACHE	96.8% (6.42e4)	78.1% (8.82e4)	44.6% (4.73e4)
D_PCACHE	0.0% (1.26e3)	3.6% (3.34e5)	3.8% (2.99e5)
I_BCACHE	11.3% (1.25e2)	6.3% (3.77e3)	6.3% (1.57e3)
D_BCACHE	7.9% (9.54e1)	25.2% (8.08e4)	21.4% (6.34e4)
All BCACHE	2.0% (2.70e2)	7.6% (9.15e4)	6.0% (6.64e4)
P0_P1_I_TB	0.2% (1.20e2)	10.5% (8.47e3)	7.0% (1.87e3)
P0_P1_D_TB	0.0% (3.36e2)	0.9% (1.61e4)	4.7% (1.09e4)
S0_I_TB	6.8% (1.02e1)	3.5% (1.85e3)	0.8% (6.45e2)
S0_D_TB	3.0% (2.92e1)	1.0% (7.13e4)	0.9% (6.83e4)

ESPRESSO:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	4.95 CPI	4.93 CPI	3.55 CPI
VIC	3.2% (6.40e5)	3.0% (6.07e5)	4.2% (8.03e5)
I_PCACHE	56.6% (3.88e5)	57.0% (3.89e5)	38.5% (3.92e5)
D_PCACHE	3.6% (3.86e5)	3.6% (3.86e5)	5.9% (6.56e5)
I_BCACHE	3.3% (7.94e3)	5.0% (1.18e4)	0.6% (1.15e3)
D_BCACHE	4.3% (1.54e4)	4.5% (1.61e4)	1.3% (7.64e3)
All BCACHE	1.8% (3.44e4)	2.0% (3.87e4)	0.4% (1.34e4)
P0_P1_I_TB	11.8% (2.77e4)	11.7% (2.71e4)	5.4% (9.58e2)
P0_P1_D_TB	0.4% (2.10e4)	0.4% (2.05e4)	5.1% (1.27e4)
S0_I_TB	0.8% (4.28e3)	0.7% (4.29e3)	0.5% (5.44e3)
S0_D_TB	0.3% (1.50e4)	0.3% (1.51e4)	1.3% (1.42e5)

FPPP:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	7.58 CPI	8.55 CPI	7.52 CPI
VIC	23.3% (2.27e6)	24.1% (2.34e6)	20.4% (1.91e6)
I_PCACHE	85.8% (1.91e6)	80.9% (1.73e6)	91.5% (2.05e6)
D_PCACHE	4.4% (8.76e5)	5.1% (1.02e6)	6.0% (1.24e6)
I_BCACHE	2.1% (4.04e4)	4.3% (8.18e4)	0.7% (1.49e4)
D_BCACHE	2.9% (2.74e4)	1.5% (1.58e4)	6.8% (6.67e4)
All BCACHE	0.7% (3.51e4)	5.2% (2.44e5)	0.5% (2.19e4)
P0_P1_I_TB	8.5% (6.16e2)	9.4% (5.81e2)	7.5% (4.54e2)
P0_P1_D_TB	2.1% (8.74e3)	2.1% (8.67e3)	4.9% (8.21e3)
S0_I_TB	2.1% (4.78e4)	2.1% (4.79e4)	2.1% (4.81e4)
S0_D_TB	0.2% (4.10e4)	0.2% (4.10e4)	0.2% (3.86e4)

GCC:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	6.99 CPI	6.99 CPI	5.68 CPI
VIC	2.9% (5.81e5)	2.8% (5.67e5)	14.5% (1.94e6)
I_PCACHE	61.0% (4.51e5)	60.5% (4.65e5)	46.7% (9.30e5)
D_PCACHE	1.9% (2.08e5)	2.0% (2.14e5)	7.6% (6.72e5)
I_BCACHE	6.3% (1.47e4)	6.3% (1.48e4)	4.3% (3.18e4)
D_BCACHE	7.7% (1.47e4)	7.7% (1.52e4)	6.5% (4.00e4)
All BCACHE	2.7% (3.90e4)	2.8% (4.14e4)	2.1% (1.03e5)
P0_P1_I_TB	2.8% (7.37e3)	2.6% (7.55e3)	6.2% (1.41e4)
P0_P1_D_TB	0.2% (1.63e4)	0.2% (1.70e4)	4.0% (3.33e4)
S0_I_TB	1.9% (1.01e4)	1.9% (1.03e4)	1.7% (3.30e4)
S0_D_TB	1.3% (2.89e4)	1.3% (2.94e4)	1.3% (1.08e5)

MATRIX:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	11.1 CPI	11.2 CPI	5.08 CPI
VIC	0.3% (1.60e4)	0.2% (1.40e4)	0.1% (2.88e3)
I_PCACHE	87.8% (2.15e4)	87.7% (2.10e4)	79.4% (4.30e3)
D_PCACHE	22.0% (2.50e6)	22.1% (2.50e6)	1.9% (1.27e5)
I_BCACHE	30.0% (1.42e3)	21.0% (8.48e2)	19.3% (2.43e2)
D_BCACHE	13.5% (3.37e5)	13.7% (3.41e5)	20.1% (2.35e4)
All BCACHE	9.0% (3.58e5)	9.6% (3.81e5)	2.0% (2.51e4)
P0_P1_I_TB	6.6% (4.94e2)	6.4% (4.87e2)	5.2% (1.33e2)
P0_P1_D_TB	5.1% (8.07e4)	5.1% (8.05e4)	2.6% (9.64e2)
S0_I_TB	18.6% (3.93e3)	18.8% (3.98e3)	4.7% (1.03e2)
S0_D_TB	14.4% (1.40e6)	14.4% (1.40e6)	0.2% (1.97e3)

NASKER:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	12.3 CPI	12.3 CPI	9.71 CPI
VIC	2.6% (3.58e5)	2.6% (3.56e5)	2.0% (2.20e5)
I_PCACHE	65.6% (1.76e5)	66.9% (1.88e5)	83.6% (1.23e5)
D_PCACHE	19.8% (5.56e6)	19.8% (5.54e6)	5.8% (1.63e6)
I_BCACHE	2.0% (2.86e3)	1.9% (2.87e3)	13.2% (2.05e3)
D_BCACHE	22.5% (8.87e5)	19.8% (5.54e6)	30.4% (4.80e5)
All BCACHE	12.8% (1.31e6)	13.2% (1.33e6)	7.8% (6.98e5)
P0_P1_I_TB	11.4% (1.06e3)	11.0% (1.07e3)	8.8% (6.49e2)
P0_P1_D_TB	6.4% (8.83e4)	6.4% (8.59e4)	5.3% (1.50e4)
S0_I_TB	1.9% (4.94e3)	2.0% (4.94e3)	2.1% (3.18e3)
S0_D_TB	4.5% (1.19e6)	4.4% (1.17e6)	0.8% (2.30e5)

SPICE:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	7.35 CPI	7.30 CPI	6.99 CPI
VIC	2.5% (2.61e6)	2.4% (2.51e6)	2.7% (2.77e6)
I_PCACHE	47.6% (1.47e6)	51.5% (1.56e6)	44.8% (1.39e6)
D_PCACHE	17.0% (1.95e7)	17.2% (1.94e7)	16.2% (1.87e7)
I_BCACHE	16.0% (2.48e5)	2.3% (2.75e4)	2.7% (3.83e4)
D_BCACHE	15.1% (2.75e6)	15.0% (2.72e6)	15.1% (2.80e6)
All BCACHE	9.7% (3.02e6)	10.2% (3.14e6)	10.0% (2.94e6)
P0_P1_I_TB	10.1% (4.62e3)	9.4% (4.53e3)	9.9% (4.03e3)
P0_P1_D_TB	9.1% (8.44e5)	9.1% (8.48e5)	5.6% (6.04e6)
S0_I_TB	2.2% (6.99e4)	2.3% (7.02e4)	2.7% (8.42e4)
S0_D_TB	5.6% (5.83e6)	5.6% (5.82e6)	5.6% (6.04e6)

TOMCATV:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	8.62 CPI	8.62 CPI	8.93 CPI
VIC	1.0% (1.06e5)	1.1% (1.23e5)	0.2% (1.34e4)
I_PCACHE	93.8% (1.10e5)	93.0% (1.01e5)	91.7% (5.10e4)
D_PCACHE	4.8% (8.23e5)	4.8% (8.27e5)	7.1% (8.39e5)
I_BCACHE	25.3% (1.88e3)	25.9% (1.84e3)	32.8% (1.34e3)
D_BCACHE	43.7% (3.44e5)	43.4% (3.43e5)	42.7% (3.58e5)
All BCACHE	15.5% (4.91e5)	15.5% (4.91e5)	17.3% (5.25e5)
P0_P1_I_TB	3.6% (6.18e2)	4.1% (6.33e2)	4.4% (4.83e2)
P0_P1_D_TB	0.3% (3.96e3)	0.3% (3.79e3)	3.4% (3.48e3)
S0_I_TB	0.9% (1.11e3)	0.9% (1.12e3)	0.6% (3.04e2)
S0_D_TB	0.1% (2.20e4)	0.1% (2.21e4)	0.2% (2.31e4)

XLISP:

	KA690 harddisk %misses (miss/sec)	KA690 RAMdisk %misses (miss/sec)	KA690 RAMdisk KAP %misses (miss/sec)
CPI	4.78 CPI	4.76 CPI	4.52 CPI
VIC	7.9% (1.25e6)	8.4% (1.33e6)	9.8% (1.52e6)
I_PCACHE	35.4% (5.47e5)	36.3% (5.59e5)	22.4% (3.86e5)
D_PCACHE	3.2% (4.42e5)	4.6% (6.13e5)	4.6% (6.25e5)
I_BCACHE	2.5% (9.76e3)	0.9% (3.75e3)	0.2% (5.06e2)
D_BCACHE	4.1% (2.22e4)	6.8% (3.73e4)	1.4% (7.98e3)
All BCACHE	0.7% (4.03e4)	0.5% (3.17e4)	0.6% (3.91e4)
P0_P1_I_TB	7.3% (1.03e4)	6.4% (1.01e4)	3.6% (4.07e3)
P0_P1_D_TB	1.0% (1.02e4)	1.0% (1.02e4)	5.9% (6.06e3)
S0_I_TB	0.4% (6.49e3)	0.4% (6.45e3)	0.3% (5.63e3)
S0_D_TB	0.4% (5.20e4)	0.4% (5.10e4)	0.2% (3.26e4)

Included in this report:

- TPC Benchmark™ A
- PC Clients Served
- SPEC® Release 1
- Office Automation
- Relative Performance

VAX 4000 Performance Report

Product Family Description

The VAX 4000 family incorporates revolutionary I/O throughput and innovative deskside packaging. It offers customers leadership price/performance while ensuring expansion capabilities and investment protection. VAX 4000 systems are designed to enable flexible, distributed processing in open workspace environments. The product family consists of the Model 200, the Model 300 and the new Model 500.

The VAX 4000 Model 500 provides leadership commercial performance against UNIX® systems and any other proprietary systems in its price class. The price/performance of the Model 500 is superior to that of the best systems in the commercial marketplace in its class, as is clearly demonstrated by the audited TPC Benchmark™ A results.

VAX 4000 Performance

The performance of the VAX 4000 systems was evaluated using both industry standard and Digital internal benchmarks and workloads. The industry standard benchmarks used are defined by a consortium of vendors and are agreed to represent specific application environments. These benchmarks allow vendors to compare their systems with other vendors' systems. The Digital internal benchmarks and workloads are based on customer application environments.

Some benchmarks, like SPECmark, are single stream, compute-intensive tests that characterize processor capabilities and must not be used to predict system-level performance. Other benchmarks, such as TPC Benchmark A, test entire system performance requiring the efficiency of not only the processor, but memory and I/O subsystems as well.

Performance characterization is one "data point" to be used in conjunction with other purchase criteria such as features, service and price. Features may include resource sharing with VAXclusters; multi-vendor integration with Network Application Support (NAS); and network management with DECmcc.

Note: The performance information in this report is for guidance only. System performance is highly dependent upon application characteristics. Individual work environments must be carefully evaluated and understood before making estimates of expected performance. This report simply presents the data, based on specified benchmarks and workloads.

For more information on the VAX 4000 family of products, please contact your local Digital sales representative.

TPC Benchmark™ A

Benchmark Description:

Transaction processing is found in many industries such as retail banking, financial trading, warehouse and distribution management, retail management and inventory control. On-line Transaction Processing (OLTP) environments emphasize update-intensive database services, which are characterized by multiple terminal sessions, significant disk input/output, a specified execution time and transaction integrity.

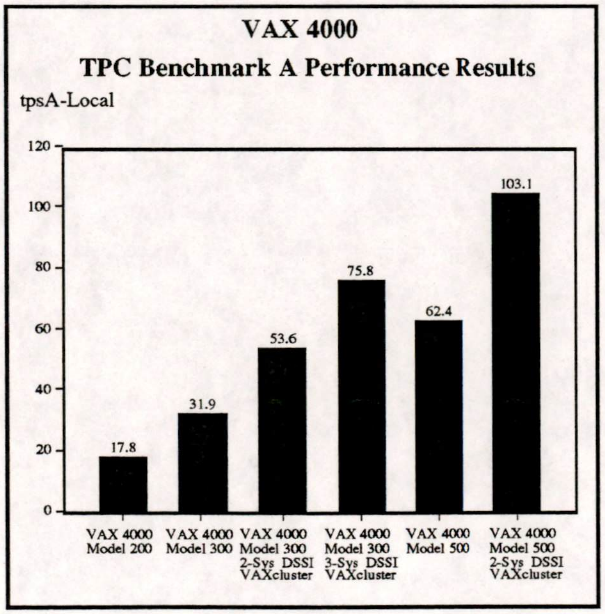
In order to test these variables, the TPC Benchmark A, which represents a banking network, was developed by the Transaction Processing Performance Council (TPC) as a vendor neutral, standard specification for measuring the number of transactions a system is capable of executing in a given period of time. The transaction, which is performed by a bank teller at a branch, represents the work done when a customer makes a deposit or withdrawal against an account. The benchmark requires that 90% of all transactions complete in less than two seconds. These results serve as useful criteria for businesses who depend on providing timely service to their customers in order to gain a competitive edge.

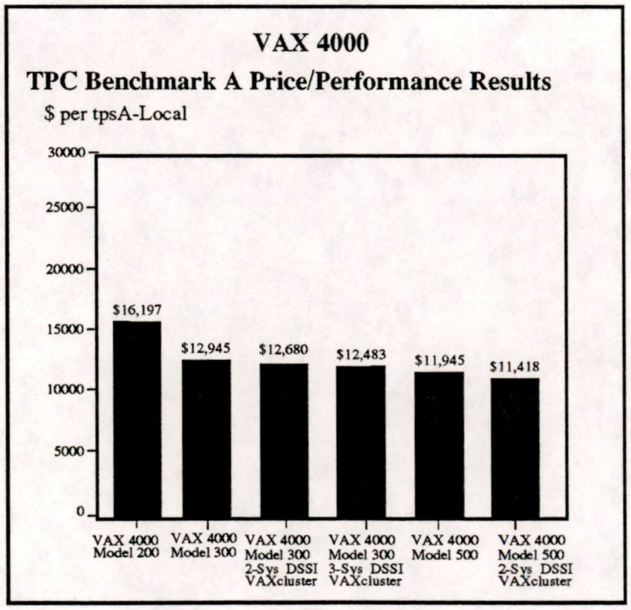
The metrics used are:

- tpsA-Local™, throughput as measured in transactions per second (tps), subject to response time constraints; and
- $ per tpsA-Local, or the associated price-per-tpsA, which is based on a five-year cost of ownership.

TPC Benchmark A Results:

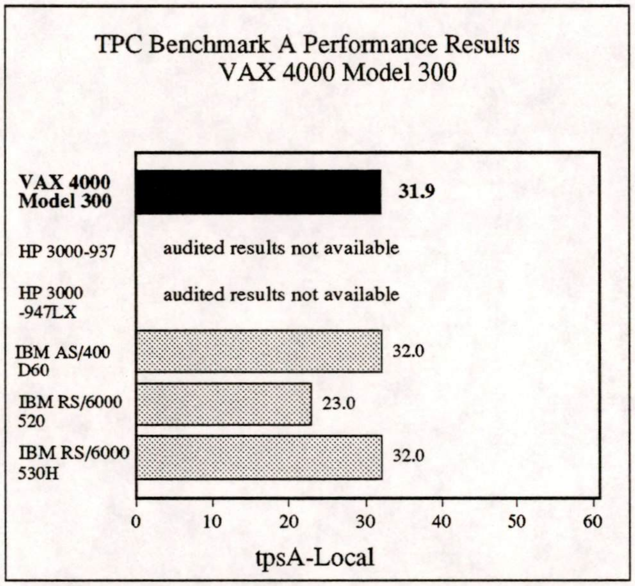
All systems were tested with ACMS version 3.2 (tp monitor) and Rdb/VMS version 4.1. While maintaining the required two-second response time, the following tpsA-Local results were delivered for this benchmark:

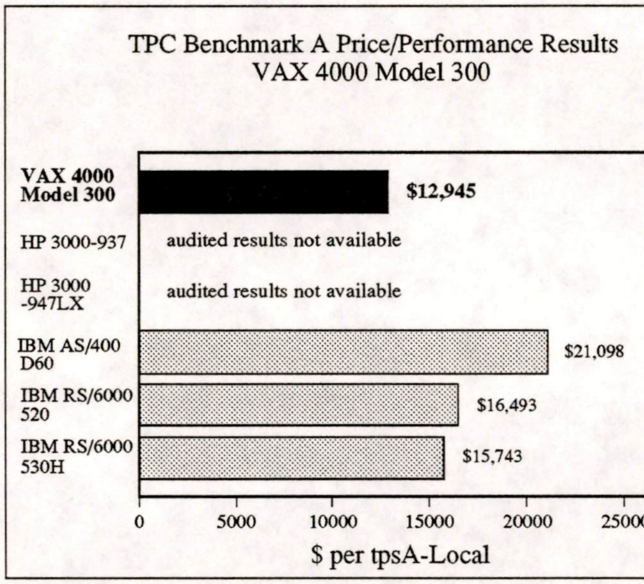


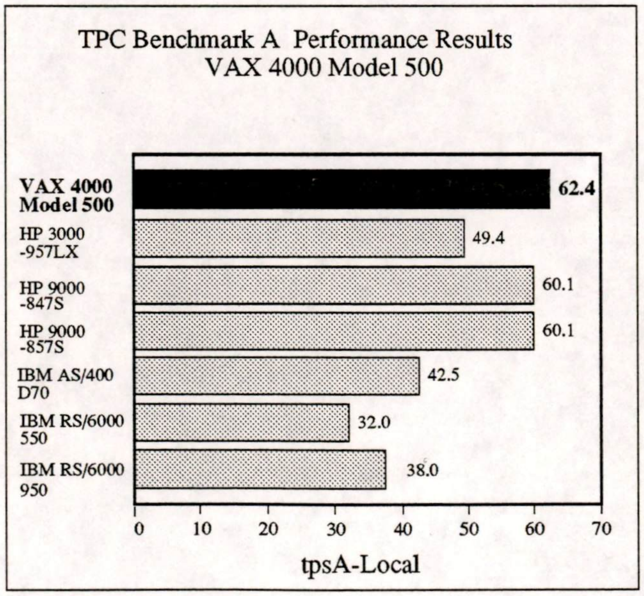


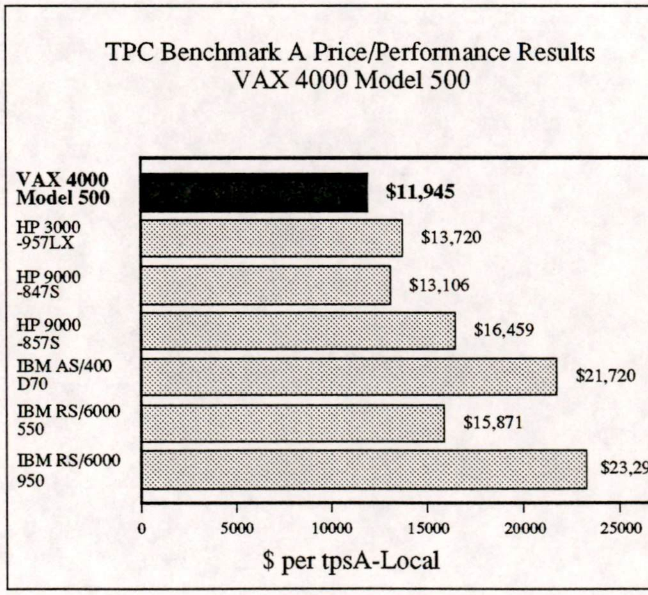
The purpose of publishing the TPC Benchmark A results is to provide a comparison of equivalent systems from various manufacturers. Systems that produce high tpsA-Local performance results and low dollars ($) per tpsA-Local price/performance cost are therefore judged to be the most powerful and the most economical. In order to help customers in making their selections, the Transaction Processing Performance Council publishes a report called the *Complete TPC Results*.

The data illustrated in the graphs below demonstrates the leadership performance and cost-effectiveness of the VAX 4000 Models 300 and 500 as compared to equivalent models from other vendors. The source of the comparative information is the January 10, 1992 issue of the *Complete TPC Results*.





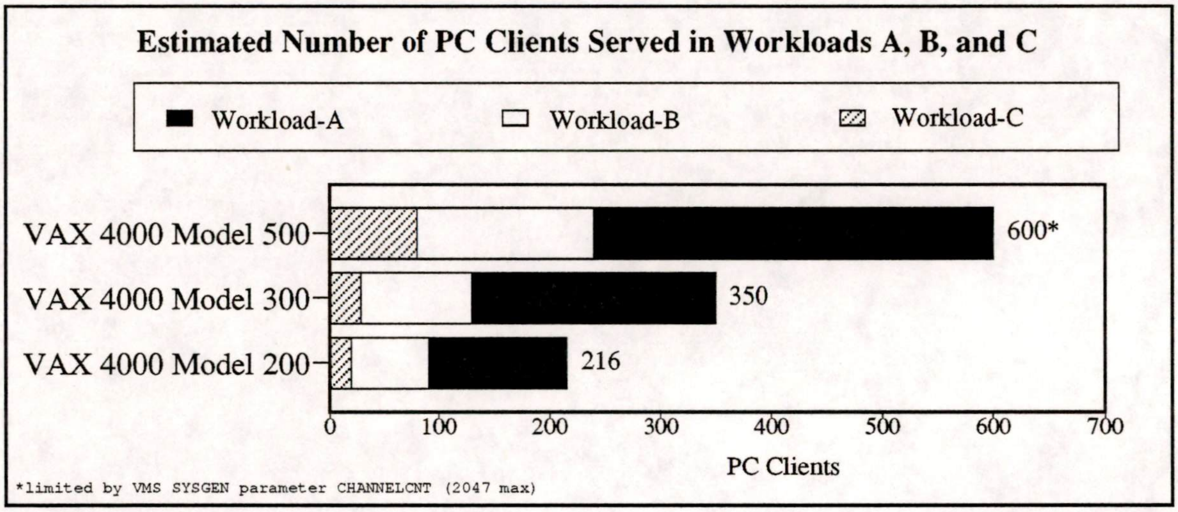




PC Clients Served

PC Client Workload Descriptions

The VAX 4000 family of products is an ideal server for PC clients. In order to characterize the quantity of PC clients served, four workloads are provided to characterize typical user environments. The results are modeled data represented in the associated graphs.



Workload-A -- File and Print Services:

Workload-A typifies very simplistic print and file services where the application users access the file server just as a repository to save or open application files. Listed below are the specifications of running this workload.

- Each user has a maximum of two files open at once.
- There is no database access or databases which are used once an hour or less.
- Power-user[1] techniques are not being employed, such as macros or automated scripts, which intensify server read/write access. Increased work is accomplished in a given time and therefore, saves rates.
- Automated file output techniques, such as word processing, form letter generation, or CAD bills of materials, are not in use.
- Applications with automatic saves enabled are not used.
- There are no MS-Windows™ users.
- All temporary files are on local disks.

[1]*Power users employ techniques using macros, may have up to six files open at once, database access may be continuous but not time-constrained by direct customer interaction (for example, 911 emergency or point-of-sale).*

Workload-B -- Database Services:

Workload-B represents a more demanding version of Workload-A. Less than five percent of the users have switched to power users (or five percent of the time, they are all power users).

The 5% power users may:

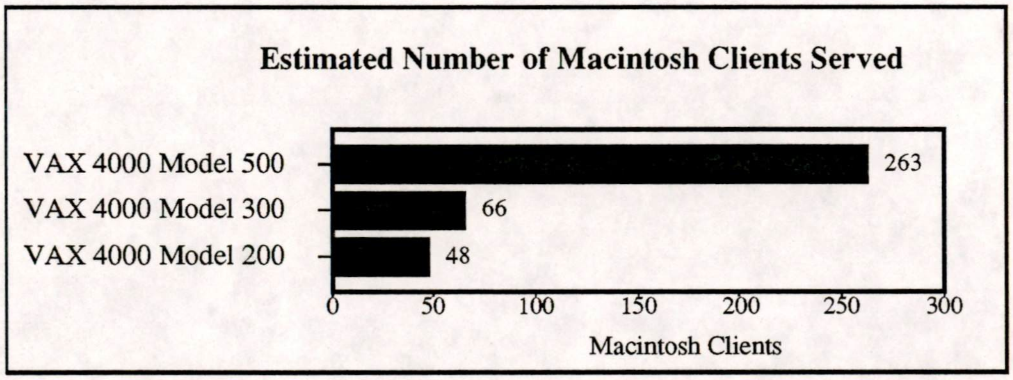
- use automated file output techniques,
- have automatic saves enabled,
- be running MS-Windows, and/or
- have temporary files on server disks.

Workload-C -- Heavy Database Services:

Workload-C represents a more mature version of Workload B above. In this case, perhaps one-third of the users are power users. Each power user may:

- have 5 to 20 files open at once,
- access a database expecting subsecond response times,
- compile and link large numbers of modules,
- copy whole directories to the server,
- file automatically every ten minutes (WordPerfect™),
- have temporary files open on the server,
- be using MS-Windows, and/or
- use automated output and macros.

Workload-D -- Macintosh® Clients:



Workload-D is made up of Macintosh clients executing office and chemical engineering tasks. While all workloads shown are primarily CPU bound, this one is almost exclusively CPU bound.

Note: These workloads are being provided for the purposes of preliminary sizing only. Variants of hardware configurations or client requirements may differ with results generated by these workloads. Please consult your local Digital PC Integration Support Specialist for final review and interpretation of this data for your environment.

SPEC® Release 1

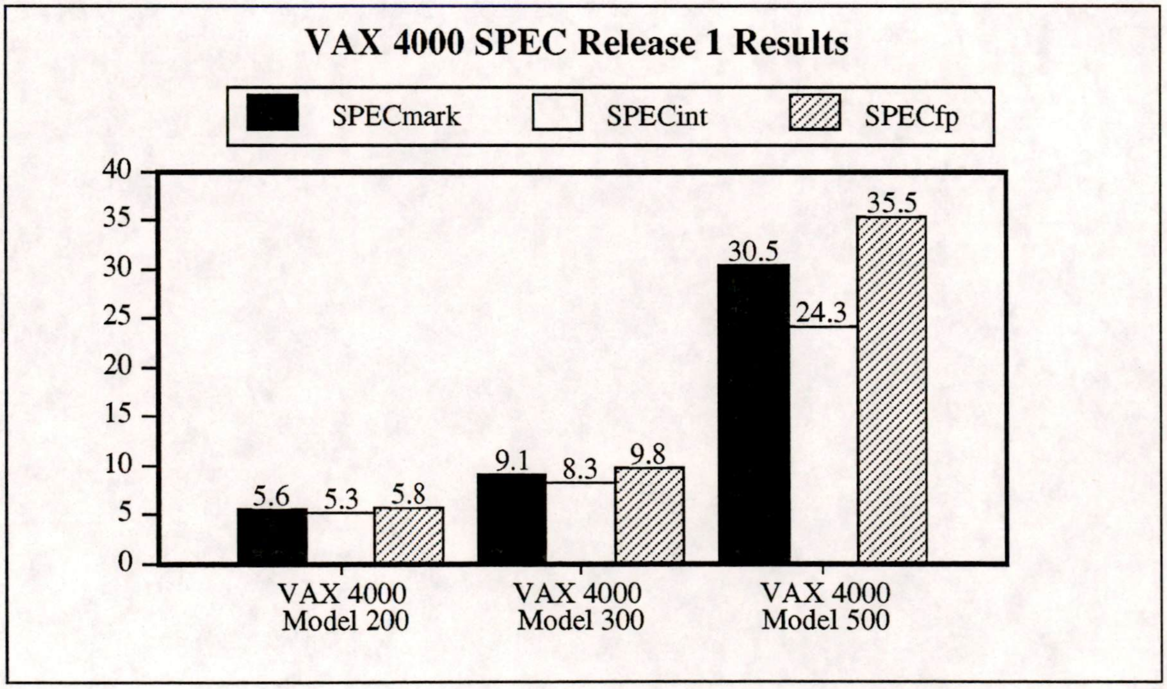
Benchmark Description:

The System Performance Evaluation Cooperative (SPEC) consists of 23 vendors who work together on developing performance benchmarks that can be run on multiple vendors' platforms. The SPEC Benchmark Suite consists of ten engineering and scientific compute-intensive benchmarks with six FORTRAN double-precision floating point benchmarks (SPECfp) and four integer benchmarks (SPECint) written in C. For each benchmark, a SPEC Ratio of elapsed time is obtained. The geometric mean of all ten SPEC Ratios yields the SPECmark.

SPECmarks are generally considered to be a workstation metric. Few midrange vendors report their results, as it is potentially misleading for commercial performance. What makes it misleading is the fact that the SPECmark is the geometric mean of ten disparate tests and these tests do not exercise I/O, nor do the tests predict heavy real-world context switching application performance. SPEC performance is useful for determining the speed of the CPU itself. For commercial and other specific user environments, benchmarks such as TPC Benchmark™ A provide more useful data.

SPEC Results:

For this benchmark, the following SPEC results were delivered. Refer to the *SPEC Newsletter* for continuous reporting of SPEC data. Note: The performance numbers of the VAX 4000 systems were measured using advanced VAX compiler technologies.



Office Automation

Workload Description:

Banks, branch offices, retail businesses, manufacturing sites, health care facilities, software development houses, and other businesses, all include office end users. These office users typically perform a variety of tasks such as word processing, electronic mail and time management functions.

ALL-IN-1, Digital's office application, provides these services to users. The ALL-IN-1 Office End-User (OEU) workload, which is based on the ALL-IN-1 office software product, is comprised of the same mix of general office tasks, and is used to determine the maximum number of users and subscribers supported by various VAX systems.

Using the results of the ALL-IN-1/OEU workload, businesses can determine the appropriate VAX system required to support their office users. The number of subscribers demonstrates how many people can be supported by a system while 50% are actively using their accounts.

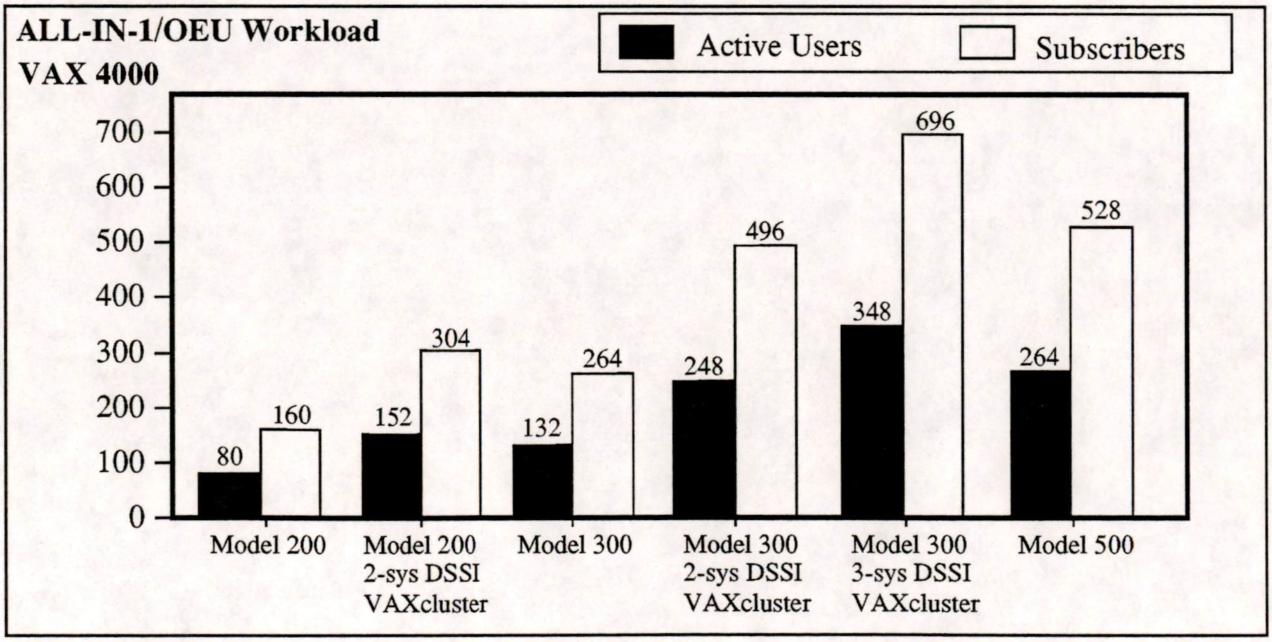
Office Automation Results:

For this workload, the following number of subscribers were delivered:

- VAX 4000 Model 500 — 528 subscribers
- VAX 4000 Model 300 — 264 subscribers
- VAX 4000 Model 200 — 160 subscribers

DSSI VAXcluster configurations were also tested; the results are:

- VAX 4000 Model 300 three-system DSSI VAXcluster — 696 subscribers
- VAX 4000 Model 300 two-system DSSI VAXcluster — 496 subscribers
- VAX 4000 Model 200 two-system DSSI VAXcluster — 304 subscribers

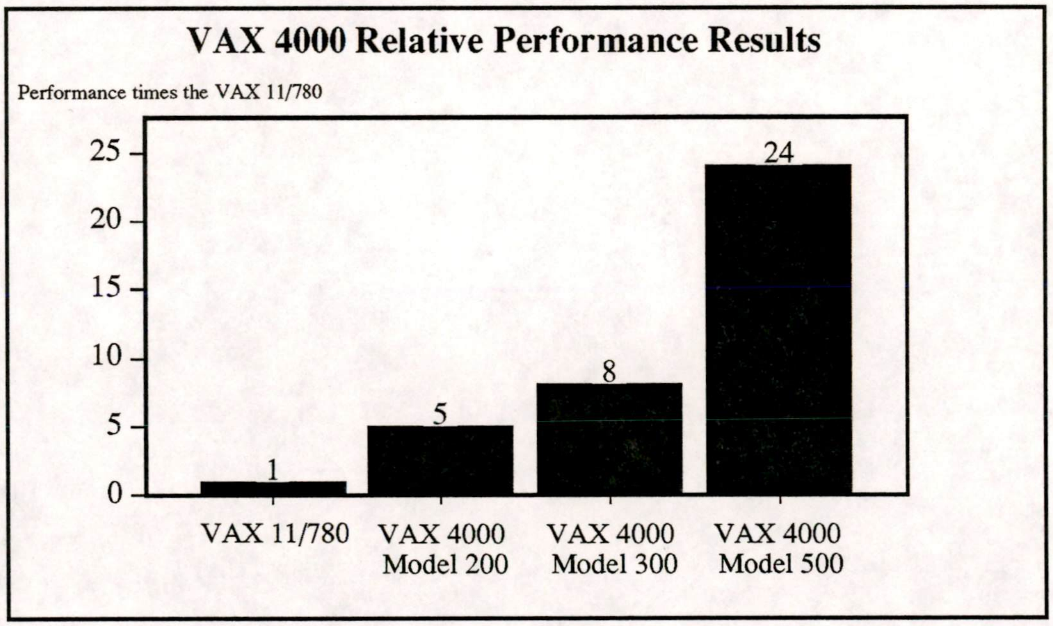


Relative Performance

Benchmark Description:

A suite of benchmarks is used to calculate the relative performance of VAX systems. These CPU-intensive programs use data sets of various sizes and data types to test the performance effects of CPU design and the efficiency of manipulating basic data types. Relative positioning is established by comparing the performance of the system under test with that of the VAX 11/780. Relative performance is the mean of those results and can be used as a relative measure in predicting CPU performance of one VAX over another. It does have some caveats in that it does not predict I/O performance, bandwith, or expandability. Relative performance is reported in order to provide a relative CPU measurement that can be consistently applied to position VAX products from the VAXstation up to the VAX 9000 mainframe, from the oldest VAX a customer might own to the newest VAX a customer may consider.

Relative Performance Results:



VAX 6000 Datacenter Systems Performance Report

Included in this report:

- TPC Benchmark™ A
- ALL-IN-1™/OEU
- Relative Performance
- Commercial Batch Benchmark
- SPEC® Release 1.2

VAX 6000 Product Description

VAX 6000 systems provide datacenter solutions across a wide range of applications. By this, we mean that VAX 6000 systems provide the necessary capabilities to support your most critical data or applications -- your key information assets. Datacenter managers do not have to compromise performance, price/performance, functionality, quality, or openness with VAX 6000 systems. New VAX 6000 Model 600 systems now deliver leadership performance and price/performance -- even better than RISC systems from IBM or HP.

VAX 6000 Performance

In order to evaluate the performance of the VAX 6000 systems, both commercial and technical benchmarks/workloads were used. VAX 6000 systems provide excellent performance under several commercial applications. The new VAX 6000 Model 610 takes a leadership position with TPC Benchmark A, an industry-standard transaction-processing workload, used to simulate an on-line transaction processing banking network environment. The ALL-IN-1 Office End-User (OEU) workload, developed by Digital, consists of a number of general office tasks, and is used to determine the maximum number of users supported by VAX systems. This workload clearly demonstrates that VAX 6000 datacenter systems can support large, demanding office environments.

The outstanding processing power available on VAX 6000 systems makes them equally attractive in the technical environment. SPEC Release 1.2 benchmark suite is used to evaluate processor power and compiler efficiency. The programs in the suite represent both electronic engineering and scientific applications. These benchmarks are single-stream and compute-intensive. In addition, a Digital-developed suite of compute-intensive benchmarks is used to compare relative performance among different VAX systems.

Note: The performance information in this report is for guidance only. System performance is highly dependent upon application characteristics. Individual work environments must be carefully evaluated and understood before making estimates of expected performance. The report simply presents the data, based on specified benchmarks and workloads.

For more information on VAX 6000 systems, please contact your local Digital sales representative.

TPC Benchmark™ A

Transaction processing is found in many industries such as finance, manufacturing, telecommunications, retailing and healthcare. On-line Transaction Processing (OLTP) environments emphasize update-intensive database services characterized by multiple terminal sessions, significant disk input/output, a specified execution time and transaction integrity.

Benchmark Description:

In order to test these variables, the TPC Benchmark A, which represents a banking network, was developed by the Transaction Processing Performance Council (TPC) as a vendor neutral, standard specification for measuring the number of transactions a system is capable of executing in a given period of time. The transaction, which is performed by a bank teller at a branch, represents the work done when a customer makes a deposit or withdrawal against an account. The benchmark requires that 90% of all transactions complete in less than two seconds. These results serve as useful criteria for businesses who depend upon providing timely service to their customers in order to gain a competitive edge.

Performance Metrics:

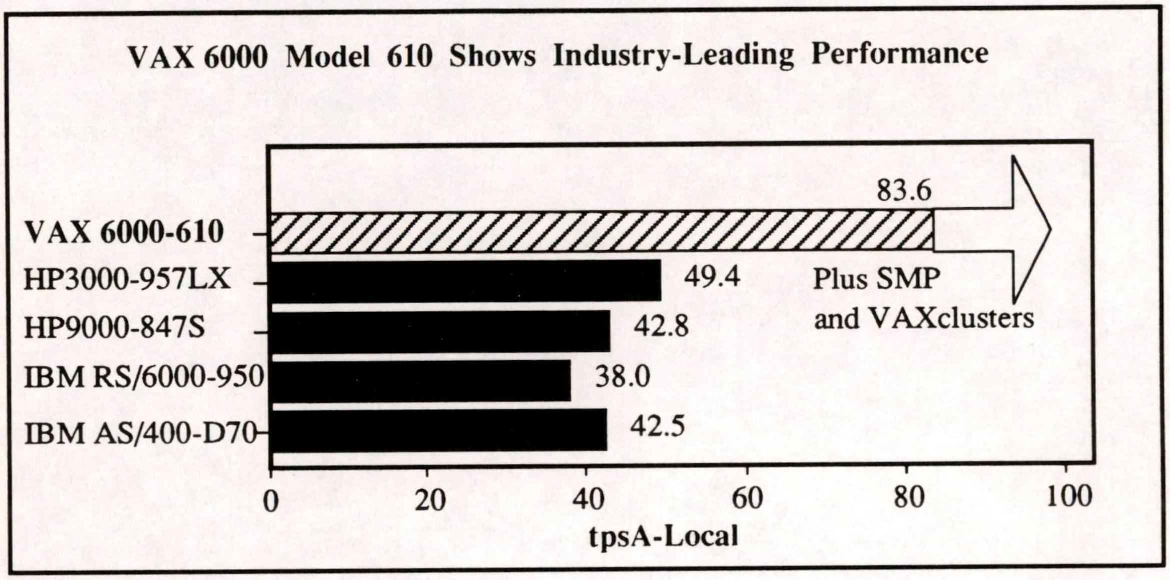
- tpsA-Local™ is defined as the number of transactions executed per second under the TPC Benchmark A.
- $ per tpsA-Local is the associated price-per-tps metric, which is based on a five-year cost of ownership.

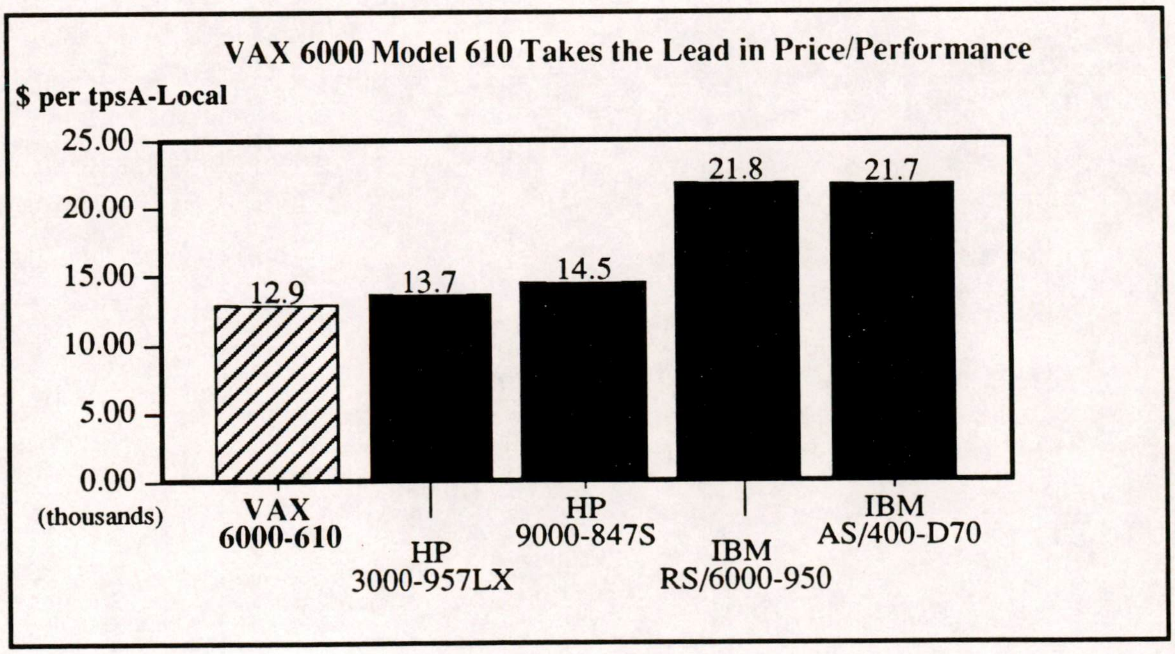
Results:

Using VAX Rdb V4.1, the VAX 6000 Model 610 clearly delivers leadership performance and price/performance with independently-audited benchmark results of 83.6 tpsA-Local at $12,922 per tpsA-Local. As shown below, the VAX 6000 Model 610 system provides leadership capabilities compared to models with the highest-announced TPC-A results.

	tpsA-Local	$ per tpsA-Local
• *VAX 6000 Model 610*	*83.6*	*12,922*
• HP3000-957LX	49.4	13,720
• HP9000-847S	42.8	14,560
• IBM RS/6000-950	38.0	21,823
• IBM AS/400-D70	42.5	21,720

The charts below demonstrate the high performance and low cost of the VAX 6000 Model 610 system compared to the highest-reported tpsA-Local results available from other vendors. The source of this information is the September 30, 1991 issue of the *Complete TPC Results*, published by the Transaction Processing Performance Council. Starting with the Model 610, up to five additional processors can be added to achieve six-way, symmetric multiprocessing, providing even higher levels of performance. VAX 6000 systems can then be grouped together in VAXcluster configurations for even higher performance. These are the performance levels required for today's demanding datacenter applications.





ALL-IN-1™ Multiuser, Multiprocessor Performance

Benchmark Description:

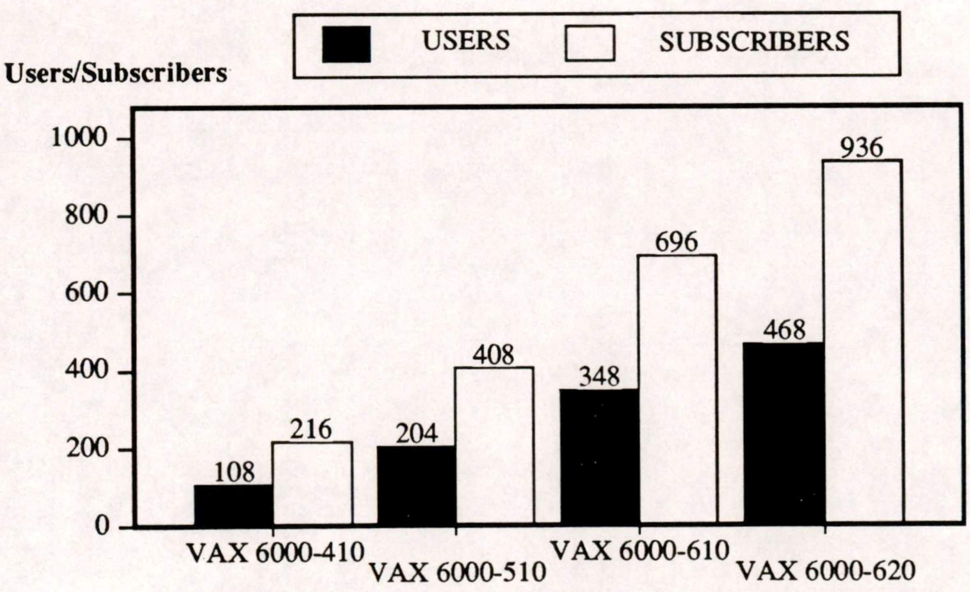
Banks, branch offices, retail businesses, manufacturing sites, health care facilities, software development houses, and other businesses, all include office end users. These office users typically perform a variety of tasks such as word processing, electronic mail and time management functions.

The ALL-IN-1 Office End-User (OEU) workload, which is based on Digital's ALL-IN-1 office software product, is comprised of the same mix of general office tasks, and is used to determine the maximum number of users and subscribers supported by various VAX systems. Using the results of the ALL-IN-1/OEU workload, businesses can determine the appropriate VAX 6000 system required to support their office users.

Results:

The VAX 6000 Model 610 uniprocessor supports almost 700 subscribers under the ALL-IN-1/OEU workload. The dual processor, Model 620, supports even more subscribers (936) using SMP. Supporting over 900 subscribers in this rigorous environment demonstrates the powerful performance and commercial strength of VAX 6000 systems. The number of subscribers indicates how many people can be supported by a system while 50% are actively using their accounts.

VAX 6000 ALL-IN-1 Results



Commercial Batch Benchmarks

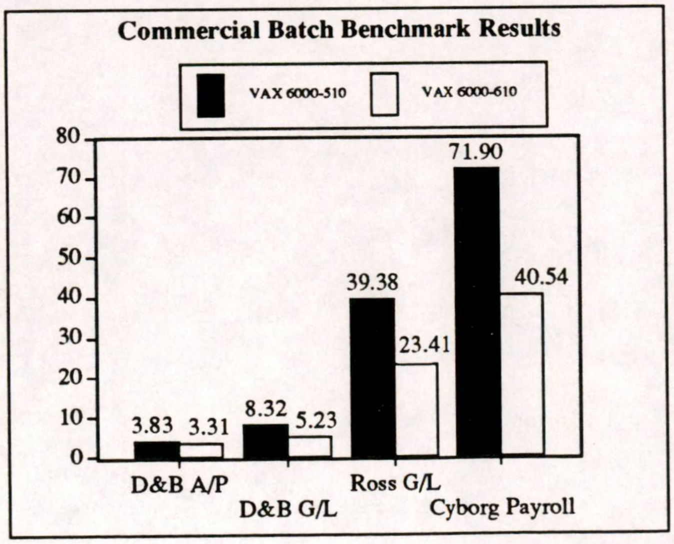
Workload Description:

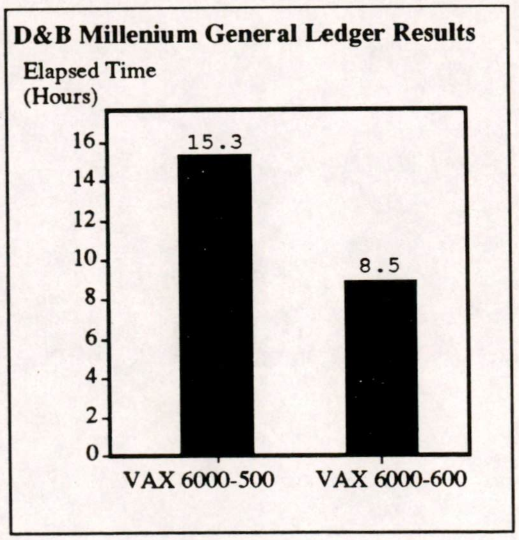
The commercial batch suite consists of four COBOL programs developed by Digital and is based on corporate financial applications from Dun and Bradstreet, Ross Systems, and Cyborg Systems. General ledger, accounts receivable/payable, and payroll are typical financial functions required by businesses. In the Commercial Batch Benchmarks, a substantial portion of the computing required consists of large batch jobs to support these functions.

- Dun and Bradstreet Accounts Payable - processes 545 Accounts Payable Vouchers against 240,000 Master File Records, 77,000 Vendor Master File Records, and 73,000 Current Invoice File Records.
- Dun and Bradstreet General Ledger - simulates each transaction's read, edit, and posting of 24,000 records to a 26,000 record General Ledger Master File.
- Ross General Ledger - simulates the reporting functions during the end-of-month update to a general ledger master file containing 37,000 records. It does not simulate the processing of detail journals or posting and update operations.
- Cyborg Payroll - simulates the calculation of a weekly payroll consisting of 60,000 employees with a timecard-to-employee ratio of 2:1. Overall, the Cyborg payroll simulates a 120,000 transaction workload. It does not include printing the checks.
- Dun and Bradstreet Millenium General Ledger - simulates quarter-ending financial report of a Fortune 10 company with two million journal entries. Tasks include sort, print, and copy.

Results:

The results show that the new VAX 6000 Model 610 datacenter system cuts the time required to complete these demanding financial tasks. For example, the Millenium batch job, running on the Model 610, now completes overnight -- so other activities can take place promptly the next day. Note: The data represented in this analysis is meant solely to position Digital platforms. The data is not meant to position the applications, especially since the databases used for each application are different.





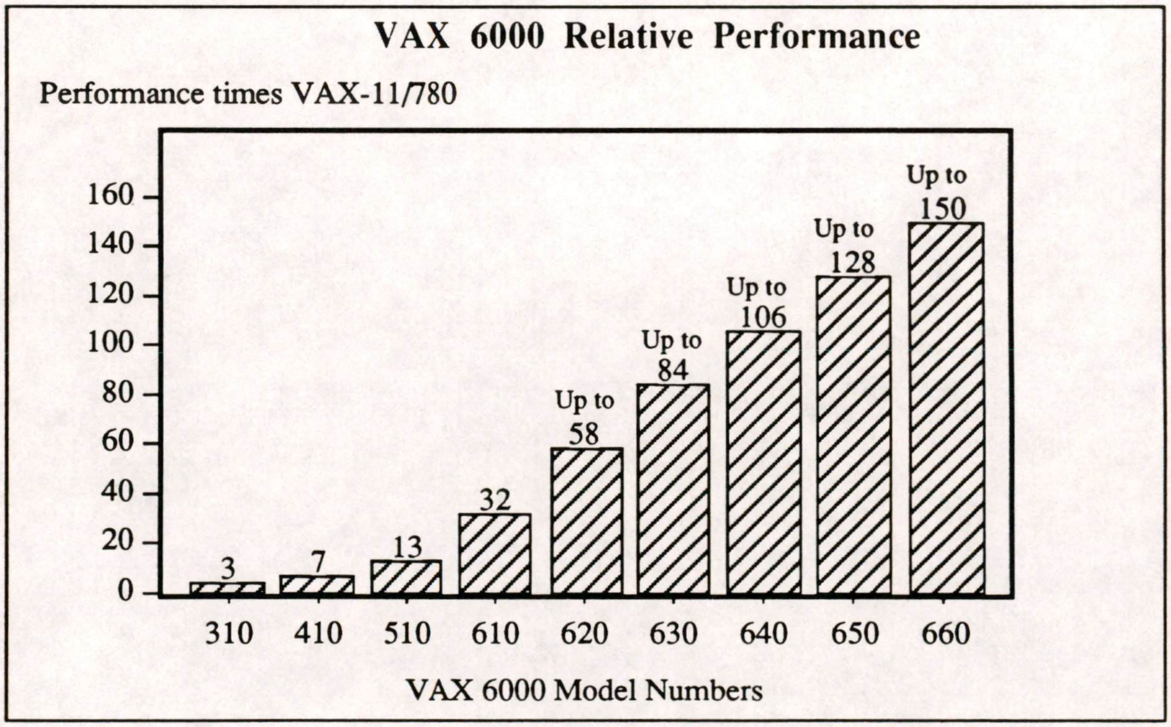
Relative Performance

Benchmark Description:

Many VAX users like the simplicity of a single performance number (times the VAX-11/780), which can be used to estimate relative performance among different VAX systems. A suite of benchmarks is used to calculate the relative CPU performance of VAX systems. Relative positioning is established by comparing the performance of the system under test with that of the VAX-11/780. Relative performance is the mean of those results and can be used as a relative measure in predicting CPU performance.

Results:

The relative performance numbers shown below represent the performance of VAX 6000 systems in a mixed commercial and technical application environment. Note that Models 620 through 660 performance results show the compute power available with symmetric multiprocessing (SMP) -- Digital's unique way to grow system performance in minutes by simply installing additional processors in the system cabinet. Up to six processors are supported in a VAX 6000 system, capable of delivering up to 150 times the processing power of the VAX-11/780.



SPEC® Release 1.2

Benchmark Description:

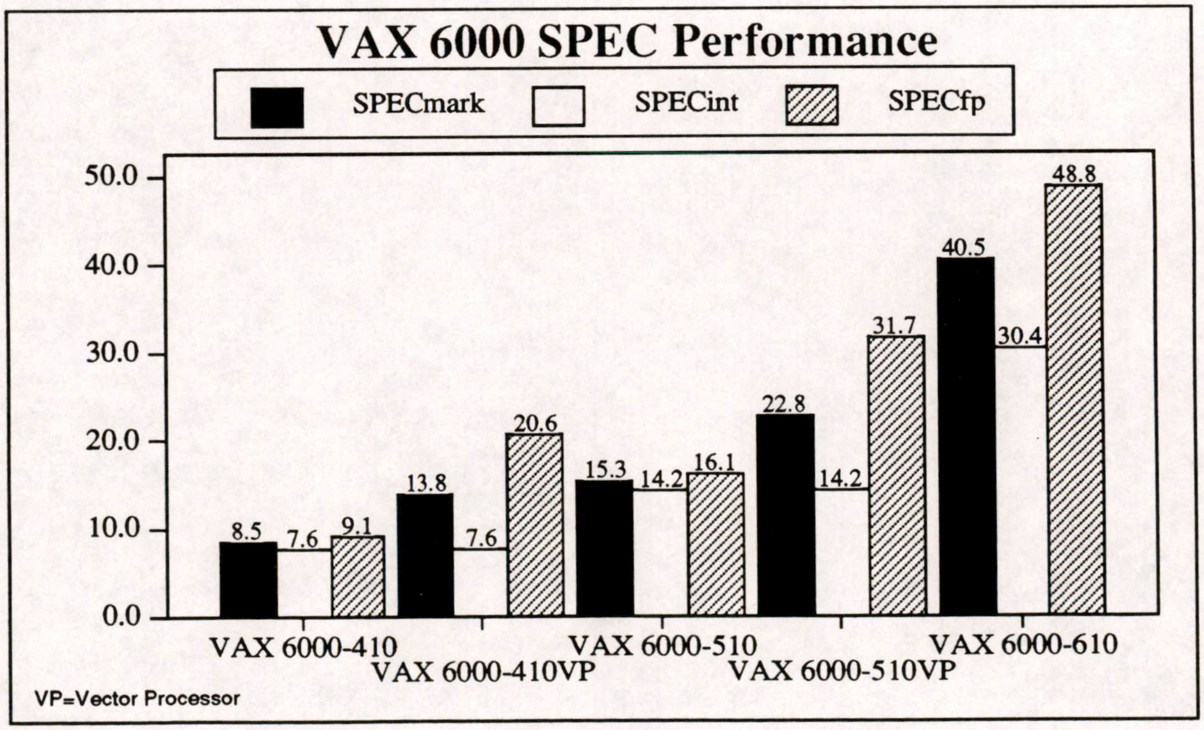
The System Performance Evaluation Cooperative (SPEC) consists of 23 vendors who work together on developing performance benchmarks that can be run on multiple vendors' platforms. The SPEC benchmark suite (Release 1.2) is used to evaluate the performance of systems in single-stream, engineering/scientific compute-intensive application environments. The suite consists of ten benchmarks -- six written in FORTRAN, using double-precision floating point data format, and four non-floating point benchmarks written in C, referred to as the integer benchmarks.

Performance Metric:

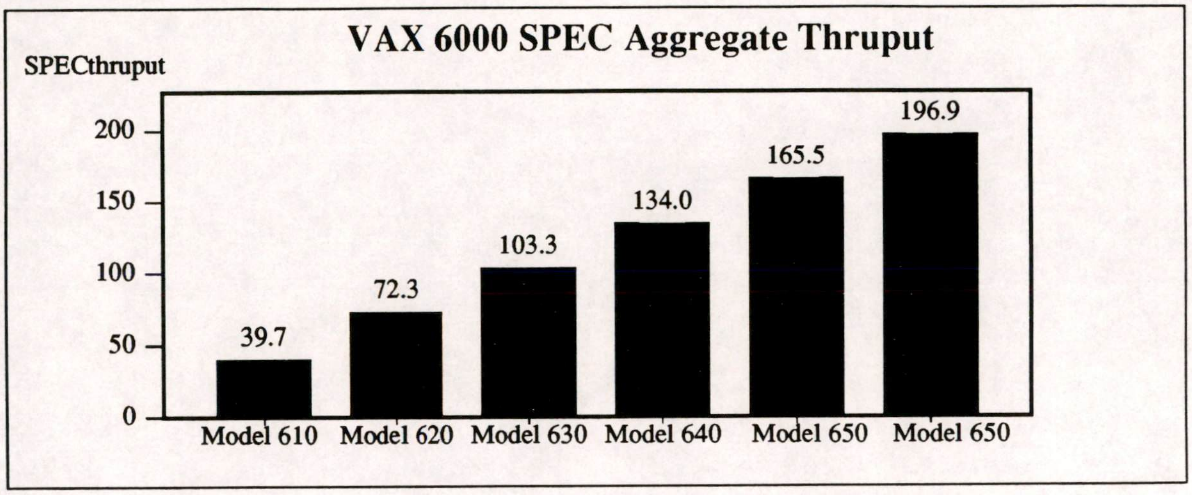
SPECmark is the geometric mean of the performance of the ten SPEC benchmarks relative to the VAX-11/780. The geometric mean, using six FORTRAN benchmarks, is defined as SPECfp. SPECfp represents the performance of the machine where FORTRAN double-precision floating point operations are a "non-trivial portion of the computation". Similarly, the geometric mean of the four C benchmarks is defined as SPECint. SPECint is intended to represent the non-floating point intensive portion of the machine's performance.

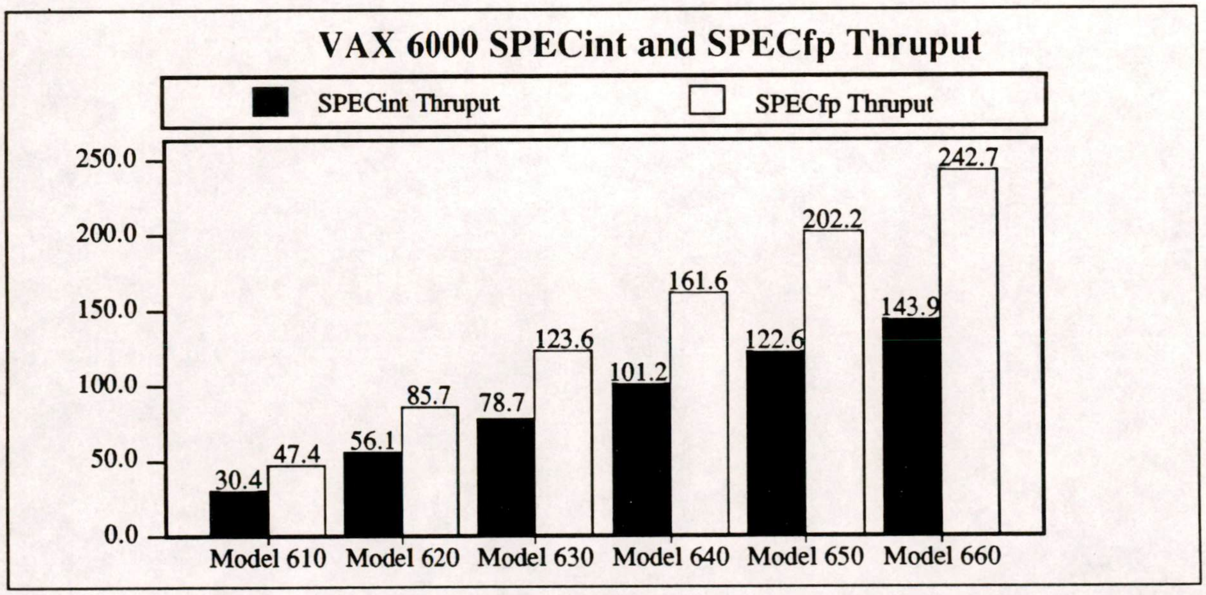
Results:

The following SPEC results have been achieved. Refer to the *SPEC Newsletter* for continuous reporting of SPEC data. Note: The performance numbers for the VAX 6000 Models were measured using advanced VAX compiler technologies.



SPECthruput is a metric used by SPEC to measure the batch throughput on a multiprocessor system. Two streams of each benchmark are run on each processor of a multiprocessor system and the elapsed time is normalized to one stream and to a reference system (VAX-11/780). A geometric mean of these numbers is the SPECthruput. SPECthruput multiplied by the number of processors provides SPEC Aggregate Thruput.





Included in this report:

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VAX 4000 Performance Report

Product Family Description

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The VAX 4000 Model 600 provides leadership commercial performance against UNIX® systems and any other proprietary systems in its price class. The price/performance of the Model 100 is superior to that of the best systems in its class in the commercial marketplace, as is clearly demonstrated by the audited TPC Benchmark™ A results.

VAX 4000 Performance

The performance of the VAX 4000 systems was evaluated using both industry standard and Digital internal benchmarks and workloads. The industry standard benchmarks used are defined by a consortium of vendors and are agreed to represent specific application environments. These benchmarks allow vendors to compare their systems with other vendors' systems. The Digital internal benchmarks and workloads are based on customer application environments.

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TPC Benchmark™ A

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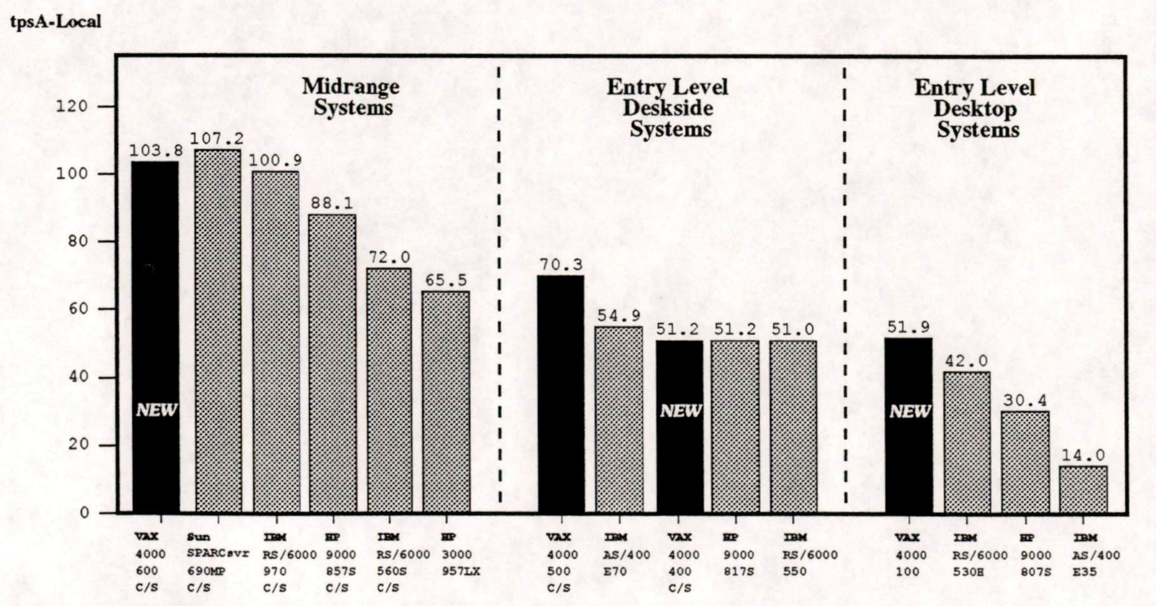
In order to test full system performance, TPC Benchmark A was developed by the Transaction Processing Performance Council (TPC) as a vendor neutral, standard specification for measuring the number of transactions a system is capable of executing in a given period of time. Even though this benchmark is set up to represent a banking network, it may be generalized across a broad range of commercial and client/server applications. The transaction, which is performed by a bank teller at a branch, represents the work done when a customer makes a deposit or withdrawal against an account. The benchmark requires that 90% of all transactions complete in less than two seconds, as measured at the teller's terminal. These results serve as useful criteria for businesses who depend on providing timely service to their customers in order to gain a competitive edge. The metrics used are:

- tpsA-Local, throughput as measured in transactions per second (tps), subject to response time constraints; and
- $ per tpsA-Local, or the associated price-per-tpsA, which is based on a five-year cost of ownership.

TPC Benchmark A Results:

Leadership Performance

OpenVMS VAX Systems Meet or Beat RISC Systems from IBM, HP and Sun

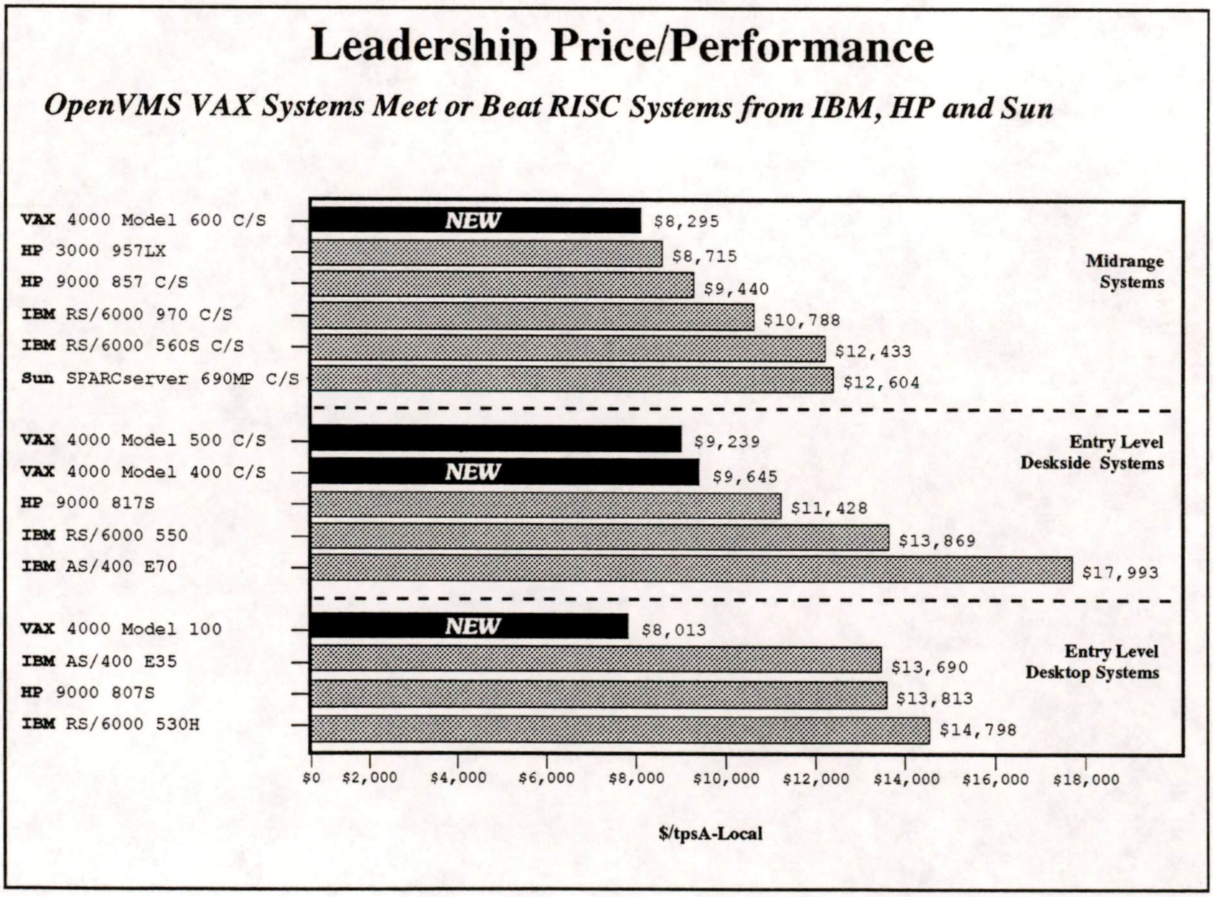


All systems were tested with ACMS version 3.2 (tp monitor) and Rdb/OpenVMS version 4.1. While maintaining the required two-second response time, the following TPC-A™ results were delivered for this benchmark

The purpose of publishing the TPC Benchmark A results is to provide a comparison of equivalent systems from various manufacturers. Systems that produce high tpsA-Local performance results and low dollars ($) per tpsA-Local price/performance cost are therefore judged to be the most powerful and the most economical. In order to help customers in making their selections, the Transaction Processing Performance Council publishes a report called the *Complete TPC Results.*

The data illustrated in these graphs demonstrate the leadership performance and cost-effectiveness of the VAX 4000 systems as compared to equivalent models from other vendors. The source of the comparative information is the June 26, 1992 issue of the *Complete TPC Results*.

TPC Benchmark A Price/Performance Results:



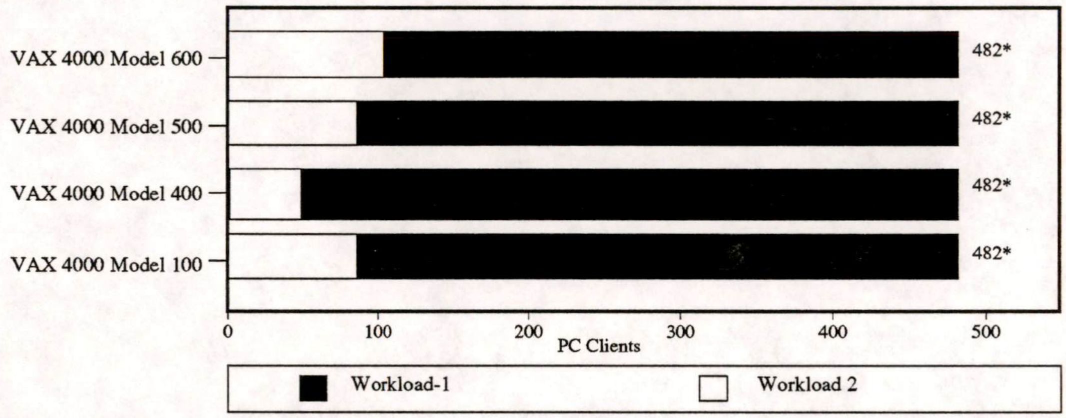
C/S denotes a client/server test configuration

PC Clients Served

PC Client Workload Descriptions

The VAX 4000 family of products is an ideal server for PC clients. In order to characterize the quantity of PC clients served, three workloads are provided to characterize typical user environments. The results are modeled data represented in the associated graphs.

Workloads 1 & 2 - Estimated Number of PC Clients Served



*Limited by OpenVMS SYSGEN parameter CHANNELCNT (2047 max), which leaves extra processing capability to perform other tasks; therefore, the VAX 4000 Model 500 should have at least two-thirds of its CPU available.

Workload-1 -- Simple File and Print Services:

Workload-1 typifies very simplistic print and file services where the application users access the file server just as a repository to save or open application files. Listed below are the specifications of running Workload-1:

- Each user has a maximum of two files open at once.
- Database access or use is once an hour or less.
- Power-user[1] techniques are not being employed, such as macros or automated scripts, which intensify server read/write access. Increased work is accomplished in a given time and therefore, saves rates.
- Automated file output techniques, such as word processing, form letter generation, or CAD bills of materials, are not in use.
- Applications with automatic saves enabled are not used.
- There are no MS-Windows™ users.
- All temporary files are on local disks.

[1]*Power users employ techniques using macros, may have up to six files open at once, database access may be continuous but not time-constrained by direct customer interaction (for example, 911 emergency or point-of-sale).*

Workload-2 -- Heavy Database & Wordprocessing Services:

Workload-2 represents more complex print and file services. At any one time, one-third of the users are power users.

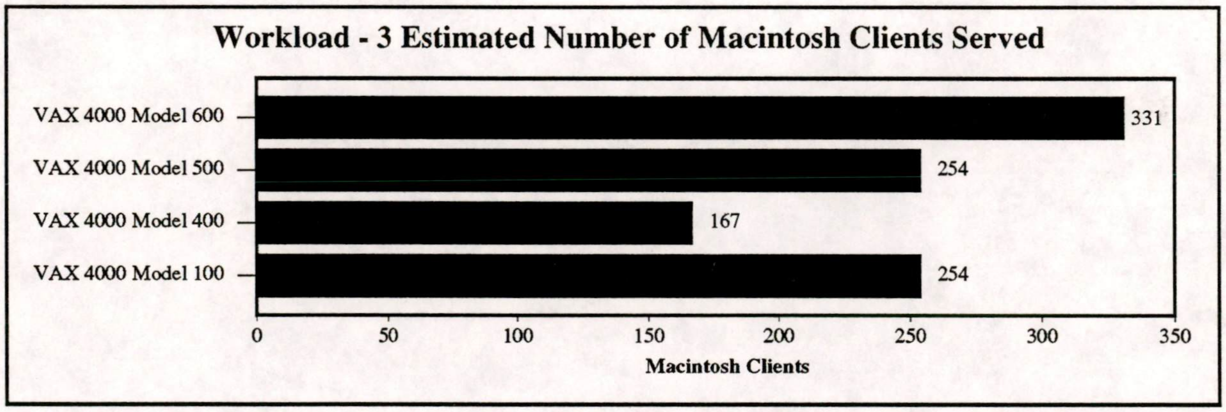
During Workload-2 each power user may:

- have 5 to 20 files open at once,
- access a database expecting subsecond response times,
- compile and link large numbers of modules,
- copy whole directories to the server,
- file automatically every ten minutes (WordPerfect™),
- have temporary files open on the server,
- be using MS-Windows, and/or
- use automated output and macros

The key difference between Workload-1 and Workload-2 is that the Workload-2 users access ten or more times the number of files as the Workload-1 users.

Workload-3 -- Macintosh® Clients:

Workload-3 is made up of Macintosh clients executing office applications such as MS Word and MS Excel in a chemical engineering environment. This workload is exclusively CPU bound.



Characteristics of the Macintosh workload are:

- Applications are not stored in the database.
- Connected clients perform file accesses even without user interaction.
- At least two files are accessed for each file displayed.

Note: These workloads are being provided for the purposes of preliminary sizing only. Variants of hardware configurations or client requirements may differ with results generated by these workloads. Please consult your local Digital PC Integration Support Specialist for final review and interpretation of this data for your environment.

SPEC® Release 1

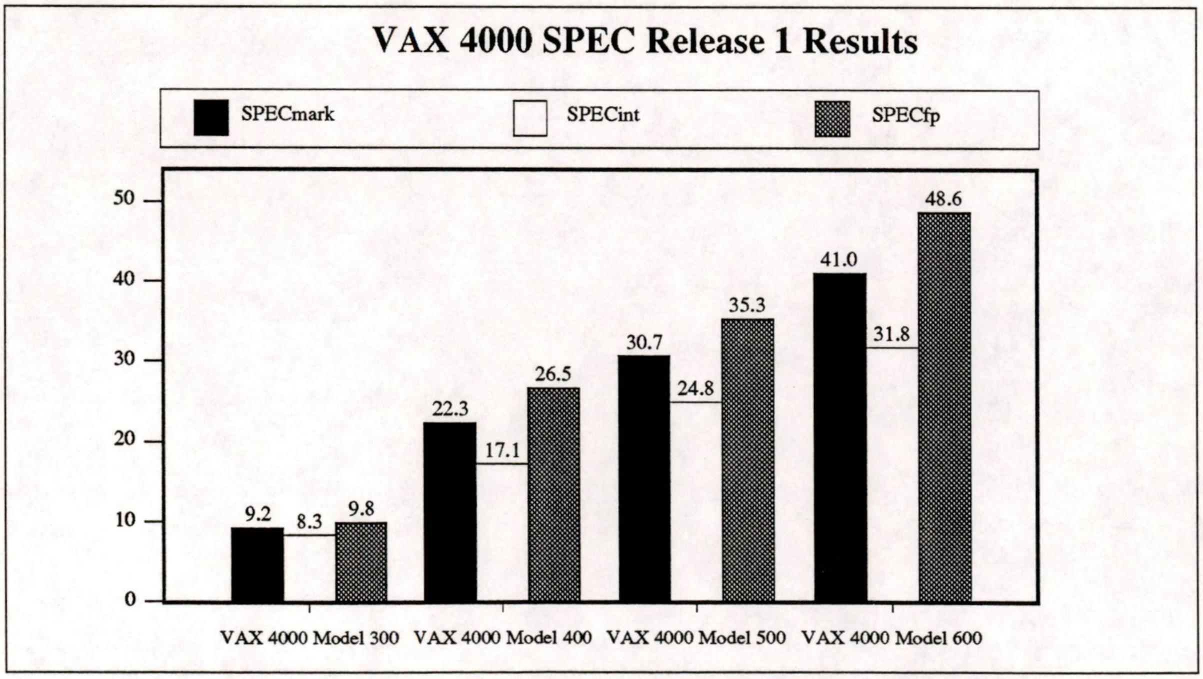
Benchmark Description:

The System Performance Evaluation Cooperative (SPEC) consists of 23 vendors who work together on developing performance benchmarks that can be run on multiple vendors' platforms. The SPEC Benchmark Suite consists of ten engineering and scientific compute-intensive benchmarks with six FORTRAN double-precision floating point benchmarks (SPECfp) and four integer benchmarks (SPECint) written in C. For each benchmark, a SPEC Ratio of elapsed time is obtained. The geometric mean of all ten SPEC Ratios yields the SPECmark.

SPECmarks are generally considered to be a workstation metric. Few midrange vendors report their results, as it is potentially misleading for commercial performance. What makes it misleading is the fact that the SPECmark is the geometric mean of ten disparate tests and these tests do not exercise I/O, nor do the tests predict heavy real-world context switching application performance. SPEC performance is useful for determining the speed of the CPU itself. For commercial and other specific user environments, benchmarks such as TPC Benchmark™ A provide more useful data.

SPEC Results:

For this benchmark, the following SPEC results were delivered. Refer to the *SPEC Newsletter* for continuous reporting of SPEC data. Note: The performance numbers of the VAX 4000 systems were measured using advanced VAX compiler technologies.



Office Automation

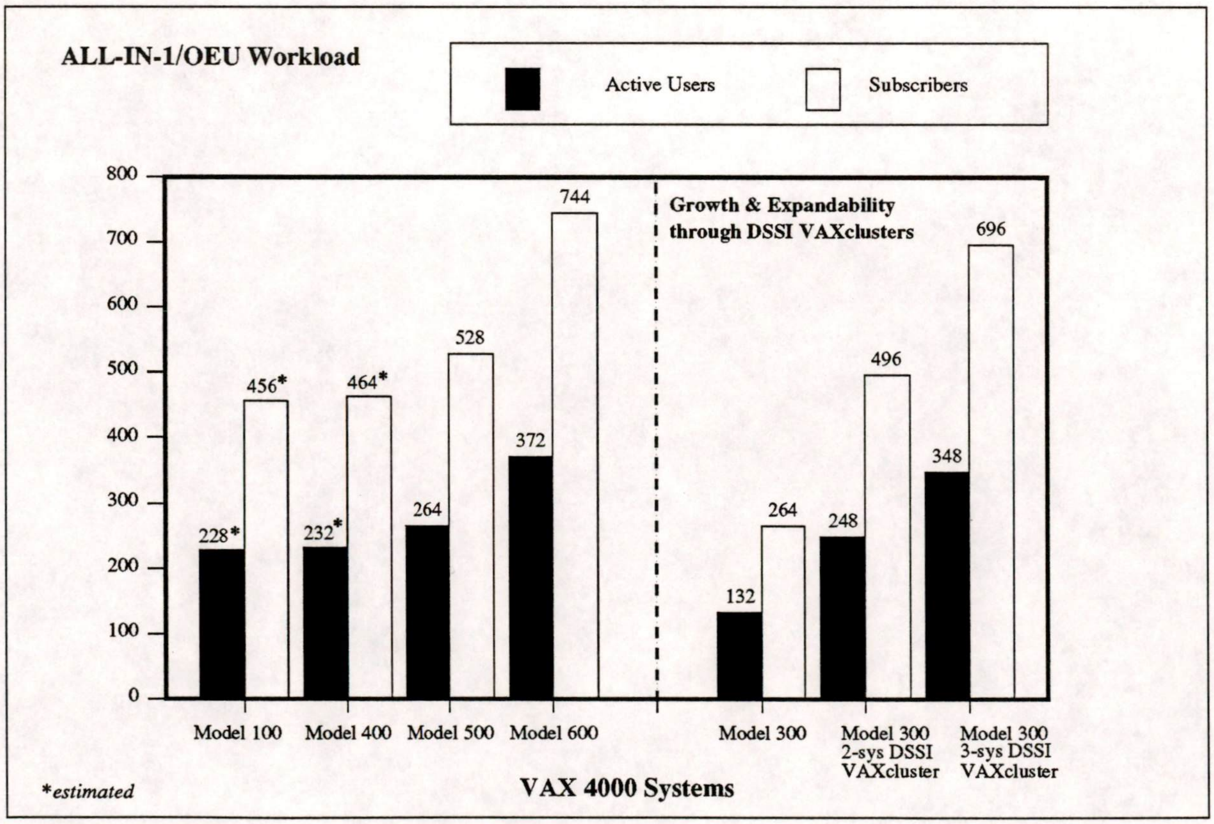
Workload Description:

Banks, branch offices, retail businesses, manufacturing sites, health care facilities, software development houses, and other businesses, all include office end users. These office users typically perform a variety of tasks such as word processing, electronic mail and time management functions.

ALL-IN-1, Digital's office application, provides these services to users. The ALL-IN-1 Office End-User (OEU) workload, which is based on the ALL-IN-1 office software product, is comprised of the same mix of general office tasks, and is used to determine the maximum number of users and subscribers supported by various VAX systems.

Using the results of the ALL-IN-1/OEU workload, businesses can determine the appropriate VAX system required to support their office users. The number of subscribers demonstrates how many people can be supported by a system while 50% are actively using their accounts.

Office Automation Results:



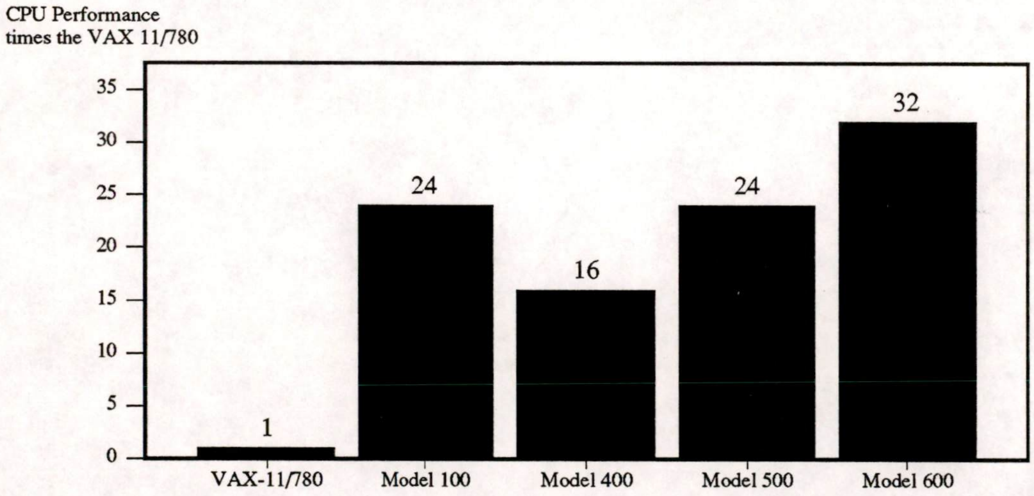
Relative Performance

Benchmark Description:

A suite of benchmarks is used to calculate the relative performance of VAX systems. These CPU-intensive programs use data sets of various sizes and data types to test the performance effects of CPU design and the efficiency of manipulating basic data types. Relative positioning is established by comparing the performance of the system under test with that of the VAX 11/780. Relative performance is the mean of those results and can be used as a relative measure in predicting CPU performance of one VAX over another. It does have some caveats in that it does not predict I/O performance, bandwith, or expandability. Relative performance is reported in order to provide a relative CPU measurement that can be consistently applied to position VAX products from the VAXstation up to the VAX 10000 mainframe, from the oldest VAX a customer might own to the newest VAX a customer may consider.

Relative Performance Results:

VAX 4000 Relative Performance Results



Digital's VAXstation 4000 Family Performance Summary

Version 3.0
July 1992
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Digital Equipment Corporation
Maynard MA

digital ™

First Printing, July 1992

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Part I

Executive Summary

1 Introduction

This revision of *Digital's VAXstation 4000 Family Performance Summary* contains performance information on Digital's newest VAX VMS workstation, the VAXstation 4000 Model 90. This workstation uses the 14 nanosecond CMOS NVAX chipset, has TURBOchannel option, supports a range of 2D and 3D graphic options, has 256 MB of writeback cache, and allows for maximum configurations of 128 MB of main memory and 6.8 GB of external storage.

The VAXstation 4000 Model 90 was designed to provide the performance needed to run applications that put a heavy computational load on the system. The VAXstation 4000 Model 90 is ideal for applications such as CAD/CAM/CAE, medical and other forms of imaging, econometrics, process control/CIM, mapping, geophysical analysis, scientific visualization, and as a trader workstation.

Digital's VAXstation 4000 Family Performance Summary provides information about the new VAXstation 4000 Model 90 workstation and the system-level performance of the VAXstation family running standard industry benchmarks and workloads. The metrics for recording system performance vary according to the workload and focus on useful work done by the system. This is a technical, reference document for Digital sales support personnel, customers, and other individuals who need to understand the performance characteristics of the VAXstation family.

The following sections briefly describe the workloads and graphically depict benchmark results. Test configurations and sources of test results are shown in Appendix A. References are listed in Appendix B.

We performed the VAXstation 4000 Model 90 benchmarks in June 1992.

2 New Product Highlights

- The VAXstation 4000 Model 90 provides improved performance for compute intensive applications for our OpenVMS customers.
- The VAXstation 4000 Model 90's 32.4 SPECmark proves that this system performs comparably with RISC-based system.

3 Summary of Relative Performance and System Attributes

The following tables show relative application performance positioning only. It is important to consider other factors when selecting a system to solve a specific problem. Other factors include operating environment, expandability (such as expanded memory and storage), and price. Using this data, the most appropriate system can be selected based on system attributes, as well as performance characterization.

Table 3-1: Digital VAXstations and Competitive Systems Graphics Results

Workstation	2D Vectors X11perf 10-pixel line (Kvectors/sec.)	2D Fill Area X11perf Copy 550x500 from pixmap to windows (Mpixels/sec.)	3D Graphics 3D Vectors (Kvectors/ second	3D Graphics 3D Polygons (Kpolygons/ second)	Picture-Level Benchmarks (PLBlit:PLBopt)				
					pc-board	sys_ chassis	cyl_head	head	shuttle
VAXstation 3100 Model 38 SPX	214.0	14.2	n/a	n/a	nr	nr	nr	nr	nr
VAXstation 3100 Model 76 SPX	183.0	14.2	57	6	nr	nr	nr	nr	nr
VAXstation 4000 VLC	156.0	13.4	n/a	n/a	nr	nr	nr	nr	nr
VAXstation 4000 Model 60 SPX	216.0	14.6	n/a	n/a	nr	nr	nr	nr	nr
VAXstation 4000 Model 60 SPXg	365.0	24.8	295	30	11.9:nr	11.0:nr	nr	nr	nr
VAXstation 4000 Model 60 SPXgt	371.0	10.4	300	33	12.3:nr	11.1:nr	8.4:nr	8.5:nr	12.5:na
VAXstation 4000 Model 90 LCSPX	266.0	18.2	n/a	n/a	na	na	na	na	na
VAXstation 4000 Model 90 SPXg	365.0	24.3	295	30	12.6:na	11.1:11.2	nr	nr	nr
VAXstation 4000 Model 90 SPXgt	365.0	10.4	295	33	13.2:na	11.8:11.8	8.5:8.7	8.3:9.2	13.5:14.1
DECstation 5000 Model 240 PXG	263.0	13.9	302	52	10.0:na	11.7:na	14.9:na	19.2:na	18.3:na
HP 9000/710	492.0	3.4	580	12	24.2:26.8	20.1:34.3	nr	nr	nr
HP 9000/720 CRX	868.0	22.8	820	23	27.6:31.6	21.1:37.1	11.4:na	14.3:15.8	15.6:na
HP 9000/720 CRX24	n/a	n/a	650	23	29.7:34.3	21.5:40.3	18.9:na	14.4:16.0	15.7:na
HP 9000/720 CRX24Z	n/a	n/a	650	165	28.4:33.0	20.9:38.0	31.9:na	32.6:42.5	21.1:na
IBM RS/6000 320H Gt4x	77.4	3.4	n/a	n/a	nr	nr	nr	na:25.4	nr
SPARCstation IPX	217.0	9.7	n/a	n/a	14.3:na	10.7:na	nr	nr	nr
SPARCstation 2 GS	205.0	8.3	150	20	3.6:na	4.0:na	7.2:na	6.2:na	9.2:na
SGI 4D/RPC Indigo	141.0	8.6	n/a	n/a	na	na	na	na	na

n/a and na = not available or not applicable
Refer to Appendix A for test configurations
Table current as of June 992

nr = not reported
np = not possible

Table 3-2: Digital VAXstations and Competitive Systems CPU and FP Benchmark Results

Workstation	SPEC-mark89	SPEC-int89	SPEC-fp89	Dhrystone MIPS V1.1	Dhrystone per second V1.1	Linpack Single MFLOPS	Linpack Double MFLOPS	Whetstone Single WIPS	Whetstone Double WIPS
VAXstation 3100 Model 38	3.7	3.5	3.8	6.14	10794	1.01	.49	3919	2514
VAXstation 3100 Model 76	6.8	7.1	6.6	12.65	22222	1.92	1.12	8216	5784
VAXstation 4000 VLC	6.2	5.8	6.3	10.87	19105	1.20	.75	6357	4070
VAXstation 4000 Model 60	12.0	11.1	12.6	17.14	30120	2.66	1.72	12774	8628
VAXstation 4000 Model 90	32.4	26.7	37.0	37.35	65616	12.91	7.27	31373	22575
DECstation 5000 Model 240	32.4	27.9	35.8	43.00	75557	10.80	6.04	42812	34457
HP 9000/710	49.7	35.4	62.4	53.69	94339	20.94	9.76	55556	34364
HP 9000/720	59.5	39.5	78.5	57.00	100149	22.90	17.20	56180	48310
IBM RS/6000 220	25.9	17.5	33.7	36.48	64102	7.60	6.50	17544	18868
IBM RS/6000 320H	43.4	21.8	68.8	37.44	65789	13.30	11.70	25000	27778
SPARCstation IPX	24.4	21.7	26.5	26.68	46875	4.34	2.65	27778	19120
SPARCstation 2	25.0	21.7	27.4	28.50	50075	6.10	4.20	19920	14641
SGI Indigo	26.3	23.6	28.4	31.27	54945	4.30	3.15	22676	17921

n/a = not available
Refer to Appendix A for test configurations
Table current as of June 1992

Part II

Benchmark Results

Results of individual benchmarks can change dramatically by the choice of operating system version, compiler version, level of optimization used, memory size, configuration, cache size, process scheduling, buffer management, and so on. Because some systems have more than one compiler available from the vendor, using different compilers can have a significant impact on benchmark performance.

The following table explains the abbreviations used in the graphs and tables contained in this section.

Table 3-3: Key to Graphs

Abbreviation	Full Product Description
VS 3100/38	Digital VAXstation 3100 Model 38
VS 3100/76	Digital VAXstation 3100 Model 76
VS 4000 VLC	Digital VAXstation 4000 VLC
VS 4000/60	Digital VAXstation 4000 Model 60
VS 4000/90	Digital VAXstation 4000 Model 90
DS 5000/240	Digital DECstation 5000 Model 240
HP 9000/710	Hewlett-Packard 9000 Model 710
HP 9000/720	Hewlett-Packard 9000 Model 720
IBM RS/6000 220	IBM RISC System/6000 220 POWERstation
IBM RS/6000 320H	IBM RISC System/6000 320H POWERstation
SPARCstation IPX	Sun Microsystems SPARCstation IPX
SPARCstation 2	Sun Microsystems SPARCstation 2
SGI Indigo	Silicon Graphics 4D/RPC Indigo

3D Graphics Benchmarks

Digital's 3D graphics benchmarks measure 3D line and 3D polygon performance using a PEX server benchmark. For Digital systems, 3D vectors are 10-pixel, 10 lines/polyline, structure mode. 3D vector results are reported in kilovectors (Kvectors)/second or 1,000 lines/second. For Digital systems, 3D polygons are 100-pixel triangles, 10 triangles/triangle strip, Z-buffered, default+directional lighting. 3D polygon results are shown in kilo-polygon (Kpolygons)/second or 1,000 polygons/second. Refer to Appendix A for descriptions of competitive systems' 3D graphics benchmark measurements.

3.1 3D Graphics Results

In general, when evaluating graphics performance, it is important to fully understand the benchmarking being quoted. One should refrain from comparing one primitive performance number to another without first understanding how the entities are defined and measured. In addition, primitive-level benchmarks are good for measuring drawing rates for particular entities, but do not take into account other operations that an application may perform (such as picking or structure editing), or characteristics of the entire system (such as typical background load or disk I/O). Therefore, the best way to evaluate a system is to run the actual application itself.

Characterizing graphics performance is a complex task. How the application is written, the characteristics of the system the application is running on, and the nature of the graphics data itself are all factors that affect graphics performance. In addition, it is possible to measure graphics performance at several different levels. For example, you could measure how long it takes to draw an individual primitive at peak hardware rates, or you could measure how long it takes to set up and draw an entire picture using a high-level Application Programming Interface (API).

Because of the complexity of the problem, there are widely varying approaches within the industry for generating graphics metrics. While X11perf offers some standardization in the realm of 2D benchmarks, examination of commonly-quoted 3D numbers show that there is little uniformity regarding what is being measured, and at what level it is measured. Although comparing 3D graphics performance numbers quoted by one vendor to those of another is rarely a meaningful comparison and can be misleading, we are showing 3D graphic performances reported by our competitors. The text appearing below each chart explains what each vendor is measuring.

Note: VAXstation 3100 Model 38, VAXstation 4000 VLC, IBM RS/6000 220, IBM RS/6000 320H, SPARCstation IPX, and SGI Indigo 3D graphic results were unavailable.

The following graph presents the 3D graphics kvectors/second.

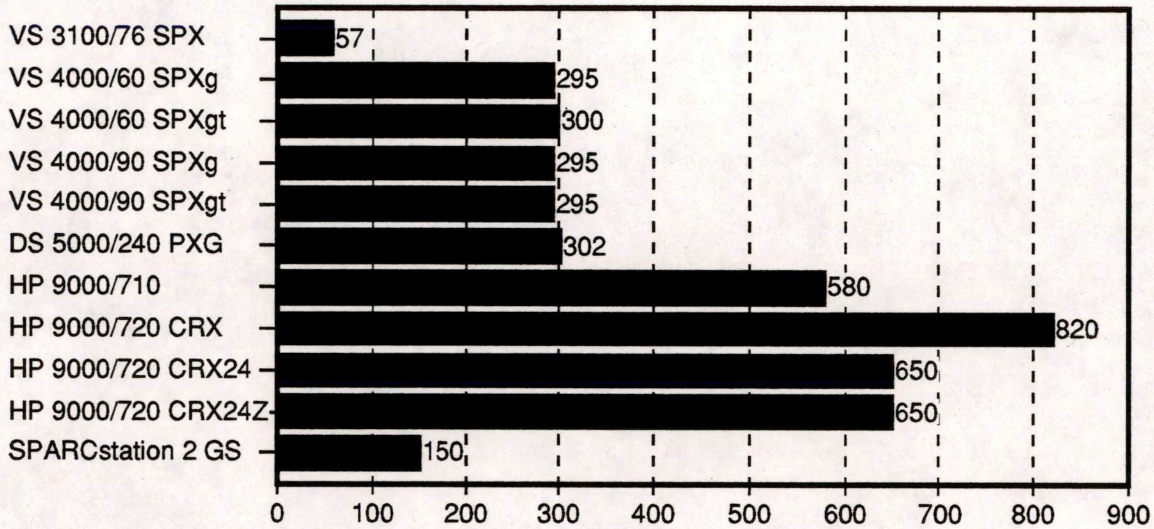

Figure 3-1: 3D Graphics Kvectors/second Results

Digital: 10 pixel lines, 10 lines/polyline, structure mode. From PEX server benchmark.

HP: 10 pixel, random orientation, clipping on perspective projection, and constant color. Through Starbase API.

Sun: 10 pixel vectors, transformed and clipped. API was not specified.

The graph below shows the the 3D kpolygons/second results for the VAXstation 4000 Model 90 and competitive systems.

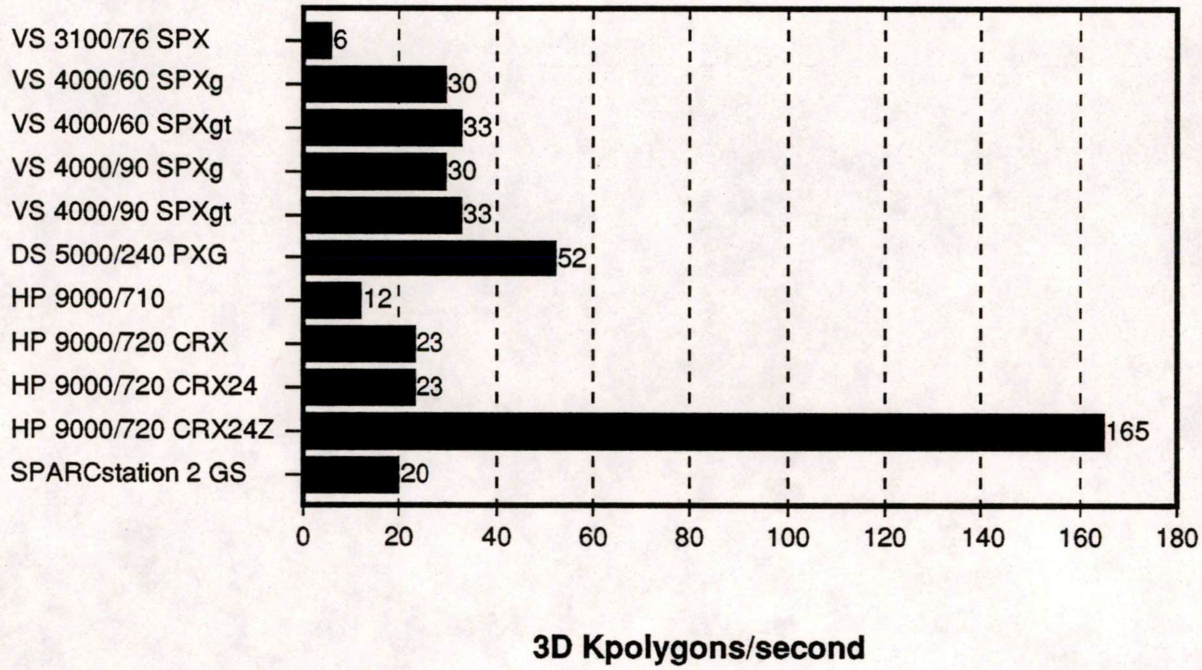

Figure 3-2: 3D Graphics Kpolygons/second Results

Digital: 100-pixel triangles, 10 triangles/triangle strip, Z-buffered, default+directional lighting. From PEX server benchmark.

HP: 10x10, 50 pixel triangles in triangular strips, random orientation, transformed, clipped checked, and Z-buffered.

Sun: 100 pixel triangles, gourand-shaded, clipped, through. Through SunPHIGS.

Picture-Level Benchmarks

Picture-Level Benchmark (PLB) is software that allows comparisons to be made of graphics display performance for different hardware platforms. It is the first product from the Graphics Performance Characterization (GPC) committee, a volunteer group of vendors, users, and consultants that provide and support standardized benchmarks for measuring graphics performance as related to specific applications. The National Computer Graphics Association (NCGA) is administrator for the committee.

PLB is designed to measure the performance of CRT-based display systems such as engineering workstations, personal computers, and special-purpose, attached, display systems. Two requirements exist for the PLB to work. The geometry must be presented to the system in a specified format, and the PLB code must have been ported to the device under test.

The five major components of the PLB are:

1. Benchmark Interchange Format (BIF), the file format for specifying the geometry.
2. Benchmark Timing Methodology (BTM) which provides a standardized performance measurement.
3. Benchmark Reporting Format (BRF), for standardized reporting of test results.
4. Picture-Level Benchmark (PLB) program which implements BIF file processing and runs the test.
5. A suite of standard tests and a report summary sheet.

In order to run BIF files, the PLB code must be customized for each hardware configuration.

To date, five application files have been approved by the GPC committee for use. They are:

1. "pc_board" - a typical 2-D electrical CAD application
2. "sys_chassis" - a 3-D wire frame model of a computer chassis
3. "cyl_head" -a 3-D solid model of an automobile engine's cylinder head
4. "head" - depicts a 3-D human head modeled using data generated by a laser scanner
5. "shuttle" - an example of low-end 3-D simulation

Note: Although the PLB allows buyers to compare performance, it does not address the issue of display quality. It is the user's responsibility to look at the image on the screen and determine superiority.

3.2 PLB Results

PLB performance results are reported using a measure called the "GPCmarks." The GPCmark is a ratio determined by dividing a normalizing constant by the elapsed time in seconds required to perform the test. The higher the number, the better the performance.

Each benchmark generates two GPCmarks: the "PLBlit" (PLB Literal) and the "PLBopt" (PLB Optimized). The PLBlit results of the GPC are most useful for users who know how their applications draw pictures. They select the benchmarks which most closely approximates the software they use, or they develop BIF files for benchmarks. They want to know what the performance of the workstation will be if the picture is drawn "as is".

PLBopt results are for the users who make whatever changes necessary to their applications to get the *best possible* performance for the workstation. The picture will not be drawn "as is." Instead, the drawing may be re-ordered, or it might use different primitives, or additional information such as surface normals may be provided.

The GPCmarks are reported in the format:

PLBlit: PLBopt

The following table contains the PLB results for the VAXstation 4000 Model 90 and competitive systems. The competitors' results are from *The GPC Quarterly Report,* Volume 2, Number 1, 1st Quarter 1992.

Note: PLB results for the SGI Indigo were not available. Comparable IBM RS/6000 220 PLB results were also unavailable.

Figure 3-3: PLB Benchmarks Results

System	PLB Benchmark PLBlit:PLBopt				
	pc_board	sys_chassis	cyl_head	head	shuttle
VS 4000/60 SPXg	11.9:nr	11.0:nr	nr	nr	nr
VS 4000/60 SPXgt	12.3:nr	11.1:nr	8.4:nr	8.5:nr	12:5:nr
VS 4000/90 SPXg	12.6:na	11.1:11.2	nr	nr	nr
VS 4000/90 SPXgt	13.2:na	11.8:11.8	8.5:8.7	8.3:9.2	13.5:14.1
DS 5000/240 PXG	10.0:na	11.7:na	14.9:na	19.2:na	18.3:na
HP 9000/710	24.2:26.8	20.1:34.3	nr	nr	nr
HP 9000/720 CRX	27.6:31.6	21.1:37.1	11.4:na	14.3:15.8	15.6:na
HP 9000/720 CRX24	29.7:34.3	21.5:40.3	18.9:na	14.4:16.0	15.7:na
HP 9000/720 CRX24Z	28.4:33.0	20.9:38.0	31.9:na	32.6:42.5	21.1:na
IBM RS/6000 320H Gt4x	nr	nr	nr	na:25.4	nr
SPARCstation IPX	14.3:na	10.7:na	nr	nr	nr
SPARCstation 2 GS	3.6: na	4.0:na	7.2:na	6.2:na	9.2:na

nr = not reported
na = not available
np = not possible

Digital used DEC PHIGS
HP used HP-PHIGS
IBM used GL

Sun used SunPHIGS

2D Graphics X11perf Benchmarks

Developed by Digital and the X consortium at the Massachusetts Institute of Technology, X11perf tests various aspects of X server performance including simple 2D graphics, window management functions, and X-specific operations. Other non-traditional graphics included are CopyPlane and various stipples and tiles.

X11perf employs an accurate client-server synchronization technique to measure graphics operations completion time. Both graphics primitive drawing speeds and window environment manipulation are tested.

X11perf is a suite of X-window system display server tests. X11perf determines the number of operations/second that a X server can deliver for 222 client requests, plus 121 client requests with XOR writing mode, for a total of 343 different client requests. To test the server, there is a single client communicating exclusively with the server by one transport mechanism.

The measurements we report are:

- 2D vector results from the X11perf *10-pixel lines* tests shown in units of kilo-vectors (Kvectors/second).
- 2D fill area results from the X11perf *Copy 500X500 from pixmap to window* tests shown in units of mega-pixels or Mpixels (megapixel=1,048,576 pixels).

3.3 X11perf Benchmark Results

X11perf results and conclusions for the VAXstation family and its comparable competitors are presented in the following pages and graphs.

Note: IBM RS/6000 220 X11perf results were unavailable.

2D X11perf kvectors/second benchmark results are shown below.

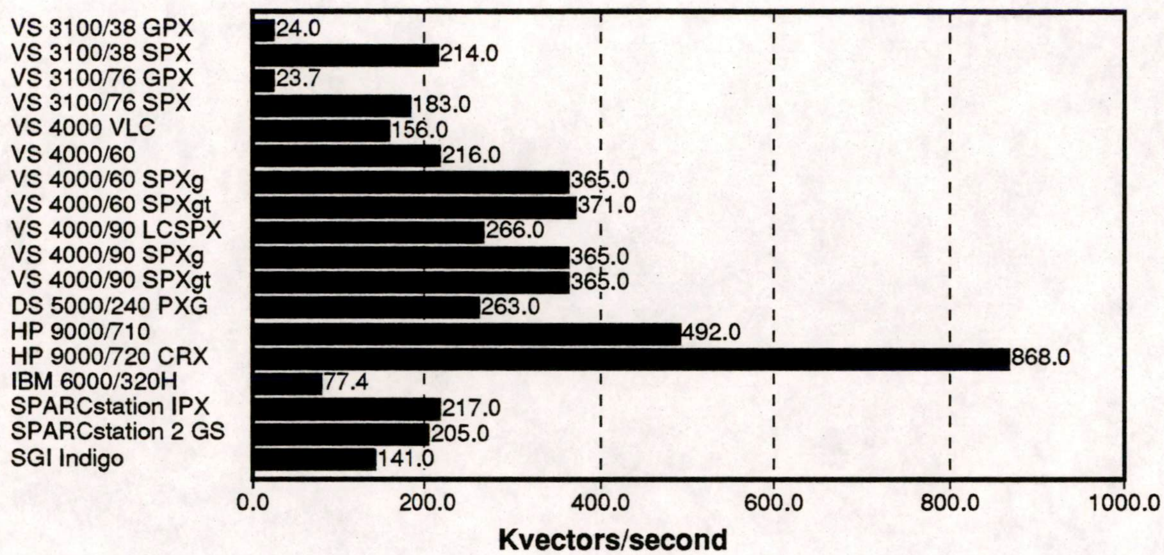

Figure 3-4: X11perf 2D Kvectors/second Benchmark Results

The following graph shows the 2D X11perf Mpixels/second benchmark results.

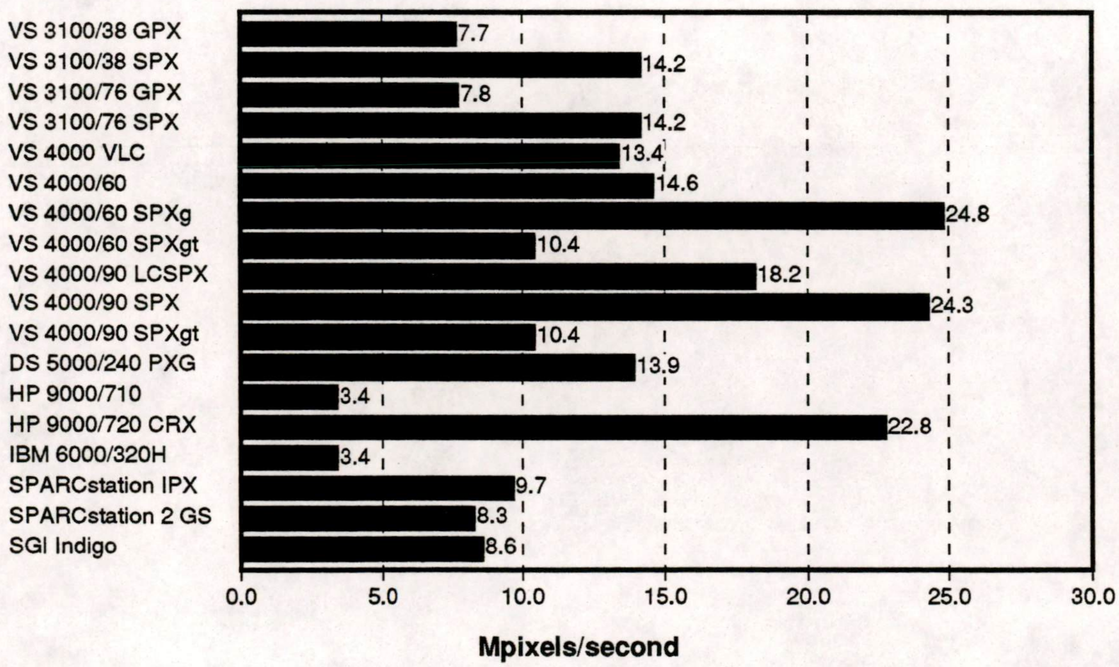

Figure 3-5: X11perf 2D Mpixels/second Benchmark Results

The SPEC R1.2 Benchmark Suite

This section presents the results of System Performance Evaluation Cooperative (SPEC) Benchmark Suite. SPEC is a nonprofit organization formed to develop a standard suite of benchmark programs that characterize system performance.

The release suite consists of ten codes/programs, four of which are written in C and considered to be compute intensive. The geometric mean of these make up the SPEC metric called SPECint and are classified as integer benchmarks. The remaining six programs are FORTRAN based and floating-point intensive. They make up the SPECfp rating. The SPECmark is the geometric mean of the ten programs' elapsed times normalized to the VAX 11/780.

3.4 SPEC R1.2 Results

SPEC R1.2 ratings for the VAXstation 4000 Model 90 and competitive systems are shown in the following three charts.

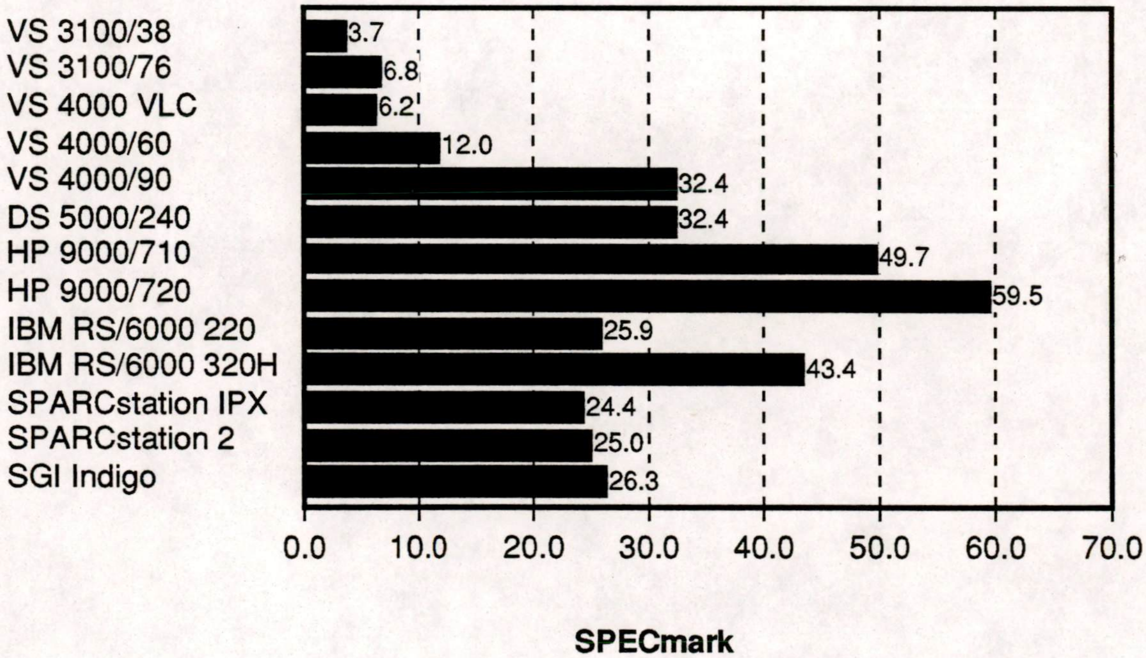

Figure 3-6: SPECmark Ratings

The SPECint ratings for the comparable systems are shown below

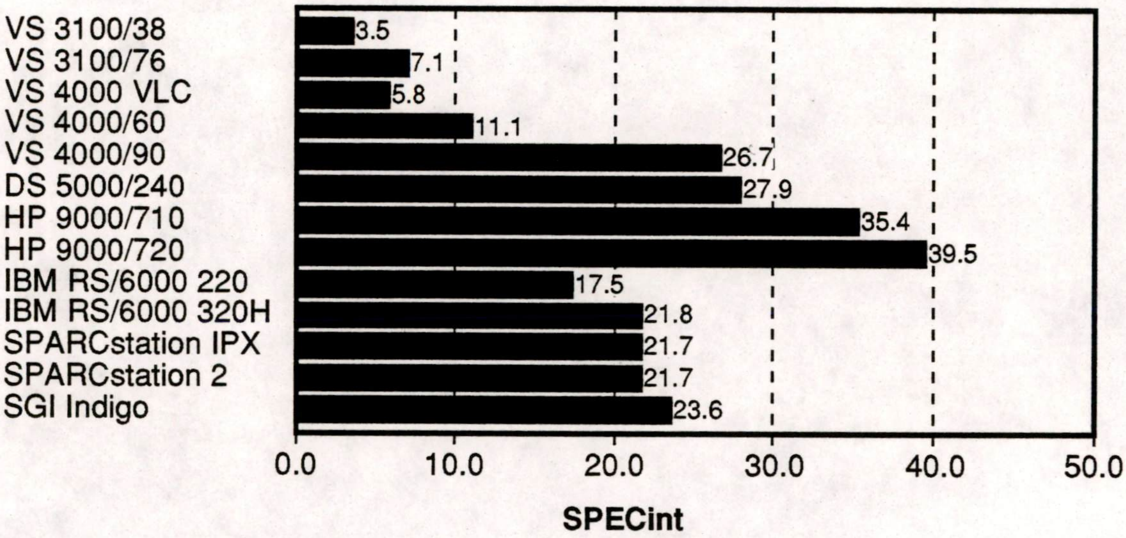

Figure 3-7: SPECint Ratings

The following graph presents the SPECfp measurements.

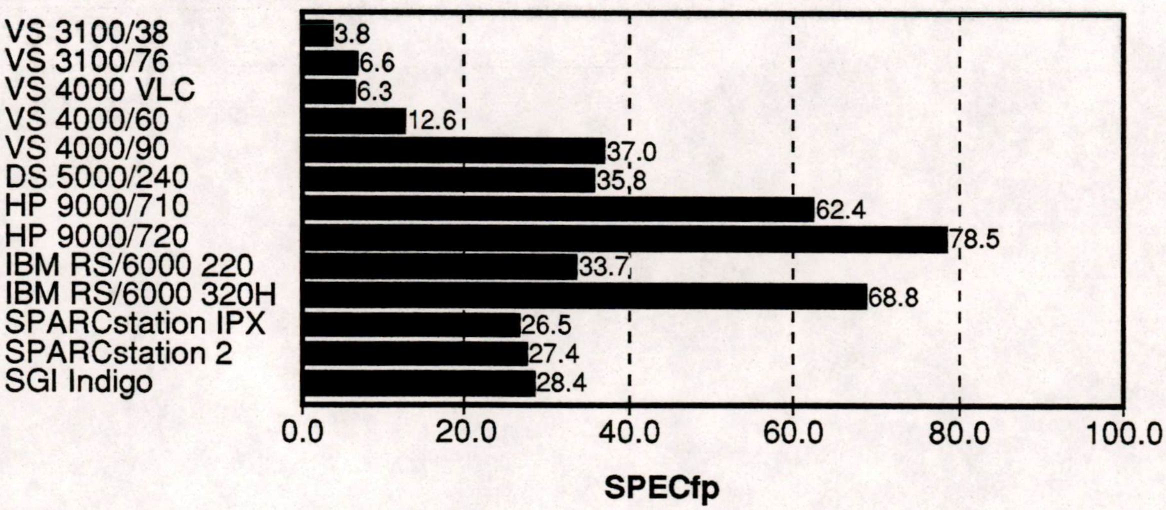

Figure 3-8: SPECfp Ratings

The SPEC Ratio for a benchmark is the quotient derived from dividing the SPEC Reference Time by a particular machine's corresponding run time. For Release 1.2, the SPEC Reference Time is the time that it takes a VAX 11/780 machine to run each particular benchmark in the suite.

Table 3-4: SPEC R1.2 SPEC Ratios for VAXstations (in seconds)

Benchmark No. & Name	Type	VS 3100/ 38	VS 3100/ 76	VS 4000/ VLC	VS 4000/ 60	VS 4000/ 90
001.gcc	Integer	3.3	7.5	6.3	11.2	27.0
008.espresso	Integer	3.3	6.7	5.3	9.9	23.2
013.spice 2g6	Floating point	3.8	8.2	5.7	10.6	20.6
015.doduc	Floating point	3.3	7.0	5.2	10.5	33.9
020.nasa7	Floating point	4.3	5.6	7.4	12.7	31.4
022.li	Integer	3.5	7.6	6.2	10.5	29.1
023.eqntott	Integer	3.5	6.5	6.7	12.9	27.7
030.matrix300	Floating point	4.6	6.6	11.7	23.6	94.7
042.fpppp	Floating point	3.2	7.3	3.9	11.0	38.4
047.tomcatv	Floating point	3.8	5.4	6.1	11.1	32.1

Table 3-5: SPEC R1.2 SPEC Ratios for RISC-based Systems (in seconds)

Benchmark No. & Name	Type	DS 5000/ 240	IBM 6000 220	IBM 6000 320H	HP 9000/ 710	HP 9000/ 720	SPARC-station IPX	SPARC-station 2
001.gcc	Integer	23.3	14.6	19.9	29.0	36.0	19.9	20.0
008.espresso	Integer	28.7	19.7	20.5	39.8	43.4	21.7	21.7
013.spice 2g6	Floating point	16.5	14.6	26.4	33.2	44.5	16.1	16.5
015.doduc	Floating point	30.8	18.1	29.5	42.5	47.6	16.6	18.2
020.nasa7	Floating point	32.0	32.3	81.3	51.7	64.5	28.4	29.1
022.li	Integer	32.5	14.7	21.3	36.7	37.7	23.0	23.1
023.eqntott	Integer	28.0	22.0	25.9	37.2	41.2	22.2	22.3
030.matrix300	Floating point	99.0	191.5	407.7	277.6	323.2	81.5	82.6
042.fpppp	Floating point	38.4	25.7	54.1	45.3	78.5	23.0	23.8
047.tomcatv	Floating point	33.8	34.7	76.1	64.1	66.4	23.8	24.9

Dhrystone Integer Benchmark

The Dhrystone benchmark was introduced in 1984 as an ADA program by Reinhold P. Weicker. It has since been translated into C and TURBO PASCAL.

This synthetic benchmark measures processor and compiler efficiency with emphasis on the type of data and operations encountered in a system rather than numerical programming. It is CPU-intensive.

Dhrystones are most commonly expressed in Integer MIPS (Millions of Instructions Per Second) where 1 MIP is the number Dhrystones per second that can be performed by a VAX 11/780 (1757 Dhrystones/second). Please note that not all vendors base their MIPS rating on the Dhrystone benchmark.

3.5 Dhrystone Results

The following graph shows the MIPS ratings for the VAXstation family and comparable, competitive workstations.

Note: Both "Inlined" and "Standard" Dhrystone results are provided. "Inlined" results can be one of the following:

- The compiler takes modules that are called and placed them "inline," removing the overhead of the call to the module and the overhead with the register set-up in the Dhrystone code.
- The loader uses "inline" string functions that are called in Dhrystone code.

We have presented the competitors' Dhrystone results without labels because that is how the vendor or benchmarking service reported them. Some manufacturers may include inline string libraries in the standard "c" library or some string manipulation instructions in their instruction sets. We were unable to verify or determine if the competitive results shown here were "Standard" or "Inlined".

The chart below shows Dhrystone V1.1 MIPS ratings for the VAXstation family and comparable, competitive systems.

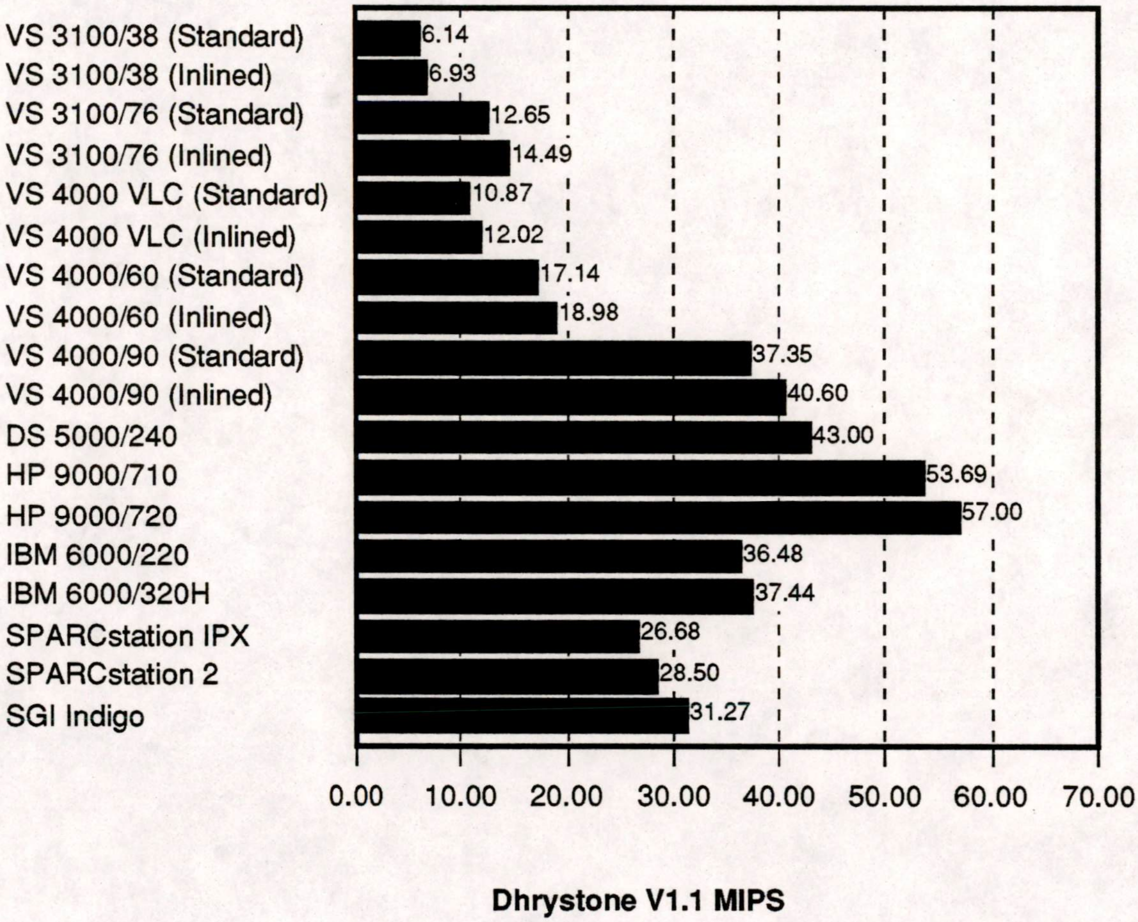

Figure 3-9: Dhrystone V1.1 MIPS Ratings

The following graph contains V1.1 Dhrystones per second.

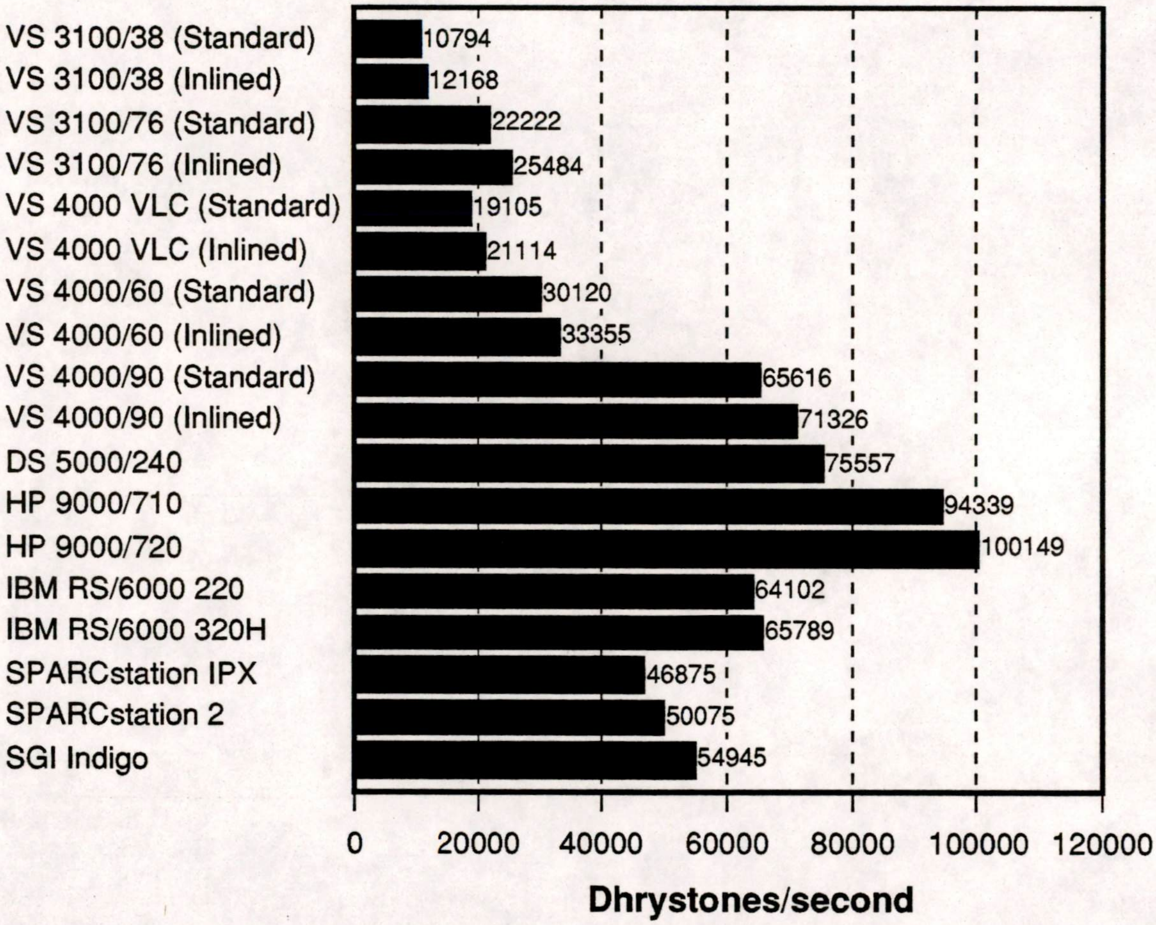

Figure 3-10: Dhrystones/second Benchmark Results

Linpack Benchmark

Developed at Argonne National Laboratories, Linpack is a FORTRAN benchmark that solves a 100x100 system of linear equations. The benchmark is used to compare the performance of mathematical and scientific applications where floating point computations are prevalent. When running, the benchmark gives little weight to I/O.

The results are measured in millions of floating point operations per second (MFLOPS). We have reported both single and double precision operations.

3.6 Linpack Results

The following graph presents single precision MFLOPS ratings for the VAXstation family and comparable, competitive systems.

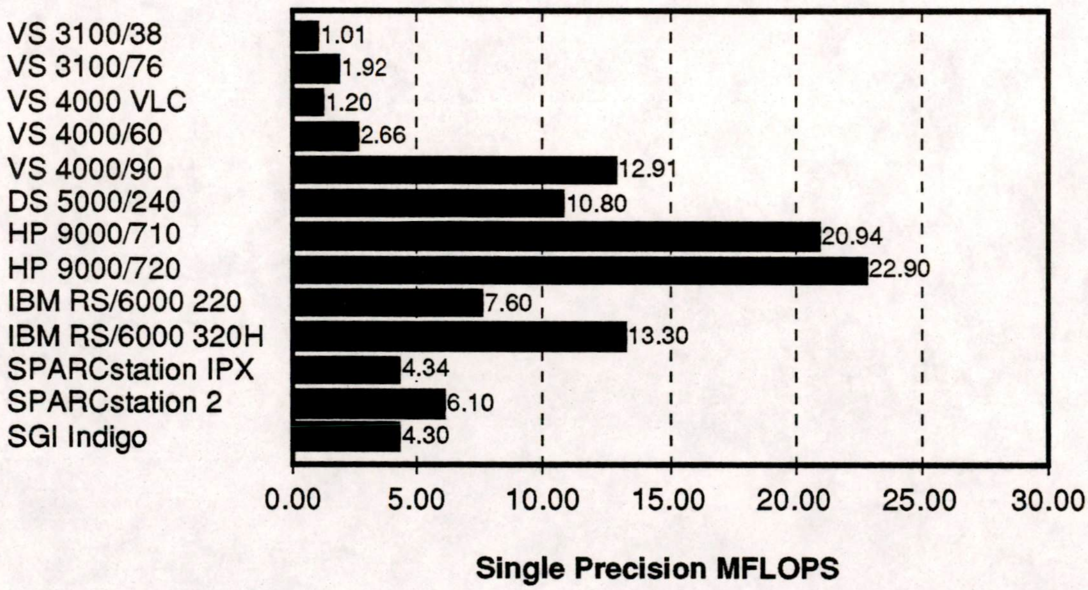

Figure 3-11: Linpack Single Precision MFLOPS Ratings

The following chart contains the double precision MFLOPS results.

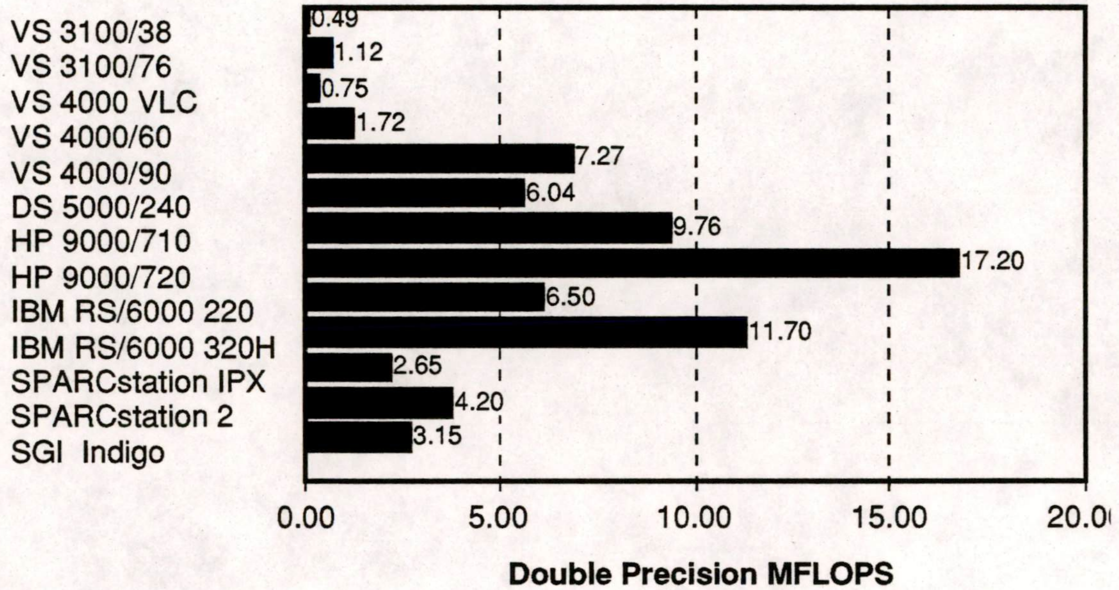

Figure 3-12: Linpack Double Precision MFLOPS Ratings

Whetstone Benchmark

The Whetstone benchmark was developed at Great Britain's National Physical Laboratory in Whetstone, England in 1970. It is a synthetic benchmark designed to represent small engineering and scientific programs.

The Whetstone benchmark has been implemented in single precision and double precision FORTRAN programs, each arranged to defeat most compiler optimizations. The results are measured in WIPS (Whetstone Instructions Per Second).

3.7 Whetstone Results

Charted below are the Whetstone single and double precision benchmark tests results.

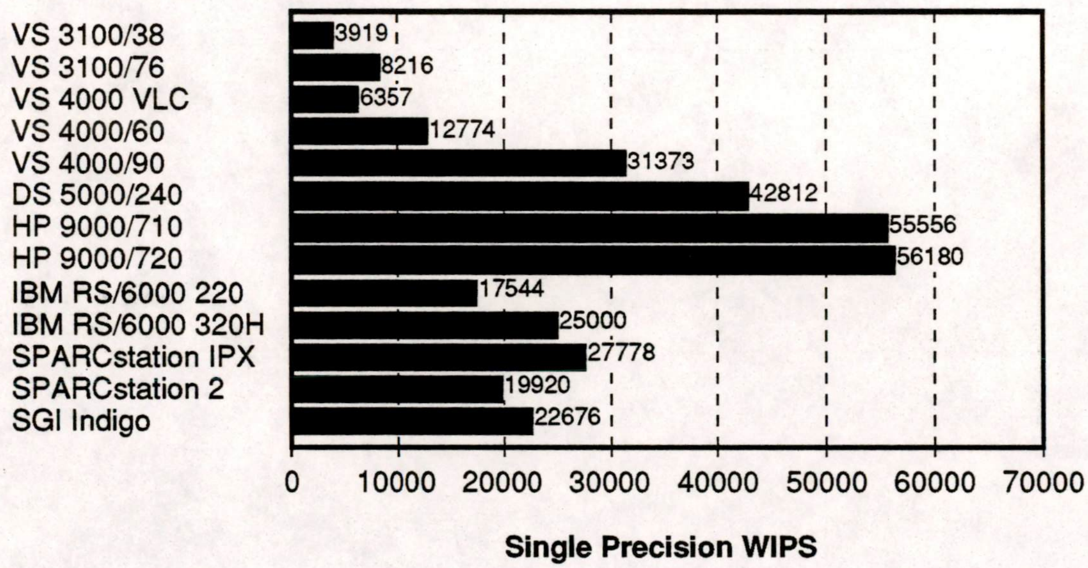

Figure 3-13: Whetstone Single Precision WIPS Ratings

Whetstone double precision WIPS ratings appear in the following chart.

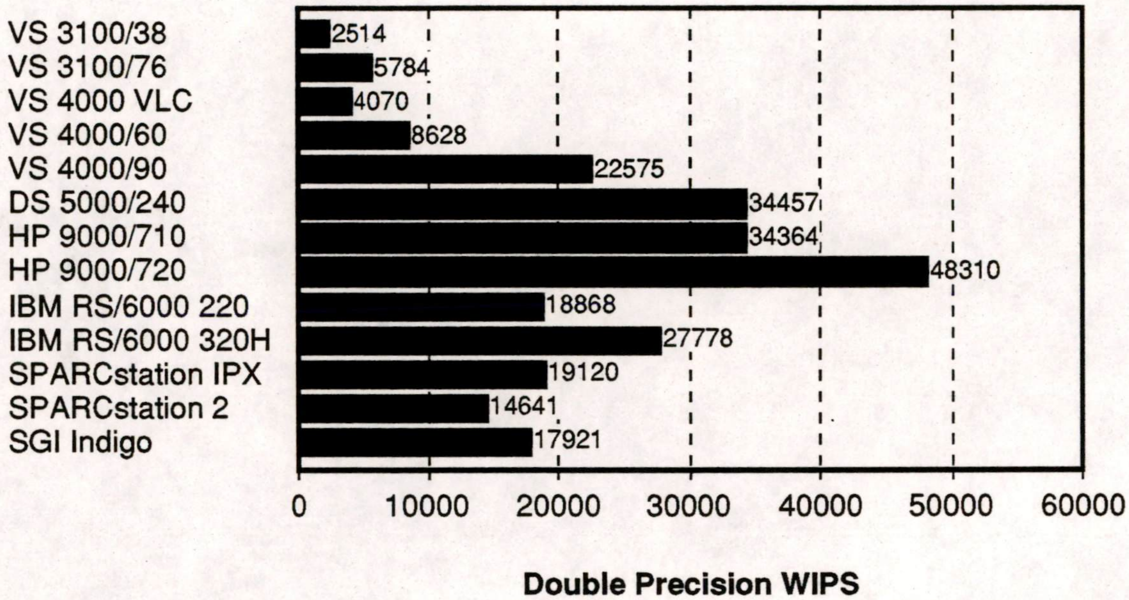

Figure 3-14: Whetstone Double Precision WIPS Ratings

A

Test Configurations

The benchmarks were run on the following system configurations:

VAXstation 3100 Model 38 Workstation:

Memory	16 MB
Disk Controller	SCSI
Disks	2 104MB RZ23
Display Device	VRT19 (1280x1024)
Network Interface	Ethernet
Operating System	VAX/VMS V5.4
Compilers	VAX FORTRAN, VAX C

Linpack and Whetstones tests used 1 665MB RZ56 disk. X11perf benchmarks used VR299 (1024x864) display device. Digital performed all benchmark tests.

VAXstation 3100 Model 76 Workstation:

CPU	REX520
FPU	DC523
Number of CPUs	1
Cache Per CPU	128KB
Memory	16 MB
Disk Controller	SCSI
Disk	2 332 MB RZ55
Network Interface	Ethernet
Operating System	VAX/VMS V5.4
Compilers	VAX FORTRAN V5.2, VAX C V3.1
Tuning Parameters	WSEXTENT=16384, WSQUO=8192, WSDEFAULT=1024
Background Load	None
System State	single user

SPEC benchmark results from *Spec Newsletter,* Volume 3, Issue 1, Winter 1991, page 34. Linpack and Whetstone benchmarks used 1 665MB RZ56 disk. X11perf benchmarks used VR299 (1024x864) display device and 2 104MB RZ23 MB disks. Digital performed all benchmark tests.

VAXstation 4000 VLC Workstation:

VAX CPU/FPU	SOC (System on a chip)
Clock Speed	25 MHz
Memory	24 MB / 80 nanosecond RAM
Read or write cycle to cache	40 nanosecond
Display Size and Type	Digital VRT13
Disk Controller	Sync SCSI
Disk	1 121 MB RZ23, 1 332 MB RZ55
Network Interface	Ethernet
Operating System	VAX/VMS T5.5-4x6
Compilers	VAX FORTRAN 5.6, VAX C 3.2
Tuning Parameters	WSMAX=16400, WSQUO=16400, WSEXTENT=16400
Background Load	None
System State	Standalone

System was booted minimum for all benchmarks except for X11perf. DECwindows was running for X11perf tests. Digital performed all benchmark tests.

VAXstation 4000 Model 60 Workstation:

VAX CPU/FPU	VAX CPU/FPU
Clock Speed	222MHz
Memory	104 MB / 80 nanosecond RAM
Read or write cycle time to cache	18 nanosecond
Display Size and Type	Digital VRT19
Disk Controller	Sync SCSI
Disk	2 209MB RZ24
Network Interface	Ethernet
Operating System	VAX/VMS T5.5-4x6
Compilers	VAX FORTRAN V5.6, VAX C V3.2
Tuning Parameters	WSMAX=53200, WSQUO=25000, WSEXTENT=25000
Background Load	None
System State	Standalone

System was booted minimum for all benchmarks except for X11perf. DECwindows was running for X11perf tests. Digital performed all benchmark tests.

VAXstation 4000 Model 90 Workstation:

VAX CPU/FPU	14 nanosecond CMOS NVAX chip set
Clock Speed	71.43 MHz
Bus Speed	23.81 MHz
Memory	32 MB
Read cycle time to cache	28 nanoseconds
Write cycle time to cache	42 nanoseconds
Disk Controller	SCSI
Network Interface	Ethernet
Operating System	VAX/VMS T5.5-2E3
Compilers	VAX C V3.2, KAP for C V1.0 VAX Fortran V5.6, KAP for Fortran V1.0
Tuning Parameters	NPAGEVIR=14000000, NPAGEDYN=3000000, WSMAX=16400
System Account Process Parameters	WSEXTENT=16384, WSQUO=16384, PGFLQUO=40960
Background Load	None

Digital performed all benchmark tests.

DECstation 5000 Model 240 PXG Workstation:

CPU chipset	R3000A
CPU MHz	40MHz
FPU chipset	R3010A
FPU MHz	40 MHz
Memory (MB)	64 MB
Disk	SCSI 1.0 GB RZ57
Cache Size	64 Kb data / 64 Kb instruction
Network Interface	Ethernet
Operating System	ULTRIX X4.2A-1 (Rev. 25)
Compilers	DEC Fortran T3.1 (ft2), DEC C V1.0
Tuning Parameters	10% bufcache, delay-Wbuffers=1, cache_bufcache=1

Digital performed all benchmark tests.

Hewlett Packard 9000/710

Processor Type & Frequency	PA-RISC/ 1.1 - 50 MHz
Floating Point	built-in
Cache Memory Size & Speed	32 Kb instruction / 64 Kb data
Memory	16 MB - 80 ns DRAM
Disk Buffer Sizes	10% of memory
Display Size & Type	19" Color
Display Resolution	1280 x 1024 pixels
Hardfile Quantity/Interface	1/SCSI
Hardfile Size	425 MB
Network Interface	Ethernet
Operating System/Rel.	HP/UX 8.07
Compilers and Switches	HP Fortran 8.05 +O3 (+O4 used for some tests), HP C 8.07 +O3

SPEC benchmarking numbers from *SPEC Newsletter,* Volume 4, Issue 1, March 1992, page 90 running HP-UX 8.05, HP C A.08.53, and HP Fortran A.08.05, and using 2-SCSI HP C2235A 420 MB disks. Dhrystones, Whetstones, Linpack, and X11perf results from *Workstation Laboratories,* 3/1/92, Volume 16, Chapter 17 GPCmarks from *The GPC Quarterly Report,* Vol. 2, No. 1, 1st Qtr 1992, page 29, on 16" display size and at 72 Hz display refresh rate. 3D graphic results from *HP Apollo 9000 Series 700 System Performance,* Revised Edition, January 1992, pages 24-25. 3D vectors (kvectors/second) benchmark conditions were 10 pixel, random orientation, clipping on perspective projection, and constant color. Through Starbase API. 3D Triangles/ (kpolygons/second) benchmark conditions were 10x10, 50 pixel triangles in trianglular strips, random orientation, transformed, clipped checked, and Z-buffered.

Hewlett Packard 9000/720 CRX, CRX24, and CRX24Z

Processor Type & Frequency	PA-RISC/50 MHz
Floating Point	built-in
Cache	128 Kb instruction / 256 Kb data
Memory	16 MB
Disk	420 MB
Network Interface	Ethernet
Operating System/Rel.	HP/UX 8.07
Windows System/Rel.	X11R4
Graphics Library	HP-PHIGS 2.2

Dhrystones, Whetstones, and Linpack numbers from *HP Apollo Series 700 Workstations Performance Overview,* March 1991. 2D graphics results (X11perf) from *Workstation Laboratories,* 4/1/91, Volume 13, Chapter 10. Model used by Workstation Laboratories was HP 9000 Model 720 CRX. 3D graphic results from *HP Apollo 9000 Series 700 System Performance,* Revised Edition, January 1992, pages 24-25. 3D vectors (kvectors/second) benchmark conditions were 10 pixel, random orientation, clipping on perspective projection, and constant color. Through Starbase API. 3D Triangles (Kpolygons/second) benchmark conditions were 10x10, 50 pixel triangles in trianglular strips, random orientation, transformed, clipped checked, and Z-buffered. GPCmarks from *The GPC Quarterly Report*, Vol. 2, No. 1, 1st Qtr 1992, pages 30,32, and 34.

IBM RS/6000 220 Workstation:

CPU	IBM RISC - 33 MHz
FPU	built into CPU chip set
Memory	32 MB
Disk	IBM 400 MB SCSI 3.5"
Cache Size	8 Kb data + instruction
Operating System	AIX 3.2
Compilers	AIX XL FORTRAN Ver. 2.2 and AIX XL C Ver. 1.2

SPEC benchmark numbers from *SPEC Newsletter*, Volume 4, Issue 1, March 1992., page 91. Dhrystone, Whetstone, and Linpack benchmark results from *Workstation Laboratories,* 3/1/92, Volume 16, Chapter 19, page V16-19-Config.

IBM RS/6000 320H Workstation:

CPU	IBM RISC-25 MHz
FPU	Integrated
Memory	16 MB
Disk Controller	DBA/SCSI
Disk	400 MB
Cache Size	32 Kb data / 8 Kb instruction
Network Interface	Ethernet
Operating System	AIX 3.2
Compilers	AIX XL FORTRAN Ver. 2.2 and AIX XL C Ver. 1.2
File System	AIX

SPEC results from *SPEC Newsletter*, Volume 4, Issue 1, March 1992, page 92. Dhrystone, Linpack, Whetstone, and X11perf ratings from *Workstation Laboratories,* 3/1/92, Volume 16, page V16-9-Config. GPCmarks from *The GPC Quarterly Report,* Vol. 1, No. 3 4th Qtr 1991, page 29. GPCmarks configuration used AIX V3, AIX windows 11.4, GL, graphics accelerator Gt4x 24 Bit , resolution 1280x1024, display size 16 ", and display refresh rate 60 Hz .

Silicon Graphics 4D/RPC Indigo Workstation:

Processor Type & Frequency	R3000 Mips RISC CPU - 33 MHz
Floating Point UNIX & Frequency	R3010 Mips RISC FPU - 33 MHz
Cache Memory Size & Speed	64 Kbytes Total - 32 Kbytes each I & D
RAM Memory Size & Speed	56 MB
Display Size & Type	16" Color
Display Resolution	1024 x 768 Pixels
Hardfile Brands & Model Numbers	Seagate 3.5" ST1480N/SCSI
Hardfile Quantity/Interface	1/SCSI
Hardfile Size(s) (Unformatted/For.)	480/400 MB
For Network Tests: "Remote" or "Local"	Remote, using Mips RC3240 server, Ethernet, 10MB/second
Operating System Name & Level	Silicon Graphics Unix OS - 4D1-4.0
Fortran Compiler, Versions, and Switches	Silicon Graphics (Mips) version 4D1-4.0 -O3 or -O2
C Compiler, Version, and Switches	Silicon Graphics (Mips) version 4D1-4.0 -O3 or -O2
Graphics Libraries Used	X11 and GL Graphics Libraries

Dhrystone, Whetstone, Linpack, Khornerstone, and X11perf benchmark results from *Workstation Laboratories,* 9/1/91, Volume 15, Chapter 23, page V15-23-Config. SPEC R1.2 results from Silicon Graphics Computer Systems, *INTRODUCING IRIS INDIGO Competitive Analysis,* July 22, 1992, page 27. Configuration used 33 MHz MIPS R3000A CPU, 32 MB memory, IRIX 4.0 Version 240, Beta software operating system, IRIX system daemons, xdm background load, network daemons for remotely-run-clients test case, and system state was multi-user, single-user login.

SPARCstation IPX Workstation:

Processor Type & Frequency	SPAR (LSI) - 40MHz
Floating Point Unix & Frequency	SPARC (Fujitsu) - 40 MHz
Cache Memory Size & Speed	64 Kbytes
RAM Memory Size & Speed	16MB / 80 nanoseconds
Hardfile Brands & Model Numbers	Maxtor 3.5" SCSI
Hardfile Quantity/Interface	1 SCSI
Hardfile Size(s) (Unformatted/For.)	?/207 MB
Operating System Name & Level	Sun OS 4.1.1
Fortran Supplier & Version & Switches	Sun Fortran 1.4 -O4
C Supplier & Version & Switches	Sun C 1.1 -O4
Graphics Libraries Used	X11

SPEC benchmark numbers from *SPEC Newsletter,* Volume 3, Issue 3, September 1991, page 22. Other software used was KAP/SUN pre-processor. Disk subsystem was 424 MB SCSI. No tuning parameters in use, no background load, and system state was single user. Dhrystone, Whetstone, Linpack, and X11perf numbers from *Workstation Laboratories*, 9/1/91, Volume 15, Chapter 22. GPCmarks from *The GPC Quarterly Report,* Vol. 2, No. 1, 1st Qtr. 1992, page 59. GPC configuration was operating system SunOS4.1.1revB GFXrev2, OpenWindows Version 3, Graphics Library SunPHIGS 2.0, PLB V1.2rev A, graphics accelerator GX, resolution 1152x900, display size 16", and display refresh rate 76MHz.

Sun SPARCstation 2 Workstation:

CPU Processor	SPARC
CPU MHz	40 MHz
FPU	SPARC (TI)
FPU MHz	40 MHz
Memory	16 MB
Disk Buffer Sizes	(14,901 available)
Disk Controller	2/SCSI
Disk	Quantum 210S & Conners CP3200F
Cache Size	64 KB data/64 KB instruction
Network Interface	Ethernet
Operating System	Sun OS 4.1.1
Compilers	Optional Sun Fortran, Optional Sun C
Compiler Switches	-O3

SPEC benchmark ratings from *SPEC Newsletter,* Volume , Issue 4, December 1991. Linpack and Dhrystone benchmark ratings from *SPARCstation 2 Performance Brief,* Sun Microsystems, Inc., November 1990. Tested configuration was SPARCstation 2 running SunOS 4.1.1beta, Sun FORTRAN 1.4beta and Sun C1.1beta. Whetstone and X11perf results from Workstation Laboratories, Inc., Volume 12, Chapter 23, page V12-23-Config. 3D graphics results from *HP Apollo 9000 Series 700 System Performance,* Revised Edition, January 1992, pages 24-25. 3D vector (kvectors/second) benchmark conditions were 10 pixel vectors, transformed and clipped. API was not specified. 3D triangles (kpolygons/second) benchmark conditions were 100 pixel triangles, gourand-shaded, clipped, through SunPHIGS. Tests ran on SPARCstation 2GS. GPCmarks from *The GPC Quarterly Report,* Volume 2, Number 1, 1st Quarter 1992, page s 61 and 65. GS configuration used 32 MB memory, 424 MB disk, operating system SunOS4.1.1revB GFXrev2, window system OpenWindows V3, graphics library SunPHIGS 2.0, PLB V1.2 rev A, graphics accelerator GS, resolution 1152x900, display size 19", and display refresh rate 76 MHz.

B

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