

A Series of Benchmark Tests
Comparing UNIX‡ System Machines
and the
Performance of VENIX†
in contrast with
Other Implementations of the UNIX System

†VENIX is a trademark of VenturCom, Inc.

‡UNIX is a trademark of Bell Laboratories.

Two programs, many UNIX systems (reprint)

Andrew S. Tanenbaum
Vrije Universiteit, Amsterdam

Teus Hagen
Mathematical Centre, Amsterdam

UNIX meetings give a splendid opportunity to run test programs on the machines present at the exhibition. At the recent meetings and expositions in Europe and the US, we have run two test programs on a wide variety of machines. Test program #1 measures CPU/memory speed; test program #2 measures I/O speed. Program #1 was tested six times, with the 'TYPE' declared in six different ways: short, register short, int, register int, long, register long. On the small machines, the tests were generally made in single user mode; on the larger mainframes we had to share the machine with others.

The programs:

```
/* Test 1 - CPU/memory */
main(){
    TYPE i,j,k;
    for (i=0;i<1000;i++)
        for (j=0;j<1000;j++)
            k=i+j+1983;
}

/*Test 2 - I/O */
main(){
    int i,j,n;
    char a[512];

    if((n=creat("foo",0755))<0)
        perror("error:foo");
    for(i=0;i<500;i++)
        write(n,a,512);
}
```

Notes:

The times reflect a combination of several factors, among them, the CPU type, the clock rate, the speed of the memory management unit, the speed of the memory itself, the width and speed of the bus, and last, but certainly not least, the quality of the C compiler used on the machine. Also the times were obtained using the time (1) command. There is reason to believe that not all vendors understand that 50 Hz!=60 Hz, which makes some of the times slightly suspect.

Conclusions:

None. You should take the measurements with a grain, or better yet, an imperial gallon, of salt. For example, comparing the PDP-11/70 with the SUN, we see that for test #1 and register short, the PDP-11/70 is nearly three times faster, but comparing register long for the two machines, the SUN is twice as fast. The difference can be explained by the fact that the PDP-11/70 really is faster, but uses memory instead of registers for register longs, whereas the SUN uses the 68000's hardware registers.

Goal:

Our goal in making these measurements is to stimulate you into making your own measurements and to make you cautious when looking at (carefully selected) comparisons thoughtfully supplied by vendors. Remember: Figures don't lie, but liars figure. If anyone wants to run the tests on other machines, we would appreciate hearing from you.

BENCHMARKS

Machine	MHz	Times in Seconds									Year	Notes
		usr short	usr short reg	usr int	usr int reg	usr long	usr long reg	real cc #1	real cc #2	#2		
DEC												
VAX 780		8.8	8.6	6.7	4.7	6.7	4.7	3	3	2	83	
VAX 750		16.2	16.5	10.9	7.3	10.8	7.3	11			84	
VAX 750		18.9	19.3	13.0	8.5	11.6	8.6	4	4	2	83	
MicroVAX		28.2	28.3	22.2	12.4	22.2	12.4	12			84	
VAX 730		37.4	37.5	23.9	14.4	24.1	14.4	11	12	6	83	
11/70		7.4	2.8	7.4	2.8	14.3	14.3	11	12	14	83	
11/60		10.4	4.2	10.4	4.2	20.2	20.2	17	19	16	83	
11/44		11.2	5.7	11.2	5.7	21.8	21.8	16	8	21	83	
11/45		19.1	7.9	19.1	7.8	38.5	38.5	12	20	12	83	
11/34		22.0	10.9	22.0	10.8	44.8	44.8	18	19	14	83	
11/24		27.7	12.2	27.4	12.4	57.0	57.5	21	20	19	83	
AEDS11(/23)		34.5	14.9	34.6	14.9	72.2	72.2	28	30	8	83	
VENIX 11/23		35.5	15.4	35.5	15.4	74.3	74.3	14	17	9	84	Note 1
VENIX/Pro		35.1	15.4	35.1	15.4	73.2	73.2	22	22	10	84	Note 1
Micro 11(/23)		36.8	16.2	36.9	16.2	76.8	76.8	29	31	24	83	
Z8000's												
Z8000	5.5	13.6	6.3	13.6	6.2	23.2	12.6	20			83	
Zilog	6	14.7	7.3	14.7		25.7	13.3	20	20	8	83	
Plexus	5	15.2	7.0	15.4	7.0	27.5	27.6	24	26	13	83	
ONYX	4	15.9	7.2	15.9	7.3	23.8	14.1	14	14	8	83	
Bleasdale	4	33.3	15.6	33.3		56.2	56.2	20	21	16	83	
Intel 8088's												
IBM XT/VENIX	4	37.7	22.3	37.6	22.2	72.8	72.8	44	48	12	84	Note 1
IBM XT/PC IX	4	53.4	30.0	53.4	30.0	108.8	108.8	25			84	
8086's												
Altos	10	13.7	7.2	13.7	7.2	27.8	27.7	18	20	7	83	
Eagle/VENIX	8	17.3	10.0	17.4	10.0	34.6	34.6	25.5	29.0	7	84	Note 1
Intel	8	29.2	17.6	29.0	17.5	59.1	59.0	17			84	
SBC 86/12A			68.1	83								
80186's												
MAD/VENIX	8	14.9	8.4	14.9	8.4	29.1	29.1	22	25	6	84	Note 1
80286's												
Intel/Xenix	5.5	17.3	10.9	17.3	10.7	34.6	34.6	27			84	
16032's												
National	6	27.4	25.6	29.3	14.0	32.4	11.7	20			83	
IBM Sritek	6	27.4	27.5	32.1	13.4	30.7	13.6	103			84	
National	4	49.9	45.0	56.7	23.3	57.4	27.2	47	49		83	mem flt

Note 1: Tests were performed at VenturCom, Inc. on machines with 256 Kbytes of main memory.

BENCHMARKS

Machine	MHz	Times in Seconds									Year	Notes
		usr short	usr short reg	usr int	usr int reg	usr long	usr long reg	real cc#1	real cc#2	#2		
68000's												
Plexus P/35	12.5	8.9	5.3	10.0	5.1	10.1	5.2	12			84	
Ch Rivers	12.5	10.1	6.0	11.8	5.9	11.8	5.9	12			83	
QU68030	10	12.0	6.0	13.0	6.0	17.0	8.0	8	11	4	83	
Parallel	12.5	11.6	7.0	13.5	6.7	13.5	6.7	17	18	8	83	
Altos	8	13.9	13.9	13.9	13.9	17.8	17.8	18	25	5	83	
SUN 1	10	13.0	7.8	14.6	7.6	14.6	7.5	9	10	5	83	
Cyb	8	15.3	9.0	15.3	8.2	17.5	8.2	27	28	12	83	
Momentum 32E	8	14.5	8.6	16.7	7.6	16.7	7.6	22			83	
TI NU	10	13.8	6.7	18.2	6.5	17.7	6.6	16			84	3 usrs
Codata	8	17.1	10.5	19.3	10.5	19.3	10.5	28	30	28	83	
CCI	8	20.5	9.3	20.5	9.3	29.9	13.2	13			84	
Pacific	10	18.1	10.7	20.7	9.7	20.8	9.7	24	23	13	83	
Power 520	8	21.1	9.2	20.7	9.2	31.4	12.5	16	16	19	83	
Hawk 32/E	8	19.0	11.3	21.5	10.3	21.5	10.3	29	19	27	83	
Pixel 100/AP	8	18.6	11.0	21.5	9.6	22.9	9.6	44	47	10	83	
Corvus	8	19.8	11.6	22.5	10.1	22.6	10.1	40	42	no sp	83	
Fortune	8	21.7	12.8	25.0	12.4	25.0	12.3	18	20	6	83	
QU68000	10	24.5	11.9	24.5		33.0	15.1	10	10	7	83	
Apple Unisoft	5	22.6	13.7	25.9	12.1	25.9	12.1	41	43	28	83	
Apple Xenix	5	22.7	13.9	26.0	13.0	25.9	13.0	58	65	no sp	83	
Altos-12	5	26.7	14.1	26.7	14.1	53.7	53.9	31	33	13	83	
Plessey S68	8	23.9	13.9	27.5	12.8	27.5	12.6	30			83	
Wicat WS150	8	24.8	14.4	28.1	13.1	28.1	13.1	19	21	12	83	
Victory 68K	10	23.7	15.0	28.3	12.6	29.1	12.5	19			83	
TRS80	8	25.2	14.9	28.3	14.0	28.4	14.2	23	28	16	83	
Codata	8	25.5	14.9	29.2	12.8	29.2	12.8	16			84	
Dual	8	26.9	15.6	30.7	13.3	30.7	13.3	21	20	27	83	
Four Phase	8	27.4	16.2	31.1	14.9	31.1	14.9	32			83	
Ch Rivers	8	28.2	15.8	31.7	15.8	31.7	15.8	28	42	14	83	
Unistar 200	8	28.7	16.5	32.8	14.3	32.8	14.3	36	40	28	83	
IBM Sritek	8	30.3	17.6	34.2	17.3	35.1	16.9	31	35	18	83	ut>rt?
IBM PC Idris	8	37.9	22.7	37.9	22.7	73.3	73.3	18	26	39	83	
Cosmos Antaris	8	34.1	19.5	38.7	16.4	38.7	16.4	26	27	9	83	
ULAB	8	37.2	21.0	44.1	18.9	44.1	19.0	38	44	15	83	

BENCHMARKS

Machine	MHz	Times in Seconds									Year	Notes
		usr short	usr short reg	usr int	usr int reg	usr long	usr long reg	real cc#1	real cc#2	#2		
Others												
Amdahl		0.5	0.5	0.3	0.3	0.3	0.3	10	5	1	84	1 usr
Concept 32/87		1.5	1.5	0.9	1.4	1.0	1.4	10	16	2	83	1 usr
Pyramid		3.3	3.3	2.0	1.9	2.0	2.0	9			84	
Ridge		7.1	2.9	4.0	1.6	4.0	1.6	19			84	
Eclipse		4.6	4.6	4.4	4.4	4.4	4.4	28			84	
Arete		5.7	5.7	5.7	5.7	5.6	5.8	15			84	
Hp 9000		9.4	9.4	7.4	7.4	7.4	7.4	28	26	3	83	
Concept 32/27		12.0	11.0	10.0	10.0	10.0	10.0	18	20	5	83	
BBN C/60		14.5	8.2	14.6	8.2	47.2	30.3	7	9	3	83	
PE3210		16.7	6.7	15.9		15.9	6.7	4	4	3	83	
Perq 1		44.5	15.6	22.2			15.0	25	25	7	83	
Perq 2		46.7	15.1	23.0	15.0	22.9	15.1	20			83	
IBM S/1 4954		37.2	37.1	37.1	37.1	62.3	62.3	28	30	32	83	

"Collected Benchmarks"

On the facing page there is a collection of benchmark results printed in the March 1984 issue of UNIQUE: (Volume 3, Number 5).

David Fiedler, the Editor of UNIQUE, suggested that his readers do the benchmark testing and submit the results, to gain "a perspective on speed claims and a starting point for comparisons." The results were gathered by running the following C programs which were printed in UNIQUE, Volume 3, Number 3.

On the following page, the first program is called "gpid" and the second program is called "bpid".

```
main()
{
    int i=10000;
        while (i --)
            getpid ( );
}
```

```
main()
{
    long i=77777;
        while (i --)
            getpid ( );
}
```

Benchmark results submitted by:

- Note 1 M. Pearson, Unicorp Software, IBM-XT (512 Kb)
- Note 2 T. Delker, Delker Electronics
- Note 3 R. Struse, Software Systems Assoc.
- Note 4 R. Struse, Software Systems Assoc., bigpid used 80000 loop
- Note 5 Bob Halloran, Telex Computer Prods.
- Note 6 Jonathan Frazier, Gould
- Note 7 VenturCom, Inc., on machines with 256 Kb of memory

Uncredited results were recorded by UNIQUE.

System	Times in Seconds									Date	Simul	Notes
	cc real	cc usr	cc sys	gpid real	gpid usr	gpid sys	bpid real	bpid usr	bpid sys			
Arete	13.6	3.5	3.7	5.2	.1	5.0	39.5	.3	39.1	01/84		
Cadmus 9790 System V	16.0	.6	2.0	6.0	.3	4.5	38.0	5.7	31.6	01/84	27.5	
Codata 3300 84 MB disk	14.0	3.0	4.1	4.0	.1	3.2	26.0	1.2	25.1	12/83		
Computer Automation Mini	28.0	3.7	5.8	5.0	.8	3.7				01/84	33.0	
Convergent Miniframe	14.3	2.0	1.9	3.7	3.4					03/84		Note 3
Convergent Megaframe	18.5	2.1	2.9	4.8	.1	4.4	36.3	1.3	34.4	03/84	30.2	Note 4
Dual 83/80 System V	14.0	4.1	5.7	4.0	.4	3.8	30.0	2.2	27.9	01/84	26.0	
Forward Technology Xenix	27.0	4.1	3.4	5.0	.9	3.7	36.0	8.3	27.4	01/84	29.0	
Gould Concept 32/6780	3.0	.7	1.7	3.0	.2	3.0	24.0	1.5	23.4	04/84	6.5	Note 6
Gould Concept 32/8750	2.0	.2	.8	1.0	.1	1.3	21.0	1.4	10.0	04/84	3.0	Note 6
Gould PowerStation 2000	14.2	1.8	2.5	3.7	.1	3.4	27.2	1.1	25.9	01/84	19.0	
Heurikon	13.4	3.6	4.3	4.5	.1	4.2	33.3	1.1	31.8	04/84	22.9	Note 5
IBC Ensign	22.0	1.9	6.3	2.0	.1	2.1	19.0	1.3	14.8	01/84		
IBM PC (PC/IX)	21.3	7.2	6.3	18.7	2.7	15.1	139.4	13.4	125.3	01/84	35.0	
IBM PC (VENIX)	44.0	6.0	8.8	9.0	0.6	7.7	66.0	15.1	49.3	05/84		Note 7
IBM PC (VENIX)	23.5	5.0	5.4	9.0	8.5		67.5	67.2		02/84	37.0	Note 1
MAD 80186 (VENIX)	18.0	1.7	2.5	4.0	0.5	3.0	29.0	6.1	22.3	05/84		Note 7
Eagle 1600 (VENIX)	54.0	2.8	3.3	6.0	0.7	3.3	33.0	6.1	24.6	05/84		Note 7
Megadata	20.0	5.2	4.6	3.0	.2	3.0	24.0	2.8	21.6	01/84		
National Semi Sys16 GENIX	24.0	3.0	9.3	8.0	1.1	6.4	58.0	8.3	48.6	04/84	22.5	Note 5
National Semi 16032 6 MHz.	16.0	2.8	5.9	7.0	1.0	6.0	61.0	7.2	46.0	01/84		
Pixel 100/AP	13.0	2.1	2.4	3.0	.3	2.5	22.0	.6	21.3	01/84	27.5	
Pacific PM200	15.0	1.7	1.6	2.0	.2	1.9	16.0	1.1	14.8	01/84	34.0	
Plexus P/35	11.0	2.6	3.6	2.0	.2	2.2	17.0		18.1	01/84	15.5	
Radio Shack Model 16/B	25.0	1.7	4.7	7.0	.8	5.0	45.0	6.3	38.3	01/84	30.0	
Radio Shack 16/B Xenix 1.3	34.0	1.8	3.3	7.0	.7	5.2	47.0	6.2	39.9	02/84		Note 2
Sage Idris 2.2	36.0	1.1	33.5	5.0	.5	4.2	41.0	7.2	32.4	12/83		
Sun Workstation (over LAN)	7.0	1.1	2.3	2.0	.3	2.2	20.0	2.8	17.3	01/84	6.5	
Ridge	20.5	7.2	.9	9.2	3.8	1.3	67.0	29.6	9.6	01/84		
Texas Instruments NuBus	13.0	.6	2.2	7.0	.1	2.0	47.0	.5	15.2	01/84		
VAX 730 BSD 4.2	15.0	2.9	5.9	6.0	0.5	5.9	50.0	4.3	46.0	05/84		Note 7
Victory Factor	16.0	3.6	4.2	3.0	.4	3.0	23.0	2.2	21.7	01/84	23.0	

[illegible]