Fermilab Computing Division
New Technology Evaluation
Final Report
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Members of the New Technology Evaluation Taskforce:
Steven Timm, Stan Naymola, Connie Sieh, Troy Dawson, Karen Shepelak, Mike Diesburg, Lance Weems

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Executive Summary:

The New Technology Taskforce has evaluated the latest dual Athlon and dual Xeon hardware. We find that both types of hardware are suitable for use at Fermilab. For applications that are commonly run on the Fermilab reconstruction farms, the dual Athlon units give better absolute performance as well as better price-performance. We propose an effective clock cycle rating as a method of comparing relative performance of the different architectures, and of quantifying price-performance for future bids.

Introduction:

Intel's Pentium III (P6) architecture, which has been used in the Fermilab Farms for the past four years almost exclusively, is near the end of its life cycle. With the introduction of its "Netburst" architecture, Intel is breaking with the pattern of having the same processor (PIII) be used for both single and dual processor machines. The Pentium 4 is only a single-processor chip. CPU's for multiprocessing applications in the "Netburst" architecture will be referred to as Xeon. There are several motherboards and chipsets now available for this dual Xeon architecture. We can expect by the end of 2002 that this will be Intel's predominant platform in the dual-CPU compute node market.

In addition, the recent availability of dual-processor Athlon MP systems from AMD is an important change in the market. These systems claim to have quite high performance, and are relatively inexpensive. In the 2001 evaluation we approved single Athlon systems for desktop use. Now we will consider them for possible use as farm workers.

The evaluation consists of four major parts: hardware reliability, software support, service, and performance. Of these, reliability and performance are weighted most heavily. We were particularly interested if these new processors could be put in a 1U form factor. We opened this new technology evaluation only to our five existing qualified farm worker vendors. Each vendor was allowed to compete in Athlon, Xeon, or both. One vendor, iXsystems, chose not to enter the evaluation, thus disqualifying themselves from further Fermilab bids this fiscal year. Richardson Electronics (Eternal Graphics) entered only with Xeon hardware. The other three vendors, Atipa, Racksaver, and Linux Networx, submitted both types of machines.

Hardware:

Specifications:

We required the following specifications in the units that were submitted:

Dual AMD Athlon XP1800+ CPU
Or
Dual Intel Xeon 2.0 GHz CPU w/ 512 Kb cache (Prestonia)
One Gbyte of RAM (DDR SDRAM or RDRAM)
One IDE system disk, 20 Gbytes or greater
IDE data disks—two 40 Gbytes or greater or one 80 Gbytes or greater.
Low-resolution video
Floppy drive
CD-ROM
100 Mbit/sec Ethernet, one or more
2U rackmount case or smaller
Rails for rackmounting.

A fuller description of the requirements that were sent to the vendors can be found at: http://www-oss.fnal.gov/scs/qualify2002/qual2002.doc.

When the machine first arrived, we tested to see if it would boot, and then filled out a comprehensive checklist on all these requirements plus the quality of construction. We checked for good cabling layout inside the case, good airflow inside the case, flatness of case, and other quality control features. The full points breakdown is listed on the hardware, software, and service checksheet, which is available in Microsoft Excel format on the web at http://www-oss.fnal.gov/scs/qualify2002/qualify-farm.xls. The point totals for each section appear at http://www-oss.fnal.gov/scs/qualify2002/checksheet.html, and that table is also reproduced below.

Electrical characteristics:

The current draw of each system was measured using an AC ammeter. We measured the current draw of each system immediately at startup, with idle CPU, and at full CPU load. We found the current draw of these systems to be consistent with the current draw of the current generation of farm workers that are currently deployed. Sometimes, however, a current spike of ~5 amperes was observed at the instant of startup, thanks to an ammeter that recorded minima and maxima. We got out a storage scope to observe the waveform of the current and found that there is indeed a spike, sometimes as much as +/- 15 amperes, but lasting for only about two AC cycles, or 32 msec. This is not likely to be a problem for a circuit breaker because it does not last long enough, and power sequencing can make sure only one of them happens at once. A full table of currents is on the web at http://www-oss.fnal.gov/scs/qualify2002/electric.html, and is reproduced below.

System Name	Power-on	Idle	Full Load
Atipa-amd1	2.13	1.75	2.01
Atipa-xeon1	1.55	0.85	1.48
Atipa-xeon2	1.47	0.79	1.33
Eg-xeon	1.57	0.82	1.46
Eg-xeon2	1.95	0.87	1.43
Ln-amd	2.22	1.62	1.92
Ln-xeon	1.68	0.88	1.41
Rs-amd	2.08	1.75	1.95
Rs-xeon	1.46	0.98	1.25

Thermal characteristics:

We used a Picoprobe external temperature probe, along with K-type thermocouples, to measure the temperature at several points inside the system case, independent of the internal sensors. The results of the temperature measurement are shown on the web at http://www-oss.fnal.gov/scs/qualify2002/Temperatures.html. A summary of the configuration of each machine is on the respective web page with its temperatures. There are also digital pictures of each machine listed on these web pages. All temperatures below are in Fahrenheit.

Machine name	CPU0	CPU1	Power	Disk 1	Disk 2	Disk 3	Exhaust
Atipa-amd1	116.24	102.24	108.59	83.70	78.51	79.72	109.94
Atipa-amd2	97.14	107.01	95.77	83.70			95.79
Atipa-xeon1	83.62	101.05	88.12	78.31	78.60	79.30	91.35
Atipa-xeon2	125.98	91.87	87.35	72.64	77.63	74.84	82.13
Eg-xeon	91.08	78.71	90.25	74.82	76.69		87.46
Eg-xeon2	81.00	81.30	85.05	80.17	83.39		78.44
Ln-xeon	86.99	77.47	87.87		76.39	72.48	77.02
Ln-amd	104.59	113.50	102.02	81.01	75.97	77.22	95.92
Rs-amd	95.34	102.11	85.73	73.40	108.99		96.15
Rs-xeon	88.57	89.82	91.83	72.21	103.69		82.35

The above temperatures were taken on a lab bench. Temperatures in the middle of a rack can be 8-9 Fahrenheit degrees higher. We raised concerns about thermal issues with any of the machines that had temperatures of CPU or disk drive greater than 107 degrees F.

Software:

We rated the competency of the various vendors to install Fermi Linux. All vendors were provided with a CD-ROM set of Fermi Linux and a kickstart disk. We examined the install they had done. The vendors were also provided with a set of benchmarks that they were supposed to run before they shipped the unit. We verified whether or not they had run the appropriate benchmarks. After we verified the initial installation, we reinstalled each system.

We ran the Fermi burn-in test on each system. Each system had one instance of seti@home on each CPU, running continuously. In addition we ran "bonnie", a disk write utility, on a regular schedule. This utility wrote and read a 1 GB file to the system disk at 2,7,17,27,37,47, and 57 minutes past the hour. We also wrote to the data disks at 2, 10, 20, 30, 40, and 50 minutes past the hour. The write at two minutes past the hour is simultaneous between the system disk and first data disk, to force exercising of both IDE busses at once. In addition, there is a script called "zioerror" which runs at 2, 5, 15, 25, 35, 45, and 55 minutes past the hour which copied a large file system with many inodes from one disk to the other, and checked for I/O errors. Finally, a cron job ran to use lm_sensors to check the temperature of each node. With the exception of the initial problems mentioned below in the service section, all nodes ran the burn-in very well and did not have any DMA errors.

Service:

All four vendors had at least one machine that required a service call. Richardson Electronics was called to fix a poor cable layout in their first unit that caused the case to bow. They fixed this the next day. Atipa was contacted due to problems with the power switch of their unit. It appeared that the unit wouldn't switch off, but this was a feature of the beta board that required holding down the power switch for three seconds to successfully power down the unit. They answered this call promptly as well.

The Racksaver AMD unit suffered from a slow read and write rate to the system disk as measured by bonnie. They could have caught this if they had looked at the results for the vendor benchmarks which they did run. The error was reported on 3/28. They attempted an unsuccessful software fix, then sent a replacement IDE cable on 4/5 and a replacement hard disk on 4/9, which finally resolved the problem. Fermi staff were involved in swapping out the parts.

Both of Linux Networx machines were dead on arrival. The Xeon unit could not see its system drive. The AMD unit wouldn't get past the first power-on self test screen at all. Inspection showed that the problem with the AMD unit was due to bad design. A flexible AGP riser card was positioned so it was directly over one of the CPU fans. Due to the flexible nature of the riser card, it was possible for it to actually contact the CPU fan. We observed that a couple of blades were chipped out of the CPU fan and it was not always spinning. Also some smoke came from the unit, indicating that one CPU probably failed. Linux Networx requested both machines to be sent back to them. We shipped on 3/29. They returned the machines on 4/2. At this point the Xeon machine was OK. The AMD machine booted briefly with 1 CPU and about 1 hour later went dead again. We shipped it out again on 4/4 and they returned on 4/11, working this time, with both CPU's and motherboard having been replaced.

Linux Evaluation Scores - Farm Units

Hardware		Atipa Xeon2	Atipa Xeon1	Atipa AMD1	EG Xeon1	EG Xeon2	Lin Net Xeon	Lin Net AMD	RS Xeon	RS AMD
Hardware Price		3,171	3,171	2,887	2,560	2,825	3,579	2,201	3,485	2,375
	Available Points									
Hardware standard	39	32	36	34	30	35.5	30	28	35	38
Hardware optional	8	4	5	5	6	6	7	3	5	2
Software standard	28	15	26	20	29	25	15	24	28	23
Software optional	1	0	0	0	0	0	0	0	0	0
Service standard	20	1	1	1	18	18	-3	-3	17	17
Service optional	3	3	3	3	0	0	0	0	0	0
System late or down		0	-20	0	0	-20	-15	-25	0	0
Grand Total										
Testing Total	87	48	63	55	77	78.5	42	49	80	78
Testing Total Optional	12	7	8	8	6	6	7	3	5	2
Total Points Earned (120 possible)		55	51	63	83	64.5	34	27	85	80

Benchmarking:

In benchmarking the systems we had two goals: We wanted to use the new SPEC2000 benchmarks to make a reference to our older systems, which up until now had been measured with SPEC CPU95 benchmarks. We also wanted to measure what the systems did on real Fermilab code. We purchased the SPEC CPU2000 benchmarks, version 1.2.

The SPEC CPU2000 benchmarks consist of twelve integer benchmarks (11 written in C, one written in C++), and fourteen floating-point benchmarks (4 in Fortran 77, 4 in C, and 4 in Fortran 90). The inclusion of the Fortran 90 benchmarks means that it is impossible to compile them with open source compilers such as g77. Absoft Fortran is also not sufficient to compile them. It was necessary to download a demo edition of Intel Fortran Compiler for Linux v5.0.1. Much of the testing of these benchmarks was done on a Pentium 4 1.9 GHz single processor machine with RDRAM. With initial naïve optimizations, using gcc and Intel Fortran, we obtained CINT2000=467 and CFP2000=489. A machine with the identical hardware is reported on SPEC to be CINT2000=634, CFP2000=696.

Anyone who has reported results to SPEC is required to publish all compiler options used in getting the result. Full optimization of the SPEC suite requires using the special Pentium 4 SSE2 instruction set, doing multi-procedure optimizations, two pass compiling, and many more heroic optimizations. Once this was complete, we obtained CINT2000=566, CFP2000=688 on this machine. This pattern proceeded through the course of the various machines we tested—floating point numbers almost consistent with what was reported, and integer numbers being consistently low by about the same percentage. We believe this to be due to two steps taken by the vendor benchmarkers which were not available to us. Most of the SPEC results include MicroQuill's proprietary heap manager library, which allows multiple threads to access the heap simultaneously. Also, most of the SPEC results on Intel and AMD hardware to date have been run under Windows NT, not under Linux. To pursue this further would have required loading Windows on all the machines and buying this library (which is available for Windows and Linux). However, this was not within the scope of our investigation, and given the numbers that we found in real-world benchmarks, we believe the investigation would be irrelevant.

We measured the performance of six applications commonly run at Fermilab on a variety of machines. We had D0 farms reconstruction, CDF farms reconstruction, CDF farms Monte Carlo, Tiny, QCD-benchmark, and seti@home. Graphs of all six benchmarks, as well as nominal and measured SPEC CINT2000 and CFP2000, are available at http://www-oss.fnal.gov/scs/qualify2002/benchmark.html.

When Intel introduced the current architecture, they went from Pentium III 1 GHz to Pentium 4 1.4 GHz with less than 10% increase in nominal performance. AMD does a similar thing by referring to a chip with actual clock speed of 1533MHz as MP1800+. Therefore we need to construct a common scale where we can make the comparison between the new chips and the Pentium III performance numbers that we are used to. In the past it used to be that the typical farms applications would scale linearly with SPECINT2000. This is no longer the case, because we must also consider how much of the theoretical capacity of the chip is actually usable given the codes that we run.

For farms buys, the correct approach is to average the performance of the CDF and D0 reconstruction software, normalized to that of a 1.0 GHz Pentium III, and then report the average. For the Athlon chips this comes out remarkably close to their true clock speed (1400 MHz for the MP1600, 1533 MHz for the MP1800). For the 2.0GHz dual Xeon units, the number is about 1430. A full table appears below of all the effective clock cycles. We have also extrapolated to chip speeds which are either currently available or will be during this fiscal year.

Machine Name	CPU Speed	Effective PIII Cycles
Eg-xeon	2000	1432
Ln-xeon	2000	1432
Rs-xeon	2000	1421
Eg-xeon2	2000	1419
Atipa-xeon1	2000	1402
Atipa-xeon2	1800	1293
Future Xeon DDR	2200	1511
Future Xeon DDR	2400	1619
Future Xeon RDRAM	2200	1541
Future Xeon RDRAM	2400	1649
Atipa-amd1 (MP1800+)	1533	1559
Rs-amd (MP1800+)	1533	1555
Ln-amd (MP1800+)	1533	1562
Future AMD MP1900+	1600	1614
Future AMD MP2000+	1667	1688
Future AMD MP2100+	1733	1763
PIII 1000 (Coppermine)	1000	1000
PIII 1266 (Tualatin)	1266	1318
Future PIII 1400 (Tualatin)	1400	1436

There are several surprising effects that we found in the benchmarking process. We found that moving from a 2.4.3-12 kernel to a 2.4.9-31 kernel was good for a 10-15% improvement in the seti@home benchmark and also increased the streams number by approximately that percentage. RDRAM systems were about 5% better than DDR SDRAM systems in SPECfp_2000 measured numbers, 17% better in streams, and 5-10% better in seti@home and QCD benchmark. But in reconstruction software the effect was only about 1%.

Finally, our results show that the 1.266 GHz dual Pentium III units that were recently bought for CDF CAF facility and for CDF Farms are quite competitive with both the dual Xeon and the dual Athlon units. We project that the performance of the Pentium III 1.4 GHz, now available, would be equal to that of the dual Xeon 2.0 GHz on the Fermilab code.

Graphs of the performance of the various units are available on the web at http://www-oss.fnal.gov/scs/qualify2002/benchmark.html. Tables are also available with the results of all the benchmarks.

Performance Benchmarks for New Technology Evaluation

Vendor	Speed	D0 Evts/ Sec	CDFMC Evts/sec	CDFREC Evts/sec	Tiny	Seti Units/sec	QCD per second
Xeons							
Racksaver-Xeon	2000	4.167E-01	1.410E-01	5.359E-01	898	1.121E-04	2.995E-04
Eternal Graphics-Xeon	2000	4.164E-01	1.404E-01	5.359E-01	898	1.122E-04	2.994E-04
linux networx - Xeon	2000	4.165E-01	1.408E-01	5.286E-01	897	1.124E-04	2.914E-04
Atipa-Xeon2	2000	3.747E-01	1.276E-01	4.862E-01	812	9.967E-05	2.714E-04
Atipa-Xeon1	1800	4.171E-01	1.397E-01	5.146E-01	902	9.485E-05	2.845E-04
Eternal Graphics-Xeon2	2000	4.113E-01	1.401E-01	5.330E-01	899	1.083E-04	2.894E-04
Pentium 4							
Boxer--Intel D850GB	1900	3.612E-01	1.302E-01	4.887E-01	861	1.009E-04	2.947E-04
Carbon--Intel D850GB	1800	3.380E-01	1.212E-01	4.470E-01	795.7	9.567E-05	2.807E-04
Dilithium--Intel D850GB	1700	3.263E-01	1.130E-01	4.302E-01	751.8	9.004E-05	2.733E-04
Xeon Ref							
qcd0902--dual Xeon 1.7	1700	3.288E-01	1.168E-01		766	8.372E-05	2.700E-04
qcd0901--dual Xeon 1.4	1400	2.792E-01	9.728E-02		633	7.185E-05	2.427E-04
Athlons							
atipa-amd1 (MP1800)	1533	4.799E-01	1.082E-01	5.543E-01	932.3	1.106E-04	2.196E-04
rs-amd (MP1800)	1533	4.772E-01	1.068E-01	5.543E-01	928	1.018E-04	2.185E-04
ln-amd (MP1800)	1533	4.806E-01	1.089E-01	5.559E-01	932	1.025E-04	2.258E-04
Athlon Ref							
fnpc110 (linux networx xp 1700)	1466	4.491E-01	1.019E-01	5.315E-01	832.4	9.737E-05	2.005E-04
b0caf01 (atipa MP 1600)	1400	4.334E-01	1.001E-01	5.119E-01	847	1.045E-04	2.177E-04
qcd0905 (Athlon mp 1200)	1200	3.440E-01			723	8.885E-05	1.915E-04
Pentium III							
fncdf155 (EG P3 1266)	1266	4.117E-01	1.248E-01	4.619E-01	728	1.050E-04	2.218E-04
fnpc108 (atipa p3 1000)	1000	3.118E-01	9.001E-02	3.508E-01	571	6.950E-05	1.466E-04
fnpc117 (atipa p3 866)	866	2.746E-01	7.918E-02	3.104E-01	496	6.314E-05	1.382E-04
fnpc114 (EG p3 800)	800	2.504E-01	7.257E-02	2.816E-01	456	5.520E-05	1.232E-04
fnpc115 (atipa p3 600)	600	1.979E-01	5.624E-02	2.180E-01	340	4.848E-05	1.176E-04
fnpc201 (eg p3 500) + fnd020	500	1.420E-01	4.444E-02	1.724E-01	285.4	3.866E-05	8.879E-05
fnpc101 (pII 400)	400	1.126E-01	3.561E-02		228	3.142E-05	7.489E-05

		D0	CDFREC	CDFMC	TINY	Seti	QCD
Vendor	Speed	Normalized	Normalized	Normalized	Normalized	Normalized	Normalized
Xeons		1 GHz	1GHz	1GHz	1GHz	1GHz	1 GHZ
Racksaver-Xeon	2000	1.336E+00	1.528E+00	1.567E+00	1.573E+00	1.613E+00	2.043E+00
Eternal Graphics-Xeon	2000	1.336E+00	1.528E+00	1.560E+00	1.573E+00	1.615E+00	2.042E+00
linux networx - Xeon	2000	1.336E+00	1.507E+00	1.565E+00	1.571E+00	1.617E+00	1.987E+00
Atipa-Xeon2	1800	1.202E+00	1.386E+00	1.417E+00	1.422E+00	1.434E+00	1.852E+00
Atipa-Xeon1	2000	1.338E+00	1.467E+00	1.552E+00	1.580E+00	1.365E+00	1.941E+00
Eternal Graphics-Xeon2	2000	1.319E+00	1.519E+00	1.556E+00	1.574E+00	1.559E+00	1.974E+00
Pentium 4							
Boxer--Intel D850GB	1900	1.158E+00	1.393E+00	1.447E+00	1.508E+00	1.452E+00	2.010E+00
Carbon--Intel D850GB	1800	1.084E+00	1.274E+00	1.347E+00	1.394E+00	1.377E+00	1.915E+00
Dilithium--Intel D850GB	1700	1.047E+00	1.226E+00	1.255E+00	1.317E+00	1.296E+00	1.864E+00
Xeon Ref							
qcd0902--dual Xeon 1.7	1700	1.055E+00		1.298E+00	1.342E+00	1.205E+00	1.842E+00
qcd0901--dual Xeon 1.4	1400	8.953E-01		1.081E+00	1.109E+00	1.034E+00	1.655E+00
Athlons							
atipa-amd1 (MP1800)	1533	1.539E+00	1.580E+00	1.202E+00	1.633E+00	1.591E+00	1.498E+00
rs-amd (MP1800)	1533	1.530E+00	1.580E+00	1.187E+00	1.625E+00	1.465E+00	1.490E+00
ln-amd (MP1800)	1533	1.541E+00	1.585E+00	1.210E+00	1.632E+00	1.475E+00	1.540E+00
Athlon Ref							
fnpc110 (linux networx xp 1700)	1466	1.440E+00	1.515E+00	1.133E+00	1.458E+00	1.401E+00	1.368E+00
b0caf01 (atipa MP 1600)	1400	1.390E+00	1.459E+00	1.112E+00	1.483E+00	1.503E+00	1.485E+00
qcd0905 (Athlon mp 1200)	1200	1.103E+00			1.266E+00	1.278E+00	1.306E+00
Pentium III							
fncdf155 (EG P3 1266)	1266	1.320E+00	1.317E+00	1.387E+00	1.275E+00	1.511E+00	1.513E+00
fnpc108 (atipa p3 1000)	1200	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
fnpc117 (atipa p3 866)	866	8.808E-01	8.848E-01	8.797E-01	8.687E-01	9.085E-01	9.429E-01
fnpc114 (EG p3 800)	800	8.032E-01	8.026E-01	8.062E-01	7.986E-01	7.943E-01	8.402E-01
fnpc115 (atipa p3 600)	600	6.346E-01	6.213E-01	6.249E-01	5.954E-01	6.975E-01	8.019E-01
fnpc201 (eg p3 500) + fnd020	500	4.554E-01	4.916E-01	4.938E-01	4.998E-01	5.563E-01	6.056E-01
fnpc101 (pII 400)	400	3.611E-01		3.957E-01	3.993E-01	4.521E-01	5.108E-01
Slope of PIII data		1.089E-03	1.052E-03	1.109E-03	1.010E-03	1.131E-03	1.041E-03
Intercept of PIII data		-6.594E-02	-2.931E-02	-6.238E-02	-7.406E-03	-3.178E-02	7.994E-02

Performance Benchmarks for New Technology Evaluation

Vendor	CINT2000	CINT2000	CFP2000	CFP2000
Xeons	Meas	Vendor	Meas	Vendor
Racksaver-Xeon	660	757	721	765
Eternal Graphics-Xeon	661	757	723	765
linux networx - Xeon	653	757	723	765
Atipa-Xeon2	591	688	642	728
Atipa-Xeon1	625	757	675	765
Eternal Graphics-Xeon2	628	757	674	765
Pentium 4				
Boxer--Intel D850GB	566	634	688	696
Carbon--Intel D850GB	552	613	668	678
Dilithium--Intel D850GB	531	587	647	659
Xeon Ref				
qcd0902--dual Xeon 1.7		593		609
qcd0901--dual Xeon 1.4		516		540
Athlons				
atipa-amd1 (MP1800)	527	609	455	547
rs-amd (MP1800)	511	609	432	547
ln-amd (MP1800)	530	609	455	547
Athlon Ref				
fnpc110 (linux networx xp 1700)		629		604
b0caf01 (atipa MP 1600)		571		526
qcd0905 (Athlon mp 1200)		522		481
Pentium III Reference units				
fncdf155 (EG P3 1266)	544	616	371	429
fnpc108 (atipa p3 1000)	410	457	288	310
fnpc117 (atipa p3 866)	377	417	267	292
fnpc114 (EG p3 800)	333	386	234	280
fnpc115 (atipa p3 600)	291	284	216	207
fnpc201 (eg p3 500) + fnd020		253		192
fnpc101 (pII 400)		223		177

Notes: Vendor benchmarks that are white background with dark text have been interpolated from other published benchmarks and not reported directly on SPEC.

Some reference machines have no measured SPEC benchmarks because we didn't have root access on those machines and couldn't run the benchmark.

Any dual Xeon with a DDR SDRAM -based chipset has no published SPEC as yet. We take the values for the RDRAM systems but really the vendor values should be lower.

Conclusions:

We find that AMD's Athlon MP processor is superior in performance to Xeon units in many real applications that are run on farm workers, and equal in most others. Given the significantly cheaper price of the Athlon MP-based units, it is likely that they will play a dominant role in our farms acquisitions for the next year. We are currently in discussions with the three vendors that supply AMD units about the thermal issues we observed during the evaluation. The Xeon units have good electrical and thermal characteristics and can also serve our purposes well. They are also preferred for computing applications such as PCQCD, which require very fast memory access.

We find that all motherboards that we tested are acceptable. In the Xeon space these include the RDRAM-based P4DC6+ and P4DCE+ from SuperMicro, and the DDR-SDRAM based Tyan 2720 and SuperMicro P4DP6. The slight extra cost of RDRAM is justified for memory-intensive applications such as seti@home or the QCD applications. In the Athlon space, the Tyan 2462, 2466, and 2468 series boards are all acceptable, although the latter two come with the 760MPX chipset and are slightly superior in performance.

We approve the following vendors on the following hardware platforms:

Richardson Electronics (Eternal Graphics): 2U Xeon—both of their units are approved.

Atipa Technologies: 1U Xeon is approved. 2U Xeon is conditionally approved, provided they solve the thermal problems with the addition of fans. 1U AMD is too hot, not approved until Atipa addresses the high CPU temperature.

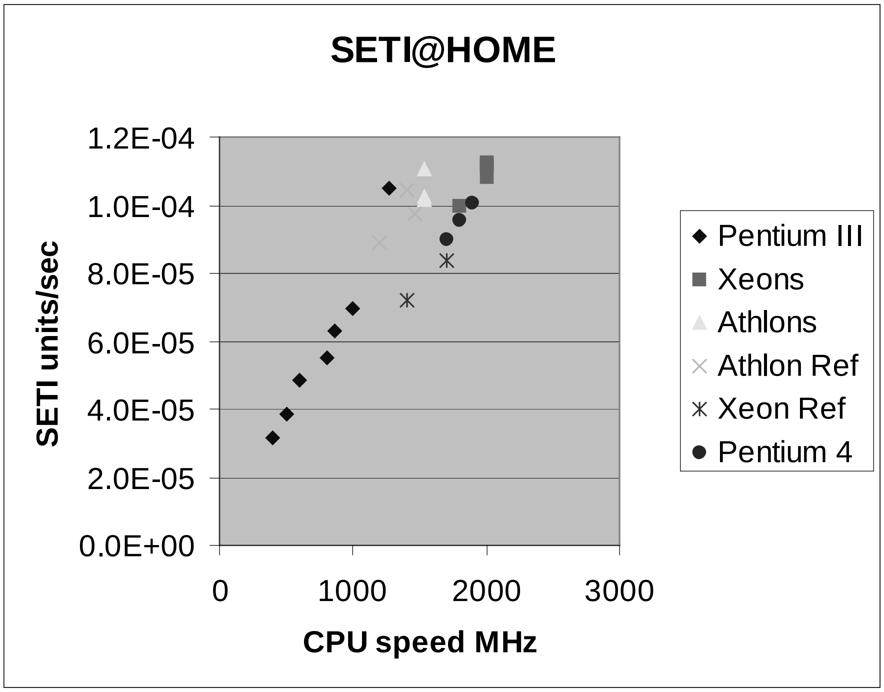
Linux Networx: 2U Xeon is approved. 2U AMD is conditionally approved provided they find a way to cool the rear CPU better.

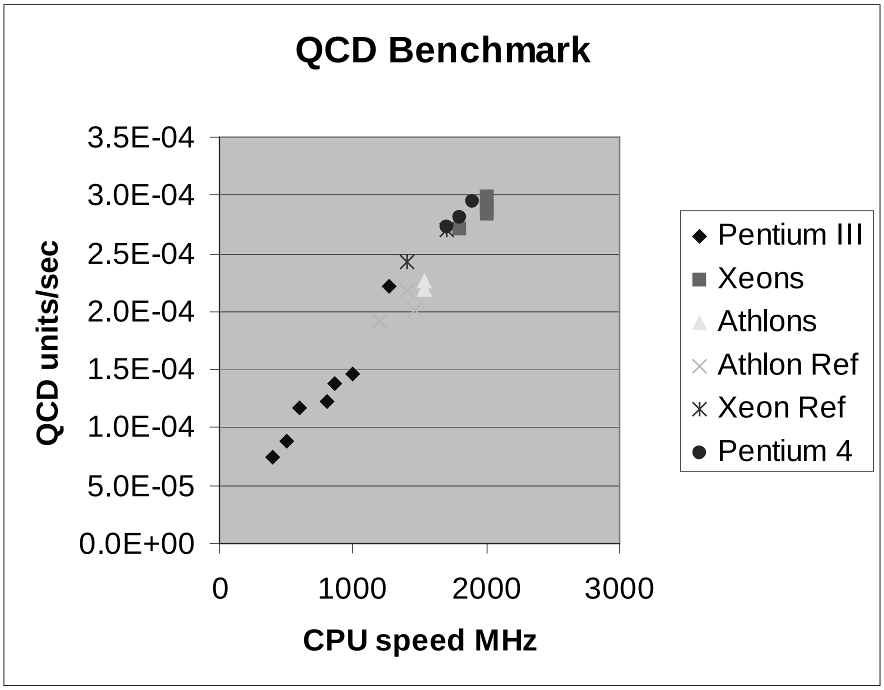
Racksaver: Both 1U Xeon and 1U AMD units would be approved with a single hard disk drive. For dual hard disk configuration, they are conditionally approved provided that Racksaver corrects the problem with the high temperature of the rear disk drive, which currently sits directly in the exhaust of the power supply.

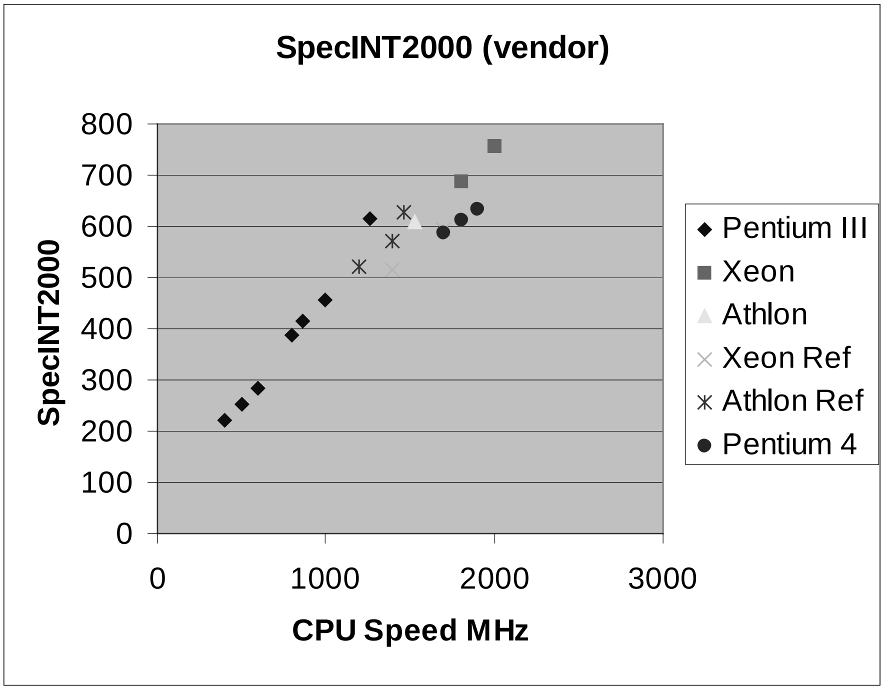
Future plans:

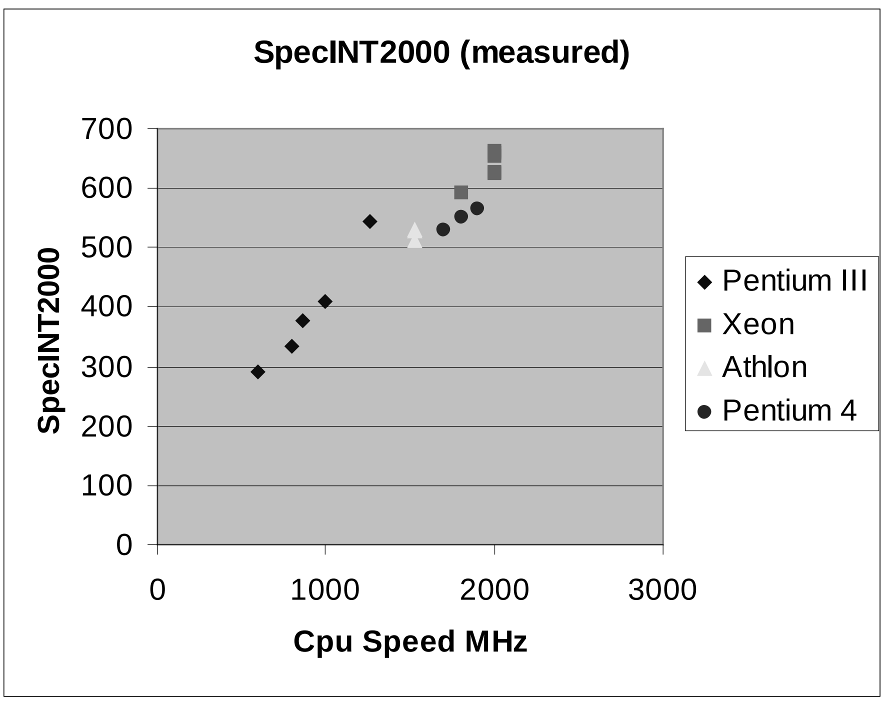
The farms group plans to make acquisitions for the remainder of this fiscal year based on the results of this evaluation. However, it is likely, particularly in the Xeon space, that other significant motherboards will be released later this year. There will be a continuing low-level effort to certify these boards as they come out. We will also continue to watch our existing units carefully, particularly the 1U variety, to continue to monitor their thermal stability.

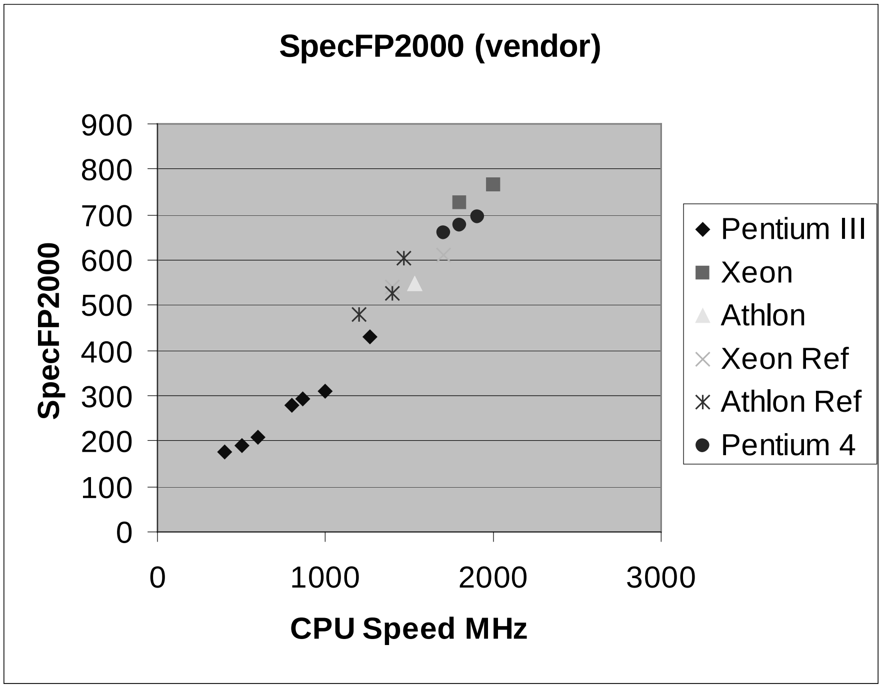
Appendix: Graphs of Benchmark Performance:

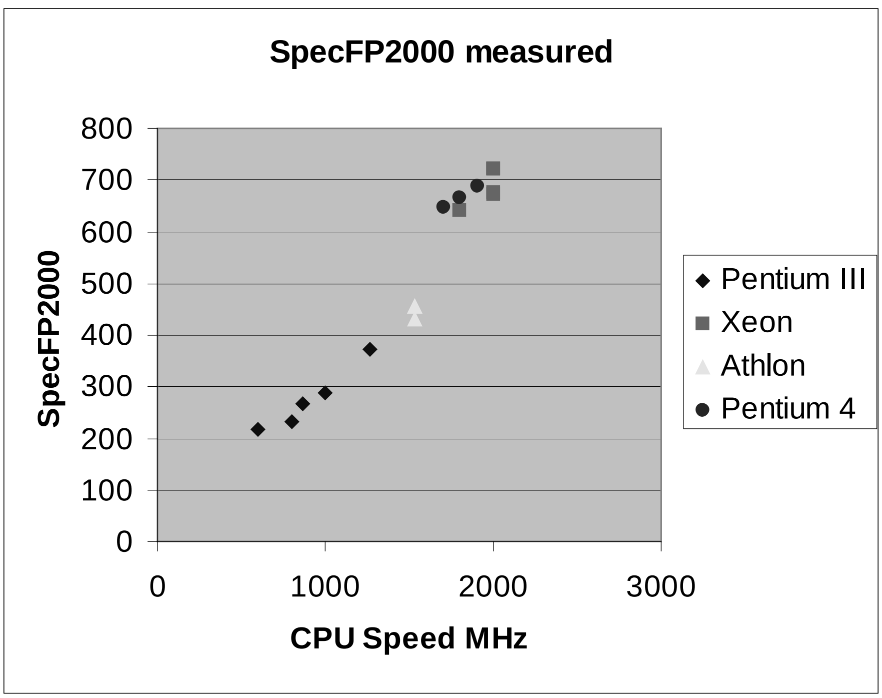


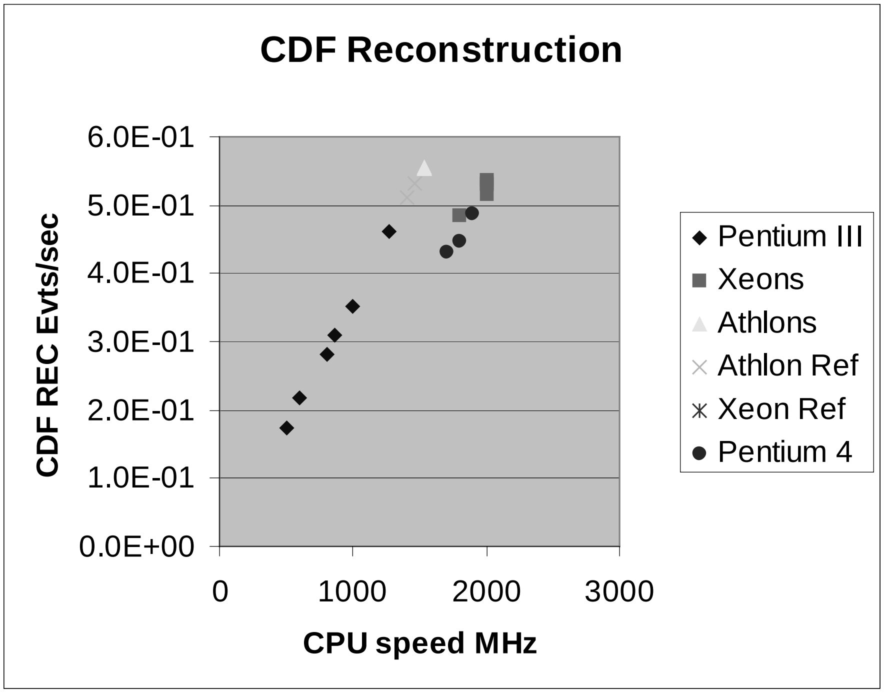


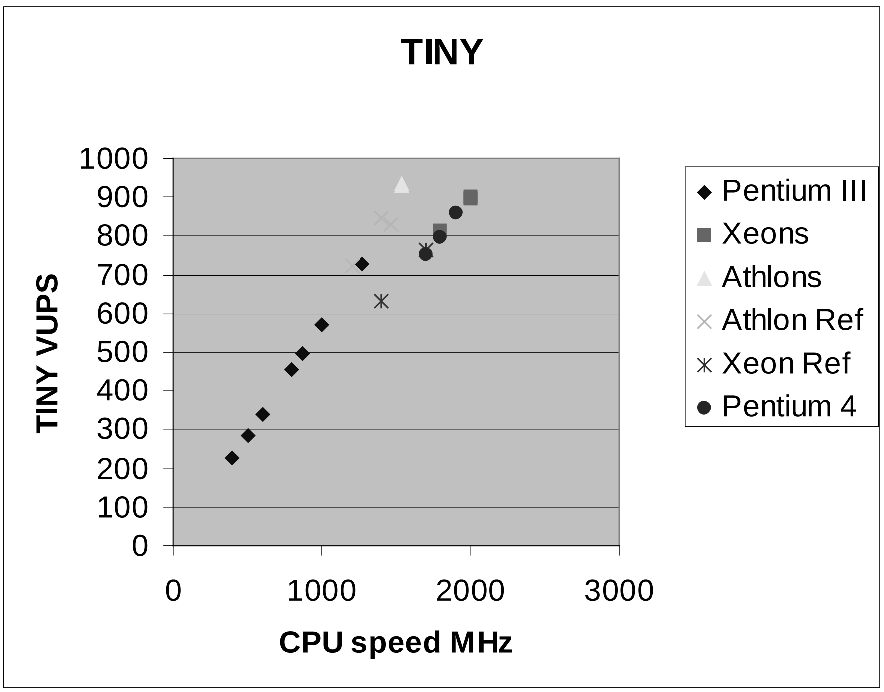

SpecINT2000 (vendor)
800
700
600
500
400
300
200
100
0
0
1000
2000
3000
SpecINT2000
CPU Speed MHz
Pentium III
Xeon
Athlon
Xeon Ref
Athlon Ref
Pentium 4

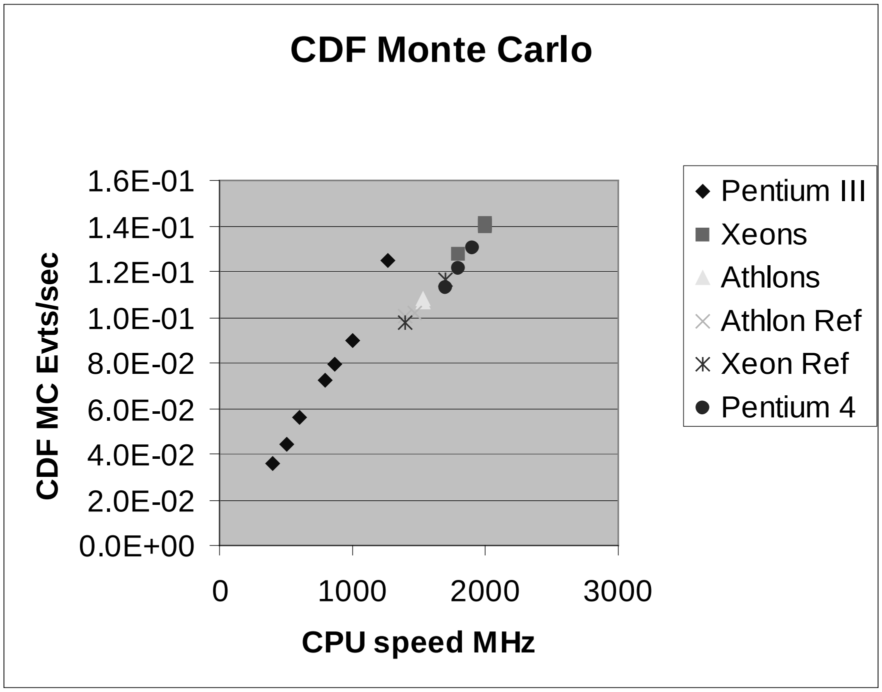

SpecINT2000 (measured)
700
600
500
400
300
200
100
0
0
1000
2000
3000
SpecINT2000
Cpu Speed MHz
Pentium III
Xeon
Athlon
Pentium 4

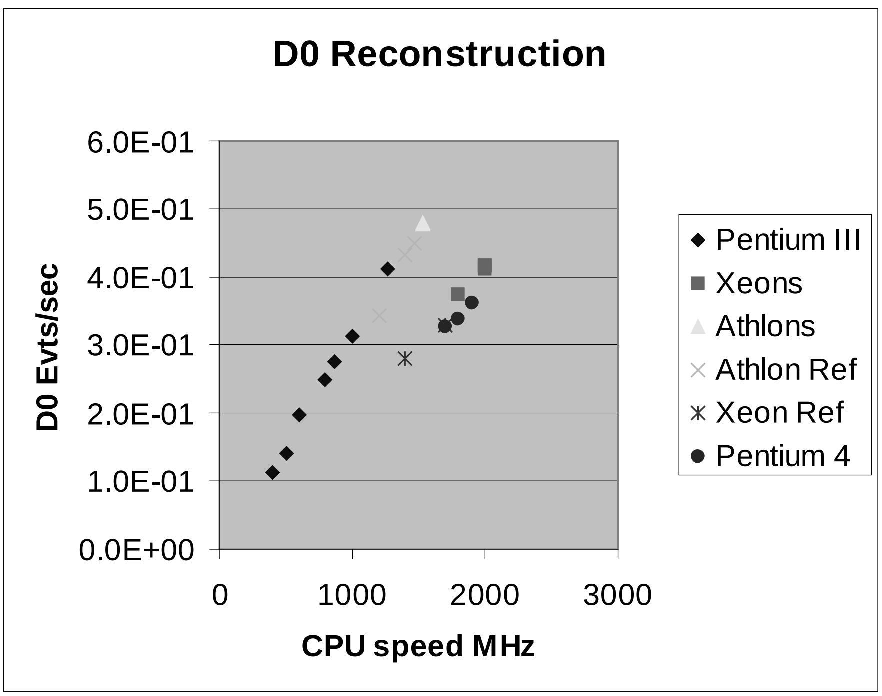

SpecFP2000 (vendor)
900
800
700
600
500
400
300
200
100
0
SpecFP2000
0
1000
2000
3000
CPU Speed MHz
Pentium III
Xeon
Athlon
Xeon Ref
Athlon Ref
Pentium 4


SpecFP2000 measured
800
700
600
500
400
300
200
100
0
SpecFP2000
0
1000
2000
3000
CPU Speed MHz
Pentium III
Xeon
Athlon
Pentium 4


CDF Reconstruction
CDF REC Evts/sec
6.0E-01
5.0E-01
4.0E-01
3.0E-01
2.0E-01
1.0E-01
0.0E+00
0
1000
2000
3000
CPU speed MHz
Pentium III
Xeons
Athlons
Athlon Ref
Xeon Ref
Pentium 4


TINY
TINY VUPS
1000
900
800
700
600
500
400
300
200
100
0
0
1000
2000
3000
CPU speed MHz
Pentium III
Xeons
Athlons
Athlon Ref
Xeon Ref
Pentium 4


CDF Monte Carlo
CDF MC Evts/sec
1.6E-01
1.4E-01
1.2E-01
1.0E-01
8.0E-02
6.0E-02
4.0E-02
2.0E-02
0.0E+00
0
1000
2000
3000
CPU speed MHz
Pentium III
Xeons
Athlons
Athlon Ref
Xeon Ref
Pentium 4


D0 Reconstruction
D0 Evts/sec
6.0E-01
5.0E-01
4.0E-01
3.0E-01
2.0E-01
1.0E-01
0.0E+00
0
1000
2000
3000
CPU speed MHz
Pentium III
Xeons
Athlons
Athlon Ref
Xeon Ref
Pentium 4