

**AMS02 Software and Hardware Evaluation**  
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# Introduction

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In view of forthcoming purchase of the bulk of the AMS offline hardware we evaluated the performance of the “official” AMS02 offline simulation/reconstruction software for various hardware platforms.

# AMS02 Benchmarks

Brand, CPU, Memory	OS/Compiler	Test1	Test2	Tests 3/4
Intel PIII dual-CPU 933 MHz 512 MB RAM, SCSI	RH Linux 6.2/gcc 2.95	0.069	0.265	5.8/42.56
Compaq $\alpha$ quad-CPU 600 MHz 2000 MB RAM, SCSI	DigitalUnix 4.0D cxx 6.2	0.081	0.262	6.11/49.05
AMD Athlon 1.2 GHz 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.049	0.182	3.67/26.2
Intel PIV 1.5 GHz 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.057	0.211	6.44/44.84
Intel PIV-Xeon dual-CPU 1.7 GHz 2 GB RAM, SCSI, "Compaq"	RH Linux 7.1/gcc 2.95	0.041	0.153	2.97/44.3
Compaq $\alpha$ -ev68 dual-CPU 866 MHz 2 GB RAM, FC	Tru64 Unix/cxx 6.2	0.036	0.090	1.60/32.62
Compaq $\alpha$ -ev68 dual-CPU 866 MHz 2 GB RAM, SCSI	RH Linux 7.1/cxx 6.2	0.034	0.087	1.585/27.3
Intel PIV-Xeon dual-CPU 2.0 GHz 1 GB RAM, SCSI, "Elonex"	RH Linux 7.2/gcc 2.95	0.041	0.132	2.71/37.65
AMD Athlon 1800MP dual-CPU 1.53 GHz, 1 GB RAM, SCSI	RH Linux 7.2/gcc 2.95	0.032	0.116	1.74/26.7
Sun-Fire 8 CPU 880 750 MHz 16 GB RAM, FC, SCSI	SunOS 5.8/C++-5.2	0.073	0.233	3.89/44.14
Sun Ultrasparc-III 24 CPU 900 MHz 96 GB RAM, FC, SCSI	Solaris 9, S9-53 C++ 5.2	0.060	0.191	3.19/37.9

NB: Lower is Faster

# AMS02 Benchmarks

Brand, CPU, Memory	OS/Compiler	Test1	Test2	Tests 3/4
Intel PIII dual-CPU 933MHz 512 MB RAM, SCSI	RH Linux 6.2/gcc 2.95	1	1	1/1
Compaq $\alpha$ -878 quad-CPU 600MHz 2 GB RAM, SCSI	DigitalUnix 4.0D cxx 6.2	1.17	0.99	1.05/1.15
AMD Athlon 1.2 GHz 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.71	0.69	0.63/0.62
Intel PIV 1.5 GHz 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.82	0.80	1.1/1.05
Intel PIV-Xeon dual-CPU 1.7 GHz 2 GB RAM, SCSI	RH Linux 7.1/gcc 2.95	0.60	0.58	0.51/1.06
Compaq $\alpha$ -ev68 dual-CPU 866MHz 2 GB RAM, FiberChannel	Tru64 Unix/cxx 6.2	0.52	0.34	0.28/0.77
Compaq $\alpha$ -ev68 dual-CPU 866MHz 2 GB RAM, SCSI	RH Linux 7.1/cxx 6.2	0.50	0.33	0.27/0.64
Intel PIV-Xeon dual-CPU 2.0 GHz 1 GB RAM, SCSI, "Elonex"	RH Linux 7.2/gcc 2.95	0.59	0.50	0.47/0.89
AMD Athlon 1800MP dual-CPU 1.53 GHz, 1 GB RAM, SCSI	RH Linux 7.2/gcc 2.95	0.47	0.44	0.3/0.63
Sun-Fire 880 8 CPU 750 MHz 16 GB RAM, FO, SCSI disks	SunOS 5.8/C++ 5.2	1.06	0.88	0.67/1.03
Sun Ultrasparc-III 24 CPU 900 MHz 16 GB RAM, SCSI	Solaris 9, S9-53 C++ 5.2	0.88	0.72	0.55/0.89

NB: Lower is Faster

# AMS02 Benchmarks

Brand, CPU, Memory	OS/Compiler	“Sim”	“Rec”
Intel PII dual-CPU 450 MHz 512 MB RAM, SCSI	RH Linux 6.2/gcc 2.95	1	1
Intel PIII dual-CPU 933 MHz 512 MB RAM, SCSI	RH Linux 6.2/gcc 2.95	0.54	0.54
Compaq $\alpha$ -878 quad-CPU 600 MHz 2 GB RAM, SCSI	DigitalUnix 4.0D cxx 6.2	0.58	0.59
AMD Athlon 1.2 GHz, 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.39	0.34
Intel PIV 1.5 GHz, 256 MB RAM, IDE	RH Linux 6.2/gcc 2.95	0.44	0.48
Intel PIV-Xeon dual-CPU 1.7 GHz 2 GB RAM, SCSI, “Compaq”	RH Linux 7.1/gcc 2.95	0.32	0.39
Compaq $\alpha$ -ev68 dual-CPU 866 MHz 2 GB RAM, FC	Tru64 Unix/cxx 6.2	0.23	0.25
Compaq $\alpha$ -ev68 dual-CPU 866 MHz 2 GB RAM, SCSI	RH Linux 7.1/cxx 6.2	0.41	0.42
Intel PIV-Xeon dual-CPU 2 GHz 1 GB RAM, SCSI, “Elonex”	RH Linux 7.2/gcc 2.95	0.29	0.35
AMD Athlon 1800MP dual-CPU 1.53 GHz 1 GB RAM, SCSI	RH Linux 7.2/gcc 2.95	0.24	0.23
Sun-Fire 880 8 CPU 750 MHz, 8 GB RAM	SunOS 5.8/C++ 5.2	0.52	0.45
Sun Ultrasparc-III 24 CPU 900 MHz 96 GB RAM	Solaris 9, S9-53 C++ 5.2	0.43	0.39
Compaq $\alpha$ -ev68 dual-CPU 866 MHz 2 GB RAM, FC	RH Linux 7.1/gcc 2.95	0.22	0.23

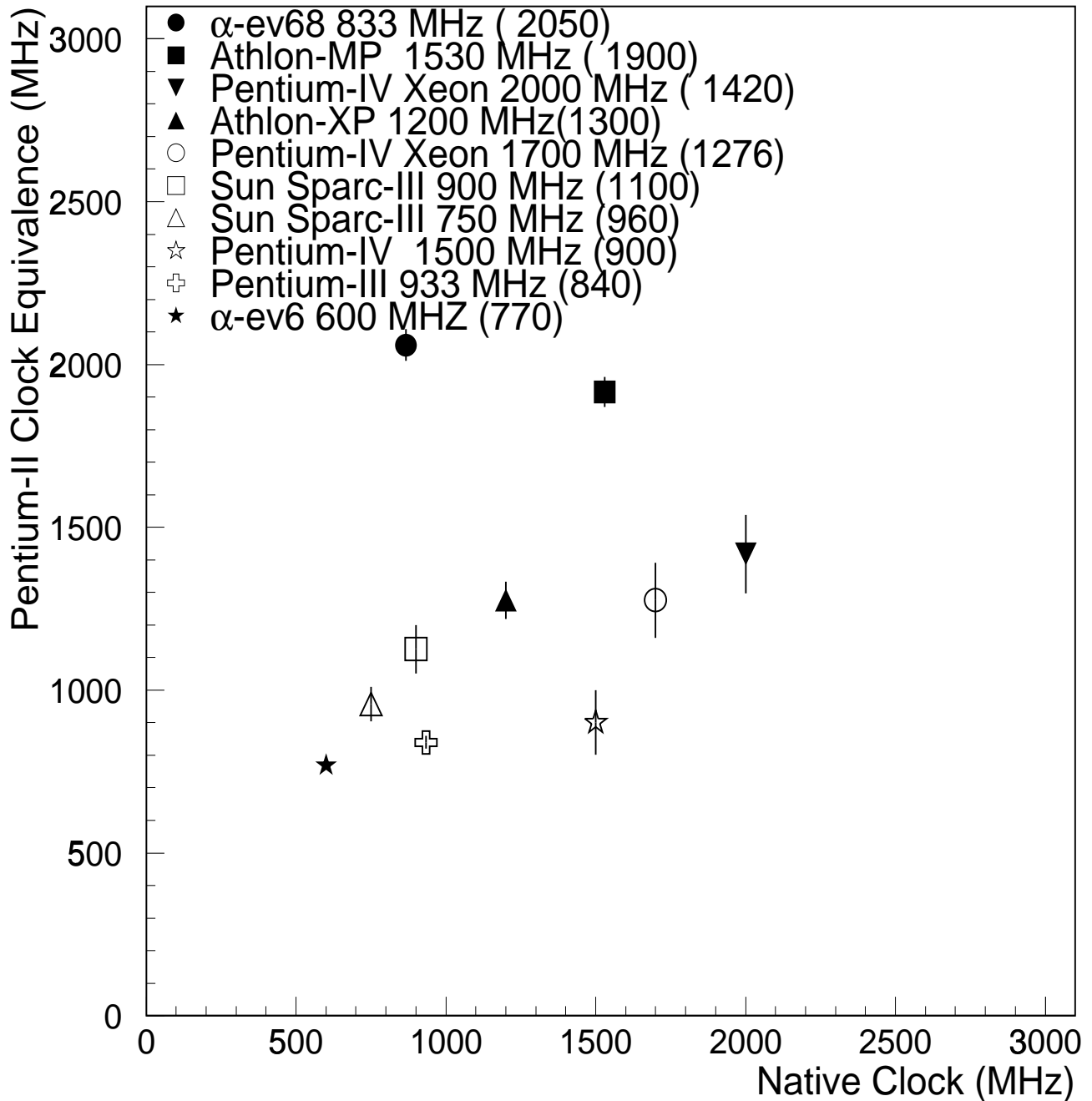
NB: Lower is Faster

# AMS02 Benchmarks

Brand, CPU clock	OS/Compiler	“Geom. Average”
Compaq $\alpha$ -ev68 dual-CPU 866 MHz	RH Linux 7.1/cxx6.2	93%
AMD Athlon 1800MP dual-CPU 1.53 GHz	RH Linux 7.2/gcc2.95	100%
Compaq $\alpha$ -ev68 dual-CPU 866 MHz	Tru64 Unix/cxx6.2	100%
AMD Athlon 1.2 GHz	RH Linux 6.2/gcc2.95	150%
“Elonex” Intel PIV-Xeon dual-CPU 2 GHz	RH Linux 7.2/gcc2.95	135%
“Compaq” Intel PIV-Xeon dual-CPU 1.7GHz	RH Linux 7.1/gcc2.95	150%
Sun Ultraspac-III 24 CPU 900 MHz	Solaris 9, S9-53/C++-5.2	170%
Sun-Fire 880 8 CPU 750 MHz	SunOS 5.8/C++-5.2	200%
Intel PIV 1.5 GHz	RH Linux 6.2/gcc2.95	213%
Intel PIII dual-CPU 933 MHz	RH Linux 6.2/gcc2.95	228%
Compaq $\alpha$ -878 quad-CPU 600 MHz	DigitalUnix 4.0D/cxx 6.2	249%
<i>Intel PIII-512 dual-CPU 1.266GHz</i>		<i>150%</i>

NB: Lower is Faster

## AMS02 Simulation Performance



# AMS Interactive Analysis

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Special benchmarking tests been made to simulate AMS Interactive Analysis sessions on Compaq Alphas to estimate the combination of disk I/O and CPU performance. 1000 AMS01 NTuples files (80 GB) stored on SCSI (15krpm) disks been read from 12 PAW session, the results for two different Alpha servers are presented in the table .

Model	OS	CPU Util % per process	disk I/O MByte/sec
Alpha Server ES40 (8 GB RAM, 4 CPU, 866 MHz)	Tru64 V5.1	35	21
Alpha Server ES45 (4 GB RAM, 4 CPU, 1 GHz)	Tru64 V5.1	17	33

# IBM 3580 (Ultrium LTO)

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To find the good replacement for DLT (20 GB cartridges) been used so far for backup and data archiving the tests with IBM Ultrium LTO (200 GB cartridges been made).

Tape drive been attached to the AMS02 Disk Server prototype :

- Red Hat 7.2
- kernel 2.4.9-7.1smp
- linux SCSI driver for /dev/st0
- dual-CPU 2GHz PIV Xeon processor
- 1GB RAM
- LSI UW SCSI adapter
- IPC RAID controller, RAID5 array (8xSeagate Barracude 180GB disks)
- tar and dd “raw” unix commands used for the tests

AMS02 Ntuples (files with size 2-20MB, total size 200 GB) been used as “write” input.

Mode	command	block size (KByte)	rate (MByte/sec)
write (from RAID5 to LTO)	tar	10	11.5
		20	11.0
write (from RAID5 to LTO)	dd	16	9.1
		128	10.2
read (from LTO to NULL)	dd	128	19
read (from LTO to RAID5)	tar	10	11

Based on benchmarking tests and long-term production run for AMS01 data we propose the following configuration for AMS02 production farm.

- AMS Processing Node
  - dual-CPU 1.5GHz+ (currently Athlon MP1900+)
  - 1GB RAM
  - 15 krpm LVD SCSI disk (system SW)
  - 3Ware IDE RAID Controller (8 channels)
  - 6x120GB+ IDE disks (600 MB RAID5 Array)
  - 1x100MBit/s ethernet interfaces
  - 2x1GBit/s ethernet interface
  - redundant power supplies

- AMS Server Node

- dual-CPU 1.4GHz+ (currently PIII or PIV Xeon)
- 1GB RAM
- 15 KRPM LVD SCSI disk (system SW)
- 3Ware IDE RAID Controller (8 channels)
- 7x120GB+ IDE disks (720 MB RAID5 Array)
- IPC SCSI RAID Controller (2 channels)
- External SCSI disk tower 8x180GB+ disks (1.4 TB RAID5 array)
- 1x100MBit/s ethernet interfaces
- 2x1GBit/s ethernet interface
- redundant power supplies

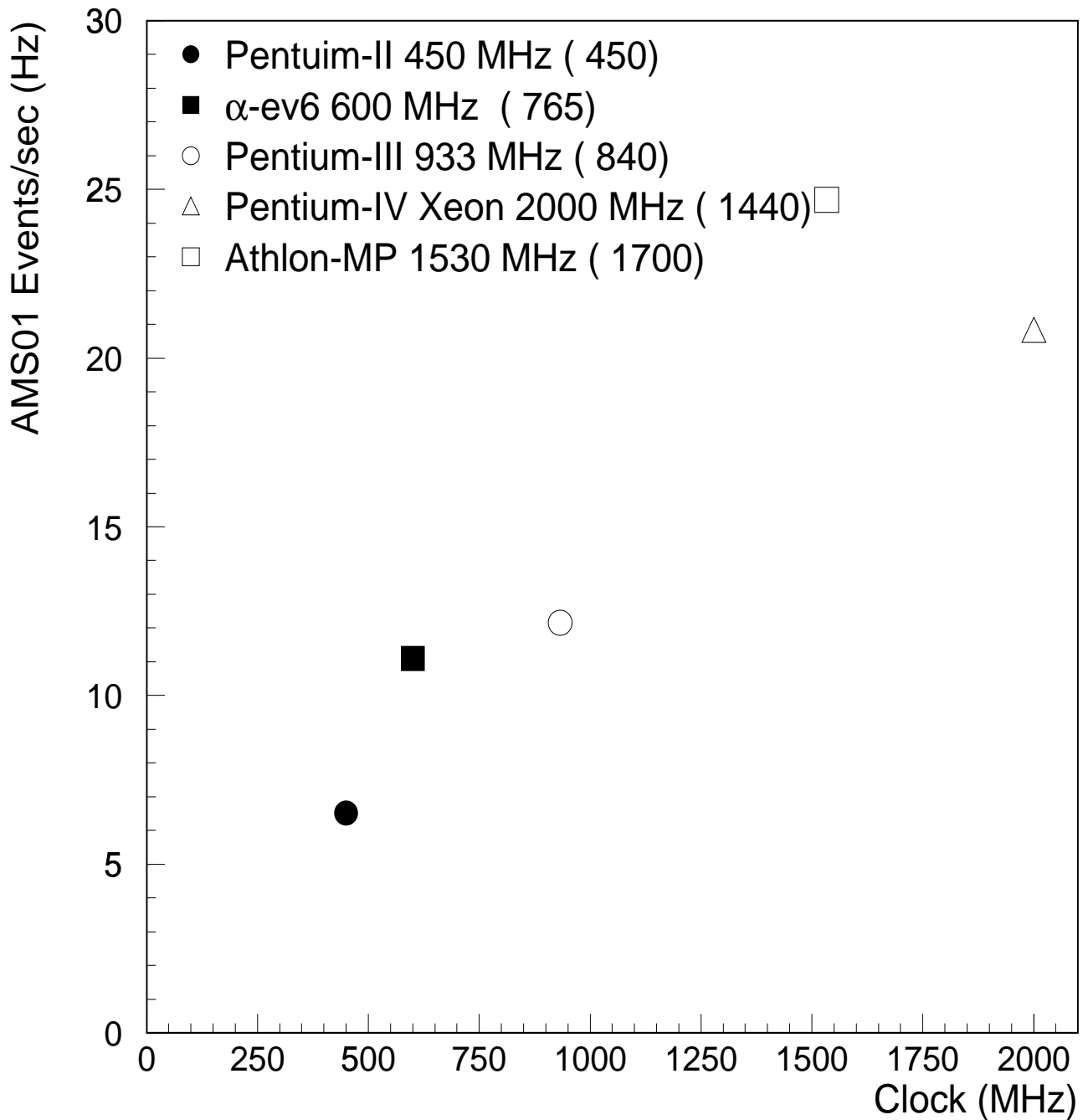
## Tape Drive

- IBM LTO Ultrium External Drive
  - 10+ Mbytes/sec disk/tape I/O
  - 200+ GBytes Cartridge;

- Features
  - 10 Linux Boxes (19 CPU) Were Used;
  - Client/Server Model with CORBA InterProc Communications Was Used;
- Observations
  - One Week Run - Total 100,000,000 Events Analysed;
  - At 300 Events/Sec (Cpu time);
  - More Than 90% Efficiency for Local I/O;
  - One PC Down During Run - No SW Problem Caused;
- Problems
  - NFS I/O Efficiency Was Low (65%) - Known Linux Kernel 2.4.9 Bug;
  - CORBA Bug Caused Server Shutdown Once, Restart OK, But Licensed CORBA Software is Highly Desirable;

- Performance

## STS91 Real Events Performance



## Summary

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- While  $\alpha$ -ev68 866MHz is the absolute champion, the AMD Athlon 1530 MHz (aka AMD Athlon MP1800+) has nearly the same performance.  
4 *CPU* AlphaServer (like ES45) might be a candidate for AMS analysis computer.
- Athlon is the ideal candidate for “AMS Processing Node”, but not for “AMS Server Node”, because of high power consumption (340 Watt).
- Pentium-IV (both “NoName” and “Xeon”) has lower performance, resulting in 15-35 % overhead for PIV-Xeon 2 GHz comparing with AMD Athlon MP1800+. There is still hope that newer compilers will boost PIV up.  
Pentium-IV Xeon or Pentium-III-S are the candidates for “AMS Server Node”.
- Sun-Sparc-III has relatively low uni processor performance (70% overhead comparing with Athlon) but presents interest as analysis computer with 8-24 CPU configuration.

# Acknowledgements

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