Very Brief Personal Computer History

Concentrating on Operating Systems and Memories

By: Michael Robinson 03-30-2006
This presentation relates to Personal Computers only.

How Operating Systems, ram/rom memory, and permanent storage have changed.

<table>
<thead>
<tr>
<th>Some Operating Systems</th>
<th>Ranges</th>
</tr>
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<tbody>
<tr>
<td>CPM, CCPM, MP/M</td>
<td>Ram 4K – Gigabytes</td>
</tr>
<tr>
<td>TrsDos, NewDos/80, LS-Dos, Multidos, DosPlus</td>
<td>Rom 4K – Megabytes</td>
</tr>
<tr>
<td>Xenix</td>
<td>Tape Drives</td>
</tr>
<tr>
<td>MS-DOS, PC-DOS</td>
<td>Floppy Drives 128K – 1.4 Meg</td>
</tr>
<tr>
<td>Windows 1.0, 2.0, 3.1, 3.11, 95, 98, me, xp</td>
<td>Hard Drives 5Meg- TeraGytes</td>
</tr>
<tr>
<td>Windows NT Workstation and Server</td>
<td>Flash Drives</td>
</tr>
<tr>
<td>Windows Server</td>
<td></td>
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<tr>
<td>OS2</td>
<td></td>
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<tr>
<td>Novell Netware</td>
<td></td>
</tr>
<tr>
<td>Lantastic</td>
<td></td>
</tr>
<tr>
<td>Linux</td>
<td></td>
</tr>
</tbody>
</table>
The Altair 8800, from Micro Instrumentation Telemetry Systems (MITS) of Albuquerque, NM, was first featured in the January 1975 edition of Popular Electronics. It is considered by many to be the first mass produced personal computer, although they were called micro-computers in those days.
**IMSAI 8080**

**The First Clone**

- **Announced:** August 1975
- **How many:** Around 20,000
- **Price:** US $599 as a kit
  - US $931 assembled
- **CPU:** Intel 8080A, 2.0 MHz
- **Display:** front panel LEDs
- **Controls:** front panel switches
- **Expansion:** card-cage w/ S-100 bus
- **RAM:** 64K max
- **Storage:** optional cassette or floppy drive
- **OS:** CP/M, BASIC

**IMSAI 8080, built by IMS Associates, Inc. of San Leandro, California**

One of the first consumer computers available.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced</td>
<td>September, 1975</td>
</tr>
<tr>
<td>Price</td>
<td>US $19,975 w/ 64K RAM</td>
</tr>
<tr>
<td>Weight</td>
<td>55 pounds</td>
</tr>
<tr>
<td>CPU</td>
<td>IBM proprietary, 1.9MHz</td>
</tr>
<tr>
<td>Display</td>
<td>5&quot; monochrome monitor 64 X 16 text</td>
</tr>
<tr>
<td>RAM</td>
<td>16K, 64K max</td>
</tr>
<tr>
<td>Storage</td>
<td>Internal 200K tape (DC300)</td>
</tr>
<tr>
<td>Ports</td>
<td>tape/printer I/O port</td>
</tr>
<tr>
<td>OS</td>
<td>APL and/or BASIC</td>
</tr>
</tbody>
</table>
With Similar Specifications

Apple I
Released: April 1976

Sol-20
Released: June 1976

Apple II
Released: April 1977

Commodore PET
Released: June 1977
TANDY RS Model I

Released: 8/3/1977 Radio Shack
Price: $599.
Keyboard
Black-and-white video display
Ram: 4KB RAM, ROM 4KB
Tape cassette
OS: TRSDOS

Model I Level II

Released: 8/1978 Radio Shack
Price: $1099
Similar to model I but included
Two 360KB Floppy Drives
OS: TRSDOS
TRS-80 Model 3

**Introduced:** July 1980

**Price:** US $699 base model
                      US $2495 w/ 32K, dual Drives

**CPU:** Zilog Z-80, 2.03 MHz

**Display:** 12-inch B/W monitor: 64X16 text

**RAM:** 4K, 48K max.

**Storage:** 0, 1, or 2 internal 178K floppy drives
Ext cassette @500/1500baud

**OS:** BASIC in ROM, TRS-DOS on disk

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TRS-80 Model 4

**Introduced:** 5/1983

**Price:** About $1,999

**RAM:** 64K, expandable to 128K

**Storage:** 0, 1, or 2 internal 178K floppy drives
Ext cassette @500/1500baud

**OS:** TRSDOS 6.0 and CP/M Plus.
Caught in the act

My daughter Rosemarie (~1982)
OS Used with TRSDOS Computers
OS’s, Languages and Applications
**Model II**

- **Released:** October 1979
- **Price:** $3450 / $3899 (64K RAM)
- **CPU:** Zilog Z-80A, 4 MHz
- **Ports:** 2 serial, One parallel port
- **Display:** Built-in 12" monochrome monitor 40 X 24 or 80 X 24 text.
- **RAM:** 32K, 64K
- **Storage:** 1 500K 8” floppy drive. External Expansion w/ 3 floppy bays.
- **OS:** TRS-DOS, BASIC.

**Model 12**

- **Released:** Summer of 1983.
- Model 12 used new double sided floppies with twice the capacity of the single sided ones in the Model II. At 1.2 Megs per floppy, this allowed a 2 drive single unit to provide the storage capacity which previously required a 4 drive In the Model II.

**Model 16**

- **TRS-80 model 16,** follow on to the Model 12. It was UNIX based (it used Microsoft's Xenix) 16 bit system (68000 plus Z80).
Save on 1-Drive and 3-Drive Bays

1-Drive (486,000 Characters)  
Reg. 1150.00  Cat. No. 26-4160

Save $401  74900

3-Drive (1,458,000 Characters)  
Reg. 2350.00  Cat. No. 26-4162

Save $851  149900

Only $42 Per Month On CitiLine Credit  
Only $83 Per Month On CitiLine Credit
External Hard Disks for Radio Shack

Radio Shack 10 meg External Hard Disk

Miniscribe 15 meg External Hard Disk
Tandy RS MC-10 CoCo
Color Computer

CPU: Motorola MC6803 8-bit
Video Generator: Motorola MC6847
Serial Interface: 4 pin DIN
Speed: 0.89 MHz
Memory: 4K RAM
Cassette Interface: 5 pin DIN
Operating System: BASIC
Tandy RS

**Model 100**

**Model 102**

**Model 200**

**Model 600**

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**Model 100 Specifications**

- **Introduced:** 3/1983 at $800 for 8KB and $1,000 for 24KB
- **CPU:** 2.4 MHz 80C85 CPU (CMOS)
- **Video:** 2" x 7.5" LCD (not lit) with a maximum of 8 lines down, and 40 characters across
- **I/O:** 1500 Baud Audio Cassette Port; Parallel Port; Serial Port; Bar Code Port; 300 Baud Modem; External
- **RAM:** 8KB - 32KB (RAM also serves as a ram-drive)
- **Disk Drive (optional)**
- **Software:** Built in BASIC, Address Book, Scheduler, Text Editor, and Terminal Program
- **Power:** 4 "AA" Batteries

**Model 600**

- **CPU:** MSM80C88 Clock 3.07 MHz
- **RAM:** 32K bytes - 224K bytes
- **ROM:** 160K bytes - 160K bytes
- **FDD:** drive Unformatted Capacity: 500K bytes
- **OS:** Rom Basic
Atari 400

- Released: November 1979
- Price: US $549.95
- CPU: MOS 6502, 1.8MHz
- Display: 24 X 40 text, 320 x 192 mono
  - 160 x 96 with 128 colors
- RAM: 8K base, 48K max
- Storage: Ext Cassette
- OS: Atari OS

Atari 800

- Released: November 1979
- Price: US $999.95
- CPU: MOS 6502, 1.8MHz
- Display: 24 X 40 text 320 x 192 mono
  - 160 x 96 with 128 colors
- RAM: 8K base, 48K max
- Storage: Ext 90K floppy drive, cassette
- OS: Atari OS
Hewlett-Packard Model 85

**Released:** January, 1980  
**Price:** US$3,250  
**Weight:** 20 lbs  
**CPU:** custom HP 8bit @ 0.613MHz  
**Display:** built-in 5 inch monitor graphics  
  built-in 32 char thermal printer  
**Ports:** four expansion ports  
**RAM:** 8K, 64K max.  
**Storage:** built-in DC100 217K tape drive  
**OS:** HP BASIC in ROM
IBM hires Paul Allen and Bill Gates to create an operating system for a new PC.

The "Microsoft Disk Operating System" or MS-DOS was based on QDOS,

The "Quick and Dirty Operating System" written by Tim Paterson of Seattle Computer Products, for their prototype Intel 8086 based computer.

QDOS was based on Gary Kildall's CP/M, Paterson had bought a CP/M manual and used it as the basis to write his operating system in six weeks, QDOS was different enough from CP/M to be considered legal.

Microsoft bought the rights to QDOS for $50,000, QDOS was renamed MSDOS and then MSDOS was licensed to IBM under the PCDOS name.

Microsoft maintained the right to sub-license MSDOS to anybody else, Tim Paterson went to work for Microsoft, and the rest is history.
First IBM PC (1981)

Model: 5150
Released: September 1981
Price: US $3000
CPU: Intel 8088, 4.77MHz
Display: 80 X 24 text
Ports: cassette & keyboard only internal expansion slots
RAM: 16K, 640K max
Storage: optional 160KB 5.25-inch disk drives
OS: IBM PC-DOS Version 1.0
Portable Computers

Introduced: April 1981  
Price: US $1,795  
Weight: 24.5 pounds  
CPU: Zilog Z80 @ 4.0 MHz  
Display: 5" monitor 53 X 24 text  
Ports: Parallel, modem/serial port  
RAM: 64K RAM  
Storage: 2 5-1/4 inch, 91K drives  
OS: CP/M

Released: 1982  
Price: US $1595.  
Weight: 26 lbs  
CPU: Zilog Z80, 2.5 MHz  
Display: 9" green 24 X 80 text only  
Ports: Serial port, Parallel port  
RAM: 64K  
Storage: 2 5-1/4"SS-DD 195K drives  
OS: CP/M, SBASIC
# Fujitsu Micro 16

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR:</strong></td>
<td>1983</td>
</tr>
<tr>
<td><strong>PRICE:</strong></td>
<td>$3995 w/color monitor, CP/M-86, Wordstar and Supercalc²</td>
</tr>
<tr>
<td><strong>CPU:</strong></td>
<td>Intel 8086, Zilog Z80-A (standard), Motorola 68000, Intel 80286, Zilog Z8000 boards</td>
</tr>
<tr>
<td><strong>SPEEDS:</strong></td>
<td>8 MHz (8086), 4 MHz (Z80)</td>
</tr>
<tr>
<td><strong>COPROCESSOR:</strong></td>
<td>Motorola 6809, MOS 6845</td>
</tr>
<tr>
<td><strong>TEXT MODES</strong></td>
<td>80 chars. x 25 lines/GRAPHIC 640 x 200</td>
</tr>
<tr>
<td><strong>COLORS</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>I/O PORTS</strong></td>
<td>Parallel, Serial, 4-A/D converter, RGB video, composite video, Light-pen</td>
</tr>
<tr>
<td><strong>STORAGE:</strong></td>
<td>1-4 320 KB 5.25&quot; floppy drive, 5-20 MB hard drive</td>
</tr>
<tr>
<td><strong>PERIPHERALS</strong></td>
<td>Ext 8&quot; or 5.25&quot; floppy and hard disc units</td>
</tr>
<tr>
<td><strong>RAM:</strong></td>
<td>128 KB up to 1152 KB</td>
</tr>
<tr>
<td><strong>VRAM:</strong></td>
<td>4 KB (Characters) + 48 KB (graphics)</td>
</tr>
<tr>
<td><strong>ROM:</strong></td>
<td>8 KB (boot loader, diagnostics)</td>
</tr>
<tr>
<td><strong>OS:</strong></td>
<td>CCP/M-86 w/GSX graphic, MP/M-86, MS-DOS, Unix</td>
</tr>
</tbody>
</table>
Can I use this?

My son Mark (~1986)
<table>
<thead>
<tr>
<th>Hardware</th>
<th>Operating Systems</th>
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</thead>
<tbody>
<tr>
<td>Tandy RS</td>
<td>Trsdos, NewDos, Multidos, Ldos</td>
</tr>
<tr>
<td></td>
<td>CP/M CCP/M MCCP/M, MP/M, Xenix</td>
</tr>
<tr>
<td>Apple</td>
<td>Apple OS, CP/M</td>
</tr>
<tr>
<td>Franklin</td>
<td>Apple OS, CP/M</td>
</tr>
<tr>
<td>Xerox (Altos)</td>
<td>CP/M CCP/M MCCP/M, MP/M</td>
</tr>
<tr>
<td>Kaypro</td>
<td>CP/M Sbasic</td>
</tr>
<tr>
<td>Fujitsu</td>
<td>CP/M CCP/M MCCP/M, MP/M, MSDOS</td>
</tr>
<tr>
<td>Commodore</td>
<td>CP/M, Commodore Dos</td>
</tr>
<tr>
<td>Osborne</td>
<td>CP/M</td>
</tr>
<tr>
<td>Zeus</td>
<td>MP/M</td>
</tr>
<tr>
<td>HP</td>
<td>HP Basic in Rom</td>
</tr>
<tr>
<td>Texas Instruments</td>
<td>Proprietary TI, UCSD-p</td>
</tr>
<tr>
<td>And many others</td>
<td></td>
</tr>
</tbody>
</table>

| IBM PC           | MSDOS, CP/M                               |
Companies That Switch To MSDOS

- IBM PC/XT
- Corona
- Columbia
- Compaq
- Data General
- Dec
- Unisys
- Dell
- Tandy Radio Shack
- Fujitsu
- Nec
- Panasonic
- Sony
- Many, many others
Columbia Personal Computer

- **Marketed**: June 1982
- **Price**: US$2.995,00
- **CPU**: 8088 4.77 MHz 16 bit registers
- **Video**: 16 colors 320 x 200 CGA Audio Simple tones
- **Interface**: 2 x RS232, parallel, monitor, keyboard
- **RAM**: 128KB 1MB max
- **Storage**: 5.25" FDD
- **OS**: MSDOS, Cp/m-86, Mp/m-86, OASIS, XENIX
First Compaq Computer (1983)

Released: March 1983  
Price: US$3590 (two floppy system)  
Weight: 28 pounds.  
CPU: Intel 8088, 4.77MHz  
Display: 9" mono 80 X 25 text Color graphic card  
Ports: 2 parallel, 1 serial  
RAM: 128K, 640K max  
Storage: 2 320K 5-1/4" disk drives  
OS: MS-DOS
Digital Equipment Rainbow 100

- **MANUFACTURER**: Digital Equipment Corporation
- **TYPE**: Professional Computer
- **ORIGIN**: U.S.A.
- **YEAR**: 1984
- **PRICE**: £2300 (U.K., 1984)
- **CPU**: Intel 8088 + Zilog Z80 A
- **SPEED**: 4.81 MHz (8088) / 4 MHz (Z80)
- **TEXT MODES**: 40 x 24 / 80 x 24 / 132 x 24
- **GRAPHIC MODES**: 320 x 200 / 640 x 200 / 800 x 240
- **COLORS**: 16 among 4096 (optional)
- **SOUND**: Beeper
- **SIZE / WEIGHT**: 48.3 (W) x 36.3 (D) x 16.5 (H) cm
- **I/O PORTS**: 2 x RS-232, keyboard, monitor
- **POWER SUPPLY**: Built-in switching power supply unit
- **PERIPHERALS**: 3 expansion slots
- **RAM**: 64 KB (up to 896 KB)
- **ROM**: 24 KB (includes self-diagnostics)
- **STORAGE**: Two 400 KB 5.25" disk-drives
- **OS**: MS DOS + CP/M (+ CP/M 86 - Prologue)
How does this work?

My youngest son Danny (~1993)
Multi-Tasking Multi-Users O.S.’s

- Windows 1.0, 2.0, 3.1, 3.11, 95, 98, me, xp
- MicroSoft Networking
- Windows NT Workstations
- Windows NT Server, Windows Server
- Novell Netware
- Lantastic
- Xenix
- OS2
OS Time Line 1975 - 1980

• BASIC (MicroSoft) released on March 1975 for the ALTAIR.
• CP/M for the IMSAI 8080 release on August 1975.
• The very first graphical user interface was developed by the Xerox Corporation at their Palo Alto Research Center (PARC) in the 1970s, but it was not until the 1980s when GUIs became widespread and popular.
• TRS-DOS version 1.0 released in August 3, 1977.
• TRS-DOS BASIC in ROM, TRS-DOS in July 1980.
OS Time Line 1980 - 1985

- MSDOS 1.0 was release on August 1981.
- SUN is incorporated in Feb 1982, with 4 employees.
- MSDOS 1.25 is released in 1982.
- MSDOS 2.0 was released March, 1983.
- TRSDOS 6.0 and CP/M Plus May 1983.
- IBM AT computer is introduced in 1984
- The 3.5-inch floppy diskette is introduced and later becomes an industry standard.
- Dell Computer is founded May 3, 1984 in Austin Texas.
- MSDOS 3.0 for the IBM PC/AT and MSDOS 3.1 for networks introduced in 1984
- The GNU manifesto is published by Dr. Dobb's Journal
- Microsoft and IBM begin collaboration on the next-generation OS/2.
- Windows 1.0 on November 20, 1985,
- IBM Top View was released in February 1985, as a DOS-based multitasking program manager without any GUI features.
OS Time Line 1986 - 1989

- MS-DOS 3.2 was released April, 1986.
- Microsoft and IBM release OS/2 1.0 in 1987.
- IBM introduces the PS / 2 personal computer, which has improved graphics, a 3.5-inch diskette drive, and proprietary bus to help prevent clone makers competition.
- IBM sends clone manufacturers letters demanding retroactive licensing fees.
- MS-DOS 3.3 was released in April 1987.
- IBM introduces MCA in 1987.
- EISA is developed as an alternative to MCA in 1998.
- MS-DOS 4.0 was released July, 1988.
- MS-DOS 4.01 was released November, 1988.
OS Time Line 1990 - 1994

• Microsoft releases **Windows 3.0** a completely new version of Windows in 1990.
• Microsoft releases **DOS 4.01** for the Russian market in 1990.
• Microsoft and IBM stop working together to develop OS’s in 1990.
• Linux is introduced by Linus Torvald in 1991.
• Microsoft changes the name of **OS/2** to **Windows NT** in 1991.
• **MS-DOS 5.0** was released June, 1991.
• Microsoft introduces **Windows 3.1**. It sells more than 1 million copies within the first two months of its release 1992.
• Microsoft releases **Windows NT** and **MS-DOS 6.0** in 1993.
• Microsoft releases **Windows NT 3.1** and **Windows for Workgroups 3.11** in 1993.
• IBM releases **OS/2 Warp** in 1994.
• **Red Hat Linux** is founded in 1994.
• **MS-DOS 6.22** was released April, 1994.
• Microsoft releases **Windows 3.11** in 1994.
OS Time Line 1995 - 1999

- Microsoft releases Windows CE on 1996.
- Microsoft Windows CE 2.x is released on 1997.
- Microsoft Windows 98 is officially released on June 25, 1998.
- Microsoft releases Windows CE 3.0 on 1999.
• **Microsoft Windows 2000** is released February of 2000.
• Microsoft releases **Windows ME** June 19, 2000.
• **Microsoft Windows XP** home and professional editions are released October 25, 2001.
• **Microsoft Windows Server 2003** is released March 28, 2003.
• IBM sells its computing division to **Lenovo Group** for $1.75 billion on December 08, 2004.
• IBM officially announces on July 14, 2005 that all sales of **OS/2** will end on December 23, 2005 and that all support from IBM for OS/2 will end on December 16, 2005.
IBM creates the first floppy disk in 1967.
- Intel Corporation is founded by Robert Noyce and Gordon Moore in 1968.
- AT&T Bell Laboratories develop Unix in 1969.
- AMD is founded in 1969.
- Western Digital is founded in 1970.
- The Xerox Palo Alto Research Center (PARC) is established to perform basic computing and electronic research in 1970.
- The first 8" floppy diskette drive was introduced in 1971.
- The compact disc is invented in the United States, 1972.
Storage and ... 1975 - 1985

• The first 5.25-inch floppy disk is invented in 1975
• Apple Computer Inc., Radio Shack, and Commodore all introduce mass-market computers. 1977
• Seagate is founded. 1979
• Novell Data System is established as an operating system developer. Later in 1983 the company becomes the Novell company.
• Maxtor is founded. 1982
• The 3.5-inch floppy diskette is introduced and later becomes an industry standard in 1984.
Hard Drives

- Seagate 1980 5 meg hard disk 5 ½
- Rodime 3.5
- According to Disk/Trend, an industry-research organization in Mountain View, Calif., more than 230 disk-drive manufacturers have dropped out of the business, leaving only 22 still making hard drives in 1997. Disk/Trend's Jim Porter estimates that the highest-capacity 3.5-inch disks (the size most popular in 1997) would store 130 Gbytes by the year 2000 at 2 cents per Mbyte.
CPU AND MEMORIES 1978 - 1994

- **Intel 8086 (1978)** up to 1 MB of RAM.
- **Intel 8088 (1979)** Identical to the 8086, it is able to work with the 8087 math coprocessor chip.
- **NEC V20 and V30 (1981)** Clones of the 8088 and 8086. They are supposed to be about 30% faster than the Intel ones, though.
- **Intel 80186 (1980)** The 186 was a popular chip. Despite this, the 186 never found itself in a personal computer.
- **Intel 80286 (1982)** up to 16 MB of RAM. able to work with virtual memory, thereby allowing much for expandability.
- **Intel 386 (1985 - 1990)** The 32-bit address bus allowed the chip to work with a full 4 GB of RAM and a staggering 64 TB of virtual memory. In addition, the 386 was the first chip to use instruction pipelining, which allows the processor to start working on the next instruction before the previous one is complete.
- **Intel 486 (1989 - 1994)** It contained an integrated 8 KB on-die cache. they were actually 3X triplers, allowing a 33 MHz processor to operate internally at 100 MHz.
CPU AND MEMORIES 1994 - 1996

- **AM486DX Series (1994 - 1995)** It contained on-board cache. The chip found its way into many 486-compatibles.

- **AMD AM5x86 (1995)** This is the chip that put AMD onto the map as official Intel competition. The 5x86 performed better than a Pentium-75. The chip became the de facto upgrade for 486 users who did not want to ditch their 486-based PCs yet.

- **The Pentium (1993)** The two separate 8K caches (code cache and data cache) and the pipelined floating point unit increase its performance beyond the x86 chips.

- **The Pentium Pro (1995-1999)** Is a RISC chip with a 486 hardware emulator on it, running at 200 MHz or below. It has two separate 8K L1 cache (one for data and one for instructions), and up to 1 MB of onboard L2 cache in the same package.

- **Cyrix 6x86 Series (1995)** 16 KB of write-back cache. It used many of the same techniques internally as the Intel and AMD chips to increase performance.

- **AMD K5 (1996)** K5’s ran from 75 MHz to 166 MHz (in P-ratings, that is). They contained 24KB of L1 cache.
• **Pentium MMX (1997)** The dual 8K caches of the Pentium were doubled to 16 KB each, and went up to 233 MHz.

• **AMD K6 (1997)** It contained 64KB of L1 cache (32KB for data and 32KB for instructions). It was released in 166MHz to 300 MHz versions.

• **Cyrix 6x86MX (1997)** It took an increased 64KB cache and an increase in speed. The first M2's were 150 MHz chips. The fastest ones operated at 333 MHz, or PR-466.

• **Pentium II (1997)** Pentium II has 32KB of L1 cache (16KB each for data and instructions) and has a 512KB of L2 cache on package. The L2 cache runs at ½ the speed of the processor, not at full speed. Nonetheless, the fact that the L2 cache is not on the motherboard, but instead in the chip itself, boosts performance.
CPU AND MEMORIES 1998 - 2006

- **Celeron (1998)** With 512 KB of cache running at half speed. Slot 1 Celerons ranged from the original 233MHz up to 433 MHz, while Celerons 300MHz and up were available in Socket 370.
- **AMD K6-2 & K6-3 (1998)** The K6-3 processor was basically a K6-2 with 256 KB of on-die L2 cache.
- **Pentium III (1999)** In February of 1999, running at 450 MHz on a 100MHz bus. eventually 600 MHz
- **AMD Athlon (1999 - Present)** The original Athlon came at 500MHz. This bus operated at 200MHz, faster than anything Intel was using. The bus had a bandwidth capability of 1.6 GB/s. In June of 2000, AMD released the Athlon Thunderbird. full speed L2 cache
- In April of 2000, Intel released their Pentium III Coppermine. While Katmai had 512 KB of L2 cache, Coppermine had half that at only 256 KB. But, the cache was located directly on the CPU core. Coppermine eventually saw 1+ GHz.
- **Celeron II (2000)** The chip is available from 533 MHz to 1.1 GHz.
- **AMD released Athlon "Palomino" (May 2001), also dubbed the Athlon 4.** It allows the chip to change its voltage requirements and clock speed depending on the usage requirement of the time. This was excellent for making the chip appropriate for power-sensitive apps such as mobile systems.
- **Duron (2000 - Current)** In August of 2001, AMD released the Duron "Morgan". This chip broke out at 950 MHz but quickly moved past 1 GHz., but with 64 KB of L2 rather than 256 KB.
- **Pentium IV (2000 - Current)** First released in 2 GHz and 2.2 GHz versions, but the new design gives P4 room to move up to 3 GHz quite easily.
• IBM ps/2 micro channel With the introduction of its Personal System/2 (PS/2) range in April 1987, IBM also introduced a new system architecture.

• The PS/2 model 30 used the familiar AT style bus and the models 50, 60 and 80 used the new Micro Channel Architecture (MCA). Since then we have seen the model 30 286 using the AT style bus, and the model 50Z and 70 386 which use MCA.
My Conclusions

• Pricing, Marketing and Tech Support
• Monopolies
• GNU
Where are we going....?

My granddaughter Paula (2006)
<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://oldcomputers.net">oldcomputers.net</a></td>
</tr>
<tr>
<td><a href="http://www.atarimagazines.com/creative/v9n10/24_TRS80_model_4_more_busi.php">www.atarimagazines.com/creative/v9n10/24_TRS80_model_4_more_busi.php</a></td>
</tr>
<tr>
<td><a href="http://www.islandnet.com/~kpolsson/comphist">www.islandnet.com/~kpolsson/comphist</a></td>
</tr>
<tr>
<td><a href="http://www.kjsl.com/trs80/model4info.html">www.kjsl.com/trs80/model4info.html</a></td>
</tr>
</tbody>
</table>
Still Under Construction