



Computer Maintenance

Unit Subtitle: CPU's



How the CPU Works

- Input/output (I/O) unit
 - Manages data and instructions entering and leaving the CPU
- Arithmetic logic units (ALUs)
 - Do all comparisons and calculations
- Control unit
 - Manages all activities inside the CPU itself

How the CPU Works

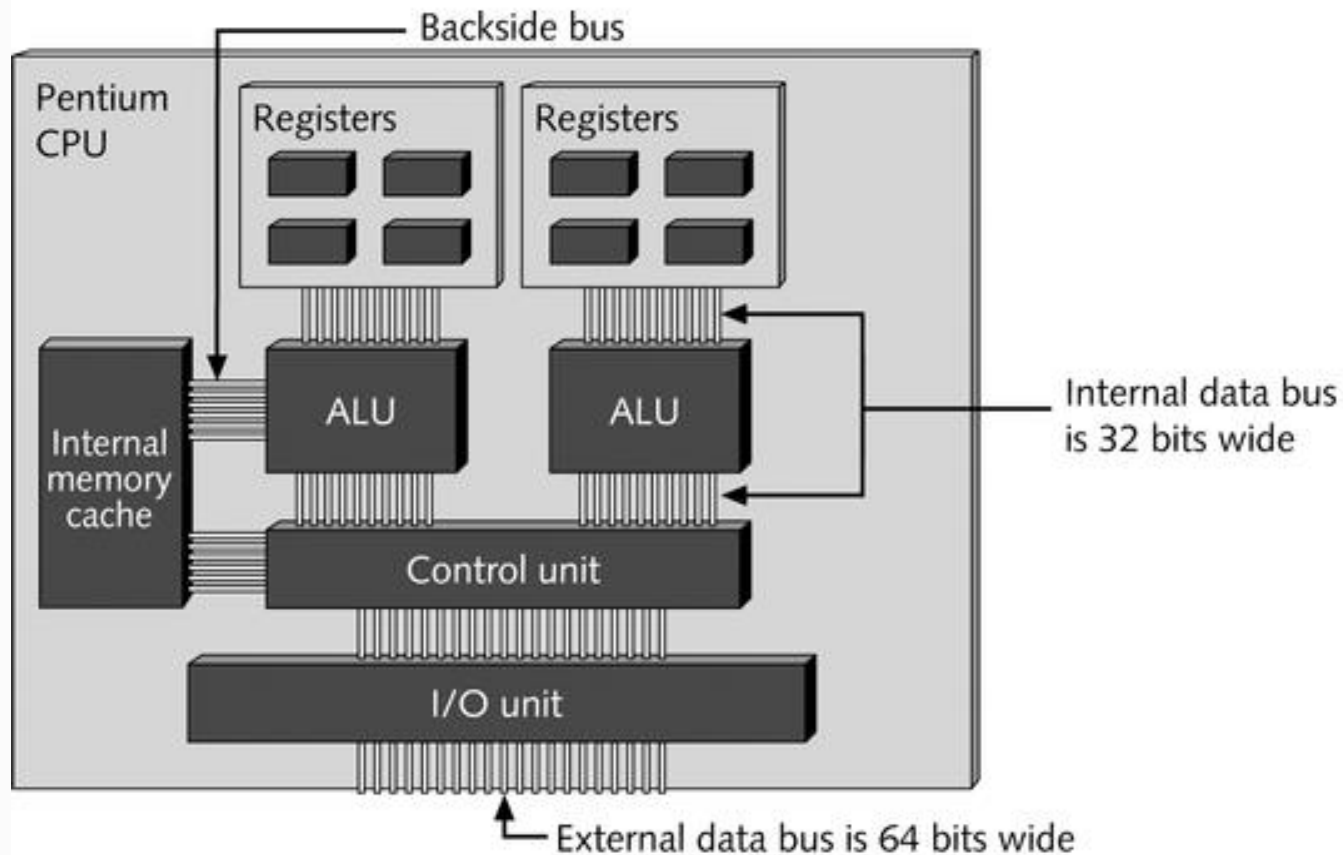


Figure 5-4 Beginning with the Pentium CPU, a CPU has two arithmetic logic units and can process two instructions at once

Attributes Used to Rate CPU



- CPU speed measured in Megahertz or Gigahertz
- Efficiency of programming code
- Number of transistors
- Number of registers
- Word size
- Data path

continued...

Attributes Used to Rate CPU



- Maximum number of memory addresses
- Amount of memory included with the CPU
- Multiprocessing ability
- Special functionality

The Pentium and Its Competitors



- Pentium processor is a true multiprocessor (has two ALUs)
- Terminology
 - Bus speed
 - Processor speed
 - The multiplier
 - Memory cache

The Pentium and Its Competitors

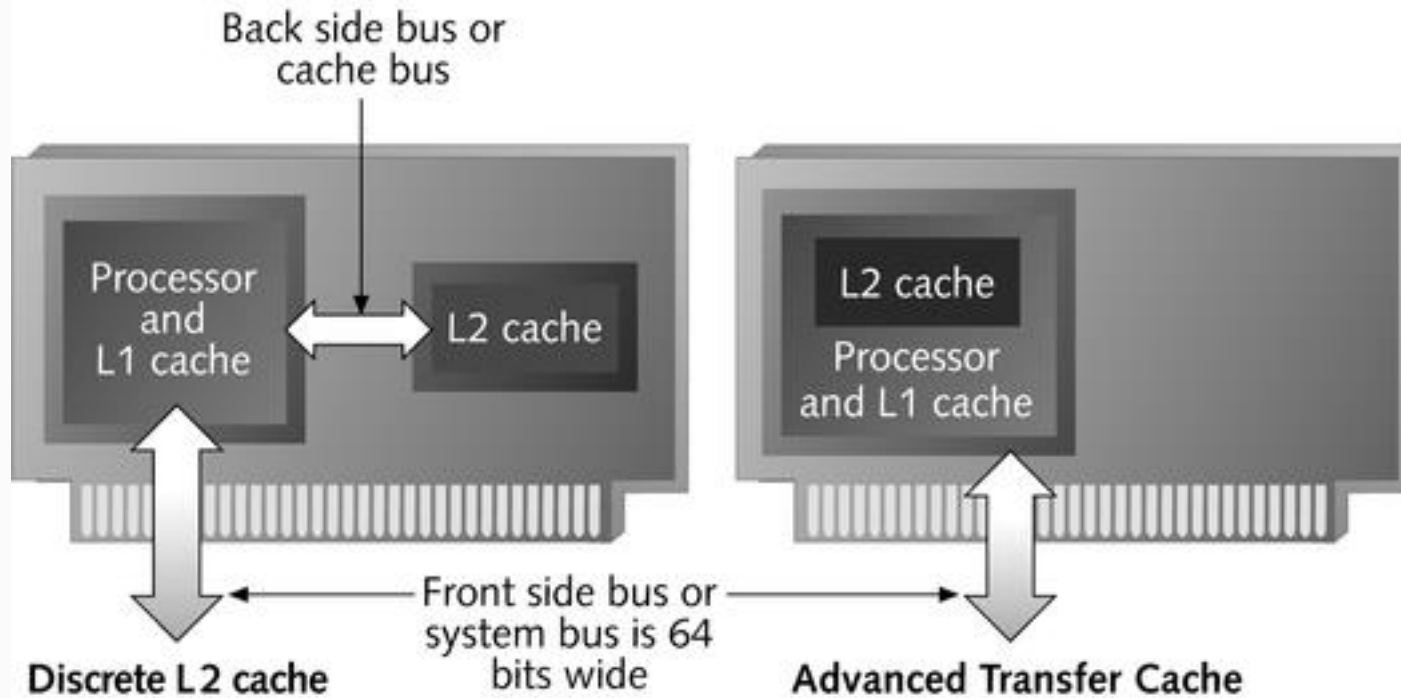


Figure 5-5 Some Pentiums contain L2 cache on separate dies (discrete L2 cache), and some contain L2 cache on the same die (Advanced Transfer Cache)

Pentium Upgrades



Intel departed from simply increasing the speed of its Pentium processor line by introducing the Pentium Pro processor. While compatible with all of the previous software written for the Intel processor line, the Pentium Pro is optimized to run 32-bit software.



Intel Itaniums

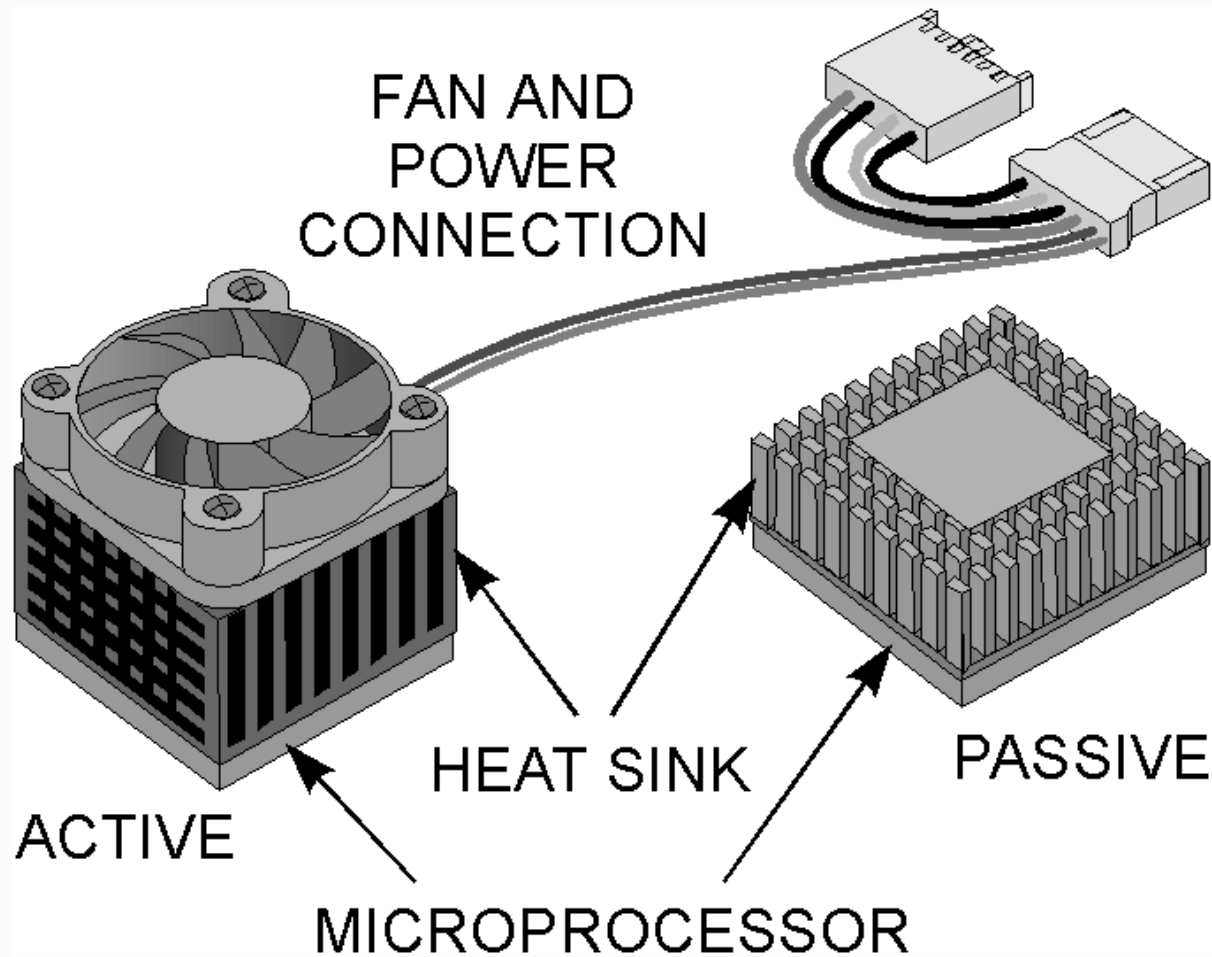
- The next-generation processor
- Intel's first 64-bit processor for microcomputers
- Designed for high-end enterprise servers
- Uses a new instruction set called the EPIC (explicitly parallel instruction computing) architecture

CPU Heat Sinks and Cooling Fans



- Heat sinks
 - Used by older CPUs to pull heat away from the CPU
 - Clip-on devices that mount on top of the CPU
- Cooling fans
 - Keep temperatures below the Intel maximum limit of 185 degrees F/85 degrees C

Microprocessor Cooling Systems



CPU Cooling Fan

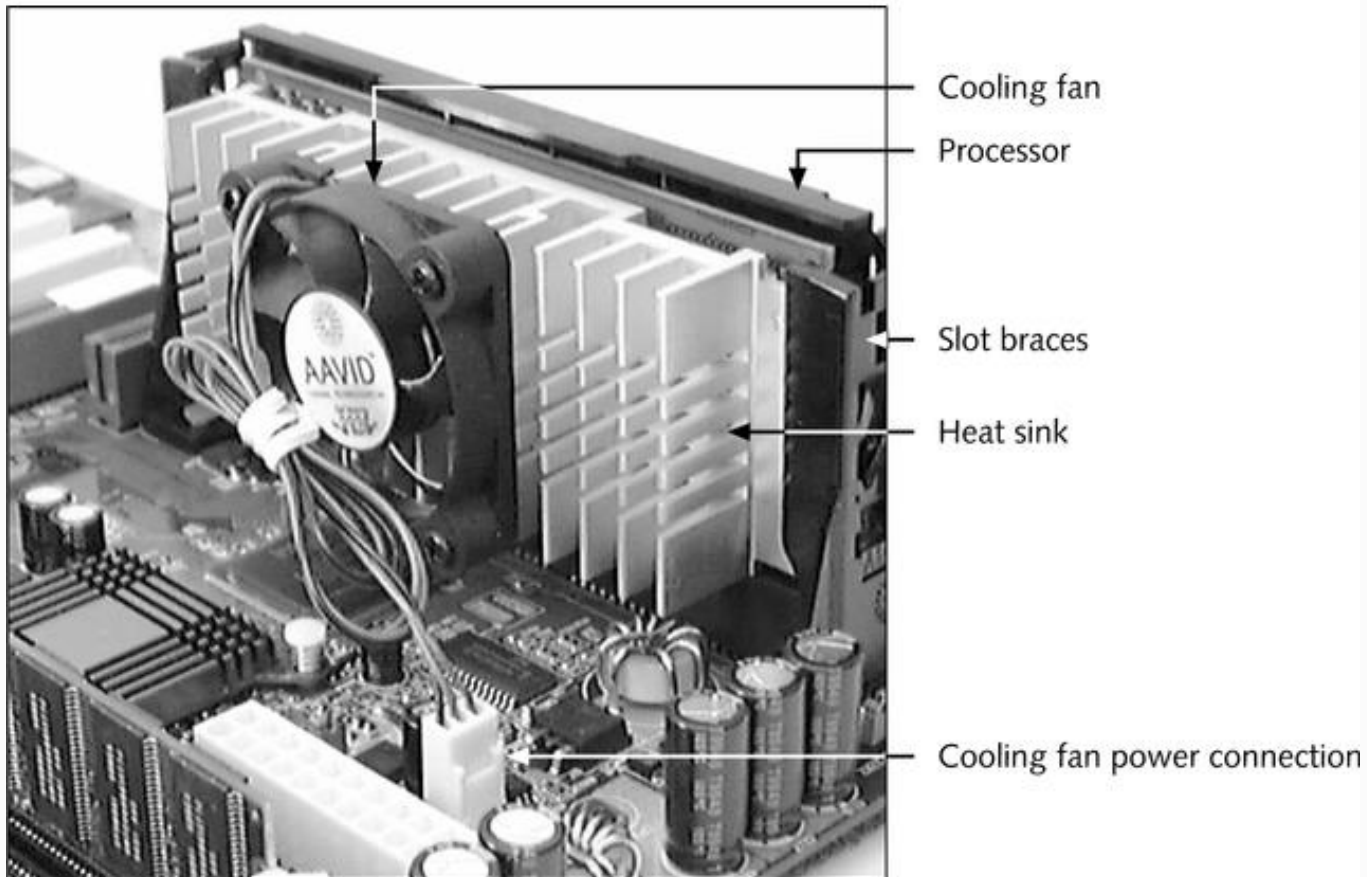


Figure 5-10 A CPU cooling fan mounts on the top or side of the CPU housing and is powered by an electrical connection to the motherboard

CPU Cooling Fan

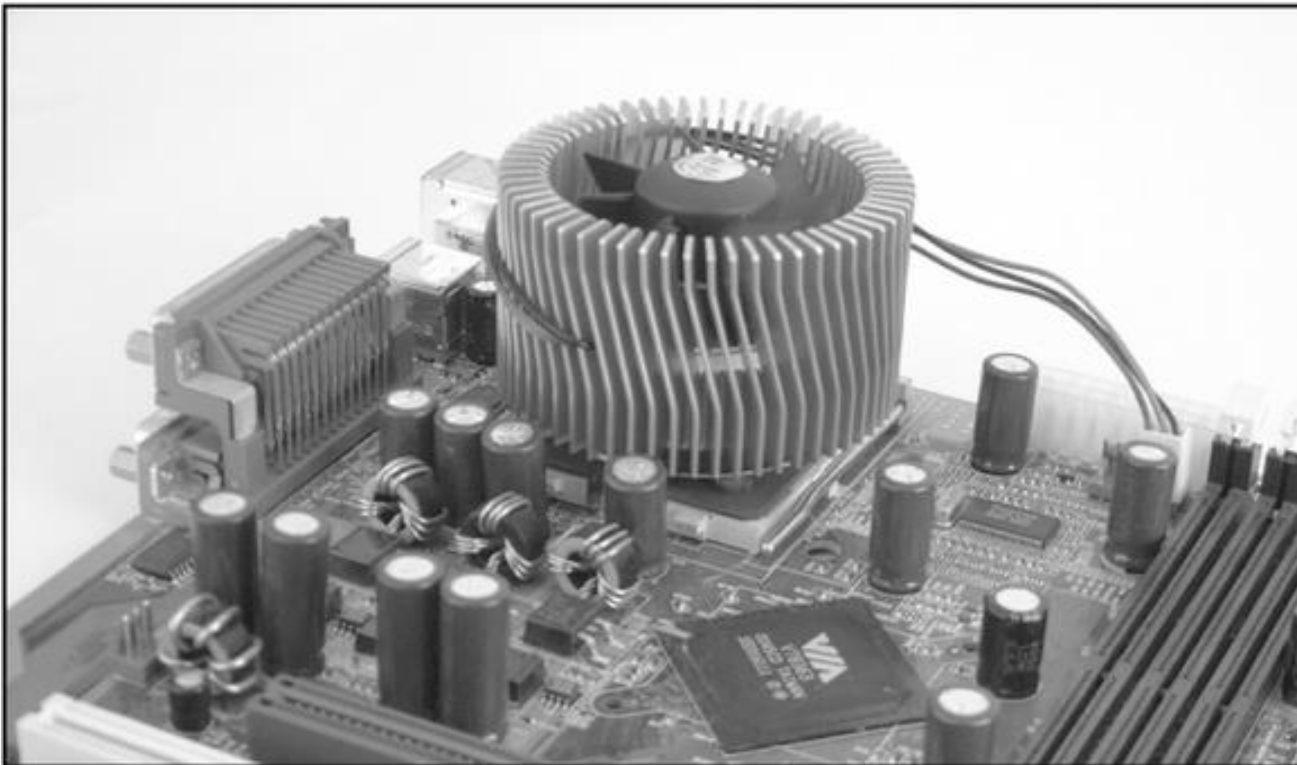


Figure 5-11 The Golden Orb cooling fan

CPU Packages

- SECC (Single Edge Contact Cartridge)
- SECC2 (Single Edge Contact Cartridge, version 2)
- SEP (Single Edge Processor)
- PPGA (Plastic Pin Grid Array)
- PGA (Pin Grid Array)
- OOI/OLGA (Organic Land Grid Array)
- FC-PGA (Flip Chip Pin Grid Array)
- FC-PGA2 (Flip Chip Pin Grid Array 2)
- PAC (Pin Array Cartridge)

Plastic Pin Grid Array

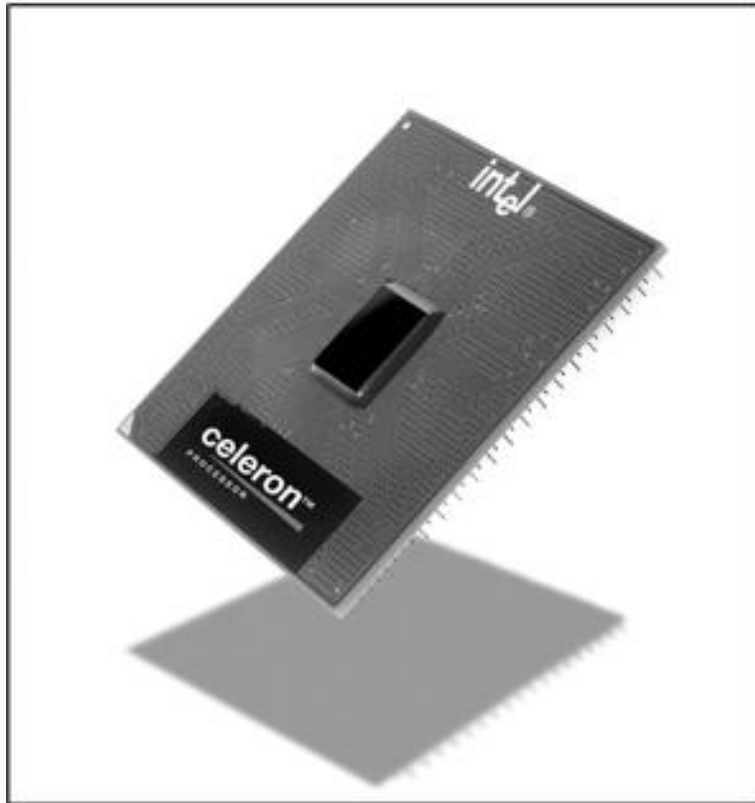


Figure 5-12 The Intel Celeron processor is housed in the PPGA form factor, which has pins on the underside that insert into Socket 370



CPU Slots and Sockets

- The physical connection used to connect the CPU to the system board
- Slots 1 and 2 are proprietary Intel slots
- Slot A is a proprietary AMD slot
- Current CPU sockets are called zero insertion force (ZIF) sockets and have a small lever on the side of the socket that lifts the CPU up and out of the socket

CPU Slots and Sockets

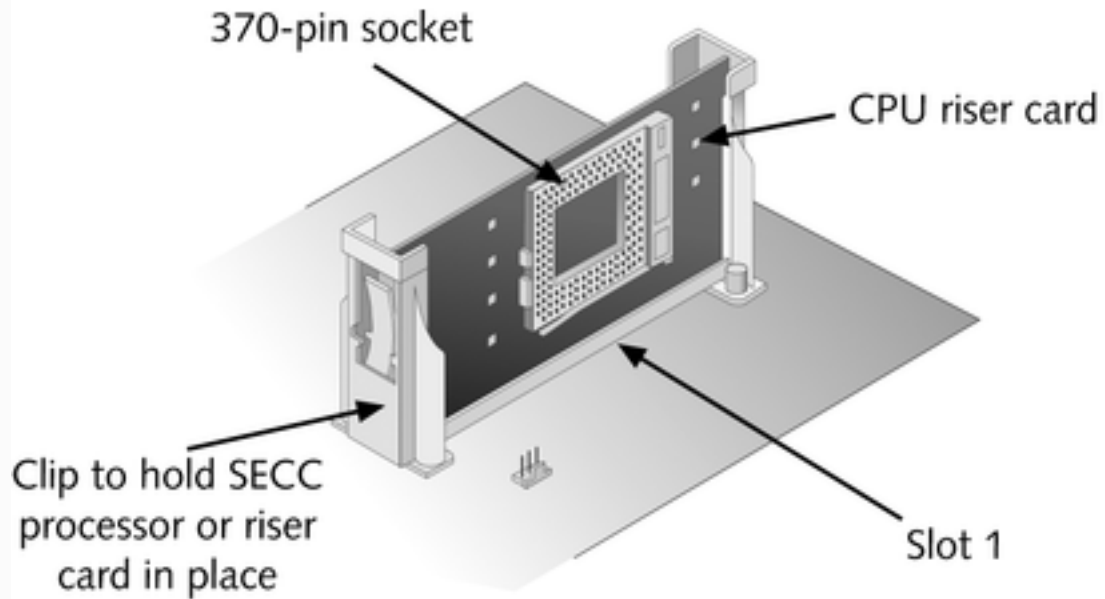


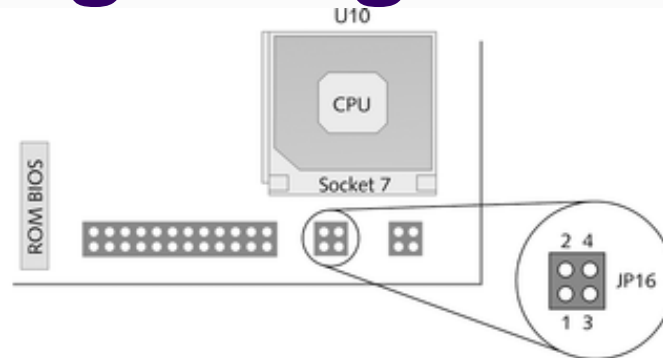
Figure 5-13 A riser card can be used to install a Celeron processor into a motherboard with slot 1



CPU Voltage Regulator

- Dual-voltage CPUs
- Single-voltage CPUs

CPU Voltage Regulator



CPU TYPE	JP16	CPU Voltage	
		Core	I/O
Single Voltage Intel P54C/CQS/CT Cyrix 6x86 AMD K5	2 ○ ○ 4 1 ○ ○ 3 open	3.5 V	3.5 V
Dual Voltage Intel P55C/MMX Cyrix 6x86L/M2 AMD K6	2 ○ ○ 4 1 ○ ○ 3 open	2.8 V	3.4 V
	2 ● ○ 4 1 ● ○ 3 1-2 closed, 3-4 open	2.9 V	3.4 V
	2 ○ ● 4 1 ○ ● 3 1-2 open, 3-4 closed	3.2 V	3.4 V

Figure 5-14 CPU voltage regulator can be configured using jumpers on the motherboard to apply the correct voltage to the CPU

Relationship of CPU Speed to Bus Speed



- When the multiplier that determines CPU speed is large, overall performance of system is not as good as when multiplier is small
- Change the speed of a computer by
 - Changing speed of system bus, or
 - Changing multiplier that determines speed of CPU

Popular CPU chips



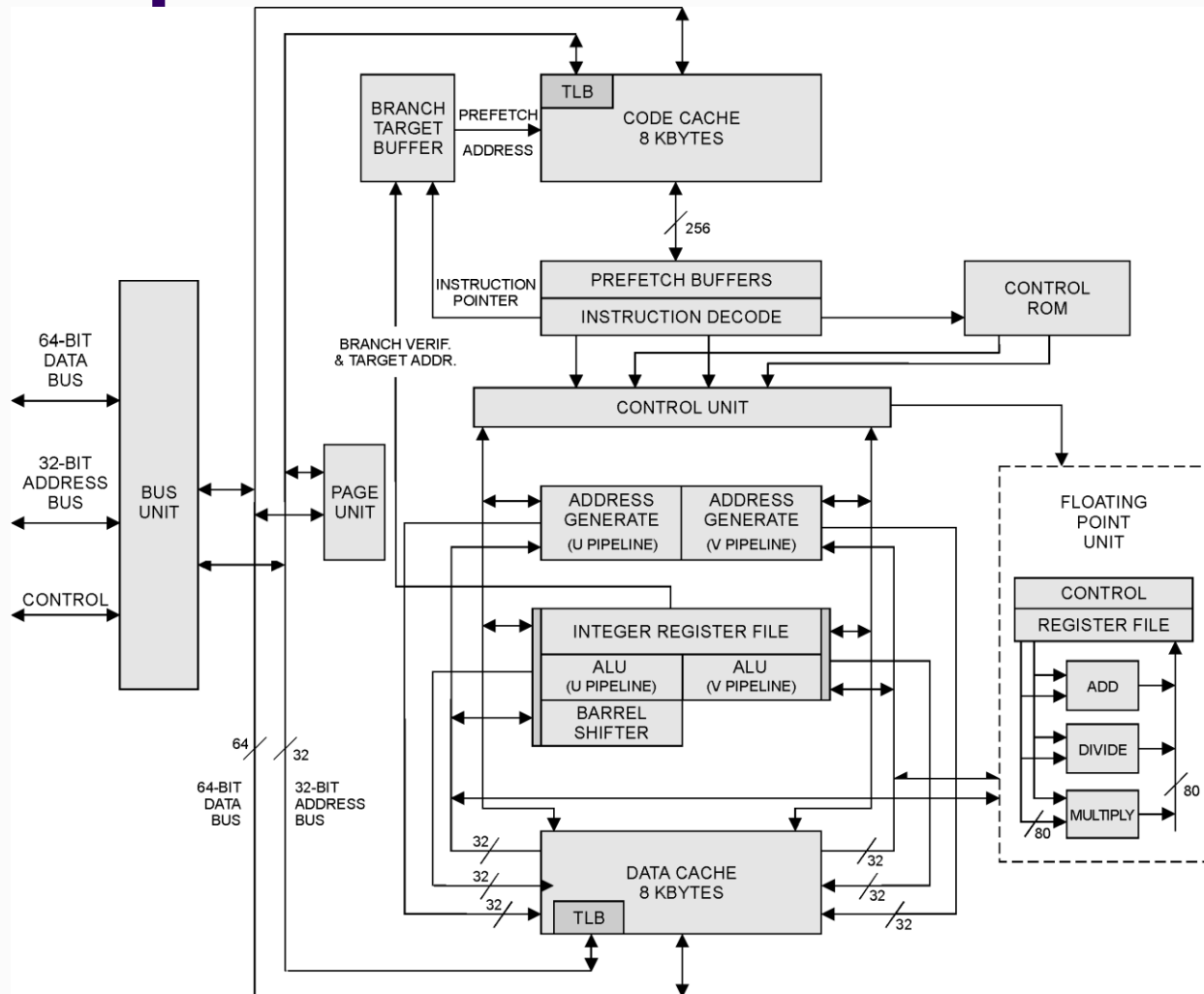
Intel, AMD, and Cyrix

Characteristics include:

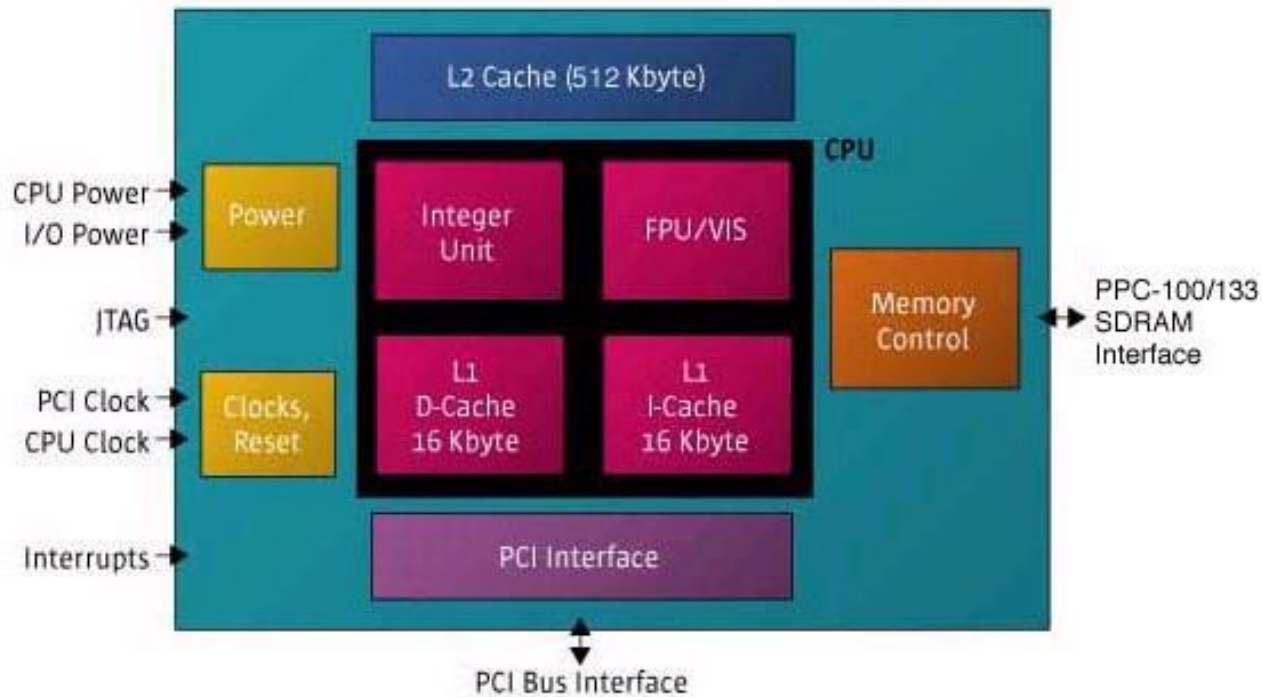
- Physical size
- Voltage
- Speeds
- On-board cache or not
- Sockets/ SEC (Single Edge Contact) Cartridge
- Number of pins

Motorola manufactures the chips found in Apple computers.

Inside the Pentium Microprocessor



Sun SPARC Processor



The SPARC processor is a 64-bit processor built to run Sun Unix servers.

Eliminated the Northbridge by incorporating the memory and PCI controllers into the CPU.

Cache



One method of increasing the memory-access speed of a computer is called caching. This memory management method assumes that most memory accesses are made within a limited block of addresses.

Processor and Memory Buses



The processor bus is the set of wires used to carry information to and from the processor. This activity is normally controlled by the system chipset. The memory bus connects the processor bus to the system memory and cache; in practice, the processor and memory buses can be thought of as the same thing.

Dedicated "Backside" Cache Bus



Conventional processors use level 2 cache on the motherboard and connect to it using the standard memory bus arrangement. To achieve better performance, many newer processors use a dedicated high-speed bus to connect the processor to the level 2 cache. A special *backside* bus manages this high-speed data link between the processor and the level 2 cache.

Processor / Memory Data Bus



Every bus is composed of two distinct parts: the data bus and the address bus. The **data bus** is what most people refer to when talking about a bus; these are the lines that actually carry the data being transferred. The CPU and memory connect to one another via the data bus.

Processor / Memory Address Bus



The **address bus** is the set of lines that carry information about where in memory the data is to be transferred to or from. No actual data is carried on this bus, rather memory addresses, which control the location that data is either read from or written to, are sent here. The speed of the address bus is the same as the data bus it is matched to.



System Clocks

Every modern PC has multiple system clocks. Each of these vibrates at a specific frequency, normally measured in MHz (megahertz, or millions of cycles per second). A clock "tick" is the smallest unit of time in which processing happens, and is sometimes called a *cycle*; some types of work can be done in one cycle while others require many.



System Clocks

The various clocks in the modern PC are created using a single clock generator circuit (on the motherboard) to generate the "main" system clock, and then various clock multiplier or divider circuits to create the other signals.



Multiprocessing

Multiprocessing is running a system with more than one processor. The theory is of course that you can double performance by using two processors instead of one.



Multiprocessing

In addition, multiprocessing is most effective when used with application software designed specifically for it. Multiprocessing is managed by the operating system, which allocates different tasks to be performed by the various processors in the system.



Multiprocessing

Multiprocessing can be said to be either *asymmetric* or *symmetric*. The term refers to how the operating system divides tasks between the processors in the system. Asymmetric multiprocessing designates some processors to perform system tasks only, and others to run applications only. Symmetric multiprocessing, often abbreviated *SMP*, allows either system or user tasks to run on any processor, which is more flexible and therefore leads to better performance. *SMP* is what most multiprocessing PC motherboards use.



Choosing a CPU

When choosing a CPU, the following should be considered:

- **Manufacturer** – the most popular type of CPU is from Intel
- **Speed** – the faster the speed of a CPU, the faster the computer can operate
- **Socket Type** – the type of socket on the system board determines the type of CPU you can install on the computer
- **Fans** – if upgrading, make sure you have enough space inside the computer to fit a new CPU's fan