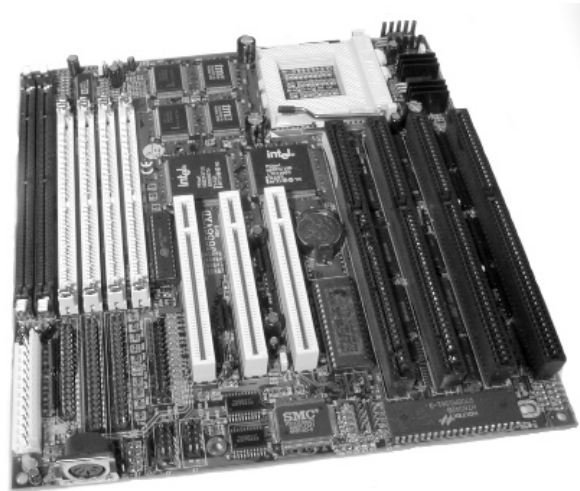


THE MOTHER OF ALL BOARDS

Probably the most obvious thing when you first open the computer cabinet, besides the tangle of wires and cables going everywhere, is the large circuit board. Since just about everything in the cabinet plugs into this board, it's easy to see why it's called the motherboard. It's also called the System Board for the same reason.

The motherboard really has two purposes. One, as we already mentioned, is that everything else in the case plugs into it. And everything that plugs into the back of the case (like the keyboard and monitor, for instance) also goes from there into the motherboard. So this is the big meeting place. If any part of the entire computer system wants to 'talk' to any other part, that conversation takes place on the motherboard.

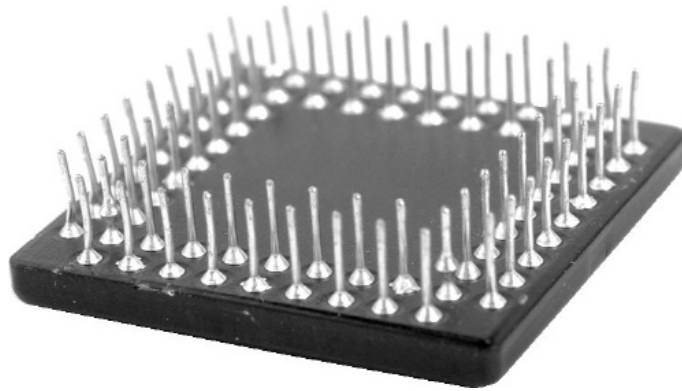


A Pentium Motherboard

The other purpose for the motherboard is to provide a home for the processing function of the computer.

THE CPU

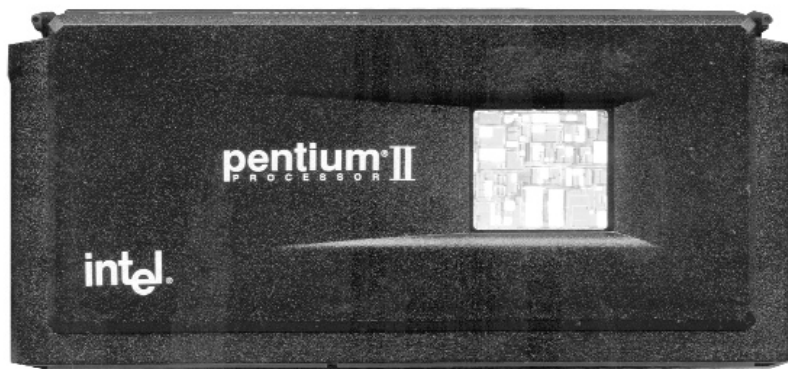
CPU stands for **C**entral **P**rocessing **U**nit. This is quite a mouthful of a name for a chip of silicon that you could see, if you were able to look inside its case, is smaller than your thumbnail. In fact, you will sometimes hear it called a **Micro-processor**, because of its small size. However, in terms of everything it does, it isn't small at all. If one single integrated circuit could be called the 'brains' of the computer, this IC is it. Remember the instructions that made up our software pro-



A typical PC CPU

grams? Well, the CPU is the piece of hardware that actually carries out those instructions. And when data needs to move from one part of the computer to another, it's the CPU that controls that, too. Kind of like a butler and a traffic cop, all rolled into one. The CPU chip is so important, a computer is often known by the type of CPU it contains. For example, one common type of CPU is the **Pentium**. Perhaps you've heard of it. The Pentium does so many things, so fast, it would get over-

heated if we didn't cool it off. So the Pentium usually has a little cooling fan attached to it, and maybe some metal cooling fins too. If you see something attached to or plugged into the motherboard that has a fan or fins on it, that's almost certainly the CPU.



Intel's Pentium II Processor

If you are working with an older, slower computer, the CPU won't need to be cooled off so much and probably won't have a fan. Just look for the biggest integrated circuit on the motherboard. It will have a number printed on it that most likely ends in 286, 386 or 486. Sometimes it will have cooling fins, kind of stuck on top and covering up the number. No matter, if you see a big IC with fins stuck on it, you've still found your CPU.

FIRMWARE

By now you know that the way the computer gets things done is that the CPU takes instructions that are stored in the RAM (memory) and does them. The main instructions come from the program called the Operating System, and those instructions let the CPU direct traffic for all the other programs, called Applications.

When the CPU does instructions, we say that it **Executes** them. It's nothing to do with assassination, all right? It just means completing an action, or carrying out a set of instructions. Feel free to **execute** the questions at the end of this chapter.

Here's a puzzle for you. When the computer is turned off, all information in the RAM is gone, so when the computer is turned on again, there is nothing there to tell the CPU what to do. What the CPU **needs** to do right then is go out to the disk and get that operating system, and bring it into the RAM so the CPU can start executing the operating system's instructions. Guess where you find the instructions that tell the CPU how to get programs off the disk and put them into RAM? That's right, in the operating system! So how do we get out of this mess?

What we need is a set of instructions which, like the ones on the hard disk, don't disappear when the computer is turned off. But we need them right there next to the CPU, so it can find them when it first wakes up. We don't need a lot of instructions, though. Maybe something like this:

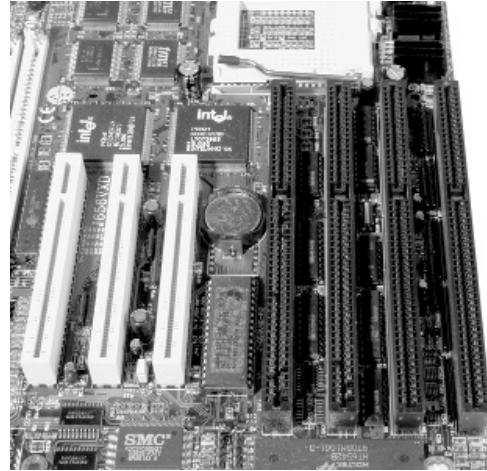
1. Here, drink this coffee.
2. Now, go get the first part of that operating system and put it in the RAM.
3. Good. Now start executing the first operating system instruction.

If we can get the CPU that far, we're home free. As you've probably guessed by now, we do have just such a set of instructions. It's called the **BIOS**, which stands for **B**asic **I**nterface and **O**utput **S**ystem. It's a little program that wakes up the computer and gets it going when you first turn it on. These instructions are stored in an integrated circuit on the motherboard, usually very close to the CPU.

We can't really use the word 'software' to describe these BIOS instructions, because we can't change them. They are set at the factory, and we say that these instructions are **hard-wired**. But we can't call them hardware either. After all, they're instructions, not nuts and bolts. So we have a new word, just for this occasion. It's called **Firmware**.

WHICH BUS DO I TAKE?

If you look at the part of the motherboard that is closest to the back of the case, you should see a row of connector sockets lined up like so many short, wide dominos. They may have circuit boards plugged into them or they may be empty. It doesn't matter. I just wanted you to see how the sockets were lined up.



PCI (on left) and ISA (on right) sockets

What you probably can't see, so I will tell you about it, is that the motherboard has the same pins of each of these sockets connected together. A trace runs from each Pin 1 to every other Pin 1, each Pin 2 to every other Pin 2, each Pin 3 (well, you get the idea). Whatever device gets plugged into one of these sockets, it will see exactly the same signals seen by the devices in every other socket. Not only that, but these same traces run around to just about everything else connected to the motherboard; the CPU, memory, disk drives, all of it.

Remember when I said the motherboard was "a big meeting place"? Right here is where that happens. Except it's not called a "meeting place", it's called a **Bus**. Why a bus? Maybe because data travels on this bus from one place to another in the computer, just like you travel on the bus from one place in town to another. Or maybe the name has nothing to do with that. I really don't know. It's just called a bus.



The computer's bus is a set of lines or traces on the motherboard, which everything else taps into if it wants to exchange data with other parts of the computer. Some of the lines of the bus carry data, and these are called **Data Lines** as you might expect. Some of the lines keep track of where the data is supposed to be going next, and are called **Address Lines**. A few of the lines carry power, because as we know, nothing in a computer works unless it can get a little electricity.

By the way, whenever the bus gets data from some part of the computer, it's called '**Reading**' the data. The act of getting data or looking at data is called a '**Read Operation**' or a '**Read Cycle**'. When it puts the data in a new place or changes data somewhere, that's called a '**Write Operation**' or a '**Write Cycle**'. Pretty simple stuff, really

Several types or variations of the bus have been developed over the years, and sometimes you will find more than one type inside a single computer. We'll compare the different types of buses in Volume 2.

One of the bus lines carries a signal we call the clock. This signal goes up and down at a certain rate, which tells everything else on the bus how fast to run. The up and down of this signal is kind of like the tick and tock of a regular clock, except that it happens faster. Much faster, like 50 or 100 million times every second. And if that's not running fast, I don't know what is.

