

Chapter 5. It all starts with the CPU

There are two very fundamental components to study on the motherboard. The CPU and the busses. The CPU does all the data processing, and the busses handle all data transfer.

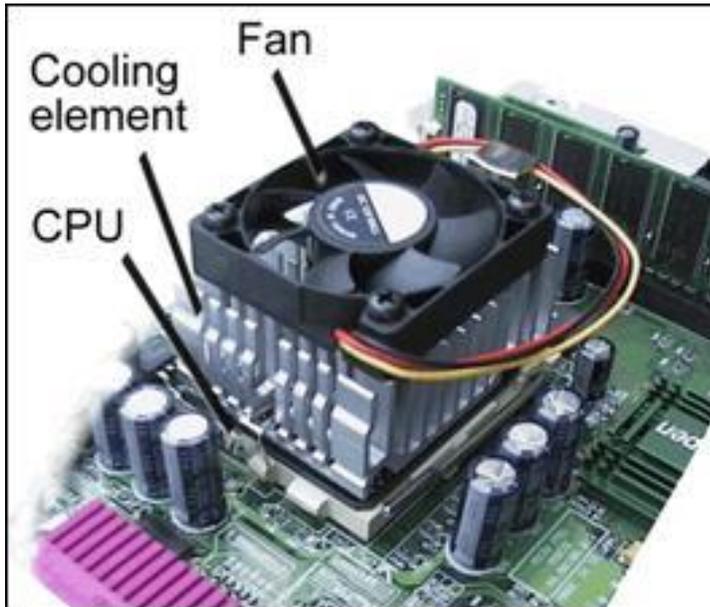


Fig. 32. The CPU is mounted on the motherboard, hidden under the cooling fan and heat sink.

What is a CPU?

CPU stands for Central Processing Unit. There can be several processors in a computer, but one of them is the central one – the CPU.

The reason the CPU is called a processor is because it can work with data. And it has two important jobs:

- It can do *calculations*.
- It can *move* data.

The CPU is very fast at doing both jobs. The faster the CPU can do calculations and move data, the faster we say the PC is. What follows is a short description of how to achieve faster data processing. Read it, and see if you understand all the concepts. There are three ways to improve a PC's performance:

- Higher *clock frequencies* (which means more clock ticks per second).
- Greater *bus width*.
- Optimizing the core of the processor and other components so that the maximum amount of work is done for each *clock tick*.

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All this can lead to better *bandwidth*, which is required throughout the PC. The entire development process is focused around the motherboard, and especially the CPU. But all of the electronics has to be able to keep up with the high pace, and that is what makes the motherboard so fascinating.

The CPU is physically quite small. At its core is an electronic circuit (called a *die*), which is no bigger than your little fingernail.



Fig. 33.
The CPU circuit (the "die") can be seen in the middle of the chip (An AthlonXP shown close to actual size).

Despite its small size, the CPU is full of transistors. The *die* in a Pentium 4 CPU contains 125 million transistors, all squashed together into a very tight space. It is about 1 cm x 1 cm in size:

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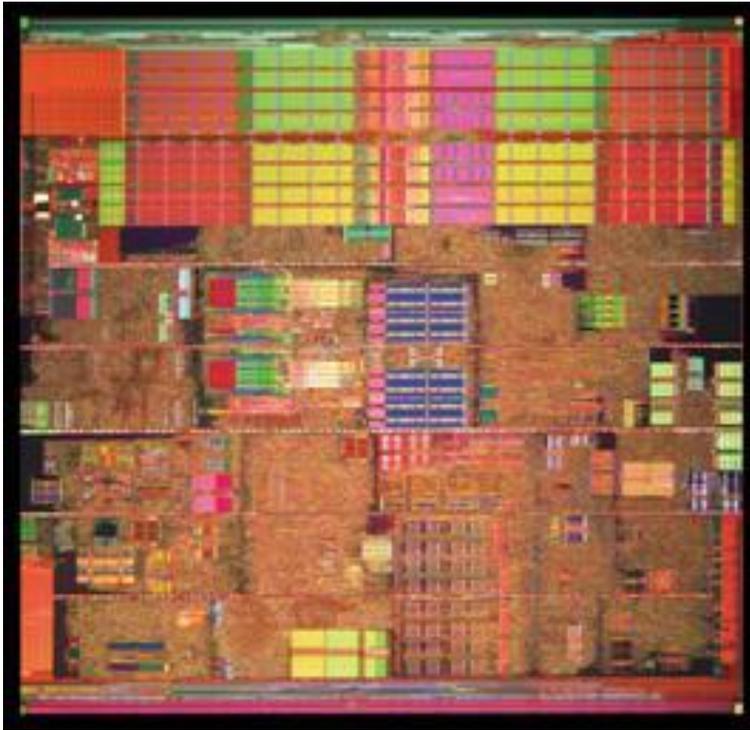
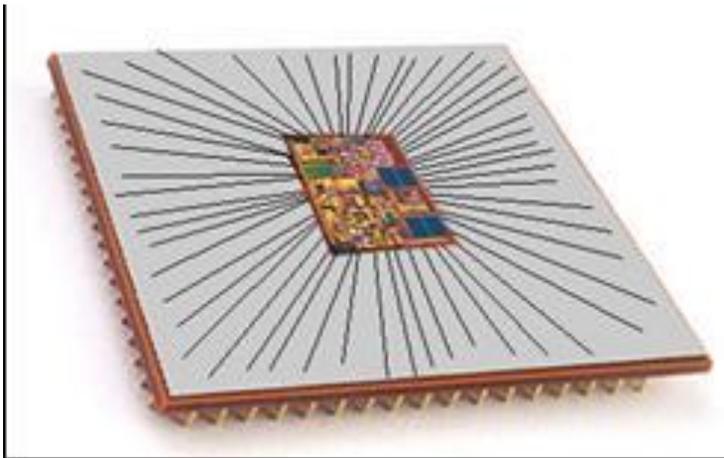


Fig. 34. Close up of a CPU circuit (die).

The electronic circuit is encapsulated in a much bigger plastic square. This is in order to make room for all the electrical contacts which are used to connect the CPU to the motherboard.



The individual contacts are called *pins*, and a CPU can have 478 of them (as does the Pentium 4). The large number of pins means that the socket has to be relatively large.

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Fig. 35.
The
underside
of a
(Pentium
4) CPU,
showing
the many
pins.

Which CPU?

The companies Intel and AMD make most CPU's. Intel laid the foundations for the development of CPU's for PCs with their more than 20 year old 8086 and 8088 processors.

CPU's are developed in series, or *generations*. Each series is known by its *name*. The last four generations of Intel processors, for example, have been the Pentium, Pentium II, Pentium III and Pentium 4. Running alongside these is the Celeron series, which are cheaper versions, typically with reduced L2 cache and a slower front side bus:



Fig. 36. A Celeron processor supplied in a box from Intel, with heat sink and fan.

Within each generation there are many variants with different *clock frequencies*. For example, when the Pentium 4 was released in the year 2000, it was as a 1400 MHz version. The original model was later followed up by versions with 1800, 2000, etc. MHz, up to 2400 MHz (the clock frequencies came in intervals of 100 MHz). In the year 2002, a new model came out for which the clock frequencies started at 2266, 2400 and 2533 MHz, and increased in intervals of 133 MHz. A year later the clock frequencies was raised to intervals of 200 MHz with the Pentium 4 chips running from 2600 to 3600 MHz. And so it continues.

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The company, AMD, produces similar processors in the Sempron and Athlon 64 series, which also come with different clock frequencies.

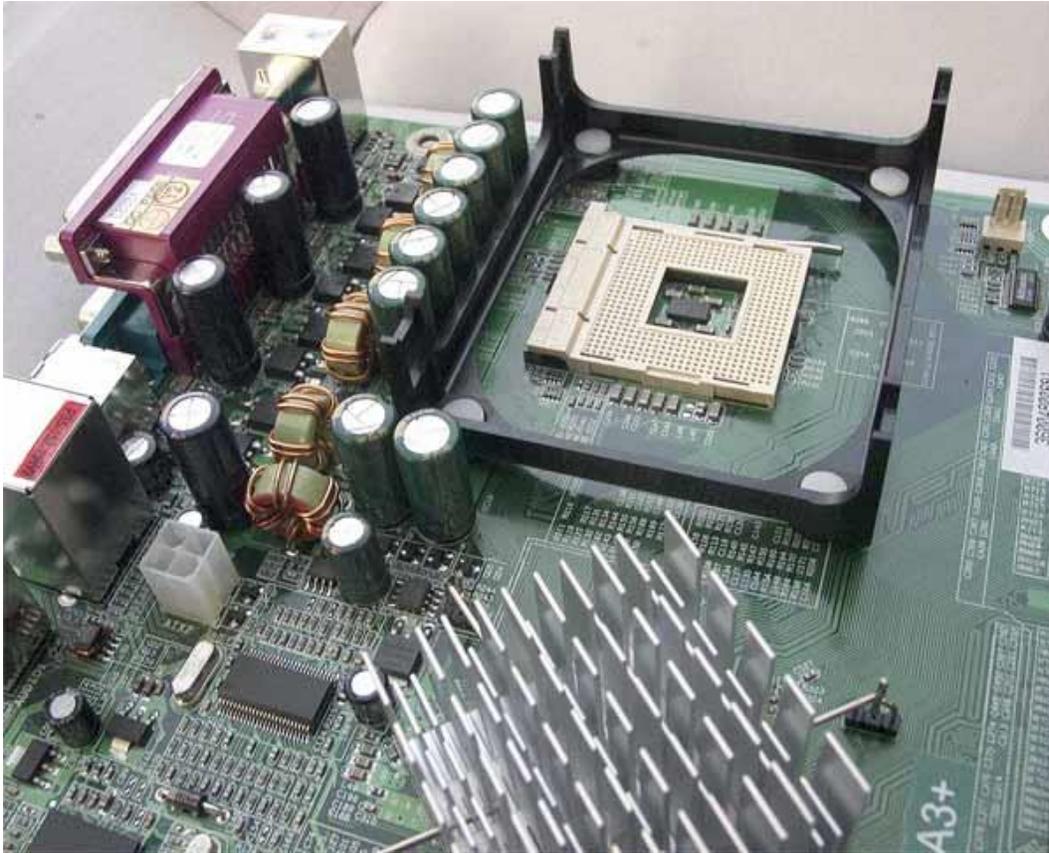


Figure 37. The Pentium 4 socket 478 on a motherboard.

Find your CPU

If you are not sure which CPU your PC uses, you can investigate this in several ways. You could check your purchase receipt. The name of the CPU should be specified there.

You could look inside your PC and locate the CPU. But it is quite difficult to get to see the model name, because there is a fan mounted on the actual chip. The fan is often glued directly onto the processor, so that it is not easy to remove it.

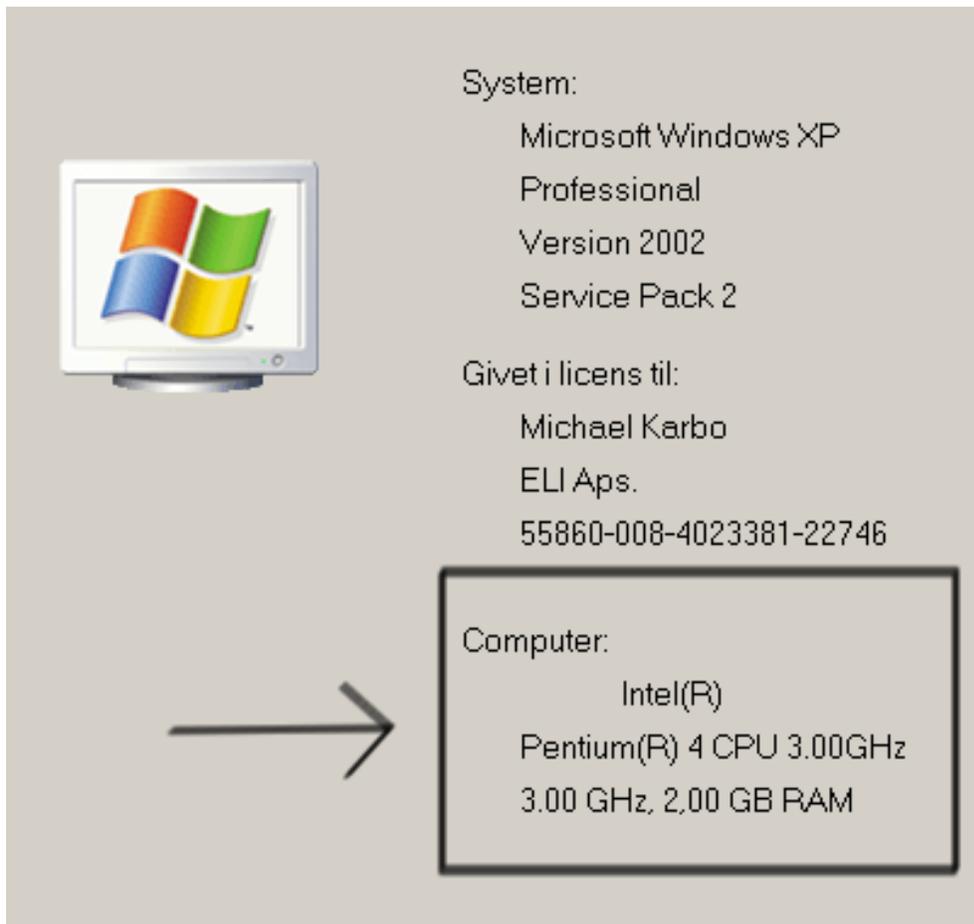
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Fig. 38. A CPU is shown here without a cooling fan. It is mounted in a small socket which it clicks into without needing any tools.

In Windows, you can select the System Properties dialog box, where you can see the processor name and clock frequency:

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You can also watch carefully when your PC starts up. Your CPU name and clock frequency is shown as one of the first things displayed on the screen. You can press the P key to pause the startup process. Below you can see a picture of the startup screen for PC. This PC has an Intel Pentium 4, with a clock frequency (work rate) of 2553 MHz:

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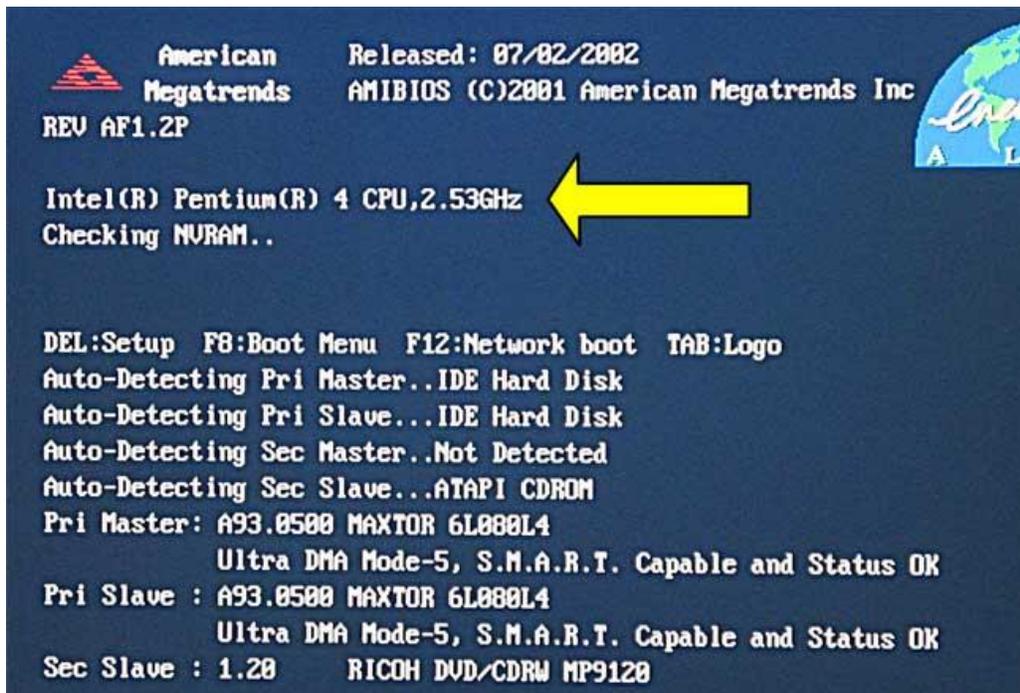


Fig. 39. If you are not sure which CPU your PC uses, you can see it on the screen, shortly after you switch on your PC.

CPU testing programs

Finally, let me just mention some small utility programs which you can download from the Internet (e.g. search for “WCPUID” or “CPU-Z” on www.google.com, and you’ll find it). The programs WCPUID and CPU-Z, reveals lots of information about your CPU, chipset, etc. They are used by motherboard nerds.

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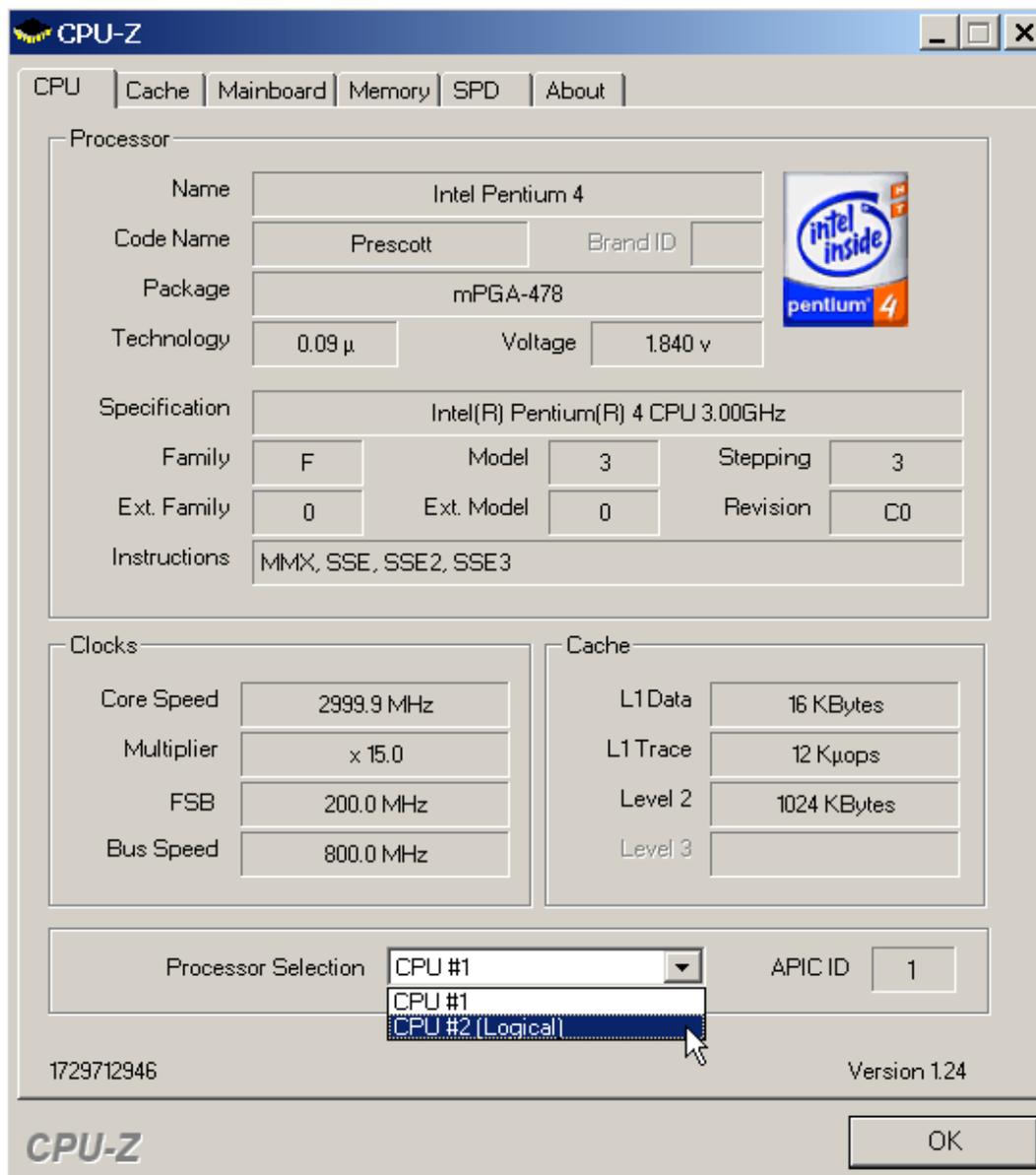


Figure 40. Here CPU-Z reports that the Pentium 4 processor is a "Prescott" model. Due to Hyper Threading, the processor virtually holds two cores.