

THE COMPUTER CORNER

No. 118. Lets Take A Bus

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Ed Rate, AA9W, always seems to come up with good suggestions for new articles. At one of the Ozaukee Radio Club Saturday morning breakfasts, Ed said that there was a lot of confusion about the processor's relationship to the front side bus, and, "What the heck is a front side bus, anyway?" So, here we go.

First, lets start with a more fundamental issue. What is a bus? The dictionary says it is a group of connectors serving as a common connection for three or more circuits, and when it is in the form of a metallic bar, it is called a bus bar. We don't have any big metallic bars in a computer, but if you look closely at the top of a motherboard, you can see hundreds of thin metallic traces that show under the protective insulation coating. There are even traces on the bottom of the motherboard, and there are yet more sandwiched in between the top and bottom surface, hidden from your view (a total of five, or even seven layers). Essentially all of these traces, visible and hidden, are part of one bus or another. There are actually many busses in a computer. So a computer bus is just a collection of wires. In a modern computer, there is a Processor Bus, a PCI Bus, an AGP Bus and an ISA Bus lumped together as System Busses. Again, each of these are just bundles of wires, linking one component or group of components with others.

The Processor Bus is also known as the Front Side Bus (FSB). It is a bundle of wires carrying information between the CPU (Central Processing Unit -- the 2 GHz chip or whatever speed you paid for) and the Memory Controller Chip on the motherboard. That Memory Controller Chip or Northbridge Chip then sends the information to memory on another bus -- the Memory Bus.

The FSB is the speediest bus on the motherboard, running at from 66 MHz to 800 MHz, depending upon what model of motherboard you have. Realize then, that even though you may have a Pentium IV 3.6 GHz CPU in your system, it is communicating with the outside world at only 800 MHz, the fastest speed that a current standard production motherboard can do! Right away, you can see that when buying a computer, the speed of the CPU is only one factor in getting a good system. You also need to know the speed of the FSB. An even more meaningful number for comparison purposes is the bandwidth a bus can carry, calculated by multiplying the frequency of the bus times 8 (8 bytes, or 64 bits). Thus, an 800 MHz FSB has a bandwidth of $8 \times 800 = 6,400$ MBps (million bytes per second). Even though the FSB is the fastest bus on the motherboard, it is pretty slow (about 20%) when compared to the speed of the CPU itself! Our 3.6 GHz CPU runs inside (has an internal bandwidth) of 8×3600 , or 28,800 MBps.

While we are at it, lets consider some other parts of the System Bus. Lets assume you have the latest and greatest mentioned above -- a Pentium IV 3.6 GHz CPU running on a motherboard with an 800 MHz Front Side Bus. Although most motherboards today have video built in, some gamers like to add a souped-up video card, plugged into the AGP (Advanced Graphics Port) socket. The AGP bus in this machine has a bandwidth of 2,133 MBps, about a third of the Front Side Bus. If you add any kind of card to your system other than the AGP video card, it is likely to be a PCI card. A typical PCI Bus runs at only 33 MHz and transfers 32 bits at a time rather than 64. Therefore its bandwidth is only 133 MBps, a very small percentage of the bandwidth of the FSB.

Lets suppose you have a motherboard with some of the older ISA bus slots, and you have an old 16-bit sound card plugged into it. The theoretical maximum speed of the ISA bus is only about 8 MBps, and if it is a really old 8-bit card, the bandwidth would be about half that! This is a far cry from the 64,000 MBps of our Front Side Bus. Keep in mind, too, that even at 8 MBps, the old ISA bus is still faster than most peripherals, such as floppy drive controllers, parallel and serial ports. For example, a good quality parallel port can only transfer data at about 2 MBps. Even the newest USB 2.0 port (480 MBps) is slow by comparison to the FSB (though this is plenty fast enough for the devices that are to be connected to it).

So, in summary, the Front Side Bus is the highway between the CPU and the Memory Controller Chip on the motherboard. If the CPU wants to send some data for storage in system memory, the FSB is the first road the data must take on its journey. Once it gets to the Memory Controller chip, that chip sends it on to RAM via a Memory Bus. There are lots of other busses in a computer. A highway (bunch of wires) must exist whenever data, timing signals or power are transferred from one place to another. OK, Ed? Happy computing!