

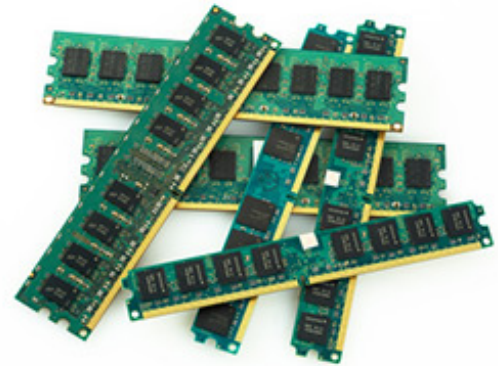
A Short Course on Computer Memory

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Every so often, a client asks us about the "innards" of the computers we sell and service. It used to happen much more in the early days of the computer revolution. These days, most clients want to just know if there's "enough"! If your "inner geek" needs some fodder, this article from HP provides a good basis for understanding more about the computer memory that most take for granted.

There are dizzying amounts of memory types in modern computer devices, from DDR SDRAM to L3 caches. And for many of us, understanding all the nuances of computer memory is a bit like understanding how the catalytic converter in your car works: It might be nice to know, but you probably don't have the time to become an expert, even if you use one every day.



But just as it's useful to still know the basics about your car, understanding the basics about computer memory can go a long way towards ensuring you get the performance you want—at the price you need. This quick primer will take you through the basic types of computer memory, and what to look for when making your next PC purchase or upgrade.

The big picture: Memory is like desk space

A typical computer has 3 types of memory: Cache memory, Random Access Memory (RAM), and virtual memory. Cache is the fastest and most expensive, RAM is slower and less expensive, and virtual memory is the slowest and least expensive type.

In order to make computers perform quickly while still remaining affordable, modern tablets, desktops, and other devices are made with less of the faster kinds of memory and more of the slower kinds, in a system known as "tiering." Each tier supplies information to the next faster tier. The cache gives data to the Central Processing Unit (CPU), RAM gives data to the cache, and virtual memory to the RAM. Meanwhile, the hard drive stores everything that's not currently in use.

While faster CPUs often help performance, much of the time it's not the processor slowing things down; instead, the limiting factor is often the memory, as the processor has to wait for the data it needs to do the calculations. Think of memory as the documents (data) that you keep in various parts of your desk: Faster memory is like the easily accessible desktop, while slower memory is like the file drawer, with lots of room for everything you need.

The desktop: Cache memory

Cache memory is the fastest and most expensive type of memory in most devices. Think of the cache as the

papers on top of your desk. They're easily and quickly accessible, but there's not room for a lot of them at once.

In order to maximize its effectiveness, cache is often integrated right into the CPU (L1 Cache) or very close to it (L2 Cache). This type of memory generally can't be upgraded, and is mostly important only when purchasing new systems. Faster, high-performing workstations feature processors with much more cache memory than consumer-grade systems.

The top drawer: Random Access Memory (RAM)

RAM is the most familiar form of computer memory for most people. Think of RAM as the top drawer on a desk. It's not quite as efficient as accessing papers right on your desktop, but the papers are still close at hand, and there's enough room to house several folders.

In most modern systems, DRAM (for dynamic RAM) is used, rather than the more expensive and larger SRAM (static RAM). Like cache memory, DRAM is "volatile" memory, which means the data it stores is lost when the power is turned off. Unlike the cache, RAM can be upgraded on many systems, particularly workstations. Generally speaking, the more programs you run at the same time (and the more intensive the programs), the more RAM you'll need in order to keep your computer running smoothly. The Windows task manager can also help you determine whether you're currently maxing out your system's memory. If you need to stay on the cutting edge, or if your needs will increase in the future, you may want to look for a device like an HP Z Workstation that is designed for easy, tool-less upgrades.

The file drawer: Virtual memory

Virtual memory is called "virtual" because it uses a section of the hard drive like an extension of the RAM, even though the hard drive is much slower than actual RAM or cache memory. Think of virtual memory as the hanging file drawer of your desk. It can take a while to find things there, but there's lots of room for all your documents.

Hard drives, and by extension virtual memory, are an example of "non-volatile" memory, as the data stored there persists even when the device is turned off. Because of where it's stored, the performance of virtual memory depends entirely on the size and speed of the hard drive. Faster hard drives—like SSDs, or Z Turbo Drives with up to 4x the performance of SSDs—will likewise increase the effectiveness of virtual memory.

On Windows systems, you can also increase the amount of space on your hard drive allocated to virtual memory in Advanced System Settings. It's important to note, however, that because of its slowness, virtual memory does not improve system performance as much as actual RAM, and will also decrease the amount of storage available on your hard drive.

The bottom line

So how much memory do you actually need? The answer depends on the type of business applications you run, and your style of computing. As of 2015, the baseline for most budget systems is 4GB of RAM and a traditional hard drive for virtual memory. The next level up, 8GB of RAM and larger traditional hard drive, is worthwhile if you keep numerous applications open at the same time.

If you run intensive programs like video editing software or large database applications, you'll want to

look for at least 16GB of RAM and an SSD rather than traditional hard drive to help ensure smooth performance. Finally, with an add-in dedicated graphics card—dedicated to managing the graphics performance in a computer—you can get various types of inputs and outputs supporting multiple displays on your PC and improved performance.

Just as you don't have to be a professional mechanic to drive a car, you don't need to be a hardware expert to make informed decisions and get the performance you need in future purchases or upgrades. By keeping the desk analogy and tips above in mind, you'll be well on your way to understanding the memory and system that's right for you.