MOTHERBOARD BASICS

A recent Tech Tip covered the basics of selecting a computer caseand made mention of the various sizes that correspond to motherboards of different form factors. A few people wrote in expressing interest in understanding more about the basics of motherboards, and that's exactly what this Tech Tip intends to address.

A motherboard, also known as a main board, is the primary circuit board inside of a computer, and is where the central processing unit (CPU), memory, expansion slots, drives, and other peripheral devices are connected. The circuitry on a motherboard facilitates the communication between all of the devices in the computer, making them as critical to a system's performance as items such as the CPU or memory.

The core circuitry of a motherboard is referred to as its chipset, and generally the manufacturer of the motherboard is not the manufacturer of the chipset. Intel does produce motherboards with their own chipsets, but buying a motherboard brand such as Gigabyte, Biostar, and ASUS means getting a board with either a VIA, Nvidia, SIS, or Intel brand chipset.

1. Form Factor

The different basic shapes and sizes of motherboards are categorized as form factors. There are several standard form factors available, but some of the more common ones found in desktop computers include: (http://www.formfactors.org/developer/specs/atx2_2.pdf), ATX (http://www.formfactors.org/developer/specs/matxspe1.2.pdf), Micro ATX (mATX) (http://www.formfactors.org/developer/specs/FlexATXaddn1_0.pdf) FlexATX (http://www.via.com.tw/en/initiatives/spearhead/mini-itx/) and Mini-ITX

The basic sizes of each are as follows:

ATX: 12" x 9.6" (305mm x 244mm)

Micro ATX: 9.6" x 9.6" (244mm x 244mm)

FlexATX: 9.0" x 7.5" (229mm x 191mm)

Mini ITX: 6.7" x 6.7" (170mm x 170mm)

ATX and mATX are by far the most popular motherboard sizes for desktop computers, and as seen in the list above, are also some of the largest. More

real estate on a motherboard allows for greater expansion possibilities and extra features, which make the use of these boards more flexible. A Mini-ITX board may feature just one slot for memory and one slot for an expansion card, while a typical ATX board may feature 4 memory slots and six slots for expansion cards.

Each form factor has its own niche that it fits into, from workstations and gaming systems for larger boards to media centers and in-car computers for smaller boards. There is definitely overlap between the potential applications of each form factor, and other features and capabilities will also influence the targeted use.

2. CPU Socket

The major processor manufacturers, AMD and Intel, are constantly waging a battle to offer the fastest, most powerful processors available. Getting more speed and performance out of a relatively small chip generally requires a change to the physical dimensions as each new generation of processor is released. Therefore, motherboards need to evolve at the same pace in order to accept the new CPUs.
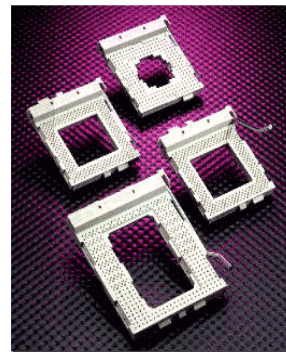
Back in the day, AMD and Intel processors shared a common CPU socket,

but those days were short lived. AMD and Intel have since been traveling down their own, relatively parallel, paths of performance and speed increases, while using different designs. Selecting a motherboard for a modern AMD processor eliminates the use of any Intel processor, and vice versa.

AMD's current offering for desktop processors includes the Athlon 64, which is available in Socket 939 and Socket 754 formats. The number in the names represents the number of pins present on the backside of the CPU that connect to the motherboard's socket. The Socket 939 Athlon 64 therefore has a staggering array of nine hundred and thirty nine tiny pins to match up with the motherboard's socket. The Chaintech VNF4 Ultra is an example of a Socket 939 motherboard based on Nvidia's NForce4 Ultra chipset technology. In addition to these two sockets, many AMD processors,

including Athlon XPs, Semprons, and Durons, share the Socket A format, also known as Socket 462 thanks to it having 462 pins for connecting to a motherboard.
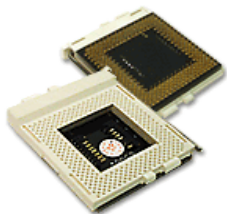
Intel's latest offering for their Pentium 4 and Celeron processors, LGA 775, doesn't have pins at all and basically swaps the pins to the motherboard for the socket. Perhaps this design move puts the burden of bent pin warranty

claims on someone else, but it is fairly unique. The Biostar P4M80-M7 is an example of an LGA 775 motherboard based on the VIA P4M800 chipset. Other Intel processors still on the market utilize the Socket 478 format for Pentium 4 and Celeron processors.

Although most motherboards support just one CPU socket, some applications benefit from having more than one processor to tackle the tasks at hand. Servers and high end workstations are two examples where a dual processor system, such as could be run on the Tyan Thunder i7500 motherboard, might make light work of more advanced applications.

3. Components

'Components' is a fairly vague term to describe this section, but the items to be covered are fairly diverse. Computer systems all use memory, storage devices, and power supplies, but among the many differences motherboards have is the type and quantity of connections for these components.

Most modern systems use DDR memory, butDDR-2 memory is becoming more common and will eventually become the standard. Although some boards provide slots for both types of memory, it is generally the case that either one or the other technology is supported. Besides operating differently, the physical difference of DDR having 184 pins and DDR-2

having 240 pins prevents them from being interchangeable. Going forward, users will have to decide whether they want to jump on the new technology bandwagon when selecting a motherboard, or to try to continue using their existing DDR for as long as possible. Regardless of technology, most motherboards come with 2 to 4 slots for memory, although as mentioned, Mini-ITX boards may just offer 1 slot.

Hard drive technology is changing too, as mentioned in the Tech Tip comparing SATA to ATA hard drives. Most motherboards over the past few years have offered two ATA connections, which could support up to 4 drives. With SATA becoming more popular, some boards now offer a mix of ATA and SATA connections, while others have abandoned ATA all together, and instead offer multiple SATA connections which only support one drive each. In addition to type and quantity, motherboards can also offer choices in hard drive capabilities by integrating RAID controllers onboard, as found on theASUS K8V SE Deluxe.
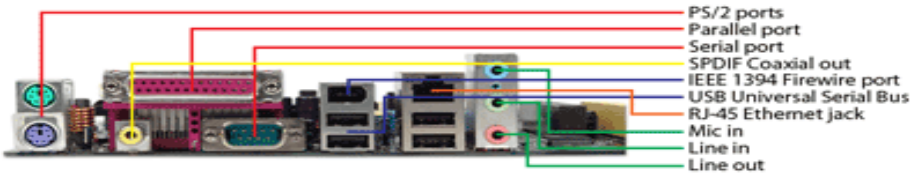
As systems become more advanced, they many times impose special power requirements to keep them running smoothly. Most motherboards feature the typical 20 pin ATX power connector, while some server boards may have a

24 pin connection in its place. Motherboards for AMD Athlon 64 and Pentium 4 processors will have a second power connection located in close proximity to the CPU socket for providing the extra power that today's high end processors demand. This special 4 pin connection isn't found on every AMD Socket A motherboard, but it will most definitely be located on an AMD Socket 939 motherboard. Power supplies have been including this special connection for years, but for those upgrading an old system with a new motherboard, the power supply may be just one more item that has to be upgraded as well.

4. Extra Features

Many motherboards now include features onboard that were once only available as expansion cards to be purchased separately. A typical motherboard will now include stereo sound capabilities, a 10/100 LAN connection, and a few USB 2.0 ports on the back panel connection. Depending on the budget and needs of the end user, many motherboards may also include other convenient features such as integrated Firewire ports, VGA connections, and onboard RAID controllers.

PS/2 ports
Parallel port
Serial port
SPDIF Coaxial out
IEEE 1394 Firewire port
USB Universal Serial Bus
RJ-45 Ethernet jack
Mic in
Line in
Line out

Although many of these items may be added later with expansion cards, if you know you want them upfront, a bit of installation hassle and expense can be eliminated by finding a board with just about everything you want included. That said, there aren't many choices of onboard components, so it's a case of take it or leave it. For example, you may want stereo sound included, but find most motherboards offer 5 channel, where you would prefer 8 channel. In that case, it may be a good thing that motherboards include expansion slots to add the sound card of your choice.
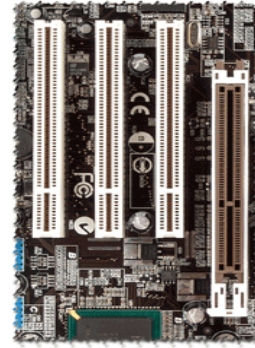
5. Expansion Slots

A motherboard typically provides at least one slot for the installation of a graphics card and a few slots for expanding the capabilities of the system in other areas.

Graphics cards are available in PCI, AGP, and now PCI Express formats, and matching a motherboard to the appropriate card is a key step. Most motherboards released over the past few years include an AGP slot, and the new wave of motherboards are now starting to feature PCI Express

slots for graphics card installation.

PCI slots are found on most motherboards, but are much slower than AGP and PCI Express slots, so they are not the optimal choice for graphics. ATX motherboards may typically feature four to five PCI slots, and although they could be used for secondary display graphics cards, more common applications include sound cards, network cards, RAID controllers, TV tuners, modems, and USB/Firewire controllers. Considering that many of these items are now included onboard, having multiple PCI slots isn't quite as important as it used to be.

6. Style

With enthusiasts adding windows and special lighting effects to just about every feature of a computer, why should the motherboard be left out of the action? Long gone are the days of the stereotypical green PCB with white connectors, and now most boards feature a vibrantly colored PCB and a rainbow of colors on expansion slots, memory slots, drive connectors, and so on.

For example, if someone was undecided on a mATX board for their Socket

754 AMD Athlon 64, style might be the deciding factor. TheChaintech MK8M800 and the Biostar K8VGA-M-N are similar boards featuring the VIA K8M800 chipset and prices under $70. The golden PCB with black and white features of the Chaintech board may appeal to some, while the red, white, blue, and yellow of the Biostar may sway others.

In general, a particular model is only available in one color scheme, and many manufacturers use the same theme across their entire current line up. As an example, the Biostar board for AMD Athlon 64 processors above features the same basic style as this Biostar board for the new Pentium LGA 775 processors. In addition to coloring, some manufacturers will include LED lighting on chipset cooling fans, or accessorize motherboards with matching cables to complete the unique looks of the board.

Some people may scoff at colors being included in the list of key features on motherboards, but there will be some that shop for style first, and then performance.