



On the Motherboard

Chapter 3



This presentation covers:

- > Benefits of Active Listening
- > Motherboard Parts
- > Processor Basics
- > Graphics Processing Unit (GPU)



Qualities of a Good Technician

“Soft skills” as they are known across many industries are essential



Active Listening Benefits

- > Gather data and symptoms quickly
- > Build customer rapport
- > Improved understanding of the issue
- > Mutual understanding between technician and customer
- > Means of positive communication between technician and customer
- > Focus on customer instead of technician
- > Customer may be more forthcoming with pertinent information

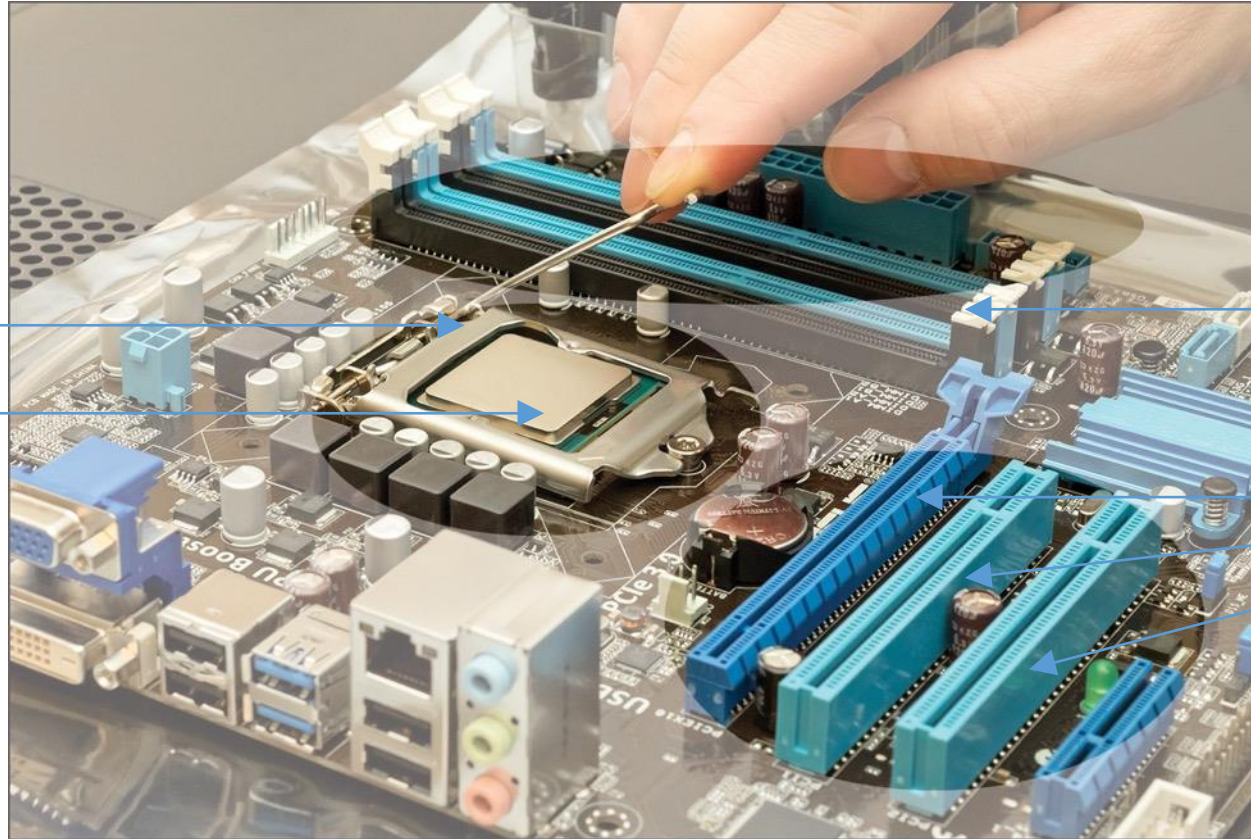
The Motherboard

CPU Socket

Processor

RAM Slots

Expansion Slots





Processor Basics

The number of bits processed at one time is the processor's register size (word size). Today's CPUs have register sizes of 64 or 128 bits.

The Processor

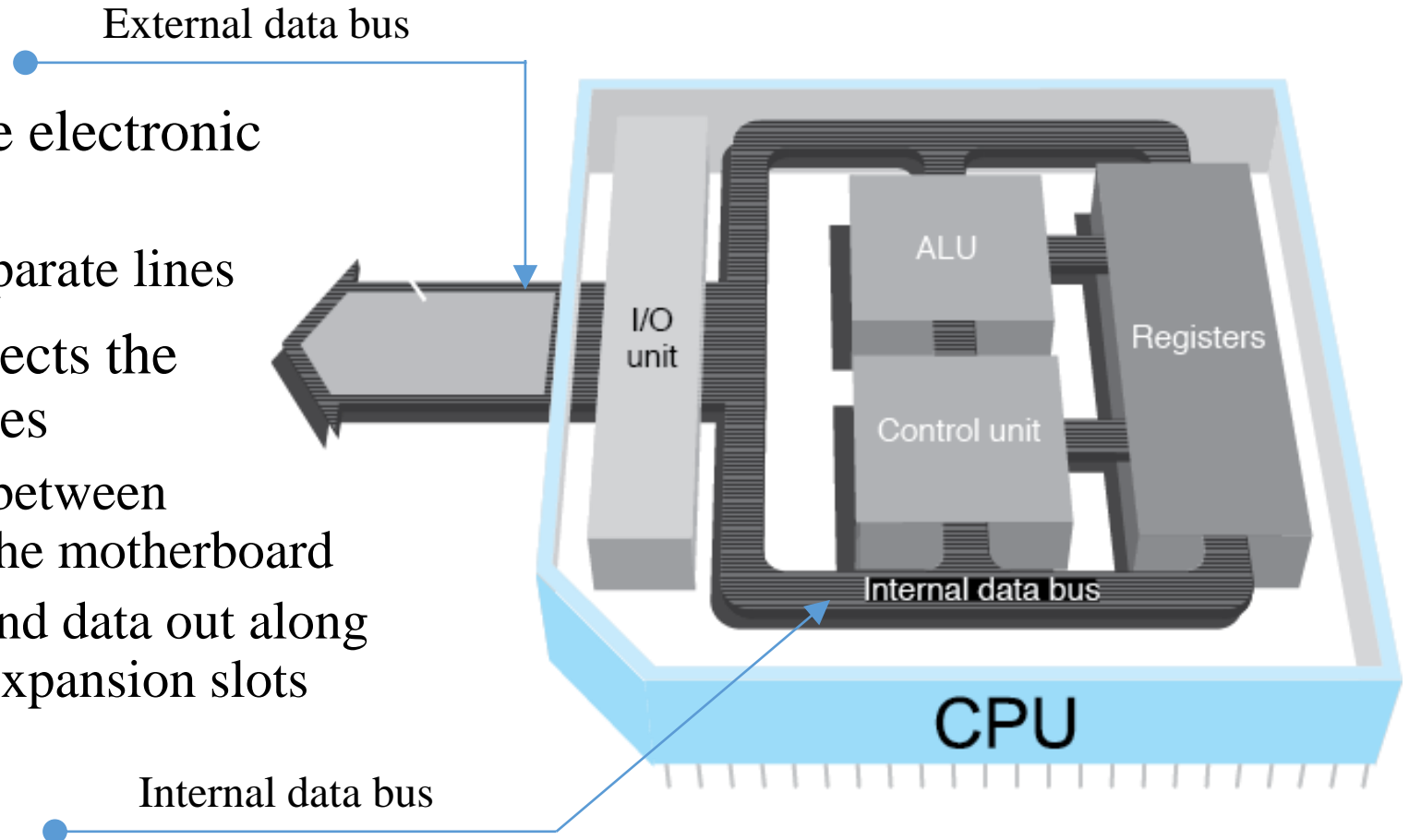
- > Have a variety of speeds
- > Are measure in gigahertz (GHz)
 - > Hertz is a measurement of cycles per second
 - > 1 Hertz = 1 cycle per second
 - > 1 GHz = 1 billion cycles per second
- > Today's processors run at speeds near 5GHz



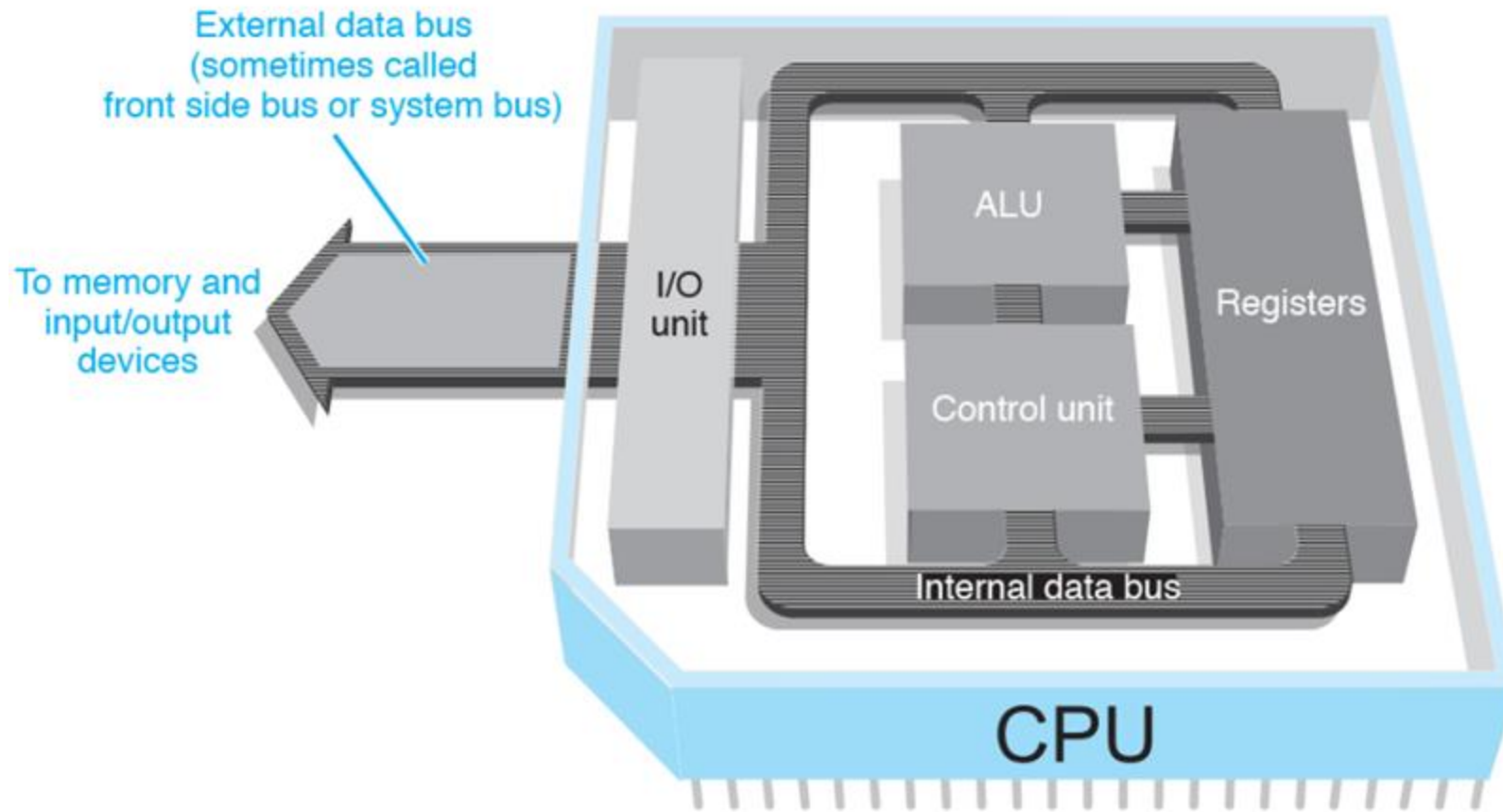
Intel Processor

Buses

- > An internal bus are the electronic lines inside the CPU
 - > Comprised of 16 separate lines
- > The external bus connects the CPU to external devices
 - > Lines are viewable between expansion slots on the motherboard
 - > Some are used to send data out along the external bus to expansion slots



CPU



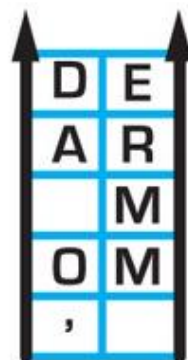
Processing Data

DEAR MOM,

The larger the bus (more lanes), the better the performance.



8088 CPU
(8-bit external bus)



80286 CPU
(16-bit external bus)



80386 CPU
(32-bit external bus)



Today
(64-bit external bus)

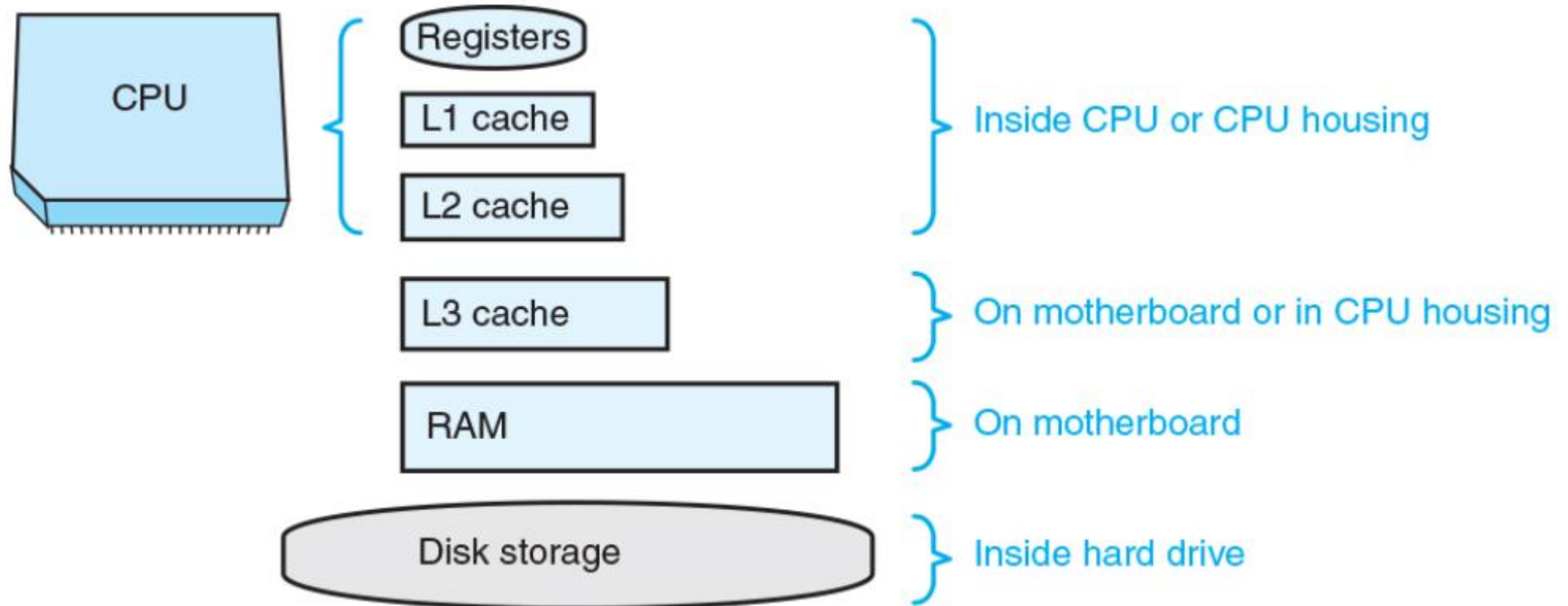
Pipelines

- > Processors have multiple pipelines, or separate internal buses that operate simultaneously
- > Process are broken down into smaller tasks and each line helps complete the entire process faster
- > A 32- or 64-bit CPU can have separate paths, each of which handles 32 or 64 bits

Speeding Up Processor Operations

- > Determining processor speed
 - > Look at model number on the chip
 - > Windows -> File Explorer -> right-click Computer/This PC and select Properties
- > Cache
 - > L1, L2, L3

Data Access Hierarchy





Speeding Up Processor Operations

- > Clocking
- > Threading
 - > Multithreading
 - > Hyperthreading Technology (HT)

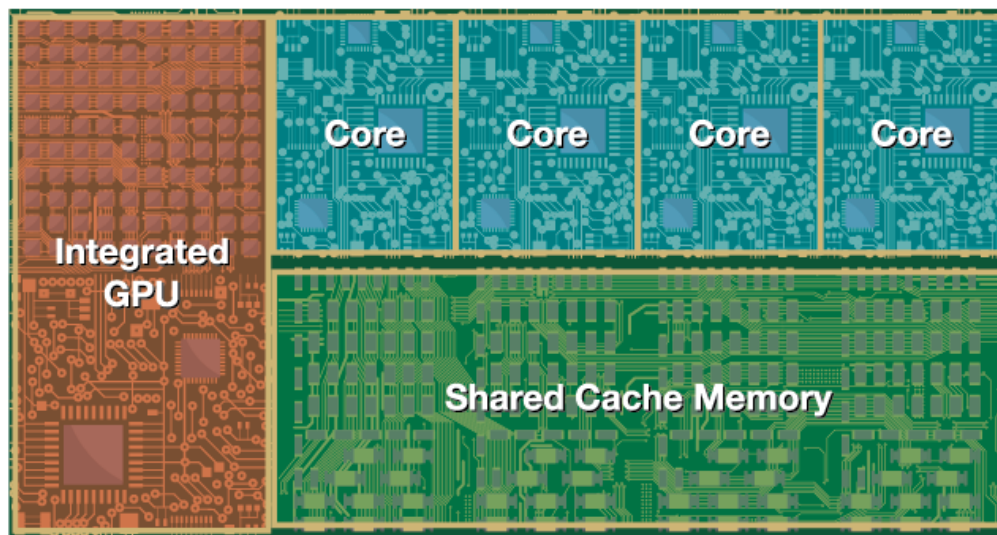
Multi-Core Processors

- > A **dual-core** processor combines two CPUs in a single unit
- > A **tri-core** processor has three processors in a single unit
- > Both Intel and AMD have **quad-core** CPU technologies
 - > Two dual-core CPUs installed on the same mother-board and two dual-core CPUs installed in a single socket – OR –
 - > Most recent models have all four cores installed in one unit
- > Hexa-core processors have six cores
- > Octa-core processors have eight cores

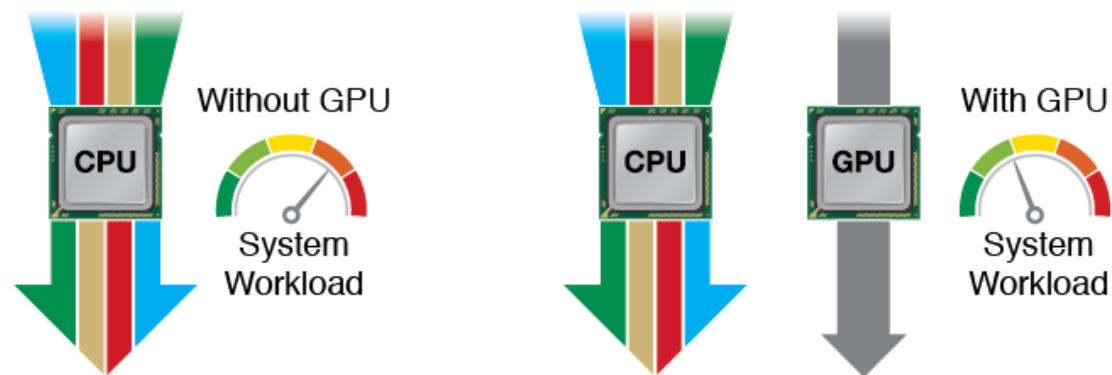
Graphics Processing Unit (GPU)

- > A GPU provides better video card performance with an adapter
- > Contain hundreds of smaller core processors
- > GPUs can also be used for other purposes that are not directly related to graphics that increase system performance
 - > These are general-purpose GPU (GPGPU)
- > A computer system can have multiple GPUs

Graphics Processing Unit (GPU)

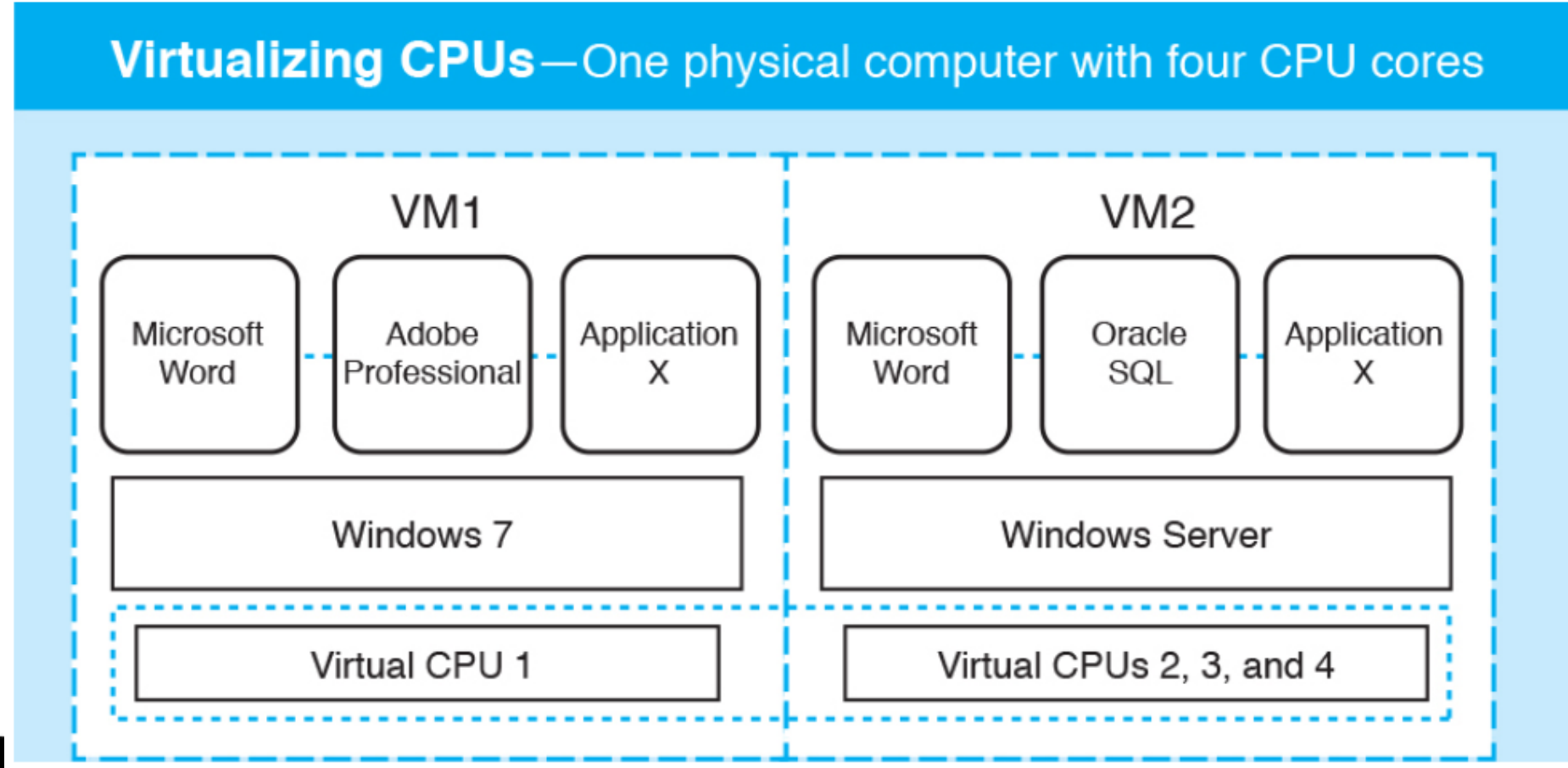


IGP within the same housing as the CPU cores



CPU vs. GPU

Virtualization



Intel Processors

Table 3.3 Intel processor families

Processor family*	Comments
Core X	18-core processor (at press time) for high performance, extreme gaming, intensive content creation, and megatasking.
Core i9	Powerful multicore processor for gaming and intensive content creation as well as megatasking.
Core i7	Multicore with cache memory shared between cores and on-board memory controller. Good for virtualization, graphic/multimedia design and creation, and gaming.
Core i5	Midrange dual- and quad-core processor. Used for video, photos, and email, and Internet access.
Core i3	Low-end desktop and mobile processor used for common tasks such as word processing and Internet access.
Core i7/i5 vPro	Workplace midrange and high performance with hardware-enhanced security.
Core m3	High-performance mobile devices with longer battery life and less heat than previous mobile CPUs.
Atom	Mobile Internet device processor.

*Intel is constantly upgrading processors. For more information, visit www.intel.com.

AMD Processors

Table 3.4 AMD processor families

Processor family	Comments
Ryzen Threadripper	8 to 16 cores and 20 to 40 MB cache for extremely high-end desktop processor
Ryzen 7	8 cores, 16 processing threads, 20 MB cache for gaming, high-end content creation, and multitasking
Ryzen 5	4 to 6 cores, up to 12 processing threads, and up to 20 MB cache for workplace or home computing use
Ryzen 3	4 cores and up to 10 MB cache for standard computing use
Ryzen PRO	A multicore processor that supports up to four monitors at resolution up to 4K, video conferencing, and business collaboration
FX	Multicore (4-, 6-, or 8-core) high-performance desktop processor
A-Series	Multicore (2-, 3-, or 4-core) high-performance processor with integrated GPU
A-Series PRO	Multicore (6-, 8-, 10-, or 12- core) high-performance desktop processor for advanced productivity and content creation

Processor Sockets

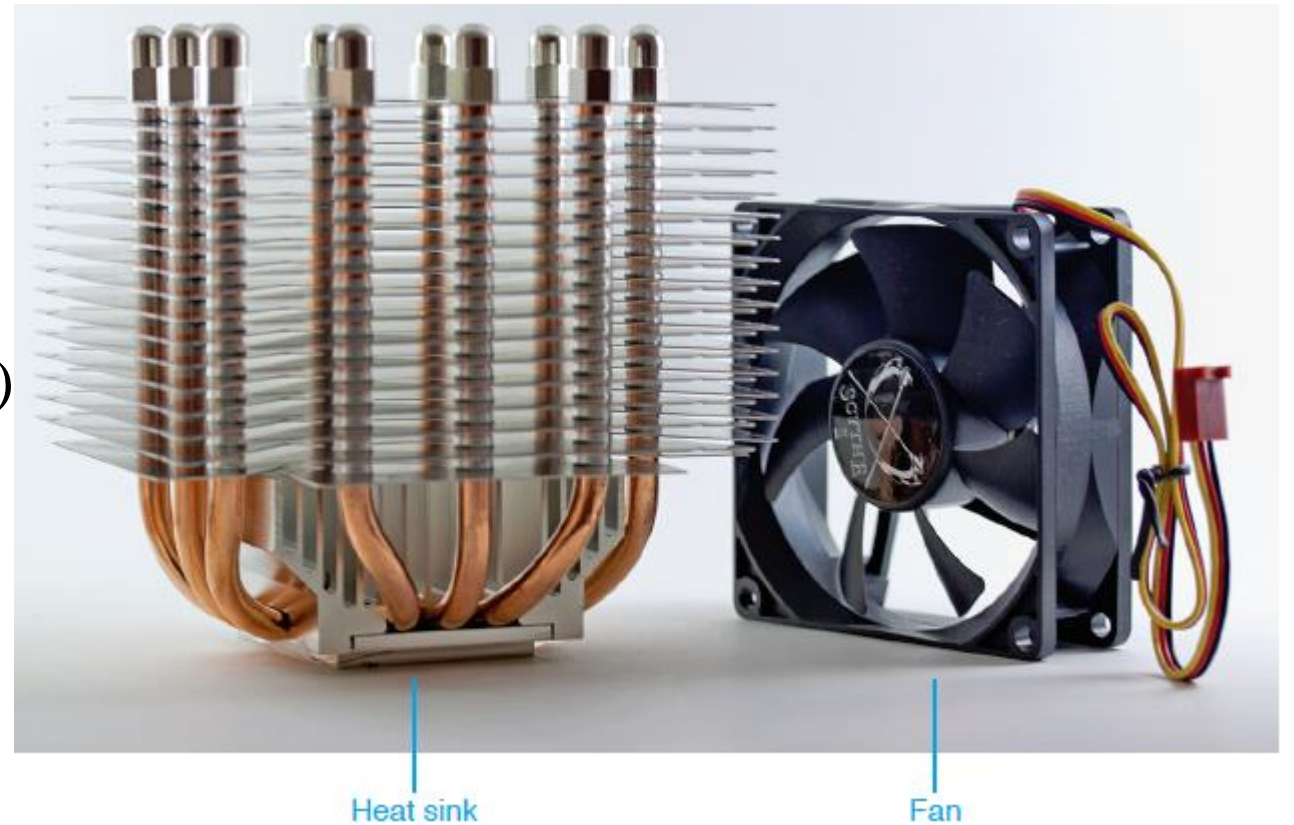
- > Motherboards have a specific CPU socket in which only certain processors will fit.

TABLE 3.5 Desktop CPU sockets

Socket	Description
LGA 775	775-pin for Intel Pentium 4s, Celerons, Core 2 Duo, Core 2 Extreme, and Core 2 Quads
LGA 1150	1150-pin for Intel Core Haswell, Broadwell
LGA 1155	1155-pin for Intel Core i7, i5, i3
LGA 1156	1156-pin for Intel Core i7, i5, i3
LGA 1366	1366-pin for Intel Core i7, Xeon, and Celeron
LGA 2011	2011-pin for Intel Core i7 and Xeon
AM3	940-pin for AMD Phenom II X3, X4, and Athlon II
AM3+	942-pin for AMD FX, Phenom II, Athlon II, Sempron
FM1	905-pin for AMD Athlon II, Llano
FM2	904-pin for AMD APU's, Trinity
FM2+	906-pin for AMD APU's, Kaveri, Godavari, and A8/A10 series

Processor Cooling

- > Heat sink
- > Fan
- > Liquid cooling
- > Passive cooling (just a heat sink)



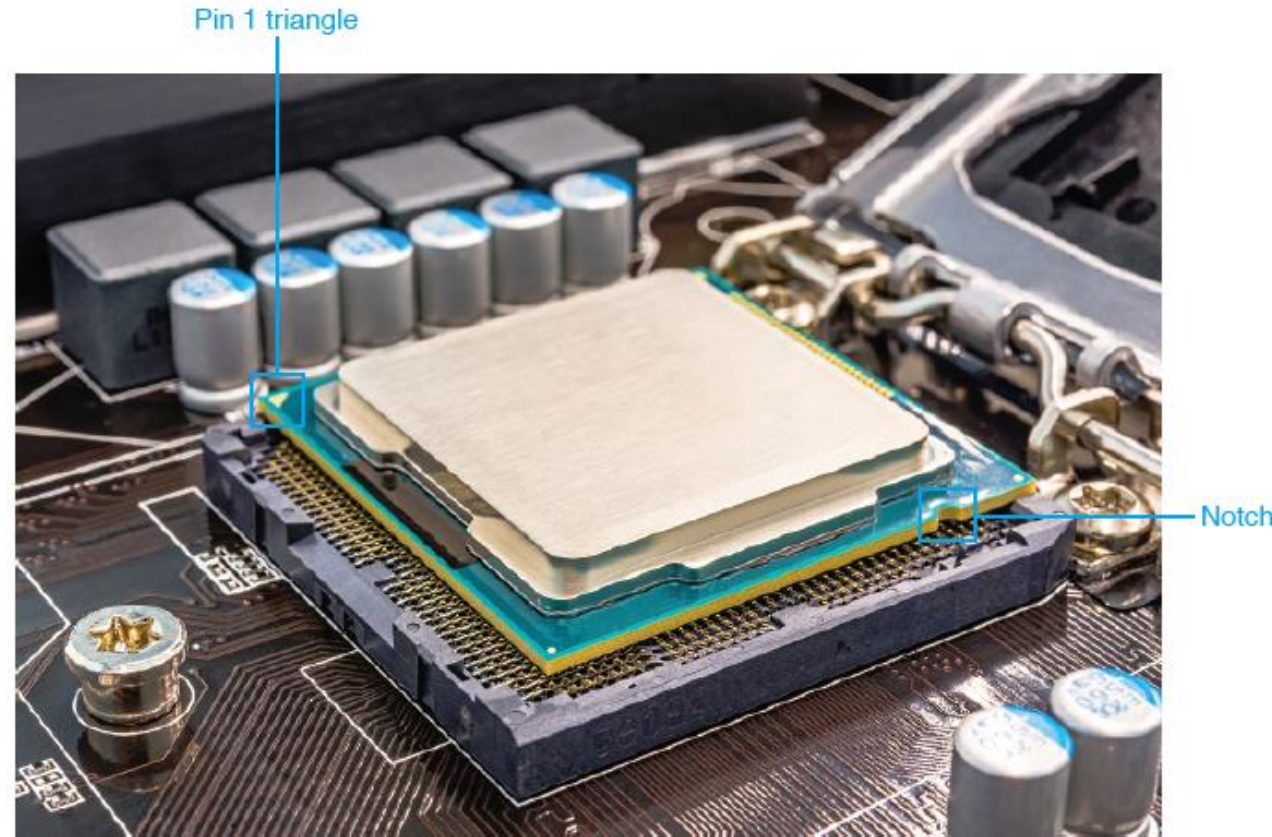
Processor Cooling

Table 3.6 Processor cooling methods

Method	Description
Heat sink	A heat sink is a block of metal (usually aluminum or copper), metal bars, or metal fins that attach to the top of the processor or other motherboard components. Heat from the processor is transferred to the heat sink and then blown away by the air flow throughout the computer case.
Fan	Fans can be attached to the processor, beside the processor, and in the case.
Thermal paste or thermal pad	Thermal paste, compound, or grease can be applied to the top of a processor before a heat sink is attached. Some heat sinks and fans have thermal paste pre-applied. A thermal pad provides uniform heat dispersion and lies between the processor and the heat sink.
Liquid cooling	Liquid is circulated through the system, including through a heat sink that is mounted on the CPU. Heat from the processor is transferred to the cooler liquid. The now-hot liquid is transported to the back of the system, converted to heat, and released outside the case. CPU temperature remains constant, no matter the usage. Some systems require the liquid to be periodically refilled.
Phase-change cooling (vapor cooling)	This expensive option uses a technique similar to a refrigerator: A gas is converted to a liquid that is converted back to gas.
Heat pipe	A heat pipe is a metal tube used to transfer heat away from an electronic component.
Passive cooling	Passive cooling involves no fans, so a heat sink that does not have a fan attached is known as a passive heat sink.

Processor Installation

1. Power off the computer and remove power cord.
2. Use proper anti-static handling procedures.
3. Release the CPU retention plate.
4. Insert the CPU into the socket and remember that it only inserts one way.



Processor Troubleshooting

Use your senses
when troubleshooting
processor problems.



- Nothing on the screen (and the power supply and monitor work)
- System powers on, but turns off quickly
- BSOD (blue screen of death)
- An error code that the documentation shows as a CPU problem

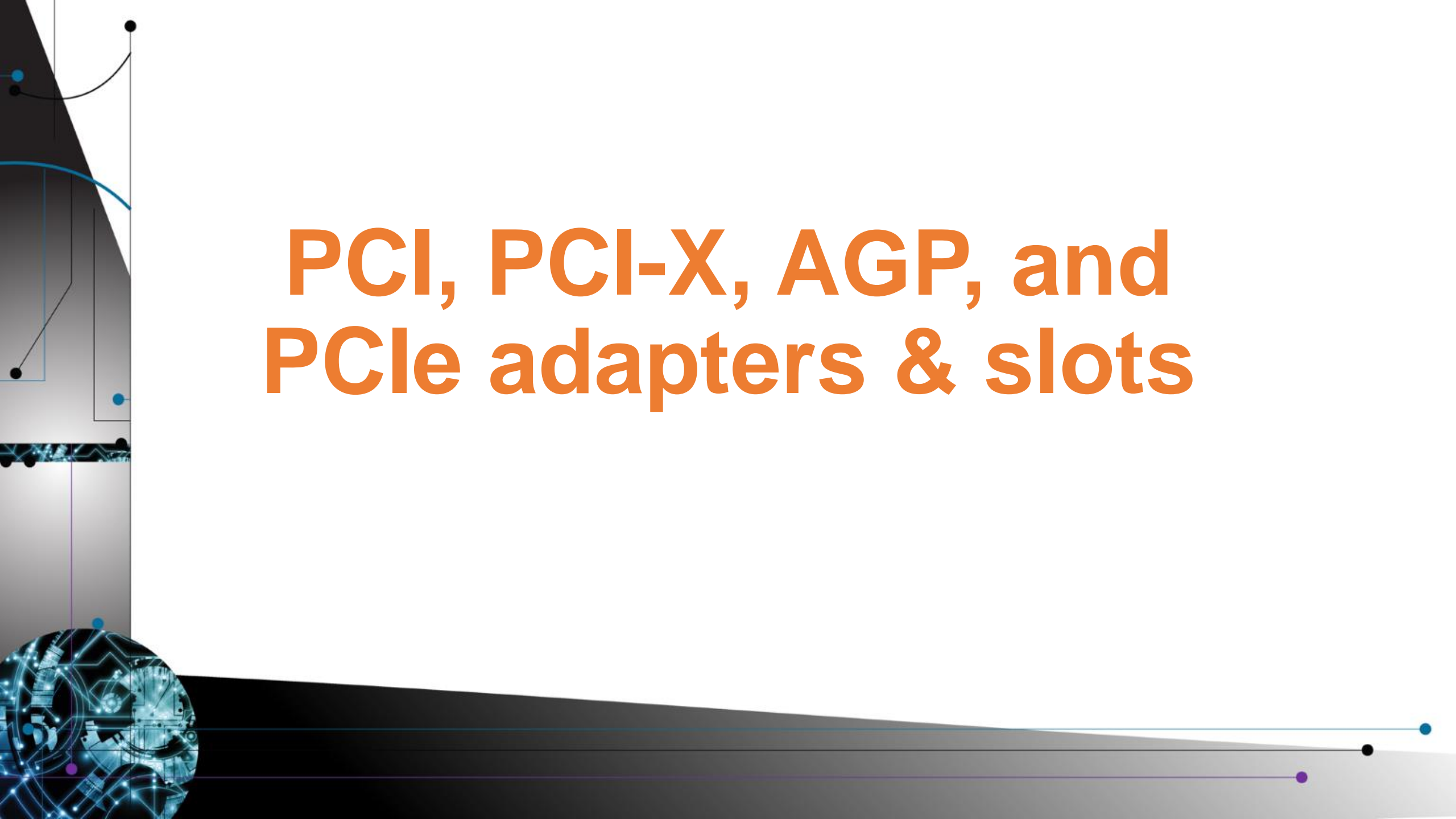


- Hear the fan(s) going frantically, but the system won't boot or boots and then shuts off
- System powers on briefly, but then shuts off
- A series of beeps that the manual shows as a CPU problem



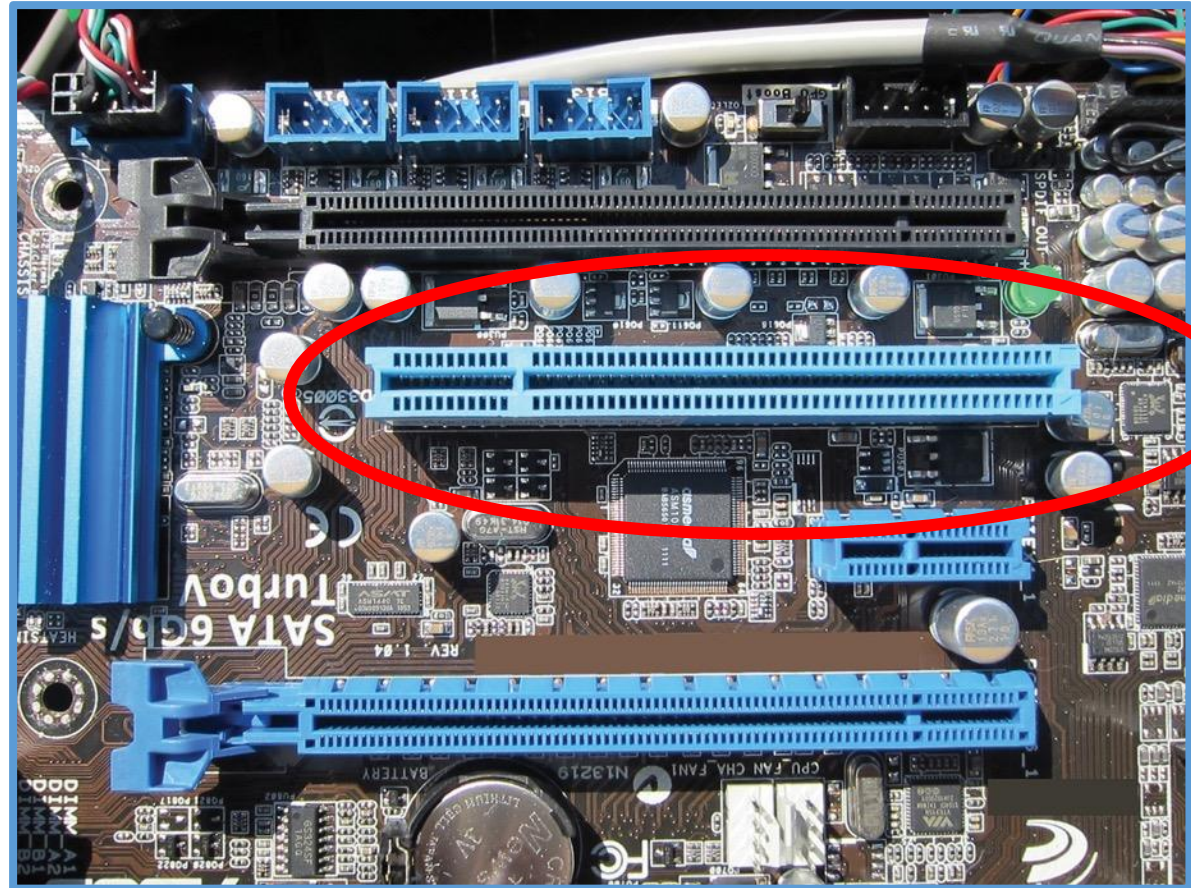
- Smell something burning (fan might be out, causing the CPU to shut down)

PCI, PCI-X, AGP, and PCIe adapters & slots



Peripheral Component Interconnect (PCI)

- > Four varieties
 - > 32-bit 33MHz
 - > 32-bit 66MHz
 - > 64-bit 33MHz
 - > 64-bit 66MHz



Most common PCI expansion slot

Accelerated Graphics Port (AGP)

AGP Expansion Slot

- > Bus interface for graphics adapters developed from the PCI bus
- > AGP speeds up 3-D graphics, 3-D acceleration, and full-motion playback
- > Video subsystem is isolated from the rest of the computer



AGP (Accelerated Graphics Port)

PCIe

- > PCIe (Peripheral Component Interconnect Express)
- > PCI, PCI-X, and AGP have been replaced with PCIe (PCI Express) or PCI-E
- > PCIe outperforms all other types of PCI expansion slots
- > PCIe sends data full-duplex bidirectionally (sends and receives at the same time)
- > PCIe slots are shown with the number of lanes that can be used simultaneously (x1, x2, x4, x8, x16 or x32)

Bus Bandwidth (PCI, AGP, PCIe)

Table 3.8 Comparing bus bandwidth

Bus	Maximum bandwidth
PCI	133 or 266 MB/s (depending on bus speed)
AGP 2x	533 MB/s
PCIe x1	250 MB/s (in each direction)
PCIe x2	500 MB/s (in each direction)
PCIe x4	1000 MB/s (in each direction)
PCIe x8	2000 MB/s (in each direction)
PCIe x16	4000 MB/s (in each direction)
PCIe x32	8000 MB/s (in each direction)

PCIe Slots

- > A PCIe x1 adapter can fit in an x1 or higher slot
- > A PCIe x8 adapter can fit in an x8 or higher slot
- > Just because the slot is an x16 slot, it does not mean that all 16 lanes are used—refer to the documentation













PCIe Versions

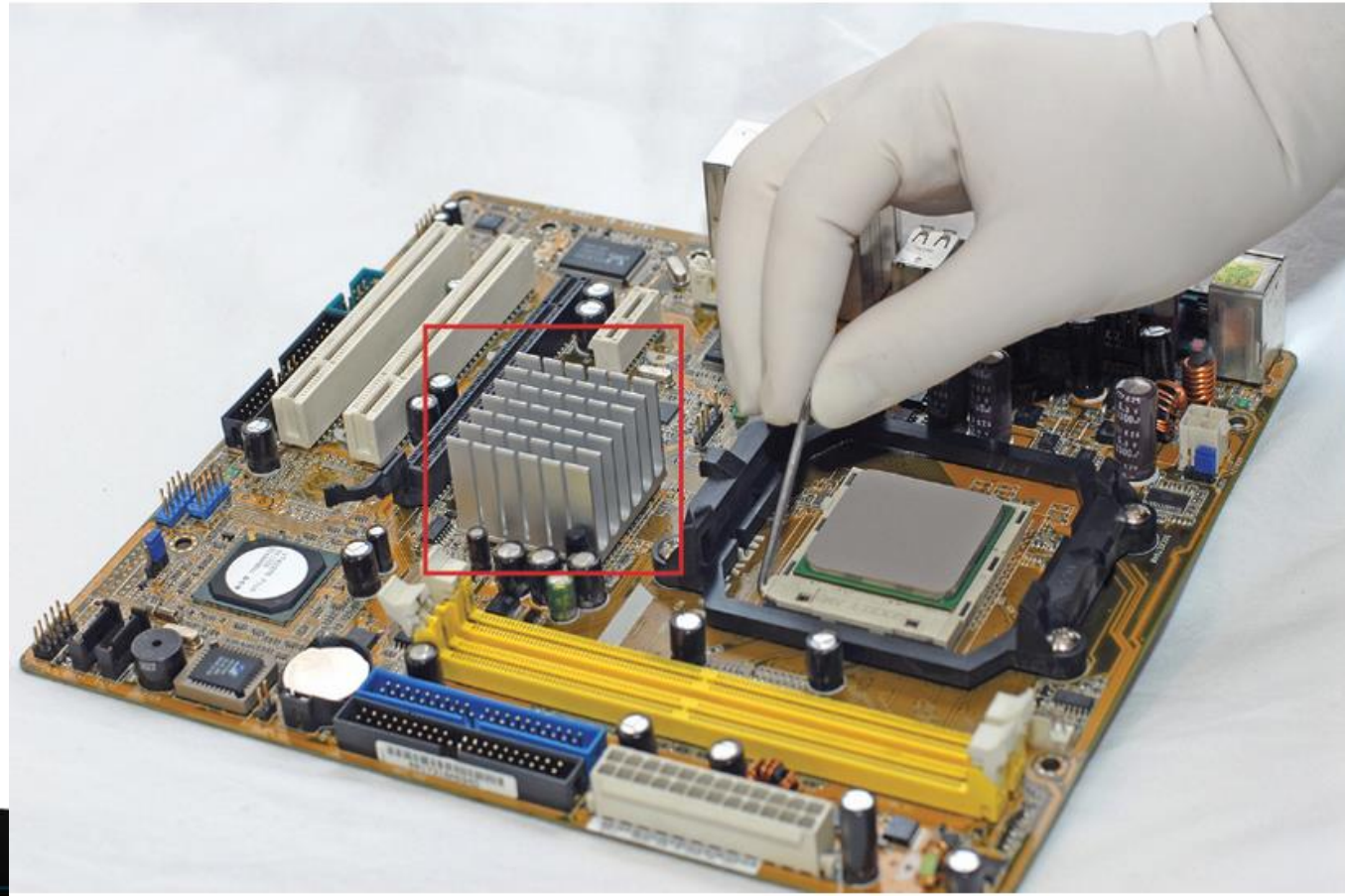
Table 3.7 PCIe versions

PCIe version	Speed (per lane per direction)
1.0	2.5 GT/s (gigatransfers per second) or 250 MB/s
2.0	5 GT/s or 500 MB/s
3.0	8 GT/s or 1 GB/s
4.0	16 GT/s or 2 GB/s
5.0	32 GT/s or 4 GB/s

PCIe Versions

PCIe Adapter Installation	x1	x2	x4	x8	x16
	●	●	●	●	●
		●	●	●	●
			●	●	●
				●	●
					●
					

Chipsets



Types of Motherboards

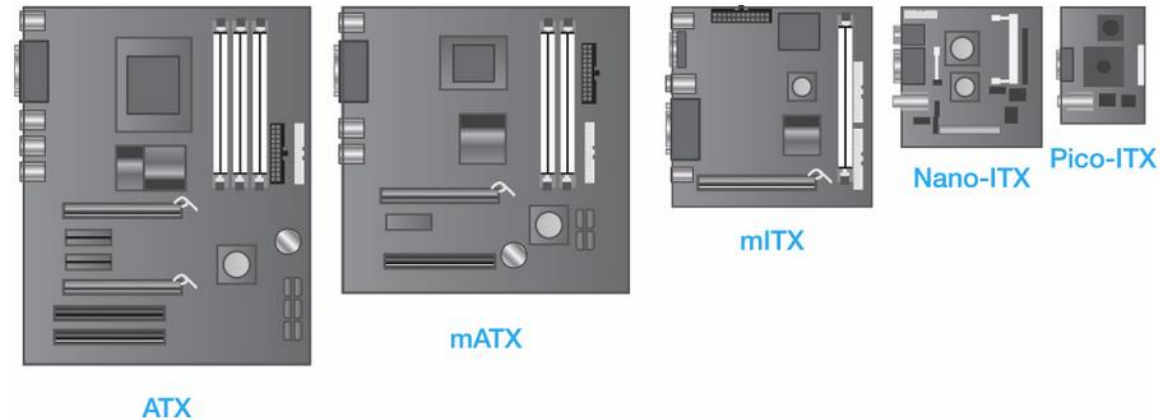


Table 3.9 Motherboard form factor comparison

Form factor	Description	Size
ATX	Used in desktop computers	12×9.6 inches (30.5×24.4cm)
mATX	MicroATX—a smaller desktop motherboard	9.6×9.6 inches (24.4×24.4cm)
ITX or mITX	Used in very small computers and set-top boxes	6.7×6.7 inches (17×17cm)
Nano-ITX	Used in entertainment devices/computers	4.7×4.7 inches (11.94×11.94cm)
Pico-ITX	Used in very small devices	3.9×2.8 inches (3.9×7.1cm)



Computer Terms

Refer to the glossary terms at the end of the textbook chapter. Review Chapter 3 and become familiar with the terms.

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