Computer Hardware Basics

Computers, Servers, and Networking

Sno Isle Skills Center

Hardware and Software work together

- Hardware is used to:
  - Input data
  - Process data
  - Output data
  - Store data
- Software is used to:
  - Control the hardware
  - Communicate to the user
  - Manage the hardware*

What does a computer "need" to work?

- A method for the processor (CPU) to communicate with the device.
  - The combination of the protocol, the pathway, and the instructions is called a BUS.
- Software to instruct and control the device.
  - We interact with the hardware through software
- Electricity to power the device.
  - No juice, no game

There are only 10 types of people in the world:
Those who understand binary and those who don't.

Binary

- At the machine level, hardware and software “talk” to each other in binary.
- Binary is a base 2 system of number and consists only of the characters 0 and 1.
- Binary is based on “on” and “off” states
- On=1
- Off=0
- Charged above 50%=1
- Charged below 50%=0

What is a computer?

- A computer is a collection of hardware that is supported by software.
- Hardware-Physical components that you can see, feel, touch, and throw at your brother.
- Software-A set of instructions that make the hardware "do stuff"
- Firmware—Software that is semi-permanent and lives on a chip inside the computer.*

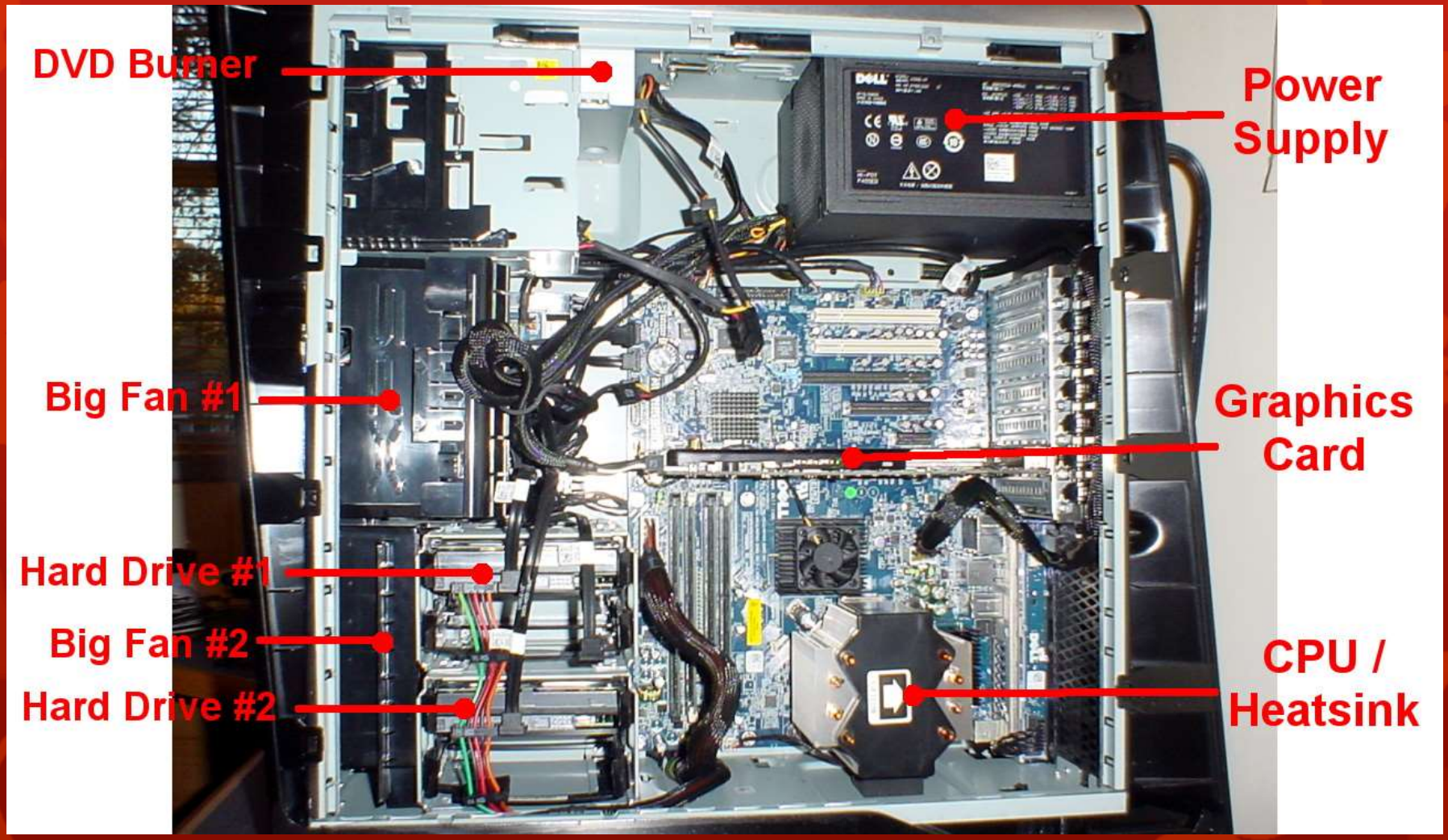
Major Hardware Components

- CPU
- Motherboard
- Chipset
- Expansion cards
  - Network
  - Video
  - Joystick
  - Etc.
- Hard Drive
  - SSDD
  - HDD
    - SATA
    - PATA
    - SCSI
    - SSD
- Power Supply
- Monitor
- Input devices
  - Mouse
  - Keyboard
  - Stylus
  - Finger
  - Voice
  - Eyes
  - Breath
- Optical Drive
  - CD/DVD
  - Bluray
- RAM
- Cables*

Hardware Inside Computer

- System board
- Floppy (maybe), hard drive, CD/DVD ROM
- Power Supply
- Circuit Boards (expansion cards)
- Cables*

Computer Guts



System Board

- Aka Mainboard, motherboard
- Contains
  - CPU
  - Chip set
  - RAM
  - CMOS and CMOS Battery
  - BIOS chip
  - Connections
  - Expansion slots*

System Board Components

- Traces—the tiny fine lines you see on the motherboard. Enable data and power to travel along the board.
- BUS—Pathway of communication that includes the method and the protocol used to communicate.
- Binary 1s and 0s travel down the lines of a bus.*

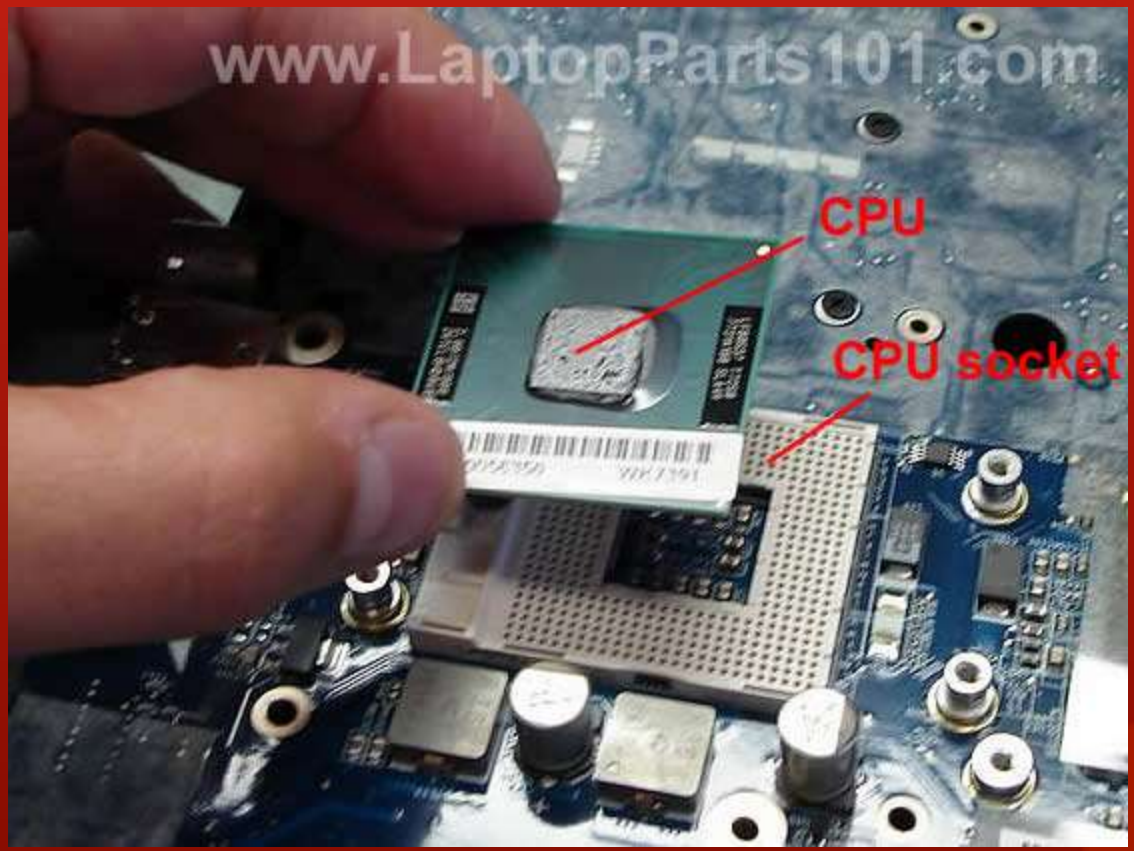
System Board Comp. Cont

- System Clock—A crystal that times activities of chips. Makes sure things happen at the right time.
- Expansion slots—Holds expansion cards such as modems, video cards, etc.

CPU

- Microprocessor—chip inside of computer that executes most commands
- Often works with a chip set
  - Microchips that do some of the low-level processing to free up CPU for high level
  - Also act as go betweens to allow hardware to get access to processing power.
- Some older machines also have a coprocessor (or slot for one) to speed up certain math functions.*

CPU



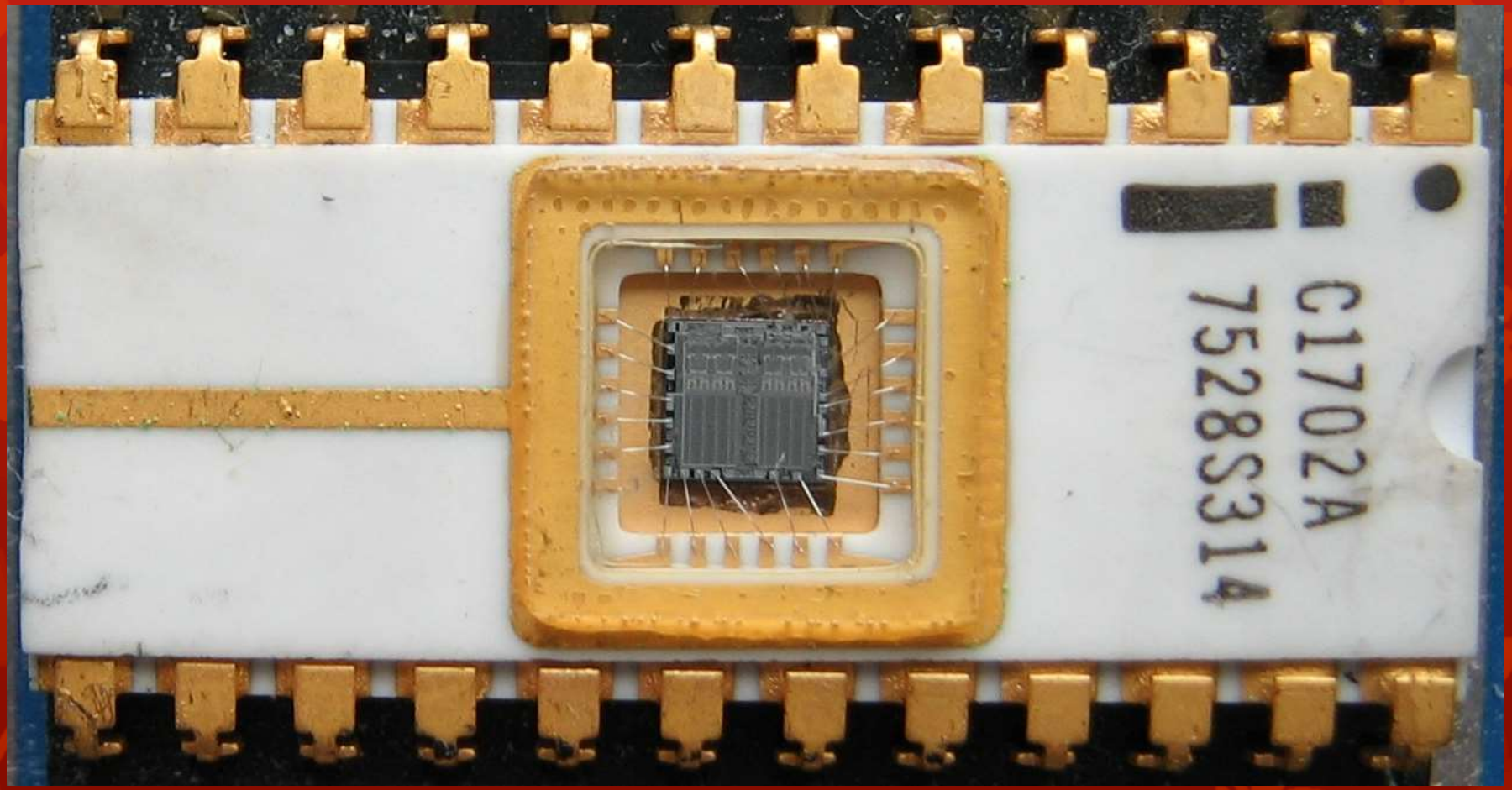
Data Stored on System Board

- Important software is stored permanently on the motherboard
  - ROM Chips
  - Setting physical DIP switches
- Firmware tells the computer how to start up before the OS starts.
- One type of ROM is the BIOS chip. Has programming necessary to start the computer.*

Updating Firmware

- Flashing the BIOS
- Can only flash FLASH ROM
  - EEPROM (Electronically Erasable Programmable Read Only Memory)
  - EPROM (Erasable Programmable Read Only Memory)
- Must use ONLY a flash program for your particular BIOS version or bad things happen.

Flashing in the Olden Days



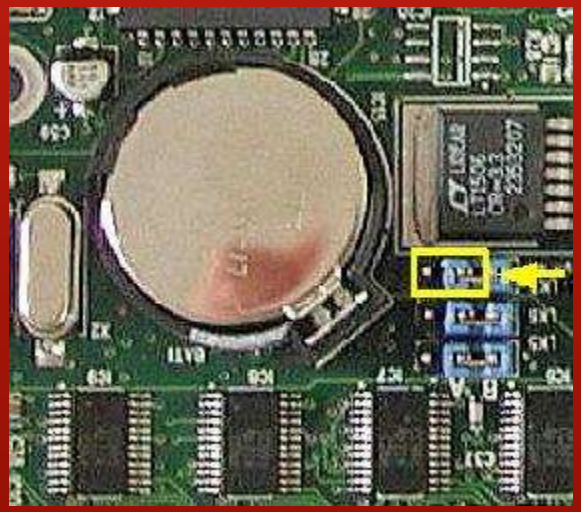
CMOS (complementary metal oxide semi-conductor)

- Is a CMOS volatile or non-volatile?
- Volatile—it requires a battery to keep the data in the chip.
- Holds configuration setup information.
- Other information is stored by physically setting jumpers or DIP switches on the board.*

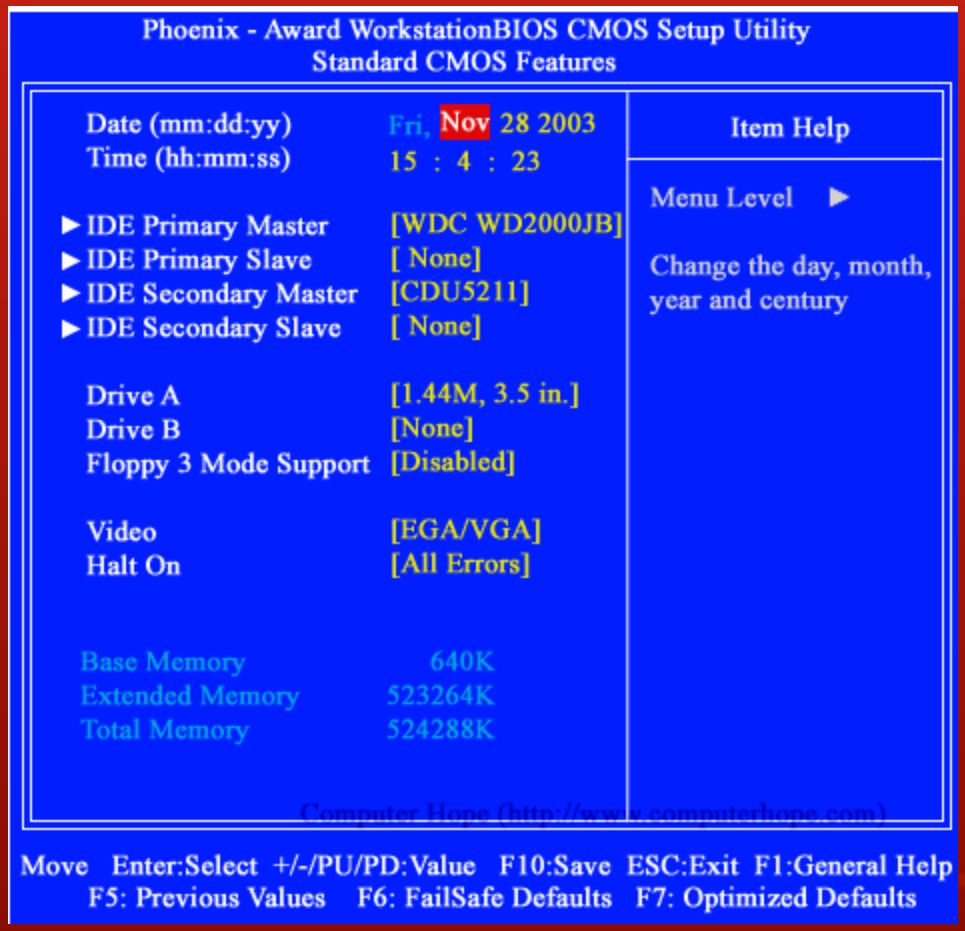
Software

- Three types of software
  - Firmware (BIOS)
  - Operating System
  - Applications
- Now we could also add VMWare—virtual pc software that you can use to emulate other operating systems on.*

CMOS battery and jumper



BIOS settings are stored in CMOS



BIOS

- Basic Input Output System
- Starts up the computer and controls some of the hardware
- By controlling some HW it frees up the OS to control other stuff.

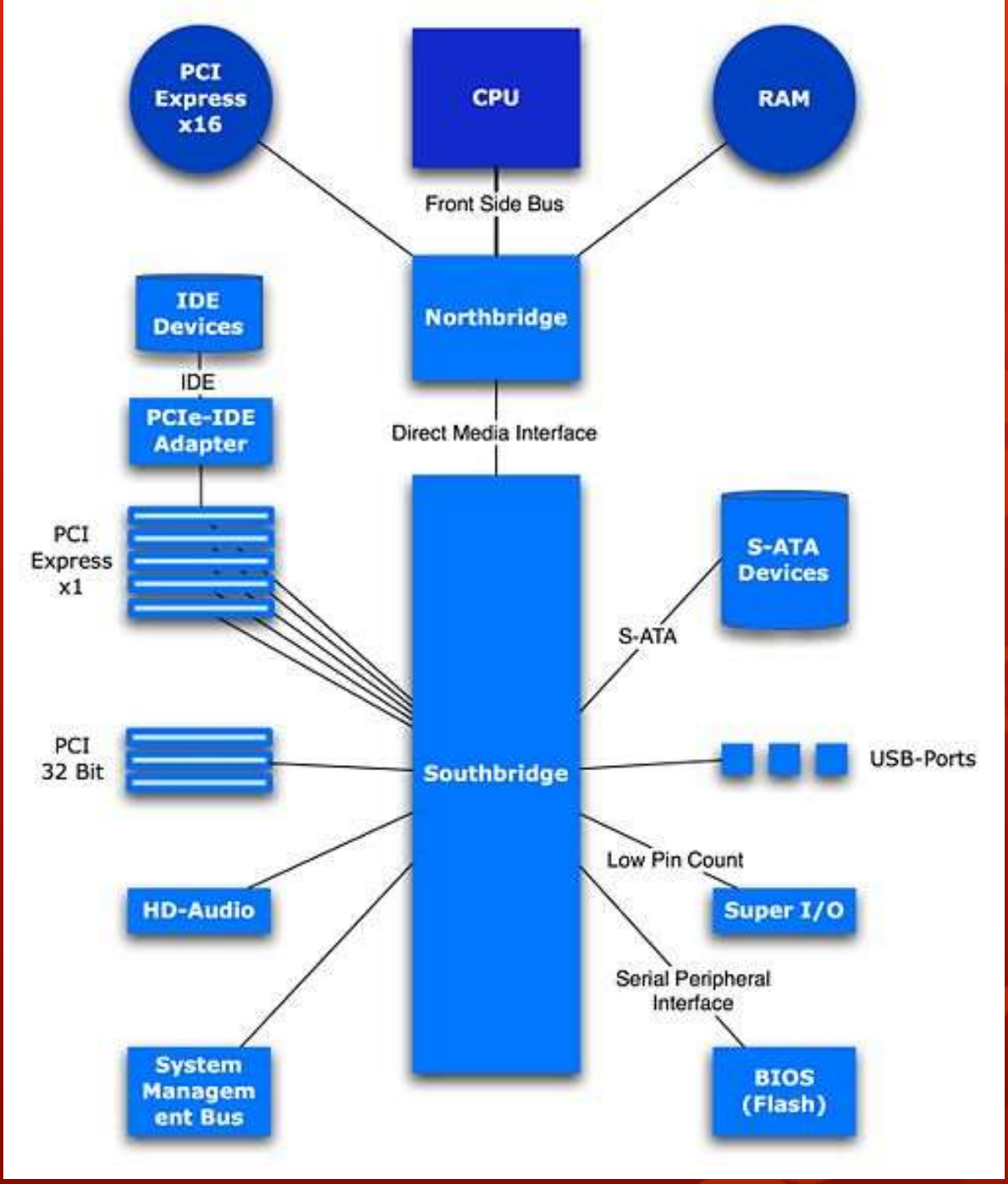
The CPU

- Stores data in storage devices
- Performs calculations
- Processes data
- Outputs results

CPU and Chipset

- The “brains” of the computer
- The CPU is the Central Processing Unit
- Most major processing takes place on the CPU
- The Chipset is a group of microchips on the motherboard that is responsible for co-processing, including
  - Timing
  - Coordination
  - Communication between CPU and other hardware
- Your CPU comes separate of your motherboard, but your chipset is soldered on.
- You CPU must be able to work with a board’s chipset.

CPU & Chipset


PCI Express x16
CPU
RAM
Front Side Bus
IDE Devices
Northbridge
IDE
PCIe-IDE Adapter
Direct Media Interface
PCI Express x1
S-ATA Devices
S-ATA
PCI 32 Bit
Southbridge
USB-Ports
Low Pin Count
HD-Audio
Super I/O
Serial Peripheral Interface
System Management Bus
BIOS (Flash)

Chipset

- Northbridge and southbridge are the chipset on the motherboard
- Northbridge
  - Intel aka memory controller
  - Handles communication between CPU and
    - RAM
    - AGP
    - PCI Express 16x
    - Southbridge

Southbridge

- Southbridge
  - Aka Input/output controller hub (ICH) or Fusion Controller Hub (FCH) in AMD
  - Handles all I/O functions such as
- The functionality found in a contemporary southbridge includes:
  - **PCI bus**. The PCI bus support includes the traditional PCI specification, but may also include support for PCI-X and PCI Express.
  - **ISA bus** (legacy)
  - **SPI bus**. The SPI bus is a simple serial bus mostly used for firmware (e.g., BIOS) flash storage access.
  - **SMBus**. The SMBus is used to communicate with other devices on the motherboard (e.g., system temperature sensors, fan controllers).

Southbridge cont

- **DMA controller-**--The DMA controller allows devices direct access to main memory without needing help from the CPU.
- **Interrupt controllers**--The interrupt controller provides a mechanism for attached devices to get attention from the CPU.
- **Mass storage controllers** such as PATA and/or SATA
- **Real-time clock**. The real time clock provides a persistent time account.
- **Power management** (APM and ACPI). The APM or ACPI functions provide methods and signaling to allow the computer to sleep or shut down to save power.
- **Nonvolatile BIOS memory**. The system CMOS, assisted by battery supplemental power, creates a limited non-volatile storage area for system configuration data.
- **AC'97** or Intel High Definition Audio sound interface.

Review

- All data and commands travel through the CPU.
- What are the four major operations of the CPU?
- This is also known as the mainboard.
- Hard drives are considered:
- RAM is considered:

CPU Comparisons

	AMD	Intel
Power consumption	Less efficient	More efficient (one of Intel's strengths)
Price range (2012)	Lower	Higher
Cooling factor	Tend to heat up under heavy use, but supposed to be improved with Bulldozer Gen2 CPUs	Tends to run cooler, longer
Performance speed	Generally considered faster under same use due to shorter "pipeline". Same throughput for lower rating.	Really edging forward with Ivy Bridge processors
Gaming and multimedia	Clocking is faster, so multimedia output is faster	Ivy Bridge is supposed to be faster.
Price to Performance ratio	Low:High	High:High

How it all works together

- You double click a program icon
- The program (instruction set) is transferred from the hard disk to RAM
- The CPU loads the program from RAM
- The data is processed
- Depending on the program this keeps happening over and over again while you're using it.*

Review

- What are the three components of the full computer system?
- How does software differ from firmware?
- What five functions does the computer perform using a combination of hardware and software?
- What is a CPU?

Input/Output Hardware

- Input
  - Keyboard
  - Mouse
  - Scanner
  - Bar code reader
  - Bluetooth Device
  - Wacom Tablet
  - Finger
  - Eyeball
  - Voice
  - Breath
  - Brainwaves
- Output
  - Printer
  - Monitor
  - Audio

Input/Output devices generally connect to the printer through ports usually found on the back of the case.

Types of Storage

- Primary
  - Temporary
  - Volatile (grrrrr)
- Secondary
  - Semi-permanent
  - Non-volatile (zen)

Temporary (Primary) Storage

- Storage that is volatile.
- Faster than permanent storage (hard drives, floppies)
- Includes
  - RAM
    - SIMMs (older, single inline memory modules)
    - DIMMs (dual inline memory modules
    - RIMMs (rambus inline memory modules)
  - Cache memory
  - COAST (cache on a stick)*

Permanent (secondary) Storage

- Permanent (non-volatile) storage
- Hard drive
- Floppy drive (legacy)
- Pen drives (aka jump drives) (1GB-128GB)
- CDR/CDRW
- DVD/BluRay*

Storage Devices

- Hard Drive
  - Regular
  - Solid State
- Floppy Drive
- Optical Drive
  - CD
  - DVD
  - Blu-Ray
- Flash Drive
- SD Cards

Power Supply

- Electrical system—Power supply connects to the mother board. Components use the power from the PSU*

External Ports

- PS/2
  - Mouse (old)
  - Keyboard (old)
- USB
- Parallel
  - Printer (old)
- Video
  - VGA
  - DVI
  - HDMI
- Sound
- E-SATA
- Serial
- Firewire
- Network
  - RJ45
- Modem
  - RJ11
- Thunderbolt

What is this?

- Serial Port

What is this?

- Parallel Port

What is this?

- Joystick Port

What is this?

- VGA

What is this?

- DVI

What is this?

- PS/2
- Keyboard or mouse?

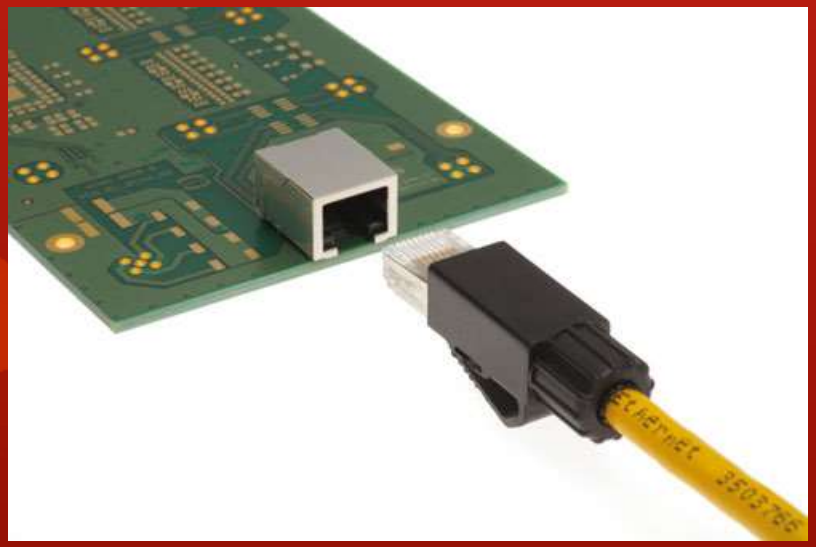
What is this?

- Audio
  - Red
  - Blue
  - Green

What is this?

- RJ11
  - AKA:
  - How many wires:

What is this?



- RJ45
  - AKA:
  - How many wires:

this?

- USB A

W this?

- IEEE/1394
- AKA

What is this?

- Thunderbolt port