CompTIA A+ Core Hardware

Service Technician

Version 3.0.0

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CompTIA A+ Core Hardware Service Technician

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Abstract:

This study guide will help you to prepare for the CompTia Exam 220-201, A+ Core Hardware Service Technician. Exam topics include PC Installation, Configuration and Upgrading, Diagnosing and Troubleshooting, Preventative Maintenance, Motherboards, Processors, and Memory, Printers, and Basic Networking.

Find even more help here:

Contents:

PC Installation, Configuration and Upgrading

Key functions of a PC (Personal Computer):

- Input
- Processing

Output

- Storage

System Components

System case

- Desktop or tower
- Designs: AT or ATX
- Cover, front panel, rear panel

Motherboard

- (aka Planar board, system board)
- Expansion slots (PCI, ISA, AGP)
- ROM BIOS Chip
- CMOS Battery
- ATX power connector
- I/O ports (parallel and serial)
- PS/2 mouse and keyboard ports.
- Memory slots (SIMMs, DIMMs)
- CPU slot, socket
- EIDE connectors

See also section on Motherboards

CPU

- Central Processing Unit (aka processor)
- PGA (Pin Grid Array, socket) or SEC (Single-Edge Cartridge, slot)

See also section on Processors

Memory

- ROM (Read-Only Memory)
- RAM (Random Access Memory)

- System RAM
- Cache RAM
- ROM BIOS
- CMOS RAM

See also section on Memory

System Clock

- Synchronizes all parts and operations of the PC (IRQ 0)

Speaker

- Part of the system board
- Indicates hardware errors

PSU

- Converts AC (wall) to DC (inside case)
- DC +/- 5 V and +/- 12 V
- Typically, 220-230 W
- AT motherboard to power supply connectors: P8 and P9 (black wires together)
- ATX motherboard to power supply connectors: P1
- Power supply to hard drive connectors: molex
- Power supply to floppy drive connectors: mini-molex

Main Peripherals

The Main PC peripherals are keyboard, monitor and mouse.

Monitor

- Analog device
- Compatibility
- Resolution (800x600, 1024x768)
- Non-interlacing (flicker rate)
- Dot pitch
- Refresh rate (vertical): 60 Hz, 72 Hz
- Viewable size

Video/Graphics Card

- DAC (Digital-Analog Converter)
- Screen images stored in RAM areas call UMA (385KB) plus onboard RAM
- Display resolution

- Number of Colors
- Standards: CGA, EGA, VGA, ...SVGA (to 16 million colors, 1600x1200)

Ports, Cabling, Connectors

I/O Ports

Port gender
- Male: pin connectors
- Female: hole connectors

Parallel Ports (IEEE 1284):
- Compatibility/Standard/Centronics mode: 8 bit (original)
- Nibble, Bi-Tronics mode: 4 bit, bi-directional channel
- Byte mode (enhanced bi-directional) mode: 8 bit, PS/2 parallel port, bi-directional
- ECP (Extended Capabilities Port)
- Bi-directional 8-bit operation: can tell data from commands (CD-ROMs, Scanners, Printers)
- EPP (Enhanced Parallel Port): bi-directional 8-bit, daisy-chain peripheral support.
- Problems: electronic noise, signal loss, and data skew – the longer the cable the more data is skewed (delayed and out of synch between the individual wires)
- Max cable lengths about 5 m

Standard Serial Ports (RS-232C)
- DTE (Data Terminal Equipment) – interface with users (all computers)
- DCE (Data Communications Equipment) – interface with DTE (modems, mice, devices)
- Max cable length usually 30 m

Universal Serial Bus (USB) Ports
- Data-intensive tasks
- One host (e.g. PC) and one or more devices (up to 127 daisy-chained)
- Support for hot-pluggable devices (computer does not need to be restarted or turned off)
- No need for external power (powered by the bus) usually
- Data rate is 12 Mb/s with a shielded cable, 1.5 Mb for unshielded.
- Max cable length 5 m

Small Computer Systems/Standard Interface (SCSI) Ports
- Uses parallel data stream, hardware handshaking, and control signals
- One SCSI controller and one or more devices (up to 7, or 15)

- Internal or external connectors
- Can look exactly like a parallel printer port (DB25F)

See also section on SCSI Devices

Network Connectors

- BNC
- RJ-45
- RJ-11

See also section on Networking Concepts

IrDA Ports and IrDA PDAs

- Infrared Device Association
- Infrared serial link
- "line of sight" communication
- (some PDAs are USB)

Cables

- Watch cable orientation
- Watch cable quality
- Watch cable length (data skew and electromagnet interference - EMI)

Connectors

Port	Connector
Parallel	DB25 female
Serial	DB9 male DB25 male
PS/2 (or mini-DIN)	6-pin female
AT keyboard	5-pin female DIN
Video	15-pin female in 3 rows
SCSI	DB25F Centronics 50-pin
EIDE	ATA 40-pin
Thinnet (10Base2)	BNC
Ethernet (10BaseT) and Token Ring	RJ-45
Phone, Modem	RJ-11

Communication Ports

First serial port	COM1	3F8
Second serial port	COM2	2F8
Third serial port	COM3	3E8
Fourth serial port	COM4	2E8
First parallel port	LPT1	378
Second parallel port	LPT2	278

Interface Cards

Interface cards are integrated circuit boards that fit into an expansion slot on the motherboard.
Expansion Card/Bus Types:

- NIC: Network Interface card
- Sound Card
- SCSI Card
- Modem card
- I/O card (ports): Input/Output
- ISA: Industry Standard Architecture
- EISA: Extended Industry Standard Architecture
- MCA: Micro Channel Architecture
- VL-Bus: VESA Local-Bus (Video Electronics Standards Association)
- PCI: Peripheral Component Interconnect
- AGP: Accelerated Graphics Port

Install and configure peripherals

Typical installation of a peripheral:

1. Power off the PC and remove the mains power cord
2. Take ESD precautions
3. Remove system case cover
4. Find available expansion slot
5. Remove blanking plate (covering slot at the back of the system case)
6. Insert PC card, pressing firmly into place, and securing with a screw
7. Replace case
8. Connect external cables (including the mains power cord)
9. Power on
10. Check BIOS, Plug n Play
11. Install drivers (Add/Remove Hardware)
12. Check for conflicts in Device Manager
13. Test the peripheral.

Always follow these steps each time, for every peripheral you install, even if installing more than one at a time. Ensure the first one is working properly before starting the next.

Modems

- Modulate/Demodulate
- Internal, external, PCMCIA modems
- Converts digital computer signals to audible analog tones to send data (modulation) and reconverts analog signals to digital to receive data (demodulation) over phone lines
- Asynchronous transmission (serial) with start and stop bits
- Speeds: V.34 - 28.8 Kbps; V.90 - 56 Kbps (Kilo*bits* per second)
- Flow control
- Software (XON and XOFF) and Hardware (RTS and CTS) handshaking
- Data compression

Modem AT (Command Language) Commands

A	Answer
D	Dial
DT	Dial with dial tones
H	Hang up
Z	Reset
/	Repeat last command

e.g. ATDT1234567

Duplexing

- Simplex: one-way communication
- Half-duplex: two-way communication, one direction at a time (walkie-talkie)
- Full duplex: two-way simultaneous communication (telephone)

Error Detection

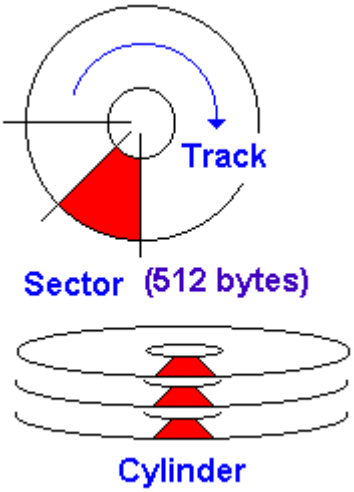
- Current modem standards: V.42 MNP4 and V.42 LAPM
- Parity check: adds a parity bit to each piece of data (sum = even/odd), not reliable (cannot detect double-bit errors)
- Checksum: sends value as last two bits
- Cyclic Redundancy Check (CRC): algorithm that divides a block of data by a binary number (16 or 32 bit) and the remainder is the checksum.

Storage Devices

Hard Drives

A hard drive is a magnetic storage device made up of platters of glass, or metal, with two usable sides marked with tracks (concentric circles). These platters revolve around a spindle. The head actuator, an arm similar to a record player's arm, holds the read/write heads (similar to the needle). You also have a controller and data cache (RAM) inside the hard drive case.

The tracks on the platters are divided into sectors, each 512K. A vertical stack of sectors is called a cylinder.



Hard disk interfaces include:

- ST-506
- ESDI: Enhanced Small Device Interface
- IDE: Integrated Device Electronics (ATA, ATA 2, ATAPI)
- EIDE: Enhanced Integrated Device Electronics (ATA 3, Ultra ATA, Fast ATA, Fast ATA 2) - have a transfer rate of 4-16 MBps

ATAPI (ATA Packet Interface) is the protocol that allows devices other than hard drives to connect via the IDE interface (ie, CD-ROMs)

PIO (Programmed Input/Output) and **DMA** (Direct Memory Access) modes define the transfer rate of the interface, and specify the protocol used between device and controller.

SMART (Self-Monitoring Analysis and Reporting Technology) pre-detects failures, and warns the user through software.

Floppy Drives

- 3.5" or 5.25"
- 720 KB (DD), 1.44 MB (HD), or 2.88 MB
- FAT12
- All disks must be formatted by the operating system, establishing a logical data structure
- ZIP drives: high capacity floppy disk from Iomega, 100-250 MB
- LS-120 SuperDisk: high capacity floppy disk from Imation, 120 MB
- Susceptible to corruption from magnetic fields (EMI).

Optical Storage Devices

CD-ROM

- 650 MB – 700 MB
- Pits (indentations) and lands (between) to represent 1s and 0s
- USB, IDE, SCSI, PCMCIA connections

CD-R (Recordable)

- WORM (Write Once, Read Many)
- Uses a chemical layer with a thin metal layer (silver alloy or gold)
- "Burning" removes reflective parts to simulate pits and lands and represent 1s and 0s (reflected light)

CD-RW (ReWritable)

- Uses phase-change material that crystallizes to write, and rewrite, CDs through a heating and cooling process

DVD-ROM and DVD-R

- Digital Video Disk
- 4.7 - 18 GB
- Backward compatible with CD-ROMs

Others

- MO (Magneto-Optical) Drives
- Tape Drives

Install and configure EIDE devices

Installation

1. Take ESD precautions

2. Ensure the new drive is jumpered correctly (master, slave)
3. Switch off PC, remove power connection, and case cover
4. Insert drive in free drive bay
5. Connect IDE ribbon cable to the drive and the drive controller (ensure pin 1 is aligned)
6. Attach power supply cable
7. Secure drive in the drive bay with small-threaded screws

Configuring

1. Check to see that the CMOS Auto-detect option works (you may need to set device-specific parameters in CMOS setup)
2. Partitioning the hard drive (FDISK command) divides it into logical volumes (drive letters)
3. Formatting the hard drive (FORMAT command) creates the boot record (which makes it bootable), File Allocation Table (FAT) table, and root directory, and checks the drive for errors.

File Systems:

- FAT16 (DOS, Windows 3.x): clusters, sectors, 2GB max
- FAT32 (Windows 9x): 2^{32} entries, 8 GB max (BIOS limitation)
- NTFS (NT, 2000): partitions are incompatible with FAT16/32

More resources:

http://members.aa.net/~obata/atafaq.htm
http://www.mkdata.dk/click/module5b1.htm

SCSI Devices

Small Computer Systems Interface (SCSI) is a complete additional expansion bus (sub-bus) used by PCs, Macintoshes, and UNIX systems to attach and add peripheral devices. SCSI devices can exchange data between them without the intervention or attention of the CPU. All devices on the SCSI bus (chain) function independently, under the control of the host adapter (usually ISA or PCI interface card).

All SCSI devices must have a unique ID, and the SCSI chain must be terminated at both ends.

SCSI Types

Interface	Bus Speed	Bus Width	Transfer Rate	Cable Length	Max Devices
Regular SCSI-1	5 MHz	8 bits	5 MB/s	6 m	8
Wide SCSI-2	5 MHz	16 bits	10 MB/s	6 m	16

Fast SCSI-2	10 MHz	8 bits	10 MB/s	3 m	8
Fast Wide SCSI-2	10 MHz	16 bits	20 MB/s	3 m	16
FireWire (serial)	400 MHz	1 bit	400 Mbps	4.5 m	63

Note how SCSI bus width and number of devices match.

The Standard for serial SCSI bus, aka FireWire, is IEEE1394

Install and configure SCSI devices

SCSI devices can be internal, external or a combination, so there are many configurations possible. Internal devices are connected with a single ribbon cable, and require a PSU connection. External devices are daisy-chained, and have their own power connection.

All SCSI devices require a unique ID, as this is how the host adapter identifies the devices and identifies priority in the chain. The higher the number, the higher the priority. The host adapter is usually set to 7. Hard drives are usually set to 0.

The chain requires termination at both ends (Only SCSI-1 requires manual termination; later specs are self-terminating).

Installation

1. Install the SCSI host adapter, ensuring no conflicts
2. Install internal devices and/or daisy chain external devices, ensuring all cable and power connections are correct.
3. Set/check SCSI Ids (0-7) – jumpers on SCSI hard drives, buttons (some are plug n play)
4. Check termination
5. Install SCSI drivers

PC Disassembly/Assembly

Before disassembling a computer, always:

- Backup everything important
- Have a clean workspace with all the necessary tools and equipment
- Take ESD precautions
- *Document everything*
- Power off all devices and disconnect them from the mains power supply
- Take your time

Typical Disassembly:

1. Detach keyboard and mouse from back of computer
2. Detach monitor
3. Detach serial and parallel devices
4. Detach network cables, speaker cables, joystick, modem phone line...
5. Detach power cable
6. Remove system case lid
7. Detach internal power cables from storage devices
8. Remove hard drive and other storage devices
9. Remove interface cards
10. Remove power cables from system board (removing PSU is not part of the disassembly)
11. Remove CPU
12. Remove RAM
13. Remove all cables from system board
14. Remove screws/clips holding system board in place
15. Remove system board (if replacing system board; otherwise it is not necessary for disassembly)

Reassembly

Reassembly in the reverse order, noting:

- Proper cable orientation (and all cables are re-connected)
- CPU orientation (pin 1)
- Jumper settings
- System board is well-secured in place
- Everything you documented as you went along is back in its place

PC Tool kit

- Screwdrivers (TORX, Hex, Phillips)
- Tweezers, grips
- Chip remover (DIP, EEPROM removal tool)
- Container (for screws, blanking plates)
- Flashlight (a penlight is great)
- Magnifying glass
- Compressed air can, or natural bristle brush (or PC vacuum)
- Multimeter
- ESD kit

BIOS and the Boot process

BIOS (Basic Input/Output System) chips

- EPROM: Erasable Programmable ROMs - flashed with UV light
- EEPROM: Electrically Erasable Programmable ROM – flashed in situ, upgrades downloaded off vendor website usually.
- BIOS is loaded into the top 64 K of the first MB of system memory
- CMOS settings kept in volatile RAM (requires a battery)

BIOS/CMOS Setup

BIOS/CMOS (Complimentary Metal Oxide Semiconductor) setup stores:

- Date, time, and daylight savings
- IDE primary and secondary master/slave parameters
- Floppy disk type
- Video display type
- Halting POST error types
- Internal (L1) and external (L2) cache
- Boot sequence and power-on/boot delay
- NumLock status
- Keyboard installed (optional POST halt)
- nnnnn-nnnnn shadow
- Shadow RAM
- Video and System BIOS shadows
- Integrated FDC (Floppy Disk Controller)
- Integrated IDE Controllers
- Integrated serial ports
- Integrated parallel ports (EPP, ECP
- PS/2 port enable
- USB enabled

Note: Run through the CMOS setup program on your computer to become familiar with it.

IRQs, DMAs, IO addresses

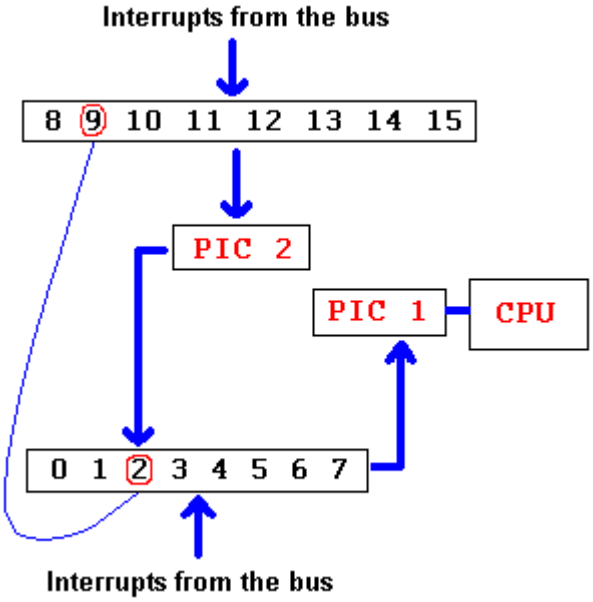
All of these can be checked in the Windows Device Manager or Microsoft Diagnostics (MSD) on your computer.

IRQ (Interrupt Requests)

The processor performs one task at a time, even if it seems simultaneous. To switch between multiple tasks, a processor shares its time by:

- Polling: processor checks each task in turn if it needs attention (waste of CPU time)

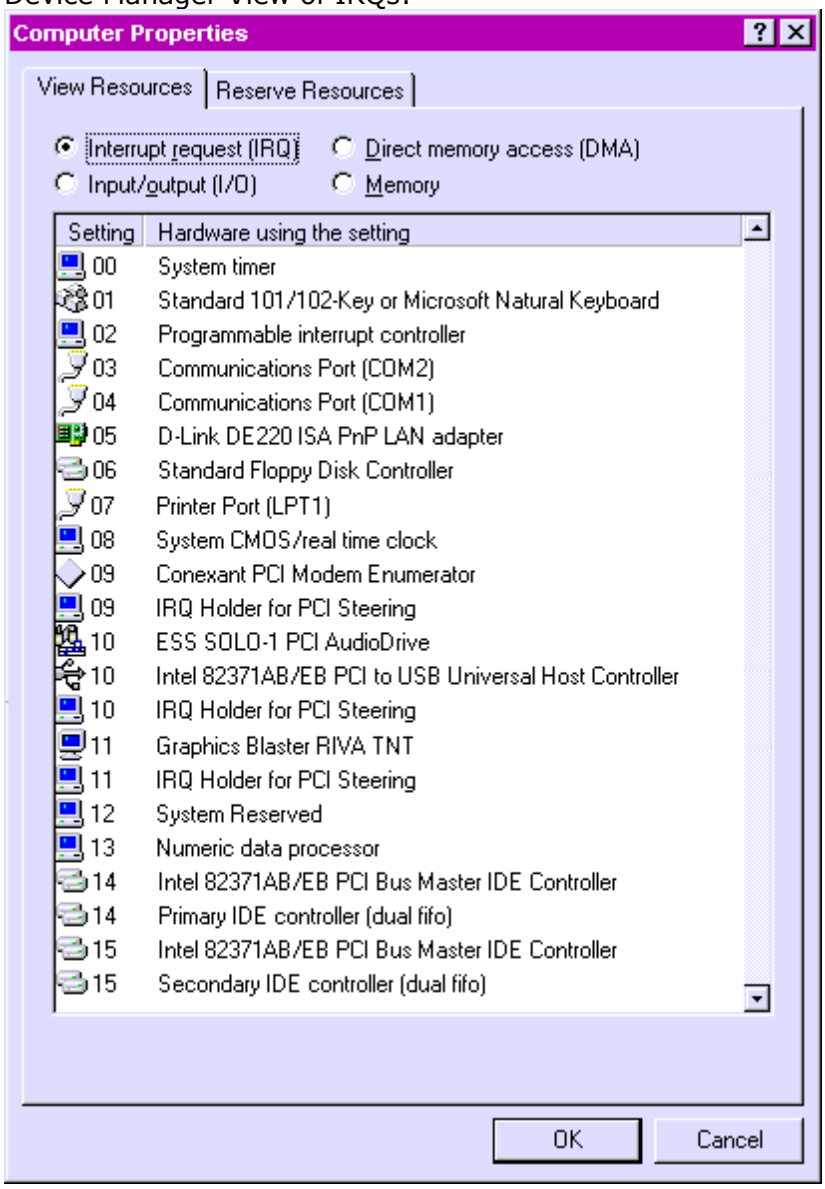
- Interrupting: each task tells the processor when it needs attention with one of two PICs (Programmable Interrupt Controllers) on the system board (IRQ 0-7 is PIC 1; IRQ 8-15 is PIC 2)



- NMI: Non-Maskable Interrupts are urgent interrupt requests that the processor cannot ignore (like memory parity check error)
- Devices can share interrupts if they are not used at the same time.
- PCI Interrupts: the PCI bus has its own interrupt system (#1-#4 or #A-#D) handled by the PCI BIOS

0	System Timer
1	Keyboard
2(9)	Video Card or cascade to IRQ 9
3	Com2, Com4
4	Com1, Com3
5	Available (Normally sound card or LPT2)
6	Floppy Disk Controller
7	Parallel Port (LPT1)
8	Real-time clock
9 (2)	Redirected IRQ2
10	Available
11	Available
12	PS/2 Mouse
13	Math Coprocessor
14	Hard Disk Controller (HDC)
15	Available (often used for second HDC)

Device Manager View of IRQs:



See also:

Mission Control: Windows Device Manager

DMAs

Hardware sometimes needs to transfer data to and from system memory directly, rather than involving the CPU (which would take more time). DMA, Direct Memory Access, devices are designed to function better (efficiently) without CPU access:

- HDCs (hard disk controllers)
- NICs (network interface cards)
- FDC (floppy disk controller)

DMA channel	Device	Transfer
0		8 bits
1		8 bits
2	FDC	8 bits
3		8 bits
4	DMA controller	16 bits
5		16 bits
6		16 bits

I/O Addresses

Port	I/O Address
COM1	3F8-3FF
COM2	2F8-2FF
COM3	3E8-3EF
COM4	2E8-2EF
LPT1	378-37F
LPT2	278-27F
DMA controller	000-01F
Primary Interrupt controller	020-03F
Timer	040-05F
Keyboard	060-06F
NMI, RT Clock	070-07F
Secondary Interrupt controller	0A0-0BF
Math co-processor	0F0-1F7
Hard disk	1F0-1F7
VGA	3D0-3DF
Floppy disk controller	3F0-3F7
Other interface cards	280-2F7 300-377 380-3AF

Memorize the first 6: COMs and LPTs.

System Performance and Optimization

- Ensure your CPU is running at the correct speed ;>
- Ensure CPU cache memory is enabled
- Ensure CPU fan is working
- Run hard drive and CD-ROM on different IDE channels
- Run hard drive utilities (defrag, scandisk) regularly
- More system memory never hurts

Laptops

Differences between the Laptop and the Desktop computer:

- Size and weight
- Display (flat-panel LCD – active matrix, dual scan passive matrix)
- Price
- Power source (Ni-Cad, NiMH, or Li-ion battery packs)
- Docking stations
- RAM: SODIMMs
- Interface cards: PCMCIA

More resources on laptops:
http://www.fringeweb.com/laptops.html

Diagnosing and Troubleshooting

Troubleshooting procedures

- Gather information and ask questions
- Be prepared
- Be calm
- Take your time
- Concentrate
- Be flexible (Don't assume anything)
- Consult (find resources)
- Know when to give in
- Cure the problem not the symptom
- Do not create new problems in process

Common Problems

Some things to always check, especially if any changes have been made recently, are:

- Check connectors and cables
- Check port, device

- Check BIOS
- Check software configuration (drivers, etc)
- Check for conflicts
- Reseat components, if possible
- Virus check

Troubleshooting Devices

CPU

- Overheating (Thermal creep)
- Speed problems
- Occasionally needs reseating
- Check fan

Memory

- Parity errors (transient or same address)
- Occasionally need reseating
- Very ESD sensitive

I/O Ports

- Loopback test

Hard Drives

- Check LED in front of system case
- Check jumpers, cables, configuration
- Check for errors, BIOS, File system

More troubleshooting resources:

Introduction to Troubleshooting
Troubleshooting the Boot Process
PCGuide's Troubleshooting and Repair Guide

Preventative Maintenance

Cleaning Products

- Use only approved cleaning fabrics (lint free) and substances (like Isopropyl alcohol)
- No volatile substances (especially on plastics)
- Use only compressed air or approved PC vacuums inside a PC

Cleaning Procedures

- Check ventilation slots of the system case
- Clean exterior of monitor, case, keyboard, mouse (disconnect cables before cleaning)
- Check fans
- Hard disks check: error checking/scandisk, backup, defrag,
- Reseat components, check cables
- Never use much force or pressure

Hazard and Safety

Power

- Surges (or spike): a very brief, abrupt change in voltage
- Sags: a brief dip in available voltage (e.g. caused by many power-ups at once)
- Brownouts: an extended sag (over a second)
- Blackout: complete loss of power

UPS

- (Uninterruptible Power Supplies)
- Online UPS: constantly supplies system power from batteries, while simultaneously charging from incoming supply
- Offline UPS: when power fails, the inverted switches over into the power circuit
- Considerations:
    - Power rating: VA rating is Watts = Volts x Amps
    - Operational time
    - Monitoring: UPS, network
    - Sinusoidal power output (step digital)
    - Manual bypass switch
    - Support and maintenance (battery life)
    - Cost

High Voltage Equipment

High voltage equipment and laser devices should NOT be serviced without specific training.

- CRTs (Cathode Ray Tube)
- Power supplies
- Laser (high power light sources)

Do not take ESD precautions with high voltage equipment – service personnel should be fully insulated.

Do not operate high power light sources with the case/covering open.

Disposal

Hazardous materials inside your PC include:
- Batteries
- Toner kits and cartridges

Recycle old computers (charities, schools) or parts whenever possible.
Always follow the manufacturer's instructions when disposing of or mixing cleaning products.

ESD (Electrostatic Discharge)

Static electricity is not harmful to people, but is nasty to (and has a cumulative effect on) most of your computer components. The risk of ESD increases significantly under hot, dry conditions (think of removing laundry from the dryer). Always take anti-static precautions when handling static-sensitive components.

Static-sensitive components and field replaceable units (FRUs) should always be put inside anti-static bags, including:
- Memory (especially sensitive)
- CPU (especially sensitive)
- Hard drives and CD-ROMs
- PC cards

Precautions:

- ESD Packaging
- ESD strap and Grounding cord/plugs
- Conductive mats
- Anti-static floors/carpets, workbenches
- Humidifier
- Temperature control

Motherboards/Processors/Memory

Processors (CPU)

Terminology

- **Clock speed** is the rate the processor executes instructions. (the faster the better usually)
- **Arithmetic Logic Unit** (ALU) is the part of the CPU that processes data.

- **Cache memory** (L1 or L2) is a very high-speed block of SRAM that interacts between the CPU and system RAM. (Usually, the more the better). Pentium processors use branch prediction
- **Data bus** refers to the wires (lines) that carry data to and from the processor (and cache, and RAM) (The wider the better, usually)
- **Address bus** refers to the wires (lines) that carry specific addresses to and from the processor. (The wider the bus, the more addresses that can be sent simultaneously)
- **Register size** refers the size of the temporary storage areas that hold data before and after processing by the ALU. This also determines software compatibility: Windows 2000 instructions are 32-bit, so it cannot run on a 16-bit processor.
- **Multitasking** is either pre-emptive or cooperative. Pre-emptive multitasking is controlled by the OS, which divides processor time accordingly. Cooperative multitasking is performed by the applications themselves
- **Multiprocessing**, which usually increases system performance, takes place simply whenever a system has more than one processor. Asymmetric multiprocessing allocates specific tasks and applications to specific processors. Symmetric multiprocessing (SMP) tasks and applications run off any processor (further increases performance).
- **Real Mode** is a processor mode where addressable memory (RAM) is seen as linear storage location that cannot be divided into sections, nor allocated to specific (ie, memory-intensive) programs. It cannot run Windows (no multitasking), only DOS.
- **Protected Mode**, introduced with the 286, allocates specific amounts/sections of memory to applications, multitasks, and supports virtual memory. All major OS use protected mode. Virtual Real Mode (or enhanced Protected Mode) emulates real mode from within protected mode to run DOS applications under Windows.

Pentium Processors

- Introduced in 1992
- 32-bit address bus
- 32-bit registers
- 64-bit data bus
- Built-in math-coprocessor
- PCI (Peripheral Component Interconnect) bus compatibility

Generation	Clock Speeds	L2 Cache	Register size	Data bus width	Addressable memory

Pentium I	60-66 90-100 120-166	16 KB	32-bit	64-bit	4 GB
MMX	166-233	32 KB	32-bit	64-bit	4 GB
Pro/P6 (RISC)	120-200	16 KB	64-bit	64-bit	4 GB
Pentium II (SEC)	233-450	512 KB	64-bit	64-bit	4 GB
Celeron	500-800	0-128K	64-bit	64-bit	4 GB
II Xeon	400-450	512KB-2MB	64-bit	64-bit	4 GB
III	450-1GHz	256KB	64-bit	64-bit	4 GB
III Xeon	500-1GHz	256KB-2MB	64-bit	64-bit	4 GB
Itanium (EPIC)	-1 GHz	L2 onchip L3 - 4 MB	64-bit	64-bit	16 GB
IV	1.4-1.5GHz	256 KB	?	Accel. 64-bit	?

Check out Webopedia's Processor Guide

Processor Sockets

- Socket 3: 486DX, AMD 5x86, Cyrix 5x86, Pentium OverDrive 63/83
- Socket 4: Pentium 60/66, Pentium OverDrive 120/133
- Socket 5: Pentium 75-133, Overdrive 125-166, MMX 125-166
- Socket 7: Pentium 75-200, Overdrive, MMX, K5, K6, 6x86MX
- Socket 8: Pentium Pro
- Slot 1: Pentium II, Pentium Pro
- Slot 2: Pentium II, Xeon

Non-Intel Processors

- AMD
- Cyrix

Generation	Clock Speeds	L2 Cache
K6 II	500-550	0
K6 III	400-450	256
Athlon	850-1.2 GHz	256
Duron	700-800	64

See also:

Intel website
AMD website

Memory

Terminology

- **Memory speed**: measured in nanoseconds, this is the time to access data that is stored in memory (50-80 ns)
- **Parity**: a simple error-checking method where each data byte includes a ninth bit called the parity bit (even/odd = 1/0).
- **ECC**: Error Checking and Correcting is a kind of enhanced memory checking that detects memory errors, but cannot correct them. Will halt the system
- **Memory Banks**: installed memory must fill a bank. Old systems required two 72-pin SIMMs, present systems only need one DIMM

ROM

- Read-Only Memory (non-volatile)
- Typically stores low-level hardware instructions (BIOS)

RAM

- Random-Access Memory (volatile)
- The processor's workspace
- Temporarily stores data (as long as constant power is being supplied)
- DRAM (Dynamic RAM)
- SRAM (Static RAM)
- Video RAM types: VRAM (Video RAM), WRAM (Windows RAM), SGRAM (Synchronous Graphics RAM)

DRAM

- Main system memory (DIMM, SIMM)
- High-density memory modules
- Stores data while programs are running (OS, applications, etc)
- Fast Page Mode DRAM
- Extended Data Output (EDO) DRAM
- Burst Extended Data Output (BEDO) DRAM
- Synchronous DRAM, or SDRAM

SRAM

- Faster than DRAM (4 times faster)
- Larger, more expensive

- Used for speed-critical functions, like cache

VRAM

- Video RAM (all though all types of Video RAM are sometimes called this generically)
- AKA Dual-port RAM
- For high-performance video adapter cards
- Two data ports: one read, one write

WRAM

- Windows RAM
- Dual ported
- Slightly faster than VRAM (25% faster)

SGRAM

- Synchronous Graphics RAM
- Synchronized with the system clock
- Single-ported

Memory Packages

- DIPP: Dual in-line Pin Packages (EEPROM)
- SIPP: Single in-line Pin Packages
- SIMM: Single in-line Memory Modules (older system RAM, 30 or 72 pin)
- DIMM: Dual in-line Memory Modules (typical system RAM, 168 pin)
- SODIMM: Small Outline DIMMS (typical Laptop/PDA/IMac system RAM, 144 pin)

See also:

The Ultimate Memory Guide
PCTechGuide on Memory

Motherboards

Motherboards are the foundation for every PC. You should be very familiar with system board architecture and be able to recognize most components. Components to be able to identify include:

- CPU
- Real-time Clock and CMOS battery
- BIOS chip
- Switch connectors

- Cache
- IDE and floppy connectors
- All expansion slots and types
- Memory banks and types
- Power connectors
- All integrated ports, including video (AGP)

Terminology

- **System Chipset**: the logic circuits for system functions like caching and interrupting. The chipset will affect the processor type, speed and multitasking, the amount of RAM and L2 cache supported, and power management.
- **Controller Chips**: Keyboard and PS/2 mouse controllers, I/O port controllers, EIDE and floppy drive controllers, and any other built-in interfaces (like sound, network)
- **Clock**: Handles multiple speeds with the clock multiplier
- **I/O Ports**: usually 2 serial, 1 parallel, 2 USB, 2 PS/2 (keybd, mouse), 2 internal EIDE, 1 internal floppy port
- **Memory Slots**: SIMM or DIMM, or both
- **Level 2 Cache**: usually a DIP chip or COASt (Cache on a stick), a dedicated high-speed *backside* bus (DIB – Dual Independent Bus) architecture.
- **Form Factors**: the shape and physical size of the system board: AT, baby AT, ATX, mini ATX, LPX, and mini-LPX, NLX.
- **Bus**: buses are a common medium for the transfer of data from one location, device, or component to another.

See also links to:

PCTechGuide Motherboards (great graphics)
Hardware Central's Tutorial

Buses:

- Processor Bus
- Memory Bus
- Cache Bus
- I/O Bus
- Expansion Bus

Bus Speeds

Device	Clock	Speed, e.g.
CPU	System clock x 4	266 MHz

L2 Cache	System clock x 2	133 MHz
System Memory		66 MHz
PCI bus	System clock x 2	33 MHz
ISA bus	PCI bus x 4	8.3 MHz

See also:

A Guide to the PC Bus Ride

Printers

Types

- Dot Matrix
- Inkjet
- Laser (and LED)

Dot Matrix

- Also called Impact printers (parts actually impact the paper)
- Fires *pins* (or print wires) at an ink ribbon, which contacts the paper and leaves a mark
- The *print head*, the assembly which contains the pins, moves left to right across the paper, line by line, creating letters out of the circular dots of ink that have impacted he paper.
- Coils of wires called *solenoids* are energized, thus creating an electromagnet, and cause the pins to shoot forward and strike the ribbon.
- Print quality is measured in "pins", as in 9-pin, 24-pin, 48-pin printers: number of pins in the print head.
- The quality of print is at best NLQ, Near Letter Quality.
- The speed of the printer is measured in *cps*, characters per second.
- The paper most often used with dot matrix is continuous, tractor-fed paper with perforated strips on the sides.
- This printer uses pin feeders and tractor feeders with this paper to prevent skewing. The roller (or *platen*) applies pressure (friction) when you use plain paper to keep the paper from slipping. If you are using multiple-copy paper, you can adjust the *platen gap* to the thickness of the paper.
- Dot matrix printers are rather expensive to purchase now because they serve the niche multiple-copy stationary market, and so many companies want old ones fixed.

Inkjet Printers

- Inkjet printers use liquid ink-filled cartridges that force out and spray ink at the page through tiny holes called *nozzles*.
- The printer sprays ink at the page through pressure and electricity. Normally, the pressure inside the ink cartridge (in the *ink reservoir*) is a bit less than pressure outside. When the *deflection plates* are electrically charged, ink is forced out.
- Inkjet printers have two kinds of print heads that move back and forth in perfect synchronization with the spray of ink. HPs have *thermal-shock* print heads, which have a heating element around each nozzle that, when heated, causes the ink to expand. Epson printers have *piezoelectric (electrostatic)* print heads that, when charged, changes the size and shape of the nozzle, and acts like a pump.
- Inkjet printers can use plain paper and inkjet specific paper (for higher print quality).
- Print quality is measured in *dpi*, dots per inch.
- Print speed is measured in *ppm*, pages per minute.

Laser Printers

The majority of businesses (including BrainBuzz here) use laser printers for demanding printing needs (speed, quantity, quality).

- Laser printers print one whole page at a time, and require RAM (more memory) to operate.
- Print quality is measured as dpi
- When the printer receives the print data for a page, it breaks the data into single-dot strips called *rasters* (this is called *rasterizing*, amazingly enough).

The Laser Printing Process:

1. Electrostatic Charging (Conditioning)
2. Imaging (Writing or Exposing)
3. Developing
4. Transferring
5. Fusing
6. Cleaning

See also:

How Printers Work
PCTechGuide's Laser Printers (excellent graphics)

Printer Connections and Configurations

To install a printer in Windows 9x/NT/2000, go to **Setting** => **Printers => Add Printer** and walk through the Print Wizard.

Connections

- Parallel (local)
- Serial (local)
- Network

More resources:
http://support.microsoft.com/support/serviceware/windows/win95/E9J2EZ8PZ.ASP

Troubleshooting Printers

- Printer not working: switched on, plugged in, online, check cables
- Paper jam: cheap paper, wrong type, stored improperly, loaded improperly
- Output corruption: printer driver, check setup
- Poor quality: toner/ribbon low, cheap/wrong paper
- Laser memory errors: not enough RAM
- Blank pages: OPC drum, corona wire improperly seated.

Networking Concepts

Introduction to Networking

- A network is two or more computers connected that share data.
- Networking on the Internet is called internetworking.

LAN

- Local Area Network
- Single site within a building
- Sharing resources and information (files, peripherals, storage, software)
- Communications: Ethernet and CSMA/CD

WAN

- Wide Area Network
- Multiple sites across a large geographic area
- Sharing resources and information (printing, files)
- Access: dial-up using modem, ISDN, DSL, cable, leased lines

How a Network Works

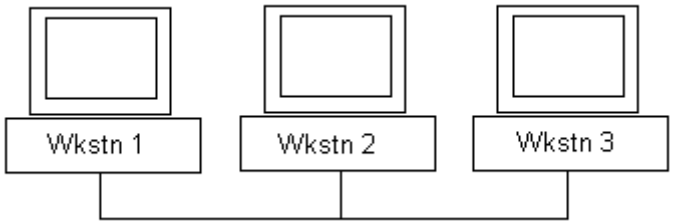
Networks are made up of three basic components:

- Protocols – rules of communication
- Transmission media – methods for interconnecting network elements
- Network Services – shared resources

Networks are either peer-to-peer or server-based.

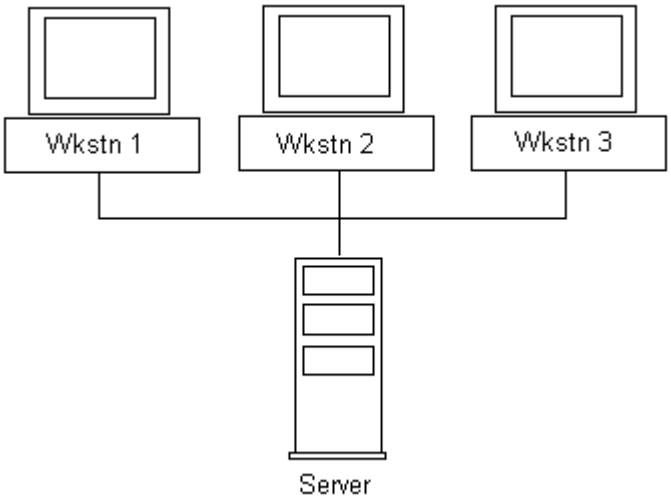
Peer-to-peer:

- Doesn't require dedicated resources: any host can share its resources with any other host on the network
- Less expensive, easier to work/maintain, less secure, fewer users (less than 10)
- File system management problems
- Windows for Workgroups 3.x/95/98

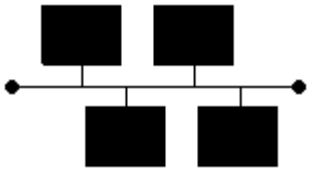
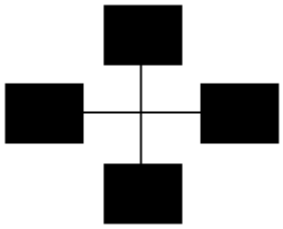
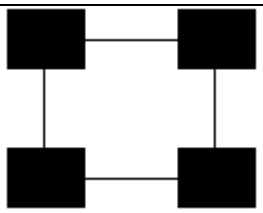


Server-based:

- Configuration of nodes. A dedicated node that shares out its resources to hosts is a server (resources like printers, files, and applications)
- More security, more expensive
- Print servers, file servers, mail servers, web servers
- Novell NetWare, UNIX, Microsoft NT/2000, Apple AppleTalk



Physical Topologies:

Bus	Star	Ring
		

Mesh: every computer is connected to every other computer
Hybrid: any of these in combination
Token Ring: (or star-wired ring) uses a MAU and token passing to ensure only one device is communicating at a time (FDDI uses token passing)

Do not confuse Physical Topologies with Logical Topologies.
Logical Topology: the actual path of a signal over a network (bus, ring)
Physical topologies: how the network devices are actually connected.

Network Operating Systems:

- Novell NetWare 5
- Microsoft NT, 2000
- UNIX

Networking Components

- **NIC** (Network Interface Card), also called an adapter card: interface between a single computer and the network
- **Repeater**: an amplifier that prevents signal degradation over distance
- **Hub**: a focal point of a network – connects computers in a physical star topology
- **Switches**: device for filtering frames and connecting segments of a network, uses MAC addresses
- **Routers**: direct data packets between networks using IP addresses
- **Brouters**: combination bridge and router
- **Bridges**: directs information flow on a network from one node to another.
- **Gateway**: converts protocols
- **Modem** (Modulate/Demodulate): a device to connect computers over analog telephone lines.

Cables

- Fiber Optic cables are the fastest, most expensive, and most difficult to implement
    - Single-mode: specific wavelength
    - Multi-mode: many wavelengths (frequencies, or modes)
- Twisted Pair cannot exceed 100 m
    - STP: shielded twisted pair
    - UTP: unshielded twisted pair

Category	Description
1	Voice (UTP only)
2	4 twisted pairs, data transmission up to 4 Mbps (UTP only), token ring
3	4 twisted pairs, data transmission up to 10 Mbps, Ethernet
4	4 twisted pairs, data transmission up to 16 Mbps, token ring
5	4 twisted pair, data transmission up to 100 Mbps, Ethernet and fast Ethernet
6	4 twisted pair, data transmission up to 155 Mbps, fast Ethernet
7	4 twisted pair, data transmission up to 1000 Mbps, gigabit Ethernet

Connectors

- RJ-45 (like phone jack)

- BNC/Coaxial (Thicknet, Thinnet - like cable TV)

Transmission Types

- **Synchronous**: transmissions are synchronized between the access devices and the network device (message-framed data), and the message is received in the order it was transmitted.
- **Asynchronous**: transmissions are asynchronized between the access device and the network device, but each character is synchronized by information in the header and trailer bits.
- Data transmission flow: circuits are:
  - **Simplex**: one direction
  - **Half duplex**: two directions, only one at a time
  - **Full duplex**: two directions simultaneously.
- **Baseband**: entire media bandwidth for a single channel using TDM (Time Division Multiplexing)
- **Broadband**: divides media bandwidth into multiple channels, each with a separate signal using FDM (Frequency Division Multiplexing)

Networking Issues

- Slowdown
- Bandwidth
- Cost
- Maintenance
- Traffic demands
- Hardware

Install and configuring a NIC

Network Interface Cards move data between a local computer and the network. Types of NICs include:

- ISA
- PCI
- PCMCIA

Note: know how to install and configure a NIC, and also how to share resources.

Shared Folder	Shared Drive	Mapped Drive
	 Local Disk (C:)	 Websites (X:)

Special thanks to Cherina Sparks for contributing this Cramsession.
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