A+ Certification 901 Study Guide

Section 1 - Hardware

BIOS and UEFI

BIOS- Basic Input / Output System
- **-The software (firmware) used to start your computer**
- **-BIOS chip is on motherboard**
- **-Initial hardware check (ram, cpu,) POST**
- **-After BIOS, computer looks for boot devices**
- **-Settings are saved in nonvolatile memory (ROM chip)**

Legacy BIOS - Limited hardware support, over 25 years old

UEFI BIOS -Unified Extensible Firmware Interface
- **-Implemented by manufacturers**
- **-Boot from large GPT disks (>2.2TB)**
- **-Pre-boot has it's own OS**
- **-Able to connect remotely**

BIOS Configuration

RAM - View and configure memory settings

Hard drive/ SSD - view and enable/disable

Optical drive - view and enable/disable

CPU- Adjust settings

Hardware diagnostics - Build in BIOS

Firmware - Do not upgrade unless current firmware is having issues

BIOS Security

BIOS password / User password - System/OS will not start w/o password

Supervisor Password - Restricts BIOS changes w/o password

Full Disk encryption- Encrypts everything, even the OS. (bitlocker)

TPM (Trusted Platform Module) -Build in or added to mobo
-used by Full disk encryption

LOJACK for laptops - Built into the BIOS
-Automatically installs to hdd

-phone home function sends location info

Secure Boot -Compares digital signatures to OS you are running

Installing BIOS Upgrades

Upgrading Firmware - Upgrade done to nonvolatile memory
- Reliable power source for no interruptions
- Improves performance/ fixes bugs
-Only upgrade if necessary (having problems)
- Modern upgrades run from .exe files

Identifying BIOS Version -start up screen
-msinfo32 (windows)

Motherboards

Form factors

ATX - Advanced technology Extended
-20 or 24 pin power connector
-May see an addition 4 or 8 pin connector

Micro ATX - Smaller ATX motherboard
-backwards compatible
-similar power connectors to ATX
-Will mount in an ATX case

ITX -Series of smaller motherboards
-screws compatible with atx and micro atx

Computer Power

Pc power connectors - 20 and 24 pin main power
-provides 3.3V, 5V, and 12V
-20 pin for original ATX, 24 pin added for PCIe
-24 pin will fit 20 pin mobo

SATA Power - 15 pin power connector, 3.3V (rare), 5V and 12V

Molex - provides 12V and 5V…….4 pins
4 pin ATX - 12V (ATXV12, P4, or cpu label)
8 pin EPS - 12V connector, provides 12V to multiple CPUs
PCIe 8 pin & 12 pin- additional power for PCIe adapters

Expansion Slots and Bus Speeds

Bus width - How much traffic can pass (throughput)
Clock Speed -measures in Hertz (1 MHz = megahertz = 1 million cycles/second……...1Ghz= 1000MHz)

PCI - Peripheral Component Interconnect
-32 and 64 bit bus length
-32 bit= 32 lines of communication 64 bit = 64 lines of communication
-parallel bus = all bit are transferred at once
-32 bit slots are shorter
PCI-x -PCI extended
-more throughput, designed for servers
-parallel communication
PCIe -PCI express
-replaced PCI, PCIx, and AGP
-communicates serially, faster than parallel
-x1, x2, x4, x8,x16, and x32….full duplex

Mini PCI and PCIe mini -made for laptops
-wifi cards

RAM Slots

DIMM -Dual Inline Memory Module
-one single chip set
-electrical contacts different on each side
-64 bit dad width
-Double Data Rate(DDR) SDRAM- 184 pins
-DDR3 and DDR3 SDRAM- 240 pins
SO-DIMM - Small outline Dual Inline Memory Module
-used in laptops
-DDR & DDR2 -200 pins
- DDR3 204 pins

Micro DIMM - very small, used in small laptops
-DDR -172 pins
-DDR2 & DDR3 - 214 pins

CPU Sockets

LGA Socket- Land grid array- pins on mobo instead of chip

Chipsets

Northbridge - Connects the CPU to the memory and high speed graphics Card (PCIe or AGP)
Southbridge - Connects the PIC interface slots, USB, ethernet, IDE, BIOS, Onboard graphics
-Serial I/O- serial port, parallel port, floppy disk, keyboard, Mouse
Modern CPU's - Most have multiple cores, memory controllers, and GPUs Integrated

Motherboard jumpers and connectors

Jumpers - Enable or disable certain mobo features
-could be used to reset BIOS

Interfaces

USB 1.1 - 1.5 Mb/s - 12 Mb/s
-5 meters max
USB 2.0 - 480 Mb/s
-5 meters max
USB 3.0 - 5Gb/s
-3 meters max
Firewire - apple trademark, IEEE 1394
-daisy chain up to 63 devices
-4.5 meters (15 ft) distance limit per link
-Firewire 400 - 100, 200, & 400 Mb/s, half duplex
-Firewire 800 - 800 Mb/s full duplex, support up to 100M
Sata - power - 15 pins, data - 7 pins

1.0 - 1.5 Gb/s, 1 meter

2.0 - 3Gb/s - 1 meter
3.0 - 6Gb/s - 1 meter

eSata- matches sata version, 2 meters

VGA - Video Graphics Array
-Blue DB-15 connector, 5-10 meters max, analog signal only
HDMI- High Definition Multimedia Interface
-all digital, 20 meters before signal loss
-19 pin type A connector
-Type C connector for mini hdmi (cameras)
BNC - Bayonet Neill, Concelman, high end video
Mini-DIN - S video, 2 channel analog
DVI - Digital Video Interface
-DVI-A: analog
-DVI-D: Digital
-DVI-I: integrated (digital and analog)
Audio Ports - Analog TRS plugs (Tip, Ring, Sleeve)
-¼" = 6.5mm ⅛" = 3.5mm
-Digital optical fiber, 10m max
RJ11- Registered Jack #11 (telephone)
-6P2C (6 positions, 2 wires used)
RJ45 - Registered Jack #45 (ethernet)
- 8P8C
Thunderbolt - Data and power on same cable, daisy chain up to 6 devices
-V1: 10Gb/s per channel, 20Gb/s total
-v2: 20Gb/s
-v3: 40Gb/s
-Copper max: 3 meters
-Optical Max: 60 meters
MIDI - Musical Instrument Digital Interface

Wireless Interfaces & Speeds

Infrared - 4Mb/s Line of sight, 1 Meter max
-laptops, phone, camera
NFC - Near field communication
-106 kb/s, 212 kb/s, 424 kb/s, range of 10 cm or less
-mobile devices, payment devices

Bluetooth - Class 1 - industrial, 100m range
- Class 2 - mobile devices, 10m range
- Class 3 - Short range use, 1 m range
- Version 1.2 - 1Mb/s
-Version 2.0 + EDR (Enhanced Data Rate) - 3 Mb/s
-Version 3.0 + High speed - 24 Mb/s
-Version 4.0 - low power spec- 24 Mb/s

802.11 Networking

802.11a	5 Ghz	54Mb/s	120 meters
802.11b	2.4 Ghz	11 Mb/s	140 meters
802.11g	2.4 Ghz	54 Mb/s	140 meters
802.11n	2.4 Ghz or 5Ghz	600 Mb/s (4 channels 150Mb/s)	250 meters
802.11ac	5 Ghz	693 Gb/s (8 channels 866.7 Mb/s)	250 meters

Frequency = number of cycles/ second (hertz)

RAM

RAM - Random Access memory
ROM - Read only memory, does not change (BIOS)
PROM - Programmable read only memory , written once
EPROM - Erasable PROM, write/erase/write again
EEPROM - Electrically Erasable PROM (Flash memory, SSD)
SRAM - Static RAM
-very fast and expensive, very large
-used often in CPU caches (L1, L2, L3)
DRAM - Dynamic RAM
-needs constant refreshing or memory disappears
- can be stored anywhere and accessed directly

SDR SDRAM -Single data rate Synchronous DRAM
-synchronized with clock cycles (very slow)
-168 pins
DDR - Double data rate, twice as fast as SDR
-184 pins
DDR2 - Twice as fast as DDR
-240 pins
DDR3 - Twice as fast as DDR2
-240 pins
All 3 DDRs not backwards compatible, notches are off

Understanding PC Memory

Parity Memory - Adds additional parity bit, will not always detect error
-Will not fix error
ECC Memory - Error correcting code memory
-Detects and fixes errors, not used by all systems
-Even parity, parity bit makes an even number
Registered Memory -Used on servers, buffer zone
Multi-channel Memory -installed in pairs or trios for max throughput
-combinations should match
Buffered Memory - Used to place less electrical load on the memory Controller

Storage Devices

Optical storage - Small bumps are written to disc with laser
CR-ROM - 700 MB capacity
DVD-ROM - Single layer- 4.7 GB
-Dual layer - 8.5 gb
Blu-ray -Single layer -25GB
-Dual layer - 50GB
HDD - slower speeds, mechanical, can break, moving parts
SSD - no moving parts, very quick
SSHD - Has spinning drive and SSD flash memory. Faster but less $$

Hot swappable - Remove or add without powering off machine
- USB, firewire, SATA, eSATA

USB Flash Drives - EEPROM - electrically erasable programmable ROM
Nonvolatile- loss of power does not erase data
Limited number of writes, easy to damage
Tape drives - magnetic tape, sequential storage, cheaper, long term storage

RAID

RAID 0 - Striping- data files split between 2 or more drives
High performance, no redundancy,one bad drive= data loss
RAID 1 - Mirroring - exact duplicate of data across 2 or more drives
redundancy , not speed
RAID 5 - Striping w/ parity - files are striped, requires at least 3 drives
High redundancy, efficient use of disk space
Parity calculation may affect performance
RAID 1+0 - stripe of mirrors,speed of striping but redundancy of mirroring, Need at least 4 drives

Display Devices

LCD displays- Liquid Crystal Display
-Light shines through liquid crystals
TN- Twisted Nematic- Most common/ low power, fast response (gaming)
IPS - In plate switching , excellent resolution, more expensive that TN
CCFL - Cold cathode fluorescent Lamp- high V, thicker, converts power
Plasma - tiny cells with noble gas and mercury
Digital Projectors - LCD common, metal-halide lamp
OLED - Organic LEDs, thinner and lighter, no backlight, short life

Display specs - Refresh rates- number of times a screen is redrawn
-measures in hertz (Hz)
Resolution- number of pixels (W x H)
-standard 4:3 (1600 x 1200)
-wide screen 16:10
-hd 16:9

Printers

Laser Printers- uses lasers, high voltage, high quality, very fast
Imaging drum- painted with a laser

-picks up toner and transfers to paper

Fuser Assembly - melts plastic toner permanently to paper

Colors - cyan, yellow, magenta, black

Four separate toner cartridges

Pickup rollers - one page at a time, periodically needs cleaned

Separation pads - pulls just top sheet of paper

Duplexing Assembly - prints to both sides of paper

PROCESS: 1.) Processing, ready to print full page at one time

2.) Charging, wire set negative charge to photosensitive drum

3.)Exposing, laser writes image to photosensitive drum

4.)Developing, toner applied to drum

5.) Transferring, toner placed on paper from drum

6.) Fusing, heat and pressure to make toner permanent

7.) cleaning, toner off of drum

INKJET PRINTERS - Inexpensive, quiet, high resolution, expensive ink

-Ink cartridges places drops of ink on pages

- Colors CYMK, cyan, magenta, yellow, key (black)

Printhead- integrated into the cartridges, some not

Feed rollers - feeds paper, some duplex

Cartridge and belt- moves cartridges over paper

Calibration- aligns nozzles to paper

Thermal Printers- receipt printers

-white paper turns black when heated, very quiet

-paper sensitive to light and heat

-heating element heats up parts of paper form characters

-paper covered with chemicals that changes color w/ heat

Impact Printers - Dot Matrix- printhead has pins that press against paper & mark

-good for carbon copies, multiple copies

-low cost, noisy, poor graphics, mostly for numbers & letters

-paper is pulled through with holes on each side of it

Print head - moves back and forth, ribbon in between head & paper

Ribbon - made of fabric, easy to replace

Virtual Printers -no physical output, sending info to a digital file

Print to file - basically saving to file

-can only be read by certain program

Print PDF -portable document format,cross platform compatibility

Print to XPS - XML paper specification,

- similar to PDF, but included in windows

Print to image - letter imaging or sharing, not integrated in OS

PRINTER MAINTENANCE

LASER PRINTERS- kits that include new rollers, fuser units, etc.

-check page count to determine maintenance need

-do calibration

-clean dust from toner

Thermal Printers- clean heating element with alcohol

-remove tiny bits of paper

-print head pops out with lever

Inkjet Printers - print heads need cleaned, can be done automatically or manual

Section 2 - Networking

CABLES AND CONNECTORS

ST connectors - straight tip connector

SC connectors - subscriber, square, standard connector

LC connector - Lucent, local, little connector

RJ 11 - 6 position, 2 conductor (6P2C)

-telephone connector

RJ45 - 8P8C, modular

T568A and T568B need to be the same termination on both sides

RJ48C - 8P4C, T1, WAN, data lines

BNC connectors - coaxial cable connector, rigid and hard to work with

-DS3 WAN links

F connector - used on coax

NETWORK CABLING

Fiber optic - uses light instead of RF

-hard to monitor or tap, no interference

Multimode Fiber - short range, up to 2Km

-inexpensive light source (LED)

Singlemode Fiber- long range, up to 100Km w/o processing

-expensive light source (laser beam)

Twisted Pair copper cabling - two wires with equal and opposite signals

-pairs w/ different twist rates

-twists help with interference

UTP- unshielded twisted pair, most common

STP- shielded twisted pair, protects from interference, needs grounding

Plenum rated cable - special cable jacket to minimize smoke during fire

Coax- two or more forms share a common axis

RG6 - used for tv

RG59 - used as a patch cable (not for long distance)

Calculating Signal Loss

-distance = signal loss

-attenuation = loss of intensity of signal

-decibel (1/10 of a bell) - signal strength ratio measurement

CABLE CATEGORY	ETHERNET STANDARD	MAX DISTANCE
CAT3	10BASE-T	100 METERS
CAT5	100BASE-TX 1000BASE-T	100 METERS
CAT5e	100BASE-TX 1000BASE-T	100 METERS
CAT6	10GBASE-T	37-55 METERS
CAT6A	10GBASE-T	100 METERS
CAT7 SHIELDED	10GBASE-T	100 METERS

TCP/IP

IPv4 and IPv6

IPv4 -32 bit address, 4 octets, with 8 bits each, max decimal value is 255
IPv6 -128 bit address, first 64 network prefix, last 64 host address, hexadecimal
IPv6 Link local address - required on every IPv6 interface

IPv6 Compression - remove leading 0's and 2 or more groups of 0's

2000:0bb0:0000:0000:0000:0000:00a0:0002
2000:bb0::a0:2
RFC1918 addresses - private addresses

10.0.0.0 - 10.255.255.255	255.0.0.0	Host Size = 24 bits
172.16.0.0 - 172.31.255.255	255.240.0.0	Host size = 20 bits
192.168.0.0 - 192.168.255.255	255.255.0.0	Host size = 16 bits

Automatic Private IP Addressing (APIPA)- used if DHCP not working
-assigned by a workstation server
-Range: 169.254.0.1 - 169.254.255.254
-first and last 256 addresses reserved
-usable range: 169.254.1.0 - 169.254.254.255
-auto assigned: ARP to confirm address not in use

TCP/IP addressing

IP address- every device needs a unique IP
Subnet mask - used by local workstation to determine what subnet it is on
Default Gateway - allows you to communicate outside local network
DNS - translates domain names to ip addresses
- many DNS servers
-13 root server clusters
-hundreds of generic top level domains (.com, .net, .org, .edu)

-over 275 country code top level domains (.us, .ca, .uk)
-IPs of DNS servers provided by admins
- two addresses for redundancy

DHCP - auto assigns IPs, configures IP, subnet mask, default gateway
-separate from DNS
-IPs used to be static

Classless Subnetting -
CIDR - Classless Inter-Domain Routing (slash as end of IP)

Decimal	CIDR
255.0.0.0	/8
255.255.0.0	/16
255.255.255.0	/24

PORTS AND PROTOCOLS

Common TCP/UDP Ports

Protocol	Port	Name	Description
FTP	TCP/20, TCP/21	File Transfer Protocol	send/receive files between systems
SSH	TCP/22	Secure Shell	Encrypted console access
Telnet	TCP/23	Telecommunications network	Insecure console access
SMTP	TCP/25	Simple mail transfer protocol	Transfer email between mail servers
DNS	UDP/53 TCP/53	Domain Name Service	Convert domain names and IP addresses
HTTP	TCP/80	Hypertext Transfer Protocol	Web server communication

POP3	**TCP/110**	**Post office protocol V3**	**Receive email into an email client**
IMAP4	**TCP/143**	**Internet message access protocol V4**	**A newer email client protocol**
HTTPS	**TCP/443**	**Hypertext transfer protocol secure**	**Web server communication with encryption**
RDP	**TCP/3389**	**Remote desktop protocol**	**Graphical display of remote access**
NETBIOS	**UDP/137**	**NetBIOS name service**	**Register, remove, and find windows services by name**
NETBIOS	**UDP/138**	**NetBIOS datagram service**	**Windows connectionless data transfer**
NETBIOS	**UDP/139**	**NetBIOS session service**	**Windows connection oriented data transfer**
SLP	**UDP/427 TCP/427**	**Service Location Protocol**	**Find MAC OS services by name**
SMB	**TCP/445**	**Server message block**	**Windows file transfers and printer sharing**
AFP	**TCP/548**	**Apple filing protocol**	**MAC OS File transfer**
LDAP	**TCP/389 UDP/389**	**Directory service protocol**	**Windows active directory**

TCP - Transmission Control Protocol- connection oriented, reliable delivery, station
Responds back acknowledging receipt of data
-can manage out of order messages

UDP - User Datagram Protocol - connectionless, no formal setup, data just sent
-unreliable, no acknowledgement of receipt
-no reorder of data, received ad is

4 things needed to communicate: server IP and port number
Client ip and port number

Example: 192.168.1.1/ 62315 ------> 182.168.1.2/ 22

Non-ephemeral ports - permanent port numbers, usually on a server
Ephemeral port - temporary port numbers, client side
Port numbers tcp/udp - range from 0 - 65,536 0-1024 are well known ports (servers)

Wireless Networking

Wireless Standards

Wireless networks - IEEE 802.11
Popular standards- a,b,g,n,ac

STANDARD	FREQUENCY (GHz)	STREAMS	MAX THROUGHPUT PER STREAM	TOTAL MAX THROUGHPUT	NOTES
802.11a	5	1	54MB/s	54MB/s	Smaller range than b because high frequency (5GHz) is absorbed rather than bouncing like 2.4 GHz
802.11b	2.4	1	11MB/s	11MB/s	Better ranger than a, more frequency conflicts (microwaves)
802.11g	2.4	1	54MB/s	54MB/s	Backwards compatible with b, same frequency conflicts as b
802.11n	5 &2.4	4	150MB/s	600MB/s	Multiple inputs,

					multiple outputs (MIMO)
802.11ac	5	8	866.7MB/s	6934 MB/s	

WIRELESS ENCRYPTION

WEP - Wired equivalent privacy,64 bit or 128 bit key size
-very vulnerable, capture enough packets and you can get key

WPA - Wifi protected access, larger encryption hash
-RC4 with TKIP (temporary key integrity protocol)
-every packets gets a unique encrypted key
WPA2- uses AES (advanced encryption standard)
-CCMP replaces TKIP
WPA2 Enterprise - everyone has their own key

CONFIGURING SOHO WIRELESS ROUTER

Wireless channels and encryption - WPA2 over WPA, never use WEP
-not all devices compatible with WPA2, may need upgrade
-use an open frequency, some APs do automatically (interference)
Configuring NAT - Automatic on SOHO routers, internal IPs translate to ext. IP
Port forwarding - 24/7 access to an internal hosted service (plex, web servers)
-external ip/ port maps to internal ip/port,
- also called destination NAT or static NAT, does not expire
Port Triggering - like port forwarding, but only under certain circumstances
-opens for game, closes when game is turned off
-only one person can trigger at a time

IP addressing - most use DHCP, IPs are easy to see on open network
Firewall and DMZ ports - every SOHO router is a firewall
-no external devices can directly access network

-DMZ ports can allow unrestricted access (bad idea)

Managing QOS - change priority of traffic (VOIP high, gaming low)

-prioritize apps, could slow down apps

Firmware updates - doesn't happen often, do not do unless router is not Working right, have backup of old firmware

UPnP - devices find other devices automatically, auto port forwarding

- no approval needed, security risk, can make changes to firewall

INTERNET CONNECTION TYPES

Cable Modem - data over cable, multiple services

DOCSIS- data over cable service interface specification, DOCSIS- international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV (CATV) system.

DSL- ADSL- Asymmetric Digital Subscriber Line 1.5 mb/s

-uses phone lines, download faster than upload (asymmetric)

VDSL- Very-high-bit-rate DSL, faster than ADSL 7 mb/s

Dial up - voice telephone lines, 56k modems, slow throughput, analog lines

Fiber- high speed, voice and data over line

-hundreds of HD channels

-1Gb/s internet, 1TB cloud, 2TB DVR

Satellite - 2GHz range, high cost, 15mb/s download, 2mb/s upload

-sensitive to weather, high latency

ISDN - Integrated Services Digital Network

- **Used on legacy telephone systems**

Cellular Networks - separates land into cells, antenna covers cell with certain Frequencies

-Tethering turns your phone into a router

LOS - line of sight, visual path between 2 antennas, high frequencies

Common in metropolitan areas

WI-MAX- Worldwide interoperability for microwave access

NETWORK TYPES

LAN - Local area network, could be one building or a group of buildings

Usually high speed, ethernet or 802.11 (wireless)

WAN - wide area network, larger than LAN

Communicating across country or world, usually slower than LAN

Different types of connections (point to point, satellite)

MAN- Metropolitan Area Network, larger than LAN, smaller than WAN

Usually in city, common to see owned by government

PAN - Personal area network, bluetooth, IR, NFC

NETWORKING DEVICES

HUB - called a multiport repeater, traffic repeated from one port to all ports

10 megabit, 100 megabit, hard to find today

Switches- Bridging done in application specific integrated circuits (ASIC)

-forwards traffic based on destination address

-core of enterprise networks

-multi-layer switches- switching and routing capabilities(layer 2&3)

Routers - Routes traffic between IP subnets

-forwarding decisions based on IP addresses

-Routers inside of switches sometimes called "layer 3 switch"

-can connect different types of networks (LAN, WAN, copper, fiber

WAP- wireless access point, acts as a bridge, extends the wired network onto

The wireless network. Forwards based on mac address

Modem - modulator/demodulator, converts analog to digital, uses phone lines

Firewalls - integrated into wireless routers or on a standalone device

-can proxy traffic

-can filter traffic based on TCP/UDP port number

-can be a router

-can filter based on data in packets

-some have VPN capabilities

Patch Panels - combo of punch down blocks and RJ45 connectors, permanent

Copper Line Drivers or extender - extends range of copper or copper ethernet

PLC - power line communication, ethernet over powerline 500MB/s

PoE- with switch - endspan, injector - midspan

Modes - Mode A- power on data pairs Mode B- power on spare pins

Networking Tools

Cable Crimpers - pinches connector to wire, metal prongs pushed in insulation
-exact modular connector for type of wire
Multimeters- read voltage, ohms, current
Toner probe - finds other end of wire
-tone generator- puts an analog sound on the wire
- Inductive probe- does not need to touch wire
-hear sound through a small speaker
Cable testers - continuity checks, identifies missing pins or crossed wires
-not used to test frequencies
Lookback Plugs - used for testing physical ports
-serial, RS232, network connections
-not used for crossover cables

Punchdown Tools - punch a wire into a wiring block
-tedious, trims wire during punch
Wireless Analysis - easy to monitor, identifies errors and interference
-purpose built hardware or mobile device add on

Section 3 Mobile Devices

Laptop Hardware

Expansion Options- Express cards - 34mm and 54mm
-USB2: 48-Mb/s
-USB3: 5 Gb/s
-PCIe: 2.5 Gb/s
SO-DIMM - small outline dual inline memory module
64mm x 32mm
DDR & DDR2 - 200 pin DDR3 - 204 pin
USB Flash Drive - EEPROM - Electrically erasable programmable ROM
-limited number of writes
-non volatile
Thunderbolt - same as mini display port, provides high speed data

Replacing a desktop with a laptop

Laptop keyboard have less keys than desktop keyboards

Storage - SSD - 2.5" and 1.8"
SSHD - flash memory and spinning disks

Laptop and mobile memory - SO-DIMM and Micro DIMM
Smartcard readers - integrated or USB
Optical Disks - becoming rarer
Wifi Cards - PCIe and mini PCI

Screens - LCD - fixed resolution, very fragile
-power adapter converts AC to DC
Batteries - Lithium ION or Li-ion, charging diminishes battery
Laptop frames - heavy duty plastic or metal
Motherboards - built to fit certain model, not easy to replace
CPU - designed for mobility
-integrated features (memory controller, video)
-not very upgradeable

Laptop Displays

LCD - liquid crystal display, light shines through liquid crystals
-requires backlight, inverter converts DC to AC
-image but no light may be bad inverter
TN - Twisted Nematic LCD, fast response for gaming, low power
IPS - excellent resolution, more expensive
Fluorescent backlight - higher voltage, added thickness
LED backlight - LEDs around edge of screen
OLED - organic LED, no backlight, degrades overtime , expensive
WIFI antennas - wires wrap around outside of LED display
-main and auxiliary wire
Webcam - audio and video,

LAPTOP Features

Function Key - Fn + key, some toggle

-Examples: volume, screen brightness, airplane mode, enable or Disable touchpad, screen orientation, gps, media options

Docking Stations - slide in and connect to mouse and keyboard

Mobile Devices

Tablets - 7" or longer

Smartphones - 3.5" - 5.5"

Phablet - 5.5" to 7"

E-readers - books plus music and other media

Smart Camera - face recognition and other features

Mobile Device Communication

NFC - Near field communication - send small amounts of data over limited area, built into phone, payment systems, transportation Access tokens, identity cards, short range w/ encryption

Proprietary Mobile Interfaces - early phones have power cable and a separate cable for data

-EU set a standard on USB

- micro USB standard, common worldwide

-other devices use micro usb

-Apple has lightning cable -higher power output

-inserted either way

-more durable

Bluetooth - Personal Area Network (PAN)

IR - used to control other IR devices (phone for tv remote)

Hotspot/tethering - phone acts as 802.11 WAP

Mobile Device Accessories

Headsets - wired used TRRS connector
(Tip Ring Ring Sleeve)
-Wireless used bluetooth
TRRC - allows to have a microphone
Speakers - wires or bluetooth
External Game Pads - game controllers for mobile
Docking Stations - no wires, charge and sync
CC readers - phone becomes Point of Sale terminal
-uses internet link for approvals
-email receipt, sign w/ finger
SD/MicroSD

SECTION 4: HARDWARE & NETWORK TROUBLESHOOTING

Troubleshooting Common Hardware Problems

Unexpected Shutdowns - could be heat related
-check temps, heatsink, fans
Overheating - heat from CPUs, video cards, dust
- clean dust, check fans, airflow, heatsink,

Failing Hardware - run hardware diagnostics
Lockups - computer freezes up
-check for activity (HDD light, status light)
-ctrl + alt + del
-update drivers
-low resources such as ram or storage

Hardware Diagnostics
POST - power on self test

-tests major components, beep codes for failures
-every manufacturer has unique beep codes

Blank screen - bad video, listen for beeps, BIOS issue

Continuous Reboots - how far is the boot going

Bad driver configuration - Boot, F8, last known good configuration

No power - check power source
-no POST could be bad motherboard
-check power supply output

Loud noises - Rattling: Loose components
Scrapping: HDD issue
Clicking: Check fans
Popping or smoke : check capacitors

Intermittent Device Failure - ban install, reseat, could be bad hardware

Indicator lights - POST codes on mobo, power, link light, speed light, HDD

Smoke and burning smell - electrical issue, remove power

BSOD - windows crash, windows stop error, check event log

Spinning Ball of death - apple issue, bug or hardware issue

Hardware Troubleshooting Tools

DMM - check voltage, continuity

Power supply tester - plugs in power supply, LCD shows voltage

Loopback Plugs - useful for testing physical plug, serial/RS232 (9 or 25 pin)

Port card/USB - detailed diagnostics during POST, LED numbers and letters
External PCI/ PCIe/ parallel

Storage Device Troubleshooting

Read/write failures

Slow performance - constant LED activity

Loud clicking noise - mechanical issue

Troubleshooting - backup, check cables, check for heat, check PSU, diagnostic

Boot failure - drive not recognized, beeps, error messages

NO OS - HDD seen but windows not seen, check boot order

RAID not found - missing or faulty raid connector, check raid software

Crash screens - may indicate bad HDD

S.M.A.R.T. - Self monitoring, Analysis & Reporting Technology
Monitors how drive is operating
Uses 3rd party utilities, finds warning signs

HDD Troubleshooting Tools

Physical Tools - screw drivers and external disc enclosures
CHKDSK / f - finds errors and repairs them
CHKDSK / r - locates bad sectors and recovers, also does /f
If volume is in use, run at startup (/r and /f)
Format - windows command, adds a file system a partition
-also removes all file entries
File recovery software - recovers files if not overwritten
Defragmentation - moves files fragments so they are contiguous
-not necessary for SSD, DEFRAG on cmd

Troubleshooting Boot Process

PC only knows the basics: keyboard, mouse, RAM, etc.
Bootstrap Loader - In BIOS, loads program that loads the OS
2nd stage Boot loader - winload, GRUB, legacy...gets the OS Started
Master Boot Record (MBR) - first sector of the HDD
-usually only 512 bytes
-contains table of primary partitions
-contains disk signature and directions to starting OS
-UEFI does not use MBR, EFI System Partition (ESP)

Windows Command Prompt - boot from install disc to access CLI
- very powerful, last resort
-complete control, modify OS files
-enable/ disable service or device startup
-repair system boot sector or MBR

BOOTREC command
BootREC / scanOS - identifies windows OS
BootREC / fixboot - writes a new boot sector
BootREC / rebuildBCD - creates new boot config
Data store

DISKPART - manage partitions

Troubleshooting Display Issues

No video connection - first check everything is connected
-no video after windows boot, use VGA mode (F8)
Image Quality Issue - check cables and pins, and interfaces
Distorted - check OS refresh rate and resolution
-disable hardware acceleration
Oversized Images - resolution too low, lower = larger
Image Sticking - problem with LCDs, white screen to refresh
Pixel Issues - stuck pixels= always bright
-dead pixels = always black
Artifacts -unusual graphics, check adapters and drivers
Motion trails - disable advanced video features
BSOD and overheating - video drivers
-monitor internal temp.

Troubleshooting Networks

No network connection - check lights on physical connection
-ping loopback 127.0.0.1
-ping local IP address
-ping default gateway
-ping devices outside local network
Automatic Private IP addressing (APIPA) -link local address
-communicates inside local subnet
-169.254.1.0 - 169.254.254.255
-169.254.0.0/24 & 129.254.25.0/24 are reserved
-automatically assigned, when DHCP unavailable
-uses ARP to confirm address not in use
Limited or no connectivity - check local IP, make sure APIPA not used
-if DHCP is in use, do PING tests
Intermittent Connectivity - check system tray, check cables and NIC
-check switch or WAP
IP conflicts - two devices cannot used same IP
-DHCP helps, statics can cause issues

-windows will identify duplicates and prevent issues
-reboot or reset NIC to restart DHCP process

Slow transfer Speeds - overloaded network or devices
-speed and duplex must match
-hardware issue or cabling, also could be malware infection

Low RF wireless signal - interference with devices on same frequency
-incorrect channel, usually automatic
-bounce and latency
-WAP location

Wireless interference - fluorescent lights, microwaves, cordless phones, High power sources, multi tenant buildings

SSID not found - could be too far away, closer networks could be louder
-SSID could be hidden, must enter manually

Network Troubleshooting Tools

Cable tester - continuity checks, crossed wires

Loopback plug - tests physical ports, serial/RS232, RJ35, T1
-only used for diagnostics

Punchdown Tools - punches wire into block, 60 & 110 blocks
-trims wires, makes neat, must maintain twist

Toner Probe - finds where cable goes
-generator puts analog sound signal on wire
-probe does not need to touch, sound through speaker
-used on punchdown blocks

Crimpers - pinches connector onto wire
-metal prongs pushed through insulation

Wireless Locators - software or hardware
-shows network frequencies, channels, etc.

Command Line Troubleshooting

PING - tests reachability & round trip time
-used ICMP, is a primary troubleshooting tool

IPCONFIG - used in windows
-IP info, DNS, default gateway, etc.

IPCONFIG/all - much more info
IFCONFIG - used in linux
TRACERT - Determine route packet takes to destination
Tracert - windows traceroute - linux
-used ICMP TTL
TTL= time to live = number of hops
-decreased by 1 everytime packet goes through router
-not all devices will reply with ICMP
-some firewalls block ICMP
NETSTAT - network statistics
Netstat - a = shows all active connections in & out PC
Netstat - b = shows binaries
Netstat - n = do not resolve names, only show IPs
NBTSTAT - netbios over TCP/IP
-windows utility for querying netbios over TCP/IP info
Nbtstat -n = list local netbios names
Nbtstat - A 192.168.1.1 = list remote netbios names And IPs

NET - windows network commands
NET stop: stop a service (net stop spooler)
NET start :start a service (net start spooler)
NET use : map a network share to drive letter
(net use h:\\<servername> / <sharename?
Net view : view network resources
(net view \\<servername>

NETDOM - manage AD, windows 8 and higher
-join PC to domain, remove account, view domain info
NSLookup - lookup info from DNS servers, windows,mac and linux

Troubleshooting Laptops

No display or dim - verify backlight, no light= replace inverters
External Display - video good but bad LCD, replace LCD
Flickering Video - check cables and connectors
Input issues - laptop keyboards more fragile
Ghost Cursor - modify configuration, update drivers

Wireless troubleshooting - check antenna cables, multiple cables
Power issues - battery not charging, batteries lose capacity over time
No power = check outlet
Master laptop reset - hold power button for 10 seconds
External Monitor Issues - Fn keys to toggle LCD, CRT, both
-external monitor bypassed LCD (uses hardware)

Troubleshooting Mobile Devices

Unresponsive Screen - could be software issue, do a reset
Apple IOS - power, slide, power button
-hold power and home for 10 seconds
Android - remove battery
APP issues - not loading or slow, reset app
IOS- double tap home, slide app up
Android - settings, apps, select app, force stop
Unable to decrypt Email - encryption built into email system
-each user has a private key
-Mobile device manager for private keys
Short battery life - bad reception, always searching for signal
-airplane mode to fix that
-disable unnecessary features, check app usage
-replace aging batteries
Overheating - phone will shut down automatically to prevent damage
-causes include charging, cpu useage
-avoid direct sunlight
Frozen Systems - nothing works, do a soft or hard reset
-ongoing issue may require factory reset
No sound from speakers - check volume settings (also in app)
-reinstall software, try headphones
-intermittent could be conflicting with other app
-no sound = factory reset
GPS not working - enable GPS and location services,need good sky view
Swollen Battery - buildup of gas, designed to self contain
-stop using immediately

Device Disassembly - much harder than desktops, hard to reassemble
-fragile
-document where parts go, cable locations

-use organizer for screws and other parts
-step by step take picture
-anti static important, tinier tools than desktop

Troubleshooting Printers

Test printer - print or scan a test page
-build into windows, not printer app
-Diagnostic tools
Bad output - Inkjet- clean print heads
-Laser - check for scratched drum
Faded or blank - low toner or ink
Ghost images - drum not cleaned properly, shadow of previous rotation
Wrong color - low ink in one cartridge
Smudges - toner now fused to paper, fuser may not be hot
Paper Jam - do not rip paper out, could damage components
Not feeding - check rollers
Creased paper - paper loading incorrectly, wrong type of paper

Printer Network Issues

No connectivity - check power, wired cabling or wireless settings
Access denied - security tab, print, manage printer, manage docs

Bad output -garbled characters
-bad drivers/wrong model
-wrong page description language (PCL or postscript)
-bad app, check test page
OS issue - unable to install printer, check 32 bit or 64 bit
-user must have proper rights to install
Backed up print queue - print server not working
-spooler crash
-restart spooler (in windows)
Error message - On printer LCD screen
Low memory - laser printer builds entire page in memory
-complex images use more memory
No output - check power, run test page (button on printer)

-check connectivity, print with attached device (USB)
-check network and apps

Printer Troubleshooting Tools

Laser printer maintenance kits - laser printers do wear out
-new feed rollers and fuser unit
-check page counter to determine if needed
-reset page counter when finished

Toner Vacuum - specially made, anti static
Outside of printer - use water or IPA
Inside of printer - wipe dust away, clean rollers with IPA

Printer Spooler - manages printing in the background of windows
-runs as a windows service
-is not always perfect