STUDY GUIDE

CompTIA

A+ Core Hardware

(220-301)

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ExamForce

About the Author

Robert J. Shimonski (CompTIA HTI+, Security+, Server+, e-Biz+, Inet+, Network+, A+, TruSecure TICSA, Cisco CCDP, CCNP, Cisco Firewall Specialist, Nortel NNCSS, Microsoft MCSE, MCP+I, Novell Master CNE, CNE 4/5/6, CIP, CIBS, IWA CWP, Prosoft MCIW, SANS GSEC, GCIH, Symantec SPS and NAI Sniffer SCP) is a Network Manager for a leading manufacturing company. Robert's technical specialties include network infrastructure design with the Cisco and Check Point product lines, Systems Engineering with Microsoft and Novell technologies and troubleshooting with Sniffer-based technologies.

Robert has served as a Subject Matter Expert (SME) for CompTIA.org, the creators of the A+ exam. Robert has helped not only beta test just about every certification created through CompTIA, but also helped CompTIA to create exam questions for exams such as HTI+ and eBiz+. He was selected based on his networking expertise and history of developing highly needed top quality material for most of the leading certification software vendors and book publishers worldwide.

Robert is also a best-selling author (www.rsnetworks.net) of many security related articles and published books to include: "Sniffer Network Optimization and Troubleshooting Handbook" from Syngress Media Inc (ISBN: 1931836574), Security+ Study Guide and DVD Training System (ISBN: 1931836728) and the newly upcoming and highly anticipated Network+ study guide based on the 2005 objectives, all from Syngress Media Inc.

About the Exam

CompTIA A+ Certification is awarded after passing two exams created by CompTIA, one of the world's leaders in certification testing. The CompTIA A+ certification is an international industry credential that validates the knowledge of an entry level PC computer technician and has no prerequisites. The skills and knowledge measured by this examination were derived from an industry-wide job task analysis and validated through an industry-wide survey of many participants. The A + exam is one of the most sought after certifications in CompTIA's arsenal of certification programs, right next to one of the other biggest leaders, the Network+. A + has about a decade of existence behind it, and if prepared for properly, is a credential that never expires, that you can hold and build on and be proud of achieving.

There are six major topic areas (domains) that make up 100% of this exam:

- Domain 1.0: Installation, Configuration and Upgrading (35%)
- Domain 2.0: Diagnosing and Troubleshooting (21%)
- Domain 3.0: Preventive Maintenance (5%)
- Domain 4.0: Motherboards/Processors/Memory (11%)
- Domain 5.0: Printers (9%)
- Domain 6.0: Basic Networking (19%)

The Exam Number is 220-301.
The Exam Title is the A+ Core Hardware.

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Objectives

Domain 1.0: Installation, Configuration and Upgrading (35%)

1.1 Identify the names, purpose, and characteristics, of system modules. Recognize these modules by sight or definition.

Examples of concepts and modules are:

- Motherboard
- Firmware
- Power supply
- Processor/CPU
- Memory
- Storage devices
- Display devices
- Adapter cards
- Ports
- Cases
- Riser cards

1.2 Identify basic procedures for adding and removing field-replaceable modules for desktop systems. Given a replacement scenario, choose the appropriate sequences.

Desktop components:

- Motherboard
- Storage device
  - FDD
  - HDD
  - CD/CDRW
  - DVD/DVDRW
  - Tape drive
  - Removable storage
- Power supply
  - AC adapter
  - AT/ATX
- Cooling systems
  - Fans
  - Heat sinks
  - Liquid cooling
- Processor/CPU
- Memory
- Display device
- Input devices
  - Keyboard
  - Mouse/pointer devices
  - Touch screen
- Adapters

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    - Network Interface Card (NIC)
    - Sound card
    - Video card
    - Modem
    - SCSI
    - IEEE 1394/Firewire
    - USB
    - Wireless

1.3 Identify basic procedures for adding and removing field- replaceable modules for portable systems. Given a replacement scenario, choose the appropriate sequences.

Portable components:

- Storage devices
    - FDD
    - HDD
    - CD/CDRW
    - DVD/DVDRW
    - Removable storage
- Power sources
    - AC adapter
    - DC adapter
    - Battery
- Memory
- Input devices
    - Keyboard
    - Mouse/pointer devices
    - Touch screen
- PCMCIA/Mini PCI Adapters
    - Network Interface Card (NIC)
    - Modem
    - SCSI
    - IEEE 1394/Firewire
    - USB
    - Storage (memory and hard drive)
- Docking station/port replicators
- LCD panel
- Wireless
    - Adapter/controller
    - Antennae

1.4 Identify typical IRQs, DMAs, and I/O addresses, and procedures for altering these settings when installing and configuring devices. Choose the appropriate installation or configuration steps in a given scenario.

Content may include the following:

- Legacy devices (e.g., ISA sound card)
- Specialized devices (e.g., CAD/CAM)

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- Internal modems
- Floppy drive controllers
- Hard drive controllers
- Multimedia devices
- NICs
- I/O ports
    - Serial
    - Parallel
    - USB ports
    - IEEE 1394/Firewire
    - Infrared

1.5 Identify the names, purposes, and performance characteristics, of standardized/common peripheral ports, associated cabling, and their connectors. Recognize ports, cabling, and connectors, by sight.

Content may include the following:

- Port types
    - Serial
    - Parallel
    - USB ports
    - IEEE 1394/Firewire
    - Infrared
- Cable types
    - Serial (Straight through vs. null modem)
    - Parallel
    - USB
- Connector types
    - Serial
        - DB-9
        - DB-25
        - RJ-11
        - RJ-45
    - Parallel
        - DB-25
        - Centronics (mini, 36)
    - PS2/MINI-DIN
    - USB
    - IEEE 1394

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1.6 Identify proper procedures for installing and configuring common IDE devices. Choose the appropriate installation or configuration sequences in given scenarios. Recognize the associated cables.

Content may include the following:

- IDE Interface Types
  - EIDE
  - ATA/ATAPI
  - Serial ATA
  - PIO
- RAID (0, 1 and 5)
- Master/Slave/cable select
- Devices per channel
- Primary/Secondary
- Cable orientation/requirements

1.7 Identify proper procedures for installing and configuring common SCSI devices. Choose the appropriate installation or configuration sequences in given scenarios. Recognize the associated cables.

Content may include the following:

- SCSI Interface Types
  - Narrow
  - Fast
  - Wide
  - Ultra-wide
  - LVD
  - HVD
- Internal versus external
- SCSI IDs
  - Jumper block/DIP switch settings (binary equivalents)
  - Resolving ID conflicts
- RAID (0, 1 and 5)
- Cabling
  - Length
  - Type
  - Termination requirements (active, passive, auto)

1.8 Identify proper procedures for installing and configuring common peripheral devices. Choose the appropriate installation or configuration sequences in given scenarios.

Content may include the following:

- Modems and transceivers (dial-up, cable, DSL, ISDN)
- External storage
- Digital cameras
- PDAs
- Wireless access points
- Infrared devices

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- Printers
- UPS (Uninterruptible Power Supply) and suppressors
- Monitors

1.9 Identify procedures to optimize PC operations in specific situations. Predict the effects of specific procedures under given scenarios.

Topics may include:

- Cooling systems
  - Liquid
  - Air
  - Heat sink
  - Thermal compound
- Disk subsystem enhancements
  - Hard drives
  - Controller cards (e.g., RAID, ATA-100, etc.)
  - Cables
- NICs
- Specialized video cards
- Memory
- Additional processors

1.10 Determine the issues that must be considered when upgrading a PC. In a given scenario, determine when and how to upgrade system components.

Issues may include:

- Drivers for legacy devices
- Bus types and characteristics
- Cache in relationship to motherboards
- Memory capacity and characteristics
- Processor speed and compatibility
- Hard drive capacity and characteristics
- System/firmware limitations
- Power supply output capacity

Components may include the following:

- Motherboards
- Memory
- Hard drives
- CPU
- BIOS
- Adapter cards
- Laptop power sources
  - Lithium ion
  - NiMH
  - Fuel cell
- PCMCIA Type I, II, III cards

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Domain 2.0: Diagnosing and Troubleshooting (21%)

2.1 Recognize common problems associated with each module and their symptoms, and identify steps to isolate and troubleshoot the problems. Given a problem situation, interpret the symptoms and infer the most likely cause.

Content may include the following:

- I/O ports and cables
  - Serial
  - Parallel
  - USB ports
  - IEEE 1394/Firewire
  - Infrared
  - SCSI
- Motherboards
  - CMOS/BIOS settings
  - POST audible/visual error codes
- Peripherals
- Computer case
  - Power supply
  - Slot covers
  - Front cover alignment
- Storage devices and cables
  - FDD
  - HDD
  - CD/CDRW
  - DVD/DVDRW
  - Tape drive
  - Removable storage
- Cooling systems
  - Fans
  - Heat sinks
  - Liquid cooling
  - Temperature sensors
- Processor/CPU
- Memory
- Display device
- Input devices
  - Keyboard
  - Mouse/pointer devices
  - Touch screen
- Adapters
  - Network Interface Card (NIC)
  - Sound card
  - Video card
  - Modem
  - SCSI
  - IEEE 1394/Firewire
  - USB

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- Portable Systems
  - PCMCIA
  - Batteries
  - Docking Stations/Port Replicators
  - Portable unique storage

2.2 Identify basic troubleshooting procedures and tools, and how to elicit problem symptoms from customers. Justify asking particular questions in a given scenario.

Content may include the following:

- Troubleshooting/isolation/problem determination procedures
- Determining whether a hardware or software problem
- Gathering information from user
  - Customer Environment
  - Symptoms/Error Codes
  - Situation when the problem occurred

Domain 3.0: Preventive Maintenance (5%)

3.1 Identify the various types of preventive maintenance measures, products and procedures and when and how to use them.

Content may include the following:

- Liquid cleaning compounds
- Types of materials to clean contacts and connections
- Non-static vacuums (chassis, power supplies, fans)
- Cleaning monitors
- Cleaning removable media devices
- Ventilation, dust and moisture control on the PC hardware interior.
- Hard disk maintenance (defragging, scan disk, CHKDSK)
- Verifying UPS (Uninterruptible Power Supply) and suppressors

3.2 Identify various safety measures and procedures, and when/how to use them.

Content may include the following:

- ESD (Electrostatic Discharge) precautions and procedures
  - What ESD can do, how it may be apparent, or hidden
  - Common ESD protection devices
  - Situations that could present a danger or hazard
- Potential hazards and proper safety procedures relating to
  - High-voltage equipment
  - Power supply
  - CRTs

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3.3 Identify environmental protection measures and procedures, and when/how to use them.

Content may include the following:

- Special disposal procedures that comply with environmental guidelines.
- Batteries
- CRTs
- Chemical solvents and cans
- MSDS (Material Safety Data Sheet)

Domain 4.0: Motherboards/Processors/Memory (11%)

4.1 Distinguish between the popular CPU chips in terms of their basic characteristics.

Content may include the following:

- Popular CPU chips (Pentium class compatible)
- Voltage
- Speeds (actual vs. advertised)
- Cache level I, II, III
- Sockets/slots
- VRM(s)

4.2 Identify the types of RAM (Random Access Memory), form factors, and operational characteristics. Determine banking and speed requirements under given scenarios.

Content may include the following:

- Types
  - EDO RAM (Extended Data Output RAM)
  - DRAM (Dynamic Random Access Memory)
  - SRAM (Static RAM)
  - VRAM (Video RAM)
  - SDRAM (Synchronous Dynamic RAM)
  - DDR (Double Data Rate)
  - RAMBUS
- Form factors (including pin count)
  - SIMM (Single In-line Memory Module)
  - DIMM (Dual In-line Memory Module)
  - SoDIMM (Small outline DIMM)
  - MicroDIMM
  - RIMM
- Operational characteristics
  - Memory chips (8-bit, 16-bit, and 32-bit)
  - Parity chips versus non-parity chips
  - ECC vs. non-ECC
  - Single-sided vs. double sided

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4.3 Identify the most popular types of motherboards, their components, and their architecture (bus structures).

Content may include the following:

- Types of motherboards:
  - AT
  - ATX
- Components:
  - Communication ports
  - Serial
  - USB
  - Parallel
  - IEEE 1394/Firewire
  - Infrared
- Memory
  - SIMM
  - DIMM
  - RIMM
  - SoDIMM
  - MicroDIMM
- Processor sockets
  - Slot 1
  - Slot 2
  - Slot A
  - Socket A
  - Socket 7
  - Socket 8
  - Socket 423
  - Socket 478
  - Socket 370
- External cache memory (Level 2)
- Bus Architecture
- ISA
- PCI
  - PCI 32-bit
  - PCI 64-bit
- AGP
  - 2X
  - 4X
  - 8X (Pro)
- USB (Universal Serial Bus)
- AMR (audio modem riser) slots
- CNR (communication network riser) slots
- Basic compatibility guidelines
- IDE (ATA, ATAPI, ULTRA-DMA, EIDE)
- SCSI (Narrow, Wide, Fast, Ultra, HVD, LVD(Low Voltage Differential))
- Chipsets

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4.4 Identify the purpose of CMOS (Complementary Metal-Oxide Semiconductor) memory, what it contains, and how and when to change its parameters. Given a scenario involving CMOS, choose the appropriate course of action.

CMOS Settings

- Default settings
- CPU settings
- Printer parallel port—Uni., bi-directional, disable/enable, ECP, EPP
- COM/serial port—memory address, interrupt request, disable
- Floppy drive—enable/disable drive or boot, speed, density
- Hard drive—size and drive type
- Memory—speed, parity, non-parity
- Boot sequence
- Date/Time
- Passwords
- Plug & Play BIOS
- Disabling on-board devices
- Disabling virus protection
- Power management
- Infrared

Domain 5.0: Printers (9%)

5.1 Identify printer technologies, interfaces, and options/upgrades.

Technologies include:

- Laser
- Ink Dispersion
- Dot Matrix
- Solid ink
- Thermal
- Dye sublimation

Interfaces include:

- Parallel
- Network
- SCSI
- USB
- Infrared
- Serial
- IEEE 1394/Firewire
- Wireless

Options/Upgrades include:

- Memory
- Hard drives
- NICs
- Trays and feeders
- Finishers (e.g., stapling, etc.)
- Scanners/fax/copier

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5.2 Recognize common printer problems and techniques used to resolve them. Content may include the following:

- Printer drivers
- Firmware updates
- Paper feed and output
- Calibrations
- Printing test pages
- Errors (printed or displayed)
- Memory
- Configuration
- Network connections
- Connections
- Paper jam
- Print quality
- Safety precautions
- Preventive maintenance
- Consumables
- Environment

Domain 6.0: Basic Networking (19%)

6.1 Identify the common types of network cables, their characteristics and connectors.

Cable types include:

- Coaxial
  - RG6
  - RG8
  - RG58
  - RG59
- Plenum/PVC
- UTP
  - CAT3
  - CAT5/e
  - CAT6
- STP
- Fiber
  - Single-mode
  - Multi-mode

Connector types include:

- BNC
- RJ-45
- AUI
- ST/SC
- IDC/UDC

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6.2 Identify basic networking concepts including how a network works.

Concepts include:

- Installing and configuring network cards
- Addressing
- Bandwidth
- Status indicators
- Protocols
  - TCP/IP
  - IPX/SPX (NWLINK)
  - AppleTalk
  - NETBEUI/NETBIOS
- Full-duplex, half-duplex
- Cabling—Twisted Pair, Coaxial, Fiber Optic, RS-232
- Networking models
  - Peer-to-peer
  - Client/server
- Infrared
- Wireless

6.3 Identify common technologies available for establishing Internet connectivity and their characteristics.

Technologies include:

- LAN
- DSL
- Cable
- ISDN
- Dial-up
- Satellite
- Wireless

Characteristic include:

- Definition
- Speed
- Connections

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Domain 1.0 - Installation, Configuration and Upgrading (35%)

Chapter 1

1.1 Identify the names, purpose, and characteristics, of system modules. Recognize these modules by sight or definition.

Examples of concepts and modules are:

a. Motherboard
b. Firmware
c. Power supply
d. Processor/CPU
e. Memory
f. Storage devices
g. Display devices
h. Adapter cards
i. Ports
j. Cases
k. Riser cards

1.2 Identify basic procedures for adding and removing field-replaceable modules for desktop systems. Given a replacement scenario, choose the appropriate sequences.

Desktop components:

a. Motherboard
b. Storage device
    - FDD
    - HDD
    - CD/CDRW
    - DVD/DVDRW
    - Tape drive
    - Removable storage
c. Power supply
    - AC adapter
    - AT/ATX
d. Cooling systems
    - Fans
    - Heat sinks
    - Liquid cooling
e. Processor/CPU
f. Memory
g. Display device
h. Input devices
    - Keyboard
    - Mouse/pointer devices
    - Touch screen
i. Adapters
    - Network Interface Card (NIC)

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- Sound card
- Video card
- Modem
- SCSI
- IEEE 1394/Firewire
- USB
- Wireless

1.3 Identify basic procedures for adding and removing field- replaceable modules for portable systems. Given a replacement scenario, choose the appropriate sequences.

Portable components:

a. Storage devices
    - FDD
    - HDD
    - CD/CDRW
    - DVD/DVDRW
    - Removable storage
b. Power sources
    - AC adapter
    - DC adapter
    - Battery
c. Memory
d. Input devices
    - Keyboard
    - Mouse/pointer devices
    - Touch screen
e. PCMCIA/Mini PCI Adapters
    - Network Interface Card (NIC)
    - Modem
    - SCSI
    - IEEE 1394/Firewire
    - USB
    - Storage (memory and hard drive)
f. Docking station/port replicators
g. LCD panel
h. Wireless
    - Adapter/controller
    - Antennae

1.4 Identify typical IRQs, DMAs, and I/O addresses, and procedures for altering these settings when installing and configuring devices. Choose the appropriate installation or configuration steps in a given scenario.

Content may include the following:

a. Legacy devices (e.g., ISA sound card)
b. Specialized devices (e.g., CAD/CAM)
c. Internal modems
d. Floppy drive controllers
e. Hard drive controllers

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f. Multimedia devices
g. NICs
h. I/O ports
    - Serial
    - Parallel
    - USB ports
    - IEEE 1394/Firewire
    - Infrared

1.5 Identify the names, purposes, and performance characteristics, of standardized/common peripheral ports, associated cabling, and their connectors. Recognize ports, cabling, and connectors, by sight.

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a. Port types
    - Serial
    - Parallel
    - USB ports
    - IEEE 1394/Firewire
    - Infrared
b. Cable types
    - Serial (Straight through vs. null modem)
    - Parallel
    - USB
c. Connector types
    - Serial
        - DB-9
        - DB-25
        - RJ-11
        - RJ-45
    - Parallel
        - DB-25
        - Centronics (mini, 36)
    - PS2/MINI-DIN
    - USB
    - IEEE 1394

1.6 Identify proper procedures for installing and configuring common IDE devices. Choose the appropriate installation or configuration sequences in given scenarios. Recognize the associated cables.

Content may include the following:

a. IDE Interface Types
    - EIDE
    - ATA/ATAPI
    - Serial ATA
    - PIO
b. RAID (0, 1 and 5)
c. Master/Slave/cable select
d. Devices per channel
e. Primary/Secondary

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f. Cable orientation/requirements

1.7 Identify proper procedures for installing and configuring common SCSI devices. Choose the appropriate installation or configuration sequences in given scenarios. Recognize the associated cables.

Content may include the following:

a. SCSI Interface Types
    - Narrow
    - Fast
    - Wide
    - Ultra-wide
    - LVD
    - HVD
b. Internal versus external
c. SCSI IDs
    - Jumper block/DIP switch settings (binary equivalents)
    - Resolving ID conflicts
d. RAID (0, 1 and 5)
e. Cabling
    - Length
    - Type
    - Termination requirements (active, passive, auto)

1.8 Identify proper procedures for installing and configuring common peripheral devices. Choose the appropriate installation or configuration sequences in given scenarios.

Content may include the following:

a. Modems and transceivers (dial-up, cable, DSL, ISDN)
b. External storage
c. Digital cameras
d. PDAs
e. Wireless access points
f. Infrared devices
g. Printers
h. UPS (Uninterruptible Power Supply) and suppressors
i. Monitors

1.9 Identify procedures to optimize PC operations in specific situations. Predict the effects of specific procedures under given scenarios.

Topics may include:

a. Cooling systems
    - Liquid
    - Air
    - Heat sink
    - Thermal compound

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b. Disk subsystem enhancements
    - Hard drives
    - Controller cards (e.g., RAID, ATA-100, etc.)
    - Cables
c. NICs
d. Specialized video cards
e. Memory
f. Additional processors

1.10 Determine the issues that must be considered when upgrading a PC. In a given scenario, determine when and how to upgrade system components.

Issues may include:

a. Drivers for legacy devices
b. Bus types and characteristics
c. Cache in relationship to motherboards
d. Memory capacity and characteristics
e. Processor speed and compatibility
f. Hard drive capacity and characteristics
g. System/firmware limitations
h. Power supply output capacity

Components may include the following:

a. Motherboards
b. Memory
c. Hard drives
d. CPU
e. BIOS
f. Adapter cards
g. Laptop power sources
    - Lithium ion
    - NiMH
    - Fuel cell
    - PCMCIA Type I, II, III cards

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PC Key Components

When working with PC components as an A+ technician, it is imperative that you be able to distinguish any component within the chassis that is identifiable by the A+ exam. You will need to be able to identify the names, purpose, and characteristics, of system modules. Recognizing these modules by sight or definition is very important.

Remember that when working with a mouse and a keyboard, you are working with Input devices. Output devices are monitors, printers, etc.

Processing is done via the CPU (central processing unit) and system memory. Storage is done via multiple devices such as a hard drive (or disk), CD-ROM, DVD-ROM, tape drive, and floppy drive as well as internal vs. external drives and so on. You have two main designs, AT and ATX

There is a main board (Planar board) or Motherboard where all devices will terminate to include the power source. Other items that will connect into the Motherboard are as follows:

- Card expansion slots - PCI, ISA, AGP, etc
- ROM BIOS/CMOS Chip and Battery
- Main Motherboard power connector
- I/O ports such as serial, parallel, and USB
- PS/2 mouse and keyboard ports
    - A mouse can also be used in a serial port, but it must be a serial mouse. Pay attention to small difference in peripherals, you can get a mouse that will connect multiple ways, such as serial, USB and PS/2 and you can find PS/2 keyboards (mini-DIN) as well as keyboards that use the older larger connectors, just be aware that there are many different ways to connect so do not assume that a peripheral will always connect the same way each time, USB is starting to become the most commonly seen aside from PS/2.
- Memory slots where you can install SIMMs and DIMMs, etc
- CPU, heat sink, fan as well as mounting socket
- Hard disk connections: 40-pin EIDE Primary and Secondary connections
- Floppy disk connections: 34-pin Floppy connector located on Motherboard

Motherboard BIOS

BIOS stands for the Basic Input/Output System, it is a simple program that runs when you first boot your PC. It starts the boot process. The BIOS is stored on an EEPROM (Electrically Erasable Programmable Read-Only Memory) chip. The BIOS is loaded into the upper 64 KB of the first 1 MB of system memory. e BIOS will (with the help of the CMOS) store your computer's hardware settings for booting. CMOS stands for Complimentary Metal Oxide Semiconductor and is a chip on the Motherboard that contains a small amount of non-volatile memory used for storing BIOS settings

Types of ROM chips

ROM

ROM stands for Read-only memory, and it is not in use much anymore.

PROM

PROM stands for Programmable ROM, which means it is a type of ROM that needs to be programmed to be functional. Embedded microprocessors commonly use PROM.

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EPROM
EPROM stands for Erasable Programmable ROM. This is old technology and not used in today's high speed computing environments. However, because of legacy equipment, it is still important to know about. EPROM uses a clear quartz crystal window set in the chip package that will allow for the chip to be erased or flashed. The Flashing is done by UV light passing through the quartz window

EEPROM
EEPROM stands for Electrically Erasable PROM. This is today's standard. Most if not all motherboards manufactured today have EEPROMS or **flash ROMs** - installed. Flash ROMs are very easy to update and most vendors have online documentation with exact steps on how to update your motherboard if needed.

CPU
The CPU, processor or microprocessor, and system BUS is the heart, brain and nervous system of the PC. You need to know the fundamentals of a CPU for the A+ exam.

Name	Date	Clock Speed (in MHz)	Data Width
8080	1974	2	8 Bits
8080	1978	5	16 Bits, 8 bit bus
80286	1982	6	16 Bits
80386	1985	16	32 Bits
80486	1989	25	32 Bits
Pentium	1993	60	32 Bits, 64 bit bus
Pentium II	1997	233	32 Bits, 64 bit bus
Pentium III	1999	450	32 Bits, 64 bit bus
Pentium 4	2000	1.5 **GHz**	32 Bits, 64 bit bus

Memory
The CPU uses memory, which used to store data and program files, to execute instructions
Memory is volatile which means that data stored in it will be lost when the power to the PC is removed. Non-volatile is the reverse, it will hold information when the power is removed. There are many types of Memory you need to know about for the A+ exam:

RAM
RAM stands for random-access memory. It is the most common computer memory which can be used by programs to perform necessary tasks while the computer is on. An integrated circuit memory chip allows information to be stored or accessed in any order and all storage locations are equally accessible

ROM
ROM or read-only memory is memory whose contents can be accessed and read but cannot be changed.

DRAM
DRAM, also known as dynamic random access memory, is a type of memory component used to store information in a computer system. "Dynamic" means the DRAMs need a constant refresh, which is a pulse of current through all of the memory cells to keep the information stored

SRAM
Static random access memory is extremely high speed RAM that does not need a constant refresh unlike DRAM. Because it is very expensive, SRAM is usually used as cache RAM on CPUs only.

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VRAM
Video random access memory is a special form of RAM that is used to store image data for a computer display. VRAM can be accessed for screen updates at the same time the video processor is providing new data.

SIMM
SIMM or single in-line memory module is a small circuit board that holds memory chips and has a 32-bit path to the memory chips

DIMM
Dual in-line memory module is a small circuit board that can hold a group of memory chips. A DIMM is capable of transferring 64 bits instead of the 32 bits each SIMM can handle. Pentium processors require a 64-bit path to memory so SIMMs must be installed two at a time as opposed to one DIMM at a time

EDO RAM
Extended data out random access memory or EDO RAM is similar to FPM memory, a form of DRAM technology that shortens the read cycle between memory and CPU. It provides improved performance by keeping available data in memory longer and eliminates much of the wait time by allowing the processor to access data during the refresh cycle. EDO memory is generally 10 to 20% faster than FPM memory, but a system must support EDO memory in order to notice an increase in performance.

Power Supply
To fuel the PC with power, you need a supply. The power supply in the PC is one of the most important, easiest to handle FRU in the case. The power supply 9 out of 10 times comes with the case itself so if it burns out, then you only need to replace it. From the power supply, you fuel the motherboard and drives. Technically, the power supply converts AC current to DC current and is not a line conditioner and that is why you need an external UPS to protect your system.

For the A+ exam, remember that DC operating voltages are +/-1.7V, +/-3.3V, +/- 5 V, and +/- 12 V

Storage Devices
PC hard disks/drives are the main storage centers for the standard PC. Although there are main alternatives such as the CD-ROM for example, you still need to consider the main disk drive and consider that it stores the PC's operating system.

When thinking about storage, the A+ covers IDE and SCSI Hard Drives. There are two primary types of hard drives and one is IDE which is really now known as EIDE (enhanced IDE) and SCSI.

IDE
IDE stands for Integrated/Intelligent Drive Electronics.

- Two ATA type connectors on motherboard
- One Primary and one Secondary
- Both 40-pin connectors
- Only allowed a maximum of 4 IDE devices overall
- Used on PCs, cheaper

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SCSI
SCSI stands for Small Computer Systems Interface

- External or internal, Integrated or PCI host card
- SCSI 50-pin connector and optional 68-pin connector
- Used mostly on Servers
- More expensive, better performance

Floppy Drives

Floppy drives for today's standards are hardly used, unless for retrieving old data or because you need one on your system for some reason (servers have floppies for drivers, boot disks, etc), and it is recommended that you have one on yours if you want to use a boot disk, or you can use a CD to boot the system with. In any case, it is still important to know about for floppy drives the A+ exam.

The 3.5" floppy drive stores up to 1.44MB of information and is typically slow. Physical size standard is 3.5". Older (larger) 5.25" drives are obsolete (think: Commodore 64). Data storage capacity is 720 KB Double Density, 1.44 MB High Density, and up to 2.88 MB. 1.44 MB High Density is most commonly seen and used. The drive is connected via a 34-pin cable.

CD-ROM

A CD-ROM or Compact Disk - Read Only Memory is a computer storage medium that stores large amounts of information; generally used to distribute software or multi-media for use on computers with CD-ROM drives. The physical size is 5.25" and data capacity is 650 MB – 700 MB and above, but these are most common. Other types are:

- CD-R (Recordable)
- CD-RW (ReWritable)
- DVD-ROM and DVD

IRQs

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

You can get to your own IRQs by going to the Computer Management Console (as seen here) and clicking on Device Manager. Right-click the Device Manager node in the Computer Management Navigation Pane and select View => Resources by type to see your own IRQs.

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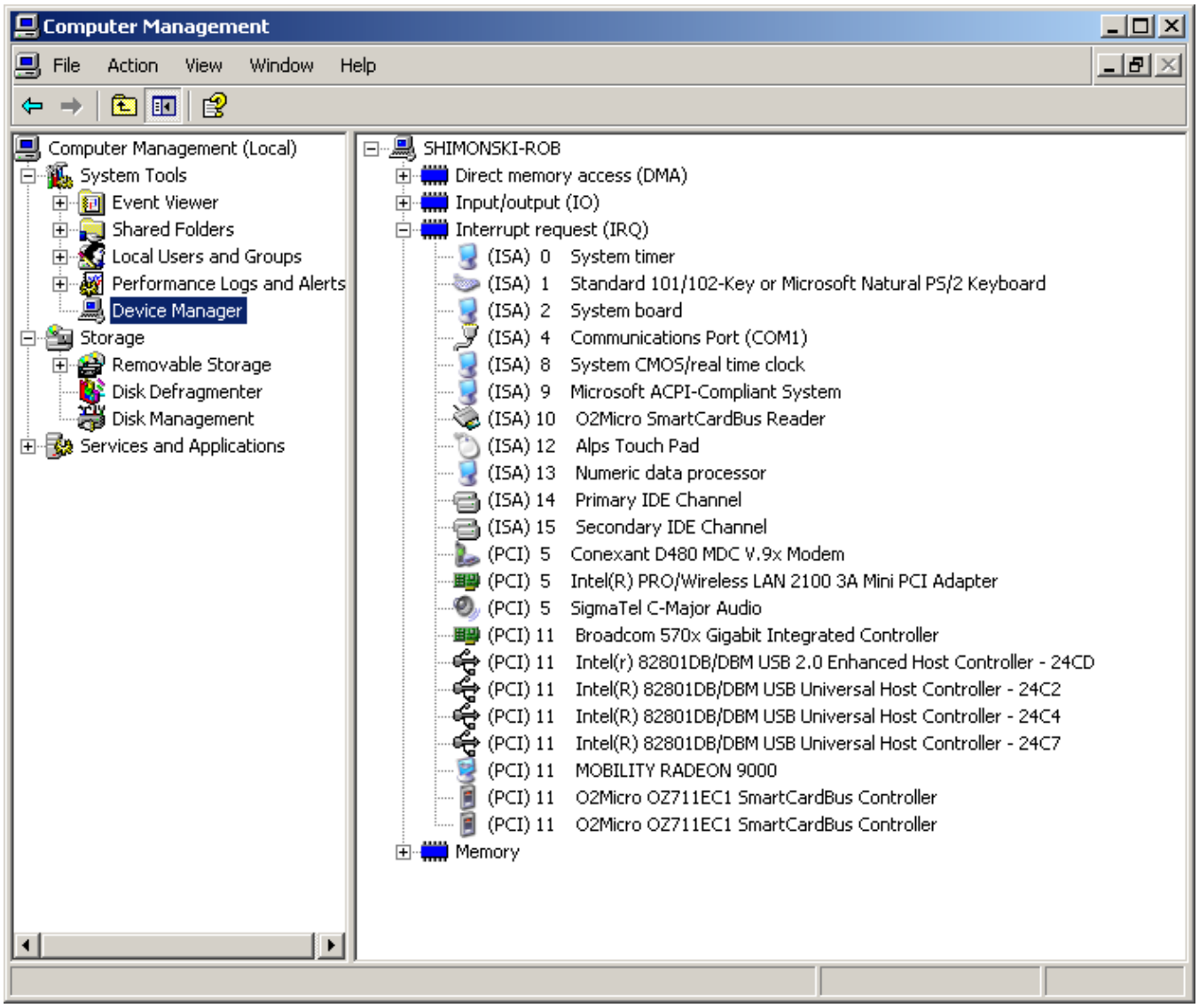

DMAs

DMA, which stands for Direct Memory Access, allows for the transfer of data directly into memory without supervision of the processor. The data is passed on the bus directly between the memory and another device. Devices using DMA include:

- HDCs and FDCs (Hard/Floppy Disk Controllers)
- NICs (Network Interface Cards)

File Systems

FAT16

A 16-bit DOS and Windows file system (see FAT) that varies cluster sizes based on hard drive size. Cluster sizes range from:

- 4K (for drives up to 127MB)
- 8K (511MB drives)
- 16K (1GB drives)
- 32K (for drives up to 2GB).
- The ultimate capacity of a FAT16 partition is 2GB

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FAT32
FAT32 is a 32-bit version of the File Allocation Table which first shipped with Windows95 SR2. It uses 32 bits to address each cluster and can support drives as big as two Terabytes. The older FAT used 16-bits to address each cluster and was limited to drive sizes of 512 Mb. Each cluster in a FAT32 system is only 4 Kb which also helps to save space on your hard drive.

NTFS (4)
NTFS is the Windows NT file system. Unlike FAT, NTFS does not use an allocation table but stores information about any file directly with the file. Other operating systems, including Windows 95, and many applications, such as ScanDisk, cannot read NTFS partitions. However, NTFS files or folders that are shared on a network can be accessed by other operating systems. Advantages of NTFS over FAT include:

- faster access to files
- more efficient information storage (for example, through a smaller cluster size),
- better data recovery
- integrated file compression
- larger disk partitions
- better file security

NTFS is preferred for Windows NT Server because of its better security and fault tolerance features. NTFS partitions also remain relatively unfragmented for long periods of time. NTFS 5.0 (NTFS5), the version of NTFS included with Win2K.

NOTE: For detailed information on NTFS5, please read this article on Microsoft's TechNet.

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnw2kmag00/html/NTFSPart1.asp

IDE and SCSI Interface Types

For the A+ examination, you should be comfortable with working with IDE and SCSI hardware.

IDE devices use the standard ATAPI interface.

IDE
IDE stands for Integrated Drive Electronics.

- ATA
- ATA 2
- ATAPI

EIDE
EIDE stands for Enhanced Integrated Drive Electronics.

- Fast ATA
- Fast ATA 2
- ATA 3
- Ultra ATA

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- ATA66
- ATA100
- ATA133

ATAPI
ATAPI stands for ATA Packet Interface.
- CD-ROMs
- CD-RWs
- DVDs

SCSI
SCSI stands for Small Computer Systems Interface.
- SCSI is a high performance advanced bus interface.
- SCSI connects many different types of devices to a PCs internal bus.
- Up to 7 devices can be connected on a single bus
- Up to 15 devices can be connected on a wide bus
- SCSI host adapters are commonly factory set to ID 7 or 15
- ID 7 or 15 are the highest IDs
- The SCSI host card uses a SCSI ID.

RAID Types

RAID 0
- Stripping
- A stripped disk array
- Blocks of data are written to separate drives.
- A minimum of two drives needed to set up.
- Better read/write performance
- No fault tolerance

RAID 1
- Mirrored disks
- A mirrored disk array, where the second or mirrored drive contains an identical copy of the first drive.
- A minimum of two disk drives is needed to set up.
- Easy to set up
- Fault tolerant

RAID 5
- Stripping with parity
- Data and parity information written across all drives in an array
- A minimum of three disk drives is needed to set up.
- Good performance
- Fault tolerant

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Domain 2.0 – Diagnosing and Troubleshooting 21%

Chapter 2

2.1 Recognize common problems associated with each module and their symptoms, and identify steps to isolate and troubleshoot the problems. Given a problem situation, interpret the symptoms and infer the most likely cause.

Content may include the following:

a. I/O ports and cables
   - Serial
   - Parallel
   - USB ports
   - IEEE 1394/Firewire
   - Infrared
   - SCSI

b. Motherboards
   - CMOS/BIOS settings
   - POST audible/visual error codes

c. Peripherals

d. Computer case
   - Power supply
   - Slot covers
   - Front cover alignment

e. Storage devices and cables
   - FDD
   - HDD
   - CD/CDRW
   - DVD/DVDRW
   - Tape drive
   - Removable storage

f. Cooling systems
   - Fans
   - Heat sinks
   - Liquid cooling
   - Temperature sensors

g. Processor/CPU

h. Memory

i. Display device

j. Input devices
   - Keyboard
   - Mouse/pointer devices
   - Touch screen

k. Adapters
   - Network Interface Card (NIC)
   - Sound card
   - Video card
   - Modem

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- SCSI
- IEEE 1394/Firewire
- USB

l. Portable Systems
- PCMCIA
- Batteries
- Docking Stations/Port Replicators
- Portable unique storage

2.2 Identify basic troubleshooting procedures and tools, and how to elicit problem symptoms from customers. Justify asking particular questions in a given scenario.

Content may include the following:

a. Troubleshooting/isolation/problem determination procedures
b. Determining whether a hardware or software problem
c. Gathering information from user
- Customer Environment
- Symptoms/Error Codes

d. Situation when the problem occurred

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Diagnosing and Troubleshooting Common Problems

For the A+ technician, nothing is more critical than accurately finding and resolving problems. Many times, working through problems quickly and effectively to a correct resolution is what makes you a cut above the rest. To do this, it takes a sharp mind and a set of steps to follow to be able to find issues and problems. This is not a complete listing, but very close to most of what it is you need to do whenever you try to isolate, diagnose, and resolve a problem.

Common things to check:

One of the most common issues encountered in PC problem troubleshooting is power issues. Power is easy to verify. Look for physical connection and any kind of latent power lights lit up on NICs (link lights), etc. Make sure you have power or you will not compute!

Make sure that all fans are operational on the PC and that you have proper airflow configured. Any overclocking or similar problem needs to be addressed with coolant or it will cause issues with the system. Check all cables and connectors to ensure they are secure and fastened properly. If not, then you may get intermittent connectivity or no connection at all. Device (hardware) conflicts are also very common. It is common to install more hardware than the system can handle, but this will cause some hardware to not function.

Again, there is much more, but it is mostly common sense. You can list out for every device a way to troubleshoot it, but remember to think about how that device works. For instance, keyboard does not work, system will not boot, BIOS beep codes may point out a problem, look it up, check connectivity and reset the jack in the system, then reboot. Check if it works, repeat steps if it does not to continue to find the problem. This is how to think outside the box and resolve issues.

Common Error Messages and Codes

Boot Failure

Booting failures and errors such as invalid boot disk, inaccessible boot device, missing NTLDR, bad or missing command interpreter appear from time to time. From an error message, you will need to know how to determine the problem and know the next steps to fix the system. At a minimum, you need to be able to determine what the problem is.

Missing Operating System

This error occurs when the boot record signature of the master boot record does not match a certain value at a certain location. In this case, the boot sector is invalid and the computer cannot boot. This error can also occur if there is no active partition defined in the partition table.

Non-System Disk or Disk Error

This error is generated by the computer's BIOS when the boot sector or master boot record of the boot drive is damaged or missing. This error can also occur if the boot device has been improperly configured in the BIOS. In this case, data in the partition may be valid and undamaged, but there is no bootable partition. This message also occurs when a non-bootable disk is left in drive A during startup. If you receive this error, make sure that there is no disk in drive A, and restart your computer.

Boot Error Press F1 to Retry

This error is generated by the computer's BIOS when the hard disk is missing a master boot record or boot sector, or when there is a problem accessing the boot drive.

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NO ROM BASIC
If there is no active partition defined, the master boot record returns an error to the BIOS. In some cases, the master boot code attempts to go to ROM Basic when no bootable disk is found. Since some computers do not have ROM Basic, they display a NO ROM BASIC or other error message. The message displayed is dependent upon the computer's BIOS.

Invalid Media Type
This error message is displayed when the boot sector of a defined partition is damaged. The error message is normally received using a new partition that has not been formatted. However, if the boot sector is damaged, the partition may appear unformatted to the operating system, and this error message is generated.

Hard Disk Controller Failure
This error message indicates either the hard disk controller has failed, that it is not set up properly in the BIOS, or the that controller cannot communicate with the attached drive(s). In this case, do not perform the troubleshooting steps below. Instead, consult the documentation included with your computer or contact the computer's manufacturer for more information.

Startup messages
Startup messages will show you errors that occur during the startup process.

Bad or Missing COMMAND.COM
This means that the OS is unable to locate the file COMMAND.COM. To fix this problem, make sure that the necessary boot files are located on the hard drive. If not, boot with the startup disk and enter the command SYS C:\, which will copy the system files to the hard drive (Windows 9x only).

HIMEM.SYS not loaded
Check the CONFIG.SYS file and make sure that the line Device=C:\HIMEM.SYS exists and that the path specified to the file is where the file actually is.

Error in CONFIG.SYS line XX
This error is usually caused by a syntax error in the CONFIG.SYS or AUTOEXEC.BAT file where XX will be the line number that the error occurred.

NOTE: Dr. Watson for Windows is a program error debugger that gathers information about your computer when an error (or user-mode fault) occurs with a program. Technical support groups can use the information that Dr. Watson obtains and logs to diagnose a program error. When an error is detected, Dr. Watson creates a text file (Drwtsn32.log) that can be delivered to support personnel by the method they prefer. You also have the option of creating a crash dump file, which is a binary file that a programmer can load into a debugger.

http://support.microsoft.com/default.aspx?scid=kb;EN-US;308538

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Startup Modes

Startup Modes are used to help troubleshoot the system that may be having problems. If you are not able to boot up or start the PC, then you may have to use the startup modes menu options to help you get into the system. These following modes are available in case you need to get into the system.

Safe mode
Safe Mode loads the system to the desktop with a minimal set of drivers and services for troubleshooting purposes

Safe Mode with command prompt
In this instance, the system loads in safe mode, and you work within the command prompt only.

Safe mode with networking
The system loads in safe mode but allows the networking drivers to load as well.

Step-by-Step/Single step mode
This mode allows you to start the PC step by step and verify or see each action taken at each step of the boot.

Automatic skip driver (ASD.exe)
Automatic Skip Driver Agent identifies devices that can cause Windows to stop responding (hang) when you start your computer, and then disables them so that they are bypassed when you next restart your computer.

Diagnostic tools, utilities and resources

There are many tools and resources you can use to troubleshoot your system.

User/installation manuals
Any reference material that comes with a system can be used to help troubleshoot the system. If the manual does not come with the system and you have an Internet connection, then you can use that as an online resource.

Internet/web resources
These are online resources you can use to help solve problems. Major search engines, vendor websites, and user forums are the best resources you can use.

Training materials
Any form of training class you take should come with a manual or some form of book-related work. These can be used to help you troubleshoot and diagnose issues.

Task Manager
Please note that Task Manager was covered earlier in this study guide. Task Manager can be used to help troubleshoot system problems, such as when your system hangs. You can start and stop processes that may be causing the issue, and you can view memory and processor statistics as well as many other things.

Boot Disk
A boot disk can help you bypass corrupted files that may have previously kept you from booting it up normally and getting into that system.

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Event Viewer
The Event Viewer is used to view system logs that can show problems in the system from startup through normal operation and during showdown.

Device Manager
Device Manager, covered earlier in the study guide, is a tool that can help you see what hardware in your PC may not be configured or operating properly.

WinMSD
WinMSD reports information on the following:

- Memory use
- Services
- Devices
- IRQs
- Ports
- Environment variables
- Network information
- Hardware information

MSD
This is the older version of WinMSD

Eliciting problem symptoms from customers

As an A+ technician, it is very important to know how to resolve problems in an organization or place of work, or at home. You need to know how to help someone who has a problem by first defining what the problem is (or getting that information from someone you are trying to help), all the way to isolating and resolving the issue.

Make sure that you can get the customer to clearly define the problem Make sure that the error is what it is; you can try to reproduce the error to prove that you have the error pinpointed. Also, always try to get the problem defined.

Always try to see what the last thing that was done was or what the last change made to the system was. Try to let the customer know that even though it might be petty to them (like putting a floppy in the A: drive), whatever the last things that they did while the computer was operational is important to know. For instance, that floppy could have had a virus on it. Also, find out if anything happened in the area like a power outage.

Viruses and virus types

A virus is software used to infect a computer. Virus code is usually buried within the code of another program. Once the program is executed, the virus is activated and attaches copies of itself to other programs in the system. The effects of a virus can range from harmless messages that appear on screen to destruction of data, either right away or on a set date. File attachments in e-mail messages are a common source of virus. More information about virus activity can be found at www.sarc.com

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Boot Process Symptoms

Common Symptoms

- No POST or POST errors
- CMOS errors
- No power on
- No LCD lights
- No boot up
- No display
- Beep codes
- Error messages

Boot Sequence for Windows NT Based Systems

The first thing that happens when you power on your PC is you have a POST. The POST stands for Power on Self Test. Memory is tested, and hardware on the system is verified. Once POST completes, the PC will attempt to locate a bootable device, and once it is found the MBR (Master Boot Record) is loaded into memory. The MBR locates the active partition and into memory loads the boot sector.

The operating system is then selected by NTLDR. NTLR will use the Ntdetect.com, boot.ini, and bootsect.dos files to get the proper OS selected and loaded. When NTLDR runs, 32-bit mode starts as opposed to the real mode (16 bit) load before it. Once NTLDR switches into 32-bit mode, the file system is loaded (NTFS, FAT32, etc) so that the boot.ini can be read and then checked. Once the boot.ini is checked, you select the OS you would like to load. Windows will now pass control over to Ntdetect.com, so it can start to gather information about your systems hardware. Such hardware as:

- Computer ID
- Bus/adapter type
- SCSI adapters
- video adapters
- keyboard
- Com ports
- Parallel ports
- Floppy disks
- Pointing devices

Once Ntdetect.com collects the needed information, NTLDR loads Ntoskrnl and passes control to it. Ntoskrnl.exe and hal.dll are loaded. Next, the Registry is loaded and a hardware profile is selected. If you have multiple hardware profiles created, you may be asked to select from one to load. After you have selected the proper hardware profile (or if the default one just loads), then you will next be greeted by the login prompt.

Alternative Boot Methods

Using a Startup disk

You can use a startup disk that contains enough files to get you up to a command prompt, so you may be able to run some tools to get things fixed or to boot to another system.

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Safe/VGA-only mode
Safe or VGA mode is nothing more than a smaller footprint of the OS loaded so that you can repair any damage that may have taken place. A good example is installing a new Video Driver that the hardware cannot support. You will not be able to load the system to repair it, so you can load the system in Safe Mode which does not load most device drivers. Your video card is now accessible and you can remove the setting or whatever caused the system to fail.

Last Known Good configuration
The last known good configuration is a revert back to the old Registry files last loaded on the system. If you make a change to your system (like install an application) and it crashes your system, the last known good configuration can be loaded instead.

Command Prompt mode
When selected, this is loaded much the same way you would use a startup disk. The Command Prompt mode allows you to run commands from within the prompt to help fix the system if it is in need of repair.

Booting to a system restore point
System Restore is a feature of Windows that allows the administrator of the PC to rollback to another instance of the system from an earlier time. It will restore your computer to a previous state, if a problem occurs, without losing:

- data files
- history
- drawing
- favorites
- e-mail

System Restore monitors changes to the system and some application files, and it automatically creates easily identified restore points unless you disable it from doing so. Stopping restore points from being created it is not recommended, but if you do, you can save a lot of disk space. The saved restore points can eat up hard disk space. These restore points allow you to revert the system to a previous time. They are created daily and at the time of significant system events (such as when an application or driver is installed). You can also create and name your own restore points at any time. Make a restore point by going to Start => Programs => Accessories => System Tools => System Restore

Recovery Console
The Recovery Console is a tool that will allow you to solve issues in the boot process or to help avert disaster – it should be used after tools like Safe Mode are attempted. Using the Recovery Console, you can enable and disable services, format drives, read and write data on a local drive (including drives formatted to use NTFS), and perform many other administrative tasks. The Recovery Console is particularly useful if you need to repair your system by copying a file from a floppy disk or CD-ROM to your hard drive, or if you need to reconfigure a service that is preventing your computer from starting properly.

There are two ways to start the Recovery Console. If you are unable to start your computer, you can run the Recovery Console from your Setup CD. As an alternative, you can install the Recovery Console on your computer to make it available in case you are unable to restart Windows. You can then select the Recovery Console option from the list of available options on startup.

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After you start the Recovery Console you will have to choose which installation you want to log on to (if you have a dual-boot or multiple-boot system), and you will have to log on with your administrator password.

The console provides commands you can use to do simple operations such as changing to a different directory or viewing a directory, and more powerful operations such as fixing the boot sector. You can access Help for the commands in the Recovery Console by typing **help** at the Recovery Console command prompt. To install the Recovery Console as a startup option:

- With Windows running, insert the Setup CD into your CD-ROM drive.
- Click Start => Run => D:\i386\winnt32.exe /cmdcons

To run the Recovery Console, restart your computer and select the Recovery Console option from the list of available options. You must be logged on as an administrator or a member of the Administrators group in order to complete this procedure.

Boot.ini switches
The Boot.ini file was covered earlier in this study guide.

Creating and using an emergency repair disk (ERD)

An ERD is a disk, created by the Backup utility that contains copies of three of the files stored in the %SystemRoot%/Repair folder including Setup.log that contains a list of system files installed on the computer. This disk can be used during the Emergency Repair Process to repair your computer if it will not start or if your system files are damaged or erased. Creating the ERD is a simple process:

- Obtain a blank, formatted, virus-free floppy diskette
- Make a backup copy of the Winnt\repair directory on to the disk.
- Click Start => Programs => Accessories => System Tools => Backup.
- On the Welcome tab => click the button next to "Emergency Repair Disk."
- In the Emergency Repair Diskette window that appears => click the box next to "Also backup the Registry to the repair directory..." Insert the floppy in the drive, and click OK.
- Once you receive the success message, click OK
- Save the disk somewhere safe, it contains sensitive information

CPU/Motherboard

Motherboard is the hardest component to troubleshoot because there is so much to look at and attempt to isolate. Also, there are many things that can be hidden from view, such as a break in the bus from an ESD issue for example.

Symptoms of CPU (overheating) and Motherboard issues are unexplained and random reboots of the system, screen freezes, and system locks are signs of CPU problems as well as ghost like issues that cannot be tracked down or isolated. Always attempt to update the BIOS code before ruling out a dead motherboard. Also, check fan and heat sink visually and in CMOS and make sure that it is working.

Troubleshooting Procedures

The most important step in PC troubleshooting is to try to keep your mind focused on the problem while working to isolate, diagnose and remedy the issue. Do not let your mind wander. Focus on the issue and fix it.

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Make sure that you play a detective role and gather all pertinent information that will be needed to strategize a fix. This might include beep codes, error messages, logs, eye witness to the crime, whatever is needed, make sure you are thinking about getting it.

Try to recreate the problem if possible. Nothing smells of victory more than being able to recreate the exact problem you are experiencing, it really shows an intimate view of your understanding of the problem and what needs to be done about it.

Gathering information, determining if the problem is hardware or software based, and trying to isolate and reproduce the error are key strategies to correct most hardware problems.

Document everything. Make sure you note the fix, the problem, the workaround, the network layout, the PC schematics, the links you referenced, and whatever is going to help you to learn from the experience and help others avoid it.

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Domain 3.0 – Preventive Maintenance 5%

3.1 Identify the various types of preventive maintenance measures, products and procedures and when and how to use them.

Content may include the following:

a. Liquid cleaning compounds
b. Types of materials to clean contacts and connections
c. Non-static vacuums (chassis, power supplies, fans)
d. Cleaning monitors
e. Cleaning removable media devices
f. Ventilation, dust and moisture control on the PC hardware interior.
g. Hard disk maintenance (defragging, scan disk, CHKDSK)
h. Verifying UPS (Uninterruptible Power Supply) and suppressors

3.2 Identify various safety measures and procedures, and when/how to use them.

Content may include the following:

a. ESD (Electrostatic Discharge) precautions and procedures
b. What ESD can do, how it may be apparent, or hidden
c. Common ESD protection devices
d. Situations that could present a danger or hazard
e. Potential hazards and proper safety procedures relating to
    - High-voltage equipment
    - Power supply
    - CRTs

3.3 Identify environmental protection measures and procedures, and when/how to use them.

Content may include the following:

a. Special disposal procedures that comply with environmental guidelines.
b. Batteries
c. CRTs
d. Chemical solvents and cans
e. MSDS (Material Safety Data Sheet)

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Preventative Maintenance and Safety

Now that you have learned about some of the internal workings of a PC and how to troubleshoot problems as they occur, now it is time to look at how to keep your PC up and running and keep it safe from harm or environmental issues.

PCs are electronically powered gadgets; electricity and water do not mix when it comes to PCs. Also, it was mentioned earlier in this study guide that it is imperative to ensure proper airflow through the chassis as well, that means that you should not run your PC with the case open, or with PCI slot cutouts not put back into open slots on the chassis when installing or removing PCI cards as an example, that will open up the back of the case to dirt, dust and debris as well as change the airflow through the chassis as it was designed to do.

These examples should show you the power of the environment when it comes to running or repairing a PC. Repairing a PC is great, but when you forget to wear a 5 dollar ESD wrist bracelet to help protect the component you may have just installed and inadvertently shocked it, ruining it, you will kick yourself. Just like any other device, PCs need attention to keep them running properly. You do not neglect your car, do you? Proactive maintenance will help to keep long lasting, dependable operation for your PC.

Cleaning Products

To clean your PC, you should use only approved, lint-free cleaning fabrics. Isopropyl alcohol can be used, but never use unapproved cleaning chemicals on a PC. Use only compressed air, as well as any approved vacuums for cleaning inside a PC, you can used canned air to blow out dust and debris from within the chassis.

Cleaning/Maintenance Procedures

When working with a PC, you should follow a few simple guidelines or procedures to give you a hand. Ventilation slots should not be blocked or obstructed. Properly upkeep them so that they stay clean. Clean the inside of PC with compressed air. Also, clean the monitor approved monitor CRT or LCD screen cleaner.

Power Issues and using a UPS (Uninterruptible Power Source)

It is imperative for the A+ technician to remember that UPSs and SPSs can protect your PC against power surges, sags, brownouts, and blackouts.

- **Surges**: a steady and abrupt change in voltage
- **Spikes**: a sudden and drastic change in voltage
- **Sags**: a quick dip in available voltage
- **Brownouts**: between a sag and a complete Blackout, not a complete loss of power, but more excessive than a sag
- **Blackout**: complete loss of power

ESD (Electrostatic Discharge)

Electrostatic Discharge is the immediate discharge of a static charge on a surface or body through a conductive path to ground. Water or moisture can be conductive. An electronic component may be damaged completely from ESD or from being in the discharge path. Make sure you consider using ESD protective gear like a wrist strap, grounding mats and so forth. Keep in mind that memory is especially sensitive to ESD so make sure you are grounded properly when touching any component, especially memory.

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Domain 4.0 – Motherboards, Processors, and Memory 11%

Chapter 4

4.1 Distinguish between the popular CPU chips in terms of their basic characteristics.

Content may include the following:

a. Popular CPU chips (Pentium class compatible)
b. Voltage
c. Speeds (actual vs. advertised)
d. Cache level I, II, III
e. Sockets/slots
f. VRM(s)

4.2 Identify the types of RAM (Random Access Memory), form factors, and operational characteristics. Determine banking and speed requirements under given scenarios.

Content may include the following:

a. Types
    - EDO RAM (Extended Data Output RAM)
    - DRAM (Dynamic Random Access Memory)
    - SRAM (Static RAM)
    - VRAM (Video RAM)
    - SDRAM (Synchronous Dynamic RAM)
    - DDR (Double Data Rate)
    - RAMBUS
b. Form factors (including pin count)
    - SIMM (Single In-line Memory Module)
    - DIMM (Dual In-line Memory Module)
    - SoDIMM (Small outline DIMM)
    - MicroDIMM
    - RIMM
c. Operational characteristics
    - Memory chips (8-bit, 16-bit, and 32-bit)
    - Parity chips versus non-parity chips
    - ECC vs. non-ECC
    - Single-sided vs. double sided

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4.3 Identify the most popular types of motherboards, their components, and their architecture (bus structures).

Content may include the following:

a. Types of motherboards:
   - AT
   - ATX

b. Components:
   - Communication ports
   - Serial
   - USB
   - Parallel
   - IEEE 1394/Firewire
   - Infrared

c. Memory
   - SIMM
   - DIMM
   - RIMM
   - SoDIMM
   - MicroDIMM

d. Processor sockets
   - Slot 1
   - Slot 2
   - Slot A
   - Socket A
   - Socket 7
   - Socket 8
   - Socket 423
   - Socket 478
   - Socket 370

e. External cache memory (Level 2)

f. Bus Architecture

g. ISA

h. PCI
   - PCI 32-bit
   - PCI 64-bit

i. AGP
   - 2X
   - 4X
   - 8X (Pro)

j. USB (Universal Serial Bus)

k. AMR (audio modem riser) slots

l. CNR (communication network riser) slots

m. Basic compatibility guidelines

n. IDE (ATA, ATAPI, ULTRA-DMA, EIDE)

o. SCSI (Narrow, Wide, Fast, Ultra, HVD, LVD(Low Voltage Differential))

p. Chipsets

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4.4 Identify the purpose of CMOS (Complementary Metal-Oxide Semiconductor) memory, what it contains, and how and when to change its parameters. Given a scenario involving CMOS, choose the appropriate course of action.

CMOS Settings

a. Default settings
b. CPU settings
c. Printer parallel port—Uni., bi-directional, disable/enable, ECP, EPP
d. COM/serial port—memory address, interrupt request, disable
e. Floppy drive—enable/disable drive or boot, speed, density
f. Hard drive—size and drive type
g. Memory—speed, parity, non-parity
h. Boot sequence
i. Date/Time
j. Passwords
k. Plug & Play BIOS
l. Disabling on-board devices
m. Disabling virus protection
n. Power management
o. Infrared

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Processors (CPU)

The CPU, which stands for Central Processing Unit, is the computer chip that has primary responsibility for interpreting commands and running programs. It is also known as the processor or microprocessor.

Cache Terminology

L1 Cache

Pentium class (and AMD) CPUs will have a an integrated L1 memory cache controller included. The L1 cache is integrated into the dye of the processor.

L2 Cache

L2 Cache is integrated with the processor core on the latest CPUs. Most modern chipsets support L2 cache.

L3 Cache

L3 Cache is used in high end system processors like Intel's Xeon as well as Itanium. The L3 cache is also integrated into the processor.

Memory Terminology

Memory speed

Memory speed is measured in nanoseconds or billionths of a second and is the time it takes to access your data stored in memory.

Parity

Parity is an added bit called the parity bit. It is a simple error-checking method where each data byte includes a ninth bit. The parity bit is used to help ensure the use of the other 8 bits.

ECC

ECC stands for error checking and correction/correcting, which is the detection in the CPU and correction of all single-bit errors. It is also the detection of double-bit and some multiple-bit errors.

ROM

A small amount of motherboard ROM BIOS memory is used to store the PC settings in CMOS.

- Read-Only
- non-volatile
- slower

RAM

Random access memory is the main memory component in a PC. Remember that all types of RAM are volatile. Also memorize the various types of RAM and their functions for the hardware exam.
Characteristics:

- Composed of Random-Access Memory
- RAM is the CPUs system memory
- Volatile
- Inexpensive

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Motherboard Components and Terminology

Form Factors

- The shape and physical size of the system board.
- AT
- Baby AT
- ATX (industry standard)
- Mini ATX
- LPX
- Mini-LPX
- NLX

System Chipset

This is a group of microchips functioning as a unit in performing one or more related tasks like caching and interrupting. It is used as a group for better performance. The chipset will affect the CPU type as well as speed. The chipset contains:

- processor bus interface
- FSB (the front-side bus)
- memory controllers
- bus controllers
- I/O controllers

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Domain 5.0 – Printers 9%

5.1 Identify printer technologies, interfaces, and options/upgrades.

Technologies include:

a. Laser
b. Ink Dispersion
c. Dot Matrix
d. Solid ink
e. Thermal
f. Dye sublimation

Interfaces include:

a. Parallel
b. Network
c. SCSI
d. USB
e. Infrared
f. Serial
g. IEEE 1394/Firewire
h. Wireless

Options/Upgrades include:

a. Memory
b. Hard drives
c. NICs
d. Trays and feeders
e. Finishers (e.g., stapling, etc.)
f. Scanners/fax/copier

5.2 Recognize common printer problems and techniques used to resolve them.

Content may include the following:

a. Printer drivers
b. Firmware updates
c. Paper feed and output
d. Calibrations
e. Printing test pages
f. Errors (printed or displayed)
g. Memory
h. Configuration
i. Network connections
j. Connections
k. Paper jam
l. Print quality
m. Safety precautions
n. Preventive maintenance
o. Consumables
p. Environment

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Printers

For the A+ exam, it is important to know key important features of Dot Matrix, Inkjet, and LaserJet printers.

Types

- Dot Matrix
- Inkjet
- LaserJet
- Others
    - Thermal
    - Solid Ink
    - Dye Sublimation

Dot Matrix

Dot Matrix printers are sometimes referred to as Impact Printers. The printer works by impacting the paper by firing pins at a ribbon. The ink is then put into the paper. The head contains the pins. The quality of the print also happens to be measured by "pins," (9 pin, 24 pin and 48 pin printers). NLQ which stands for Near Letter Quality is the best quality you can get in a Dot Matrix print job.

Inkjet Printers

Inkjet printers use liquid ink-filled cartridges. The cartridge, when used properly, will allow for a force out and spray of electrostatic-charged droplets of ink onto a page. This is done via pin holes called *nozzles* located on the printer. Pressure and electricity allow the printer to spray ink onto the page. Print quality is measured in dpi which stands for dots per inch.

Laser Printers

Most companies (and even home users now) are shifting to laser printers. Laser printers allow for demanding printing needs that other printer types just cannot handle, such as Dot Matrix. Laser printers need to warm up if first turned on, to get the fusing stage ready. They also need memory to operate and support bidirectional communication. Print quality is measured as dpi (which stands for dots per inch). Some degrees of quality include:

- 300 dpi
- 600 dpi
- 1200 dpi

The LaserJet Printing Process

Cleaning or Preparing

The cleaning or preparing process is when the print drum will have any residual toner or debris removed and the drum is prepared for the next job

Conditioning

The Drum gets charged (600V).

Writing or Exposing

This is the stage where the image is created on the drum, which is written by a difference in charges.

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Developing
The drum spins past the toner cartridge where toner particles are attracted to the image on the drum.

Transferring
A positive charge is added to the paper so that the paper pulls the toner to it from the drum.

Fusing
Heat and pressure fuse the toner to the paper and then the document is ready to taken.

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Domain 6.0 – Basic Networking 19%

6.1 Identify the common types of network cables, their characteristics and connectors.

Cable types include:

a. Coaxial
   - RG6
   - RG8
   - RG58
   - RG59

b. Plenum/PVC

c. UTP
   - CAT3
   - CAT5/e
   - CAT6

d. STP

e. Fiber
   - Single-mode
   - Multi-mode

Connector types include:

a. BNC

b. RJ-45

c. AUI

d. ST/SC

e. IDC/UDC

6.2 Identify basic networking concepts including how a network works.

Concepts include:

a. Installing and configuring network cards

b. Addressing

c. Bandwidth

d. Status indicators

e. Protocols
   - TCP/IP
   - IPX/SPX (NWLINK)
   - AppleTalk
   - NETBEUI/NETBIOS

f. Full-duplex, half-duplex

g. Cabling—Twisted Pair, Coaxial, Fiber Optic, RS-232

h. Networking models
   - Peer-to-peer
   - Client/server

i. Infrared

j. Wireless

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6.3 Identify common technologies available for establishing Internet connectivity and their characteristics.

Technologies include:

a. LAN
b. Mesh, Ring, Bus, Star
c. DSL
d. Cable
e. ISDN
f. Dial-up
g. Satellite
h. Wireless

Characteristic include:

i. Definition
j. Speed
k. Connections

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Networking Concepts

A network is two or more connected devices that share network resources. Computers, printers, modems, and scanners are examples of devices on a typical network.

LAN

A local area network (LAN) is usually one site, which contains one or more buildings housing the network. LANs are used by small companies and organizations.

WAN

A wide area network (WAN) is an extension of a LAN that can encompasses several sites and buildings and can span large geographical area around the world.

How a Network Works

Networks are made up of four basic components

- Protocols
- Transmission media
- NOS (Network Operating System)
- Shared resources

Peer to Peer and Server Based

There are two major types of networks, peer-to-peer and server-based. Peer-to-peer networks are used in many households and in small companies. Each computer in a peer-to-peer network can both share and use resources like files and printers.

Peer-to-peer networks lack security and fault tolerance and are meant for small businesses that are not growing or expanding. A peer-to-peer network does not require a dedicated resource (a server) which means that any host can share its resources with any other host on the network. A Server based network is quite the opposite of a peer-to-peer. It allows for more hosts, it has a solid security model and is scalable. It revolves around a model that the end users attach to a security domain that allows control over centralized resources.

Star Topology

A Star Topology is physical network topology that has all connections terminating into a centralized concentrator as seen in the illustration. A switch (normally used to create a Star topology) is used to have all devices centrally connect to a device that will record its MAC address after the flooding stage, once completed; each device can communicate with other devices on the Star. Star topologies are easy to add on to as well. You can add up to 5 more devices to this particular switch. As well, you can uplink this star into another portion of the network.

Star topologies offer the following:

- Commonly uses 10BaseT, 100BaseT
- Easy and cheap cabling
    - Unshielded (or Shielded - STP) Twisted Pair (UTP) cabling can be used.
- Easy to maintain
    - You only need to ensure that you have a concentrator and good cabling connections into the device.
- Easy to grow the network with this topology
    - As long as you follow standards and rules set forth by the IEEE, a star is very easy to expand to facilitate network growth.

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The bandwidth on the network is not fully optimized because there is a large amount of broadcast based traffic. Either via Flooding, ARP, CSMA/CD (all of which will be covered later in this study guide), which are all normal processes, but still, uses up available bandwidth.

There are limitations as to what can be done with a Star topology. For one, each node that connects to the Star can be no farther than 100 Meters (approximately 330 feet) from it without the use of a repeating device to regenerate the signal. Only 1024 nodes can be added to a single LAN. This cannot be added to without breaking up the LAN into smaller segments. There is also a 5-4-3 rule which dictates that there will be no more than 5 network segments broken down by 4 segmentation devices (switches) and no more than 3 of them can be populated by nodes. Again, these are not show stoppers to using the technology, it is just essential that you know what those limitations are so that you do not overstep them and degrade performance of the network.

Bus Topology

A Bus Topology is pretty outdated and although normally not installed anymore, you will still find it out there in your travels as an A+ technician. A Bus is nothing more than what you may already know about from PC based Planer Boards. Signals are sent along the bus to get to and from Disks, memory, CPU, and so on. The network Bus is similar in theory. Data travels along the Bus to get from node to node. In the illustration, you can see how this is laid out.

Not widely seen and no longer widely deployed, a Bus topology was commonly seen before Star topologies become cost efficient (being able to buy a hub, bridge, or switch) and today, most of what is left is deemed legacy. This is in widely seen with 10Base2 (thinnet) and 10Base5 (thicknet).

The Bus is normally formed up from a 50 Ohm coaxial cable which connects all the computers in the LAN. (This is seen in the illustration.) Each segment is terminated at both ends by 50 Ohm resistors. This is done so as to prevent reflections from the discontinuity at the end of the cable. Each segment is also normally run to earth ground at one end for electrical safety.

Good for small networks because you can forgo the cost of a concentrator device, but it would be nearly impossible to find thinnet for sale to use with all the connection hardware. Since most 5 port hubs can be bought for under 40 US dollars, it is not uncommon to see small networks still use a Star topology. Bus topologies are old and outdated, but they are still in use!

It is very hard to troubleshoot bus topologies because any break in the bus can be a break in the network. Also, this break needs to be isolated or located to a specific connection point and repaired. They are also easy to crash, considering that one break on the network can potentially bring down the whole network.

Mesh Topology

A Mesh Topology is a topology that means nothing more than two ways to every path, or a redundant path. A good example of a Mesh topology is seen in the illustration. Inside the cloud in the illustration shows what is called a Mesh. Each site connected to the MPLS (Multi Protocol Label Switching). Wide Area Network (WAN) connects into a cloud that is meshed so that any site wanting to talk to another site has the shortest distance to choose from, so in the case of a host on the 10.1.1.0 network wanting to talk to a host on the 10.1.2.0 network, the path is clear, the traffic sent from one host to the other enters the routers, leaves the routers and goes into the cloud where within the cloud a mesh network is setup to get the traffic from point A to B very quickly and efficiently. Most commonly shown in A+ books as a bunch of PCs connected with a bunch of lines to each other, this just is not realistic. Who connects PCs in this fashion? A mesh network is most commonly seen in MPLS networks and other WAN types

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A mesh is expensive for a few reasons. One, telecommunication lines will always cost more than your standards LAN technologies like Ethernet, Fast Ethernet, etc. Two, there is redundancy involved, which always means extra cost. Whenever you make something redundant, most times you are adding to it, which inevitably costs money. Every device on your network is connected to every other device on your network. This creates a nice blanket of redundancy, but you will pay for it.

A Mesh, also referred to as a Full Mesh, is a topology that is also difficult to design, implement and manage. With multiple paths to choose from through the network, it is imperative that it is designed and implemented then managed correctly to ensure that the return on investment (ROI) is there. If not, then you have a large network that is not efficient.

The biggest benefit is for disaster recovery purposes (multiple paths through the network), as well, the second biggest benefit is with speed. Since there is a mesh, a path can be found through the network quickly, and the path chosen (if designed and implemented correctly) should be the quickest from the source to the destination.

Mesh topologies are normally never found on PCs can be configured for clustered servers with multiple NICs, and WAN topologies such as MPLS.

Ring Topology

A Ring Topology is based on the design that all nodes on the network are connected into the concentrator via a circle as seen in the illustration. It is hard to conceptualize this because the concentrator used looks like a switch or a hub, so you would confuse this with a Star topology. However, the internal configuration of the concentrator shows that with a Ring topology, the internals of the concentrator are laid out logically like a ring and a token passes throughout from node to node ready for work. In the concentrator (in older IBM, Token Ring days' these were known as Multi Station Access Units or MAUs for short), there is no shared media, like with a Star. NO contention takes place because the nodes on the Star would be contending for time on the network via CSMA/CD. Rings are deterministic.

Local LAN Rings are not used very often any more, but like a Bus, they are still out there and require someone's attention. These days, rings (Token Ring, SONET Ring, FDDI Ring, etc) are usually kept to specific segments of your network like the Backbone or Core where reliable high speed data transfer is required. Also, many legacy Mainframes (IBM) that still exist many times have a Token Ring NIC installed. Many times, this may be the Ring topology on your network you have work with. Most Token Ring Local Area Network have been replaced by the more common Star topologies which means high speed switches and Category 5 UTP based cable. Rings also use this cabling, but can also be found using very old TYPE based cabling design and created by IBM. This cabling resembles the 10Base5 thicknet used in older networks rolled out years ago.

Since most folks are not rolling out Token Ring these days or that they are using it in small niche sections of their network or in high speed areas, it should be known already that this equipment is costly compared to what you can get to build a Star topology. Rings are also falling by the wayside because many companies are standardizing their technologies to reduce administrative overhead and to reduce costs.

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NOTE: You need to know the topologies well enough to distinguish them from each other on the exam. Make sure you remember the key points that make them similar as well as different. Be able to see a diagram and know what topology you are referencing from the diagram.

Network Cabling

Twisted pair 10BaseT and 100BaseT are the most common cable types used in networks today. Review the twisted pair cable categories, description, and speeds along with the coaxial network standards and their specifications in the tables for the exam.

10BASE-T, 10BASE-FL, 100BASE-TX and 100BASE-FX, 1000BASE-TX, 1000BASE-CX, 1000BASE-SX, and 1000BASE-LX

For the A+ exam, you need to know the following cable standards. Beyond the scope of the exam, to be a well prepared Network Technician, Engineer, Analyst or Manager, you will find knowing these characteristics can quickly help you in a jam when trying to order and purchase networking equipment, trying to order cable or design and implement a network. Yes, you can most likely pull out a chart and get this information from there, but for the exam, the test wants to ensure that you can pretty much pull the following from memory come test time. It also helps you know at the very least, the fundamentals of what cable standards are found on most networks today and how to correctly, identity the right connectors and see what the maximum distances you can run copper cabling or fiber.

Standard	Media Type	Cable Length	Transfer Speed	Connector
10BaseT	Cat3 or higher UTP	100 meters	10 Mbps	RJ45
100BaseTX	Cat5 or higher UTP	100 meters	10 Mbps	RJ45
100BaseFX	Fiber optic	100 meters	10 Mbps	Fiber optic
1000BaseT	Cat5 or higher UTP	100 meters	10 Mbps	RJ45
1000BaseSX	Fiber optic	100 meters	10 Mbps	Fiber optic
1000BaseLX	Fiber optic	100 meters	10 Mbps	Fiber optic
1000BaseCX	Fiber optic	100 meters	10 Mbps	Fiber optic

- Cat = Category. Category 5e cabling. Cat5e cabling.
- UTP is Unshielded Twisted Pair
- STP is Shielded Twisted Pair

SC and ST connectors are optical fiber connector types. SC and ST are commonly found on networking equipment such as Nortel, 3Com or Cisco switches and hubs. Fiber optics connections are actually quite diverse. A search on the web will show you at least a dozen or more types of connections that can be created for many different needs, so you are not going to need to memorize optical fiber connectors for the exam beyond what is commonly known and seen. It does make sense to research this anyway, so you know for future reference all the different types of connections you can make (and why) with optical fiber.

10BaseFL is an older 10 Mbps fiber based technology. This is primarily where you would see older ST based connectors in use.

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Twisted Pair
10BaseT and 100BaseTX cable cannot exceed 100 m in length. Here are the main two types:

- **STP:** Shielded Twisted Pair
- **UTP:** Unshielded Twisted Pair

RJ-11 (Registered Jack)
The RJ-11 connector is something that you have probably been looking at for years and perhaps if you never knew its definition, only now know what it is formally called. Every time you pick up your telephone at home, it is a good chance that somewhere on that phone or base unit is a RJ-11 connection. An RJ-11 connector is primarily used in the United States and its surrounding territories, so internationally it may not be as widely known or seen. It is not commonly used for data networks, although it can be used, it is recommended that you use newer technology, which is currently the RJ-45 connector. RJ-11 connectors are most commonly seen and used on PSTN (Public Switched Telephone Network) which is nothing more than the international telephone system based on copper wires carrying analog voice to the homes of people worldwide depending on where it is deployed.

RJ-45 (Registered Jack)
RJ-45 is short for Registered Jack-45. This is a cable termination that specifics an eight-wire connector which is used to connect computers and create a network. These are the most commonly seen termination types you are likely to see. RJ-45s are found on Token Ring and Ethernet networks. Telecommunications connections used on a WAN most commonly are seen with RJ-45 connections. Commonly confused with RJ-11s, RJ-45s are easy to distinguish from RJ-11s by simply looking at the width; the wider termination is an RJ-45.

Fiber Optic
Fiber Optic cables are the fastest, most expensive cabling option, and use glass fibers for the core. Moreover, they are the most difficult to implement. 10BaseFL and 100BaseFX are the related network types.

Definitions:

- **Single-mode:** specific wavelength
- **Multi-mode:** many wavelengths (frequencies or modes)

ST (Straight Tip)
An ST connector is most commonly found on fiber optic cable. ST stands for *straight tip* and is the older version of the most commonly used fiber connector, which is SC. The tip of the fiber is terminated with a ST connector that has a screw on type of locking mechanism. You need to seat the fiber connector and Stick and Twist it on. You can remember the type of connector it is from ST or Stick and Twist.

It is one of the most commonly found fiber termination, and it has a BNC type connector look at feel. Always keep in mind that it is very sensitive and can break very easily. Handle fibers with great care.

SC (Standard Connector)
An SC connector is most commonly found on fiber optic cable. SC stands for standard connector and is the newer version of the most commonly used fiber connector. The tip of the fiber is terminated with a SC connector that has a *click-in* type of locking mechanism. You need to seat the fiber connector and Stick and Click it on. You can remember the type of connector it is from SC or Stick and Click.

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It is one of the most commonly found fiber termination that is most commonly seen on equipment such as Cisco GBICs which are used to connect fiber optics into the switch chassis. It clicks in to position when you push it to seat it. Again, make certain that you handle with care as it is very sensitive and can break very easily. Handle fibers with great care.

Hubs

One of the most common connection based network components ever created, hubs are located in homes, offices, buildings and networks almost everywhere. Hubs, the predecessor of the switch, were based on the Star topology where you have a central concentrator that your nodes connect to and operate from. A hub falls in two categories, passive and active. Active hubs have a plug so that it has an outside power source; passive hubs do not. Active hubs are covered on the A+ exam. A hub is nothing more than a multiport repeater. Not covered on this version of the exam as a testable objective, it still benefits you to understand what a repeater does so you can understand what a hub does. A repeater is nothing more than a signal amplifier. It does not just amplify (this is actually the wrong terminology), it actually regenerates the signal to its original (and strong) form. Because of the distance limitations you learned of in this section of the study guide (such as 10BaseT is limited to 100 meters). After 100 meters, the signal will degrade. Since it is Baseband technology, the signal is either strong (which is a one) or it is off (and that is a zero). If the signal degrades, ones and zeros (binary math 1s and 0s) can become garbled and that equals corrupted data.

A repeater takes the signal that may be falling short and regenerate it into its former strength. Now that you know what a repeater is, think of a hub as the same thing, but with more than two ports. One is to bridge up to segments to get more distance out of your LAN. Those days are gone, and that equipment is just a memory in most cases. However, the technology is essentially the same, only evolved. Fast forward to the year 2005. We can find a hub or technology that surpasses it in just a great many homes and businesses in the world. Before we talk about switches, where we are today, we need to cover a hub. Hubs are used to connect segments of a LAN, create a LAN for nodes to connect to and participate on. A hub contains multiple ports, usually 4 or more. Most hubs are contained to 24 or 28 ports and anything about that is either modular or stackable.

A hub's operation is simple. When a packet arrives at one port, it is sent to all the other ports on the hub so that all segments of the LAN can see all packets. This is how communication takes place. Hubs do not have memory associated with them, so they do not contain any type of MAC or CAM table to use for forwarding of data from one part to another without having to broadcast out all ports to find a destination. This is what a switch does. Sometimes switches are referred to as *switching hubs*. Obviously, this may prove to be confusing. However, such problems can be avoided by calling each device by its own name. Just remember that there is another term, the switching hub, which is actually a switch.

Switches

A switch is the step up from the hub. Operating at faster speeds, some outfitted with ASIC chips to increase speed and efficiency (and a great many other benefits), switches are the way of the future. Switches operate by filtering and forwarding packets between LAN segments or from node to node. Switches operate at the data link layer (layer 2) of the OSI model and sometimes the network layer (layer 3) of the OSI model which means that there is an integrated router function into the switch. These are commonly known as Layer 3 Switches because they do not just operate at the Data Link layer, but above it, in the Network layer where routing decision can be made.

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Bridges

A bridge is a device that connects two local-area networks (LANs) or two segments of a LAN in order to segment it because the collision domain is too large. A bridge is an older version of a switch. When hubs were primarily in use, and switches did not officially exist, there were bridges. Rarely seen on today's networks, bridges served one major purpose. It acted like a switch (it kept a MAC table), but it segmented a LAN that may have been all hubbed and may have experienced a large amount of collisions and broadcasts because of such a large area that all nodes must occupy. To make the network smaller and more manageable, it is wise to segment it by a Bridge.

Bridges are old technology, but the principals are primarily the same as a switch. The difference is a switch has many ports and other features, whereas a bridge normally has only 2 ports to segment a large network in half to improve performance.

Routers

Routers move up one layer in the OSI model to the Network layer. On this layer, IP packets are sent to destination networks based on routing decisions made by routers across paths in which they connect and help control. Either via static or dynamic routing decisions, packets are sent from one network segment to another. As a packet enters the router, it is examined. A route is looked up for the destination address requested and it is either forwarded or ICMP helps you to know why it was not. Either way, understand that a router is nothing more than a traffic cop that takes data in and sends it out to where it is intended to go.

Routers can connect multiple Ethernet LANs, Token Ring, ISDN, Frame Relay, Internet connections to use for Internet access, the media types and connections are almost limitless as routers become more and more modular over time. Routers will use headers and forwarding tables to determine the best path for forwarding the packets. They use protocols, such as ICMP, to communicate with each other and configure the best route between any two hosts as was just mentioned. It is imperative that you understand the fundamental make up of what a router does and how it operates for the A+ exam.

Gateways

A gateway is a node on a LAN that serves as an entrance or exit to another network. When you open up a Command Prompt on a Windows 2000 or XP Professional desktop and type in ipconfig, you will see what is called a Default Gateway entry in the output.

NOTE: Windows 9x and Me use winipcfg, Linux uses ifconfig, Windows NT, 2000, 2003, and XP use ipconfig.

NICs (Network Interface Card)

Network Interface Cards, often called NICs for short, are one of the most commonly used and preferable methods of attaching devices to a network. A NIC is nothing more than an expansion board for your PC that you install to give you access to your local network. If you are on a 100Mbps fast Ethernet LAN, you will need to purchase a card compatible with your LAN requirements. Also, you will need to know what type of LAN you are on; a Token Ring NIC is very different from an Ethernet NIC. Lastly, you will need to know what you are connecting it to, a laptop or PC. ISA slot or PCI? If you have a laptop,

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you will most likely need a PCMCIA card if a NIC is not integrated into your motherboard. Most are set up this way.

Facts you may need to know about NICs for the A+ exam.
The NIC is manufactured with a unique identifier called a MAC address. Most times, the first half of the MAC address is the vendor ID and the second half is the unique identifier. Every MAC address on a network needs to be unique because the MAC address is what is resolved via Arp resolution traffic between the nodes. If a duplicate exists, then there is a conflict and a conflict means that one node will not be able to transmit. This is why the NIC has what is called a BIA (Burned in Address) so that each one can be unique. Occasionally duplicates show up over time, but there are ways to update the card to fix it or just update it because it is obviously very old.

Remember that MAC addresses operate on the Data Link layer of the OSI model. Also, NICs give you access to the network. They are expansion cards, but do not concentrate on that fact of it being a card, concentrate on what it does fundamentally, which is to provide a unique identifier to each node on a network, this way they can be accurately located through MAC tables on local switches, arp caches in routers and other nodes and so on. Understanding what it does helps you make the transition from certifications like A+ to high level certifications like the Cisco CCIE. This way when you start to install network hardware from a vendor such as Cisco, you know that Switches have a MAC associated with them to identify them uniquely on the network for management purposes. What about the default gateway we just talked about? Well, the router's Ethernet port has a MAC associated with it. This means that it is essentially a network interface. The only difference is that it is probably an integrated port of a card. This way when you start to install those T1s just mentioned, you know what a WIC is when you order it – a WAN Interface Card for the router.

ISDN (Integrated Services Digital Network) adapters

ISDN, otherwise known as integrated services digital network, is a Wide Area Network (WAN) based telecommunications technology. We just talked about the CSU/DSU; we had installed a T1 line. Well, say we only used a couple of channels (2) and ran pure Digital on it with one extra channel in line to give us control over the session for good reliability. This technology would essentially be the foundations of ISDN.

ISDN, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires is commonly seen in the corporate office of companies around the world. Mostly used for Wide Area Network links from one company to another, ISDN is unique in that it is *call-initiated* and *call-terminated*, so you only pay for what you use. ISDN uses telephone number like entities called SPIDS or Service Provider IDs to dial from peer to peer to bring up the line when interesting traffic, such as some streaming video needs to be sent across it. Once the call is deemed over due to inactively, the call is ended and so is the billing for that usage.

ISDN supports data transfer rates of 64 Kbps (64,000 bits per second). There are two types of ISDN: Basic Rate Interface (BRI) which consists of two 64-Kbps B-channels and one D-channel for transmitting control information. –and – Primary Rate Interface (PRI) which consists of 23 B-channels and one D-channel (U.S.) or 30 B-channels and one D-channel (Europe). The B channel is used for control. You can bundle multiple ISDN BRIs or PRIs to expand on your bandwidth usage. Adapters are defined by which country you are in and what standards are in place.

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WAPs (Wireless Access Point)

Short for Wireless Access Point (and abbreviated further by just saying AP or Access Point), an AP is a hardware device that will allow you to associate to it, and access a Wireless network. The goal thereafter is to get to a Wired network. As you can see in the next illustration, it is very possible to join a Wired LAN segment as long as an Access Point is connected (and configured properly) so that roaming or mobile users (such as the laptop seen in the graphic) can participate on your network and share resources.

Configure protocols

TCP/IP

Transmission Control Protocol/Internet Protocol, the suite of communications protocols used to connect hosts on the Internet TCP/IP is actually two separate protocols, TCP and IP. IP addressing is the logical addressing used to identify a unique host on a network. *Normally seen as 10.0.0.1*

Gateway

When configuring IP addresses, you may need to configure a gateway address, which is basically nothing more than a device (normally a router) that will know what to do with your request, it will know where to send it if it is configured properly.

Subnet mask

A mask helps to identify the host and the network portions of an IP address.

DNS (and domain suffix)

Domain Name System is a system that allows you to remember easy to remember words, instead of having to memorize IP addresses. A Domain Name System will use a system of records in a database that will make the connection between the IP address and the Domain Name to the requesting client. If you wanted to get to a website, the DNS name you use would resolve to your Internet DNS server if you were trying to access the website while connected via your ISP.

WINS

WINS is the Windows Internet Naming Service. It resolves IP addresses to NetBIOS names, like your computer name.

Static address assignment

You can statically assign an IP address to your PC.

- Start => Control Panel => Network Connections.
- Right-click the connection you would like to configure and select Properties.

Automatic address assignment (APIPA, DHCP)

You can use automatic IP addressing features as well. Keeping a static database of IP addresses can be cumbersome. Using a DHCP server can help in the keeping of the IP addressing database and give out the IP addresses to the client for you. DHCP is short for Dynamic Host Configuration Protocol, which is a protocol used for assigning dynamic IP addresses to devices on a network or LAN. Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without the hassle of manually assigning it a unique IP address.

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APIPA
APIPA stands for Automatic Private IP Addressing, which is a feature of later Windows operating systems. With APIPA, DHCP clients can automatically self-configure an IP address and subnet mask when a DHCP server is not available. The IP address range is 169.254.0.1 through 169.254.255.254 (default class B subnet mask of 255.255.0.0). A client uses the self-configured IP address until a DHCP server becomes available.

IPX/SPX (NWLink)
This is the Internetwork Packet Exchange/Sequenced Packet Exchange. On Novell NetWare systems, IPX is a network layer protocol used in the file server operating system. SPX is a transport layer protocol built on top of IPX and used in client/server applications.

AppleTalk
This is a proprietary local area network developed by Apple Computer to link Macintosh computers and peripherals, especially LaserWriter printers

NetBEUI/NetBIOS
Network Basic Input Output System is a network protocol created by IBM for their PC-Net network. It is used by IBM (OS/2 Networking), Artisoft (Lantastic), Microsoft (Microsoft Networking) Samba, and others. NetBEUI stands for NetBIOS Enhanced User Interface. NetBIOS is not routable and must be encapsulated in TCP/IP to go through routers (NetBIOS over TCP/IP or TCPBEUI).

Protocols and terminologies

ISP
Short for Internet Service Provider, an ISP is a company that provides access to the Internet. For a monthly fee, the service provider gives you a software package, username, password and access phone number. Equipped with a modem, you can then log on to the Internet and browse the World Wide Web and USENET and send and receive e-mail. In addition to serving individuals, ISPs also serve large companies, providing a direct connection from the company's networks to the Internet. ISPs themselves are connected to one another through Network Access Points (NAPs).

E-mail (POP, SMTP, IMAP)

IMAP4
Short for Internet Message Access Protocol (version 4), this is a protocol for retrieving e-mail messages. The latest version, IMAP4, is similar to POP3 but supports some additional features. For example, with IMAP4, you can search through your e-mail messages for keywords while the messages are still on mail server. You can then choose what messages to download to your machine

POP3
Short for Post Office Protocol (version 3), POP3 is a protocol used to retrieve e-mail from a mail server. Most e-mail applications (sometimes called an e-mail client) use the POP protocol, although some can use the newer IMAP (Internet Message Access Protocol). There are two versions of POP. The first, called POP2, became a standard in the mid-80s and requires SMTP to send messages. The newer version, POP3, can be used with or without SMTP.

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SMTP
SMTP or Simple Mail Transfer Protocol, a protocol for sending e-mail messages between servers. Most e-mail systems that send mail over the Internet use SMTP to send messages from one server to another; the messages can then be retrieved with an e-mail client using either POP or IMAP. In addition, SMTP is generally used to send messages from a mail client to a mail server. This is why you need to specify both the POP or IMAP server and the SMTP server when you configure your e-mail application

HTTP
HTTP or HyperText Transport Protocol is the protocol for moving hypertext files across the Internet. It requires a HTTP client program on one end, and an HTTP server program on the other end. HTTP is the most important protocol used in the World Wide Web (WWW).

HTTPS
The Secure and Encrypted form of HTTP. HTTP sends data in cleartext so HTTPS helps to secure it.

SSL
SSL is the Secure Sockets Layer. A protocol designed by Netscape Communications to enable encrypted, authenticated communications across the Internet. SSL used mostly in communications between web browsers and web servers. URLs that begin with https indicate that an SSL connection will be used. SSL provides 3 important things:

- Privacy
- Authentication
- Message Integrity

Telnet
Telnet is a protocol for remote computing on the Internet. It allows a computer to act as a remote terminal on another machine anywhere on the Internet. This means that when you telnet to a particular host and port, the remote computer (which must have a telnet server) accepts input directly from your computer (which must have a telnet client) and output for your session is directed to your screen.

FTP
FTP stands for File Transfer Protocol. This is a very common method of moving files between two Internet sites. FTP is a special way to login to another Internet site for the purposes of retrieving and/or sending files. There are many Internet sites that have established publicly accessible repositories of material that can be obtained using FTP, by logging in using the account name anonymous, thus these sites are called anonymous ftp servers

DNS
The Domain Name System is a system of mapping names to IP addresses. Because domain names are alphabetic, they are easier for humans to remember. The Internet, however, is really based on IP addresses. Every time you use a domain name, DNS translates the name into the corresponding IP address. It is similar to a phonebook for the Internet.

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Connectivity technologies

DSL networking

DSL is short for Digital Subscriber Line. This technology uses ordinary copper telephone lines to provide Internet speeds ranging from 1.5 to 9 Mbps--speeds that are 30 to 50 times faster than a regular 56-kbps dial-up modem. DSL also allows users to receive voice and data simultaneously, since the signal is carried on a higher frequency than normal telephone communications. xDSL refers to all types of Digital Subscriber Lines, including:

- **ADSL:** Asymmetric Digital Subscriber Lines
- **SDSL:** single-line digital subscriber lines
- **HDSL:** high-data-rate digital subscriber lines
- **VDSL:** very-high-data-rate digital subscriber lines

ISDN networking

Integrated Services Digital Network and is a system of digital phone connections which allows voice and data to be transmitted simultaneously across the world using end-to-end digital connectivity. There are two basic types of ISDN service. Basic Rate Interface (BRI) and Primary Rate Interface (PRI). BRI is a basic service is intended to meet the needs of most individual users. PRI is intended for users with greater capacity requirements

Cable

Cable is normally referenced from cable TV as the normally the providers of Cable TV will give a portion of the bandwidth that the television programming comes on to Data transferring.

Satellite

Internet gateways can be accessed via geostationary satellites also known as *GEOs*. These systems are not optimized for TCP/IP and Internet use, and they can be quite expensive. Delay may prove problematic for Voice over Satellite as well.

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