



Overview of Networks

CompTIA Network+ (N10-007)

Computer Networks

- What comes to mind?
- Is it limited to computers?
- Is it limited to Ethernet, WiFi, or fiber?



Purpose of Networks

- To make connections between machines
- Converged networks combine multiple types of traffic like data, video, and voice
- We expect 99.999% availability (The 5 9's)
 - Only 5 minutes downtime per year



Network Traffic Examples

- File sharing
- Video chatting
- Surfing the Web
- Social Media
- Streaming Video
- E-mail
- Messaging
- VoIP





Network Components

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Network Components

- Client
- Server
- Hub
- Wireless Access Point
- Switch
- Router
- Media
- WAN Link



Client

- Device end-user accesses the network with
- Workstation, laptop, tablet, smartphone, television, server, or other terminal device
- Can be any device that connects to the network



Server

- Provides resources to the rest of the network
- Different servers provide different functions, such as an E-mail server, Web server, File server, Chat server, and Print server
- Can be a dedicated server hardware/software or can be a device that is acting like a server for a particular function



Hub

- Older technology to connect networked devices, such as clients and servers
- Can be interconnected to provide more ports, but leads to increased network errors
- Receives information in one port and rebroadcasts it out all the other ports



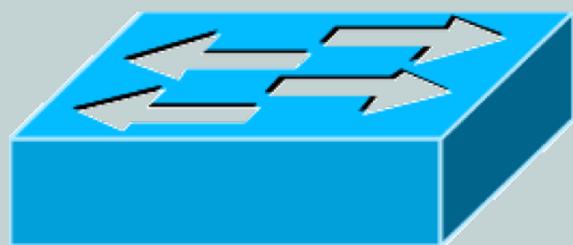
Wireless Access Point (WAP)

- Device that allows wireless devices to connect into a wired network
- Commonly used in home, small business, and even some large enterprise networks
- Acts as a wireless hub



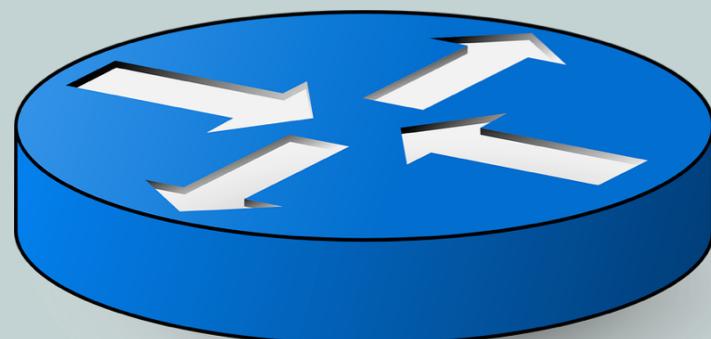
Switch

- Connects networked devices such as clients and servers (like a hub)
- Switches learn what devices are on which switch ports
- Switches only forward traffic received from a port to the destination port based on the device's MAC address
- Provides more security and efficiently uses available bandwidth



Router

- Connect two different networks together
- Intelligently forwards traffic to and from a network based on its logical address
- Most modern routers use Internet Protocol (IP) address to determine routing of traffic



Media

- Connect two devices or a device to a port
- Made from copper cable, fiber optic cable, or radio frequency waves (WiFi)
- Each type has strengths and limitations, such as its available bandwidth, capacity, distance that can be covered, and cost to install and maintain



Wide Area Network (WAN) Link

- Physically connects networks together
- Numerous WAN links are available: leased lines, DSL, Cable, Fiber Optic, Satellite, Cellular, Microwave, ...
- Connects internal network to external networks, such as a SOHO network to Internet



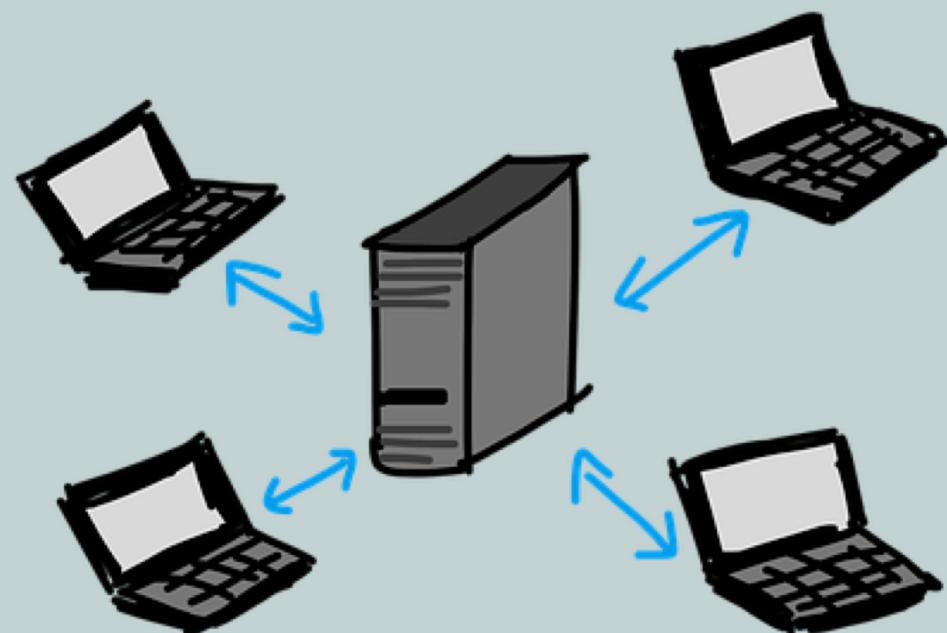


Network Resources

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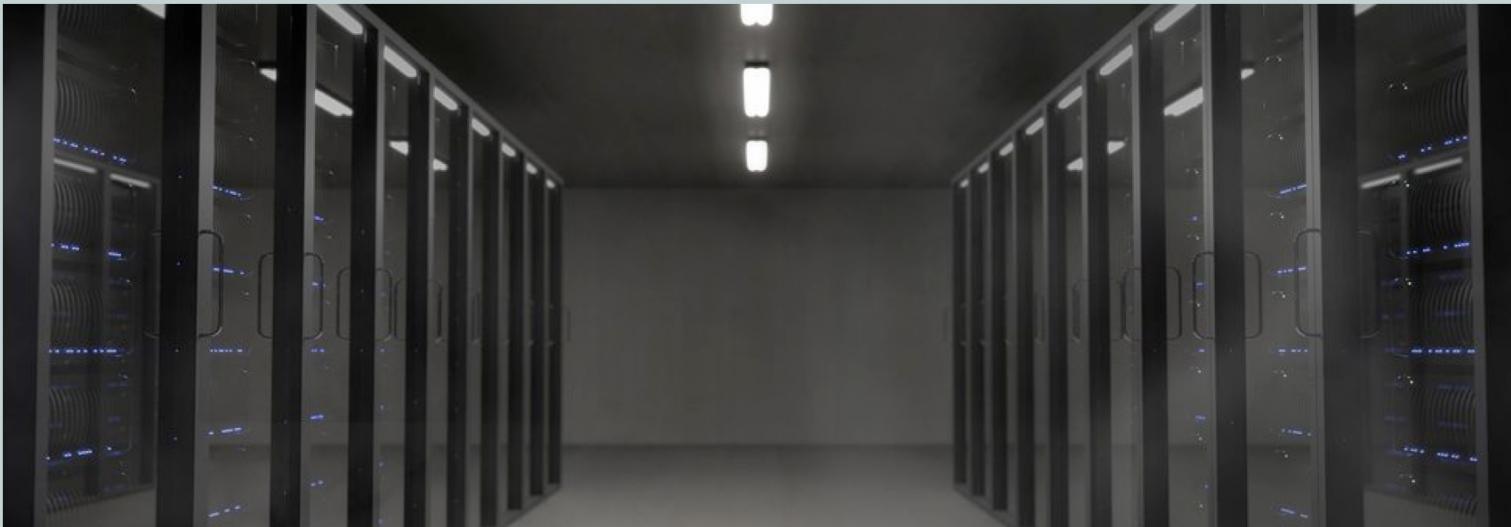
Client/Server Model

- Uses dedicated server to provide access to files, scanners, printers, and other resources
- Administration and backup is easier since resources are located on a few key servers



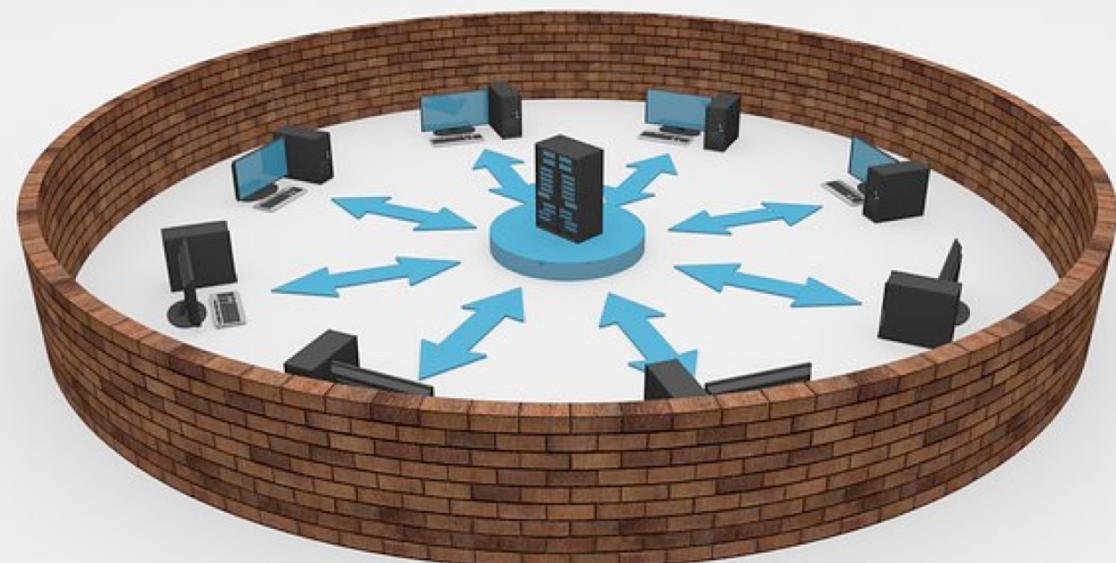
Benefits of Client/Server

- Centralized administration
- Easier management
- Better scalability



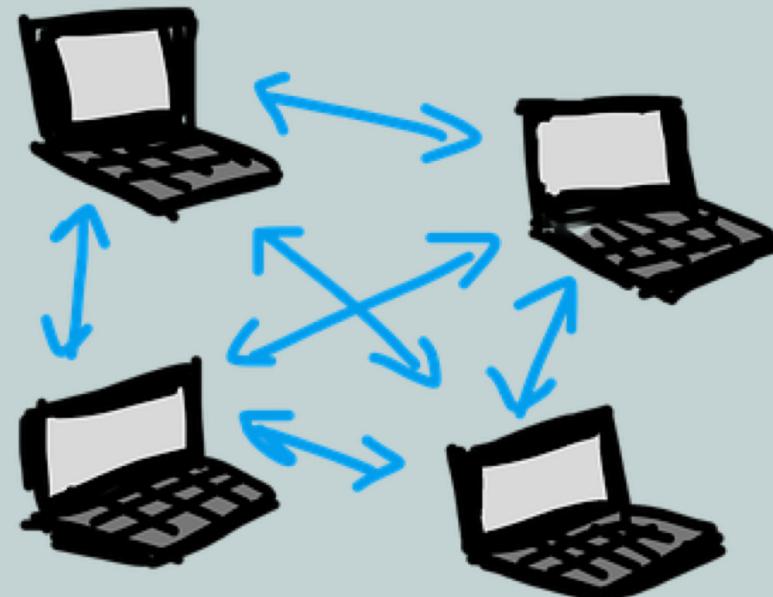
Drawbacks of Client/Server

- Higher cost
- Requires dedicated resources
- Requires network operating system



Peer-to-Peer Model

- Peers (PCs) share resources (files/printers) with each other directly
- Administration and backup is more difficult since resources are located on many PCs which adds to the administrative burden



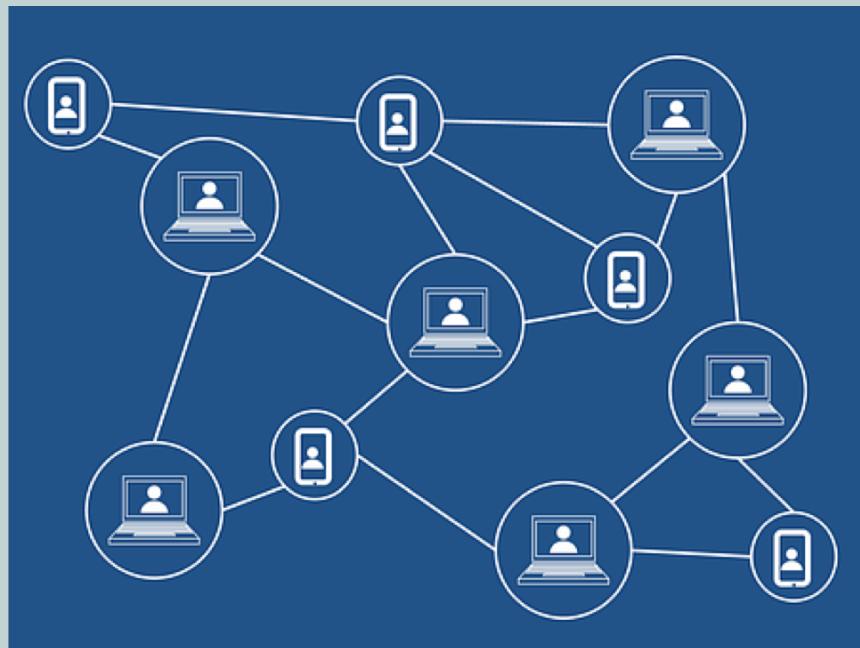
Benefits of Peer-to-Peer

- Lower cost
- No dedicated resources required
- No specialized operating system required



Drawbacks of Peer-to-Peer

- Decentralized management
- Inefficient for large networks
- Poor scalability



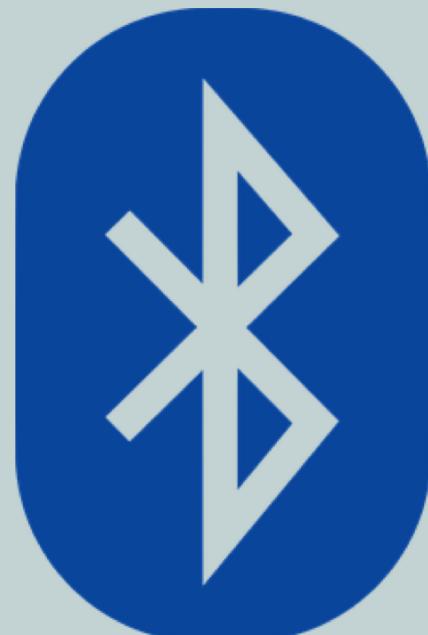


Network Geography

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Personal Area Network (PAN)

- Smallest type of wired or wireless network
- Covers the least amount of area (few meters)
- Examples:
 - Bluetooth cellphone to car
 - USB hard drive to laptop
 - Firewire video camera to computer



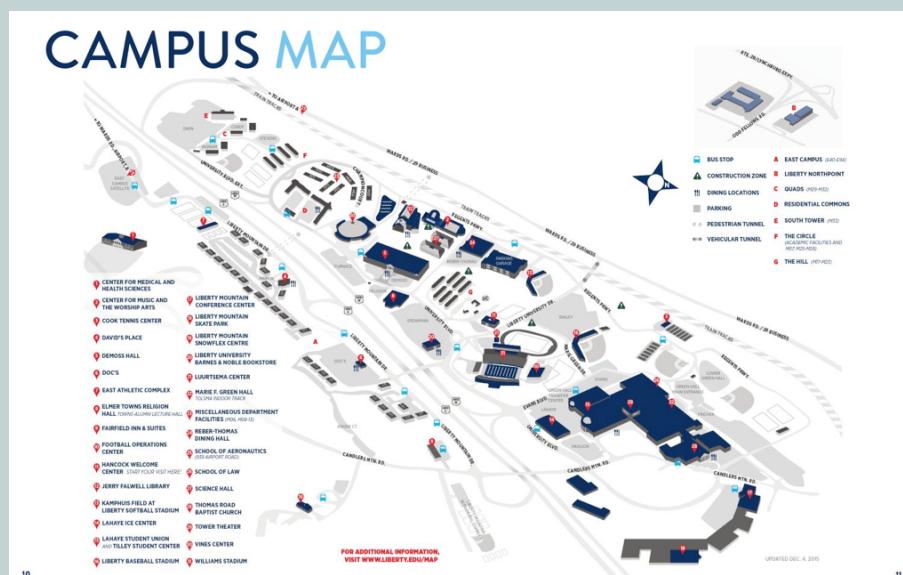
Local Area Network (LAN)

- Connects components in a limited distance
- Each segment is limited to short distances, such as 100 meters with CAT 5 cabling
- Consists of Ethernet (IEEE 802.3) or WiFi networks (IEEE 802.11)
- Examples:
 - Internal wired or wireless networks



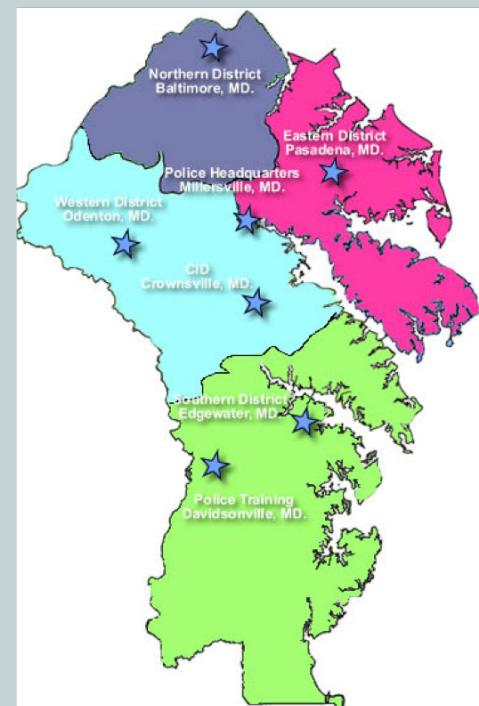
Campus Area Network (CAN)

- Connects building-centric LANs across a university, industrial park, or business park
- Covers many square miles and buildings
- Examples:
 - College campus
 - Business Parks
 - Military bases



Metropolitan Area Network (MAN)

- Connects scattered locations across a city
- Larger than a CAN, but smaller than a WAN
- Covers up to a 25 mile radius in larger cities
- Examples:
 - City departments like the police department
 - Community college with campuses spread across a county

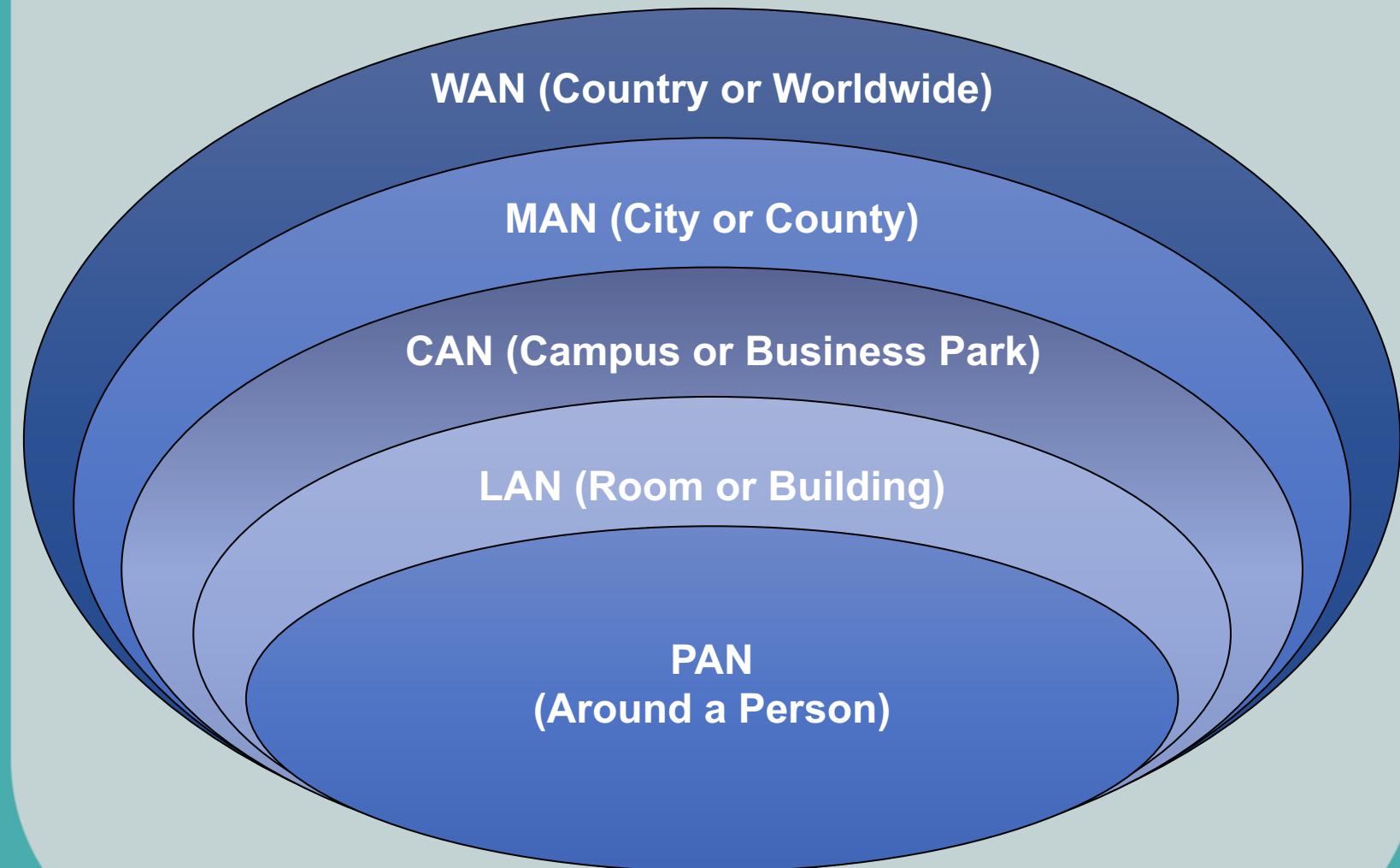


Wide Area Network (WAN)

- Connects geographically disparate internal networks
- Consists of leased lines or Virtual Private Networks tunneled over the Internet
- Covers distances around the country or around the world
- Examples:
 - The Internet (largest WAN)
 - Connecting two private corporate networks from New York to Seattle



Network Geography



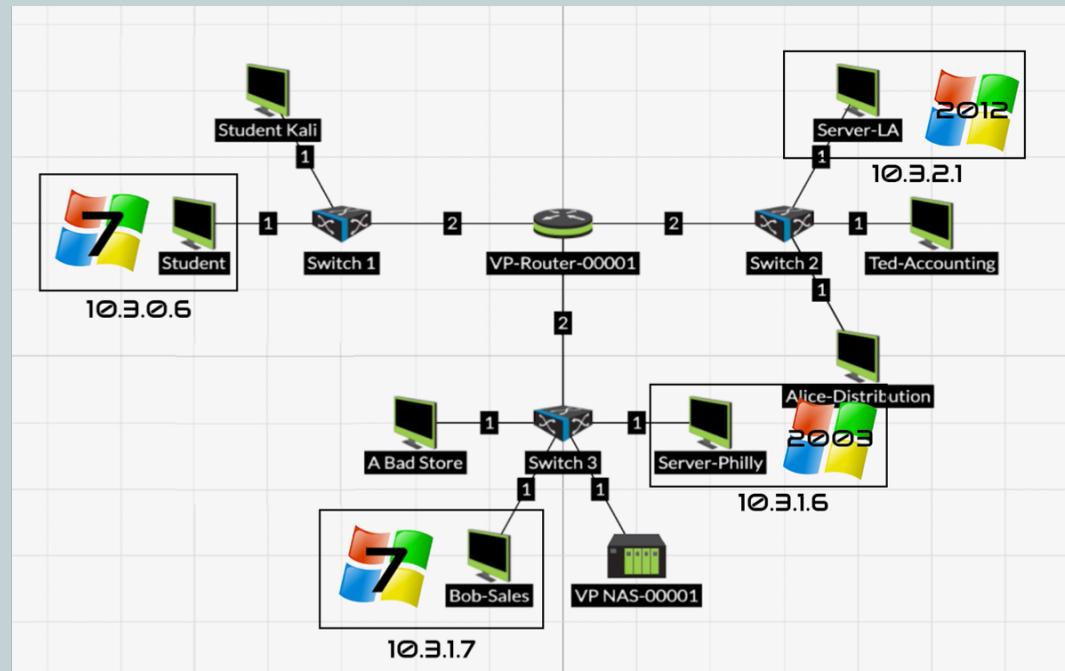


Wired Network Topology

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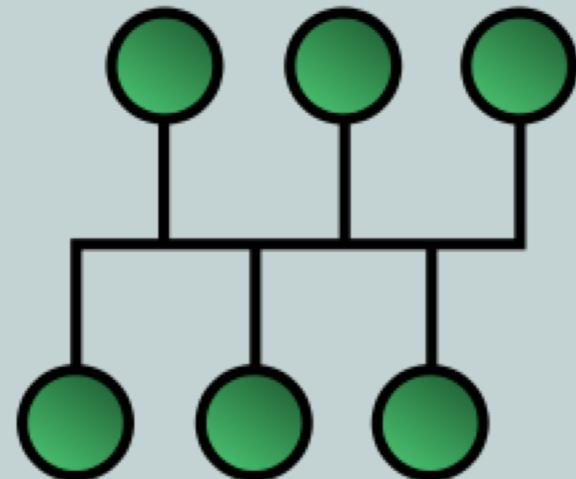
Defining Network Topology

- Physical Topology
 - How devices are physically connected by media
- Logical Topology
 - How the actual traffic flows in the network



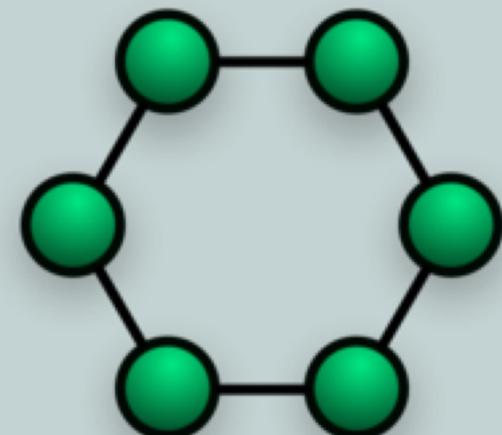
Bus Topology

- Uses a cable running through area that required network connectivity
- Each device “taps” into the cable using either a T connector or vampire tap
- Old technology, not commonly used anymore
- Devices on cable form single collision domain



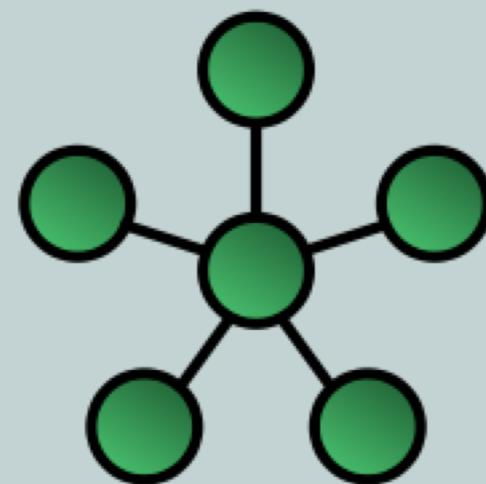
Ring Topology

- Uses a cable running in a circular loop
- Each device connects to the ring, but data travels in a singular direction
- FDDI (Fiber networks) used two counter-rotating rings for redundancy
- On token ring networks, devices wait for a turn to communicate on ring by passing a token



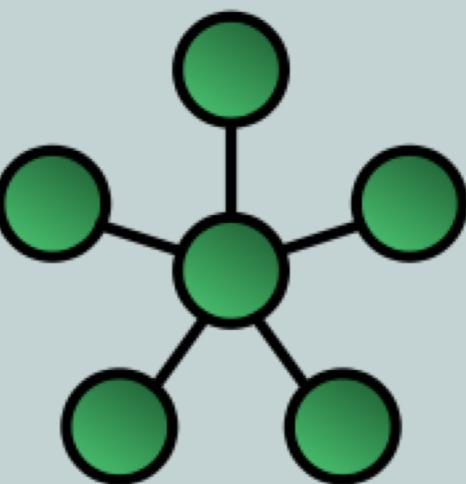
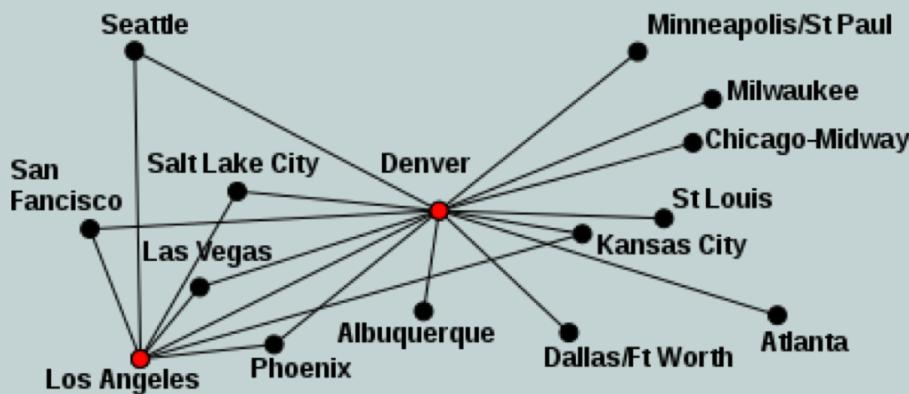
Star Topology

- Most popular physical LAN topology
- Devices connect to a single point
- Most commonly used with Ethernet cabling, but wireless or fiber are also used
- If the central device fails, the entire network fails



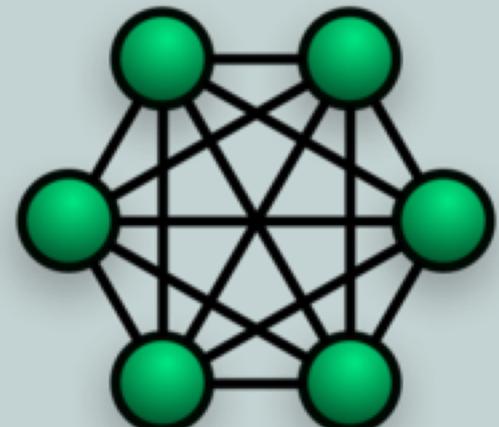
Hub-and-Spoke Topology

- Used for connecting multiple sites
- Similar to Star, but with WAN links instead of local area network connections
- Not redundant, if central office (hub) fails, the whole network can fail



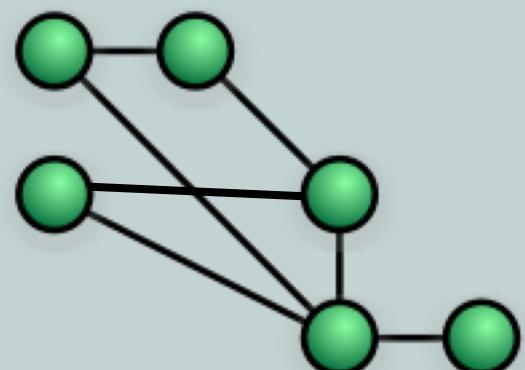
Full-Mesh Topology

- Most redundant topology
- Every node connects to every other node
- Optimal routing is always available
- Very expensive to maintain and operate
- Number of Connections
$$x = n(n - 1) / 2$$



Partial-Mesh Topology

- Hybrid of the full-mesh and the hub-and-spoke topologies
- Provides optimal routes between some sites, while avoiding the expense of connecting every site
- Must consider network traffic patterns to design it effectively





Wireless Network Topology

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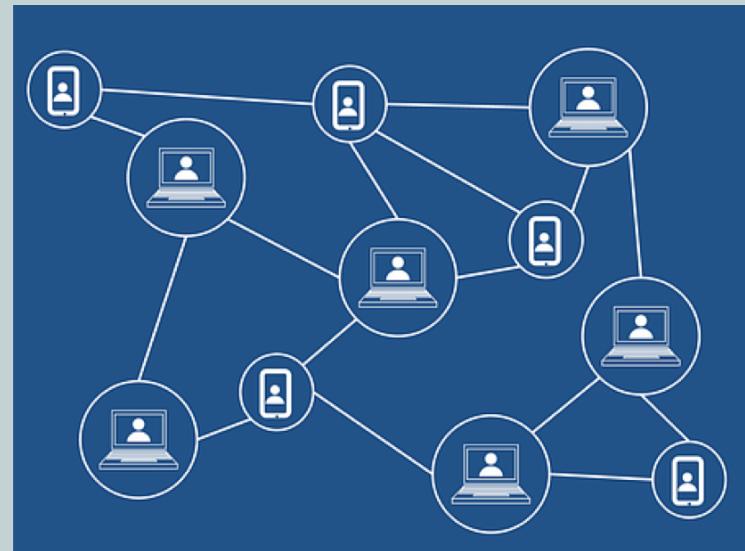
Infrastructure Mode

- Most common type of wireless network
- Requires centralized management
- Uses a wireless access point as a centralized point like a star topology
- Supports wireless security controls



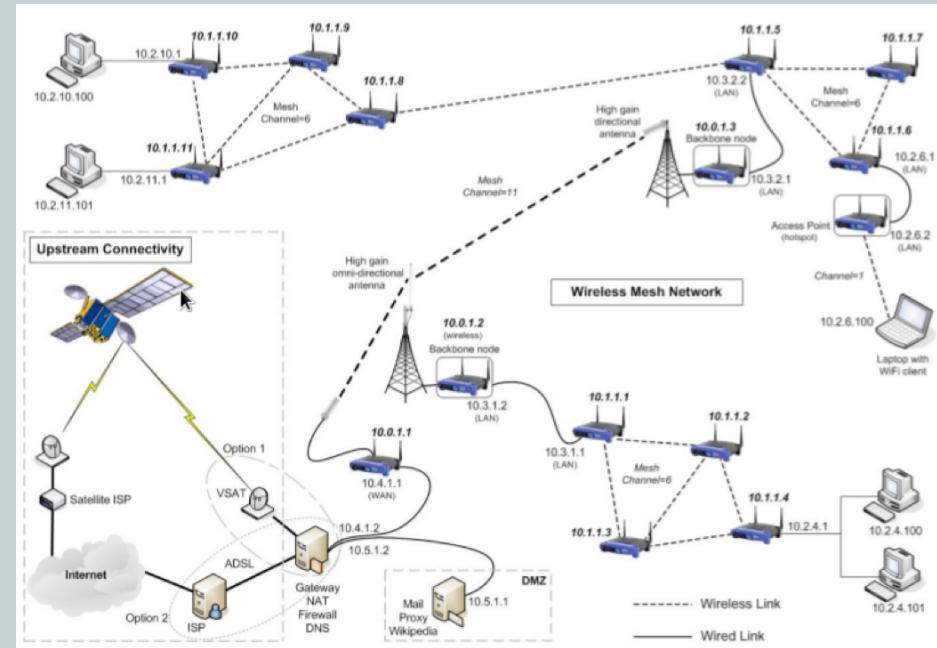
Ad Hoc Mode

- Decentralized wireless network
- No routers or access points are required
- Forwarding decisions for data on the network are made dynamically
- Allows creation/joining of networks “on-the-fly”
- Creates P2P connections



Wireless Mesh Topology

- Interconnection of different types of nodes or devices
- Consists of clients, routers, and gateways
- Utilizes different radio frequencies to extend and expand access
- Reliable and redundant connections





Internet of Things (IoT)

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Internet of Things (IoT)



IoT Technologies

- 802.11
 - Operates as infrastructure or ad hoc
- Bluetooth
 - Low energy use variant of Bluetooth which allows for a mesh network
- RFID
 - Uses electromagnetic fields to read data stored in embedded tags
- NFC
 - Enables two electronic devices to communicate within a 4 cm range



IoT Technologies

- Infrared (IR)
 - Operates with line of sight
- Z-Wave
 - Provides short-range, low-latency data transfer at rates and power consumption lower than Wi-Fi
 - Used primarily for home automation
- Ant+
 - Collection and transfer of sensor data
 - Used with remote control systems (tire pressure, TVs, lights)

