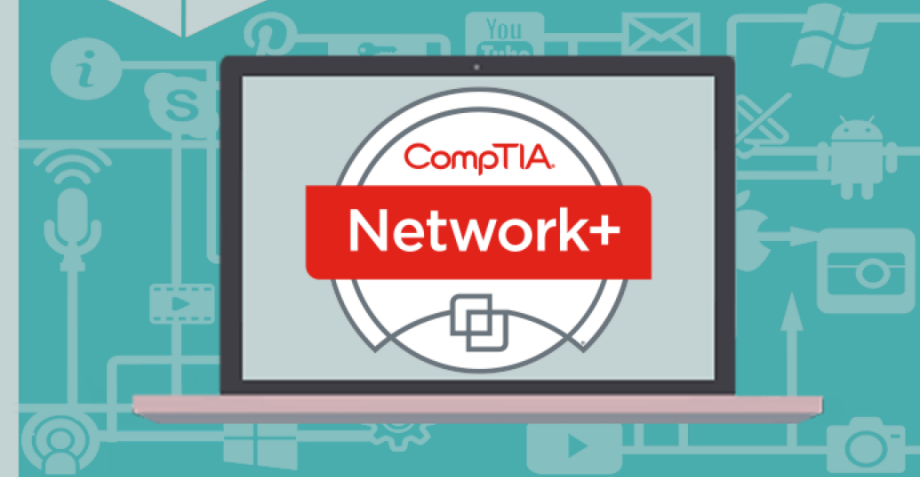# Overview of Networks

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
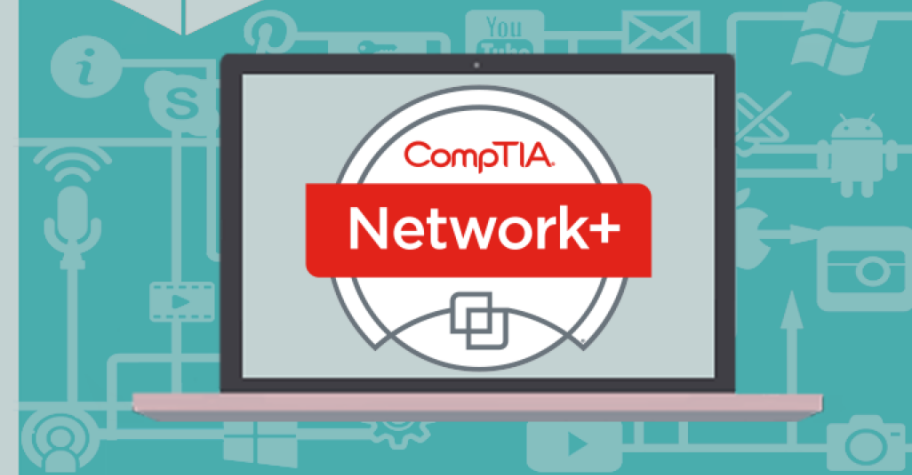
Network Components

CompTIA Network+ (N10-007)

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

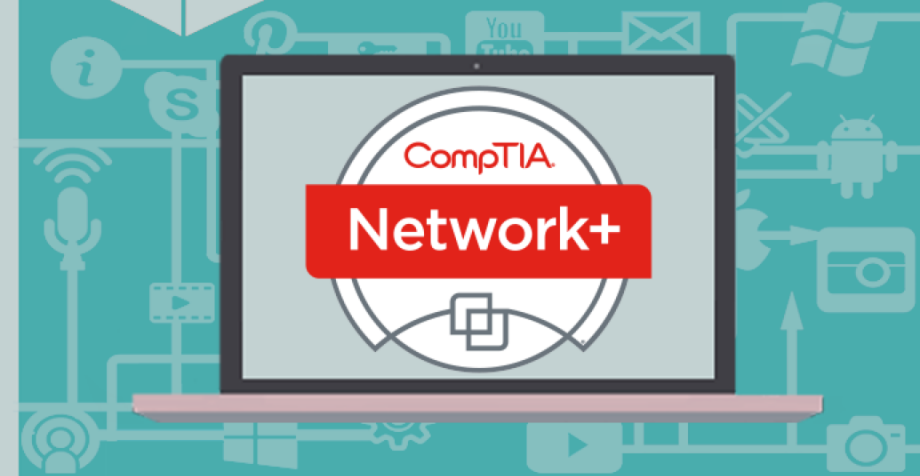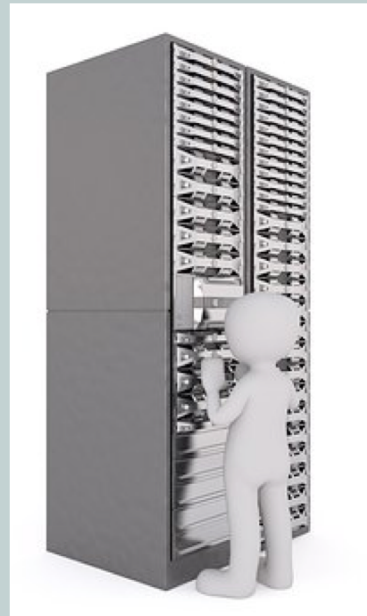- Can be any device that connects to the network

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
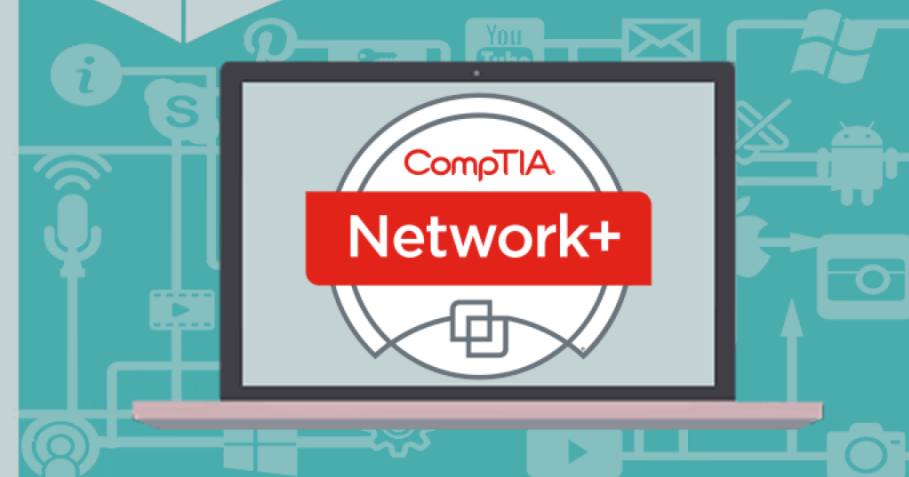
Wireless Access Point (WAP)

- 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
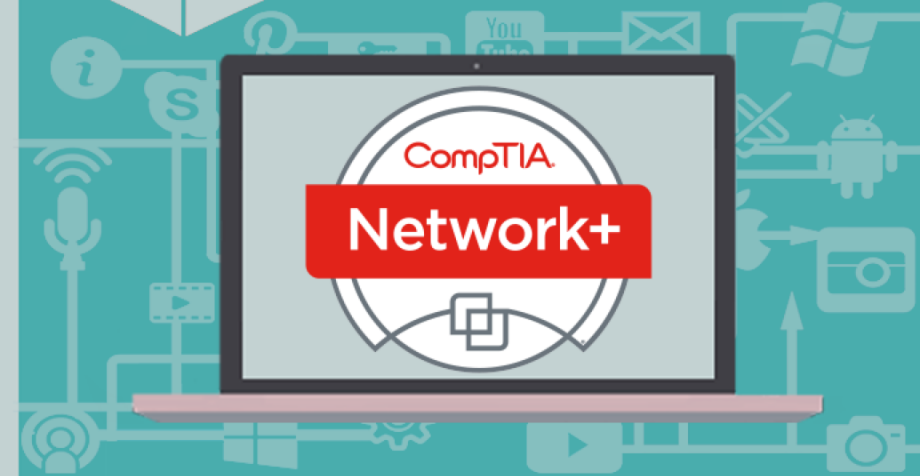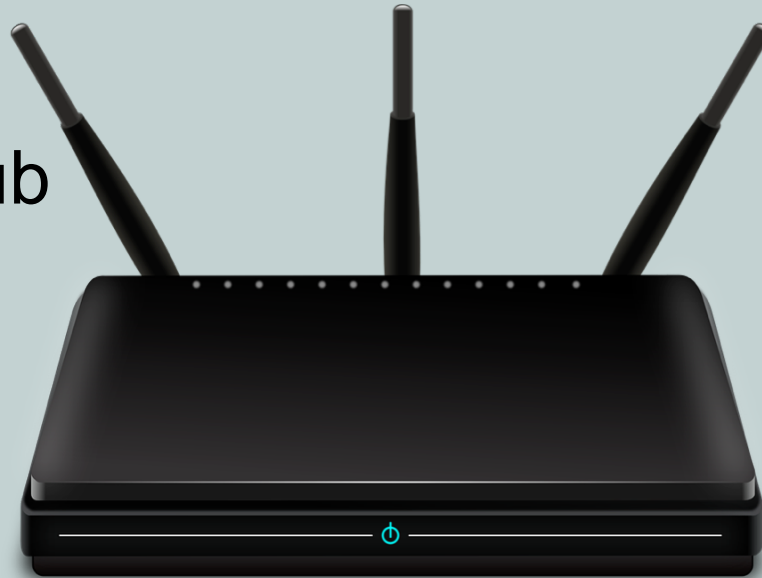
Switch

- 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

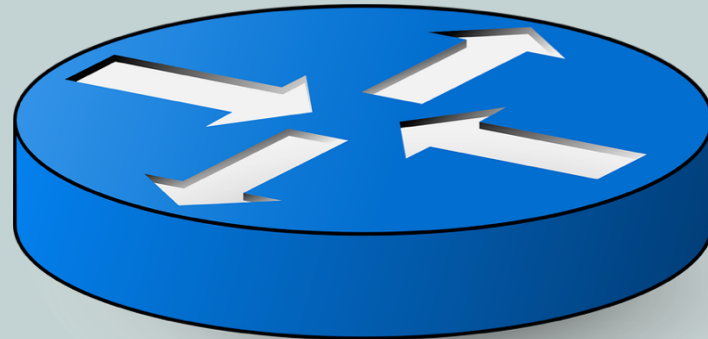- Provides more security and efficiently uses available bandwidth

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
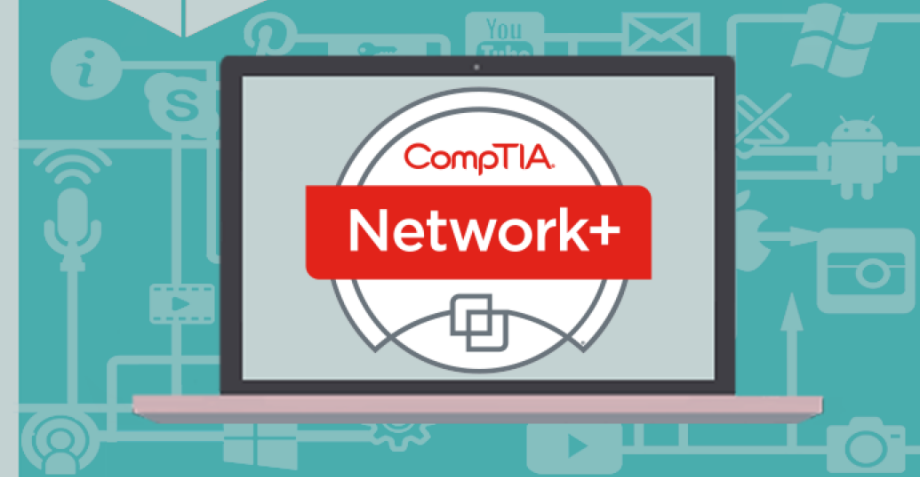
Wide Area Network (WAN) Link

- Physically connects networks together

- Numerous WAN links are available: leased lines, DSL, Cable, Fiber Optic, Satellite, Cellular, Microwave, …

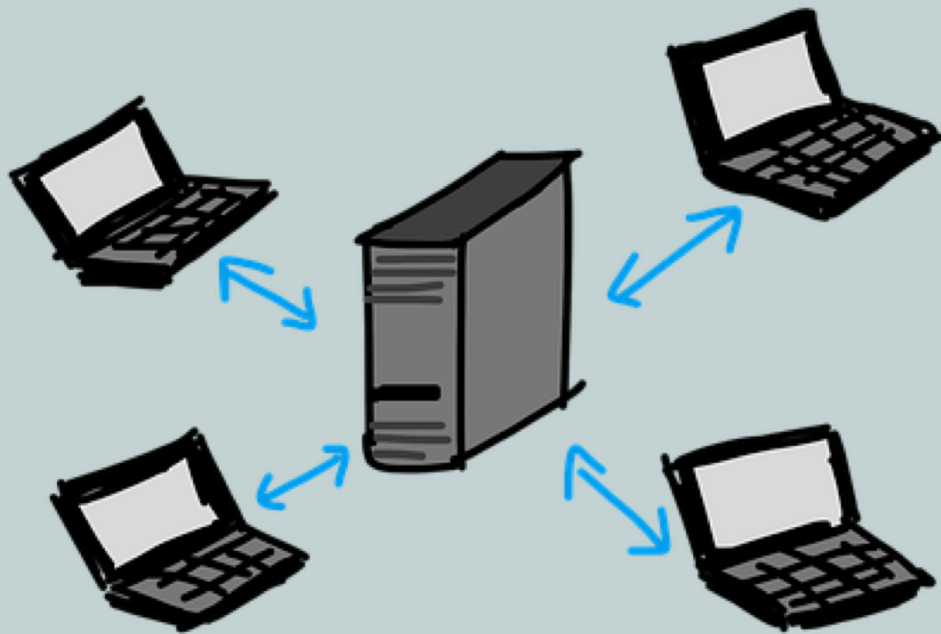- Connects internal network to external networks, such as a SOHO network to Internet
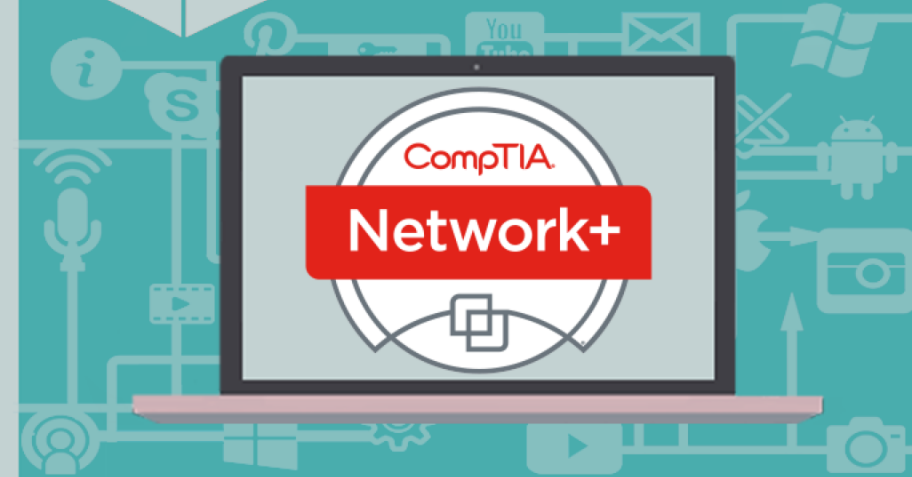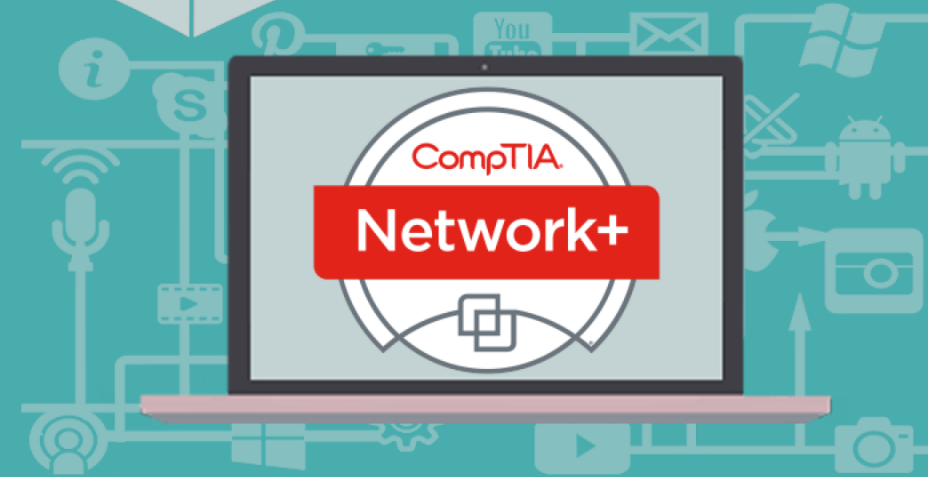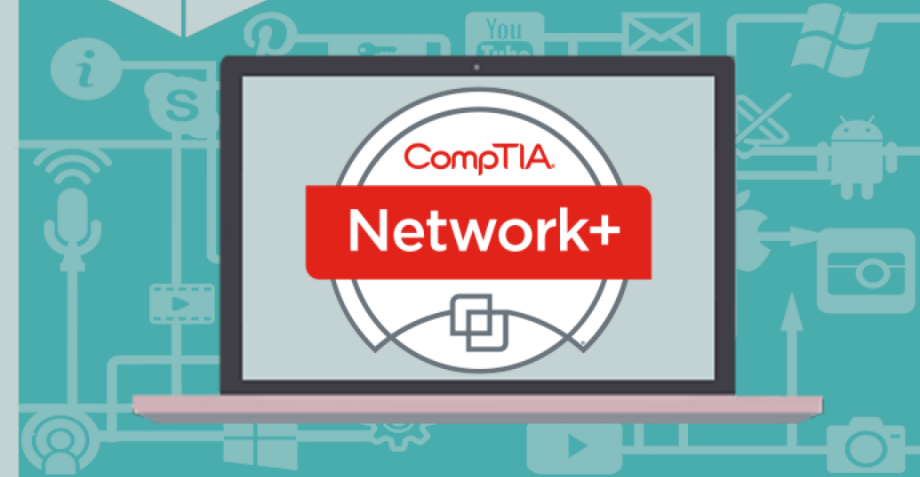
Network Resources

CompTIA Network+ (N10-007)

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
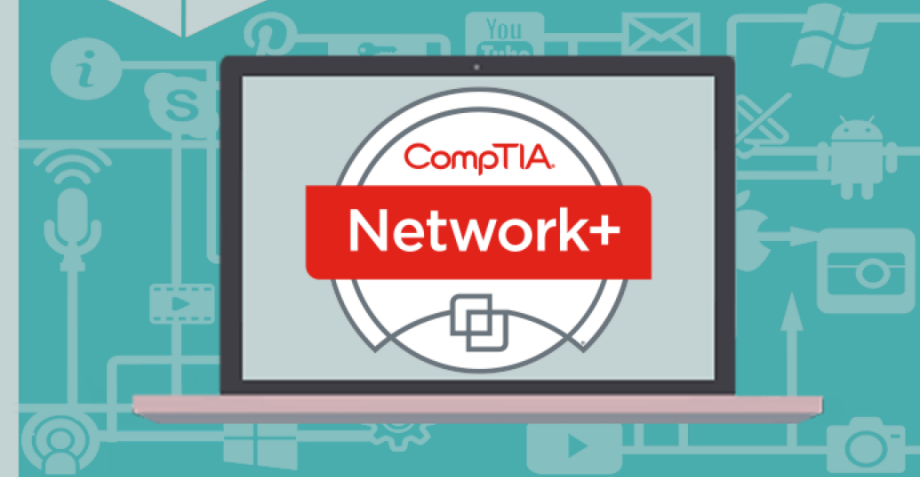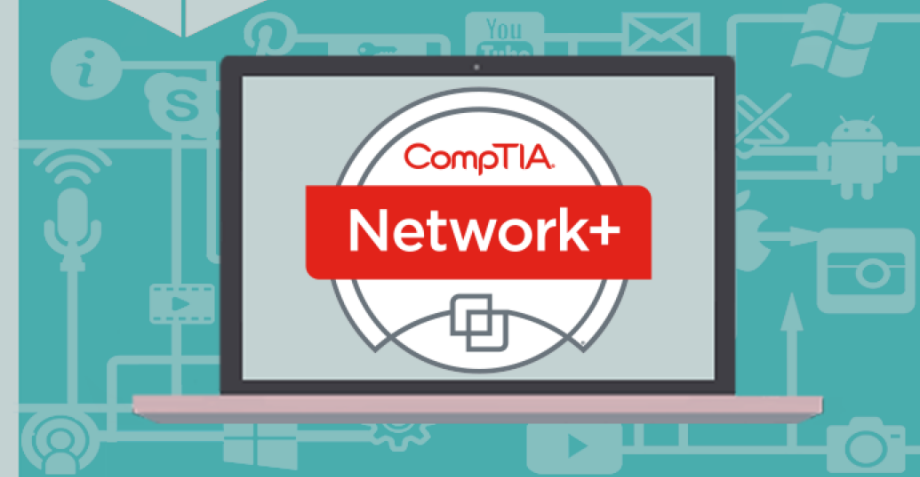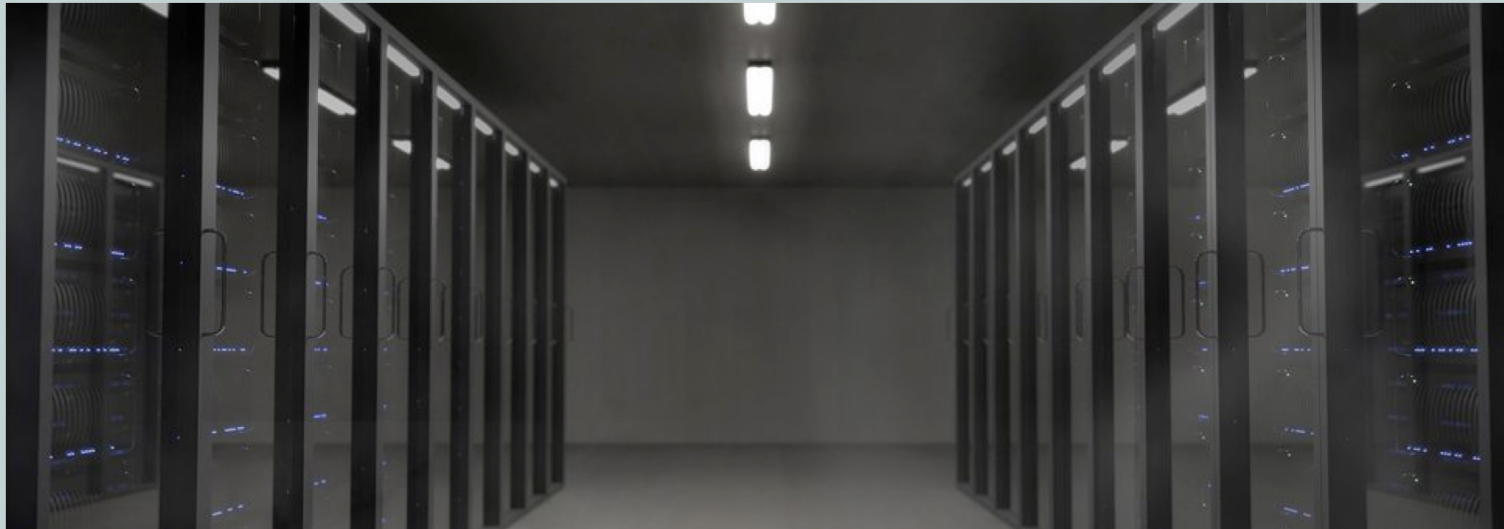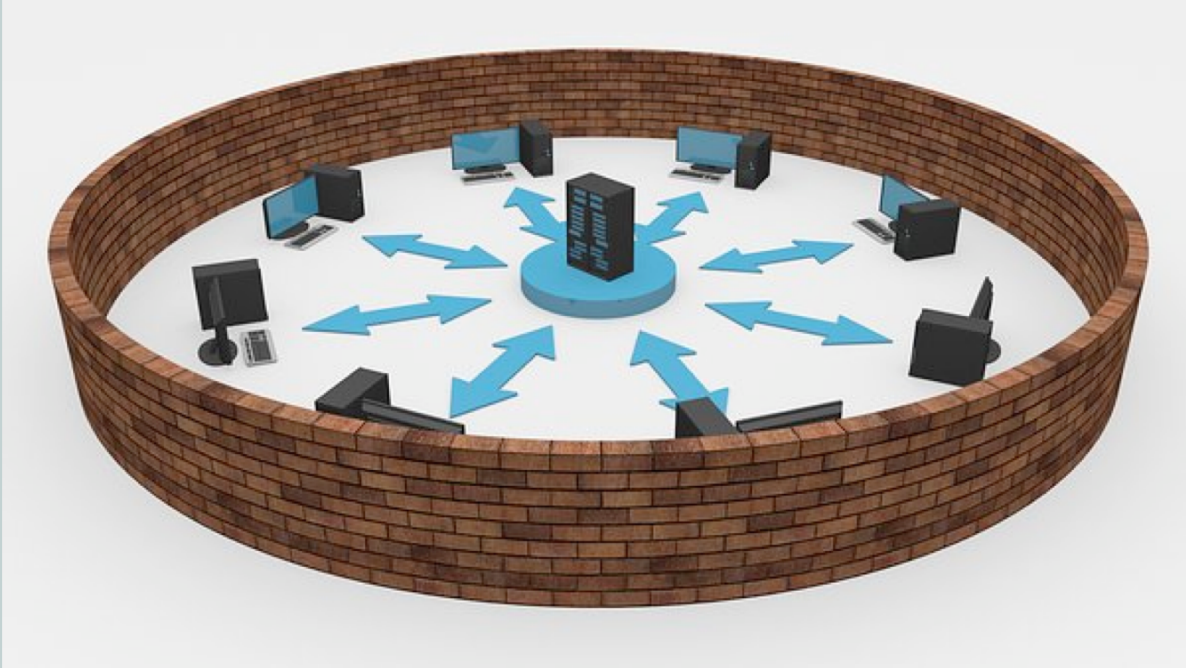
Benefits of Client/Server

- 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 difficulty since resources are located on a many PCs which adds to the administrative burden
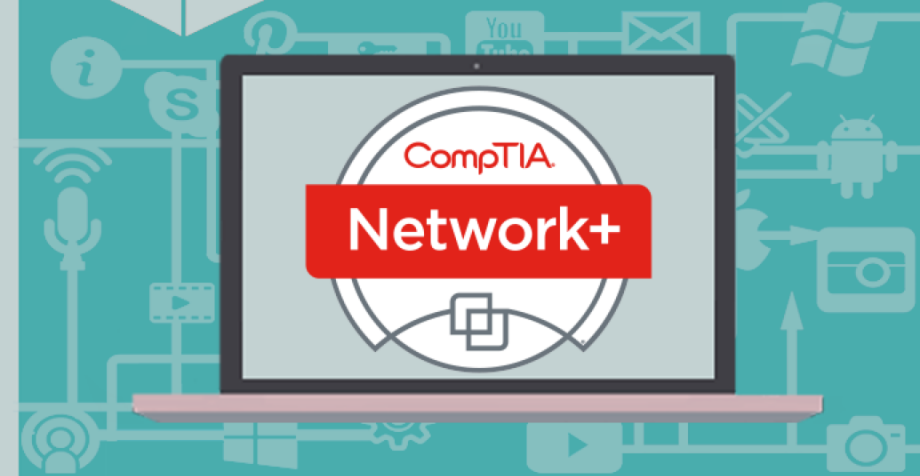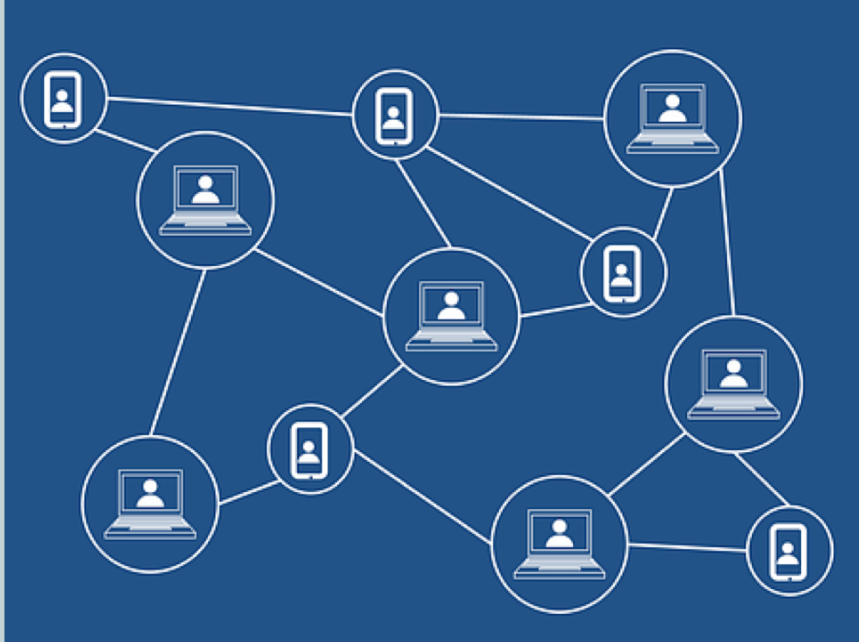
Benefits of Peer-to-Peer

- Lower cost

- No dedicated resources required
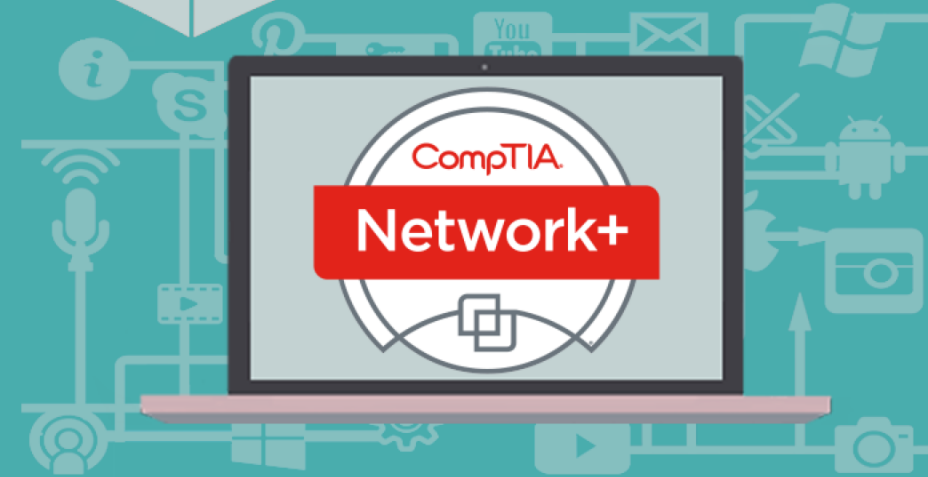
- No specialized operating system required

Drawbacks of Peer-to-Peer

- Decentralized management

- Inefficient for large networks

- Poor scalability

Network Geography

CompTIA Network+ (N10-007)

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
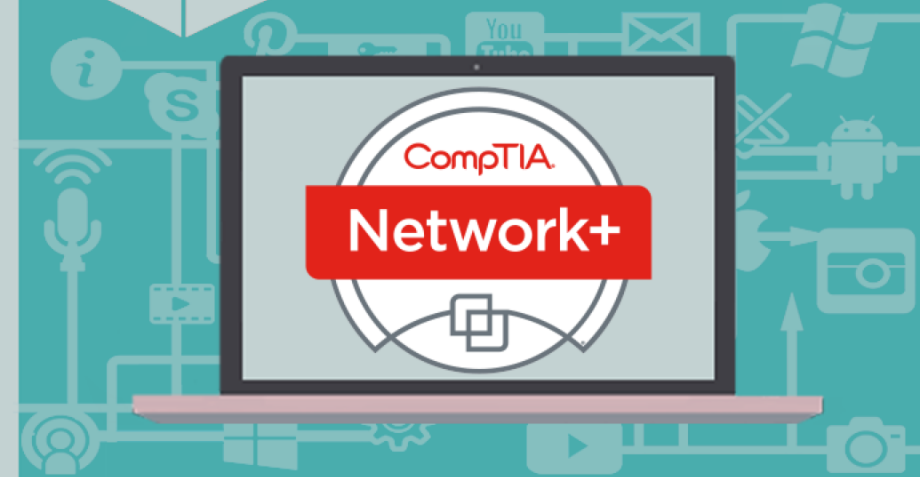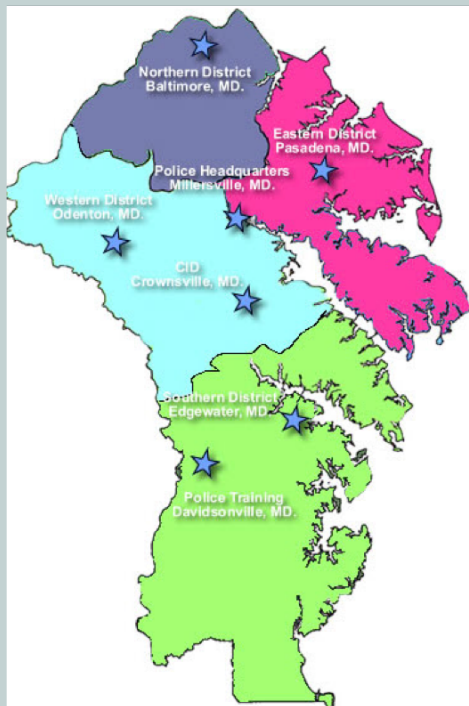 - Military bases
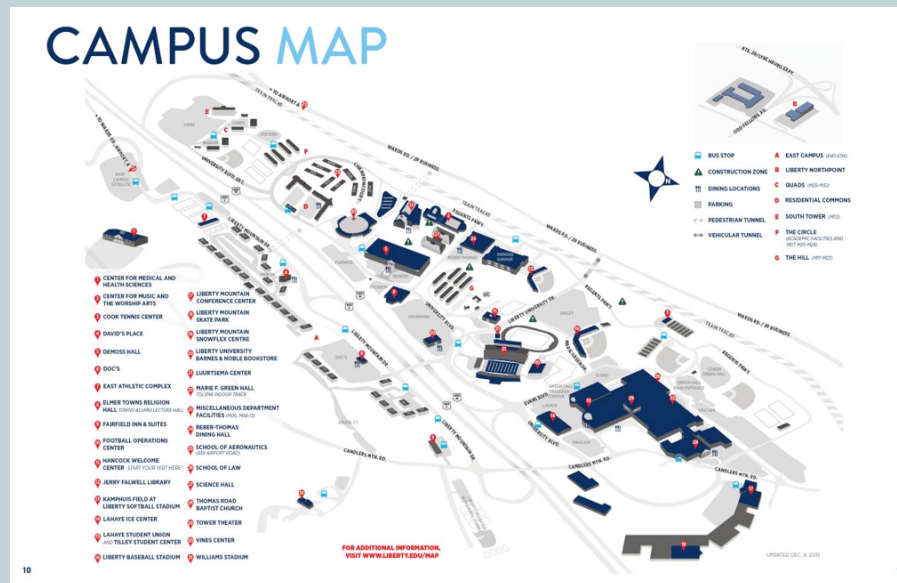
Metropolitan Area Network (MAN)

- 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
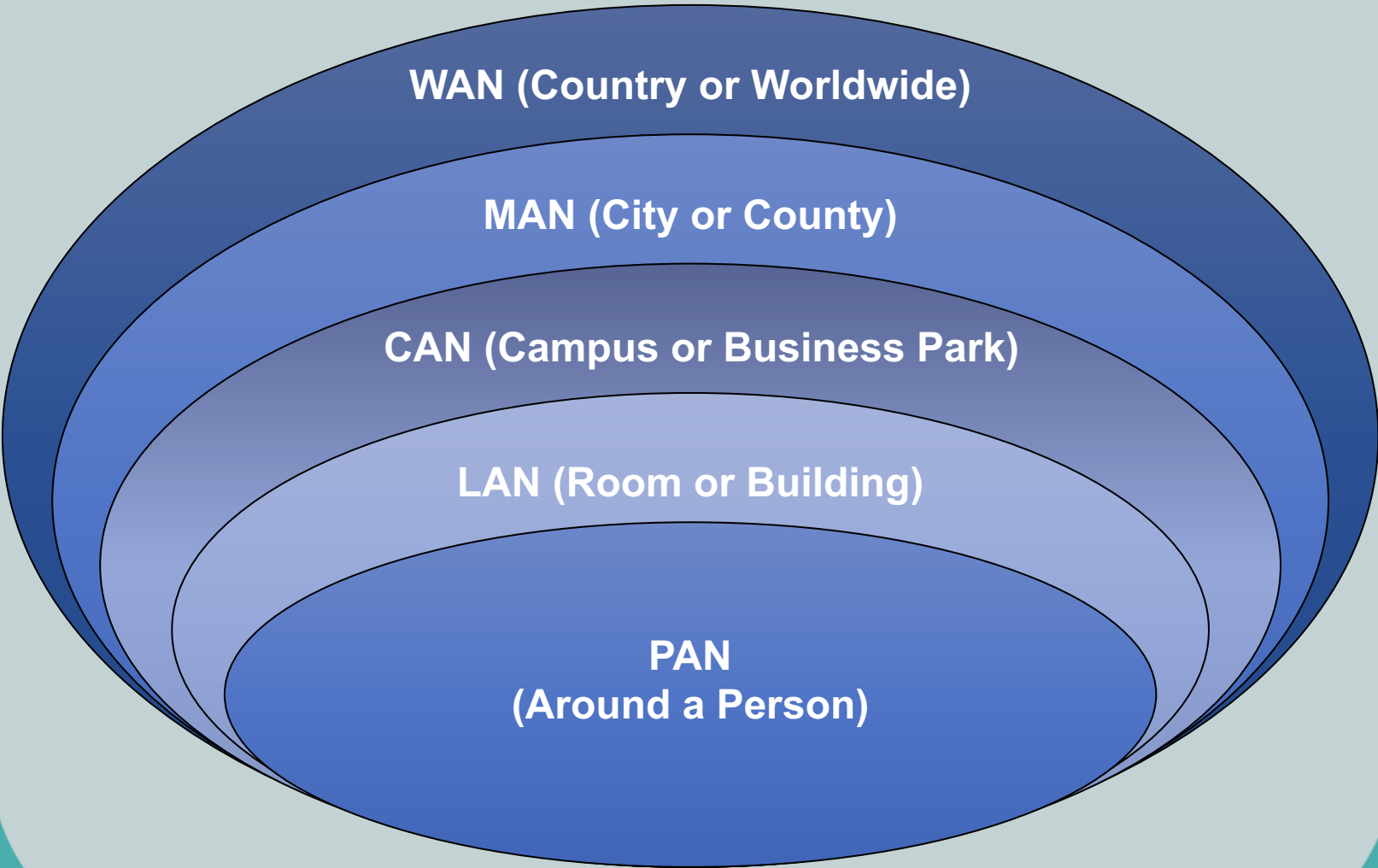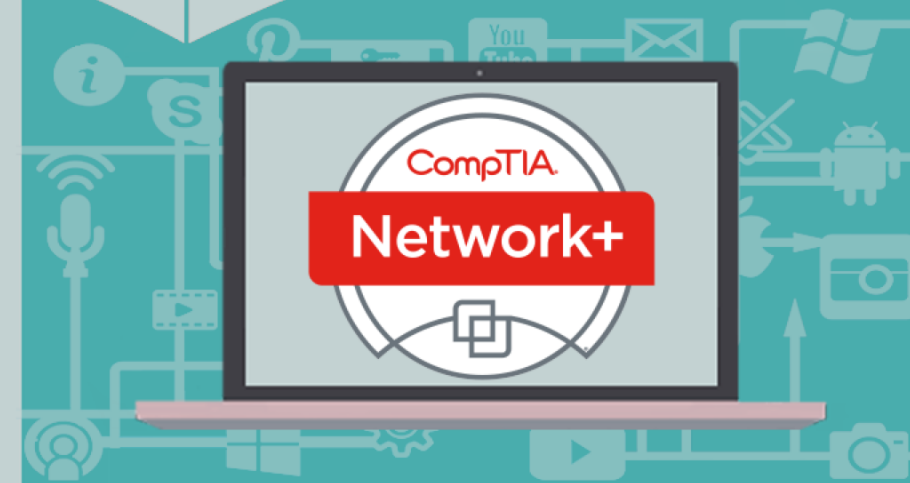 - Community college with campuses spread across a county

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

WAN (Country or Worldwide)

MAN (City or County)

CAN (Campus or Business Park)

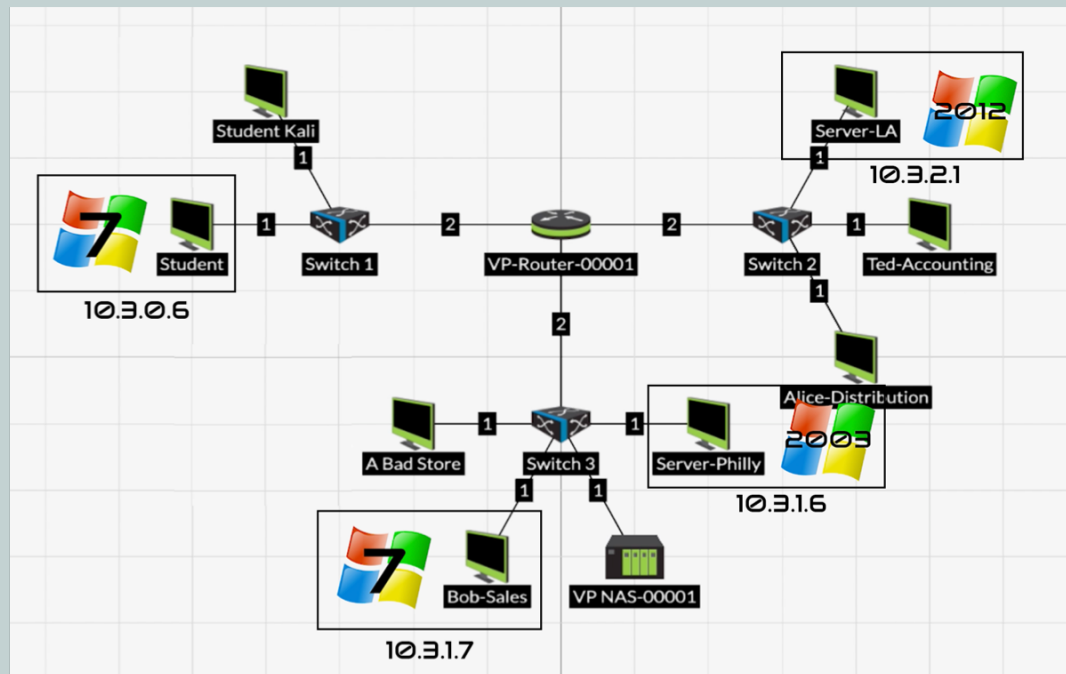LAN (Room or Building)

PAN
(Around a Person)

Wired Network Topology

CompTIA Network+ (N10-007)

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
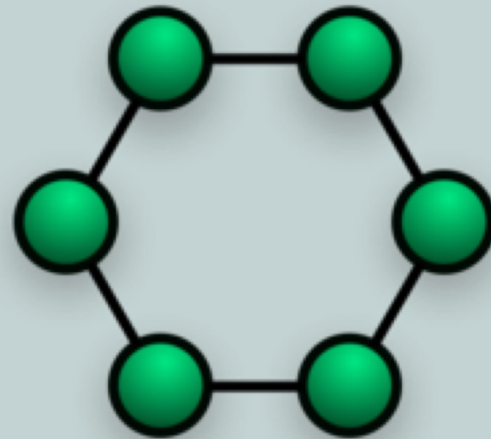
- Devices on cable form single collision domain
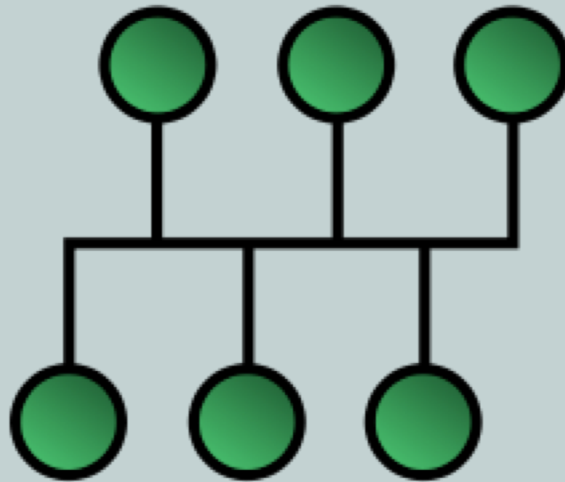
Ring Topology

- 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
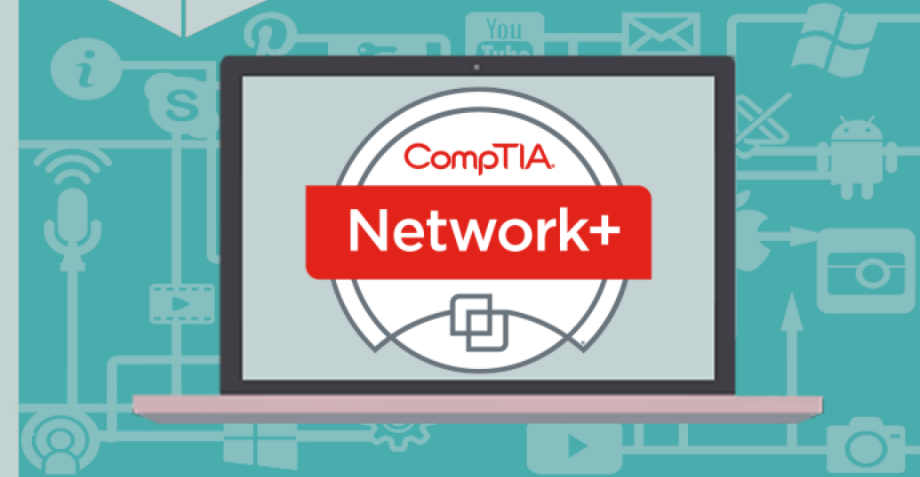
Star Topology

- Most popular physical LAN topology

- Devices connect to a single point

- Most commonly used with Ethernet cabling, but wireless or fiber are also used
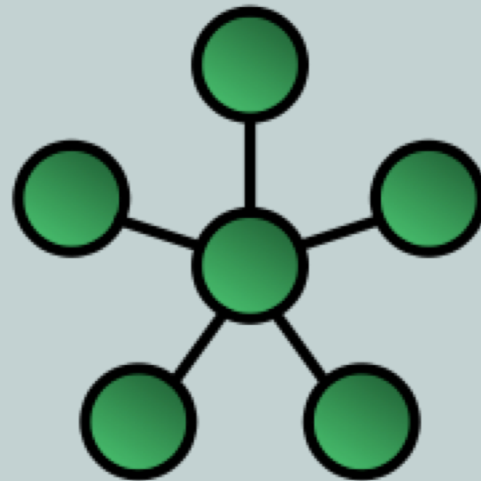
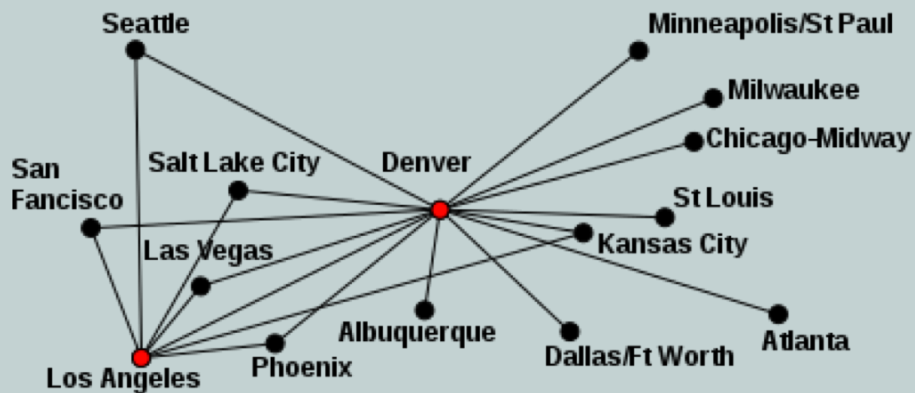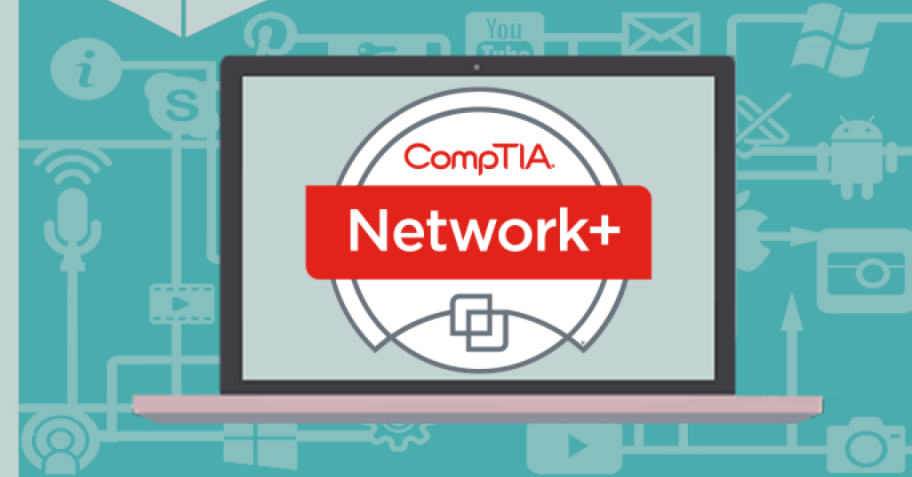- If the central device fails, the entire network fails
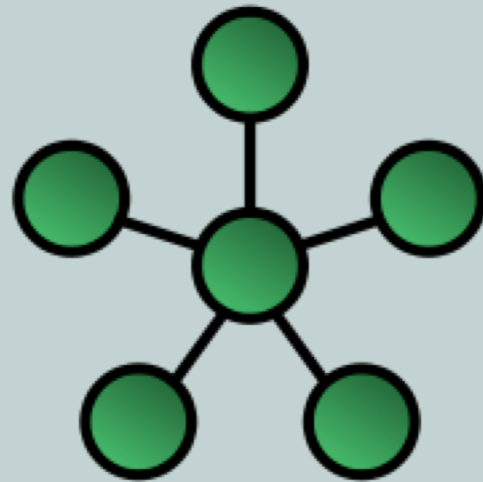
Hub-and-Spoke Topology

- Used for connecting multiple sites

- Similar to Star, but with WAN links instead of local area network connections

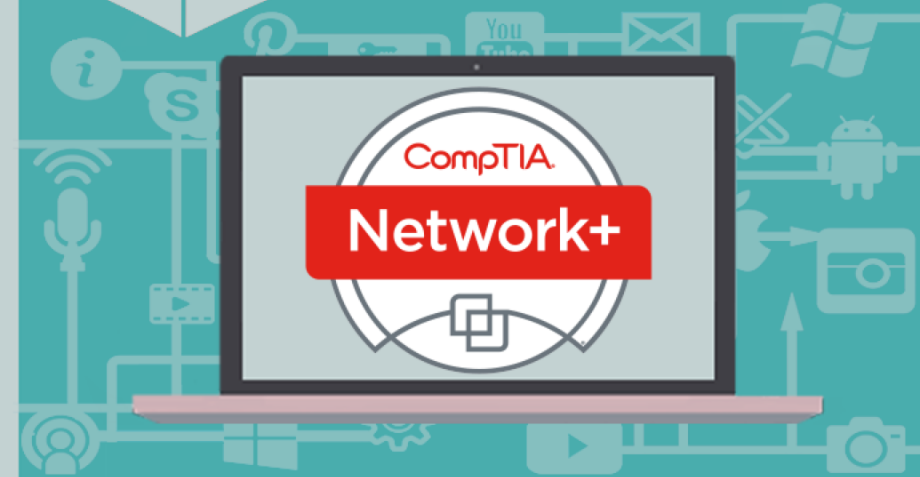- Not redundant, if central office (hub) fails, the whole network can fail
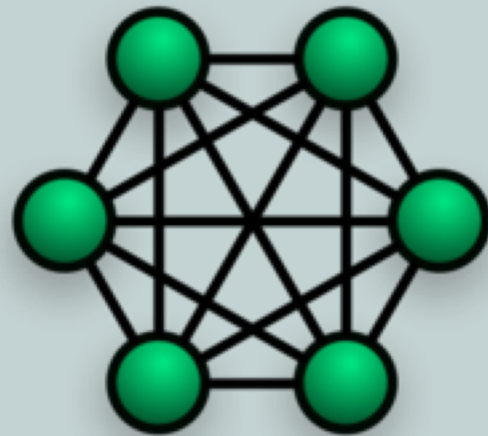
Full-Mesh Topology

- Most redundant topology

- Every node connects to every other node

- Optimal routing is always available
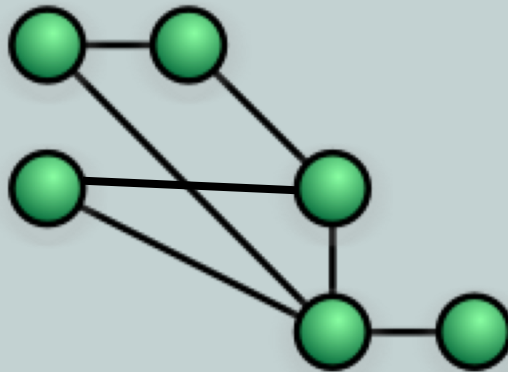
- Very expensive to maintain and operate

- 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

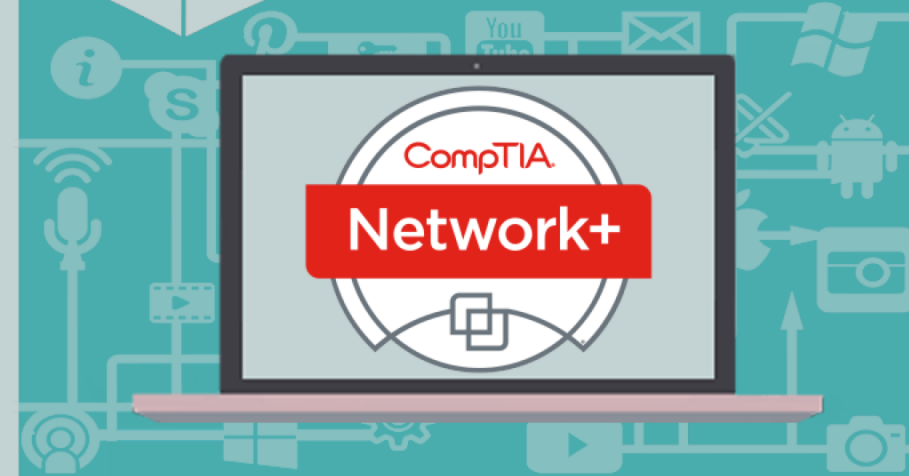- Must consider network traffic patterns to design it effectively

Wireless Network Topology

CompTIA Network+ (N10-007)

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
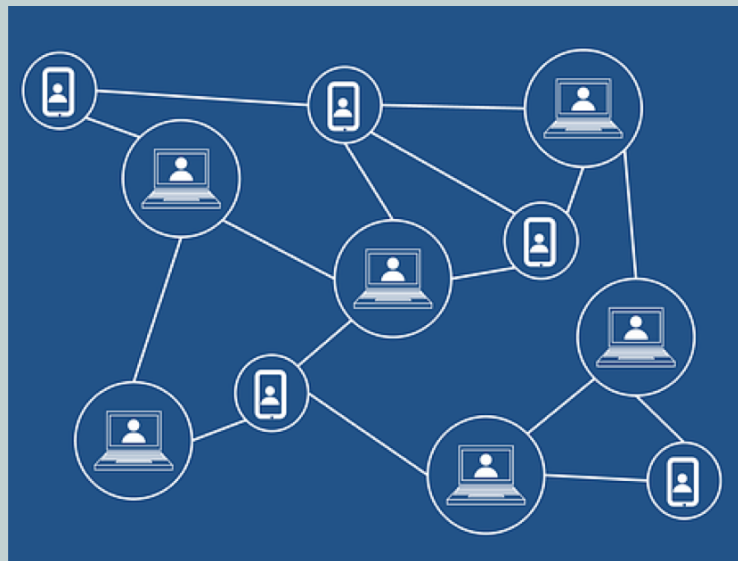
Wireless Mesh Topology

- Interconnection of different types of nodes or devices

- Consists of clients, routers, and gateways

- Utilizes different radio frequencies to extend and expand access
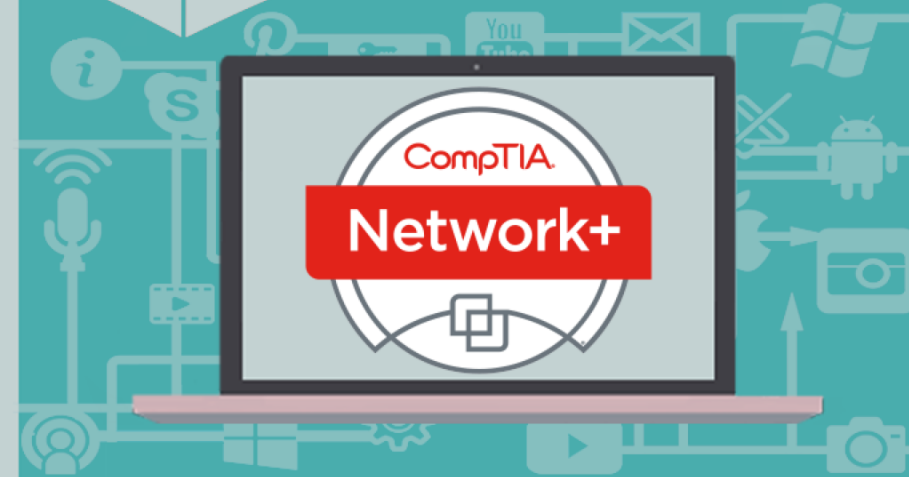
- Reliable and redundant connections
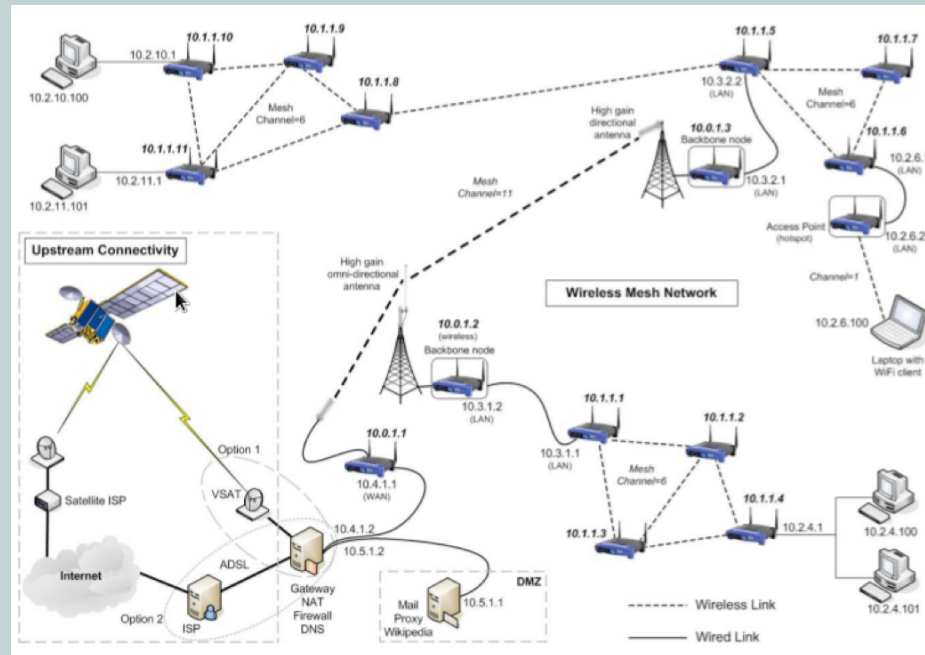
Internet of Things (IoT)

CompTIA Network+ (N10-007)
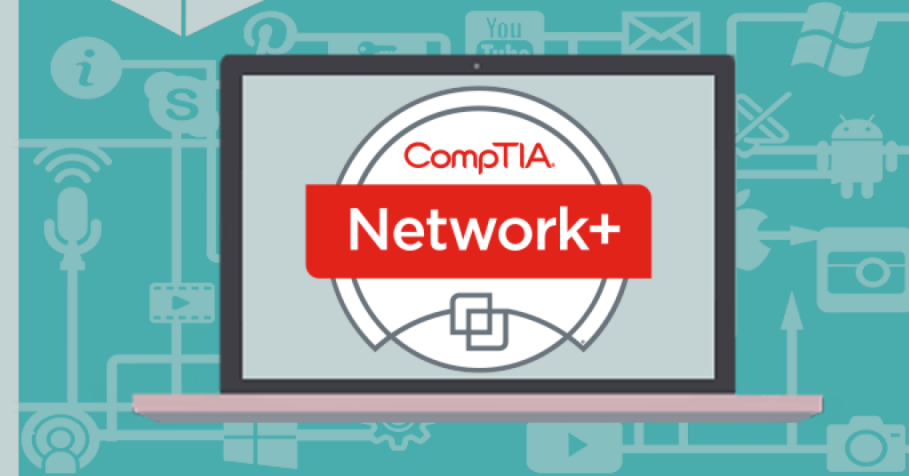
Internet of Things (IoT)

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)