CompTIA N+ (N10-009) Day 1

Chapter 1: Fundamentals of Network Communication

Introduction to Networks

Terms to be familiar with:

- **Network:** A group of interconnected devices.
- **Node:** Any device that can send, receive, or forward packets. *(CompTIA wants you to know this.)*
- **Host/Client:** Typically refers to an endpoint device like a workstation. A host is also a node and requests resources from a server.
- **Server:** Provides resources to clients.
- **Layer 2 Switch:** Operates at the Data Link layer; forwards frames using MAC addresses.
- **Layer 3 Switch:** Operates at the Network layer; can route packets in addition to switching.
- **Router:** Connects multiple networks and routes traffic between them.
- **Edge Router:** Connects an internal network to an external network (such as the internet).
- **Bridge:** Connects two or more network segments at the Data Link layer to reduce collisions.

Chapter 2: Networking Concepts

Networking Models

OSI and TCP/IP Model – Standardizes how applications and networking operate.
(Please Do Not Throw Sausage Pizza Away — from bottom to top)

OSI Model (Theory):
7 – **Application:** File, print, message, database, and application services. *Relies on lower layers for delivery.*
6 – **Presentation:** End-to-end encryption, compression, and translation services.
5 – **Session:** Session management, formation, and teardown.
4 – **Transport:** End-to-end connections, segmentation, UDP/TCP, ports.
3 – **Network:** Packet routing, IPv4/IPv6, ICMP.
2 – **Data Link:** Framing, MAC addressing, ARP, CRC/FCS, frame switching.
1 – **Physical:** Bits, physical connectivity (cables), hubs, electrical & optical signals.

TCP/IP Stack (Real World):

- Application (Layers 7, 6, 5)
- Transport (Layer 4)
- Internet (Layer 3)
- Link (Layers 2, 1)

Decoding Network Headers

Encapsulation (Sender perspective) / Decapsulation (Receiver perspective)

Protocol Data Units (PDUs) — Sender perspective:

- **Application:** DATA (application protocols like FTP, SSH, RDP)
- **Transport:** DATA + L4 Header (UDP/TCP)
  - *Segment* for TCP
  - *Datagram* for UDP
- **Internet:** DATA + L4 Header + L3 Header (IPv4/IPv6) → *Packet*
- **Link:** Trailer + DATA + L4 Header + L3 Header + L2 Header → *Ethernet Frame*
  - Components:
    - Preamble
    - Destination MAC
    - Source MAC
    - Type
    - Packet
    - FCS
- Converted to electrical/optical pulses (1's and 0's) at the Physical layer.BITs
- TCP – DATA > SEGEMT > PACKET > FRAME > BITS
- UDP – DATA > DATAGRAM > PACKETS > FRAMES > BITS

Reverse this order for decapsulation.

Intro to Network Addressing

Address Lengths:

- **Hexadecimal:** Digits 0–9 and A–F.
- **MAC (Layer 2):** HH:HH:HH:HH:HH:HH
  - Each H = 4 bits (nibble)
  - Total = 48 bits (12 hex digits)
- **IPv4 (Layer 3):** ddd.ddd.ddd.ddd (decimal)
  - Each octet = 8 bits
  - Total = 32 bits

- **IPv6 (Layer 3):** HHHH:HHHH:HHHH:HHHH:HHHH:HHHH:HHHH:HHHH
  - Each block = 16 bits
  - Total = 128 bits

Types of Layer 2 Communication

- **Unicast:** 1-to-1
- **Broadcast:** 1-to-all (FF:FF:FF:FF:FF:FF)
- **Multicast:** 1-to-many (01:00:5E:xx:xx:xx)

IPv4 Address Classes

IPv4 Address Classes

Class	First Octet	Type
A	1–126	Host addressing
B	128–191	Host addressing
C	192–223	Host addressing
D	224–239	Multicast
E	240–255	Experimental

127.x.x.x is reserved for loopback.

127.x.x.x is reserved for loopback testing.

Types of Layer 3 Communication

- **Unicast:** 1-to-1 (unique IP to unique IP)
- **Broadcast:** 1-to-all (255.255.255.255)
- **Multicast:** 1-to-many (Class D, e.g., 239.10.157.88)

ARP (Address Resolution Protocol)

ARP is a broadcast.
Maps Layer 3 IP addresses to Layer 2 MAC addresses within a subnet/broadcast domain. Results are stored in ARP cache.

Attacks:

- ARP Spoofing/Poisoning — pretending to be another IP (often the default gateway) by sending false MAC address replies.
- Can enable on-path (man-in-the-middle) attacks.

Network Topologies

Physical vs. Logical:

- Logical — How traffic flows
- Physical — How devices are connected

Types:

- **Bus:** Single backbone cable; one device transmits at a time.
- **Ring:** Closed loop; token passing controls access.
- **Star:** Central hub/switch; common today with Ethernet.
- **Mesh:** Every node connects to every other; highly redundant.

LAN Three-Tier Hierarchical Model

- **Core:** Layer 3 (mesh topology)
- **Distribution (Spine):** Connects core and access layers
- **Access (Leaf):** Layer 2 (star topology)

Software-Defined Networking (SDN) in Data Centers

- Distribution layer becomes *spine*, access layer becomes *leaf*.

Network Traffic Directions

- **Northbound:** Outbound from the network
- **Southbound:** Inbound into the network
- **East-West:** Internal traffic within the network

Introduction to IP Subnets

- Defined by IP address + subnet mask.
- Mask identifies the bits all hosts in a subnet share.

Example: (Class A with /24 mask)

- /24 mask = 255.255.255.0
- Binary = 11111111.11111111.11111111.00000000
- Ip Network - Network | Subnet | Subnet | Host