

Network Layer Summary

Transition from Link Layer to Network Layer

- Link Layer: Responsible for sending frames over a single link.
- Network Layer: Manages end-to-end packet transfer across one or multiple links, involving several devices.
- The router operates at OSI Layer 3 (Network Layer) and uses the destination IP address to forward packets.

Core Network Layer Protocols

- Internet Protocol (IP): The fundamental protocol providing best-effort, unreliable, and connectionless service.
- Supporting protocols: ICMP (Internet Control Message Protocol), ARP (Address Resolution Protocol).

IP Addressing

- IP Header: Contains IP addresses with either IPv4 or IPv6 formats, focusing here on IPv4 which uses 32 bits (4 octets).

IP Address Structure

- Binary representation example: 11000000.10101000.00000101.00000110
- Decimal representation (human-friendly): 192.168.5.6
- Each router interface has a unique IP address.

IP Address Types

- Network ID vs Host ID: Similar to a student ID system (e.g., GroupID + StudentID). • Network ID identifies the network. • Host ID identifies the device within that network.

Classful Addressing

1. Class A: • 1-126 in the first octet. • Format: N.H.H.H (Network ID is the first octet). • E.g., 12.15.20.31, Network ID = 12.
2. Class B: • 128-191 in the first octet. • Format: N.N.H.H. • E.g., 131.15.20.31, Network ID = 131.15.
3. Class C: • 192-223 in the first octet. • Format: N.N.N.H. • E.g., 200.15.20.31, Network ID = 200.15.20. • Valid host addresses are from 200.15.20.1 to 200.15.20.254.

Subnetting

- Subnetting: Dividing a larger network into smaller, manageable segments, allowing for better utilization of IP address space while limiting broadcast traffic.
- Subnet Mask: Indicates which portion of the IP address is the network and which is the host.
- Common default subnets: Class C /24, Class B /16, etc.

Variable Length Subnet Masking (VLSM)

- Allows for subnets of different sizes within the same network, optimizing address space usage and minimizing waste.
- Example: Create one subnet with 128 hosts (/25) and another with 64 hosts (/26).

ARP (Address Resolution Protocol)

- ARP: Maps IP addresses to MAC addresses within the local network.
- Steps in the ARP process:
 1. Host checks if the destination IP is local or remote.
 2. If local, it checks its ARP cache for the MAC address.
 3. If not found, it sends an ARP request; the destination responds with its MAC address.
- ARP cache entries are refreshed dynamically.

Private and Public IP Addresses

- Private IP: Used within local networks, not routable on the Internet (e.g., 192.168.x.x, 10.x.x.x).
- Public IP: Unique across the Internet, needed for reaching external networks.
- NAT (Network Address Translation): Allows multiple devices on a local network to share a single public IP address when accessing the internet.

Wireless Networking (WLAN)

- Characterized by mobility, cost-effectiveness, but can suffer signal fluctuations due to interference.
- WLANs operate on standards like 802.11 a/b/g/n/ac/ad, differing in max speeds, frequency bands, and technologies like MIMO.

Switching and VLANs

- Switching is done at Layer 2 (Data Link) primarily based on MAC addresses, reducing collisions and maintaining a smaller broadcast domain.
- VLAN (Virtual Local Area Networks): Segments networks for improved traffic management and security. Each VLAN must be a separate subnet.

Configuration Highlights

- Basic configuration commands on switches include creating VLANs, assigning ports, and showing VLAN info.

- Use of trunking to maintain traffic between multiple VLANs, utilizing tagging for differentiation.

By understanding these topics in detail, you can grasp the fundamental concepts of the Network Layer and effectively configure and manage networking environments.