Report on IP Networking

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1. Routing in the System Based on Classes A, B, and C Internet Addresses

In the early days of the internet, IP addresses were divided into three classes: A, B, and C. Each class had a different network portion and host portion, allowing for varying numbers of networks and hosts. Routing in this system was based on the class of the destination IP address.

- Routing Tables: Routing tables are data tables stored in routers that contain information about the networks to which the router is connected and how to reach other networks. They are created and maintained using routing protocols such as RIP (Routing Information Protocol) or OSPF (Open Shortest Path First).

- Creation of Routing Tables: Routing tables are created dynamically by routers exchanging routing information with neighboring routers. Each router learns about networks from its neighbors and adds this information to its routing table.

- Size of Routing Tables: The size of routing tables depends on the number of networks that a router needs to reach. In the class-based addressing system, routing tables could be large due to the need to store information for each classful network.

- Working of Routing Tables: When a router receives a packet, it looks up the destination IP address in its routing table to determine the next hop towards the destination. The router then forwards the packet to the next hop router until it reaches its final destination.

2. CIDR (Classless Inter-Domain Routing)

CIDR was introduced to address the limitations of the class-based addressing system. CIDR allows for more efficient use of IP addresses by allowing the creation of custom-sized networks, rather than being constrained by the fixed network sizes of the class-based system.

- Routing in CIDR: Routing in CIDR is based on the longest prefix match. When a router receives a packet, it looks for the most specific (longest prefix) match in its routing table to determine the next hop.

- Routing Tables in CIDR: CIDR routing tables are typically smaller than class-based routing tables because they only need to store information about specific network prefixes rather than entire classful networks.

3. Coexistence of Class-Based and CIDR Systems

The transition from class-based addressing to CIDR was gradual, with both systems coexisting for a period of time. Routers and networking devices were updated to support CIDR, and the internet gradually moved towards CIDR as the standard addressing scheme.

4. IPv6 (Internet Protocol version 6)

IPv6 was developed to address the limitations of IPv4, primarily the exhaustion of available IPv4 addresses. IPv6 uses 128-bit addresses, allowing for a significantly larger number of unique addresses compared to IPv4.

- Address Format: IPv6 addresses are represented as eight groups of four hexadecimal digits, separated by colons (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334).

- Routing in IPv6: Routing in IPv6 is similar to IPv4, with routers using routing tables to determine the next hop for packets based on the destination IPv6 address.

5. CIDR in IPv6

CIDR is integral to IPv6 addressing, allowing for efficient allocation of IPv6 addresses. CIDR notation is used to specify the network prefix length in IPv6 addresses (e.g., 2001:0db8::/32).

6. Translation Between IPv4 and IPv6 Addresses

There are various methods for translating between IPv4 and IPv6 addresses, including:

- Dual Stack: Running IPv4 and IPv6 concurrently on network interfaces.
- Tunneling: Encapsulating IPv6 packets within IPv4 packets for transmission over an IPv4 network.
- NAT64: Performing address translation between IPv4 and IPv6 addresses.

Function of the Network Layer (Layer 3) in the OSI Model

The Network Layer is responsible for logical addressing, routing, and forwarding of data packets. It provides end-to-end communication between hosts on different networks.

- Type of Communication: The Network Layer is primarily associated with end-to-end communication because it deals with addressing and routing packets between networks. However, it also plays a role in node-to-node communication by forwarding packets within a network.

The Network Layer's primary function is to ensure that data packets are delivered from the source to the destination across multiple networks, making it essential for both end-to-end and node-to-node communication.

References:

- For IPv4 and CIDR: [RFC 4632 - Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan] (https://datatracker.ietf.org/doc/html/rfc4632)

- For IPv6: [RFC 2460 - Internet Protocol, Version 6 (IPv6) Specification] (https://datatracker.ietf.org/doc/html/rfc2460)

- For OSI Model: [ISO/IEC 7498-1:1994 - Information technology -- Open Systems Interconnection -- Basic Reference Model: The Basic Model] (https://www.iso.org/standard/20269.html)