CELEBAL TECHNOLOGY INTERNSHIP (CSI)

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Research & Development Document

Table of Content

Title: In-depth Research on IP Addressing and Subnetting in IPv4 and IPv6

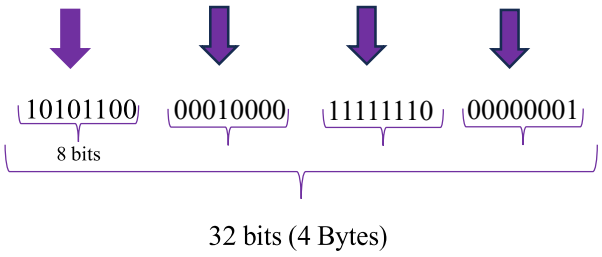
Objective: To perform comprehensive research and gain hands-on understanding of IP addressing and subnetting, with the ability to:

- Understand IP address structure and classes.
- Create subnets using default and custom subnet masks.
- Apply CIDR notation for both IPv4 and IPv6.
- Calculate total and usable hosts for a given IP range.

1. IP Addressing Overview

1.1 IPv4 Addressing

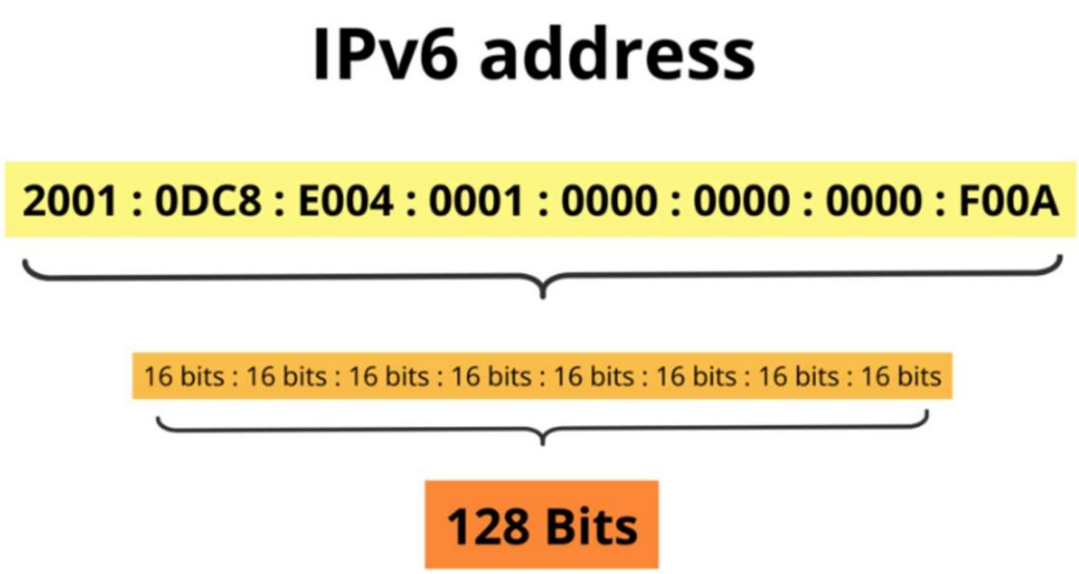
- IPv4 addresses are 32-bit numerical labels written in dotted decimal format (e.g., 192.168.1.1).
- Address divided into 4 octets (8 bits each).
- IPv4 Address Classes:
    - Class A: 0.0.0.0 to 127.255.255.255 (/8 default)
    - Class B: 128.0.0.0 to 191.255.255.255 (/16 default)
    - Class C: 192.0.0.0 to 223.255.255.255 (/24 default)
    - Class D & E: Reserved for multicast and experimental



1.2 IPv6 Addressing

- IPv6 addresses are 128-bit hexadecimal numbers separated by colons (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334).
- Supports 3.4 x 10^38 unique addresses.
- Representation may include '::' to compress consecutive zeroes.

- CIDR notation used exclusively.



2. Subnetting Fundamentals

2.1 Subnet Masks (IPv4)

- Subnet mask defines how many bits belong to the network and host portions.
- Example: 255.255.255.0 = /24 = 24 network bits, 8 host bits

2.2 CIDR (Classless Inter-Domain Routing)

- CIDR notation replaces class-based addressing.
- Format: IP address/Prefix length (e.g., 192.168.1.0/24)
- Enables efficient IP address allocation and routing.

3. IPv4 Subnetting: Methodology

3.1 Subnet Calculation Example Given: 192.168.1.0/26

- Subnet Mask: 255.255.255.192
- New bits for subnetting: 2 (from /24 to /26)
- Subnets created: 2^2 = 4
- Hosts per subnet: 2^6 - 2 = 62

Subnets List:

1. 192.168.1.0/26 (Range: 192.168.1.1 - 192.168.1.62)

2. 192.168.1.64/26 (Range: 192.168.1.65 - 192.168.1.126)
3. 192.168.1.128/26 (Range: 192.168.1.129 - 192.168.1.190)
4. 192.168.1.192/26 (Range: 192.168.1.193 - 192.168.1.254)

3.2 Host Count Formula

- Usable hosts = 2^(32 - prefix) - 2

3.3 Special Subnets

- /30: Used for point-to-point links (2 usable hosts)
- /32: Represents a single host

4. IPv6 Subnetting

4.1 IPv6 CIDR Basics

- Default subnet: /64 (common in LANs)
- Other common prefix lengths: /48, /56
- Subnetting involves incrementing bits in the subnet part of the address

4.2 Example: Subnetting a /48 Prefix Given: 2001:0db8::/48

- Subnet 1: 2001:0db8:0000:0000::/64
- Subnet 2: 2001:0db8:0000:0001::/64
- Up to 65,536 subnets possible (/64s within /48)

4.3 No Broadcast in IPv6

- IPv6 uses multicast and anycast instead
- No need to subtract 2 from host calculation

5. Host Calculation Table (IPv4)

CIDR	Host Bits	Usable Hosts
/24	8	254
/25	7	126
/26	6	62

/27	5	30
/28	4	14
/29	3	6
/30	2	2
/31	1	0 (special)
/32	0	1 (single IP)

Class A Networks

Bits Count	8 Bits	8 Bits	8 Bits	8 Bits
Network Part / Host Part	Network	Host	Host	Host
Subnet Mask in Decimals	255	0	0	0
Subnet Mask in Binaries	11111111	00000000	00000000	00000000

6. Tools and Resources

- Subnet calculators (online)
- Packet Tracer, Wireshark for practical simulation

7. Conclusion This research and development exercise offers a strong foundation in IP addressing and subnetting techniques. Mastery of these concepts is essential for network design, implementation, and troubleshooting in both legacy IPv4 and emerging IPv6 environments.

Next Steps:

- Practice subnetting exercises.
- Explore IPv6 address planning.
- Simulate subnets in network simulators.

Reference: Cisco Subnetting Guide

• [https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html]

• Tanenbaum, A. S., & Wetherall, D. J. (2010). Computer Networks (5th ed.). Pearson.