

IPStructure

Module Code: ELEE1157

Module Name: Network Routing Management

Credits: 15

Module Leader: Seb Blair BEng(H) PGCAP MIET MIHEEM FHEA

What is IPv4?

- **IPv4:** Internet Protocol version 4 is a core protocol that defines IP addresses used in networking.
- **32-bit** address space, supporting up to **4.3 billion addresses**.

IPv4 Address Structure

- IPv4 addresses are written as four **octets** separated by periods.
- Example: 192.168.1.1
- Each octet is an **8-bit binary number** (total 32 bits).

IPv4 Address Example: 11000000.10101000.00000001.00000001

- Each octet ranges from 0-255 in decimal.

IPv4 Address Classes

IPv4 addresses are divided into five classes:

Class	Range	Usage	Networks	Hosts
A	1.0.0.0 - 126.0.0.0	Large networks	16777216	16777214
B	128.0.0.0 - 191.255.0.0	Medium networks	65534	65534
C	192.0.0.0 - 223.255.255.0	Small networks	2097152	254
D	224.0.0.0 - 239.255.255.255	Multicasting		
E	240.0.0.0 - 255.255.255.255	Experimental		

Reserved IP Ranges

IPv4 has reserved addresses for private networks and special purposes.

Range	Description
10.0.0.0 - 10.255.255.255	Class A private
172.16.0.0 - 172.31.255.255	Class B private
192.168.0.0 - 192.168.255.255	Class C private
127.0.0.0 - 127.255.255.255	Loopback (localhost)

Subnetting in IPv4

What is Subnetting?

- Dividing a large network into smaller, manageable subnetworks.
- Uses a **subnet mask** to identify network and host portions.

Example:

- IP: 192.168.1.0/24
- Subnet Mask: 255.255.255.0

Network Portion	Host Portion
192.168.1	.0 - .255

CIDR Notation

CIDR (Classless Inter-Domain Routing)

- Uses slash notation to indicate the subnet mask length (e.g., /24).
- 192.168.1.0/24 means the first 24 bits are network bits.

Examples of CIDR:

- /8 (Class A) -> 255.0.0.0
- /16 (Class B) -> 255.255.0.0
- /24 (Class C) -> 255.255.255.0

Example: Calculating Subnets P1

Given Network: whose IP is range is `192.168.1.0/24` create four subnets.

|1. To create four subnets, we need to borrow bits from the host portion

- **Subnet Mask:**

- `/26` -> `255.255.255.192` or `11111111.11111111.11111111.11000000`

2. Calculate Number of Subnets and Hosts per Subnet:

- With `/26`, the first 26 bits are the network portion, and the remaining 6 bits are for hosts.
- Number of subnets created: $2^2 = 4$ (since we borrowed two bits)
- Hosts per subnet: $2^6 = 64$ \$ addresses per subnet (62 usable)

Example: Calculating Subnets P2

3. Determine the Subnet Ranges::

- Starting with 192.168.1.0, each subnet has 64 addresses, incrementing by 64 for each subsequent subnet.

Subnet ID	Range	Description
192.168.1.0/26	192.168.1.0 - 192.168.1.63	First subnet
192.168.1.64/26	192.168.1.64 - 192.168.1.127	Second subnet
192.168.1.128/26	192.168.1.128 - 192.168.1.191	Third subnet
192.168.1.192/26	192.168.1.192 - 192.168.1.255	Fourth subnet

Summary

- IPv4 is a 32-bit address space with classes for different network sizes.
- Subnetting divides a network into smaller parts using subnet masks.
- CIDR provides flexible subnetting options.