Internet Protocol (IP) Addresses

What is an IP Address?

- Unique identifier for devices in a network

- Functions: Identification, Location, Routing

- Analogy: Like a postal address (Network = Street, Host = House)

Versions of IP

◇ IPv4 (32-bit): ~4.3 billion addresses, Example: 192.168.1.5

◇ IPv6 (128-bit): ~3.4 × 10^38 addresses, Example: 2001:db8::1

◇ IPv6 created to overcome IPv4 exhaustion

Types of IP Addresses

◇ **Public**: Routable on the Internet

◇ **Private**: Used within LANs (RFC1918 ranges)

◇ **Static**: Fixed, manually configured

◇ **Dynamic**: Automatically assigned by DHCP

IPv4 Address Classes

Class	Range	Default Mask	Hosts/Net	Private Range	Usage
A	0–127	/8	~16M	10.0.0.0/8	ISPs, enterprises
B	128–191	/16	~65K	172.16.0.0/12	Medium orgs
C	192–223	/24	254	192.168.0.0/16	Small/home networks
D	224–239	Multicast	–	–	Streaming, conferencing
E	240–255	Reserved	–	–	Research/experimental

Special IPv4 Addresses

◇ **127.0.0.1** → Loopback (localhost)

◇ **0.0.0.0** → Unspecified (any interface)

◇ **255.255.255.255** → Broadcast (local network)

Subnetting Basics

◈ **Subnetting** = dividing a network into smaller sub-networks

◈ **Benefits**: efficient IP use, better performance, security isolation

◈ **Subnet mask** determines network vs host bits

Case Study: Subnetting a /24

◈ Company buys 192.168.10.0/24 (**256 addresses**)

◈ Needs **3** networks:

◈ Subnet A → **100** hosts

◈ Subnet B → **50** hosts

◈ Subnet C → **25** hosts

Subnetting Solution

◇ **Subnet A** (/25): 192.168.10.0 – 192.168.10.127, **126 usable** hosts

◇ **Subnet B** (/26): 192.168.10.128 – 192.168.10.191, **62 usable** hosts

◇ **Subnet C** (/27): 192.168.10.192 – 192.168.10.223, **30 usable** hosts

◇ **Remaining**: 192.168.10.224 – 192.168.10.255

IPv6 Highlights

◈ 128-bit addresses (virtually unlimited)

◈ Example: 2001:db8::1/64

◈ Types: Unicast (one-to-one), Multicast (one-to-many), Anycast (one-to-nearest)

◈ No NAT required

Summary

◈ **IP** = Unique identifier for devices

◈ **IPv4 (32-bit)** and IPv6 (128-bit)

◈ **Public** vs **Private**, **Static** vs **Dynamic**

◈ **Classes A–E** with **private ranges**

◈ **Special addresses**: loopback, broadcast

◈ **Subnetting**: efficient address division

◈ **IPv6** = future of addressing