



Lecture 3 — DNS & Classes of IPv4

1. DNS (Domain Name System)

What is DNS?

DNS is a system that **converts domain names (google.com)** into **IP addresses (142.250.195.78)**.

Humans remember names, computers understand numbers → DNS bridges the gap.

2. How DNS Works (Step-by-Step)

When you type **google.com** in a browser:

Step 1: DNS Resolver

- Your device sends the request to a **DNS Resolver** (usually provided by your ISP or Google DNS 8.8.8.8).
 - The resolver tries to find the IP address.
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Step 2: Check Cache

- Resolver checks if the IP is already stored in **DNS cache**.
 - If yes → returns instantly (fast response).
 - That's why DNS **cache should be cleared regularly** to remove outdated data.
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Step 3: Root Server

- If not cached, resolver contacts a **Root DNS Server**.
- Root servers know where TLD servers are located.

There are only **13 sets** of root servers worldwide (A–M).

Step 4: TLD Server (Top Level Domain Server)

- Handles domains like:
 - .com
 - .in
 - .org
 - .net
 - TLD tells the resolver which **Authoritative DNS server** holds the actual record.
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Step 5: Authoritative DNS Server

- Stores final DNS records.
 - Example: Google's DNS server returns the actual IP of google.com.
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Step 6: IP Sent to Client

- Resolver sends IP back to your browser.
 - Browser connects to that server.
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Why DNS Is Used?

- Humans cannot remember IP addresses.
 - Helps load websites faster.
 - Organizes the internet naming system.
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Daily-Life Example

- Typing **youtube.com** instead of its complex IP address.
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3. Public DNS Servers

Google DNS:

- **8.8.8.8** (most famous open DNS)

Cloudflare DNS:

- **1.1.1.1**
 - Faster than Google DNS in many regions.
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4. Binary to Decimal Conversion

Each octet of an IP is **8 bits**, so maximum value = **255**
(11111111 in binary)

Why it cannot exceed 255?

Because 8 bits can represent values from **0 to 255** only.

5. Ping (Packet Internet Groper)

What is Ping?

- A tool used to **check connectivity** between your device and a server.

How it works?

- Sends an ICMP echo request.
- If the server replies → connection is alive.

Why used?

- To check delay, connectivity issues, or packet loss.

Example

- ping google.com
Used by network engineers daily.
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6. IPv4 Limitations

$2^{32} = \sim 4.29$ Billion IPs

Total IPv4 addresses \approx 4.29 billion.

Major Authorities:

- **IANA (Internet Assigned Numbers Authority)**
→ Manages global IP ranges.
- **RIR (Regional Internet Registries)**
→ Assign IPs to countries and ISPs.

Problem:

Even these organizations couldn't manage IP shortage →
→ So IP **Classes** were created.

7. Classes of IPv4 Addresses

Class A

- Range: **1.0.0.0 – 126.255.255.255**
- First octet = Network
- Remaining 3 octets = Host
- Hosts possible: **~ 16 Million**

Example Usage:

Large companies like Microsoft or big ISPs.

Class B

- Range: **128.0.0.0 – 191.255.255.255**
- First 2 octets = Network
- Last 2 = Host
- Hosts possible: **$\sim 65,000$**

Example:

Universities, medium organizations.

Class C

- Range: **192.0.0.0 – 223.255.255.255**
- First 3 octets = Network
- Last 1 = Host
- Hosts possible: **254**

Example:

Small businesses, home networks.

Class D

- Range: **224.0.0.0 – 239.255.255.255**
 - Purpose: **Multicast**
(Used for live video broadcasting, IPTV)
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Class E

- Range: **240.0.0.0 – 255.255.255.255**
 - Purpose: **Reserved for experimental use**
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8. Special Address: 127.x.x.x (Loopback)

What is Loopback?

- A special range used for testing your own device's network card (NIC).
- Most common: **127.0.0.1**

Why Used?

- To test network functionality without using the internet.

Example:

- Running local servers (XAMPP, Node.js)

9. Binary Conversion Example

Convert: 168.10.100.255 into binary

Decimal Binary

168 10101000

10 00001010

100 01100100

255 11111111

So the full binary is:

10101000.00001010.01100100.11111111

10. CIDR (Classless Inter-Domain Routing)

CIDR tells how many bits are for **network** and how many for **host**.

CIDR Values:

- **Class A → /8**
(first 8 bits = network portion)
- **Class B → /16**
(first 16 bits = network portion)
- **Class C → /24**
(first 24 bits = network portion)

Why CIDR is Used?

- Saves IP address space.
- More flexible than classful IP addressing.
- Helps in subnetting.

Daily Example:

Your home router often assigns IPs like:

- 192.168.1.0/24