📘 Lecture 3 - What is DNS

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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.

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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.

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- That's why DNS **cache should be cleared regularly** to remove outdated data.

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.

Step 5: Authoritative DNS Server

- Stores final DNS records.
- Example: Google's DNS server returns the actual IP of google.com.

Step 6: IP Sent to Client

- Resolver sends IP back to your browser.
- Browser connects to that server.

Why DNS Is Used?

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

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.

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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

C^32 = ~4.29 Billion IPs

Total IPv4 addresses ≈ 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.

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