

## 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.

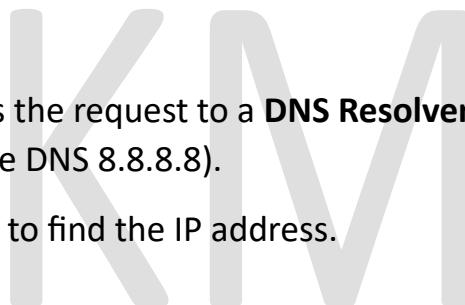
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### 2. How DNS Works (Step-by-Step)

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- That's why **DNS cache should be cleared regularly** to remove outdated data.

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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).

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## **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.

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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

$C^32 = \sim 4.29$  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.

