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# 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.

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  - That's why **DNS cache should be cleared regularly** to remove outdated data.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

$$C^32 = \sim 4.29 \text{ Billion IPs}$$

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.

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## 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.

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### Class B

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

### Example:

Universities, medium organizations.

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### 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.

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### 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**

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## 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