



## Lecture 4- Classes of IP

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### 1. What is an IP Address?

An **IP Address (Internet Protocol Address)** is a **logical address** used to uniquely identify a device on a network .

- It is called *logical* because it can be changed.
- It helps devices **find and communicate** with each other.



#### Daily Life Example:

- Just like your **home address** helps delivery people find your house ,
- An IP address helps data find the correct device .



### 2. IP Address Size (IPv4)

- An IPv4 address is **32 bits** long
- These 32 bits are divided into **4 parts**
- Each part is **8 bits = 1 byte = 1 octet**



#### Example:

192.168.10.2

Here:

- 192 → 1st octet
- 168 → 2nd octet
- 10 → 3rd octet
- 2 → 4th octet

### 3. What are Bits and Bytes?

#### ◆ Bit

- Smallest unit of data
- Can be only **0 or 1**  

#### ◆ Byte

- 8 bits = 1 byte

 1 Octet = 8 Bits = 1 Byte

#### Example:

- Switch ON = 1
- Switch OFF = 0

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### 4. Binary Number System

- Binary works only with **0 and 1**
- Used by computers because hardware understands ON/OFF signals 

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### 5. Powers of 2 (Very Important)

Each bit has a value from  **$2^7$  to  $2^0$**

#### Bit Position Power of 2 Value

$2^7$	128
$2^6$	64
$2^5$	32
$2^4$	16
$2^3$	8
$2^2$	4

## Bit Position Power of 2 Value

$2^1$	2
$2^0$	1

👉 Total = 255 (Maximum value of 1 octet)

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## ⌚ 6. Decimal to Binary Conversion (Step-by-Step)

### ⌚ Rule:

- If number is needed → ON (1)
  - If not needed → OFF (0)
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### ✓ Example 1: Convert 192.168.10.2 to Binary

#### ◆ 192

$$128 + 64 = 192$$

$$128 \ 64 \ 32 \ 16 \ 8 \ 4 \ 2 \ 1$$

1 1 0 0 0 0 0

Binary: **11000000**

#### ◆ 168

$$128 + 32 + 8 = 168$$

$$1 \ 0 \ 1 \ 0 \ 1 \ 0 \ 0 \ 0$$

Binary: **10101000**

#### ◆ 10

$$8 + 2 = 10$$

$$0 \ 0 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0$$

Binary: **00001010**

◆ 2

0 0 0 0 0 0 1 0

Binary: **00000010**

 **Final Binary IP:**

11000000.10101000.00001010.00000010

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 **Example 2: Convert 172.191.121.24 to Binary**

- 172 → 10101100
- 191 → 10111111
- 121 → 01111001
- 24 → 00011000

 **Final Binary:**

10101100.10111111.01111001.00011000

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 **Example 3: Convert 169.254.10.21 to Binary**

- 169 → 10101001
- 254 → 11111110
- 10 → 00001010
- 21 → 00010101

 **Final Binary:**

10101001.11111110.00001010.00010101

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 **7. Types of IP Addresses**

◆ **IPv4**

- 32 bits
- About **4.3 billion addresses**

- Written in decimal format

#### ◆ **IPv6**

- 128 bits
- Uses **hexadecimal**
- Created because IPv4 addresses are finishing 🚨

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## 🔗 8. Static vs Dynamic IP

### 📌 **Static IP**

- Fixed IP
- Used for servers 💻

### 📌 **Dynamic IP**

- Changes automatically
- Given by DHCP
- Used in homes 📱



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## 🏡 9. Private vs Public IP

### 🔒 **Private IP**

- Used inside office/home network
- Cannot access internet directly

### 🌐 **Public IP**

- Used on the internet
- Helps different networks communicate

### 🧠 **Example:**

- Office employees use private IP
- Router uses public IP to access internet

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## 10. DNS Mapping

- DNS converts **domain names → IP addresses**

 Example:

- google.com → 142.250.x.x

 Without DNS, we would need to remember IPs instead of names 

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## 11. IP Address Classes

### Class A

- Range: 0 – 127
- 1 Octet → Network
- 3 Octets → Host



### Class B

- Range: 128 – 191
- 2 Octets → Network
- 2 Octets → Host
- About **65,000 hosts**

### Class C

- Range: 192 – 254
- 3 Octets → Network
- 1 Octet → Host
- Total = 256
- Usable hosts = **254**

 Why 254?

- 1 reserved for Network ID
- 1 reserved for Broadcast ID

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## D Class D

- Used for **Multicast** 

## E Class E

- Reserved for **Research & Future use** 
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## G Summary

- IP address = Logical address
  - IPv4 = 32 bits
  - Binary = 0 and 1
  - Decimal to Binary uses  $2^7$  to  $2^0$
  - Classes define network & host part
  - IP helps devices communicate
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## 1 CHAPTER SUMMARY

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### 🌐 What is an IP Address?

An **IP Address (Internet Protocol Address)** is a **logical address** used to **uniquely identify a device** on a network 🌎.

- ◆ Called *logical* because:

- It **can be changed**
- Assigned by network or ISP

### 📦 Purpose:

- Helps devices **locate** each other
- Enables **data communication**

### 🧠 Daily Life Example:

- Home address 🏠 → finds your house
- IP address 💻 → finds your device

### 🔢 IPv4 Address Size

- IPv4 = **32 bits**
- Divided into **4 parts**
- Each part:
  - 8 bits = 1 byte = 1 octet

### 📌 Example:

192.168.10.2

### Octet Value

1st 192

2nd 168

## Octet Value

3rd 10

4th 2

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## ✿ Bits & Bytes

### ◆ Bit

- Smallest unit of data
- Can be **0 or 1**  

### ◆ Byte

- **8 bits = 1 byte**
- Also called **1 octet**

📌 Rule:

1 Octet = 8 Bits = 1 Byte

🧠 Example:

- Switch ON → 1
  - Switch OFF → 0
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## 12 Binary Number System

- Computers use **binary (0 & 1)**
  - Based on **ON / OFF electrical signals** 
- 📌 Human → Decimal
- 📌 Computer → Binary
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## Powers of 2 (MOST IMPORTANT 🔥)

Each bit has a positional value:

### Bit Position Power Value

$2^7$       128

$2^6$       64

$2^5$       32

$2^4$       16

$2^3$       8

$2^2$       4

$2^1$       2

$2^0$       1

 Maximum value of 1 octet:

$$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$$

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## Decimal to Binary Conversion

### Rule:

- Needed value → 1
- Not needed → 0

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### Example 1: 192.168.10.2

**192**

$$128 + 64 = 192$$

Binary → 11000000

**168**

$$128 + 32 + 8$$

Binary → 10101000

**10**

$8 + 2$

Binary → 00001010

**2**

Binary → 00000010



Final Binary IP:

11000000.10101000.00001010.00000010

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**Example 2: 172.191.121.24**

172 → 10101100

191 → 10111111

121 → 01111001

24 → 00011000

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**Example 3: 169.254.10.21**

169 → 10101001

254 → 11111110

10 → 00001010

21 → 00010101

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**Types of IP Addresses**

◆ **IPv4**

- 32 bits
- ~4.3 billion IPs
- Decimal format

## ◆ IPv6

- 128 bits
  - Hexadecimal format
  - Created due to **IPv4 exhaustion** 
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## Static vs Dynamic IP

### Static IP

- Fixed IP
- Manually configured
- Used for **servers** 

### Dynamic IP

- Changes automatically
- Assigned by **DHCP**
- Used in homes 



## Private vs Public IP

### Private IP

- Used inside LAN
- Not reachable directly from Internet

### Public IP

- Used on Internet
- Provided by ISP

### Example:

- Laptop → Private IP
- Router → Public IP

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## DNS Mapping

- DNS converts:

Domain Name → IP Address

 Example:

google.com → 142.250.x.x

 Without DNS, internet is unusable 

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## IP Address Classes

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### Class A

- Range: **0 – 127**
  - 1 Octet → Network
  - 3 Octets → Host
  - Very large networks
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### Class B

- Range: **128 – 191**
  - 2 Octets → Network
  - 2 Octets → Host
  - ~65,000 hosts
- 

### Class C

- Range: **192 – 254**
- 3 Octets → Network
- 1 Octet → Host

👉 Total = 256

👉 Usable = **254**

❓ Why 254?

- 1 → Network ID
  - 1 → Broadcast ID
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#### D Class D

- Used for **Multicast** 

#### E Class E

- Research & future use 
- 



## 2 CONCLUSION

IP Addressing is the **core foundation of networking** 

Without IP:

- ✗ No communication
- ✗ No Internet
- ✗ No Cyber Security

This chapter explains:

- ✓ How devices are identified
- ✓ How data finds destination
- ✓ How networks are structured

👉 Every networking & cyber security role depends on IP knowledge  

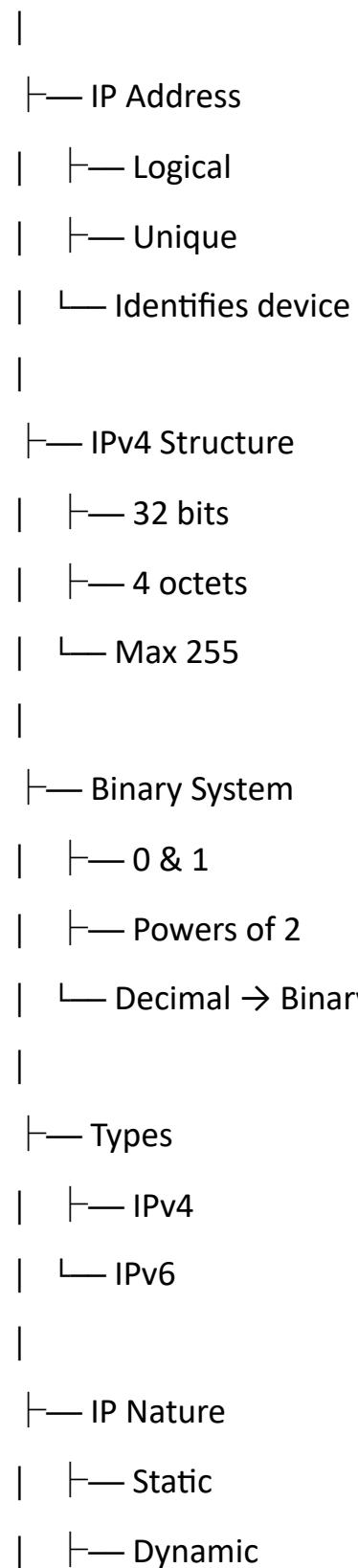
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## MIND MAP

### Lecture 4 – IP Address



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|   |--- Private  
|   |--- Public  
|  
|--- DNS Mapping  
|   |--- Name → IP  
|  
|--- IP Classes  
    |--- Class A  
    |--- Class B  
    |--- Class C  
    |--- Class D  
    |--- Class E
```

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## INTERVIEW QUESTIONS & ANSWERS

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**?** Q1. What is an IP address?

**✓ Answer:**

An IP address is a logical address used to uniquely identify a device on a network.

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**?** Q2. Why IP is called logical?

**✓ Answer:**

Because it can be changed and is assigned by the network.

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**?** Q3. What is IPv4 size?

**✓ Answer:**

IPv4 is 32 bits long.

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**?** Q4. How many octets in IPv4?

**✓ Answer:**

4 octets, each of 8 bits.

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**?** Q5. What is a bit and byte?

**✓ Answer:**

Bit is smallest data unit (0/1).

8 bits = 1 byte.

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**?** Q6. Why binary is used?

**✓ Answer:**

Because computers understand ON/OFF electrical signals.

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**?** Q7. Max value of one octet?

**✓ Answer:**

255.

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**?** Q8. Why not 256?

**✓ Answer:**

Because 8 bits give values from 0 to 255 only.

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**?** Q9. Difference between IPv4 and IPv6?

**✓ Answer:**

IPv4 = 32 bit

IPv6 = 128 bit

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**?** Q10. What is static IP?

**✓ Answer:**

A fixed IP address used for servers.

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**?** Q11. What is dynamic IP?

**✓ Answer:**

An IP that changes automatically and is assigned by DHCP.

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**?** Q12. Private vs Public IP?

**✓ Answer:**

Private → Internal network

Public → Internet communication

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**?** Q13. What is DNS mapping?

**✓ Answer:**

Converting domain names into IP addresses.

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**?** Q14. What are IP classes?

**✓ Answer:**

They divide IP addresses into network & host parts.

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**?** Q15. Range of Class A?

**✓ Answer:**

0 – 127.

**?** Q16. Range of Class B?

**✓ Answer:**

128 – 191.

**?** Q17. Range of Class C?

**✓ Answer:**

192 – 254.

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**?** Q18. Why Class C usable hosts are 254?

**✓ Answer:**

Because network ID and broadcast ID are reserved.

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**?** Q19. What is Class D?

**✓ Answer:**

Used for multicast communication.

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**?** Q20. Why IP is important in cyber security?

**✓ Answer:**

IP helps in tracking attackers, filtering traffic, and detecting intrusions.

