

Internet Protocol

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# INTERNET PROTOCOL

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Internet Protocol

## IP as a Routed Protocol

- IP is a connectionless, unreliable, best-effort delivery protocol.
- IP accepts whatever data is passed down to it from the upper layers and forwards the data in the form of IP Packets.
- All the nodes are identified using an IP address.
- Packets are delivered from the source to the destination using IP address

The diagram illustrates the encapsulation process: 'Email' data is placed into 'Data' blocks, which are then grouped and added with a 'Network Header' to form an IP packet. This packet is further encapsulated with a 'Frame Header' and 'Frame Trailer' to become a frame. Below, a network topology shows a source computer connected to three routers (A, B, C) which route the packet to a destination computer. A binary IP address '110001010101011000001010010101010' is shown at the bottom.

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Internet Protocol

## Packet Propagation

The diagram shows a network topology with two hosts, X and Y, and three routers, A, B, and C. Host X sends a packet to router A, which forwards it to router B, then to router C, and finally to host Y. Below the topology, a table shows the OSI layers (1-7) for each device. The layers used by each device are highlighted with red boxes: Physical (1), Data Link (2), Network (3), and Transport (4). The text below states: 'Each router provides its services to support upper-layer functions.'

7	Application	3	Network	3	Network	3	Network	3	Network	7	Application
6	Presentation									6	Presentation
5	Session									5	Session
4	Transport									4	Transport
3	Network	3	Network	3	Network	3	Network	3	Network		
2	Data Link	2	Data Link	2	Data Link	2	Data Link	2	Data Link		
1	Physical	1	Physical	1	Physical	1	Physical	1	Physical		

Each router provides its services to support upper-layer functions.

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Internet Protocol

## IP Address

- IP address is for the INTERFACE of a host. Multiple interfaces mean multiple IP addresses, i.e., routers.
- 32 bit IP address in dotted-decimal notation for ease of reading, i.e., 193.140.195.66
- Address 0.0.0.0, 127.0.0.1 and 255.255.255.255 carries special meaning.
- IP address is divided into a network number and a host number.
- Also bits in Network or Host Address cannot be all 0 or 1.

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Internet Protocol

## IP Address

The diagram illustrates a 32-bit IP address structure. A horizontal bar is divided into two sections: 'Network' and 'Host'. Above the bar, a double-headed arrow indicates the total length is 32 Bits. Below the bar, four boxes represent dotted decimal notation, each with an arrow indicating it is 8 Bits wide. The values under these boxes are 172, 16, 122, and 204, separated by dots.

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Internet Protocol

## IP Address

The diagram shows three classes of IP addresses with their bit distributions:

- Class A:** The first bit is 0. The Network portion is 7 bits long, and the Host portion is 24 bits long. A vertical scale on the left shows bit weights: 128, 64, 32, 16, 8, 4, 2, 1.
- Class B:** The first two bits are 1 and 0. The Network portion is 14 bits long, and the Host portion is 16 bits long.
- Class C:** The first three bits are 1, 1, and 0. The Network portion is 21 bits long, and the Host portion is 8 bits long.

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Internet Protocol

## IP Address

- **Class A** : Address begins with bit 0. It has 8 bit network number (range 0.0.0.0-to-127.255.255.255), 24 bit host number.
- **Class B** : Address begins with bits 10. It has 16 bit network number (range 128.0.0.0-to-191.255.255.255), 16 bit host number.
- **Class C** : Address begins with bits 110. It has 24 bit network number (range 192.0.0.0-to-223.255.255.255), 8 bit host number.
- **Class D** : Begins with 1110, multicast addresses (224.0.0.0-to-239.255.255.255)
- **Class E** : Begins with 11110, unused

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Internet Protocol

## Subnet Mask

- Consider IP address = 192.168.2.25
  - First few bits (left to right) identify network/subnet
  - Remaining bits identify host/interface
- Number of subnet bits is called subnet mask, e.g.
  - Subnet IP Address range is 192.168.2.0 - 192.168.2.255 or Mask = 255.255.255.0
  - Subnet IP Address range is 192.168.2.0 - 192.168.2.15 or Mask = 255.255.255.240

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## IP Address, Subnet Mask and Gateway

- IP Address and Subnet Mask define the Subnet
- For Example IP address 172.31.1.0 and Subnet Mask of 255.255.240.0 means that the subnet address ranges from 172.31.0.0 to 172.31.15.255
- Another notation is 172.31.1.0/28
- The first Address is the Network Address and the last Address is the Broadcast Address. They are reserved and cannot be assigned to any node.
- The Gateway Address is the Address of the router where the packet should be sent in case the destination host does not belong to the same subnet

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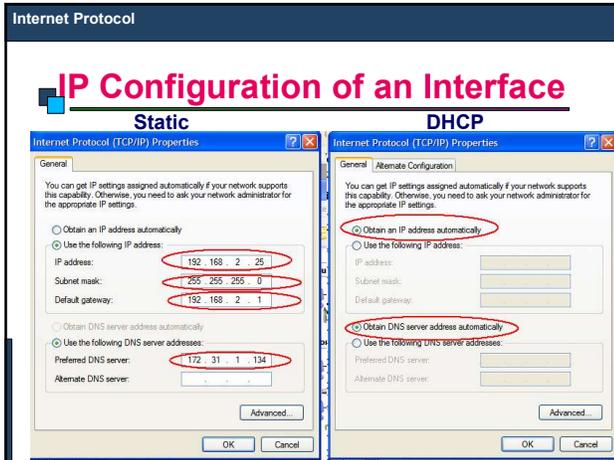
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### ARP

- **ARP (Address Resolution Protocol) is used in Ethernet Networks to find the MAC address of a node given its IP address.**
- **Source node (say 192.168.2.32) sends broadcast message (ARP Request) on its subnet asking "Who is 192.168.2.33".**
- **All computers on subnet receive this request**
- **Destination responds (ARP Reply) since it has 192.168.2.33**
  - **Provides its MAC address in response**

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### IPv6

- **Internet Protocol Version 4 is the most popular protocol in use today, although there are some questions about its capability to serve the Internet community much longer.**
- **IPv4 was finished in the 1970s and has started to show its age.**
- **The main issue surrounding IPv4 is addressing—or, the lack of addressing—because many experts believe that we are nearly out of the four billion addresses available in IPv4.**
- **Although this seems like a very large number of addresses, multiple large blocks are given to government agencies and large organizations.**
- **IPv6 could be the solution to many problems posed by IPv4**

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## IPv6

- IPv6 uses 128 bit address instead of 32 bit address.
- The IPv6 addresses are being distributed and are supposed to be used based on geographical location.

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