Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

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Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
- MTech from Indian Institute of Information Technology, Gwalior
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
- Google Scholar: https://scholar.google.com/citations?user=UZ_8yAMAAAAJ&hl=hi
- Contact: gyancity@gyancity.com, +91-7428640820 (For help in this Subject @ BIAS and Guidance for future MS from Europe and USA after BIAS)

About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-11 (Including Lab on Vivado)
- UNIT 3: Lecture No 14-18
- UNIT 4: Lecture No 19-21, Lecture 12-13
- UNIT 5: Lecture No 22-28 (Including Lab on Packet Tracer)
- Lecture No 29-35: Discuss Previous Year Question of UKTU
- Out of 35 Lectures: Some will delivered by Professor From Foreign University

IP Address: Lecture 12

OUTLINE OF LECTURE 12

- IPv4 Address
  - IP Packet
  - Structure
  - Types: Static and Dynamic
  - Types: Classless and Classful
  - Domain to IP Address Conversion
- The IPv4 Address Resource Problem
- IPv6 Addressing Structure

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INTRODUCTION

- What is the current internet addressing scheme and what limitations does it face.

- A new addressing scheme that would resolve the limitations, and an interim path towards the new scheme.

IPv4 Address Scheme

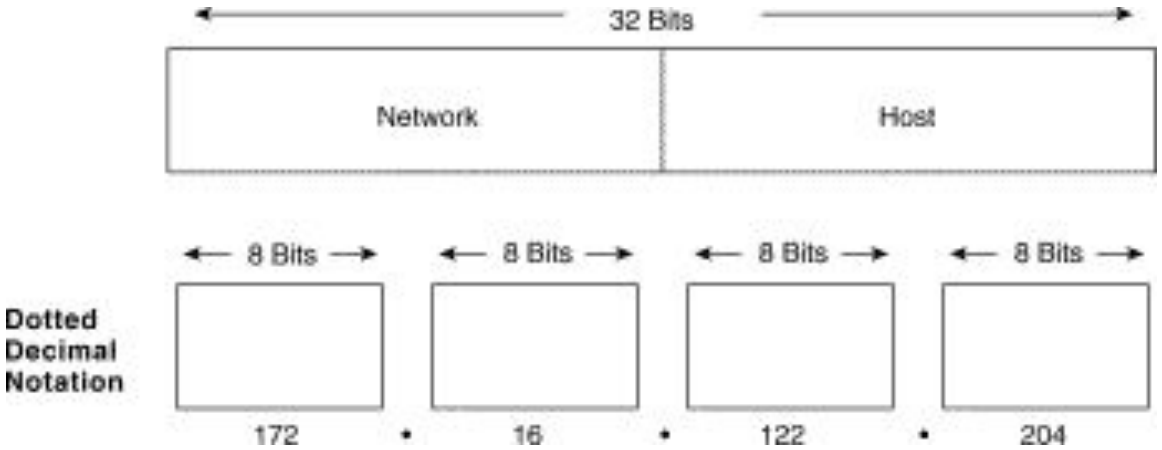
- **IP Packet Format**

- An IP packet contains several types of information, as illustrated.

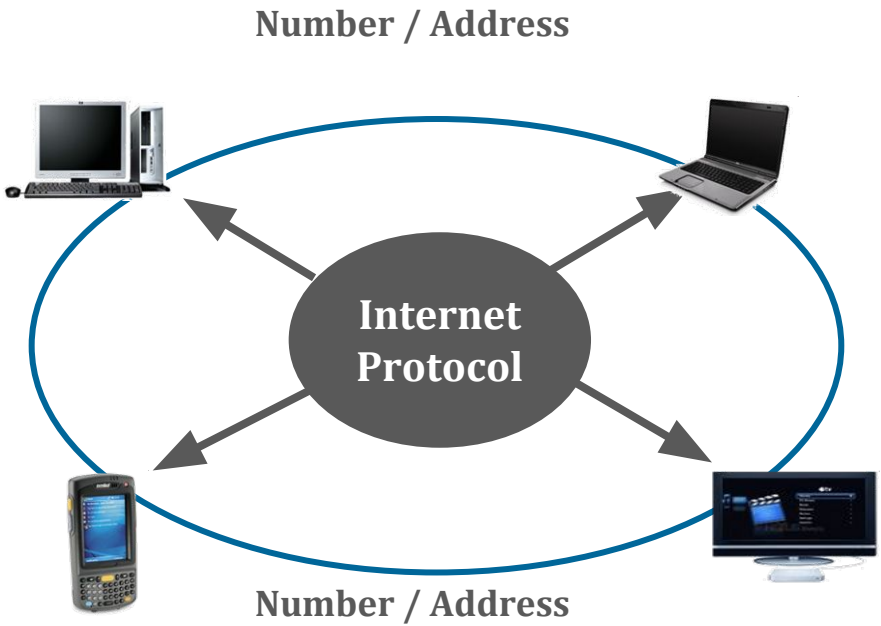
- ***Version*---Indicates the version of IP currently used.**
- ***IP Header Length (*IHL)---Indicates the datagram header length in 32-bit words.**
- ***Type-of-Service*---Assigns datagrams various levels of importance.**
- ***Total Length*---Specifies the length, in bytes, of the entire IP packet.**
- ***Identification*---Contains an integer that identifies the current datagram.**
- ***Flags*---The two low-order (least-significant) bits control fragmentation. The low-order bit specifies whether the packet can be fragmented. The middle bit specifies whether the packet is the last fragment in a series of fragmented packets. The third or high-order bit is not used.**
- ***Fragment Offset*---Indicates the position of the fragment's data relative to the beginning of the data in the original datagram.**
- ***Time-to-Live*---Maintains a counter that gradually decrements down to zero, at which point the datagram is discarded. This keeps packets from looping endlessly.**
- ***Protocol*---Indicates which upper-layer protocol receives incoming packets after IP processing is complete.**
- ***Header Checksum*---Helps ensure IP header integrity.**
- **S*ource Address*---Specifies the sending node.**
- ***Destination Address*---Specifies the receiving node.**
- ***Options*---Allows IP to support various options, such as security.**
- ***Data*---Contains upper-layer information.**

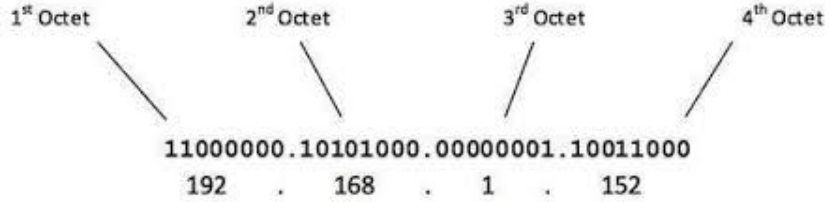
IPv4 Addressing

- **Each host on a TCP/IP network is assigned a unique 32-bit logical address that is divided into two main parts: the network number and the host number.**
- **The 32-bit IP address is grouped eight bits at a time, separated by dots, and represented in decimal format (known as *dotted decimal notation*). Each bit in the octet has a binary weight (128, 64, 32, 16, 8, 4, 2, 1). The minimum value for an octet is 0, and the maximum value for an octet is 255.**



IPv4 Addressing





Types of IP Address

- IP Addresses may be of the following two types:
  - Static IP Address
  - Dynamic IP Address

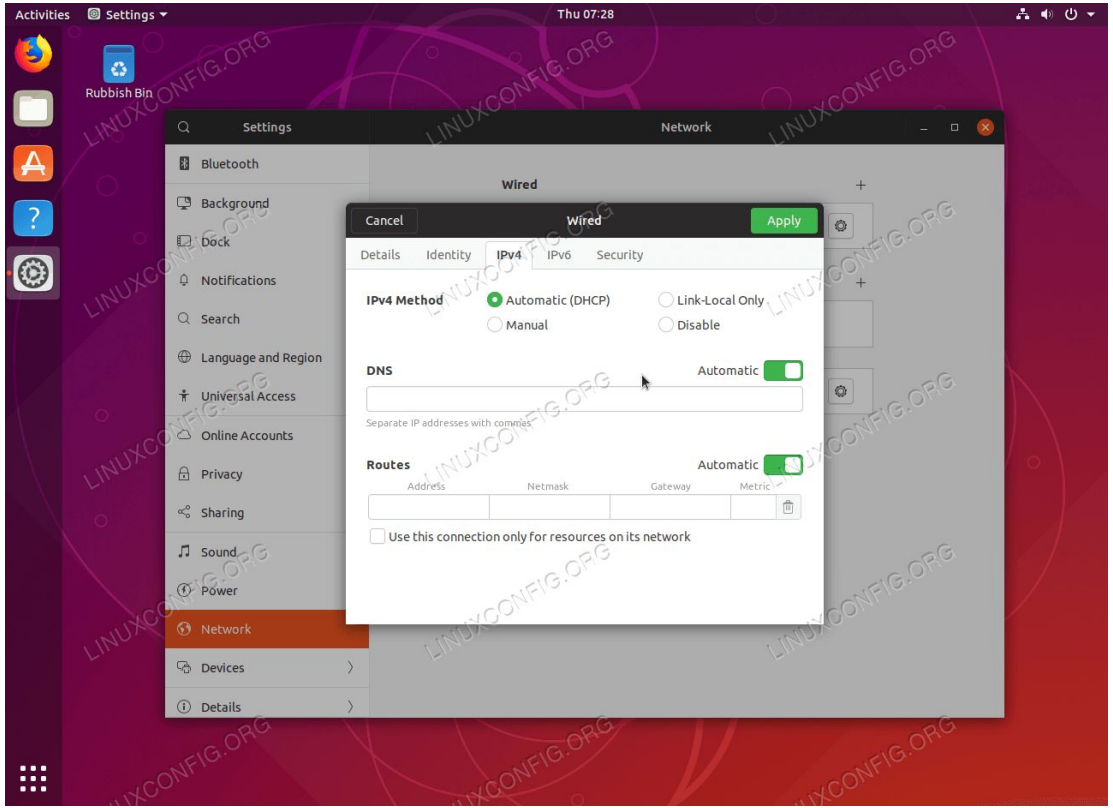
Static IP Address

- Static IP Address is an IP Address that once assigned to a network element always remains the same.
- They are configured manually.

Dynamic IP Address

- Dynamic IP Address is a temporarily assigned IP Address to a network element.
- It can be assigned to a different device if it is not in use.
- DHCP assigns dynamic IP addresses.

Static IP Address in LINUX UBUNTU



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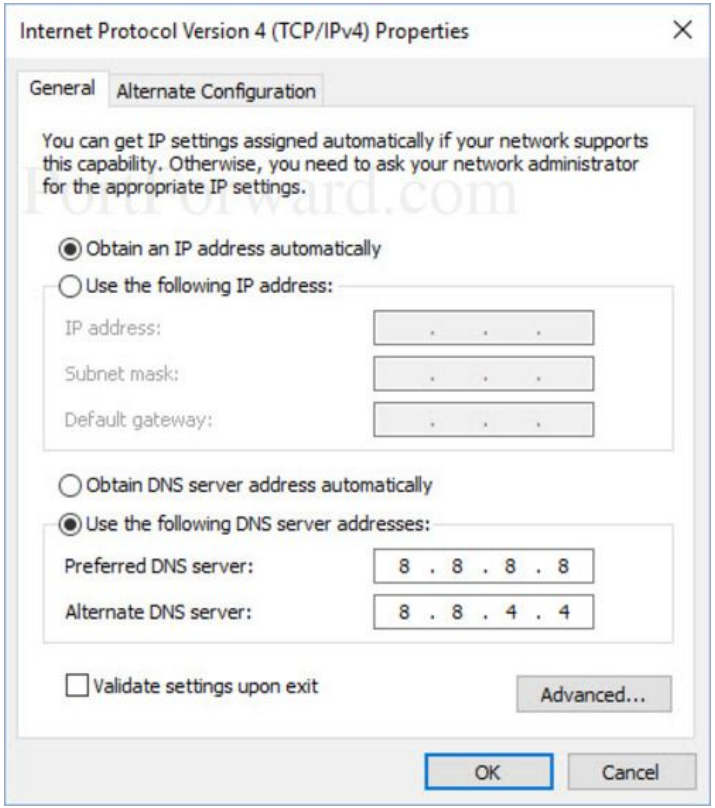
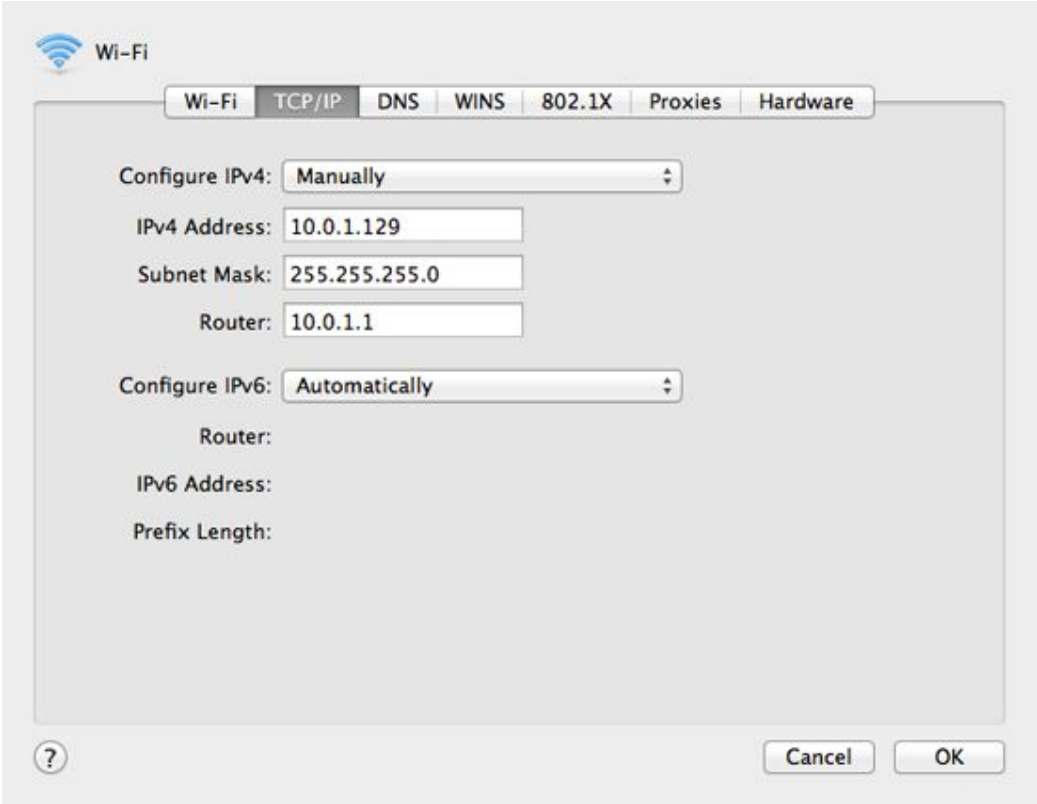
Static IP Address in Windows

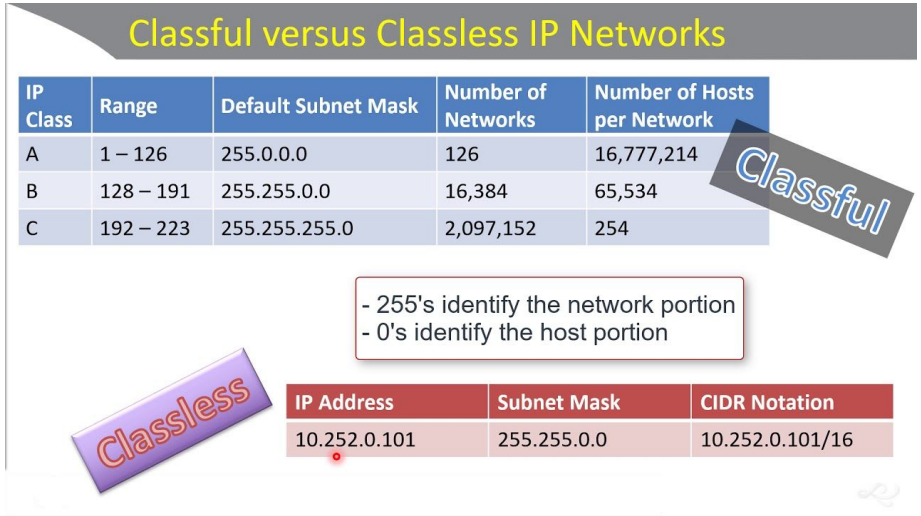


Static IP Address in Apple Mac



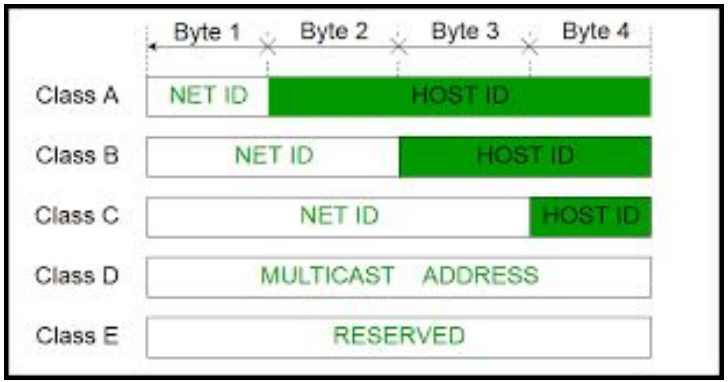
Types of IP Address

- IP Addresses may be of the following two types:
  - Classful IP Address
  - Classless IP Address



Classes of IP addresses

- TCP/IP defines five classes of IP addresses: class A, B, C, D, and E.

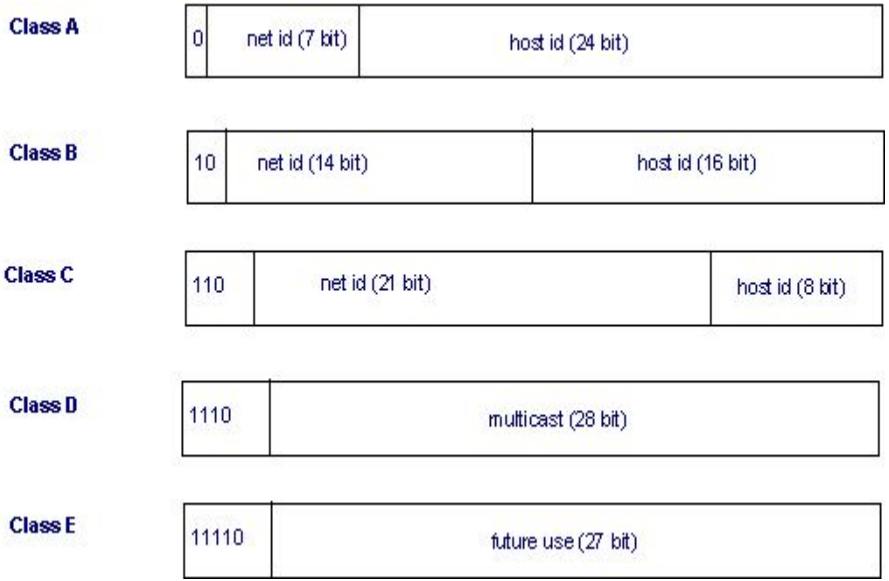


- IP addresses from the first three classes (A, B and C) can be used for host addresses.

- The other two classes are used for other purposes – class D for multicast and class E for experimental purposes.

Classes of IP addresses

- Each class has a range of valid IP addresses.
- The value of the first octet determines the class.



Address Class	RANGE	Default Subnet Mask
A	1.0.0.0 to 126.255.255.255	255.0.0.0
B	128.0.0.0 to 191.255.255.255	255.255.0.0
C	192.0.0.0 to 223.255.255.255	255.255.255.0
D	224.0.0.0 to 239.255.255.255	Reserved for Multicasting
E	240.0.0.0 to 254.255.255.255	Experimental

Note: Class A addresses 127.0.0.0 to 127.255.255.255 cannot be used and is reserved for loopback testing.

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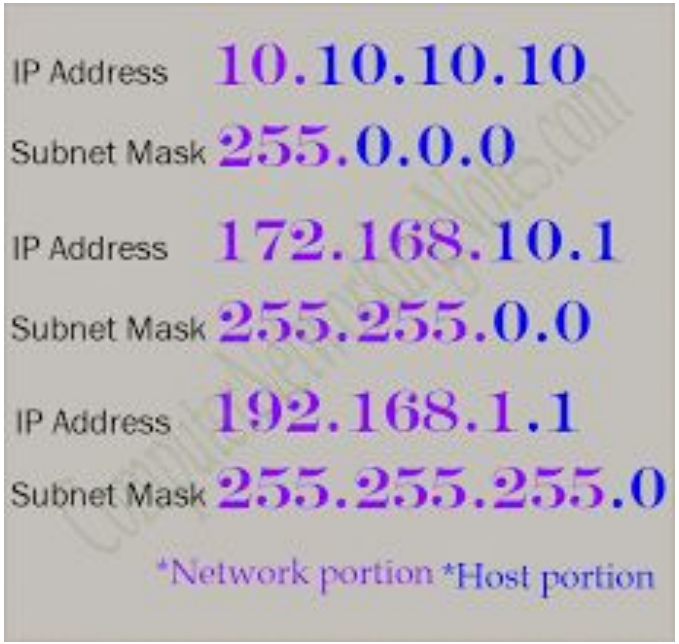
Classes of IP addresses

- In exam, IP address will given. They may ask what is Subnet Mask of corresponding IP Address?



Classes of IP addresses

S.No	IP Address	Class	Net id	Host id
1.	227.34.78.7	Class D	no net id	no host id
2.	4.23.145.90	Class A	4	23.145.90
3.	198.76.9.23	Class C	198.76.9	23
4.	129.6.8.4	Class B	129.6	8.4
5.	246.7.3.8	Class E	no net id	no host id

- In exam, IP address will given. They may ask what are classes of given IP Addresses?

Classes of IP addresses

Historical classful network architecture

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Start address	End address
A	0	8	24	128 (2^7)	16,777,216 (2^{24})	0.0.0.0	127.255.255.255
B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	128.0.0.0	191.255.255.255
C	110	24	8	2,097,152 (2^{21})	256 (2^8)	192.0.0.0	223.255.255.255

- In exam, they may ask number of network and number of network in a given class?

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Classes of IP addresses

IP Address Classes

	First Octet
Class A Range	0 thru 127
Class B Range	128 thru 191
Class C Range	192 thru 223
Class D Range	224 thru 239
Class E Range	240 thru 255

Sample IP Addresses. What class are they?

- 10.2.100.5
- 180.5.6.7
- 166.5.7.200
- 222.5.7.8
- 230.7.8.100

Classes of IP addresses

Special IP address ranges that are used for special purposes are:

- **0.0.0.0**– addresses used to communicate with the local network
- **127.0.0.0** – loopback addresses

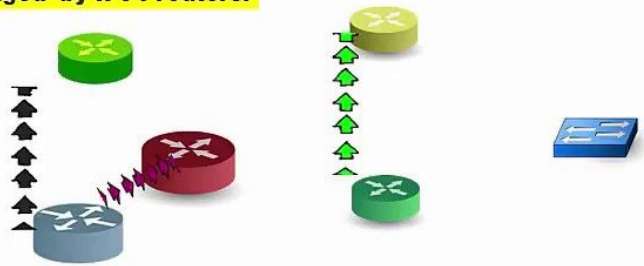
Classless IP Address

CIDR is the short for **Classless Inter-Domain Routing,**
an IPv4 addressing scheme that **replaces** the older system based on classes A, B, and C.

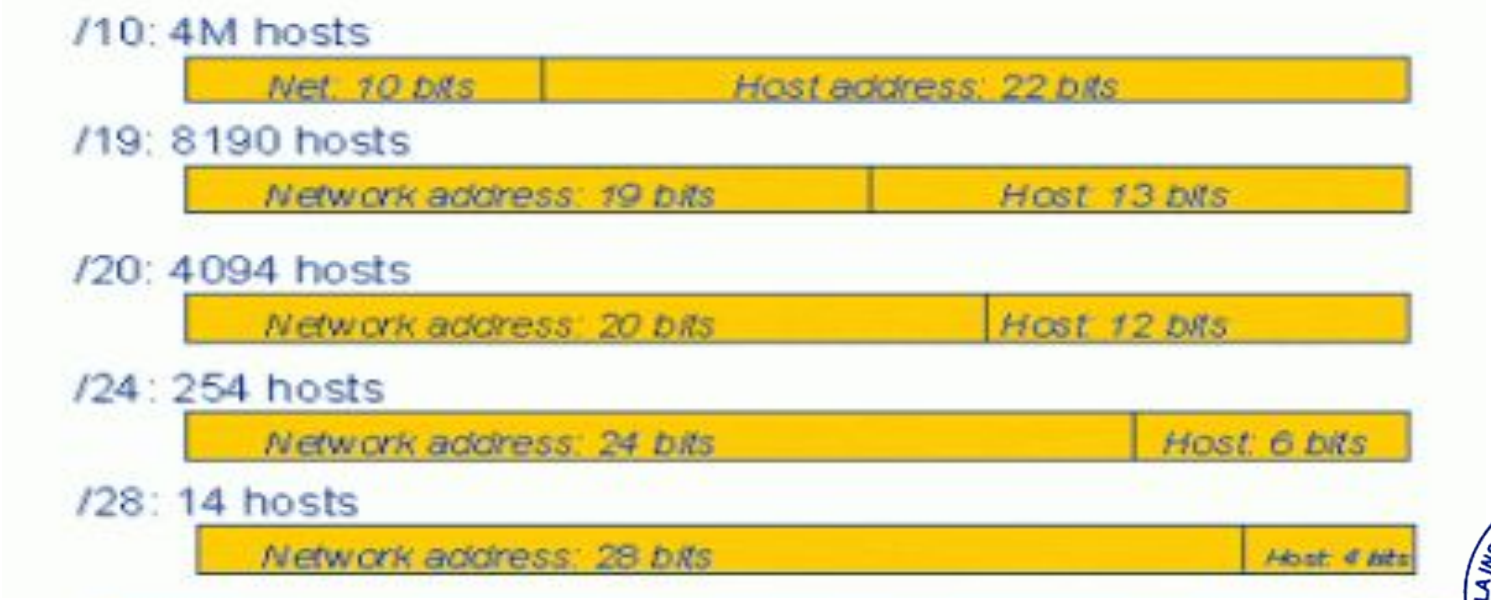
A CIDR **IP address** looks like a normal IP address except that
it **ends** with a slash **followed** by a number, called the IP network prefix.

192.168.12.0/8 → Network Prefix

This **facilitates** the process of routing and routing tables managed by IPv4 routers.
CIDR addresses **reduce** the size of routing tables



Classless IP Address



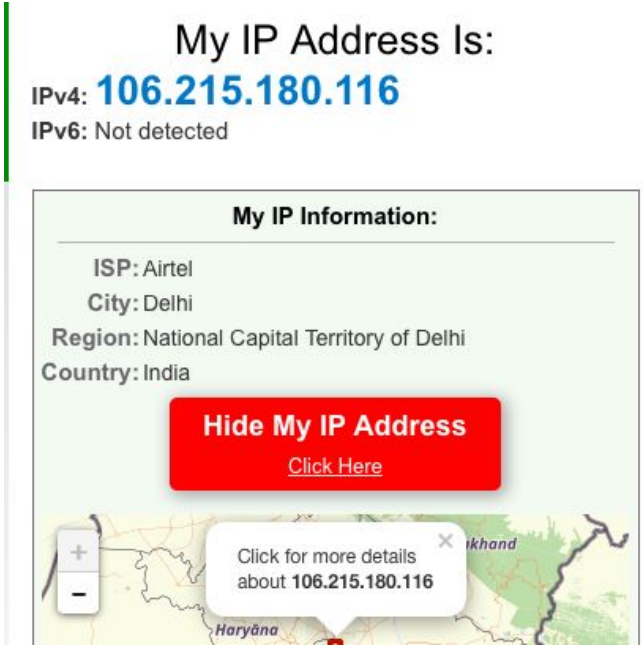
Classless IP Address

CIDR Address Blocks

CIDR Prefix	Dotted Decimal Notation	# Node Addresses	# of Traditional Class Networks
/13	255.248.0.0	512K	8 B or 2048 C class
/14	255.252.0.0	256K	4 B or 1024 C class
/15	255.254.0.0	128K	2 B or 512 C class
/16	255.255.0.0	64K	1 B or 256 C class
/17	255.255.128.0	32K	128 C class
/18	255.255.192.0	16K	64 C class
/19	255.255.224.0	8K	32 C class
/20	255.255.240.0	4K	16 C class
/21	255.255.248.0	2K	8 C class
/22	255.255.252.0	1K	4 C class
/23	255.255.254.0	512	2 C class
/24	255.255.255.0	256	1 C class
/25	255.255.255.128	128	1/2 C class
/26	255.255.255.192	64	1/4 C class
/27	255.255.255.224	32	1/8 C class

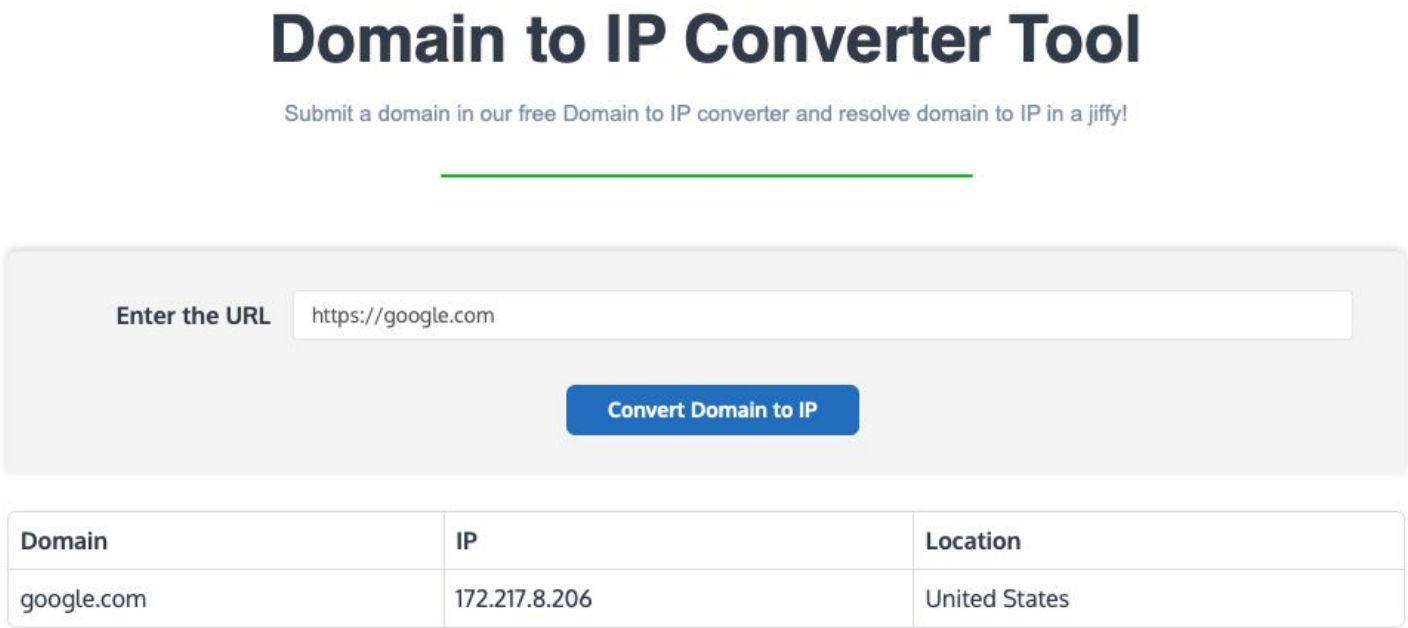
Know Your IP Address?

- https://whatismyipaddress.com



Usage of IP Address

- https://www.rankwatch.com/free-tools/domain-to-iP-converter-tool



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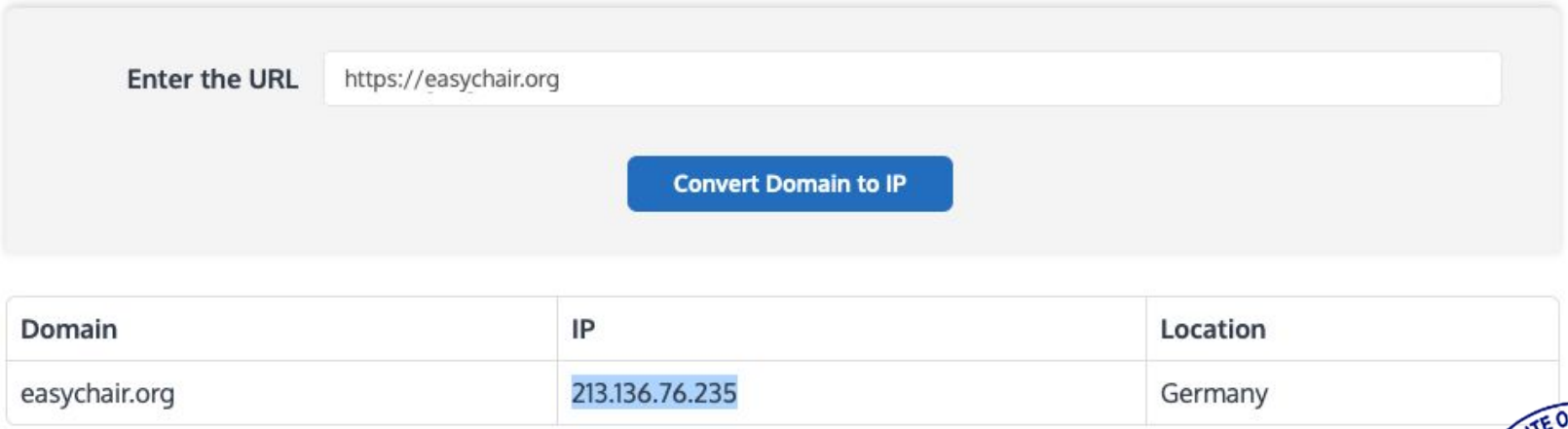

Current IP address version: IPv4

Fixed length, 32 bit scheme, more than 4 billion (2^{32}) addresses

Management of IPv4 address space by IANA (ICANN), RIRs

Low Government involvement; need for International cooperation

Policy to assign IPv4 addresses was based on *First come, First serve*

Preoccupancy of substantial amount of IPv4 addresses stockpiled by early entrants and will likely not be available to those who need it

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Migration From IPv4 to IPv6

Global Shortage of IP addresses

Continued rapid growth of the Internet,
IP addresses have **greater demand**

Despite NAT, IPv4 addresses expected to
run out in the next few years

Need a fair and equitable policy for **allocation of the remaining IPv4 address space**

Now, deployment of IPv6 has become an urgent global issue

Public policy concern on IPv6 is

"The smooth migration from IPv4 to IPv6"

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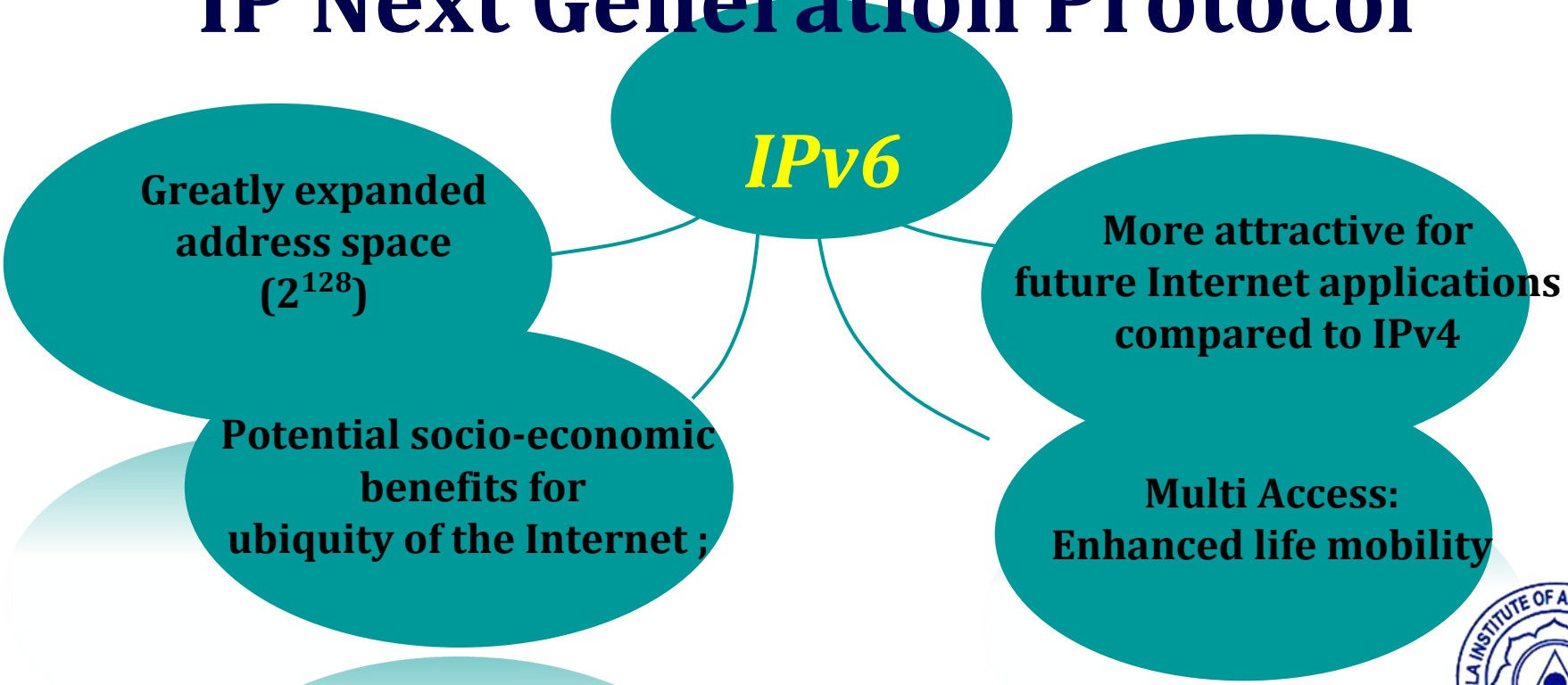
IP Next Generation Protocol



An IPv6 address (in hexadecimal)

2001:0DB8:AC10:FE01:0000:0000:0000:0000

2001:0DB8:AC10:FE01::

Zeroes can be omitted

0010000000000001:0000110110111000:1010110000010000:1111111000000001:

0000000000000000:0000000000000000:0000000000000000:0000000000000000