SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 107

Accredited by NAAC-UGC with 'A' Grade

Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai
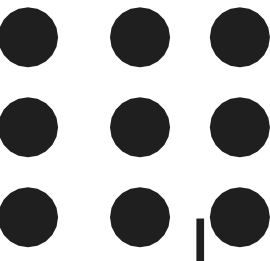
Department of Information Technology

Course Name – 19IT401 Computer Networks

II Year / IV Semester

Unit 3 – Network Layer

Topic 2- IP Datagram-IPv4

IPv4

- The identifier used in the IP layer of the TCP/IP protocol suite to identify the connection of each device to the Internet is called the Internet address or IP address.

- An IPv4 address is a 32-bit address that uniquely and universally defines the connection of a host or a router to the Internet.

- The IP address is the address of the connection, not the host or the router, because if the device is moved to another network, the IP address may be changed.

Address Space
- A protocol like IPv4 that defines addresses has an address space. An address space is the total number of addresses used by the protocol.

- IPv4 uses 32-bit addresses, which means that the address space is 2^{32} or 4,294,967,296 (more than four billion). If there were no restrictions, more than 4 billion devices could be connected to the Internet.

IPv4

Notation
- There are three common notations to show an IPv4 address: binary notation (base 2), dotted-decimal notation (base 256), and hexadecimal notation (base 16).
- In binary notation, an IPv4 address is displayed as 32 bits
- To make the IPv4 address more compact and easier to read, it is usually written in decimal form with a decimal point (dot) separating the bytes. This format is referred to as dotted-decimal notation.
- We sometimes see an IPv4 address in hexadecimal notation. Each hexadecimal digit is equivalent to four bits.
- This means that a 32-bit address has 8 hexadecimal digits. This notation is often used in network programming
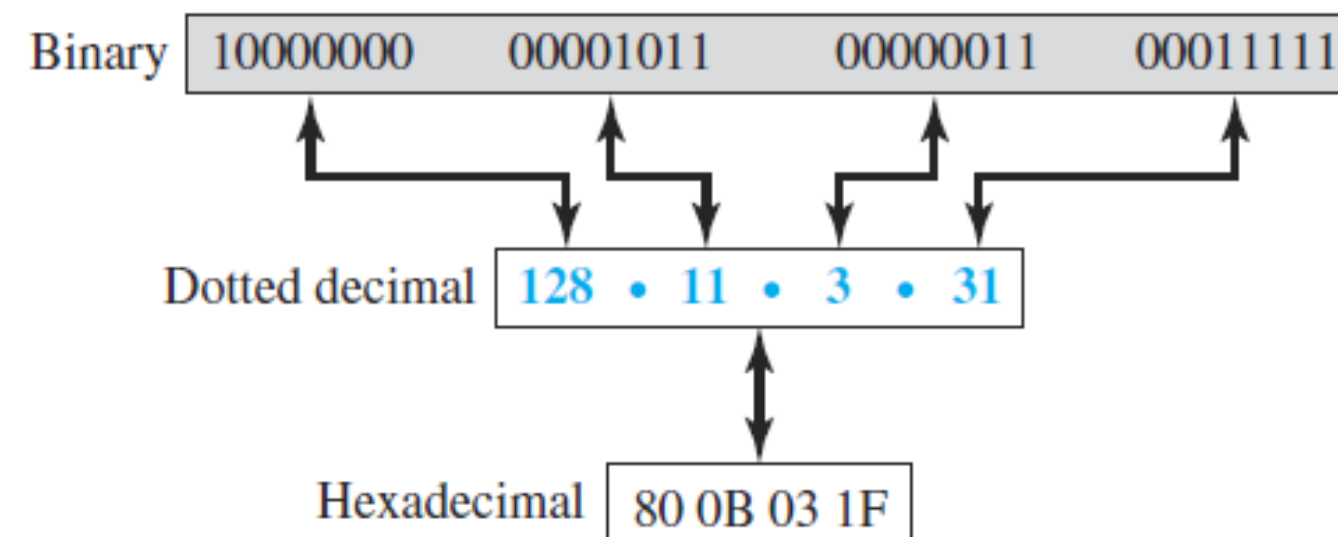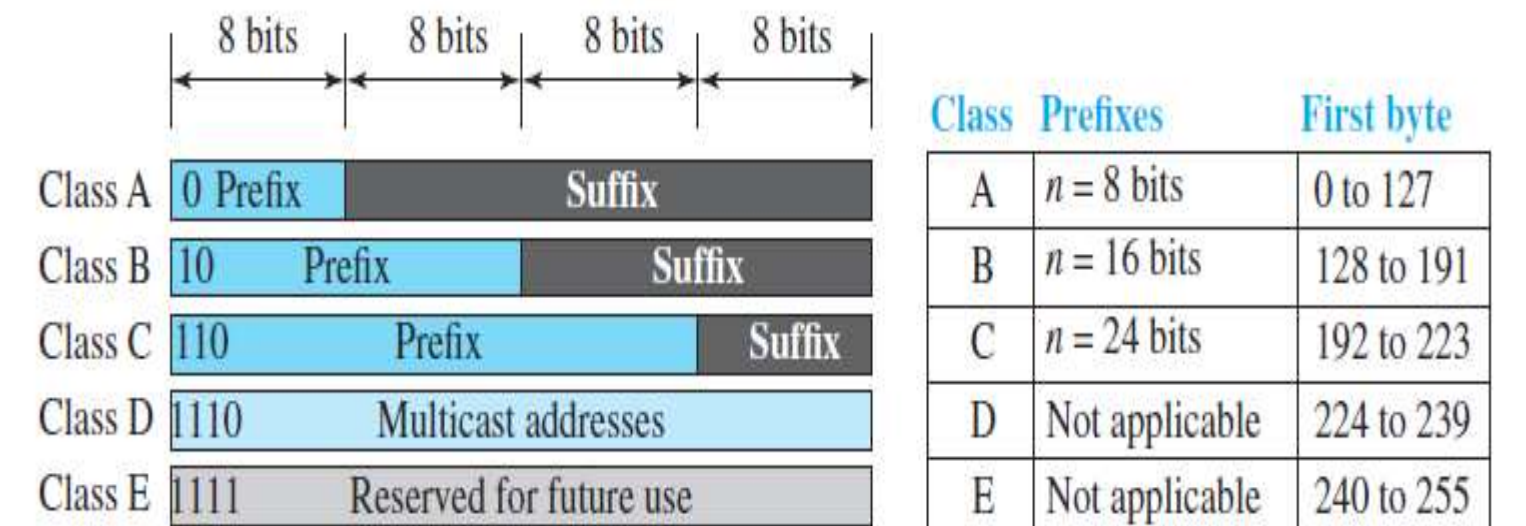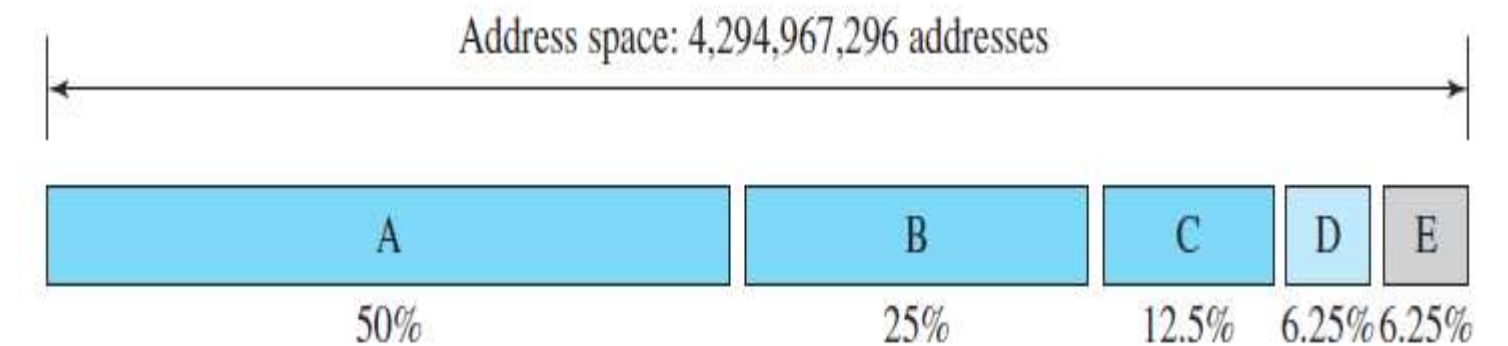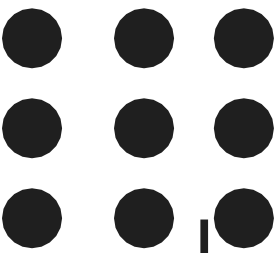
IPv4

Hierarchy in Addressing

- A 32-bit IPv4 address is hierarchical, but divided only into two parts. The first part of the address, called the prefix, defines the network; the second part of the address, called the suffix, defines the node (connection of a device to the Internet).

Classful Addressing

- When the Internet started, an IPv4 address was designed with a fixed-length prefix, but to accommodate both small and large networks, three fixed-length prefixes were designed instead of one (n = 8, n = 16, and n = 24).
- The whole address space was divided into five classes (class A, B, C, D, and E)
- This scheme is referred to as classful addressing.

Address space: 4,294,967,296 addresses

A	B	C	D	E
50%	25%	12.5%	6.25%	6.25%

8 bits | 8 bits | 8 bits | 8 bits

Class A	0 Prefix	Suffix
Class B	10 Prefix	Suffix
Class C	110 Prefix	Suffix
Class D	1110	Multicast addresses
Class E	1111	Reserved for future use

Class	Prefixes	First byte
A	n = 8 bits	0 to 127
B	n = 16 bits	128 to 191
C	n = 24 bits	192 to 223
D	Not applicable	224 to 239
E	Not applicable	240 to 255

IPv4

In class A, the network length is 8 bits, but since the first bit, which is 0, defines the class, we can have only seven bits as the network identifier. This means there are only 2^7 = 128 networks in the world that can have a class A address.

In class B, the network length is 16 bits, but since the first two bits, which are $(10)_2$, define the class, we can have only 14 bits as the network identifier. This means there are only 2^{14} = 16,384 networks in the world that can have a class B address.

All addresses that start with $(110)_2$ belong to class C. In class C, the network length is 24 bits, but since three bits define the class, we can have only 21 bits as the network identifier. This means there are 2^{21} = 2,097,152 networks in the world that can have a class C address.

Class D is not divided into prefix and suffix. It is used for multicast addresses. All addresses that start with 1111 in binary belong to class E. As in Class D, Class E is not divided into prefix and suffix and is used as reserve.

IPv4

Address Depletion

The reason that classful addressing has become obsolete is address depletion.

Classless Addressing

With the growth of the Internet, it was clear that a larger address space was needed as a long-term Solution.

A short-term solution was also devised to use the same address space but to change the distribution of addresses to provide a fair share to each organization.

The short-term solution still uses IPv4 addresses, but it is called classless addressing. In other words, the class privilege was removed from the distribution to compensate for the address depletion.

IPv4

Datagram Format

a. IP datagram

b. Header

Legend

VER: version number
HLEN: header length
byte: 8 bits
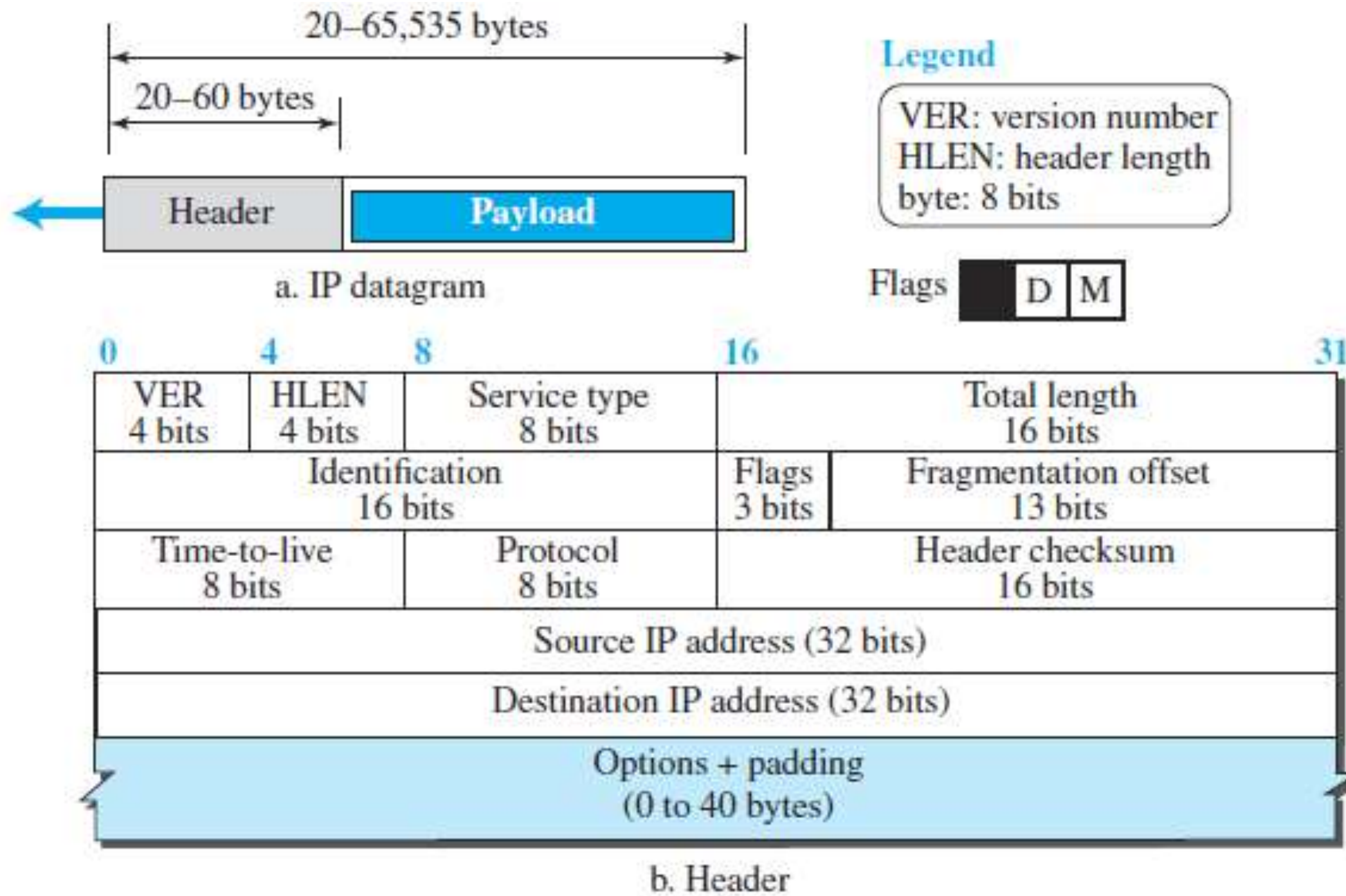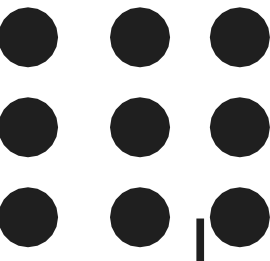
IPv4

Version Number - The 4-bit version number (VER) field defines the version of the IPv4 protocol, which, obviously, has the value of 4.

Header length (HLen) - defines length of the datagram header in 4-byte words

Service Type - Type of Service (TOS) - allows packets to be treated differently based on application needs. It is based on one of the parameters delay, throughput, reliability and cost

Length - specifies the total packet length (header plus data). The total length of the IPv4 datagram is restricted to 65,535 bytes.

Identification - The 16-bit identifier uniquely identifies a datagram.

Flags - t is a 3-bit field. The first bit is reserved. The second bit (D) is called the do not fragment bit. The third bit (M) is called the more fragment bit.

Time to live - defines lifetime of the datagram (default value 64). It is used to control the maximum number of hops visited by the datagram. Each router decrements TTL by 1 before forwarding. If the value is zero, the datagram is discarded to avoid looping.

IPv4

Protocol - specifies the higher-level protocol that uses the services of the IPv4 layer such as TCP(6), UDP(17).

Checksum - contains 16-bit checksum for the packet header to ensure that header information is Correct.

Source address - 32-bit field source address identifying the sender.
Destination address - 32-bit field destination address for delivery of the datagram

Options - A datagram header can have up to 40 bytes of options. Options can be used for network testing and debugging.

payload - It is the content of the package

THANK YOU