Chapter - 01

1. Identify the five components of a data communications system.

Answer :-

The five components of a data communications system are:

1. Message
2. Sender
3. Receiver
4. Protocol
5. Medium

2. What are the advantages of distributed processing?

Answer :-

The advantages of distributed processing include:

1. Reliability
2. Security
3. Collaboration via information sharing
4. Faster processing due to work being distributed among several systems.

3. What are the three criteria necessary for an effective and efficient network?

Answer :-

The three criteria necessary for an effective and efficient network are:

1. Performance
2. Reliability
3. Security

4. What are the advantages of a multipoint connection over a point-to-point connection?

Answer:-

The advantages of a multipoint connection over a point-to-point connection are ease of installation, low cost, reliability. A point-to-point connection is used for connecting 2 devices, whereas in a multipoint connection more than 2 devices share the communication link. Therefore, multipoint connection provides more reliability. It is easier to add more users in a multipoint connection, than creating individual connections between all users separately. This also leads to low cabling cost and installation cost.

5. What are the two types of line configuration?

Answer :-

There are two types of line configurations: Multipoint and point to point. A multipoint line configuration connects multiple users, while a point to point connection maintains individual connection links between all pairs of users.

6. Categorize the four basic topologies in terms of line configuration.

Answer :-

There are four basic network topologies - bus, ring, mesh and star.

- **Multipoint** : Bus, Ring. A bus topology consists of a single cable connecting all devices in the network. Same goes for a ring topology, where a single ring connection is used to connect all devices together. The devices communicate via the shared cable.

- **Point to point** : Mesh, Star. A mesh topology consists of a network of devices all connected to each other individually. Same goes for a star topology. Each device is connected to almost every other device in this network.

7. What is the difference between half-duplex and full-duplex transmission modes?

Answer :-

In half-duplex mode, both stations can transmit and receive, but only one at a time. When one station sends a message, it cannot receive messages. In full duplex mode, both stations can transmit and receive messages simultaneously.

8. Name the four basic network topologies, and cite an advantage of each type.

Answers :-

The four basic network topologies include bus, ring, star and mesh. The advantages of each topology are mentioned below:

- Mesh: Robust, secure, privacy, reduced traffic
- Star: Robust, less expensive than mesh
- Bus: Easy to install, inexpensive, less cabling
- Ring: Easy to install and reconfigure, fault isolation

9. For n devices in a network, what is the number of cable links required for a mesh, ring, bus, and star topology?

Answer :-

The number of cable links required by each network topology are given below. n is the number of devices in the network.

- Mesh: n * (n-1) / 2
- Ring: n
- Bus: n + 1 (n for cables, 1 for backbone)
- Star: n

10. What are some of the factors that determine whether a communication system is a LAN or WAN?

Answer :-

Geographical area spanned by a network determines whether it is a LAN or a WAN. A LAN, or Local Area Network, spans a relatively smaller area, whereas a WAN, or Wide Area Network, covers a much larger area. Also, WANs have a higher propagation delay than LANs because of the large distance to be covered.

11. What is an internet? What is the Internet?

Answer :-

The internet is a general term for an interconnected network, while the Internet refers to a specific worldwide internetwork.

12. Why are protocols needed?

Answer :-

Protocols are set of rules and standards which are used to facilitate timely and accurate communication between multiple devices with different configurations.

13. Why are standards needed?

Answer :-

Protocols are set of rules and standards which are used to facilitate timely and accurate communication between multiple devices with different configurations.

14. What is the maximum number of characters or symbols that can be represented by Unicode?

Answer:-

Unicode uses 32 bits, so maximum number of characters or symbols is 2^32.

15. A color image uses 16 bits to represent a pixel. What is the maximum number of different colors that can be represented?

Answer :-

The maximum number of different colors that can be represented is 2^16.

16. Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?

Answer :-

Let n be the number of connected devices in the network. Now, for mesh topology, we know the equation is no. of cables = n * (n-1)/2 = 6 * 5 / 2 = 15 cables. Number of devices connected per device = n-1 = 5, so number of ports per device = 5.

17. For each of the following four networks, discuss the consequences if a connection fails.

Answer :-

a. *Five devices arranged in a mesh topology*
   - No major setback to the complete network, if one connection fails, others will continue to work.

b. *Five devices arranged in a star topology (not counting the hub)*
   - Connection to that particular device is lost, others can communicate.

c. *Five devices arranged in a bus topology*
   - If the backbone connection fails, then all communication is over.

d. *Five devices arranged in a ring topology*
   - One failed connection will disable the entire network

18. You have two computers connected by an Ethernet hub at home. Is this a LAN, a MAN, or a WAN? Explain your reason.

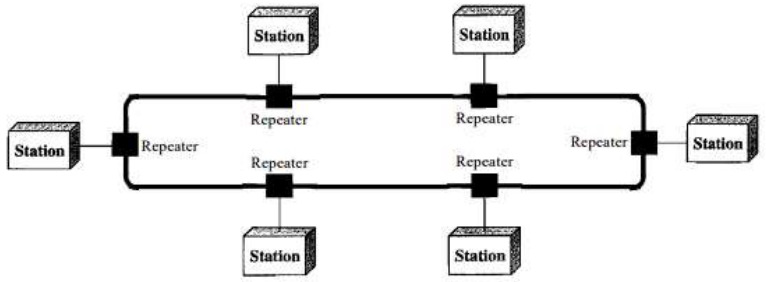
Answer :-

LAN, because the geographical area spanned by the network would be very small, connects two computers locally.

19. In the ring topology in Figure 1.8, what happens if one of the stations is unplugged?

Answer :-

Figure 1.8 *A ring topology connecting six stations*

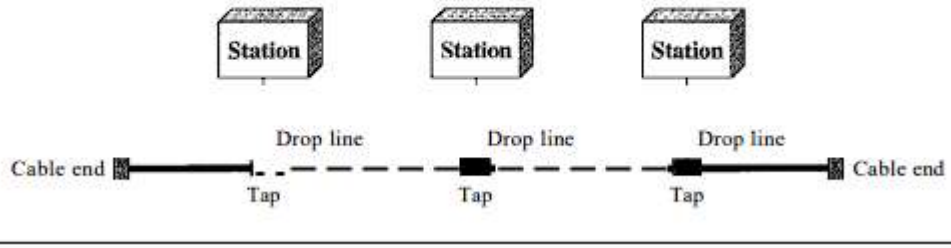


If one station is unplugged, then the whole system would be disconnected (if no measures are in place to bypass a station).

20. In the bus topology in Figure 1.7, what happens if one ofthe stations is unplugged?

Answer :-

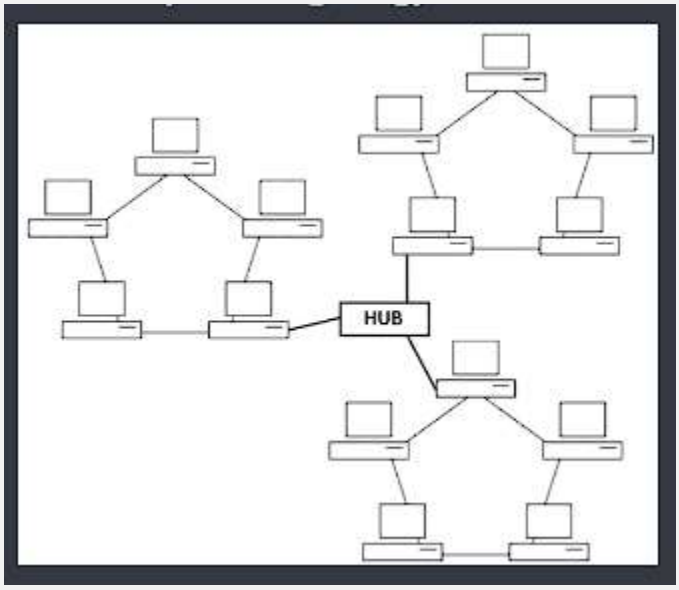
Figure 1.7 *A bus topology connecting three stations*



If one of the stations is unplugged, connection to only that station will be affected.

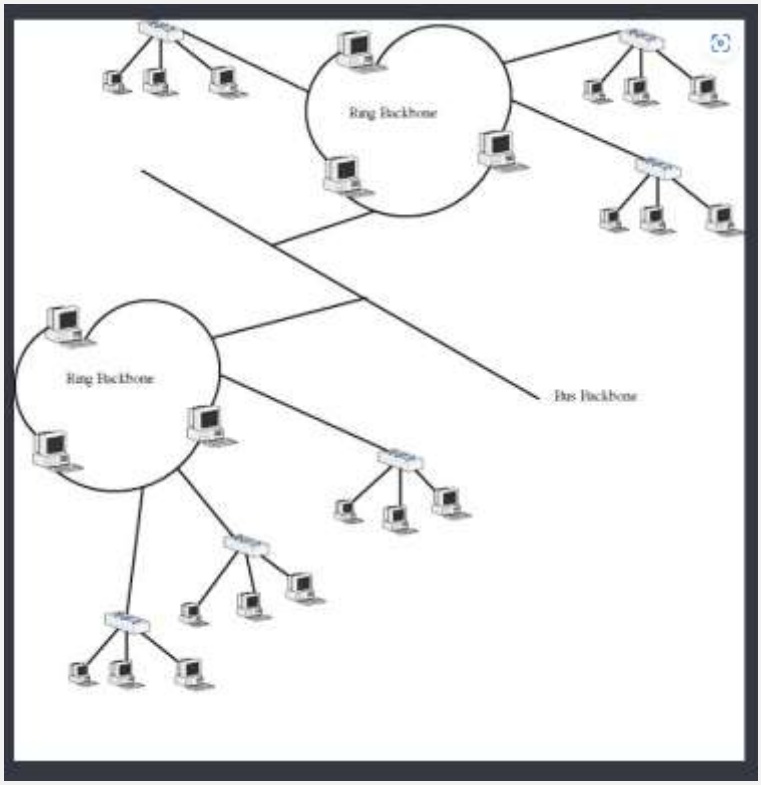
21. Draw a hybrid topology with a star backbone and three ring networks.

Answer :-



22. Draw a hybrid topology with a ring backbone and two bus networks.

Answer :-



23. Performance is inversely related to delay. When you use the Internet, which of the following applications are more sensitive to delay?

Answer:-

a. *Sending an e-mail*
   - Not highly sensitive to delay, once a message is sent, it remains in the inbox for a while

b. *Copying a file*
   - Not very sensitive to delay either

c. *Surfing the Internet*
   - It is sensitive to delay, as it is an interactive application and users demand immediate results.

24. When a party makes a local telephone call to another party, is this a point-to-point or multipoint connection? Explain your answer.

Answer :-

When a party makes a local telephone call to another party, it will be a point to point connection because it is a local call between only two parties.

25. Compare the telephone network and the Internet. What are the similarities? What are the differences?

Answer :-

- **Similarities**: 2-way communication, wired/wireless capabilities.

- **Differences**: Internet has file sharing system, voice and video chat, telephone enables only voice communication. Telephone-circuit switched network, Internet-packet switched network.

Chapter - 02

1. List the layers of the Internet model.

   Answer :-

   - Physical,
   - Data Link,
   - Network,
   - Transport,
   - Application.

2. Which layers in the Internet model are the network support layers?

   Answer :-

   - Physical,
   - Data Link,
   - Network.

3. Which layer in the Internet model is the user support layer?

   Answer :-

   - Application

4. What is the difference between network layer delivery and transport layer delivery?

   Answer :-

   Transport layer is responsible for process (source) - to - process (destination) delivery of entire message, whereas network layer oversees host (source) - to - host (destination) delivery of individual packets across multiple links.

5. What is a peer-to-peer process?

   Answer :-

   The processes at each machine that communicate at a given layer. Physical Layer has a direct link between 2 devices, while other layers have to pass the information down to the lower layers on the sender device by adding extra bits at each layer, and the receiver device unwraps the message at each layer moving upwards till it finally reaches the corresponding communicating layer.

6. How does information get passed from one layer to the next in the Internet model?

Answer :-

At the physical layer, communication is direct between devices. At the higher layers, however, communication must move down through the layers on sending device, over to receiving device, and then back up through the layers. Each layer in the sending device adds its own information to the message it receives from the layer just above it and passes the whole package to the layer just below it. At layer I the entire package is converted to a form that can be transmitted to the receiving device. At the receiving machine, the message is unwrapped layer by layer, with each process receiving and removing the data meant for it.

7. What are headers and trailers, and how do they get added and removed?

Answer :-

Additional information wrapped with the data unit at each layer. Usually, a trailer is added at data link layer. Header and trailer contain information such as source/destination address, control bits, error correction bits etc. These extra bits are added at the layer at sender's side, and removed at the corresponding layer at receiver's side.

8. What are the concerns of the physical layer in the Internet model?

Answer :-

The physical layer is concerned with actual transfer of data bits across a transmission medium between 2 devices. The physical layer coordinates the functions required to carry a bit stream over a physical medium. It deals with the mechanical and electrical specifications of the interface and transmission medium. It also defines the procedures and functions that physical devices and interfaces have to perform for transmission to occur. Physical characteristics of interfaces and medium, Representation of bits, data rate, synchronization of bits, line configuration, physical topology, transmission mode.

9. What are the responsibilities of the data link layer in the Internet model?

Answer :-

- Transforms physical layer to reliable link,
- Framing,
- Physical addressing,
- Flow,
- Error and access control.

10. What are the responsibilities of the network layer in the Internet model?

Answer :-

Transforms physical layer to reliable link, framing, physical addressing, flow, error and access control.

11. What are the responsibilities of the transport layer in the Internet model?

Answer :-

Process - to - process delivery of entire message, service point addressing, segmentation and reassembly, connection, flow and error control.

12. What is the difference between a port address, a logical address, and a physical address?

Answer :-

Port address - transport layer, logical address - network layer, physical address - data link and physical layer. Port address is the address of a process on a host. A logical address (IP) in the Internet is currently a 32-bit address that can uniquely define a host connected to the Internet. Physical address is address of node as defined by it's LAN or WAN.

13. Name some services provided by the application layer in the Internet model.

Answer :-

The application layer enables the user, whether human or software, to access the network. It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services. Network virtual terminal, file transfer, access and management, mail services, directory services.

14. How do the layers of the Internet model correlate to the layers of the OSI model?

Answer :-

The TCPIIP protocol suite was developed prior to the OSI model. Therefore, the layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the host-to-network layer is equivalent to the combination of the physical and data link layers. The internet layer is equivalent to the network layer, and the application layer is roughly doing the job of the session, presentation, and application layers with the transport layer in TCP/IP taking care of part of the duties of the session

layer. So in this book, we assume that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application. The first four layers provide physical standards, network interfaces, internetworking, and transport functions that correspond to the first four layers of the OSI model. The three topmost layers in the OSI model, however, are represented in TCP/IP by a single layer called the application layer.

15. How are OSI and ISO related to each other?

Answer :-

ISO is the organization (International Standards Organization), and OSI (Open Systems Interconnection) is its model.

16. Match the following to one or more layers of the OSI model:

Answer :-

a. *Route determination*
   - Network

b. *Flow control*
   - Transport and Data Link

c. *Interface to transmission media*
   - Physical

d. *Provides access for the end user*
   - Application

17. Match the following to one or more layers of the OSI model:

Answer :-

a. *Reliable process-to-process message delivery*
   - Transport

b. *Route selection*
   - Network

c. Defines frames
   - Data Link

d. *Provides user services such as e-mail and file transfer*
   - Application

e. *Transmission of bit stream across physical medium*
   - Physical

18. Match the following to one or more layers of the OSl model:

Answer :-

a. *Communicates directly with user's application program*
   - Application

b. *Error correction and retransmission*
   - Data Link and Transport

c. *Mechanical, electrical, and functional interface*
   - Physical

d. *Responsibility for carrying frames between adjacent nodes*
   - Data Link

19. Match the following to one or more layers of the OSI model:

Answer :-

a. *Format and code conversion services*
   - Presentation

b. *Establishes, manages, and terminates sessions*
   - Session

c. *Ensures reliable transmission of data*
   - Data Link and Transport

d. *Log-in and log-out procedures*
   - Session

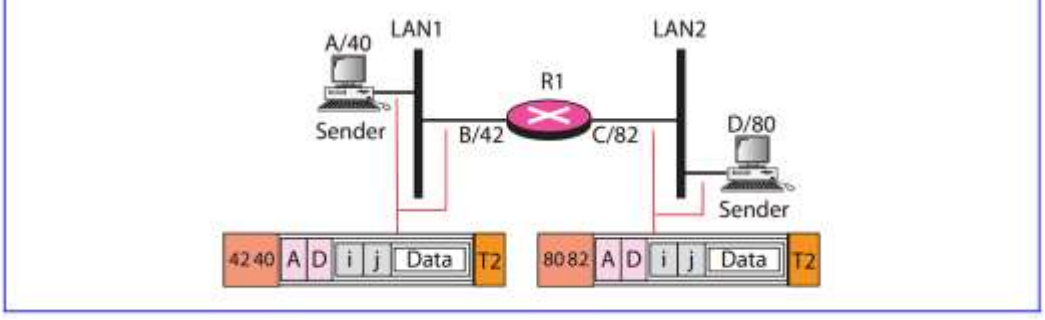
e. *Provides independence from differences in data representation*
   - Presentation

20. In Figure 2.22, computer A sends a message to computer D via LANl, router Rl, and LAN2. Show the contents of the packets and frames at the network and data link layer for each hop interface.

21. In Figure 2.22, assume that the communication is between a process running at computer A with port address i and a process running at computer D with port address j. Show the contents of packets and frames at the network, data link, and transport layer for each hop.

Answer :-

Figure 2.1 *Solution to Exercise 21*



22. Suppose a computer sends a frame to another computer on a bus topology LAN. The physical destination address ofthe frame is corrupted during the transmission. What happens to the frame? How can the sender be informed about the situation?

Answer :-

If the corrupted destination address does not match any station address in the network, the packet is lost. If the corrupted destination address matches one of the stations, the frame is delivered to the wrong station. In this case, however, the error detection mechanism, available in most data link protocols, will find the error and discard the frame. In both cases, the source will somehow be informed using one of the data link control mechanisms discussed in Chapter 11.

23. Suppose a computer sends a packet at the network layer to another computer somewhere in the Internet. The logical destination address of the packet is corrupted. What happens to the packet? How can the source computer be informed of the situation?

Answer :-

Before using the destination address in an intermediate or the destination node, the packet goes through error checking that may help the node find the corruption (with a high probability) and discard the packet. Normally the upper layer protocol will inform the source to resend the packet.

24. Suppose a computer sends a packet at the transport layer to another computer somewhere in the Internet. There is no process with the destination port address running at the destination computer. What will happen?

Answer :-

Most protocols issue a special error message that is sent back to the source in this case.

25. If the data link layer can detect errors between hops, why do you think we need another checking mechanism at the transport layer?

Answer :-

The errors between the nodes can be detected by the data link layer control, but the error at the node (between input port and output port) of the node cannot be detected by the data link layer.

26. Give some advantages and disadvantages of combining the session, presentation, and application layer in the OSI model into one single application layer in the Internet model.
Answer :-

27. Dialog control and synchronization are two responsibilities of the session layer in the OSI model. Which layer do you think is responsible for these duties in the Internet model? Explain your answer.
Answer :-

28. Translation, encryption, and compression are some of the duties of the presentation layer in the OSI model. Which layer do you think is responsible for these duties in the Internet model? Explain your answer.
Answer :-

29. There are several transport layer models proposed in the OSI model. Find all of them. Explain the differences between them.
Answer :-

30. There are several network layer models proposed in the OSI model. Find all of them. Explain the differences between them.
Answer :-

Chapter - 19

1. What is the number of bits in an IPv4 address? What is the number of bits in an IPv6 address?

   Answer :-

   An IPv4 address is 32 bits long.

   An IPv6 address is 128 bits long.

2. What is dotted decimal notation in IPv4 addressing? What is the number of bytes in an IPv4 address represented in dotted decimal notation? What is hexadecimal notation in IPv6 addressing? What is the number of digits in an IPv6 address represented in hexadecimal notation?

   Answer:-

3. What are the differences between classful addressing and classless addressing in IPv4?

   Answer :-

   Classful addressing assigns an organization a Class A, Class B, or Class C block of addresses. Classless addressing assigns an organization a block of contiguous addresses based on its needs.

4. List the classes in classful addressing and define the application of each class (unicast, multicast, broadcast, or reserve).

   Answer :-

5. Explain why most of the addresses in class A are wasted. Explain why a medium-size or large-size corporation does not want a block of class C addresses.

   Answer :-

A block in class A address is too large for almost any organization. This means most of the addresses in class A are wasted and not used. A block in class C is probably too small for many organizations

6. What is a mask in IPv4 addressing? What is a default mask in IPv4 addressing?
   Answer :-

7. What is the network address in a block of addresses? How can we find the network address if one of the addresses in a block is given?
   Answer :-
   The network address in a block of addresses is the first address. The mask can be ANDed with any address in the block to find the network address.

8. Briefly define subnetting and supemetting. How do the subnet mask and supemet mask differ from a default mask in classful addressing?
   Answer :-

9. How can we distinguish a multicast address in IPv4 addressing? How can we do so in IPv6 addressing?
   Answer :-
   Multicast addresses in IPv4 are those that start with the 1110 pattern. Multicast addresses in IPv6 are those that start with the 11111111 pattern.

10. What is NAT? How can NAT help in address depletion?
    Answer :-

11. What is the address space in each of the following systems?
    Answer :-
    a. *A system with 8-bit addresses*
       - $2^8 = 256$
    b. *A system with 16-bit addresses*
       - $2^{16} = 65536$
    c. *A system with 64-bit addresses*
       - $2^{64} = 1.846744737 \times 10^{19}$

12. An address space has a total of 1024 addresses. How many bits are needed to represent an address?

Answer :-

13. An address space uses the three symbols 0, 1, and 2 to represent addresses. If each address is made of 10 symbols, how many addresses are available in this system?

Answer:-

- $3^{10} = 59,049$

14. Change the following IP addresses from dotted-decimal notation to binary notation.

Answer :-

a. 114.34.2.8

b. 129.14.6.8

c. 208.34.54.12

d. 238.34.2.1

15. Change the following IP addresses from binary notation to dotted-decimal notation.

Answer :-

a. 01111111 11110000 01100111 01111101

- 127.240.103.125

b. 10101111 11000000 11111000 00011101

- 175.192.240.29

c. 11011111 10110000 00011111 01011101

- 223.176.31.93

d. 11101111 11110111 11000111 00011101

- 239.247.199.29

16. Find the class of the following IP addresses.

Answer :-

a. 208.34.54.12

b. 238.34.2.1

c. 114.34.2.8

d. 129.14.6.8

17. Find the class of the following IP addresses.

Answer :-

a. *11110111 11110011 10000111 11011101*
   - Class E (first four bits are 1s)

b. *10101111 11000000 11110000 00011101*
   - Class B (first bit is 1 and second bit is 0)

c. *11011111 10110000 00011111 01011101*
   - Class C (first two bits are 1s and the third bit is 0)

d. *11101111 11110111 11000111 00011101*
   - Class D (first three bits are 1s and the fourth bit is 0)

18. Find the netid and the hostid of the following IP addresses.

Answer :-

a. 114.34.2.8

b. 132.56.8.6

c. 208.34.54.12

19. In a block of addresses, we know the IP address of one host is 25.34.12.56/16. What are the first address (network address) and the last address (limited broadcast address) in this block?

Answer :-

Host Address:	**25**	.	**34**	.	**12**	.	**56**
Mask (ANDed):	**255**	.	**255**	.	**0**	.	**0**
Network Address (First):	**25**	.	**34**	.	**0**	.	**0**

The last address can be found by ORing the host address with the mask complement 0.0.255.255.

Host Address:	**25**	.	**34**	.	**12**	.	**56**
Mask Complement (ORed):	**0**	.	**0**	.	**255**	.	**255**
Last Address:	**25**	.	**34**	.	**255**	.	**255**

However, we need to mention that this is the largest possible block with 2^{16} addresses. We can have many small blocks as long as the number of addresses divides this number.

20. In a block of addresses, we know the IP address of one host is 182.44.82.16/26. What are the first address (network address) and the last address in this block?

Answer :-

21. An organization is granted the block 16.0.0.0/8. The administrator wants to create 500 fixed-length subnets.

Answer:

a. *Find the subnet mask.*
   - $\log_2 500 = 8.95$ Extra 1s = 9 Possible subnets: 512 Mask: /17 (8+9)

b. *Find the number of addresses in each subnet.*
   - $2^{32-17} = 2^{15} = 32,768$ Addresses per subnet

c. *Find the first and last addresses in subnet 1.*
   -

Subnet 1: The first address in the this address is the beginning address of the block or **16.0.0.0**. To find the last address, we need to write 32,767 (one less than the number of addresses in each subnet) in base 256 (0.0.127.255) and add it to the first address (in base 256).

First address in subnet 1:	**16**	.	**0**	.	**0**	.	**0**
Number of addresses:	**0**	.	**0**	.	**127**	.	**255**
Last address in subnet 1:	**16**	.	**0**	.	**127**	.	**255**

d. Find the first and last addresses in subnet 500

➢

Subnet 500:

Note that the subnet 500 is not the last possible subnet; it is the last subnet used by the organization. To find the first address in subnet 500, we need to add 16,351,232 (499 × 32678) in base 256 (0. 249.128.0) to the first address in subnet 1. We have 16.0.0.0 + 0.249.128.0 = **16.249.128.0**. Now we can calculate the last address in subnet 500.

First address in subnet 500:	**16**	.	**249**	.	**128**	.	**0**
Number of addresses:	**0**	.	**0**	.	**127**	.	**255**
Last address in subnet 500:	**16**	.	**249**	.	**255**	.	**255**

22. An organization is granted the block 130.56.0.0/16. The administrator wants to create 1024 subnets.

Answer :-

a. Find the subnet mask.

b. Find the number of addresses in each subnet.

c. Find the first and last addresses in subnet 1.

d. Find the first and last addresses in subnet 1024.

23. An organization is granted the block 211.17.180.0/24. The administrator wants to create 32 subnets.

Answer :-

a. Find the subnet mask.

b. Find the number of addresses in each subnet.

c. Find the first and last addresses in subnet 1.

d. Find the first and last addresses in subnet 32.

24. Write the following masks in slash notation (In).

Answer

a. 255.255.255.0

b. 255.0.0.0

c. 255.255.224.0

d. 255.255.240.0

25. Find the range of addresses in the following blocks.

Answer

a. 123.56.77.32/29

b. 200.17.21.128/27

c. 17.34.16.0/23

d. 180.34.64.64/30

26. An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to 2600 customers as follows.

Answer

a. The first group has 200 medium-size businesses; each needs 128 addresses.

b. The second group has 400 small businesses; each needs 16 addresses.

c. The third group has 2000 households; each needs 4 addresses.

Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.

27. An ISP is granted a block of addresses starting with 120.60.4.0/22. The ISP wants to distribute these blocks to 100 organizations with each organization receiving just eight addresses. Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.

Answer

28. An ISP has a block of 1024 addresses. It needs to divide the addresses among 1024 customers. Does it need subnetting? Explain your answer.

Answer

29. Show the shortest form of the following addresses.

Answer

a. 2340: lABC: 119A:AOOO:0000:0000:0000:0000

b. OOOO:OOAA:OOOO:OOOO:OOOO:OOOO: 119A:A231

c. 2340:0000:0000:0000:0000: 119A:AOO1:0000

d. 0000:0000:0000:2340:0000:0000:0000:0000

30. Show the original (unabbreviated) form of the following addresses.

Answer

a. 0::0

b.O:AA::O

c. 0: 1234::3

d. 123::1:2

30. What is the type of each of the following addresses?

Answer

a. FE80::12

b. FECO: :24A2

c. FF02::0

d. 0::01

31. What is the type of each of the following addresses?

Answer

a. 0::0

b. 0: :FFFF:O:O

c. 582F:1234::2222

d. 4821::14:22

e. 54EF::A234:2

32. Show the provider prefix (in hexadecimal colon notation) of an address assigned to a subscriber if it is registered in the United States with ABC1 as the provider identification.

Answer

33. Show in hexadecimal colon notation the IPv6 address

Answer

a. Compatible to the IPv4 address 129.6.12.34

b. Mapped to the IPv4 address 129.6.12.34

35. Show in hexadecimal colon notation

Answer

a. The link local address in which the node identifier is 0:: 123/48

b. The site local address in which the node identifier is 0:: 123/48

36. Show in hexadecimal colon notation the permanent multicast address used in a link local scope.

Answer

37. A host has the address 581E: 1456:2314:ABCD:: 1211. If the node identification is 48 bits, find the address of the subnet to which the host is attached. 38. A site with 200 subnets has the class B address of 132.45.0.0. The site recently migrated to IPv6 with the subscriber prefix 581E:1456:2314::ABCD/80. Design the subnets and define the subnet addresses, using a subnet identifier of 32 bits.

Answer