

Network Routing Algorithm. (UNIT-1)

Syllabus.

- ✓ (1) Router, Application, function.
- ✓ (2) Types of Routing Protocols.
- ✓ (3)* Classful IP addressing.
- ✓ (4)* OSI Reference Model
- ✓ (5)* IP Protocol Stack Architecture.
- ✓ (6) Network Topology Architecture
- (7)* PSTN (Public Switched Telephone Network),
- (8) Communication & Technology
- (9) Network Protocol Analyzers.

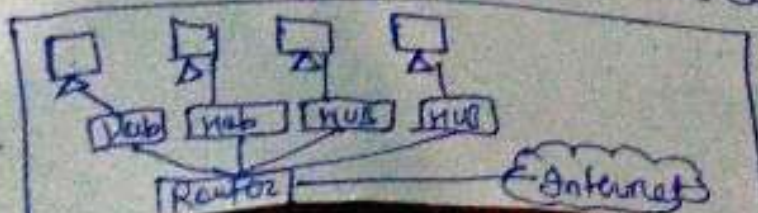
Topic-1

* Router: Router is a physical or virtual interconnecting/inter networking device that is designed to receive, analyze and forward data packet between computer networks. A router examines the IP address of of a given data packet and it uses the headers and forwarding table to decide the best way or path to transfer the packets. Popular companies develop routers are: Cisco, Juniper, HP, Nokia etc.

- A router works on third layer of OSI model and it uses protocol ICMP to communicate b/w two or more networks. It is also known as intelligent device.
- A router is used in LAN & WAN ex: used in offices for connectivity, we can also establish connection b/w distant network like from Delhi to Agartala.
- It is more expensive than other n/w device like hub, switch.

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diagram:



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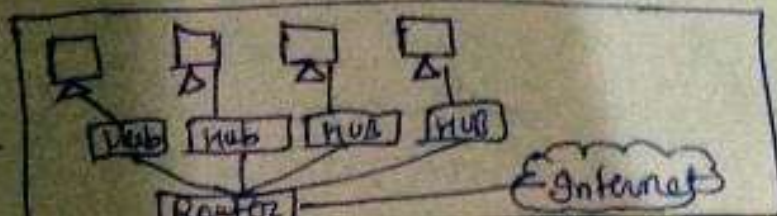
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diagram:



Advantage of Router

- ① Security: It provide security as LAN work in broadcast mode, the data is available to each station but the station which is specially addressed reads the data.
- ② Performance enhancement: It improves performance within individual network. It reduces ^{volume of} traffic in network by dividing it into sub-networks.
- ③ Reliability: If one network gets down when server was stopped then the routers services & other networks will not be affected.
- ④ Networking Range: Cable used to connect the devices, but its length cannot exceed 1000 mtrs.

Topic-2

Routing Protocol

Routing protocol are mechanism by which routing information is exchanged b/w routers so that routing decisions can be made.

- ① Open Short Path first (OSPF): It is used to calculate the best route route for given packet to reach destination in a set of connected networks. It is identified by Internet engineering task force (IETF) as Interior gateway protocol.
- ② Border Gateway protocol (BGP): Routed information exchanged b/w edge routers. It provide network stability for router, If one internet connection gets down while forwarding the packets, it can adapt other connection quickly to send the packets.

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③ Interior Gateway Protocol :- It specifies how routing information will be exchanged between gateways within an independent network.

Topic: ④ Enhanced Interior gateway Routing Protocol :- In this Aim/Objective: protocol, if routers unable to find path to a destination from the tables, it asks route to its neighbours.

⑤ Exterior Gateway protocol :- It decides how routing information can be exchanged between two neighbor gateway hosts, each of which has its own router. In this exchange routing table information blur hosts.

⑥ Routing Information Protocol (RIP) :- It determines how routers can share information while transferring traffic among connected group of LAN.

* Routing algorithm

:- Routing protocol is a routing algorithm that provides the best path from source to the destination. The best path is the path which has "least-cost-path". from source to destination. Network layer provide the best route to transmit data packet.

Adaptive Routing algo.

Non-adaptive Routing algo.

① Define :- an algorithm that constructs the routing table based on n/w condition.

② Usage :- It is used by dynamic routing.

③ Routing decision :- Routing decision made based on topology & network traffic.

④ Categorization :- Centralized isolation.

⑤ Complexity :- It is more complex

→ Construct static table to determine which node to send the packet.

→ It is used by static routing.

→ Routing decision over the static tables.

→ used by static routing.

→ It is simple algo.

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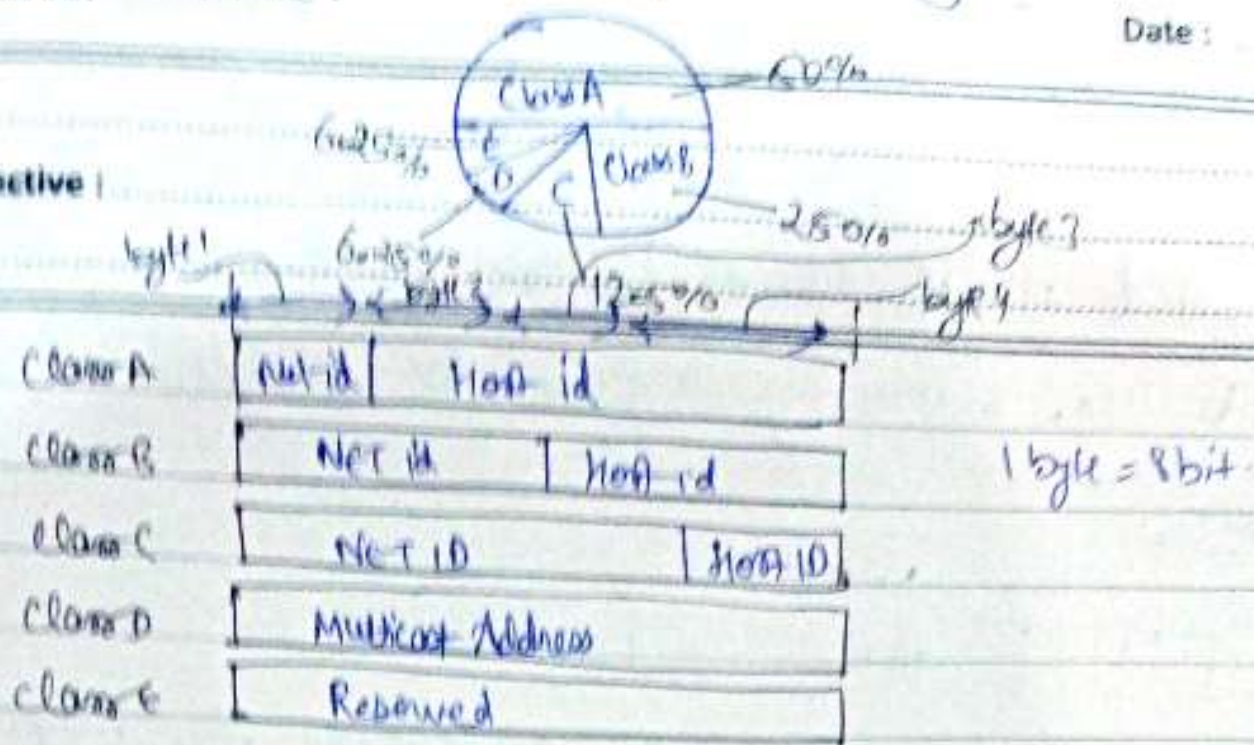
Classes: In classful addressing IP addressing is divided into 5 classes.

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Topic:

Aim/Objective:



① Class A

7 BIT	24 BIT
Network	Host

If address belongs to class A contains

Large no. of hosts.
 Network ID = 8 bit, Host ID = 24 bits long.
 First octet in class A is always set to zero and rest used to determine network ID.
 used to determine host in any n/w.

② Class B

14 BIT	16 BIT
10	Network
	Host

first octet of class B is set to 10 and rest 14 is used to determine network ID.

$2^{14} = \text{Net address}$
 $2^{16} - 2 = \text{host address}$

③ Class C

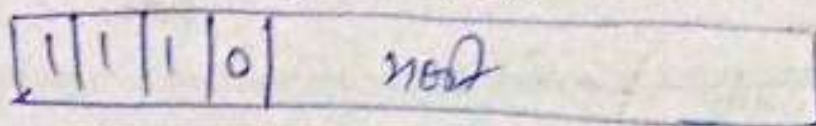
21 BIT	8 BIT
110	Network
	Host

first octet of class C are always 110. rest used to determine network ID & 8 bit of host ID used to determine host in any n/w.

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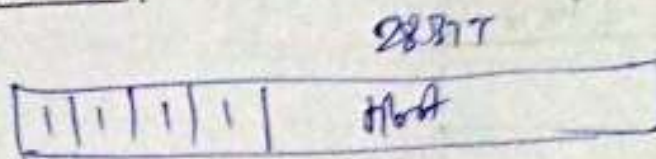
$2^{21} = \text{Net address}$
 $2^8 - 2 = \text{host address}$

④ Class D: - 28877



IP addresses belonging to Class D are reserved for multicasting. first octet of IP addresses belonging to class D are always set to 1110, remaining are used to recognize host.

⑤ Class E:



IP addresses belonging to class E are reserved for experimental and research purposes. first octet are always set to 1111. This class doesn't have any subnet mask. address of this class range from 240.0.0.0 - 255.255.255.255.

⑥ Classless Addressing

Problems of Classful addressing: millions of class A, many of B address are wasted, whereas the no of address available in class C is so small. ~~to~~ ~~so~~ so that it cannot cater the need of organizations. Class D are used for multicast addresses & E for reserved.

These all problems overcome by classless addressing was replaced by (CIDR) in 1993.

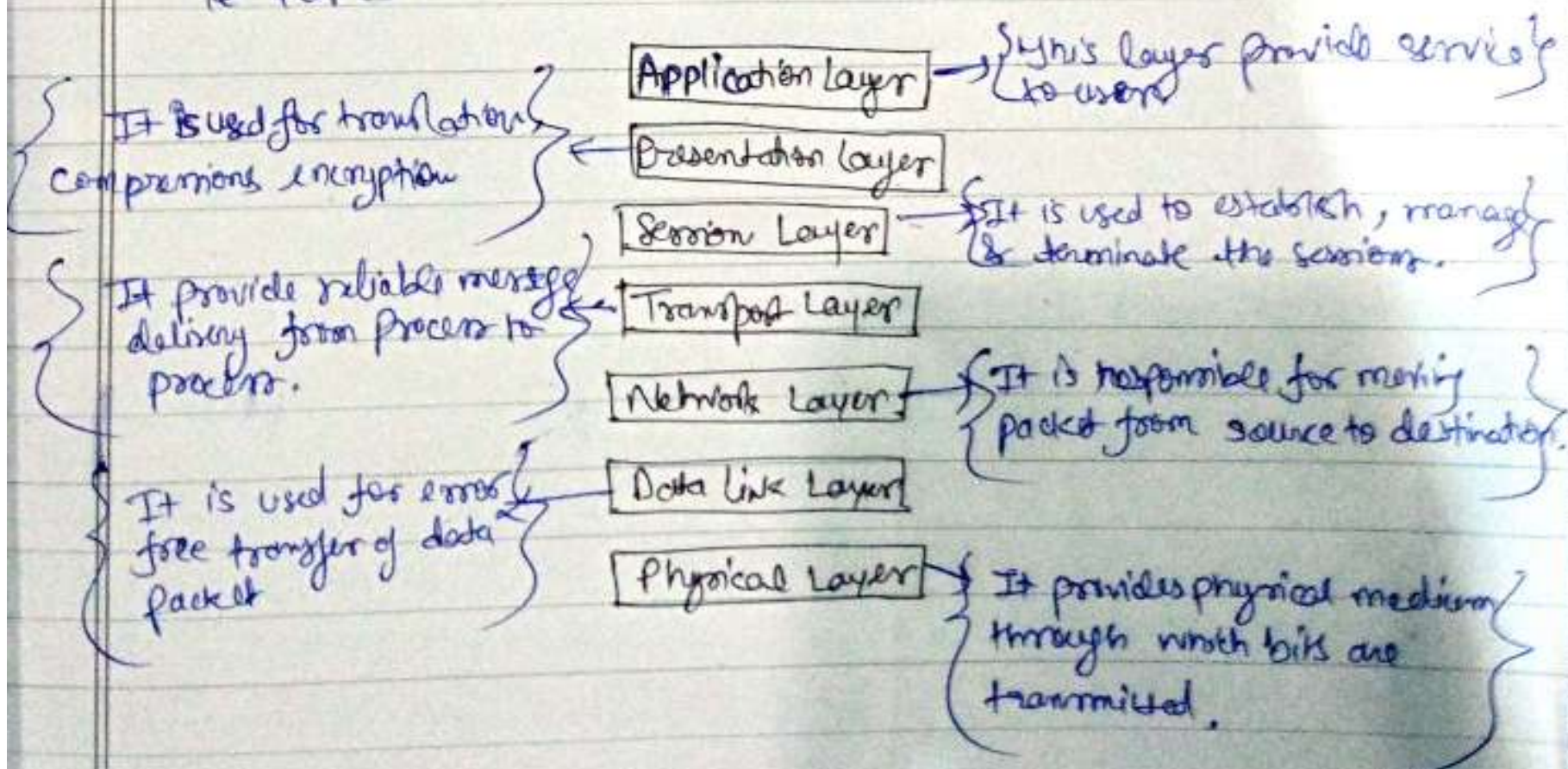
→ To reduce the wastage of IP addresses in a block, we use sub-netting. we use host id bits as net id bits of classful address.

Topic : _____

Aim/Objective : _____

⊗ OSI Reference Model

- OSI stands for Open System Interconnection. is a reference model that describes how information from a SW application in one computer moves through a physical medium to the software application in other computer.
- OSI consist of seven layers & each perform a particular function.
- OSI model was developed by ISO (International organization for standardization) in 1984, now considered as architectural model for inter-computer communication.
- OSI model divides the whole task into seven smaller, manageable task.



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1) Physical layer:- The lowest layer of OSI model is the physical layer. It is responsible for actual physical connection b/w devices. It contains info. in the form of bits. When receiving data, this layer will get the signal received & convert it into 0's & 1's & send them to Data Link layer which will put the frame back together.

→ Functions:-

- (a) Bit Synchronization: The physical layer provides the synchronization of bits by providing a clock. This clock controls both sender & receiver thus providing synch. at bit level.

- (b) Bit rate control: defines transmission rate; no. of bits transfer per second.

- (c) Transmission mode: It defines the way in which data flows between the two connected devices.

- (d) Physical topologies: It specifies the way in which the different devices are arranged in a network.

Hub, modem, cables are physical layers.

2) Data Link Layer: The data link layer is responsible for the node-to-node delivery of message. The main function is to make sure data transfer is error free from one node to another.

→ function:-

- (i) Framing: Framing is a function of D/L which provides a way for a sender to transmit a set of bits that are meaningful for receiver.

(i) Physical Addressing: After creating frame, DL adds physical addresses of sender & receiver in header of each frame.

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Topic: _____

Aim/Objective: _____

(ii) Error control: It detect, retransmit damaged or lost frame.

(iv) flow control: The data rate must be constant on both side else data may get corrupted. Thus flow control coordinate that amount of data that can be sent before receiving acknowledgement.

Note:

- * Packet in DL referred as frame
- * DL is handled by (NIC) Network Interface card
- * Switch & Bridge are DL device.

3) Network layer & Network layer works for transmission of data from one host to other located in another n/w. It also take care of packet routing i.e select shortest path to transmit the packet. The sender & receiver IP addresses are placed in header by the network layer.

function:

a) Routing: Network layer determine which route is best or suitable from source to destination.

b) Local addressing: In order to define each ~~address~~ ^{device} on internetwork uniquely, network layer defines an addressing schema.

Note:

- * Segments in NW layer are referred as packet
- * NW layer is implemented by N/w device such as routers.

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4) Transport Layer : It provides service to the application layer takes services from network layer. The data in transport layer is referred to as segment. It is responsible for end-to-end delivery of complete message.

functions

a) Segmentation & Reassembly : This layer accepts message from session layer & breaks the message into smaller parts. Each of segment produced has a header associated with it. The transport layer at receiver end reassembles the data.

b) Service Point Addressing : In order to deliver the message to correct process, transport layer header includes a type of address called Service point address ^{or} port address.

* Transport layer called heart of OSI.

5) Session Layer : It is responsible for establishment of connection, maintenance of session, authentication & ensure security.

functions

a) Session Establishment, maintenance & termination : This layer allows two processes to establish, use & terminate a connection.

b) Synchronization : This layer allows a process to add checkpoint which are considered as synchronization point into the data. These points help to identify error.

Experiment No.

(c) Dialog controllers: This layer allows two system to start communication with each other. Date:

Topic:

Aim/Objective:

6) Presentation layer: Also called as Translation layer. The data from application layer is extracted here and manipulated as per requirement format to transmit over the network.

function: ① Translation ② Encryption ③ Compression.

7) Application layer: At the top of ^{OSI} model, we find application layer which is implemented by network applications. These network application provide or produced data which has to be transferred over the N/W. It is also called desktop layer.

functions:

- 1) Mail Services
- 2) Directory Services
- 3) FTAM - File Transfer, access & Management
- 4) Network Virtual Terminal.

(*) Topics

TCP/IP Model / IP Protocol Stack Architecture

It consists of four layers • application layer • transport layer • Internet layer • link layer. In this networking TCP & IP layers are most widely used protocol, this model named as TCP/IP model or IP stack architecture. TCP/IP is a concise version of the OSI model.

1) Link layer / Network access layer: This layer correspond to a combination of Data link layer & Physical layer of the OSI model. Protocol present in this layer allows us the physical transmission of data.

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2. Internet layer! It defines the protocol which are responsible for logical transmission of data over the entire network. The main protocols working at this layer:

a) IP: stands for internet protocol & it is responsible for delivering packets from the source host to destination host by looking at the IP address in packet headers.

b) ICMP: stands for Internet control Message Protocol. It is encapsulated within IP datagrams & is responsible host with information about N/w problems.

c) ARP: Address resolution Protocol. Its job to find hardware address of host from a known IP address.

ARP → • Reverse ARP
• Proxy ARP
• Gratuitous ARP
• Inverse ARP

3) Transport layer / Host-to-Host layer: This layer is responsible for end-to-end comm. and error free delivery of data. It shields the upper layer applications from the complexity of data. Two protocols present in this layer.

TCP (Transmission Control Protocol)

- It provides reliable & error free communication b/w end systems.
- It has acknowledgement feature & control control the flow of data through flow control mechanism.
- It is costly.

UDP (User Datagram Protocol)

- It does not provide such features. It is the go-to protocol if your application doesn't require reliable transport.
- It is cost effective.

Note : TCP is Connection-oriented Protocol
Experiment No. : UDP is Connectionless Protocol. Date :

Topic :

Aim/Objective :

4) Application Layer : The layer performs the function of top 3 layers of OSI model which is application, presentation & session layer. It is responsible for node-to-node comm. & control user-interface specifications. Protocol include in this layer are :

- a) HTTP & HTTPS : Hypertext transfer Protocol. It is used by WWW to manage ~~communication~~ communication b/w web browser & server.
- b) SSH : Secure Shell. It is a terminal emulation software similar to TELNET. SSH is more preferred because its ability to maintain encrypted connection. It set Secure session over TCP/IP connection.
- c) NTP : Network Time Protocol. It is used to synchronize the clocks on our computer to one standard time source. It is used in situation like bank txn.

Topic-6

Network Topology Architecture

There are various network topologies architecture :

- 3 tier architecture
- 2 tier architecture
- Spine leaf arch.
- WAN arch.
- SD-WAN arch.
- Cloud arch.

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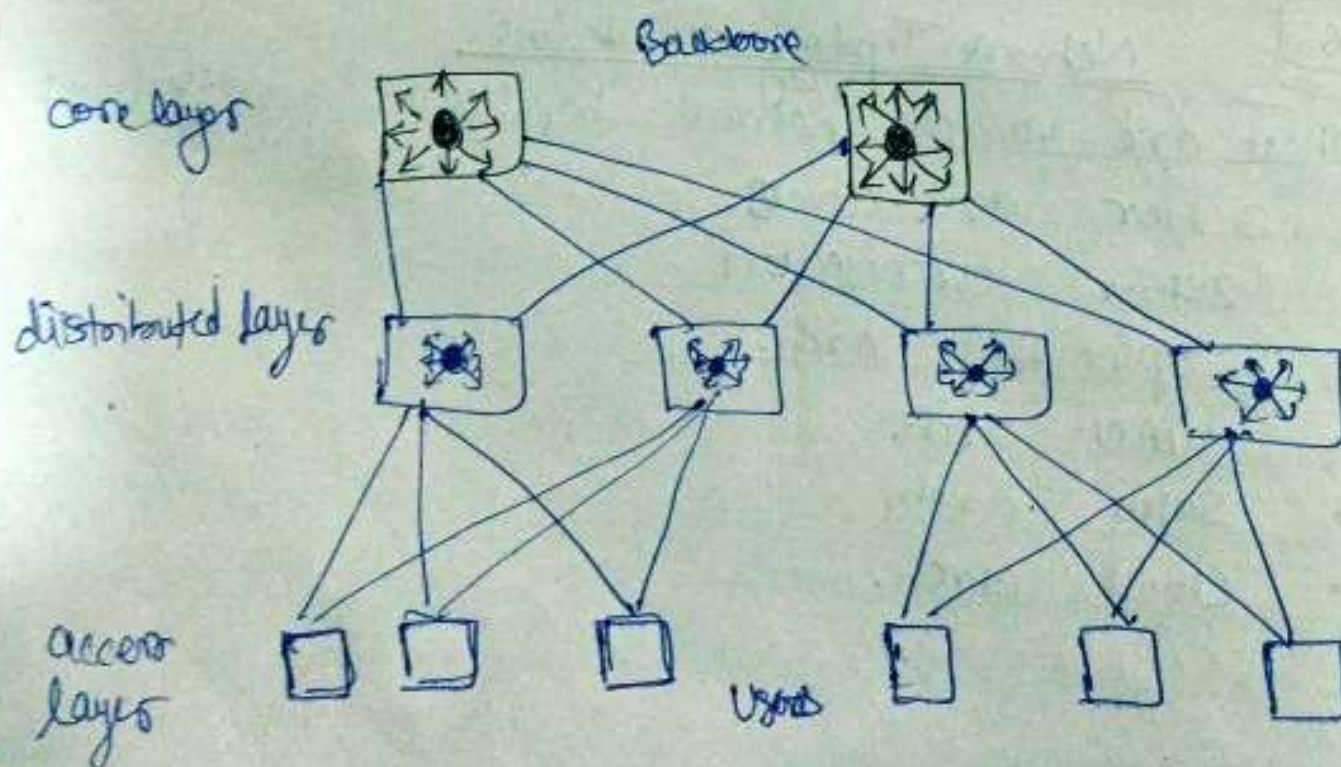
1) Three tier arch (3-tier): 3 tier architecture is also called three-layered Hierarchical Model used by large enterprises. It is scalable & resilient solution for large enterprise. These layers are:

Access: is the lower layer of 3-tier arch. Access switches resides & users are connected to these switches.

Distribution layer: middle layer of 3-tier, works as a bridge b/w access layer & core layer. Multilayer switches are used in distributed layer.

Core layer: also known as backbone N/W. Core layer connect distribution layer devices. main job of this layer is providing routing b/w them & the distribution layer.

3-tier diagram

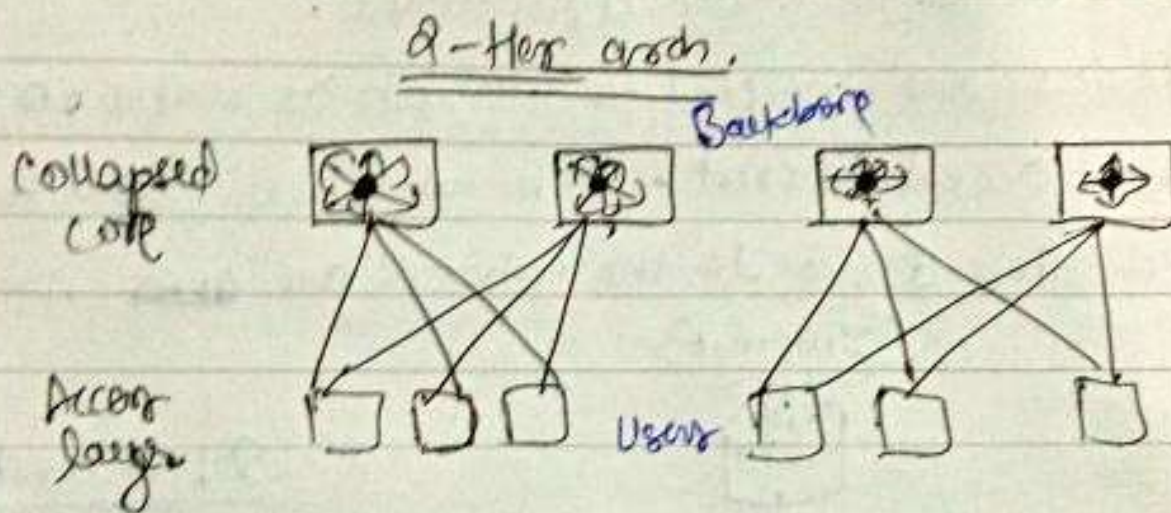


2) 2 Tier Architecture is also called 2 layer hierarchical model. It is used by small enterprise.

Experiment No. _____ Date _____
Topic: that cannot use 3-tier arch because of expensive solution.

Aim/Objective: Small enterprise overcome this by combining core and distributed layer in one layer.

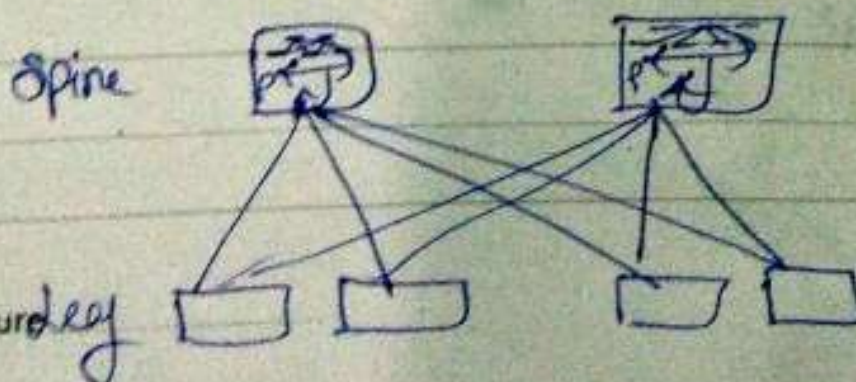
Two layers in this arch: • collapsed core layer
• Access layer



3) Spine leaf architecture: This design replace the 3-tier architecture & it mostly used in networking world. It also has good solution for evolving datacenters. It is more scalable, fast, efficient.

→ Spine leaf architecture is the network architecture with which all the devices are the ^{same} segments away. It is the 2-layer arch.

- 1) Spine layer
- 2) leaf layer



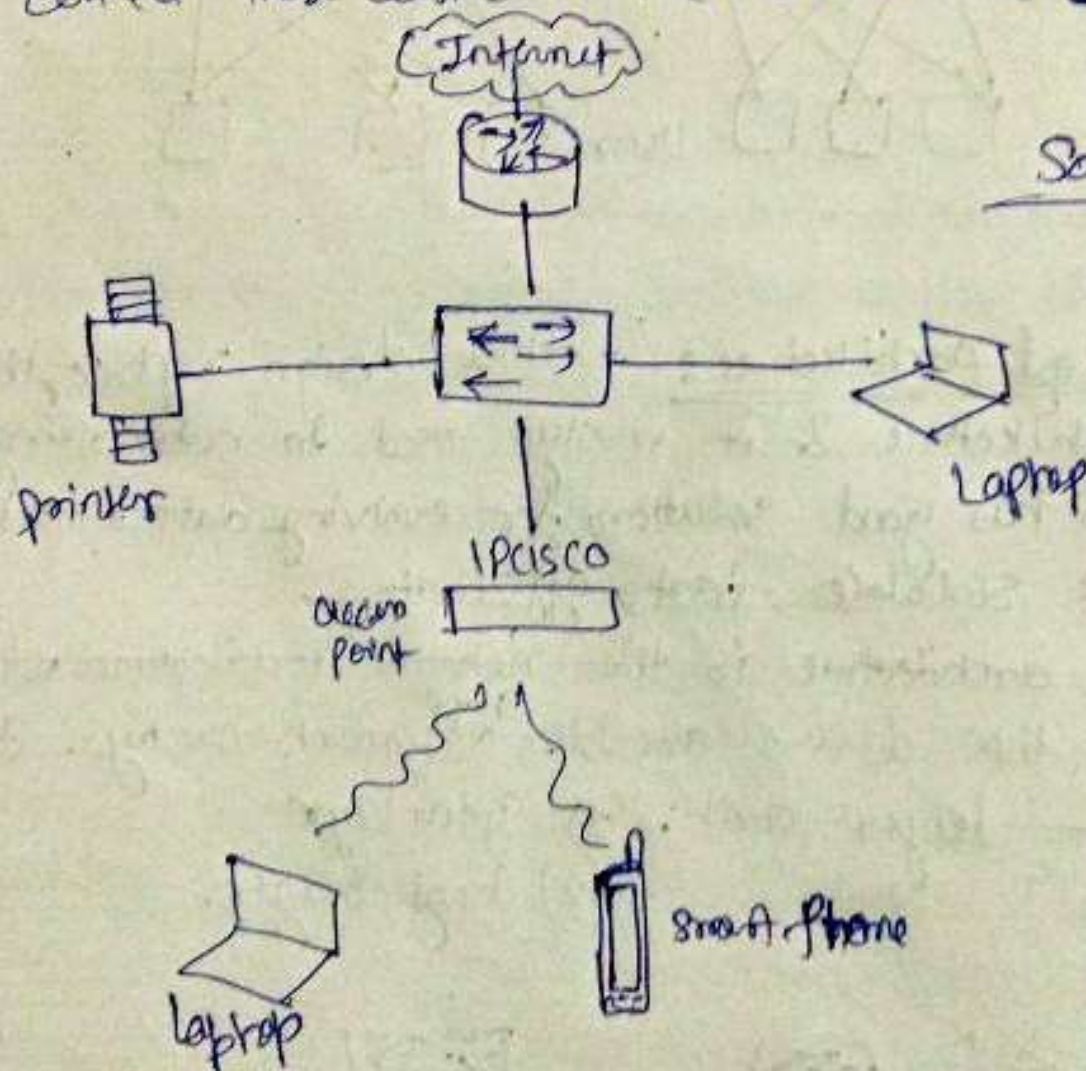
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4) Small office / House office (SOHO) architecture:

→ SOHO is the abbreviation of Small office / Home office architecture. It is the simplest arch. used in houses or in small enterprises.

→ In SOHO arch, there is a small switch, router & connected some devices like PC's, printer etc. Ethernet technology is used to connect the devices in SOHO architecture.

→ Access devices are connected to switch or router so that they can access Internet. Ethernet cables used to connect these device to the network are ~~CAT5~~ CAT5, CAT6



Cloud Architecture :

Experiment No. _____

→ Private cloud
→ Public Cloud

Date : _____

Topic : _____

Aim/Objective :

Private Cloud : It provide services to local users in the same company. Employees in the company can request virtual machine for their works, development etc. and these virtual devices are provided these users by cloud architecture of the company.

Public Cloud : It provide ^{cloud} service to the other companies. The companies employees that receive cloud services can request to create virtual devices in the cloud service provider's network.

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