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ASSIGNMENT-03

Que 1: What is the role of the Network Layer in the OSI model?

Ans The Network Layer (Layer 3) in the OSI model is responsible for the following key functions :-

1. Logical Addressing (IP Addressing) :- Assigns and manages logical addresses (such as IP addresses) to uniquely identify devices across different networks
2. Routing :- Determins the best path for data packets to travel from the source to the destination across multiple networks using routing protocols (e.g. OSPF, BGP, RIP)
3. Packet Forwarding :- Moves packet from one network to another based on routing tables and destination addresses.
4. Fragmentation and Reassembly :- Breaks down large packets into smaller fragments if necessary (to meet requirement of different network types) and reassembles than at the destination.
5. Error Handling and Diagnostics :- uses protocols like ICMP (Internet Control Message Protocol) to report errors & network issues.

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Ques Explain algorithms OSPF (Open Shortest Path First) with an example.

ans OSPF (Open Shortest Path First) is a link-state routing protocol used to determine the shortest-path between network routers. It is widely used in large enterprise networks due to its efficiency, scalability and fast convergence

How OSPF Works :-

① Neighbor Discovery -> Routers discover other OSPF routers in network & establish neighbor relationships

② Link-State Advertisement (LSA) Exchange :- Each routers shares information about its connected links & costs with all other routers in network

③ Topology Database Creation :- Routers store all LSAs in a link-state database (LSDB) to build a complete map of the network.

④ Shortest Path Calculation -> Using Dijkstra's Algorithm, each routers calculates the shortest path to all destinations

⑤ Routing Table Update -> Based on the shortest path, the router updates its routing table to forward packets efficiently

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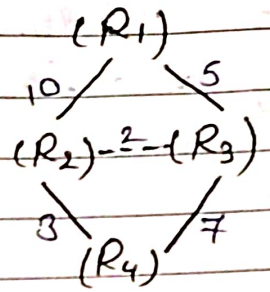
OSPF Example :-

Scenario :- A network with four routers (R_1, R_2, R_3, R_4) running OSPF. Each link has a cost value



- R_1 and R_2 → Cost = 100
- R_1 and R_3 → Cost = 5
- R_2 to R_3 → Cost = 2
- R_2 to R_4 → Cost = 3
- R_3 to R_4 → Cost = 7

OSPF Shortest Path Calculation (R_1 to R_4) :-

Possible paths :-

① $R_1 \rightarrow R_2 \rightarrow R_4$ (Cost = 10+3 = 13)

② $R_1 \rightarrow R_3 \rightarrow R_4$ (Cost = 5+7 = 12)

③ $R_1 \rightarrow R_3 \rightarrow R_2 \rightarrow R_4$ (Cost = 5+2+3 = 10)

→ OSPF chooses. $R_1 \rightarrow R_3 \rightarrow R_2 \rightarrow R_4$ (Cost = 10) as best route

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Que 3 What is the difference between Static & Dynamic Routing ?

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Ans Difference between Static and Dynamic Routing are as follow

Static Routing	Dynamic Routing
① The network administrator must do the route entry in the routing table	① Routing entry is done by routing protocol
② More overhead to a network administrator	② Less overhead to a network administrator
③ Less CPU utilization	③ High CPU utilization
④ It does not use a complex algorithm	④ It uses a complex algorithm
⑤ Implemented in a small network	⑤ Implemented in a large network
⑥ Additional resources are not required	⑥ Additional resources are required

Ques Explain the concept of IPV4 address class (A, B, C, D and E)

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ans IPV4 addresses are 32-bit numerical identifiers used for network communication. They are divided into five classes (A, B, C, D and E) based on their first octet (first 8 bits) and intended purpose

① Class A :- • Used for large networks, such as corporations and ISPs
- The octet ranges from 1 to 126
- Default ~~sbo~~ subnet mask : 255.0.0.0.
- Can support millions of devices in a single network

② Class B :- • Designed for medium-sized networks such as universities and large organizations
- First octet ranges from 128 to 191
- Default subnet mask : 255.255.0.0
- Can accomodate up to 65,534 devices per network

③ Class C :- • Used for small networks, such as home networks & small businesses
- First octet ranges from 192 to 223
- Default subnet mask : 255.255.255.0
- Supports up to 254 devices per network

④ Class D :- • Reserved for multicasting, where data ~~rans~~ is sent to multiple devices simultaneously
- First octet range from 224 to 239
- No subnet mask, as it does not assign IPs to individual devices

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(d) Class E :- • Reserved for experimental and future use
• First octet ranges from 240 to 255
• Not used for ~~manual~~ normal communication

Private IP Ranges (Non-Routable on Internet):-

• Class A :- 10.0.0.0 - 10.255.255.255
• Class B :- 172.16.00 - 172.31.255.255
• Class C :- 192.168.0.0 - 192.168.255.255

Ques What is IPV6, and how does it differ from IPV4?

Ans

IPV6 :- IPV6 (Internet Protocol version 6) is the latest version of the Internet Protocol, designed to replace IPV4 due to IPV4 address exhaustion. It provides a vastly larger address space and improved network efficiency.

Key Differences Between IPV6 and IPV4

Ans

Features	IPV4	IPV6
(1) Address Length	32 bit (4.3 billion addresses)	128-bit (340
(2) Address Format	Decimal e.g. → 192.168.1.1	Hexadecimal. e.g → 2001:0db8:8503:8a2e:0370:7334

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Header Complexity	Complex	Simplified for faster processing
Subnetting	Uses Subnet Mask	Uses Prefix length (/64, /48, etc.)
Broadcast	Supports broadcasting	No broadcasting, uses multicast & anycast
Security	Security optional (IPsec not mandatory)	Built-in security with IPsec
Configuration	Manual or DHCP	Auto-configuration (SLAAC)
Compatibility	Widely used but running out of addresses	Future-proof, support IOT and mobile networks

Ques What is classless addressing (CIDR)?

Ans Classless addressing :- CIDR (Classless Inter-Domain Routing) is an IP addressing method that replaces the traditional class-based system (Class A, B, C) to allow for more flexible and efficient allocation of IP addresses

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Key features of CIDR :-

- No Fixed classes :- IP addresses are assigned based on actual need rather than rigid classes
- Uses Slash Notation :- CIDR uses a suffix (e.g. /24, /26) to indicate the number of network bits
- More Efficient Addressing :- Reduces IP wastage by allowing custom subnet sizes
- Eliminates class Limitations :- A network can have any numbers of IPs, not just class A, B or C sizes

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Ques How do you calculate the number of subnets, hosts per subnet, and the new subnet mask?

Ans

- Calculating the Number of Subnets formula :-

$$\text{Number of Subnets} = 2^s$$

where,

s = number of borrowed bits from the host portion

- Calculating Hosts per Subnet formula :-

$$\text{Hosts per subnet} = 2^4 - 2$$

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where,

h = number of host bits

(subtracting 2 accounts for the network address and broadcast addresses)

- Determining the New Subnet Mask.

- Convert the subnet mask to binary
- Increase the network portion by borrowing bits
- Convert back to decimal