Computer Network

Lecture-36

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Delivery, Forwarding, and Routing

The Routing Information Protocol (RIP)

It is an intra domain routing protocol used inside an autonomous system. It is a very simple protocol based on distance vector routing. RIP implements distance vector routing directly with some considerations:

1. In an autonomous system, we are dealing with routers and networks (links). The routers have routing tables; networks do not.
2. The destination in a routing table is a network, which means the first column defines a network address.
3. The metric used by RIP is very simple; the distance is defined as the number of links (networks) to reach the destination. For this reason, the metric in RIP is called a hop count.
4. Infinity is defined as 16, which means that any route in an autonomous system using RIP cannot have more than 15 hops.
5. The next-node column defines the address of the router to which the packet is to be sent to reach its destination.

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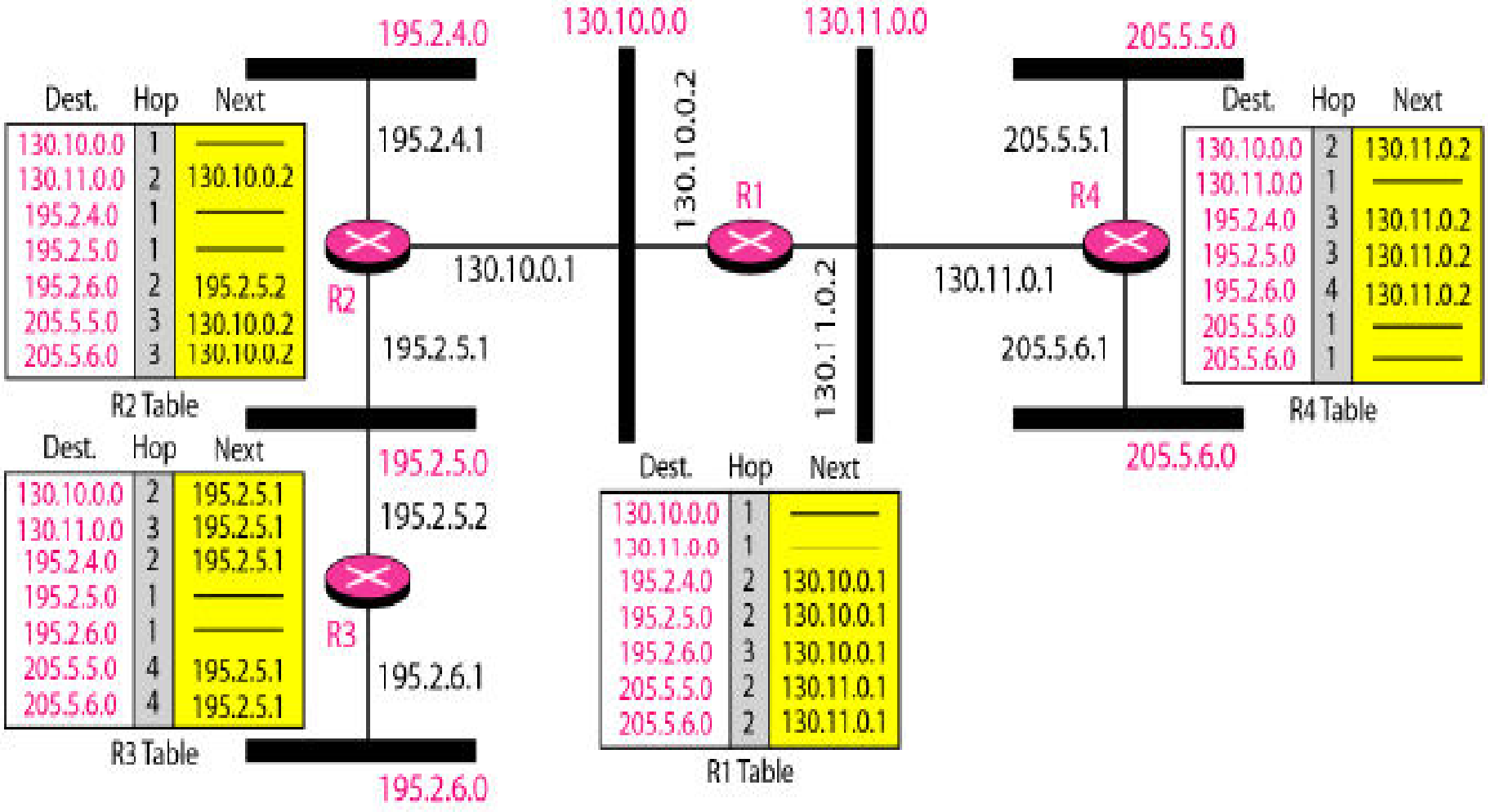
Following figure shows an autonomous system with seven networks and four routers. The table of each router is also shown.



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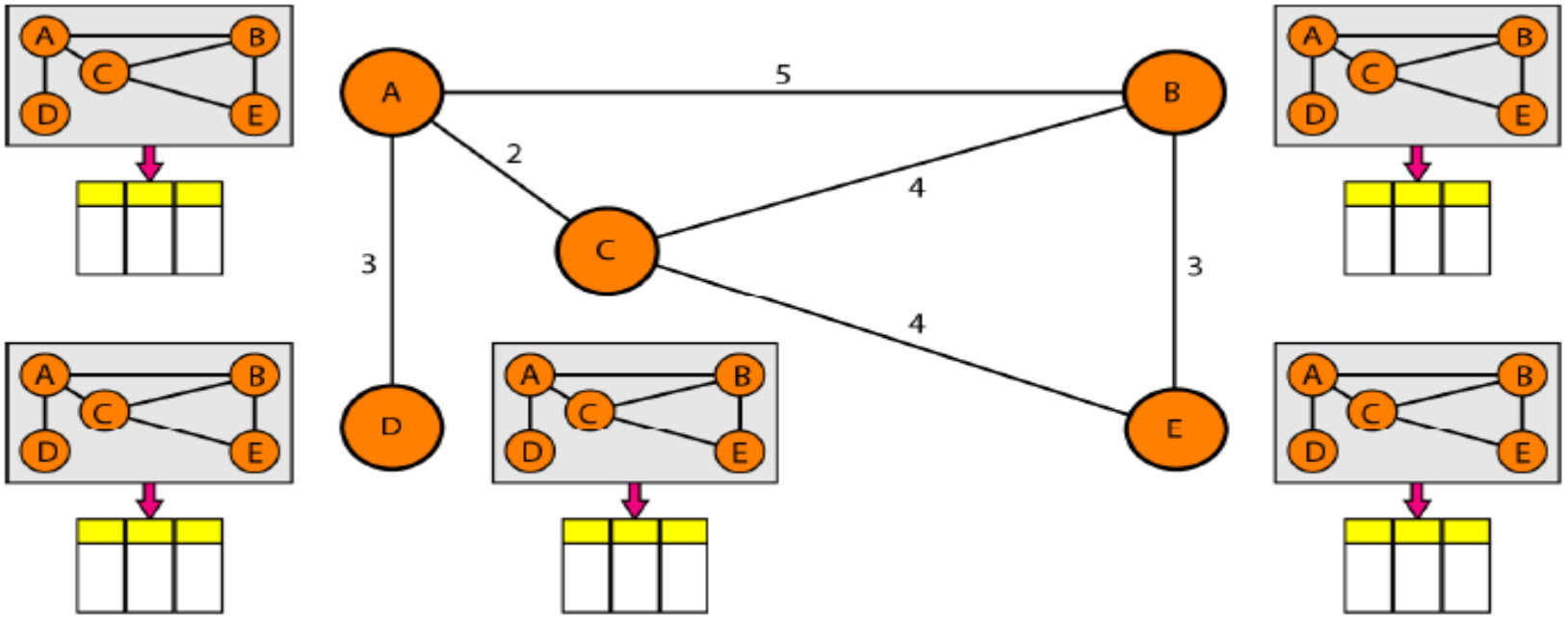
Link State Routing

In link state routing, each node in the domain has the entire topology of the domain i.e. the list of nodes and links, how they are connected including the type, cost (metric), and condition of the links (up or down). The node can use Dijkstra's algorithm to build a routing table.



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- Each node uses the same topology to create a routing table, but the routing table for each node is unique because the calculations are based on different interpretations of the topology.
- The topology must be dynamic, representing the latest state of each node and each link. If there are changes in any point in the network (a link is down, for example), the topology must be updated for each node.

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Building Routing Tables

In link state routing, four sets of actions are required to ensure that each node has the routing table showing the least-cost node to every other node.

1. Creation of the states of the links by each node, called the link state packet (LSP).
2. Dissemination of LSPs to every other router, called flooding, in an efficient and reliable way.
3. Formation of a shortest path tree for each node.
4. Calculation of a routing table based on the shortest path tree.

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Creation of Link State Packet (LSP)

A link state packet can carry a large amount of information. For the moment, however, we assume that it carries a minimum amount of data: the node identity, the list of links, a sequence number, and age. The first two, node identity and the list of links, are needed to⇒make the topology. The third, sequence number, facilitates flooding and distinguishes new LSPs from old ones. The fourth, age, prevents old LSPs from remaining in the domain for a long time. LSPs are generated on two occasions:

1. When there is a change in the topology of the domain.
2. On a periodic basis.

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Flooding of LSPs

After a node has prepared an LSP, it must be disseminated to all other nodes, not only to its neighbors. The process is called flooding and based on the following:

1. The creating node sends a copy of the LSP out of each interface.

2. A node that receives an LSP compares it with the copy it may already have. If the newly arrived LSP is older than the one it has, it discards the LSP. If it is newer, the node does the following:

a. It discards the old LSP and keeps the new one.

b. It sends a copy of it out of each interface except the one from which the packet arrived. This guarantees that flooding stops somewhere in the domain (where a node has only one interface).

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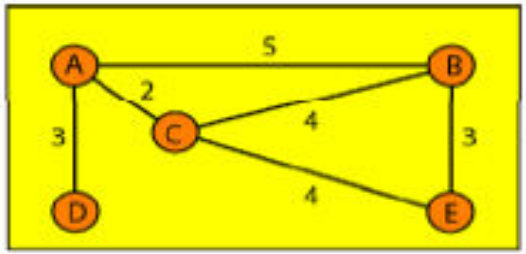
Formation of Shortest Path Tree:

After receiving all LSPs, each node will have a copy of the whole topology. Using Dijkstra algorithm, we create shortest path tree at each node.

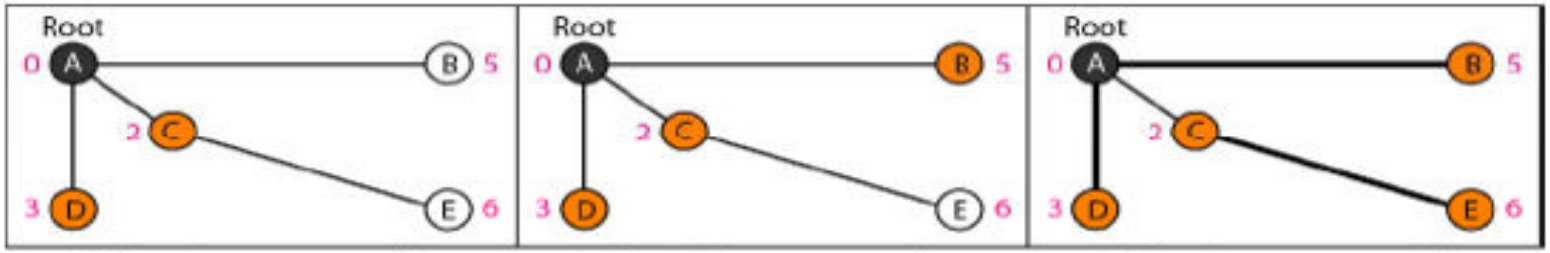


Topology

1. Set root to A and move A to tentative list.

2. Move A to permanent list and add B, C, and D to tentative list.

3. Move C to permanent and add E to tentative list.



4. Move D to permanent list.

5. Move B to permanent list.

6. Move E to permanent list (tentative list is empty).

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Calculation of Routing Table from Shortest Path Tree

Each node uses the shortest path tree protocol to construct its routing table. The routing table shows the cost of reaching each node from the root. Following table shows the routing table for node A.

Node	*Cost*	*Next Router*
A	0	—
B	5	—
C	2	—
D	3	—
E	6	C

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Open Shortest Path First(OSPF) Routing Protocol

- The Open Shortest Path First or OSPF protocol is an intra domain routing protocol based on link state routing. Its domain is also an autonomous system.

- To handle routing efficiently and in a timely manner, OSPF divides an autonomous system into areas. An area is a collection of networks, hosts, and routers all contained within an autonomous system. All networks inside an area must be connected.

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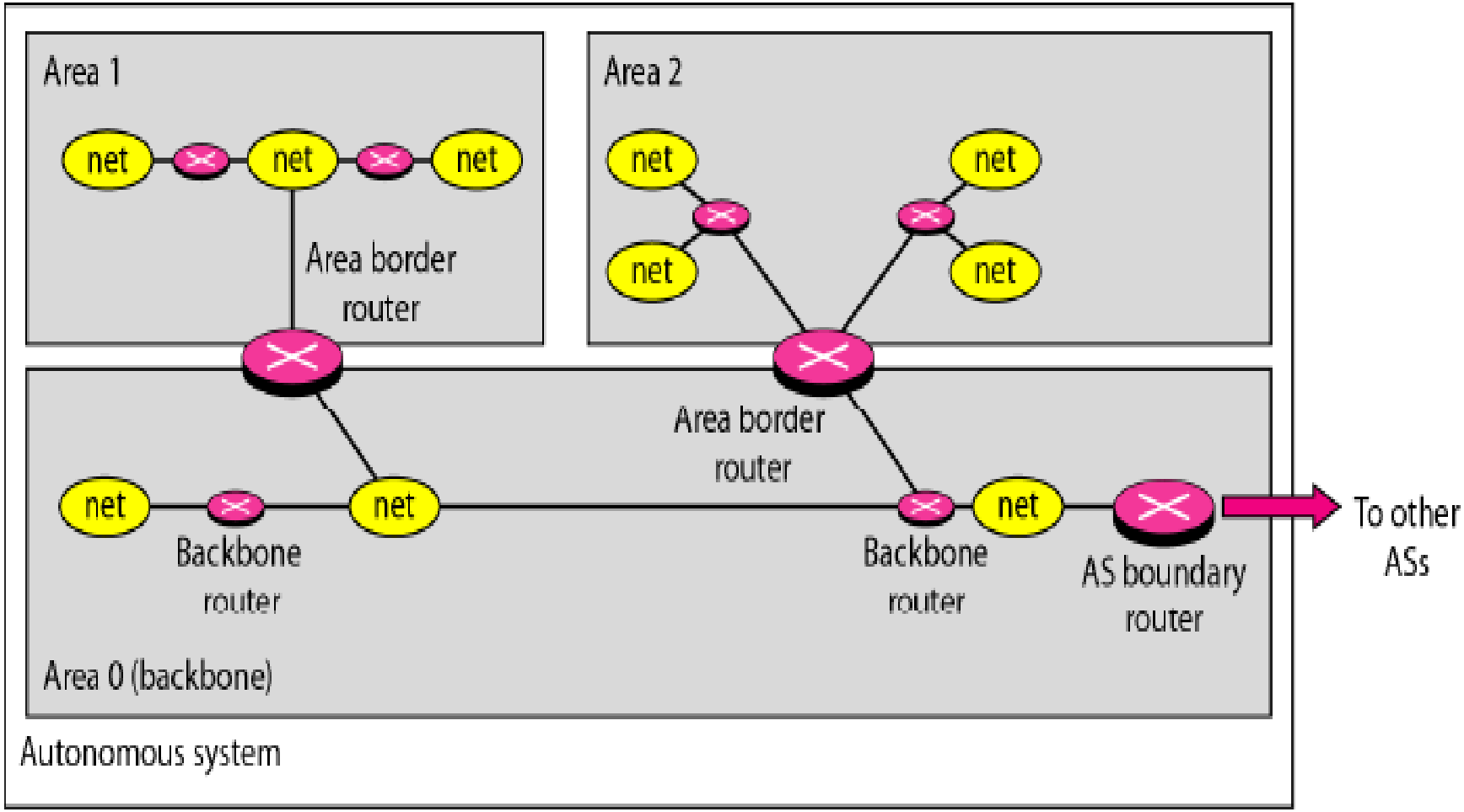

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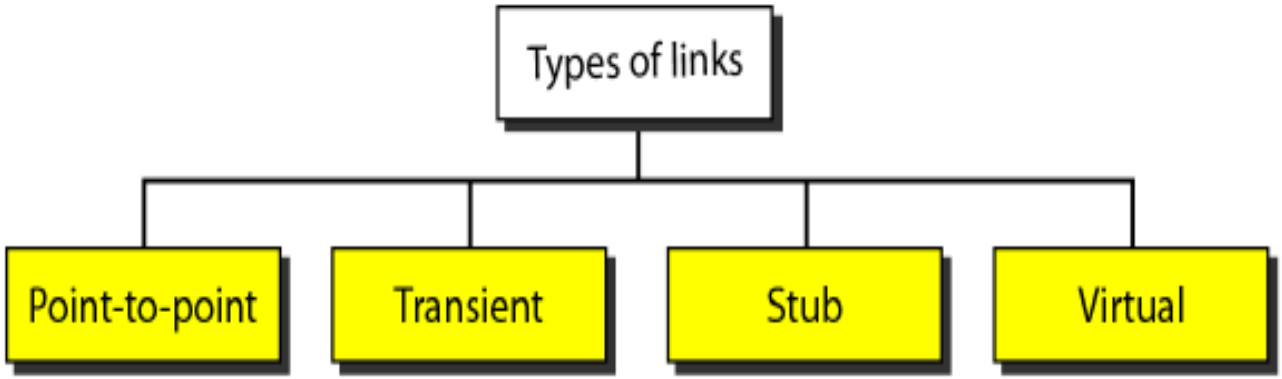
Metric: The OSPF protocol allows the administrator to assign a cost, called the metric, to each route. The metric can be based on a type of service (minimum delay, maximum throughput, and so on).

Types of Links: In OSPF terminology, a connection is called a link. Four types of links have been defined: point-to-point, transient, stub, and virtual.



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Point-to-Point link

A point-to-point link connects two routers without any other host or router in between. There is no need to assign a network address to this type of link.

Transient link

A transient link is a network with several routers attached to it. The data can enter through any of the routers and leave through any router. All LANs and some WANs with two or more routers are of this type. In this case, each router has many neighbors.

Stub link

A stub link is a network that is connected to only one router. The data packets enter the network through this single router and leave the network through this same router.

Virtual link

When the link between two routers is broken, the administration may create a virtual link between them, using a longer path that probably goes through several routers.

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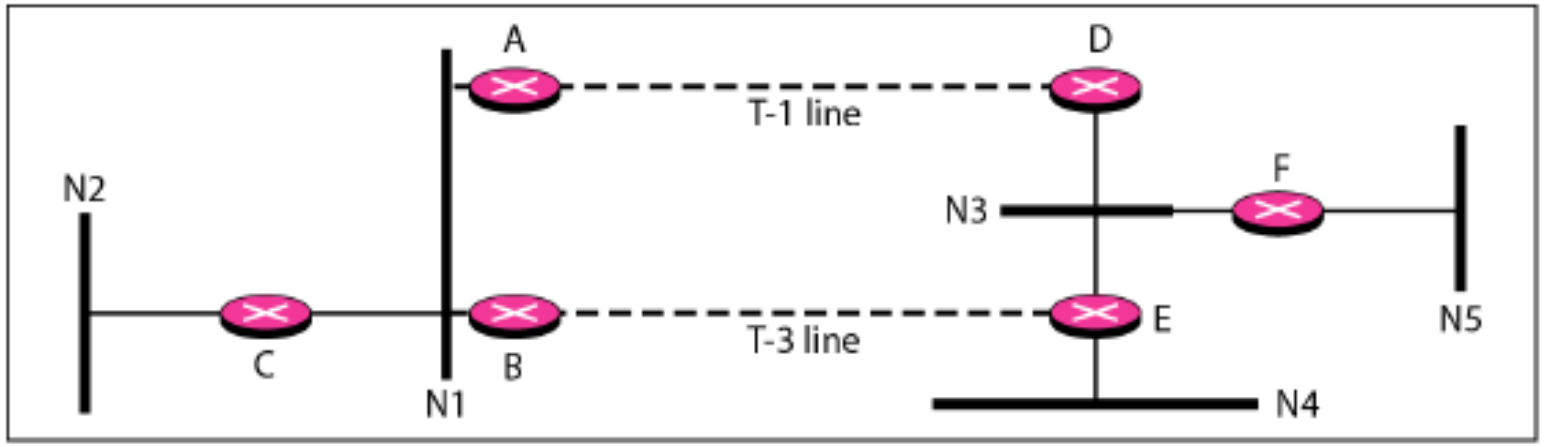
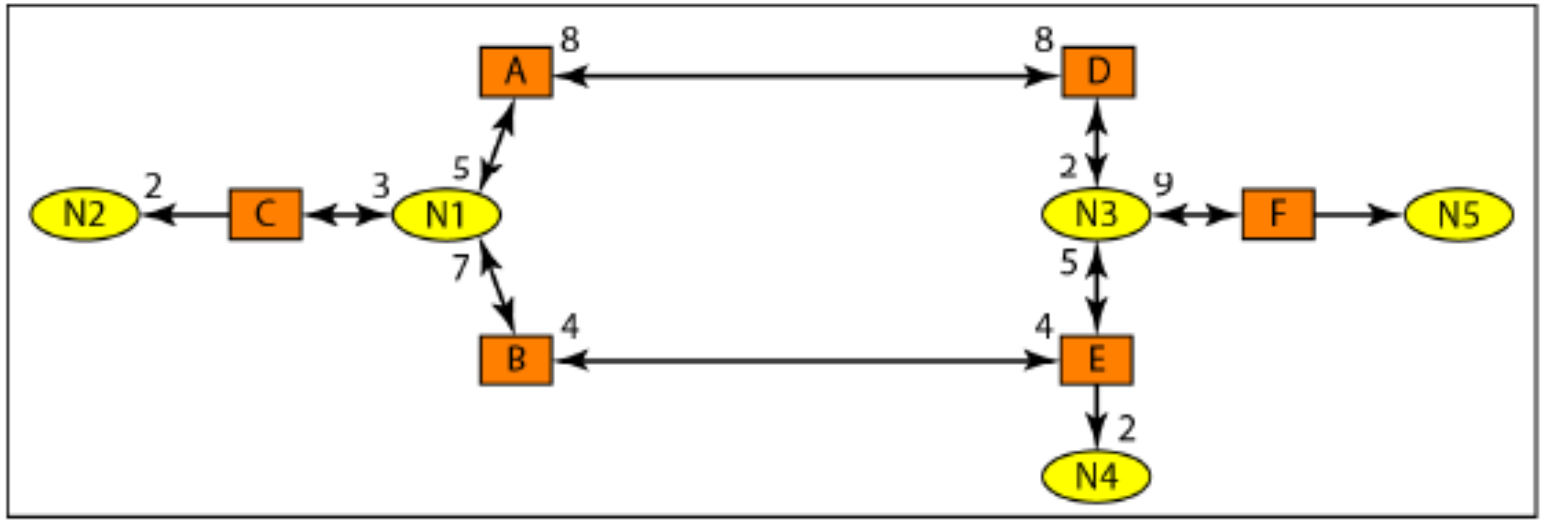
Example of an AS and its graphical representation in OSPF



a. Autonomous system



b. Graphical representation

AKTU Examination Questions

1. If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?
2. What is count-to-infinity problem?
3. What is time-to-live or packet lifetime?
4. What is unicast routing? Discuss unicast routing protocols.
5. Write advantages of Next-generation IPV6 over IPV4.
6. The IP network 200.198.160.0 is using subnet mask 255.255.255.224. Design the subnets.

AKTU Examination Questions

7. Write two use of subnet mask.
8. Convert the IPv4 address whose hexadecimal representation is C22F15B2 to dotted decimal notation. What is the class of this address?
9. What do you mean by adaptive and non-adaptive routing algorithm? Discus Distance Vector Routing including count to infinity problem.
10. Sketch the IP header neatly and explain the functions of each field. What are the deficiencies of IPV4 over IPV6?
11. An organization is granted a block 211.17.180.0 /24. The administrator wants to create 32 subnets.

    i) Find the subnet mask.

    ii) Find the number of addresses in each subnet.

    iii) Find the first & last address in subnet 1.

    iv) Find the first & last address in subnet 32.

AKTU Examination Questions

12. Given the IP address 180.25.21.I72 and the subnet mask 255.255.192.0, what is the subnet address?
13. What is IP addressing? How it is classified? How is subnet addressing is performed?
14. What is unicast routing? Discuss unicast routing protocols.
15. With the given IP-address, how will you extract its net-id and host-id?
16. Describe the problem of count to infinity associated with distance vector routing technique.
17. Given the IP address 180.2 5.21 .I72 and the subnet mask 255.255.192.A, what is the subnet address?

AKTU Examination Questions

18. What is the net mask of the gateway interface in a subnetwork where maximum of 25 hosts exist and IP address of one of the hosts is 192.168.1.1 ?
19. Define routing. In what way it is different from switching?
20. What is unicast routing? Discuss unicast routing protocols.
21. Find the class of each address
    (a) 140.213.10.80
    (b) 52.15.150.11
22. What is the type of the following address?
    (a) 4F::A234:2
    (b) 52F::1234:2222