Department of Computer Science and Engineering

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Laboratory Report

CSE 4412: Data Communication and Networking Lab

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Section	**: BSc in SWE(Group A)**
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Title: Configuration of OSPF in a network topology.

Objective:

1. Understand Link State Routing Protocol
2. Understand OSPF
3. Understand the difference between DV and LS routing

Devices/ software Used:

1. Cisco Packet Tracer
2. 2960-24TT Switch
3. Router-PT
4. PC-PT
5. Server-PT

Theory:

Link State (LS) Routing

Link State Routing is a computer networking protocol that operates by having every router create and maintain a database of the status of all the links in the network. This database is called the Link-State Database (LSDB). It contains information about the network topology, including the status of each link, the routers in the network, and the metrics associated with each link. An example of Link State Routing involves the use of OSPF. This approach helps the packets to find the shortest path using a modified version of the Dijkstra algorithm where the weight of the individual edges becomes the metric or the cost assigned with respect to the bandwidth. Metric is discussed later. There are other SPF algorithms which were not discussed in this week's lab.

Link-State Database (LSDB)

The Link State Database (LSDB) stores a wealth of information about the network topology. It records the status of every link in the network, as well as the routers that are present and the metrics associated with each link. This information is essential for efficient routing in complex networks. LSDB is configured based on the following information: neighbors, exchange LSDB and choosing the best path.

Link State Packet

The Link State Packet (LSP) is a fundamental unit of communication in the Link State Routing protocol. It contains information about a router's neighboring routers and the status of their links. This information is used to update the LSDB on each router. The packet contains information about the router's neighbors as well as their current status. The individual packets have a unique ID called Link-State ID as well as a sequence number. Upon generating the LSP, it configures itself as per the generated LSP. Then the LSP is broadcasted to all the other routers in a given network, thus enabling them to build up the LSDB. The LSP upon being received is compared and with the aid of the sequence number it reconstructs the LSDB only if the sequence number(which also acts as the routerID) for the current record of the database is greater than that from a different router via a process known as polling, otherwise no change occurs. This ensures an updated map of the network topology and thus allows greater reliability and more optimized routing of packets from one router to another.

Open Shortest Path First (OSPF)

Metric: The value used to determine the cost of using a particular link for routing traffic. The cost is inversely proportional to the bandwidth with the constant usually set to 10,000. There can be other forms of cost based on link state which may involve reliability.

Areas: OSPF divides the network into areas, which are groups of routers that share the same LSDB. Each area is identified via a 32 bit area number. This approach helps to minimize the amount of traffic that needs to be exchanged between routers. The area number helps distinguish between the multiple OSPF instances that may run on the same router.

Link State Advertisement (LSA): LSA is a packet that contains information about the network topology, and is used to update the LSDB on each router. The information may consist of subnets, IP addresses, other routers connected to it as well as additional network information.

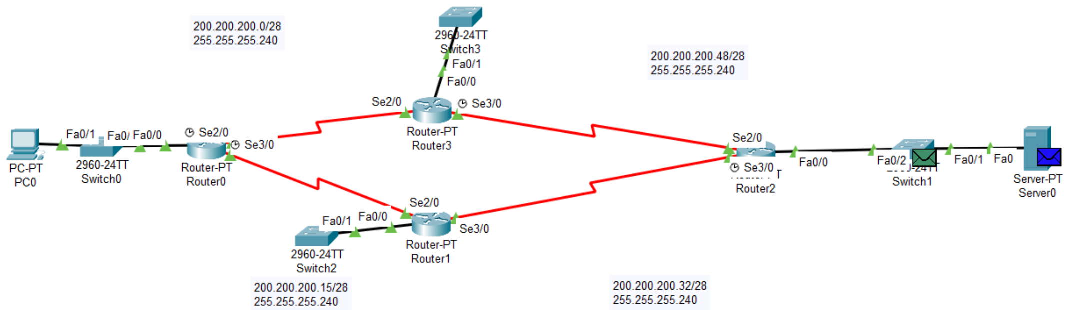
OSPF Implementation: To implement OSPF, first design the network topology and configure OSPF on each router. OSPF divides the network into areas for routing efficiency and uses metrics to optimize network performance. Configure OSPF authentication to prevent unauthorized access and verify the configuration. Finally, monitor OSPF to ensure efficient network operation.

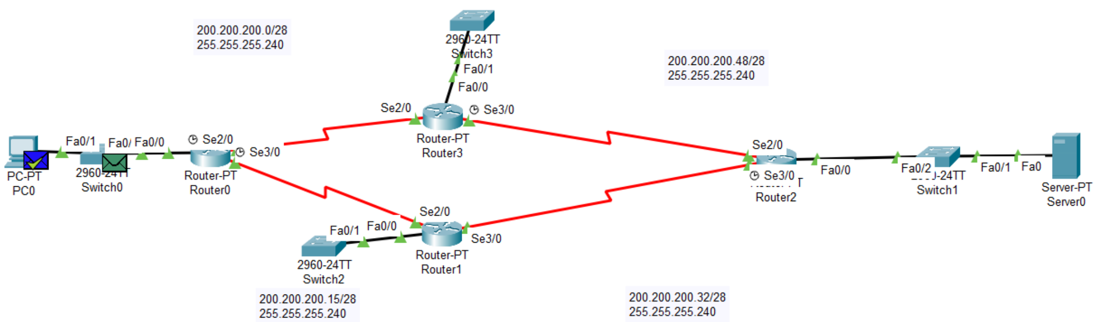
Performance:

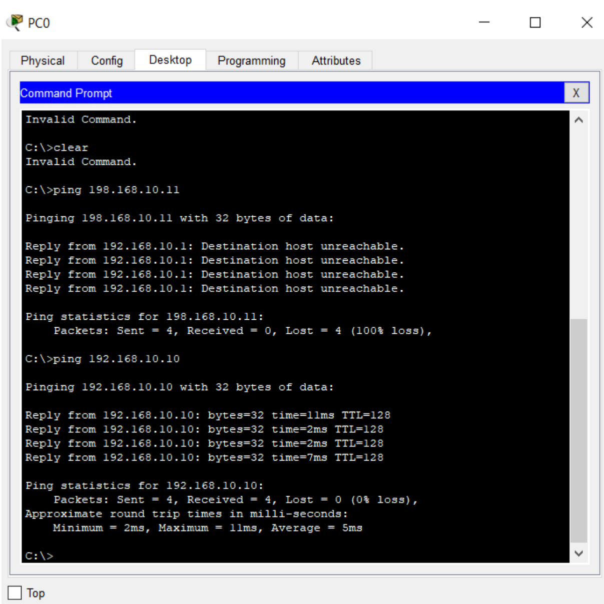
Update Message: It is sent by a router to inform its neighbors of changes in the network topology. The message contains new LSAs and updates to existing LSAs. This ensures that each router has the most current information about the network topology.

Convergence of Forwarding Tables: This process involves routers updating their forwarding tables based on changes in the network topology. OSPF provides fast convergence, which means that forwarding tables are updated quickly after a change occurs. This feature helps to ensure that traffic is routed efficiently in the network.

Diagram of the experiment:

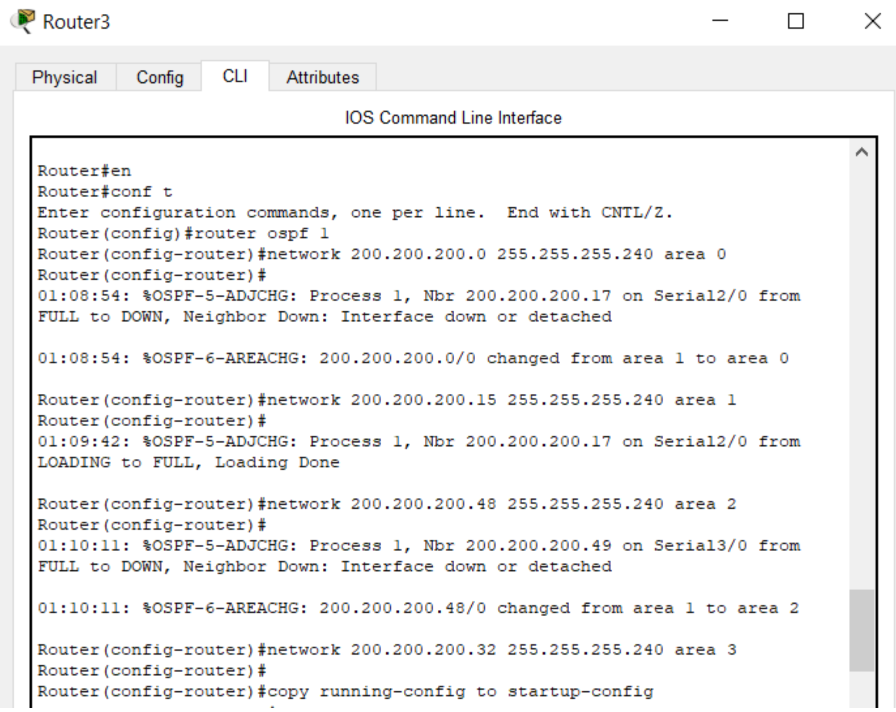






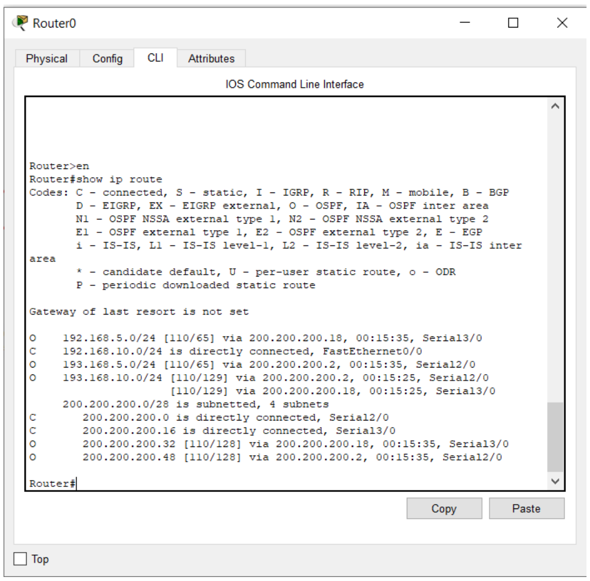
Configuration of Routers:

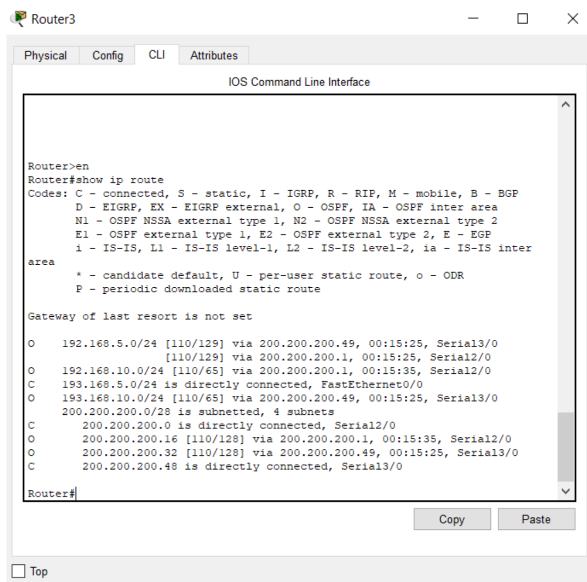
Commands for configuring OSPF

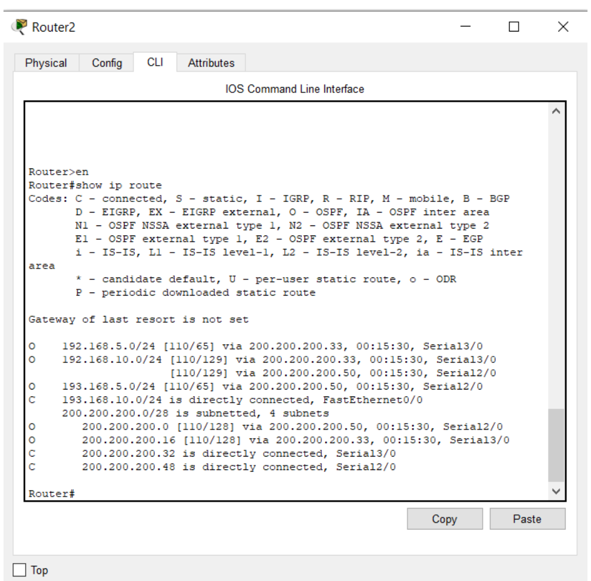


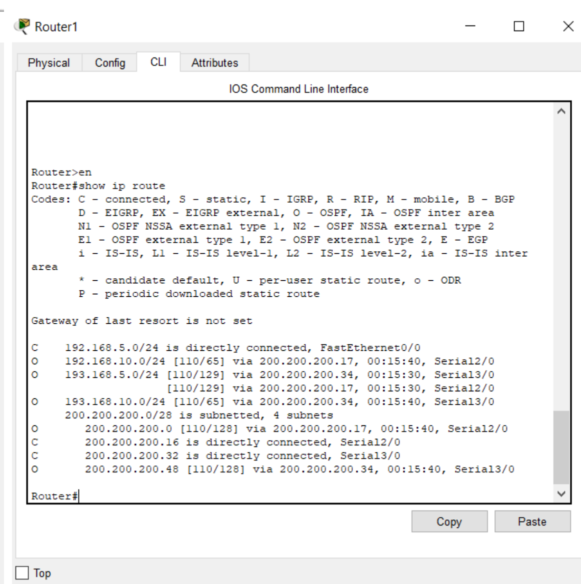
Observation:

The screenshots of routing table of each router is shown below:









Another key observation is how the change in bandwidth can show different routing paths. Similar to RIP from the previous lab, upon switching off the router for a particular path, OSPF reconfigures itself to select an alternate path if present. But what's interesting here is that it can do something similar for the cost as well. If we change the bandwidth for a given path, then it reconfigures itself to select an alternate path which most efficiently transmits the packets from one router to the next. To experiment, I noticed that packets were being routed from the PC to the server through router 1, via router 0 to router 2. However, shutting down router 1 resulted in the packets being routed through router 3, which suggests the use of dynamic routing similar to RIP. Upon restarting router 1, I adjusted the bandwidth of the serial ports on router 3 connecting router 1, from 100(default given in pkt) to 300 on router 1. Subsequently, I observed that the packets were being routed through router 1, as it had the minimum cost due to the inverse proportional relationship, I outlined earlier.

Challenges:

This lab was especially challenging in the theoretical part since some of the topics required a degree of further study. I am still not confident I understand thoroughly as to how OSPF works but I managed to get a brief glimpse. Also the pkt file came preconfigured so I had to reconfigure on the preconfigure to carry out the task in an identical manner to the preconfiguring.