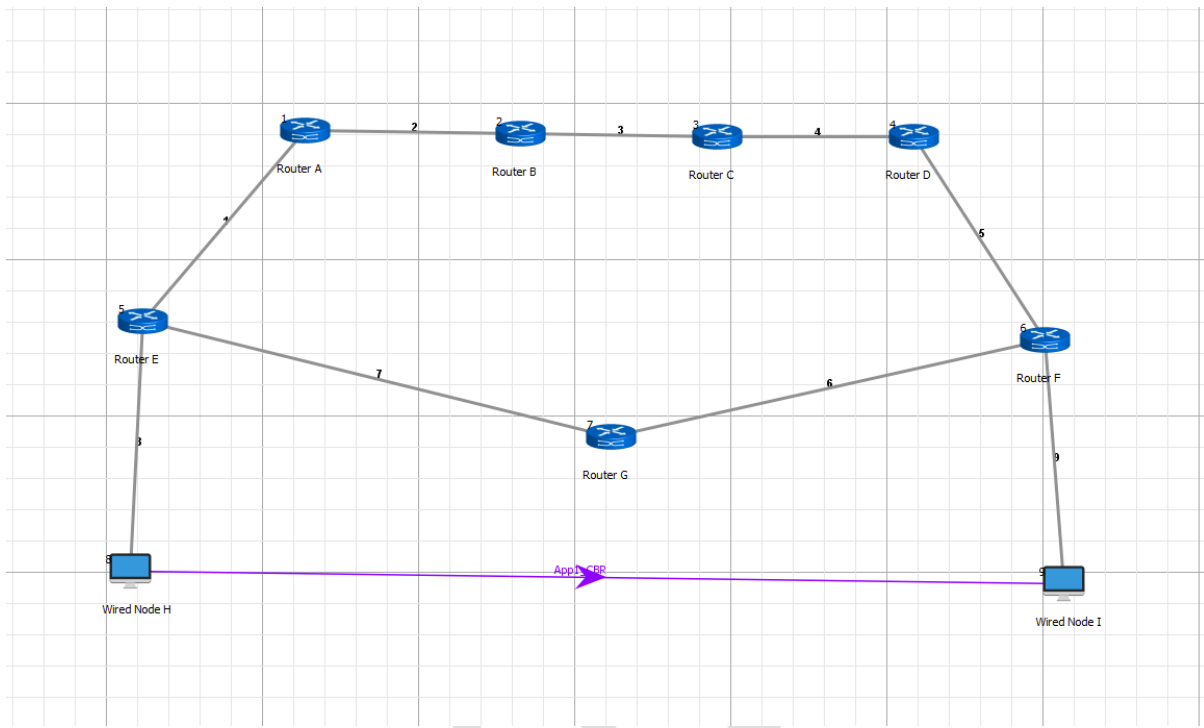




### 3.1 Experiment:



### 3.2 Exercise:

1) Explain the packets used in OSPF: LSR, LSA, D-D, LSU and Hello packet.

#### 1. Hello Packet:

i) Is it exchanged between neighbor or all routers?

| AZ |           |         |                |            |           |                |          |          |           |           |          |           |           |           |           |           |           |          |           |
|----|-----------|---------|----------------|------------|-----------|----------------|----------|----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
|    | A         | B       | C              | D          | E         | F              | G        | H        | I         | J         | K        | L         | M         | N         | O         | P         | Q         | R        | S         |
| 1  | PACKET_ID | SEGMENT | PACKET_TYPE    | CONTROL    | SOURCE_ID | DESTINATION_ID | TRANSMIT | RECEIVER | APP_LAYER | TRX_LAYER | NW_LAYER | MAC_LAYER | PHY_LAYER | PHY_LAYER | PHY_LAYER | APP_LAYER | TRX_LAYER | NW_LAYER | MAC_LAYER |
| 2  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-1  | ROUTER-5       | ROUTER-1 | ROUTER-5 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 3  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-2  | ROUTER-1       | ROUTER-2 | ROUTER-1 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 4  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-3  | ROUTER-2       | ROUTER-3 | ROUTER-2 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 5  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-4  | ROUTER-3       | ROUTER-4 | ROUTER-3 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 6  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-5  | ROUTER-1       | ROUTER-5 | ROUTER-1 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 7  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-6  | ROUTER-4       | ROUTER-6 | ROUTER-4 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 8  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-7  | ROUTER-6       | ROUTER-7 | ROUTER-6 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 9  | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-1  | ROUTER-2       | ROUTER-1 | ROUTER-2 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 10 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-2  | ROUTER-3       | ROUTER-2 | ROUTER-3 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 11 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-3  | ROUTER-4       | ROUTER-3 | ROUTER-4 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 12 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-4  | ROUTER-6       | ROUTER-4 | ROUTER-6 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 13 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-5  | ROUTER-7       | ROUTER-5 | ROUTER-7 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 14 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-6  | ROUTER-7       | ROUTER-6 | ROUTER-7 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 15 | 0         | 0       | Control_Packet | OSPF_HELLO | ROUTER-7  | ROUTER-5       | ROUTER-7 | ROUTER-5 | 0         | 0         | 0        | 0         | 0         | 0         | 0         | 10.44     | 48        | 48       | 48        |
| 16 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-5  | ROUTER-1       | ROUTER-5 | ROUTER-1 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 17 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-1  | ROUTER-2       | ROUTER-1 | ROUTER-2 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 18 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-2  | ROUTER-3       | ROUTER-2 | ROUTER-3 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 19 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-3  | ROUTER-4       | ROUTER-3 | ROUTER-4 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 20 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-4  | ROUTER-6       | ROUTER-4 | ROUTER-6 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 21 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-6  | ROUTER-7       | ROUTER-6 | ROUTER-7 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 22 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-7  | ROUTER-5       | ROUTER-7 | ROUTER-5 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 23 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-5  | ROUTER-7       | ROUTER-5 | ROUTER-7 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 24 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-1  | ROUTER-5       | ROUTER-1 | ROUTER-5 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 25 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-2  | ROUTER-1       | ROUTER-2 | ROUTER-1 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |
| 26 | 0         | 0       | Control_Packet | OSPF_D-D   | ROUTER-3  | ROUTER-2       | ROUTER-3 | ROUTER-2 | 10.44     | 10.44     | 10.44    | 10.44     | 10.44     | 10.44     | 21.2      | 52        | 52        | 52       |           |

It is exchanged between only neighbor routers.

ii) What is its use?

To elect DR and BDR.

iii) What is the time duration of its exchange in theory? Write time duration you observed during your simulation?

The simulation time seen in the first case was 10.44 microseconds, whereas in the second example, the simulation time observed for links 1, 2, 3, 5, and 6 and 7 was 10.44 microseconds and 59.4 microseconds, respectively.

iv) Explain the core fields of the packet.

**Network Mask:** Subnet mask of the advertising OSPF interface.

**Hello Interval:** The frequency at which Hello packets are promoted. By default, NBMA/Broadcast connections run for 30 seconds while point-to-point links run for 10 seconds (2-bytes).

**Options:** The local router advertises its capabilities in this field. (1-byte)

**RTR Priority:** The local router's priority. Elections for DR and BDR are held using it. The router is not eligible for the election if it is set to 0. One byte

**Router Dead Interval:** The Dead Interval that the advertising router has requested. By default, NBMA/Broadcast links (4-bytes) are broadcast for 120 seconds, and point-to-point connections for 40 seconds. **Designated Router:** The IP address of the current DR. Set to 0.0.0.0 if no DR is elected yet. (4-bytes)

**Backup Designated Router:** The BDR's IP address at the moment. If no BDR has yet been chosen, set to 0.0.0.0. Four bytes

**Neighbor:** The BDR's IP address at the moment. If no BDR has yet been chosen, set to 0.0.0.0. Four bytes

## 2. D-D Packets:

i) Is it exchanged between neighbor or all routers?

|    |   |   |                |            |          |          |          |          |       |       |       |       |       |       |       |    |    |    |    |    |
|----|---|---|----------------|------------|----------|----------|----------|----------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|
| 13 | 0 | 0 | Control_Packet | OSPF_HELLO | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 0     | 0     | 0     | 0     | 0     | 0     | 10.44 | 48 | 48 | 48 | 68 | 68 |
| 14 | 0 | 0 | Control_Packet | OSPF_HELLO | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 0     | 0     | 0     | 0     | 0     | 0     | 10.44 | 48 | 48 | 48 | 68 | 68 |
| 15 | 0 | 0 | Control_Packet | OSPF_HELLO | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 0     | 0     | 0     | 0     | 0     | 0     | 10.44 | 48 | 48 | 48 | 68 | 68 |
| 16 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-5 | ROUTER-1 | ROUTER-5 | ROUTER-1 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 17 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 18 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 19 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 20 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 21 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 22 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 23 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 24 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 25 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 26 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 27 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 28 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 29 | 0 | 0 | Control_Packet | OSPF_D-D   | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 52 | 72 | 72 |
| 30 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 31 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 32 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 33 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 34 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 35 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 36 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 37 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 38 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |
| 39 | 0 | 0 | Control_Packet | OSPF_LSR   | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 36 | 56 | 56 |

It is exchanged between only neighbor routers.

ii) What is its use?

Since link-state routing protocols necessitate that all routers' link-state databases stay synchronized, D-D (Data-Descriptor) packets are utilized.

iii) What is the time duration of its exchange in theory? Write time duration you observed during your simulation?

The simulation duration in example 1 was found to be 10.76 microseconds, whereas case 2 showed that the simulation time was 6.2.6 microseconds for links 6 and 7 and 10.76 microseconds for links 1, 2, 3, and 5.

iv) Explain the core fields of the packet.

**Interface MTU:** For virtual links, this field is set to 0x0000. (2-bytes)

**Options:** Same as Options field (1-byte)

**I (Initial Bit):** It is the first in the series of DBD packets (1-bit)

**M (More bit):** Specifies if the DBD packet comes last in the sequence of packets. Every packet before it has had a value of 1, but the most recent packet has a value of 0. One bit

**MS (Master/ Slave bit):** Master=1, Slave=0 (1-bit)

**DD Sequence Number:** Used for sorting the DBD packet collection. There should be just one starting value. After that, the sequence number increases by 1 until the entire DD is sent. 4 bytes

**LSA Header:** The LSA headers that describe the database of the local router are contained in this field. (changeable duration)

### 3. LSR Packets:

i) Is it exchanged between neighbour or all routers?

|    |   |   |                |          |          |          |          |          |       |       |       |       |       |       |       |    |    |    |
|----|---|---|----------------|----------|----------|----------|----------|----------|-------|-------|-------|-------|-------|-------|-------|----|----|----|
| 26 | 0 | 0 | Control_Packet | OSPF_D-D | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 72 |
| 27 | 0 | 0 | Control_Packet | OSPF_D-D | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 72 |
| 28 | 0 | 0 | Control_Packet | OSPF_D-D | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 72 |
| 29 | 0 | 0 | Control_Packet | OSPF_D-D | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 21.2  | 52 | 52 | 72 |
| 30 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 31 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 32 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 33 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 34 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 35 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 36 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 37 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 38 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 39 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 40 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 41 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 42 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 43 | 0 | 0 | Control_Packet | OSPF_LSR | ROUTER-5 | ROUTER-1 | ROUTER-5 | ROUTER-1 | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 21.2  | 30.68 | 36 | 36 | 56 |
| 44 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-5 | ROUTER-1 | ROUTER-5 | ROUTER-1 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |
| 45 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |
| 46 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |
| 47 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |
| 48 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |
| 49 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64 | 64 | 84 |

It is exchanged between only neighbor routers.

ii) What is its use?

Pieces from the most recent neighbor database update are requested using it.

iii) What is the time duration of its exchange in theory? Write time duration you observed during your simulation?

The simulation time in the first example was determined to be 9.48 microseconds, whereas in the second case, the simulation time was determined to be 49.8 microseconds for links 6 and 7 and 9.45 microseconds for links 1, 2, 3, and 4.

iv) Explain the core fields of the packet.

**LS Type:** Shows type of LSA requested

**Link State ID:** Depends upon the type of LSA

**Advertising Router:** Gives Router ID of the requesting router.

#### 4. LSU Packets:

i) Is it exchanged between neighbor or all routers?

|    | A | B | C              | D        | E        | F        | G        | H        | I     | J     | K     | L     | M     | N     | O     | P     | Q  | R  |
|----|---|---|----------------|----------|----------|----------|----------|----------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|
| 52 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 53 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 54 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 55 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 56 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 57 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 42.4  | 64    | 64 | 64 |
| 58 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-5 | ROUTER-1 | ROUTER-5 | ROUTER-1 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 59 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 60 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 61 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 62 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 63 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 64 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 65 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 66 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 67 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 68 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 69 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 70 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 71 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 30.68 | 37.4  | 49.12 | 64 | 64 |
| 72 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-1 | ROUTER-5 | ROUTER-1 | ROUTER-5 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 73 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-5 | ROUTER-1 | ROUTER-5 | ROUTER-1 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 74 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 75 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 76 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 77 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-6 | ROUTER-3 | ROUTER-6 | ROUTER-3 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 78 | 0 | 0 | Control_Packet | OSPF_LSU | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 55.84 | 64 | 64 |
| 79 | 0 | 0 | Control_Packet | OSPF_LSA | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 42.4  | 44.12 | 54.24 | 44 | 44 |

It is exchanged between only neighbor routers.

ii) What is its use?

To implement flooding of packets

iii) What is the time duration of its exchange in theory? Write time duration you observed during your simulation?

The simulation time in the first example was found to be 11.72 microseconds, whereas in the second case, the simulation time was found to be 72.2 microseconds for links 6 and 7 and 11.72 microseconds for links 1, 2, 3, and 4.

iv) Explain the core fields of the packet.

**LSAs:** Number of LSAs within an LSU packet. The complete LSA is encoded within this field and may contain single or multiple LSAs.

## 5. LSA Packets:

i) Is it exchanged between neighbors or all routers?

|    |   |                  |          |          |          |          |          |      |      |      |      |      |       |       |    |    |
|----|---|------------------|----------|----------|----------|----------|----------|------|------|------|------|------|-------|-------|----|----|
| 73 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-3 | ROUTER-1 | ROUTER-3 | ROUTER-1 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 74 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 75 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 76 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 77 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 78 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 55.84 | 64 | 64 |
| 79 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 80 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 81 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 82 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 83 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 84 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-1 | ROUTER-2 | ROUTER-1 | ROUTER-2 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 85 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-5 | ROUTER-7 | ROUTER-5 | ROUTER-7 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 44.12 | 54.24 | 44 | 44 |
| 86 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 50.84 | 60.96 | 44 | 44 |
| 87 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 50.84 | 60.96 | 44 | 44 |
| 88 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-4 | ROUTER-3 | ROUTER-4 | ROUTER-3 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 50.84 | 60.96 | 44 | 44 |
| 89 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-6 | ROUTER-4 | ROUTER-6 | ROUTER-4 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 50.84 | 60.96 | 44 | 44 |
| 90 | 0 | 0 Control_Packet | OSPF_LSA | ROUTER-7 | ROUTER-6 | ROUTER-7 | ROUTER-6 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 50.84 | 60.96 | 44 | 44 |
| 91 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-2 | ROUTER-3 | ROUTER-2 | ROUTER-3 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 49.24 | 60.96 | 64 | 64 |
| 92 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-3 | ROUTER-4 | ROUTER-3 | ROUTER-4 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 49.24 | 60.96 | 64 | 64 |
| 93 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-4 | ROUTER-6 | ROUTER-4 | ROUTER-6 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 49.24 | 60.96 | 64 | 64 |
| 94 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-6 | ROUTER-7 | ROUTER-6 | ROUTER-7 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 49.24 | 60.96 | 64 | 64 |
| 95 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-7 | ROUTER-5 | ROUTER-7 | ROUTER-5 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 49.24 | 60.96 | 64 | 64 |
| 96 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-2 | ROUTER-1 | ROUTER-2 | ROUTER-1 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 55.96 | 67.68 | 64 | 64 |
| 97 | 0 | 0 Control_Packet | OSPF LSU | ROUTER-3 | ROUTER-2 | ROUTER-3 | ROUTER-2 | 42.4 | 42.4 | 42.4 | 42.4 | 42.4 | 55.96 | 67.68 | 64 | 64 |

It is exchanged between only neighbor routers.

ii) What is its use?

To send acknowledgements of received packets.

iii) What is the time duration of its exchange in theory? Write time duration you observed during your simulation?



The simulation time in the first example was found to be 10.12 microseconds, whereas in the second case, the simulation time was found to be 5.6.2 microseconds for links 6 and 7, and 10.12 microseconds for links 1, 2, 3, and 5.

**iv) Explain the core fields of the packet.**

**LS Advertisement Type:** Shows the type of LSA.

**Link State ID:** It depends upon the type of LSA.

**Advertising Router:** Router ID of the advertising router.

**LS Sequence Number:** Sequence number of the packet being acknowledged.

**2) What is the cost of each link in each scenario?**

**Case 1:** Cost of all links:  $100/100 = 1$ .

**Case 2:** Cost of links 1,2,3,4 and 5:  $100/100 = 1$

Cost of links 6 and 7:  $100/10 = 10$ .

**3) How the cost is calculated in Net-Sim?**

We use reference bandwidth as 100 Mbps and hence  $\text{Cost} = 100 / \text{uplink speed}$ .

**Case 1:** Cost of all links:  $100/100 = 1$ .

**Case 2:** Cost of links 1,2,3,4 and 5:  $100/100 = 1$

Cost of links 6 and 7 is  $100/10 = 10$ .

**4) What is the total cost of two paths in each scenario? Show the cost of each link in a graph.**

**Case 1:** Path 1 (1-2-3-4-5): 7

Path 2 (6-7): 4



**Case 2:** Path 1 (1-2-3-4-5): 7

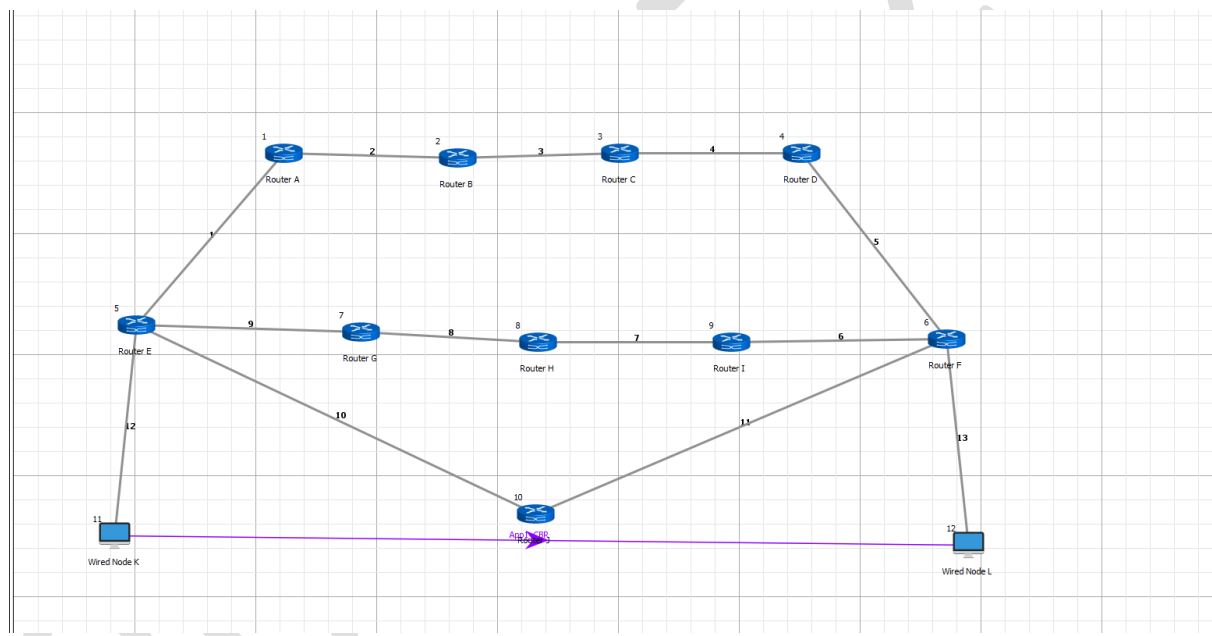
Path 2 (6-7): 22

**5) Write your observation from the two scenarios.**

**For Case 1** as the Cost of path 2 < Cost of path 1, path 2 will be chosen.

**For Case 2** as the Cost of path 1 < Cost of path 2, path 1 will be chosen.

### 3.3 Exercise:



**I. What is cost for all three paths?**

The cost of Path 1 (1-2-3-4-5) is: 52

The cost of Path 2 (8-9-10-11) is: 22

The cost of Path 3 (6-7) is: 22.

**II. What path the data packets take and why? Explain in detail.**



Packets will choose a path with minimum cost. However, here path 2 and path 3 both have a minimum cost of 22. In this case, fewer routers will be given preference as there will be less indexing in the forwarding table. So, path 3 will be chosen.

#### **4. Question set:**

##### **4.1. Answer the following:**

**I. Does all the interfaces of routers belong to same network or different network? List down all interfaces of Router A and Router C of exercise 3.3.**

All the interfaces of the router belong to different networks.

**Router A:** Interfaces are 11.1.1.1, 11.3.1.1, 11.9.1.2, 11.11.1.1

**Router B:** Interfaces are 11.4.1.2, 11.5.1.1

**II. Does the router sharing same link belong to same network or different? Observe for any link and write down their Network IP address.**

IP addresses are distinct even though routers connected by the same link share a network. Routers A and B are connected by Link 1, which establishes their network address of 11.3.0.0. However, as every router must have a unique IP address, Router A's address is 11.3.1.1, while Router B's address is 11.3.1.2.

##### **4.2. Observe and list down parameters of Routing table in detail.**

**Network Destination:** Shows the destination network address.

**Netmask/Prefix length:** Shows subnet mask for destination IP.

**Gateway:** The following device in the path and its IP address.

**Interface:** the router's interface that the packet uses to get to its destination.

**Metrics:** It displays the bare minimum of hops needed to get to the desired location.

**Type:** Gives the kind of routing algorithm that is being used.