Department of Computer Science and Engineering

Islamic University of Technology (IUT)

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Laboratory Report

CSE 4412: Data Communication and Networking Lab

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Section: B

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Title: Configuring and Verifying of RIP and OSPF in a network topology.

Objective:

1. Describe the concept of dynamic routing
2. Explain disadvantages of RIPv1 and improvement in RIPv2
3. Configure Routing Information Protocol (RIP) in a network topology following given specifications
4. Describe the concept of OSPF and related terminologies
5. Explain the advantages of OSPF over RIP
6. Configure OSPF in a network topology following the given specifications

Devices/ software Used:

1. Cisco Packet Tracker

Theory:

(Explain in brief the listed keywords)

Routing Information Protocol (RIP): is a dynamic routing protocol that uses hop count as a routing metric to find the best path between the source and the destination network. It is a distance-vector routing protocol that has an AD value of 120 and works on the Network layer of the OSI model. RIP uses port number 520.

Forwarding Table used in RIP:
A table to make decisions about where to send received frames.

Hop Count as cost

- The hop count represents the number of routers between the source and destination networks.
- RIP aims to find the path with the fewest hops and places it in the routing table.
- The maximum hop count allowed in RIP is 15, and a hop count of 16 indicates network unreachability**.**

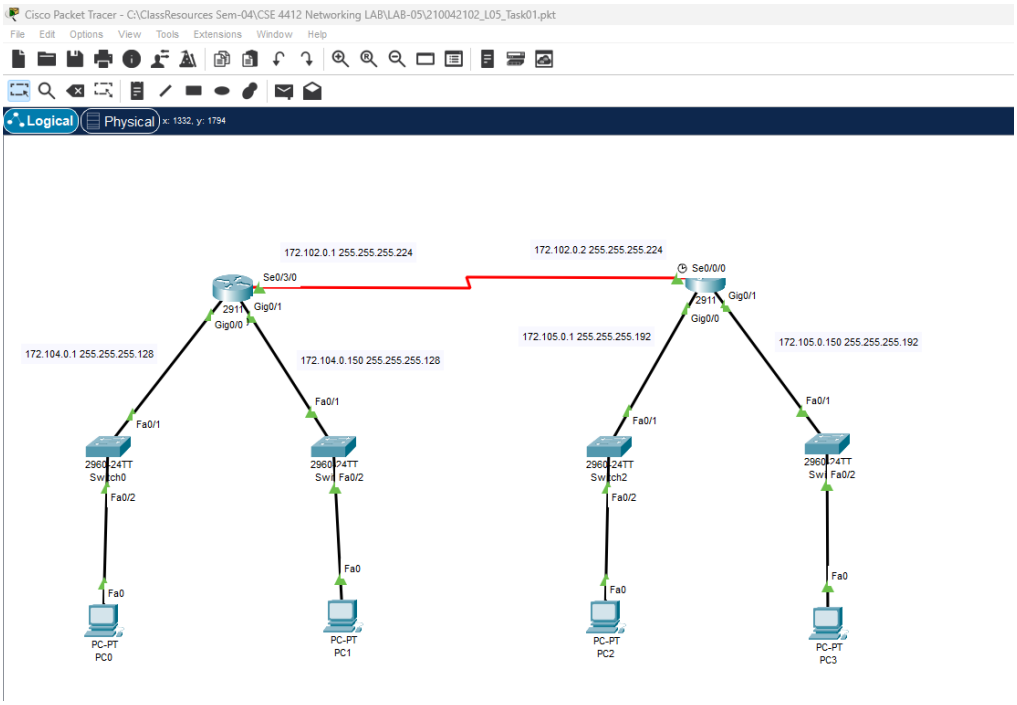
Timers in RIP:

- **Update timer:** The default timing for routing information being exchanged by the routers operating RIP is 30 seconds. Using an Update timer, the routers exchange their routing table periodically.
- **Invalid timer:** If no update comes until 180 seconds, then the destination router considers it invalid. In this scenario, the destination router mark hop counts as 16 for that router.
- **Hold down timer:** This is the time for which the router waits for a neighbor router to respond. If the router isn't able to respond within a given time then it is declared dead. It is 180 seconds by default.
- **Flush time:** It is the time after which the entry of the route will be flushed if it doesn't respond within the flush time. It is 60 seconds by default. This timer starts after the route has been declared invalid and after 60 seconds i.e time will be 180 + 60 = 240 seconds.

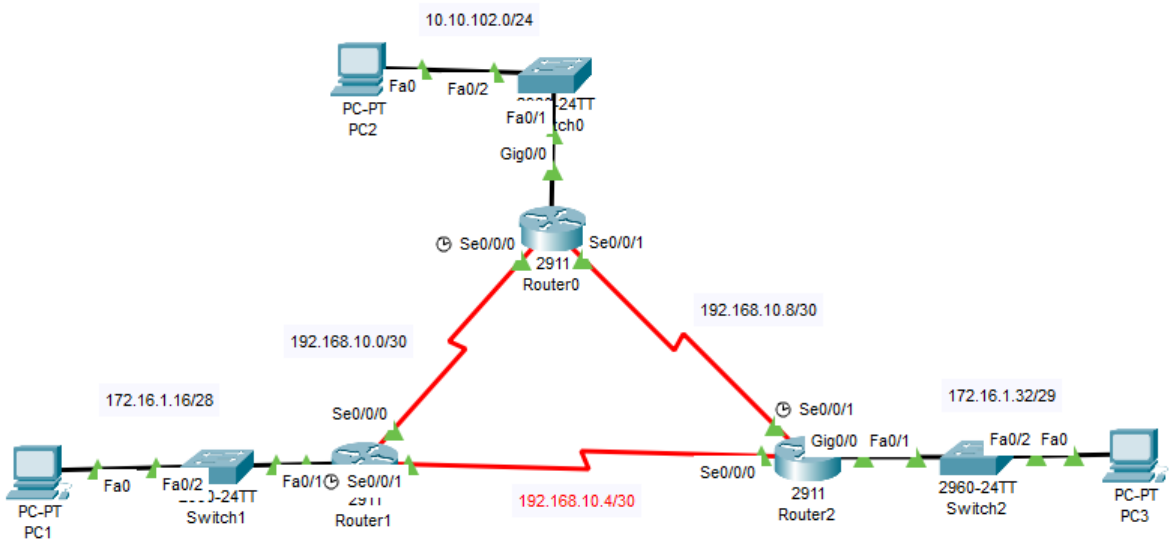
Diagram of the experiment:

(Provide screenshot of the final network topology. Make sure to label the network components.)

Task #01:



Task #02:



Working Procedure:

(Explain in brief how you completed the tasks. Provide necessary screenshots of used commands for each task.)

Task #01:

1) We have 2 routers. First of all we need to configure the interfaces of those 2 routers.
2) Then we need to configure the pc.
3) At last we need to configure RIP in both routers:
   R1 (config)#router rip
   R1 (config-router)#version 2
   R1 (config-router)#network 172.102.0.0
   R1 (config-router)#network 172.104.0.0

Task #02:

Step 1: Configure the routers

```
Router>
Router>en
Router#hostname R1
               ^
% Invalid input detected at '^' marker.

Router#conf
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#
R2(config)#
R2(config)#in
R2(config)#interface gig
R2(config)#interface gigabitEthernet 0/0
R2(config-if)#ip addre
R2(config-if)#ip address 10.10.102.1 255.255.255.0
R2(config-if)#no shut

R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed
state to up

R2(config-if)#exit
R2(config)#
R2(config)#
R2(config)#
R2(config)#in
R2(config)#interface s
R2(config)#interface serial 0/0/0
R2(config-if)#ip add
R2(config-if)#ip address 192.168.10.2 255.255.255.252
R2(config-if)#no shut

R2(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up


R2(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

R2(config-if)#exit
R2(config)#
R2(config)#
R2(config)#
R2(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state
to up

R2(config)#in
R2(config)#interface s
R2(config)#interface serial 0/0/1
R2(config-if)#ip add
R2(config-if)#ip address 192.168.10.9 255.255.255.252
R2(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/0/1, changed state to down
```

Task: Configure OSPF on the R1 Router

```
R1>
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#no ip domain-lookup
R1(config)#
R1(config)#
R1(config)#
R1(config)#router ospf 1
R1(config-router)#net
R1(config-router)#network 172.16.1.16 0.0.0.15 area 0
R1(config-router)#net
R1(config-router)#network 192.168.10.0 0.0.0.3 area 0
R1(config-router)#net
R1(config-router)#network 192.168.10.4 0.0.0.3 area 0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#
```

TASK : Use loopback addresses to change the router IDs of the routers in the topology.

```
R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
R1(config)#
R1(config)#inter
R1(config)#interface loo
R1(config)#interface loopback 0
R1(config-if)#ip add
R1(config-if)#ip address 10.1.1.1 255.255.255.255
R1(config-if)#
```

Step 3: Reload the routers to force the new Router IDs to be used.

```
R1>
R1>
R1>en
R1#
R1#
R1#reload
System configuration has been modified. Save? [yes/no]:y
Building configuration...
[OK]
Proceed with reload? [confirm]
System Bootstrap, Version 15.1(4)M4, RELEASE SOFTWARE
(fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2010 by cisco Systems, Inc.
Total memory size = 512 MB - On-board = 512 MB, DIMM0 =
0 MB
```

Step 5: Use the router-id command to change the router ID on the R1 router.

```
R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#
R1(config)#router os
R1(config)#router ospf 1
R1(config-router)#rou
R1(config-router)#router-id 10.4.4.4
R1(config-router)#Reload or use "clear ip ospf process" command, for this to
take effect


R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#clear ip os
R1#clear ip ospf p
R1#clear ip ospf process
Reset ALL OSPF processes? [no]: yes

R1#
00:06:51: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to
DOWN, Neighbor Down: Adjacency forced to reset

00:06:51: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to
DOWN, Neighbor Down: Interface down or detached

00:06:51: %OSPF-5-ADJCHG: Process 1, Nbr 10.3.3.3 on Serial0/0/1 from FULL to
DOWN, Neighbor Down: Adjacency forced to reset

00:06:51: %OSPF-5-ADJCHG: Process 1, Nbr 10.3.3.3 on Serial0/0/1 from FULL to
DOWN, Neighbor Down: Interface down or detached

R1#
```

```
R2#
R2#sho
R2#show ip o
R2#show ip ospf n
R2#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time
Address         Interface
10.4.4.4          0   FULL/  -        00:00:36
192.168.10.1    Serial0/0/0
10.3.3.3          0   FULL/  -        00:00:37
192.168.10.10   Serial0/0/1
R2#
```

Step 6: Use the show ip ospf neighbor command on router R2 to verify that the router ID of R1 has been changed

```
R1#
R1#
R1#
R1#show ip os
R1#show ip ospf ne
R1#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time
Address         Interface
10.2.2.2          0   FULL/  -        00:00:38
192.168.10.2    Serial0/0/0
10.3.3.3          0   FULL/  -        00:00:35
192.168.10.6    Serial0/0/1
R1#
```

Task: Verify OSPF Operation

Step 2: On the R1 router, use the show ip protocols command to view information about the routing protocol operation.

```
R1#
R1#
R1#show ip os
R1#show ip ospf ne
R1#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
10.2.2.2          0   FULL/  -        00:00:38    192.168.10.2    Serial0/0/0
10.3.3.3          0   FULL/  -        00:00:35    192.168.10.6    Serial0/0/1
R1#
R1#
R1#
R1#
R1#
R1#show ip pro
R1#show ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.1.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.16 0.0.0.15 area 0
    192.168.10.0 0.0.0.3 area 0
    192.168.10.4 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.1.1.1             110      00:01:02
    10.2.2.2             110      00:01:02
    10.3.3.3             110      00:01:05
    10.4.4.4             110      00:02:10
    192.168.10.5         110      00:27:04
    192.168.10.9         110      00:12:36
    192.168.10.10        110      00:11:18
  Distance: (default is 110)

R1#
```

Task: Examine OSPF Routes in the Routing Tables

```
R1#
R1#
R1#
R1#
R1#show ip r
R1#show ip ro
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.102.0/24 [110/65] via 192.168.10.2, 00:01:51, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.16/28 is directly connected, GigabitEthernet0/0
L       172.16.1.17/32 is directly connected, GigabitEthernet0/0
O       172.16.1.32/29 [110/65] via 192.168.10.6, 00:03:04, Serial0/0/1
     192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.1/32 is directly connected, Serial0/0/0
C       192.168.10.4/30 is directly connected, Serial0/0/1
L       192.168.10.5/32 is directly connected, Serial0/0/1
O       192.168.10.8/30 [110/128] via 192.168.10.2, 00:01:51, Serial0/0/0
                        [110/128] via 192.168.10.6, 00:01:51, Serial0/0/1

R1#
```

Task: Configure OSPF Cost

Step 1: Use the show ip route command on the R1 router to view the OSPF cost to reach the 10.10.102.0/24 network.

```
R1#
R1#
R1#
R1#
R1#show ip r
R1#show ip ro
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
O       10.10.102.0/24 [110/65] via 192.168.10.2, 00:01:51, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.16/28 is directly connected, GigabitEthernet0/0
L       172.16.1.17/32 is directly connected, GigabitEthernet0/0
O       172.16.1.32/29 [110/65] via 192.168.10.6, 00:03:04, Serial0/0/1
     192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.1/32 is directly connected, Serial0/0/0
C       192.168.10.4/30 is directly connected, Serial0/0/1
L       192.168.10.5/32 is directly connected, Serial0/0/1
O       192.168.10.8/30 [110/128] via 192.168.10.2, 00:01:51, Serial0/0/0
                        [110/128] via 192.168.10.6, 00:01:51, Serial0/0/1

R1#
```

Step 2: Use the show interfaces serial0/0/0 command on the R1 router to view the bandwidth of the Serial 0/0/0 interface.

```
R1>
R1>en
R1#show in
R1#show interfaces se
R1#show interfaces serial 0/0/0
Serial0/0/0 is up, line protocol is up (connected)
  Hardware is HD64570
  Internet address is 192.168.10.1/30
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 1158 kilobits/sec
  5 minute input rate 54 bits/sec, 0 packets/sec
  5 minute output rate 54 bits/sec, 0 packets/sec
     438 packets input, 33084 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     425 packets output, 30604 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up

R1#
```

Step 3: Use the bandwidth command to change the bandwidth of the serial interfaces of the R1 and R2 routers to the actual bandwidth, 64 kbps.

```
R1#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
R1(config)#in
R1(config)#interface se
R1(config)#interface serial 0/0/0
R1(config-if)#band
R1(config-if)#bandwidth 64
R1(config-if)#in
R1(config-if)#exit
R1(config)#in
R1(config)#interface se
R1(config)#interface serial 0/0/1
R1(config-if)#bandwi
R1(config-if)#bandwidth 64
R1(config-if)#
```

Step 4: Use the show ip ospf interface command on the R1 router to verify the cost of the serial links

```
R1#
R1#
R1#show ip os
R1#show ip ospf int
R1#show ip ospf interface

GigabitEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.17/28, Area 0
  Process ID 1, Router ID 10.1.1.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.1.1.1, Interface address 172.16.1.17
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:00
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.1/30, Area 0
  Process ID 1, Router ID 10.1.1.1, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.2.2
  Suppress hello for 0 neighbor(s)
Serial0/0/1 is up, line protocol is up
  Internet address is 192.168.10.5/30, Area 0
  Process ID 1, Router ID 10.1.1.1, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
```

Step 5: Use the ip ospf cost command to configure the OSPF cost on the R3 router.

```
R3>
R3>
R3>en
R3#conf t
Enter configuration commands, one per line.  End with
CNTL/Z.
R3(config)#int
R3(config)#interface se
R3(config)#interface serial 0/0/0
R3(config-if)#ip os
R3(config-if)#ip ospf cost 1562
R3(config-if)#exit
R3(config)#in
R3(config)#interface s
R3(config)#interface serial 0/0/1
R3(config-if)#ip os
R3(config-if)#ip ospf co
R3(config-if)#ip ospf cost 1562
R3(config-if)#
R3(config-if)#
```

Step 6: Use the show ip ospf interface command on the R3 router to verify that the cost of the link the cost of each of the Serial links is now 1562.

```
R3#
R3#show ip os
R3#show ip ospf in
R3#show ip ospf interface

GigabitEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.33/29, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.3.3.3, Interface address 172.16.1.33
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:06
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/1 is up, line protocol is up
  Internet address is 192.168.10.10/30, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:03
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.2.2
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.6/30, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
 --More--
```

Q/A for the tasks:

(There were many q/a sections inside the task pdfs. Copy the questions and your answers here.)

Task #02:

1) What is the router ID for R1? **ANS: 192.168.10.5**
2) What is the router ID for R2? **ANS: 192.168.10.9**
3) What is the router ID for R3? **ANS: 192.168.10.10**

1) When the router is reloaded, what is the router ID for R1? **ANS: 10.1.1.1**
2) When the router is reloaded, what is the router ID for R2? **ANS: 10.2.2.2**
3) When the router is reloaded, what is the router ID for R3? **ANS: 10.3.3.3**

Observation:

Task-02 was challenging but fun.

Challenges (if any):

Took a long time to do task-2.

References:

1) Routing Information Protocol (RIP) - GeeksforGeeks