IGRP

- Interior Gateway Routing Protocol.
- Used for finding route in an autonomous system.
- It's a distance vector routing protocol (works on basis of hops).
- Its cisco proprietary product.
- It supports a maximum of 100 routers.
- Metric based on: bandwidth, delay, reliability, load, MTU size.
- Its classful routing protocol (fixed length subnet mask)
- Consumes more bandwidth than EIGRP.
- IGRP is not supported after IOS 12.3 release.

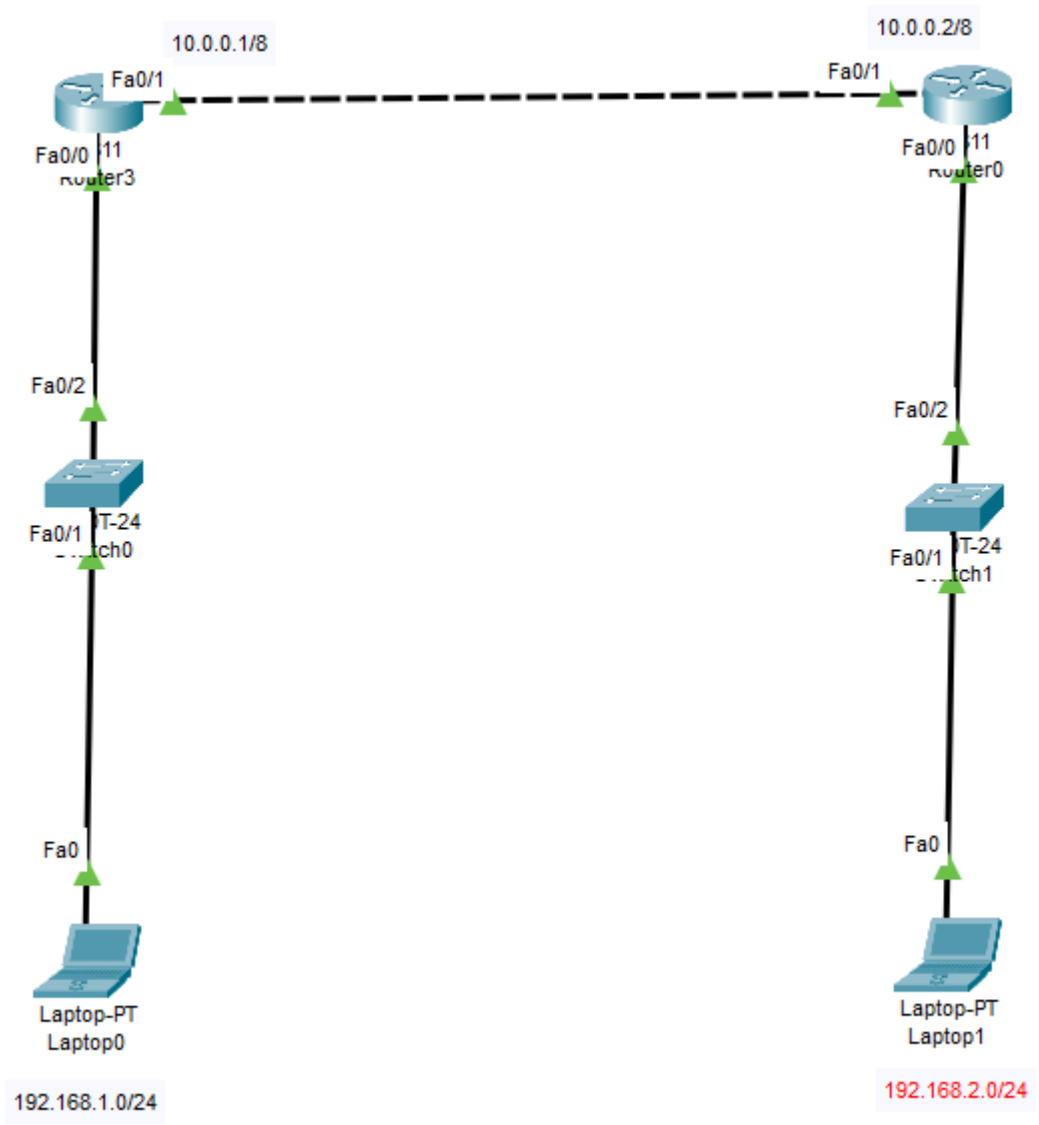
EIGRP

- Enhanced Interior Gateway Routing Protocol.
- It's a hybrid routing protocol and has both characteristics of
  - Distance Vector Routing Protocol
  - Link State
- It's Cisco proprietary product.
- Its successor of IGRP.
- Metric based on: Bandwidth, Delay, Load, Reliability.
- Convergence is faster, as it uses DUAL (Diffusing Update Algorithm)

EIGRP

- Packet delivery is handled using:
  - Reliable transport protocol (RTP)
  - Reliable multicast on 224.0.0.10
  - EIGRP uses IP protocol number 88.
- Uses variable length subnet mask (VLSM).
- Classless routing protocol.
- Loop free topology

EIGRP WITH 2 ROUTERS



EIGRP ON R1

```
R1>
R1>en
R1>enable
R1#
R1#conf t
R1#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router
R1(config)#router eig
R1(config)#router eigrp ?
  <1-65535>  Autonomous system number
R1(config)#router eigrp 1
R1(config-router)#network 192.168.1.0 255.255.255.0
R1(config-router)#network 10.0.0.0 255.0.0.0
R1(config-router)#exit
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#wr
Building configuration...
[OK]
R1#
```

EIGRP ON R2

```
R2(config)#router eigrp 1
R2(config-router)#network 192.168.2.0 255.255.255.0
R2(config-router)#network 10.0.0.0 255.0.0.0
R2(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 10.0.0.1 (FastEthernet0/1) is up: new adjacency

R2(config-router)#wr
                  ^
% Invalid input detected at '^' marker.

R2(config-router)#exit
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#wr
Building configuration...
[OK]
R2#
```

OSPF

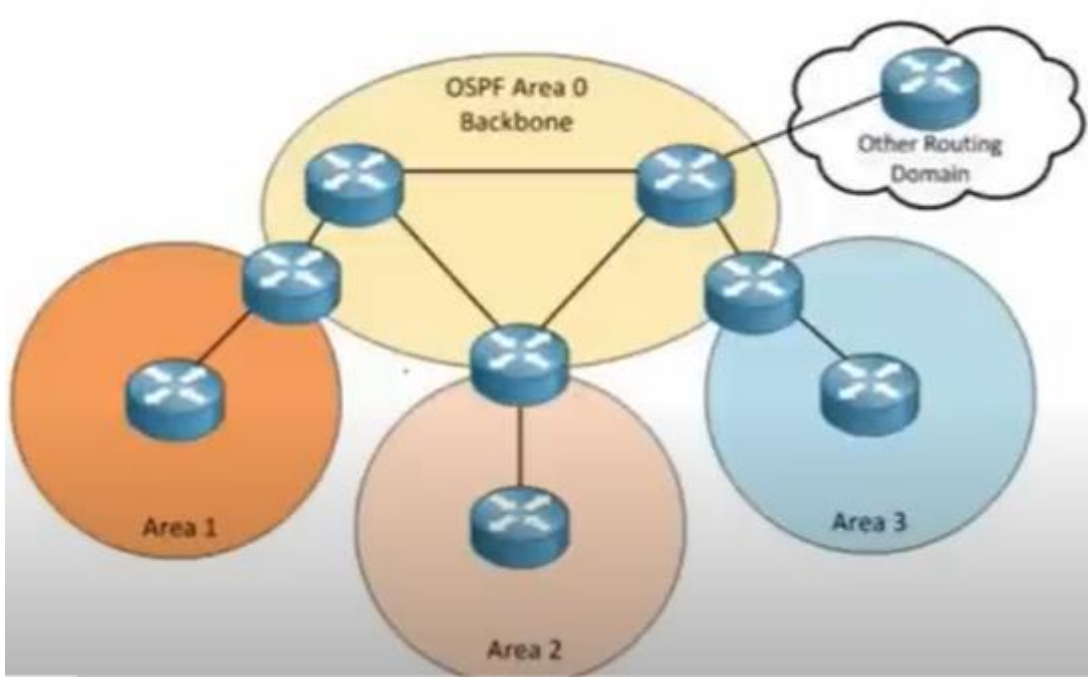
- Open Shortest Path First.
- Widely used protocol.
- It is an Interior Gateway protocol (IGP).
- It is a Link-state routing protocol.
- After all the routers are connected to each other, all routers have same information about the network.
- It sends LSA (Link State Advertisements), to get the information about
  - Subnet
  - Router
    - & some other information.

OSPF

- OSPF stores all the LSA information in a database called LSDB.
- Steps for OSPF working:
  - Becoming neighbors – two routers running OSPF on the same link agree to form a neighbor relationship.
  - Exchange database information – the neighbour routers swap their LSDB information with each other.
  - Choose the best routers – each router choose the best routes to add to its routing table based on the learned LSDB information.

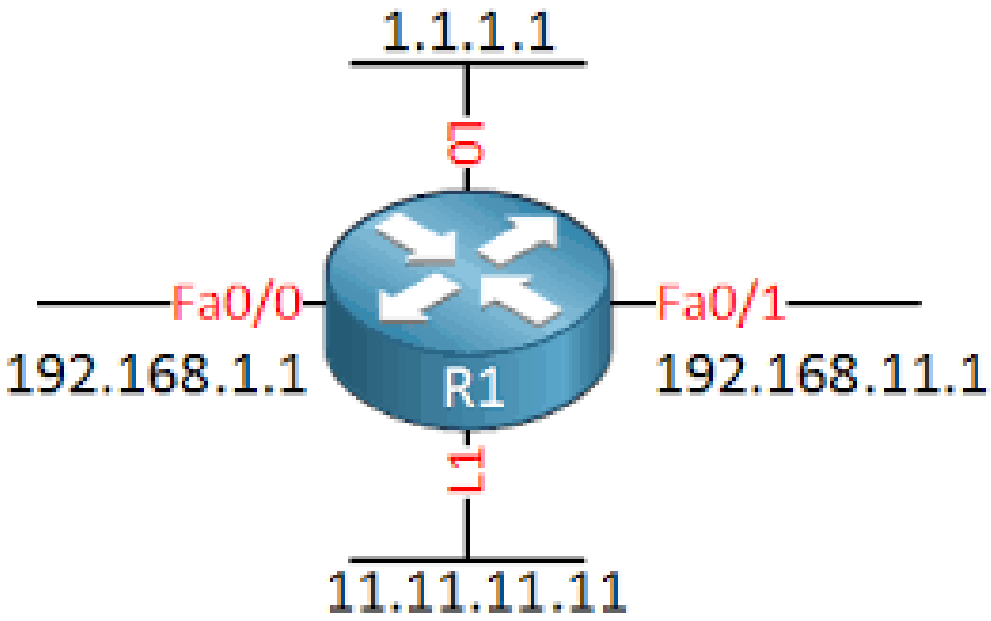
OSPF

- It uses SPF (Shortest Path First) or DIJKISTRA algo.
- Unlimited hop count.
- It supports equal cost load balancing.
- Introduced the concept of Area's to ease management and control traffic.
- All areas must be connect to area 0.
- Supports authentication.
- Uses multicast address: 224.0.0.5 & 224.0.0.6



ROUTER ID IN OSPF

- The highest IP address of the active physical interface of the router ID.
- If logical interface is configured, the highest IP address of the logical interface is Router ID.
- Loopback address gets the highest priority.



OSPF TABLES

- OSPF maintains 3 tables:
  - Neighbor table
    - This table contains information about the directly connected OSPF neighbors forming adjacency.
  - Database table
    - This table contains information about the entire view of the topology with respect to each router.
  - Routing information table
    - Routing table contains information about the best path calculated by the shortest path first algorithm in the database table.

WILDCARD

Subnet Mask	Wildcard mask
255.0.0.0	0.255.255.255
255.255.0.0	0.0.255.255
255.255.255.0	0.0.0.255

It's the opposite of subnet mask.

For VLSM (128)

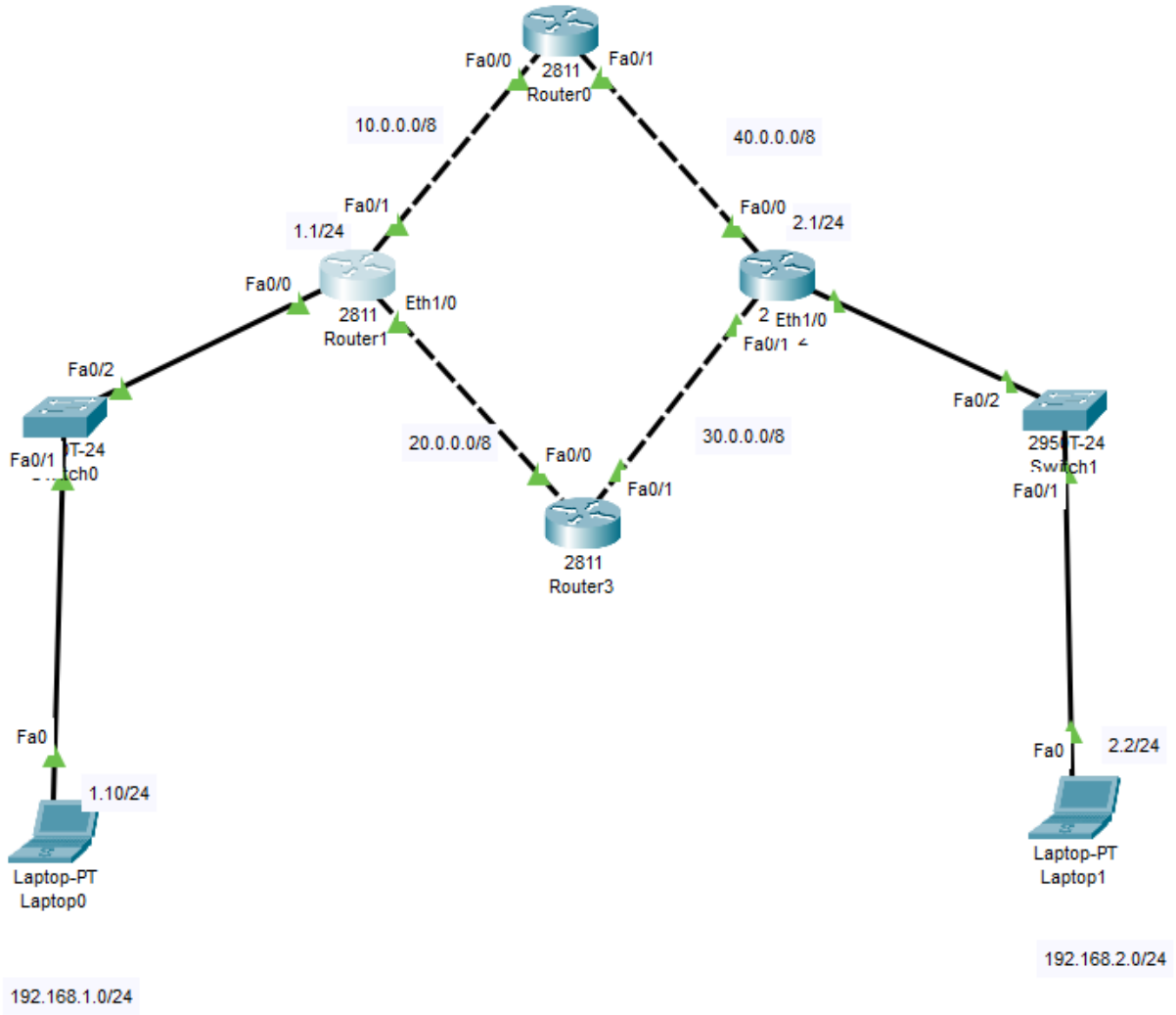
255.255.255.255 – 255.255.255.128 = 0.0.0.127

SYNTAX OF OSPF COMMAND

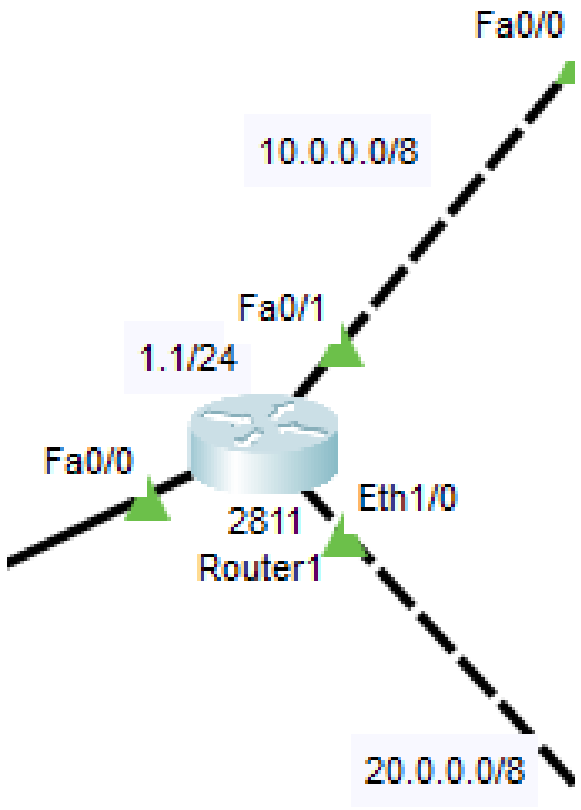
```
Router(config)#route
Router(config)#router ospf 1
Router(config-router)#net
Router(config-router)#network 192.168.10.0 0.0.0.255
Router(config-router)#network 192.168.10.0 0.0.0.255 area 0
Router(config-router)#
```

Network <ip-address-range> <wildcard-mask> area 0

OSPF

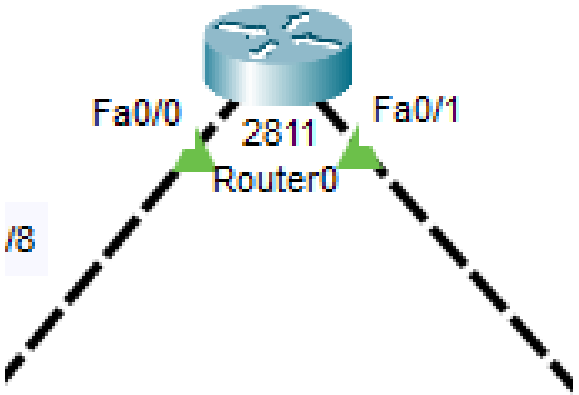

Fa0/0
2811
Router0
Fa0/1
10.0.0.0/8
40.0.0.0/8
Fa0/1
1.1/24
Fa0/0
2.1/24
Fa0/0
2811
Router1
Eth1/0
Eth1/0
Fa0/2
Fa0/2
20.0.0.0/8
30.0.0.0/8
Fa0/0
Fa0/1
Fa0/1
2811
Router3
Fa0
Fa0
2.2/24
1.10/24
Laptop-PT
Laptop0
Laptop-PT
Laptop1
192.168.1.0/24
192.168.2.0/24

OSPF CONFIGURATION ON ROUTER R1



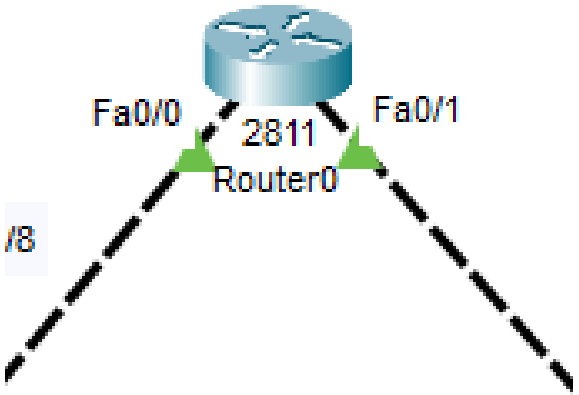

```
Router>en
Router>enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#rou
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#netwo
Router(config-router)#network 192.168.1.0 0.255.255.255 ar
Router(config-router)#network 192.168.1.0 0.255.255.255 area 0
Router(config-router)#network 10.0.0.0 255.0.0.0 area 0
Router(config-router)#network 20.0.0.0 255.0.0.0 are
Router(config-router)#network 20.0.0.0 255.0.0.0 area 0
Router(config-router)#exit
Router(config)#
Router(config)#
```

OSPF CONFIGURATION ON ROUTER R0



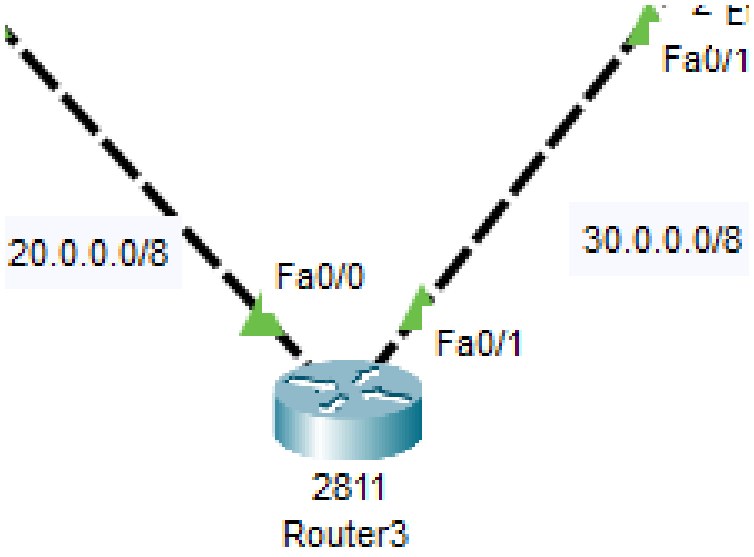

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20
00:17:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on FastEthernet0/0 from LOADING to
FULL, Loading Don
% Incomplete command.
Router(config-router)#
Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

OSPF CONFIGURATION ON ROUTER R0



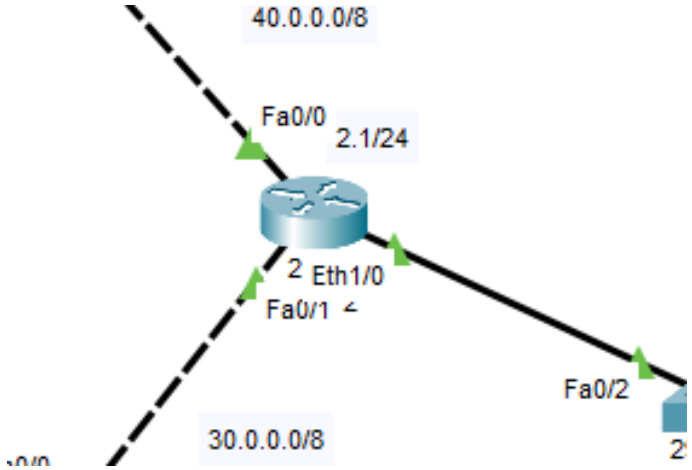

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20
00:17:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on FastEthernet0/0 from LOADING to
FULL, Loading Don
% Incomplete command.
Router(config-router)#
Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

OSPF CONFIGURATION ON ROUTER R3




```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20
00:17:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on FastEthernet0/0 from LOADING to
FULL, Loading Don
% Incomplete command.
Router(config-router)#
Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

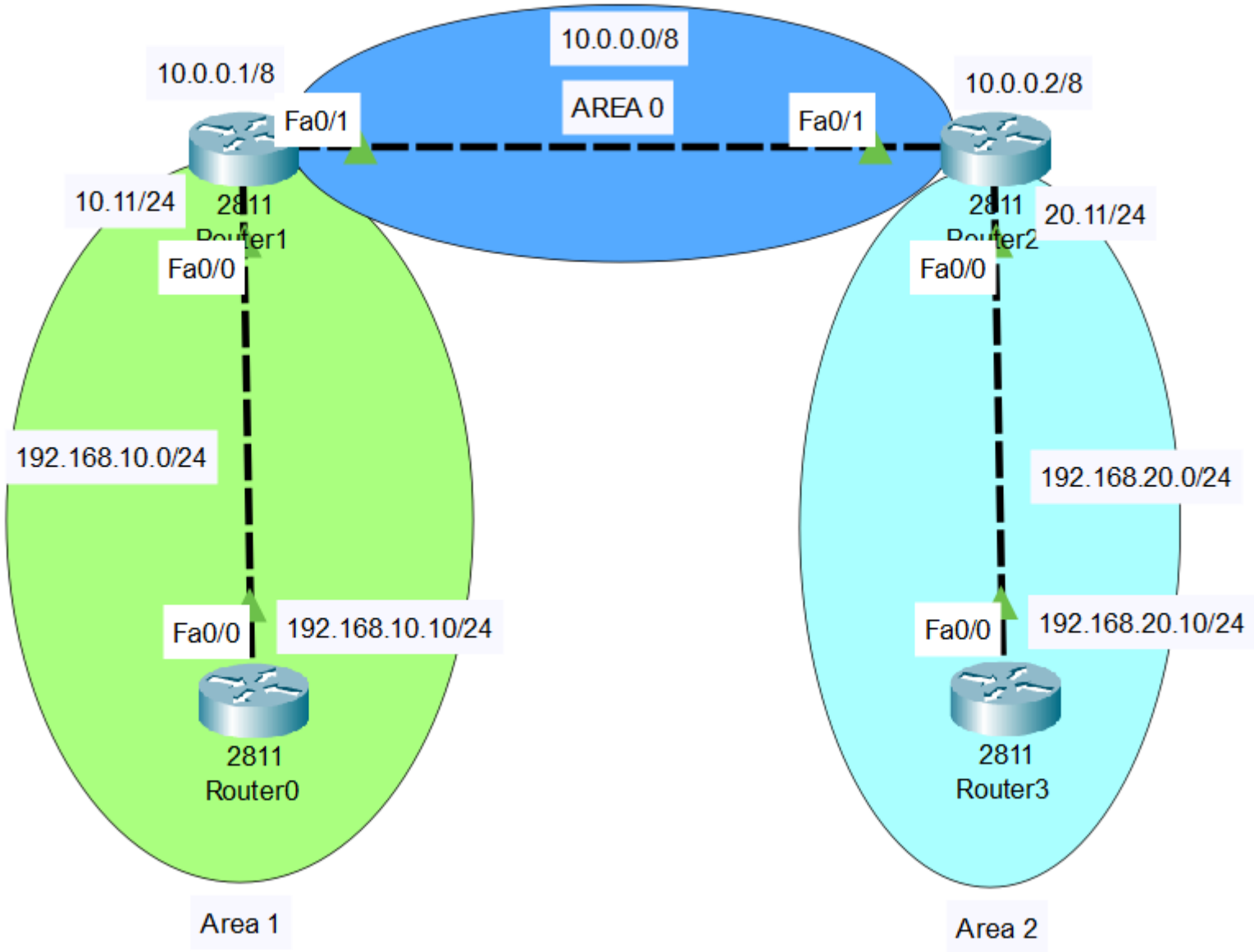
OSPF CONFIGURATION ON ROUTER R2




```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#rout
Router(config)#router osp
Router(config)#router ospf 1
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#network 40.0.0.0 0.255.255.255 ar
00:26:12: %OSPF-5-ADJCHG: Process 1, Nbr 30.0.0.1 on FastEthernet0/1 from LOADING to
FULL, Loading Done
e
% Incomplete command.
Router(config-router)#network 40.0.0.0 0.255.255.255 are
Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Router(config-router)#network 192.168.2.0
00:26:26: %OSPF-5-ADJCHG: Process 1, Nbr 40.0.0.2 on FastEthernet0/0 from LOADING to
FULL, Loading Done

% Incomplete command.
Router(config-router)#network 192.168.2.0 0.0.255.255 are
Router(config-router)#network 192.168.2.0 0.0.255.255 area 0
Router(config-router)#exit
Router(config)#
Router(config)#
```

OSPF MULTI AREA



OSPF MULTI AREA – ROUTER 1 – AREA 0

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf
Router(config)#router ospf ?
  <1-65535>  Process ID
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#
00:25:39: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.20.11 on FastEthernet0/1 from LOADING to
FULL, Loading Done
```

Verify the neighbor on Router 1

```
Router#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.20.11     1   FULL/BDR        00:00:33    10.0.0.2        FastEthernet0/1
Router#
```

OSPF MULTI AREA – ROUTER 2 – AREA 0

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#
Router(config-router)#
00:25:37: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.11 on FastEthernet0/1 from LOADING to
FULL, Loading Done
```

Verify the neighbor on Router 2

```
Router#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.10.11     1   FULL/DR         00:00:36    10.0.0.1        FastEthernet0/1
Router#
```

OSPF MULTI AREA – ROUTER 1 – AREA 1

Router 1

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#netwo
Router(config-router)#network 192.168.10.0 0.0.0.255 area 1
Router(config-router)#exit
```

Router 0

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#netw
Router(config-router)#network 192.168.10.0 0.0.0.255 area 1
Router(config-router)#
00:47:55: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.11 on FastEthernet0/0 from LOADING to
FULL, Loading Done

Router(config-router)#
```

LISTING ROUTES – ROUTER 2

```
Router#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       10.0.0.0/8 is directly connected, FastEthernet0/1
L       10.0.0.2/32 is directly connected, FastEthernet0/1
O IA 192.168.10.0/24 [110/2] via 10.0.0.1, 00:08:14, FastEthernet0/1
     192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.20.0/24 is directly connected, FastEthernet0/0
L       192.168.20.11/32 is directly connected, FastEthernet0/0
```

LISTING OSPF EVENTS – ROUTER 1

```
Router#debug ip ospf events
OSPF events debugging is on
Router#
00:55:22: OSPF: Rcv hello from 192.168.10.10 area 1 from FastEthernet0/0 192.168.10.10

00:55:22: OSPF: End of hello processing

00:55:28: OSPF: Rcv hello from 192.168.20.11 area 0 from FastEthernet0/1 10.0.0.2

00:55:28: OSPF: End of hello processing

00:55:32: OSPF: Rcv hello from 192.168.10.10 area 1 from FastEthernet0/0 192.168.10.10

00:55:32: OSPF: End of hello processing

00:55:38: OSPF: Rcv hello from 192.168.20.11 area 0 from FastEthernet0/1 10.0.0.2

00:55:38: OSPF: End of hello processing
```

To disable debugging:

```
Router#unde
Router#undebug all
All possible debugging has been turned off
Router#
```

OSPF MULTI AREA – ROUTER 2 – AREA 2

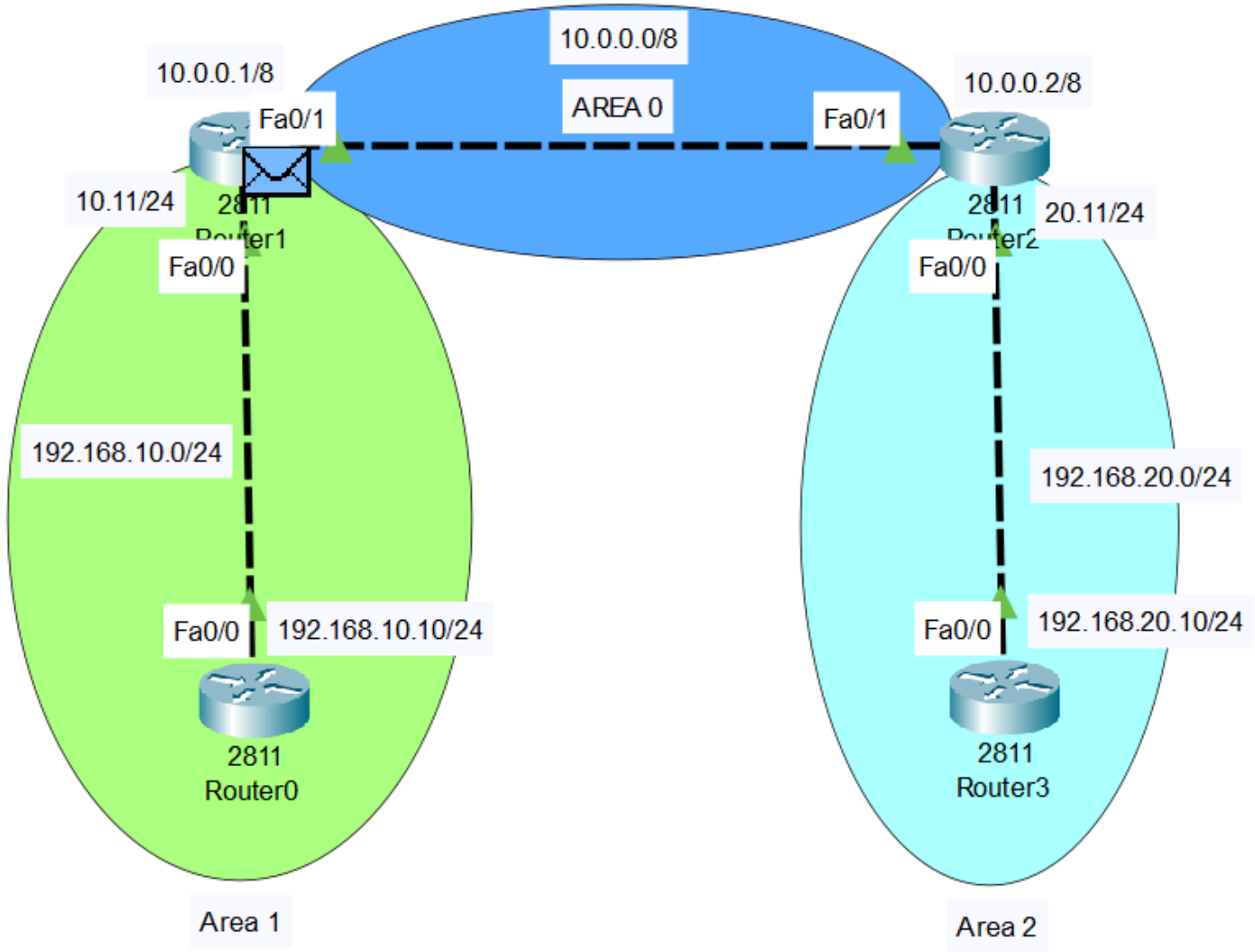
Router 2

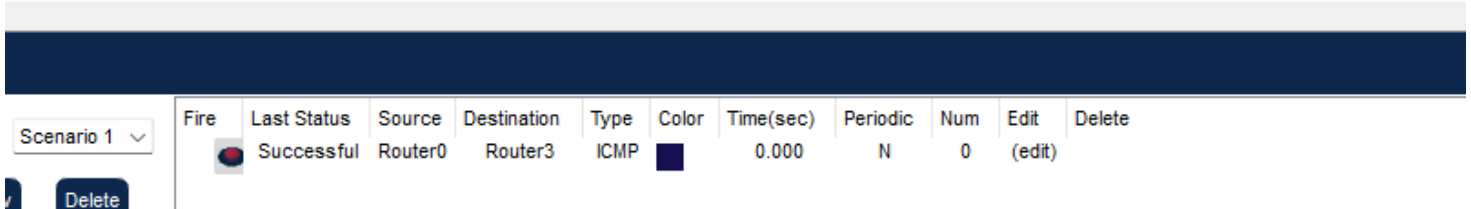
```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 192.168.20.0 0.0.0.255 area 2
Router(config-router)#
```

Router 3

```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 192.168.20.0 0.0.0.255 area 2
Router(config-router)#exit
Router(config)#
01:03:32: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.20.11 on FastEthernet0/0 from LOADING to
FULL, Loading Done
```

PINGING FROM ROUTER 0 TO ROUTER 3

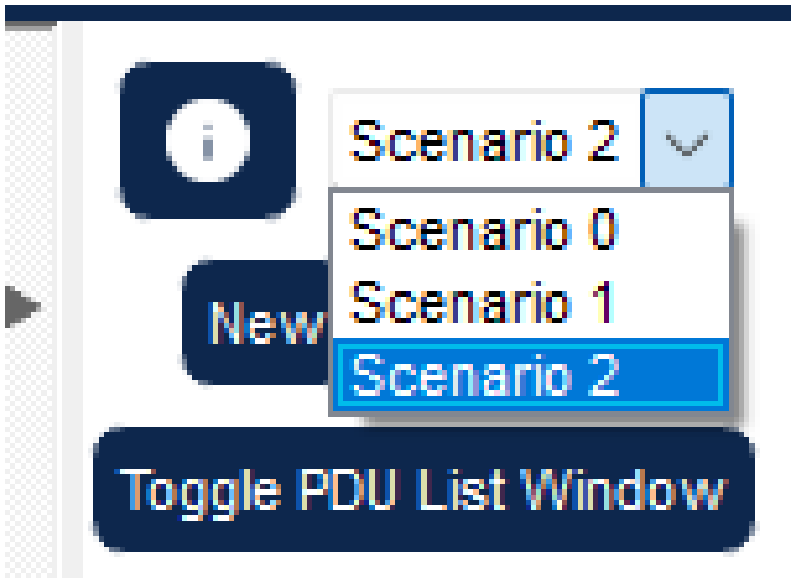


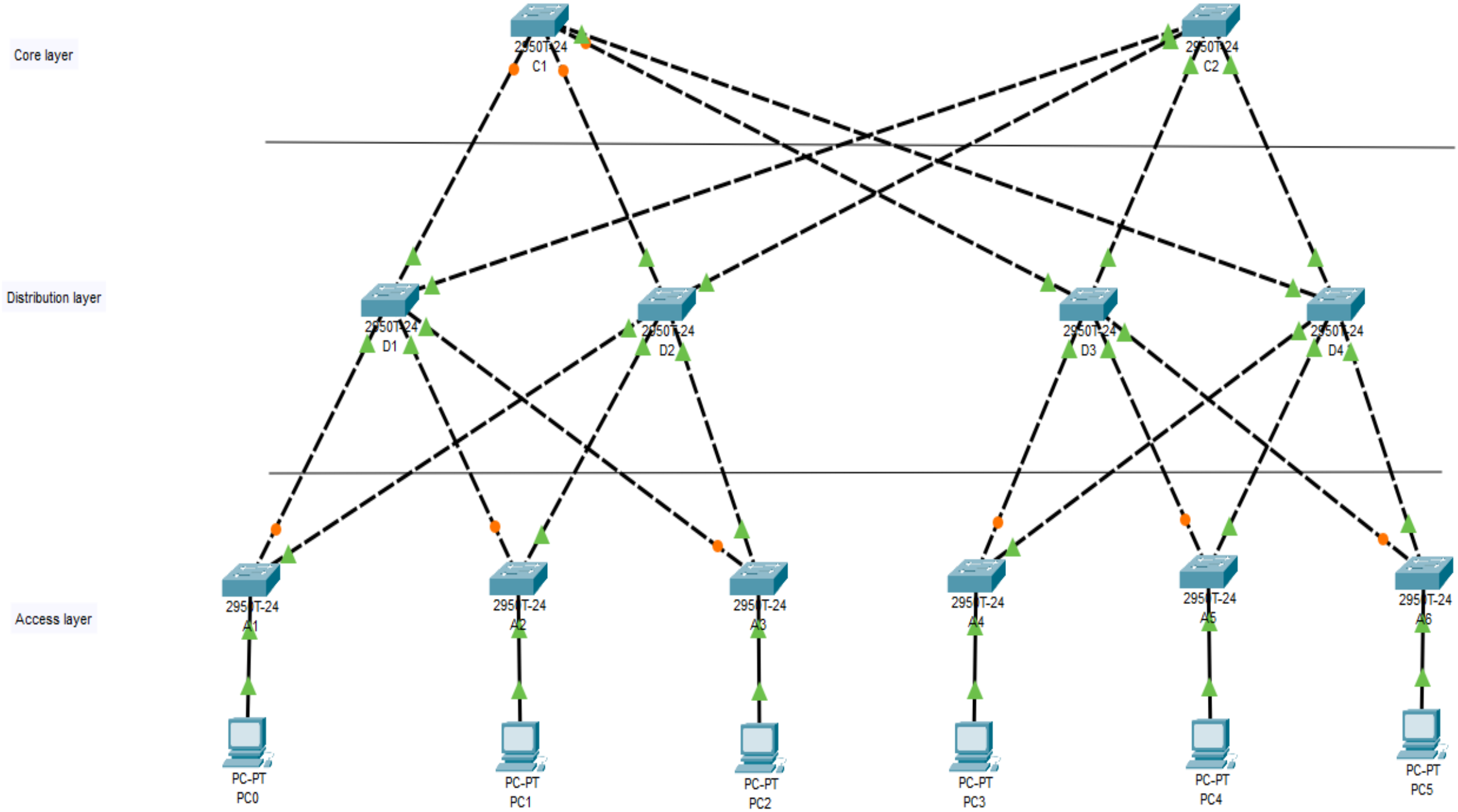


TASK - 1

- Capture ARP and ICMP packet on the following network.

- Create scenarios for both.

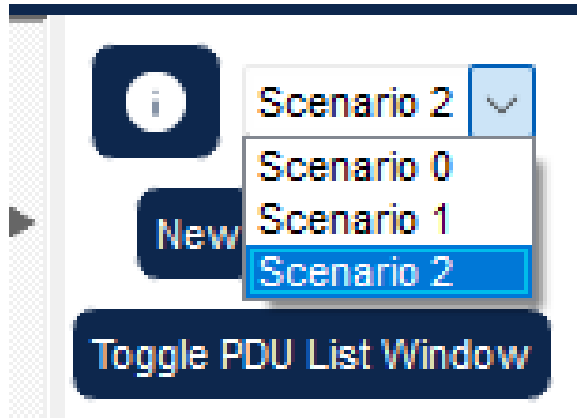



Core layer
Distribution layer
Access layer
2950T-24
C1
2950T-24
C2
2950T-24
D1
2950T-24
D2
2950T-24
D3
2950T-24
D4
2950T-24
A1
2950T-24
A2
2950T-24
A3
2950T-24
A4
2950T-24
A5
2950T-24
A6
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3
PC-PT
PC4
PC-PT
PC5

TASK - 2

1. Capture ARP details from PC2 to PC4 for the following network.
2. Delete the uplink between A1 & D2 switches and ping from PC0 to PC5
3. Delete the uplink between C1 & D4 & ping PC0 to PC5.
4. Delete D4 uplink & ping PC0 to PC5.
5. Delete C1 uplink & ping PC0 to PC5.

Note: for every task, create a new scenario.



FINAL OUTPUT