ROUTER

- Its a networking device to allow communication between 2 or more NETWORKS.
- Types of routers:

    1. Branch router

        - used for small org.

        - series: 800, 1800, 2800, 2900..

    2. Internet-edge router

        - used by mid-level orgs.

        - series: 1000, 7000, 7500, 7560, 7600...

    3. Service provide router

        - used by WAN or big/huge orgs. like ISPs.

        - series: 900, 1000, 7200, 7300, 7600...

ROUTER COMPONENTS

- The basic components of any Cisco router are :
  - Interfaces – for accessing routers
  - The Processor (CPU) – used for connecting with other device.
  - Internetwork Operating System (IOS) – it the Operating system (current: *Cisco IOS XE 17.6.1*)
  - RXBoot Image – aka boot loader, used when IOS is not in use (for maintenance purpose)
  - RAM - 32 to 64 MB
  - NVRAM - router holds its configuration
  - ROM – read-only memory that stores code like Bootstrap & POST.
  - Flash memory – it stores the router's operating system (IOS)
  - Configuration Register – determines if the router is going to boot the IOS image from its Flash, tftp server or just load the RXBoot image.

ROUTING

- It is a process of selecting path/route along which the data can be transferred from source to destination.
- Routing is done with the help of router.
- Routing works on "network layer" of OSI model.
- Routing works on "internet layer" of TCP/IP model.
- Routing Algo. are used for routing the packets
  - Routing algorithm is responsible for deciding the optimal path.
- Types of Routing:
  1. Static routing
  2. Default routing
  3. Dynamic routing

TYPES OF ROUTING – **STATIC ROUTING**

- Aka Non-Adaptive Routing.
- In this, administrator manually enters/adds routes in the routing table.
- Advantage:
  - No overhead – no CPU usage, cheap.
  - No bandwidth – usage between routers.
- Disadvantage:
  - Difficult for large networks.
  - Admins must have in-depth knowledge on the topology, as each route is added manually.

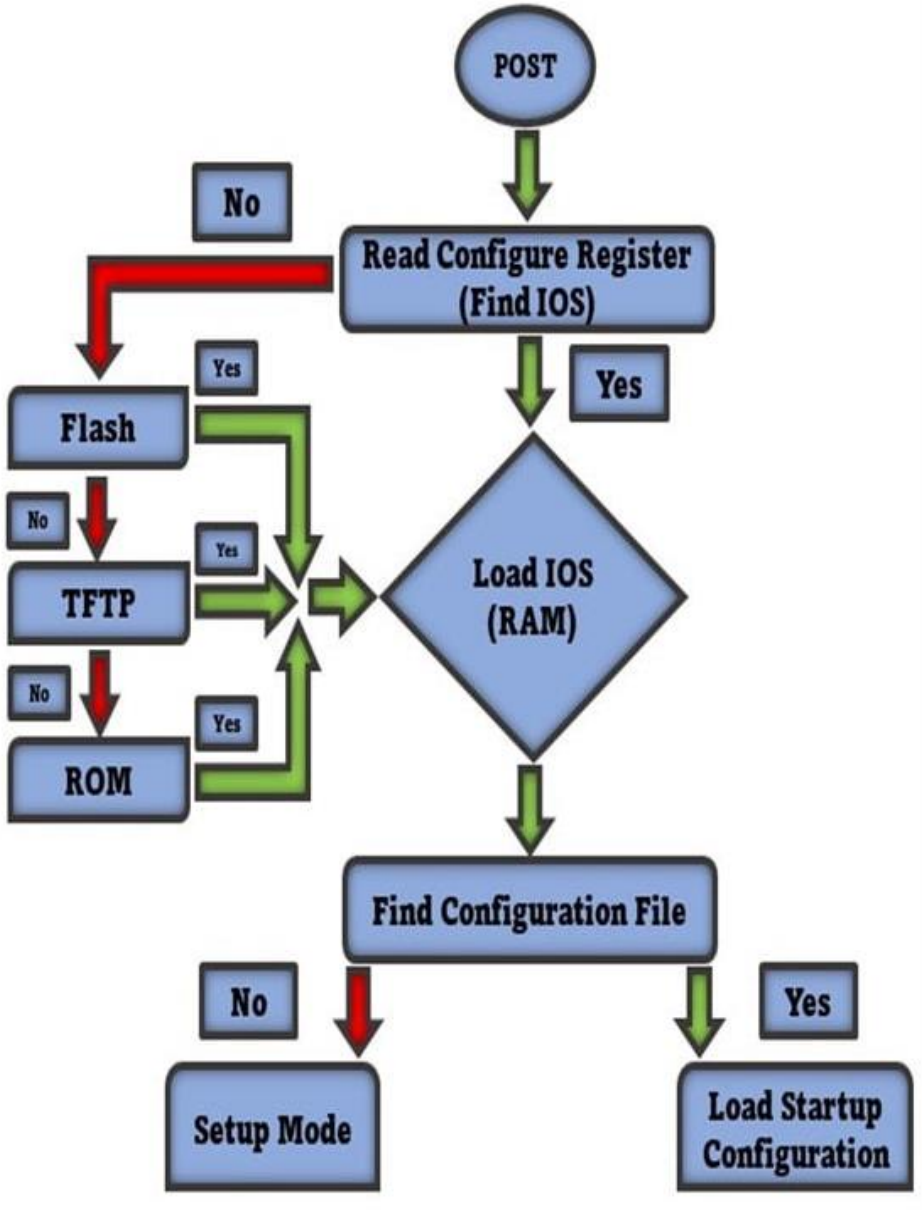
TYPES OF ROUTING – **DEFAULT ROUTING**

- It's a technique in which a router is configured to sent all the packets to the same hop device.
- It doesn't matter whether if belongs to a particular network or net.
- A PKT is transmitted to the device for which it is configured in default routing.
- Default routing is used when networks deal with the single exit point.

TYPES OF ROUTING – **DYNAMIC ROUTING**

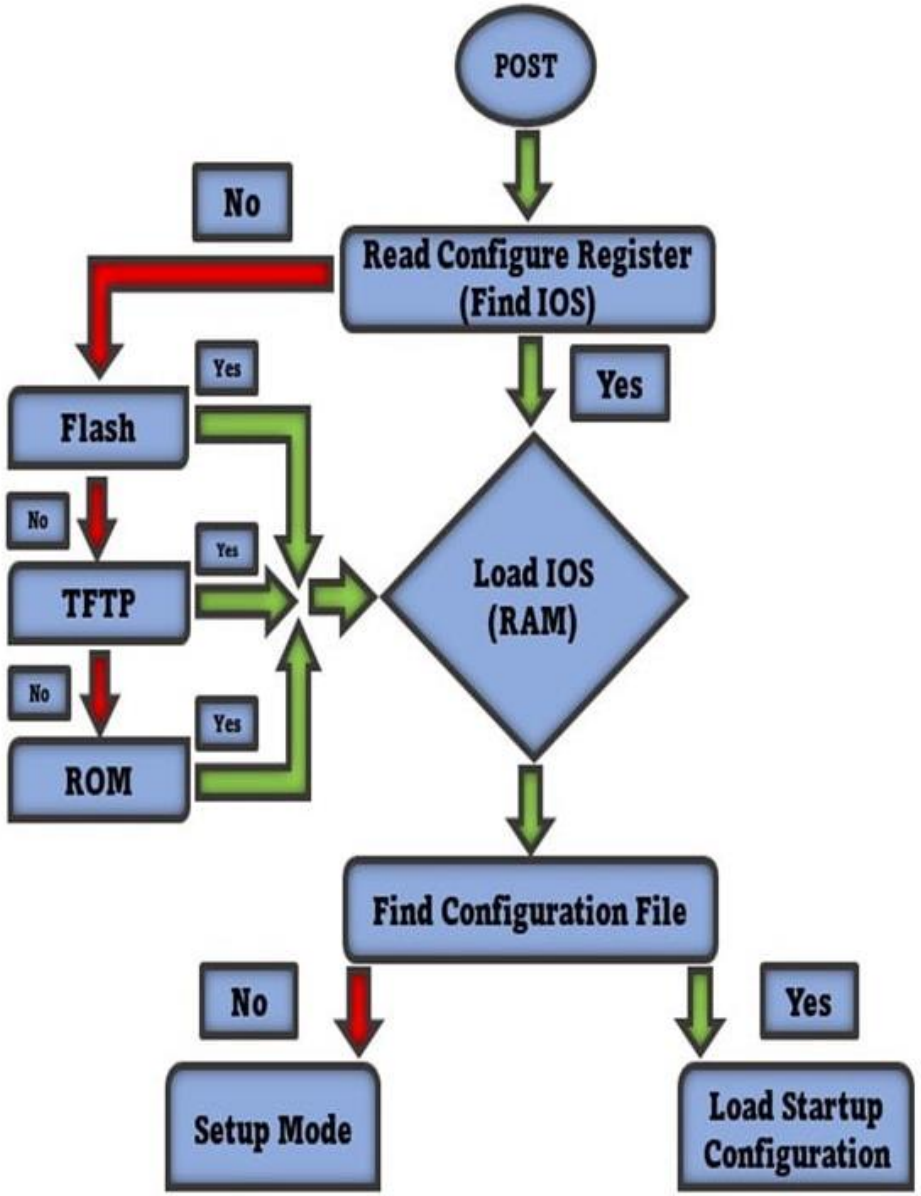
- AKA adaptive Routing
- Here, router adds a new route response to the changes in the condition or topology of network.
- Dynamic protocols are used to discover the new routes to reach the destination.
  - Protocols like RIP & OSPF
- Advantages:
  - Easier to configure.
- Disadvantage:
  - More expensive. Less secure than default & static routing.

THE ROUTER BOOT SEQUENCE



THE ROUTER BOOT SEQUENCE

1. Router is powered on.
2. It performs POST (power on self-test).
3. Bootstrap program is loaded & executed (whenever IOS is found, load it)
4. Bootstrap reads configuration register values & loads the IOS.
5. If bootstrap fails, it will drop boot sequence & then move it to the ROMMON troubleshooting program.
6. If the IOS is loaded, it will try to load the config file.
7. Once the configuration is loaded then CLI interface will be present in front of you.



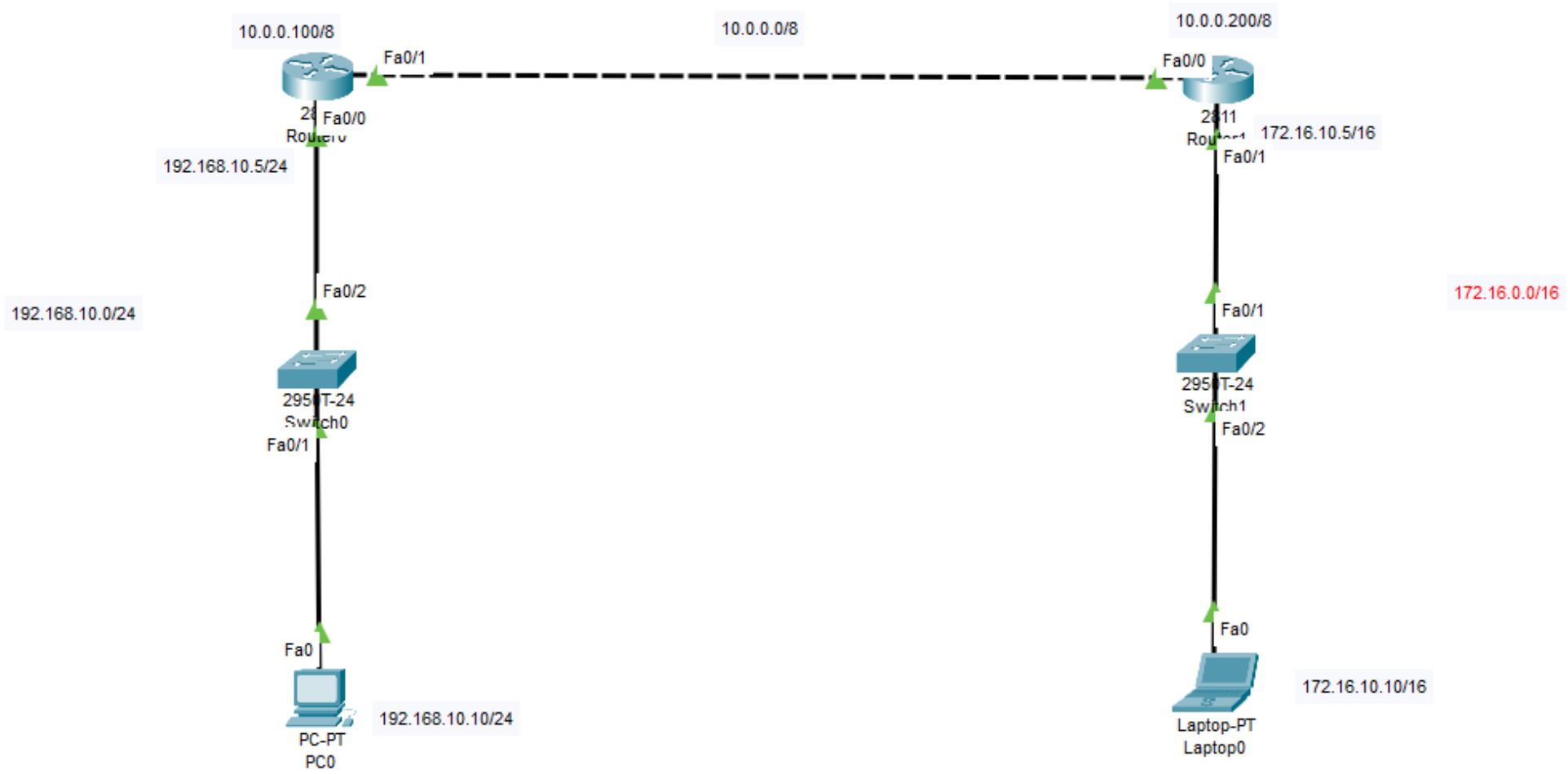
TYPES OF INTERFACES

- Ethernet – physical interface, operates at 10Mbps (IEEE 802.3).
- Fast Ethernet – physical interface, operates at 100Mbps (IEEE 802.3u).
- Gigabit Ethernet – operates at 1000 Mbps (IEEE 802.3ab)
- Serial – used for WAN connections from ISP.
- FDDI – Fiber Distributed Data Interface, 100 Mbps, uses token-passing mech to prevent collisions.
- Token Ring – can operate at either 4 Mbps or 16 Mbps

CISCO DISCOVERY PROTOCOL (CDP)

- CDP is a network discovery tool, which assists network administrators and engineers in identifying neighboring Cisco devices, particularly those running lower-layer (data link layer), transparent protocols.
- It is used to share information about other directly connected Cisco equipment, such as the operating system version and IP address.
- CDP is a Cisco proprietary protocol that is used for collecting directly connected neighbor device information like hardware, software, device name details

STATIC ROUTING



STATIC ROUTING – STEPS

- Add PCs to the environment with IP, subnet & gateway.
- Connect the PC with the switch.
- Connect switch with the router (R1) with default gateway IP address.
- Connect other interface with other network using different IP.
- Enable IP route (via command)
  - Syntax: ip route <network id> <subnet mask><next hop>
    - Router(config)#ip route 172.16.0.0 255.255.0.0 10.0.0.200

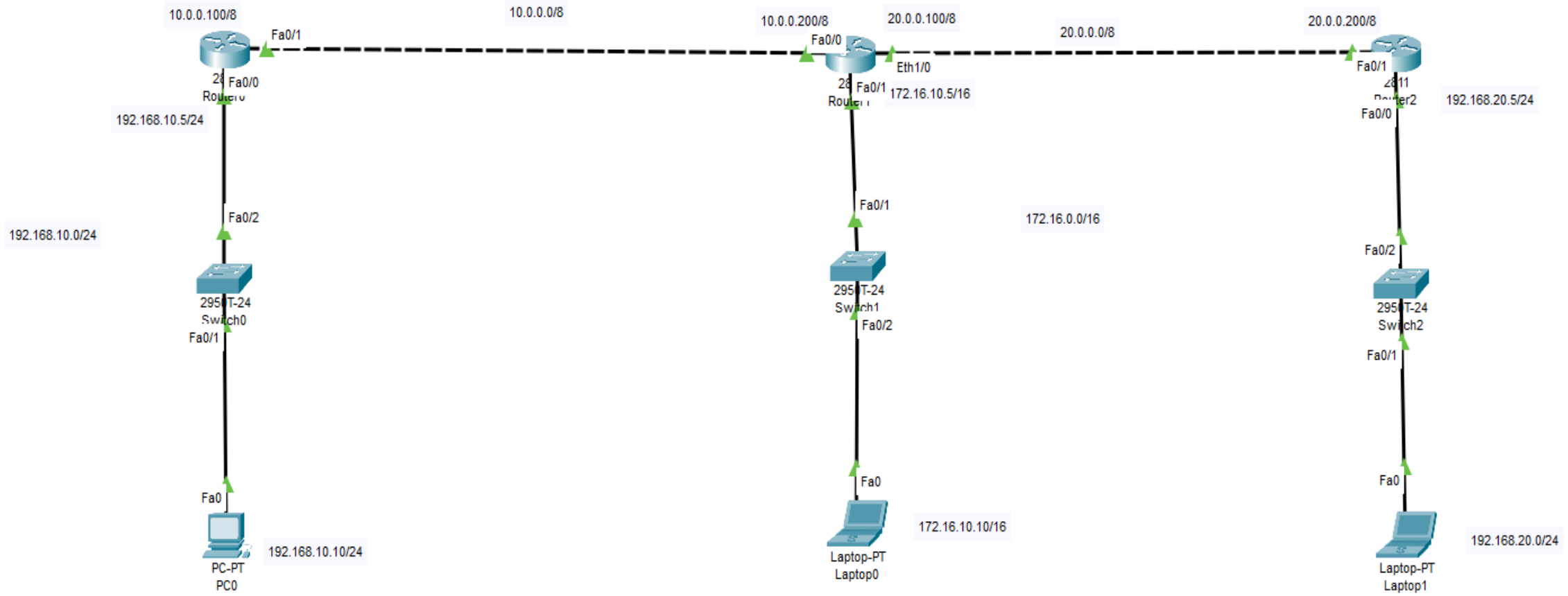
TO LIST ROUTING TABLE

```
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       10.0.0.100/32 is directly connected, FastEthernet0/1
     192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.10.0/24 is directly connected, FastEthernet0/0
L       192.168.10.5/32 is directly connected, FastEthernet0/0
```

TRYING WITH 3 ROUTERS



R1 ROUTE CONFIG

```
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       10.0.0.0/8 is directly connected, FastEthernet0/1
L       10.0.0.100/32 is directly connected, FastEthernet0/1
S    20.0.0.0/8 [1/0] via 10.0.0.200
S    172.16.0.0/16 [1/0] via 10.0.0.200
     192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.10.0/24 is directly connected, FastEthernet0/0
L       192.168.10.5/32 is directly connected, FastEthernet0/0
S    192.168.20.0/24 [1/0] via 10.0.0.200
```

R2 ROUTE CONFIG

```
R2#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, FastEthernet0/0
L       10.0.0.200/32 is directly connected, FastEthernet0/0
     20.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
S       20.0.0.0/8 [1/0] via 20.0.0.200
C       20.0.0.0/24 is directly connected, Ethernet1/0
L       20.0.0.100/32 is directly connected, Ethernet1/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, FastEthernet0/1
L       172.16.10.5/32 is directly connected, FastEthernet0/1
S    192.168.10.0/24 [1/0] via 10.0.0.100
S    192.168.20.0/24 [1/0] via 20.0.0.200
```

R3 ROUTE CONFIG

```
R3#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

     10.0.0.0/24 is subnetted, 1 subnets
S       10.0.0.0/24 [1/0] via 20.0.0.100
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, FastEthernet0/1
L       20.0.0.200/32 is directly connected, FastEthernet0/1
S    172.16.0.0/16 [1/0] via 20.0.0.100
S    192.168.10.0/24 [1/0] via 20.0.0.100
     192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.20.0/24 is directly connected, FastEthernet0/0
L       192.168.20.5/32 is directly connected, FastEthernet0/0
```

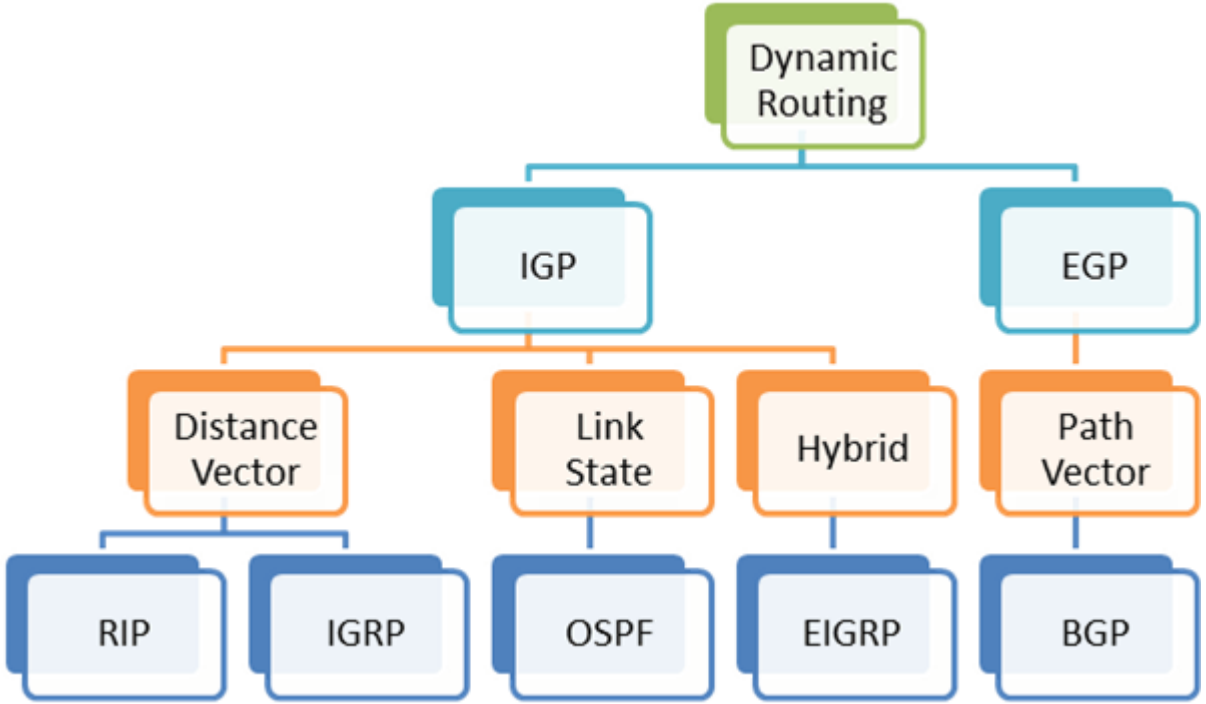
ROUTING TERMINOLOGIES

- Administrative Distance
- Metric
- Hop
- Bandwidth & Delay
- Load & Reliability

DYNAMIC ROUTING

Dynamic routing is the process where routers automatically discover and adapt network paths to optimize data transmission.

Unlike static routing, where paths are manually configured, dynamic routing allows for flexibility and adaptability in complex networks.



INTERIOR GATEWAY PROTOCOL (IGP)

- IGP is used within a single 'autonomous system'.
- An autonomous system is a network or a group of networks under a common administration and with common routing policies.
- Examples of IGPs:
  - RIP (Routing Information Protocol)
  - OSPF (Open Shortest Path First)
  - EIGRP (Enhanced Interior Gateway Routing Protocol)
  - IS-IS (Intermediate System to Intermediate System)

EXTERIOR GATEWAY PROTOCOL (EGP)

- is a type of routing protocol used to exchange routing information between different autonomous systems (ASes) on the internet.
- Autonomous systems are distinct networks or groups of networks under separate administrative control, often managed by different organizations, such as internet service providers (ISPs) or large enterprises.
- Example of EGP:
  - BGP (Border Gateway Protocol)
    - *eBGP (External BGP):* Used to exchange routing information between different ASes.
    - *iBGP (Internal BGP):* Used within an AS to ensure all routers have consistent BGP routing information, even though it's primarily an IGP.

ROUTING INFORMATION PROTOCOL V1

- It has 2 version RIPv1 & RIPv2.
- Open standard protocol – supported in every networking device (like: Cisco, Juniper, etc.)
- Classful routing protocol – subnetting not supported.
- Updates are broadcasted (even to a Non-RIP configured router) via 255.255.255.255.
- Metric based on: Hop count.
- Maximum hops allowed: 15
- Maximum routers allowed: 16 (1+15)
- Supports load balancing.
- Entire routing table is exchanged after every 30seconds.

RIP TIMER

- Update timer
  - Time between consecutive updates.
  - 30 seconds
- Invalid timer
  - Time that router waits to hear updates.
  - The route is marked unreachable if there is no update during this interval.
  - 180 seconds
- Flush timer
  - Time before the invalid route is purged/removed from the routing table.
  - 240 seconds

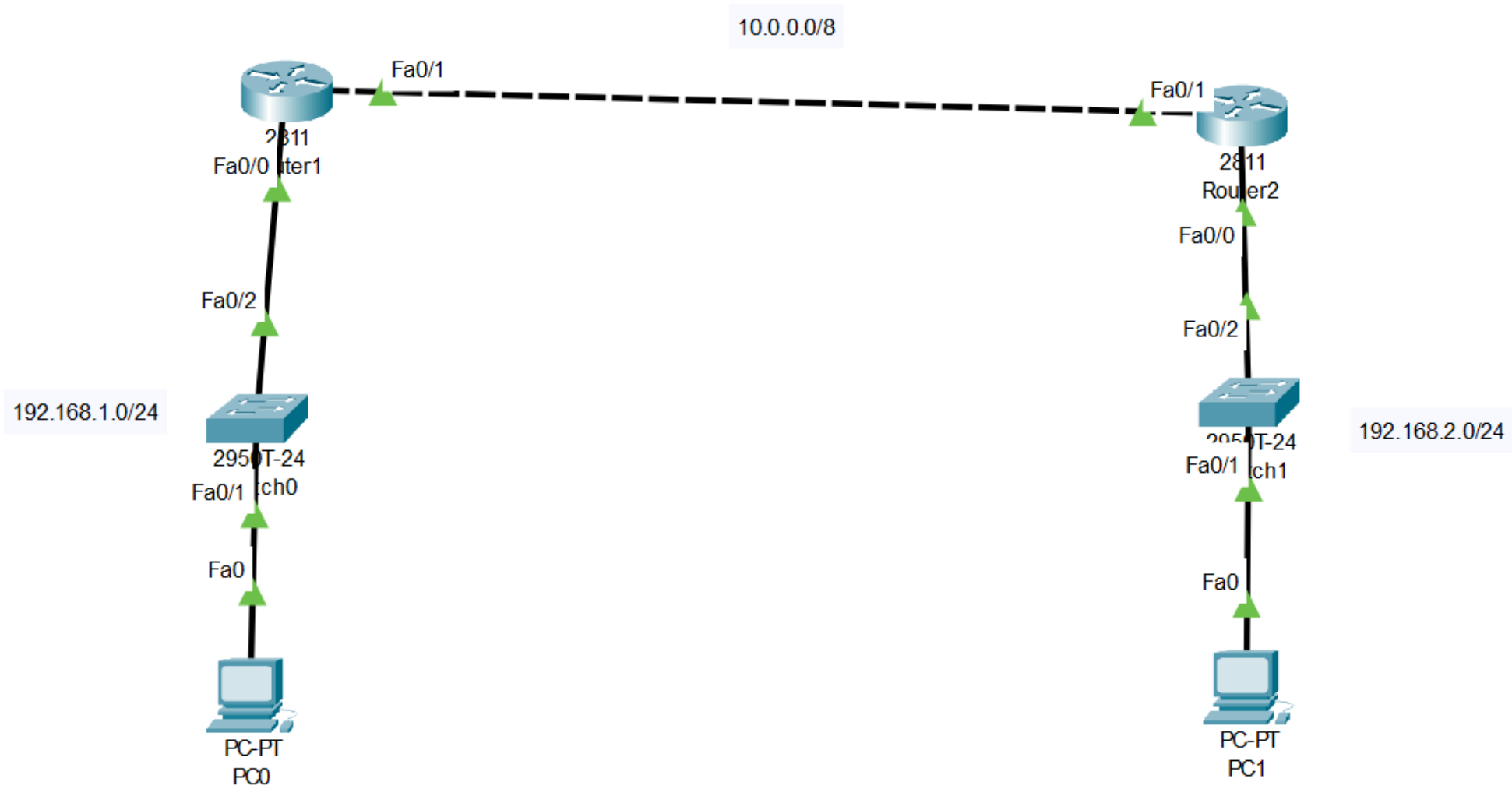
ADVANTAGES & DISADVANTAGES

- Advantages:
  - Easy to configure
  - No design constraints
  - No complexity
  - Less overhead
- Disadvantages:
  - Bandwidth utilization is very high as broadcast for every 30 seconds
  - Works only on hop count.
  - Not scalable as hop count is only 15.

ROUTING INFORMATION PROTOCOL V2

- Similar to RIPv1.
- Supports classless routing protocol.
- Supports VLSM
- Auto summary can be done on every router.
- Supports authentication.
- Trigger updates
- Uses multicast address: 224.0.0.9

CONFIGURING RIP



ROUTER R1 CONFIG

```
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 10.0.0.0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

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

ROUTER R2 CONFIG

```
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 192.168.2.0
Router(config-router)#network 10.0.0.0
Router(config-router)#exit
Router(config)#
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

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

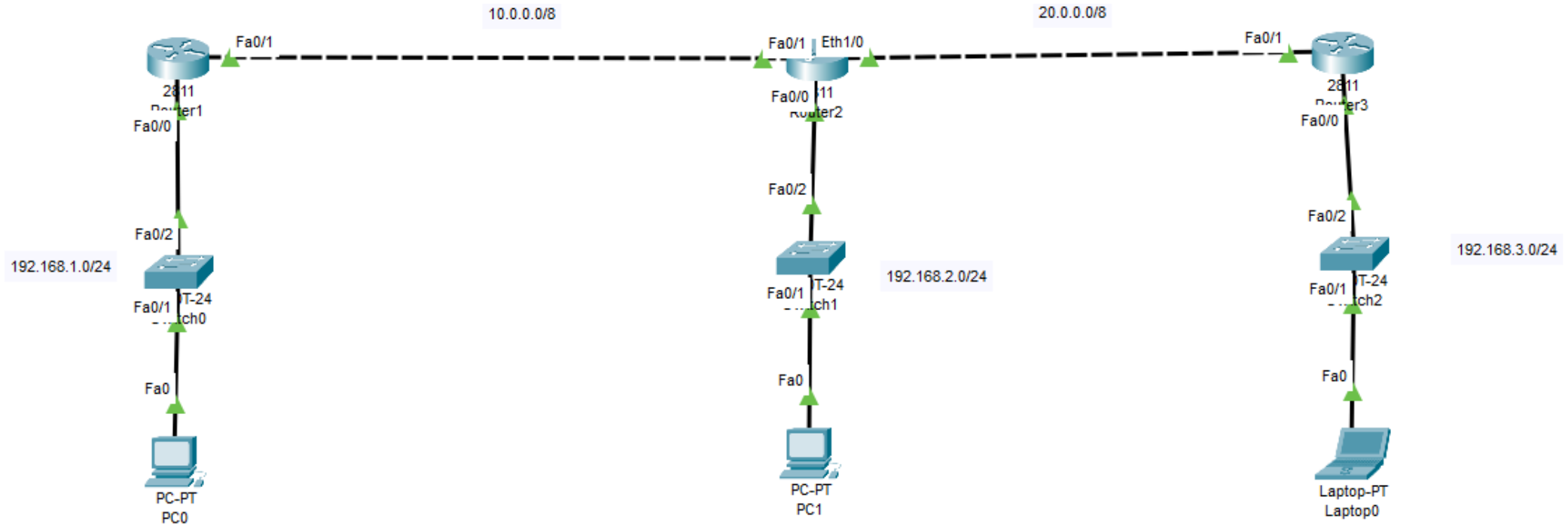
TO LIST ROUTING TABLE – R1

```
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
R    192.168.1.0/24 [120/1] via 10.0.0.1, 00:00:23, FastEthernet0/1
     192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, FastEthernet0/0
L       192.168.2.1/32 is directly connected, FastEthernet0/0
```

3 ROUTERS RIP CONFIG



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.

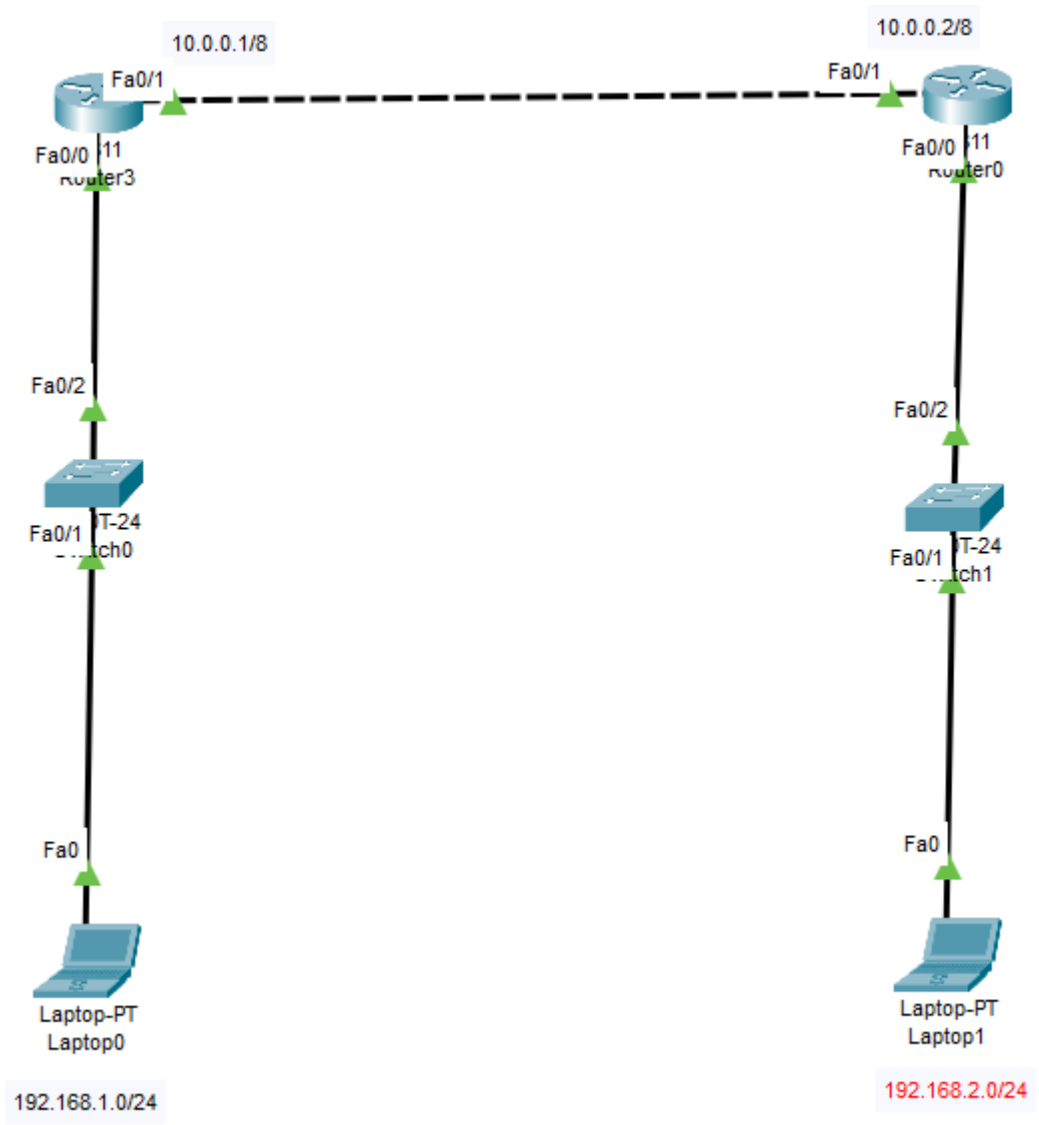
EIGRP

- 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

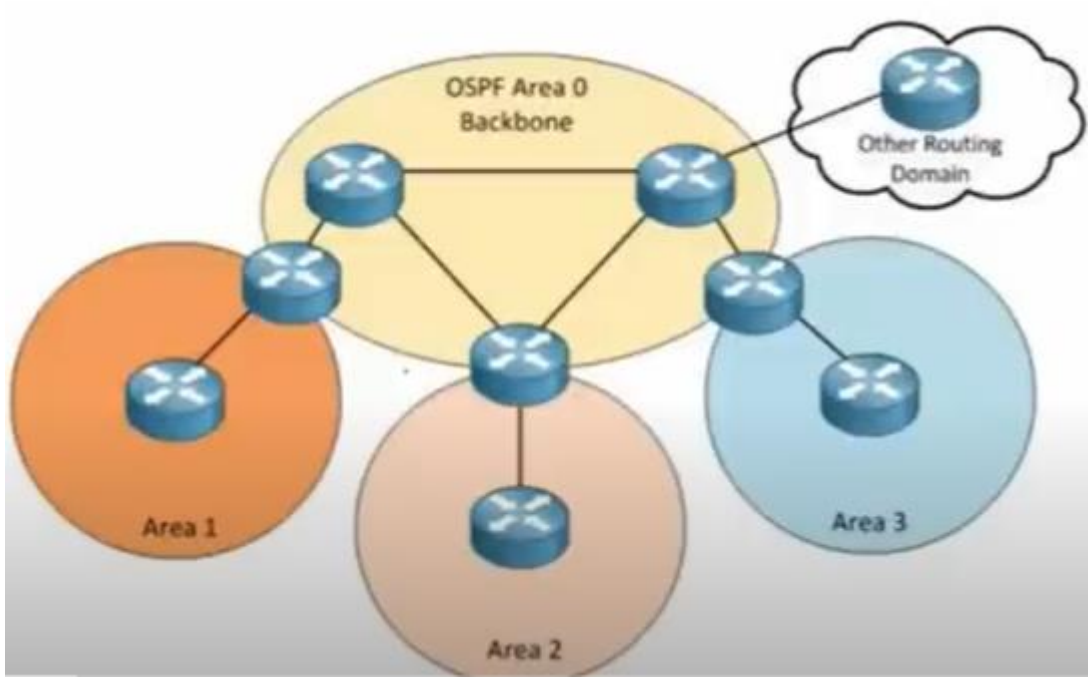
- Open Shortest Path First.
- Widely used protocol.
- It is an Interior Gateway protocol (IGP).
- It is a Link-state routing protocol.
- After all the routers are connected to each other, all routers have same information about the network.
- It sends LSA (Link State Advertisements), to get the information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

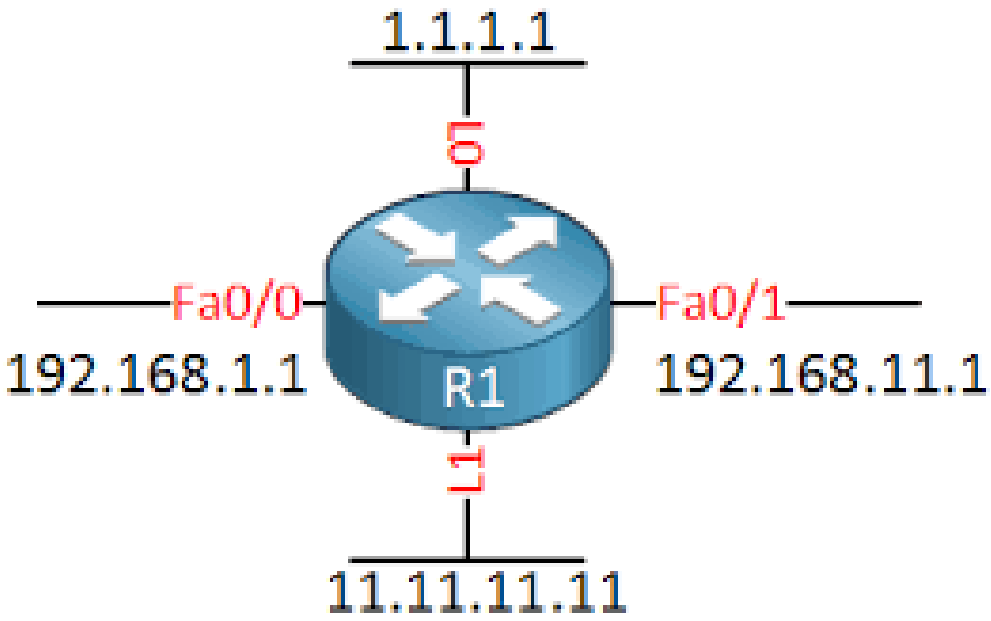
OSPF

- 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)

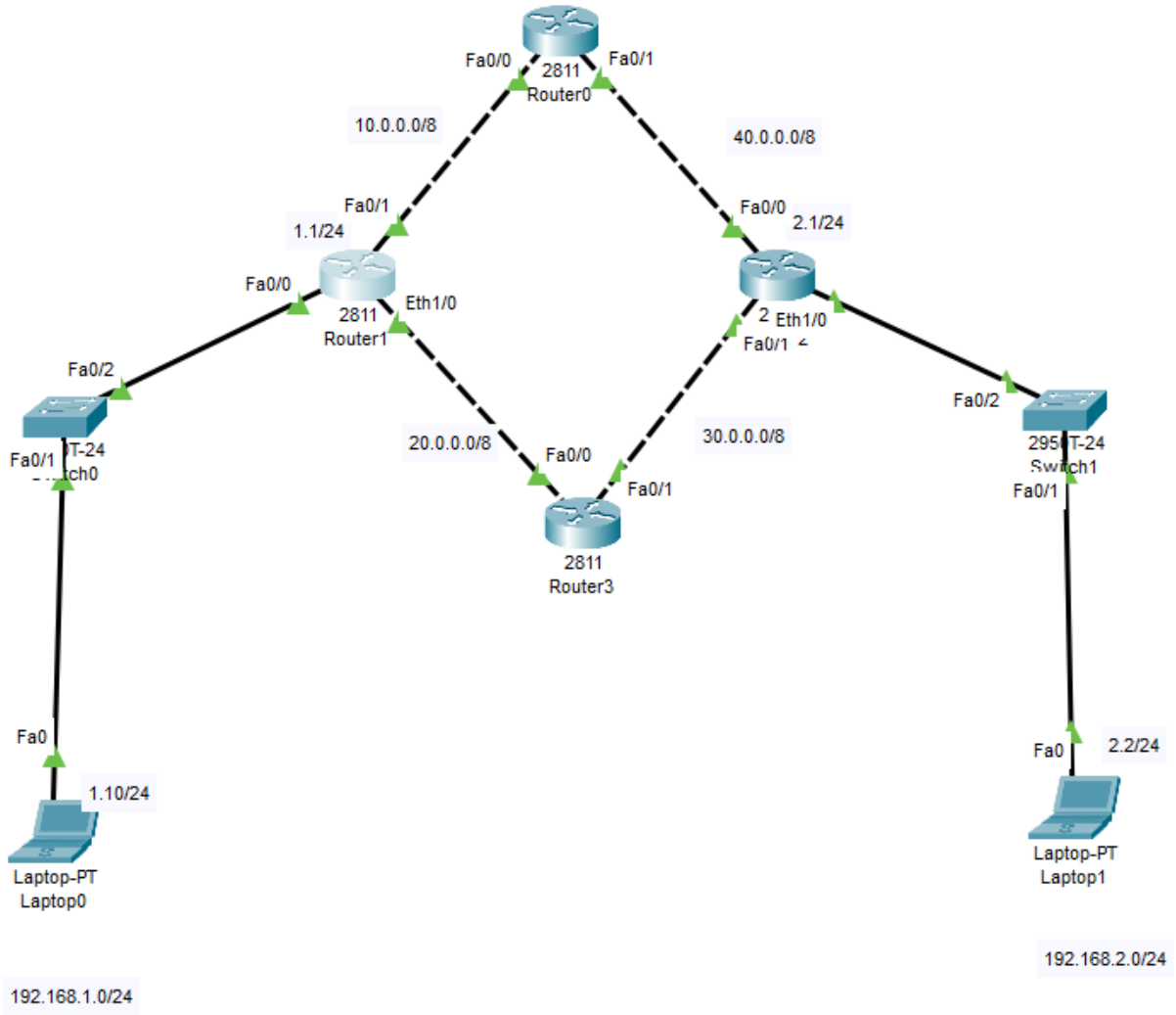
255.255.255.255 – 255.255.255.128 = 0.0.0.127

SYNTAX OF OSPF COMMAND

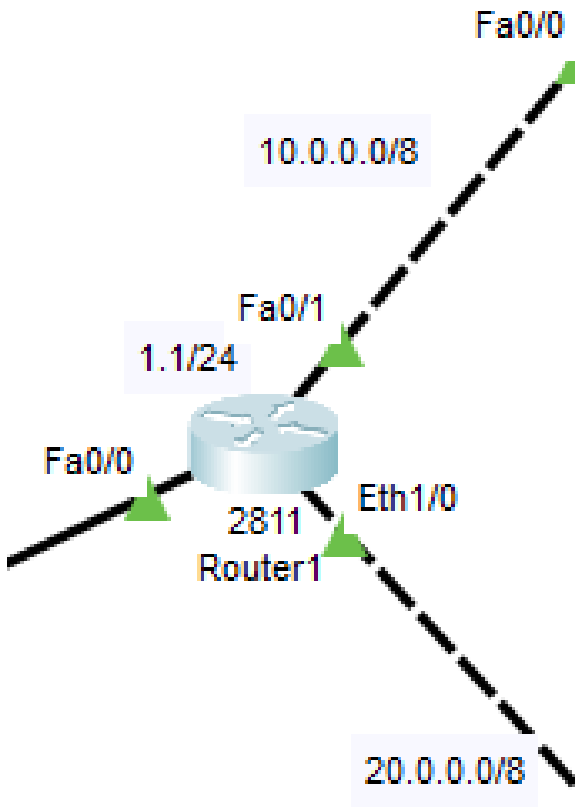
```
Router(config)#route
Router(config)#router ospf 1
Router(config-router)#net
Router(config-router)#network 192.168.10.0 0.0.0.255
Router(config-router)#network 192.168.10.0 0.0.0.255 area 0
Router(config-router)#
```

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

OSPF

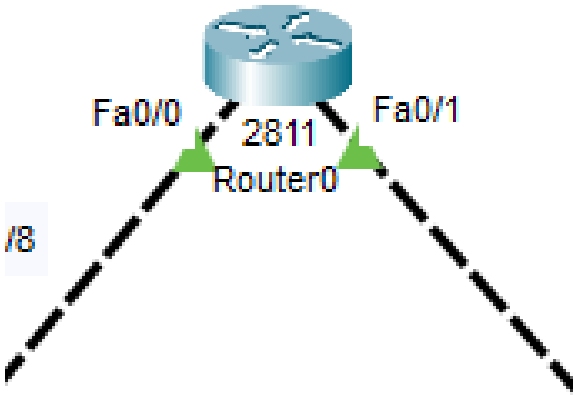

Fa0/0
2811
Router0
Fa0/1
10.0.0.0/8
40.0.0.0/8
Fa0/1
1.1/24
Fa0/0
2.1/24
Fa0/0
2811
Router1
Eth1/0
Eth1/0
Fa0/2
Fa0/2
20.0.0.0/8
30.0.0.0/8
Fa0/0
Fa0/1
Fa0/1
2811
Router3
Fa0
Fa0
2.2/24
1.10/24
Laptop-PT
Laptop0
Laptop-PT
Laptop1
192.168.1.0/24
192.168.2.0/24

OSPF CONFIGURATION ON ROUTER R1



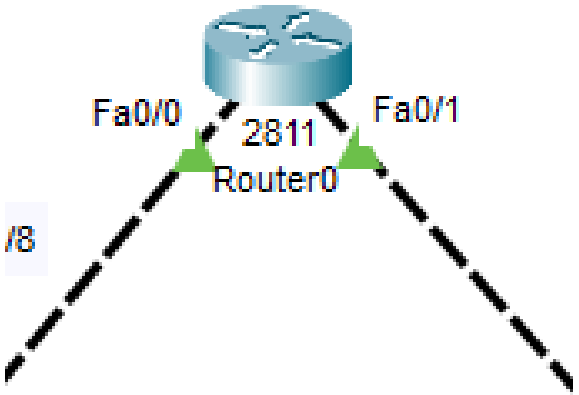

```
Router>en
Router>enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#rou
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#netwo
Router(config-router)#network 192.168.1.0 0.255.255.255 ar
Router(config-router)#network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



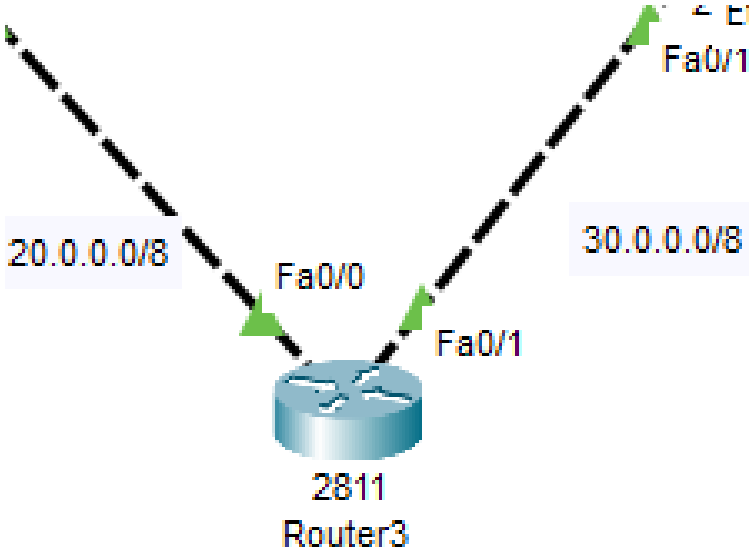

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20
00:17:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 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



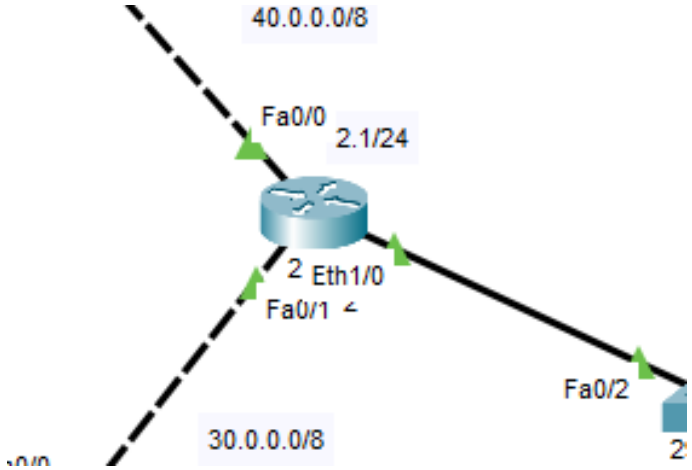

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#route
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20
00:17:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 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)#
```

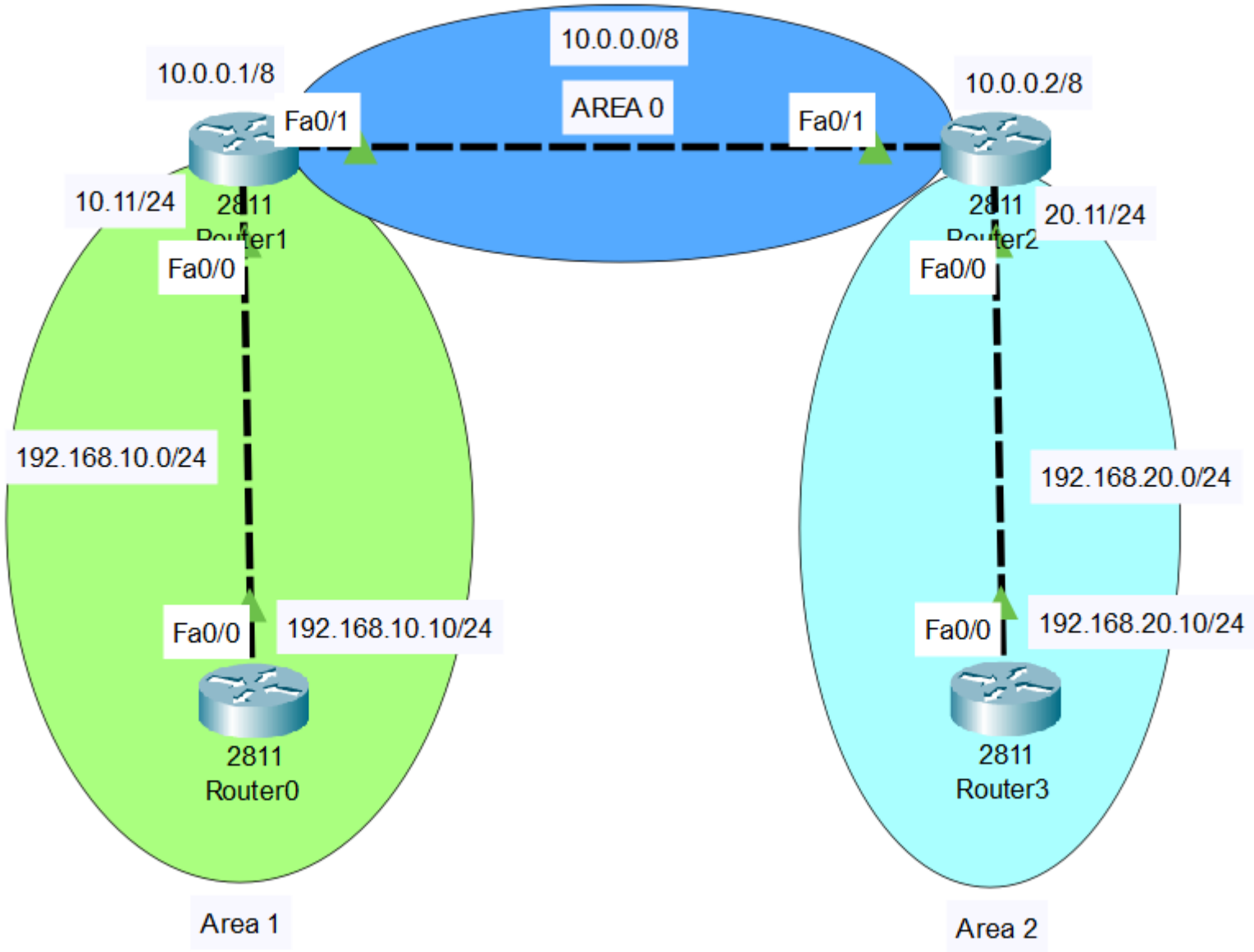
OSPF CONFIGURATION ON ROUTER R2




```
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

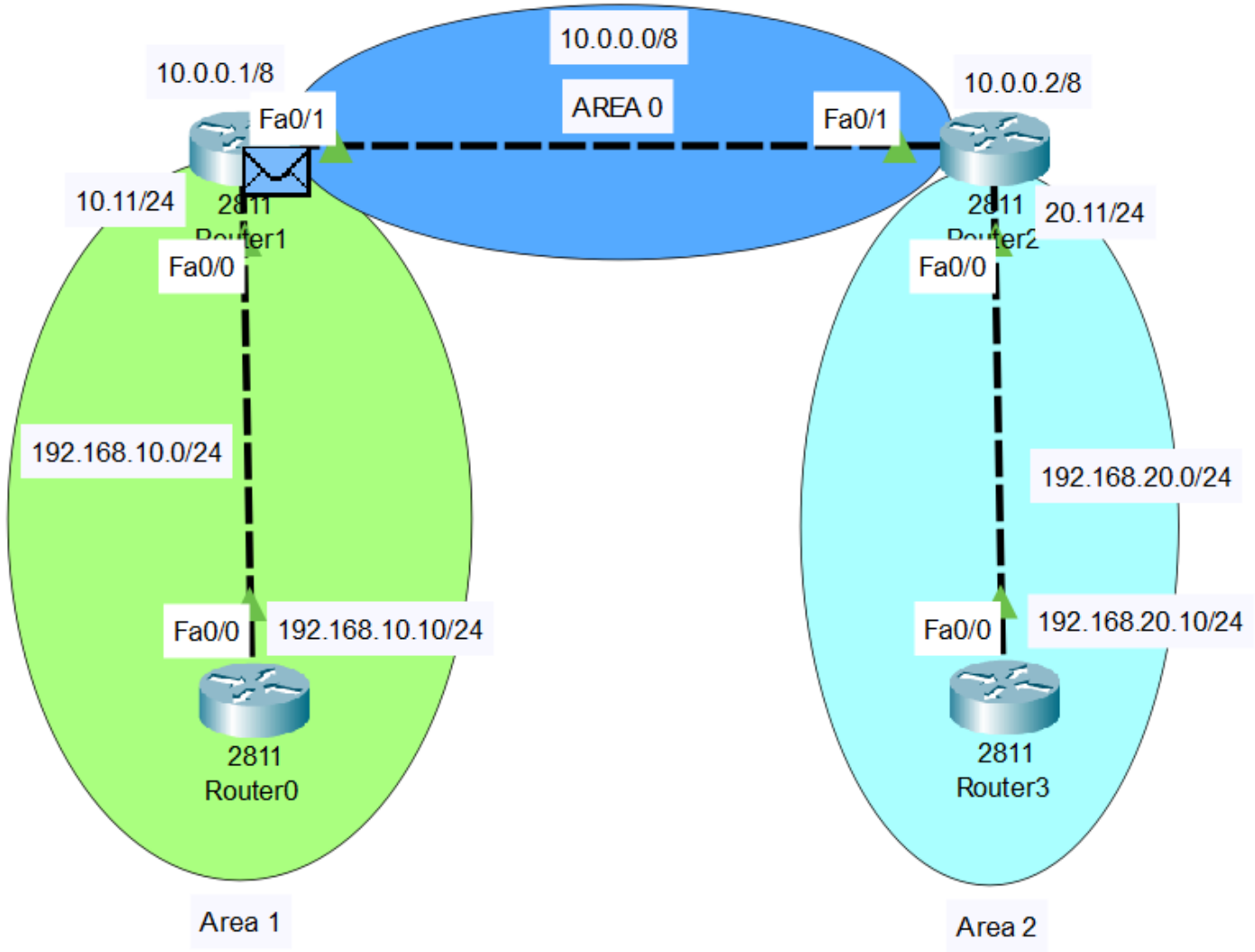
Router 2

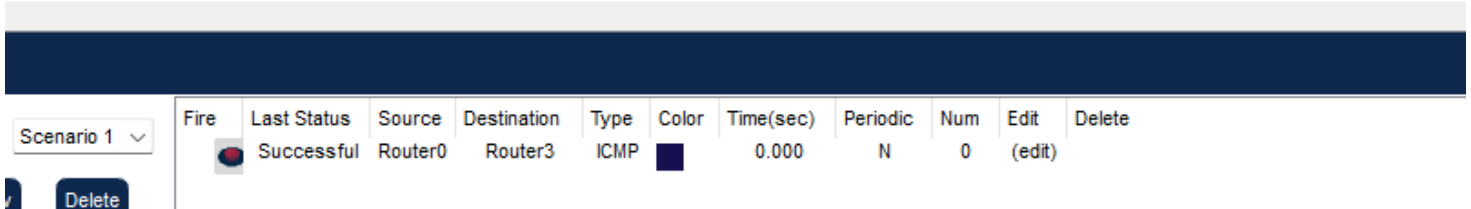
```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router os
Router(config)#router ospf 1
Router(config-router)#network 192.168.20.0 0.0.0.255 area 2
Router(config-router)#
```

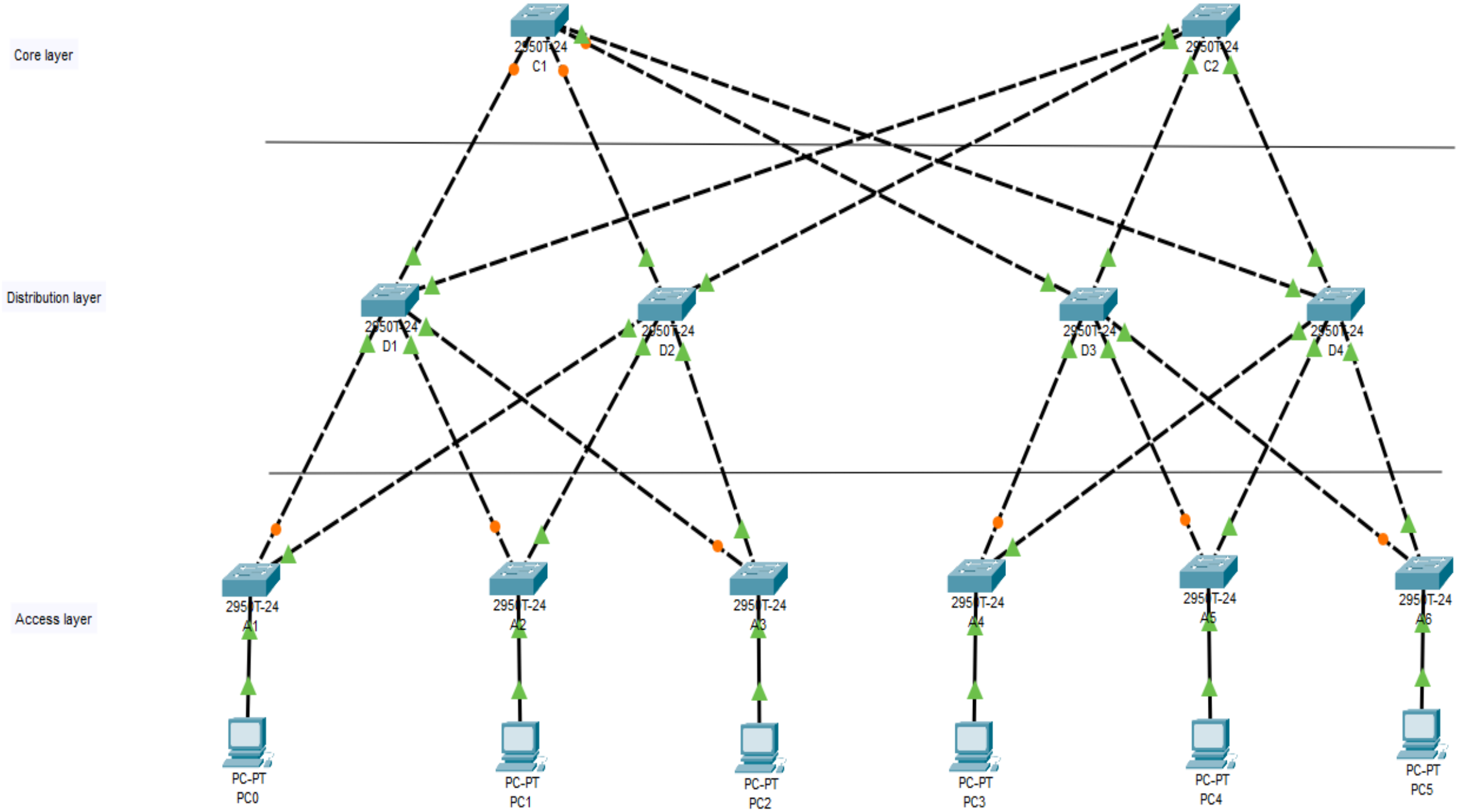
Router 3

```
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



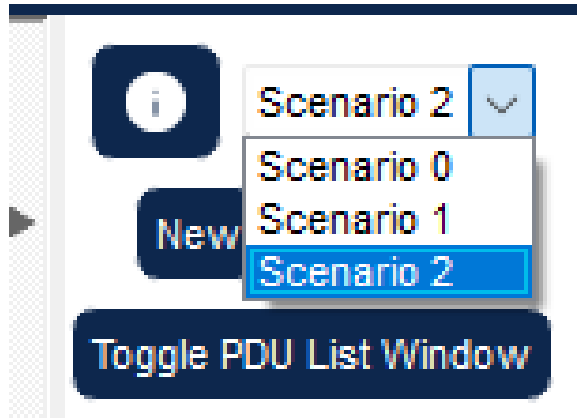



Core layer
Distribution layer
Access layer
2950T-24
C1
2950T-24
C2
2950T-24
D1
2950T-24
D2
2950T-24
D3
2950T-24
D4
2950T-24
A1
2950T-24
A2
2950T-24
A3
2950T-24
A4
2950T-24
A5
2950T-24
A6
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3
PC-PT
PC4
PC-PT
PC5

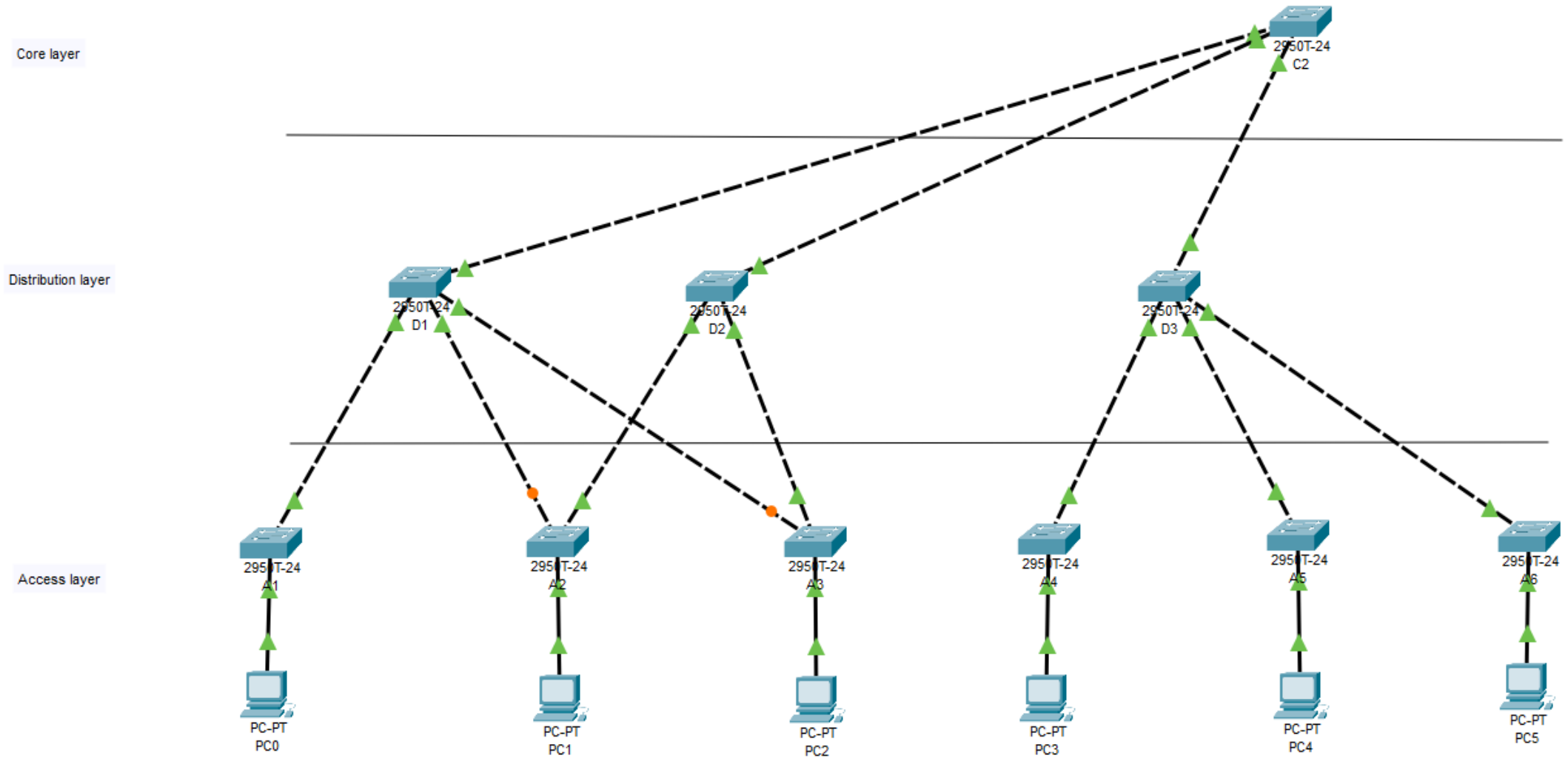
TASK

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.

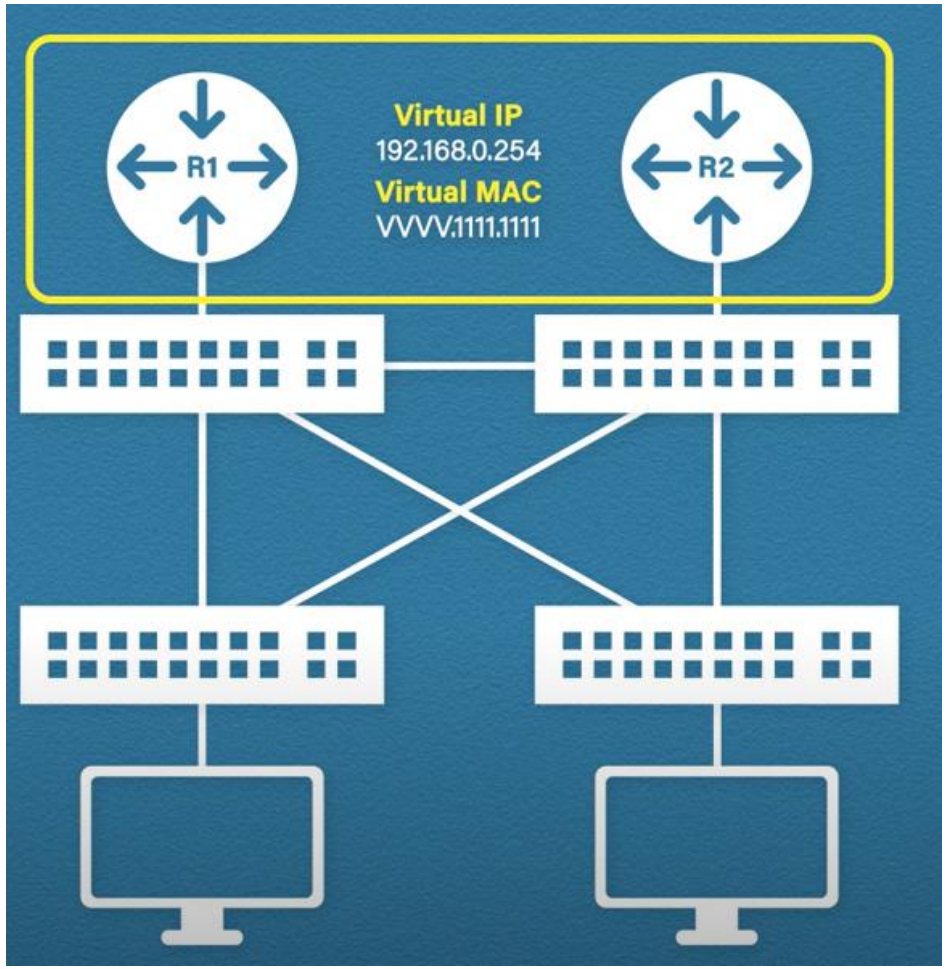


FINAL OUTPUT



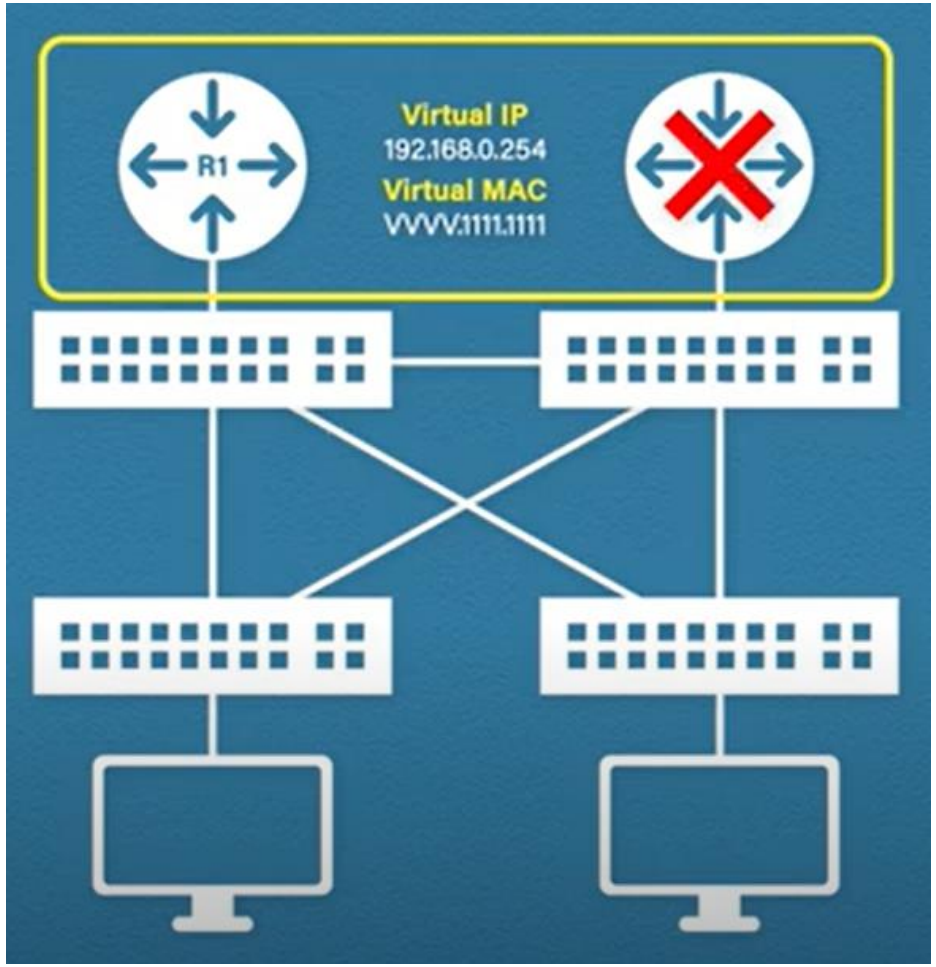
FIRST HOP REDUNDANCY PROTOCOL

- Ensures network availability by providing redundancy for the default gateway (first hop) in case of a failure.
- FHRP allows multiple routers to share a virtual IP address that acts as the default gateway for hosts on a subnet.
- If the primary gateway fails, the backup router automatically takes over, minimizing downtime.



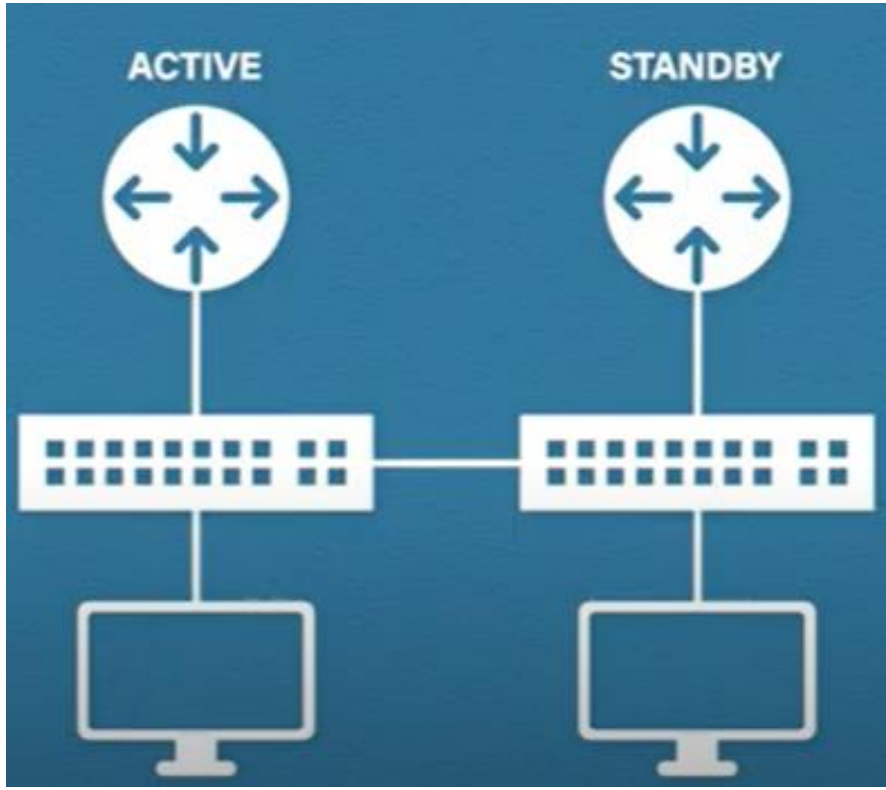
FIRST HOP REDUNDANCY PROTOCOL

- Common FHRPs:
  - HSRP
    - Hot Standby Router Protocol
    - Cisco proprietary, uses an active and standby router model.
  - VRRP
    - Virtual Router Redundancy Protocol
    - Open standard, similar to HSRP but with differences in election process and IP address usage.
  - GLBP
    - Gateway Load Balancing Protocol
    - Cisco proprietary, supports load balancing by allowing multiple active routers.



HOT STANDBY ROUTER PROTOCOL

- HSRP multicast sends & receives multicast UDP hello packets every 3 seconds.
  - In Version 1, it uses 224.0.0.2 &
  - In Version 2, it uses 224.0.0.102
- Virtual IP add is set for the group's default gateway.
- Active router election
  1. Highest priority
  2. Highest IP address

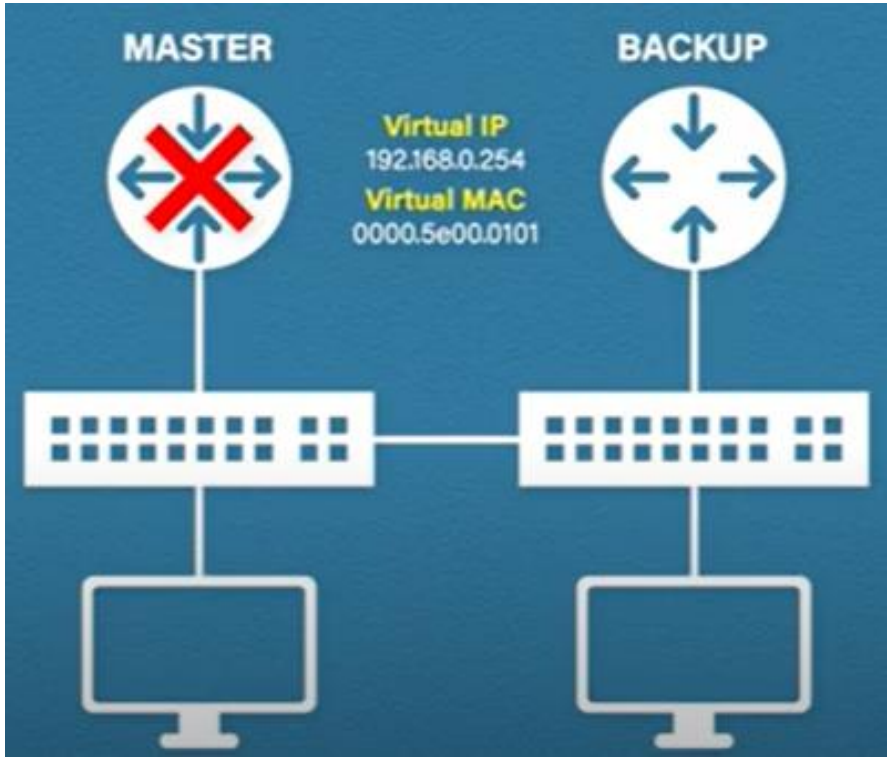


HOT STANDBY ROUTER PROTOCOL

- Router sends “Hello” packet after every 3 seconds.
- If any router fails, it “holds” for 10 seconds.
- If no response till the hold time, then standby/passive announces itself as the “active” router and send the information to network to update the MAC address table.
- If master (old) comes online, it will not replace the new master by default.

VIRTUAL ROUTER REDUNDANCY PROTOCOL

- Here we have concept of Master router & Backup router.
- Here, any 1 router will be assigned with a 'virtual IP', this makes this router as "IP address owner".
- Master router election happens on the priority of:
  1. IP Address Owner
  2. Highest Priority
  3. Highest IP Address



VIRTUAL ROUTER REDUNDANCY PROTOCOL

- Unlike HSRP, the messages within the network is only sent by “master router”.
- Master router sends the multicast packets to address: 224.0.0.18
- The advertisements are sent every 1 second by default.
- It (master) has a downtime of 3 seconds.
  - & then “backup” router will assume the role of “master” router & announces itself to the network.
- If the master (old) router comes online again, it will “takeover” as master router once again.

GATEWAY LOAD BALANCING PROTOCOL

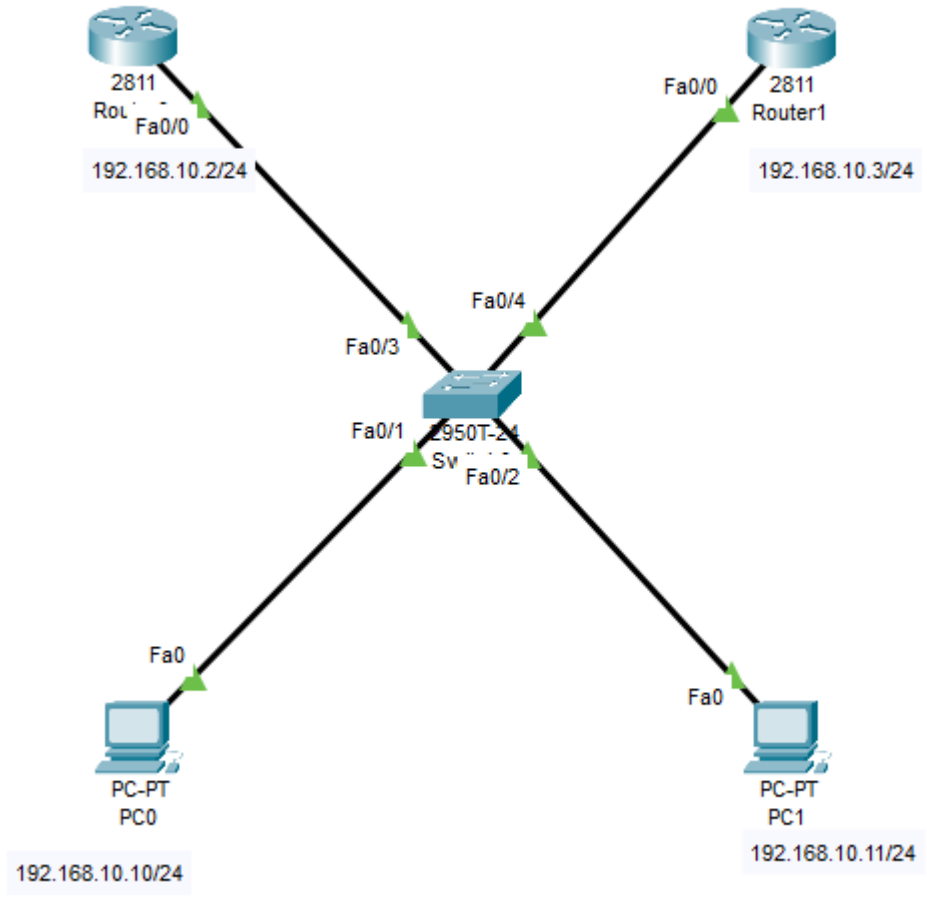
- GLBP is similar to HSRP, as it's a Cisco proprietary.
- Like HSRP, each router will send "hello" message to the network after every 3 seconds.
- It uses multicast address: 224.0.0.102
- & UDP port: 3222
- Active router election is similar to HSRP
- In GLBP, it assigns 'virtual MAC' address to each router.

FHRP TABLE FOR EXAM

	Standard	Router roles	Multicast address	MAC address	No. of virtual MAC address
HSRP	Cisco proprietary	Active/Standby	224.0.0.2 224.1.1.102	000.0C07.ACXX	ONE
VRRP	RFC 5798 (open standard)	Master/Backup	224.0.0.18	0000.5e00.01XX	ONE
GLBP	Cisco proprietary	Active/Standby	224.0.0.102	0007.b400.XXYY	Four (shared)

HOT STANDBY ROUTER PROTOCOL

- PC0 = 192.168.10.10/24
- DGW(PC0) = 192.168.10.1
- PC1 = 192.168.10.11/24
- DGW (PC1) = 192.168.10.1
- Router0 = 192.168.10.2/24
- Router1 = 192.168.10.3/24



HSRP CONFIGURATION – ROUTER 1

```
Router(config)#int fastEthernet 0/0
Router(config-if)#
Router(config-if)#standby ?
  <0-4095>  group number
  ip        Enable HSRP and set the virtual IP address
  ipv6      Enable HSRP IPv6
```

```
Router(config-if)#standby 1 ?
  ip        Enable HSRP and set the virtual IP address
  ipv6      Enable HSRP IPv6
  preempt   Overthrow lower priority Active routers
  priority  Priority level
  timers    Hello and hold timers
  track     Priority Tracking
Router(config-if)#standby 1 ip 192.168.10.1
```

```
Router(config-if)#do sh standby br
                    P indicates configured to preempt.
                    |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0       1    100   Active  local           unknown         192.168.10.1
Router(config-if)#
```

HSRP CONFIGURATION – ROUTER 1

```
Router(config-if)#do sh standby
FastEthernet0/0 - Group 1
  State is Active
    4 state changes, last state change 00:10:54
  Virtual IP address is 192.168.10.1
  Active virtual MAC address is 0000.0C07.AC01
    Local virtual MAC address is 0000.0C07.AC01 (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.132 secs
  Preemption disabled
  Active router is local
  Standby router is unknown
  Priority 100 (default 100)
  Group name is hsrp-Fa0/0-1 (default)
Router(config-if)#
```

HSRP CONFIGURATION – ROUTER 0

```
Active(config-if)#standby 1 ip 192.168.10.1
% Warning: address is not within a subnet on this interface
Active(config-if)#
Active(config-if)#do sh standby br
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Speak -> Standby

                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0       1    100   Standby  192.168.10.3    local           192.168.10.1
Active(config-if)#
Active(config-if)#standby 1 ip 192.168.10.1
% Warning: address is not within a subnet on this interface
Active(config-if)#
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Speak -> Standby

Active(config-if)#
Active(config-if)#
```

HSRP CONFIGURATION – CHANGING PRIORITY

By changing priority, stand by router becomes active.

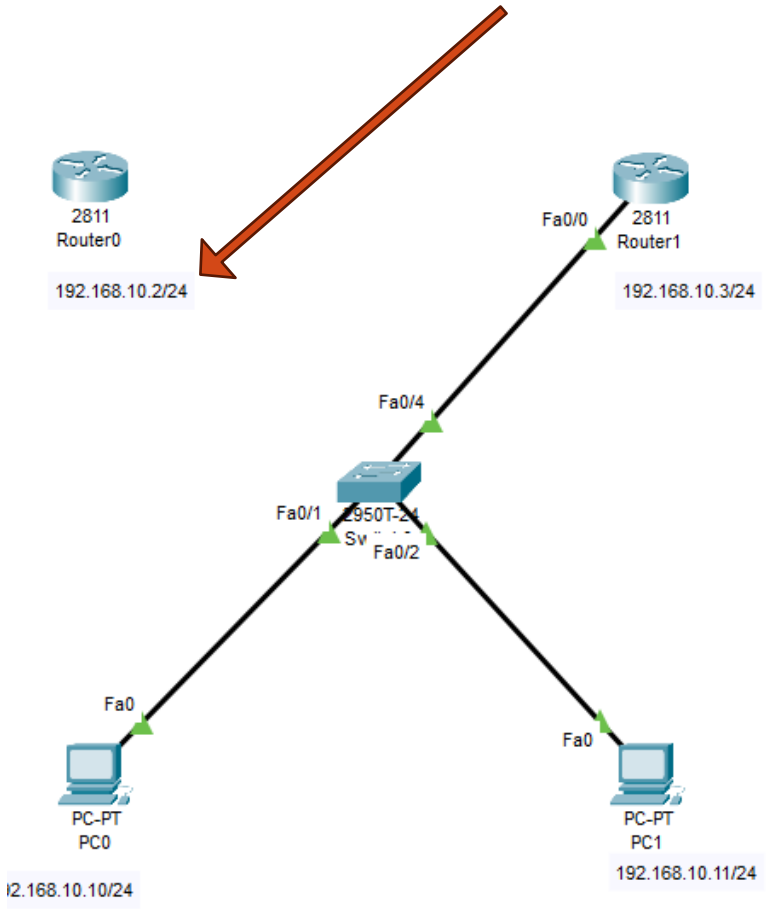
```
Active(config-if)#standby 1 pri
Active(config-if)#standby 1 priority 105
Active(config-if)#do sh standby br
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0       1    105   Standby  192.168.10.3    local           192.168.10.1
Active(config-if)#
Active(config-if)#standby 1 pree
Active(config-if)#standby 1 preempt
Active(config-if)#
 %HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Standby -> Active

Active(config-if)#do sh standby br
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Fa0/0       1    105 P Active  local           192.168.1.2     192.168.10.1
```

forcefully changing the router mode.

HSRP CONFIGURATION – DELETE ROUTER 0

Just delete the link for the active & wait for 3 seconds. & verify on Router1



Router1

Physical Config CLI Attributes

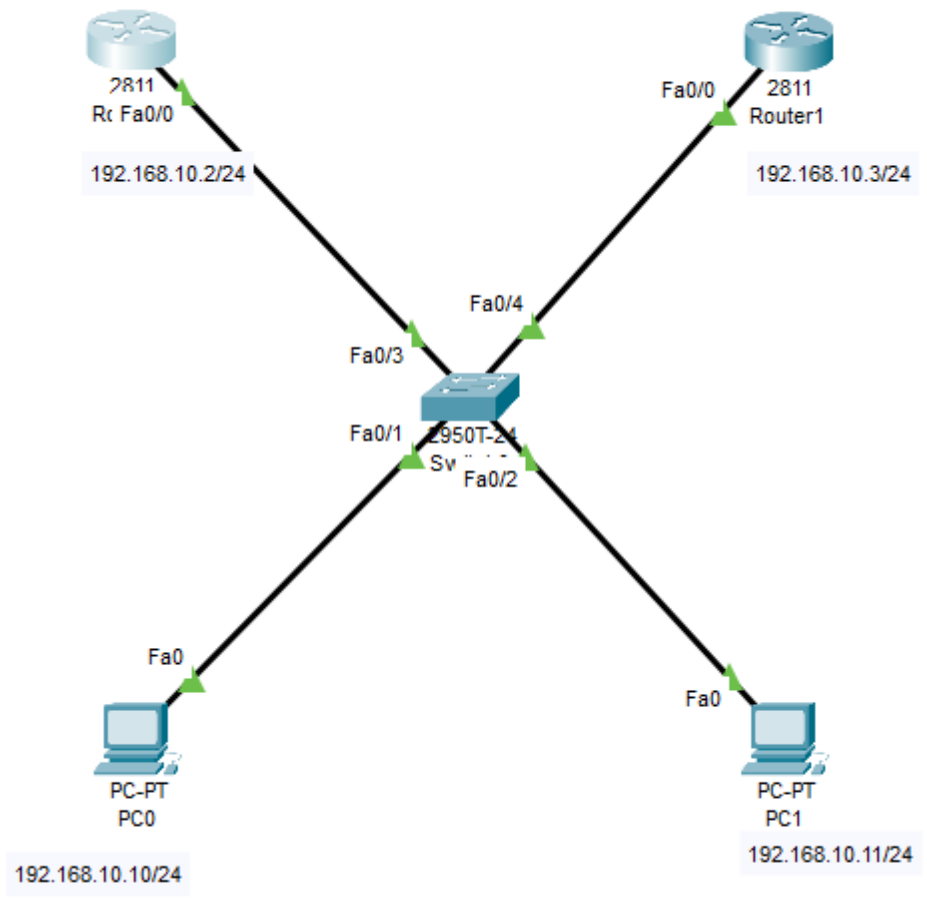
IOS Command Line Interface

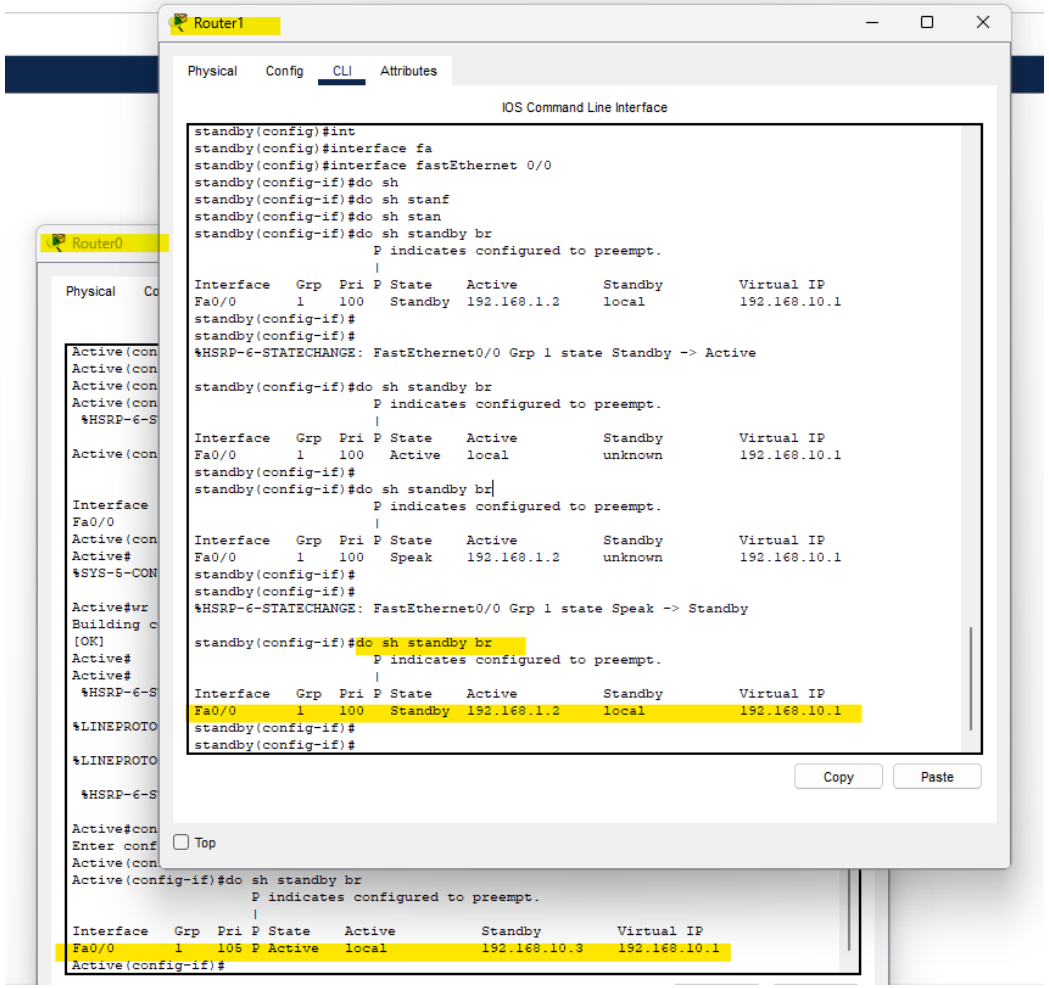
```
Router(config)#
Router(config)#host
Router(config)#hostname standby
standby(config)#
standby(config)#^Z
standby#
%SYS-5-CONFIG_I: Configured from console by console

standby#wr
Building configuration...
[OK]
standby#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
standby(config)#
standby(config)#do sh st
standby(config)#do sh stand
standby(config)#int
standby(config)#interface fa
standby(config)#interface fastEthernet 0/0
standby(config-if)#do sh
standby(config-if)#do sh stanf
standby(config-if)#do sh stan
standby(config-if)#do sh standby br
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       1    100   Standby  192.168.1.2     local           192.168.10.1
standby(config-if)#
standby(config-if)#
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 1 state Standby -> Active

standby(config-if)#do sh standby br
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       1    100   Active   local           unknown         192.168.10.1
standby(config-if)#
```

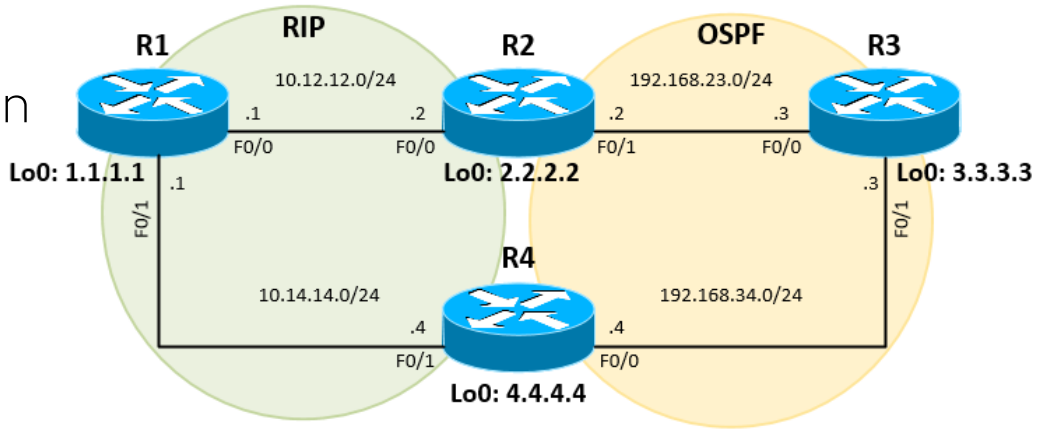
HSRP CONFIGURATION – REACTIVATION OF R0





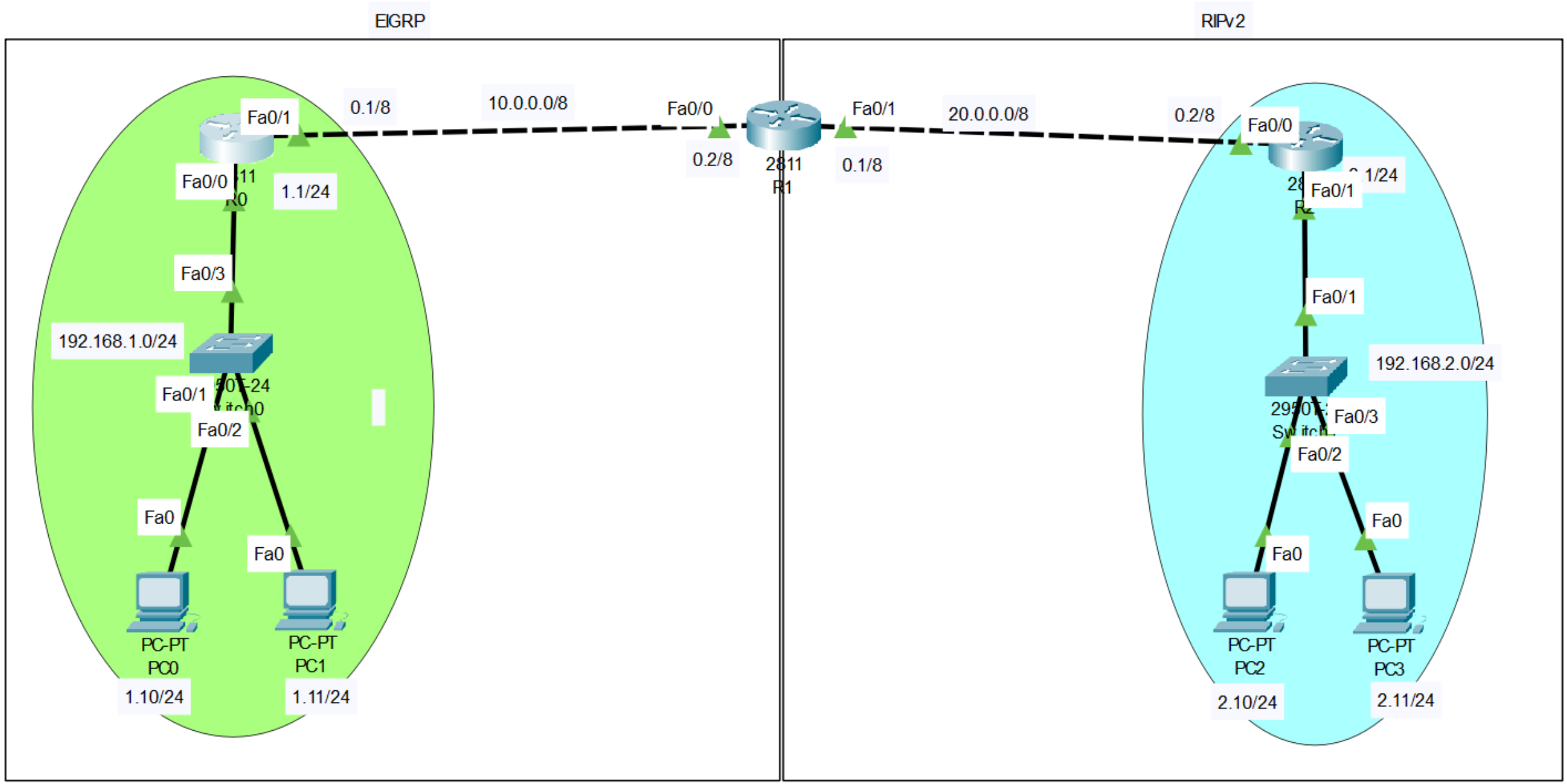
REDISTRIBUTION

- Redistribution involves sharing routes between different routing protocols, allowing for interoperation in complex network environments.



- Redistribution can occur between various routing protocols like OSPF, EIGRP, BGP, RIP, and others.
- Redistribution can be one-way (routes from one protocol are redistributed into another) or two-way (routes are shared between both protocols).
- When redistributing routes, metric values must be converted appropriately to match the receiving protocol's metric type (e.g., cost, hop count).
- Redistribution can lead to routing loops if not configured carefully, especially with two-way redistribution.

REDISTRIBUTION ON EIGRP & RIP



CONFIGURING EIGRP ON R0

```
R0#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R0(config)#
R0(config)#rout
R0(config)#router eigrp 13
R0(config-router)#network 192.168.1.0
R0(config-router)#network 10.0.0.0
R0(config-router)#no auto-su
R0(config-router)#no auto-summary
R0(config-router)#exit
```

```
R0#show ip protocols

Routing Protocol is "eigrp  13 "
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  Redistributing: eigrp 13
```

CONFIGURING EIGRP ON R1

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router ei
R1(config)#router eigrp 13
R1(config-router)#network 10.0.0.0
R1(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 13: Neighbor 10.0.0.1 (FastEthernet0/0) is up: new adjacency

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

R1#show ip eigrp nei
R1#show ip eigrp neighbors
IP-EIGRP neighbors for process 13
H   Address         Interface       Hold Uptime    SRTT    RTO   Q   Seq
                                    (sec)          (ms)        Cnt Num
0   10.0.0.1        Fa0/0           13   00:00:26  40      1000  0   1

R1#
```

CONFIGURING RIP ON R1

```
R1#conf t
R1#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#no auto-sum
R1(config-router)#no auto-summary
R1(config-router)#network 20.0.0.0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#
```

CONFIGURING RIP ON R2

```
R2>en
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#
R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#no auto-summary
R2(config-router)#network 20.0.0.0
R2(config-router)#network 192.168.2.0
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#
```

CONFIGURING REDISTRIBUTION ON R1

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router eigrp 13
R1(config-router)#res
R1(config-router)#red
R1(config-router)#redistribute rip ?
  metric  Metric for redistributed routes
  <cr>
R1(config-router)#redistribute rip met
R1(config-router)#redistribute rip metric ?
  <1-4294967295>  Bandwidth metric in Kbits per second
R1(config-router)#redistribute rip metric 1 ?
  <0-4294967295>  EIGRP delay metric, in 10 microsecond units
R1(config-router)#redistribute rip metric 1 1 ?
  <0-255>  EIGRP reliability metric where 255 is 100% reliable
R1(config-router)#redistribute rip metric 1 1 255 ?
  <1-255>  EIGRP Effective bandwidth metric (Loading) where 255 is 100% loaded
R1(config-router)#redistribute rip metric 1 1 255 255 ?
  <1-65535>  EIGRP MTU of the path
R1(config-router)#redistribute rip metric 1 1 255 255 1
R1(config-router)#exit
R1(config)#
```

Metric value: **“Bandwidth” + “Delay” + “Load” + “MTU” + “Reliability”**

VALIDATING ROUTES ON R0

```
R0#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       10.0.0.1/32 is directly connected, FastEthernet0/1
D EX 20.0.0.0/8 [170/2560002816] via 10.0.0.2, 00:03:00, FastEthernet0/1
     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, FastEthernet0/0
L       192.168.1.1/32 is directly connected, FastEthernet0/0
D EX 192.168.2.0/24 [170/2560002816] via 10.0.0.2, 00:03:00, FastEthernet0/1
```

CONFIGURING EIGRP UNDER RIP ON R1

```
R1(config)#router rip
R1(config-router)#red
R1(config-router)#redistribute ei
R1(config-router)#redistribute eigrp 13 me
R1(config-router)#redistribute eigrp 13 metric ?
  <0-16>       Default metric
  transparent  Transparently redistribute metric
R1(config-router)#redistribute eigrp 13 metric 1
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#sho
R1#show ip rou
R1#show ip 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, FastEthernet0/0
L       10.0.0.2/32 is directly connected, FastEthernet0/0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, FastEthernet0/1
L       20.0.0.1/32 is directly connected, FastEthernet0/1
D    192.168.1.0/24 [90/30720] via 10.0.0.1, 00:13:59, FastEthernet0/0
R    192.168.2.0/24 [120/1] via 20.0.0.2, 00:00:19, FastEthernet0/1
```

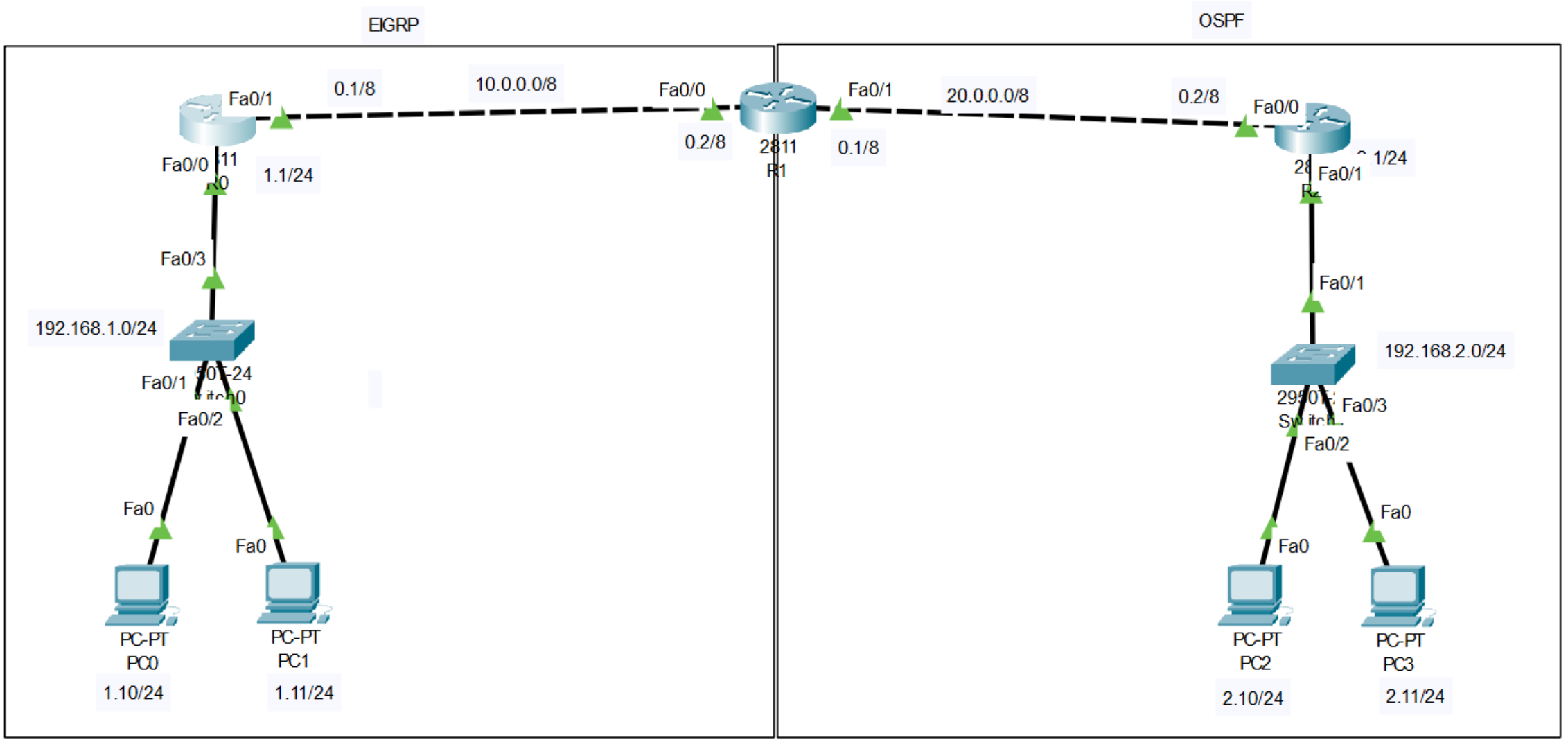
VALIDATING ROUTES ON R2

```
R2#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

R    10.0.0.0/8 [120/1] via 20.0.0.1, 00:00:19, FastEthernet0/0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, FastEthernet0/0
L       20.0.0.2/32 is directly connected, FastEthernet0/0
R    192.168.1.0/24 [120/1] via 20.0.0.1, 00:00:19, FastEthernet0/0
     192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, FastEthernet0/1
L       192.168.2.1/32 is directly connected, FastEthernet0/1
```

REDISTRIBUTION ON EIGRP & OSPF



ON ROUTER R0:

```
R0>en
R0#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R0(config)#router eigrp 14
R0(config-router)#network 192.168.1.0
R0(config-router)#network 10.0.0.0
R0(config-router)#no auto-sum
R0(config-router)#no auto-summary
R0(config-router)#exit
```

ON ROUTER R1:

```
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router eigrp 14
R1(config-router)#network 10.0.0.0
R1(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 14: Neighbor 10.0.0.1 (FastEthernet0/0) is up: new adjacency

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

Listing neighbours on R1:

```
R1#
R1#sh
R1#show ip ei
R1#show ip eigrp ne
R1#show ip eigrp neighbors
IP-EIGRP neighbors for process 14
H   Address         Interface       Hold Uptime    SRTT    RTO   Q   Seq
                                    (sec)          (ms)        Cnt Num
0   10.0.0.1        Fa0/0           11   00:00:41  40      1000  0   1
```

CONFIGURING OSPF ON ROUTER R1

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#network 20.0.0.0 0.255.255.255 area 0
R1(config-router)#exit
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

CONFIGURING OSPF ON ROUTER R2

```
R2>en
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#network 20.0.0.0 0.255.255.255 area 0
R2(config-router)#network 192.168.2.0 0.0
00:09:00: %OSPF-5-ADJCHG: Process 1, Nbr 20.0.0.1 on FastEthernet0/0 from LOADING
R2(config-router)#netwo
R2(config-router)#network 192.168.2.0 0.0.0.255 area 1
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
```

LISTING OSPF EXTERNAL ENTRY ON ROUTER R1:

```
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       10.0.0.0/8 is directly connected, FastEthernet0/0
L       10.0.0.2/32 is directly connected, FastEthernet0/0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       20.0.0.0/8 is directly connected, FastEthernet0/1
L       20.0.0.1/32 is directly connected, FastEthernet0/1
D    192.168.1.0/24 [90/30720] via 10.0.0.1, 00:07:47, FastEthernet0/0
O IA 192.168.2.0/24 [110/2] via 20.0.0.2, 00:01:14, FastEthernet0/1
```

ON ROUTER R1, REDISTRIBUTING OSPF, UNDER EIGRP

```
R1#
R1#router ei
R1#con
R1#conf t
R1#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#router ei
R1(config)#router eigrp 14
R1(config-router)#re
R1(config-router)#redistribute ospf 1 met
R1(config-router)#redistribute ospf 1 metric 1 1 255 255 1
R1(config-router)#exit
R1(config)#
```

ON ROUTER R1, REDISTRIBUTING EIGRP, UNDER OSPF

```
R1(config)#router ospf 1
R1(config-router)#red
R1(config-router)#redistribute eigrp 14 subnets
R1(config-router)#exit
R1(config)#^Z
R1#
%SYS-5-CONFIG_I: Configured from console by console
```