رواد مصر الرقمية

CONFIGURE AND TROUBLESHOOT OSPF AND EIGRP

CISCO NETWORK ADMINISTRATOR
GRADUATION PROJECT

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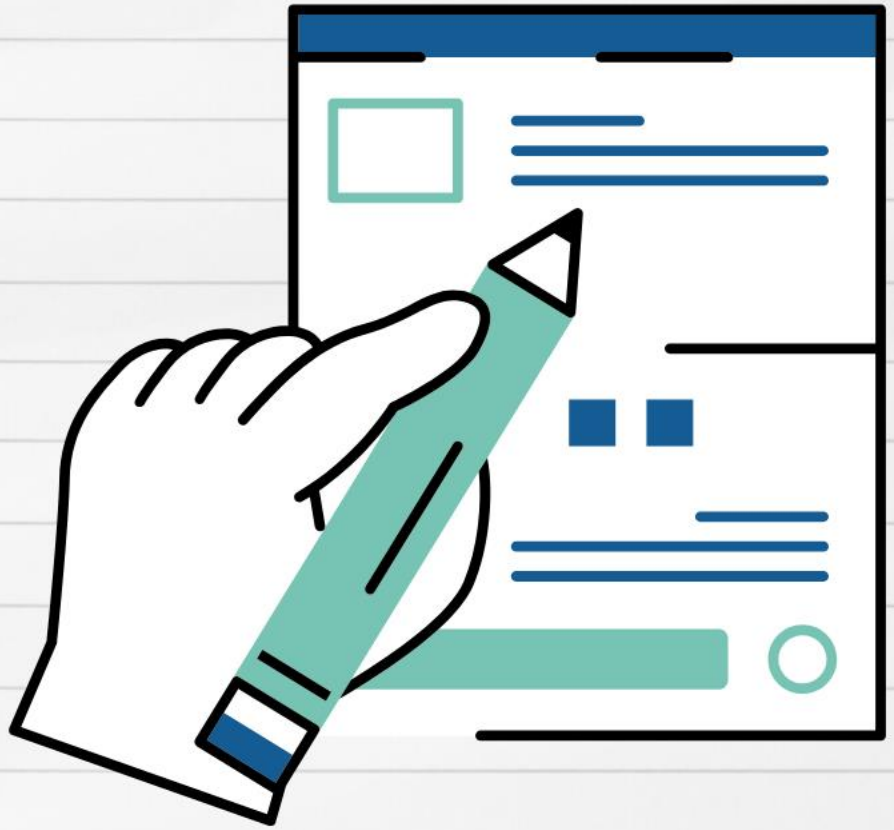
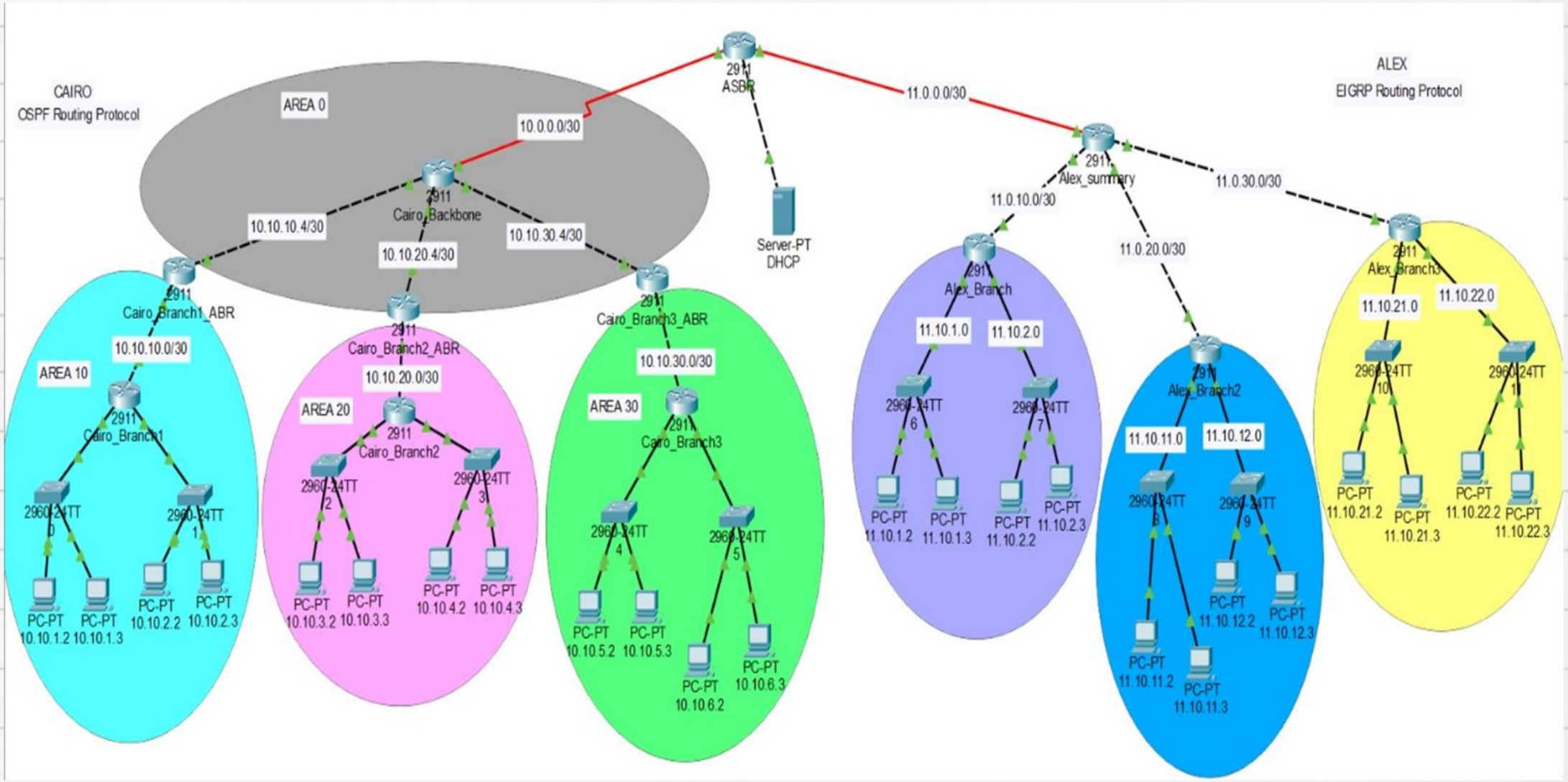
PROJECT OVERVIEW

CONFIGURE AND TROUBLESHOOT
OSPF AND EIGRP



- This project focuses on configuring an efficient network infrastructure that connects multiple branches using dynamic routing.
- We implemented OSPF with multi-area configuration and EIGRP with summarization, as well as redistribution between both protocols for seamless communication.
- The goal is to ensure scalability, efficiency and optimal routing between branches

FULL PROJECT DESIGN



STATIC ROUTING

VS

DYNAMIC ROUTING

STATIC ROUTING DEFINATION

Static routing is the process of manua ly assigning fixed routes between networks, configured by the network administrator.

STATIC ROUTING

ADVANTAGES

- Complete control over the routes.
- Higher security since there are no automatic changes.
- Low resource usage as it doesn't rely on complex protocols.

DISADVANTAGES

- Inflexible, requiring manual updates if network changes occur.
- Difficult to scale in large networks.
- No automatic adaptation to link failures without manual intervention.

DYNAMIC ROUTING DEFINATION

Dynamic routing uses protocols to automatically update routing tables based on network changes.

DYNAMIC ROUTING

ADVANTAGES

- Highly flexible and automatica ly adapts to changes in the network.
- Easier to manage in large networks.
- Load balancing across available routes.

DISADVANTAGES

- Higher resource consumption due to continuous information exchange.
- Lower security if the network isn’t properly secured.
- More complexity In setup and management.

COMPARISON BETWEEN STATIC AND DYNAMIC ROUTING

Aspect	Static Routing	Dynamic Routing
flexibility	Inflexible, requires manual updates	Flexible, automatica lly adapts to changes
Security	More secure due to complete control	Requires additional security
Use Case	Suitable for small networks	Suitable for large and changing networks
Resource Usage	Low resource consumption on	Requires more resources

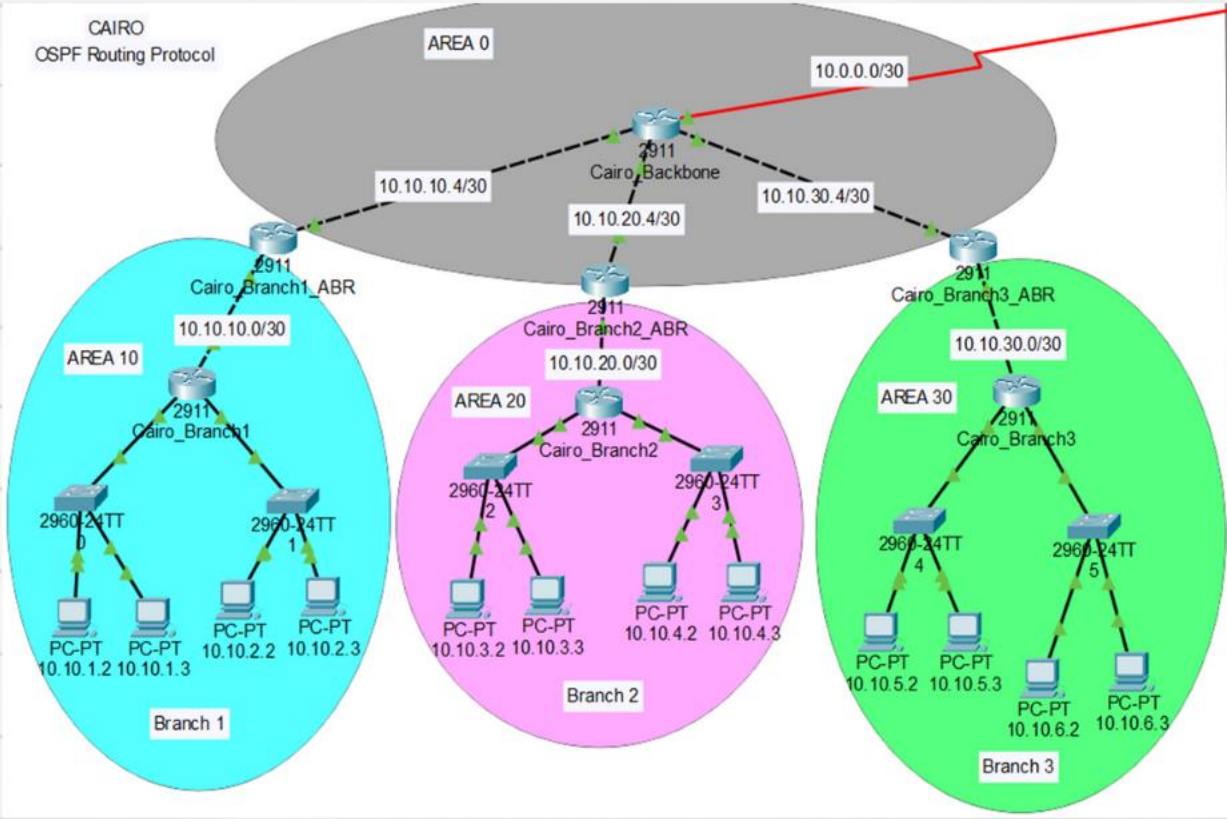
OSPF CONFIGURATION

MULTI-AREA OSPF:

Three different areas connected to the back bone area(Area0).

Each area contains a branch router connected to LAN switches.

Area Boundary Router (ABR) connects areas to the backbone router.



OSPF Configurations - Branch 1

- **Branch 1 (Area 10):**

-Advertises two LANs:

10.10.1.0/24

10.10.2.0/24

-Point-to-point network with ABR:

10.10.10.0/30

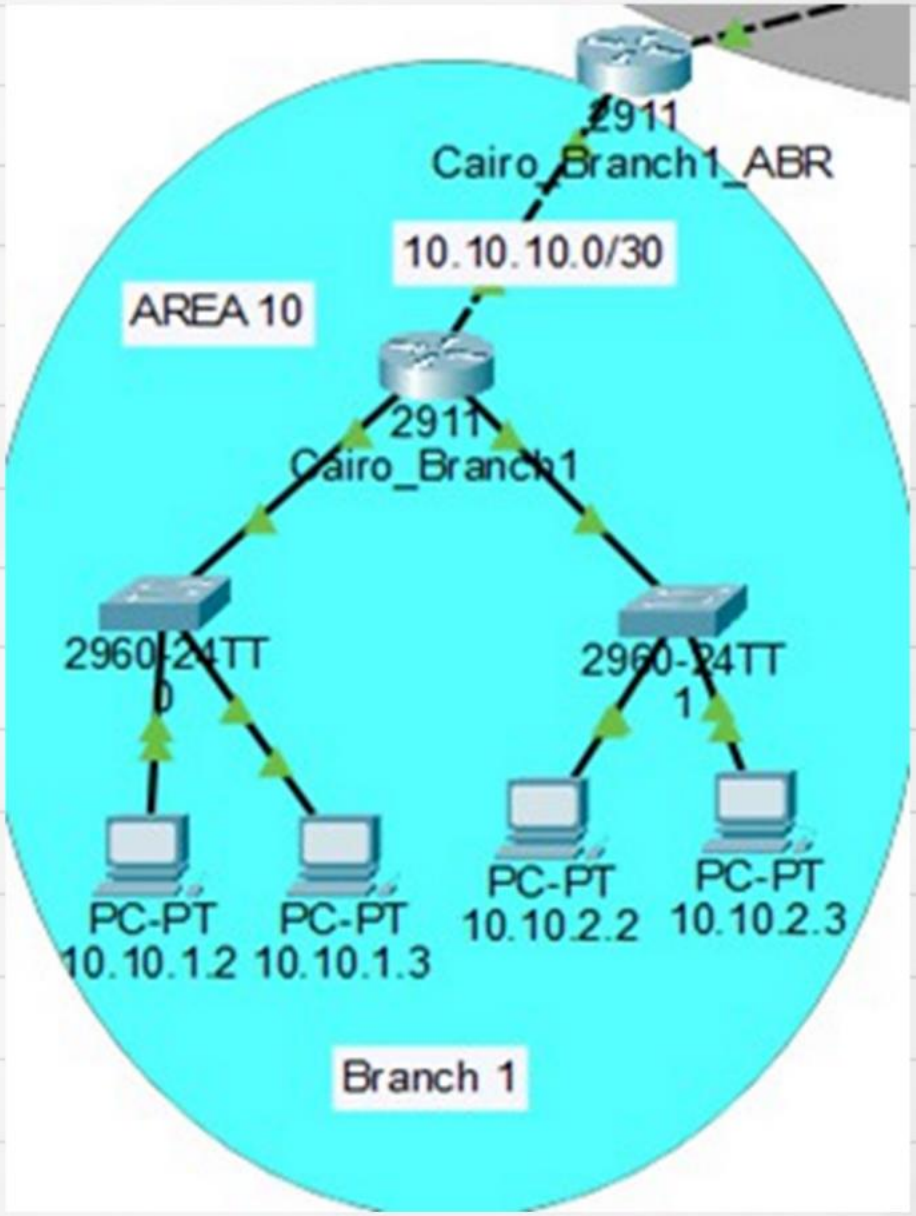
- **Configuration:**

-router ospf 1

-network 10.10.1.0 0.0.0.255 area 10

-network 10.10.2.0 0.0.0.255 area 10

-network 10.10.10.0 0.0.0.3 area 10



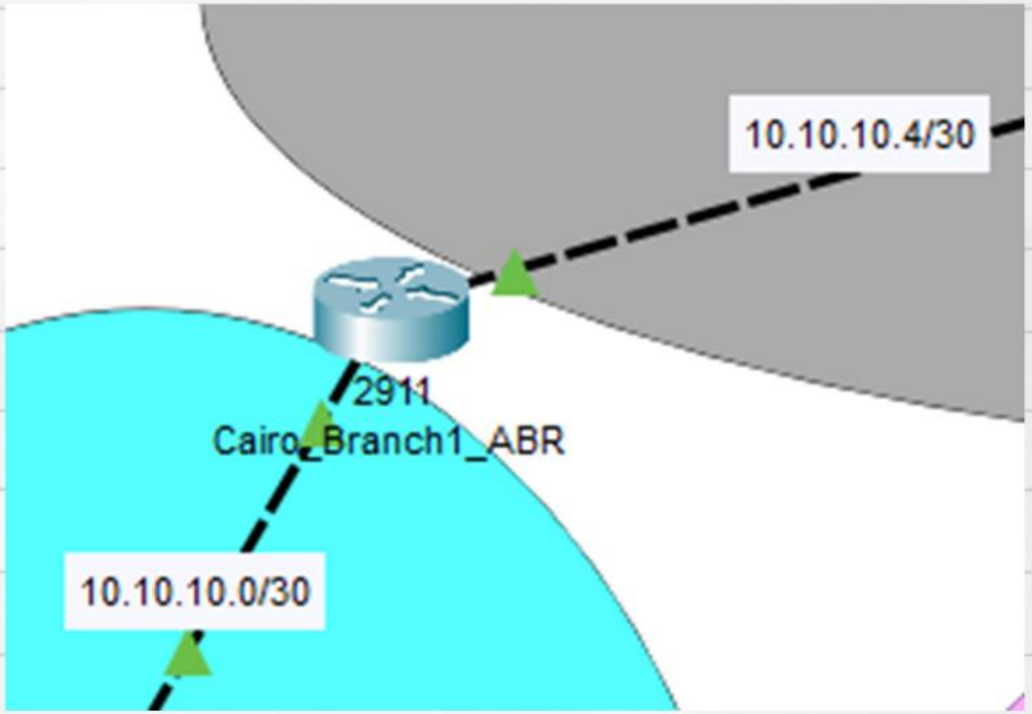
Configurations -Branch 1ABR

- **ABR Configuration:**

-Advertises twopoint-to-pointroutes: Connection to Branch Router Connection to Backbone Router (Area0)

- **Configuration:**

-router ospf1
-network 10.10.10.4 0.0.0.3 area0
-network 10.10.10.0 0.0.0.3 area10



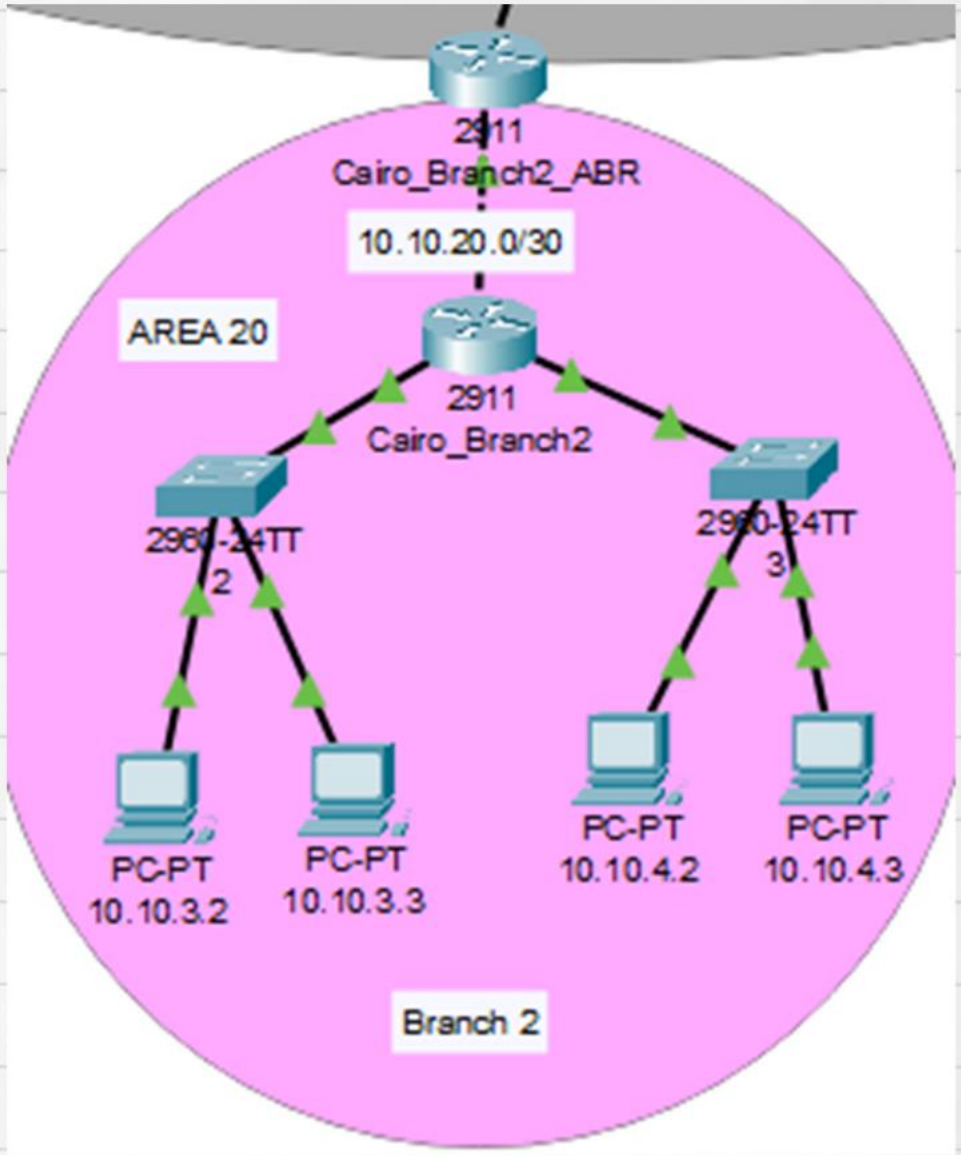
OSPF Configurations -Branch 2

- **Branch 2(Area20):**

-Advertises two LANs:
10.10.3.0/24
10.10.4.0/24
-Point-to-point network with ABR:
10.10.20.0/30

- **Configuration:**

-router ospf1
-network 10.10.3.0 0.0.0.255 area20
-network 10.10.4.0 0.0.0.255 area20
-network 10.10.20.0 0.0.0.3 area20



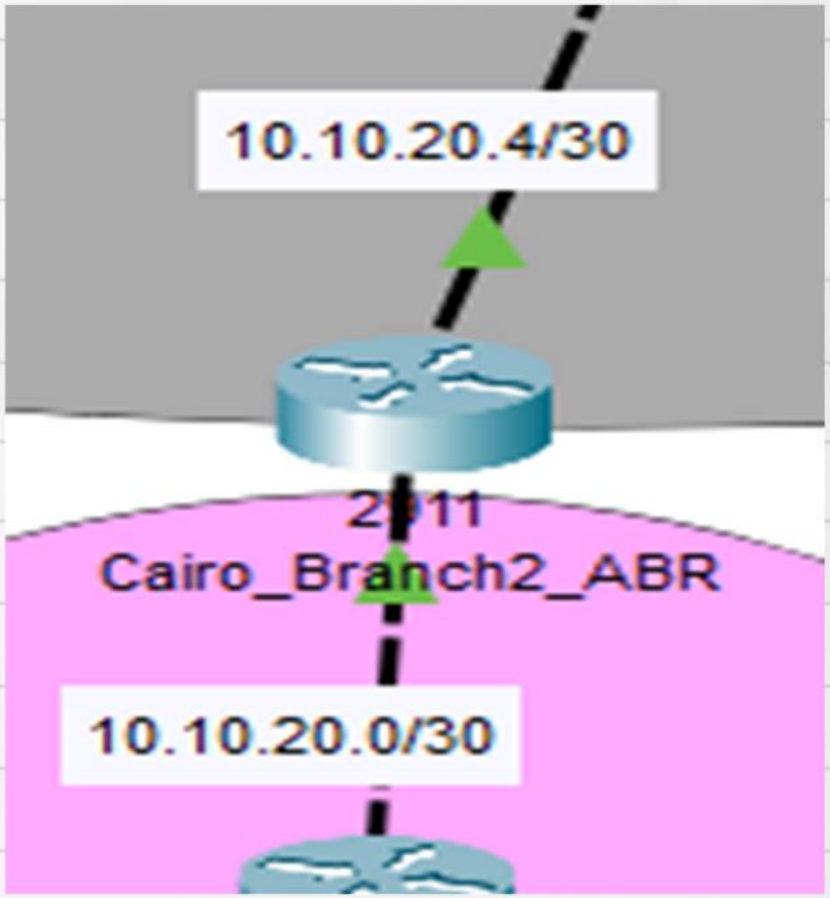
OSPF Configurations -Branch 2ABR

- **ABR Configuration:**

Advertises two point-to-point routes:
-Connection to Branch Router
-Connection to Backbone Router (Area 0)

- **Configuration:**

-router ospf1
-network 10.10.20.0 0.0.0.3 area20
-network 10.10.20.4 0.0.0.3 area0



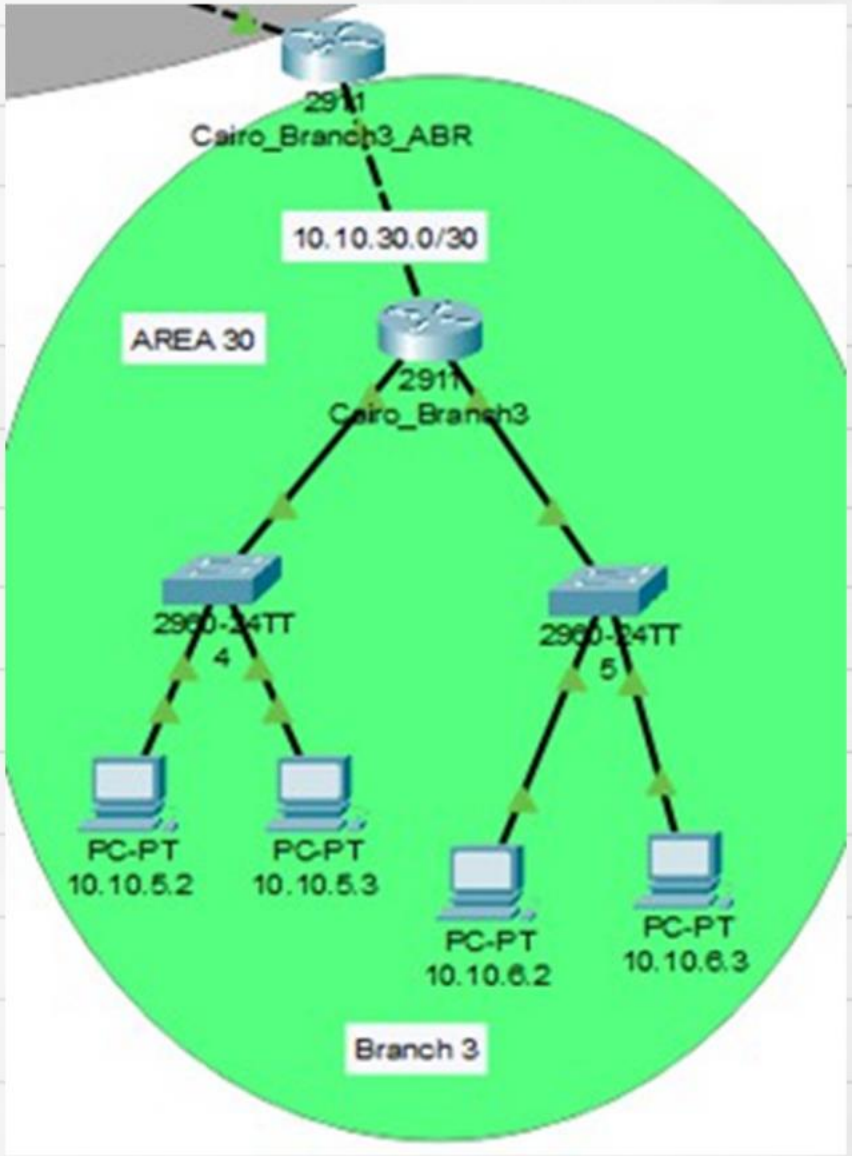
OSPFConfigurations -Branch 3

- **Branch 3(Area30):**

-Advertises two LANs:
10.10.5.0/24
10.10.6.0/24
-Point-to-point network with ABR:
10.10.30.0/30

- **Configuration:**

-router ospf1
-network 10.10.5.0 0.0.0.255 area30
-network 10.10.6.0 0.0.0.255 area30
-network 10.10.30.0 0.0.0.3 area30



- **Backbone Router Functionality:**

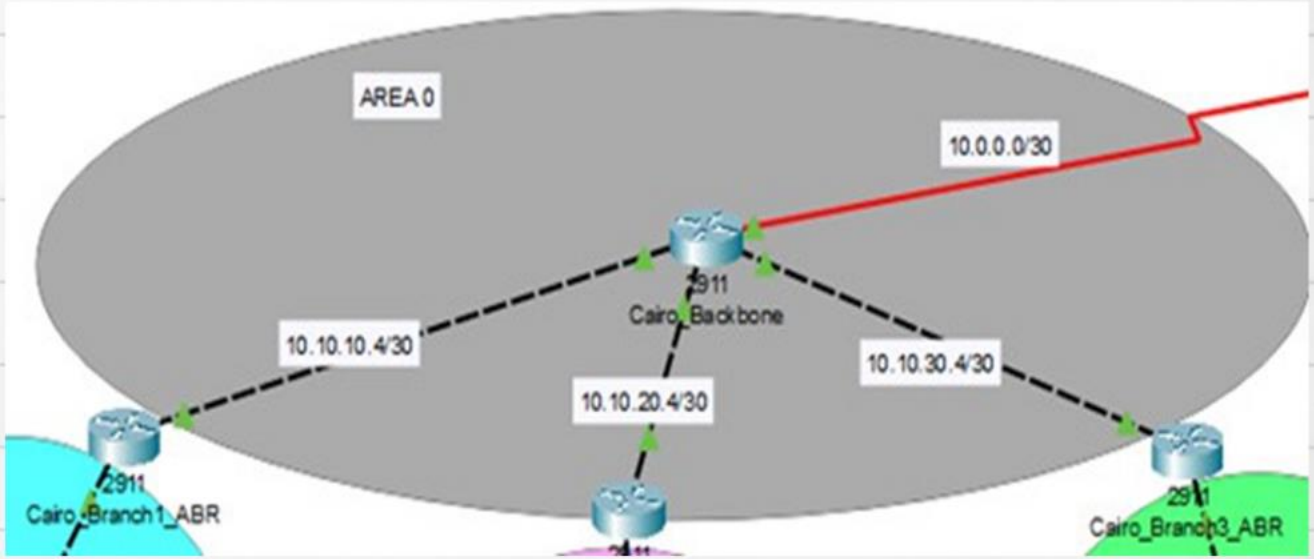
-Connects allABRsofdifferent areas.

-Manages routing information and Link-State Advertisements (LSAs).

-Acts astheDesignated Router (DR)for centralized updates management.

- **Configuration:**

-router ospf 1
-router-id7.7.7.7
-network 10.0.0.0 0.0.0.3 area0
-network 10.10.10.4 0.0.0.3 area0
-network 10.10.20.4 0.0.0.3 area0
-network 10.10.30.4 0.0.0.3 area0



- **OSPFVerification**

BackboneRouter:

- **RouteTracing Examples:**

From10.10.1.2 (Area10) to 10.10.6.5 (Area30)

```
C:\>tracert 10.10.6.5

Tracing route to 10.10.6.5 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      10.10.1.1
  2    0 ms      0 ms      0 ms      10.10.10.2
  3    0 ms      0 ms      0 ms      10.10.10.6
  4    0 ms      0 ms      0 ms      10.10.30.5
  5    0 ms      0 ms      0 ms      10.10.30.1
  6    0 ms      2 ms      0 ms      10.10.6.5

Trace complete.
```

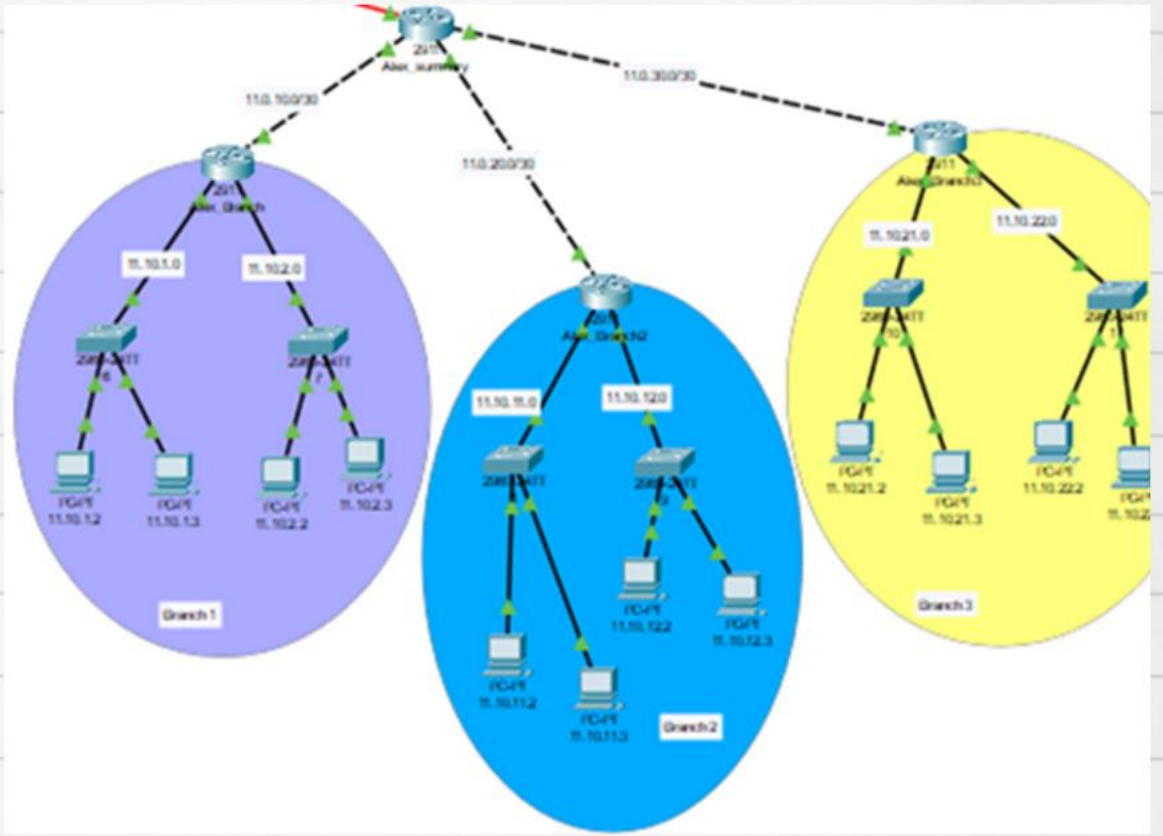
From 10.10.4.2(Area 20) to 10.10.2.4 (Area10)

```
C:\>tracert 10.10.2.4

Tracing route to 10.10.2.4 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      10.10.4.1
  2    0 ms      0 ms      0 ms      10.10.20.2
  3    0 ms      1 ms      1 ms      10.10.20.6
  4    0 ms      0 ms      0 ms      10.10.10.5
  5    0 ms      1 ms      0 ms      10.10.10.1
  6    0 ms      0 ms      11 ms     10.10.2.4

Trace complete.
```

EIGRP
CONFIGURATION

- EIGRP uses equation to calculate route metric.
- The EIGRP metric is calculated using the following Kvalues:

K1: Bandwidth
K2: Load
K3: Delay
K4: Reliability
K5: MTU

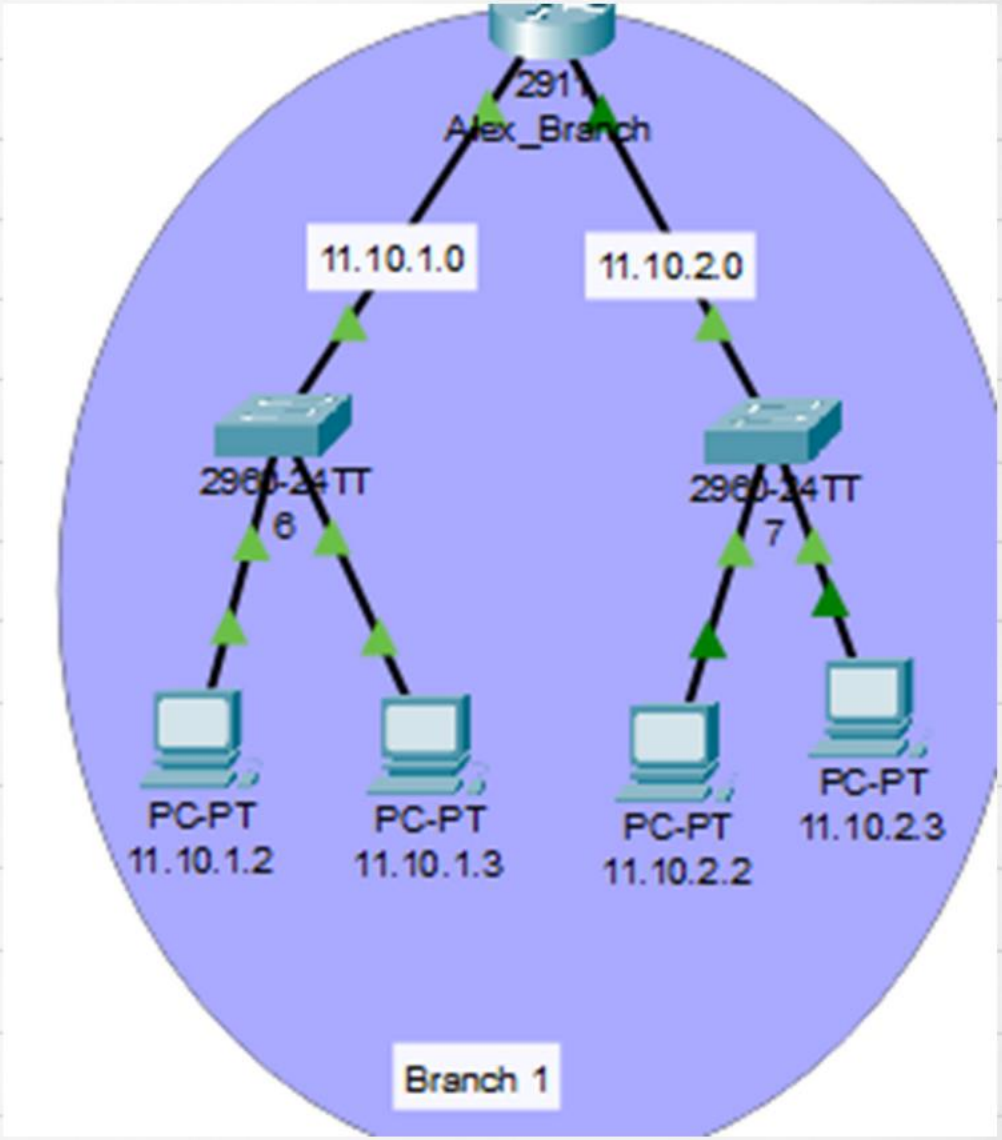


- Configuration: We used the default metric (K1=1,K3=1)with others set to 0 to stabilize metric values.

- Branch 1 Configuration
- Connected LANs:
- 11.10.1.0/24
- 11.10.2.0/24
- Summary Network:
- 11.10.0.0/21 (applied on the outside interface)

- Router Configurations:
- router eigrp1
- network 11.0.10.0 0.0.0.3
- network 11.10.1.0 0.0.0.255
- network 11.10.2.0 0.0.0.255

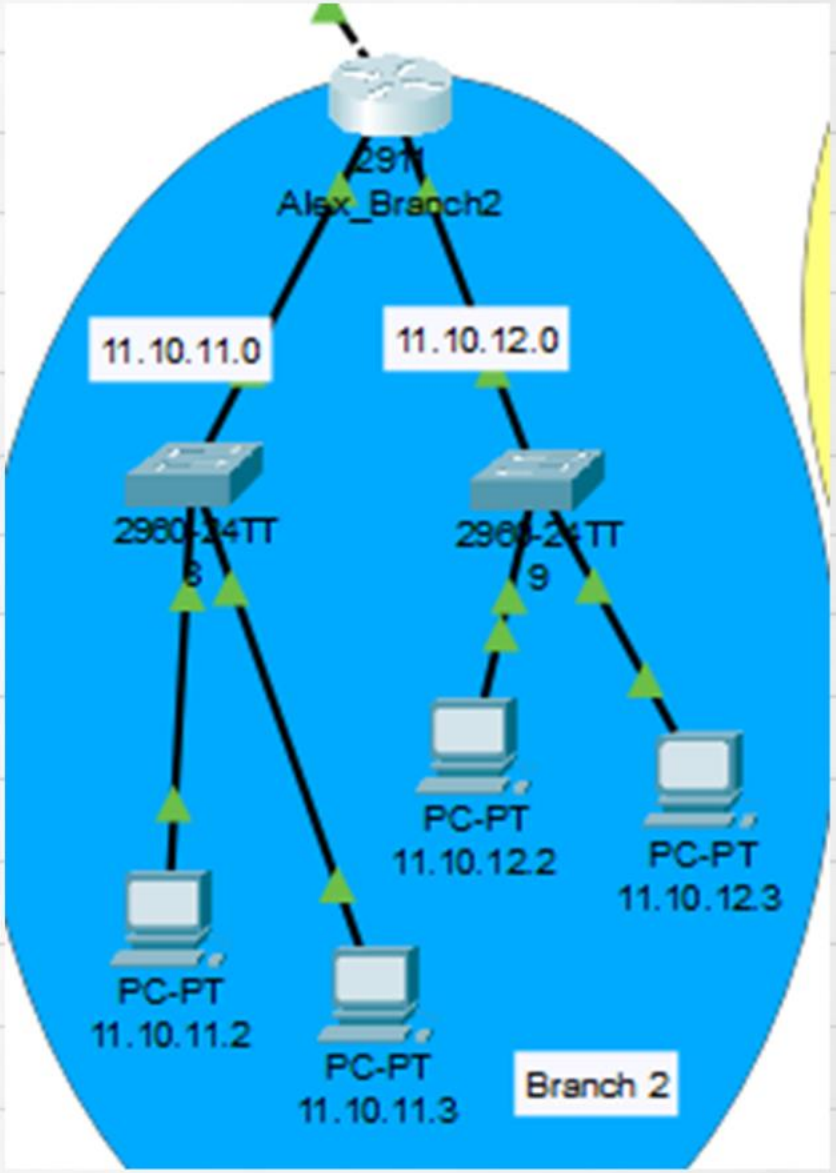
- interface GigabitEthernet0/2
- ip summary-address eigrp 111.10.0.0 255.255.248.0



- Branch 2 Configuration Connected LANs:
- 11.10.11.0/24
- 11.10.12.0/24
- Summary Network:
- 11.10.8.0/21
- Router Configurations:

- router eigrp1
- network 11.0.20.0 0.0.0.3
- network 11.10.11.0 0.0.0.255
- network 11.10.12.0 0.0.0.255

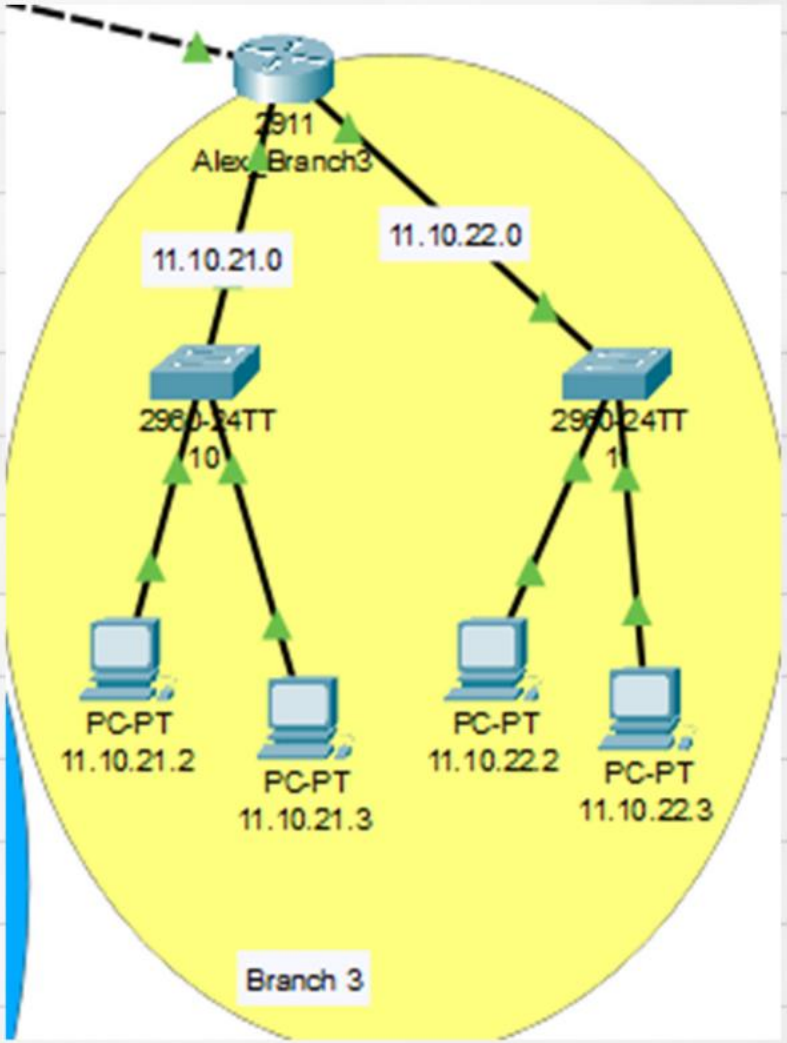
- interface GigabitEthernet0/2
- ip summary-address eigrp 111.10.8.0 255.255.248.0



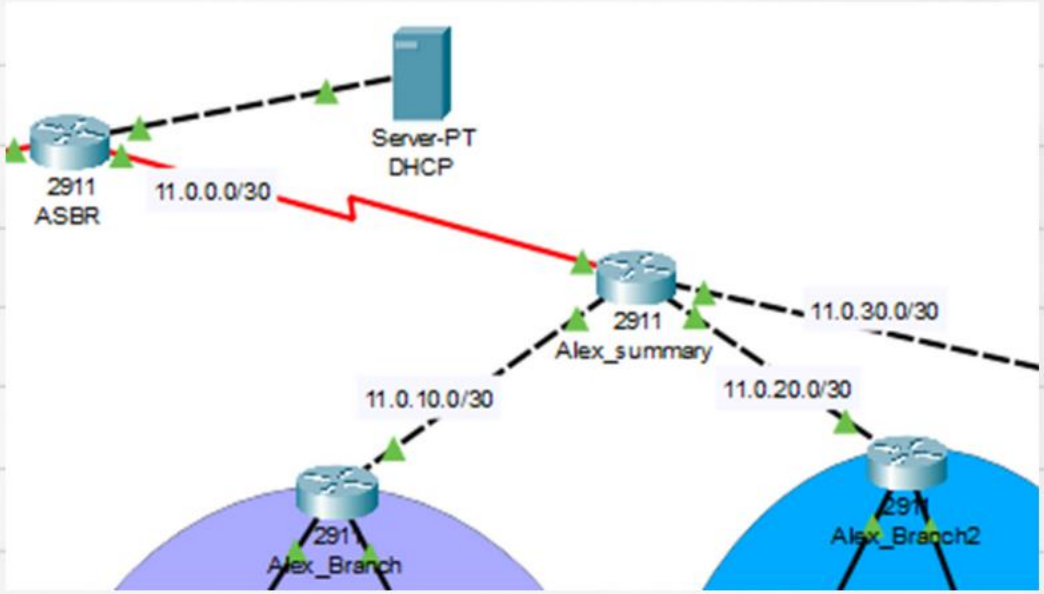
- Branch 3 Configuration
- Connected LANs:
- 11.10.21.0/24
- 11.10.22.0/24
- Summary Network:
- 11.10.16.0/21
- Router Configurations:

- router eigrp1
- network 11.0.30.0 0.0.0.3
- network 11.10.21.0 0.0.0.255
- network 11.10.22.0 0.0.0.255

- interface GigabitEthernet0/2
- ip summary-address eigrp 111.10.16.0 255.255.248.0



- Edge Router
- Function: Facilitates routing between the three branches and connects to the ASBR for communication with Cairo branches.
- Router Configurations:



- router eigrp1
- network 11.0.10.0 0.0.0.3
- network 11.0.20.0 0.0.0.3
- network 11.0.30.0 0.0.0.3
- network 11.0.0.0 0.0.0.3
-
- IP route 192.168.1.0 255.255.255.0 11.0.0.2

- EIGRP Verification
- Tracing Routes Between Devices:
- From Branch 1 to Branch 2:

```
C:\>tracert 11.10.11.2

Tracing route to 11.10.11.2 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      11.10.1.1
  2    0 ms      0 ms      0 ms      11.0.10.2
  3    1 ms      14 ms     0 ms      11.0.20.1
  4    0 ms      0 ms      11 ms     11.10.11.2

Trace complete.
```

- FromBranch 2 toBranch 3:

```
C:\>tracert 11.10.22.2

Tracing route to 11.10.22.2 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      11.10.12.1
  2    1 ms      0 ms      0 ms      11.0.20.2
  3    2 ms      0 ms      0 ms      11.0.30.1
  4    0 ms      0 ms      1 ms      11.10.22.2

Trace complete.
```

- FromBranch 3toBranch 1:

```
C:\>tracert 11.10.1.3

Tracing route to 11.10.1.3 over a maximum of 30 hops:

  1    0 ms      0 ms      1 ms      11.10.21.1
  2    0 ms      1 ms      0 ms      11.0.30.2
  3    0 ms      10 ms     0 ms      11.0.10.1
  4    0 ms      0 ms      0 ms      11.10.1.3

Trace complete.
```

REDISTRIBUTION BETWEEN OSPF AND EIGRP

REDISTRIBUTION :

- Redistribution is a feature that allow routes learned by one dynamic routing protocol to be advertised into another protocol, enabling interoperability between different routing domains.

- During redistribution, proper metric adjustment is essential to avoid routing loops and ensure metric compatibility foreachrouting protocol. AsEIGRPuses K values with bandwidth and delay, while OSPF uses cost based on link bandwidth.

- To configure redistribution, we added a router between the edge routers of OSPF and EIGRP networks which called autonomous system boundary router (ASBR).

- This router has 1link configured with ospf and the other with eigrp to learn all the routes in both networks and see routing configurations.

- Configuration:

For OSPF:

- router ospf1
- redistribute eigrp 1subnets For EIGRP:

- router eigrp1
- redistribute ospf1metric 100001002511500

After redistribution is enabled:

OSPF router

```
     10.0.0.0/8 is variably subnetted, 17 subnets, 3 masks
C       10.0.0.0/30 is directly connected, Serial0/0/0
L       10.0.0.2/32 is directly connected, Serial0/0/0
O IA    10.10.1.0/24 [110/3] via 10.10.10.5, 10:43:25, GigabitEthernet0/2
O IA    10.10.2.0/24 [110/3] via 10.10.10.5, 10:43:25, GigabitEthernet0/2
O IA    10.10.3.0/24 [110/3] via 10.10.20.5, 10:43:25, GigabitEthernet0/1
O IA    10.10.4.0/24 [110/3] via 10.10.20.5, 10:43:25, GigabitEthernet0/1
O IA    10.10.5.0/24 [110/3] via 10.10.30.5, 10:43:15, GigabitEthernet0/0
O IA    10.10.6.0/24 [110/3] via 10.10.30.5, 10:43:15, GigabitEthernet0/0
O IA    10.10.10.0/30 [110/2] via 10.10.10.5, 10:43:25, GigabitEthernet0/2
C       10.10.10.4/30 is directly connected, GigabitEthernet0/2
L       10.10.10.6/32 is directly connected, GigabitEthernet0/2
O IA    10.10.20.0/30 [110/2] via 10.10.20.5, 10:43:25, GigabitEthernet0/1
C       10.10.20.4/30 is directly connected, GigabitEthernet0/1
L       10.10.20.6/32 is directly connected, GigabitEthernet0/1
O IA    10.10.30.0/30 [110/2] via 10.10.30.5, 10:43:15, GigabitEthernet0/0
C       10.10.30.4/30 is directly connected, GigabitEthernet0/0
L       10.10.30.6/32 is directly connected, GigabitEthernet0/0
     11.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
O E2    11.0.0.0/30 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.0.10.0/30 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.0.20.0/30 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.0.30.0/30 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.10.0.0/21 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.10.8.0/21 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
O E2    11.10.16.0/21 [110/20] via 10.0.0.1, 02:25:30, Serial0/0/0
S    192.168.1.0/24 [1/0] via 10.0.0.1
```

EIGRP router

```
     10.0.0.0/8 is variably subnetted, 13 subnets, 2 masks
D EX    10.0.0.0/30 [170/2195456] via 11.0.0.2, 02:29:27, Serial0/0/0
D EX    10.10.1.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.2.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.3.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.4.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.5.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.6.0/24 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.10.0/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.10.4/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.20.0/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.20.4/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.30.0/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
D EX    10.10.30.4/30 [170/2195456] via 11.0.0.2, 02:29:12, Serial0/0/0
     11.0.0.0/8 is variably subnetted, 11 subnets, 3 masks
C       11.0.0.0/30 is directly connected, Serial0/0/0
L       11.0.0.1/32 is directly connected, Serial0/0/0
C       11.0.10.0/30 is directly connected, GigabitEthernet0/0
L       11.0.10.2/32 is directly connected, GigabitEthernet0/0
C       11.0.20.0/30 is directly connected, GigabitEthernet0/1
L       11.0.20.2/32 is directly connected, GigabitEthernet0/1
C       11.0.30.0/30 is directly connected, GigabitEthernet0/2
L       11.0.30.2/32 is directly connected, GigabitEthernet0/2
D       11.10.0.0/21 [90/5376] via 11.0.10.1, 02:29:27, GigabitEthernet0/0
D       11.10.8.0/21 [90/5376] via 11.0.20.1, 02:29:27, GigabitEthernet0/1
D       11.10.16.0/21 [90/5376] via 11.0.30.1, 02:29:27, GigabitEthernet0/2
S    192.168.1.0/24 [1/0] via 11.0.0.2
```

DHCP CONFIGURATION

Dynamic Host Configuration Protocol (DHCP)

- Function: Automatically assigns IP addresses and other network configuration settings (subnet mask, gateway, and DNS servers) to devices, simplifying network management.
- It eliminates the need for manual IP configuration by dynamically leasing IP addresses from a centralized DHCP server to clients, ensuring efficient address allocation and avoid human error or duplicated addresses.
- DHCP plays a crucial role in simplifying network administration, especially in large and dynamic environments where devices frequently join and leave the network and for large subnets and branches like our project.

The DHCP process consists of four main steps

01 Discover

The client broadcasts a DHCP Discover message to find available DHCP servers

02 Offer

DHCP servers respond with an available IP address offer

03 Request

The client requests the offered IP address from the server

04 Acknowledge

The DHCP server acknowledges the request and assigns the IP address to the client.

In this project, we implemented 1 DHCP server connected to the ASBR router, and to define the server route in all routers we used static routing to the server:

- In OSPF backbone router:

```
ip route 192.168.1.0 255.255.255.0 10.0.0.1
```

- In EIGRP edge router:

```
ip route 192.168.1.0 255.255.255.0 11.0.0.2
```

- To allow each router to connect the devices to the DHCP server and request ip addresses, we must write this command in all router interfaces connected to LANs:

```
interface GigabitEthernet0/0
ip helper-address 192.168.1.50

interface GigabitEthernet0/1
ip helper-address 192.168.1.50
```

IP Pools Configuration

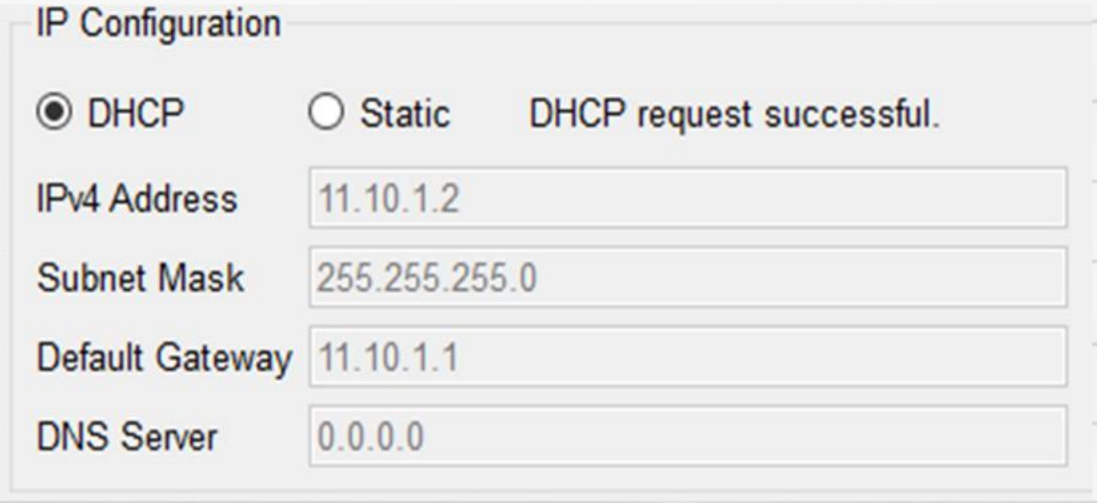
- **Cairo Branches IP Pools:**

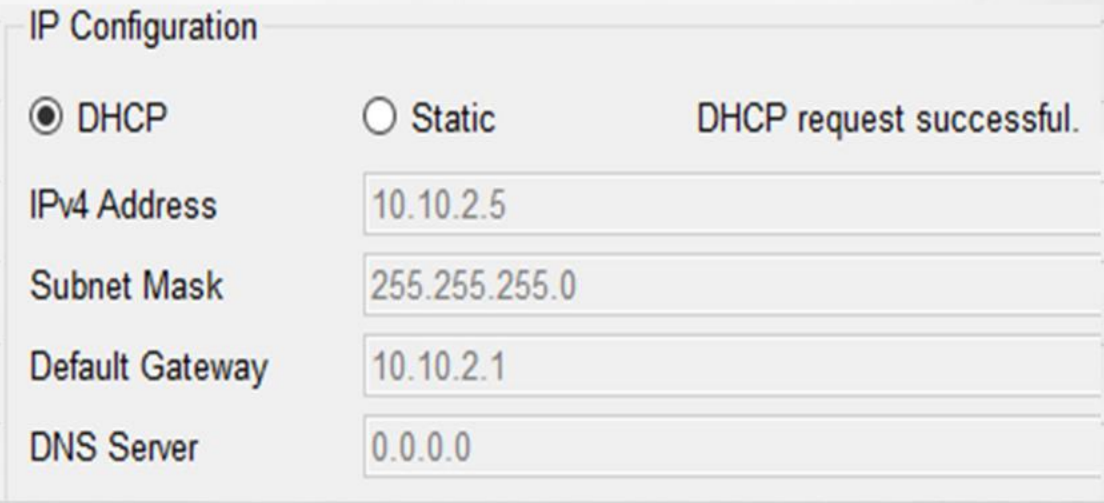
Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User
cairo3_LAN2	10.10.6.1	0.0.0.0	10.10.6.2	255.255.255.0	254
cairo3_LAN1	10.10.5.1	0.0.0.0	10.10.5.2	255.255.255.0	254
cairo2_LAN2	10.10.4.1	0.0.0.0	10.10.4.2	255.255.255.0	254
cairo2_LAN1	10.10.3.1	0.0.0.0	10.10.3.2	255.255.255.0	254
cairo1_LAN2	10.10.2.1	0.0.0.0	10.10.2.2	255.255.255.0	254
cairo1_LAN1	10.10.1.1	0.0.0.0	10.10.1.2	255.255.255.0	254

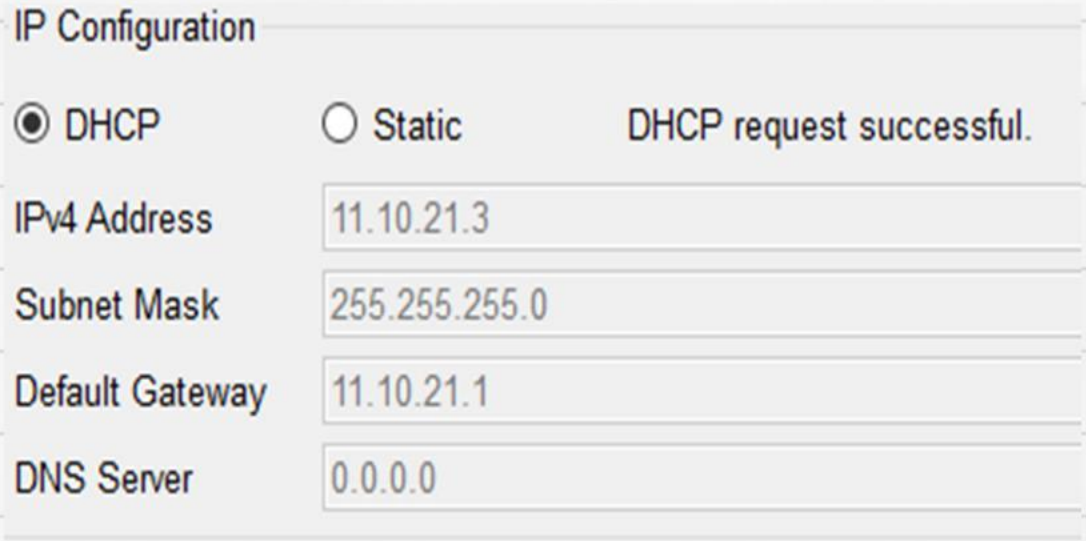
- **AlexBranches IP Pools:**

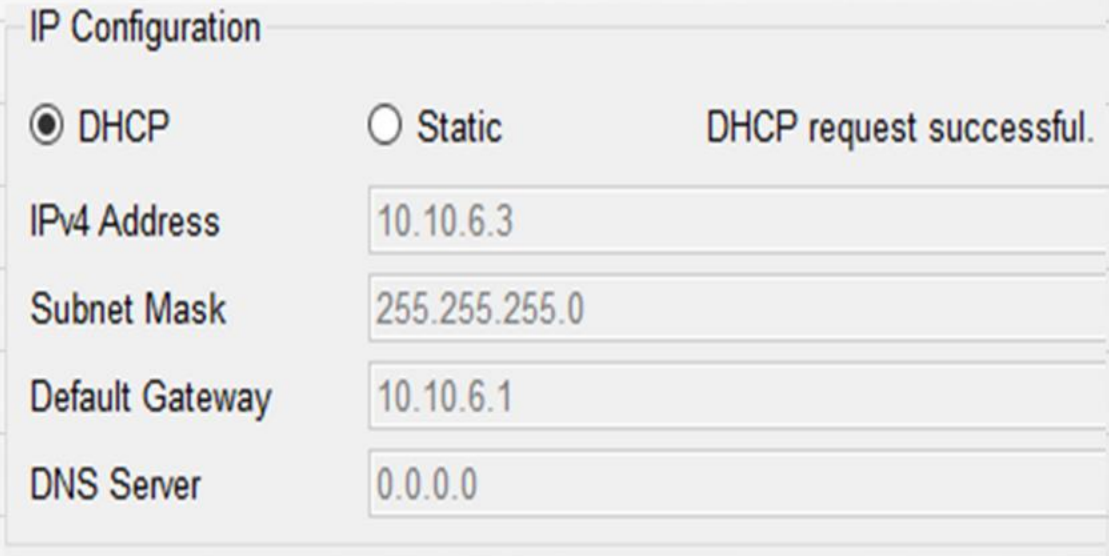
Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User
alex3_LAN2	11.10.22.1	0.0.0.0	11.10.22.2	255.255.255.0	254
alex3_LAN1	11.10.21.1	0.0.0.0	11.10.21.2	255.255.255.0	254
alex2_LAN2	11.10.12.1	0.0.0.0	11.10.12.2	255.255.255.0	254
alex2_LAN1	11.10.11.1	0.0.0.0	11.10.11.2	255.255.255.0	254
alex1_LAN2	11.10.2.1	0.0.0.0	11.10.2.2	255.255.255.0	254

- **Here are some IP configuration on different network devices assigned from the centralized DHCP server:**









THANK YOU !