

Small Office Network with DHCP IP Assigning,  
and EIGRP, OSPF, Static and RIP routing

# CISCO PROJECT

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## OBJECTIVE

The objective of this project is to design and implement a small office network that dynamically assigns IP addresses using **DHCP** and ensures efficient routing between different network segments using **multiple routing protocols**: EIGRP, OSPF, Static routing, and RIP. The purpose is to demonstrate an understanding of inter-protocol communication and network scalability, ensuring seamless connectivity and efficient resource management within the network.

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## TECHNOLOGIS USED

1. **Cisco Packet Tracer:**
  - A network simulation tool used to design, configure, and test network topologies, including routing and DHCP configurations.
2. **Routing Protocols:**
  - **EIGRP (Enhanced Interior Gateway Routing Protocol):** For dynamic routing within the network, providing efficient and scalable routing.
  - **OSPF (Open Shortest Path First):** A link-state routing protocol used to ensure fast convergence and scalability across multiple routers.
  - **RIP (Routing Information Protocol):** A distance-vector routing protocol that uses hop count as its metric.
  - **Static Routing:** Manually configured routes for directing traffic in specific directions.
3. **DHCP (Dynamic Host Configuration Protocol):**
  - Used to dynamically assign IP addresses to devices in the network, reducing manual configuration efforts.
4. **IP Addressing and Sub-netting:**
  - Classless addressing and sub-netting to efficiently allocate IP ranges within the network.
5. **Command-Line Interface (CLI):**
  - Cisco IOS commands used for configuring routers and switches, including routing, DHCP, and interface management.
6. **Ethernet:**
  - For interconnecting devices within the network.
7. **Network Troubleshooting Tools:**
  - **Ping:** For basic connectivity testing.
  - **Traceroute:** For verifying the path of packets through the network.
8. **ACL:**
  - Access-control list to control who can access what

### **Design and Approach:**

I wanted to make a small office network with 3 departments which were Management, Support and Sales, so I decided to use sub-netting and instead of using a lot of ip-addresses so I can use minimum ip-addresses and the offices needs are also fulfilled.

Now the Management Department doesn't require much man power since it has to manage the departments only I gave it 16 ip-addresses, the Support Department needs more people then Managing Department but less than the Sales department so I decided to give them 76 ip-addresses since it is a small office and don't require more than that and likewise I gave 156 ip-addresses to Sales Department.

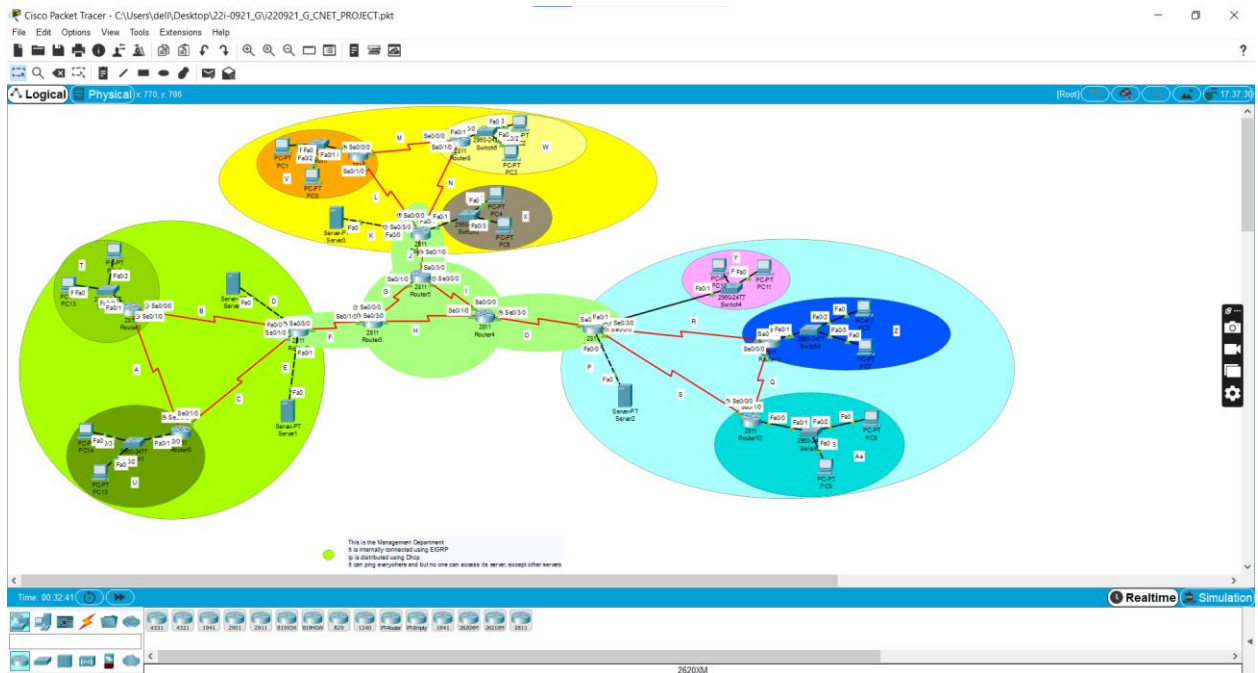
I gave each Department its own server to store the Data while the Management Department has 2 servers one to store their Data and the other for making backup of the offices data. Sales and Support Department can only access their own servers, while the Management Department can access all servers since they have to make the backup and manage the office. Leaving the servers aside all the people working can communicate with all the people including their Department and other Departments as well.

The Management Department uses Eigrp to communicate within the Department but uses OSPF to connect to other Departments, and in order to show the internal communication of the Department I gave them 3 routers and distributed the ip's amongst them. The Support Department uses RIP to communicate within the Department but uses OSPF to connect to other Departments, and in order to show the internal communication of the Department I gave them 3 routers and distributed the ip's amongst them. The Sales Department uses Static to communicate within the Department but uses OSPF to connect to other Departments, and in order to show the internal communication of the Department I gave them 3 routers and distributed the ip's amongst them. These ip's were distributed using DHCP which can automatically configure the ips of pc's added so none of the department face any issue when recruiting new people.

I first created the Topology on paper and did the working for the sub-netting process, then I created the same Topology on cisco, configured it using DHCP, after which I made the internal Department connections as planned, the I connected them with each other using OSPF. Then at last I used ACL to restrict access to the serveres.

## Topology:

This is the Topology with its description,



**This is the Management Department**  
It is internally connected using EIGRP  
ip is distributed using Dhcp  
It can ping everywhere and but no one can access its server, except other servers

T - 192.168.21.240/29  
U - 192.168.21.248/29

A - 192.168.9.0/30  
B - 192.168.9.4/30  
C - 192.168.9.8/30  
D - 192.168.9.12/30  
E - 192.168.9.16/30

**This is the Pathway Connecting all the Department**  
It connects all the Departments using OSPF

F - 192.168.9.20/30  
G - 192.168.9.24/30  
H - 192.168.9.28/30  
I - 192.168.9.32/30  
J - 192.168.9.36/30  
O - 192.168.9.56/30

**This is the Sales Department**  
It is internally connected using Static Routing  
ip is distributed using Dhcp  
It can ping everywhere and but not ping to the server of Management Department and Support Department

V - 192.168.21.0/26  
W - 192.168.21.64/26  
X - 192.168.21.128/27


K - 192.168.9.40/30  
L - 192.168.9.44/30  
M - 192.168.9.48/30  
N - 192.168.9.52/30

**This is the Support Department**  
It is internally connected using RIP Routing  
ip is distributed using Dhcp  
It can ping everywhere and but not ping to the server of Management Department and Sales Department

Aa - 192.168.21.192/27  
Z - 192.168.21.160/27  
Y - 192.168.21.224/28

P - 192.168.9.60/30  
Q - 192.168.9.64/30  
R - 192.168.9.68/30  
S - 192.168.9.72/30

## Management Link router,

 Router2

Physical Config CLI Attributes

IOS Command Line Interface

```
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.9.22 (Serial0/3/0) is up: new adjacency
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.9.9 (Serial0/1/0) is up: new adjacency
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.9.29 on Serial0/3/0 from LOADING to FULL, Loading Done

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

    192.168.9.0/30 is subnetted, 16 subnets
D       192.168.9.0 [90/21024000] via 192.168.9.5, 01:41:42, Serial0/0/0
        [90/21024000] via 192.168.9.9, 01:41:38, Serial0/1/0
C       192.168.9.4 is directly connected, Serial0/0/0
C       192.168.9.8 is directly connected, Serial0/1/0
C       192.168.9.12 is directly connected, FastEthernet0/0
C       192.168.9.16 is directly connected, FastEthernet0/1
C       192.168.9.20 is directly connected, Serial0/3/0
O       192.168.9.24 [110/128] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.9.28 [110/128] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.9.32 [110/192] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.9.36 [110/192] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.9.40 [110/193] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.9.56 [110/192] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.9.60 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.9.64 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.9.68 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.9.72 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.21.0/24 is variably subnetted, 8 subnets, 4 masks
O E2    192.168.21.0/26 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.21.64/26 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O       192.168.21.128/27 [110/193] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.21.160/27 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.21.192/27 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
O E2    192.168.21.224/28 [110/20] via 192.168.9.22, 01:41:17, Serial0/3/0
D       192.168.21.240/29 [90/20514560] via 192.168.9.5, 01:41:42, Serial0/0/0
D       192.168.21.248/29 [90/20514560] via 192.168.9.9, 01:41:38, Serial0/1/0


Router#
```

Ctrl+F6 to exit CLI focus

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## Management internal router,

 Router0

Physical Config **CLI** Attributes

IOS Command Line Interface

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.9.1 (Serial0/1/0) is up: new adjacency
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.9.10 (Serial0/0/0) is up: new adjacency

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

    192.168.9.0/30 is subnetted, 16 subnets
C      192.168.9.0 is directly connected, Serial0/1/0
D      192.168.9.4 [90/21024000] via 192.168.9.1, 01:43:12, Serial0/1/0
          [90/21024000] via 192.168.9.10, 01:43:11, Serial0/0/0
C      192.168.9.8 is directly connected, Serial0/0/0
D      192.168.9.12 [90/20514560] via 192.168.9.10, 01:43:11, Serial0/0/0
D      192.168.9.16 [90/20514560] via 192.168.9.10, 01:43:11, Serial0/0/0
D      192.168.9.20 [90/21024000] via 192.168.9.10, 01:43:11, Serial0/0/0
D EX   192.168.9.24 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.28 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.32 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.36 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.40 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.44 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.48 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.52 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.56 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.60 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.64 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.68 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.9.72 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
    192.168.21.0/24 is variably subnetted, 8 subnets, 4 masks
D EX   192.168.21.0/26 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.21.64/26 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.21.128/27 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.21.160/27 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.21.192/27 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D EX   192.168.21.224/28 [170/20537600] via 192.168.9.10, 01:42:50, Serial0/0/0
D      192.168.21.240/29 [90/20514560] via 192.168.9.1, 01:43:12, Serial0/1/0
C      192.168.21.248/29 is directly connected, FastEthernet0/0

Router#
```

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## Static link router,

Router6

Physical Config **CLI** Attributes

IOS Command Line Interface

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/3/0, changed state to up
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.9.37 on Serial0/1/0 from LOADING to FULL, Loading Done

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

    192.168.9.0/30 is subnetted, 18 subnets
S       192.168.9.0 [1/0] via 192.168.9.37
S       192.168.9.4 [1/0] via 192.168.9.37
S       192.168.9.8 [1/0] via 192.168.9.37
S       192.168.9.12 [1/0] via 192.168.9.37
S       192.168.9.16 [1/0] via 192.168.9.37
S       192.168.9.20 [1/0] via 192.168.9.37
S       192.168.9.24 [1/0] via 192.168.9.37
S       192.168.9.28 [1/0] via 192.168.9.37
S       192.168.9.32 [1/0] via 192.168.9.37
C       192.168.9.36 is directly connected, Serial0/1/0
C       192.168.9.40 is directly connected, FastEthernet0/0
C       192.168.9.44 is directly connected, Serial0/3/0
C       192.168.9.52 is directly connected, Serial0/0/0
S       192.168.9.56 [1/0] via 192.168.9.37
S       192.168.9.60 [1/0] via 192.168.9.37
S       192.168.9.64 [1/0] via 192.168.9.37
S       192.168.9.68 [1/0] via 192.168.9.37
S       192.168.9.72 [1/0] via 192.168.9.37
    192.168.21.0/24 is variably subnetted, 8 subnets, 4 masks
S       192.168.21.0/26 [1/0] via 192.168.9.46
S       192.168.21.64/26 [1/0] via 192.168.9.54
C       192.168.21.128/27 is directly connected, FastEthernet0/1
S       192.168.21.160/27 [1/0] via 192.168.9.37
S       192.168.21.192/27 [1/0] via 192.168.9.37
S       192.168.21.224/28 [1/0] via 192.168.9.37
S       192.168.21.240/29 [1/0] via 192.168.9.37
S       192.168.21.248/29 [1/0] via 192.168.9.37

Router#
Router#
```


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RIP link router with access list,

 Router9

PhysicalConfigCLIAttributes

IOS Command Line Interface

```
00:00:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.9.57 on Serial0/1/0 from LOADING to FULL, Loading Done

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

  192.168.9.0/30 is subnetted, 16 subnets
O E2   192.168.9.0 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.9.4 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.9.8 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.9.12 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.9.16 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O      192.168.9.20 [200/192] via 192.168.9.57, 01:46:01, Serial0/1/0
O      192.168.9.24 [200/192] via 192.168.9.57, 01:46:01, Serial0/1/0
O      192.168.9.28 [200/128] via 192.168.9.57, 01:46:11, Serial0/1/0
O      192.168.9.32 [200/128] via 192.168.9.57, 01:46:11, Serial0/1/0
O      192.168.9.36 [200/192] via 192.168.9.57, 01:46:01, Serial0/1/0
O      192.168.9.40 [200/193] via 192.168.9.57, 01:46:01, Serial0/1/0
C      192.168.9.56 is directly connected, Serial0/1/0
C      192.168.9.60 is directly connected, FastEthernet0/0
R      192.168.9.64 [120/1] via 192.168.9.74, 00:00:25, Serial0/0/0
          [120/1] via 192.168.9.70, 00:00:02, Serial0/3/0
C      192.168.9.68 is directly connected, Serial0/3/0
C      192.168.9.72 is directly connected, Serial0/0/0
  192.168.21.0/24 is variably subnetted, 8 subnets, 4 masks
O E2   192.168.21.0/26 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.21.64/26 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O      192.168.21.128/27 [200/193] via 192.168.9.57, 01:46:01, Serial0/1/0
R      192.168.21.160/27 [120/1] via 192.168.9.70, 00:00:02, Serial0/3/0
R      192.168.21.192/27 [120/1] via 192.168.9.74, 00:00:25, Serial0/0/0
C      192.168.21.224/28 is directly connected, FastEthernet0/1
O E2   192.168.21.240/29 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0
O E2   192.168.21.248/29 [200/20] via 192.168.9.57, 01:46:01, Serial0/1/0

Router#show access-list
Standard IP access list 1
    10 deny host 192.168.9.14
    20 deny host 192.168.9.18
    30 deny host 192.168.9.42
    40 permit any (1 match(es))

Router#
```

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## RESULT AND TESTING








### The Results of my Testing:








#### Management Department:

 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Successful	PC15	Server3	ICMP		0.000	N	2	(edit)	(delete)	
Toggle PDU List Window		Successful	PC15	Server2	ICMP		0.000	N	3	(edit)	(delete)	
		Successful	PC12	PC9	ICMP		0.000	N	4	(edit)	(delete)	▾








 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Successful	PC15	Server1	ICMP		0.000	N	0	(edit)	(delete)	
Toggle PDU List Window		Successful	PC15	PC3	ICMP		0.000	N	1	(edit)	(delete)	








#### Support Department:

 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Successful	PC9	Server2	ICMP		0.000	N	0	(edit)	(delete)	
Toggle PDU List Window		Failed	PC9	Server3	ICMP		0.000	N	1	(edit)	(delete)	
		Failed	PC9	PC5	ICMP		0.000	N	2	(edit)	(delete)	▾

 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Failed	PC9	Server1	ICMP		0.000	N	3	(edit)	(delete)	
Toggle PDU List Window		Failed	PC6	Server0	ICMP		0.000	N	4	(edit)	(delete)	
		Successful	PC11	PC15	ICMP		0.000	N	5	(edit)	(delete)	▾

#### Sales Department:

 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Successful	PC2	Server3	ICMP		0.000	N	0	(edit)	(delete)	
Toggle PDU List Window		Failed	PC2	Server2	ICMP		0.000	N	1	(edit)	(delete)	
		Failed	PC1	Server0	ICMP		0.000	N	2	(edit)	(delete)	▾

 Scenario 0 ▾	Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete	^
New Delete		Failed	PC5	Server1	ICMP		0.000	N	3	(edit)	(delete)	
Toggle PDU List Window		Successful	PC1	PC12	ICMP		0.000	N	4	(edit)	(delete)	
		Successful	PC3	PC9	ICMP		0.000	N	5	(edit)	(delete)	▾

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## CHALLENGES AND LEARNING

I had challenges like connecting different routing protocols together but I learned redistribution and with help of it I was able to connect these networks. I also was not able to put sub-nets in RIP protocol so I learned about RIPv2 and used it for sub-netting connections.

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## CONCLUSION

The successful implementation of the **Small Office Network** project demonstrates the effective design and configuration of a multi-protocol network using **EIGRP**, **OSPF**, **RIP**, and **Static Routing**, along with dynamic IP address allocation through **DHCP**. By integrating different routing protocols, the project highlights how diverse protocols can coexist and communicate efficiently within a network through proper route redistribution and configuration.

This project provided valuable insights into network scalability, efficient resource management, and troubleshooting techniques. The use of **Cisco Packet Tracer** facilitated the simulation and validation of the network, ensuring all devices maintained seamless connectivity. The challenges encountered during the configuration process, especially in protocol redistribution and addressing conflicts, were overcome through meticulous planning and the application of networking best practices.

In conclusion, this project not only strengthened foundational networking skills but also demonstrated the importance of protocol interoperability and dynamic IP management in modern networks. Future improvements could include implementing **security measures** such as **ACLs** and **OSPF authentication**, as well as exploring **QoS** (Quality of Service) to optimize traffic flow.