

Course: CSE 462 - Network Analysis and Design**LAB 3 – InterVLAN routing and ACL**

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Final Score	

Lab Exercise Submission

Students are responsible for submitting the requested work files by the stated deadline for full scores. Late submissions are NOT accepted.

Objective: This lab is to guide you how to configure Inter-VLAN routing and ACL in LAN networks.

NOTE: *Students should read the guideline carefully before conducting Lab experiments.*

☐ - **Good luck** - ☐

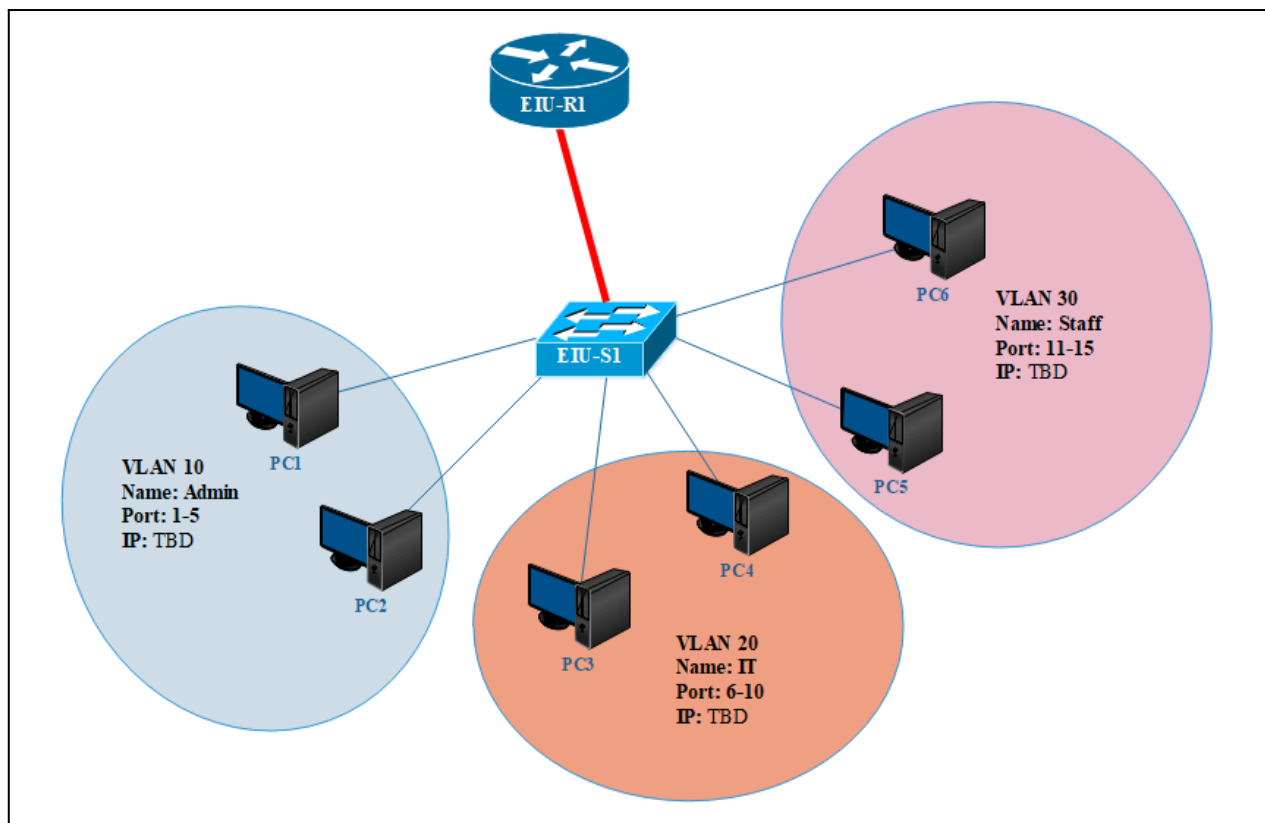


Figure 3.1. Network Topology

TASK 1 – IP ADDRESS ASSIGNMENT

Table 3.1. IP Address Allocation for each group.

#	Group	IP Assignment
1	Group 1	192.168.10.0/24
2	Group 2	192.168.20.0/24
3	Group 3	192.168.30.0/24

- Based on the IP address allocation for your GROUP, you need to assign IP address for each VLAN in your network (**at least 50 IP addresses for each VLAN**) and complete the Table 3.2.

Table 3.2. IP Address Allocation for each VLAN in your network.

#	VLAN Name	VLAN ID	IP Allocation
1	Admin	10	192.168.10.0 - 192.168.10.63
2	IT	20	192.168.10.64 - 192.168.10.127
3	Staff	30	192.168.10.128 - 192.168.10.191

- Based on the IP address allocation for your GROUP, you need to assign IP address for all devices in the network and complete the Table 3.3.

Table 3.3. IP Address Allocation for all devices in your network.

Device	Interface	IP Address	Subnet Mask	Default Gateway
EIU-R1	Gi0/1.10	192.168.10.1/26	255.255.255.192	192.168.10.1
	Gi0/1.20	192.168.10.65/26	255.255.255.192	192.168.10.65
	Gi0/1.30	192.168.10.129/26	255.255.255.192	192.168.10.129
EIU-S1	Fa0/17	192.168.10.135	255.255.255.224	
PC1	Fa0/1	192.168.10.3	255.255.255.192	192.168.10.1
PC2	Fa0/2	192.168.10.4	255.255.255.192	192.168.10.1
PC3	Fa0/7	192.168.10.66	255.255.255.192	192.168.10.65
PC4	Fa0/8	192.168.10.67	255.255.255.192	192.168.10.65
PC5	Fa0/11	192.168.10.130	255.255.255.192	192.168.10.129
PC6	Fa0/12	192.168.10.131	255.255.255.192	192.168.10.129

TASK 2 – BASIC CONFIGURATION

Step 1: Configure IP Address for all PC devices in the network model (Figure 3.1) according to your IP address allocation (Table 3.3)

PC1 (VLAN10) :

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address: 192 . 168 . 10 . 3

Subnet mask: 255 . 255 . 255 . 192

Default gateway: 192 . 168 . 10 . 1

Ethernet adapter Ethernet:

```
Connection-specific DNS Suffix . : 
Link-local IPv6 Address . . . . . : fe80::69e1:12bb:4001:a6e2%12
IPv4 Address. . . . . : 192.168.10.3
Subnet Mask . . . . . : 255.255.255.192
Default Gateway . . . . . : 192.168.10.1
```

PC3 (VLAN20) :

Ethernet adapter Ethernet:

```
Connection-specific DNS Suffix . : 
Link-local IPv6 Address . . . . . : fe80::fa:b4d4:a397:8205%17
IPv4 Address. . . . . : 192.168.10.66
Subnet Mask . . . . . : 255.255.255.192
Default Gateway . . . . . : 192.168.10.65
```

PC5 (VLAN 30) : 192.168.10.130

255.255.255.192

192.168.10.129

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network support this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address:	192 . 168 . 10 . 130
Subnet mask:	255 . 255 . 255 . 192
Default gateway:	192 . 168 . 10 . 129

Step 2: Configure IP Address for the switch EIU-S1

- To configure the IP for the Switch, you **must go to interface vlan1**, and the IP on the switch is **only for the management purpose**.

```
EIU-S1(config)#  
EIU-S1(config)#int vlan1  
EIU-S1(config-if)#ip add 192.168.10.2 255.255.255.0  
EIU-S1(config-if)#ip add 192.168.10.2 255.255.255.192  
EIU-S1(config-if)#exit  
EIU-S1(config)#ip de  
EIU-S1(config)#ip defa  
EIU-S1(config)#ip default-ga  
EIU-S1(config)#ip default-gateway 192.168.10.1  
EIU-S1(config)#exit  
EIU-S1#
```

Step 2: Configure SSH services for Router EIU-R1 and Switch EIU-S1

- Set enable pass as “**ei@123**”
- Configure and set password for **SSH** session, password is “**cisco@123**”
- Check the SSH service by connecting from the PCs using SSH service

Router:

```
Enter configuration commands, one per line.
Router(config)#hostname EIU-R1
EIU-R1(config)#enable secret eiu@123
EIU-R1(config)#ip dom
EIU-R1(config)#ip domain-name router.com
EIU-R1(config)#cr
EIU-R1(config)#cry
EIU-R1(config)#crypto key gen
EIU-R1(config)#crypto key generate rsa
The name for the keys will be: EIU-R1.router.com
Choose the size of the key modulus in the range of 360 to 4096 for your
  General Purpose Keys. Choosing a key modulus greater than 512 may take
  a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...
[OK] (elapsed time was 1 seconds)
```

```
EIU-R1(config)#
Nov  7 06:34:20.611: %SSH-5-ENABLED: SSH 1.99 has been enabled
EIU-R1(config)#
EIU-R1(config)#username admin p
EIU-R1(config)#username admin pro
EIU-R1(config)#username admin pri
EIU-R1(config)#username admin privilege
EIU-R1(config)#username admin privilege 15 se
EIU-R1(config)#username admin privilege 15 secret cisco@123
EIU-R1(config)#line vty 0 4
EIU-R1(config-line)#trans
EIU-R1(config-line)#transport i
EIU-R1(config-line)#transport input ssh
EIU-R1(config-line)#login local
EIU-R1(config-line)#exit
EIU-R1(config)#ip ssh ver 2
EIU-R1(config)#exit
EIU-R1#
```

Switch:

```
EIU-S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
EIU-S1(config)#enable secret eiu@123
EIU-S1(config)#crypto key generate rsa
% Please define a domain-name first.
EIU-S1(config)#ip dom
EIU-S1(config)#ip domain-name switch.com
EIU-S1(config)#crypto key generate rsa
The name for the keys will be: EIU-S1.switch.com
Choose the size of the key modulus in the range of 360 to 4096 for your
  General Purpose Keys. Choosing a key modulus greater than 512 may take
  a few minutes.

How many bits in the modulus [512]: 1024
```

```
EIU-S1(config)#
*Mar  1 00:27:19.075: %SSH-5-ENABLED: SSH 1.99 has been enabled
EIU-S1(config)#username admin pri
EIU-S1(config)#username admin privilege 15 se
EIU-S1(config)#username admin privilege 15 secret cisco@123
EIU-S1(config)#line vty 0 4
EIU-S1(config-line)#tran
EIU-S1(config-line)#transport in
EIU-S1(config-line)#transport input ssh
EIU-S1(config-line)#logi
EIU-S1(config-line)#login lo
EIU-S1(config-line)#login local
EIU-S1(config-line)#exit
EIU-S1(config)#ip ssh ver 2
EIU-S1(config)#exit
EIU-S1#
```

Step 3: Verify the network connection.

1. Ping between PC1 and PC2, PC3 and PC4? Was it successful? Why?

PC1 → PC2 : Successful . This is because they have the same default gateway.

2. Ping between PC1, PC3 and PC5? Was it successful? Why?

PC1 → PC3 : Failed : Because : they are different in Default Gateway

TASK 3 – VLAN CONFIGURATION**Step 1: Create VLAN on Switch**

```
EIU-S1(config-if)#exit
EIU-S1(config)#vlan 10
EIU-S1(config-vlan)#name Admin
EIU-S1(config-vlan)#exit
EIU-S1(config)#vlan 20
EIU-S1(config-vlan)#name IT
EIU-S1(config-vlan)#exit
EIU-S1(config)#vlan 30
EIU-S1(config-vlan)#name Staff
EIU-S1(config-vlan)#exit
EIU-S1(config)#
```

Step 2: Assign ports to VLANs

```
EIU-S1(config-if-range)#sw
EIU-S1(config-if-range)#switchport mode ac
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport ac
EIU-S1(config-if-range)#switchport access vlan 10
EIU-S1(config-if-range)#int range fa0/6 - 10
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport access vlan 20
EIU-S1(config-if-range)#int range fa0/11 - 15
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport access vlan 30
EIU-S1(config-if-range)#
```

Step 3: Check configuration information:

SW1#show running-config

```

EIU-S1#sh run
Building configuration...

Current configuration : 2381 bytes
!
! Last configuration change at 00:38:11 UTC Mon
!
version 12.2
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname EIU-S1
!

```

SW1#show vlan

VLAN	Name	Status	Ports
1	default	active	Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22, Fa0/23 Fa0/24, Gi0/1, Gi0/2
10	Admin	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5
20	IT	active	Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10
30	Staff	active	Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15
1002	fddi-default	act/unsup	

Step 4: Check the connection between PCs and between PC and Switch

1. Use the **Ping** command to test the connection between PCs in the same VLAN. Was it successful? Why?
2. Use the **Ping** command to check the connection between PCs in different VLANs. Was it successful? Why?

Answer:

1. Yes, because it is in the same Vlan.
2. No, because it is in a different Vlan.

TASK 4 – ROUTING BETWEEN VLANS

Step 1: On Switch EIU-S1, configure Trunk mode for the interface connecting EIU-S1 and EIU-R1

SW1 (config)#interface **xxx** (**xxx** is the interface on S1 used to connect to R1)

SW1 (config-if)#switchport mode trunk

```
EIU-S1(config)#int fa0/17
EIU-S1(config-if)#s
EIU-S1(config-if)#sw
EIU-S1(config-if)#switchport trunk int en
EIU-S1(config-if)#switchport trunk en
EIU-S1(config-if)#switchport trunk encapsulation dot1q
EIU-S1(config-if)#swo
EIU-S1(config-if)#swi
EIU-S1(config-if)#switchport mode trunk
```

Step 2: Allow VLANs to pass through the trunk port on Switch S1

SW1 (config-if)# switchport trunk allowed vlan 10 **(Allow VLAN 10)**

Do the same for other VLANs.

```
EIU-S1(config-if)#sw
EIU-S1(config-if)#switchport trunk a;
EIU-S1(config-if)#switchport trunk al
EIU-S1(config-if)#switchport trunk allowed vlan 10,20,30
EIU-S1(config-if)#exit
```

Step 4: Configure routing for VLANs on ROUTER R1

On Router R1, **create a sub_interface** for the interface used to connect to S1 (for example Fastethernet0/0)

Firstly, you **must activate** the Fastethernet interface, but **do not assign an IP address**.

Router(config)#interface **fastethernet 0/0**

Router(config-if)#**no shutdown**

Router(config-if)#exit

```
EIU-R1(config)#int gi0/1
EIU-R1(config-if)#no shut
EIU-R1(config-if)#exit
EIU-R1(config)#
```

Create sub_interface (corresponding to VLANs on switch S1):

Router(config)#**interface fastethernet 0/0.10**

Router(config-subif)#**encapsulation dot1q 10** (Create connection for VLAN 10)

Router(config-subif)#**ip address xxx**

Router(config-subif)# **exit**

Similarly, create sub interfaces for other VLANs

```
EIU-R1(config)#
EIU-R1(config)#int gi0/1.10
EIU-R1(config-subif)#en
EIU-R1(config-subif)#encapsulation dot1q 10
EIU-R1(config-subif)#ip add 192.168.10.1
% Incomplete command.

EIU-R1(config-subif)#ip add 192.168.10.1 255.255.255.192
EIU-R1(config-subif)#exit
```

```
EIU-R1(config)#int gi0/1.20
EIU-R1(config-subif)#encapsulation dot1q 20
EIU-R1(config-subif)#ip add 192.168.10.65 255.255.255.192
EIU-R1(config-subif)#int gi0/1.30
EIU-R1(config-subif)#encapsulation dot1q 30
EIU-R1(config-subif)#ip add 192.168.10.129 255.255.255.192
EIU-R1(config-subif)#
```

Step 5: Check the configuration with the following commands:

#Show running-config

```
EIU-R1#
EIU-R1#sh run
Building configuration...

Current configuration : 1706 bytes
!
! Last configuration change at 06:59
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname EIU-R1
!
boot-start-marker
boot-end-marker
```

```

interface GigabitEthernet0/1.10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.192
!
interface GigabitEthernet0/1.20
 encapsulation dot1Q 20
 ip address 192.168.10.65 255.255.255.192
!
interface GigabitEthernet0/1.30
 encapsulation dot1Q 30
 ip address 192.168.10.129 255.255.255.192
!

```

#Show ip interface brief

```

EIU-R1#show vlan brief
% Ambiguous command: "show vlan brief"
EIU-R1#sh ip int brief

```

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	unassigned	YES	unset	up	up
GigabitEthernet0/1.10	192.168.10.1	YES	manual	up	up
GigabitEthernet0/1.20	192.168.10.65	YES	manual	up	up
GigabitEthernet0/1.30	192.168.10.129	YES	manual	up	up

```

Enter Configuration Commands
EIU-R1(config)#ip routing
EIU-R1(config)#end
EIU-R1#

```

#Show int trunk (cannot run this command)

The informations we needs is in command #show running-config

Step 6: Perform a connection testing between PCs in different VLANs, PCs and Router/Switch in the network.

1. Any comments on the ping command results?_____
2. Explain?

Yes, PCs can ping in different Vlan

Because:

- When Inter-VLAN Routing is configured, the router acts as a route between these VLANs.
- If a computer in VLAN 10 sends a packet to VLAN 20, the packet will be forwarded to the router.
- The router will read the destination IP address, recognize it as a different network (different VLAN) and forward the packet to VLAN 20 through the sub-interface or SVI of VLAN 20.

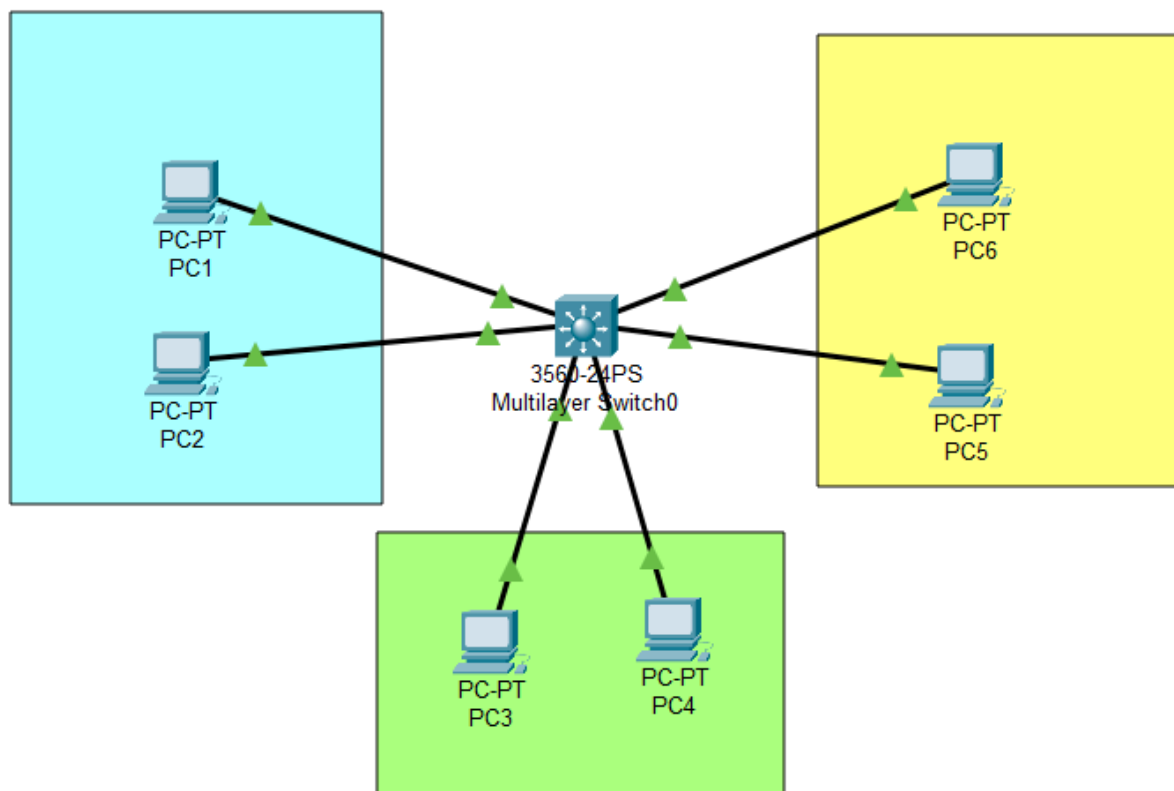
TASK 5 – Inter-VLAN Routing Solutions

1. Propose other solutions to perform routing between VLANs

Layer 3 Switch with SVIs: Configure a Layer 3 switch with Switch Virtual Interfaces (SVIs) for each VLAN. Each SVI acts as a default gateway for its VLAN, enabling efficient inter-VLAN routing at the switch level.

Use of a Multilayer Switch with VRF: Configure VRFs (Virtual Routing and Forwarding) on a Layer 3 switch to create separate routing instances for different VLANs. This approach adds segmentation and security by allowing different VLANs to communicate with other VLANs only if explicitly permitted.

2. Implement your solutions using the devices in Cyber Lab or you can use the simulation tools if the devices are not available.



Port	Link	VLAN	IP Address	IPv6 Address
FastEthernet0/1	Up	10	<not set>	<not set>
FastEthernet0/2	Up	10	<not set>	<not set>
FastEthernet0/3	Down	10	<not set>	<not set>
FastEthernet0/4	Down	10	<not set>	<not set>
FastEthernet0/5	Down	10	<not set>	<not set>
FastEthernet0/6	Down	20	<not set>	<not set>
FastEthernet0/7	Up	20	<not set>	<not set>
FastEthernet0/8	Up	20	<not set>	<not set>
FastEthernet0/9	Down	20	<not set>	<not set>
FastEthernet0/10	Down	20	<not set>	<not set>
FastEthernet0/11	Up	30	<not set>	<not set>
FastEthernet0/12	Up	30	<not set>	<not set>
FastEthernet0/13	Down	30	<not set>	<not set>
FastEthernet0/14	Down	30	<not set>	<not set>
FastEthernet0/15	Down	30	<not set>	<not set>
FastEthernet0/16	Down	1	<not set>	<not set>
FastEthernet0/17	Down	1	<not set>	<not set>
FastEthernet0/18	Down	1	<not set>	<not set>
FastEthernet0/19	Down	1	<not set>	<not set>
FastEthernet0/20	Down	1	<not set>	<not set>
FastEthernet0/21	Down	1	<not set>	<not set>
FastEthernet0/22	Down	1	<not set>	<not set>
FastEthernet0/23	Down	1	<not set>	<not set>
FastEthernet0/24	Down	1	<not set>	<not set>
GigabitEthernet0/1	Down	1	<not set>	<not set>
GigabitEthernet0/2	Down	1	<not set>	<not set>
Vlan1	Down	1	<not set>	<not set>
Vlan10	Up	10	192.168.10.1/26	<not set>
Vlan20	Up	20	192.168.10.65/26	<not set>
Vlan30	Up	30	192.168.10.129/26	<not set>

VLAN	Name	Status	Ports
1	default	active	Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22, Fa0/23 Fa0/24, Gig0/1, Gig0/2
10	Admin	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5
20	IT	active	Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10
30	Staff	active	Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15


```

EIU-S1(config)#int r
EIU-S1(config)#int range fa0/1 -5
EIU-S1(config-if-range)#sw
EIU-S1(config-if-range)#switchport m
EIU-S1(config-if-range)#switchport mode ac
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport mode access v
EIU-S1(config-if-range)#switchport mode access vl
EIU-S1(config-if-range)#switchport mode access vl
EIU-S1(config-if-range)#switchport mode access vlan 10
^
% Invalid input detected at '^' marker.

EIU-S1(config-if-range)#switchport ac
EIU-S1(config-if-range)#switchport access vlan 10
EIU-S1(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up

EIU-S1(config-if-range)#int range fa0/6 - 10
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport access vlan 20
EIU-S1(config-if-range)#
EIU-S1(config-if-range)#
EIU-S1(config-if-range)#
EIU-S1(config-if-range)#int range fa0/11 - 15
EIU-S1(config-if-range)#switchport mode access
EIU-S1(config-if-range)#switchport access vlan 30
EIU-S1(config-if-range)#

Enter configuration commands, one per line. End with CNTL/Z.
EIU-S1(config)#int vlan 10
EIU-S1(config-if)#ip add 192.168.10.1 255.255.255.192
EIU-S1(config-if)#no shut
EIU-S1(config-if)#exit
EIU-S1(config)#int vlan 20
EIU-S1(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up









EIU-S1(config-if)#ip add 192.168.10.65 255.255.255.192
EIU-S1(config-if)#no shut
EIU-S1(config-if)#exit
EIU-S1(config)#
EIU-S1(config)#
EIU-S1(config)#
EIU-S1(config)#
EIU-S1(config)#
EIU-S1(config)#
EIU-S1(config)#int vlan 30
EIU-S1(config-if)#
%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up

EIU-S1(config-if)#ip add 192.168.10.129 255.255.255.192
EIU-S1(config-if)#no shut
EIU-S1(config-if)#
EIU-S1(config-if)#
EIU-S1(config-if)#exit

EIU-S1(config)#
EIU-S1(config)#ip routing
EIU-S1(config)#

```

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC1	PC6	ICMP		0.000	N	0	(edit)
	Successful	PC1	PC3	ICMP		0.000	N	1	(edit)
	Successful	PC2	PC5	ICMP		0.000	N	2	(edit)
	Successful	PC2	PC4	ICMP		0.000	N	3	(edit)