

Computer Network

network project.

work team:

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Step1:

Networks identified.

Computing and Data Science

Host (212)

$2^8=256$

Network IP=193.158.1.0

Broadcast IP= 193.158.1.255

First Host IP=193.158.1.2

Last Host IP=193.158.1.254

Default Gateway=193.158.1.1

Subnet Mask=255.255.255.0

**Subnet Mask (Binary)=11111111 11111111 11111111
00000000**

Business Analytics

Host (125)

$2^7=128$

Network IP=193.158.2.0

Broadcast IP= 193.158.2.127

First Host IP=193.158.2.2

Last Host IP=193.158.2.126

Default Gateway=193.158.2.1

Subnet Mask=255.255.255.128

**Subnet Mask (Binary)=11111111 11111111 11111111
10000000**

Intelligent Systems

Host (47)

$2^6=64$

Network IP=193.158.2.128

Broadcast IP= 193.158.2.191

First Host IP=193.158.2.130

Last Host IP=193.158.2.190

Default Gateway=193.158.2.129

Subnet Mask=255.255.255.192

**Subnet Mask (Binary)=11111111 11111111 11111111
11000000**

Cybersecurity

Host (36)

$2^6=64$

Network IP=193.158.2.192

Broadcast IP= 193.158.2.255

First Host IP=193.158.2.194

Last Host IP=193.158.2.254

Default Gateway=193.158.2.193

Subnet Mask=255.255.255.192

**Subnet Mask (Binary)=11111111 11111111 11111111
11000000**

Media Analytics

Host (10)

$2^4=16$

Network IP=193.158.3.0

Broadcast IP= 193.158.3.15

First Host IP=193.158.3.2

Last Host IP=193.158.3.14

Default Gateway=193.158.3.1

Subnet Mask=255.255.255.240

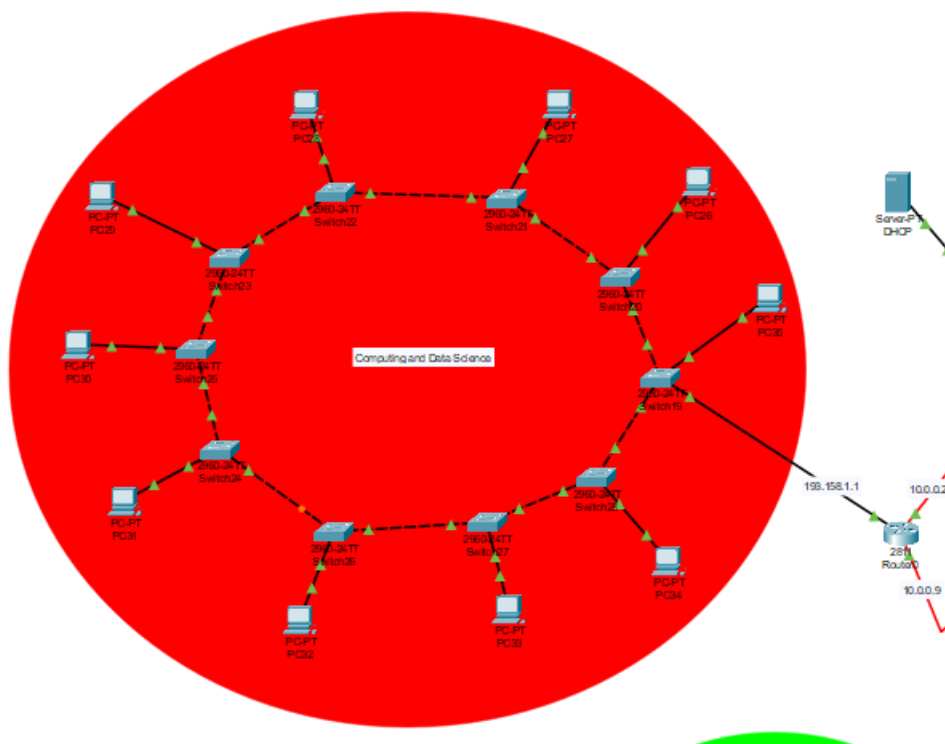
**Subnet Mask (Binary)=11111111 11111111 11111111
11110000**

Step2:

Determine the types of topology that we will use in the project, which are (Bus, Mesh, Ring, Tree and Star)

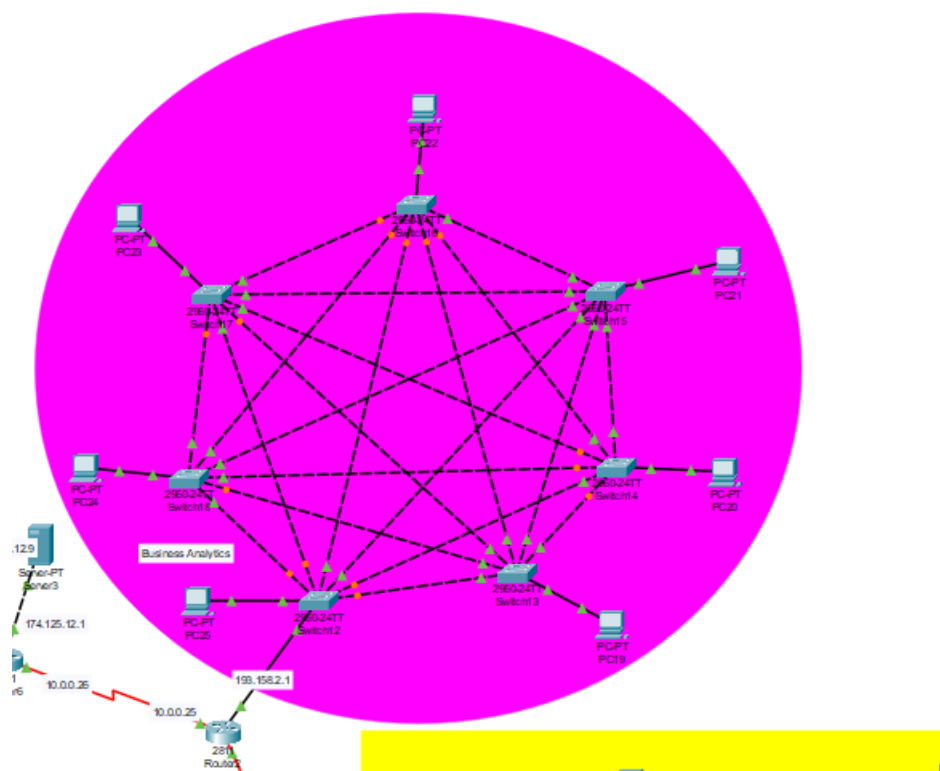
I used Ring Topology with the Computing and Data Science Department because the number of hosts is very large (212) and one of the advantages of Ring Topology is

- The data transmission is high-speed.
- The possibility of collision is minimum in this type of topology.
- Cheap to install and expand.
- It is less costly than a star topology.



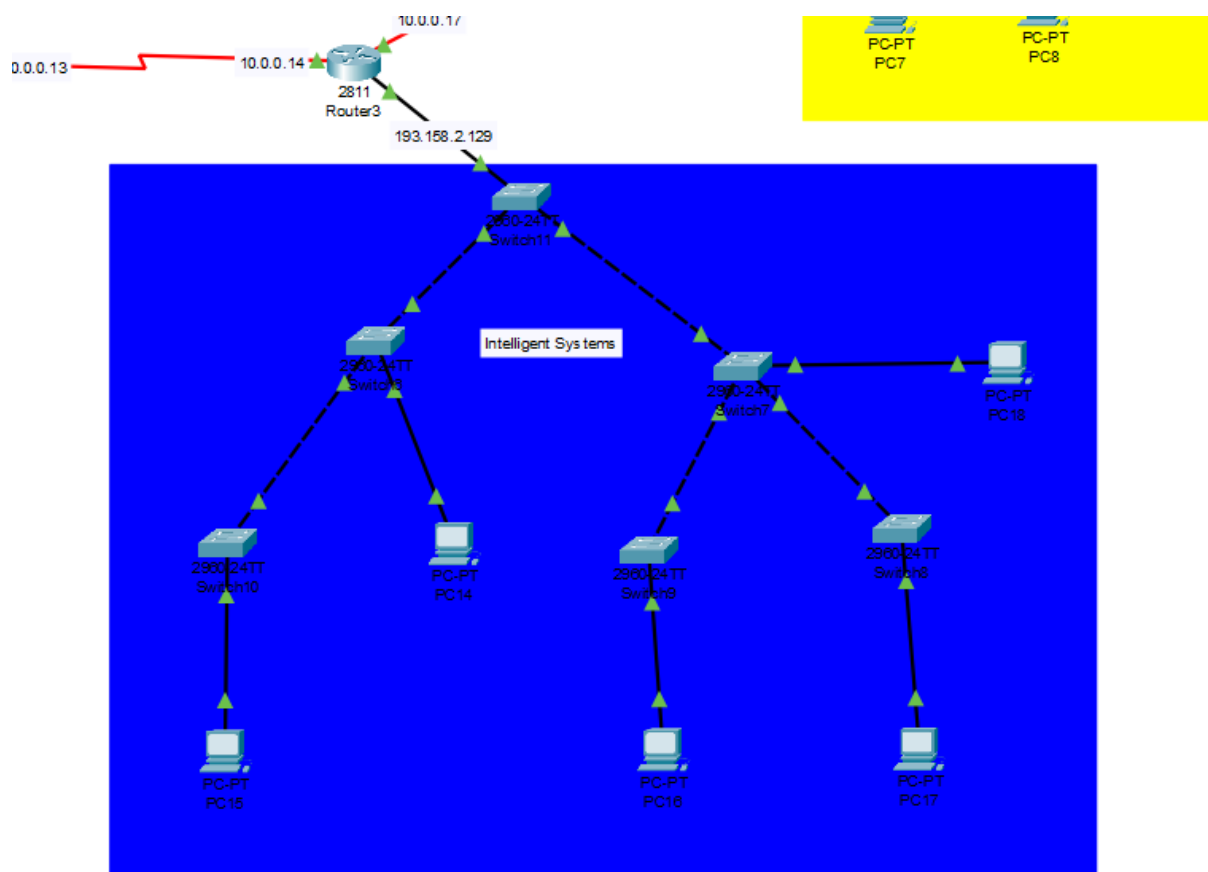
I used Mesh Topology with the Business Analytics Department because the number of hosts is large (125) and one of the advantages of Ring Topology is

- Communication is very fast between the nodes.
- Mesh Topology is robust.
- The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links.
- Provides security and privacy.



I used Tree Topology with the Intelligent Systems Department because the number of hosts is average (47) and one of the advantages of Ring Topology is

- It allows more devices to be attached to a single central hub thus it decreases the distance that is traveled by the signal to come to the devices.
- It allows the network to get isolated and also prioritize from different computers.
- We can add new devices to the existing network.
- Error detection and error correction are very easy in a tree topology.

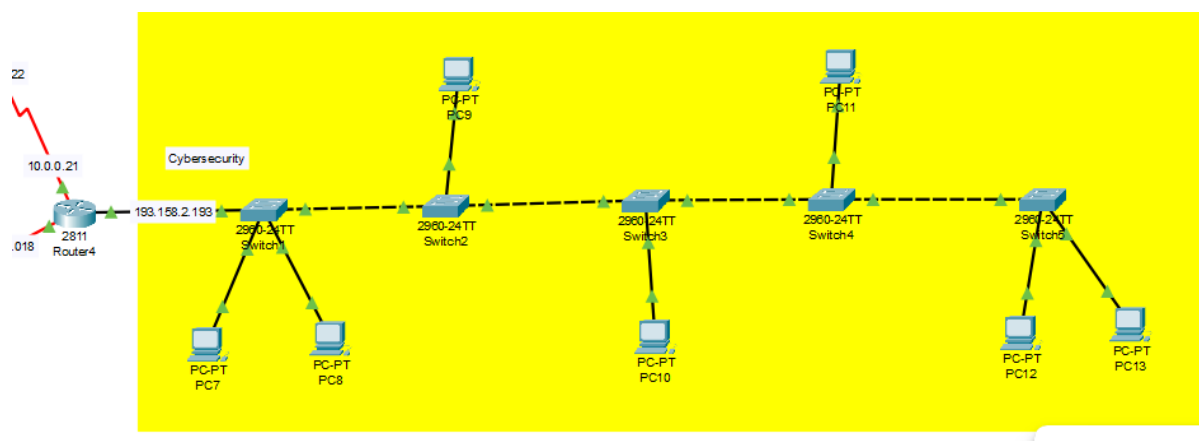


I used Bus Topology with the Cybersecurity Department because the number of hosts is small (36) and one of the advantages of Ring Topology is

- Coaxial or twisted pair cables are mainly used in bus-based networks that support up to 10 Mbps.
- The cost of the cable is less compared to other topologies, but it is used to build small networks.
- Bus topology is familiar technology as installation and troubleshooting techniques are well known.

Drawbacks of Bus Topology

- If the common cable fails, then the whole system will crash down.
- If the network traffic is heavy, it increases collisions in the network.

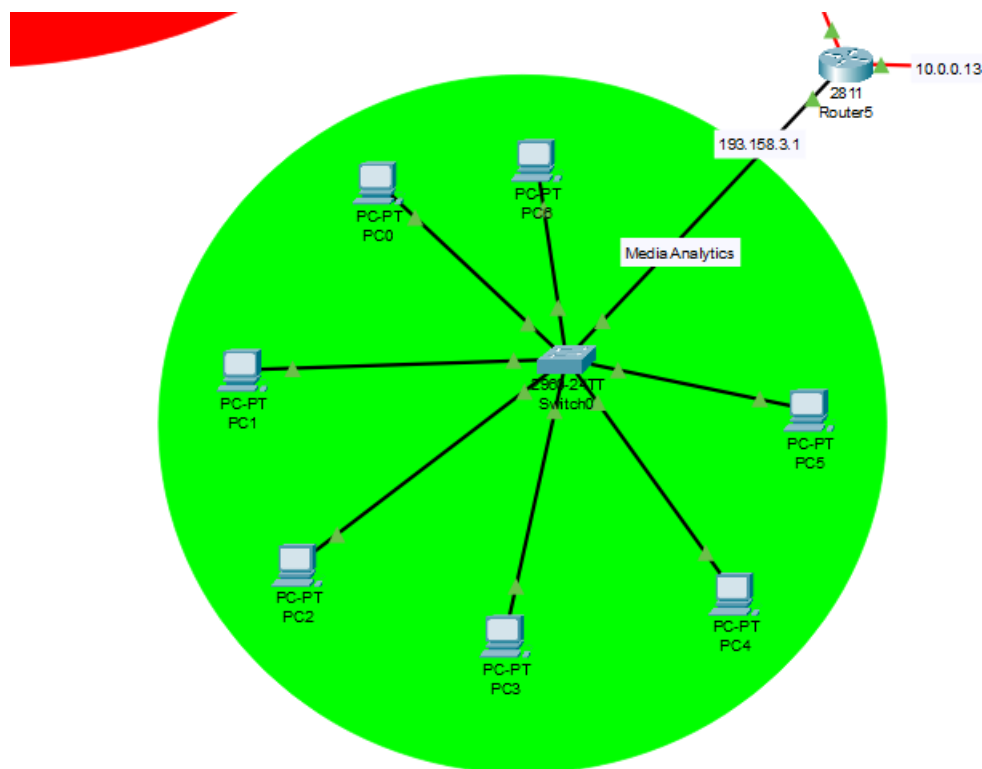


I used Star Topology with the Media Analytics Department because the number of hosts is very small (10) and one of the advantages of Ring Topology is

- It is Robust. If one link fails only that link will affect and not other than that.
- Easy to fault identification and fault isolation.
- Star topology is cost-effective as it uses inexpensive coaxial cable.

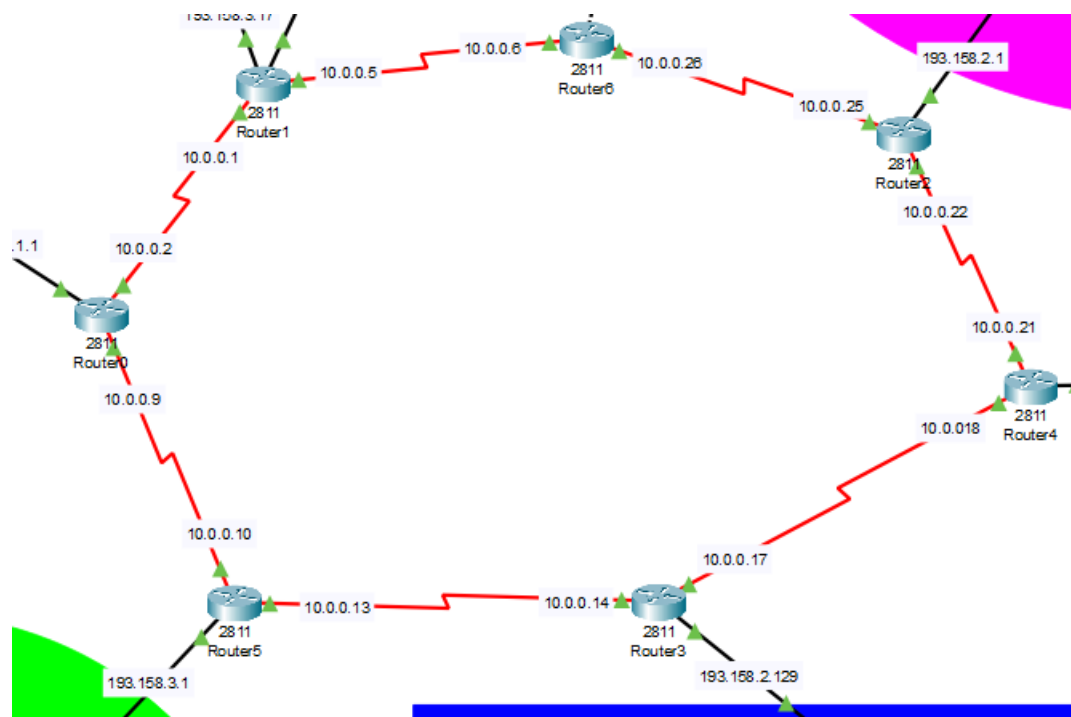
Drawbacks of Star Topology

- If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down.
- The cost of installation is high.
- Performance is based on the single concentrator i.e. hub.



Step3:

I connected all the routers to the 10.0.0 network.



Then I connected the routers to switches.

Step4:

I have made two types of dynamic routing

- The first type (OSPF)

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#rout
Router(config)#router ospf 1
Router(config-router)#new
Router(config-router)#newt
Router(config-router)#net
Router(config-router)#network 193.158.1.0 0.0.0.255 area 0
Router(config-router)#network 193.158.3.0 0.0.0.255 area 0
Router(config-router)#network 193.158.2.128 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#ex
Router(config-router)#exit
Router(config)#
```

```

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 193.158.3.16 0.0.0.255 area 0
Router(config-router)#network 193.158.1.0 0.0.0.255 area 0
Router(config-router)#network 193.158.3.0 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#ex
Router(config-router)#exit
Router(config)#

```

Repeat the same steps to configure the rest of the routers.

- The second type (eIGRP)

```

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
Router(config)#router
Router(config)#router eigrp 10
Router(config-router)#net
Router(config-router)#network 193.158.3.0
Router(config-router)#network 193.158.2.128
Router(config-router)#network 193.158.2.192
Router(config-router)#network 10.0.0.0
Router(config-router)#ex
Router(config-router)#exit
Router(config)#

```

```

Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router
Router(config)#router eigrp 10
Router(config-router)#netw
Router(config-router)#network 193.158.1.0
Router(config-router)#network 193.158.3.0
Router(config-router)#network 193.158.2.128
Router(config-router)#network 10.0.0.0
Router(config-router)#exit
Router(config-router)#exit
Router(config)#

```

Repeat the same steps to configure the rest of the routers.

Step5 (bonus)

I created a DHCP server because it automatically gives IP to hosts and I linked it to a network (193.158.3.16)

Then I gave a range to each network

DHCP

Interface FastEthernet0 ▼ Service ☒ On ☐ Off

Pool Name Business

Default Gateway 193.158.2.1

DNS Server 193.158.3.19

Start IP Address : 193 158 2 0

Subnet Mask: 255 255 255 128

Maximum Number of Users : 125

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Media	193.158.3.1	193.158.3.19	193.158.3.1	255.255.2...	10	0.0.0.0	0.0.0.0
data	193.158.1.1	193.158.3.19	193.158.1.1	255.255.2...	255	0.0.0.0	0.0.0.0
Business	193.158.2.1	193.158.3.19	193.158.2.0	255.255.2...	125	0.0.0.0	0.0.0.0
cyber	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	36	0.0.0.0	0.0.0.0
intelligent	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	47	0.0.0.0	0.0.0.0
serverPool	193.158.1.1	193.158.3.19	193.158.3.20	255.255.2...	4	0.0.0.0	0.0.0.0

Physical Config **Services** Desktop Programming Attributes

SERVICES
 HTTP
DHCP
 DHCPv6
 TFTP
 DNS
 SYSLOG
 AAA
 NTP
 EMAIL
 FTP
 IoT
 VM Management
 Radius EAP

DHCP

Interface: FastEthernet0 Service: ☒ On ☐ Off

Pool Name: Media

Default Gateway: 193.158.3.1

DNS Server: 193.158.3.19

Start IP Address : 193 158 3 1

Subnet Mask: 255 255 255 240

Maximum Number of Users : 10

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Media	193.158.3.1	193.158.3.19	193.158.3.1	255.255.2...	10	0.0.0.0	0.0.0.0
data	193.158.1.1	193.158.3.19	193.158.1.1	255.255.2...	255	0.0.0.0	0.0.0.0
Business	193.158.2.1	193.158.3.19	193.158.2.0	255.255.2...	125	0.0.0.0	0.0.0.0
cyber	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	36	0.0.0.0	0.0.0.0
intelligent	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	47	0.0.0.0	0.0.0.0
serverPool	193.158.1.1	193.158.3.19	193.158.3.20	255.255.2...	4	0.0.0.0	0.0.0.0

DHCP

Interface: FastEthernet0 Service: ☒ On ☐ Off

Pool Name: cyber

Default Gateway: 193.158.2.193

DNS Server: 193.158.3.19

Start IP Address : 193 158 2 193

Subnet Mask: 255 255 255 192

Maximum Number of Users : 36

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Media	193.158.3.1	193.158.3.19	193.158.3.1	255.255.2...	10	0.0.0.0	0.0.0.0
data	193.158.1.1	193.158.3.19	193.158.1.1	255.255.2...	255	0.0.0.0	0.0.0.0
Business	193.158.2.1	193.158.3.19	193.158.2.0	255.255.2...	125	0.0.0.0	0.0.0.0
cyber	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	36	0.0.0.0	0.0.0.0
intelligent	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	47	0.0.0.0	0.0.0.0
serverPool	193.158.1.1	193.158.3.19	193.158.3.20	255.255.2...	4	0.0.0.0	0.0.0.0

DHCP

Interface FastEthernet0 Service ☒ On ☐ Off

Pool Name intelligent

Default Gateway 193.158.2.129

DNS Server 193.158.3.19

Start IP Address : 193 158 2 129

Subnet Mask: 255 255 255 192

Maximum Number of Users : 47

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Media	193.158.3.1	193.158.3.19	193.158.3.1	255.255.2...	10	0.0.0.0	0.0.0.0
data	193.158.1.1	193.158.3.19	193.158.1.1	255.255.2...	255	0.0.0.0	0.0.0.0
Business	193.158.2.1	193.158.3.19	193.158.2.0	255.255.2...	125	0.0.0.0	0.0.0.0
cyber	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	36	0.0.0.0	0.0.0.0
intelligent	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	47	0.0.0.0	0.0.0.0
serverPool	193.158.1.1	193.158.3.19	193.158.3.20	255.255.2...	4	0.0.0.0	0.0.0.0

DHCP

Interface FastEthernet0 Service ☒ On ☐ Off

Pool Name data

Default Gateway 193.158.1.1

DNS Server 193.158.3.19

Start IP Address : 193 158 1 1

Subnet Mask: 255 255 255 0

Maximum Number of Users : 255

TFTP Server: 0.0.0.0

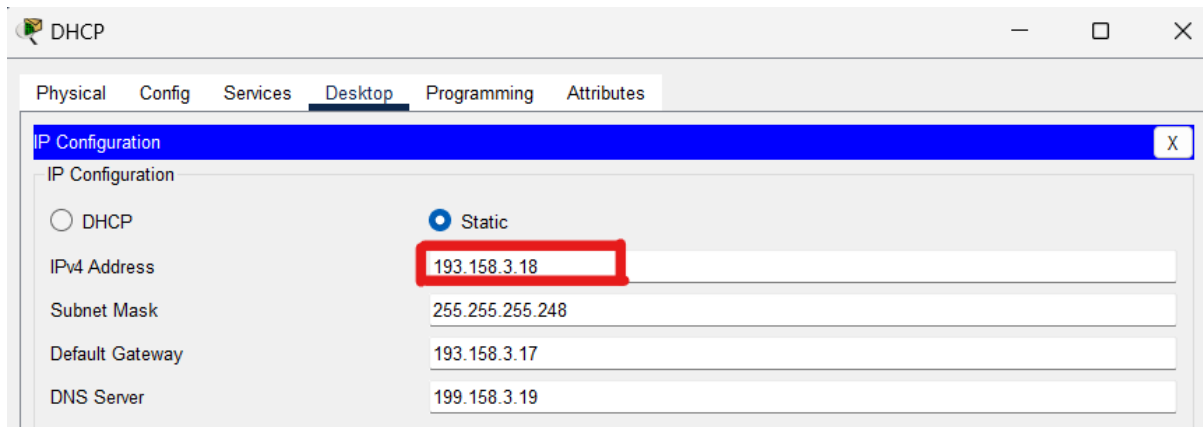
WLC Address: 0.0.0.0

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Media	193.158.3.1	193.158.3.19	193.158.3.1	255.255.2...	10	0.0.0.0	0.0.0.0
data	193.158.1.1	193.158.3.19	193.158.1.1	255.255.2...	255	0.0.0.0	0.0.0.0
Business	193.158.2.1	193.158.3.19	193.158.2.0	255.255.2...	125	0.0.0.0	0.0.0.0
cyber	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	36	0.0.0.0	0.0.0.0
intelligent	193.158.2....	193.158.3.19	193.158.2....	255.255.2...	47	0.0.0.0	0.0.0.0
serverPool	193.158.1.1	193.158.3.19	193.158.3.20	255.255.2...	4	0.0.0.0	0.0.0.0

Next, I went to each router and typed IP helper + DHCP IP address

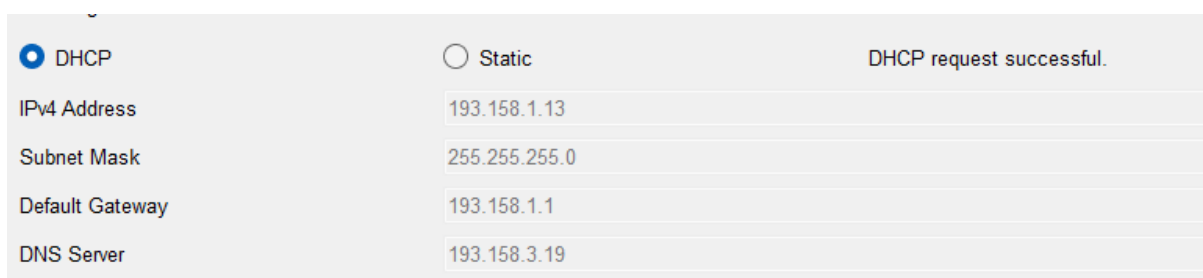
Because when a DHCP broadcast message comes to the router, it starts converting it to the DHCP IP address.



IP Configuration	
<input type="radio"/> DHCP <input checked="" type="radio"/> Static	
IPv4 Address	193.158.3.18
Subnet Mask	255.255.255.248
Default Gateway	193.158.3.17
DNS Server	199.158.3.19

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip helper 193.158.3.18
Router(config-if)#ex
Router(config-if)#exit
Router(config)#
```

After that, I switched the hosts from Static to DHCP



IP Configuration	
<input checked="" type="radio"/> DHCP <input type="radio"/> Static	
IPv4 Address	193.158.1.13
Subnet Mask	255.255.255.0
Default Gateway	193.158.1.1
DNS Server	193.158.3.19

DHCP request successful.

Step6:

NAT

- The first type (PAT)

Media Analytics Department:

```
Router(config-if)#int nat out
Router(config-if)#int nat outs
Router(config-if)#ip nat out
Router(config-if)#ip nat outside
Router(config-if)#ex
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#ex
Router(config-if)#exit
Router(config)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#int se0/3/0
Router(config-if)#ip nat outside
Router(config-if)#exit
Router(config)#access-list 1 permit 193.158.3.0 0.0.0.15
Router(config)#ip nat inside source list 1 interface Se0/3/0 overload
Router(config)#do sh ip nat tr
Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.13:1        193.158.3.2:1    193.158.2.3:1     193.158.2.3:1
icmp 10.0.0.13:2        193.158.3.2:2    193.158.2.3:2     193.158.2.3:2
icmp 10.0.0.13:3        193.158.3.2:3    193.158.2.3:3     193.158.2.3:3
icmp 10.0.0.13:4        193.158.3.2:4    193.158.2.3:4     193.158.2.3:4

Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.13:5        193.158.3.2:5    193.158.2.195:5   193.158.2.195:5
icmp 10.0.0.13:6        193.158.3.2:6    193.158.2.195:6   193.158.2.195:6
icmp 10.0.0.13:7        193.158.3.2:7    193.158.2.195:7   193.158.2.195:7
icmp 10.0.0.13:8        193.158.3.2:8    193.158.2.195:8   193.158.2.195:8

Router(config)#
```

Cybersecurity Department:

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#ex
Router(config)#int se0/3/1
Router(config-if)#ip nat out
Router(config-if)#ip nat outside
Router(config-if)#ex
Router(config)#access-list 1 permit 193.158.2.192 0.0.0.63
Router(config)#ip nat inside source list 1 interface Se0/3/1 overload
Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.21:1        193.158.2.195:1   193.158.2.3:1     193.158.2.3:1
icmp 10.0.0.21:2        193.158.2.195:2   193.158.2.3:2     193.158.2.3:2
icmp 10.0.0.21:3        193.158.2.195:3   193.158.2.3:3     193.158.2.3:3
icmp 10.0.0.21:4        193.158.2.195:4   193.158.2.3:4     193.158.2.3:4
```


Intelligent Systems Department:

```
Router(config)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#^
% Invalid input detected at '^' marker.

Router(config-if)#ip nat inside
Router(config-if)#int se0/3/1
Router(config-if)#ip nat outside
Router(config-if)#ex
Router(config)#Access-list 1 permit 193.158.2.128 0.0.0.63
Router(config)#ip nat inside source list 1 interface se0/3/1 overload
Router(config)#do sh ip nat tr
Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.17:13        193.158.2.130:13  193.158.2.195:13   193.158.2.195:13
icmp 10.0.0.17:14        193.158.2.130:14  193.158.2.195:14   193.158.2.195:14
icmp 10.0.0.17:15        193.158.2.130:15  193.158.2.195:15   193.158.2.195:15
icmp 10.0.0.17:16        193.158.2.130:16  193.158.2.195:16   193.158.2.195:16
icmp 10.0.0.17:17        193.158.2.130:17  193.158.2.194:17   193.158.2.194:17
icmp 10.0.0.17:18        193.158.2.130:18  193.158.2.194:18   193.158.2.194:18
icmp 10.0.0.17:19        193.158.2.130:19  193.158.2.194:19   193.158.2.194:19
icmp 10.0.0.17:20        193.158.2.130:20  193.158.2.194:20   193.158.2.194:20
```

- The second type (Static NAT)

Web server

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#int se0/3/1
Router(config-if)#ip nat out
Router(config-if)#ip nat outside
Router(config-if)#ex
Router(config)#ip nat inside source static 174.125.12.9 10.0.0.6
Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.6:6         174.125.12.9:6    193.158.3.3:6      193.158.3.3:6
icmp 10.0.0.6:7         174.125.12.9:7    193.158.3.3:7      193.158.3.3:7
icmp 10.0.0.6:8         174.125.12.9:8    193.158.3.3:8      193.158.3.3:8
---  10.0.0.6           174.125.12.9      ---                ---

Router(config)#
```

- The third type (Dynamic NAT)

HTTP server

```
Router#
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/1
Router(config-if)#ip nat inside
Router(config-if)#int se0/3/0
Router(config-if)#ip nat outside
Router(config-if)#ex
Router(config)#access-list 1 permit 172.125.12.0 0.0.255.255
Router(config)#access-list 1 deny any
Router(config)#ip nat pool POOL_1 10.0.0.1 10.0.0.5 netmask 255.0.0.0
Router(config)#ip nat inside source list 1 pool POOL_1
Router(config)#do sh ip nat tr
Pro  Inside global      Inside local      Outside local      Outside global
icmp 10.0.0.1:5          172.125.12.9:5    10.0.0.6:5         10.0.0.6:5
icmp 10.0.0.1:6          172.125.12.9:6    10.0.0.6:6         10.0.0.6:6
icmp 10.0.0.1:7          172.125.12.9:7    10.0.0.6:7         10.0.0.6:7
icmp 10.0.0.1:8          172.125.12.9:8    10.0.0.6:8         10.0.0.6:8
Router(config)#
```

Step7:

security

- The first type (Standard IP Access List)

Between Computing and Data Science Department and Business Analytics Department

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 10 deny 193.158.1.0 0.0.0.255
Router(config)#access-list 10 permit any
Router(config)#int s0/3/0
Router(config-if)#ip access-group 10 in
Router(config-if)#int s0/3/1
Router(config-if)#ip access-group 10 in
Router(config-if)#
Router(config-if)#
Router(config-if)#ex
Router(config)#ex
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#do show ip access-list
^
% Invalid input detected at '^' marker.

Router#show ip access-list
Standard IP access list 10
 10 deny 193.158.1.0 0.0.0.255
 20 permit any (11 match(es))

Router#
```

- The second type (Extended IP Access List) (bonus)

Between Computing and Data Science Department and Business Analytics Department

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 101 permit tcp 193.158.1.0 0.0.0.255 host 193.158.2.0 0.0.0.127 eq 80
                                     ^
% Invalid input detected at '^' marker.

Router(config)#access-list 101 permit tcp 193.158.1.0 0.0.0.255 193.158.2.0 0.0.0.127 eq 80
Router(config)#int fa0/0
Router(config-if)#ip access-group 101 in
Router(config-if)#ex
Router(config)#sh ip acces-list
      ^
% Invalid input detected at '^' marker.

Router(config)#shwo ip acces-list
      ^
% Invalid input detected at '^' marker.

Router(config)#show ip acces-list
      ^
% Invalid input detected at '^' marker.

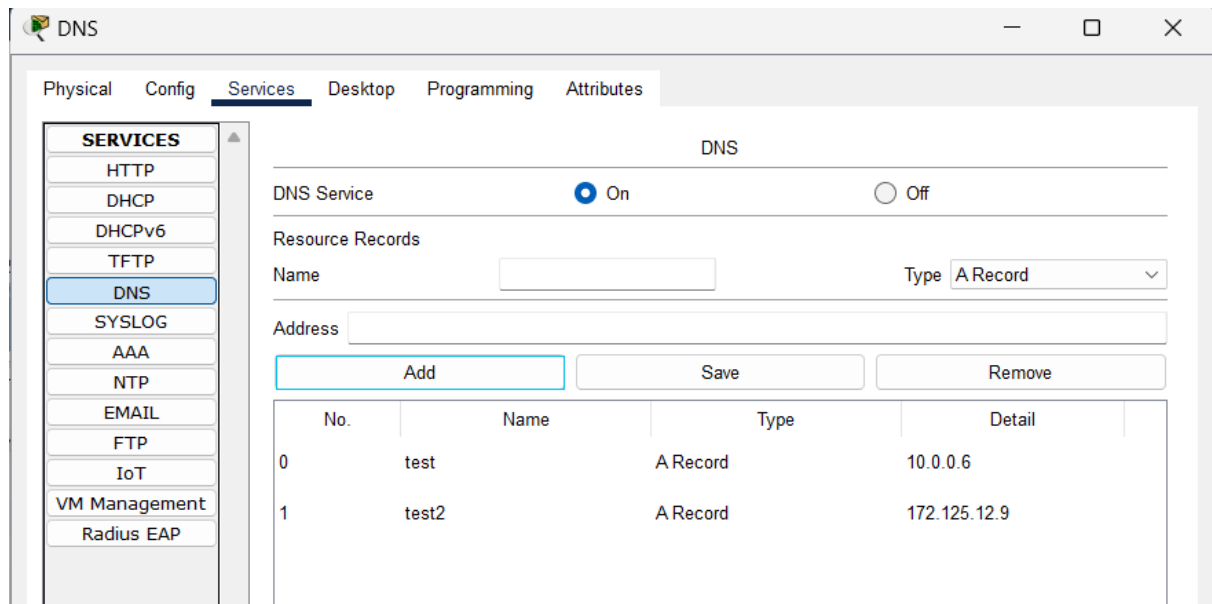
Router(config)#show access-lists
      ^
% Invalid input detected at '^' marker.

Router(config)#ex
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show access-lists
Extended IP access list 101
  10 permit tcp 193.158.1.0 0.0.0.255 193.158.2.0 0.0.0.127 eq www
Router#
```

Step8: bonus in project

- DNS server.



Ping DNS

```
Minimum = 12ms, Maximum = 22ms, Average = 17ms

C:\>ping test2

Pinging 172.125.12.9 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time=2ms TTL=126
Reply from 10.0.0.1: bytes=32 time=22ms TTL=126
Reply from 10.0.0.1: bytes=32 time=23ms TTL=126
Reply from 10.0.0.1: bytes=32 time=2ms TTL=126

Ping statistics for 172.125.12.9:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 23ms, Average = 12ms

C:\>
```

- Using FTP server.

Physical Config **Services** Desktop Programming Attributes

SERVICES

- HTTP
- DHCP
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA
- NTP
- EMAIL
- FTP**
- IoT
- VM Management
- Radius EAP

FTP

Service ☒ On ☐ Off

User Setup

Username Password

☐ Write ☐ Read ☐ Delete ☐ Rename ☐ List

	Username	Password	Permission
1	cisco	cisco	RWDNL
2	test	1234	RWNL

Add Save Remove

File


1	asa842-k8.bin
2	asa923-k8.bin
3	c1841-advipservicesk9-mz.124-15.T1.bin
4	c1841-ipbase-mz.123-14.T7.bin
5	c1841-ipbasek9-mz.124-12.bin
6	c1900-universalk9-mz.SPA.155-3.M4a.bin
7	c2600-advipservicesk9-mz.124-15.T1.bin

Remove

- web server with a designed HTML page.



- DHCP server (page 11).
- more port security on all switches (page 18).

If you want to download the project from here 

[https://drive.google.com/drive/folders/171jQ7g_JNL
AwL8jFZPALx9LxFx_I2WKW?usp=sharing](https://drive.google.com/drive/folders/171jQ7g_JNLAwL8jFZPALx9LxFx_I2WKW?usp=sharing)