East West University

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Mini project

Design a full-fledged network for an organization with multiple subnets

Submitted To:

Dr. Anisur Rahman
Associate Professor,
Department of Computer Science and Engineering
East West University, Dhaka

Submitted By:

K. M. Safin Kamal
ID: 2020-1-60-235

Department of Computer Science and Engineering
East West University, Dhaka

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Title: Design a full-fledged network for an organization with multiple subnets.

1. Introduction:

This is a mini project on University of Professionals is an enterprise that owns a large number of computers, with a complex network infrastructure. Apart from wired internet access, the university also provides wireless internet access for everyone. On top of that the university runs a number of complex networked systems to support several of its business process like admissions, advising, results and so on. This complex network infrastructure is subnetted and switching/routing mechanisms are in practice. University's full network has covered its six campuses with six routers. This university also has some like WEB, DNS and DHCP server.

2. Tools:

1. HTTP Server
2. DNS Server
3. DHCP Server
4. Routers (PT)
5. Switches (2960)
6. Wireless Routers(WRT300N)
7. Access point(PT)
8. Other devices- PC, Laptop, Tablet-PC, smart phone
9. Connectors- straight through, crossover, serial DCE

3. Implementations:

In this project, I have used Cisco Packet Tracer software. Here I have implanted:

1. A Web page that will reflect University of Professionals' web page.
2. A DNS Server to locate webserver
3. A DHCP Server so that IP of hosts of different campuses will be automatically assigned
4. Wireless links to the network
5. Established the University's full network using Six routers of six campuses
6. Subnets in the networks.
7. Network and subnet addresses are formed using all 3 classes
8. Perfect Connectivity between all the hosts

4. Physical Diagram:

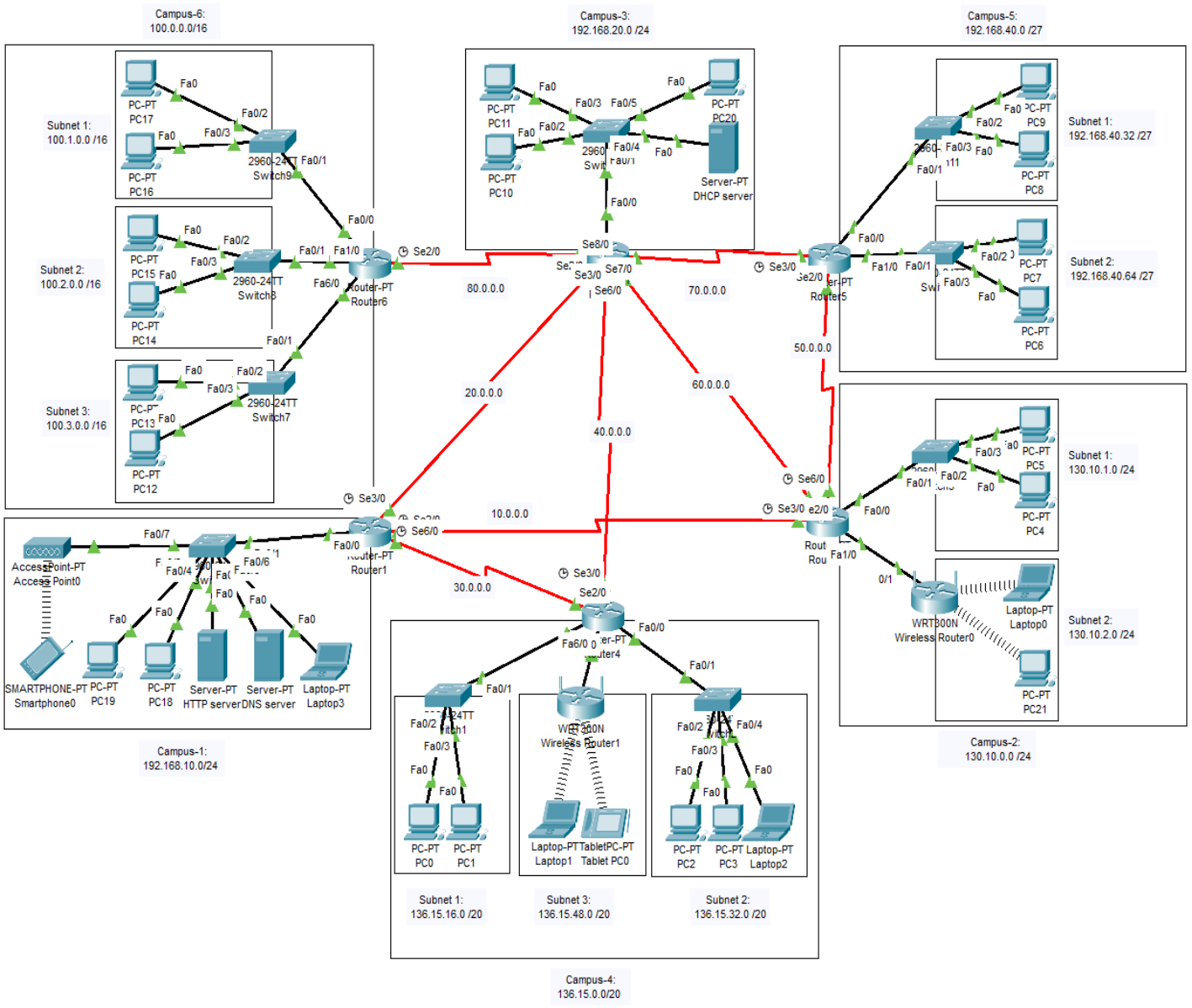

Figure 1: physical diagram of networks of the university area

In this area, there are in total **14** networks and multiple subnets under some networks. I have used all **3** classes for network and subnet addresses. A DHCP server provides IP to all hosts. Wireless links in the networks are available. Here I have used total **28** hosts, **3** servers, **10** switches, **2** wireless routers, **1** access point and **6** PT routers. But we can easily increase the hosts, servers and subnets in future.

5. Project tasks description:

5.1. Networks:

In this project, there is total 14 networks. But 6 of them are the most important networks. Because those are considered as campus networks, others are router to router networks. I have used all 3 classes of IP addresses in those networks. Campus-6 network has class-“A” IP address. Campus-2 and 4 network have class-“B” IP address. Campus-1, 3 and 5 network have class-“C” IP address. Also the router to router networks have class- “A” IP address. The number of networks is fixed in this project. Some of campus networks also have subnets.

5.2. Multiple subnets:

In this project, I have created multiple subnet in the campus networks. In campus 4 and 6 network, there are 3 subnets and in campus 2 and 5 networks have 2 subnets on each. I have used all 3 classes IP to create subnet addresses. Campus-6 subnets have class-“A” IP address. Campus-2 and 4 subnets have class-“B” IP address. Campus- 5 subnets have class-“C” IP address. The subnets are created using different number of bits. For example campus-4 used 4 bits, campus-5 used 3 bits, campus-6 used 8 bits for subnets and so on. Here we can also create more subnets for future use.

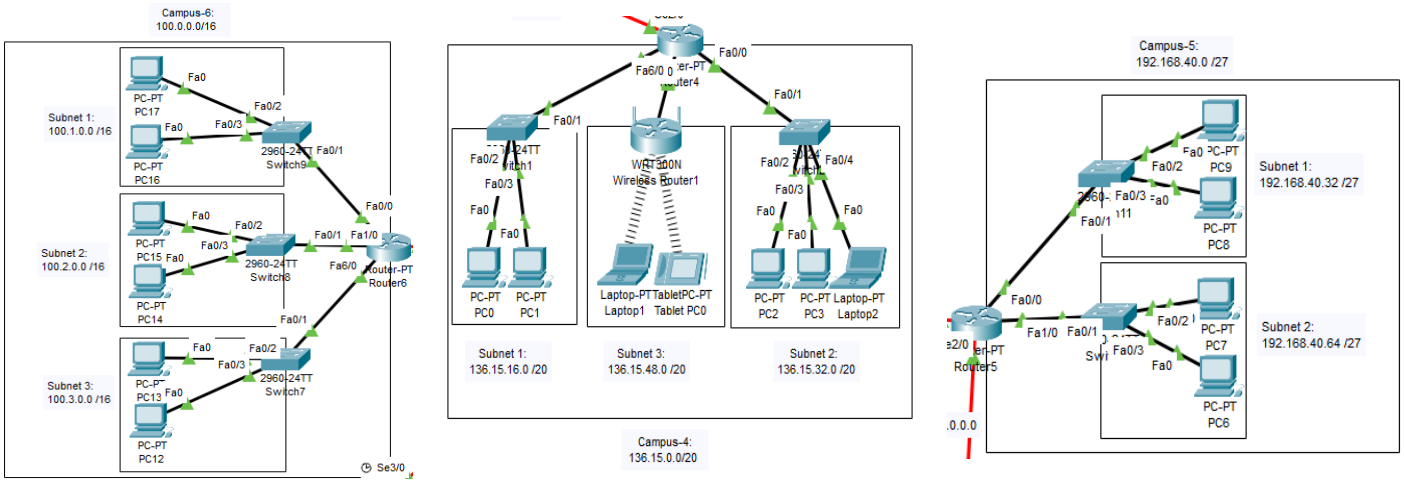

Figure 2: some example of networks with subnets

5.3. Web page and DNS server:

Here I have created a HTTP and DNS server for webpage of the university. I have kept the http and DNS server under same network (campus 1) so that authority can maintain web server easily. Any host can access to the webpage from any campus using the following address: http://www.professionals.edu The Web page of the university reflects University of Professionals’ web page.

IP of HTTP server is 192.168.10.100 and DNS server is 192.168.10.101

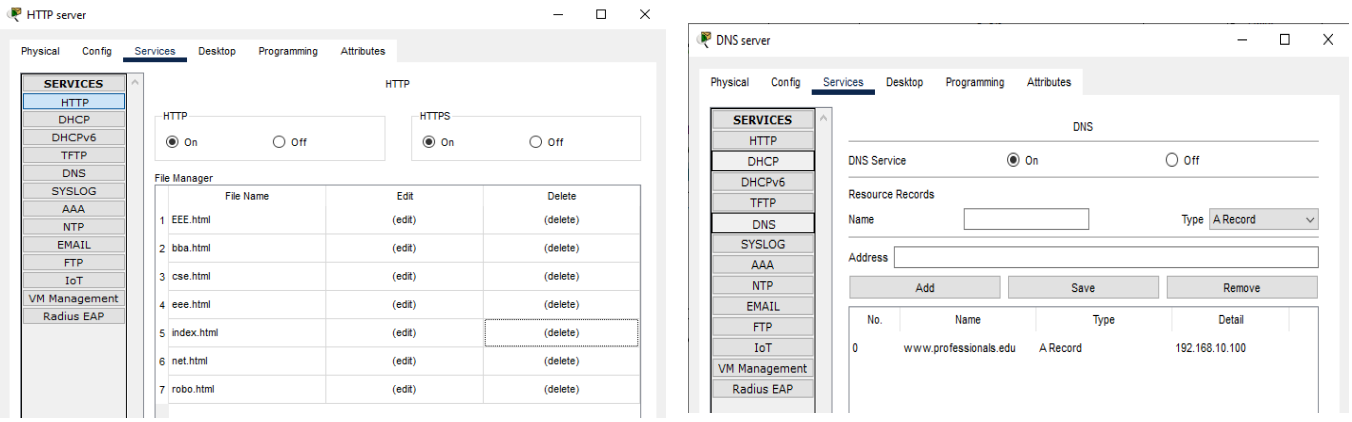

Figure 3: Setting up HTTP and DNS server

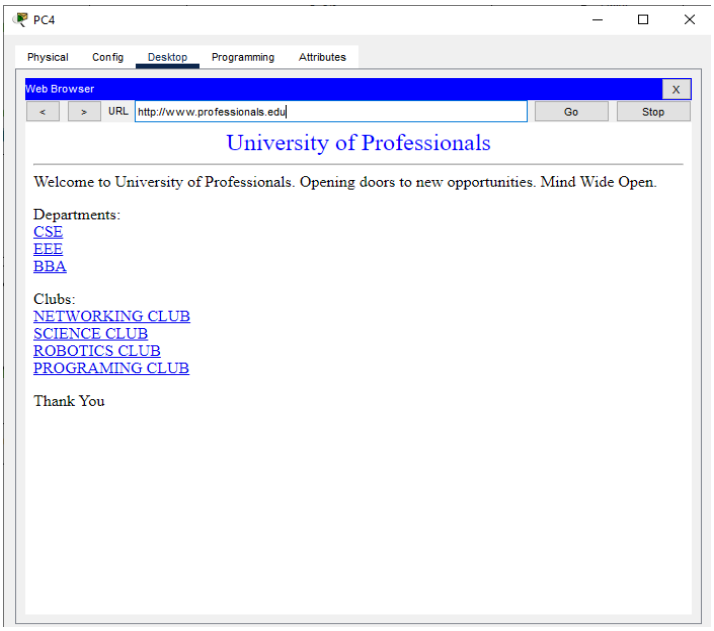

Figure 4: Web page of university

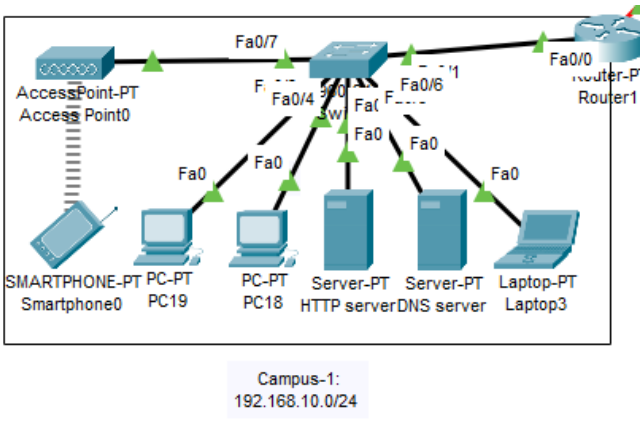

Figure5: HTTP and DNS server location

5.4. DHCP server:

I have used a single DHCP server to provide IP address for the hosts of different campuses automatically. The most challenging part was giving IP to the outer networks' and subnets' hosts. Here I used "Pool Name" technique to solve the problem. After using some command lines, the DHCP successfully provides IP to the outer networks' and subnets' hosts.

I have kept the DHCP server in campus 3. IP of DHCP server is 192.168.20.2

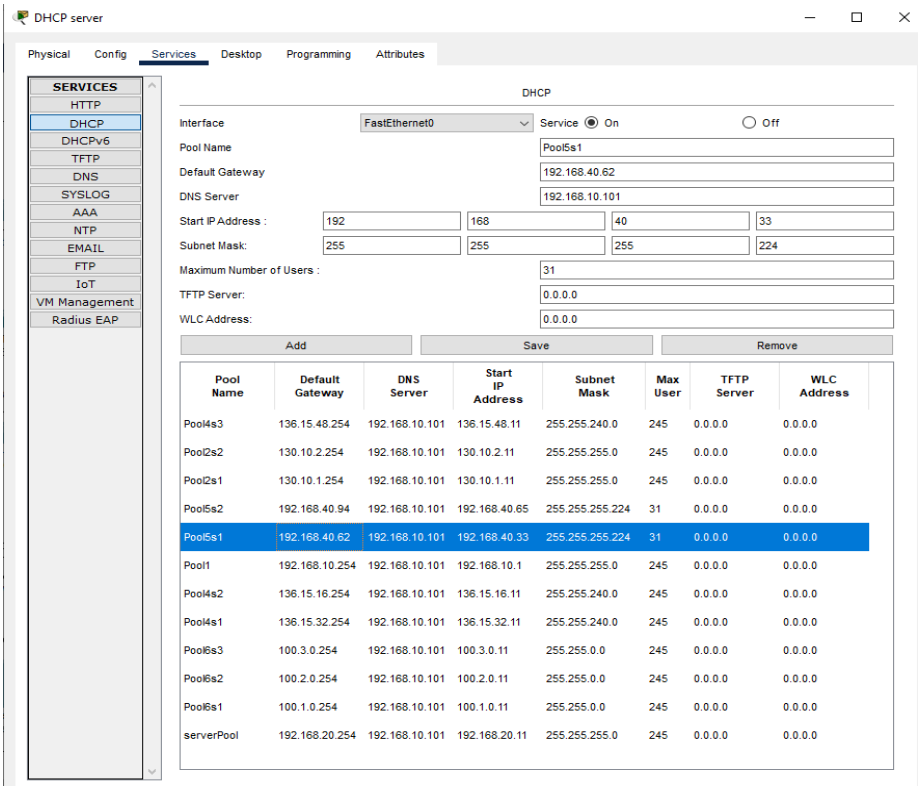

Figure 6: Setting up DHCP server to provide IP for the hosts of different campuses

To provide IP addresses to different campus networks' hosts, I had to config the campus routers using some command lines. The structure of the commands is:

```
conf term               #(command for configuring terminal)
 int fa0/0              #(command for interface at which N/W attached)
 ip helper-address  192.168.20.2   #(IP of DHCP server)
 exit
exit
```

After this, the hosts get IP autommettically :

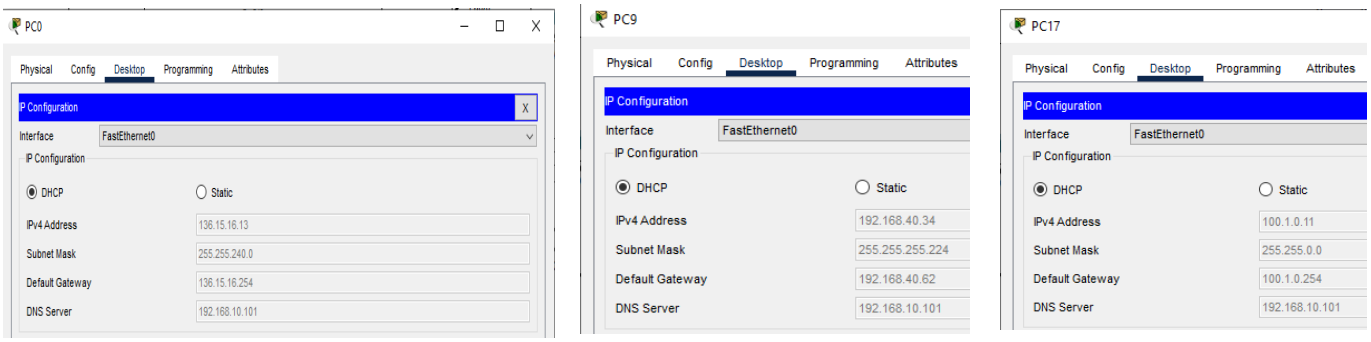

Figure 7: Giving IP address dynamically to hosts of different networks (showing 3 hosts as example)

5.5. Wireless connection:

I have also kept wireless connection facility in some networks as example. The University authority can use wireless connection in every campuses using wireless routers. For wireless connections, I used wireless routers (WRT300N) and access point (PT) and then config them. Also we have to change the network interface card of PCs and laptops to connect with wireless links.

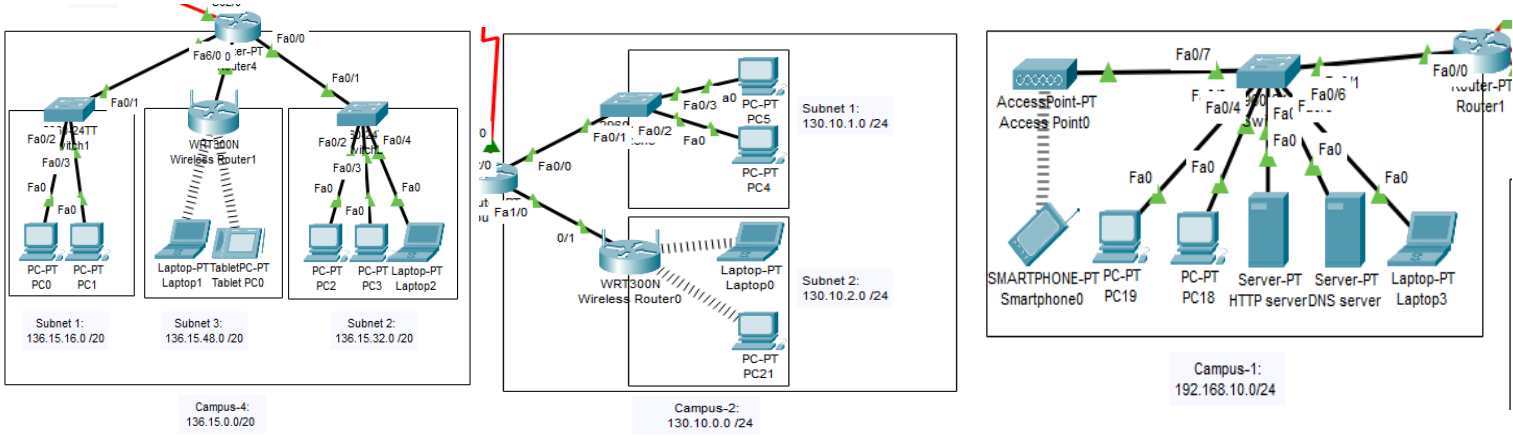

Figure 8: wireless links in campus 1, 2 and 4 networks

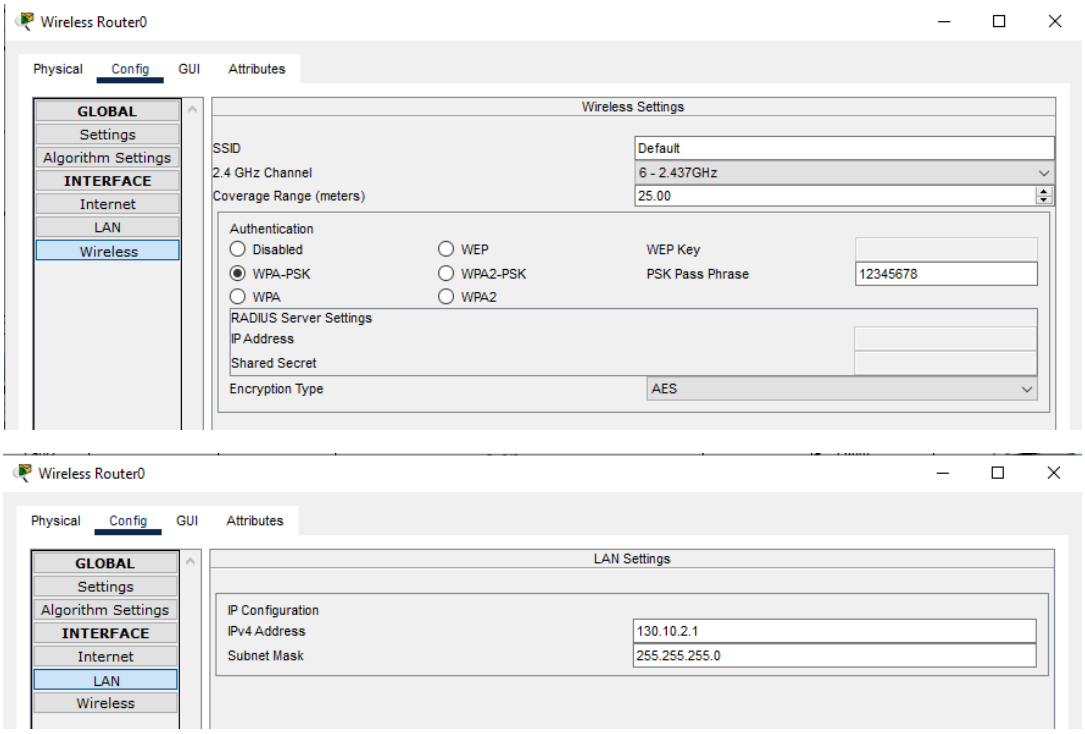

Figure 9: Configuring Wireless routers and access points

5.6. Connectivity between all the hosts:

After configuring all routers, servers, switches and hosts, I have tested the whole network by sending simple PDUs from one host to another host. The result is perfect. Every PDUs successfully reached to destination from different networks/ subnets. So connectivity between all the hosts are perfectly established.

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC1	PC4	ICMP		0.000	N	0	(edit)
	Successful	Laptop1	PC11	ICMP		0.000	N	1	(edit)
	Successful	PC14	PC9	ICMP		0.000	N	2	(edit)
	Successful	PC20	PC21	ICMP		0.000	N	5	(edit)
	Successful	Laptop3	Tablet PC0	ICMP		0.000	N	6	(edit)
	Successful	PC9	PC22	ICMP		0.000	N	7	(edit)
	Successful	PC13	PC3	ICMP		0.000	N	8	(edit)

Figure 10: some examples of successful connections between hosts of different networks/subnets

6. Limitations:

In this project, all the tasks are completed successfully including feature tasks to get bonus. Networks have subnets. Here all the hosts can communicated with each other and can access to the web page using URL. A single DHCP server can give IP automatically. All classes of IP address are used and also have wireless links. But I have used small amount of hosts (28) in each networks to give the project a clean look. Small amount of hosts could be a limitation. Otherwise there is no major limitation.

7. Conclusion:

Despite the fact that I encountered some difficulties, I was able to implement my plan in accordance with the project description in the end. This mini project is a reflection of our gained knowledge from computer networking course. In this project, we had to use the knowledge of different type of classes of IP address, networks, subnets, different type of servers and so on. We learned many new terms and got a chance to use our previous knowledge. So this project is so helpful to us.

8. Codes:

To configure the router I had to use many lines of code in routers' CLI.

8.1. Configure the ports of routers:

```
###########Campus 1 router:
interface fa0/0
ip address 192.168.10.254 255.255.255.0
no shut
do wr

exit

interface se2/0
ip address 10.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit

interface se3/0
ip address 20.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit

interface se6/0
ip address 30.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit



###########Campus 2 router:
interface fa0/0
ip address 130.10.1.254 255.255.255.0
no shut
do wr

exit

interface fa1/0
ip address 130.10.2.254 255.255.255.0
no shut
do wr

exit


interface se2/0
ip address 10.0.0.2 255.0.0.0
```

```
no shut
do wr

exit

interface se3/0
ip address 60.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit

interface se6/0
ip address 50.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit



###########Campus 3 router:
interface fa0/0
ip address 192.168.20.254 255.255.255.0
no shut
do wr

exit

interface se2/0
ip address 20.0.0.2 255.0.0.0
no shut
do wr

exit


interface se3/0
ip address 40.0.0.2 255.0.0.0
no shut
do wr

exit


interface se6/0
ip address 60.0.0.2 255.0.0.0
no shut
do wr

exit
```

```
interface se7/0
ip address 70.0.0.2 255.0.0.0
no shut
do wr

exit

interface se8/0
ip address 80.0.0.2 255.0.0.0
no shut
do wr

exit



##########Campus 4 router:
interface fa0/0
ip address 136.15.32.254 255.255.240.0
no shut
do wr

exit

interface fa1/0
ip address 136.15.16.254 255.255.240.0
no shut
do wr

exit

interface fa6/0
ip address 136.15.48.254 255.255.240.0
no shut
do wr

exit

interface se2/0
ip address 30.0.0.2 255.0.0.0
no shut
do wr

exit

interface se3/0
ip address 40.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit
```

```
###########Campus 5 router:
interface fa0/0
ip address 192.168.40.62 255.255.255.224
no shut
do wr

exit

interface fa1/0
ip address 192.168.40.94 255.255.255.224
no shut
do wr

exit

interface se2/0
ip address 50.0.0.2 255.0.0.0
no shut
do wr

exit

interface se3/0
ip address 70.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit


###########Campus 6 router:
interface fa0/0
ip address 100.1.0.254 255.255.0.0
no shut
do wr

exit


interface fa1/0
ip address 100.2.0.254 255.255.0.0
no shut
do wr

exit

interface fa6/0
ip address 100.3.0.254 255.255.0.0
no shut
do wr

exit
```

```
interface se2/0
ip address 80.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr

exit
```

8.2. Put Routing table to the routers dynamically

```
##########Campus 1 router:

router ospf 1
network 192.168.10.0 0.0.0.255 area 1
network 10.0.0.0 0.255.255.255 area 1
network 20.0.0.0 0.255.255.255 area 1
network 30.0.0.0 0.255.255.255 area 1

exit



##########Campus 2 router:

router ospf 2
network 130.10.0.0 0.0.0.255 area 1
network 10.0.0.0 0.255.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
network 60.0.0.0 0.255.255.255 area 1

exit


##########Campus 3 router:
router ospf 3
network 192.168.20.0 0.0.0.255 area 1
network 80.0.0.0 0.255.255.255 area 1
network 20.0.0.0 0.255.255.255 area 1
network 40.0.0.0 0.255.255.255 area 1
network 60.0.0.0 0.255.255.255 area 1
network 70.0.0.0 0.255.255.255 area 1

exit
```

```
###########Campus 4 router:
router ospf 4
network 136.15.0.0 0.0.15.255 area 1
network 30.0.0.0 0.255.255.255 area 1
network 40.0.0.0 0.255.255.255 area 1

exit


###########Campus 5 router:
router ospf 5
network 192.168.40.0 0.0.0.31 area 1
network 50.0.0.0 0.255.255.255 area 1
network 70.0.0.0 0.255.255.255 area 1

exit


###########Campus 6 router:
router ospf 6
network 100.0.0.0 0.0.255.255 area 1
network 80.0.0.0 0.255.255.255 area 1

exit
```

8.3. Configure routers to connect with DHCP server

```
###########Campus 1 router:
int fa0/0
ip helper-address 192.168.20.2
exit

###########Campus 2 router:
int fa0/0
ip helper-address 192.168.20.2
exit

int fa1/0
ip helper-address 192.168.20.2
exit


###########Campus 3 router:
int fa0/0
ip helper-address 192.168.20.2
exit


###########Campus 4 router:
int fa0/0
ip helper-address 192.168.20.2
exit
```

```
int fa1/0
ip helper-address 192.168.20.2
exit

int fa6/0
ip helper-address 192.168.20.2
exit


##########Campus 5 router:
int fa0/0
ip helper-address 192.168.20.2
exit

int fa1/0
ip helper-address 192.168.20.2
exit


##########Campus 6 router:
int fa0/0
ip helper-address 192.168.20.2
exit

int fa1/0
ip helper-address 192.168.20.2
exit

int fa6/0
ip helper-address 192.168.20.2
exit
```