BIRZEIT UNIVERSITY

Faculty of Engineering and Technology

Department of Electrical and Computer Engineering

ENEE3320, COMPUTER NETWORTKS

Course project 2

Packet Tracer

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Sec:1

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Abstract:

This project consists of 5 parts. All of them are to learn how to use packet tracer. Also, learn how to do the IP subnetting and assignment. Moreover, learn how to configure HTTP Web servers, DNS servers, and Email servers. In addition to that, learn how to setup the routing algorithms on routers like RIPv2 and OSPF. And finally, learn how to setup the VLANs on our switches and routers and PCs (Companies and Data center).

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Procedure

Part0: IP assignment and subnetting:

At the beginning, we connected the topology as specified in the project. The ID chosen for the topology is 1200348 so that the value of the IP address is 195.03.0.0/24. Now, since we need to make 6 subnets then, they can be written in following way:

IP: 195.03.0.0/27

Subnet	Network Address	For which Area	Broadcast Address
First subnet	195.03.0.00000000 → 195.03.0.0/27	VLAN10 (Company1)	195.03.0.31
Second subnet	195.03.0.00100000 → 195.03.0.32/27	VLAN20 (Company2)	195.03.0.63
Third subnet	195.03.0.01000000 → 195.03.0.64/27	VLAN30 (Data Center)	195.03.0.95
Forth subnet	195.03.0.01100000 → 195.03.0.96/27	Home	195.03.0.127
Fifth subnet	195.03.0.10000000 → 195.03.0.128/27	Area 0 Between Router1 and Router2	195.03.0.159
Sixth subnet	195.03.0.10100000 → 195.03.0.160/27	Area 0 Between Router1 and Router0	195.03.0.191

Table 1: Subnetting Table

- subnet mask

  255.255.255.224/27

Part1: Building the topology

structure of the system

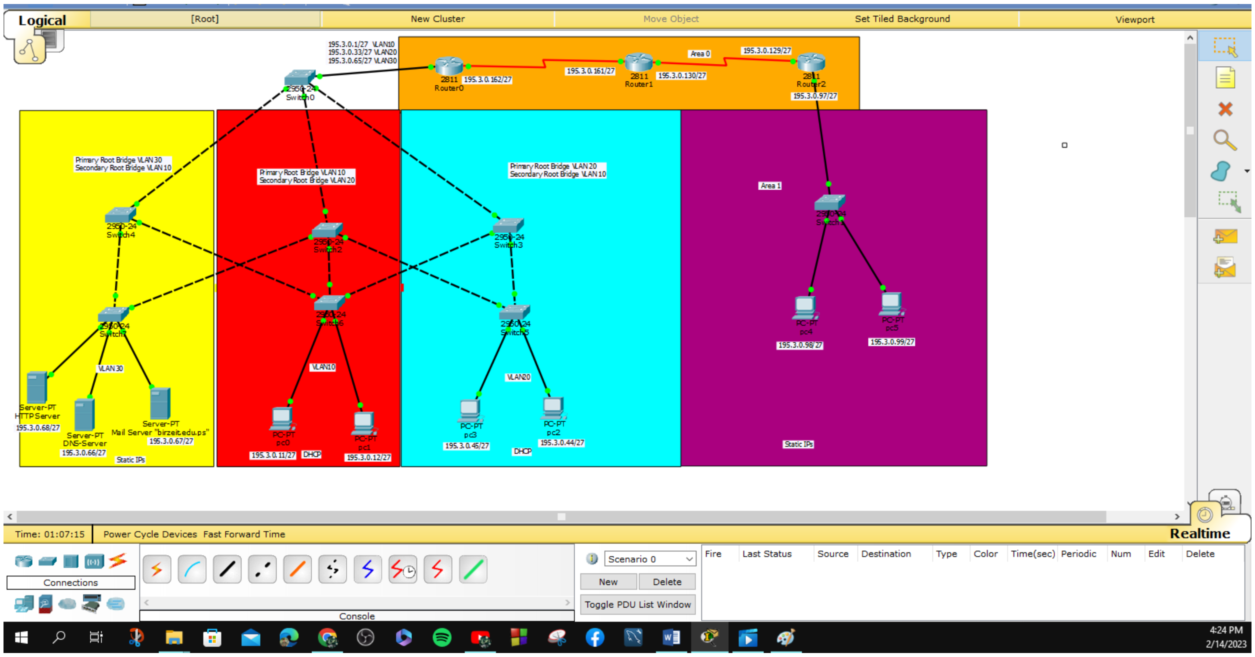

Figure 1:the topology with IPs

As shown in the Figure 1, we built the topology through the packet tracer program, and as it appears, the system is divided into several sub-networks.

The topology consists of the following sub-networks:

1. Data center (Yellow): 3-servers and 2-switches.
2. Company 1 (Red): 2-PCs and 2-switches.
3. Company 2 (Blue): 2-PCs and 2-switches.
4. Home (Purple): 2-PCs and 1-switch.
5. Core (Orange): 3-routers.

The subnetting to Networks

Servers in VLAN 30 in the datacenter network (yellow) are given their IP addresses in a static fashion based on the IP address from the first part. And we gave the computers in VLANs 10 and 20 (green and blue) the IP addresses from the router "Router0", and DHCP is configured for each VLAN as explained in Part Two.

But first, we gave the network between Router 0 and the switches in the Data center network, Company1, and Company2 the First subnet for VLAN 10, Second subnet for VLAN 20 and Third subnet for VLAN30, as shown in the Figure.

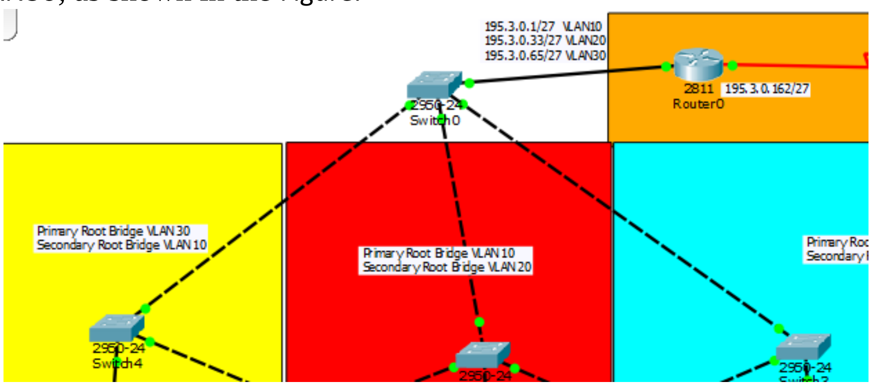

Figure 2:subnetting in VLANs

Using Router on a Stick For VLAN10:

Router(config)#interface f0/0

Router (config-if)#no shut

Router (config-if)#interface f0/0.10

Router (config-subif)#encapsulation dot1q 10

Router (config-subif)#ip address 195.3.0.1 255.255.255.224

And we repeated the steps for the rest of the VLANs (VLAN20,VLAN30),we change the values in red color for VLAN10 f0/0.20 , dot1q 20 ip address 195.3.0.33 , For VLAN30 f0/0.30 , dot1q 20 ip address 195.3.0.65

Servers in VLAN 30 in the data center network (Yellow) are getting their IPs in a static manner based on our assigned network IP.

As shown in Figure3 below we put the IP Configuration statically we give the DNS Server IP address:195.3.0.66 and Gateway: 195.3.0.65 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

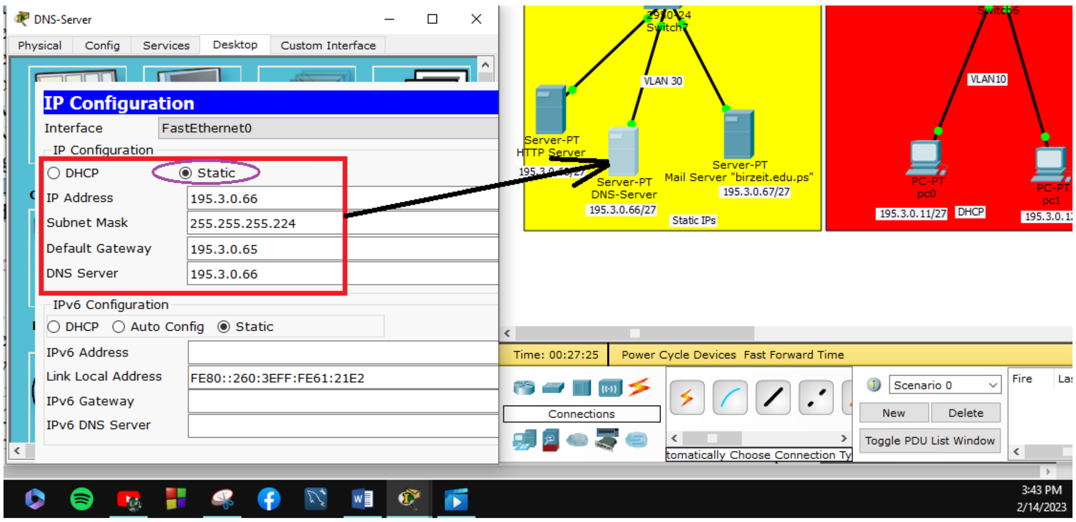

Figure 3:IP Configuration For DNS Server

As shown in Figure4 below we put the IP Configuration statically we give the HTTP Web Server IP address:195.3.0.68 and Gateway: 195.3.0.65 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

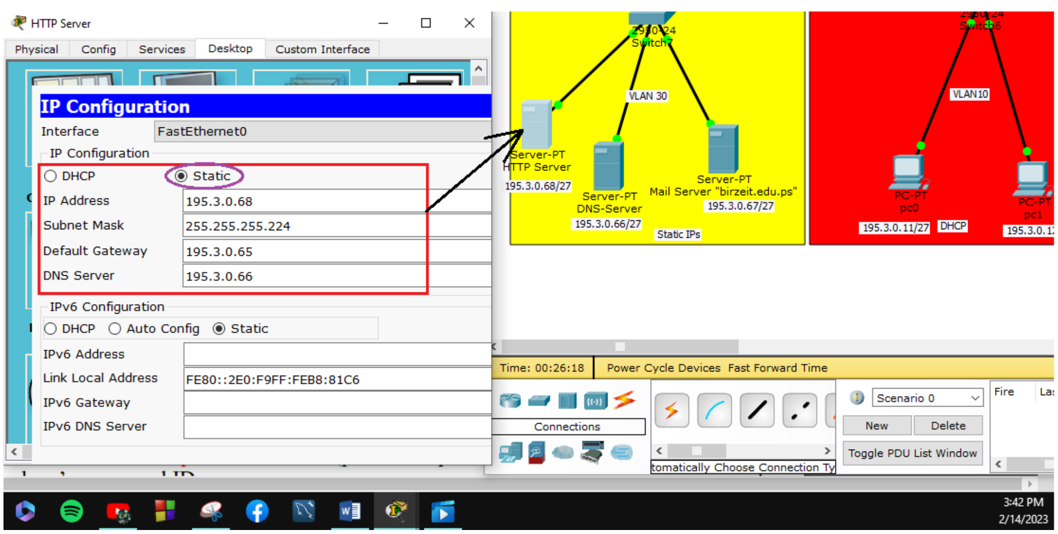

Figure 4:IP Configuration For HHTP Web Server

As shown in Figure5 below we put the IP Configuration statically we give the Mail Server IP address:195.3.0.67 and Gateway: 195.3.0.65 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

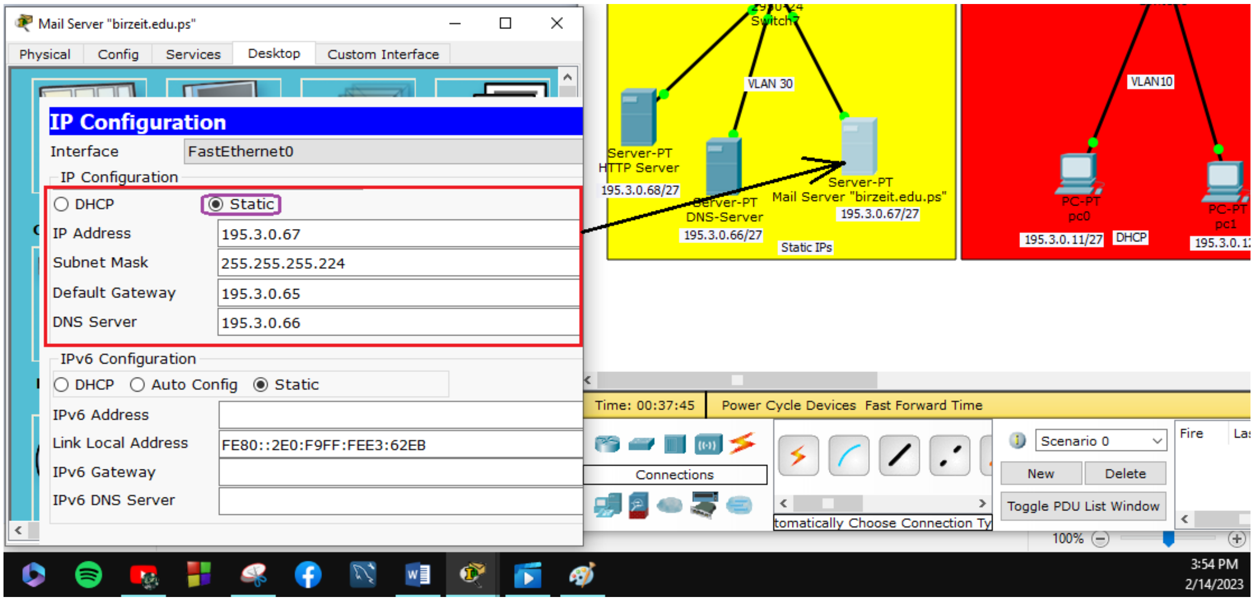

Figure 5:IP Configuration For Mail Server

Now for PCs in VLANs 10 and 20 (Red and Blue) are getting IPs from router “Router”, we configure DHCP for each VLAN.

We use these DHCP settings Command on a router For VLAN10:

Router(config)#ip dhcp pool p1

Router (dhcp-config)#network 195.03.0.0 255.255.255.224

Router (dhcp-config)#default 195.03.0.1

Router (dhcp-config)#dns-server 195.3.5.66

Router (dhcp-config)#ip dhcp exclude 195.03.0.1 195.03.0.10

And we repeated the steps for VLAN20, we change the values in red color for VLAN20 pool p2, network 195.03.0.32 , default 195.03.0.33 and exclude 195.03.0.33 195.03.0.43.

Thus, when setting PCs in VLANs 10 and 20 (Red and Blue) to the DHCP option, it gives the devices their information automatically as shown in Figures below.

For pc0:

IP address:195.3.0.11 and Gateway: 195.3.0.1 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

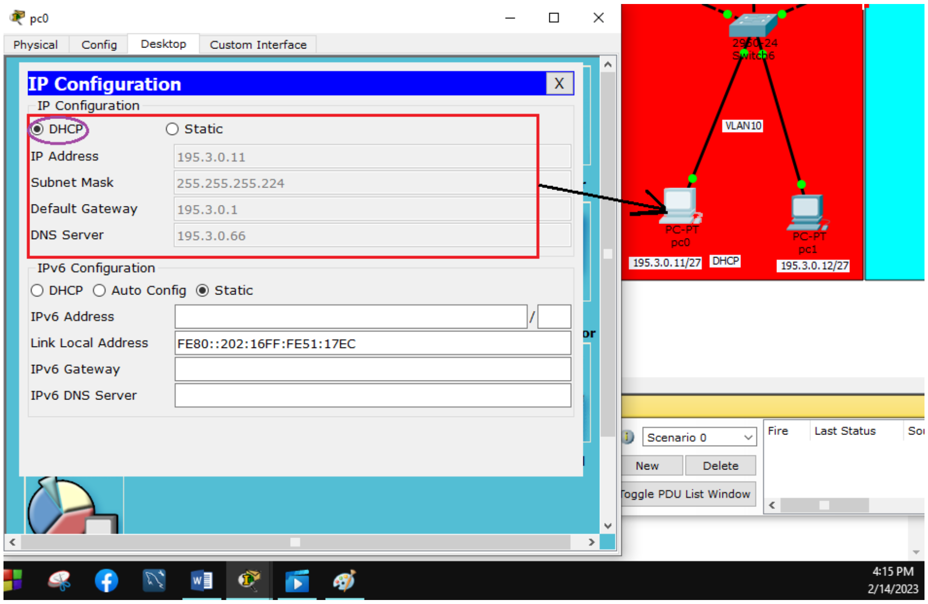

Figure 6:IP Configuration For pc0

For pc1:

IP address:195.3.0.12 and Gateway: 195.3.0.1 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

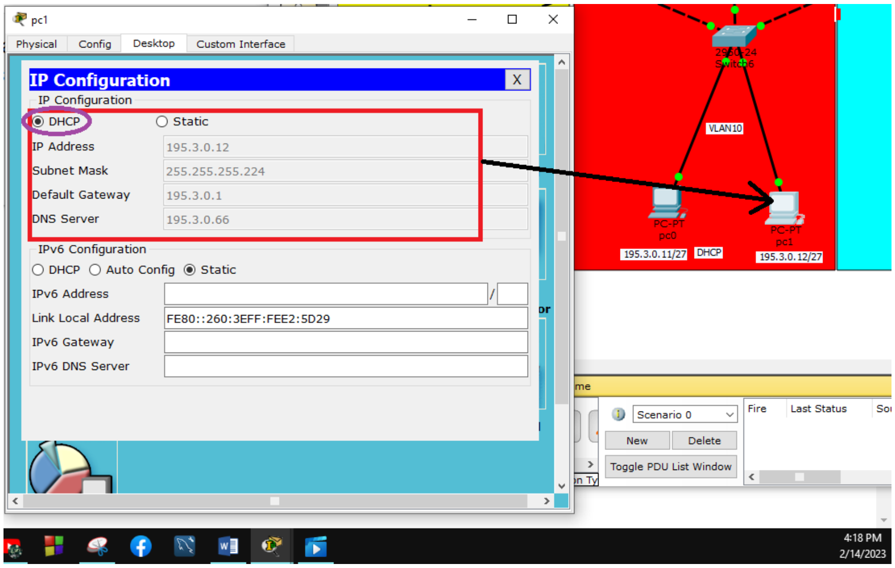

Figure 7:IP Configuration For pc1

For pc2:

IP address:195.3.0.44 and Gateway: 195.3.0.33 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

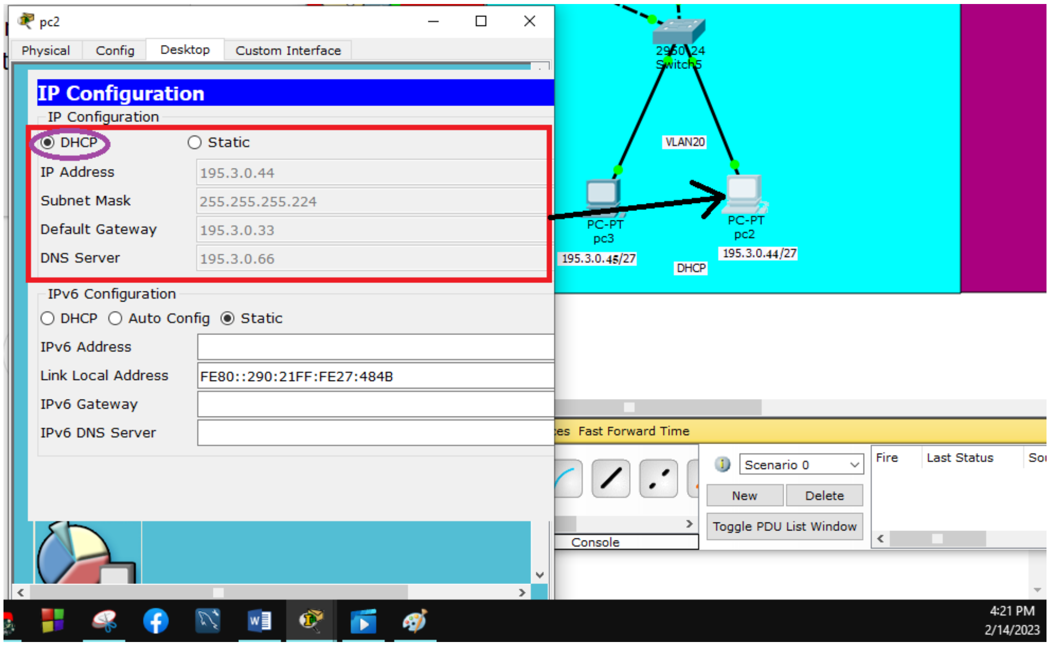

Figure 8:IP Configuration For pc2

For pc3:

IP address:195.3.0.45 and Gateway: 195.3.0.33 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

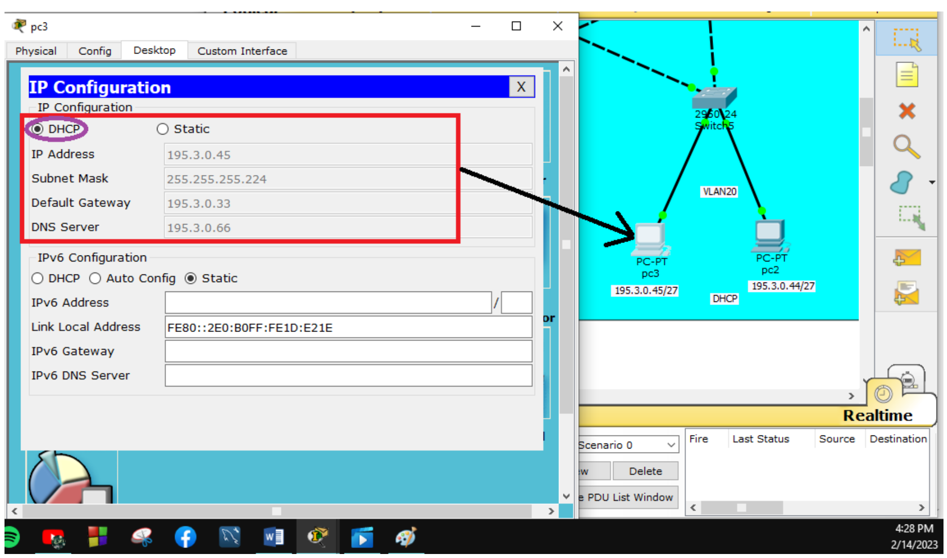

Figure 9:IP Configuration For pc3

We added the PCs in the home network (Purple) and gave them their IP addresses in a static way based on the IP address of the selected network. But first, we gave the network between Router 3 and the switch in the home network, the Forth subnet, as shown in the Figure.

We use these Commands for connection:

Router(config)#int fa0/0

Router(config-if)# no shutdown

Router(config-if)#ip address 195.3.0.97 255.255.255.224

And then we put the IPs for pc4 and pc5 static way

For pc4 and pc5:

pc4: IP address:195.3.0.98 and Gateway: 195.3.0.97 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224, pc5 : IP address:195.3.0.99 and Gateway: 195.3.0.97 with DNS Server: 195.3.5.66 and Subnet Mask :255.255.255.224

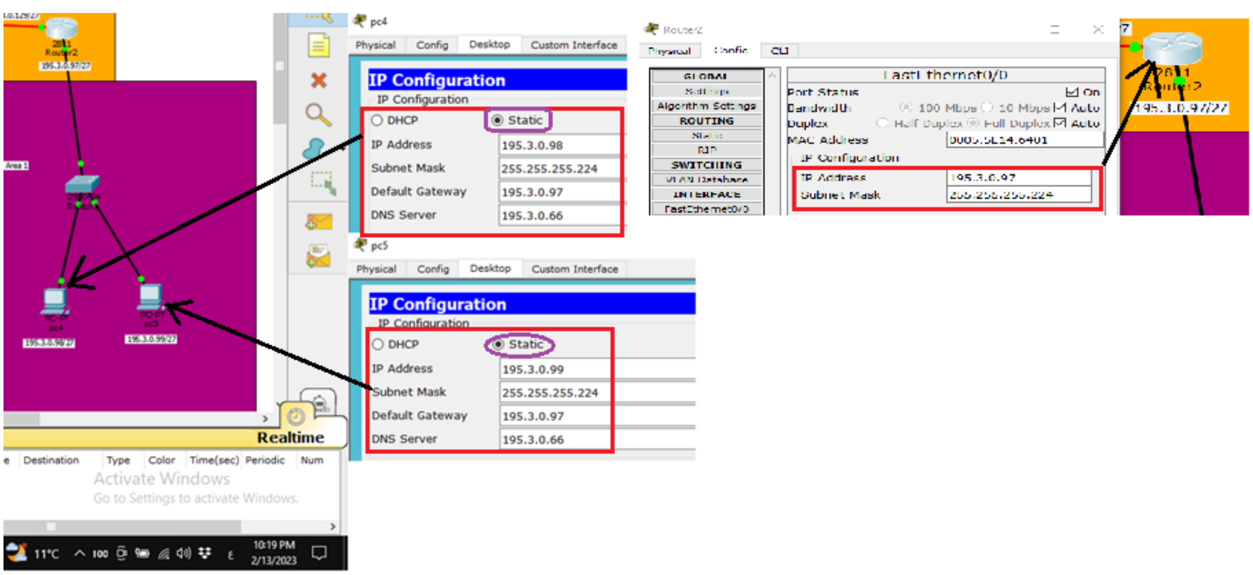

Figure 10: IP Configuration For pc4 and pc5

We connected Router 2 and Router 1 to the Fifth subnet: 195.03.0.128/27 as follows:

We use these Commands for connection router 2 with router 1 :

For router2:

Router(config)#int se1/0

Router(config-if)# no shutdown

Router(config-if)#ip address 195.3.0.129 255.255.255.224

For router1:

Router(config)#int se1/1

Router(config-if)# no shutdown

Router(config-if)#ip address 195.3.0.130 255.255.255.224

router2: IP address:195.3.0.129 and Subnet Mask :255.255.255.224

router1: IP address:195.3.0.130 and Subnet Mask :255.255.255.224

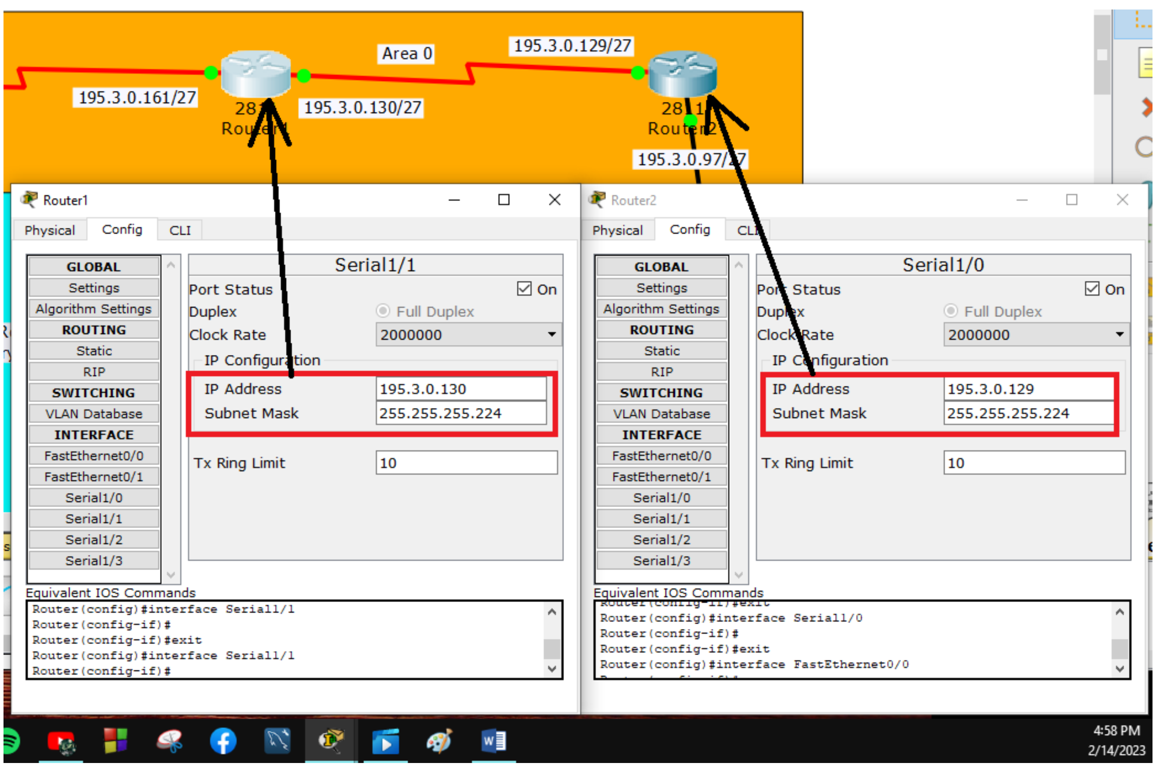

Figure 11:IP Configuration For router2 with router1

We connected Router 0 and Router 1 to the sixth subnet: 195.03.0.160/27 as follows:

We use these Commands for connection router 0 with router 1:

For router0:

Router(config)#int se1/0

Router(config-if)# no shutdown

Router(config-if)#ip address 195.3.0.162 255.255.255.224

For router1:

Router(config)#int se1/0

Router(config-if)# no shutdown

Router(config-if)#ip address 195.3.0.161 255.255.255.224

router0: IP address:195.3.0.162 and Subnet Mask :255.255.255.224

router1: IP address:195.3.0.161 and Subnet Mask :255.255.255.224

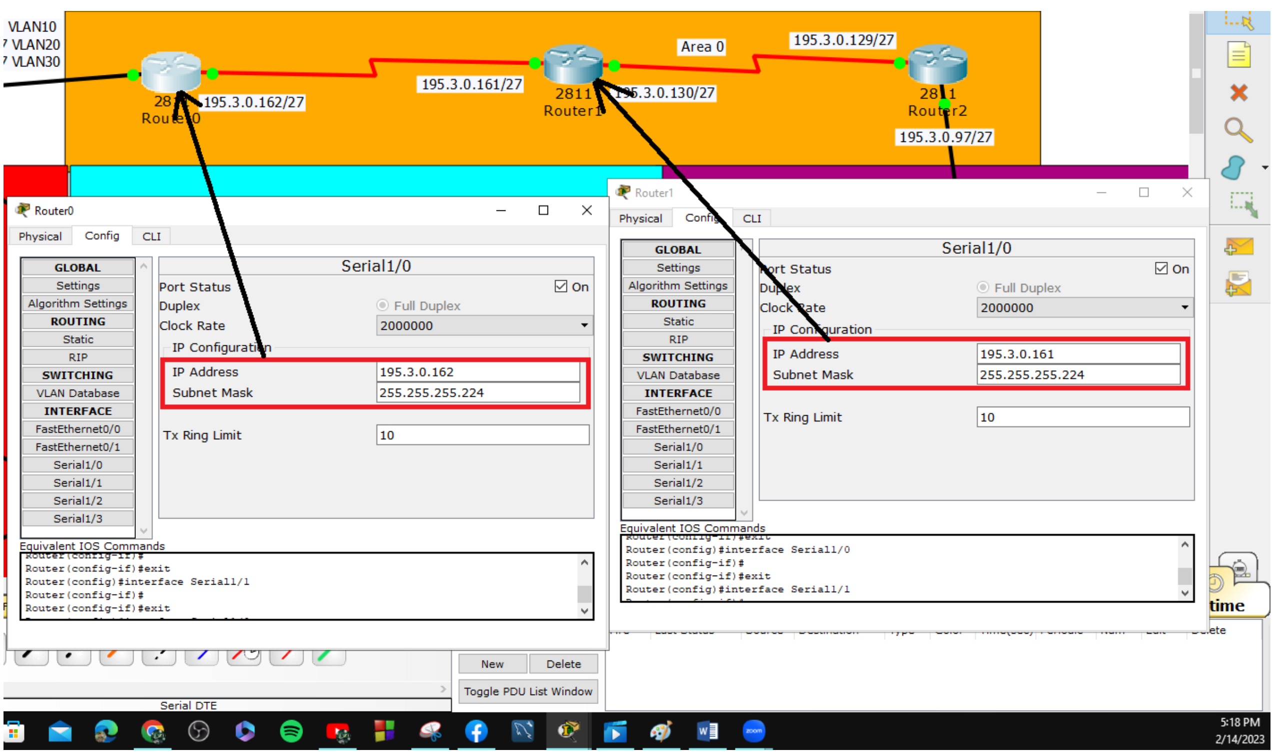

Figure 12:IP Configuration For router0 with router1

Part2: Configuring servers and VLANs

VLANs:

A LAN is a group of computers or other devices in the same place e.g., the same building or campus that share the same physical network. A LAN is usually associated with an Ethernet broadcast domain, which is the set of network devices an Ethernet broadcast packet can reach. [1]

A VLAN, like the LAN it sits atop, operates at Layer 2 of the network, the Ethernet level. VLANs partition a single switched network into a set of overlaid virtual networks that can meet different functional and security requirements. This partitioning avoids the need to have multiple, distinct physical networks for different use cases. [1]

In the beginning, we connected the routers in series and used the module NM-4A/S, then we connected the switches with router number 0 and router number 3, and we added servers and PCS so that the "trunk" networking was between the switches and between the switch and the router, but between the switch and the server and between the switch and the PC was "access".

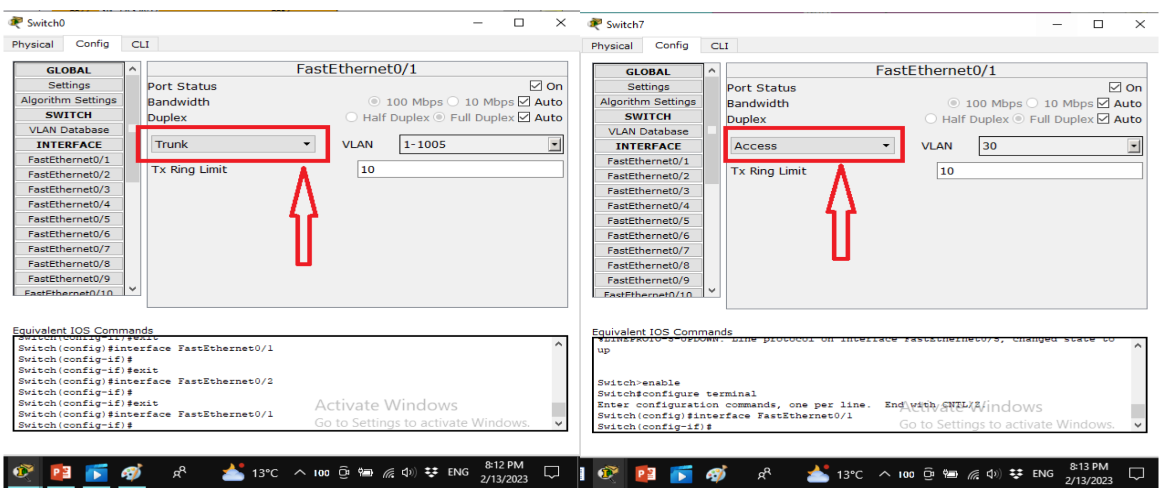

Figure 13:Trunk and Access

Trunk

A trunk is a single channel of communication that allows multiple entities at one end to correspond with the correct entity at the other end. [2]

During the networking of the switches, we created VLANS between the switches, starting from the switch connected to the router 0. We created VLAN10, VLAN20, and VLAN30 as shown in the Figur14.

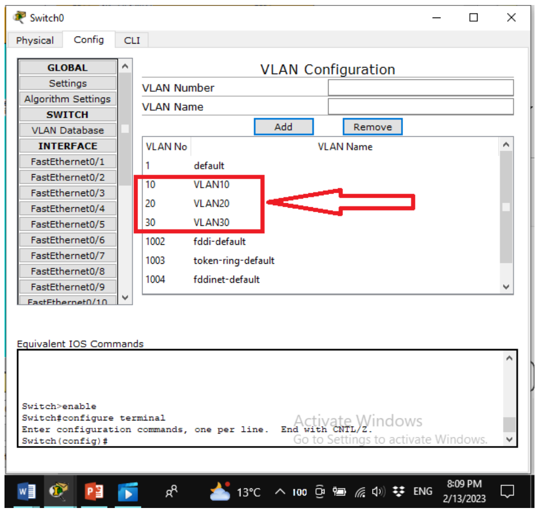

Figure 14:VLANs IN Switch0

Then we added the VLAN DATABASE to each switch as shown in the Figure.

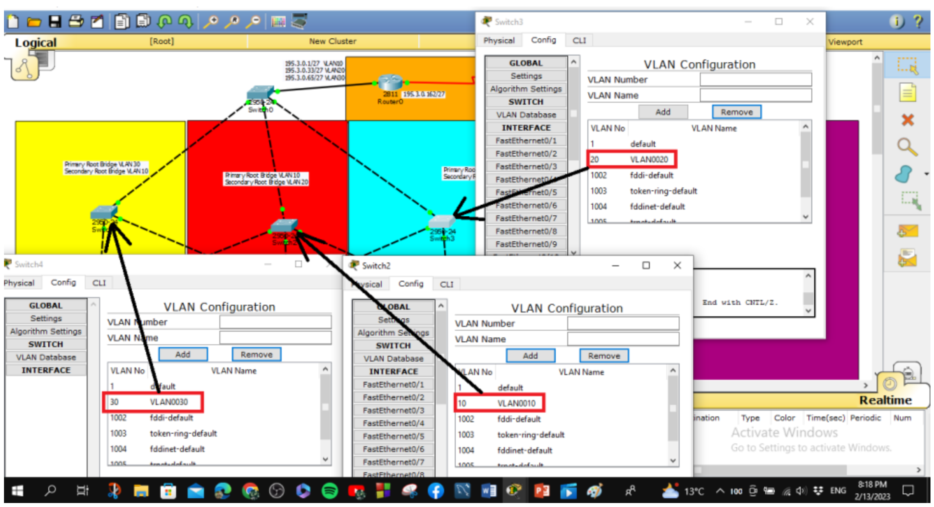

Figure 15:VLANs in Switches

After that, we connected the VLANs to each switch that connected with PCs, as shown in the Figure5.

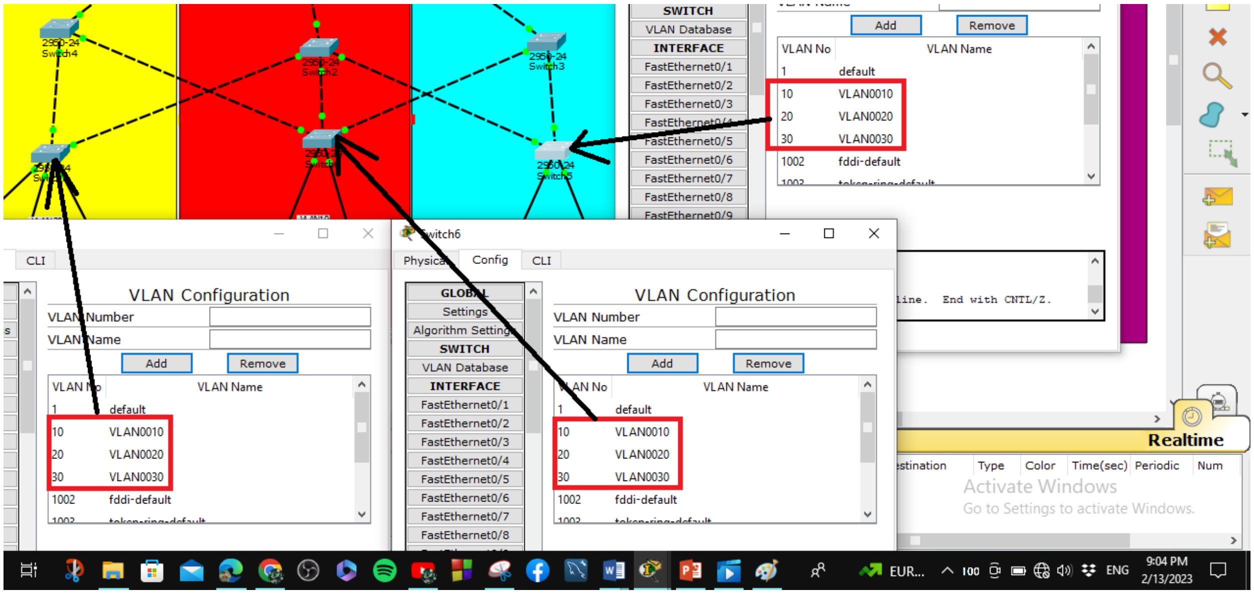

Figure 16:VLANs in switches which close to PCs

Then we connect each PC and server with its own VLAN as show in Figure6.

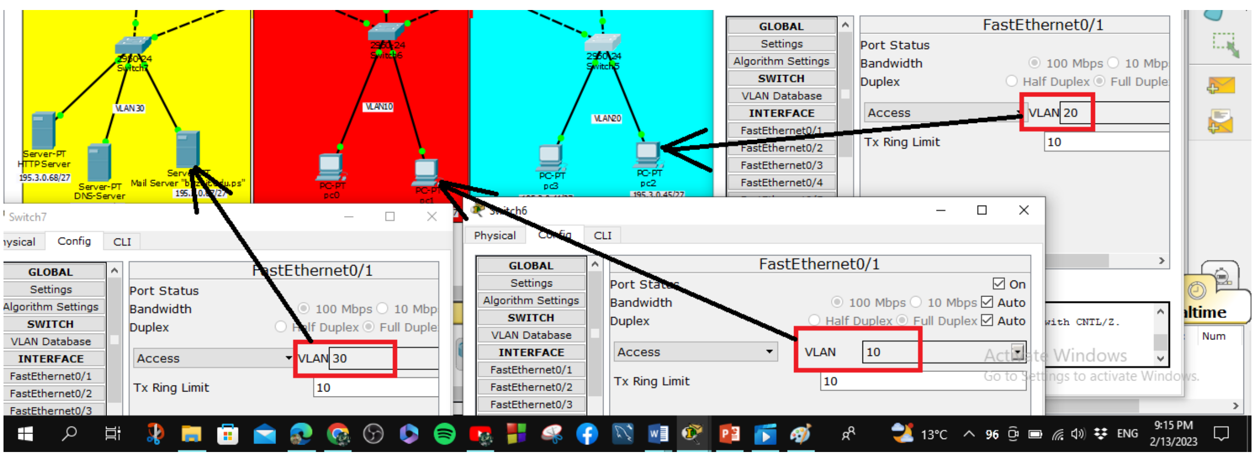

Figure 17:VLAN for each PC and Server

VLAN10 is in the 1st assigned sub-network and Router0 is the gateway, the Primary and secondary root bridge in VLAN10:

Primary Root Bridge VLAN 10.

Secondary Root Bridge VLAN 20.

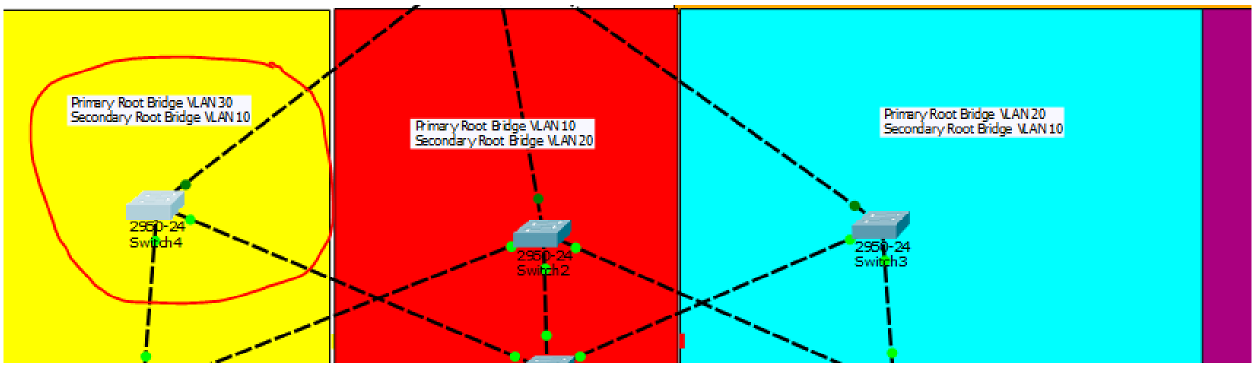

Figure 18: Primary and Secondary Root for VLAN

Commands in IOS Command Line Interface:

switch(config)#vlan 10

switch(config)#spanning-tree mode pvst

switch(config)#spanning-tree vlan 10 priority 0

switch(config)#spanning-tree vlan 10 root primary

switch(config)#spanning-tree vlan 20 root second

switch(config)#no spanning-tree vlan 1

VLAN20 is in the 2nd assigned sub-network and Router0 is the gateway

VLAN30 is in the 3rd assigned sub-network and Router0 is the gateway

And we repeated the steps for VLAN20, VLAN30 we change the values in red color for **VLAN20** vlan 20, 20 priority 4,096, 20 root primary and 10 root second, for **VLAN30** vlan 30, 30 priority 4 8,192 , 30 root primary and 10 root second.

Primary Root Bridge

A root bridge is the central point of all switches and will be responsible for forwarding the traffic. The switch selects a root bridge by using the switch priority and the MAC address. Each switch has its own bridge ID and has a default priority value of 32768. [3]

Secondary Root Bridge VLAN

A secondary root bridge is a switch that may become the root bridge for a VLAN if the primary root bridge fails. Assuming that the other bridges in the VLAN retain their default STP priority, this switch becomes the root bridge if the primary root bridge fails. [4]

DNS-Server

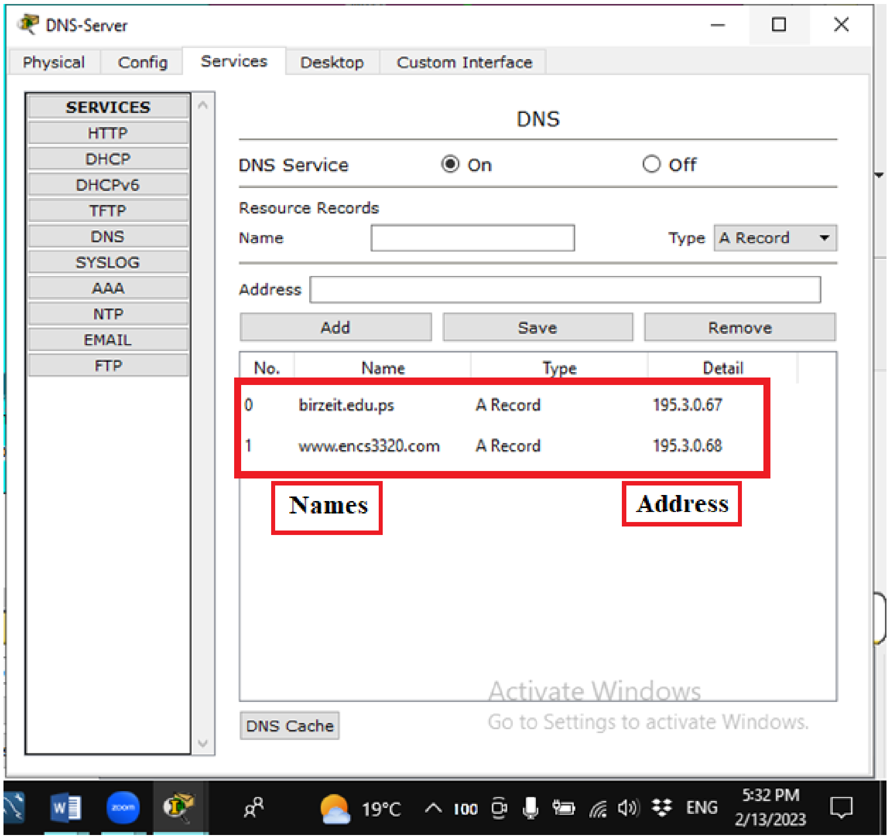

Figure 19:Resource Records Of Servers in DNS

The resource record for the HTTP Web Server (www.encs3320.com, 195.3.0.68, A)

The resource record for the Mail Server (birzeit.edu.ps, 195.3.0.67, A)

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources. [5]

HTTP/WEB server:

We have configured a DNS server and a WEB server with the domain name www.ENCS3320.com. As shown in Figure we add the address with the Domain name.

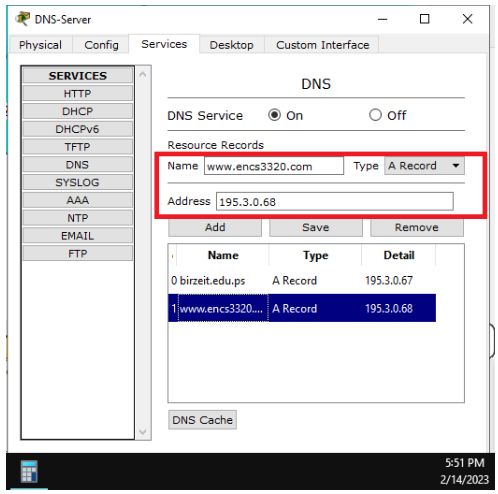

Figure 20:DNS server with WEB server

We created our website by modifying the index. html in the HTTP server. As our website contains:

- "ENCS3320-My First Website" in the title
- "Welcome to our course Computer Networks"
- Our names and IDs
- Some information about us.
- We make the page looks nice by css file
- We add a link to https://www.netacad.com/courses/packet-tracer

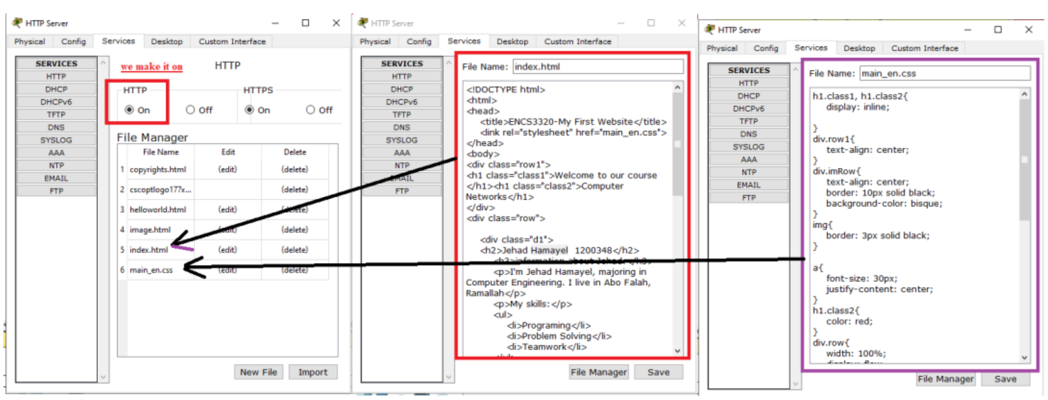

Figure 21:index.html and css file

Email server

We have configured a DNS server and an Email server with the domain name birzeit.edu.ps. As shown in Figure we add the address with the Domain name.

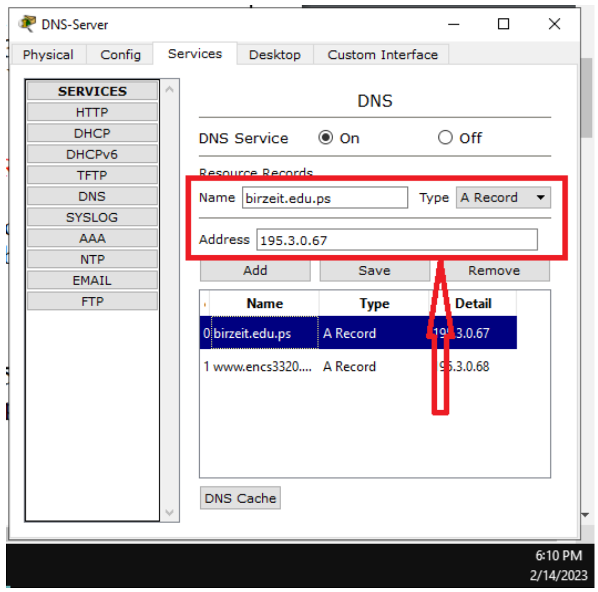

Figure 22:DNS server with Email server

We generated usernames/passwords for all computers (PC0, PC1, PC2, PC3, PC4, and PC5) in the email server (birzeit.edu.ps). The usernames are pc0, pc1, pc2, pc3, pc4, pc5 and their passwords are the same for all '123'.

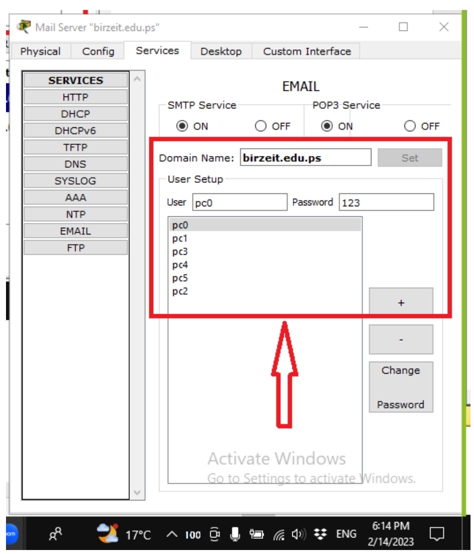

Figure 23:generated usernames/passwords for all computers

Configure Mails:

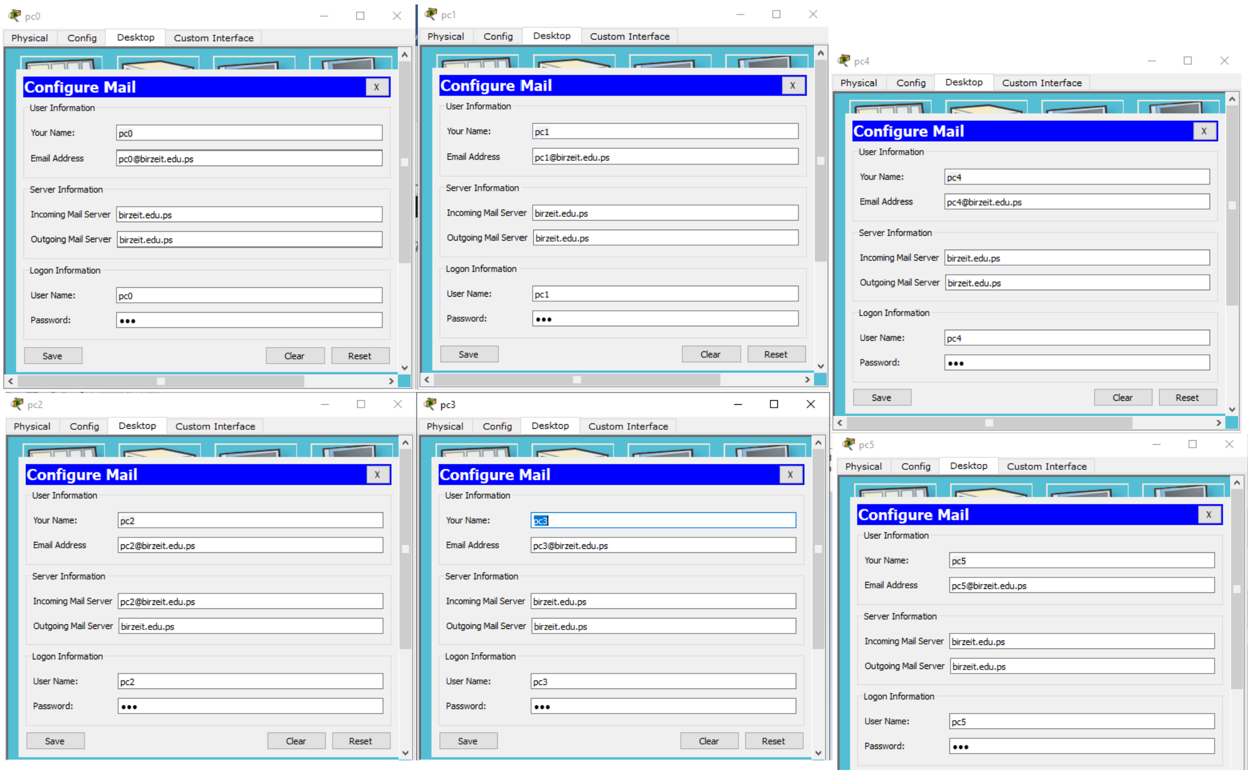

Figure 24:Configure Mails

Part3: Applying the routing protocols

Routing Information Protocol version 2 (RIPv2) on “Router0”:

We use these Command For RIP CONFIGURATION For Router0 and Router1:

For Router0:

Router (config)#router rip

Router (config-router)#version 2

Router (config-router)#no auto-summary

Router (config-router)#network 195.03.0.0

Router (config-router)#network 195.03.0.32

Router (config-router)#network 195.03.0.64

Router (config-router)#network 195.03.0.128

For Router1:

Router (config)#router rip

Router (config-router)#version 2

Router (config-router)#no auto-summary

Router (config-router)#network 195.03.0.128

Open Shortest Path Protocol (OSPF) on “Router2”:

We use these Command For OSPF CONFIGURATION For Router2 and Router1:

For Router2:

Router (config)#router ospf 1

Router (config-router)#network 195.3.0.96 0.0.0.31 area 1

Router (config-router)#network 195.03.0.128 0.0.0.31 area 0

For Router:

Router (config)#router ospf 1

Router (config-router)#network 195.03.0.128 0.0.0.31 area 0

REDISTRIBUTING ROUTING PROTOCOLS:

For Router1:

Router (config)#router rip

Router (config-router)#redistribute ospf 1 metric 0

Router(config)#router ospf 1

Router (config-router)#redistribute rip subnets

Routing information protocol version 2 (RIPv2)

The Routing Information Protocol, version 2 (RIPv2) is an enhanced version of RIP that includes support for important routing features such as class-less addressing and variable-length subnet masks [37]. RIPv2 is a distance-vector protocol that has been in use for many years. [6]

Open shortest path protocol (OSPF)

Open Shortest Path First (OSPF) is a link-state routing protocol that was developed for IP networks and is based on the Shortest Path First (SPF) algorithm. OSPF is an Interior Gateway Protocol (IGP). [7]

Part4: Testing the connectivity:

Test the connectivity between all PCs:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	pc0	pc1	ICMP		0.000	N	0	(edit)	(delete)
	Successful	pc0	pc2	ICMP		0.000	N	1	(edit)	(delete)
	Successful	pc0	pc3	ICMP		0.000	N	2	(edit)	(delete)
	Successful	pc0	pc4	ICMP		0.000	N	3	(edit)	(delete)
	Successful	pc0	pc5	ICMP		0.000	N	4	(edit)	(delete)
	Successful	pc1	pc2	ICMP		0.000	N	5	(edit)	(delete)
	Successful	pc1	pc3	ICMP		0.000	N	6	(edit)	(delete)
	Successful	pc1	pc4	ICMP		0.000	N	7	(edit)	(delete)
	Successful	pc1	pc5	ICMP		0.000	N	8	(edit)	(delete)
	Successful	pc2	pc3	ICMP		0.000	N	9	(edit)	(delete)
	Successful	pc2	pc4	ICMP		0.000	N	10	(edit)	(delete)
	Successful	pc2	pc5	ICMP		0.000	N	11	(edit)	(delete)
	Successful	pc3	pc4	ICMP		0.000	N	12	(edit)	(delete)
	Successful	pc3	pc5	ICMP		0.000	N	13	(edit)	(delete)
	Successful	pc4	pc5	ICMP		0.000	N	14	(edit)	(delete)

Figure 25:Test the connectivity

All the connections were successfully established and the data was sent as seen in the column of "Last Status" which shows the value "Successful"

Test ping for pc0 with all pcs:

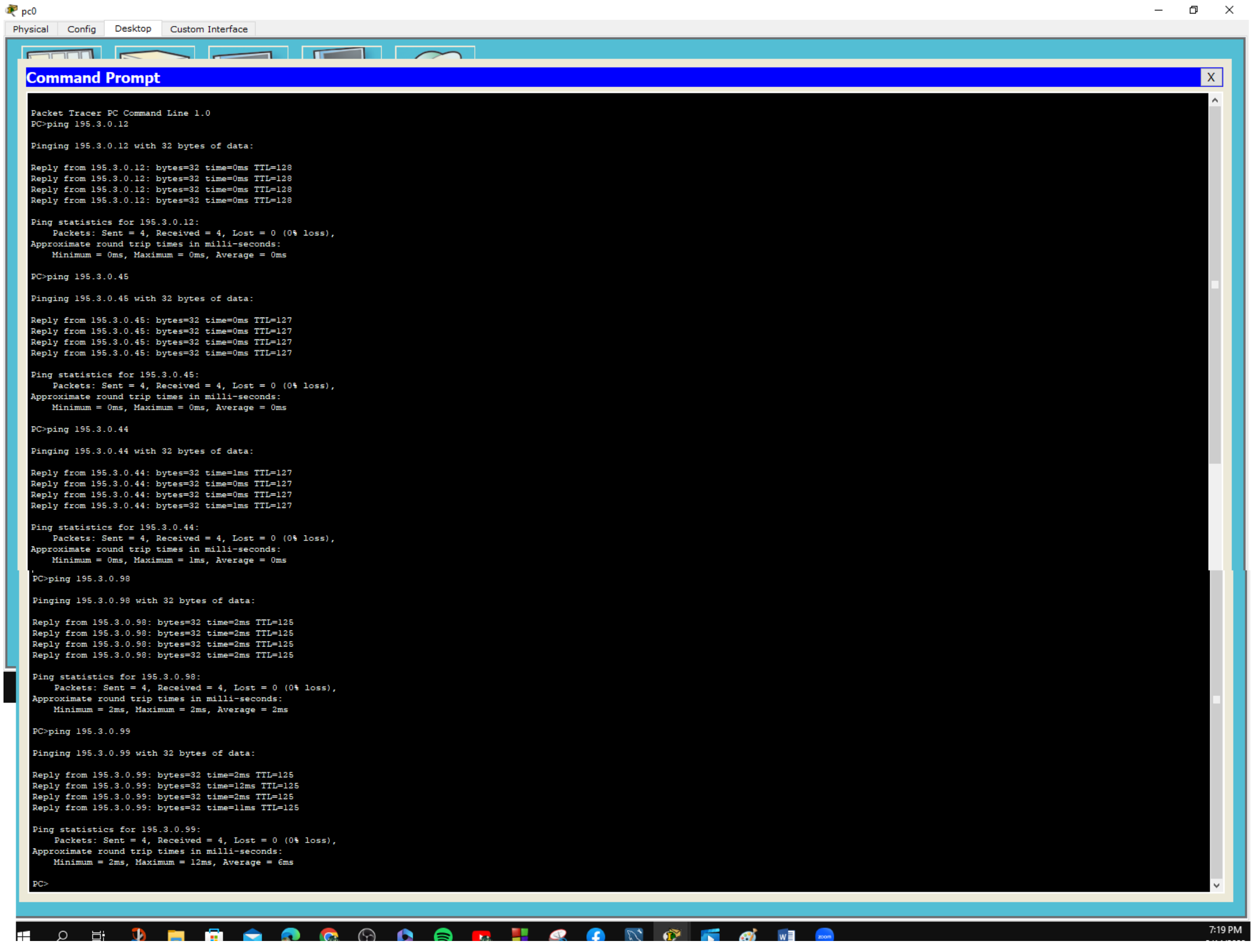

Figure 26:Test ping in pc0

pc0 pinging pc1, pc2, pc3, pc4 and pc5
Pinging pc1: four packets were sent from pc0 to pc1 (195.3.0.12) to check the connectivity. The four packets were successfully received. The size of the packet is 32 bytes. The time to live (TTL) is need nearly 0ms(average) to reach the router pc1.

And so one for all other PCs.

Test ping for pc1 with all pcs

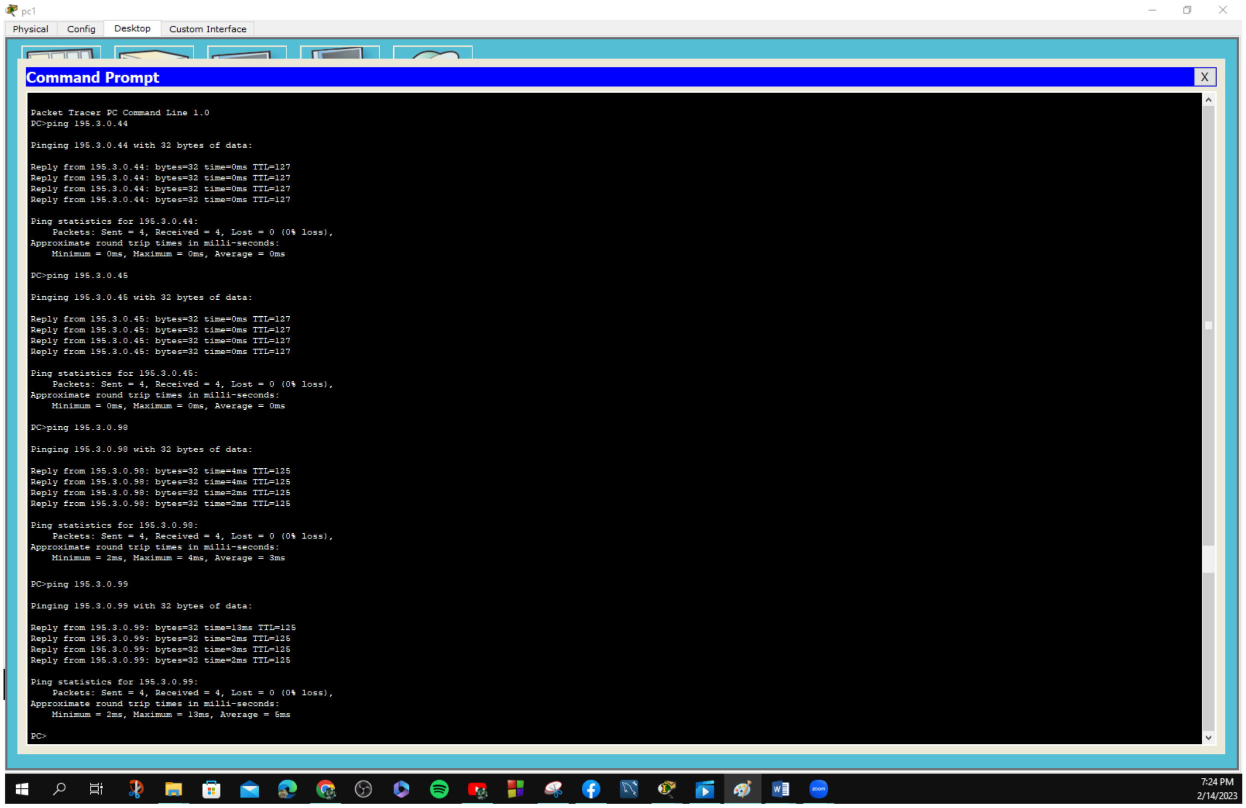

Figure 27:Test ping in pc1

pc1 pinging pc2, pc3, pc4 and pc5

Pinging pc2: four packets were sent from pc1 to pc2 (195.3.0.44) to check the connectivity. The four packets were successfully received. The size of the packet is 32 bytes. The time to live (TTL) is need nearly 0ms(average) to reach the router pc2.

And so one for all other PCs.

Test ping for pc2 with all pcs

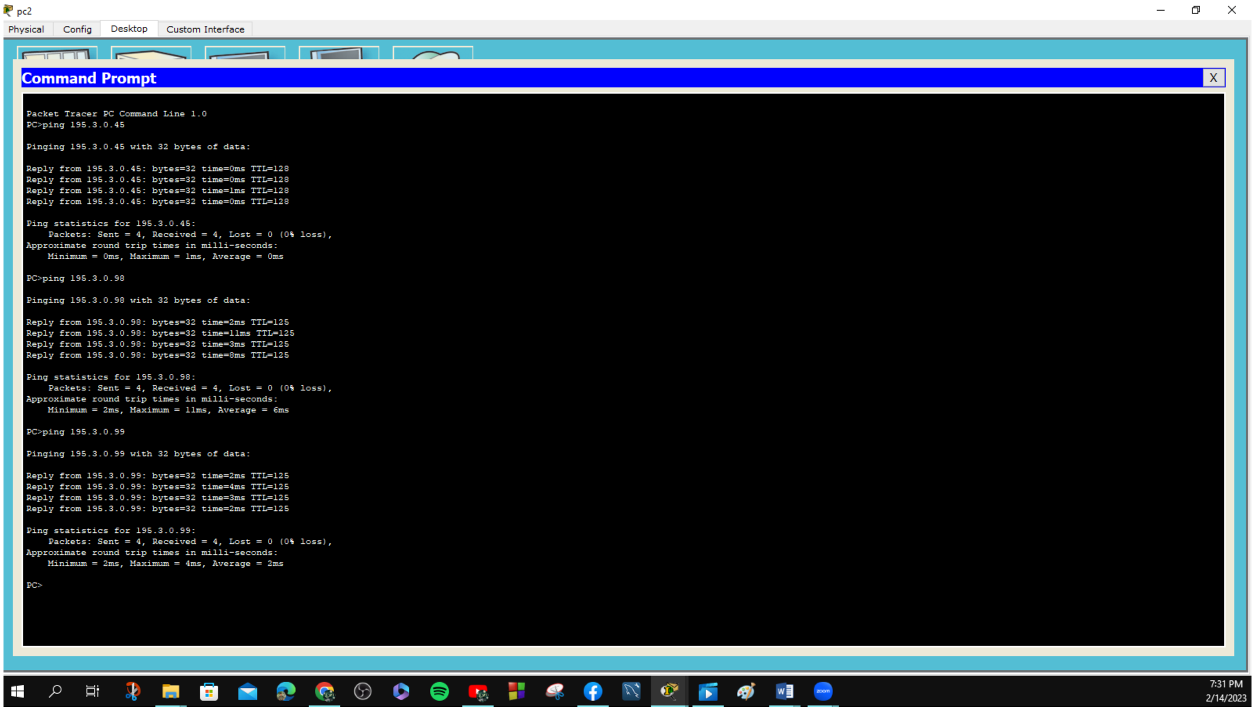

Figure 28:Test ping in pc2

Pc2 pinging pc3, pc4 and pc5

Pinging pc3: four packets were sent from pc2 to pc3 (195.3.0.45) to check the connectivity. The four packets were successfully received. The size of the packet is 32 bytes. The time to live (TTL) is need nearly 0ms(average) to reach the router pc3.

And so one for all other PCs.

Test ping for pc3 with all pcs

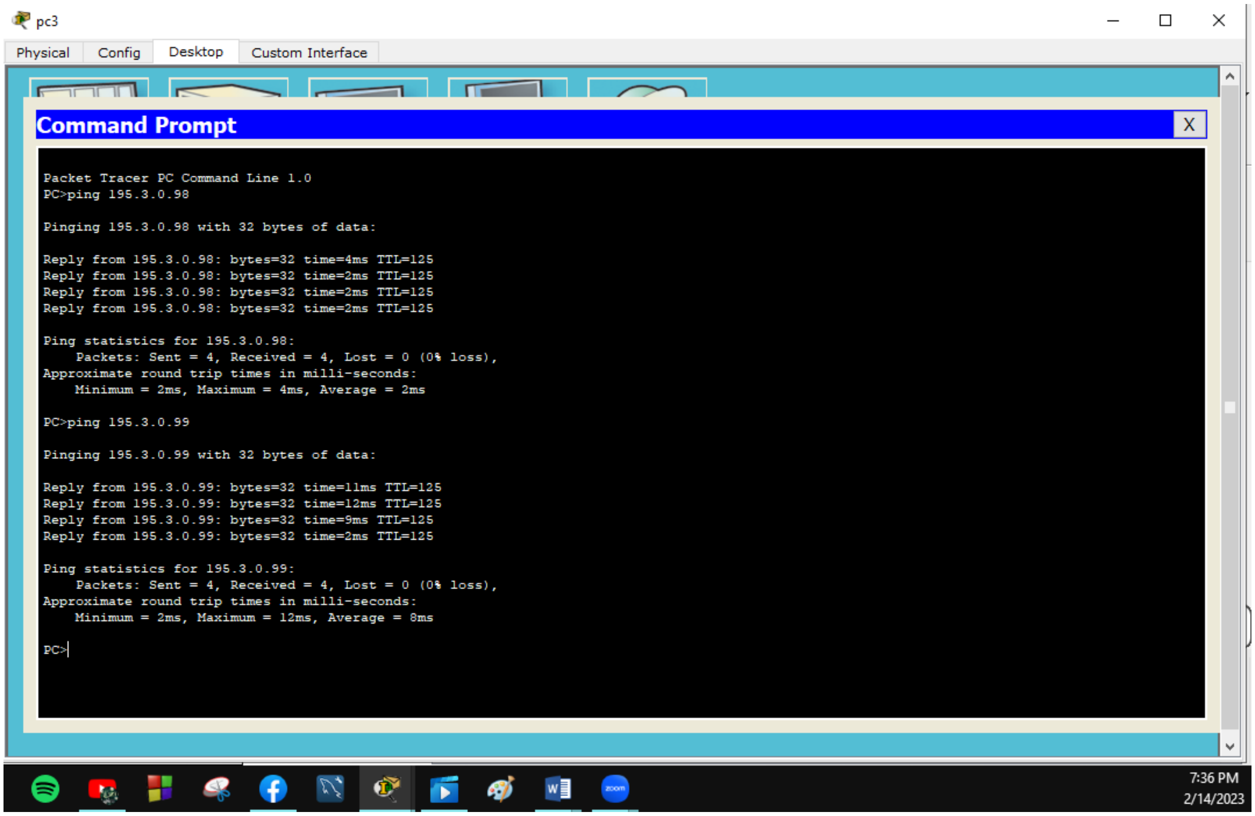

Figure 29:Test ping in pc3

pc3 pinging pc4 and pc5

Pinging pc3: four packets were sent from pc3 to pc4 (195.3.0.98) to check the connectivity. The four packets were successfully received. The size of the packet is 32 bytes. The time to live (TTL) is need nearly 2ms(average) to reach the router pc4.

And so one for all other PCs.

Test ping for pc4 with all pcs

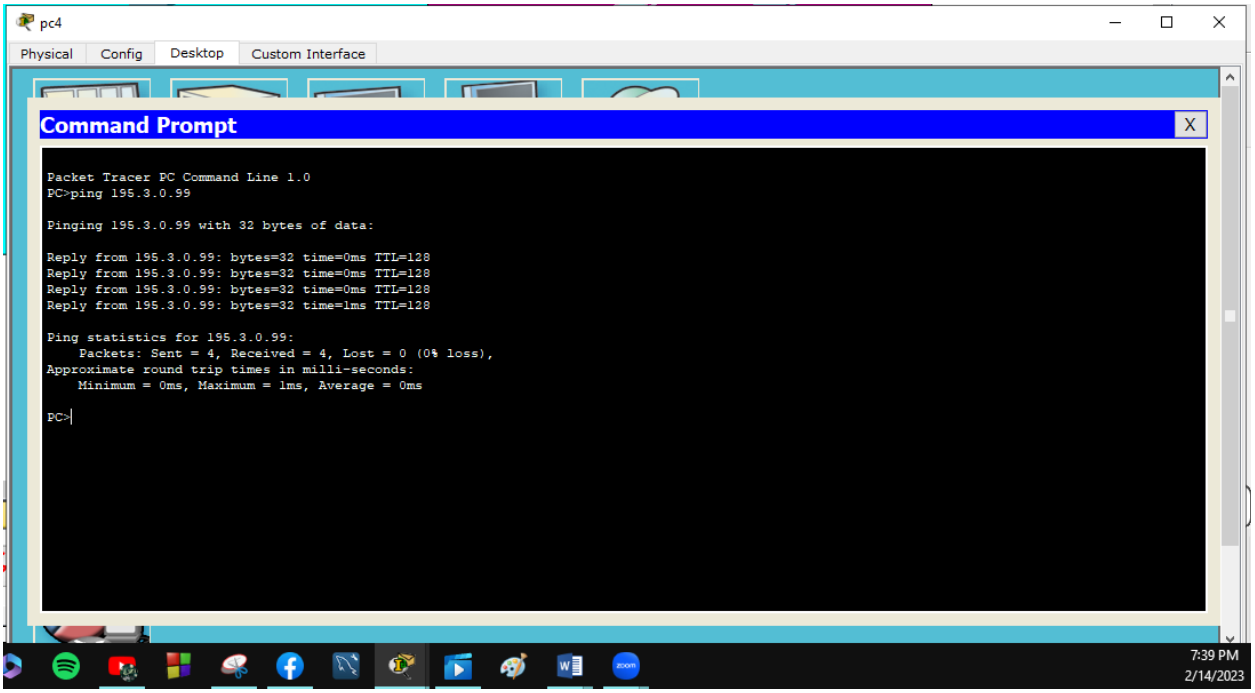

Figure 30:Test ping in pc4

Pc4 pinging pc5

Pinging pc3: four packets were sent from pc4 to pc5 (195.3.0.99) to check the connectivity. The four packets were successfully received. The size of the packet is 32 bytes. The time to live (TTL) is need nearly 0ms(average) to reach the router pc5.

And so one for all other PCs.

Test tracert for pc0 with all pcs

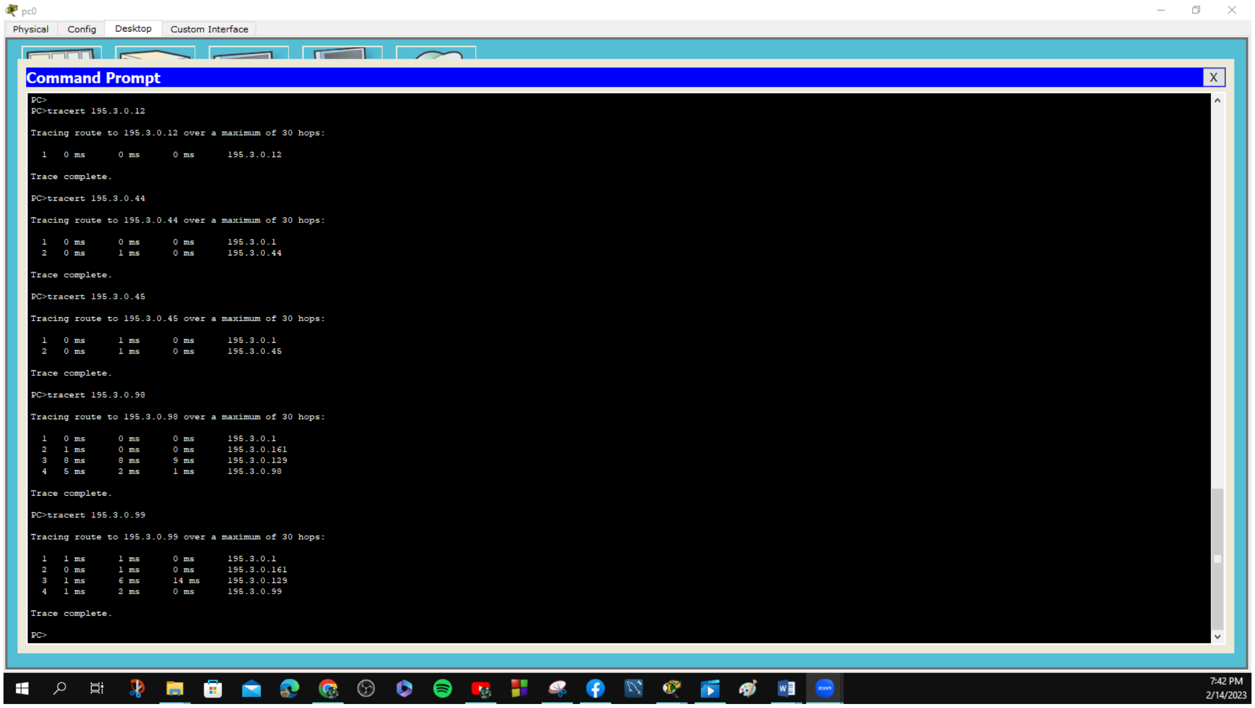

Figure 31:Test tracer in pc0

Access www.ENCS3320.com from all PCs:

pc0:

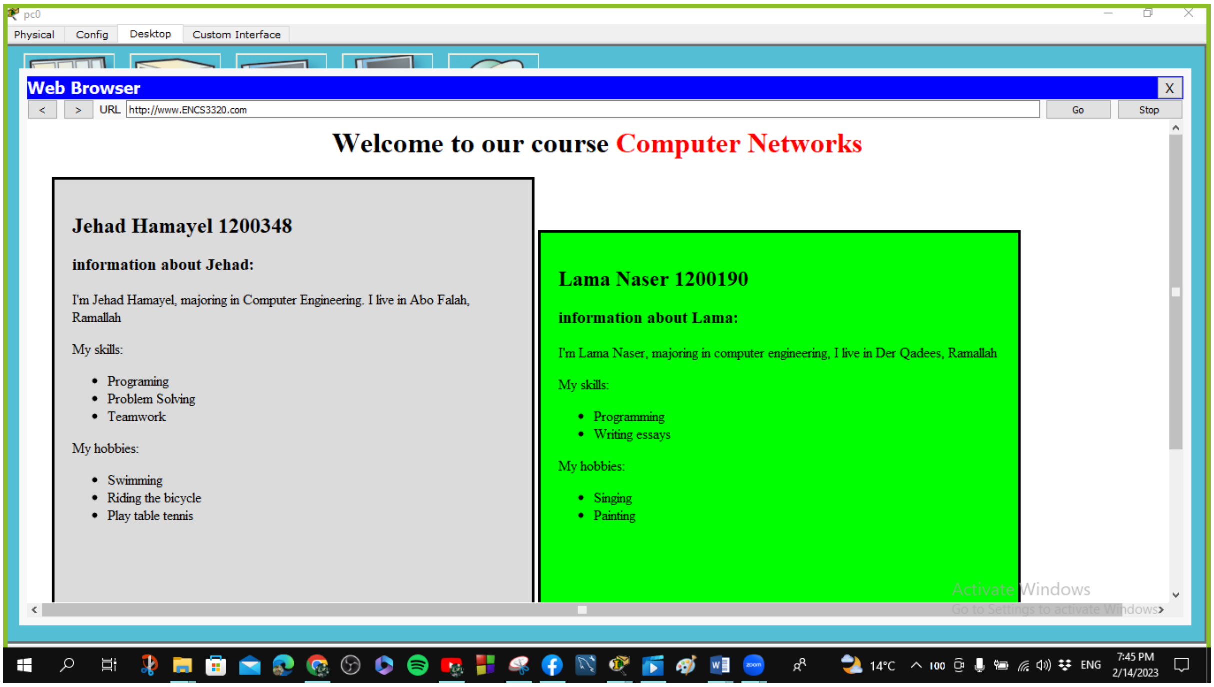

Figure 32:Test HTTP Server from pc0

pc2:

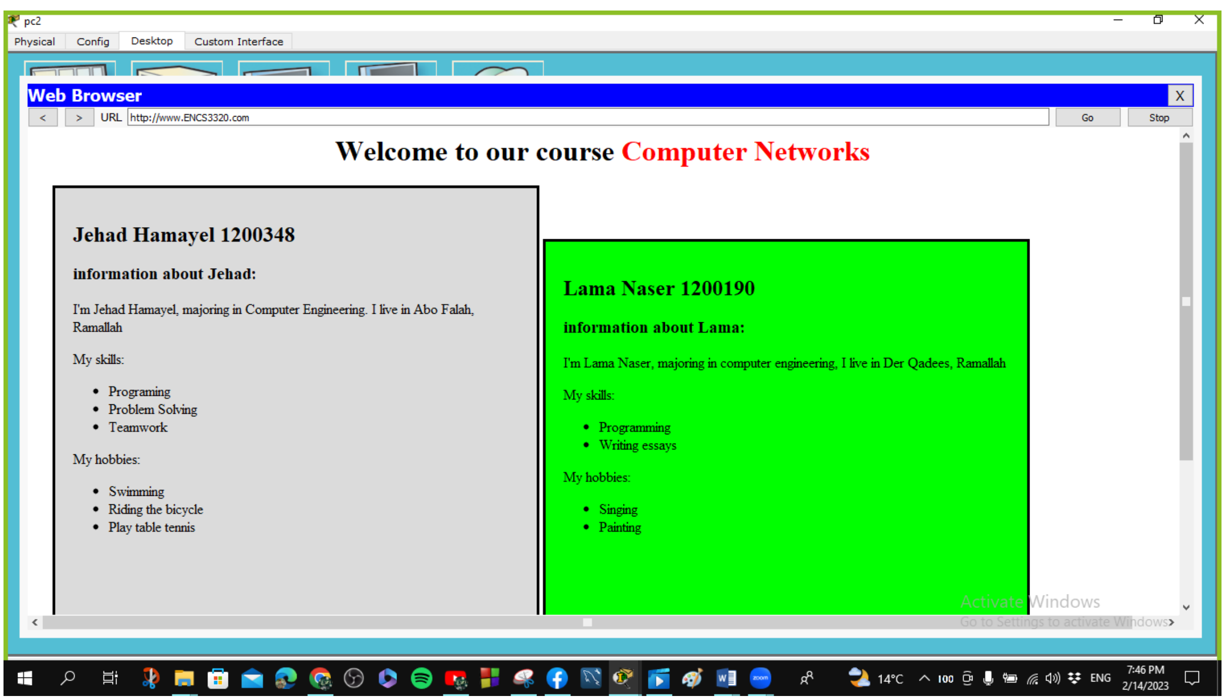

Figure 33:Test HTTP Server from pc2

pc4:

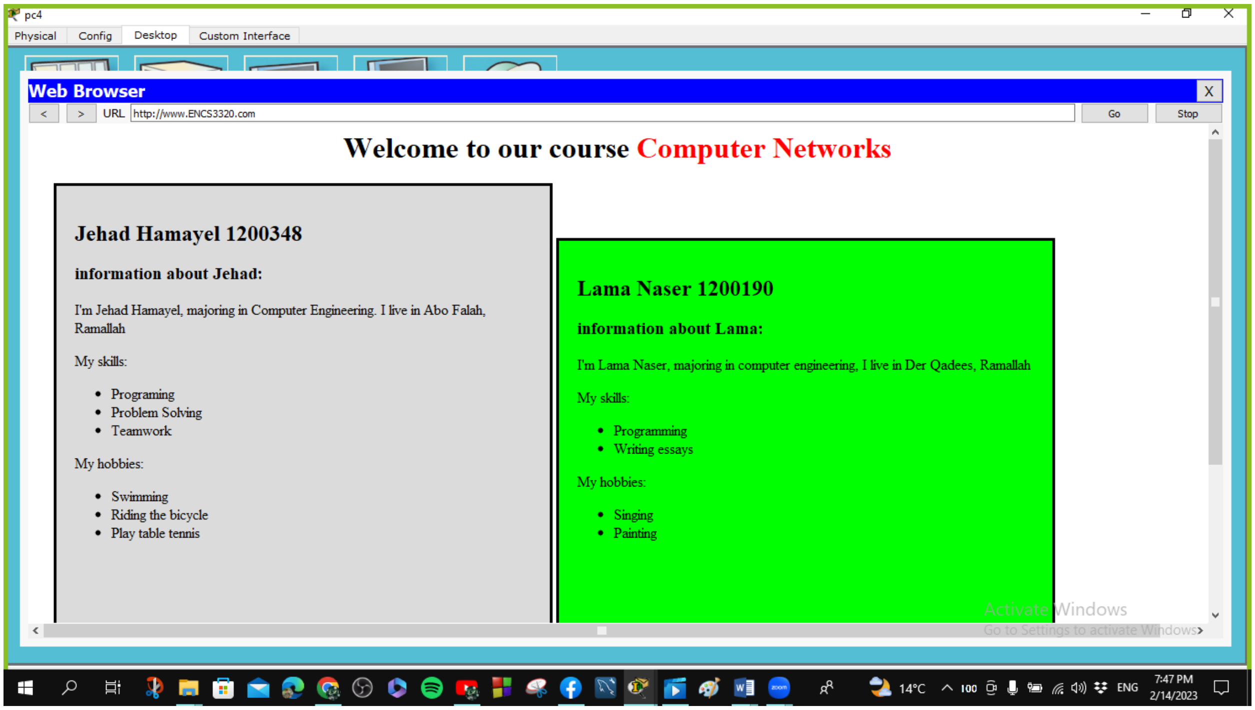

Figure 34:Test HTTP Server from pc4

Send emails from pc0 to all pcs:

At pc1, pc2, pc3, pc4 and pc5:

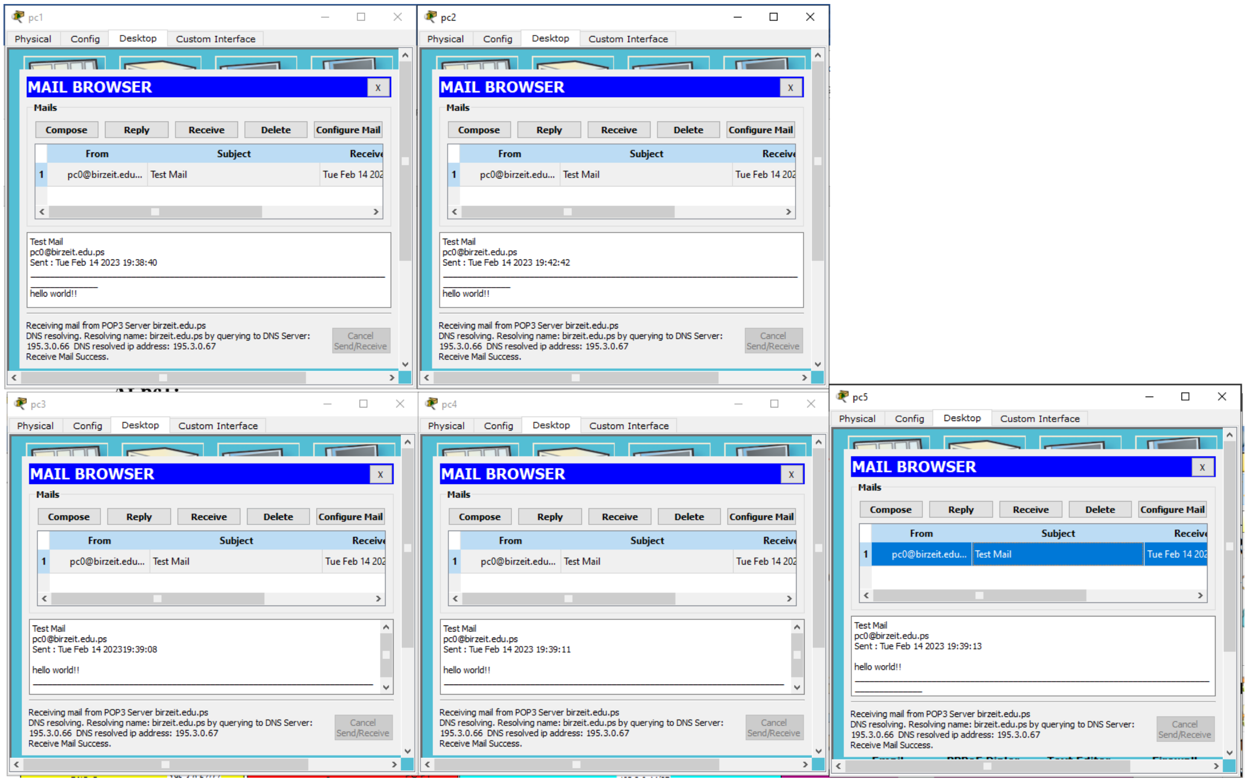

Figure 35:Arrival Mail

Conclusion:

In this project, we have learned how to use Packet Tracer on HTTP, DNS and Email servers. Also, setup the routing algorithms on our routers. In addition to that, setup the VLANs on our switches and routers. We have done some commands and recognized the results we had after executing them. We also learned much more about building a topology.

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