An-Najah National University
Faculty of Engineering and IT

جامعة النجاح الوطنية
كلية الهندسة وتكنولوجيا المعلومات

Computer Engineering Department
Course Name: Networks Lab Number: 10636594
Lab Report Grading Sheet

Instructor: Dr. Muhannad Al-Jabi	Experiment #: 4
Academic Year: 2020/2021	Experiment Name: Routers Configuration
Semester: Summer Semester	

Students	
1- Mohammad Badawi	2- Taher Anaya
3-	4-
Performed on: 1th of July	Submitted on: 29th of July

Report's Outcomes

ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %

Evaluation Criterion	Grade	Points
Abstract answers of the questions: "What did you do? How did you do it? What did you find?"	0.5	
Introduction and Theory Sufficient, clear and complete statement of objectives. In addition to Presents sufficiently the theoretical basis.	1.5	
Apparatus/ Procedure Apparatus sufficiently described to enable another experimenter to identify the equipment needed to conduct the experiment. Procedure sufficiently described.	2	
Experimental Results and Discussion (In-Lab Worksheet) Crisp explanation of experimental results. Comparison of theoretical predictions to experimental results, including discussion of accuracy and error analysis in some cases.	4	
Conclusions and Recommendations Conclusions summarize the major findings from the experimental results with adequate specificity. Recommendations appropriate in light of conclusions. Correct grammar.	1	
Appearance Title page is complete, page numbers applied, content is well organized, correct spelling, fonts are consistent, good visual appeal.	1	
Total	10	

Abstract:

In this experiment, we are going to configure the router to behave in static routing mode and dynamic routing mode in two different parts.

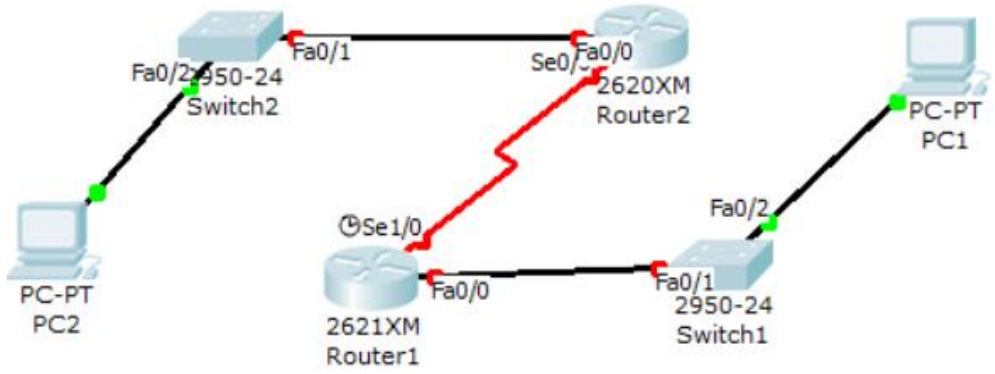
Objectives:

- Understanding the main concepts of static routing and dynamic routing.
- Using the static and dynamic routing in actual practice.
- Configuring the IP addresses on the router interfaces.
- Configuring the Cisco routers using the commands terminal.
- Using different utilities to test the operation of the router.
- Troubleshooting problems with static routing.

Procedure:

First of all, we need to connect the routers with the switches and the PCs before working with any configuration.

The diagram below summarizes the connected network:



We will connect both PCs to the consoles of each router to start configuring each one.

We need to note that one router will act as DCE (Data Circuit-terminating Equipment) which requires setting a clock, and the other router will act as a DTE (Data Terminal Equipment) which requires setting a bandwidth.

Procedure: *(cont.)*

First of all, we will connect to the routers through the console cables, then we will set the router names to **Router1** and **Router2** respectively. Additionally, we will set the message of the day (motd) banner to be **WELCOME** which will be presented to the user when he connects to the router.

```
Cisco 2611XM (MPC860P) processor (revision 2.0) with 127115K/3957K bytes of memo
ry.
Processor board ID JAE0747007R
M860 processor: part number 5, mask 2
2 FastEthernet interfaces
4 Low-speed serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
32K bytes of NVRAM.
49152K bytes of processor board System flash (Read/Write)

Configuration register is 0x2142

Router#en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Router1
Router1(config)#banner motd $WELCOME$
Router1(config)#_
```

```
Cisco 2610XM (MPC860P) processor (revision 4.1) with 127627K/3445K bytes of memo
ry.
Processor board ID JHY0916K05K
M860 processor: part number 5, mask 2
1 FastEthernet interface
1 Serial interface
32K bytes of NVRAM.
49152K bytes of processor board System flash (Read/Write)

Configuration register is 0x4F

Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Router2
Router2(config)#banner motd $WELCOME$
Router2(config)#_
```

Now will be configure the Ethernet and the Serial interfaces according to the following table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	172.16.3.1	255.255.255.0	N/A
	S1/0	172.16.2.1	255.255.255.0	N/A
R2	Fa0/0	172.16.1.1	255.255.255.0	N/A
	S0/0	172.16.2.2	255.255.255.0	N/A
PC1	NIC	172.16.3.10	255.255.255.0	172.16.3.1
PC2	NIC	172.16.1.10	255.255.255.0	172.16.1.1

Procedure: *(cont.)*

First we will configure the FastEathernet0/0 interface for both routers:

```
Router#en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Router1
Router1(config)#banner motd $WELCOME$
Router1(config)#interface FastEthernet0/0
Router1(config-if)#ip address 172.16.3.1 255.255.255.0
Router1(config-if)#no shut down
                   ^
% Invalid input detected at '^' marker.

Router1(config-if)#no shutdown
Router1(config-if)#
*May 13 18:42:26.699: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state t
o up_
```

```
Router2(config-if)#ip address 172.16.1.1 255.255.255.0
Router2(config-if)#no shut down
                   ^
% Invalid input detected at '^' marker.

Router2(config-if)#no shutdown
Router2(config-if)#
*Feb 19 18:06:22.989: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state t
o up
*Feb 19 18:06:25.048: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et0/0, changed state to up_
```

To verify that the interfaces are up and running, we will run the **show ip interface brief** command:

```
Router1#en
*May 13 18:45:50.113: %SYS-5-CONFIG_I: Configured from console by consoconf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router1(config)#exit
Router1#
*May 13 18:46:02.176: %SYS-5-CONFIG_I: Configured from console by console
Router1#show i interface brief
% Ambiguous command:  "show i interface brief"
Router1#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            172.16.3.1      YES manual up                    up

FastEthernet0/1            unassigned      YES unset  administratively down down

Serial1/0                  unassigned      YES unset  administratively down down

Serial1/1                  unassigned      YES unset  administratively down down

Serial1/2                  unassigned      YES unset  administratively down down

Serial1/3                  unassigned      YES unset  administratively down down

Router1#
```

Procedure: *(cont.)*

```
Router2#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            172.16.1.1      YES manual up                    up

Serial0/0                  unassigned      YES unset  administratively down down
```

Now we will configure the Serial1/0 interface for the first router and Serial0/0 interface for the second router:

```
Router1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router1(config)#interface serial 1/0
Router1(config-if)#ip address 172.16.2.1 255.255.255.0
Router1(config-if)#no shutdown
Router1(config-if)#
*May 13 18:49:46.108: %LINK-3-UPDOWN: Interface Serial1/0, changed state to down
_
```

```
Router2(config)#interface serial 0/0
Router2(config-if)#ip address 172.16.2.2 255.255.255.0
Router2(config-if)#no shutdown
Router2(config-if)#
```

Since one side is acting as a DCE and the other is working as a DTE, the DCE side will require setting a clock rate:

```
Router1(config)#interface serial 1/0
Router1(config-if)#clockrate64000
                   ^
% Invalid input detected at '^' marker.

Router1(config-if)#clockrate 64000
```

The DTE side will require setting a bandwidth:

```
Router2(config)#interface serial 0/0
Router2(config-if)#bandwidth 64
```

To check that everything is up and running, we will run the **show ip interface brief** command again:

Procedure: *(cont.)*

```
Router1#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            172.16.3.1      YES manual up                    up

FastEthernet0/1            unassigned      YES unset  administratively down down

Serial1/0                  172.16.2.1      YES manual up                    up

Serial1/1                  unassigned      YES unset  administratively down down

Serial1/2                  unassigned      YES unset  administratively down down

Serial1/3                  unassigned      YES unset  administratively down down

Router1#_
```

```
Router2#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            172.16.1.1      YES manual up                    up

Serial0/0                  172.16.2.2      YES manual up                    up
```

Before we configure the static routing, we will look at the IP routes configured on the router already, to monitor the changes after configuring the static routing:

```
Router1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.2.0 is directly connected, Serial1/0
C       172.16.3.0 is directly connected, FastEthernet0/0
Router1#
```

```
Router2#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, FastEthernet0/0
C       172.16.2.0 is directly connected, Serial0/0
```

Procedure: *(cont.)*

We will now configure the static routing using the **ip route** command according to the previous table:

```
Router1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router1(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.2
Router1(config)#
```

```
Router2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router2(config)#ip route 172.16.3.0 255.255.255.0 172.16.2.1
```

We will check the IP route menu again to verify the changes:

```
Router1#show ip route
*May 13 19:07:37.440: %SYS-5-CONFIG_I: Configured from console by console
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     172.16.0.0/24 is subnetted, 3 subnets
S       172.16.1.0 [1/0] via 172.16.2.2
C       172.16.2.0 is directly connected, Serial1/0
C       172.16.3.0 is directly connected, FastEthernet0/0
Router1#_
```

```
Router2(config)#exit
Router2#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     172.16.0.0/24 is subnetted, 3 subnets
C       172.16.1.0 is directly connected, FastEthernet0/0
C       172.16.2.0 is directly connected, Serial0/0
S       172.16.3.0 [1/0] via 172.16.2.1
```

Procedure: *(cont.)*

We will also configure a default static route:

```
Router1(config)#ip route 0.0.0.0 0.0.0.0 172.16.2.2
```

```
Router2(config)#ip route 0.0.0.0 0.0.0.0 172.16.2.1
```

In the IP route menu:

```
Router1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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 172.16.2.2 to network 0.0.0.0

     172.16.0.0/24 is subnetted, 3 subnets
S       172.16.1.0 [1/0] via 172.16.2.2
C       172.16.2.0 is directly connected, Serial1/0
C       172.16.3.0 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 172.16.2.2
Router1#
```

```
Router2#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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 172.16.2.1 to network 0.0.0.0

     172.16.0.0/24 is subnetted, 3 subnets
C       172.16.1.0 is directly connected, FastEthernet0/0
C       172.16.2.0 is directly connected, Serial0/0
S       172.16.3.0 [1/0] via 172.16.2.1
S*   0.0.0.0/0 [1/0] via 172.16.2.1
```

Now will test our network by pinging between both PCs using the command terminal:

```
C:\Users\NetworksPC>ping 172.16.1.10

Pinging 172.16.1.10 with 32 bytes of data:
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126

Ping statistics for 172.16.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 19ms, Maximum = 19ms, Average = 19ms
```

Procedure: *(cont.)*

```
C:\Users\NetworksPC>ping 172.16.3.10

Pinging 172.16.3.10 with 32 bytes of data:
Reply from 172.16.3.10: bytes=32 time=20ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126

Ping statistics for 172.16.3.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 19ms, Maximum = 20ms, Average = 19ms
```

For the second part of the experiment, we will configure a dynamic routing network.

First of all, we will set the routing protocol to RIP:

```
Router1(config)#router rip
Router1(config-router)#network 172.16.0.0
Router1(config-router)#
```

```
Router2(config)#router rip
Router2(config-router)#nework 172.16.0.0

% Invalid input detected at '^' marker.

Router2(config-router)#network 172.16.0.0
Router2(config-router)#_
```

We will now test the connection between both PCs using the **ping** command in the terminal:

```
C:\Users\NetworksPC>ping 172.16.1.10

Pinging 172.16.1.10 with 32 bytes of data:
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126
Reply from 172.16.1.10: bytes=32 time=19ms TTL=126

Ping statistics for 172.16.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 19ms, Maximum = 19ms, Average = 19ms

C:\Users\NetworksPC>
```

Procedure: *(cont.)*

```
C:\Users\NetworksPC>ping 172.16.3.10

Pinging 172.16.3.10 with 32 bytes of data:
Reply from 172.16.3.10: bytes=32 time=22ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126
Reply from 172.16.3.10: bytes=32 time=19ms TTL=126

Ping statistics for 172.16.3.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 19ms, Maximum = 22ms, Average = 19ms
```

We will now configure the security options to be able to connect to the router configuration page using the telnet feature.

```
Router1(config)#line con 0
Router1(config-line)#password cisco
Router1(config-line)#login
Router1(config-line)#
```

```
Router2(config)#line con 0
Router2(config-line)#password cisco
Router2(config-line)#login
Router2(config-line)#
```

```
Router1(config)#line ?
  <0-70>   First Line number
  aux      Auxiliary line
  console  Primary terminal line
  tty      Terminal controller
  vty      Virtual terminal
  x/y      Slot/Port for Modems

Router1(config)#line ?
  <0-70>   First Line number
  aux      Auxiliary line
  console  Primary terminal line
  tty      Terminal controller
  vty      Virtual terminal
  x/y      Slot/Port for Modems

Router1(config)#line vty ?
  <0-181>  First Line number

Router1(config)#line vty 0 4
Router1(config-line)#password cisco
Router1(config-line)#login
Router1(config-line)#
```

Procedure: *(cont.)*

```
Router2(config)#line ?
  <0-70>   First Line number
  aux      Auxiliary line
  console  Primary terminal line
  tty      Terminal controller
  vty      Virtual terminal
  x/y      Slot/Port for Modems

Router2(config)#line
% Incomplete command.

Router2(config)#line vty ?
  <0-181>  First Line number

Router2(config)#line vty 0 4
Router2(config-line)#password cisco
Router2(config-line)#login
Router2(config-line)#
```

We will now attempt to connect to the first router using the telnet feature from PC2, we will also execute the **show ip route** command:

```
User Access Verification

Password:
Router1>en
Password:
Router1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

     172.16.0.0/24 is subnetted, 3 subnets
R       172.16.1.0 [120/1] via 172.16.2.2, 00:00:27, Serial1/0
C       172.16.2.0 is directly connected, Serial1/0
C       172.16.3.0 is directly connected, FastEthernet0/0
Router1#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            172.16.3.1      YES manual up                    up

FastEthernet0/1            unassigned      YES unset  administratively down down

Serial1/0                  172.16.2.1      YES manual up                    up

Serial1/1                  unassigned      YES unset  administratively down down

Serial1/2                  unassigned      YES unset  administratively down down

Serial1/3                  unassigned      YES unset  administratively down down
```

Procedure: *(cont.)*

We will also use the **traceroute** command in the terminal to see how the packets move from one PC to another:

```
C:\Users\NetworksPC>tracert 172.16.1.10

Tracing route to WORKGROUP [172.16.1.10]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  172.16.3.1
  2    22 ms    22 ms    22 ms  172.16.2.2
  3    27 ms    26 ms    27 ms  WORKGROUP [172.16.1.10]

Trace complete.
```

```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\NetworksPC>traceroute 172.16.3.10
'traceroute' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\NetworksPC>tracert 172.16.3.10

Tracing route to WORKGROUP [172.16.3.10]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  172.16.1.1
  2    22 ms    22 ms    22 ms  172.16.2.1
  3    27 ms    27 ms    27 ms  WORKGROUP [172.16.3.10]

Trace complete.
```

Conclusion:

In the end, we learned how the static routing works by configuring multiple routers/switches to send packets from one PC to another. We also learned how to bypass the entire process of static routing by using the dynamic routing, which is definitely better for larger networks. We also learned how to troubleshoot and trace packets sent between two PCs. Finally, we learned how to connect to the router configuration page using the telnet feature.