Usman Institute of Technology

Department of Computer Science

Course Code: CS222

Course Title: Data Communication & Computer Networks

Fall 2022

Lab 09

Objective:

Introduction to routers and setting up static routes.

Student Information

Student Name	
Student ID	
Date	

Assessment

Marks Obtained	
Remarks	
Signature	

Usman Institute of Technology
Department of Computer Science
CS222- Data Communication & Computer Networks

Lab 09

Instructions

State the instruction that student needs to follow for performing the example and exercises. Some sample instructions are given below which can be altered as needed
E.g.

- Come to the lab in time. Students who are late more than 15 minutes, will not be allowed to attend the lab.
- Students have to perform the examples and exercises by themselves.
- Raise your hand if you face any difficulty in understanding and solving the examples or exercises.
- Lab work must be submitted on or before the submission date.

1. Objective

Introduction to routers and setting up static routes

2. Labs Descriptions

1. ROUTERS

They are small electronic devices that join multiple computer networks together via either wired or wireless connections.

1.1. HOW ROUTERS WORK

In technical terms, a router is a Layer 3 network gateway device, meaning that it connects two or more networks and that the router operates at the network layer of the OSI model. Routers contain a processor (CPU), several kinds of digital memory, and input-output (I/O) interfaces. They function as special-purpose computers, one that does not require a keyboard or display. The router's memory stores an embedded operating system (O/S). Compared to general-purpose OS products like Microsoft Windows or Apple Mac OS, router operating systems limit what kind of applications can be run on them and also need much smaller amounts of storage space. Examples of popular router operating systems include Cisco Internetwork Operating System (IOS) and DD-WRT. These operating systems are manufactured into a binary firmware image and are commonly called router firmware. By maintaining configuration information in a part of memory called the routing table, routers also can filter both incoming or outgoing traffic based on the addresses of senders and receivers.

1.2. ROUTERS FOR BUSINESS NETWORKS AND THE INTERNET

Before home networking became popular, routers could be found only the closets of businesses and schools. Each cost thousands of dollars and required special technical training to set up and manage. The largest and most powerful network routers form the Internet backbone. These routers must manage many terabits of data flowing through and between Internet Service Provider (ISP) networks.

1.3. HOME BROADBAND ROUTERS

Routers became mainstream consumer devices when households began to accumulate multiple computers and wanted to share the home Internet connection home networks use Internet Protocol (IP) routers to connect computers to each other and to the Internet. Early generations of home routers supported wired networking with Ethernet cables while newer wireless routers supported Wi-Fi together with Ethernet. The term broadband router applies to any home wired or wireless router being used for sharing a broadband Internet connection.

Home routers often cost USD $100 or less. They are manufactured to be much more affordable than business routers in part because they offer fewer features. Still, home routers provide many essential home networking functions:

i. sharing of home Internet connections for dozens of devices
ii. basic home network firewall and other security support
iii. ability to change router configuration settings from a Web browser

1.4. OTHER TYPES OF ROUTERS AND ROUTING DEVICES

A class of portable Wi-Fi routers called travel routers are marketed to people and families who want to use the functions of a personal router at other locations besides home. Routing devices called mobile hotspots that share a mobile (cellular) Internet connection with Wi-Fi clients are also available. Many mobile hotspot devices only work with certain brands of cell service.

2. ROUTING TABLE

A routing table contains the information necessary to forward a packet along the best path toward its destination. Each packet contains information about its origin and destination. When a packet is received, a network device examines the packet and matches it to the routing table entry providing the best match for its destination. The table then provides the device with instructions for sending the packet to the next hop on its route across the network.

A basic routing table includes the following information:

i. Destination: The IP address of the packet's final destination
ii. Next hop: The IP address to which the packet is forwarded
iii. Interface: The outgoing network interface the device should use when forwarding the packet to the next hop or final destination
iv. Metric: Assigns a cost to each available route so that the most cost-effective path can be chosen
v. Routes: Includes directly-attached subnets, indirect subnets that are not attached to the device but can be accessed through one or more hops, and default routes to use for certain types of traffic or when information is lacking.

Routing tables can be maintained manually or dynamically. Tables for static network devices do not change unless a network administrator manually changes them. In dynamic routing, devices build and maintain their routing tables automatically by using routing protocols to exchange information about the surrounding network topology. Dynamic routing tables

allow devices to "listen" to the network and respond to occurrences like device failures and network congestion.

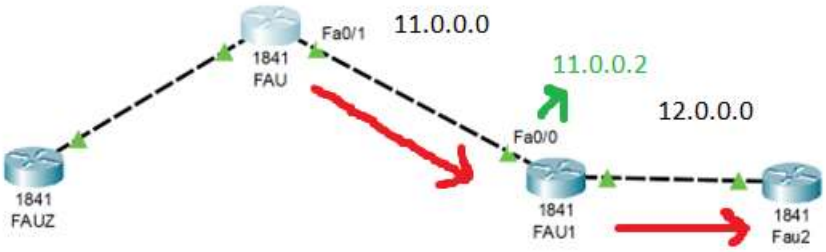

Figure1: Depicting a network of routers the directly connected devices can communicate with each other but the distant one's required static route establishment.

```
Fauzan'sRouter#sh ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

C    10.0.0.0/8 is directly connected, FastEthernet0/0
C    11.0.0.0/8 is directly connected, FastEthernet0/1
S    12.0.0.0/8 [1/0] via 11.0.0.2
```

Figure 2: Using 'Show IP Route' command to see the routing table

3. CONFIGURING A ROUTER

3.1. HOW TO SET BANNER

A banner is a message that is presented to someone using the router. The type of banner you configure determines when this message is shown to the user. You can configure three main types of banners on a Cisco router.

i. Message of the Day (MOTD): This type of logon message has been around for a long time on Unix and mainframe systems. The idea was to display a temporary notice to users, such as issues with system availability. However, because it displays when you connect to the device prior to login, most

network administrators now use it to display legal notices regarding access to the router, such as unauthorized access to this device is prohibited and violators will be prosecuted to the full extent of the law.

ii. Login: This banner displays before login to the system but after the MOTD banner is displayed. Typically, this banner displays a permanent message to users.

iii. Exec: This banner displays after the login is completed when the connecting user enters User EXEC mode. Whereas the other banners are seen by all people who attempt to connect to the router, this banner is seen only by users who successfully log on to the router. This banner can be used to post reminders to network administrators.

To configure each of these banners, examine the following commands, which set all three banners up on your router:

Router(config)#banner motd c Enter TEXT message. End with the character 'c'. This device is for authorized personnel only.

If you have not been provided with permission to access this device - disconnect at once. c Router(config)#banner login c Enter TEXT message. End with the character 'c'. *** Login Required. Unauthorized use is prohibited *** c

Router(config)#banner exec c Enter TEXT message. End with the character 'c'. *** Ensure that you update the system configuration *** *** documentation after making system changes. *** c

Notice that each of the banner lines ends with a ‘c’ to delimit the end of the message. You can specify any character you want, but you will be using it to end the banner message. Here is what these messages look like when you connect to the router:

Router Con0 is now available Press RETURN to get started! This device is for authorized personnel only. If you have not been provided with permission to access this device - disconnect at once.

**** Login Required. Unauthorized use is prohibited*

**** User Access Verification*

Password:

**** Ensure that you update the system configuration *** *** documentation after making system changes. ****

Router>

3.2. HOST NAME CONFIGURATION

Router# Config t

Router(Config)#hostname enter name

Exit

3.3. DISPLAY RUNNING CONFIGURATION

Router> en

Router# show running-config

3.4. LINE CONSOLE PASSWORD

Router# Config t

Router(Config)#line console 0

Router(Config)#login

Router(Config)#password enter password

Router(Config)#exit

3.5. PASSWORD FOR EXECUTIVE MODE

Router# Config t

Router(Config)#enable password give password

Router(Config)#exit

4. Router Serial Connectivity

Given below is the network diagram that you must configure using Generic Routers

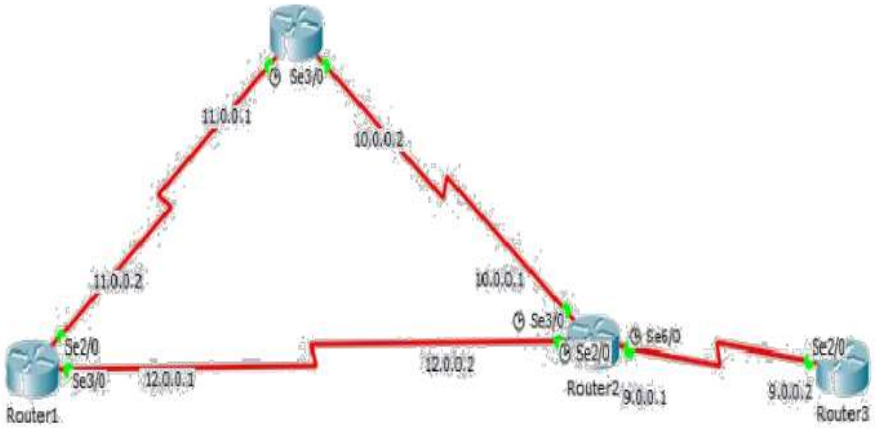

Figure 3: Depicting four routers connected and the distant one should be approached using static routes

ROUTER 0

R0#

R0#config t

Enter configuration commands, one per line. End with CNTL/Z.

R0(config)#int s2/0

R0(config-if)#ip add 11.0.0.1 255.0.0.0

R0(config-if)#clock rate 64000 // setting clock for synchronization, required in serial interfaces

R0(config-if)#no shut

R0(config)#int s3/0

R0(config-if)#ip add 10.0.0.2 255.0.0.0

R0(config-if)#no shut

R0(config)#ip route 9.0.0.0 255.0.0.0 10.0.0.1 // statically define the route

ROUTER 1

Router(config)#int s2/0

Router(config-if)#ip add 11.0.0.2 255.0.0.0

Router(config-if)#no shut

Router(config-if)#exit

Router(config)#int s3/0

Router(config-if)#ip add 12.0.0.1 255.0.0.0

Router(config-if)#no shut

Router(config)#ip route 9.0.0.0 255.0.0.0 12.0.0.2 // statically define the route

ROUTER 2

Router(config)#int s2/0

Router(config-if)#ip add 12.0.0.2 255.0.0.0

Router(config-if)#clock rate 64000

Router(config-if)#no shut

Router(config-if)#exit

Router(config)#int s3/0

Router(config-if)#ip add 10.0.0.1 255.0.0.0

Router(config-if)#clock rate 64000

Router(config-if)#no shut

Router(config-if)#exit

Router(config)#int s6/0

Router(config-if)#ip add 9.0.0.1 255.0.0.0

Router(config-if)#clock rate 64000

Router(config-if)#no shut

ROUTER 3

Router#config t

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#int s2/0

Router(config-if)#ip add 9.0.0.2 255.0.0.0

Router(config-if)#no shut

Router(config)#ip route 10.0.0.0 255.0.0.0 9.0.0.1 // statically define the route

Router(config)#ip route 12.0.0.0 255.0.0.0 9.0.0.1

Router(config)#ip route 11.0.0.0 255.0.0.0 9.0.0.1

Lab tasks

Implement following topology using packet tracer and configure static routes