Lab Manual

EE5302 - Computer Networks

Department of Electrical and Information Engineering

Faculty of Engineering

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Sri Lanka

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Table of Contents

Introduction

The following material contained in this text was written with the intent to guide and assist the student in obtaining the maximum educational benefit from the module **EE5302 Computer Networks**. This lab manual is intended to enhance the learning experience of the student in topics encountered in EE5302. In these laboratories, students are expected have hands on experience in configuring and setting up basic network devices and equipment to match the theoretical concepts introduced in the module. How the student performs in the lab depends on his/her preparation, participation, and teamwork. Each team member must participate in all aspects of the lab to ensure a thorough understanding of the equipment and new concepts.

The student's goals should be

- To relate the laboratory experiments to theory courses and reinforce the principles learned in the classroom
- To obtain practice and develop an interest in planning an experimental test
- To obtain practice in interacting with the experiment and with other personnel involved in the group effort
- To develop a proficient style in technical communication, both written and oral
- To develop an appreciation of the open ended type of problems in research and design and the multiple paths available in the problem solution.

The overall objective is to improve the students' capabilities in these areas and thereby increase their professional competence. It is expected that students will perform and develop in laboratory courses with the same attitude and goals as in theory-oriented courses.

Responsibilities

The student, instructor and the lecturer have certain responsibilities towards successful completion of the lab's goals and objectives, which are listed below.

Student Responsibilities

- Read the lab manual and related text books before coming to the lab class
- Carry out any pre lab preparation which may include performing some calculations
- Consult your instructor to solve any problems that you might have encountered
- Do not wait till the last moment to consult your instructor
- Actively participate in all lab activities
- Understand the procedure of each lab session
- Stay alert and use commonsense while performing the lab experiment
- Keep a professional and accurate record of the experiments in the note book.
- Report any errors in the lab manual to the instructors.

Instructor Responsibilities

- Familiarize with each lab prior to the class.
- Provide the students with a syllabus and safety review during the first class.
- Provide the students with Instructor's office hours, telephone number, and the name of the lecturer in charge.
- Make sure that all the necessary equipment and other material preparations for the lab are available in working condition.
- Answer any questions posed by the students and supervise the students performing the lab experiments.
- Grade the pre-labs, lab notebooks, and reports in a fair and timely manner.
- Reports should be returned to the students in the next lab period following submission.
- Report any errors in the lab manual to the lecturer in charge.

Lecturer Responsibilities

- Ensure that the laboratory is properly equipped.
- Resolve any questions or problems identified by the Instructor or the students.
- Make any necessary corrections to this manual.
- Ensure that the soft copy of the manual is regularly updated and available.

Lab Policy and Grading

The student should understand the following polices.

Attendance

Attendance is mandatory and any absence must be for a valid excuse and must be documented or informed as earlier as possible.

Lab Records

The student must:

1. Perform the Pre-Lab assignment before the initiation of each lab.
2. Maintain a NOTEBOOK to keep the records and perform the pre-lab sessions.
3. Complete and submit lab reports to the instructors on or before the deadline.

Grading Policy

20% of the marks are being allocated for Laboratories. Grading for each laboratory class includes Pre-lab, viva, observations and discussion sections. The distribution of marks for each category is mentioned in the provided lab report.

Use of Laboratory Instruments

One of the major goals of this lab is to familiarize the student with the proper equipment and techniques for setting up computer networks. Some understanding of the lab instruments is necessary to avoid personal or equipment damage. By understanding the device's purpose and following a few simple rules, costly mistakes can be avoided.

In general, all devices have physical limits. These limits are specified by the device manufacturer and are referred to as the device RATING. The ratings are usually expressed in terms of voltage limits, current limits, power limits, port types and protocols. It is up to the engineer to make sure that these ratings (limit valves) are not exceeded or mismatched in device operation. The following rules provide a guideline for instrument protection.

Instrument Protection Rules

1. Do not disconnect cables when devices are power on.
2. Use appropriate cables for relevant devices.
3. Ensure the cable connector and the socket is of the same type before connecting.
4. Ensure whether the ground (earth) of the instrument or the power supply is connected properly. Avoid accidental grounding of "hot" leads, i.e., those that are above ground potential.
5. Lab environment should be properly air conditioned to avoid the overheating of devices.

General Laboratory Safety Rules

In addition, the department of Electrical and Information Engineering is committed to provide a safe laboratory environment for all students. The students and staff are required to adhere to general laboratory safety rules in all department operated laboratories.

- Shoes shall be worn that provide full coverage of the fee, and appropriate personal clothing shall be worn in laboratories.

- Students shall be familiar with the locations and operation of safety and emergency equipment such as, emergency power off, fire extinguishers and emergency exits.

- Do not displace or remove laboratory equipment without instructor or technician authorization.

- Never open or remove cover of equipment in the laboratories without instructor authorization.

- Report all problems to the relevant technical officer.

Description of Laboratory Instruments related to EE5302 Labs

Network Cables

There are many types of network cables used in the real-world applications. Some of them are given below:

- Unshielded twisted pair:

  As the name indicates, the wires are twisted one another as indicated in the Figure 1. Cable is similar to the preceding but without conductive coating that makes it resistant to the noise and external electromagnetic influences. But modern technology overcomes this weakness. Each pair is individually wrapped and then all twisted together to resist the external influences. A plastic sheath is enclosing the twisted pairs for protection.

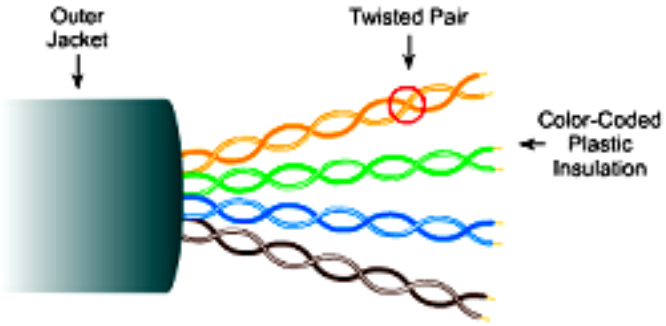


Figure 1: Unshielded twisted pair cable

- Shielded twisted pair:

  This cable as shown in Figure 2, is shielded with a copper conductive netting or casing, laid around individually shielded twisted pair (STP) or an external conductive shield around all pairs (STP - Screened Twisted Pair). For more detailed considerations of this kind are sometimes used the name of the FTP (Foil screened Twisted Pair), when it comes to a conductive foil shielding.

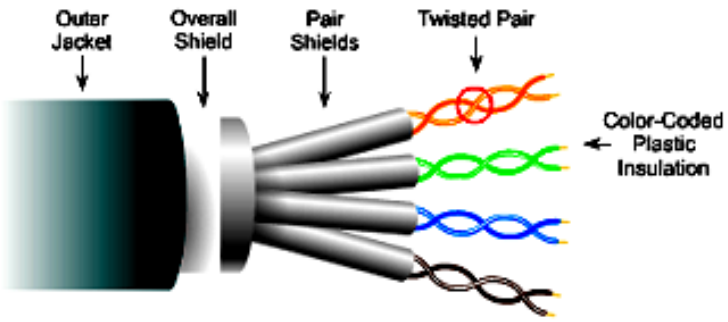


Figure 2: Shielded twisted pair cable

- Coaxial Cable

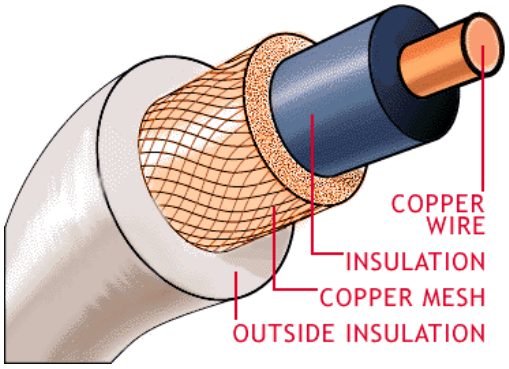


Figure 3: Coaxial cable

Cable Connection Types

- Straight through cable:

The colour coding of the connectors are same on both the ends of a straight through cable. This type of cable is used when we connect different types of devices [switch and router, router and hub, switch and PC, etc]. The colours of the wires and their respective pin numbers are mentioned in Figure 4.

Green [Pin 1]	⇨	Green [Pin 1]
White Green [Pin 2]	⇨	White Green [Pin 2]
White Orange [Pin 3]	⇨	White Orange [Pin 3]
Blue [Pin 4]	⇨	Blue [Pin 4]
White Blue [Pin 5]	⇨	White Blue [Pin 5]
Orange [Pin 6]	⇨	Orange [Pin 6]
White Brown [Pin 7]	⇨	White Brown [Pin 7]
Brown [Pin 8]	⇨	Brown [Pin 8]

Figure 4: Straight through cable connection

- Cross-over cable

Here, the colour sequences of the connectors at two ends are different. This type of cable is used when we connect similar devices [router and router, switch and switch, PC and PC, etc] and with some exceptions [switch and hub, Router and PC]. The colors of the wires and their respective pin numbers are mentioned in Figure 5.

Green [Pin 1]	⇨	White Orange [Pin 1]
White Green [Pin 2]	⇨	Orange [Pin 2]
White Orange [Pin 3]	⇨	Green [Pin 3]
Blue [Pin 4]	⇨	White Brown [Pin 4]
White Blue [Pin 5]	⇨	Brown [Pin 5]
Orange [Pin 6]	⇨	White Green [Pin 6]
White Brown [Pin 7]	⇨	Blue [Pin 7]
Brown [Pin 8]	⇨	White Blue [Pin 8]

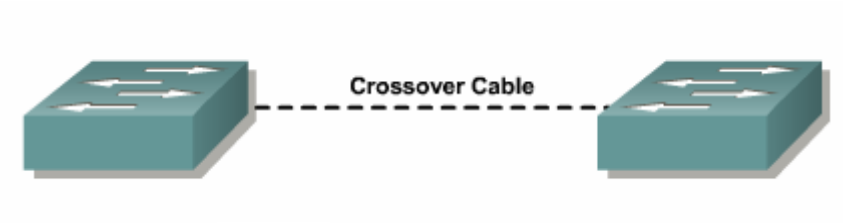


Figure 5: Cross over cable connection

- Roll over cable

The colour sequences of the connectors in a roll over cable made in reverse order as shown in Figure 6. This type of cable is used to connect a router or a switch to the PC via a console port for accessing and configuration purposes.

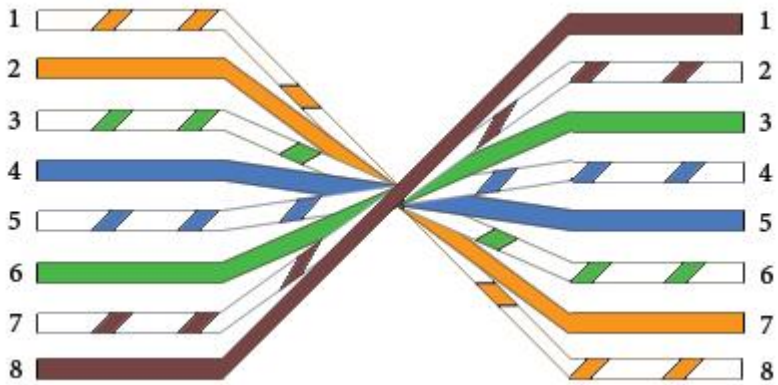


Figure 6: Roll over cable connection

Routers

The type of the routers used in the networking laboratory is Cisco 2911. There are LED indicators in the front side of the router which represent following parameters.

- Power: Indicates the router's operating status. Comes on when power is supplied to the router and the router is operational.
- RPS [Redundant Power System]: Off—No RPS is attached; On—RPS is attached and operational; Blinking—RPS is attached, but has a failure.
- Activity: Off—In the Cisco IOS software, but no network activity; Blink (500 ms ON, 500 ms OFF)—In ROMMON, no errors; Blink (500 ms ON, 500 ms OFF, 2 seconds between codes)—In ROMMON, error detected; Blink (less than 500 ms)—In the Cisco IOS software, the blink rate reflects the level of activity.

The Figure 7 illustrates the different components included in a front panel of a Cisco 2911 router.

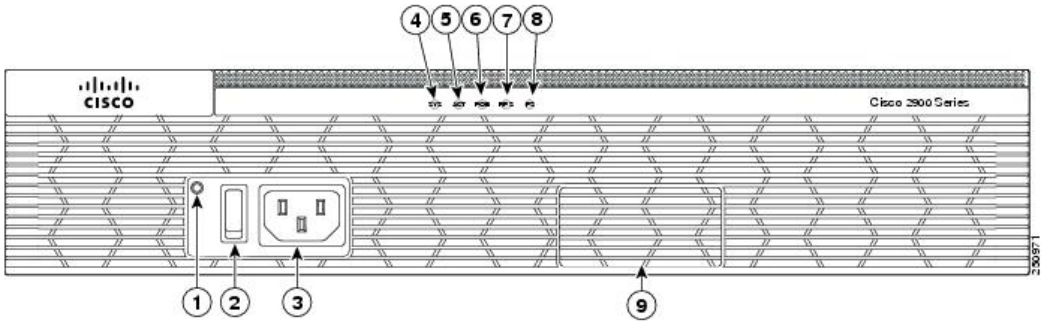


Figure 7: Front panel of the Cisco 2911 router

1	AC OK[1]	**2**	On/off switch
3	AC power connector	**4**	SYS
5	ACT	**6**	POE
7	RPS[2]	**8**	PS[3]
9	Optional RPS adapter (blank panel shown)		

[1] LED goes off if the AC power fails or is disconnected. It does not go on and off with the power switch
[2] RPS = Redundant Power Supply
[3] PS = power supply

The router has serial and fast Ethernet ports. These ports are mostly used for data transfer among networks. It has console and auxiliary ports, which are used for accessing purposes. The ports and other components included in the back side of the router is shown in Figure 8.

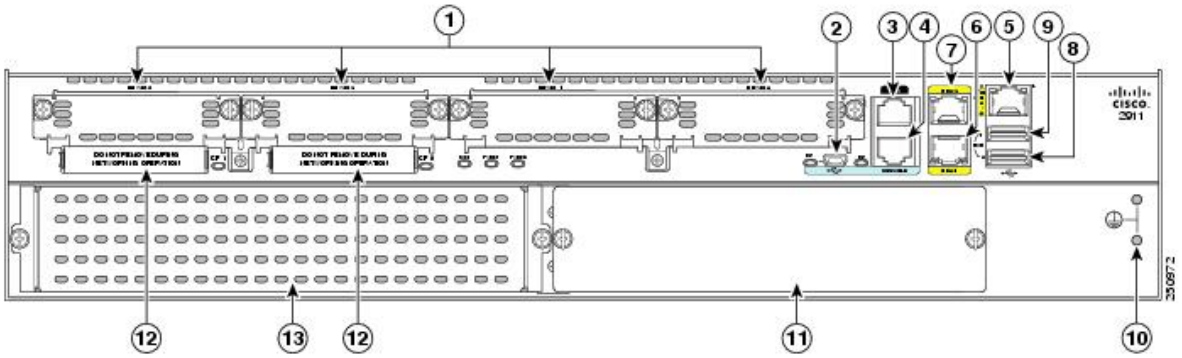


Figure 8: Back panel of the Cisco 2911 router

1	EHWIC slots[1] 0, 1, 2, and 3 (0, Far right)	**2**	USB serial port
3	AUX	**4**	RJ-45 serial console port
5	10/100/1000 Ethernet port (GE0/0)	**6**	10/100/1000 Ethernet port (GE0/1)
7	10/100/1000 Ethernet port (GE0/2)	**8**	USB 0
9	USB 1	**10**	Ground
11	AC, DC, AC-POE, or DC-POE Power Module	**12**	CompactFlash[2] 0 and 1 (0, Right)
13	Service module[3] slot 1		

1. Double-wide EHWICs can fit into slot 0 and 1, and into slot 2 and 3. EHWIC slots support HWIC, VIC, and WIC.
2. Only Advanced Capability Compact Flash (CF) purchased from Cisco operates in Cisco 2900 series and Cisco 3900 series ISRs. Legacy CF can impact and several degrade performance in these routers. See the "Memory" section. When legacy CF is inserted, the following error message appears:

WARNING: Unsupported compact flash detected. Use of this card during normal operation can impact and severely degrade performance of the system. Please use supported compact flash cards only.

3. Service module slots support legacy network modules when inserted with an adapter. See the router product page at Cisco.com for a list of supported modules.

SWITCHES

The switches been used in these laboratories are Cisco 2960. The front and back view of the Cisco Catalyst 2960 switch is shown in Figure 9.

The Cisco Catalyst 2960 LAN Lite Switches offer

- Both 24 and 48 port POE is available using 802.3af class 3 with 370 Watt power capacity.
- Dual-purpose uplinks for Gigabit Ethernet uplink flexibility, allowing use of either a copper or a fiber uplink. A dual-purpose uplink port has one 10/100/1000 Ethernet port and one Small Form-Factor Pluggable (SFP)-based Gigabit Ethernet port, with one port active at a time.
- Scalable and secure ease of use functionality such as auto configuration with Auto Smart Ports and easy installation with Auto Install to lower total cost of ownership.
- Enhanced troubleshooting for problem solving including link connectivity and cable diagnostics
- QoS for traffic classification and shaping to prioritize various applications including voice, video, and multicast applications.
- Single IP address, syslog, and Simple Network Management Protocol (SNMP) management for a stack of up to 16 switches.
- Baseline Network Admission Control based on users, ports, and MAC addresses.
- Limited lifetime hardware warranty.
- Software updates at no additional cost.

Cisco 2960 series switches have following specifications.

- Forwarding bandwidth 16Gbps
- Flash memory 32MB
- Maximum Transmission Unit Up to 9000 bytes
- Max VLANs 64

Figure 9: Front and back view of the Cisco 2960 switch

Laboratory Notebooks and Reports

The Laboratory Notebook

The student records and interprets his/her experiments via the laboratory notebook and the laboratory report. The laboratory notebook is essential in recording the methodology and the results of an experiment. In engineering practice, the laboratory notebook serves as an invaluable reference to the technique used in the lab and is essential when trying to duplicate a result or write a report. Therefore, it is important to learn to keep an accurate notebook.

The laboratory notebook should:

- Contain the experiment's title, the date, the equipment and instruments used,
- Circuit diagrams, the procedure used, the data (often in tables when several measurements have been made), and the analysis of the results.
- Contain plots of data and sketches when these are appropriate in the recording and analysis of observations.
- Be an accurate and permanent record of the data obtained during the experiment and the analysis of the results. You will need this record when you are ready to prepare a lab report.

The Laboratory Report

The laboratory report is the primary means of communicating your experience and conclusions to other professionals. In this course you will use the lab report to inform your Instructor what you did and what you have learned from the experience. Engineering results are meaningless unless they can be communicated to others. Your laboratory report should be clear and concise. Even though you will work with one or more lab partners, your report must (shall) be the result of your individual effort in order to provide you with practice in technical communication.

UNIVERSITY OF RUHUNA
DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING
EE 5302 – Computer Networks

Laboratory 1

Configuring VLANs and Trunking

INTRODUCTION: This laboratory will demonstrate the basic commands in configuring VLANs in a Cisco Switch. The laboratory apparatus consists of 3 Cisco switches and 6 PCs. Students are guided to create 3 VLANs and 2 trunks in switches. Further, basic switch configuring commands will be demonstrated.

LEARNING OBJECTIVES:

1. Learn to use basic commands in a Cisco Switch
2. Learn to create VLANs in a Cisco Switch
3. Learn to create trunking between switches.

EXPERIMENTAL OBJECTIVES

1. Understand communication within VLAN
2. Understand communication between inter-VLANs.

PRE-LAB:

Reading:

1. Read and study the Background section of this Laboratory.

.

Writing:

1. What is the difference between a router and a switch?
2. Describe the advantage of using VLANs within computer networks.

EQUIPMENT NEEDED:

1. Cisco 2960 switches 3
2. PC 6
3. Ethernet cables
4. Console cables

BACKGROUND:

A switch is used to connect devices together on a computer network and to establish the data connectivity among the nodes by filtering and forwarding. A network switch is considered more advanced than a hub because a switch will only send a message to the device that needs or requests it, rather than broadcasting the same message out of each of its ports. Switches are layer 2 devices and are therefore relatively easy to configure in comparison to routers.

Switches can be configured through network ports or console ports. Network ports facilitate remote manage capabilities in a switch. The console port will be used as the main configuration method in this laboratory. If and when the switch has a network connection and a valid IP address, then a number of options are available for remote management of a switch such as Telnet, HTTP (Hyper Text Transfer Protocol), SNMP and TFTP which are illustrated in Figure 1.1.

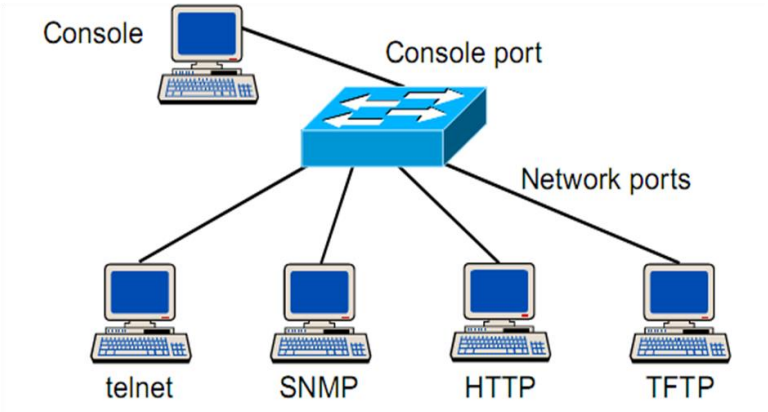


Figure 1.1: Managing a Switch through ports

There are several modes in a Switch. The commands that can be executed in a switch are categorized under these modes. Configuration of a switch cannot be done by a single command. It requires numerous commands, distributed over the switch modes. Therefore, in order to configure a switch completely, the administrator has to go through these modes. A brief description about these modes is given below.

1. **User Mode**

Command line Prompt: Switch>

This mode provides basic access to the switch with limited command availability (basically simple monitoring and troubleshooting commands). Depending on the Cisco device's configuration, you might be prompted for a password to access this mode. This mode is typically used for basic troubleshooting of networking problems. User mode is indicated with the > next to the switch name.

2. **Privilege Mode**

Command line Prompt: Switch#

Once you have gained access to User mode, you can use the **enable** command to access Privilege mode. Privilege mode commands include extended ping and trace abilities, managing configuration files and detailed troubleshooting using debug commands. If you wish to return to User mode from Privilege mode, use the **exit** command.

3. Global Configuration Mode

Command line Prompt: **Switch(config)#**

You can enter global configuration mode from privileged mode using the **configure terminal command.** From global configuration mode, you can access specific configuration modes. Some of them are listed at Table 1.1.

Table 1.1: Special Configuration Modes

Command in configuration mode	Task
Switch(config)#line console 0	Enters line console mode
Switch(config)#line vty 0 4	Enters line vty mode for all five virtual ports
Switch(config)#interface fa0/1	Enters interface configuration mode

Table 1.2 describes the commands to switch between modes. Table 1.3 has the basic configuration commands in Switch configuration and VLAN creation. Table 1.4 contains the basic show commands. Show commands are used to display current configuration in the switch.

Table 1.2: Commands - Switch between Modes of a Switch

Mode	Prompt
User mode	Switch>
Enter Privilege mode	Switch>enable
Privileged mode	Switch#
Enter configuration mode	Switch#configure terminal
Global Configuration mode	Switch(config)#
Enter Interface mode	Switch(config)#interface fa0/ 1
Interface mode	Switch(config-if)
Return to global configuration	Switch(config-if)exit
Exit Global Configuration mode	Switch(config)#exit
Return to user mode	Switch#disable
Logout	Switch>exit

Table 1.3: Commands - Basic configuration of a Switch

Task	Command
Configure device system name to “SWITCH1”	Switch(config)#hostname SWITCH1
Sets the unencrypted enable password “class”	SWITCH1(config)#enable password class
Enable password encryption on all clear text password within the configuration file	SWITCH1(config)#service password -encryption
Configure a message of the banner, with an ending character of $	SWITCH1(config)#banner motd $ DONOT ENTER WITHOUT PERMISSION $
Configures 5 Telnet session each with a password of “class”	SWITCH1(config)#line vty O 4 SWITCH1(config-line)#login SWITCH1(config-line)#password class
Enable and define console password of “class”	SWITCH1(config)#line con O SWITCH1(config-line)#login SWITCH1(config-line)#password class
Select one interface	SWITCH1(config)#int fa0/1
Select a range of interfaces	SWITCH1(config)#int range fa0/1 - 12
Set the interface description	SWITCH1(config-if)#description THIS INTERFACE IS CONNECTED TO A COMPUTER
Add vlan using config mode	SWITCH1(config)#vlan 1 SWITCH1(config-vlan)#name VLAN1

Assign an access interface to access a specific VLAN	SWITCH1(config)# interface fastEthernet 0/5 SWITCH1(config-if)# switchport mode access SWITCH1(config-if)# switchport access vlan 10
Assign an Interface into trunking.	SWITCH1(config)# interface fastEthernet 0/5 SWITCH1 (config-if)#switchport mode trunk
Configure Interface fa0/1 at speed 100 Mbps and full duplex	SWITCH1(config-if)#speed 100 SWITCH1(config-if)#duplex full
Enable Interface	SWITCH1(config- if)#no shutdown
Disable Interface	SWITCH1(config- if)#shutdown

Table 1.4: Show Commands

Task	Commands
Displays the configuration held in DRAM which will be lost, if not copy run start command is not used	Switch#show running-config
Displays the NVRAM (None volatile) configuration	Switch#show startup-config
Saves the configuration. Without this command all changes/configuration will be lost.	Switch#copy running-config startup-config
Display the IOS version along with other useful information	Switch#show version

Displays the clock	Switch#show clock
Displays the users currently logged on	Switch#show users
By default displays the last 10 commands	Switch#show history
Lists all the configured vlans	Switch#show vlan
Ping selected address	Switch#ping 10.1.1.1
Display the interface status	Switch#show int fa0/1

VLANs are a mechanism to allow network administrators to create logical broadcast domains that can span across a single switch or multiple switches, regardless of physical proximity. This function is useful to reduce the size of broadcast domains or to allow groups or users to be logically grouped without the need to be physically located in the same place. Figure 1.2 shows a simple network with three switches. There are three VLANs in the network, VLAN 10, VLAN 20 and VLAN 30. Switch 1 and switch 2 is connected through a trunk and Switch 2 and switch 3 is connected through a trunk.

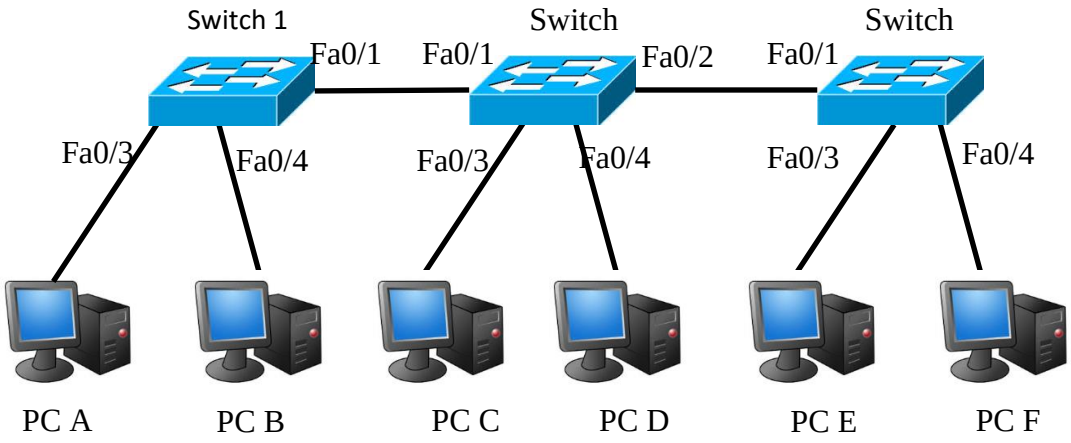


Figure 1.2: VLANs

Table 1.5: Configuration details of PCs

PC	VLAN	IP address
PC A	10	192.168.10.101
PC B	20	192.168.20.101
PC C	30	192.168.30.101
PC D	10	192.168.10.102
PC E	20	192.168.20.102
PC F	30	192.168.30.102

Configure the PCs.

(a) Set the IP addresses in PCs according to the table 1.5 (Refer Figure 1.3).

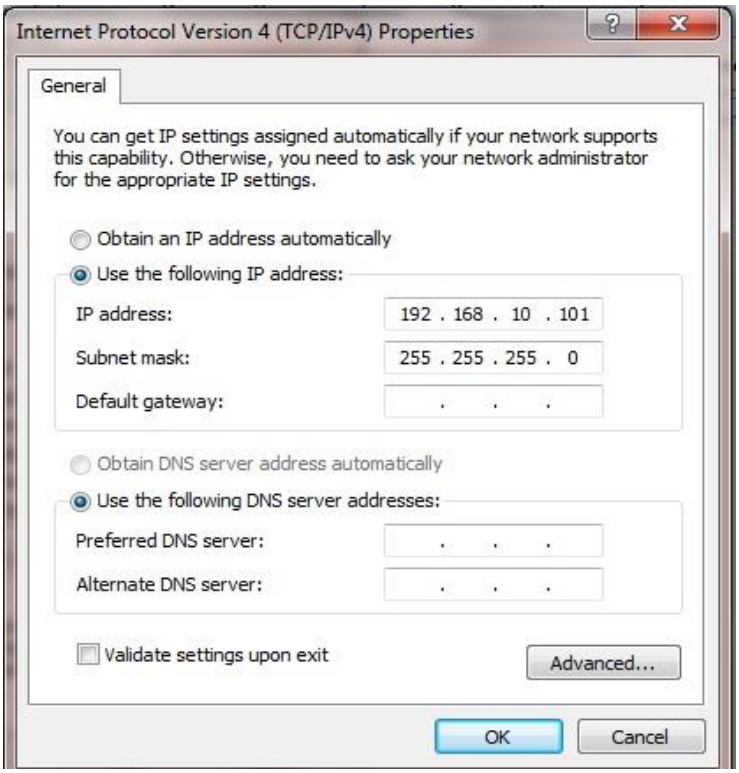


Figure 1.3: Set the IP address of a PC

(b) Configure the switches.

1. Set the enable password
2. Set console password
3. Set vty(telnet) password
4. Set a banner
5. Set the hostname of each switch as SWITCH1. You have to select the switch number (1, 2 or 3) according to the label in the switch.

(c) Configure the VLANs.

1. Create relevant VLANs in Switch 1, 2 and 3.
2. Name them as VLAN10, VLAN20 and VLAN30.
3. Assign interfaces to access VLANs (Refer the figure 1.2)
4. Configure the trunks in SWICH2.

(d) Test the configuration

1. List all the configured VLANs in a Switch.
2. Ping between PCs in the same VLAN.(ex: VLAN10-PC A and PC D)
3. Ping between PCs in different VLANs.(ex: VLAN10-PC A and VLAN20-PC B)

During the above section, the communication within a VLAN can be attained. But inter-VLAN communication is not possible.

Task:

Find the possibilities of achieving inter-VLAN communication with a Router. Implement your suggested solution using Cisco packet tracer. Assume you have provided a switch, a router and 2PCs. Create two VLANs and assign the PCs to the VLANs in the Switch. (Hint: you can divide a router interface into sub interfaces)

UNIVERSITY OF RUHUNA
DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING
EE 5302 – Computer Networks

Laboratory 2

Configuring routing in a Network

INTRODUCTION: This laboratory will demonstrate the basic commands in configuring RIP (Routing Information Protocol) routing in a network. The laboratory apparatus consists of 3 Cisco switches, 3 Cisco routers and 3 PCs. The testing network has 5 separate networks. Students are guided to assign addresses to router interfaces and PCs. The basic commands in configuring dynamic routing in Cisco routers using RIP will be demonstrated.

LEARNING OBJECTIVES:

1) Understand difference between switching and routing
2) Understand dynamic routing

EXPERIMENTAL OBJECTIVES

1) Learn to use basic commands in a Cisco Router
2) Learn to configure dynamic routing in a Cisco Router

PRE-LAB:

Reading:

1. Read and study the Background section of this Laboratory.

.

Writing:

1. What is the difference between RIP V1 and RIP V2?
2. Compare and contrast the different types of routing protocols.

EQUIPMENT NEEDED:

1. Cisco 2960 switches 3
2. Cisco 2911 routers 3
3. PC 3
4. Ethernet cables
4. Console cables

BACKGROUND:

Routers are used to connect networks whereas switches connect devices like PCs. The primary function of a **router** is to forward a packet toward its destination **network**. To do this, router needs an idea about reachable networks. A router maintains a **routing table**, which contains information about the connected networks and the best path to reach those networks. Routing, in essence, is the act of finding a path from one network

to another on which a packet can travel. This information is stored in the routing table in order to use them in packet forwarding.

Routing tables can contain directly connected, manually configured static routes and routes learned dynamically using a routing protocol. **Static routes** are added to the routing table manually, using the knowledge of the internetwork topology. With contrast to static routing, **dynamic routing** consists of routing tables that are built and maintained automatically through an ongoing communication between routers. This communication is facilitated by a **routing protocol**, a series of periodic or on-demand messages containing routing information that is exchanged between routers.

Some of the most common routing protocols include RIP, IGRP, EIGRP, OSPF, IS-IS and BGP. Different routing protocols use different algorithms to choose the best path that packet can travel. According to the requirements, network administrator could choose a routing protocol to a network.

During this laboratory, dynamic routing will be configured in a network using Routing Information Protocol.

Prior to the configuration of the routing information, basic settings of a router should be set such as enable password, host name etc. the basic configuration of a router is same as a Router. A router can be configured through network ports or console ports.

There are several modes in a Router. The commands that can be executed in a router are categorized under these modes. Configuration of a Router cannot be done by a single command. It will be required numerous commands, distributed over the Router modes. Therefore, in order to configure a Router completely, the administrator has to go through these modes. A brief description about these modes is given below.

1. **User Mode**

Command line Prompt: Router>

This mode provides basic access to the Router with limited command availability (basically simple monitoring and troubleshooting commands). Depending on the Cisco device's configuration, you might be prompted for a password to access this mode. This mode is typically used for basic troubleshooting of networking problems. User mode is indicated with the > next to the Router name.

2. **Privilege Mode**

Command line Prompt: Router#

Once you have gained access to User mode, you can use the **enable** command to access Privilege mode. Privilege mode commands include extended ping and trace abilities, managing configuration files and detailed troubleshooting using debug commands. If you wish to return to User mode from Privilege mode, use the **exit** command.

3. Global Configuration Mode

Command line Prompt: **Router(config)#**

You can enter global configuration mode from privileged mode using the **configure terminal command.** From global configuration mode, you can access specific configuration modes. Some of them are listed at Table 2.1.

Table 2.1: Special Configuration Modes

Command in configuration mode	**Task**
Router(config)#line console 0	Enters line console mode
Router(config)#line vty 0 4	Enters line vty mode for all five virtual ports
Router(config)#interface fa0/1	Enters interface configuration mode

Table 2.2 describes the commands to switch between modes. Table 2.3 contains the basic configuration commands in a router. Basic configuration of a router is same as a switch. Table 2.4 has the Show commands which are useful in understanding prevailing configuration in the Router.

Table 2.2: Commands - Switch between Modes of a Router

Mode	**Prompt**
User mode	Router>
Enter Privilege mode	Router>enable
Privileged mode	Router#
Enter configuration mode	Router#configure terminal
Global Configuration mode	Router(config)#
Enter Interface mode	Router(config)#interface fa0/ 1
Interface mode	Router(config-if)
Return to global configuration	Router(config-if)exit
Exit Global Configuration mode	Router(config)#exit
Return to user mode	Router#disable
Logout	Router>exit

Table 2.3: Commands - Basic configuration of a Router

Task	Command
Configure device system name to “ROUTER1”	Router(config)#hostname ROUTER1
Sets the unencrypted enable password “class”	ROUTER1(config)#enable password class
Enable password encryption on all clear text password within the configuration file	ROUTER1(config)#service password -encryption
Configure a message of the banner, with an ending character of $	ROUTER1(config)#banner motd $ DONOT ENTER WITHOUT PERMISSION $
Configures 5 Telnet session each with a password of “class”.	ROUTER1 (config)#line vty O 4 ROUTER1 (config-line)#login ROUTER1 (config-line)#password class
Enable and define console password of class	ROUTER1 (config)#line con O ROUTER1 (config-line)#login ROUTER1 (config-line)#password class
Select one interface	ROUTER1(config)#int fa0/1
Select a range of interfaces	ROUTER1(config)#int range fa0/1 - 12
Set the interface description	ROUTER1(config-if)#description THIS INTERFACE IS CONNECTED TO A ROUTER2
Configure Interface fa0/1 at speed 100 Mbps and full duplex	ROUTER1(config-if)#speed 100 ROUTER1(config-if)#duplex full
Assign an ip address to an interface	ROUTER1(config)#int fa0/1 ROUTER1(config- if)#ip address 10.1.1.1 255.255.255.0
Enables RIP version2 and associate a network with routing process	ROUTER1(config)#router rip ROUTER1(config-router)#network 10.0.0.0 ROUTER1(config- router)#version 2

Disable Split horizon on an interface	ROUTER1(config-if)# no ip split-horizon
Enable Interface	ROUTER1(config-if)#no shutdown
Disable Interface	ROUTER1(config-if)#shutdown

Table 2.4: Show Commands

Task	**Commands**
Displays the configuration held in DRAM which will be lost, if not copy run start command is not used	Router#show running-config
Displays the NVRAM (None volatile) configuration	Router#show startup-config
Saves the configuration. Without this command all changes/configuration will be lost.	Router#copy running-config startup-config
Display the IOS version along with other useful information	Router#show version
Displays the clock	Router#show clock
Displays the users currently logged on	Router#show users
By default displays the last 10 commands	Router#show history
Ping selected address(This command can be run on operating systems in addition)	Router#ping 10.1.1.1
List the routes that packets take when traveling to the destination (This command can be run on operating systems in addition)	Router#traceroute 10.1.1.1
Display the interface status	Router#show int fa0/1

Displays the interface operational status and IP addresses for all router interfaces	Router#show ip interface brief
Displays all the configured routing protocols	Router#show ip protocols
Displays the IP routing table	Router#show ip route

Figure 2.1 shows 5 networks which are connected with 3 routers. 3 PCs are connected to the routers through switches. The network IDs of the networks are shown in the Table 2.5.

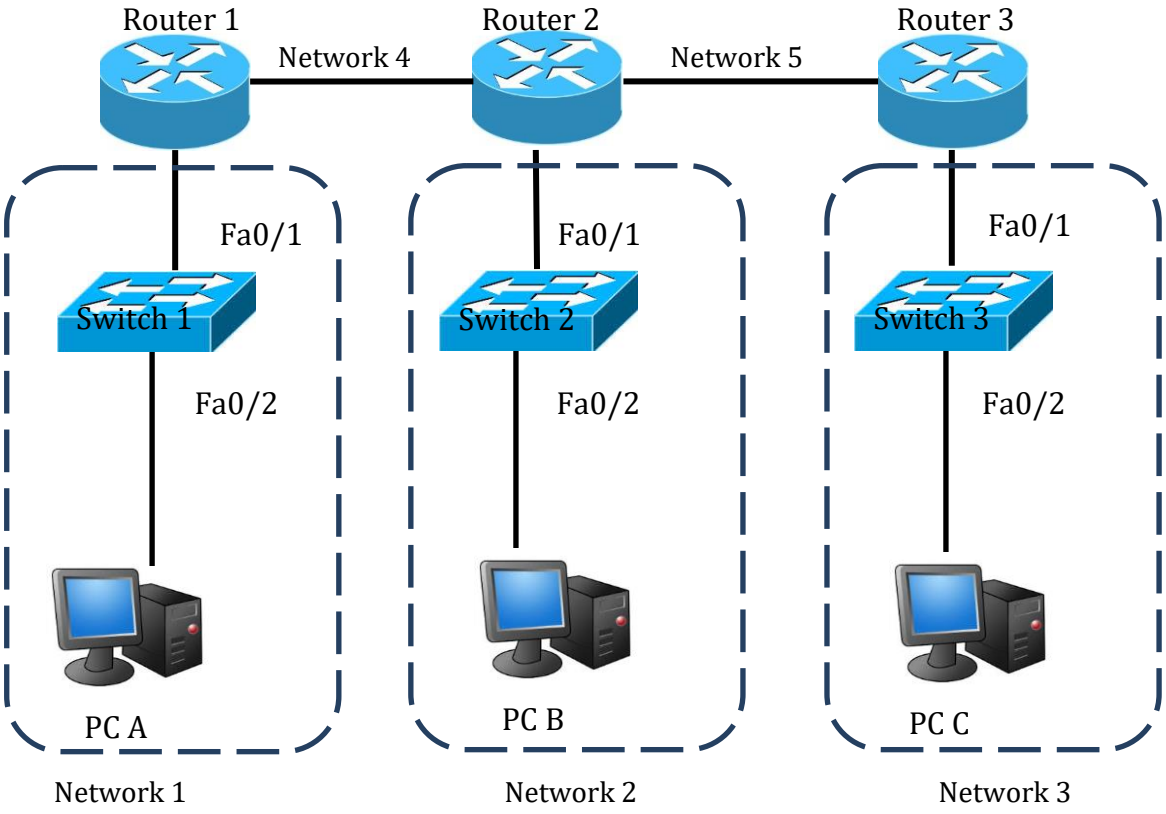


Figure 2.1: Network

Table 2.5: Network addresses.

Network	Network ID
1	192.168.10.0/24
2	192.168.20.0/24
3	192.168.30.0/24
4	192.168.40.0/30
5	192.168.40.4/30

(a) Configure the PCs.

1. Set the IP addresses in PCs according to the Table 2.5 (Refer Figure 1.2). You have to decide an IP address for a PC according to the network that it belongs to.

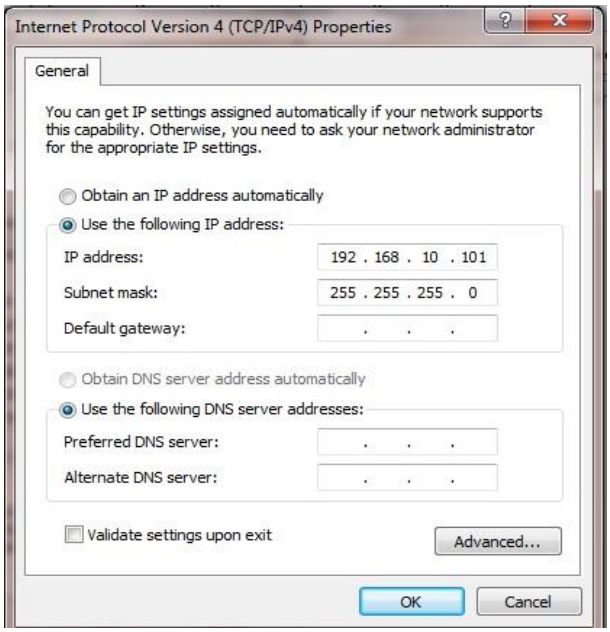


Figure 2.2: Set the IP address of a PC

(b) Configure the Routers.

1. Set the enable password
2. Set console password
3. Set vty(telnet) password
4. Set a banner
5. Set the hostname of each Router as ROUTER1. You have select the Router number (1, 2 or 3), according to the label in the Router.

(c) Configure the router interfaces.

1. Set a description
2. Set the IP address (Consider the subnet mask when assigning IP address to the inter-router interfaces)
3. Enable the interface

(d) Configure RIPv2 (RIP version 2) in routers.

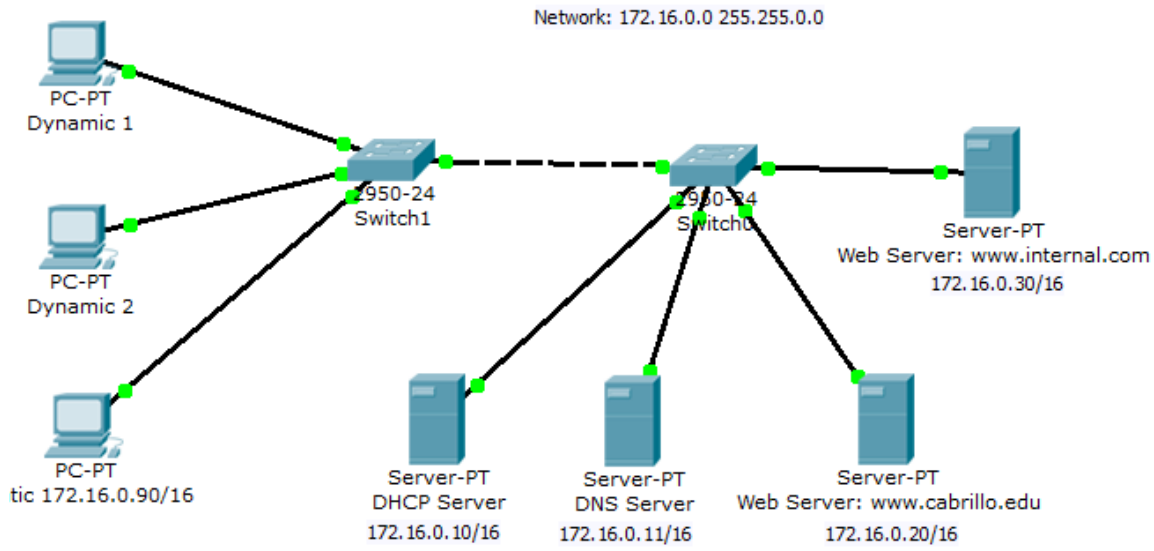
(e) Test the configuration

1. Ping PC A to PC B and PC C and vice versa.
2. Run Show commands and see the IP routing tables in routers.
3. Run “traceroute” on PC A to list the routes taken to reach PC C and vice versa.

UNIVERSITY OF RUHUNA
DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING
EE 5302 – Computer Networks

Laboratory 3

Network Simulation for user Applications using Packet Tracer



This is an example of what your final topology should look like.

Instructions:

1) Start Packet Tracer using **Realtime** mode.

- Options -> Preferences
  - Enable "Show Link Lights"
  - Disable "Hide Device Label"

2) Configuring the DHCP Server

   Add a server.

   Global Settings:

   - Change the Display Name to "**DHCP Server**"
   - Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.10**
- Set the Subnet Mask to **255.255.0.0**

HTTP:

- Set HTTP Service and HTTPS Service to **Off**

DHCP:

- Set the Default Gateway to **172.16.0.1**
- Set the DNS Server to **172.16.0.11**
- Set the Start IP Address to **172.16.0.100**

DNS:

- Set the Service to **Off**

3) Configuring the DNS Server

Add a server.

Global Settings:

- Change the Display Name to "**DNS Server**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.11**
- Set the Subnet Mask to **255.255.0.0**

HTTP:

- Set HTTP Service and HTTPS Service to **Off**

DHCP:

- Set the Service to **Off**

DNS:

- Entering the www.tsrb.edu Domain Name
  - Enter for the Domain Name **www.tsrb.edu**
  - Enter for IP Address **172.16.0.20**
  - Click **Add**
- Entering the www.internal.com Domain Name
  - Enter for the Domain Name **www.internal.com**
  - Enter for IP Address **172.16.0.30**
  - Click **Add**

4) Configuring the www.tsrb.edu Web Server

Add a server.

Global Settings:

- Change the Display Name to "**Web Server: www.tsrb.edu**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.20**
- Set the Subnet Mask to **255.255.0.0**

DHCP:

- Set the Service to **Off**

DNS:

- Set the Service to **Off**

HTTP

- Change the sentence, "<hr>Welcome to Packet Tracer 5.0, the best thing since..... Packet Tracer 4.0." to "<hr> Welcome to Tsrb's public web page!" You may add other information as well.

5) Configuring the www.internal.com Web Server

Add a server.

Global Settings:

- Change the Display Name to "**Web Server: www.internal.com**"
- Set the Gateway to **172.16.0.1**

FastEthernet:

- Set the IP address to **172.16.0.30**
- Set the Subnet Mask to **255.255.0.0**

DHCP:

- Set the Service to **Off**

DNS:

- Set the Service to **Off**

HTTP

- Change the sentence, "<hr>Welcome to Packet Tracer 5.0, the best thing since..... Packet Tracer 4.0." to "<hr> This is the corporate internal network!" You may add other information as well.

6) Configure Two Client Computers using DHCP

Add two client computers.

Global Settings:

- Change the Display Names to "**Dynamic 1**" and to "**Dynamic 2**" respectively
- Set the Gateway/DNS to **DHCP**

FastEthernet:

- Set the IP Configuration to **DHCP**

7) Configure One Client Computers using Static IP Addressing

Add two client computers.

Global Settings:

- Change the Display Name to "**Static**"
- Set the Gateway/DNS to **Static**
  - Set Gateway to **172.16.0.1**
  - Set the DNS Server to **172.16.0.11**

FastEthernet:

- Be sure the configuration is set to **Static**
- Set the IP address to **172.16.0.90**
- Set the Subnet Mask to **255.255.0.0**

8) Adding switches

- Add two switches.
- Connect the servers to one switch using a straight-through cable.
- Connect the client computers to the other switch using a straight-through cable.
- Interconnect the two switches using a crossover cable.

9) Verify connectivity

- Ping (ICMP)
  - From a client computer use the Desktop Command prompt to ping the other client computers and the servers.
  - Example: From the Dynamic 1 client, C> **ping 172.16.0.20**

- The first one or two pings may fail, but you should receive a reply on the later pings. This is due to the ping timing out while the ARP process takes place (later).

- Web Browser (HTTP)
  - On the client computers use the Desktop Web Browser, enter the URLs of the Web Servers www.tsrb.edu and www.internal.com.
  - You should see the web pages that you created on these servers.

10) Using Simulation Mode

Click on Simulation.

Note: To reset a simulation, click on "Reset Simulation"

Click on Edit Filters

- Choose **Show All/None** so that all the boxes (protocols) are unchecked.
- Select (check) the following protocols: **DHCP**, **ICMP**, **HTTP**, **DNS**.

Web Browser (HTTP)

- On the client computers use the Desktop Web Browser, enter the URLs of the Web Servers www.tsrb.edu or www.internal.com.
- Click on **Auto Capture/Play** (automatically forwards the packets) or **Capture Forward** (must keep clicking to advance the packets)

DHCP

- Reset the simulation by clicking on "Reset Simulation"
- To view DHCP, on one of the "Dynamic "client computers using DHCP go to the Desktop Command prompt.
- To have the client computer ask for new IP address and other information from the DHCP server, enter the command: C> **ipconfig /renew**