

LABORATORY 4: Dynamic Host Configuration Protocol (DHCP)

Objectives

By the end of the laboratory, students will be able to

- configure a DHCP server for dynamic IP address allocation.
- configure a wireless router for mixed static and dynamic IP address allocation.

Introduction:

In the past few lab experiments, we have been using “static” IP addresses. The IP addresses of the hosts were fixed, and we did the configuration manually. This approach (manual allocation and configuration of IP addresses) is acceptable for networks with small number of hosts. For networks with large number of hosts, we run the risk of allocating same IP address to multiple hosts, causing IP address conflict. The process is also laborious, especially if the hosts are joining and leaving the network frequently. The number of IP addresses may not be sufficient too if the number of hosts is very large. If there is any change in the default gateway or DNS server, we would have to manually re-configure all the hosts!

A better approach for networks supporting large number of hosts is to use dynamic IP address configuration. With dynamic address configuration, we just need to define a pool of IP addresses to be dynamically allocated to hosts when they join the network. This process makes use of the Dynamic Host Configuration Protocol (DHCP). DHCP is a client-server model process, where the DHCP client service running on a host joining a network broadcasts for DHCP server to send network configuration information to it. Upon receiving the request, the DHCP server picks an available IP address from the defined pool and sends the network configuration information to the DHCP client. The network configuration information may also contain parameters like subnet mask, default gateway, DNS server’s IP address, and lease duration.

Both static and dynamic IP addresses may be used in a network. For mobile devices like laptops, it is more sensible to use dynamic IP addresses, since these devices join and leave the network too frequently. For server (example, file server, web server), it is desirable to have fixed IP addresses, so that the clients can easily contact these servers. Some DHCP servers support reservation of IP addresses and allocate these reserved IP addresses according to the MAC address of the requesting host.

Equipment:

Windows OS laptops with Cisco Packet Tracer installed.

Procedures:

1. Construction and Configuration of a Computer Network for Testing DHCP service

- 1.1 Construct the network shown in Figure 4.1. You may use Cisco router model **2811** for Router0.

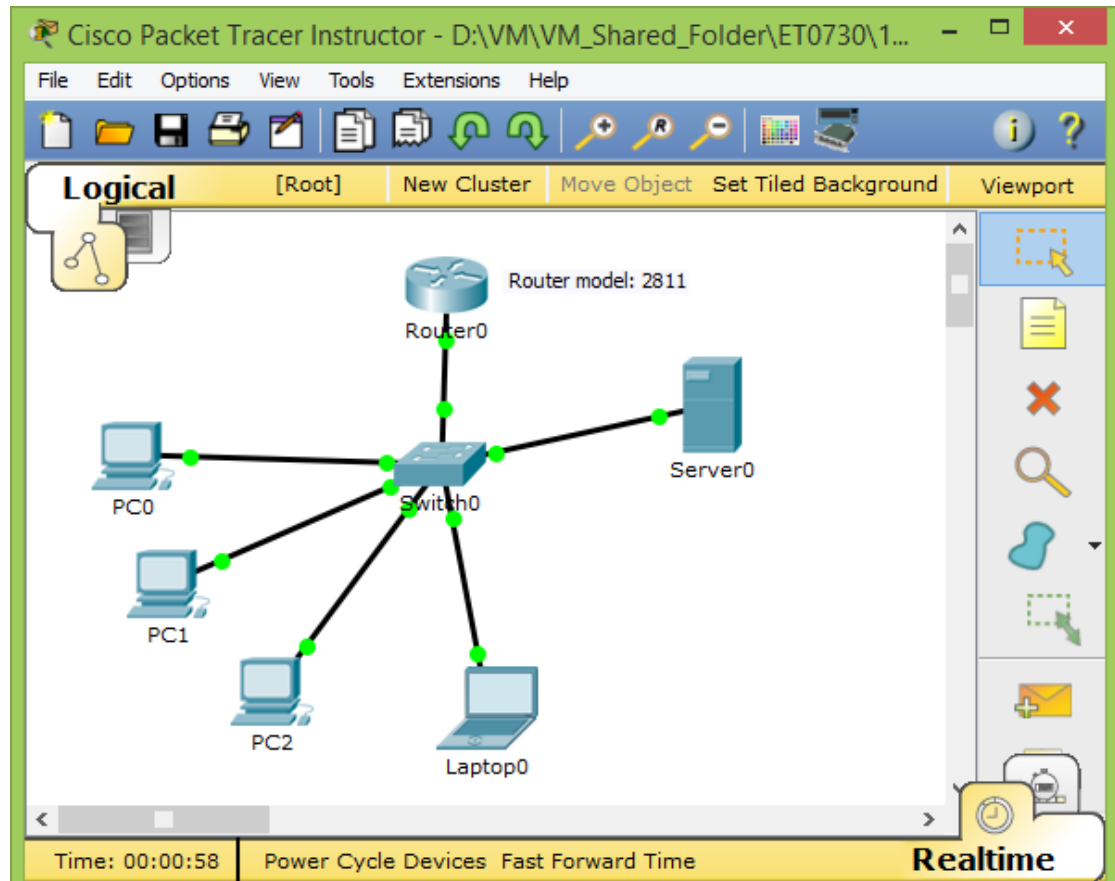


Figure 4.1 - A network for testing DHCP service.

- 1.2 Configure Laptop0, Router0's Fe0/0 interface and Server0 with parameters as shown in Table 4.1 below.

Device	IP Address	Subnet Mask	Default gateway	DNS server
Laptop0	192.168.1.33	255.255.255.0	192.168.1.1	111.111.111.1
Router0's Fe0/0	192.168.1.1	255.255.255.0	Not applicable	-
Server0	192.168.1.2	255.255.255.0	192.168.1.1	-
PC0	To be obtained using DHCP			
PC1	To be obtained using DHCP			
PC2	To be obtained using DHCP			

Table 4.1 – Network configuration parameters for Figure 4.1.

- 1.3 Hosts PC0, PC1 and PC2 are to be configured to obtain IP configuration parameters using the DHCP mechanism.
- 1.3.1 Double-click PC0 and a new device configuration Window will pop-up. Select “Config → Setting” (see Figure 4.2). Under the “Gateway/DNS”, click the “DHCP” radio button. This configures PC0 to obtain the “Default gateway” and “DNS Server” IP addresses using the DHCP mechanism. You may ignore the setting under the “Gateway/DNS IPv6” because this is only used in IPv6 (Internet Protocol Version 6), which is not covered in this lab experiment.

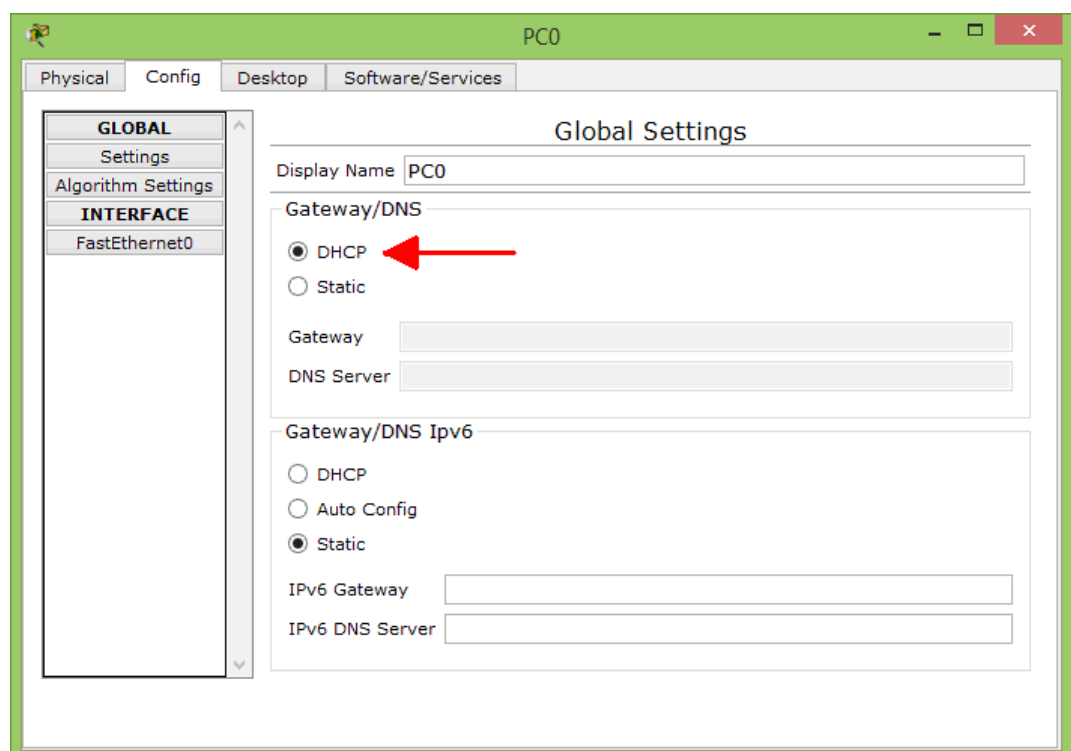


Figure 4.2 – Select “DHCP” in the Global Settings menu.

- 1.3.2 Select “Config → FastEthernet0” to show the IP configuration menu for FastEthernet0 interface (see Figure 4.3). Under “IP Configuration”, click the radio button next to “DHCP”. Again, you may ignore the setting under “IPv6 Configuration” as we are not using IPv6 in this lab experiment.

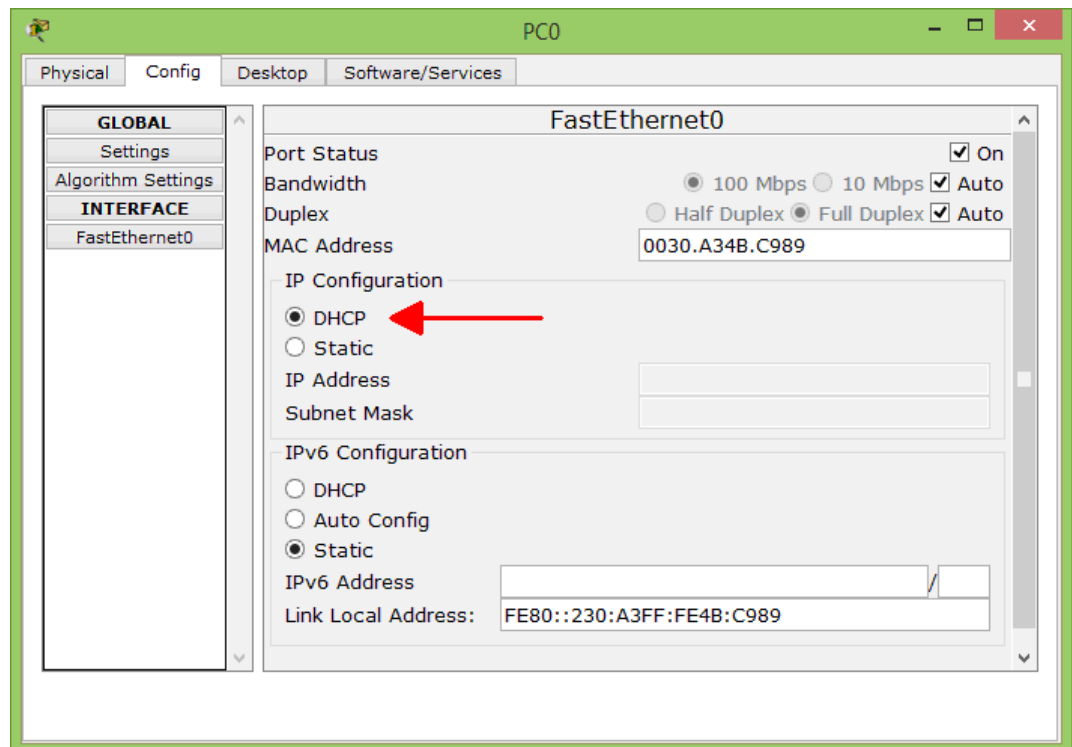


Figure 4.3 Select “DHCP” in the FastEthernet’s settings menu.

- 1.3.3 Repeat Steps 1.3.1 and 1.3.2 for PC1 and PC2 so that they will also obtain the IP configuration parameters using the DHCP mechanism.
- 1.4 Server0 will be configured as a **DHCP Server** to provide the IP configuration parameters to DHCP clients (PC0, PC1 and PC2) upon request. Configure the DHCP service for Server0 by carrying out the following steps.
- 1.4.1 Click on Server0.
 - 1.4.2 Click “Services” → “DHCP”.
 - 1.4.3 In the bottom textbox, there is already a pool of IP addresses pre-defined and called “serverPool”. Click on the entry to modify it.
 - 1.4.4 In the textbox next to “Default Gateway”, enter 192.168.1.1.
 - 1.4.5 In the textbox next to “DNS Server”, enter 222.222.222.2.
 - 1.4.6 In the textbox next to “Start IP Address”, enter 192.168.1.121.
 - 1.4.7 In the textbox next to “Subnet Mask”, enter 255.255.255.0.
 - 1.4.8 In the textbox next to “Maximum number of Users”, enter 20.

- 1.4.9 Click the “On” radio-button next to “Service” at the top, to activate the DHCP service on this server.
- 1.4.10 Click the “Save” button the configuration of the “serverPool”.
- 1.4.11 Check that you observe the same result as shown in Figure 4.4.

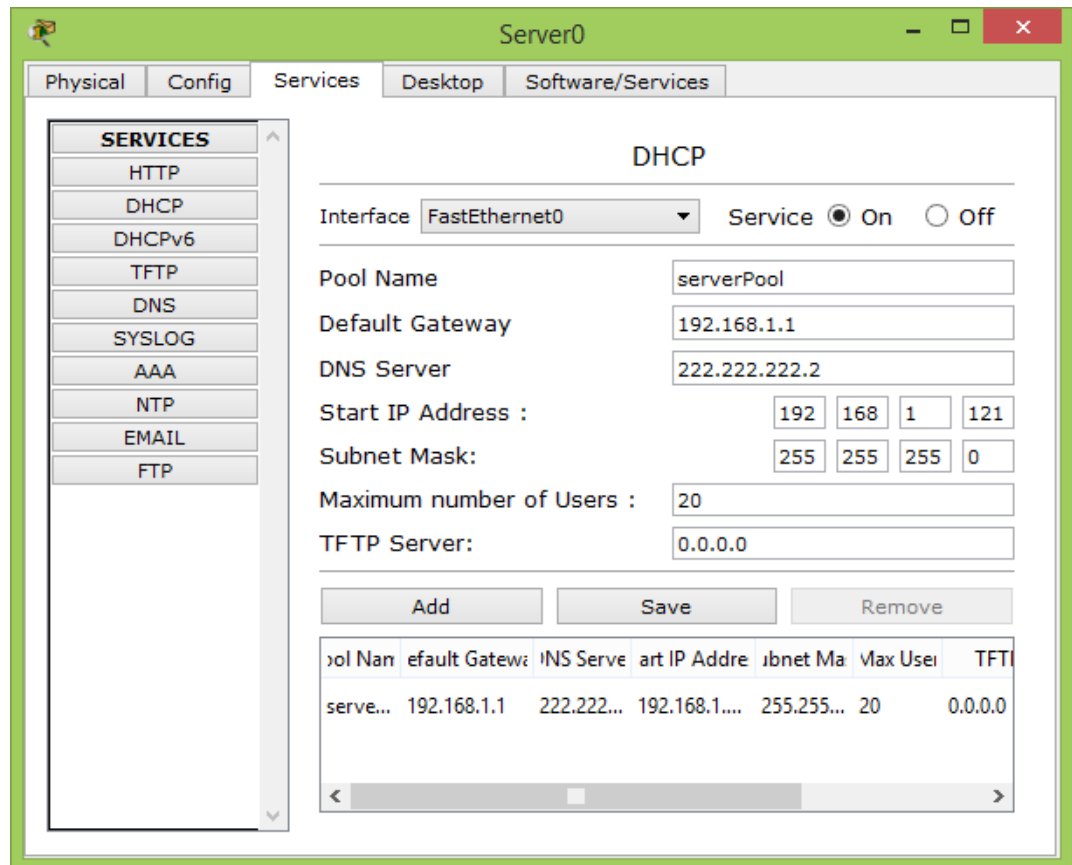


Figure 4.4 – DHCP service configuration for Server0.

- 1.5 Verify the connectivity from Laptop0 to Server0. This is to make sure that Server0 is contactable by PC0, PC1 and PC2.
- 1.6 Place your mouse over PC0 and wait for a short while, a window will pop-up, showing its network configuration. Observe the IP address, subnet mask, default gateway and DNS server settings of this host.
- 1.7 If these parameters have not been configured, click on PC0's symbol, “Config” → “Global” → Settings”. Click on the “Static” radio-button, wait for one second, and click the “DHCP” radio-button. Wait for a few seconds, and you should see some setting (grey text) appear in the textboxes of the “Gateway” and “DNS Server”. This shows that PC0 has successfully contacted Server0's DHCP service.

Question:

Record the IP address, subnet mask, default gateway and DNS server settings of PC0.

IP address = 192.168.1.121

Subnet mask = 255.255.255.0

Default gateway = 192.168.1.1

DNS Server = 222.222.222.2

Question:

Compare the DNS Server of PC0 with Laptop0. Are they identical? The DNS Server IP address of Laptop0 was configured manually in Step 1.2. Where does PC0 get the setting for its DNS Server?

Laptop0 and PC0 have different DNS settings. The DNS setting of PC0 was retrieved from Server0.



- 1.8 Repeat Steps 1.6 and 1.7 for PC1 and PC2. Make sure that their network configurations have been completed.
- 1.9 Verify connectivity among the three hosts (PC0, PC1 and PC2), the laptop, the router and the server.
- 1.10 Try to add another host (either a new laptop or a new PC) to the network, connecting to Siwtch0. Configure its network configuration setting to “DHCP”. Verify that the network configuration has been done automatically.

Question:

What is the IP address of this host?

The IP address is 192.168.1.124.

2. Reserved IP Addresses in DHCP Service

- 2.1 Construct the network shown in Figure 4.5. The router is a “WRT300N” wireless router (you should have something similar at home if you subscribe to the internet broadband service) that can be found under the “Wireless Devices” (symbol: ) family in the Packet Tracer.
- 2.2 When connecting the hosts and server to the wireless router, you **MUST NOT** use the  symbol (“Automatically choose connection type”), else the Packet Tracer will pick the wrong cable and port. You have to make the connections manually by choosing the cable and selecting the port. The four connections to the WRT300N router should be made to ports Ethernet 1 to 4 (order does not matter). Leave the “Internet” port of the router unconnected. All the cables are copper **straight-through** cables except the connection between the hub and the router which is a **copper cross-over** cable (dotted line).

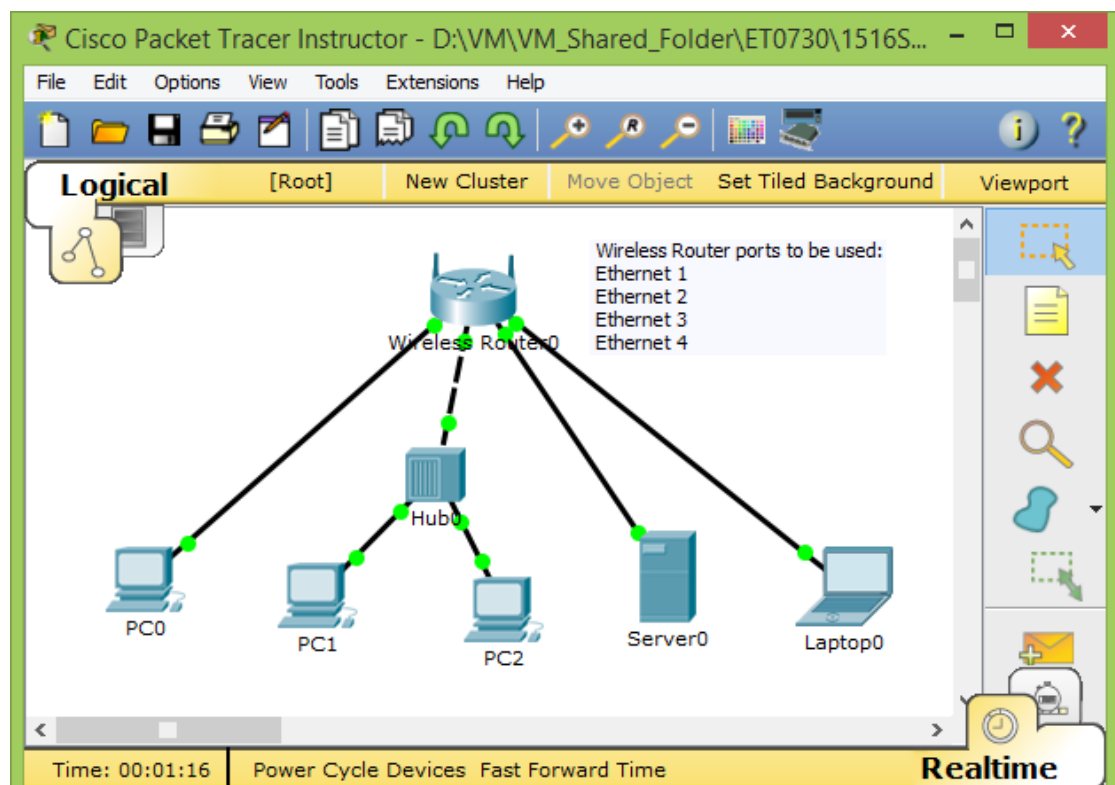


Figure 4.5 - A network for testing IP address reservation in DHCP service.

- 2.3 Configure the four hosts (PC0, PC1, PC2 and Laptop0) and the Web server (Server0 is a web server this time, no longer a DHCP server) with parameters as shown in Table 4.2 below.

Device	IP Address	Subnet Mask	Default gateway	DNS server
PC0	To be obtained using DHCP			
PC1	To be obtained using DHCP			
PC2	To be obtained using DHCP			
Server0 (Web)	To be obtained using DHCP			
Laptop0	192.168.0.44	255.255.255.0	192.168.0.1	111.111.111.1

Table 4.2 – Network configuration parameters for Figure 4.5.

- 2.4 Click on Server0. Click “Config” → “FastEthernet0”.
 - 2.5 Record the “MAC Address” in the format of xx:xx:xx:xx:xx:xx.
00:05:5E:C0:B9:00
-
- 2.6 Click “Services” → “HTTP”. This is the web-service (web-page hosting) running of Server0. Leave it as it is. There is no need to configure the web service on Server0. It is already pre-configured and set to active.
 - 2.7 Configure the DHCP service on the WRT300N router by carrying out the following steps.
 - 2.7.1 Click on Wireless Router0.
 - 2.7.2 Click “GUI” → “Setup”. Expand the window to occupy the full screen.
 - 2.7.3 The top part belongs to “Internet Setup”. Leave this portion as it is (blank).
 - 2.7.4 Under the “Network Setup” portion, make sure that the “IP Address” setting is 192.168.0.1 and subnet mask is 255.255.255.0.
 - 2.7.5 In the textbox next to “Start IP Address:”, enter 110 (i.e. Start IP address = 192.168.0.110).
 - 2.7.6 Enter “10” for “Maximum number”.
 - 2.7.7 For “Static DNS 1:”, enter 222.222.222.222.
 - 2.7.8 Click the “Save Settings” button at the bottom (may need to scroll down further to reveal the button) to save the DHCP service configuration of the WRT300N Wireless Router.
 - 2.7.9 Check that you observe the same result as shown in Figure 4.6.

The screenshot shows the configuration interface for a Wireless Router. The top navigation bar includes tabs for Physical, Config, and GUI. Below this, a menu bar contains Setup, Wireless Security, Access Restrictions, Applications & Gaming, Administration, and Status. The Setup menu is expanded, showing sub-items: Basic Setup, DDNS, MAC Address Clone, and Advanced Routing. The main content area is divided into two sections: Internet Setup and Network Setup. The Internet Setup section includes a dropdown for 'Automatic Configuration - DHCP' and fields for Host Name, Domain Name, MTU, and Size. The Network Setup section includes fields for Router IP, Subnet Mask, and DHCP Server settings. The DHCP Server is currently set to 'Enabled'. Below this, there are fields for Start IP Address (192.168.0.110), Maximum number (10), IP Address Range (192.168.0.110 - 119), Client Lease Time (0 minutes), Static DNS 1 (222.222.222.222), Static DNS 2 (0.0.0.0), Static DNS 3 (0.0.0.0), and WINS (0.0.0.0). A 'DHCP Reservation' button is also present.

Figure 4.6 – DHCP service configuration for Wireless Router.

- 2.8 Configure the **DHCP Reservation** (IP address reservation) on the WRT300N router by carrying out the following steps.
 - 2.8.1 Click on the “DHCP Reservation” button.
 - 2.8.2 Under the “Manual Adding Client”, enter “WebServer” into the textbox labelled as “1”.
 - 2.8.3 Enter “88” into the textbox labelled as “2” (i.e. IP address = 192.168.0.88).
 - 2.8.4 For the textbox labelled as “3”, enter the MAC address that you recorded in Step 2.4. It must be in the format of xx:xx:xx:xx:xx:xx.

- 2.8.5 Click the “Add” button under the label “4”. You should observe a new entry is added to the listing table under the “Clients Already Reserved” portion.
- 2.8.6 Check that you observe the same result as shown in Figure 4.7.
- 2.8.7 Click the “Save Settings” button, then “the “Close” button to close the “Dialog” window.
- 2.8.8 Click the “Save Settings” button (GUI window) at the bottom (may need to scroll down further to reveal the button) to save the DHCP service configuration of the WRT300N Wireless Router.

Wireless-N Broadband Router

DHCP Reservation

Select Clients from DHCP Tables

Client Name	Interface	IP Address	MAC Address	Select
	LAN	192.168.0.111	00:90:0C:15:C9:D0	<input type="checkbox"/>
	LAN	192.168.0.112	00:30:A3:4B:C9:89	<input type="checkbox"/>

Manually Adding Client

1	2	3	4
WebServer	192.168.0.88	00:60:5C:CD:25:57	<input type="button" value="Add"/>

Clients Already Reserved

1	2	3	4
WebServer	192.168.0.88	00:60:5C:CD:25:57	<input type="button" value="Remove"/>

Figure 4.7 – DHCP Reservation configuration for Wireless Router.

- 2.9 Click the Server0 symbol, and then select “Config” → “Global” → “Settings”. Click on the “Static” radio-button, wait for one second, and click the “DHCP” radio-button. Wait for a few seconds, and you should see some setting (grey text) appear in the textboxes of the “Gateway” and “DNS Server”. This shows that Server0 has successfully contacted the Wireless Router’s DHCP service.

- 2.10 Place your mouse over Server0 and wait for a short while, a window will pop-up, showing its network configuration. Observe the IP address, subnet mask, default gateway and DNS server settings of this host.

Question:

Record the IP address, subnet mask, default gateway and DNS server settings of PC0.

IP address = 192.168.0.88

Subnet mask = 255.255.255.0

Default gateway = 192.168.0.1

DNS Server = 222.222.222.222

Question:

Is the IP address allocated to Server0 within the range defined by “serverPool”? Where was it defined?

The IP address of the server is the DHCP reserved IP instead of from
range of server pool.

Question:

Based on what did the DHCP server in the WRT300N router decide the IP address to be assigned to Server0?

The router assigned and IP to Server0 based on the DHCP reserved IP.

- 2.11 Add another laptop to the network. Connect it to the hub.
- 2.12 Configure the WRT300N Wireless Router such that this new laptop is always allocated the IP address of 192.168.0.99 when it is connected to this network.
- 2.13 Verify that your DHCP configuration does exactly what you configure it to do in Step 2.11.
- 2.14 Verify connectivity among all the end devices.