

■ ECE/CS 4984: Wireless Networks and Mobile Systems ■

In-class Laboratory Exercise 1 (L1)

Part I – Objectives and Lab Materials

Objective:

The objectives of this lab are to:

- ❑ Familiarize you with the wireless devices to be used in experiments in this course.
- ❑ Introduce various network monitoring utilities that will be needed in future labs for the course.

After completing the assignment, you should be able to:

- ❑ Configure the wireless LAN cards for the notebook.
- ❑ Use basic network monitoring utilities to measure performance.

Hardware to be used in this lab exercise:

- ❑ Xircom 802.11a cardbus adapter
- ❑ Xircom 802.11b wireless Ethernet adapter
- ❑ Dell Latitude C640 laptop computer
- ❑ Intel dual access point (prepared by GTA)

Software to be used in this lab exercise:

- ❑ Xircom client utility for 802.11b card and Intel PRO/Wireless toolset for 802.11a card

Part II – In-class lab exercise

The GTA will first demonstrate using the Observer software for packet capture and analysis. The demonstration includes real-time capturing of IEEE 802.11b traffic. Next, we will configure the IEEE 802.11b WLAN card on the laptop; you will learn how to select the mode of operation (infrastructure versus ad hoc), data rate, transmission power, etc. We will also perform some elementary link tests and throughput measurements.

You are expected to perform the following tasks:

- ❑ Start the Xircom Client Utility for 802.11b on the notebook by clicking on the Xircom Wireless Ethernet Client Utility icon on the desktop. We will now configure the wireless 802.11b card. Each wireless local area network (WLAN) is assigned an identifier. This is known as the Service Set Identifier (SSID). The SSID differentiates one WLAN from another; therefore, all access points and all devices attempting to connect to a specific WLAN must use the same SSID. To edit the properties for the adapter, open Commands>Edit Properties. Under the tab “System Parameters” set the SSID1 field to “ECECS4984.”

Note: The four ESSID fields can be used to enter identifiers for four different wireless subnets.

- ❑ A wireless LAN operates in two modes: Ad-hoc and Infrastructure. In an ad-hoc network, computers are brought together to form a network “on the fly.” In an infrastructure network, mobile nodes communicate through fixed network access points. Under the tab “System Parameters” set the network type to “Infrastructure.”
- ❑ The WLAN allows the exchange of data between nodes at different rates depending on the modulation mechanism used at the physical layer. The 802.11b standard lists 1Mbps, 2Mbps, 5.5Mbps and 11Mbps as the data rates at which the protocol works. Under the tab “RF network” set the data rate to “Auto Rate Selection.” This means that the adapter will exchange data at the speed that is best suited to minimize the losses for existing channel conditions.
- ❑ The transmission power of the WLAN card can be switched between different levels. The Xircom card allows you to switch power between two levels (1mW and 30mW). A higher transmit power will increase the range of the transmission, but at the expense of decreased battery life and the potential for increased interference. Under the tab “RF network” set the transmit power to “1mW.”
- ❑ WEP can be enabled on the card by clicking on the “Network security” tab and checking the “Enable WEP” option. In order to set the WEP key, open the Xircom Client Encryption Manager on your desktop. Enter “Xircom” as the default password. Click on Commands>Enter WEP key and set the WEP key 1 to “ABCDEF4984.” The WEP key is fixed for all sessions with the access point. Check the “persistent” button in the client manager.
- ❑ Other settings will be dealt with in the later stages of the course and the default values are already set. The Xircom client on your computer is associated with the Access Point. Make a note of the MAC address of the access point. This can be done by observing the status bar at the bottom of the utility window.
- ❑ The utility also provides the user with an option to collect various statistics such as the number of packets transmitted and received, the number of errors that occurred in a transmission, etc. To view the statistics for a particular session, from the menu bar open Commands>Statistics in the client utility. To measure statistics for a session we will now reset the present statistics by clicking on the reset button. Use Internet Explorer to open the pages at <http://192.0.2.100>, and write down the approximate number of bytes received as shown in the client utility.
- ❑ The status of the link between the notebook and the access point is defined by two factors: signal strength and signal quality. The client utility allows the user to check the status of the wireless

link. To view the link status open `Commands>status` and note the variation in signal strength and signal quality after every 30 seconds for 2 minutes.

- ❑ While setting up a wireless local area network, a site survey is done to determine the required number and optimum placement of the access points. The link test can be used to assess the performance of the RF link and to determine the required number and placement of access points. This helps eliminate ‘dead spots’, where low RF signal levels (due to multipath fading, for instance) can result in the loss of the connection between a wireless LAN adapter and the access point. Perform a link test (`Commands>linktest`) by entering 192.0.2.1 as the IP of the access point and start the test for 100 packets by clicking on “start.” Report any packet loss by observing the number of packets successfully received.

We will now experiment with a network-monitoring tool for Windows, namely *wsttcp*. This utility will be used for network performance assessment in some of the upcoming labs as well.

- ❑ Teams consisting of two groups each (for a total of four students) will perform this experiment. The GTA will form the teams.
- ❑ *wsttcp* is a throughput measuring utility and is based on the client-server model. One node acts as a traffic generator and the other as a receiver. One of the two groups will act as the transmitter and the other will be the receiver. The utility is already installed in `C:\WMSD\Labs\Lab_1`. On Windows 2000, open the command window by going to `Start>Run` and typing “cmd” in the *run* field. On the command window use the change directory command (`cd`) to change to `C:\WMSD\Labs\Lab_1`.
- ❑ Note the IP address of the *wsttcp* receiver (server) obtained from the DHCP server running on the GTA notebook computer. The IP address of the *wsttcp* server can be obtained by running the *ipconfig* command in the server’s command window. Type *ipconfig /?* in the command window to display the options associated with the command. Type *wsttcp* in the command window to list the options. On the receiver side, use one of these options to start the “server”. Configure the server to receive 100 datagrams of UDP traffic each of length 8192 bytes on port 4984. On the transmitter side, use the *wsttcp* options to send 100 datagrams of UDP traffic to the server at port 4984. Report the throughput of the connection as returned by *wsttcp*.
- ❑ Restart the notebook by going to `Start>Shut down`. Select the *restart* option from the selection displayed on your screen. When the machine reboots, you will see two options that highlight the operating systems loaded on the notebook. Reboot in Linux by selecting “Red Hat Linux 7.3.” In Linux the command to use for accessing help on any system command or tool is *man*, which

stands for manual. We have installed the wireless toolkit on your notebooks that will help to configure wireless LAN cards. One of the commands in the wireless toolkit is *iwconfig*. Type *man iwconfig* to display all the options *iwconfig* offers to change the wireless configuration.

Hint: To find the name of the interface associated with the IEEE 802.11b card you can type *iwconfig* without any options.

Use one of the options and set the SSID to “ECECS4984” and transmission power of the wireless card to 1mW (0dBm). Set the WEP key to “ABCDEF4984.” Make a note of the command you used, including all options. Verify your settings have been applied.

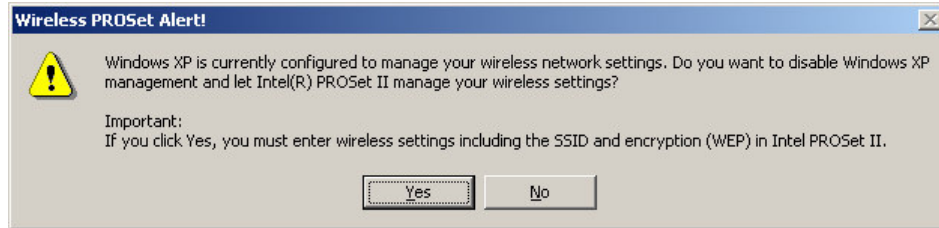
- ❑ *iwconfig* allows you to set the parameters for the current session only. If you restart the machine or the adapter, you will have to set the options again. A method by which these changes can be made permanent is to edit the `/etc/sysconfig/network-scripts/ifcfg-eth1` file.
- ❑ Open the terminal window to start the vi editor to edit the file. Type `vi /etc/sysconfig/network-scripts/ifcfg-eth1`. In order to insert any character in vi, enter the edit mode of the vi editor by typing ‘i’ and change the SSID from “any” to “ECECS4984”. In order to save the work and exit, press the ESC key to enter in command mode of vi. Now type ‘:’ followed by ‘wq’ to save the changes and exit. Stop the interface by executing the command `ifdown eth1`. Restart the interface again by executing the command `ifup eth1`. Now verify if the changes made in the `ifcfg-eth1` file are reflected in the configuration of the card.

In this phase of the lab, we will set up options on the IEEE 802.11a card in your laptop. More detailed performance measurements (throughput, in particular) using 802.11a are deferred until later.

- ❑ Restart the notebook in Windows 2000. Remove the 802.11b card, and insert the 802.11a cardbus card in the card slot.

Note: In order to remove the IEEE 802.11b card from the card slot in Windows 2000, you need to first stop the card by clicking on the ‘Unplug or Eject hardware icon’ in the taskbar. Select the ‘Xircom Wireless Ethernet Adapter’ and stop it. It is now safe to remove the card from the notebook. Use this procedure for any PCMCIA card (IEEE 802.11a, Bluetooth etc.).

- ❑ To configure the 802.11a adapter, double-click the Intel PROSet II icon in the Windows Control Panel. If an alert window appears (as shown below), click ‘No’ to continue.



Switch to the “Settings” tab and click on the “*My WLAN places*” button to edit the WLAN profiles. Double click on “Intel PRO/Wireless 5000 LAN Cardbus adapter” and then open the “Default” profile. Set the SSID to “Intel_dual_1”. Select the Security tab and check the “Enable Security” option. Set the first WEP key to “ABCDEF4984”.

- ❑ In the PROSet II configuration window, select the “Settings” tab and click on “*View AP*” button. Write down the MAC address and the signal level for each access point in range.
- ❑ The power consumption of the adapter can be modified to save power when the notebooks are running on battery. You can change the power by clicking on “Power settings” and move the slider to “Power mode Three.” Make sure that you do not lose connectivity with the access point at the new power settings.