Wireless LAN Measurement Assignment 50 Points
Due: April 18, 2006

This assignment is to be done by the program teams used for the MiniNet Assignment.

The goal of this assignment is to provide hands on experience with a wireless local area network (WLAN) and to provide an opportunity to conduct real measurements.

The WLAN equipment is available in the Fossil Lab. We will provide the students in the class access to the Fossil Lab via WPI card id access and create accounts for the students on the machine, **fossil**, which will serve as the server for the experiments conducted. You will need to log in remotely to **fossil** from a client machine.

The basic configuration for your WLAN measurements will consist of the **fossil** server which can communicate through a **host AP** to two PC's running Windows XP and acting as **wireless clients**. One of the PC's will be labeled as the **good** machine at a good location and the other PC will be labeled as **bad**. We have guaranteed that the **bad** PC will get poorer reception quality by removing its antenna. The **host AP** is a PC configured to operate as a wireless access point. **RTS/CTS** will be turned off. Both clients will be set to operate in 802.11b mode and the **host AP** will be set to in automatic mode. The **host AP** will use channel 6. Unless the host AP dies, you should have no reason to interact with it.

The task of each program team is to conduct measurements to determine the performance of the WLAN by sending ***downstream*** traffic from the server to the clients. One important component of this assignment is the ability to collect measurement data concurrently at multiple layers of the protocol stack.

While you are free to run more experiments than those assigned, the minimum assignment includes the design and implementation of reasonable measurement experiments to determine:

1. *Throughput* when sending a large file using **TCP** from the server to the **good** client.
2. *Throughput* when sending a large file using **TCP** from the server to the **bad** client.
3. *Throughput* when sending concurrently one large file using **TCP** from the server to the **good** client and a copy of the large file using **TCP** from the server to the **bad** client.
4. Repeat experiment **1** but replace the **TCP** file transfer with a **UDP** file transfer of equivalent time duration using the ***mgen*** tool**.** Choose your

parameters for ***mgen*** such that the goal of this experiment is to determine the maximum throughput that can be sent.

5. Repeat experiment **4** but use a ***smaller*** packet size to send the same UDP file.
6. Run one experiment where you send concurrently the **TCP** file to the **good** client and the **UDP** file to the **bad** client.
7. Run one experiment where you send concurrently the **TCP** file to the **bad** client and the **UDP** file to the **good** client.

While measuring ***throughput***, your experiments should also determine ***packet loss rate***, use ***WRAPI+*** to measure ***RSSI*** and ***wireless layer retries*** and use ***typeperf*** to measure ***wireless layer target sending capacity***.

Experimental Design Considerations

Before running any of your experiments the following are a list of issues to consider before designing and running your experiments: file size, packet size, length of a single measurement, number of iterations of each experiment to run, and experimental procedures employed to reduce the number of independent variables and sources of interference and variability.

Tools Available

The WPI Wireless Streaming Multimedia Lab has a webpage that will be useful for this assignment (see http://perform.wpi.edu/wsml/). Additionally, the WPI Congestion Control (CC) research group has a web page specifically designed to discuss tools to be used in network measurements (see http://perform.wpi.edu/tools/). The following is a list of tools that you have available to collect measurement data at multiple levels in the protocol stack:

wget is a standard tool for transferring TCP files that we will make available on fossil ***(see item 2 in the cookbook).***

mgen is a tool that generates UDP traffic and provides measurement data will be available on **fossil.** The ***mgen*** user's manual can be found at: http://pf.itd.nrl.navy.mil/mgem/ ***(see item 3 in the cookbook).***

WRAPI+ is an extension to the open-source WRAPI tool developed by the WPI WSML (see http://perform.wpi.edu/tools/). ***WRAPI+*** monitors and records wireless statistics that includes received signal strength, transmitted frame count, failed frame transmissions and frame retry counts on a Windows XP end hosts' IEEE 802.11b/g network device. We have installed WRAPI+ on both the **good** and the **bad** client ***(see item 4 in the cookbook).***

ping is a standard tool available on XP that can be used to measure RTT and packet lost rates. You may not need to run ***ping.***

typeperf is the command-line version of **Performance Monitor** of Windows XP which can be used to collect processor utilization and network data including data received bit rate and the current wireless target capacity ***(see item 5 in the cookbook).***

Deliverables

Completing this assignment requires turning in a WLAN measurement report that discusses the design and completion of your experiments. Be sure to include a discussion of your experimental methodology. Your report should include graphs of your performance results and analysis of your results.

Assistance

While not actual TAs for this course, graduate students Mingzhe Li and Feng Li, are very knowledgeable with respect to the configuration and tools that you will use. You can contact Mingzhe via email at lmz@cs.wpi.edu and Feng Li at lif@cs.wpi.edu. Below is a document prepared by these two students that we refer to as the ***cookbook*** for this assignment.

Wireless LAN Experiments Cookbook
Version 1.1 March 21, 2006

by Mingzhe Li (lmz@cs.wpi.edu) and Feng Li (lif@cs.wpi.edu)

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1. All the tools you need for this measurement project
   are installed, you don't need to install them yourself.

2. How to measure TCP throughput using "wget"
   A. We put a file named "dummy.zip" on fossil' http server.
   B. Run wget to download "dummy.zip", wget will give you the
      TCP throughput information at the end of download.
   C. To record the info to a file, you can use -o option to redirect
      the output to a log file.
      Example:
        wget.exe -o wget.dat http://fossil.wpi.edu/~lif/dummy.zip
   D. Run "wget.exe --help" and visit
        http://www.gnu.org/software/wget/manual/wget.html
      for more information on wget.

3. How to measure UDP throughput using mgen
   A. mgen is a client/server application that send the udp
      traffic from the server to client. We had mgen installed on both
      the server (fossil) and the clients (Your good and bad Windows
      XP computers).
   B. Start the client on Windows XP side first:
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      Open a new cmd window, run"
         mgen.exe output mgen_recv.dat port 5000
      this will start mgen receiver on port 5000.
   C. Start sender on fossil server:
          ssh fossil.wpi.edu mgen input /home/cs513/udp-load-good.mgn txlog log
mgen_snd.log
      mgen uses configuration file to generate traffic:
         udp-load-good.mgn:
            #start  the UDP Load traffic at time 0.0 sec
            0.0 ON 1 UDP SRC 5000 DST 192.168.3.4/5000 PERIODIC [ 800 1400 ]
            #stop the UDP load traffic at time 120:00 sec
            120.0 OFF 1
      You can follow the example in fossil:/home/cs513 to create your
      own configuration files.
   D. Use trpr.exe to analysis the mgen log files
      For example, run:
        trpr mgen input mgen_recv.dat output sample.gp post sample.eps

      will give you the analysis result in "sample.gp", then you can
      use "gnuplot" or MS Excel (ignore the gnuplot scripts part) to
      generate figures.
      Visit http://pf.itd.nrl.navy.mil/protools/trpr.html for more
      information about trpr.

4. How to use wrapi+ to record wireless signal strength.
   A. first you need to stop a windows service to allow wrapi to take
      control of the wireless card: "net stop WZCSVC"
   B. running "SWAN_WRAPI.exe wrapi.log" will log all data gathered by
      wrapi.
   C. after finishing a test, use Ctrl-C to kill wrapi+ and restart the
      windows wireless service: "net start WZCSVC"
   D. Use Excel to analysis the log data.

5. How to use typeperf to record wireless links adaptation capacity.
   A. We put two configuration files on the XP computers:
        bad: wlan-bad.cfg
          good: wlan-good.cfg
      Run "typeperf.exe -cf bin\wlan-bad.cfg -si 1 -f CSV -o typeperf.cvs"

      This will log everything listed in the "wlan-bad.cfg" file. You may
      want to change the configuration in wlan-bad.cfg to log only the
      data you want to analyze.
   B. Use Excel to analysis the log data.

   C. For more information about typeperf visit:
        http://www.microsoft.com/resources/documentation/windows/xp/all/proddocs/en-
        us/nt_command_typeperf.mspx?mfr=true

6. How to put everything together in a BAT file:
   It is not necessary to run all the commands automatically. However, it
   will make your life easier if you put everything together in a BAT file.
   A. Example:
      ...
       net stop WZCSVC
       start bin\SWAN_WRAPI.exe wrapi.log
       start bin\typeperf.exe -cf bin\wlan-bad.cfg -si 1 -f CSV -o typeperf.csv
       bin\wget.exe -o wget.dat http://fossil.wpi.edu/~lif/dummy.zip
       del dummy*.zip

       taskkill /F /IM typeperf.exe
       taskkill /F /IM SWAN_WRAPI.exe
      ...
  B. Start mgen remotely in a BAT file without input passwd everytime:
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The basic idea is that a personal private/public key pair is generated using the ssh-keygen command. The public key is then copied onto a remote system's .ssh/authorized_keys file. You are now able to SSH over to the remote system's account without the use of a password.
For more detail, visit:
http://rcsg-gsir.imsb-dsgi.nrc-cnrc.gc.ca/documents/internet/node31.html
And/or:
http://cc.jlab.org/docs/services/unix/SSH2/ssh-intro.html

C. To manage your experiments:
Use tools: gettime.exe, pauseUntil.exe, and sleep.exe
in your scripts. Read the included example BAT file to get more information.