Laboratory measurements

Instructions for making laboratory mesurements of the WLAN laboratory work. Laboratory measurements consist of two parts. In part A we study the impact of packet size and signal strength to the WLAN channel throughput. In part B we study the VoIP quality as a function of channel throughput. In both paths the radio channel environment is generated by PROPSIM channel simulator.

You should answer the post laboratory work questions and return them together with the measurements reports.

Part A

L1: initial configuration

In this exercise you configure the *"madwifi"* driver and measure the surrounding radio environment. For later usage you have to configure both computers: tltpc117 and tltpc10.

1.1 The driver initialization.

The drivers are already installed and your task is only to configure them. First you have to check whether the interface exist or not. You can test this by running command

```
iwconfig
```

The interface is called `ath#`. (Where # stands for a number). If you see interface called `ath#` you have to destroy it. For example for ath0 you can do it as:

```
ifconfig ath0 down
wlanconfig ath0 destroy
```

After destroying the previous interface you have to create a new instance of the interface in place of it.

```
#create an instance of the interface in adhoc mode
wlanconfig ath0 create wlandev wifi0 wlanmode adhoc
# set the interface into 11g mode
iwpriv ath0 mode 3
# assing the name of the network
# and the channel used by the interface
iwconfig ath0 essid madwifi channel 8
```

After creating the interface you have to activate it. For activating you have to assign the corresponding IP addresses.

PC	IP address
tltpc117	10.0.0.2
tltpc10	10.0.0.3

```
ifconfig ath0 10.0.0.3 netmask 255.255.255.0 up
```

You can check the configurations by running commands

```
ifconfig
iwconfig
```

1.2 Radio environment measurement.

Make a measurement report about the surrounding radio environment. The report should include the task description, measurement description, time of measurement, reported measurement result.

You can make the measurements as following:
With outside antenna connected scan the environment and make a list of observed wlan networks, used channels, corresponding received signal levels and SNR levels.

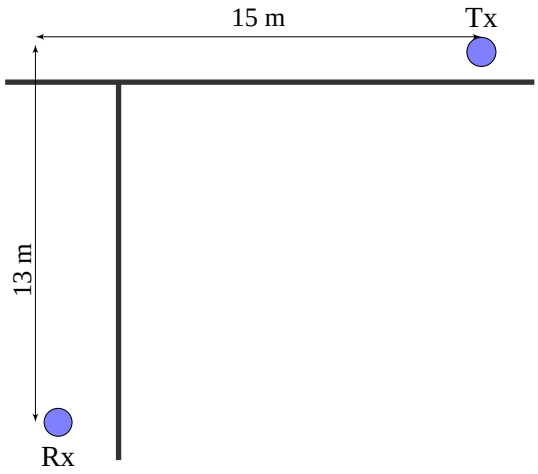
```
#scanning the environment
iwlist ath0 scanning
# or
wlanconfig ath0 list scan
```

1.3 Post laboratory exercises:

1.3.1 Collect the list of all visible networks.

1.3.2 What are the recieved signal levels of the visible networks

1.3.3 For the “Aalto” network on channel 1 estimate what is the wall attenuation constant if the transmitter and reciever are located as in the figure 5. The transmitter power is 10 dBm and before the antenna connection loss is 10 dB. The antenna gain is 0 dB. The attenuation dependes on distance r and the attenuation constant α: $r^{-\alpha}$ is assumed to be $\alpha = 3.5$. Locations of the transmitter and receiver are given in the diagram below.



L2: Packet size and throughput

In this exercise we measure how different packet sizes impact throughput over radio interface. The throughputs are measured for different modulation schemes in a relatively good channels. In a good channel we do not loose any packet because of noise. The differences in troughput are due to the protocol overheads. The measurements are made for UDP and TCP protocols.

For measuring use iperf program.

Set tltpc10 to be server:

```
# server tltpc10
iperf -s -u -i5
```

switch	explanation
-s	server
-u	uses UDP protocol
-i	repetition time for measurements

tltpc117 to be client:

```
iperf -c 10.0.0.3 -b 54M -u -l1470 -t5
```

switch	explanation
-c	server address
-b	data rate
-u	UDP mode
-l	packet size
-t	time to measure

More information about `iperf` is available on its help pages: `man iperf`.

Measure the throughput for 5 different UDP packet sizes in the interval $300 - 1470$. Each measurement should be at least $5\ s$ long.

2.1 UDP without `rts`

Check that the `rts` value is off

- measurement in $54\ Mbit/s$ transmission mode

```
# Check that the cards are in 11g modes
iwconfig
# set the transmission rate to be 54M
iwconfig ath0 rate 54M fixed
```

- measurement in $11\ Mbit/s$ tranmisssion mode

```
# set the transmission rate to be 11M
iwconfig ath0 rate 11M fixed
```

2.2 UDP with `rts`

```
#set the rts value
iwconfig ath0 rts 250
```

- Repeat the measurements for 54, and $11\ Mbit/s$ transmission mode

2.3 Make the measurement report.

2.3.1 Give the measurement results in a table.

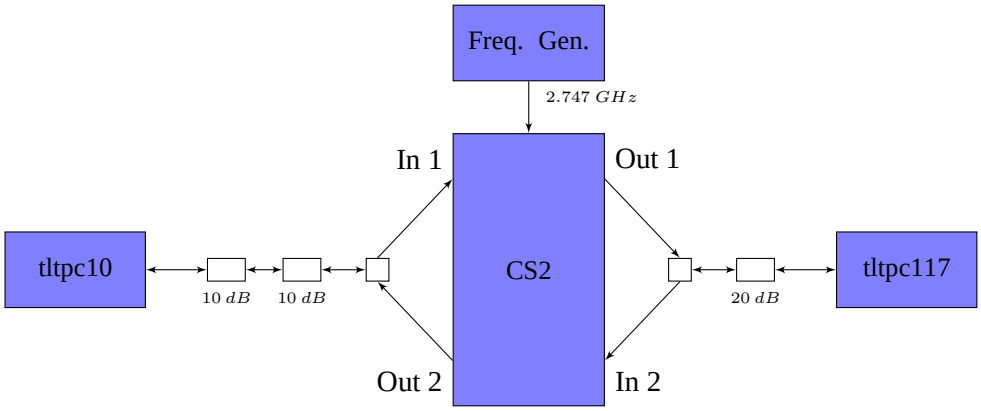
2.3.2 Plot the measurement curves: packet size versus throughput for each measured rate.

2.3.3 Calculate the percentage each measured throughput is from the nominal data rate for particular modulation (i.e. 54 and $11\ Mbit/s$).

2.3.4 Plot the percentage curves for each transmission mode on a same plot. Comment on the result.

L3: attenuation and throughput

In this exercise we measure how the attenuation in the channel impacts the throughput. We connect the pc:s over the radio channel simulator as seen on Fig. 1. In this exercise we use channel simulator for generating attenuation. The attenuation can be adjusted from the simulator menu. By adjusting the output gains make the measurements of throughput in 54M, 36M, 11M modulation modes.



Make the measurements for two different packet sizes 300 and 1470. Set tltpc10 to be server and tltpc117 to be client. Make measurements for relevant channel attenuation values (the values where the throughput changes) such that you can present the result on the plot.

For each measurement collect at least 5 samples. The final throughput is average over them.

3.1 UDP in attenuating channel
By using the UDP transmission and set `rts` to 250. Measure the throughput change when the channel is attenuating by reducing the attenuation in channel 2 output.

3.2 TCP in attenuating channel
Repeat the measurements for TCP connection. Make the measurements only for data rates 54, 11 Mbit/s. (not for 36 Mbit/s)
For making TCP measurements you can configure `iperf` at the server tltpc10:

```
iperf -s -i5
```

and at the client tltpc117:

```
iperf -c 10.0.0.3 -t5
```

3.3 Post laboratory exercises:

3.3.1 Plot the througput as a funtion of received signal level. The received singal level can be estiamted by using transmitted signal level and attennuation from transmitter to receiver.

3.3.2 Give the tables of the attenuation versus throughput.

3.3.3 What would be the cell size if

3.3.3.1 the attenuation model is $r^{-\alpha}$ and $\alpha = 3.5$.

3.3.3.1 the attenuation model is $r^{-\alpha}$ where $\alpha = 3.5$ and the signal goes through one wall. Where the attenuation through the wall is computed in the exercise 1.2.3 above.

Part B

In this part of the laboratory work we study impact of the attenuation the the VoIP connection quality. For that purpose we establish VoIP conneciton between the computers and record the transferred sound quality. The measurements are made for different attenuation values.

L4: voice quality over attenuating channel

Establish the VoIP connection between the computers. For that start in tltpc10 “Ekiga Softphone” and in tltpc117 “linphone” VoIP clients. Make a call from tltpc117 to tltpc10 sip address

```
sip:wifi@10.0.0.3
```

Start to play music in tltpc117. Direct from the player to be in the capture output. That can be done by setting the sound capture source to be mixer. That can be done from Volume control panel by setting in “Switches” menu the capture source to be “Mix”.

Now you should hear the music from both the tltpc117 and tltpc10 loudspeakers. For better differentiation you could switch off tltpc117 loudspeakers.

4.1 Measure the connection quality in various attenuation levels.
At each level record the received sound into a file and captuare packet statistics with “Wireshark”.

- Recording with Wireshark
  Edit the ”tsharkScript.sh” located on the Desktop.

Set the directory accordingly to your group number. Create in the desktop a directory with the same name. Give everybody a right to write into this directory.

```
chmod 777 Group#_date
```

For different measurements set the corresponding attnuation and codec values. These values are assigned to the variables at the beginning of the script.

Run the script in a command window. The script orders Wireshark to records the communication trace and save it into a file.

```
sudo ./tsharkScript.sh
```

– Recording the sound
Start the sound recorder: from the Desktop icon or from the menu.

Set the recording input to Mix and the recording quality to be CD quality lossless (FLAC audio).

Start recording and record one minute of the sound.

4.2 Post laboratory exercises:

4.2.1 Assign the voice quality mean opinion score (MOS) to sound measured at different attenuation values. Plot the result.

4.2.2 What is the mean jitter between the packets in each measurements. Plot the histogram of the jitter.

4.2.3 How many packetes where lost in each measurements. Plot the signal level versus packet loss. Plot MOS values versus packet loss.

4.2.5 At what signal level the voice connection is still reasonable.