



WirelessLab WS 2016/17 Homework 10: Transport over Wireless : Part2

There has been significant amount of work on wireless transport, ranging from improving TCP operation to new transport protocol proposals. In this homework, we will have a first look at TCP performance in different scenarios. You will conduct the experiments on real hardware.

Question 1: (70 Points) *Communication between Station and AccessPoint*

- (a) Setup your two nodes so that they can communicate with each other over their wireless interfaces, and reach the student host over the wired interface. Furthermore, setup an additional monitor interface on the node that should act as the receiver.

Set these parameters on the two communicating wireless interfaces to the following: (Note: have a look at the tool `iw` and the `/sys/kernel/debug/ieee80211/` kernel options)

- Transmission power: 1 dBm
- Transmission rate: three different values - 6 Mbps, 24 Mbps, and 54 Mbps.
- Make use of the 802.11g card.
- Disable ANI.
- Set Noise Immunity level to 0 (noise-low).
- Enable OFDM Weak Signal Detection.
- RX and TX antenna = 2
- Disable diversity as follows:
`echo 'fixed-b' > /sys/kernel/debug/ieee80211/phy0/ath5k/antenna`

- (b) For each transmission rate, set up the following experiments using `iperf`. Make sure to spread your runs across different times of the day to account for any time of day effects (note down the times in your report). An `IPerf` server is started on the access point and one `IPerf` client is started on the first station.

- Send UDP traffic from the sender to the receiver. Do this 20 times where each iteration corresponds to 60 secs. Make sure that you slightly exceed the transmission rate in order to saturate the medium.
- Send TCP traffic from the sender to the receiver. Do this 20 times where each iteration corresponds to 60 secs.

Collect the output of the `iperf` sessions and a `tcpdump` trace for each run. For the `tcpdump` trace, make sure you do the measurements with a monitor mode interface.

- (c)
1. What is the measured TCP throughput in infrastructure mode from station to access point? Compare this throughput with the physical data rate of 54 Mbps that the hardware is configured with. Can you explain the difference (generic, no calculations needed)?
 2. Is the TCP throughput lower compared to the UDP throughput? If yes, why?
 3. What is (are) the limiting factor(s) in the TCP protocol?
 4. What is the optimum packet size (accuracy 1 byte) and the corresponding data rate for maximum UDP throughput?
 5. Why is the throughput lower if you use a packet size higher than the optimum? Explain the optimum value as identified previously. Hint: look at configuration settings at network layer (output of `ifconfig`) and data link layer (output of `iwinfo`). What are the sizes of the headers of IP, UDP, etc. ?

6. Check the congestion control algorithm in your node **Hint : `sysctl -a | grep congestion`**. Please carry out measurements twenty times each on TCP Reno and TCP Cubic by sending two parallel iperf streams distributed during the day and plot the throughput and explain your observations.

Question 2: (30 Points) *Communication between two Ad-Hoc nodes*

- (a) In this part, we will evaluate the throughput of an IEEE 802.11 configuration in Ad-Hoc mode, using only the two stations from the previous section.

Although the topology is simpler than the infrastructure example (we don't need an access point to manage the communication) the complexity of the stations increases since both are responsible of maintaining the Ad-Hoc network

This added complexity is more or less invisible to the user, since the following command will suffice to join (or create) an Ad-Hoc network:

```
Hint : iw phy phy0 interface add ah0 type ibss
ifconfig ah0 up
iw dev ah0 ibss join AdHocNetworkName 2412
```

- (b) Do the experiment 10 times where each iteration corresponds to 60 secs. What is the throughput in ad hoc mode from station 1 to station 2? Compare the throughput between 2 stations in ad-hoc mode with the throughput measured in infrastructure mode (previous question). Is it higher or lower than in ad-hoc mode? Why?

Reading

H. Balakrishnan, et al. A comparison of mechanisms for improving TCP performance over wireless links, ACM Sigcomm 1996.

Submission

<https://isis.tu-berlin.de/course/view.php?id=8501>

Submit the following:

- For all questions: write a report with the plots and their discussion (i.e. the answers to the discussion questions). You can prepare your document using latex. Preferred format is a PDF document.
- For all questions: all the commands and scripts. All code must be properly documented using inline comments in English.
- Make an archive (.tar.gz, .zip) containing a directory with all of your files (scripts, traces etc.) and having your group number in its file name. Delete all files that you don't want to have graded before you finalize your submission. Please also upload a README file, if you think you need some extra documentation (if we don't understand what you submit, we cannot grade it).

Due Date: Wednesday, January 25th, 23:55.