TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Internet Network Architectures

WirelessLab WS 2016/17
Homework 7: Rate Control Algorithms

The purpose of this homework is to understand rate control in wireless networks. For the first part, you will use the minstrel automatic rate control algorithm and see how it reacts to different link conditions, emulated by varying the transmit power at the sender. You will analyze what rates nodes finally choose, and observe the achieved throughput.
In the second part, you will gain a deeper understanding of Minstrel and analyze the differences between your evaluation setup and the one in a scientific paper.

Question 1: (30 Points) *Rate Control Algorithms in mac80211*

In this exercise, you will test the Minstrel rate control algorithm that is supported in the Linux mac80211 drivers.

(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. Note, use the 802.11g WiFi card for sending and receiving the experiment related traffic.
Set up an experiment for active measurement, configuring the following rate control algorithm and transmission power levels:

- Rate control algorithm: minstrel.
- Transmission power: 1 dBm, 10 dBm, 20 dBm.
- Antenna (RX + TX) ports: 1 and 2.

Hence, there are six scenarios in total. Please choose a non-overlapping channel on the 2.4 GHz spectrum (channel 1, 6 or 11).
Please record the date and time of your experiment, and what channel you are using. This helps putting your results into context (e.g. what cross traffic might exist at this time of day). Again, don't forget to record the time when you conduct each run. Note, use tcpdump with a reasonable snaplen to reduce the size of the traces. **Please keep the traces until the debriefing**.

For each power level, do the following:

- Send UDP traffic at a constant bit rate of 55 Mbit/s from the sender to the receiver, using iperf with a packet sizeof 1024 B. Do this twelve times for a 30-seconds long run. In order to mitigate time-of-day effects, spread the runs across meaningfully different times of the day (morning and evening, for instance).
- Record the throughput (as reported by the receiver) and collect a packet trace on the monitor interface at the receiver.

(b) Please plot the following:

- Produce one boxplot that shows the throughput values at the different transmission power levels and antenna settings.
- Produce a barplot that shows how many data frames were received at what rate for each transmission power level and antenna setting.

What observations do you make? What do you conclude? Why?

Question 2: (20 Points) *Analysis of Rate Control Algorithms*

In this exercise, you will analyze the rate control algorithms in more detail, compare your results with the ones presented in a scientific paper, and reflect on the differences between the experiment setups.

For this, please read the paper "Performance of mac80211 Rate Control Mechanisms". (The reference is given below, but the PDF is also provided on ISIS2.) You do not need to understand every single plot, so do not get lost in the technical details, but focus on the description of Minstrel in Section 2.1 and on the different evaluation setups presented in Sections 3.1 and 4.

(a) Write pseudo code or a sequence diagram of how Minstrel selects its rate when there is something to send. Annotate the branches or pseudo code sections with probabilities where necessary.

(b) Compare your results of which algorithm performs better with the results of the paper. What differences between their evaluation setup and your evaluation setup can you find, what are your limitations? How are they likely to influence the results?

Rate Control Algorithm Evaluation Paper

Performance of mac80211 Rate Control Mechanisms, W. Yin, P. Hu, J. Indulska, and K. Bialkowsk *Proceedings of the 14th ACM international conference on Modeling, analysis and simulation of wireless and mobile systems*, 2011

Submission

`https://www.isis.tu-berlin.de/2.0/course/view.php?id=8501`

Submit plots of measurements, experiment scripts or used commands, answers to the questions and one example of each trace file for each scenario. All uploaded files must have the question/sub-question in their filename. Delete all files that you don't want to have graded before you finalize your submission. All code must be properly documented using inline comments. 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, December 14th, 23:55.