EECE5698: Wireless Multimedia Sensor Networks

Instructor: Dr. Tommaso Melodia

Homework 1

Due: March 4, 2016

We use ns-2 to study the throughput of a multi-hop IEEE 802.11 network. In the class, we listed several factors that would affect the throughput, 1) number of nodes, 2) the back-off mechanism for contention resolution, 3) use of ACK and 4) packet size and use of RTS/CTS etc. The purpose of this assignment is to evaluate the impact of some of these factors.

Construct a simulation scenario with ($n = 49$) nodes in a multi-hop network. A constant bit rate (CBR) source on top of UDP transport is used as the source. For this experiment, set the bit rate of the source to 80 kbps. To do this, use CBR source, set the packet size to 500 bytes and set the packet interarrival time to yield 80 kbps. Choose AODV routing protocol and set the data rate at the physical layer to 2 Mbps. Dimension of the terrain is $490X490$ and the sensors are located 70 meters apart at x and y coordinates. Create a grid with sensors located 70 meters apart from one another. Throughput is defined as the total number of application layer bits received. Measure the throughput and end-to-end delay with respect to the following parameters. Vary the number of sender/receiver pairs (with all sources transmitting at the same rate).

a. Randomly choose sender/receiver pairs among 49 sensors and vary the number of sender/receiver pairs from 1 to 20. All the sources start transmitting at 5 s and stop at 25 s. For each randomly chosen pairs run the experiment with the parameters as above for 10 times with different random seed values, e.g. $(1, 10, 100, \ldots)$ and compute the average to get the final results. Plot the throughput and average delay versus the number of pairs. (You can use the *throughput.awk* file posted on BB to analyze the trace file.)

b. Repeat the experiment a. with RTS/CTS disabled.

c. Repeat the experiment a. and b. by varying the size of application packets. Use packet size $(100, 300, 500, 1000)$ and set the packet interarrival time to yield 80kbps.

d. (bonus) Let the number of connection nodes to be $n = 9$. Dimension of the terrain is $210X210$ and the sensors are located 70 meters apart at x and y coordinates. Create a grid with sensors located 70 meters apart from one another. Choose sender/receiver connection pairs as follows

$1-3$, $4-6$ and $7-9$ with application packet size $200, 500, 1000$ bytes respectively. Set the bit rate of the source to 80 kbps. All the sources start transmitting at 5s and stop at 25s. Define throughput fairness index as

$$f(T_1, \ldots, T_n) = \frac{1}{n} \frac{(\sum_{i=1}^{n} T_i)^2}{\sum_{i=1}^{n} T_i^2}$$

where $T_i; i = 1, 2, \ldots, n$ are the throughput of the ith sender/receiver pair. Compare the fairness index with and without RTS/CTS. Repeat each experiment 10 times with different random seed values, e.g. $(1, 10, 100, \ldots)$ and compute the average to get the final results. Note that some of the simulations may require minor modification of source codes. [hint: locate the mac-802.11 related codes in the ns-2 source tree first and then start with a single pair of sender and receiver scenario.] Summarize your findings and comment on whether the use of different routing protocols would have an impact on the results and how.