Summary

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Lab05: CSMA/CA and RTS/CTS (Instructions)

Lab05: CSMA/CA and RTS/CTS

Objective:

1. Use ns3 simulator to study the performance of CSMA/CA in terms of system efficiency and fairness
2. Perform the hidden terminal experiment and observe the effect of using RTS/CTS

Reference Material

1. Videos corresponding to WiFi on Bodhitree
2. ns3 Installation - ns3 Installation Instructions

General Instructions

1. Download the files associated with this lab by right-clicking the “View Documents” button at the bottom.
2. Place the two C code files - hidden-stns.cc and nsta-udp.cc in ns-allinone-3.30.1/ns-3.30.1/scratch/
    i. nsta-udp.cc explores how MAC throughput varies with the number of nodes
    ii. hidden-stns.cc explores RTS/CTS in the context of hidden nodes
3. Place the python script - summarize.py in ns-allinone-3.30.1/ns-3.30.1/
    i. This script reads the output file generated by the nsta-udp script and summarizes it for you. Details below.
    ii. This script uses pandas, a library for data manipulation. “Pip” is a package installer for python. If you don’t have them, install via “sudo apt install python3-pip”, followed by “pip install pandas”
    iii. Run all commands within the current working directory ns-allinone-3.30.1/ns-3.30.1/
    iv. Don’t copy-paste commands - hyphens can cause issues - type it yourself instead
4. The code files contain a comment block at the top of the files describing the simulated network and how to run the file.
5. You need not go through the code in the code files but the comment block would be useful to run the simulation and answer some questions in the quizzes.

Lab Instructions

Part-1: CSMA/CA warmup

Go through the summary of what nsta-udp.cc does, as listed at the beginning of the file. Skim through the rest of the code if you are interested.

Use the nsta-udp file for the following exercise. Run the simulation with only one client (STA) and one AP.

An interesting observation here is that a simulator that simulates say 5 sec of activity, will often take a lot more time to run. You can use the time command to check this out: time -p ./waf –run “nsta-udp –uplinks=1”

Now attempt the quiz titled “Lab05-CSMA-CA-warmup”.

Part-2: CSMA/CA efficiency and fairness

Use the same nsta-udp file for this exercise as well. In theory, we learned that CSMA/CA does not perform well under high load. We are going to try and observe this through simulation now. Let’s take 5 network instances with 1, 5, 10, 20, 30 client nodes respectively. Run nsta-udp for each of these scenarios and use summarize.py to obtain per second minimum, maximum and total throughput aggregated over all uplinks.

For a given network instance, we define:

“Avg. Throughput” as the average of the total throughputs, and

“Avg. Min/Max ratio” as the average of the ratio of minimum and maximum throughput observed across clients.

For example, Time,Min,Max,Total

1.0,4.5,5.0,19.1

2.0,4.4,5.5,20.1

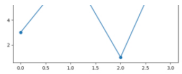
“Avg. Throughput” is (19.1 + 20.1) / 2 = 19.6

“Avg. Min/Max ratio” is (4.5/5.0 + 4.4/5.5) / 2 = 0.85

You may want to refer to the code within summarize.py to automate the task or can do the computations manually.

Compute the metrics - “Avg. Throughput” and “Avg. Min/Max ratio” - for all 5 network instances. Generate a “line plot with markers” each with the X-axis as the number of nodes and the Y-axis as the metric value. (There would be 5 points on both the plots) Add appropriate labels to axes and a suitable title for each plot. The title should contain your roll number as well.

Example of a “line plot with markers”:



Now attempt the quiz titled "Lab05-CSMA-CA-metrics".

Part-3: Hidden Terminal and RTS/CTS

Use the hidden-stns file for the following exercise. The file contains comments describing the simulated network and how to run it.

Run four experiments: Case 1: No contention, No RTS/CTS

Case 2: No contention, With RTS/CTS

Case 3: With contention, No RTS/CTS

Case 4: With contention, With RTS/CTS

Now attempt the quiz titled "Lab05-Hidden-terminal".

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