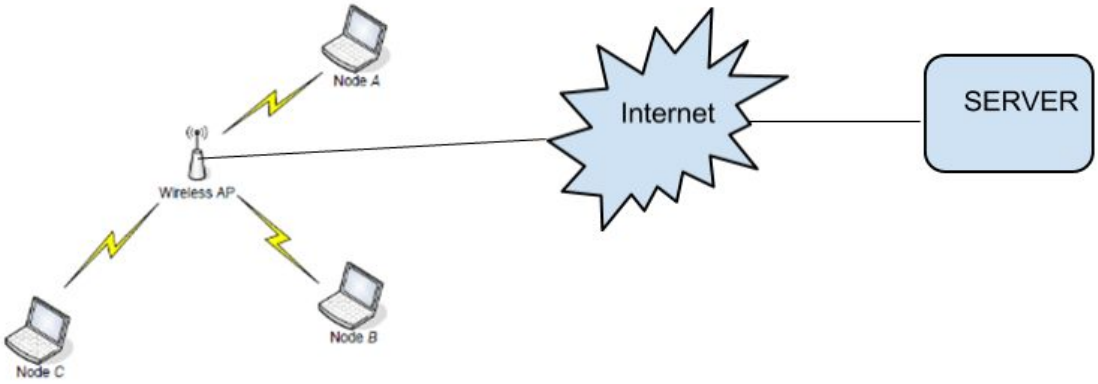
Assignment 3 (revised): Impact of RTS/CTS handshake on IEEE 802.11 MAC Performance



Create an IEEE **802.11n** BSS (i.e., without QoS, 802.11e enabled) with ESSID "ASG3" as given in the above figure in **NS-3, version 3.25 (latest release)**. BSS should consist of one AP and 30 client stations (STAs). AP and Server (remote host) are connected to the Internet (Cloud) over wired backhaul connections of 100 Mbps capacity each with 2ms propagation delay. Clients should be placed at uniformly random locations in the coverage area of AP in the BSS. Each STA is part of maximum of one-flow (TCP Bulk send application which is transferring a file of size 1MB (with packet size of 512B as its MSS) from respective STAs to the Server located in the Internet.). In the simulation, you can use default fading and pathLoss model supported in NS-3 Wi-Fi with ConstantSpeedPropagationDelayModel.

PART A:

Network Scenario: 1-hop BSS where every node can transmit/receive from the AP and may not from all other nodes i.e., the radius of BSS is 100 meters for placing STAs and transmission range of AP and STAs is 100 meters. This scenario helps you to simulate hidden node problem in the experiments. Max distance between two STAs is 200 meters, e.g., S1-----AP------S2

You need to create the following TCP flows as a part of this assignment and study their performance for the cases of With RTS-CTS and W/O RTS-CTS handshaking. That is either RTS-CTS is enabled and used for all data transmissions (With RTS-CTS case) or RTS-CTS is disabled for all data transmissions (W/O RTS-CTS case).

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Use TCP Bulk send application available in NS-3 to create TCP flows. You need to vary number of TCP flows in the range (1, 5, 10, 20, 30) in your experiments. All TCP flows start as different STAs almost all the same time and send 1 MB of data to the server located in the Internet. Find all the results by considering following traffic patterns:

a) All the flows should be uplink (from STAs to Server via AP)

b) All the flows should be downlink (from Server to STAs via AP)

Calculate the average throughput of the TCP flows (not TCP ACK flows) from FlowMonitor stats and show the results using graphs plotted using Gnuplot/etc tools. **Average your results for each case over 5 seeds.**

Result Set 1: Draw a single graph which shows the average throughput of TCP flows by varying number of TCP flows on X-axis for the cases of With RTS-CTS and W/O RTS-CTS for *Network Scenario 1* for Downlink and Uplink traffic patterns given above**.** Similarly draw graphs showing No of collisions (PHYRxDrops) vs No. of Flows and No. of packet (frame) drops (reported by FlowMonitor) vs No. of Flows for Network Scenario 1 for Downlink and Uplink traffic patterns**.**
So, each of the 3 graphs should consists of 4 plots namely,
a) With RTS-CTS & Uplink
b) With RTS-CTS & Downlink
c) Without RTS-CTS & Uplink
d) Without RTS-CTS & Downlink
Use legends to clearly distinguish all the plots clearly.

Result Set 2: Scenario is same as that for generating Result Set 1 except that this time TCP Bulk send application uses different packet size as its MSS, 1200 Bytes instead of 512 Bytes for sending its 1MB file.

Simulation time =30 min or whatever it takes for TCP flows to finish successfully. All the flows must be started around time t=0. Your results be averaged out over 5 re-runs of same experiment by varying RngRun.

PART B:

Propose myBO algorithm which could perform better than 802.11 BO algorithm (i.e., Binary Expoential BackOff mechanism with ShortRetryLimit=7, LongRetryLimit=4, CWmin and CWmax where CW is reset to CWmin after successful/failure tx attempts of each Data packet in the MAX TX Queue) for at least one of the cases considered in PART A of this assignment. That means myBO algorithm should outperforms 802.11 default BO mechanism in either of the following cases:

A. With RTS-CTS & Uplink for 512B MSS or 1200B MSS for any of traffic loads of varying no. of TCP flows
B. Without RTS-CTS & Uplink for 512B MSS or 1200B MSS for any of traffic loads of varying no. of TCP flows
C. If not, create a new but realistic scenario where myBO algorithm outperforms 802.11 default BO mechanism

As it's always better to design a well performing BO mechanism which could work in variety of

scenarios, you should come up with a simple and elegant algorithm for myBO to gain maximum no. of marks! Needless to say, you need to show % improvement in performance (consider metrics studied in PART A or come up with any other metrics of relevance) by repeating the experiment for 5 seeds.

Deliverables in a tar ball on GC with the following:

- **README**
- **All NS-3 programs written by your group with proper documentation and comments**
- **All NS-3 output (trace) files, scripts (to analyze results, plotting results), etc**
- **Readable Report summarizing your design/experimental setup, analyzing plots for both PART A and PART B**
- **Answers to below Questions**
    a. **Max PHY data rate supported by 11n in NS-3**
    b. **Default Tx power levels of AP and STA nodes and Tx levels that you have set for scenarios 1 and 2**
    c. **What is the path loss model used in expts and what are its configurable parameters?**
    d. **Which channel is used by AP for setting up BSS? Note that you could use either 2.4GHz or 5.2GHz bands with 802.11n**
    e. **What are the configurable parameters (attributes) of AP node in NS-3?**

Instructions:

- **Max 2 students per group: you choose your partner**
- **Each student of the group need to upload their tar ball by due date**
- **Use shell scripts to automate the task of running each expt for different seeds and redirect the output to logFiles for further processing**
- **Again use perl/awk/etc to process logFiles to generate input dataset for plotting**
- **Contact TAs for help in plotting and any other doubts**
- **Strictly follow NS-3 coding guidelines**