CSE 566: Wireless Networks Security
Project 1b

Date: 03/12/2015   **Due Date: 04/09/2015**

This is the second part of the simulation project which builds on the part that was already completed. This part aims at implementing a MAC layer attack using the NS2-network simulator.

Specifications of the Project

Problem:
Misbehavior by nodes is a common attack in networks involving the 802.11 MAC Protocol. By misbehaving we mean nodes which do not adhere to the rules of the 802.11 protocol. The aim of this project is to see how changing contention window by nodes affects throughput and delay.

Simulation Setup:
Topology:
Construct a simple grid topology with 21 nodes in a multihop environment. The dimension of the terrain is 350 x 150 meters. Place the nodes at coordinates which are 50 meters apart, i.e., the grid should have 3 rows and each row should have 7 nodes.

Network Details:
Use a CBR source connected to a UDP transport layer. Use AODV as the routing protocol. Use the 802.11 as the MAC protocol. The physical channel rate should be 2Mbps. You can use default link layer protocol for the simulations.

CBR Source Details:
Set the bitrate to 70 kbps and packet size to 250 bytes. You will need to calculate the source interval to get the desired bitrate.

Network Sources:
You will need to attach the CBR sources and sinks to get the following source sink pairs:

Pair No.	Source (Node Id)	Sink (Node ID)
1	1	8
2	8	9
3	17	10
4	10	11
5	11	12
6	5	12
7	14	21
8	13	14
9	9	16

Simulation Specifics:
Length of Simulation: 60 seconds.

Pair No.	Transmission Start Time (secs)	Transmission Stop Time (secs)
1	5	40
2	10	55
3	12	30
4	20	55
5	30	45
6	10	50
7	5	49
8	12	30
9	6	47

Definition of the Metrics:
Throughput is defined as the total number of bits received at the application layer. End-to-end delay is defined as the difference between the time the source application layer transmits a packet and the time the destination application layer receives the same packet. You need to evaluate the Throughput and the End-to-End Delay for the following:
(See deliverables for the kinds of throughput)

1) For the above specifications without any misbehavior (default packet size).
2) For the above specifications with
   a. All nodes misbehaving
   b. Some nodes misbehaving (specifics are given in the following section).
3) Repeat 1 for different packet sizes – 600 bytes and 900 bytes.
4) Repeat 3 for the different packet sizes – 600 bytes and 900 bytes with
   a. All nodes misbehaving and
   b. Some nodes misbehaving (specifics are given in the following section).
5) Simulate the scenario using specifications of 1) but some nodes are misbehaving using the Back-off Timer misbehavior mode, the specifics of which are given in the Misbehavior Parameters section). Also, repeat for packet sizes of 750 bytes and 878 bytes. Note that in this scenario you will have to reset the contention window value to the default NS2 value.

Misbehavior Parameters:
   Below are two modes of node misbehavior in an 802.11 setup.
   1.   **Contention Window Misbehavior (use this mode in scenarios 2 and 4):** As mentioned earlier the misbehavior can be caused by manipulating the contention window for the 802.11 protocol.
   For evaluation 1 and 3: Default 802.11 contention window.
   For evaluation 2a and 4a: Contention window is fixed at 64 (both minimum and maximum).
   For evaluation 2b and 4b: Use the following table for setting the windows.

Node Id	Contention window minimum	Contention window maximum
9	64	96
11	32	96
17	10	64
13	1	32
21	32	128

2. **Back-off Timer Misbehavior (use this mode in scenario 5):** In this mode, a node misbehaves by using a reduced back-off timer when it senses a collision. Choose nodes 9, 11, 13, 17 and 21 as misbehaving. The remaining nodes in the network should use the default back-off timer values as specified by 802.11. You will need to ensure that the back-off timer for the nodes specified above randomly chooses a number between 16 and 32 during the run time.

What you are expected to learn:

You are expected to learn

i. How to specify the different OSI layers in NS2.
ii. How to specify different parameters for different nodes.
iii. Creating and Running a simulation setup.
iv. Creating and Running a simulation setup where different nodes have different protocols running.
v. What are the two ways nodes can misbehave in an 802.11 setup
vi. What is a contention window and how it affects a network using 802.11.
vii. By manipulating the contention window what advantage/disadvantage a node gets in terms of the metrics.
viii. What is the back-off timer and how it affects a network using 802.11.
ix. By manipulating the back-off timer is it possible for a node to get any advantage/disadvantage in terms of the metrics.

Deliverables:

(i) **A hard copy of your project report** submitted in class on the due date. The project report should contain *__only__* the plots of the various throughputs, delays you obtain from your simulation, a brief description of the plots and your observations and analysis if any.
   a. Your report should explain your inferences and observations (if any) about the phenomenon you notice from the plots and not just describe the plots.
   b. Specifics for the plots:
      i. For evaluation 1, 3 (all are benign nodes): Network Throughput and End-to-End Delay plotted against the simulation time (as done in project 1a) for each packet size, separately. Two (2) graphs (Throughput and Delay) for each packet size (6 graphs.)

      ii. For evaluation 2a, 4a (all are misbehaving nodes):

1. Network Throughput and End-to-End Delay plotted against simulation time for each packet size, separately (2 plots for the 3 packet sizes = 6 plots).
2. Plots of Throughput and End-to-End Delay for each packet size for the source-sink pair numbers 2, 3, 4, 5 and 8 (ref. 1st table) v/s simulation time. For each packet size, 1 graph containing all the individual Throughputs calculated for each of the specified source-sink pairs and 1 graph for the End-to-End Delay calculated for each of the specified source-sink pairs (total of 6 plots).

iii. For evaluation 2b, 4b (some nodes are misbehaving while others are benign):
1. Network Throughput and End-to-End Delay plotted against simulation time for each packet size, separately. 2 plots for the 3 packet sizes (total of 6 plots).
2. Plots of Throughput and End-to-End Delay for each packet size for the source-sink pair numbers 2, 3, 4, 5 and 8 (ref. 1st table) v/s simulation time For each packet size, 1 graph containing all the individual Throughputs calculated for each of the specified source-sink pairs and 1 graph for the End-to-End Delay calculated for each of the specified source-sink pairs (total of 6 plots).

iv. For evaluation 5 (Some nodes are misbehaving while others are benign):
1. Network Throughput and End-to-End Delay plotted against simulation time for each packet size separately (6 plots).
2. Plots of Throughput and End-to-End Delay for each packet size for the source-sink pair numbers 2, 3, 4, 5 and 8 (ref. 1st table) v/s simulation time. For each packet size, 1 graph containing the individual Throughputs calculated for each of the specified source-sink pairs and 1 graph for the End-to-End Delay calculated for each of the specified source-sink pairs (total of 6 plots).

(ii)   A zip of all the files used in the simulation should be emailed to hayreddi@buffalo.edu. List the group members in the mail. The subject of your email must be "CSE566:Project-1b-Source." The deadline for this submission is also the same as the report.

Grading:
Grading will be based on the correctness of your plots, report and simulation sources as well as the observations made.

Note:
(i)   This project is not very difficult, but will take up a lot of time analyzing and understanding. So start early; the TA might not be able to help you if you start late.

(ii)   A part of the project may entail modifications to existing default NS2 files. The exercise is for you to analyze and understand if the files require modifications. If any files are changed, they **need to be emailed as part of the zip with a readme file**, **_specifying which lines of files were modified and for what purpose._**

(iii) Your report needs to contain all 42 plots displaying the metrics asked for. Any other graphs will not be considered.

(iv)   Your graphs should be **_clear enough to read_** and self-explanatory.

(v)   If all simulation sources are not provided you will lose points.

(vi)   Use MS-Excel or Matlab for plotting, if you are not familiar/proficient with Xgraph. Also if you are handing in a grayscale printout of the report, make sure the colors used in the plots are easy to read even in grayscale. This can be done by using different line types and line markers. Also, make sure the size of the graphs is sufficient for reading.