**Assignment 2: Analyzing MAC Layer Misbehavior using ns-2**

**(SN 616 Wireless Security)**

**[Assignment Due: April 8th, 11:59 pm]**

**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.

**Network Set-up:** Construct a simple topology with 50 nodes deployed in a random manner. Make sure that nodes communicate over a multi-hop network and that they hear each other. Use a CBR source connected to a UDP transport layer. Use AODV as the routing protocol. Use the 802.11 as the MAC protocol. You can use default link layer protocol for the simulations.

**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:

1) For the specifications without any misbehavior (default packet size).

2) For the specifications with

a. All nodes misbehaving

b. Some nodes misbehaving.

3) Repeat 1 for different packet sizes.

4) Repeat 3 for the different packet sizes 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. Also, repeat for varying packet sizes. Note that in this scenario you will have to reset the contention window value to the default ns-2 value.

**Misbehavior Parameters:**

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.

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 a random percentage of nodes to be misbehaving. The remaining nodes in the network should use the default back-off timer values as specified by 802.11.

**Deliverables**:

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.

**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 for each packet size, separately. Two (2) graphs (Throughput and Delay) for each packet size

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 of Throughput and End-to-End Delay for each packet size for the source-sink pairs v/s simulation time. For each packet size, 1 graph containing all the individual Throughputs calculated for each of the source-sink pairs and 1 graph for the End-to-End Delay calculated for each of the specified source-sink pairs.

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 of Throughput and End-to-End Delay for each packet size for the source-sink pairs 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.

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.

2. Plots of Throughput and End-to-End Delay for each packet size for the source-sink pairs 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.

**Grading:**

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