



Emerging Network Technologies

NetSim Exercise 6

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6. Analyze the performance of a MANET, (running CSMA/CA (802.11b) in MAC) with increasing node density

6.1 Theory:

Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links to form an arbitrary topology without the use of existing infrastructure. The nodes are free to move randomly. Thus the network's wireless topology may be unpredictable and may change rapidly.

The node density also has an impact on the routing performance. With very sparsely populated network the number of possible connection between any two nodes is very less and hence the performance is poor. It is expected that if the node density is increased the throughput of the network shall increase, but beyond a certain level if density is increased the performance degrades.

6.2 Performance metrics:

The different parameters used to analyze the performance are explained as follows:

- **Throughput:** It is the rate of successfully transmitted data packets in unit time in the network during the simulation.
- **Average Delay:** It is defined as the average time taken by the data packets to propagate from source to destination across a MANET. This includes all possible delays caused by routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times.

6.3 Procedure:

In NetSim, Select -Simulation → New → Advanced Wireless Networks →MANET.

Step 1: Create /Design the Network

Devices Required: 2 Wireless Nodes

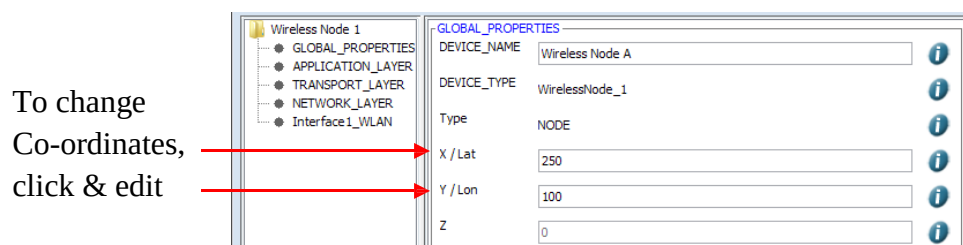
Step 2: Configure the Network (Sample 1)

Wireless Node Properties:

- Click & drop 2 Wireless Nodes onto the Simulation Environment.
- Arrange the positions of the nodes as per the following table:

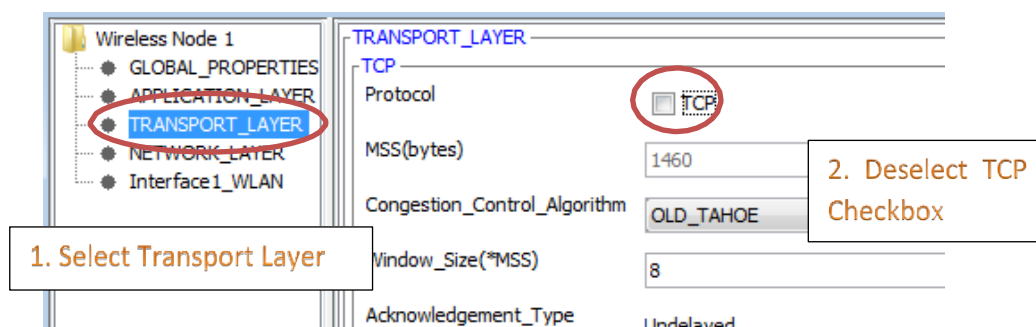
Wireless Node	X-Coordinate	Y-Coordinate
1	50	100
2	100	150

NOTE: To edit the position, change the (x, y) co-ordinates in Global Properties as shown:



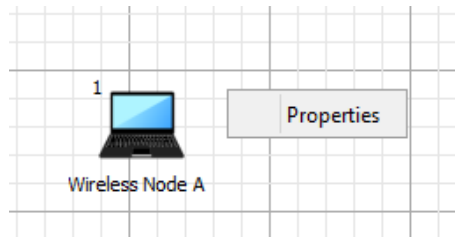
- Disable TCP in all Wireless Nodes.

Right Click on any **Wireless Node** → Properties

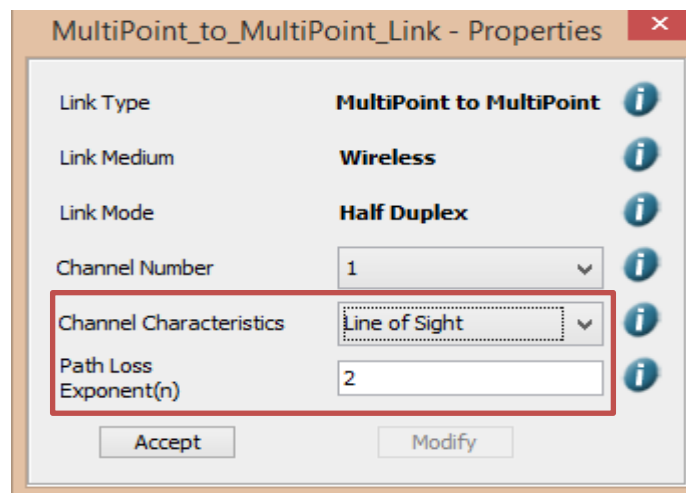


Wireless Link Properties:

Right Click anywhere on the Grid Environment → Properties



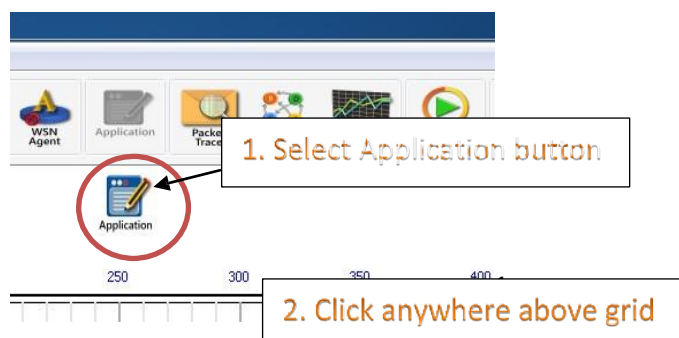
Channel Characteristics	Line of Sight
Path Loss Exponent (n)	2

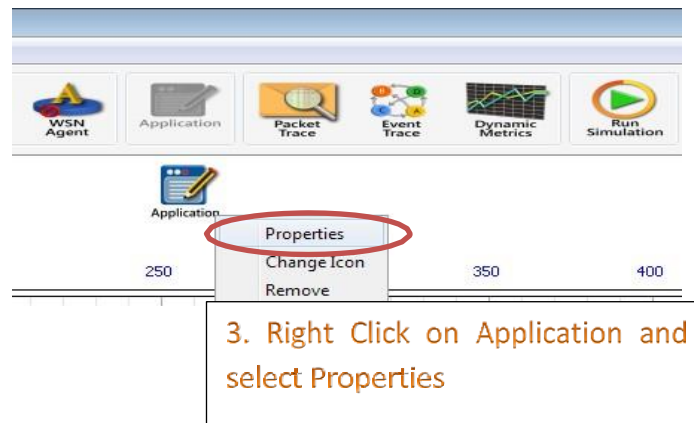


Path loss is the reduction in the power density of radio wave as it travels. The loss is proportional to (distance) to the power (n), where n is the path loss exponent. The general value of n is from 2 to 5. As the value of n is increased there will be more reduction in power and hence higher likelihood of error in the packet. In general, users would notice that as n increases the error increases, the data rate decreases and the throughput decreases.

Step 3: Model Traffic in the Network (Sample 1)

Select the Application Button and click on the gap between the Grid Environment and the ribbon. Now right click on Application and select Properties.





Application Properties:

Application Type	Custom
Source ID	1 (Wireless Node A)
Destination ID	2 (Wireless Node B)
Packet Size	
Distribution	Constant
Value(Bytes)	1460
Inter Arrival Time	
Distribution	Constant
Value(μs)	60000

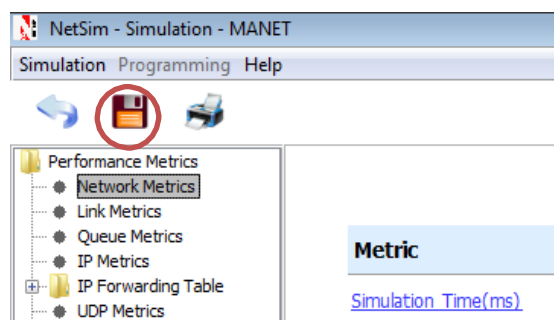
Step 4: Simulate

Simulation Time - 100 Sec

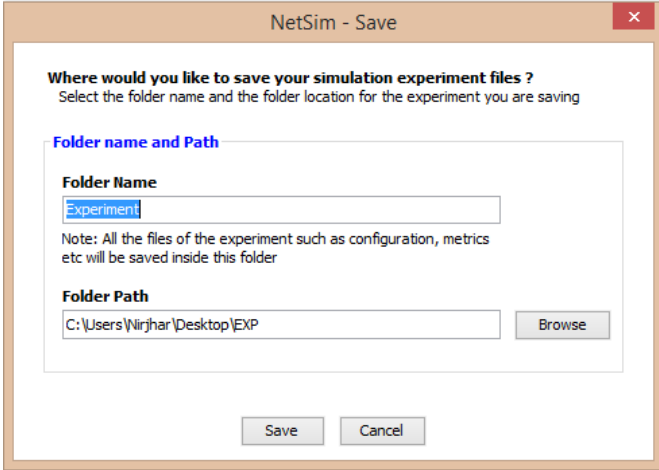
After completion of the experiment, –Save the experiment for future analysis of results.

Steps to save an experiment:

Step 1: After simulation of the network, on the top left corner of Performance metrics screen, click on the –Save Network and Metric as button



Step 2: Specify the **Experiment Name** and **Save Path** and click on **OK**

A screenshot of the 'NetSim - Save' dialog box. The title bar says 'NetSim - Save' with a close button. The main text asks 'Where would you like to save your simulation experiment files?' and 'Select the folder name and the folder location for the experiment you are saving'. There are two input fields: 'Folder Name' with the text 'Experiment' and 'Folder Path' with the text 'C:\Users\Nirjhar\Desktop\EXP'. A 'Browse' button is next to the 'Folder Path' field. A note says 'Note: All the files of the experiment such as configuration, metrics etc will be saved inside this folder'. At the bottom are 'Save' and 'Cancel' buttons.

NetSim - Save

Where would you like to save your simulation experiment files ?
Select the folder name and the folder location for the experiment you are saving

Folder name and Path

Folder Name
Experiment

Note: All the files of the experiment such as configuration, metrics etc will be saved inside this folder

Folder Path
C:\Users\Nirjhar\Desktop\EXP

Browse

Save Cancel

Step 5: Configure the Network (Sample 2)

Wireless Node Properties:

- Click & drop 2 more Wireless Nodes onto the Simulation Environment.
- Arrange the positions of the nodes as per the following table:

Wireless Node	X-Coordinate	Y-Coordinate
1	50	100
2	100	150
3	75	75
4	125	125

- Disable TCP in all Wireless Nodes.

Right Click on any **Wireless Node** → Properties

The remaining properties are same as Sample 1.

Step 6: Model Traffic in the Network (Sample 2)

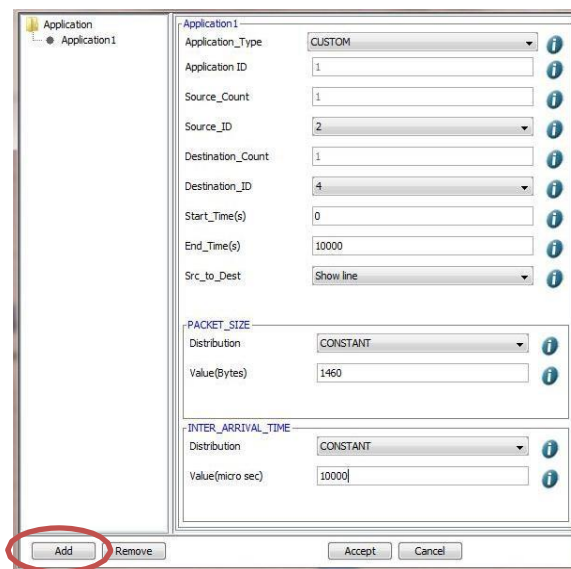
Select the Application Button and click on the gap between the Grid Environment and the ribbon. Now right click on Application and select Properties.

Application Properties:

Application Type	Custom	Custom
Source ID	1 (Wireless Node A)	3 (Wireless Node C)
Destination ID	2 (Wireless Node B)	4 (Wireless Node D)
Packet Size		
Distribution	Constant	Constant
Value(Bytes)	1460	1460
Inter Arrival Time		
Distribution	Constant	Constant
Value(µs)	60000	60000

NOTE: The procedure to create multiple applications are as follows:

Step 1: Click on the ADD button present in the bottom left corner to add a new application.



Step 7: Simulate

Simulation Time - 100 Sec

After completion of the experiment, -Save the experiment for future analysis of results.

Step 8: Configure the Network (Sample 3)

Wireless Node Properties:

- Click & drop 2 more Wireless Nodes onto the Simulation Environment.

- Arrange the positions of the nodes as per the following table:

Wireless Node	X-Coordinate	Y-Coordinate
1	50	100
2	100	150
3	80	70
4	140	130
5	110	40
6	160	90

- Disable TCP in all Wireless Nodes.

The remaining properties are same as Sample 2.

Step 9: Model Traffic in the Network (Sample 3)

- Select the Application Button and click on the gap between the Grid Environment and the ribbon. Now right click on Application and select Properties.

Application Properties:

Application Type	Custom	Custom	Custom
Source ID	1 (Wireless Node A)	3 (Wireless Node C)	5 (Wireless Node E)
Destination ID	2 (Wireless Node B)	4 (Wireless Node D)	6 (Wireless Node F)
Packet Size			
Distribution	Constant	Constant	Constant
Value(Bytes)	1460	1460	1460
Inter Arrival Time			
Distribution	Constant	Constant	Constant
Value(µs)	60000	60000	60000

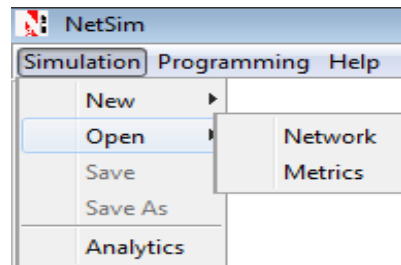
Step 10: Simulate

Simulation Time - 100 Sec

After completion of the experiment, –Save the experiment for future analysis of results.

6.4 Output

Go to **Simulation** → **Open** → **Metrics** menu to open the results of saved experiments.



- Go to Application metrics and compute the sum of all column wise values of throughput.

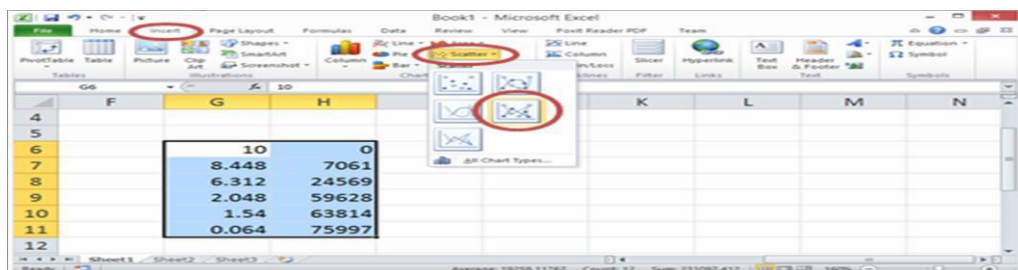
Throughput = Sum of throughputs obtained from all Applications

- Go to Application metrics and compute the Average delay by taking average of all row wise values of Delay.

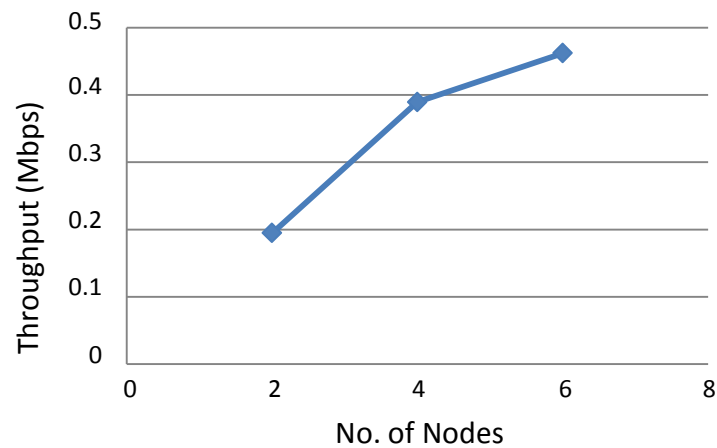
Delay = Average delay obtained from all Applications

NOTE – To create Graph in Excel 2010, follow the steps

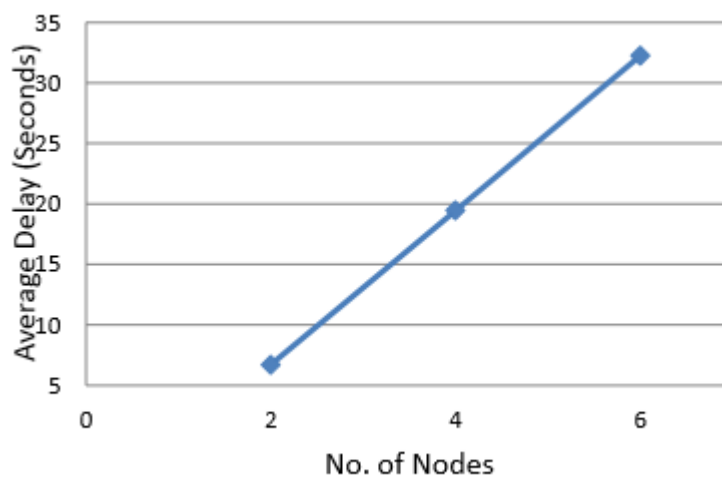
- Copy the data in an Excel sheet.
- Select the data. Go to **Insert** → **Scatter** (under Charts) → **Scatter with Straight lines and Markers**.



Plotting the Throughput obtained from the above 3 samples with respect to Number of Nodes and the graph which is obtained, follows the pattern as below:



Plot the Average Delay obtained from the above 3 samples with respect to Number of Nodes and the graph obtained is similar to:



6.5 Inference

As the number of nodes increases ($2 \rightarrow 4 \rightarrow 6$) the throughput of the network increases because the channel is able to handle additional network traffic. However, if the number of nodes is increased further, the throughput may decrease as the network traffic is too high, and this leads to collisions.

As the number of nodes increases, the delay also increases as it takes more time for a packet to reach its destination.