School of
Applied Computing

Network Simulation

NetSim
Exercise 11 (Optional)

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11. Plot the characteristic curve throughput versus offered traffic for a Slotted ALOHA system

11.1 Theory:

ALOHA provides a wireless data network. It is a multiple access protocol (this protocol is for allocating a multiple access channel). There are two main versions of ALOHA: pure and sloted. They differ with respect to whether or not time is divided up into discrete slots into which all frames must fit.

Slotted ALOHA:

In slotted Aloha, time is divided up into discrete intervals, each interval corresponding to one frame. In Slotted ALOHA, a computer is required to wait for the beginning of the next slot in order to send the next packet. The probability of no other traffic being initiated during the entire vulnerable period is given by e^{-G} which leads to $S = G\,e^{-G}$ where, S (frames per frame time) is the mean of the Poisson distribution with which frames are being generated. For reasonable throughput S should lie between 0 and 1.

G is the mean of the Poisson distribution followed by the transmission attempts per frame time, old and new combined. Old frames mean those frames that have previously suffered collisions.

It is easy to note that Slotted ALOHA peaks at G=1, with a throughput of $S = {}^{1}/_{e}$ or about 0.368. It means that if the system is operating at G=1, the probability of an empty slot is 0.368

Calculations used in NetSim to obtain the plot between S and G:

Using NetSim, the attempts per packet time (G) can be calculated as follows;

$$G = \frac{\text{Number of packets Transmitted} * \text{PT}}{\text{ST} * 1000}$$

Where,	G	=	Attempts per packet time
	PT	=	Packet time (in seconds)

ST = Simulation time (in seconds)

The throughput (in Mbps) per packet time can be obtained as follows:

$$S = \frac{\text{Throughput(in Mbps)} * 1000 * PT}{PS * 8}$$

Where, S = Throughput per packet time

PT = Packet time (in milliseconds)

PS = Packet size (in bytes)

Calculations for the packet time:

$$PT = \frac{\text{Packet Size(bits)}}{\text{Band Width(Mbps)}}$$

In the following experiment, we have taken packet size=1472 (Data Size) + 28 (Overheads) = 1500 bytes

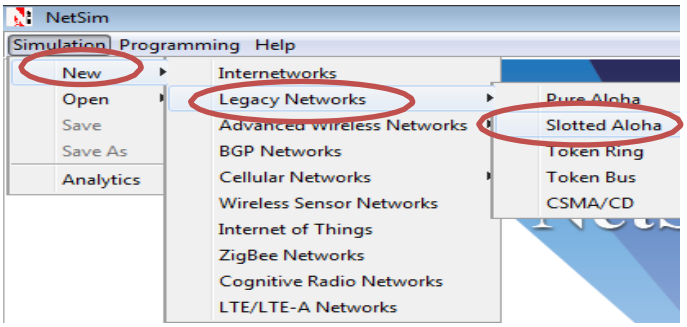
Bandwidth is 10 Mbps and hence, packet time comes as 1.2 milliseconds.

11.2 Procedure:

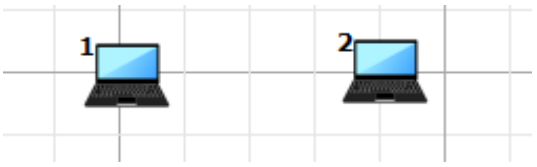
Step 1:

How to Create Scenario:

- **Create Scenario**: –Simulation → New →Legacy Networks → Slotted Aloha‖.



Click and drop two nodes as shown in the screen shot.

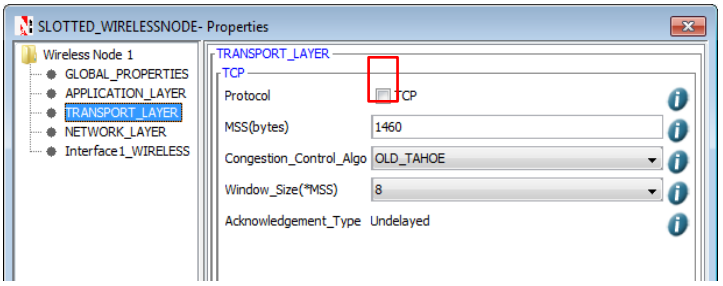


Sample Inputs:

Input for Sample 1: Node 1 generates traffic. The properties of Node 1 which transmits data to Node 2 are selected as follows:

Wireless Node Properties:

Wireless Node Properties	
Transport Layer	
TCP	disable
Interface1_Wireless	
Slot Length(mus)	1500
Data Rate(mbps)	10



Right click on the Grid environment and select the channel characteristics as **no path loss**.

Application Properties: Click and drop the Application icon and set following properties as shown in below figure:-

Application Type	Custom	
Source_Id	1	
Destination_Id	2	
Packet Size	**Distribution**	Exponential
	Value (bytes)	1472
Inter Arrival Time	**Distribution**	Exponential
	Packet Inter Arrival Time (µs)	20000

Simulation Time- 10 Seconds

(*Note:* *The Simulation Time can be selected only after doing the following two tasks,*

- *Set the properties of Nodes*
- *Then click on Run Simulation button*)**.**
  - Obtain the values of Throughput and Total Number of Packets Transmitted from the statistics of NetSim simulation for various numbers of traffic generators.

Input for Sample 2: Node 1 and Node 2 both generate traffic. Node 1 transmits data to Node 2 & Node 2 transmits data to Node 1.The properties of Node 1 and Node 2 are set as shown in Sample 1.

Input for Sample 3: 3 Nodes are generating traffic. Node 1 transmits data to Node 2, Node 2 transmits data to Node 3 and Node 3 transmits data to Node 1.

And so on continue the experiment by increasing the number of nodes generating traffic as 4, 5, 7, 9, 10, 15, 20 22 and 24 nodes.

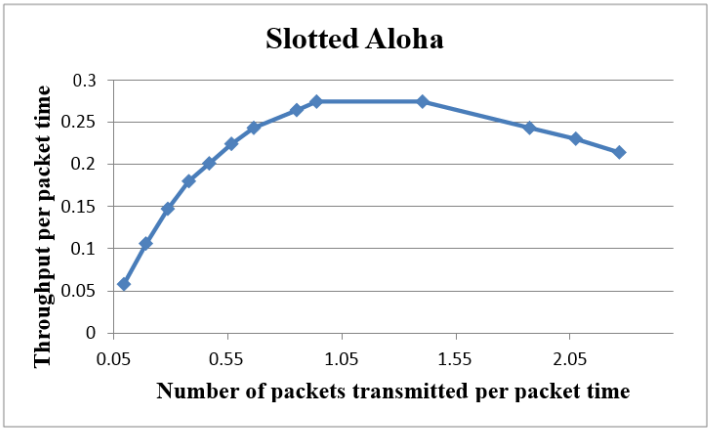
Comparison Table:

The values of Throughput and Total Number of Packets Transmitted obtained from the network statistics after running NetSim simulation are as follows. Throughput per packet time and Number of Packets Transmitted per packet time calculated from the above mentioned formulae are tabulated as below:

Number of nodes generating traffic	Throughput (in Mbps)	Total number of Packets Transmitted	Throughput per packet time	Number of Packets Transmitted per packet time
1	0.58	793	0.058	0.095
2	1.06	1602	0.106	0.192
3	1.47	2394	0.147	0.287
4	1.8	3164	0.18	0.379
5	2.01	3913	0.201	0.469

7	2.43	5531	0.243	0.663
9	2.64	7101	0.264	0.852
10	2.74	7824	0.274	0.938
15	2.74	11695	0.274	1.403
20	2.43	15606	0.243	1.872
22	2.3	17288	0.23	2.074
24	2.14	18884	0.214	2.266

Thus the following characteristic plot for the Slotted ALOHA is obtained, which matches the theoretical result.



Note: The optimum value is slightly less than the theoretical maximum of 0.368 because NetSim's simulation is per real-world and includes overheads, inter-frame gaps etc.