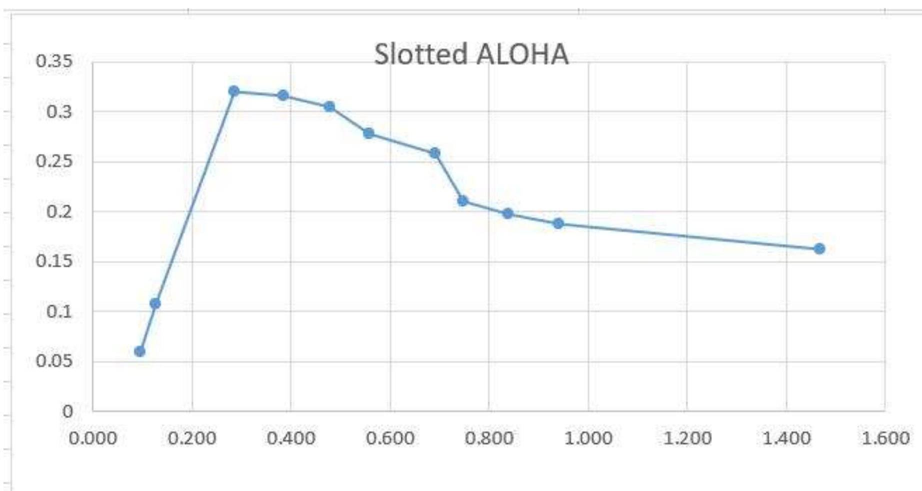
SLOTTED ALOHA:

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	0.589019	793	0.0589019	0.095
2	1.067784	1062	0.1067784	0.127
3	3.1992	2386	0.31992	0.286
4	3.15	3207	0.315	0.385
5	3.044	3984	0.3044	0.478
6	2.783153	4657	0.2783153	0.559
7	2.5747	5775	0.25747	0.693
8	2.10549	6241	0.210549	0.749
9	1.975212	6994	0.1975212	0.839
10	1.872166	7841	0.1872166	0.941
15	1.624065	12236	0.1624065	1.468
21	1.89	16702	0.189	2.004
24	1.702	18623	0.1702	2.235



EXP NO: 10 **DATE:**	**MAC Protocols**

SLOTTED ALOHA:

AIM:

To study and analyze slotted ALOHA system and plot the characteristic curve of throughput versus offer traffic for the same.

SOFTWARE REQUIRED:

NETSIM

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 slotted. They differ with respect to whether or not time is divided up into discrete slots into which all frames must fit.

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

$$S = G\ e^{-G}$$

S → the mean of the Poisson distribution with which frames are being generated. (frames per frame time)

G → the mean of the Poisson distribution followed by the transmission attempts per frame time.

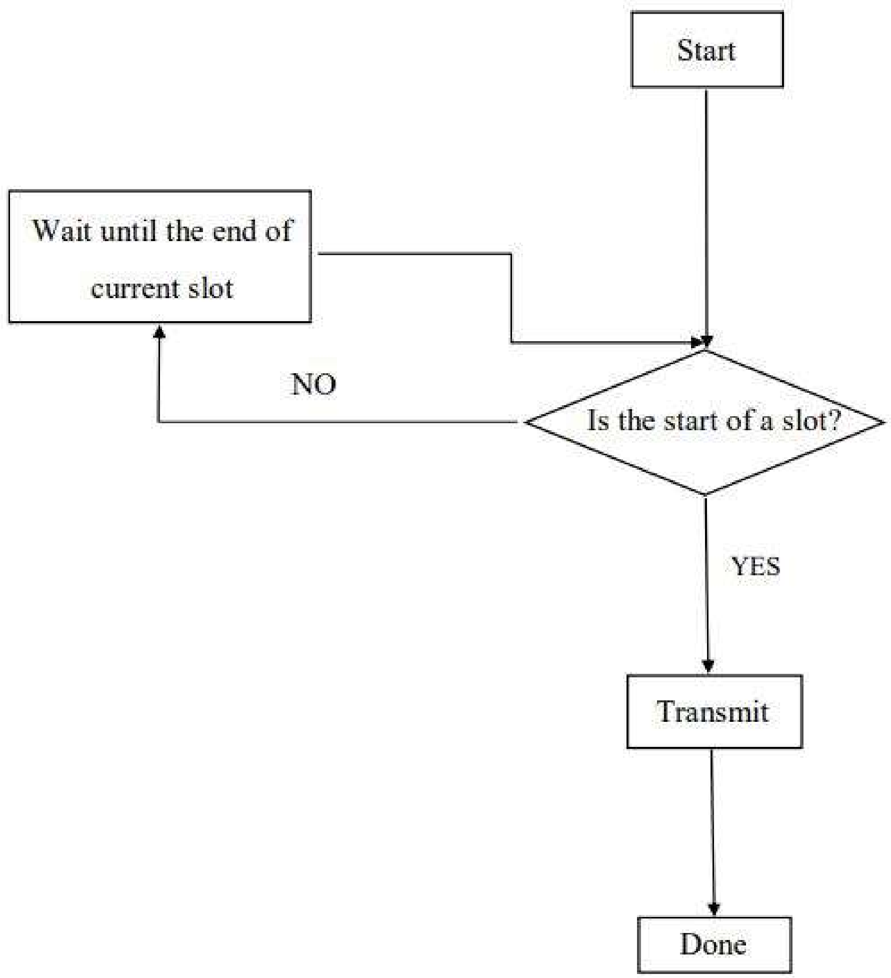
For reasonable throughput S should lie between 0 and 1.

FORMULA:

Attempts per packet time (G) can be calculated as follows;

$$G = \frac{\text{No. of packets transmitted x PT}}{\text{ST x 1000}}$$

FLOWCHART


Start
Wait until the end of current slot
NO
Is the start of a slot?
YES
Transmit
Done

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:

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

S → Throughput per packet time
PT → Packet time (in milliseconds)
PS → Packet size (in bytes)

Packet size (PS) =1472 (Data Size) + 28 (Overheads) = 1500 bytes

$$PT = \frac{packet\ size(bits)}{bandwidth(Mbps)}$$

Packet time = 1.8 millisec (Bandwidth=10Mbps)

PROCEDURE:

- For creating scenarios, we select a new file for slotted ALOHA using legacy network.
- The requires components for slotted ALOHA is available. Initially 2 nodes are dropped and application is created.
- Edit the wireless node properties for generating traffic.

TCP → Disable
Slot length → 1500
Data rate → 10Mbps

Edit the application icon properties as

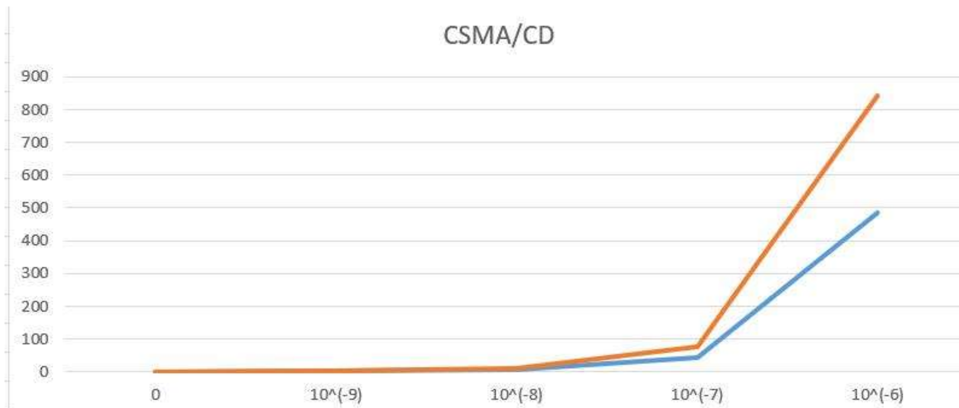
Application method	→	Unicast
Application type	→	Custom
Source ID	→	1
Destination ID	→	2
Packet size	→	Exponential 1472
Inter arrival time	→	Exponential 20000 µs

- Set the simulation time as 10s.
- Now repeat the process for different no. of nodes 3, 4, 6, 8 so on.

CSMA/CD:

BER	packets errored (one node)	packets errored (two node)	packets generated (one node)	packets generated (two node)
0	0	0	39999	79998
10^(-9)	2	2	39999	79998
10^(-8)	6	10	39999	79998
10^(-7)	45	75	39999	79998
10^(-6)	485	841	39999	79998

Transmitted packet time vs Throughput per packet time



- Note and tabulate the n values for various nodes.

INFERENCE:

From the graph of No. of packets, transmitted packet time vs throughput per packet time, we can infer that there if a steady increase in graph and later it decreases.

When average no. of packets per slot increases, the throughput per slot also increases. Conversely since there is a high probability of collision as the no. of nodes N increases, the throughput per slot decreases.

CSMA/CD:

AIM:

To understand the impact of bit error rate on packet error and investigate the impact of error on a simple hub based CSMA / CD network.

SOFTWARE REQUIRED:

NETSIM

THEORY:

Bit error rate (BER): The bit error rate or bit error ratio is the number of bit errors divided by the total number of transferred bits during a studied time interval i.e.

$$\text{BER} = \frac{Bit\ error}{Total\ no.of\ bits\ transmitted}$$

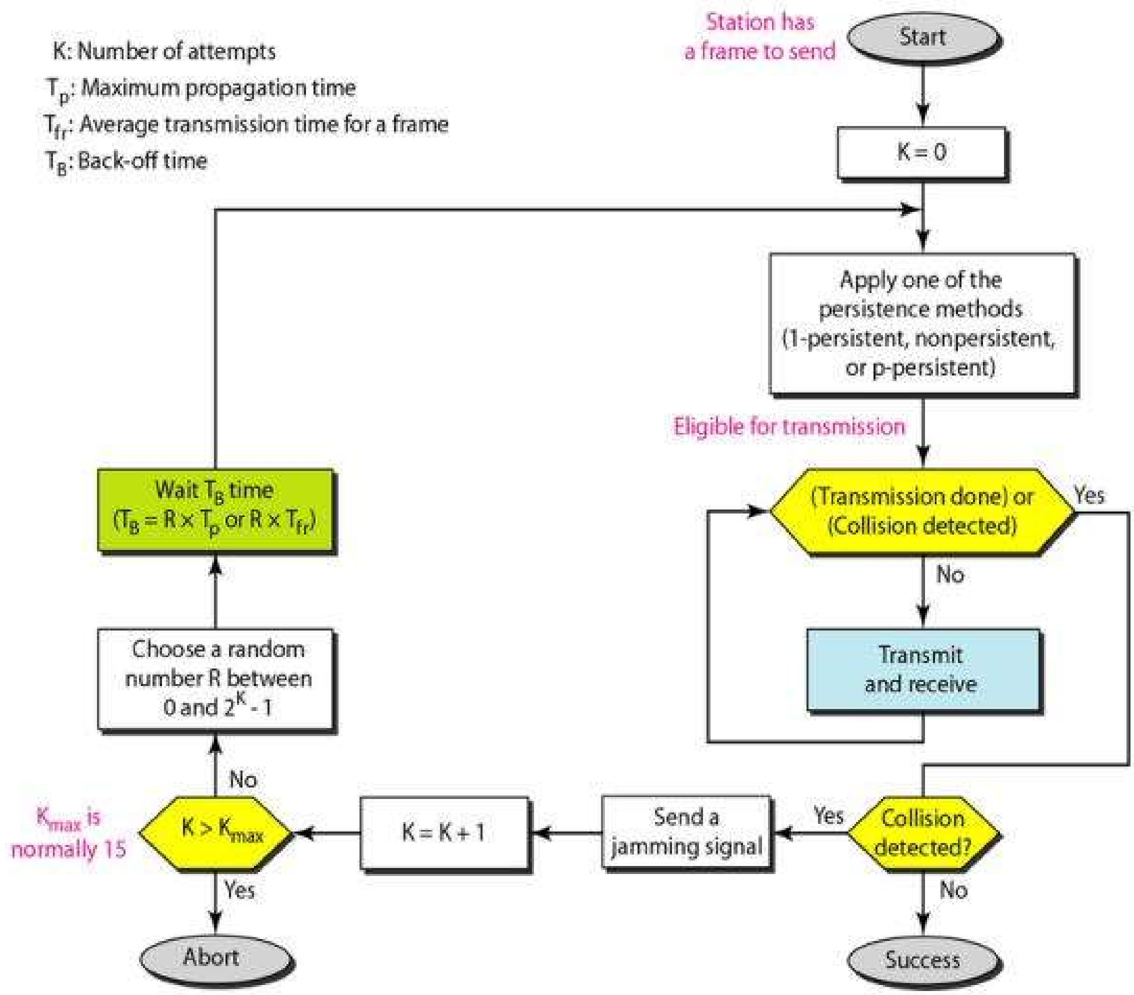
As BER coupler, the effect of all the components in the system given the actual performances of the system that has to be tested. Bit error probability is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time interval and a high number of bit errors.

A packet is incorrectly received even if one bit is errorless

$$P_p = 1 - [1 - P_e]^N$$

P_p → Packet error probability
P_e → Bit error probability
N → length of N bits in a packet.

FLOWCHART



K: Number of attempts
T_p: Maximum propagation time
T_{fr}: Average transmission time for a frame
T_B: Back-off time
Station has a frame to send
Start
K = 0
Apply one of the persistence methods (1-persistent, nonpersistent, or p-persistent)
Eligible for transmission
(Transmission done) or (Collision detected)
Yes
No
Transmit and receive
Collision detected?
Yes
No
Success
Send a jamming signal
K = K + 1
$K > K_{max}$
K_{max} is normally 15
No
Yes
Abort
Choose a random number R between 0 and 2^K - 1
Wait T_B time ($T_B = R \times T_p$ or $R \times T_{fr}$)

PROCEDURE:

- For creating a new scenario we select legacy networks and then CSMA/CD.
- From the available components in the network, drag and drop one hub and two nodes, Node 1 and 2.
- Connect them using wires. Their properties are:

Link properties	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Data rate(Mbps)	10	10	10	10	10
Bit error rate (BER)	No error	10^{-9}	10^{-8}	10^{-7}	10^{-6}

And set of application
Application method → Unicast
Application type → Custom
Source ID → 1
Destination ID → 2
Packet size → Constant 1472
Packet interval time → Constant 2500 μs

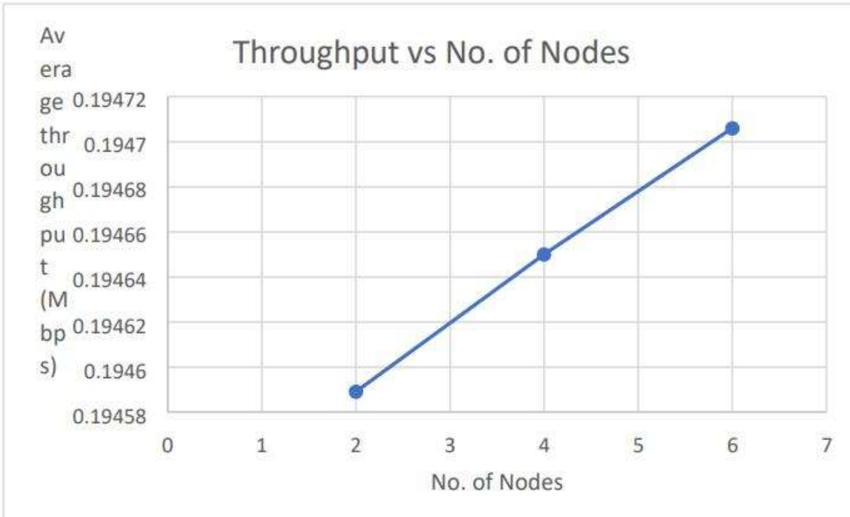
- Run the simulation and note down the values.
- For the next step, click and drop one bit with 4 nodes and connect them using wires.
- Set the same properties as above and note down the table for packet generated.
- Plot the graph for packets errored and bit error rate for both node transmission.

I NFERENCE:

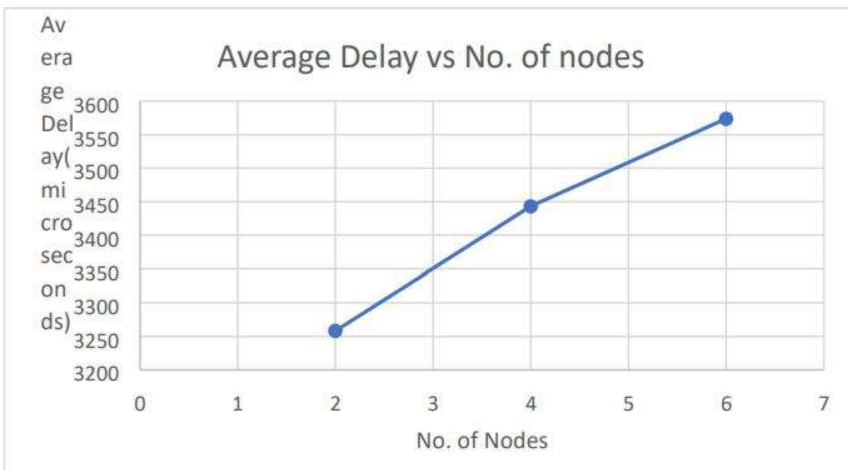
From the graph of CSMA/CD, we get that when BER increases, packets errored also increases. This is because when there is an error in the bits, chance of packets begin correctly decreases.

The performance of CSMA/CD network and minimum bit error rate that can be tolerated without causing excessive packet error is calculated using graph.

CSMA/CA:



Throughput vs No. of Nodes
Average throughput (Mbps)
0.19472
0.1947
0.19468
0.19466
0.19464
0.19462
0.1946
0.19458
0
1
2
3
4
5
6
7
No. of Nodes



Average Delay vs No. of nodes
Average Delay(microseconds)
3600
3550
3500
3450
3400
3350
3300
3250
3200
0
1
2
3
4
5
6
7
No. of Nodes

CSMA/CA:

AIM:

To analyse the performance of a MANET running CSMA/CA in MAC as the node density is increased and to plot

Throughput versus No. of nodes

Delay average versus No. of nodes

SOFTWARE REQUIRED:

NETSIM

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.

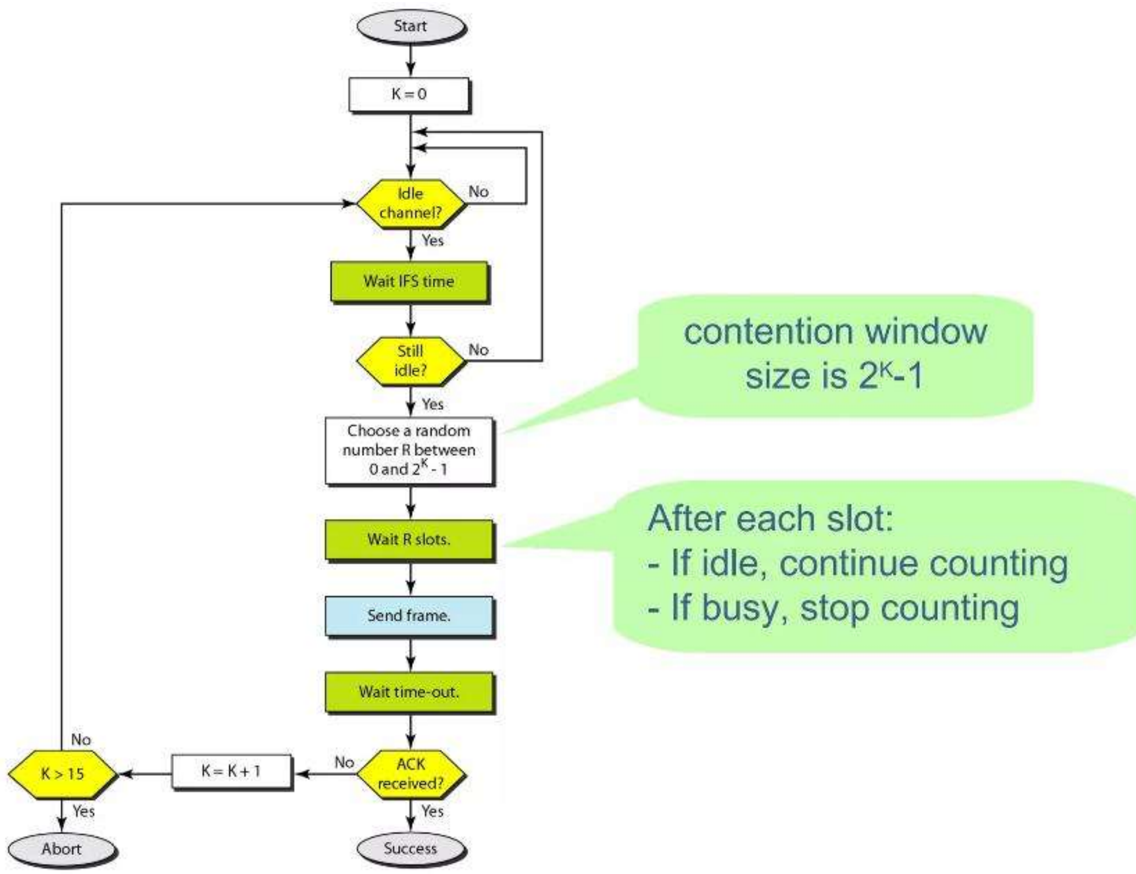
The nodes are free to move randomly. Thus the network's wireless topology may be unpredictable and may change rapidly.

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.

PROCEDURE:

- For creating new scenario, we select new legacy window network and then CSMA/CA.
- Then create the network using a wireless nodes. So from now, wireless nodes are increased.
- Correspondingly table below are 2 levels of simulation. Each level should be executed separately with the application properties mentioned.

FLOWCHART


Start
K = 0
Idle channel?
No
Yes
Wait IFS time
Still idle?
No
Yes
Choose a random number R between 0 and 2^K - 1
Wait R slots.
Send frame.
Wait time-out.
ACK received?
No
Yes
K = K + 1
K > 15
No
Yes
Abort
Success
contention window size is 2^K-1
After each slot:
- If idle, continue counting
- If busy, stop counting

Level	Wireless Node	X Ordinate	Y Ordinate
1	1 2	50 100	100 150
2	1 2 3 4	50 100 75 125	100 150 75 125
3	1 2 3 4 5 6	50 100 80 140 110 160	100 150 70 130 40 90

- Disable TCP in all wireless nodes.
- Right click on grid area to modify wireless node properties.

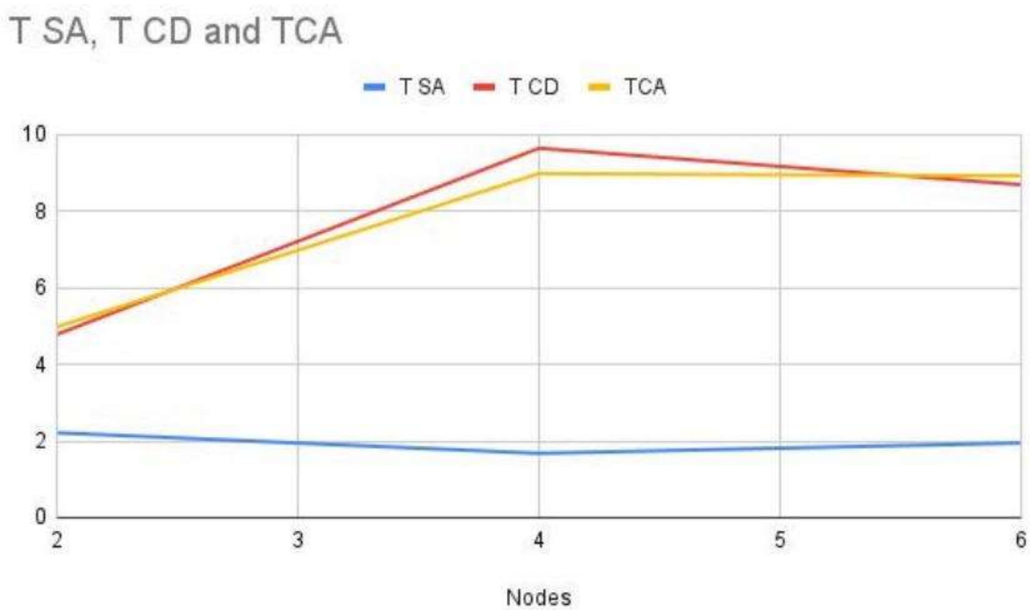
Path loss model → log distance
Path loss component → 2

- Then we have to model the traffic in network using application after selecting the applications dialog box. Set the below mentioned values:

Application type → Custom
Source ID → As per levels source ID is varied as per nodes
Destination ID → Same rule applies for destination ID
Packet size
Distribution →Constant
Value (bytes) →1472
Inter arrival time
Distribution →Constant
Value (µs) →60000

- Save the schematic and note down the values. Repeat the same steps for level 2 and level 3with increasing application.

COMPARISON GRAPH:



INFERENCE:

From the graph of average delay versus no. of nodes, when no. of nodes increases, average delay also increases. It takes longer for a packet to reach its destination.

From the graph of average throughput versus no. of nodes, the average throughput increases for well designed network.

RESULT:

MAC protocol namely slotted ALOHA, CSMA/CA, CSMA/CD are implemented and verified using NETSIM.