Report of The Mac Protocol

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1.Abstract

Implement simulation programs to evaluate MAC protocols including Aloha, Slotted Aloha, andCSMA 1-persistent. Get better understanding of the MAC protocols .
This project include 2 programs. In the first program, we will use Mersenne Twister algorithm to generate a random traffic file and seed to make sure weather the result is random or constant. In the second program, we will use 3 different MAC protocols:Aloha, slotted ALOHA, CSMA 1-persistent to calculate the throughput.
Lastly, drawing the graph of offered load and throughput, we should get a conclusion about the relation between offered load and throughput.
We will code this program by C++ language and run it at Linux OS.

2. Generating the traffic file

Using traffic generator to generate the traffic files. The traffic generator should execute with the following parameters

./traffic_generator num_node pkt_size offered_load num_pkts_per_node [seed]

num_node: the number of stations in the system that can send and receive packets. The value of this parameter is from 2 to 200.

pkt_size: the packet size in bits. The value of this parameter is from 100 to 2000.

offered_load: it value is from 0.01 to 10.

pkts_per_node: the number of packets sent from each station in the traffic file.

gap: after the station sent a packet, we should select a random time t form [0, 2*gap], then this station will send the next packet after time t.
pkt_size/(pkt_size+gap)=offered_load/num_node

seed: It is optional. This parameter that is for setting the seed for random number generator. If this parameter is not provided, the program should generate a different traffic with the same statistical characteristics each time it runs. If the same seed is provided, the program should generate exactly the same file every time.

Then using the Mersenne Twister algorithm to generate the synthetic random traffic and store the traffic in a file.

The first line of the traffic file contains a number telling the total number of packets in the file. After that, the traffic file contains lines of the formats :
pkt_id src_node dst_node pkt_size time
and are sorted based on the time. Each line represents a packet of size pkt_size in bits from src_node to dst_node that is ready to be sent at time time. The pkt_id must be unique for each packet in the file.

3. Using MAC protocols to calculate the throughout

3.1 ALOHA Protocol

Each station sends when data is available.

Each station can detect if the frame it sent collided with frames from other stations. If yes, this frame is failed to be sent.

***pseudocode*:**

Read a Packet
Send the packet
If channel is free, send the packet, the channel is busy. After sending the packet, the channel is free again.
else, there is a collision. All packets at the channel will be failed to be sent.
Read Next packet.

3.2 Slotted ALOHA Protocol

Time is divided into slots and each station sends at the beginning of time slots.

Each station can detect if the frame it sent collided with frames from other stations. If yes, this frame is failed to be sent.

In this program, we let the slot time equal to the time to transmit a packet.

***pseudocode*:**

Read a Packet
Send the packet at the begin of the next slot.
If channel is free, send the packet, the channel is busy. After sending the packet, the channel is free again.
else, there is a collision. All packets at the channel will be failed to be sent.
Read Next packet.

3.3 CSMA 1-persistent Protocol

Station listens to the channel, if busy, waits until idle and send immediately.

If collision, this frame is failed to be sent.

***pseudocode*:**
Read a Packet
Send the packet, and listen to the channel.
If channel is free, send the packet, the channel is busy. After sending the packet, the channel is free again.
else, wait the idle of the channel. When the channel is free, sending the packet immediately. If there if a collision, all packets have a collision will be failed to be sent.
Read Next packet.

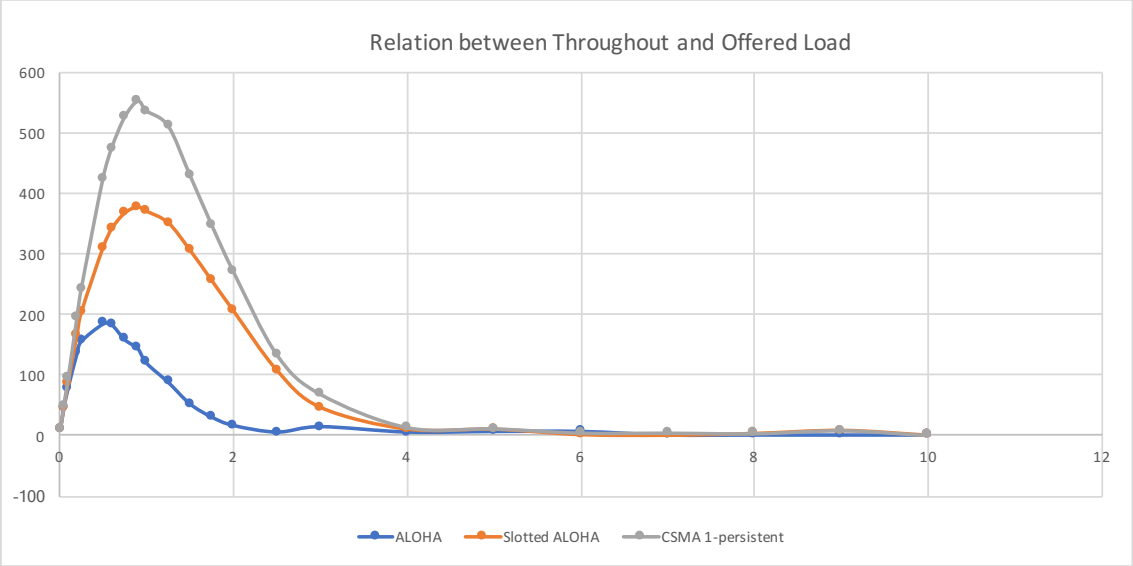
4. Result

In this program, we suppose that the wireless system operate at a speed of 1M bps.
The number of nodes is 10; the pkt_size is 100 bits; the num_pkts_per_node is 1000.

	ALOHA	Slotted ALOHA	CSMA 1-persistent
0.01	9	9	9
0.05	44	46	49
0.1	79	87	95
0.2	135	165	194
0.25	156	202	242
0.5	185	309	424
0.6	184	340	474
0.75	159	366	525
0.9	144	376	551
1	120	369	535
1.25	88	350	510
1.5	52	305	429
1.75	30	255	347
2	16	205	270
2.5	5	107	133
3	14	46	68
4	5	10	13
5	6	10	11
6	6	1	4
7	0	0	4

8	0	3	3
9	0	8	8
10	0	0	0

Then we can get the throughout by using different protocol at different offered load.



The figure at textbook.

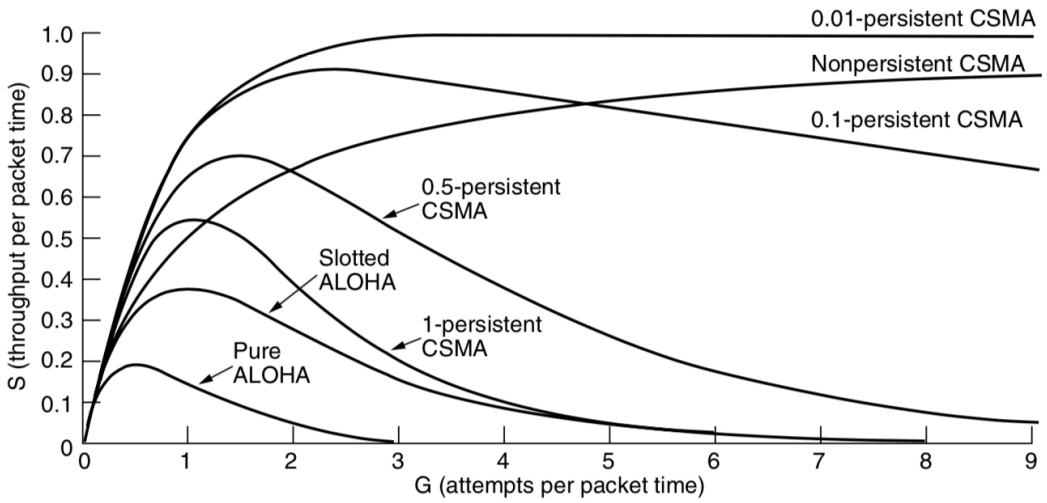


Figure 4-4. Comparison of the channel utilization versus load for various random access protocols.

These 2 pictures are really similar.

5.Conclusion

So we can get the relation between throughout and offered load as following:

With the increasing of offered load, the through will increase. The throughout will reach the peak around the offered load is 1.0. Then it will go down and finally reach 0 when the throughout close 10.