CS16B039
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ASSIGNMENT 2

ANALYSIS OF ALOHA PROTOCOL

The slotted ALOHA that we have implemented is a protocol that we know is bound by the theoretical limit of efficiency given by 1/e which roughly amounts to 36%. In the current implementation we try to introduce order to ,the otherwise random, transmissions from users in ALOHA by adding an element of backoff which serves like a penalty to the users that collided with other users recently. This penalty is enforced onto all the users that collide at a certain point in time, however the actual backoff is given by a number picked from the distribution : Uniform(0, W[i]-1) where W[i] is the penalty that we mentioned.

Adding this factor could either increase or decrease the overall efficiency. It is not intuitive or visible without mediation which direction this effect could be because there are two **anti-parallel factors** acting here :

1. Decrease in the entropy of collisions due to random back-off
2. The back-off time itself

Thus our implementation can be used as a means to measure this rise/fall in the efficiency of the new protocol. We also can observe the variation of this efficiency with the parameter packet_gen_rate which decides the probability that a user transmits when it's buffer is empty.

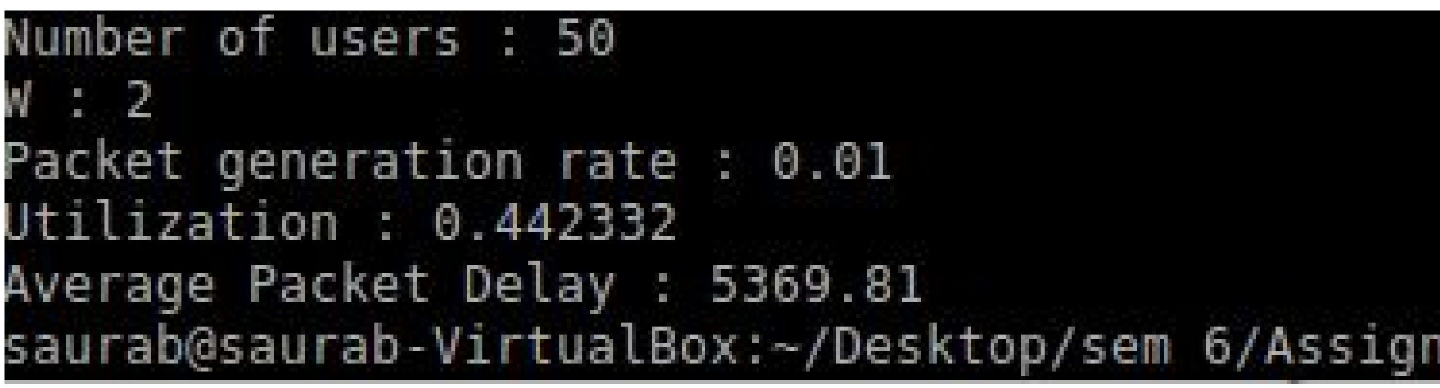
The following table shows the utilization over 5000 successful transmissions of 50 users for various packet_gen_rates and back-off maximum penalties : (in 1/1000 units)

	P = 0.01	P = 0.02	P = 0.03	P = 0.05	P = 0.1
W = 1	446	441	439	448	433
W = 2	442	439	451	438	440
W = 4	451	445	454	445	443

The observed trend can be **justified by considering the two extreme values** possible for **p** :

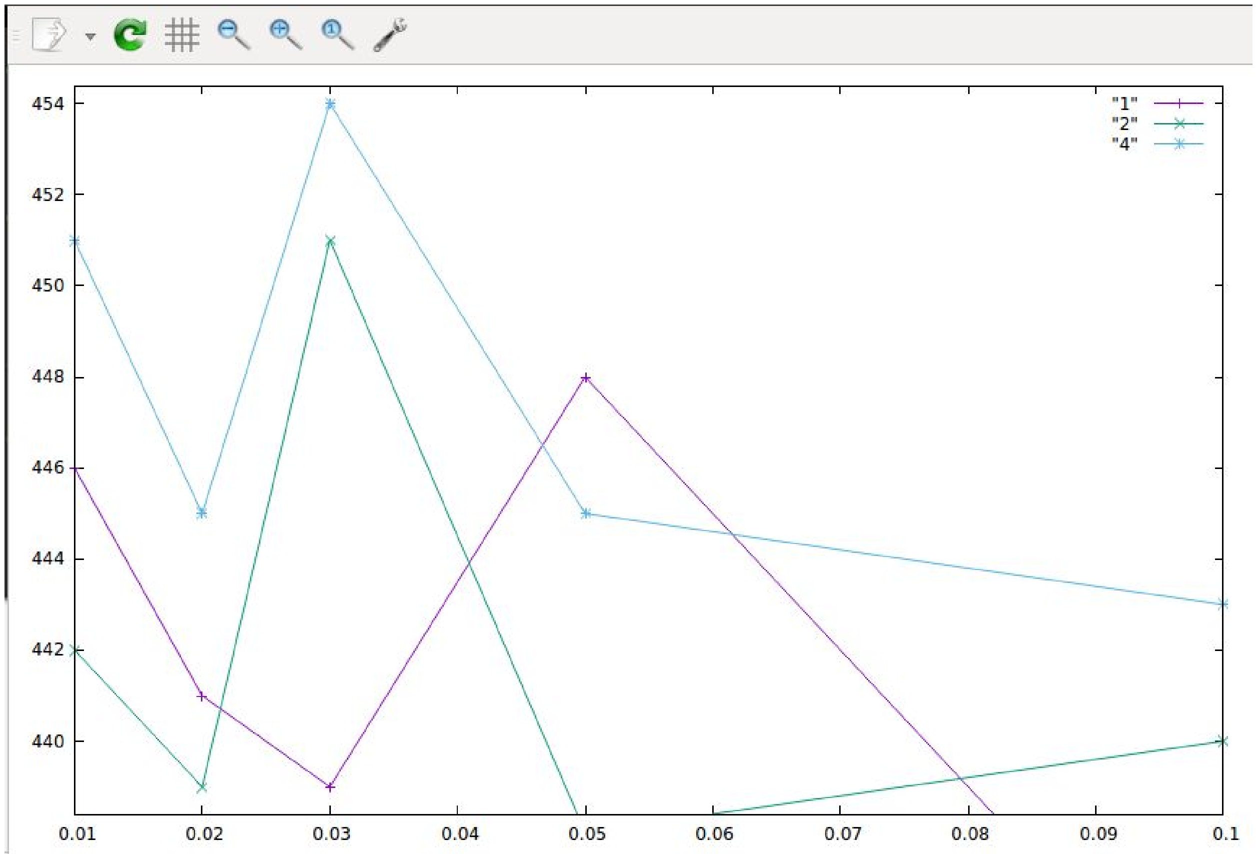
1. When p = 1, every time few users get non-backlogged, they will surely try to transmit and that would result in a fast explosion of w[i]'s reaching 256 units of time at the worst case.
2. When p = 0.000001, even if a user is non-backlogged, it will wait for a long time (E[t] = 1/p) before it's possibly empty buffer can refill.

Thus we can conclude that there exists a maximum for p between (0,1) not close to the ends of boundaries. In purely SLOTTED ALOHA we had p = 1/n which reminds us of such similar peak of efficiency. Here due to introduction of complex back-offs, we cannot get to a closed form formula for p to have maximum efficiency but we can make the plots as below.



```
Number of users : 50
W : 2
Packet generation rate : 0.01
Utilization : 0.442332
Average Packet Delay : 5369.81
saurab@saurab-VirtualBox:~/Desktop/sem 6/Assign
```

A sample execution of our new protocol



Note : the legend shows the colors of plots for various W's.

Justification of the graph :

1. The first dip in the graph at 0.02 for all curves is unexpected from the "idle-slot" concept. This is counter-intuitive but cannot be ruled out because there is still a possibility that on the rare occasions where users do transmit, the collisions are higher which results in a back-off period introduced and this effect dominates the idle-slots count.
2. The peaks go back w.r.t p as W increases this means that as penalty is increases, it is better to transmit less frequently than when penalties are low. This effect is similar to "negative marking scheme" where if the penalties are high, it is better to take only a few calculated guesses.
3. The above point is the justification for the movement of peak to left when W increases. We have already justified the presence of a peak earlier. As we have guessed the presence of a peak somewhere in

the middle of (0,1) interval we can now see that that peak lies within (0,0.1) and our previous justification is valid.