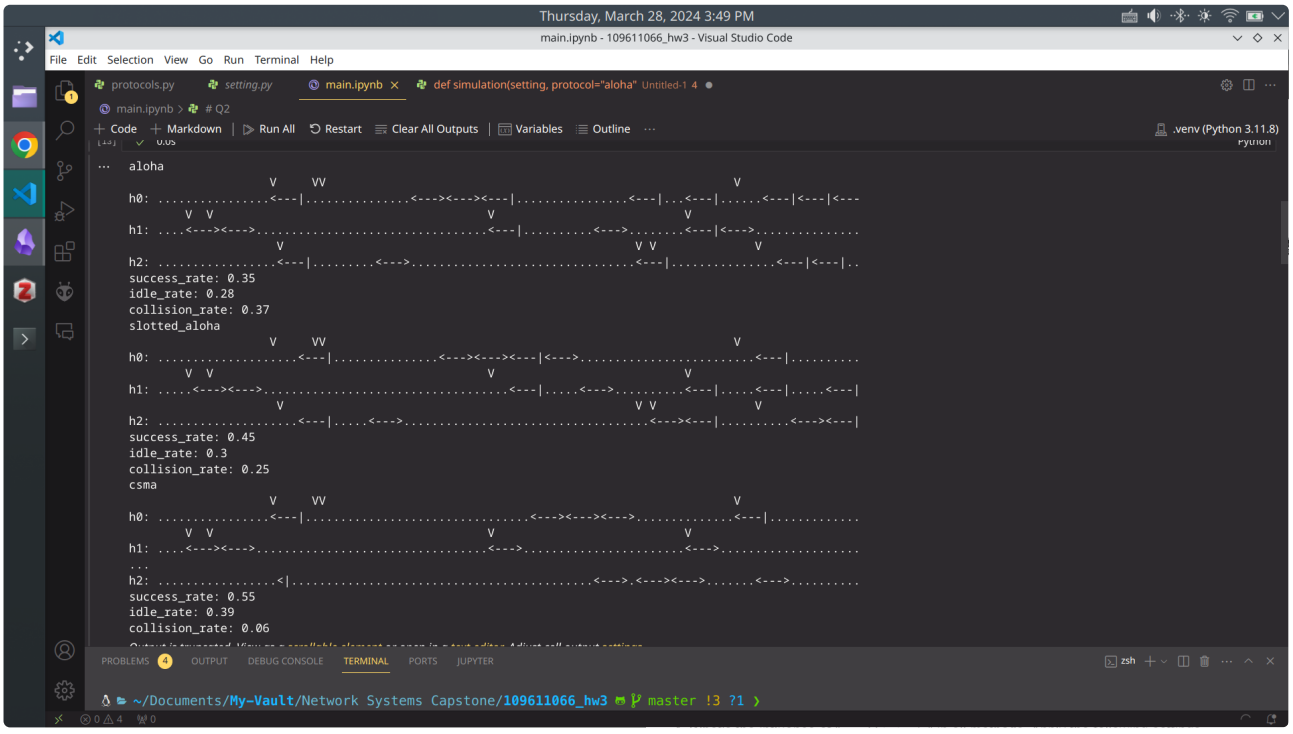
109611066_report

1. Code Section Screenshots



The text in the screenshot:

```
aloha
                    V     VV                                                  V
h0: ................<---|...............<--><---><---|................<---|...<---|......
<---|<---|<---
        V  V                                    V                          V
h1: ....<---><--->.................................<---|..........<--->........<---|<---
>...............
                     V                                                 V V             V
h2: .................<---|.........<--->.............................<---
|..............<---|<---|..
success_rate: 0.35
idle_rate: 0.28
collision_rate: 0.37
slotted_aloha
                    V     VV                                                  V
h0: ....................<---|...............<--><---><---|<--->.......................
<---|..........
        V  V                                    V                          V
h1: .....<---><--->.................................<---|.....<--->..........<---|.....
<---|.....<---|
                     V                                                 V V             V
h2: ...................<---|.....<--->.................................<---><---
|..........<---><---|
success_rate: 0.45
```

```
idle_rate: 0.3
collision_rate: 0.25
csma
                   V     VV                                                          V
h0: ................<---|.............................<--><--><-->.............<---
|.............
        V  V                                    V                          V
h1: ....<--><-->.............................<-->.....................<---
>.....................
                    V                                                 V V             V
h2: .................<---|.........<-->.............................................<--
-|......<--><
success_rate: 0.45
idle_rate: 0.42
collision_rate: 0.13
csma_cd
                   V     VV                                                          V
h0: ................<--|.........<--><--><---
>.................................................<-
        V  V                                    V                          V
h1: ....<--><-->.............................<-->.........................<---
>................
                    V                                                 V V             V
h2: .................<|.........................................<-->.<--><-->.......
<-->..........
success_rate: 0.55
idle_rate: 0.39
collision_rate: 0.06
```

2. Questions

2.1. Two Expressions

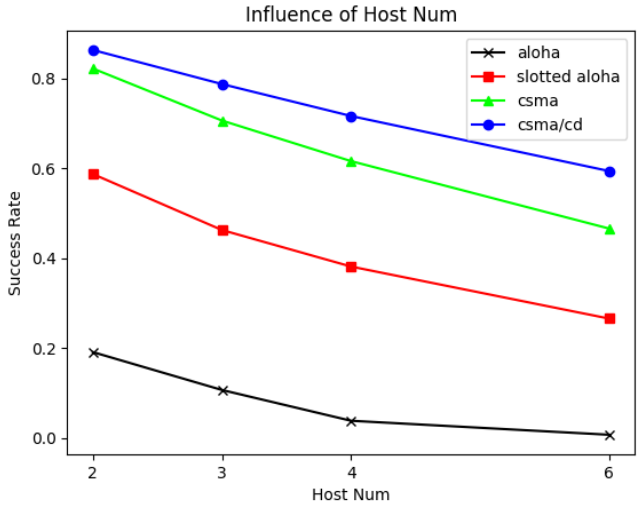
$$
\begin{aligned}
\text{max\_collision\_wait\_time} &= c \cdot \text{host\_num} \cdot \text{packet\_time} \\
\text{p\_resend} &= \frac{1}{c \cdot \text{host\_num}}
\end{aligned}
$$

For $\text{max\_collision\_wait\_time}$, if there are more hosts or longer packet time, we need to make it longer to avoid collision.

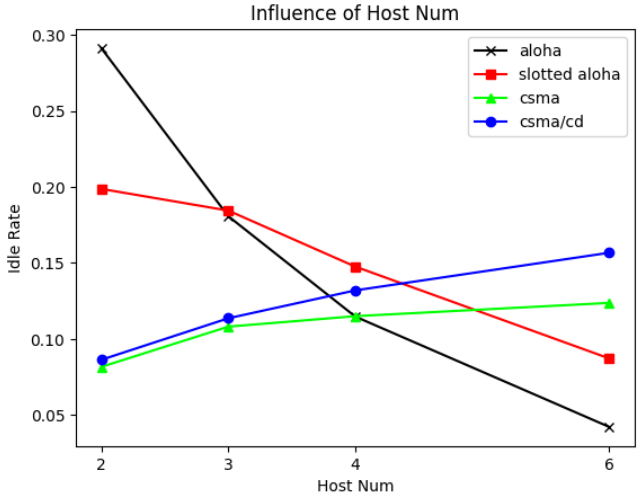
For p_resend, the number of hosts is an important factor. Although packet time is another important factor, it is not as important as the number of hosts.

2.2. Plot the results

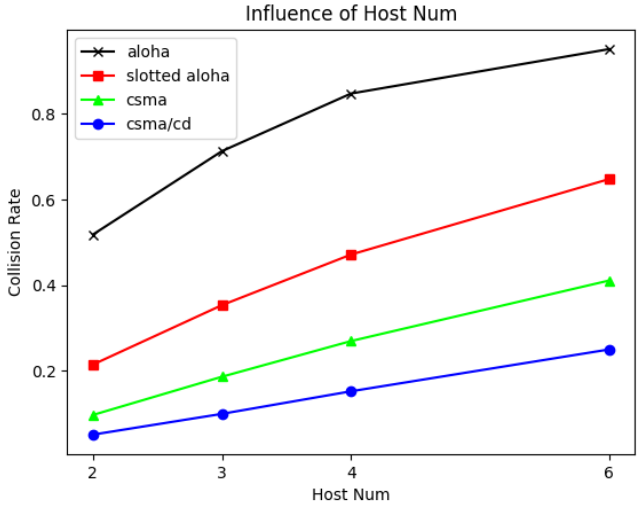
Success rate:



Idle rate:

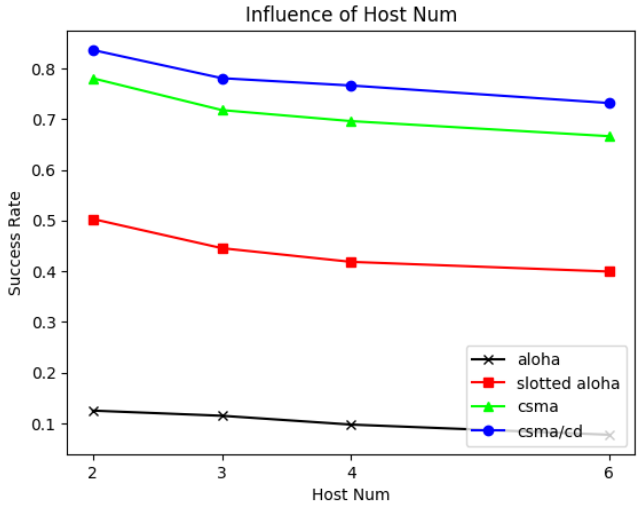


Collision rate:

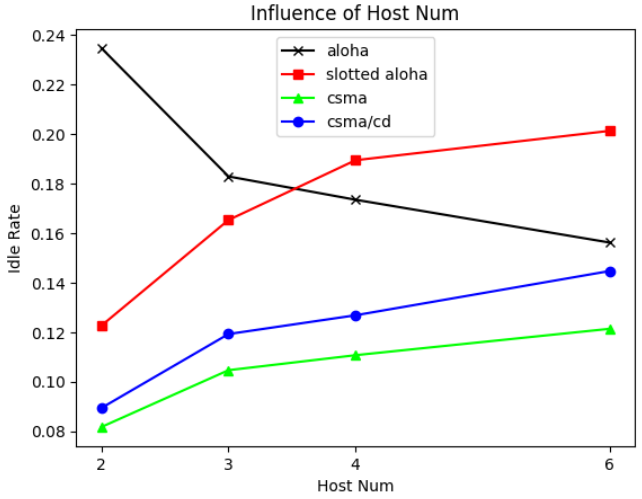


2.3. Plot of modified coefficient

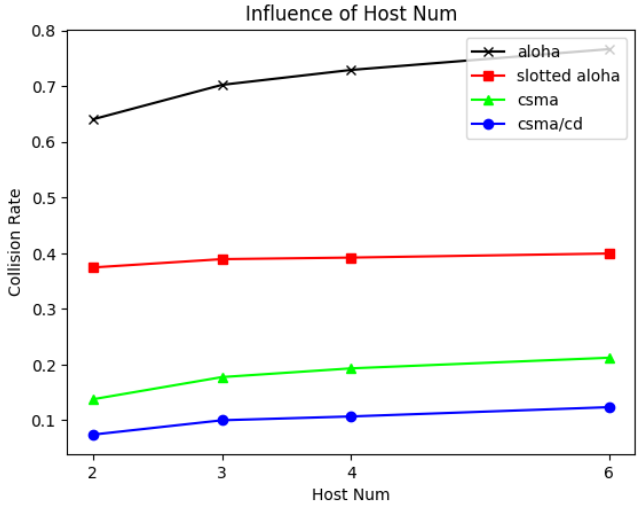
Success rate:



Idle rate:



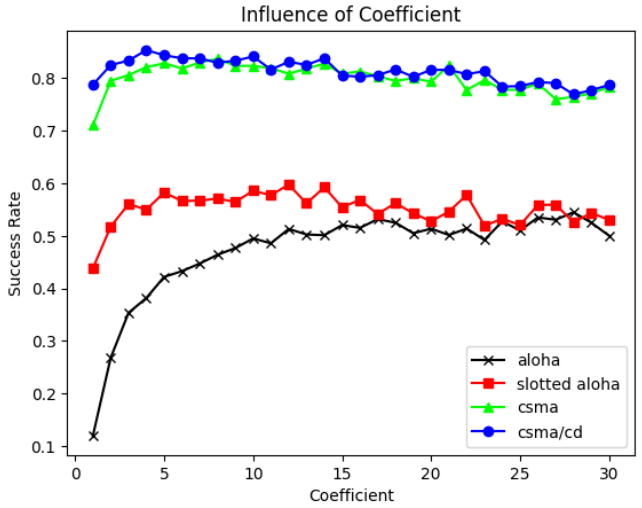
Collision rate:



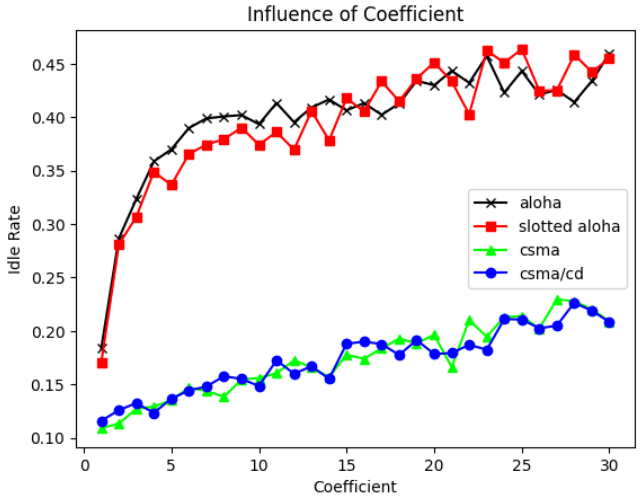
Compared to question 2, the `max_collision_wait_time` and `p_resend` are dynamically changed with the number of hosts. For success rate, idle rate, and collision rate, we can see that because we take the number of hosts into account, the influence of it is smaller.

2.4. Influence of coefficient

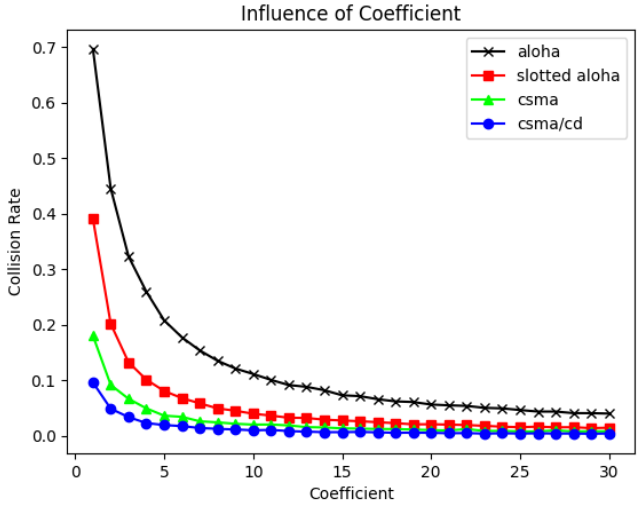
Success rate:



Idle rate:



Collision rate:

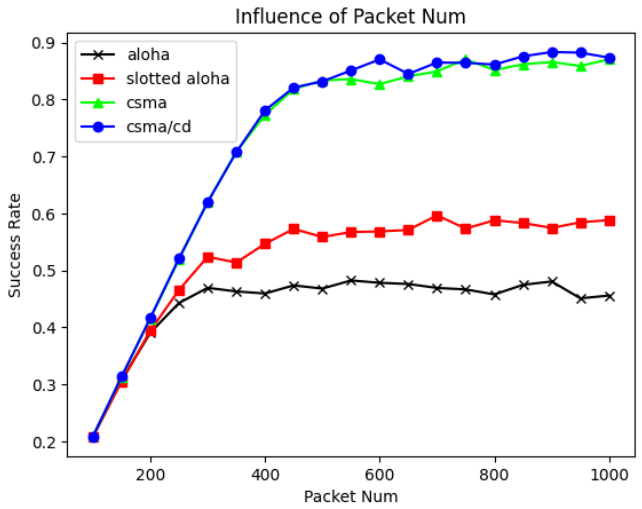


With higher coefficient, the hosts will wait longer if a collision happens. From the figures above, we can see that the collision rate generally becomes lower. For success rate, it increases at the beginning and fluctuates after `coefficient=4`. For idle rate, it increases with the coefficient.

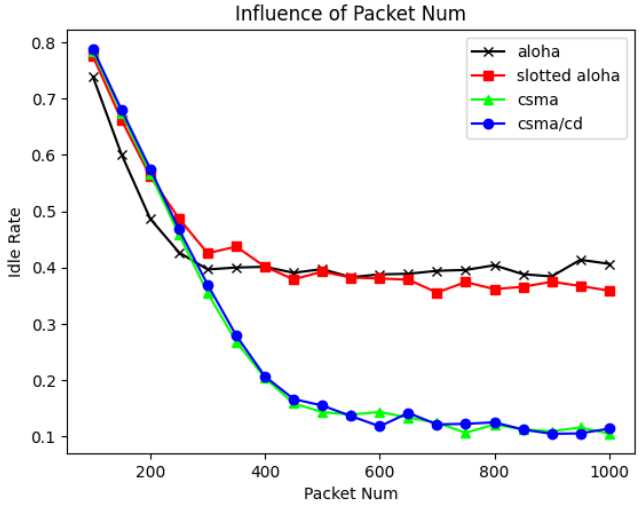
We can conclude from the results that larger coefficient will reduce the collision rate, but larger coefficient also means that the idle rate is larger. From the figures above, it seems that `coefficient=4` is the best choice, since the success rate fluctuates after this value.

2.5. Influence of packet_num

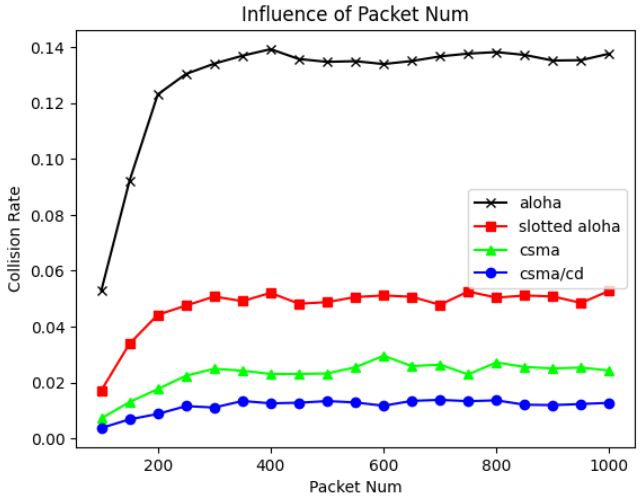
Success rate:



Idle rate:



Collision rate:



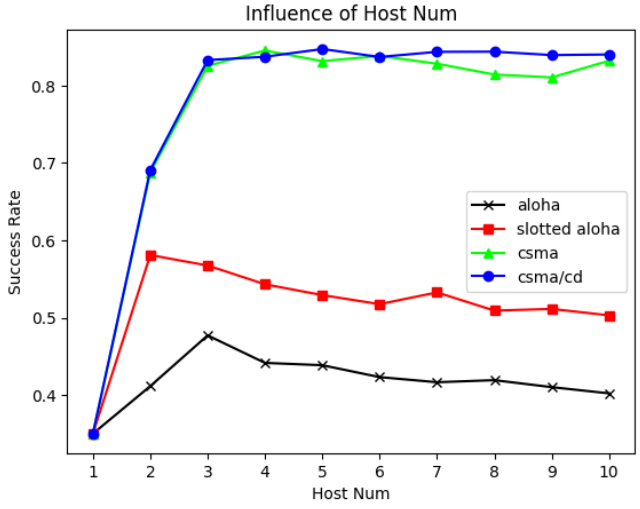
Because of the increasing traffic, the idle rate must decrease and the collision rate must increase. At a very low traffic, the collision rate is low due to the low traffic. At a certain higher packet number, the collision rate converge to a value that is close to always busy.

In the figure of success rate, we can see that the method with more sophisticated methods like CSMA/CD achieve higher success rates. For ALOHA, it does not have mechanisms to effectively handle collisions, so it performs the worst. For Slotted ALOHA, it uses time slots to reduce collisions and therefore performs better than ALOHA.

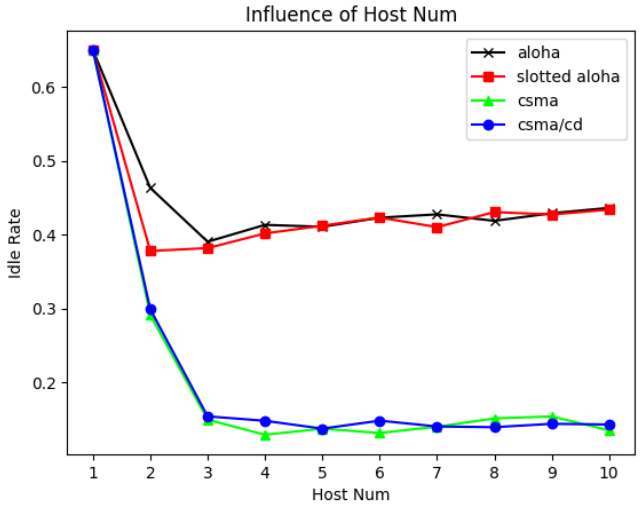
The initial lower success rate at low traffic is because the high idle rate, causing the success rate (efficiency) in the experiment seems lower.

2.6. Influence of host_num

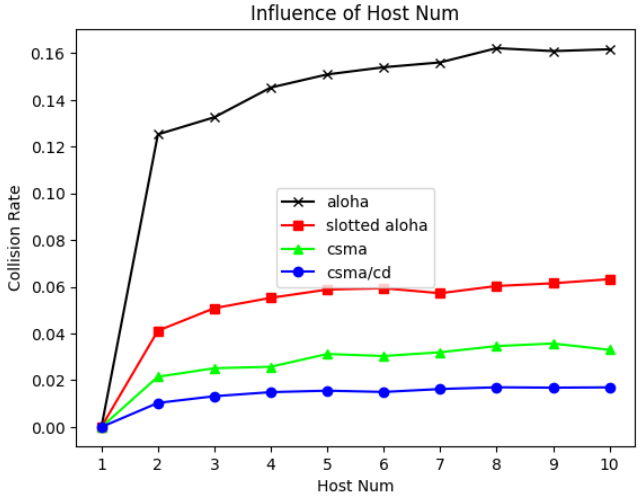
Success rate:



Idle rate:



Collision rate:



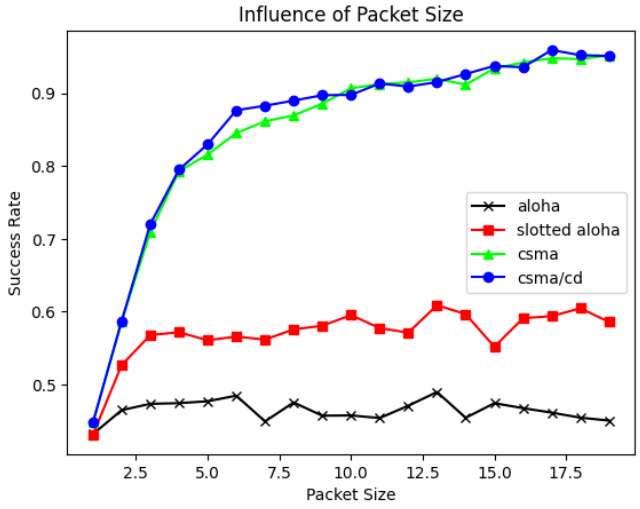
For only 1 host, there is only success and idle because there is no possibility for collision with another host.

With 2 or more hosts, the scenario starts to become realistic:

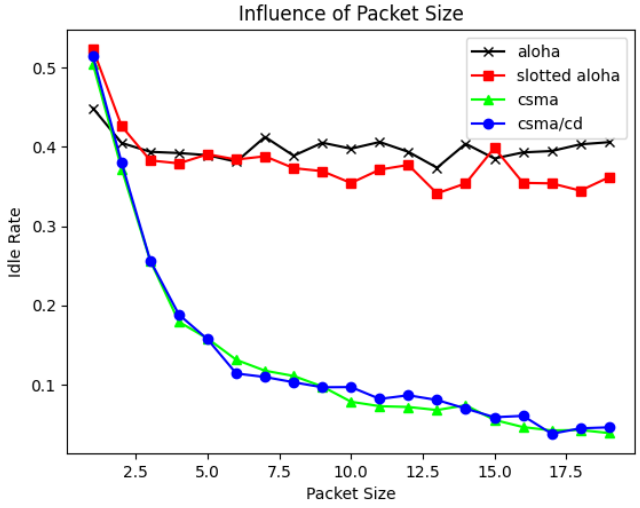
- The success rate decreases with higher host number.
- The idle rate increases due to the higher waiting time (for ALOHA, CSMA and CSMA/CD) or lower probability of re-transmission (for slotted ALOHA).
- The collision rate slightly increases because of the increasing host number. Because we included the host number in the waiting time and the re-transmission rate, the collision rate only increases slightly.

2.7 The influence of packet_size

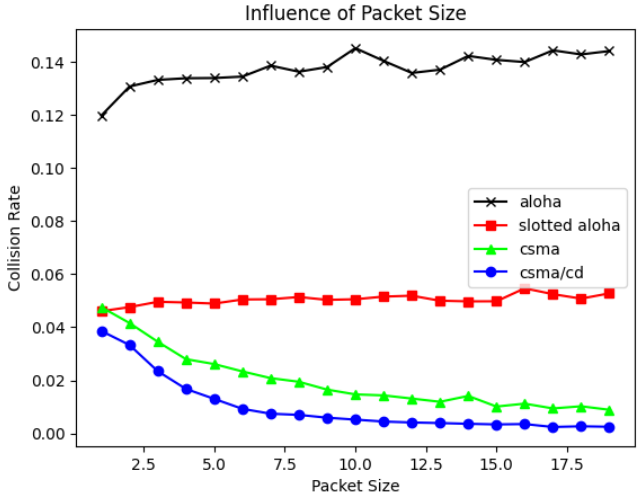
Success rate:



Idle rate:



Collision rate:

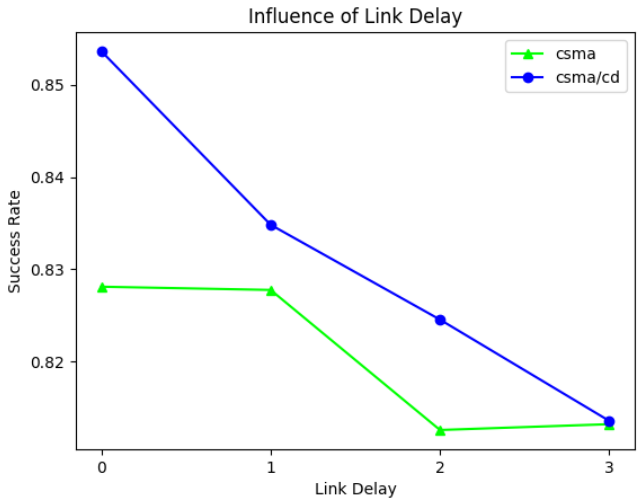


For CSMA and CSMA/CD, the results are better with higher packet sizes. This is because the wait time includes the factor of packet size.

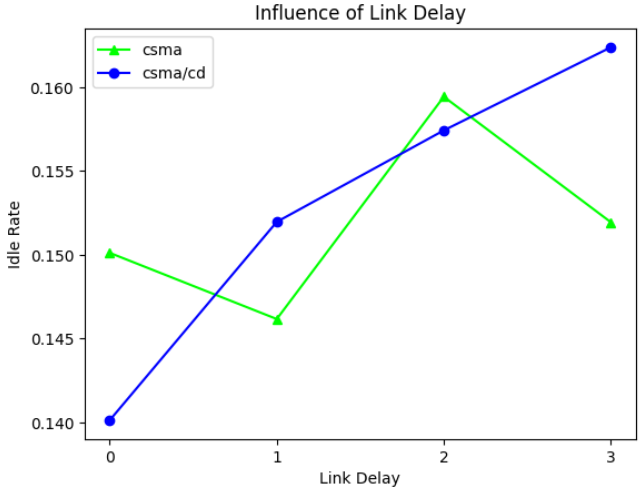
For ALOHA and slotted ALOHA, they perform worse than other protocols. For higher packet sizes, CSMA and CSMA/CD can out perform ALOHA greatly.

2.8 Influence of link_delay

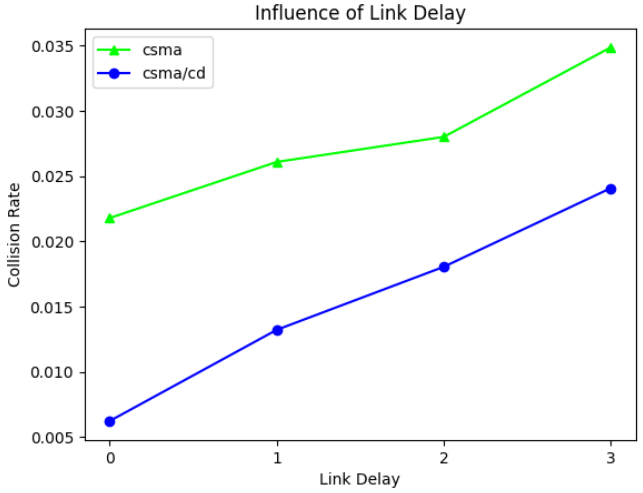
Success rate:



Idle rate:



Collision rate:



When the link delay increases and the packet time remains constant, there is a larger delay for any hosts to detect that another host is transmitting. Therefore, the success rate decreases and the collision rate increases. Since more collisions happen, the hosts spend more time on waiting, therefore the idle time increases too.