CS765 Assignment 2 : Report

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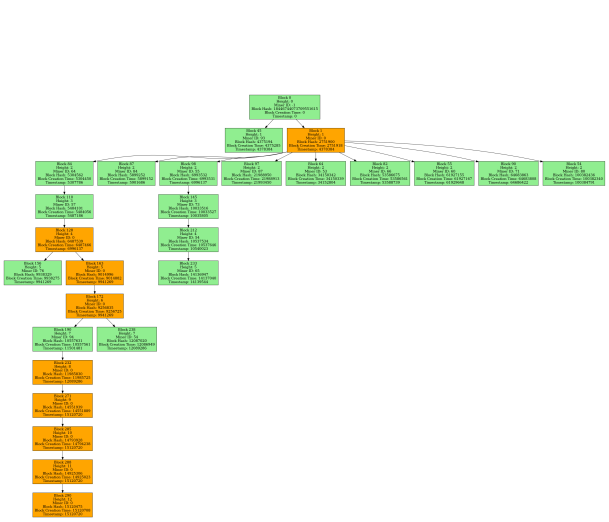
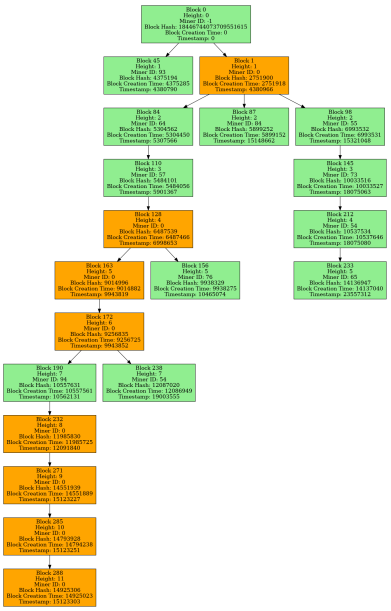
Analysis

Effect of Eclipse Attack

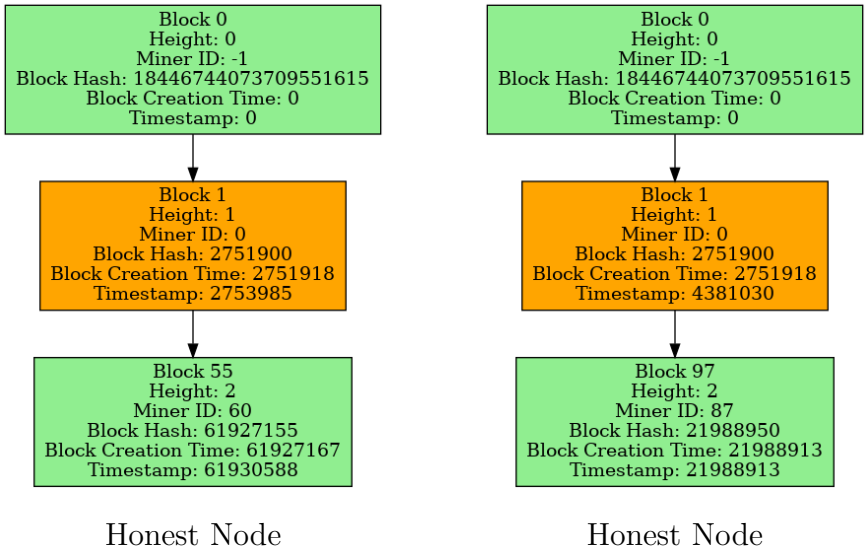
We know that when an eclipse attack is enabled, many isolated clusters (completely surrounded by malicious nodes) of honest nodes may not have complete access to blocks generated by other honest nodes. This leads to multiple such clusters mining on their own latest block, resulting in more forks, which ultimately benefits malicious nodes. Below is the blockchain view of malicious nodes as well as some honest nodes. We can clearly observe the inconsistency among the blockchains of honest nodes due to the eclipse attack.



Malicious Node



Honest Node

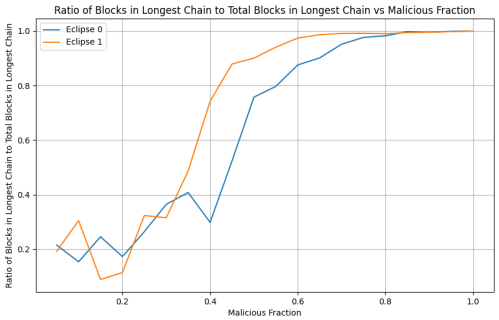


Honest Node Honest Node

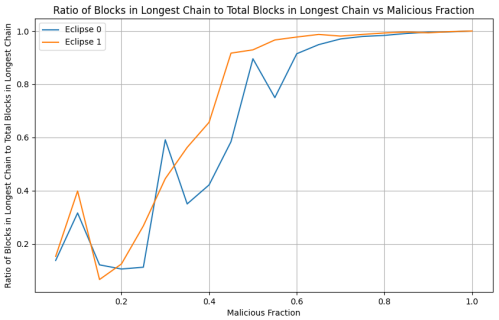
Figure 1: Orange blocks are of malicious miners, and green blocks are of honest miners

In case of no eclipse attack all the blockchain views of all hoenst nodes are the same. However, selfish mining will still continue, leading to the orphaning of many honest blocks.

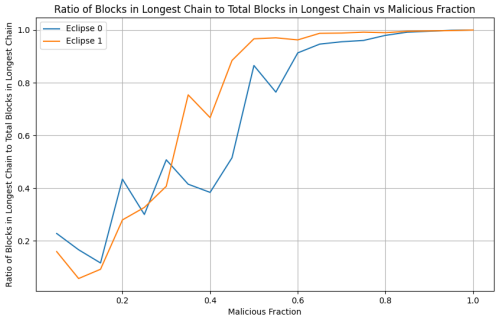
Ratio of the number of blocks generated by Ringmaster in the longest chain to total blocks in the longest chain



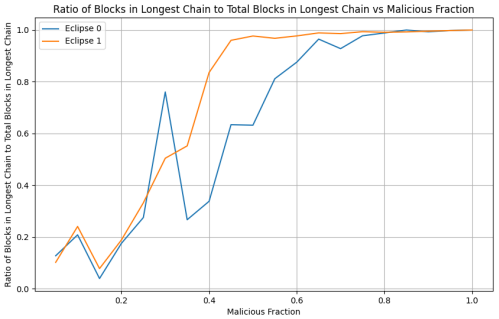
Tt = 50 sec



Tt = 100 sec

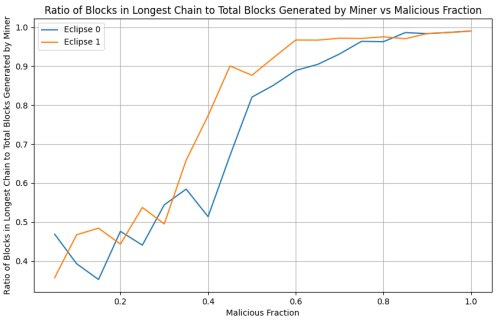


Tt = 200 sec

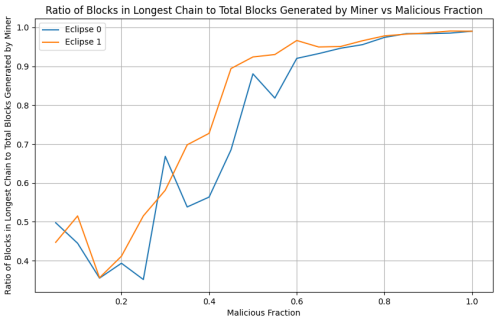


Tt = 500 sec

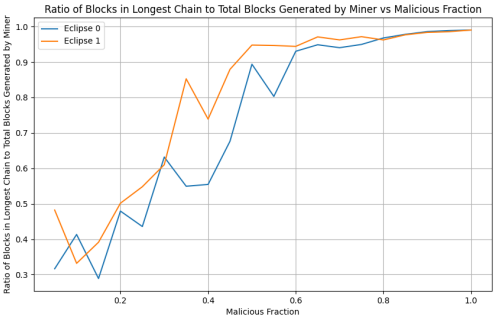
Ratio of the number of blocks generated by Ringmaster in the longest chain to total blocks generated by Ringmaster



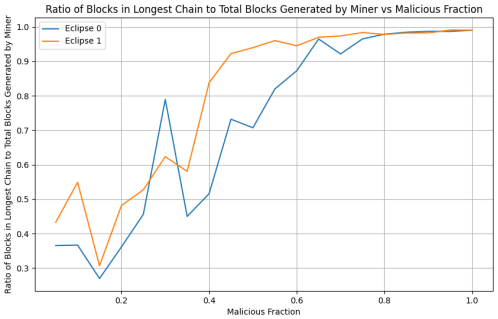
Tt = 50 sec



Tt = 100 sec



Tt = 200 sec



Tt = 500 sec

Questions

Discuss the observed differences and explain how removing the Eclipse Attack impacts the above ratios

Below are the observations regarding the differences caused due to eclipse attack:

- When the fraction of malicious miners is less (< 0.3), we notice that there is no difference in the performance of selfish mining with or without eclipse attack, this is expected because in case of less malicious miners in the network it is less likely that clusters of honest nodes are isolated from each others, and as there are rarely isolated clusters, the attack does not serve its purpose and is therefore is not useful.
- When the fraction of malicious miners is between 0.3 & 0.5, we clearly notice an improvement in selfish mining attack with eclipse attack; this suggests that the number of malicious miners are now enough to isolate clusters of honest miners, and therefore eclipse attack is most effective in this area.
- When the fraction of malicious miners is more than 0.5, the selfish mining instance is transformed to a 51% attack, for which we know that malicious miners always wins, and therefore eclipse attack does not play a much important role here.

How does increasing the timeout time (Tt) affect block propagation in the presence of an eclipse attack?

Increasing the timeout (Tt) results in longer wait times, causing honest nodes to waste time waiting for a block if they send a request to a malicious neighbor. This, in turn, delays block propagation in the network and leads to honest miners working on different blocks for an extended period. From the graphs, we observe that when the malicious fraction is between 0.4 and 0.5 (this is the interval where eclipse attack is most relevant), increasing the timeout results in a higher number of malicious nodes in the main chain.

Suggest countermeasures to mitigate or weaken the above-described attack

We can mitigate this attack by modifying the protocol used to send GET requests. During its lifetime, an honest node can identify malicious neighbors by analyzing the fraction of times a particular neighbor responds with a block to a GET request. This allows the node to select the least likely malicious neighbor and send the GET request to that neighbor.

This method was effective in weakening the attack. The following are the results obtained from the implementation of this countermeasure:

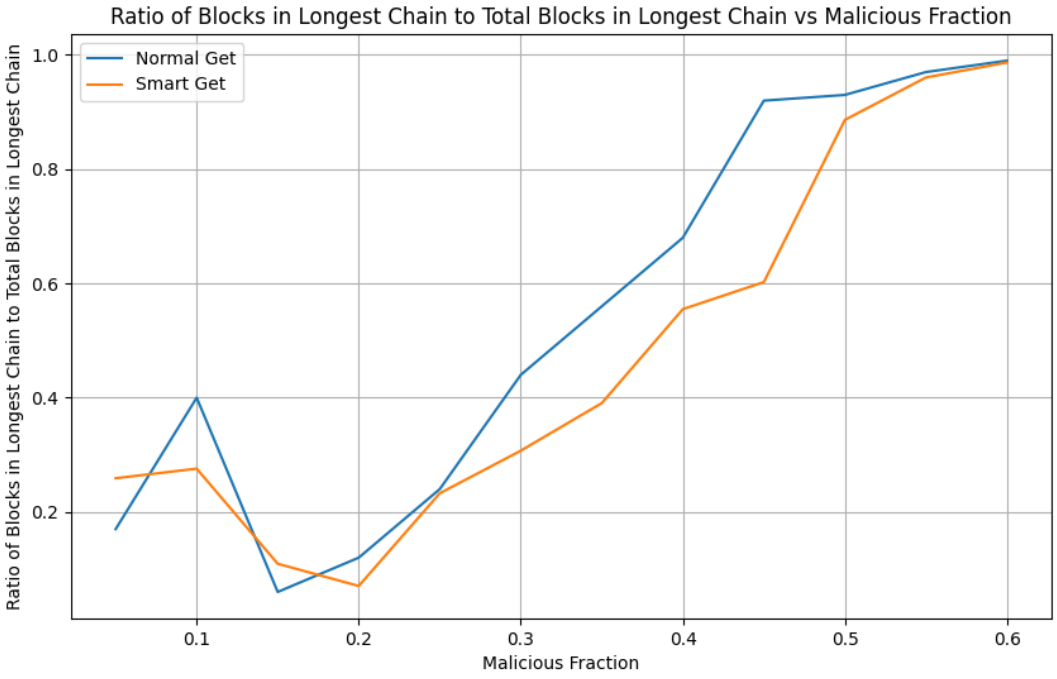


Figure 2: Decreased effectiveness of selfish mining attack