CS765 Spring 2025 Semester

Project Part-1

Simulation of a P2P Cryptocurrency Network

Indian Institute of Technology Bombay



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1. Introduction

We have implemented a discrete-event simulator for a peer-to-peer cryptocurrency network. A discrete-event simulator maintains an event queue and a global clock. From this queue, it executes the earliest event and also pushes some new events which were generated as a result of the execution of this event (if any). In this report, we describe some design choices, and we analyse different simulations based on different system parameters specified in the configuration file.

1. What are the theoretical reasons of choosing the exponential distribution for interarrival time sampling?

The exponential distribution is ideal for modeling transaction interarrival times because it accurately represents random, independent events occurring in a Poisson process, consistent with real world behaviour, has the memoryless property, and is computationally efficient.

The exponential distribution is memoryless, meaning the probability of a new transaction occurring does not depend on past transactions. This property makes it a good fit for modeling random independent events like transaction arrivals.

In real-world financial networks, transactions do not arrive at fixed intervals. Instead, they occur sporadically over time. Exponential interarrival times capture this randomness better than a fixed or uniform distribution.

1. Why is the mean of (queuing delay) inversely related to (link speed)? Give justification for this choice.

The mean queuing delay is inversely proportional to the link speed ​ because a higher link speed allows a node to process and transmit messages faster, reducing the time spent in the queue.

We have the Queuing Delay Formula as:  
The queuing delay is modeled as an exponential random variable with a mean:

where is the link speed in bits per second.

Intuition:

* + If increases, the node can transmit more bits per second, clearing the queue faster, thus reducing ​.
  + If ​ decreases, the node takes longer to send data, leading to higher queue build-up and increased queuing delay.

1. Reason for the choice of a particular mean for block inter-arrival time in PoW simulation.
2. Experiments

We performed simulations with different values for the following system parameters:

* 1. Total number of nodes (n) = 10, all the nodes are slow
  2. Total number of nodes (n) = 10, all the nodes are fast
  3. Total number of nodes (n) = 30, 50% of the nodes are slow (z), transaction inter arrival mean (Ttx) = 5s, block average mining time (Tk) = 600s
  4. Total number of nodes (n) = 30, 80% of the nodes are slow (z), transaction inter arrival mean (Ttx) = 10s, block average mining time (Tk) = 60s