**Discrete Event Simulation of**

**M/M/1 Single Server**

**&**

**802.11 CSMA/CA**

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I. Discrete Event Simulation

The use of discrete event simulation is one analytical tool that can be used to observe the properties of a system under some operation. The process notes particular changes in the state of the system and treats them as events which can be simulated. One may also observe the state and record any observations on it.

In this project, we are particularly interested in using discrete event simulation to observe the behavior of two processes, the M/M/1 queue and CSMA/CA protocol of IEEE 802.11.

For many applications, discrete event simulation is a straightforward way to determine the results of a complex operation for some systems that may not be easily made with statistical analysis.

Designing programs to model processes with discrete event simulation also provides greater insight into the mechanisms behind the systems being simulated. There is a whole other reward for just building the simulation implementation!

II. Phase I Discussion

In Phase I we aim to simulate a typical M/M/1 queue, modeled by an arrival rate parameter and a processing rate parameter. This reduction is used to show how the typical link processor behaves with a queue of packets to process.

Two important points of observation are the mean queue length and utilization rate of the server. By varying the rate at which packets arrive at the queue and the rate at which packets take time to be processed in the server, these two properties change.

Another property not easily calculated is the number of packets dropped in a finite queue, which can be easily recorded and shown in a simulation.

Along with simulations and modeling, we can also apply statistical methods to analyze the behaviors of the queue.

We conclude that mean queue length grows exponentially and utilization grows linearly with increasing arrival rates given a constant service rate.

III. Phase I Logic

To simulate the M/M/1 queue with discrete event simulation, we simply implement a list of time-based events to process and a queue of packets to process.

We generate events to represent two actions; the arrival of a packet to the system and the departure of a packet from the system. The timing of these events are determined by statistical distributions.

Events are stored in a global event list, implemented as a linked list in the simulation code. As we process events by running the simulation, we note the “current” time and perform the necessary actions to modify that state of the simulation. We also record statistics for later analysis.

IV. Phase II Description

Phase II is concerned with the behavior of a CSMA/CA-like protocol operating over a wireless ad-hoc network. In order to better understand the behavior of such a system, which may be difficult to model mathematically, we simulate such a network’s behavior with N host all within range of one another (no hidden terminals).V. Phase II Implementation

VI. Phase II Code

VII. Phase II Results

XII. Phase II Results Analysis