SPTF SCHEDULING

Course of traffic theory 2023/2024

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The aim of the project is to implement an M/G/1 system with a Shortest Processing Time first scheduling policy. For the simulation has been used OMnet ++.

The system (Figure 1) is composed by:

- A source that generates packets according to a Poisson process
- MG1 which is a queue that works using the SPTF scheduling policy
- A sink that represents the final destination of the packets.

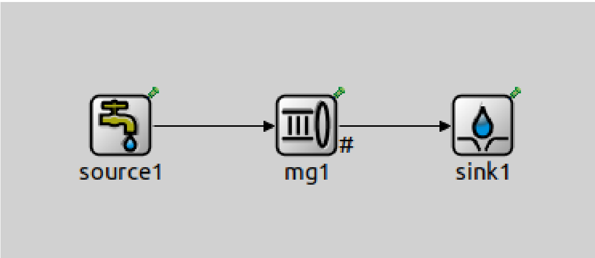

Figure 1

For what regards the implementation, first of all has been modified the *omnet.ini* in order to insert all the parameters as NED parameters and has been created a new class of messages *ModifiedMessage* in which is specified the service time of the messages, generated by a uniform random generator in (0,2).

Subsequently has been created the source that generates messages according to a Poisson process having an intensity of 0.75 users/s; then has been implemented the queue that when receives a message from the source works in the following way:

- If the server is free, the packet immediately starts its service;
- If the server is busy, the packet is put inside the queue in a specific order such that the packet on top of the queue is the one with the lowest service time;
- When the server becomes free, the packet on top of the queue starts its service

Finally, has been implemented the Sink that simply receives packets that have been served.

The results obtained from the simulation, considering an inter arrival rate λ = 0.75 users/s, a service time uniformly distributed in the in the interval (0,2s) and a simulation time of 100h are the following:

1. ***Average queueing time***: 1.388 s
2. ***Conditional queueing time***: it represents the queueing time as a function of the workload (Figure 2)
3. ***Average response time***: 2.38 s
4. ***Utilization factor of the server***: 0.752
5. ***Queue length over time***: it represents the length of the queue over time (Figure 3)

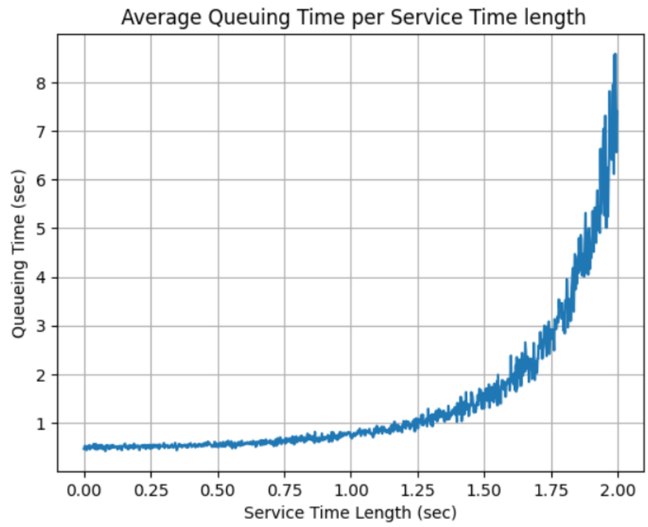

Figure 2

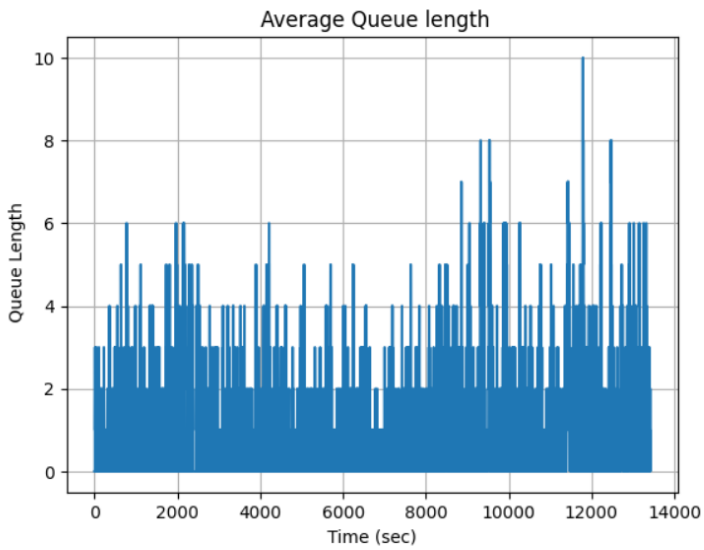

Figure 3

The results obtained from the simulation have been compared to the theoretical results that have been calculated using a python script. The formulas that have been used are:

1. Average queueing time:

$$W^q = \frac{\lambda \mathrm{E}[S^2]}{2} \int_0^\infty \frac{b_s(x)}{\left(1 - \lambda \int_0^x t b_s(t) dt\right)^2} dx$$

2. Average conditional queueing time:

$$W_x^q = \frac{\lambda \mathrm{E}[S^2]}{2\left(1 - \lambda \int_0^x t b_s(t) dt\right)^2}$$

3. Average response time:

$$W = W^q + E[S]$$

4. Utilization factor of the server:

$$\rho = \lambda E[S]$$

Given:

- λ = 0.75 users/s
- S: service time distribution; where S: U(0,2)
- $b_s(x)$: probability density function of S

Figure 4 shows the difference between the theoretical conditional queueing time and the one obtained from the simulation. For what regards the other performance values, they are compared in table 1 and as can be seen the theoretical values and the ones obtained from the simulation are really similar.

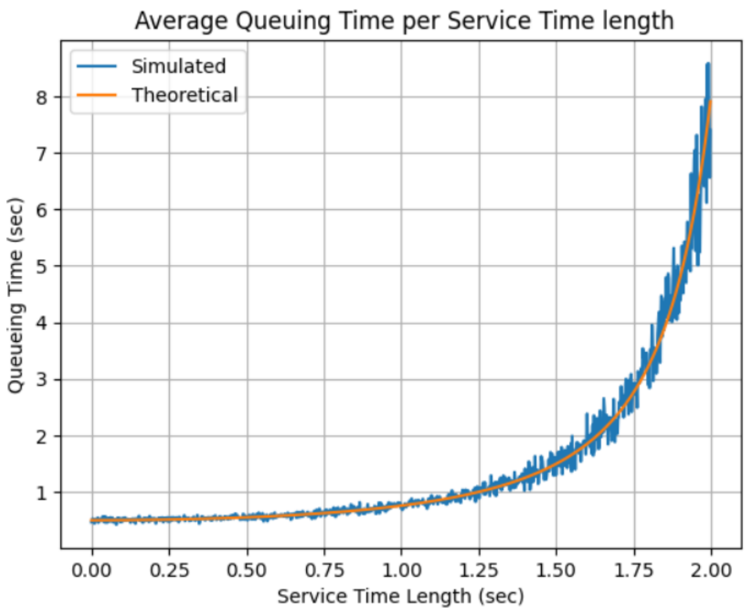

Figure 4

Performance figures	Experimental	Theoretical
Average queueing time	1.388	1.380
Average response time	2.380	2.380
Server utilization factor	0.752	0.750

Table 1