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Assignment 2

Performance Engineering

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1 Introduction

This report is going to study the performance of a software system that executes web sessions from users from the Internet.

The system is composed of five service centers: A *WebServer,* an *ApplicationServer*, a *Database*, a *CardPaymentServer,* and a *VoucherPaymentServer.*

The running system has been observed during 1000 minutes. During these 1000 minutes, 72000 user sessions have been completed and 1.2 sessions per second arrived at an average rate.

2 Calculation results

Time (T) =1000 minutes=60 000 seconds

No.of completed requests (C) = 72 000

Throghput (X) = C/T= 72000 /60000 = 1.2

2.1 *A1*

Average service time S_k of the *ApplicationServer* and the *VoucherPaymentServer*

ApplicationServer

U= 0.528 V_k= 2

<u>Utilization Law</u>

$U_k = D_k. X \Rightarrow D_{k=} U_k / X$
$D_k = 0.528/ 1.2$
$D_k = 0.44$

<u>Service Demand Law</u>

$D_k = S_k * U_k$
$S_{k=} D_k / U_k$
$S_{k=} 0.44/ 2$
$S_k = 0.22$

Therefore, service time of application server is 0.22s

VoucherPaymentServer

Avg no.of jobs (N) = 0.168
Avg system residence time (R)= 0.35
Demand Time (D_k)= 0.12s

Little’s Law
$N = X_k * R$
$X_k = N / R$
$X_k = 0.48$

Using Service Demand Law

$U_k = D_k * X$
$U_k = 0.12 * 1.2$
$U_k = 0.144$

Using Utilization law

$S_k = U_k / X_k$
$S_k = 0.144 / 0.48$
$S_k = 0.3$ s

Therefore, service time of the VoucherPaymentServer is 0.3s

2.2 A2

To calculate the minimum amount of resources that we need in each service center to handle an average arrival rate to the system of 10 sessions per second. When expect that the workload to our e-commerce site will increase to an average rate of 10 user sessions per second.

Solution:
Using the operational laws I found the amount of resources for each service center for which the service center is not saturated.

Given:

10 sessions per second imlies throughput.
X= 10
We assume that the time taken is the same.
T-60000 s

Using the Forced flow law I have calculated the saturation of the service centres.
According to the law the system utilization should not exceed 100 %.
I have made reasonal assumptions on the minimum number of resources.
This was also verfiifed using JMT and in all instances, the utilization of the each service centre is less than 100%.

WebServer	***ApplicationServer***	***Database***	***VoucherPayment***	***CardPayment***
X=10	$X_k=V_{k*}X$	X=10	$U_k=10*0.3=3$	$U_k=X_{k*}S_k$
S=0.09	$X_k=2*10$	S=0.045		$U_k=10*0.4=4$
$U_k=X_{k*}S_k$	$X_k=20$	$U_k=10*0.045=0.45$	c=2	c=6
Uk=0.9	S=0.22	Since, iterating 5 times		
c =2	$U_k=0.22*20$	$U_k=0.45*5=2.25$		
	$U_k=4.4$	c=5		
	c=5			

Where,
c = number of resources
Uk= utilization of a servicd centre

3 JMT Queueing Network simulation

The system has been modeled using JMT Queueing Network simulation engine

3.1 Model

Queueing Networks Design

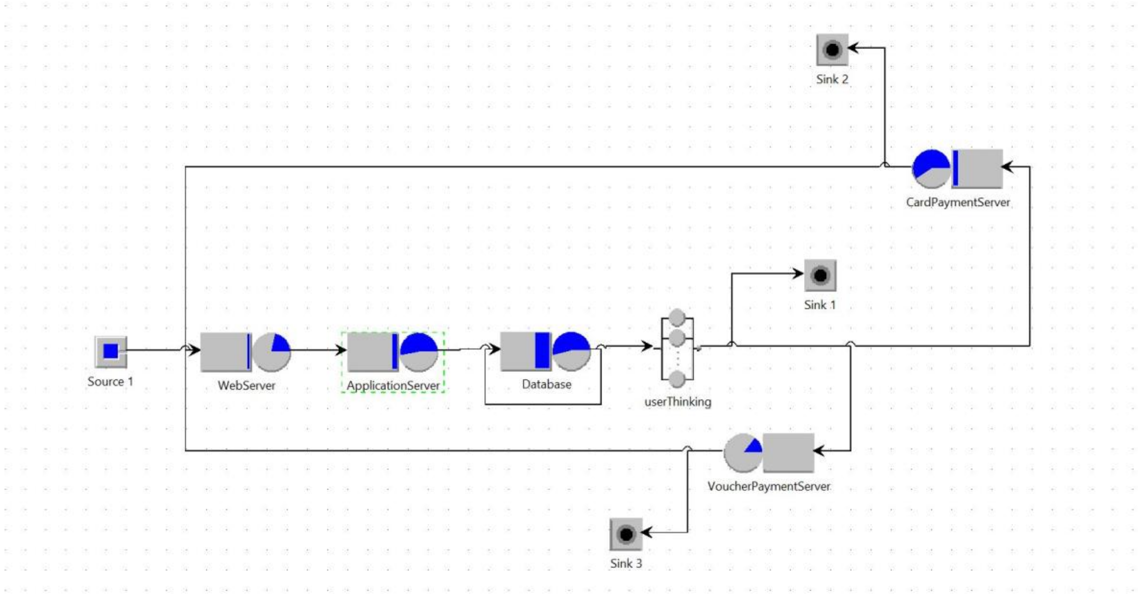
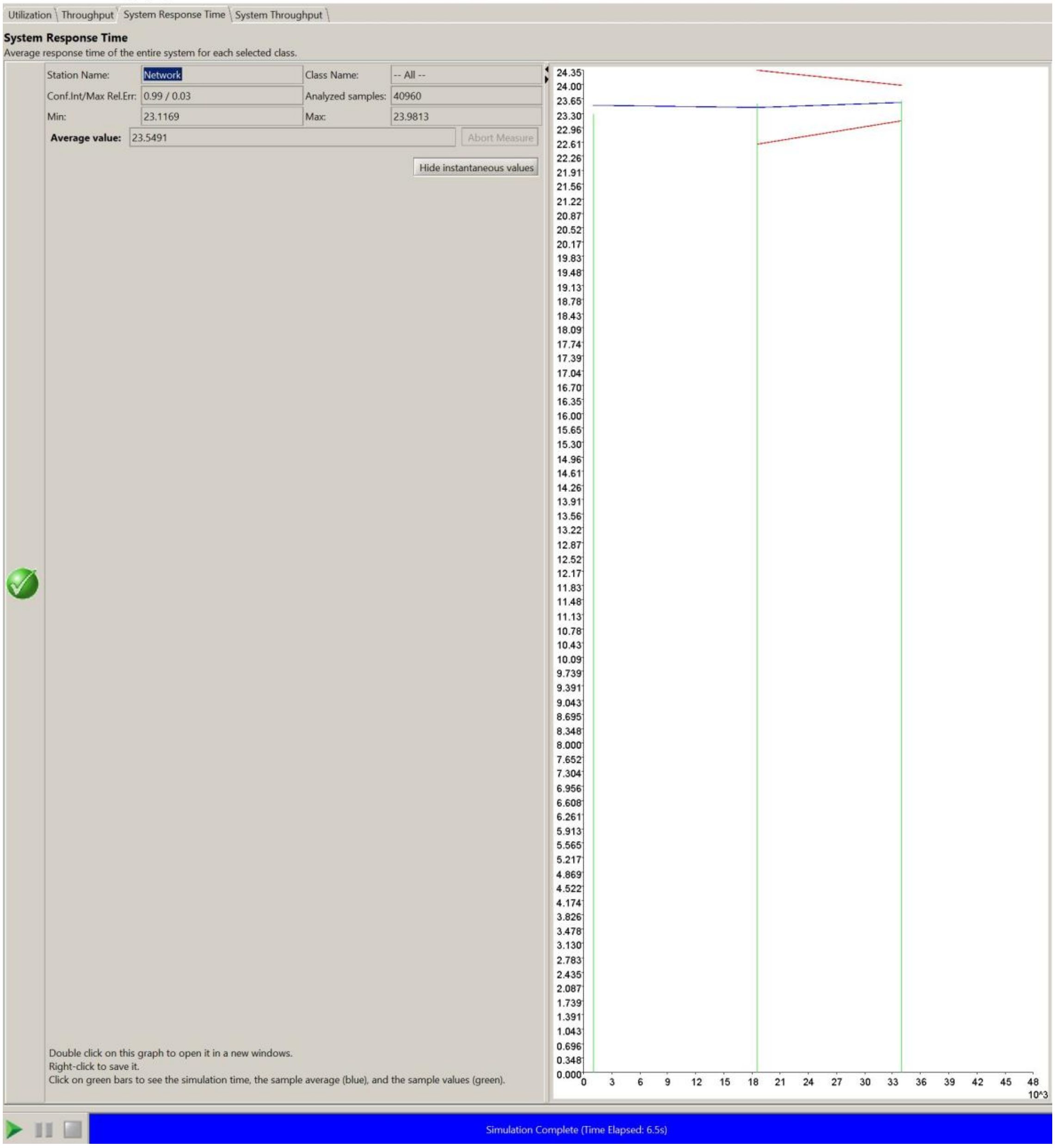


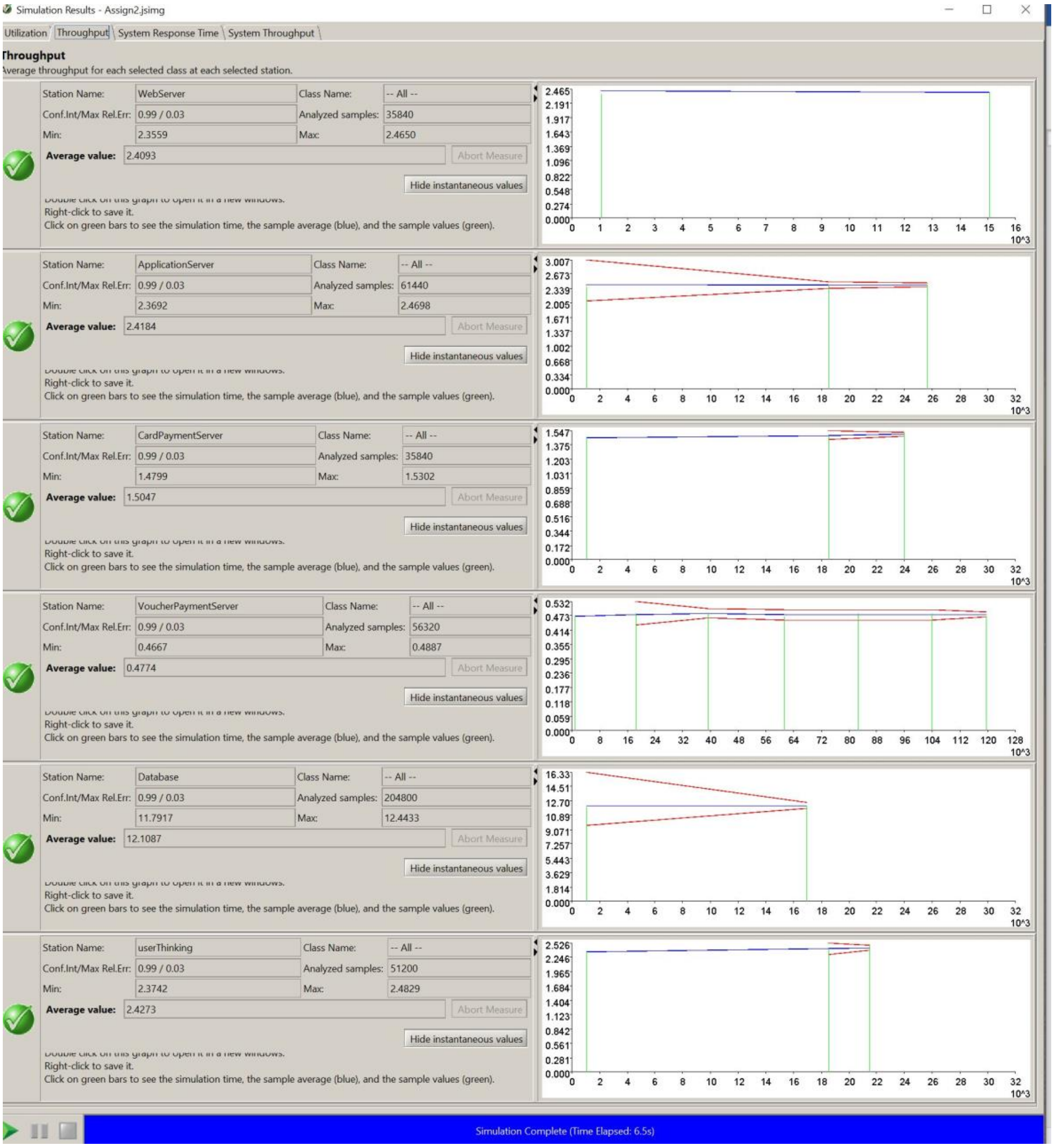
Figure 1: JMT Queueing Network simulation engine

3.2 System Response Time

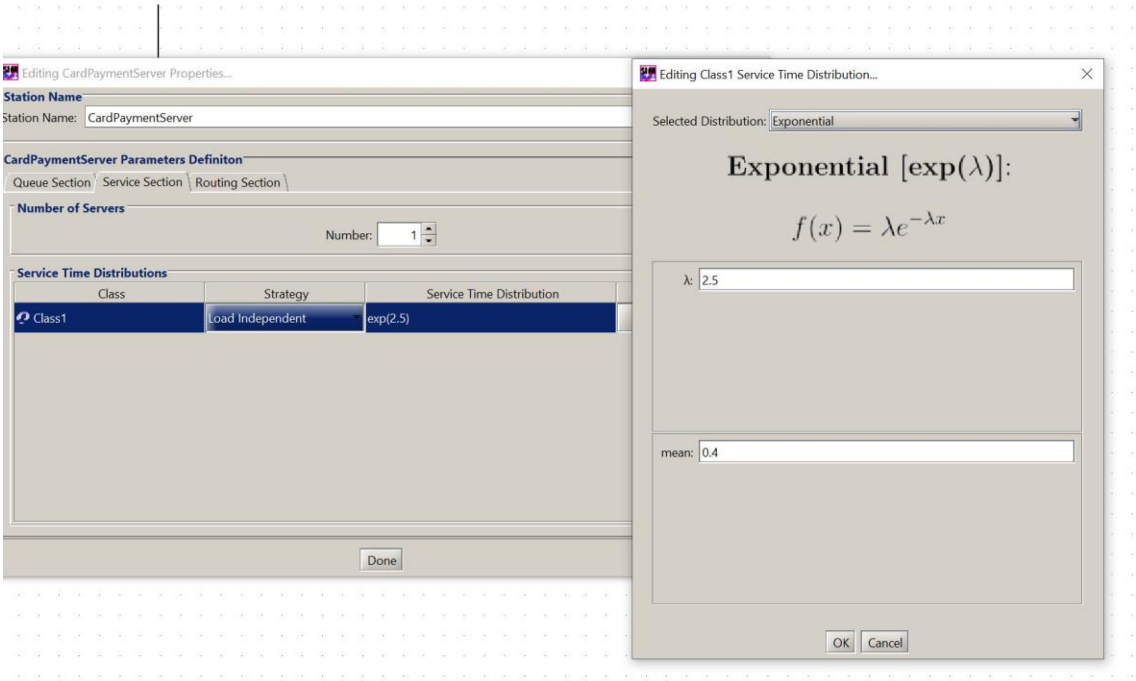


3.3 Utilization of each service center

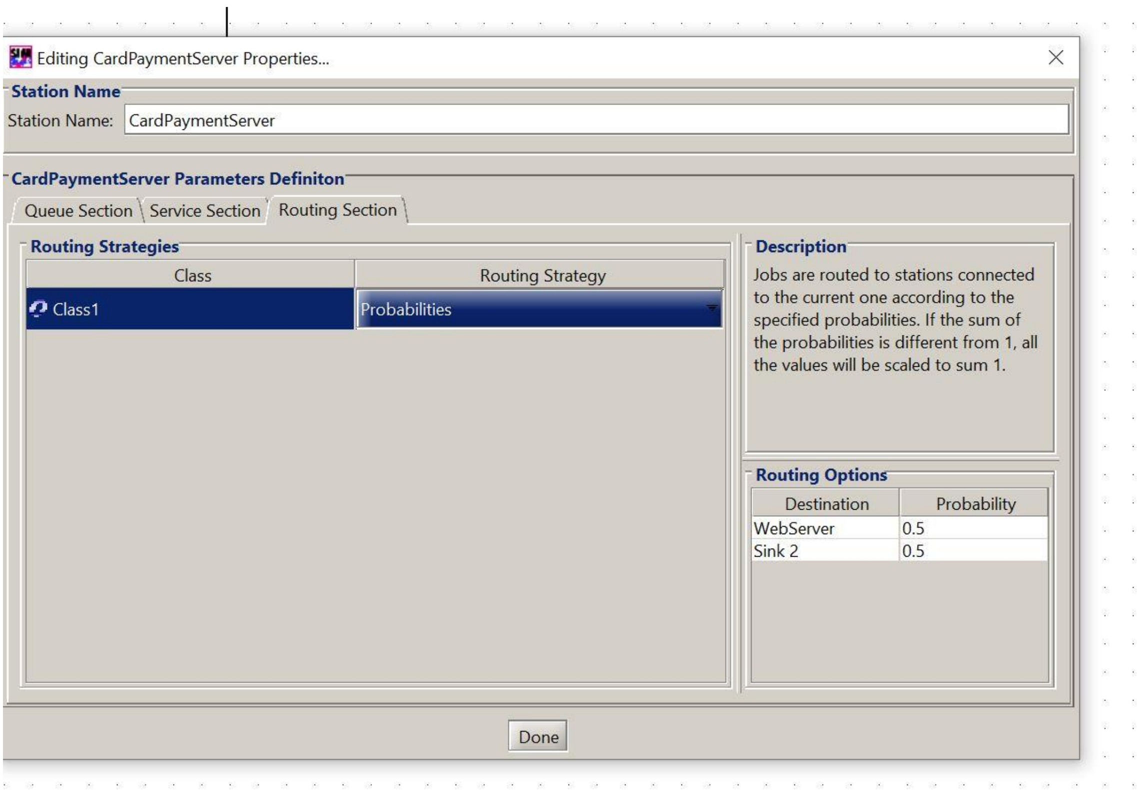
3.4 Throughput of each service center



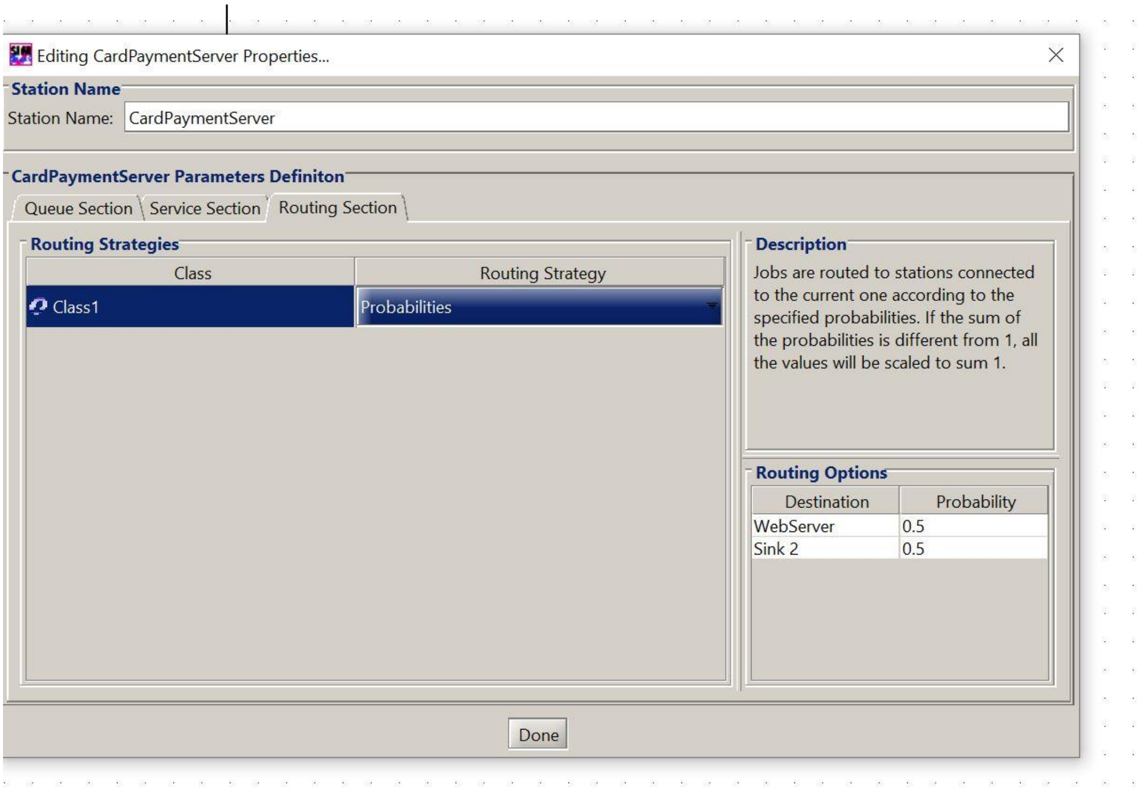
3.5 Card payment server service section



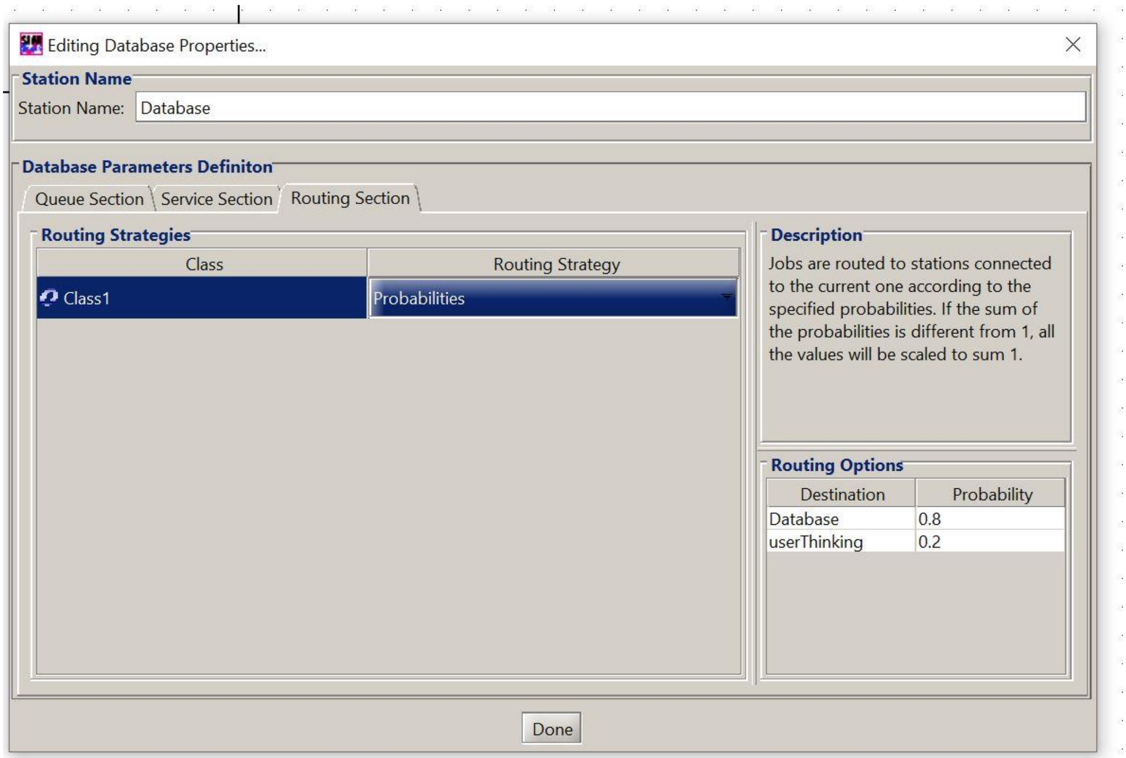
3.6 Card payment server Routing section



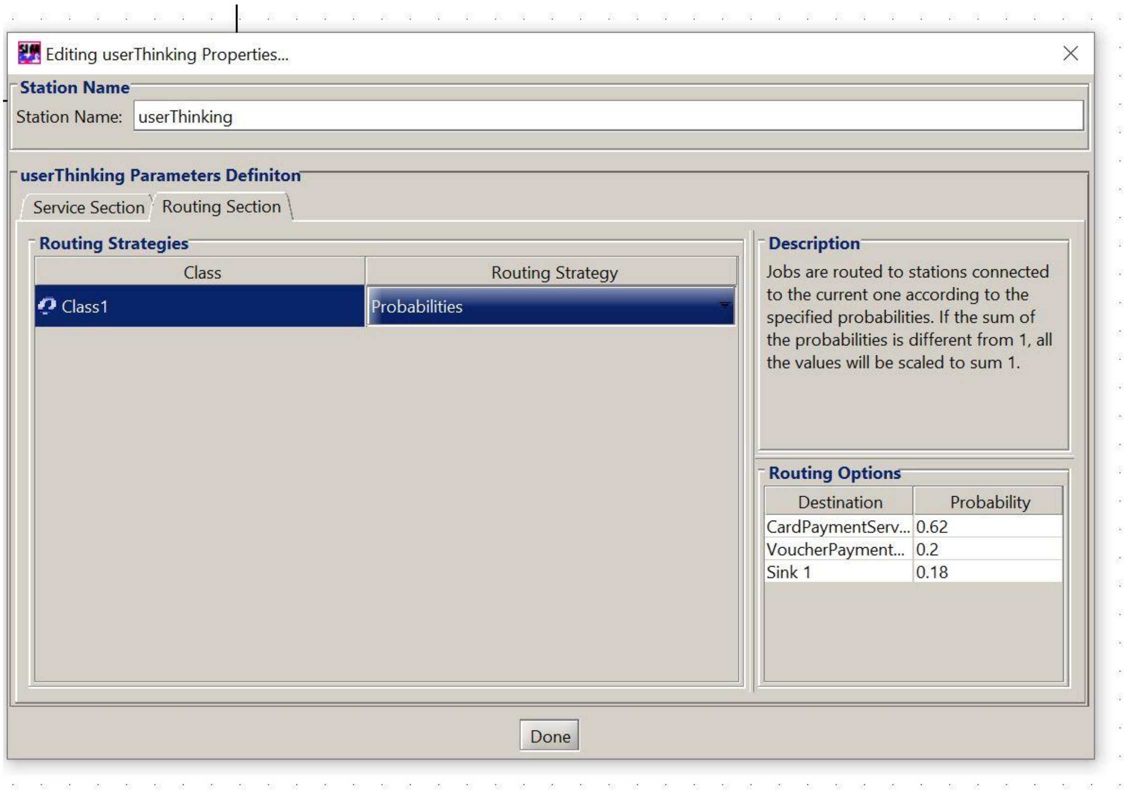
3.7 Database service section



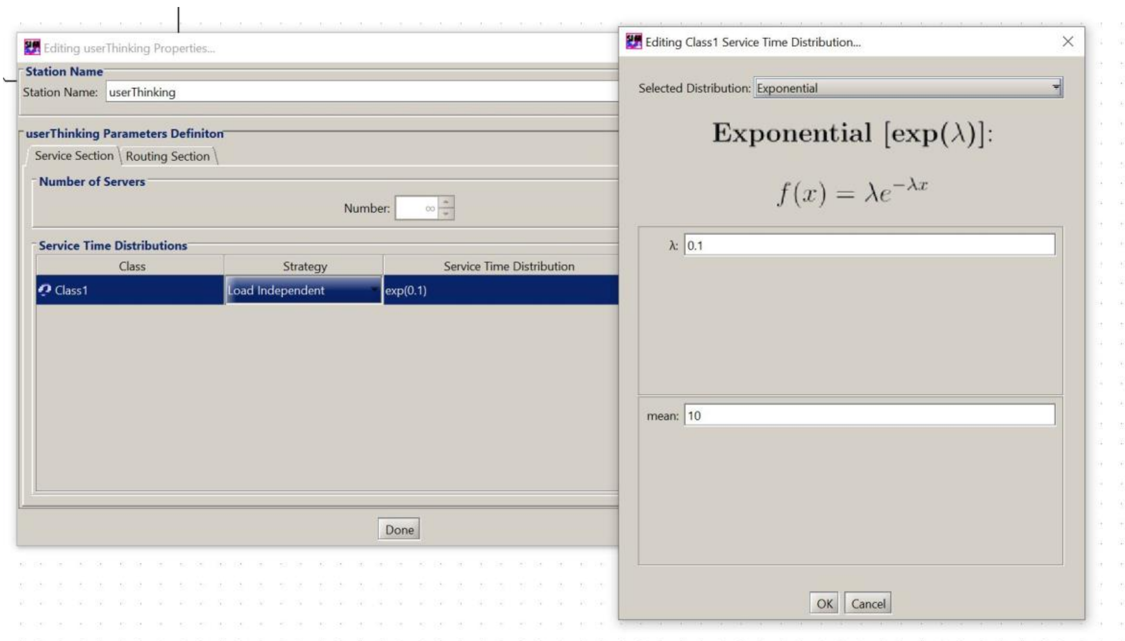
3.8 Database Routing Section



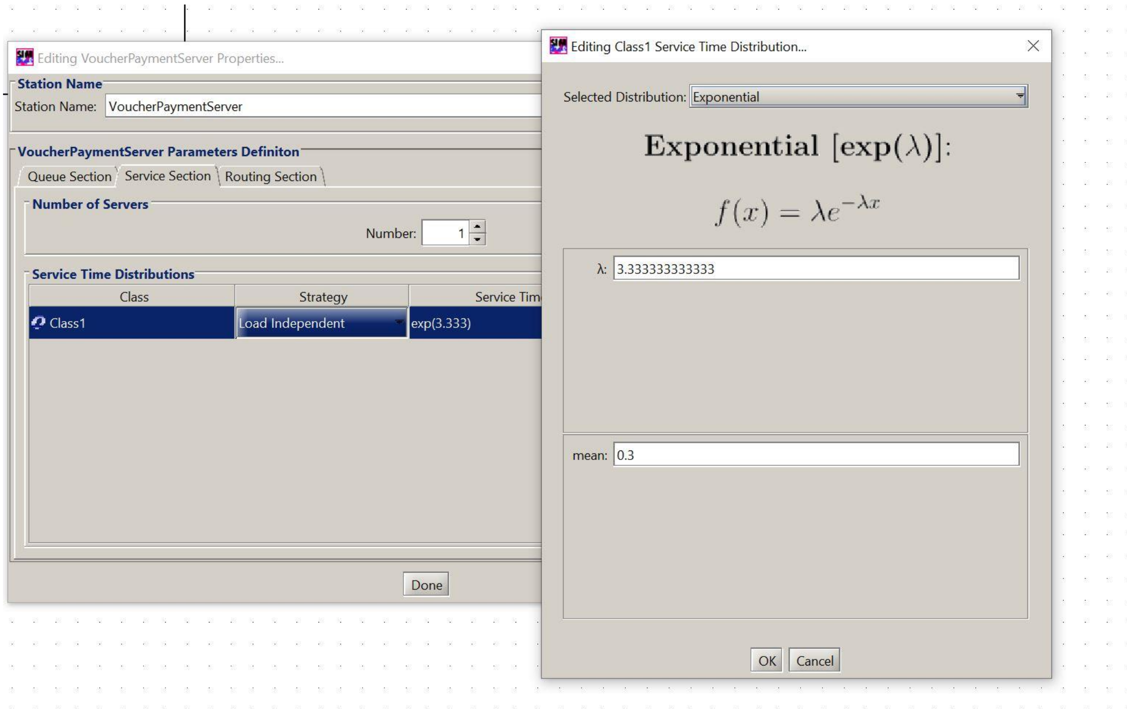
3.9 User thinking Routing



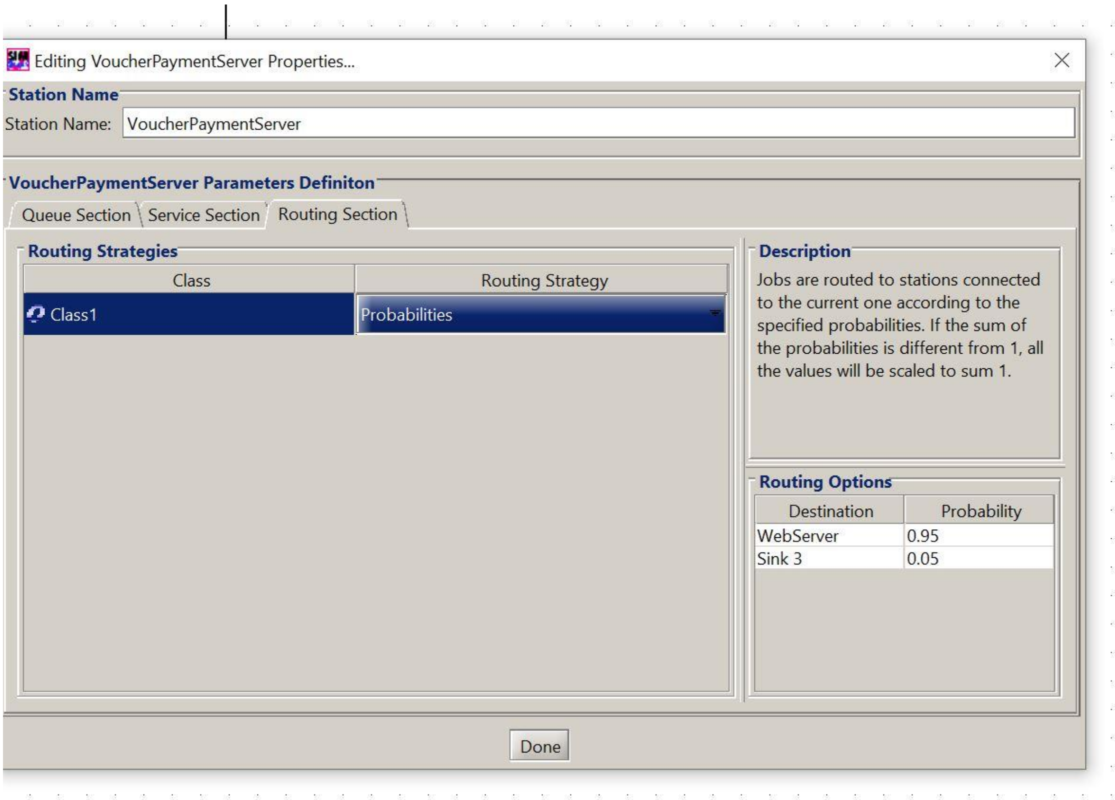
3.10 User thinking service section



3.11 Voucher payment card service section



3.12 Voucher payment card Routing section

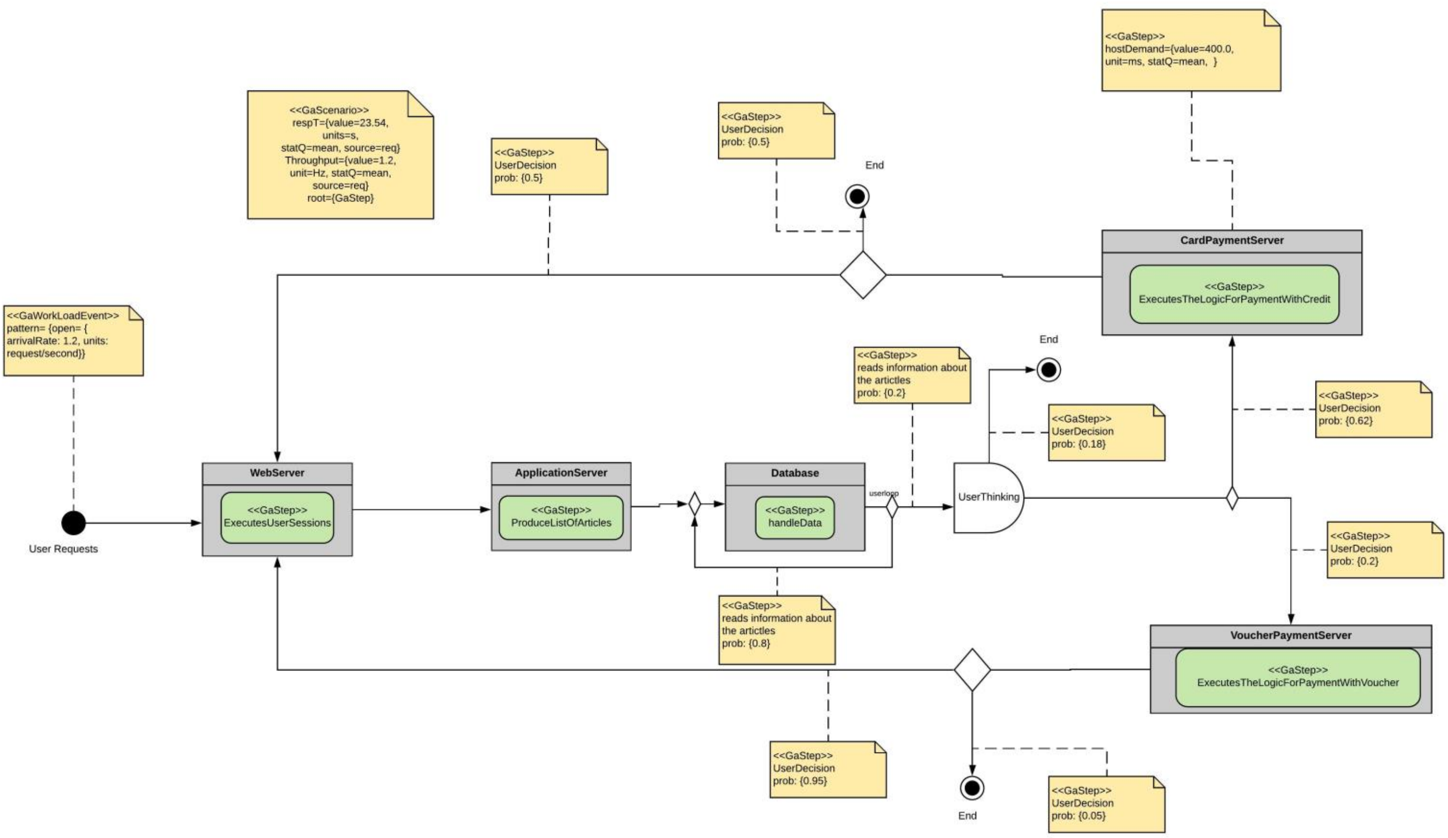


3.13

4 UML Diagrams profiled with MARTE

Only represents the workload of the system and the time that the CardPaymentServer needs to execute

4.1 MARTE



5 Bonus points

Find the number of visits (V_k) of the Application server using the given data

Solution:

According to the question, a request that arrives to the Application server is executed 5 times in the Database. This implies that

The text does not imply the next formula.
There is not any reason for which the service time of the AppliationServer does not need to be 5 times the service time of the DB.

$$\boxed{S_{ApplicationServer} = 5 * (S_{Database})}$$

According to the question, the service time (S_k) of the Database is 0.045s.

Therefore, $S_{ApplicationServer} = 5 * 0.045 = 0.22$

<u>Utilization Law</u>
$U_k = D_k. X \Rightarrow D_{k=} U_k / X$

$D_k = 0.528/ 1.2 = 0.44$

<u>Using Service Demand Law,</u>

$V_k = D_k/ S_k = 0.44/ 0.22$

$V_k = 2$

Hence, visits of application server is 2.

End