

Mugla Sıtkı Kocman University

Computer Engineering Department

CENG 4513

Modeling and Simulation

Project Name:

Blockchain Used System Simulation and Modeling
Project

Team Members

Fatih TEKE

120709038

Advisor

Assist. Prof. Dr. Zeynep Filiz Eren Doğu

1.Introduction and Problem Statement

1.1 Introduction

This project is a part of the course CENG 4513-Simulation and Modeling where the main focus lies on the simulation software called 'Arena' owned by Rockwell Software. The aim of this project is to prepare a transaction flowing simulation model of the blockchain integrated network system for finding an ideal solution to next-generation network systems using the software 'Arena'. The model in Arena gives a precise output of the statistical accumulators like the total number of entities served, sum of the queue times for all the entities, maximum time in queue, sum of the total times in system, maximum total time in system observed etc. where requests (transactions) would be the Entities for this model. This model uses the facts and parameters that are available from the IBM website and in linked attachments, management system, options of blockchain and sequence followed, resources available etc. and puts them in Arena to prepare the skeleton of the model. For this model, the input data was the variables of the entities and the service times accepted as full work which was collected from IBM official website to run the model. The model was run for 8 hours to analyze the results and based on the statistical conclusions, suggestions were made to economically improve the efficiency and working of Blockchain integrated network systems.

1.2 Problem Statement

The blockchain is a new and a trending technology for the network systems. Also, the Network system is a cornerstone for the business world. IBM is one of the biggest network and blockchain company in the world. Sometimes when we want to get a website or make a transaction in the network we could wait hours and at this century it's very bad for companies and networks. With the blockchain technology, we start to use networks much more and it's getting bigger. I couldn't find a study case for this area to sure about the future of networks and I decided to create one. According to IBM, I collected the blockchain integrated network necessities, average wait time, machine utilities etc. Also, I added the API management system to make this project more realistic.

1.3 Assumptions

The existing system at IBM or Blockchain integrated networks could not be modeled and simulated exactly the way it is due to natural variabilities and unknown facilities. There has to be some assumptions in order to exclude these activities. Even though the model does not delineate the exact situation at networks, the statistical inferences that we get from Arena are very useful in analyzing the situation. Here are a few assumptions that were made for the model in this project ;

1. The system is open for 18 hours.
2. There are no work shifts between the machines.
3. There are no breaks for the machines during the time when the model is running.
4. Some system machines minimized. (Because of the Arena Simulation Toll student version restrictions.)

5. The treated values for the system security weakness assigned to the transactions randomly.
6. Some of the machine and systems data for decision modules were taken from the IBM and research articles due to lack of sample points.
7. For the API management system decision api variable assigned.
8. The machines fault tolerance wouldn't be used for this project. A threatening transaction can't harm the system work.

All these assumptions hold valid for the time when the model is running.

2.DATA COLLECTION AND DISTRIBUTION FITTING

2.1 Data Collection

The model prepared in this project considers the resources present at the current network like IBM servers, Gateways, Storage Servers, Portal Services etc. to keep track of the sequence of packet deliverance. Data was created with looking nowadays current server numbers. There is no such system like that at the moment with blockchain but some systems say they partially achieved this like Blockstack.

2.2 Data Fitting to Distributions

The Arena model requires the data as an input to run and analyze the situation. For convenience, Arena needs the data in the form of a distribution which best fits the raw data. But we are looking system efficiency and utility for this project so, the only matters for us is time results and how many jobs finished for now. Also as we mention that there is no such system yet in real life. So, the raw time of the inter-arrival times and service times for each resource don't need to be fitted to a distribution which then would be used in Arena. We accept the first creation of the packets starts at 0.0 time and all the entities start together.

3.ARENA MODEL

3.1 Modeling the System

The Blockchain integrated network system was bifurcated into pieces to prepare the model in Arena. Various modules e.g. Create, Process, Record, Assign, Decision etc. are used in

the Arena to simulate the real world scenario. The procedure that any entity packets follows at the network is divided into certain steps to give a flow in the Arena model. The steps can be treated as;

1. Different type of person creating transactions packets with different devices (it depends to chance)
2. All packets get the thread value randomly to make process with firewalls (we think they could be malicious so we gave them a thread value randomly.)
3. Packets go to HTTP servers to get address resolution. (Domain Name System - its a Blockchain Address Resolution (Blockstack))
4. The packets go to the content delivery system to arrive final site faster.
5. Then the first firewall checks the packets for “Variable 2” type thread packets and drops them.
6. After the firewall our packets will go to the API area, we need to assign API status to these packets and this process is happening at this step.
7. Load Balancer module separates them according to API level of packets. Some packets have to wait in a queue for getting necessary status with Provider Cloud Portal Service.
8. There were 2 different firewalls between Load Balancer and Server Runtime Servers. They check the packets for the second thread variable.
9. According to API level, all the checked packets go to the different level of API system and end of the process and queues all the packets have the same API level, it means all of them equal as API level.
10. Transformation and Connectivity Model decide the packets are ready to save, they are good to write or they are not malicious data.

11. Enterprise Data module looked the all packets for the necessary information for the system then off ledger data record them one by one.

1. Entities = Packets

Entity - Basic Process									
	Entity Type	Initial Picture	Holding Cost / Hour	Initial VA Cost	Initial NVA Cost	Initial Waiting Cost	Initial Tran Cost	Initial Other Cost	Report Statistics
1 ▶	Developers	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
2	Auditors	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
3	Operators	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
4	Business Users	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
5	Administrators	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>

Double-click here to add a new row.

2. Queues = FIFO

Queue - Basic Process				
	Name	Type	Shared	Report Statistics
1 ▶	Route 1.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Route 2.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	Route 3.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	Route 4.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5	Route 5.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	Enterprise Data.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7	Blockchain Network.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8	Peer Provider Cloud.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9	Blockchain Layer.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10	Routing Layer.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11	Ledger.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12	Virtual Chain Layer.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
13	Provider Cloud Portal Service.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14	API Developer Toolkit.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15	API Gateway.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
16	API Management.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
17	API Visualization and Analytics.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
18	API Developer Portal Machines.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>
19	API Runtime.Queue	First In First Out	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Double-click here to add a new row.

3.Resources

Resource - Basic Process									
	Name	Type	Capacity	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
1	Pool1	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
2	Event Distribution	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
3	Membership Services	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
4	Communication Protocol	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
5	Cryptographic Services	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
6	Secure Runtime Enviroment	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
7	Transactions	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
8	Smart Contracts	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
9	Ledger 2	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
10	Blockchain Nodes	Fixed Capacity	20	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
11	Enterprise Secure Connectivity Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
12	Transformation Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
13	Enterprise Data Connectivity Checker	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
14	Transactional Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
15	Application Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
16	Log Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
17	Develop and Compose API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
18	Connect API to Data Source Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
19	Build Deploy Scale API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
20	Monitor and Debug API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
21	API Policy Enforcement Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
22	Enterprise Security Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
23	Traffic Control Machine1	Fixed Capacity	2	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
24	Workload Optimization Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
25	Monitoring and Analytic Collection Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
26	Unified Polyglot API Execution Enviroment Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
27	Provision Syatem Resources	Fixed Capacity	2	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
28	Monitor Runtime Health Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
29	Scale the Enviroment Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
30	Peer Provider Cloud Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
31	Blockchain Layer Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
32	Routing Layer Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
33	Ledger Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
34	Virtual Chain Layer Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
35	Provider Cloud Portal Services Machines	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
36	API Developer Toolkit Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
37	API Gateway Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
38	API Management Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
39	API Visualization and Analytics Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
40	API Developer Portal Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
41	API Runtime Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
42	Blockchain Layer Machines	Fixed Capacity	20	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>

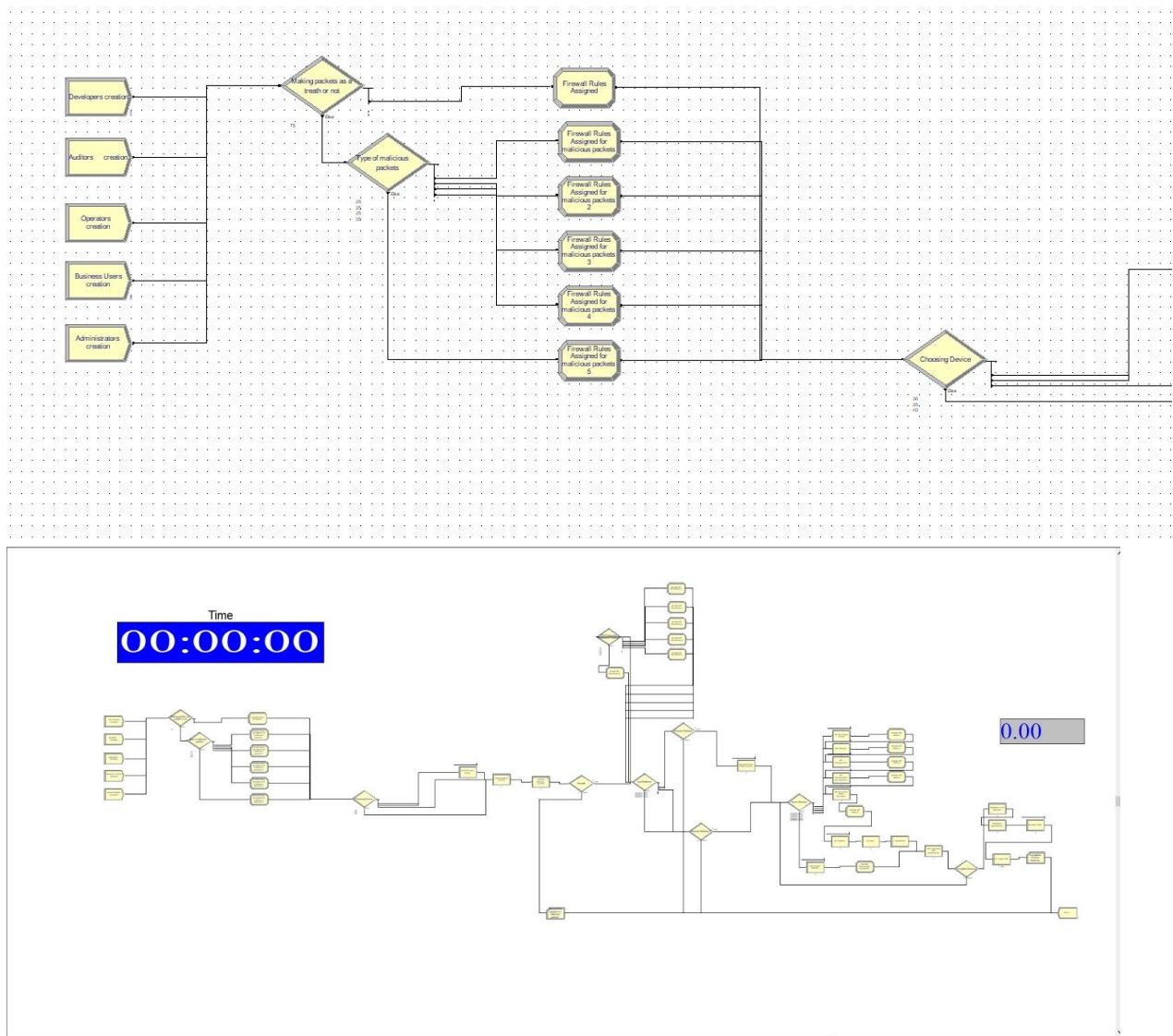
Double-click here to add a new row.

4.Sets

Set - Basic Process				
	Name	Type	Member Definition Method	Members
1	Pools	Resource	Manual List	1 rows
2	Blockchain Network 2	Resource	Manual List	9 rows
3	Enterprise Data Phase	Resource	Manual List	3 rows
4	Transformation and Connectivity Phase	Resource	Manual List	3 rows

Double-click here to add a new row.

Here is a snapshot of the Arena Model that was prepared



To explain the model parameters stepwise, we will go through each step mentioned earlier looking closely into the modules and logic used to prepare the model. 1. Different type workers create transaction packets – The packet enters the network by a create module named ‘Developer, Auditors, Operators, Business Users, Administrators creation’” in Arena whose dialog box is shown below. The expressions here is the one that we got from the input analyzer.

Create ? X

Name: Entity Type:
Developers creation Developers

Time Between Arrivals
Type: Value: Units:
Random (Expo) 1 Hours

Entities per Arrival: Max Arrivals: First Creation:
1 10 0.0

OK Cancel Help

Create ? X

Name: Entity Type:
Auditors creation Auditors

Time Between Arrivals
Type: Value: Units:
Random (Expo) 1 Minutes

Entities per Arrival: Max Arrivals: First Creation:
1 15 0.0

OK Cancel Help

Create ? X

Name: Entity Type:
Operators creation Operators

Time Between Arrivals
Type: Value: Units:
Random (Expo) 1 Seconds

Entities per Arrival: Max Arrivals: First Creation:
1 17 0.0

OK Cancel Help

Create ? X

Name: Entity Type:

Time Between Arrivals

Type: Value: Units:

Entities per Arrival: Max Arrivals: First Creation:

OK Cancel Help

Create ? X

Name: Entity Type:

Time Between Arrivals

Type: Value: Units:

Entities per Arrival: Max Arrivals: First Creation:

OK Cancel Help

With the deciding module, I separated the packets % 75 -%15 for the thread.

Decide ? X

Name: Type:

Percentages:

75	Add... Edit... Delete
<End of list>	

OK Cancel Help

One of the thread assigning module. I gave the 5 variable as thread selector.

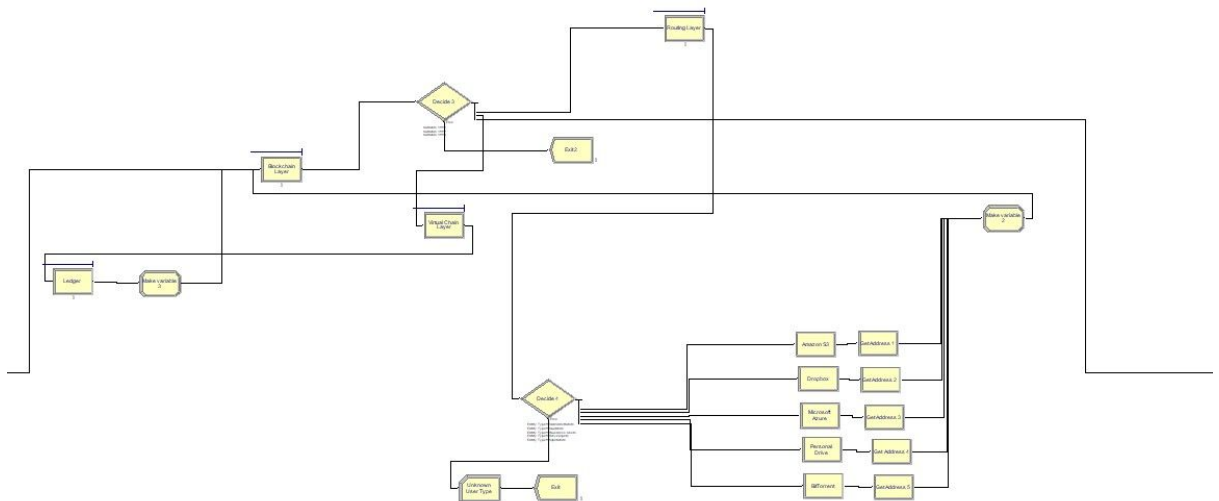
The 'Assign' dialog box is shown with the following details:

- Name:** Firewall Rules Assigned
- Assignments:**
 - Variable, Variable 1, 1
 - Variable, Variable 2, 10
 - Variable, Variable 3, 10
 - Variable, Variable 4, 10
 - Variable, Variable 5, 10
 - <End of list>
- Buttons:** Add..., Edit..., Delete, OK, Cancel, Help

Then the packets go to Peer Provide Cloud and Domain Name System.

The 'Process' dialog box is shown with the following details:

- Name:** Peer Provider Cloud
- Type:** Standard
- Logic:**
 - Action:** Seize Delay Release
 - Priority:** High(1)
- Resources:**
 - Resource, Peer Provider Cloud Machine, 1
 - <End of list>
- Buttons:** Add..., Edit..., Delete
- Delay Type:** Normal
- Units:** Seconds
- Allocation:** Non-Value Added
- Value:(Mean):** 1
- Std Dev:** .2
- ☒ Report Statistics
- Buttons:** OK, Cancel, Help



Firewalls decision for variable 2 kind malicious thread.

Decide

?

×

Name:

Firewall

Type:

2-way by Condition

If:

Variable

Named:

Variable 2

Is:

>

Value:

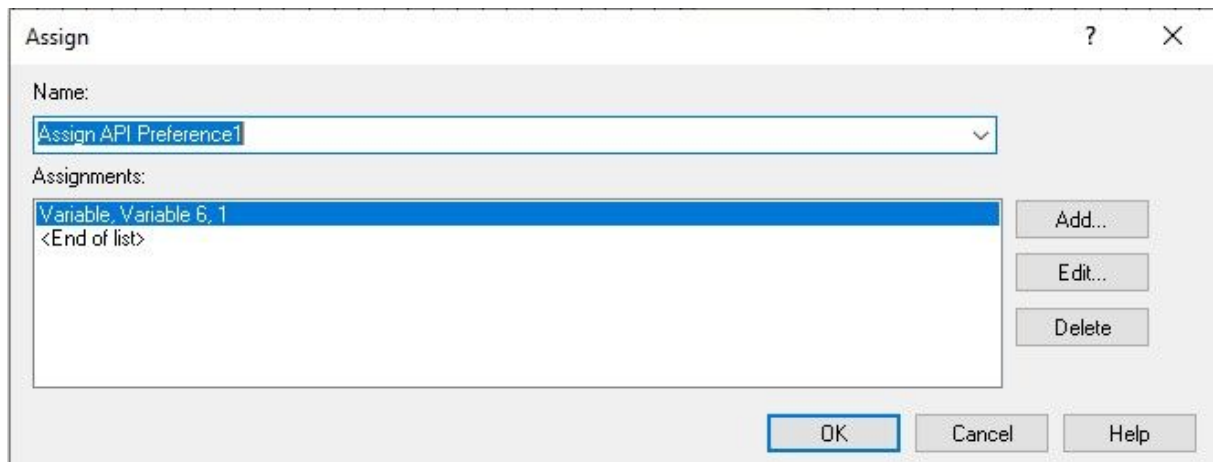
1

OK

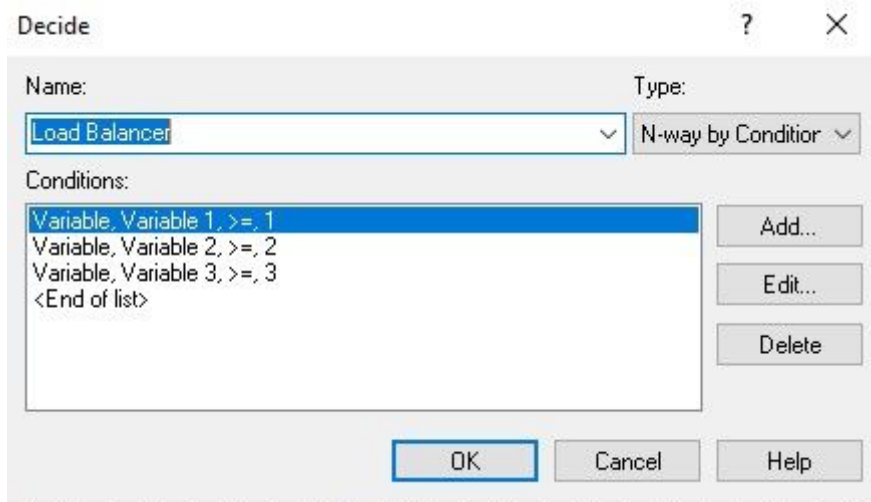
Cancel

Help

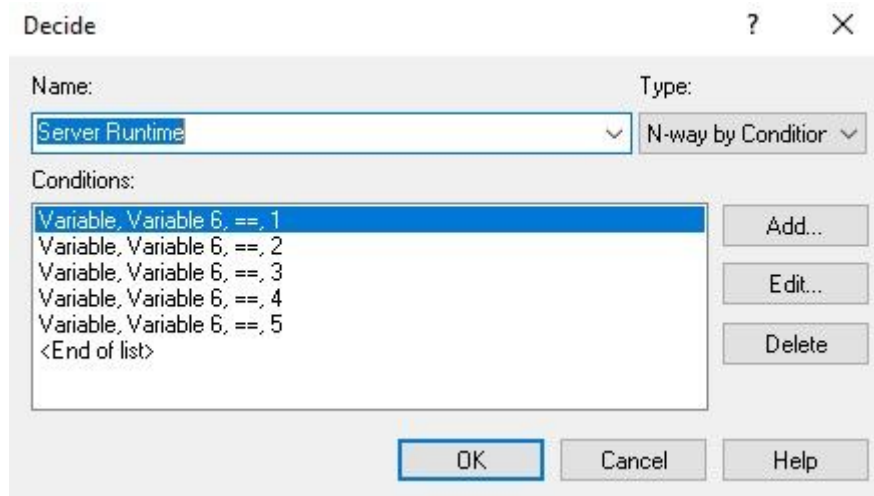
After the packets pass the upper systems they arrive the API system. So These packets get the API features here. Variable 6 for the API level.



Next Packet gets the API levels and they are ready to go. But there were so many ready packets and some of them will come with a portal usage application so we have to send them via these applications portal because of them we are separating them with necessary kind of variables. Before they arrive the next systems that all packets checks by firewalls again for the variable 3 value.



After that, The packets go to the Server Runtime. They follow the necessary road to get the blockchain system.



After Server runtime check, the packets flow between server machines API Developer tools, API Gateway, API Management, API Visualization, and Analytics and the final API Developer Portal Machines. These Machines are little subsystem a real but the ARENA software is student version and I'm to be limited with 200 models so I show them as one process.

Then all packets go to the API Runtime module and they stay a while here because these packets wait for a resource online to keep going their process. Some of them go to the Blockchain Module according to the API level.

Process

Name: API Runtime Type: Standard

Logic

Action: Seize Delay Release Priority: Medium(2)

Resources:

Resource, API Runtime Machines, 1
<End of list>

Add...
Edit...
Delete

Delay Type: Normal Units: Seconds Allocation: Non-Value Added

Value:(Mean): 1 Std Dev: .2

☒ Report Statistics

OK Cancel Help

All the packets came to the Transformation and Connectivity module. We couldn't show all the processes here due to Arena software limitation. So, I created this module as a delay module and the delay value shows the average time of packets transformation and conversion time.

Process ? X

Name: Transformation And Connectivity ▾ Type: Standard ▾

Logic

Action: Delay ▾

Delay Type: Normal ▾ Units: Seconds ▾ Allocation: Transfer ▾

Value: (Mean): 1 Std Dev: .2

☒ Report Statistics

OK Cancel Help

Process ? X

Name: Blockchain Network Type: Standard

Logic

Action: Seize Delay Release Priority: High(1)

Resources:

Set, Blockchain Network 2, 1, Cyclical, Attribute 1
<End of list>

Add...
Edit...
Delete

Delay Type: Normal Units: Minutes Allocation: Non-Value Added

Value: (Mean): 1 Std Dev: .2

☒ Report Statistics

OK Cancel Help

After all the processes done the passed packets goes to the Enterprise record section. They will be collected and saved to the off ledger data.

Process ? X

Name: Enterprise User Directory Type: Standard

Logic

Action: Delay

Delay Type: Normal Units: Seconds Allocation: Transfer

Value: (Mean): 1 Std Dev: .2

☒ Report Statistics

OK Cancel Help

Process ? X

Name: Enterprise Data ▾ Type: Standard ▾

Logic

Action: Seize Delay Release ▾ Priority: High(1) ▾

Resources:

Set, Enterprise Data Phase, 1, Cyclical, Attribute 1
<End of list>

Add...
Edit...
Delete

Delay Type: Normal ▾ Units: Seconds ▾ Allocation: Transfer ▾

Value:(Mean): 1 Std Dev: .2

☒ Report Statistics

OK Cancel Help

Process

Name: Off Ledger Data

Type: Standard

Logic

Action: Delay

Delay Type: Normal

Units: Seconds

Allocation: Transfer

Value:(Mean): 1

Std Dev: .2

☒ Report Statistics

OK Cancel Help

4.RESULTS AND INTERPRETATION

4.1 Results

The Arena Software produces a detailed and structured result window which allows the user to view results by Entity, Queue, Resource and anything that is specified in the model. The category overview has a pre-defined KPI as the Number out. This gives the number of entities which successfully left the system. For the Blockchain Integrated Network System model, which was run for a replication length of 13 hours, the Number Out value was 83, for 1 replication.

4.1.1 By Entity

The most important attribute variable to the entity is 'API status and thread status'. Arena gives a detailed output with Average value, Minimum, Maximum, Half width etc. for the various times that are observed by the entity during its stay in the system. In Blockchain Integrated Network System model, the main output is the Total time in the system, the wait

time and the service time. It also gives the number of entities in and out of the system. Here is the output from Arena

06:48:41

Category Overview

Ocak 17, 2019

Unnamed Project

Replications: 1Time Units: Hours

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00	(Insufficient)	0.00	0.00
Auditors	0.00	(Insufficient)	0.00	0.00
Business Users	0.00	(Insufficient)	0.00	0.00
Developers	0.00	(Insufficient)	0.00	0.00
Operators	0.00	(Insufficient)	0.00	0.00

NVA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.02212640	(Insufficient)	0.00203129	0.03592107
Auditors	0.02165598	(Insufficient)	0.00348223	0.03792034
Business Users	0.01763957	(Insufficient)	0.00027314	0.04104691
Developers	0.01992027	(Insufficient)	0.01627334	0.02291472
Operators	0.02182817	(Insufficient)	0.00206164	0.03594469

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.1673	(Insufficient)	0.00	0.9253
Auditors	0.00881564	(Insufficient)	0.00	0.07089945
Business Users	0.01419036	(Insufficient)	0.00	0.0963
Developers	0.00175251	(Insufficient)	0.00	0.01157887
Operators	0.01096710	(Insufficient)	0.00026271	0.04120744

Transfer Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00198054	(Insufficient)	0.00	0.00251679
Auditors	0.00208540	(Insufficient)	0.00113656	0.00381349
Business Users	0.00223695	(Insufficient)	0.00	0.00454223
Developers	0.00209207	(Insufficient)	0.00145822	0.00233760
Operators	0.00186847	(Insufficient)	0.00	0.00380138

Other Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00	(Insufficient)	0.00	0.00

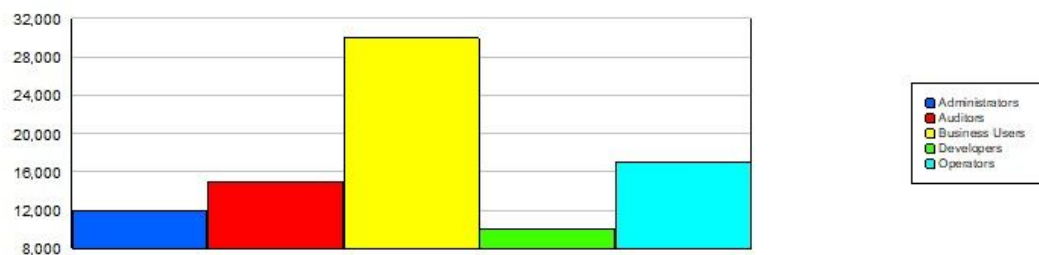
Entity

Time

Total Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.1914	(Insufficient)	0.00203129	0.9464
Auditors	0.03255702	(Insufficient)	0.00543913	0.1118
Business Users	0.03406688	(Insufficient)	0.00027314	0.1397
Developers	0.02376485	(Insufficient)	0.01840000	0.03523596
Operators	0.03466374	(Insufficient)	0.00232436	0.07939704

Other

Number In	Value
Administrators	12.0000
Auditors	15.0000
Business Users	30.0000
Developers	10.0000
Operators	17.0000



Number Out	Value
Administrators	11.0000
Auditors	15.0000
Business Users	30.0000
Developers	10.0000
Operators	17.0000

WIP	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.1570	(Insufficient)	0.00	2.0000

4.1.2. By Queue

Unnamed Project

Replications: 1 Time Units: Hours

Queue**Time**

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal	0.00012939	(Insufficient)	0.00	0.00091466
Machines.Queue				
API Developer Toolkit.Queue	0.03385741	(Insufficient)	0.00	0.0924
API Gateway.Queue	0.00002127	(Insufficient)	0.00	0.00029982
API Management.Queue	0.00008159	(Insufficient)	0.00	0.00043786
API Runtime.Queue	0.00002570	(Insufficient)	0.00	0.00017665
API Visualization and Analytics.Queue	0.00014261	(Insufficient)	0.00	0.00074308
Blockchain Layer.Queue	0.00	(Insufficient)	0.00	0.00
Blockchain Network.Queue	0.00000762	(Insufficient)	0.00	0.00040028
Enterprise Data.Queue	0.00000736	(Insufficient)	0.00	0.00020363
Ledger.Queue	0.00004895	(Insufficient)	0.00	0.00028277
Peer Provider Cloud.Queue	0.00018505	(Insufficient)	0.00	0.00099757
Provider Cloud Portal Service.Queue	0.00000459	(Insufficient)	0.00	0.00025208
Route 1.Queue	0.00093165	(Insufficient)	0.00	0.00658515
Route 2.Queue	0.00068139	(Insufficient)	0.00	0.00960185
Route 3.Queue	0.00001711	(Insufficient)	0.00	0.00025664
Route 4.Queue	0.1103	(Insufficient)	0.00	0.9253
Route 5.Queue	0.01722486	(Insufficient)	0.00	0.2238
Routing Layer.Queue	0.00210954	(Insufficient)	0.00	0.00566699
Virtual Chain Layer.Queue	0.00087679	(Insufficient)	0.00	0.00376373

Other

The API Developer Tool queue waiting time decreased but such a system like these systems that's not enough. For the efficiency result, we have to give much much capacity to this system. Also, the administrator waiting time is so high and we don't want that. Because of that, I will change the priority of the administrator packets to high.

Then Results ;

Unnamed Project

Replications: 1 Time Units: Hours

Queue

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal	0.00078087	(Insufficient)	0.00	4.0000
Machines.Queue				
API Developer Toolkit.Queue	0.02774798	(Insufficient)	0.00	6.0000
API Gateway.Queue	0.00003487	(Insufficient)	0.00	1.0000
API Management.Queue	0.00028570	(Insufficient)	0.00	2.0000
API Runtime.Queue	0.00015507	(Insufficient)	0.00	1.0000
API Visualization and Analytics.Queue	0.00065874	(Insufficient)	0.00	3.0000
Blockchain Layer.Queue	0.00	(Insufficient)	0.00	0.00
Blockchain Network.Queue	0.00004143	(Insufficient)	0.00	1.0000
Enterprise Data.Queue	0.00004334	(Insufficient)	0.00	2.0000
Ledger.Queue	0.00031363	(Insufficient)	0.00	2.0000
Peer Provider Cloud.Queue	0.00053770	(Insufficient)	0.00	4.0000
Provider Cloud Portal Service.Queue	0.00002703	(Insufficient)	0.00	1.0000
Route 1.Queue	0.00124942	(Insufficient)	0.00	2.0000
Route 2.Queue	0.00101533	(Insufficient)	0.00	2.0000
Route 3.Queue	0.00001912	(Insufficient)	0.00	1.0000
Route 4.Queue	0.1232	(Insufficient)	0.00	6.0000
Route 5.Queue	0.01925005	(Insufficient)	0.00	4.0000
Routing Layer.Queue	0.01288801	(Insufficient)	0.00	23.0000
Virtual Chain Layer.Queue	0.00561795	(Insufficient)	0.00	14.0000

As we see that the average waiting time of the API Developer Toolkit Queue is so high for this system. According to this result, we can say that this system needs to an improvement of the APU Developer Systems.

4.1.3 By Resource

Unnamed Project

Replications: 1 Time Units: Hours

Resource

Usage

Instantaneous Utilization	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal Machine	0.00165540	(Insufficient)	0.00	1.0000
API Developer Toolkit Machines	0.01396123	(Insufficient)	0.00	1.0000
API Gateway Machines	0.00044433	(Insufficient)	0.00	1.0000
API Management Machines	0.00102762	(Insufficient)	0.00	1.0000
API Policy Enforcement Machine	0.00	(Insufficient)	0.00	0.00
API Runtime Machines	0.00173091	(Insufficient)	0.00	1.0000
API Visualization and Analytics Machines	0.00129869	(Insufficient)	0.00	1.0000
Application Data Recorder	0.00054663	(Insufficient)	0.00	1.0000
Blockchain Layer Machine	0.00	(Insufficient)	0.00	0.00
Blockchain Layer Machines	0.00025940	(Correlated)	0.00	0.3500
Blockchain Nodes	0.00172199	(Insufficient)	0.00	1.0000
Build Deploy Scale API Machine	0.00	(Insufficient)	0.00	0.00
Communication Protocol	0.00625822	(Insufficient)	0.00	1.0000
Connect API to Data Source Machine	0.00	(Insufficient)	0.00	0.00
Cryptographic Services	0.00568532	(Insufficient)	0.00	1.0000
Develop and Compose API Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Data Connectivity Checker	0.00	(Insufficient)	0.00	0.00
Enterprise Secure Connectivity Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Security Machine	0.00	(Insufficient)	0.00	0.00
Event Distribution	0.00767890	(Insufficient)	0.00	1.0000
Ledger 2	0.00793056	(Insufficient)	0.00	1.0000
Ledger Machines	0.00176887	(Insufficient)	0.00	1.0000
Log Data Recorder	0.00053026	(Insufficient)	0.00	1.0000
Membership Services	0.00756481	(Insufficient)	0.00	1.0000
Monitor and Debug API Machine	0.00	(Insufficient)	0.00	0.00
Monitor Runtime Health Machine	0.00	(Insufficient)	0.00	0.00
Monitoring and Analytics	0.00	(Insufficient)	0.00	0.00

API Developer toolkit Machines	0.01396123	(Insufficient)	0.00	1.0000
API Gateway Machines	0.00044433	(Insufficient)	0.00	1.0000
API Management Machines	0.00102762	(Insufficient)	0.00	1.0000
API Policy Enforcement Machine	0.00	(Insufficient)	0.00	0.00
API Runtime Machines	0.00173091	(Insufficient)	0.00	1.0000
API Visualization and Analytics Machines	0.00129869	(Insufficient)	0.00	1.0000
Application Data Recorder	0.00054663	(Insufficient)	0.00	1.0000
Blockchain Layer Machine	0.00	(Insufficient)	0.00	0.00
Blockchain Layer Machines	0.00025940	(Correlated)	0.00	0.3500
Blockchain Nodes	0.00172199	(Insufficient)	0.00	1.0000
Build Deploy Scale API Machine	0.00	(Insufficient)	0.00	0.00
Communication Protocol	0.00625822	(Insufficient)	0.00	1.0000
Connect API to Data Source Machine	0.00	(Insufficient)	0.00	0.00
Cryptographic Services	0.00568532	(Insufficient)	0.00	1.0000
Develop and Compose API Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Data Connectivity Checker	0.00	(Insufficient)	0.00	0.00
Enterprise Secure Connectivity Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Security Machine	0.00	(Insufficient)	0.00	0.00
Event Distribution	0.00767890	(Insufficient)	0.00	1.0000
Ledger 2	0.00793056	(Insufficient)	0.00	1.0000
Ledger Machines	0.00176887	(Insufficient)	0.00	1.0000
Log Data Recorder	0.00053026	(Insufficient)	0.00	1.0000
Membership Services	0.00756481	(Insufficient)	0.00	1.0000
Monitor and Debug API Machine	0.00	(Insufficient)	0.00	0.00
Monitor Runtime Health Machine	0.00	(Insufficient)	0.00	0.00
Monitoring and Analytic Collection Machine	0.00	(Insufficient)	0.00	0.00
Peer Provider Cloud Machine	0.00078849	(Insufficient)	0.00	1.0000
Pool1	0.00	(Insufficient)	0.00	0.00
Provider Cloud Portal Services Machines	0.00032656	(Insufficient)	0.00	1.0000
Provision Syatem Resources	0.00	(Insufficient)	0.00	0.00
Routing Layer Machine	0.00164660	(Insufficient)	0.00	1.0000
Scale the Enviroment Machine	0.00	(Insufficient)	0.00	0.00
Secure Runtime Enviroment	0.00732319	(Insufficient)	0.00	1.0000
Smart Contracts	0.00726023	(Insufficient)	0.00	1.0000

Unnamed Project

Replications: 1 Time Units: Hours

Resource**Usage**

Instantaneous Utilization	Average	Half Width	Minimum Value	Maximum Value
Traffic Control Machine1	0.00	(Insufficient)	0.00	0.00
Transactional Data Recorder	0.00058606	(Insufficient)	0.00	1.0000
Transactions	0.00735346	(Insufficient)	0.00	1.0000
Transformation Machine	0.00	(Insufficient)	0.00	0.00
Unified Polyglot API Execution Environment Machine	0.00	(Insufficient)	0.00	0.00
Virtual Chain Layer Machines	0.00174896	(Insufficient)	0.00	1.0000
Workload Optimization Machine	0.00	(Insufficient)	0.00	0.00

Resource

Usage

Number Busy	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal Machine	0.00165540	(Insufficient)	0.00	1.0000
API Developer Toolkit Machines	0.01396123	(Insufficient)	0.00	1.0000
API Gateway Machines	0.00044433	(Insufficient)	0.00	1.0000
API Management Machines	0.00102762	(Insufficient)	0.00	1.0000
API Policy Enforcement Machine	0.00	(Insufficient)	0.00	0.00
API Runtime Machines	0.00173091	(Insufficient)	0.00	1.0000
API Visualization and Analytics Machines	0.00129869	(Insufficient)	0.00	1.0000
Application Data Recorder	0.00054663	(Insufficient)	0.00	1.0000
Blockchain Layer Machine	0.00	(Insufficient)	0.00	0.00
Blockchain Layer Machines	0.00518807	(Correlated)	0.00	7.0000
Blockchain Nodes	0.03443973	(Insufficient)	0.00	20.0000
Build Deploy Scale API Machine	0.00	(Insufficient)	0.00	0.00
Communication Protocol	0.00625822	(Insufficient)	0.00	1.0000
Connect API to Data Source Machine	0.00	(Insufficient)	0.00	0.00
Cryptographic Services	0.00568532	(Insufficient)	0.00	1.0000
Develop and Compose API Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Data Connectivity Checker	0.00	(Insufficient)	0.00	0.00
Enterprise Secure Connectivity Machine	0.00	(Insufficient)	0.00	0.00
Enterprise Security Machine	0.00	(Insufficient)	0.00	0.00
Event Distribution	0.00767890	(Insufficient)	0.00	1.0000
Ledger 2	0.00793056	(Insufficient)	0.00	1.0000
Ledger Machines	0.00176887	(Insufficient)	0.00	1.0000
Log Data Recorder	0.00053026	(Insufficient)	0.00	1.0000
Membership Services	0.00756481	(Insufficient)	0.00	1.0000
Monitor and Debug API Machine	0.00	(Insufficient)	0.00	0.00
Monitor Runtime Health Machine	0.00	(Insufficient)	0.00	0.00
Monitoring and Analytic Collection Machine	0.00	(Insufficient)	0.00	0.00
Peer Provider Cloud Machine	0.00078849	(Insufficient)	0.00	1.0000
Pool1	0.00	(Insufficient)	0.00	0.00
Provider Cloud Portal Services Machines	0.00163278	(Insufficient)	0.00	5.0000
Provision Syatem Resources	0.00	(Insufficient)	0.00	0.00
Routing Layer Machine	0.00164660	(Insufficient)	0.00	1.0000

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Category Overview

Ocak 17, 2019

Unnamed Project

Replications: 1 Time Units: Hours

Resource

Usage

Number Busy	Average	Half Width	Minimum Value	Maximum Value
Traffic Control Machine1	0.00	(Insufficient)	0.00	0.00
Transactional Data Recorder	0.00058606	(Insufficient)	0.00	1.0000
Transactions	0.00735346	(Insufficient)	0.00	1.0000
Transformation Machine	0.00	(Insufficient)	0.00	0.00
Unified Polyglot API Execution Environment Machine	0.00	(Insufficient)	0.00	0.00
Virtual Chain Layer Machines	0.00174896	(Insufficient)	0.00	1.0000
Workload Optimization Machine	0.00	(Insufficient)	0.00	0.00

Resource

Usage

Scheduled Utilization	Value
API Developer Portal Machine	0.00165540
API Developer Toolkit Machines	0.01396123
API Gateway Machines	0.00044433
API Management Machines	0.00102762
API Policy Enforcement Machine	0.00
API Runtime Machines	0.00173091
API Visualization and Analytics Machines	0.00129869
Application Data Recorder	0.00054663
Blockchain Layer Machine	0.00
Blockchain Layer Machines	0.00025940
Blockchain Nodes	0.00172199
Build Deploy Scale API Machine	0.00
Communication Protocol	0.00625822
Connect API to Data Source Machine	0.00
Cryptographic Services	0.00568532
Develop and Compose API Machine	0.00
Enterprise Data Connectivity Checker	0.00
Enterprise Secure Connectivity Machine	0.00
Enterprise Security Machine	0.00
Event Distribution	0.00767890
Ledger 2	0.00793056
Ledger Machines	0.00176887
Log Data Recorder	0.00053026
Membership Services	0.00756481
Monitor and Debug API Machine	0.00
Monitor Runtime Health Machine	0.00
Monitoring and Analytic Collection Machine	0.00
Peer Provider Cloud Machine	0.00078849
Pool1	0.00
Provider Cloud Portal Services Machines	0.00032656
Provider Cloud Portal Services Machines	0.00

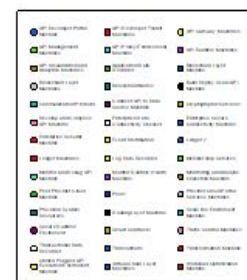
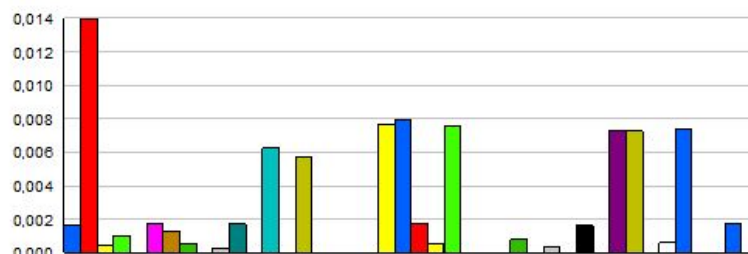
Unnamed Project

Replications: 1 Time Units: Hours

Resource

Usage

Scheduled Utilization	Value
Traffic Control Machine1	0.00
Transactional Data Recorder	0.00058606
Transactions	0.00735346
Transformation Machine	0.00
Unified Polyglot API Execution Environment Machine	0.00
Virtual Chain Layer Machines	0.00174896
Workload Optimization Machine	0.00



Resource

Usage

Total Number Seized	Value
API Developer Portal Machine	81.0000
API Developer Toolkit Machines	11.0000
API Gateway Machines	22.0000
API Management Machines	47.0000
API Policy Enforcement Machine	0.00
API Runtime Machines	81.0000
API Visualization and Analytics Machines	62.0000
Application Data Recorder	26.0000
Blockchain Layer Machine	0.00
Blockchain Layer Machines	252.00
Blockchain Nodes	28.0000
Build Deploy Scale API Machine	0.00
Communication Protocol	5.0000
Connect API to Data Source Machine	0.00
Cryptographic Services	5.0000
Develop and Compose API Machine	0.00
Enterprise Data Connectivity Checker	0.00
Enterprise Secure Connectivity Machine	0.00
Enterprise Security Machine	0.00
Event Distribution	6.0000
Ledger 2	6.0000
Ledger Machines	86.0000
Log Data Recorder	26.0000
Membership Services	6.0000
Monitor and Debug API Machine	0.00
Monitor Runtime Health Machine	0.00
Monitoring and Analytic	0.00

Arena gives a myriad of outputs for Resource Usage but the most important here is the Scheduled Utilization of the Resources. This gives the utilization of all the resources in the Model. The bottom is the output – It can be observed that the API Developer Toolkit and ledger 2 is used up for a maximum time while the utilization of other resources is very less comparatively.

Unnamed Project

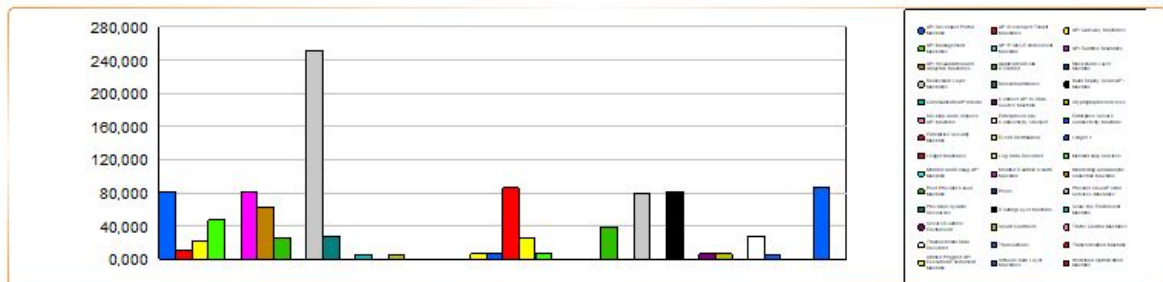
Replications: 1 Time Units: Hours

Resource**Usage**

Total Number Seized

Value

Traffic Control Machine1	0.00
Transactional Data Recorder	27.0000
Transactions	5.0000
Transformation Machine	0.00
Unified Polyglot API Execution	0.00
Enviroment Machine	
Virtual Chain Layer Machines	86.0000
Workload Optimization Machine	0.00

**User Specified****Counter**

Count

Value

Counter 1	3330.00
-----------	---------

4.2 Interpretations

It is observed that the API Developer Tool and the Ledger 2 systems have ;

- High Utilization
- Number Busy

Also, the packets spend more time than twice the time waiting in the queues as compared to the time when they are being served.

The Efficiency of Blockchain Integrated Network System would increase when the average total time spent by a packet would decrease. According to the above interpretations, it can be concluded that some improvements in the above two recourses are needed in order to reduce the average time in the system.

Improving the System

As mentioned in the interpretations, the API Developer Toolkit and Ledger 2 resources have the maximum utilization and longest queues on an average. Hence to reduce the average total time in the system, we can increase the capacity of the API Developer Toolkit and Ledger 2 resource. To do this economically the resource for API Developer Toolkit should be cross-trained to serve Ledger 2 as well. This would help in balancing the utilization of the resources and reduce the waiting time in the long queues.

As far as the changes in the system flow are connected, there is one change that can increase the efficiency of the system. Instead of having another resource for packets, Blockchain Integrated Network System can have two API Developer Toolkit and both of these resources can serve velocity to the packets there itself. As most of the velocity of flows available at Blockchain Integrated Network System is readily available and doesn't require any preparation. This is a feasible option. The model was renovated with the above suggestions and here is a glimpse of the new model.

Changes ;

1. The capacity of API Developer Toolkit Machine increased to 5
2. The capacity of the Ledger 2 system increased to 5.

Resource - Basic Process									
	Name	Type	Capacity	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
20	Monitor and Debug API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
21	API Policy Enforcement Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
22	Enterprise Security Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
23	Traffic Control Machine1	Fixed Capacity	2	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
24	Workload Optimization Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
25	Monitoring and Analytic Collection Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
26	Unified Polyglot API Execution Enviroment Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
27	Provision Syatem Resources	Fixed Capacity	2	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
28	Monitor Runtime Health Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
29	Scale the Enviroment Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
30	Peer Provider Cloud Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
31	Blockchain Layer Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
32	Routing Layer Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
33	Ledger Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
34	Virtual Chain Layer Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
35	Provider Cloud Portal Services Machines	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
36	API Developer Toolkit Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
37	API Gateway Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
38	API Management Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
39	API Visualization and Analytics Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
40	API Developer Portal Machine	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
41	API Runtime Machines	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
42	Blockchain Layer Machines	Fixed Capacity	20	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>

Resource - Basic Process									
	Name	Type	Capacity	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
1	Pool1	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
2	Event Distribution	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
3	Membership Services	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
4	Communication Protocol	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
5	Cryptographic Services	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
6	Secure Runtime Enviroment	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
7	Transactions	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
8	Smart Contracts	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
9	Ledger 2	Fixed Capacity	5	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
10	Blockchain Nodes	Fixed Capacity	20	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
11	Enterprise Secure Connectivity Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
12	Transformation Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
13	Enterprise Data Connectivity Checker	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
14	Transactional Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
15	Application Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
16	Log Data Recorder	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
17	Develop and Compose API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
18	Connect API to Data Source Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
19	Build Deploy Scale API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
20	Monitor and Debug API Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
21	API Policy Enforcement Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
22	Enterprise Security Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
23	Traffic Control Machine1	Fixed Capacity	2	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>
24	Workload Optimization Machine	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>

Result

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00	(Insufficient)	0.00	0.00
Auditors	0.00	(Insufficient)	0.00	0.00
Business Users	0.00	(Insufficient)	0.00	0.00
Developers	0.00	(Insufficient)	0.00	0.00
Operators	0.00	(Insufficient)	0.00	0.00
NVA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.02297654	(Insufficient)	0.01468110	0.03287127
Auditors	0.02192464	(Insufficient)	0.01432929	0.04581373
Business Users	0.01781568	(Insufficient)	0.00027314	0.04156517
Developers	0.02236323	(Insufficient)	0.00168646	0.03889081
Operators	0.01906201	(Insufficient)	0.00206164	0.03335109
Wait Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.3557	(Insufficient)	0.00	3.3492
Auditors	0.00906512	(Insufficient)	0.00	0.06807771
Business Users	0.01463722	(Insufficient)	0.00	0.0913
Developers	0.00535685	(Insufficient)	0.00	0.04762226
Operators	0.01484741	(Insufficient)	0.00026271	0.1057
Transfer Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00233758	(Insufficient)	0.00135875	0.00316094
Auditors	0.00233227	(Insufficient)	0.00149357	0.00351949

Unnamed Project

Replications: 1 Time Units: Hours

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal Machines.Queue	0.00	(Insufficient)	0.00	0.00
API Developer Toolkit.Queue	0.03198266	(Insufficient)	0.00	0.0937
API Gateway.Queue	0.00007462	(Insufficient)	0.00	0.00085648
API Management.Queue	0.00026928	(Insufficient)	0.00	0.00158399
API Runtime.Queue	0.00049158	(Insufficient)	0.00	0.00222508
API Visualization and Analytics.Queue	0.00004300	(Insufficient)	0.00	0.00029270
Blockchain Layer.Queue	0.00	(Insufficient)	0.00	0.00
Blockchain Network.Queue	0.00000003	(Insufficient)	0.00	0.00000217
Enterprise Data.Queue	0.00000137	(Insufficient)	0.00	0.00008276
Ledger.Queue	0.00003777	(Insufficient)	0.00	0.00024011
Peer Provider Cloud.Queue	0.00018042	(Insufficient)	0.00	0.00099757
Provider Cloud Portal Service.Queue	0.00000453	(Insufficient)	0.00	0.00025208
Route 1.Queue	0.00085829	(Insufficient)	0.00	0.01096754
Route 2.Queue	0.00377283	(Insufficient)	0.00	0.04762226
Route 3.Queue	0.2234	(Insufficient)	0.00	3.3492
Route 4.Queue	0.06312072	(Insufficient)	0.00	0.7776
Route 5.Queue	0.00707578	(Insufficient)	0.00	0.0943
Routing Layer.Queue	0.00211338	(Insufficient)	0.00	0.00571886
Virtual Chain Layer.Queue	0.00072198	(Insufficient)	0.00	0.00324894

Other

The mistake was made by me. I changed the API Portal machines capacities, not the API Toolkit Machines capacity. Then I changed by right way then see the results as you see ;

Unnamed Project

Replications: 1 Time Units: Hours

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00	(Insufficient)	0.00	0.00
Auditors	0.00	(Insufficient)	0.00	0.00
Business Users	0.00	(Insufficient)	0.00	0.00
Developers	0.00	(Insufficient)	0.00	0.00
Operators	0.00	(Insufficient)	0.00	0.00
NVA Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.02093169	(Insufficient)	0.01271197	0.02777133
Auditors	0.02539673	(Insufficient)	0.00154004	0.04335336
Business Users	0.01828930	(Insufficient)	0.00027314	0.03569877
Developers	0.02098550	(Insufficient)	0.01703686	0.02674327
Operators	0.01962572	(Insufficient)	0.00206164	0.03949383
Wait Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.1166	(Insufficient)	0.00	0.5541
Auditors	0.00215835	(Insufficient)	0.00	0.01176936
Business Users	0.00656440	(Insufficient)	0.00	0.01456918
Developers	0.02130900	(Insufficient)	0.00	0.1941
Operators	0.00743987	(Insufficient)	0.00026271	0.01482459
Transfer Time	Average	Half Width	Minimum Value	Maximum Value
Administrators	0.00235587	(Insufficient)	0.00211631	0.00306364

Administrator waiting time decreased.

Unnamed Project

Replications: 1 Time Units: Hours

Queue**Time**

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
API Developer Portal	0.00051026	(Insufficient)	0.00	0.00235594
Machines.Queue				
API Developer Toolkit.Queue	0.00021744	(Insufficient)	0.00	0.00304414
API Gateway.Queue	0.00009060	(Insufficient)	0.00	0.00090287
API Management.Queue	0.00010674	(Insufficient)	0.00	0.00089455
API Runtime.Queue	0.00004137	(Insufficient)	0.00	0.00028329
API Visualization and Analytics.Queue	0.00010105	(Insufficient)	0.00	0.00075126
Blockchain Layer.Queue	0.00	(Insufficient)	0.00	0.00
Blockchain Network.Queue	0.00066556	(Insufficient)	0.00	0.00675213
Enterprise Data.Queue	0.00000441	(Insufficient)	0.00	0.00016238
Ledger.Queue	0.00008113	(Insufficient)	0.00	0.00053058
Peer Provider Cloud.Queue	0.00016613	(Insufficient)	0.00	0.00099757
Provider Cloud Portal Service.Queue	0.00000470	(Insufficient)	0.00	0.00019762
Route 1.Queue	0.00077038	(Insufficient)	0.00	0.01015452
Route 2.Queue	0.01141133	(Insufficient)	0.00	0.1940
Route 3.Queue	0.00022537	(Insufficient)	0.00	0.00338060
Route 4.Queue	0.05580978	(Insufficient)	0.00	0.5541
Route 5.Queue	0.02823397	(Insufficient)	0.00	0.2707
Routing Layer.Queue	0.00209478	(Insufficient)	0.00	0.00598008
Virtual Chain Layer.Queue	0.00034113	(Insufficient)	0.00	0.00166614

Other

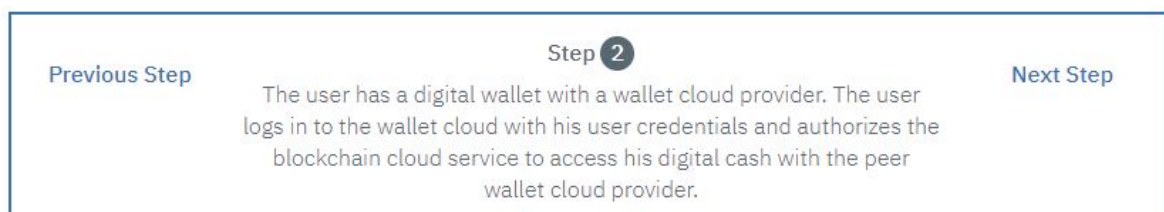
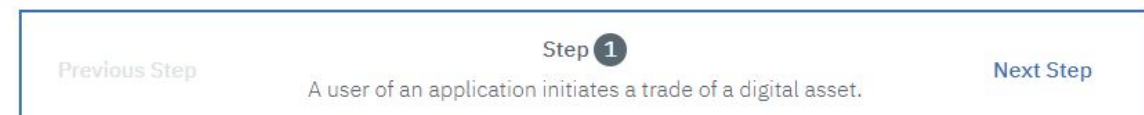
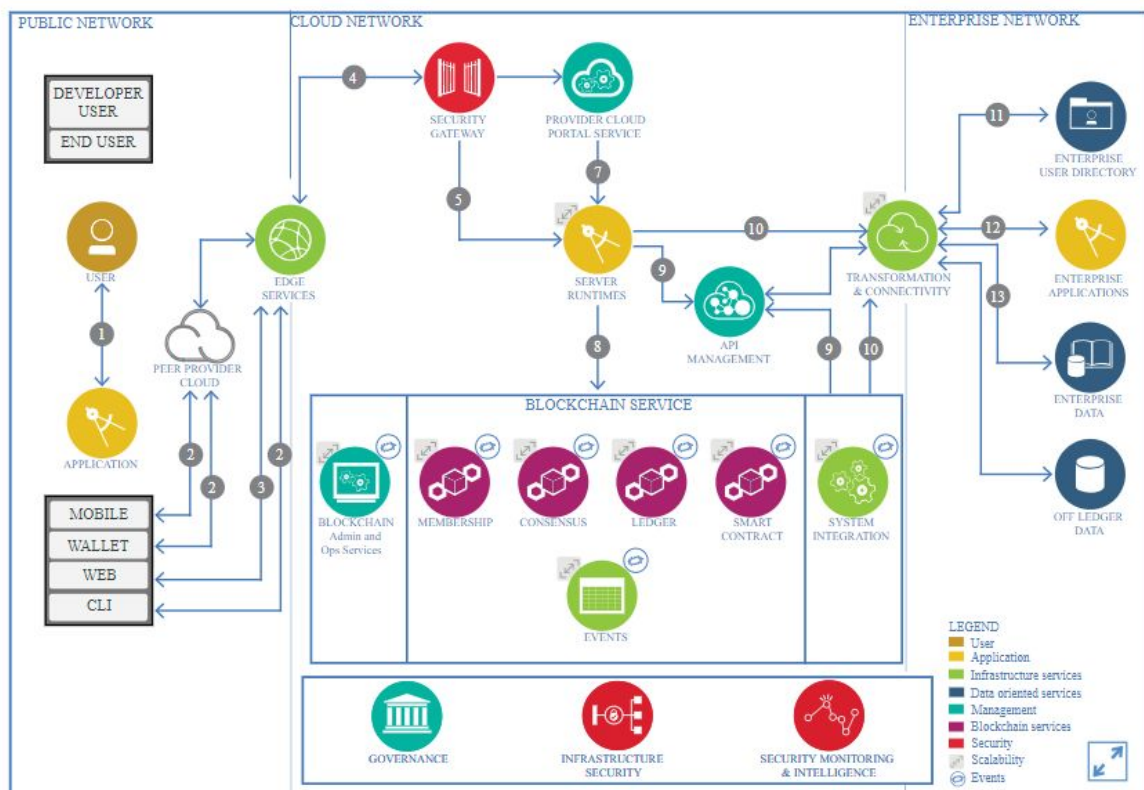
Also API Developer Toolkit waiting time is decreased.

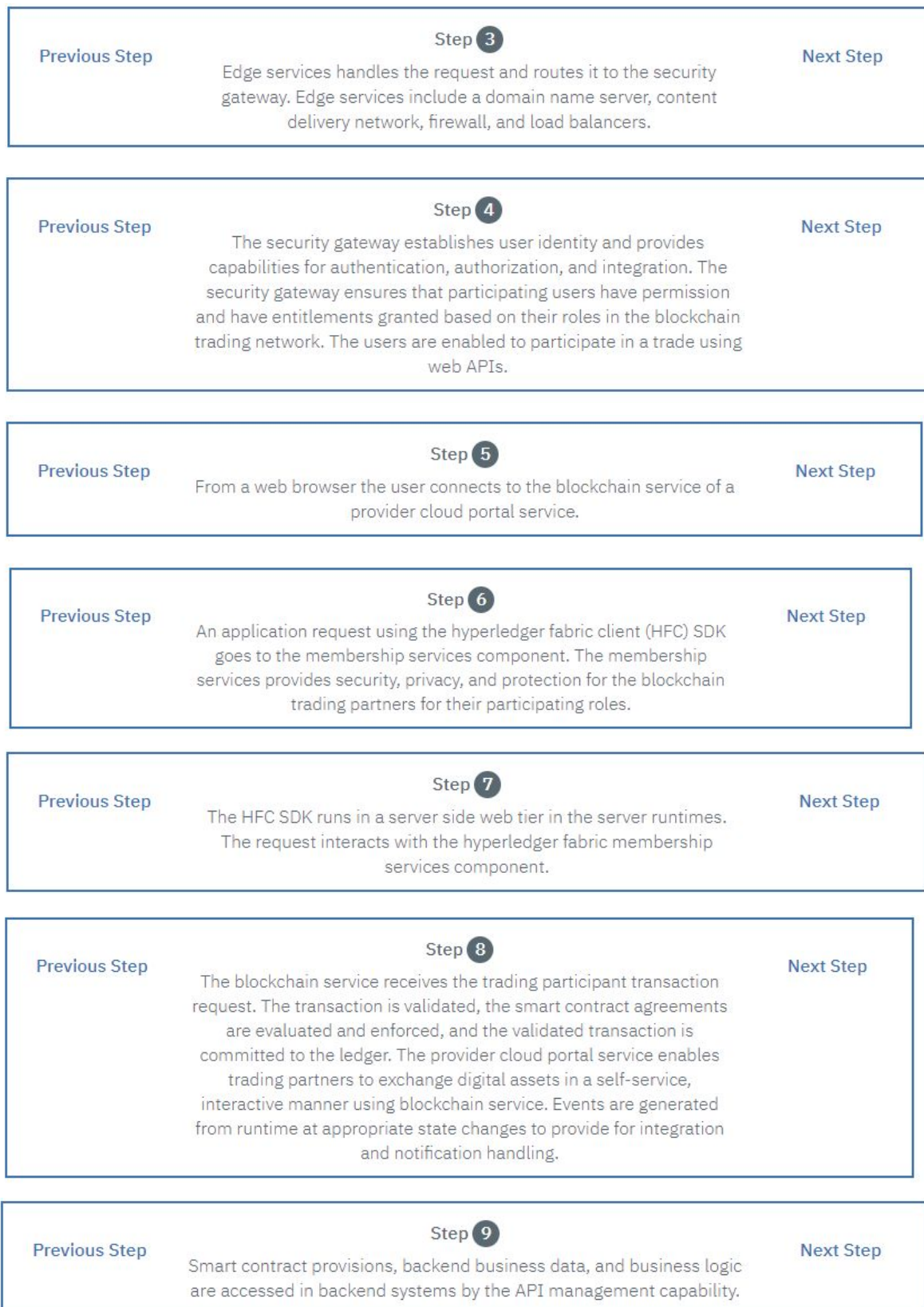
Conclusion

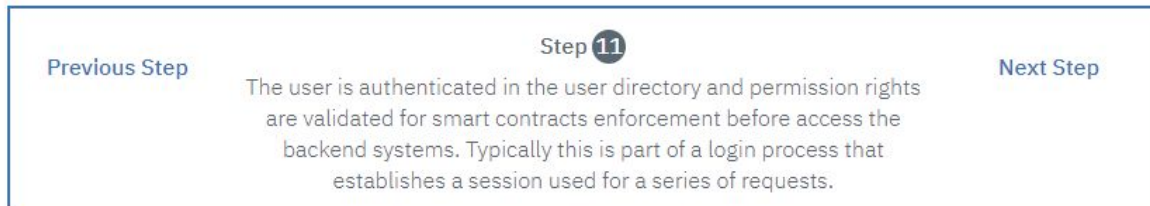
The aforementioned Blockchain Integrated Network System was modeled in ARENA Simulation Software and the results about the relevant parameters were generated. A deep analysis was done on the output results of Arena and it was observed that the average packet time in the system along 8 hours was large enough for Blockchain Integrated Network System to lose potential customers and downgrade the business. By probing into the flow of counters of the system, it was observed that the waiting time in the queue at the Api developer Toolkit was significantly large as compared to other queues. So, taking into consideration the resources available at this system a suggestion was made where the

packets would be served at the API Developer Toolkit itself and another 4 API Developer Toolkit added. To increase the efficiency economically, it was suggested that the server for Ledger 2 should be cross-trained to serve Ledger 2 as well. The new model was compared statistically. Hence, with certain suggested changes in the management and operations at this network, there can be an increase in their Business. Again, there can be ample suggestions on and modifications in the models to optimize the output bot economically and commercially; but we have discussed only two of them.

For the Blockchain Understanding







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