Dissertation Phase-IV Report on

Software simulator for Orbitstudio and System1

Submitted in partial fulfilment of the requirement for the degree of

MASTER OF TECHNOLOGY

(COMPUTER SCIENCE AND ENGINEERING)

Submitted by

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2020-2021

Dedicated to

my parents

Declaration

I, hereby declare that work reported in dissertation titled, **"Software Simulator for OrbitStudio and System1 "** submitted herein has been carried out by me in Baker Hughes, Mumbai and Department of Computer Science and Engineering, Walchand College of Engineering. The work is original and has not been submitted earlier as a whole or in part for the award of any degree/diploma at this or any other Institute/University.

Swarup Babaso Fule

Date: 19/08/2021

Certificate

This is to certify that the dissertation work entitled "Software Simulator for OrbitSudion and System1" submitted by **Swarup Babaso Fule (2019MTECSCO003)** in partial fulfillment of the requirement for the degree of "Master of Technology (Computer Science and Engineering)" is a record of his own work carried out under my supervision during the year 2020-21.

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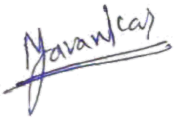

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The candidate has completed all the required phases of evaluation and he has performed satisfactorily. Hence, recommended for the partial fulfillment of the requirement for the said degree.

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Abstract

Keeping track of industrial machinery is important to ensure efficient working operation and to avoid future downtime of machine. The data which is collected from machines is highly complex and huge in size. For such data providing holistic view of machines is important. One web based application is proposed to resolve this issue under tag Enterprise Insight, Which is web based application which collects data from condition monitoring software. This document elaborate about EI software simulator. Which is used by developers of Enterprise insight to test this cloud, Web based application for real world scenarios. This software simulator is make to simulate 200 big enterprises which pushed to Enterprise Insight, also by using simulator developers can simulate real world and complex scenarios on which Enterprise insight will be tested. The simulator is made be online all the time which also simulate important concept called as continues integration and continues deployment(CI/CD). So simulator itself cooks the data and send it to enterprise insight.

Keywords: Condition monitoring, Azure cloud, CICD pipelines, micro-services , Data processing hubs.

A

Dissertation Proposal

On

Software simulator for Orbit60 Development

For the Degree of

Master of Technology

In

Computer Science and Engineering

Submitted by

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(2019MTECSCO003)

Under the Guidance of

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2020-21

CERTIFICATE

This is to certify that the dissertation work entitled "***Software simulator for Orbit60 Development"*** submitted by **"*Swarup Fule (2019MTECSCO003)* "** in partial fulfillment of the requirement for the degree of "***Master of Technology (Computer Science and Engineering)*"** is reviewed by DPGC and approved as the final dissertation work for degree of Masters of Technology during the academic year ***2020-21***.

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4. Broad Area : Asset Monitoring System

5. Title of the proposed dissertation

"Software simulator for Orbit60 Development "

6. Introduction

Fig- Orbit 60 firmware

An Orbit 60 is next generation machine monitoring and diagnostic system. with highly secure data transmission over channels. which supports over 6 million types of sensors that can easily configured with Orbit Studio. Orbit studio comes with following features.

1. Security and data isolation – built in data diode technology
2. More data handling for better decision making
3. High processing power
4. Distributed architecture
5. Has backward compatibility – Ie with ancestors System 1 and 3500 series
6. Provides firmware and software simulators for developers

Data in oil and gas industry –

Oil and gas industry provide huge amount of data. It will be nothing wrong to say data is more expensive that oil and gas itself. following is some mainly focusable fileds in oil and gas industry they are not complete list but this element has more significance.

1. Speed
2. Thrust
3. Vibration
4. Torque
5. Temperature
6. Operating time
7. Last Maintenance

and many more.

This data must be handled with care. because this data not only needed for better decision making but also to reduce redundant cost.

Built in Data diode technology

There is possibility that system may encounter malicious data. this data may be harmful to software which manages machines. hence new technology comes in picture data diode technology which will allow data flow in only one direction

7. Problem Statement

To add software simulator in system which generate similar data as original machinery does and provide it with highly secure channels to Orbit Studio System.

8. Significance

1. In order to modify system features the developer need machine data to work with. however, it is not always possible to get access of machinery because huge team is working on same problem.
2. If something went wrong it may damage machinery which cost millions and billions.
3. In some cases, developer may need to work only with small portion of data. i.e., like only temperature data
4. May cost you more

9. Literature Survey

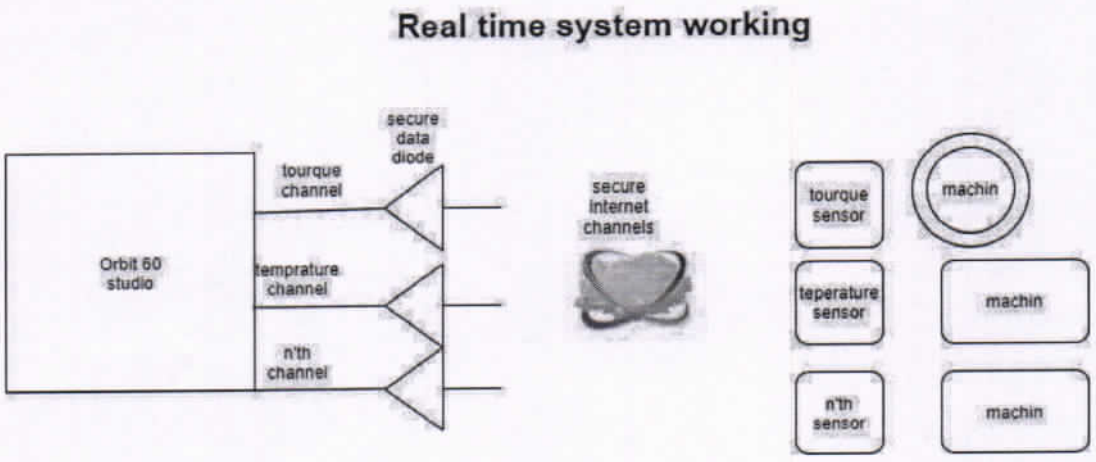

Fig: Realtime system working

Above shown the Realtime working of orbit 60 system. availability of sensor data is limited because few powerful orbits 60 system can able to handle huge amount of data. but in development phase each programmer may working on different data. hance it is not possible to provide sensor access to huge Orbit 60 developer community.

10. Objectives

Following are the objectives of the proposed dissertation work:

1. To understand oil and gas industry data sets.
2. To design or develop System which generate similar data as original machines does.
3. To implement secure channel based on data diode technology
4. To analyze and evaluate type of data.

11. Methodology

Data diode technology-

When malicious data enter into system it can flow back to the control system because there are two-way channels. can cause huge data as well as financial loss to organization

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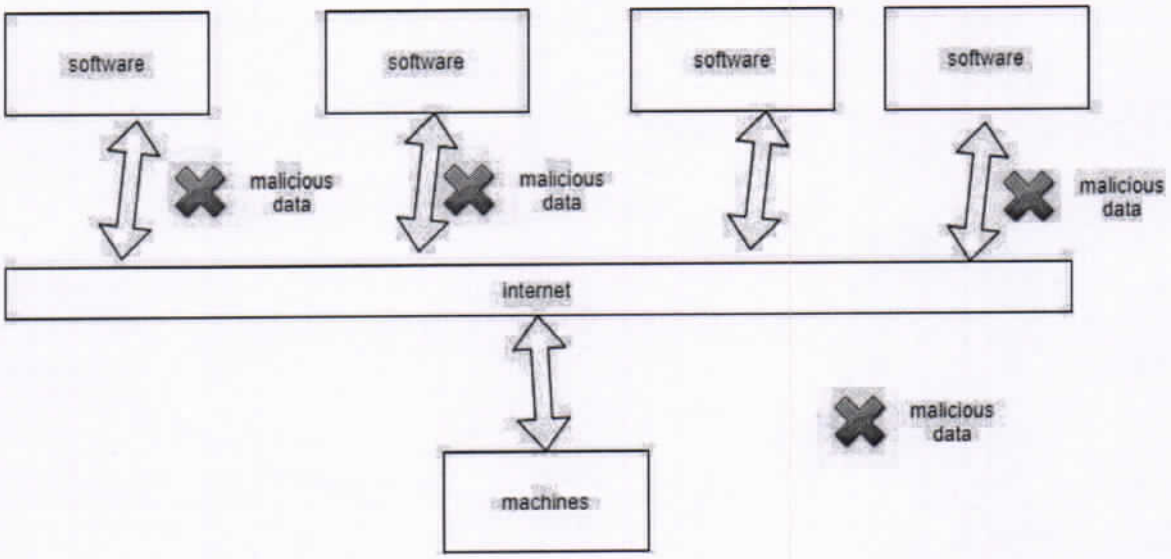


Above shown system without data diode technology.

Following is general data diode technology diagram which provide more security

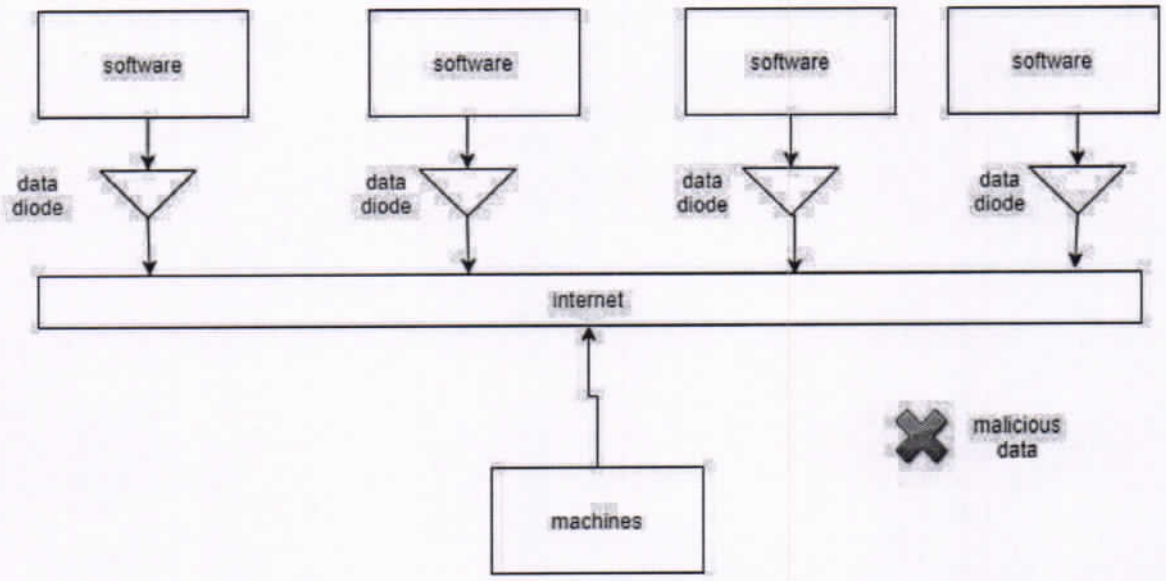


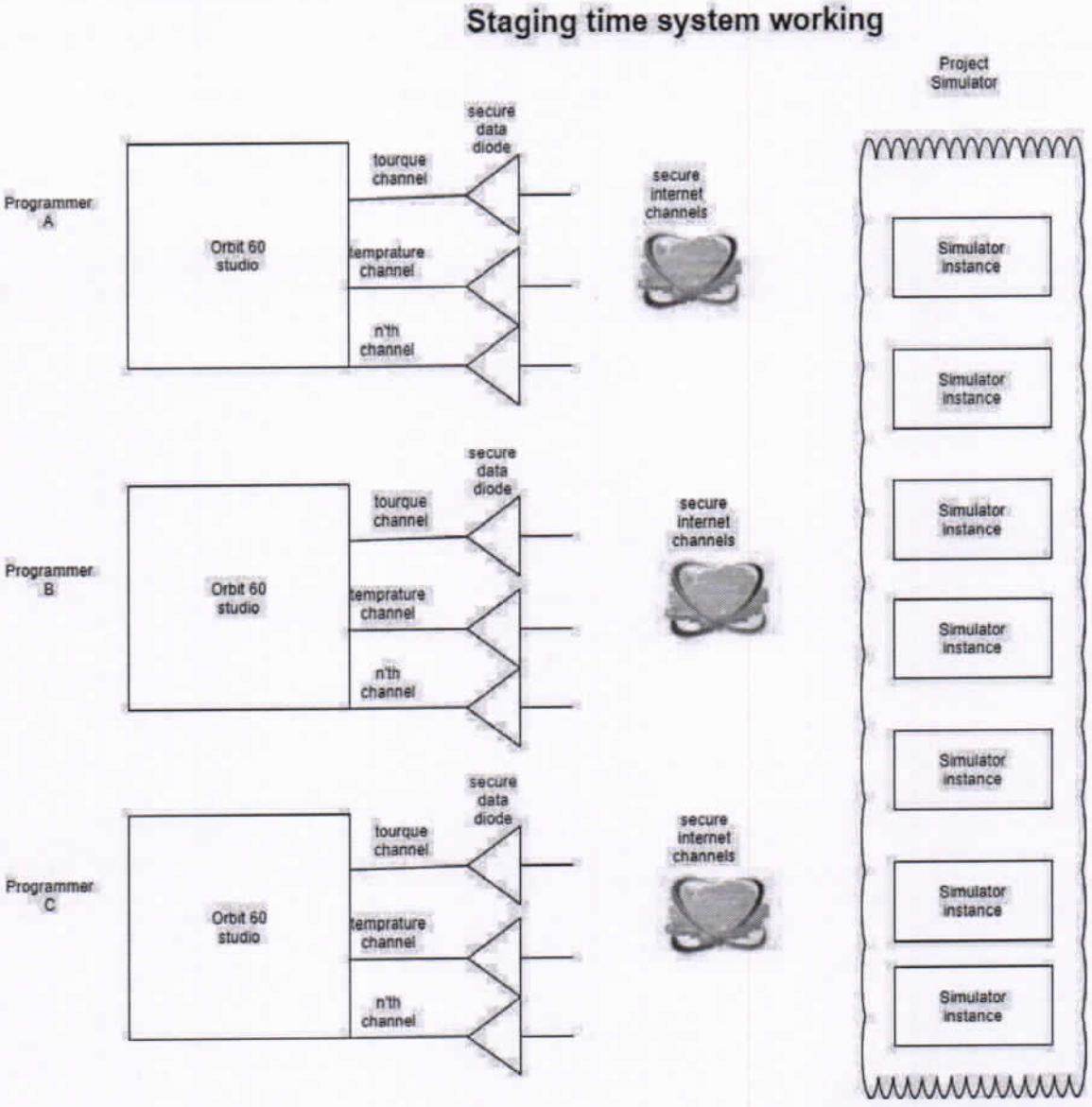
Fig: general data diode technology

Simulators-

Simulator need to provide following features to programmers/ developers

1. Infinite instance of machine data
2. Provide data which must be useful to specific area. i.e., if programmer is working on temperature module then simulator must generate more temperature specific data.
3. Should support wide range of sensor modules.
4. Provide secure channel to work with.
5. Generate data that can test every aspect of system.

Follow is sample scenario when system is in development phase



12. Place of Work:

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3.12.20

DR.M.A Shah
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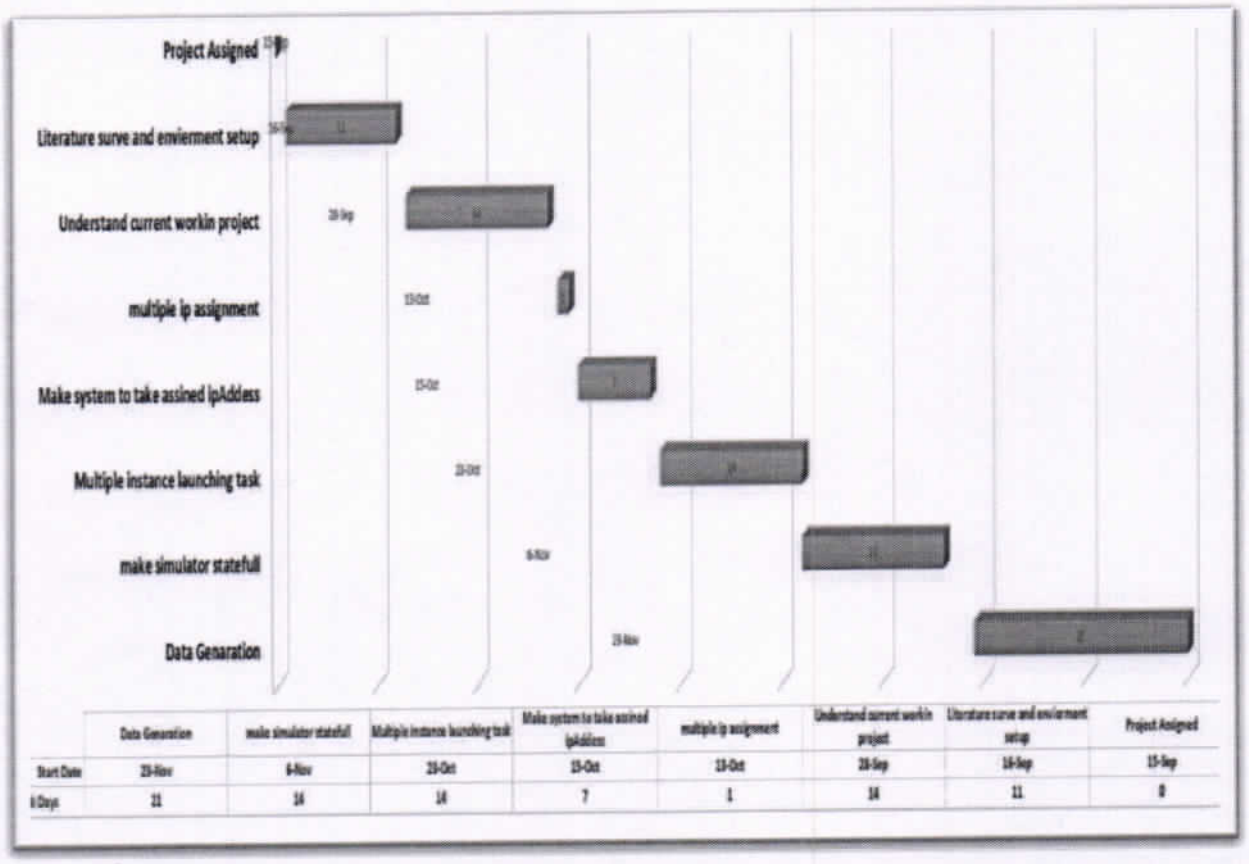
Gantt Chart



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List of Figures

Abbreviations

CM:	Condition Monitoring
CI:	Continues Integration
CD:	Continues Deployment
DAQ:	Data acquisition layer
DHP:	Data processing Hub
EI:	Enterprise Insight

Contents

Chapter 1

INTRODUCTION

Monitoring parameters and estimating condition of object is done by humans since while. To monitor health of machine GE provided software package name System1 which monitors the parameters of machine. Based on the parameters administrators have to take appropriate action, actions may include stopping rotating-moving part, switch on other mechanisms such as cooling, reporting to someone specific and many more.

The system 1 is condition monitoring software which is standalone application need to install on consumer's machines. Condition monitoring data is complex and were hard to interpret for common user. also because of being standalone application(System 1) availability of condition of machine is big concern. To resolve this issue one web based solution is proposed under tag Enterprise insight. The complex data is now pushed to cloud and Enterprise insight is responsible to make this data available to consumers in more holistic way. Because Enterprise insight pulls data from System 1 DAQ layer which internally gets data from sensors which located on actual machines, Simulating real-word scenarios was complex. The software simulator is cloud based solution which takes small portion of data from actual system 1 and simulate 200 enterprises which will serve to Enterprise insight to test EI as real-world entity.

Light weight - In-concern with data storage and all software simulator only runs logic on cloud pods and required files is fetched from azure file share.

Less time consuming - Simulator is online azure cloud all the time so pushing real enterprises to respected environments is as easy as changing connection string, then simulator will start pushing data to that particular environment.

Infinite instance - Horizontal as well as vertical scaling is possible for simulator.

1.1 Problem formulation

Software simulator improves productivity by mimicking the actual working of System, hence developers and testers now can work independently without waiting for machines to be allocated.

Before software simulator introduced, developers of Enterprise insight, test there application on actual machines and System 1. This was time consuming and simulating real-word scenarios is near to impossible.

Enterprise insight when launch, will deal with large number of huge real enterprises. Any application which deal with such huge data are now implemented using micro service architecture. For web based application each micro service need to be validate properly and sometimes isolated.

1.2 Objectives

1. To understand oil and gas industry data sets .
2. To design and develop System which simulate data.
3. To reproduce the System 1 real-time scenarios.
4. To understand type of data which affects system most.

Chapter 2

LITERATURE SURVEY

2.1 The traditional System 1 and Enterprise insight scenario

System 1 condition monitoring software by using its DAQ layer senses and represent condition of machine to users. The Enterprise insight on other hand pulls data from System 1 DAQ at specific time called as heartbeat. By using system 1 with real machine in several type of testings of Enterprise insight is very time consuming and lengthy task.

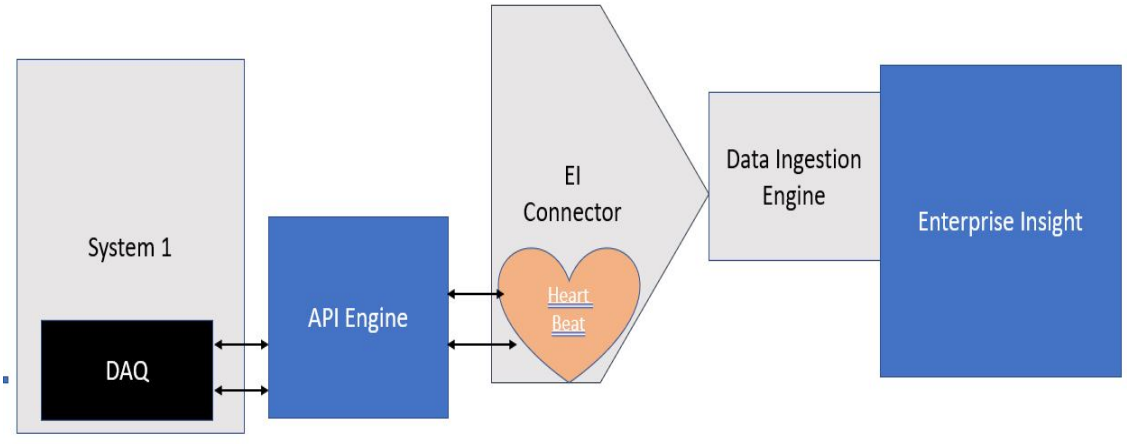

Figure 2.1: Enterprise Ingestion with connector.

Simulating real load is impossible - In this scenario developer can only follow testing with happy path. .

Can not get specific data - As original machines working on high cost and human resources interrupting machines to just get specific data is unrealistic .

Costly - Working with actual machines may result into high cost.

Time consuming - Making handshake with actual machine taking too much time

2.2 A new approach - Software simulator

One way to tackle above problems is to buy new set of machines which mimic original machine set, which is not realistic and easy. Another approach is create software implantation which mimic the actual machine working.

Simulation of real load - Software simulator let create as many as 200 enterprises with more than 5000 of assets and more than 5,00,000 alarm and system event each.

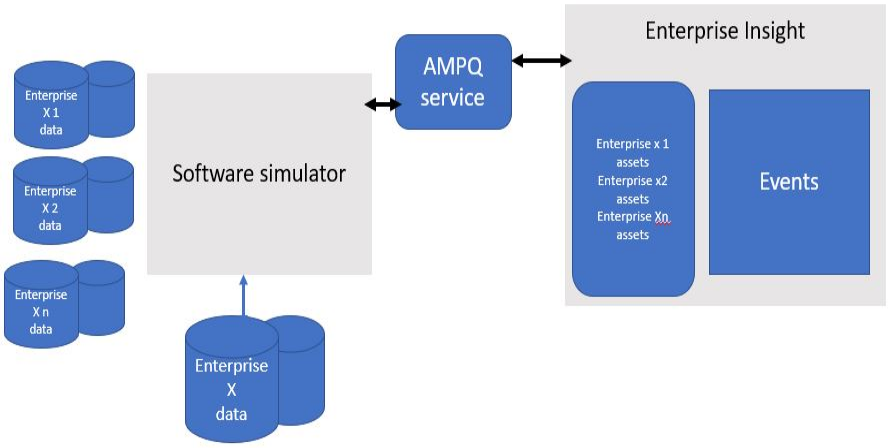

Figure 2.2: Software simulator scenario.

Chapter 3

METHODOLOGY

A software simulator is heavily micro-service based implantation which act as System 1 for Enterprise insight a web bast asset management portal.

3.1 Pillars of simulator

following are some key pillars for simulator working simulator

- Micro service architecture
- asynchronous message queuing protocol (AMQP)
- Azure fileshare

Above are tools and technique are heavily used in design and development of simulator. The micro service

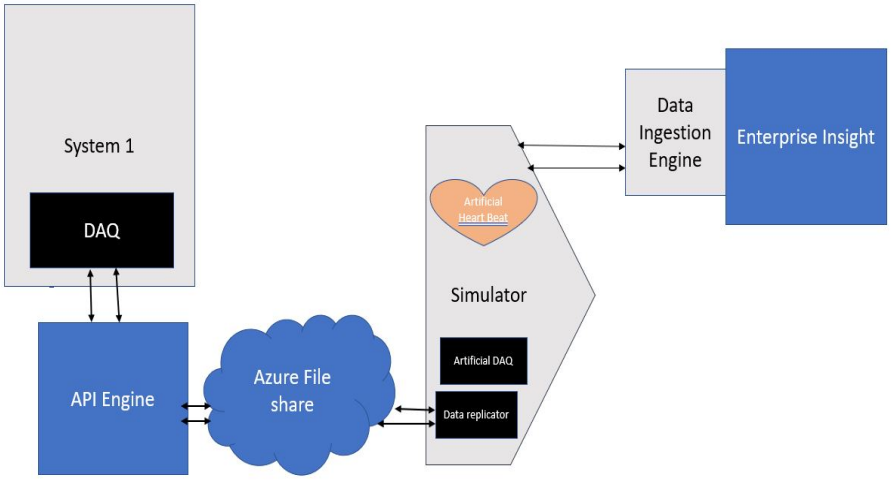

Figure 3.1: Proposed design.

Figure 3.1 elaborate software simulator as a System 1 for enterprise insight. Simulator stores and retrieves files from azure file share which is collected from System 1 DAQ.

3.1.1 Micro service architecture

There are two types of architecture any commercial software follows

- monolithic
- Micro service based

both service has its own advantages and disadvantages, because of scalability and to avoid tight coupling the micro service based architecture were used. In this particular scenario simulator use 3 service namely

- Asset service
- Event service
- Update event service (running 24/7)
- Updated asset service (running 24/7)

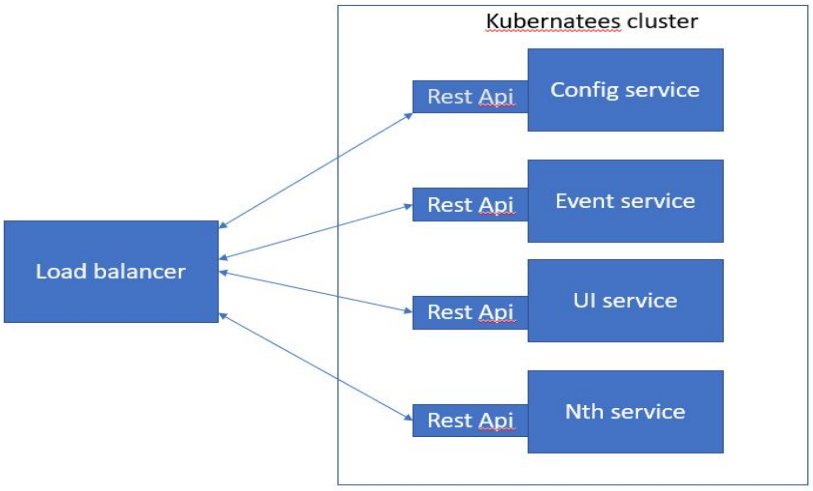

Figure 3.2: Simulator micro services.

3.1.2 AMQP protocol

Asynchronous messaging is another key concept used in simulator. To make any code usable now day asynchronous calls are getting popular. in AMQP the message is pushed to queue and then simulator only subscribe for that queue and it is free to do other stuffs. when some events occurs on that queue then simulator do appropriate actions this gives fill as simulator is working as real machine.

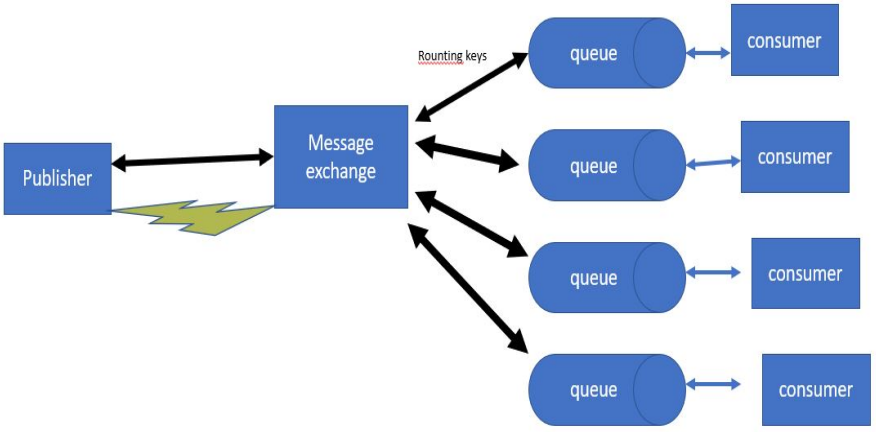

Figure 3.3: Proposed design.

3.1.3 Azure Fileshare

Simulator tackle large number of files and data which including asset data, events data, reguided data. which need to be store somewhere which should provide reasonable write and read time. A azure fileshare one such solution. Another reson to use azure fileshare is that simulator is running on cloud cluster so from cloud to cloud communication speed is very high

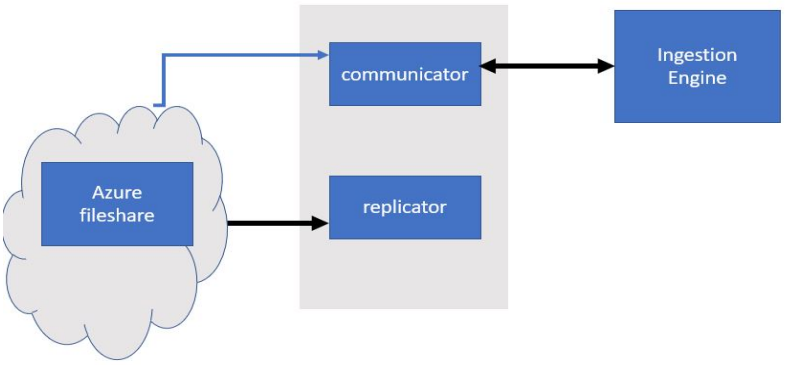

Figure 3.4: Azure fileshare with simulator.

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Chapter 4

RESULT AND ANALYSIS

4.1 Hardware configuration used in experimentation

1. Laptop/ Desktop

4.2 Software packages used in experimentation

1. Visual Studio 2019 professional
2. GE's System 1
3. Proxyfier tool if running in Virtual machine
4. Azure storage explorer
5. Virtual machines (if very huge Enterprise begin senf)
6. API Dhp communicator tool resources

4.3 Dataset

1. Asset files collected from System 1 DAQ
2. Event files collected from System 1 DAQ

4.4 Simulator pushed 10 Enterprises (Scaling)

BumbleBee is huge database with more than 5 Lakh events and arround 2050 asset. The simulator successfully pushed such 10 replications to enterprise insight

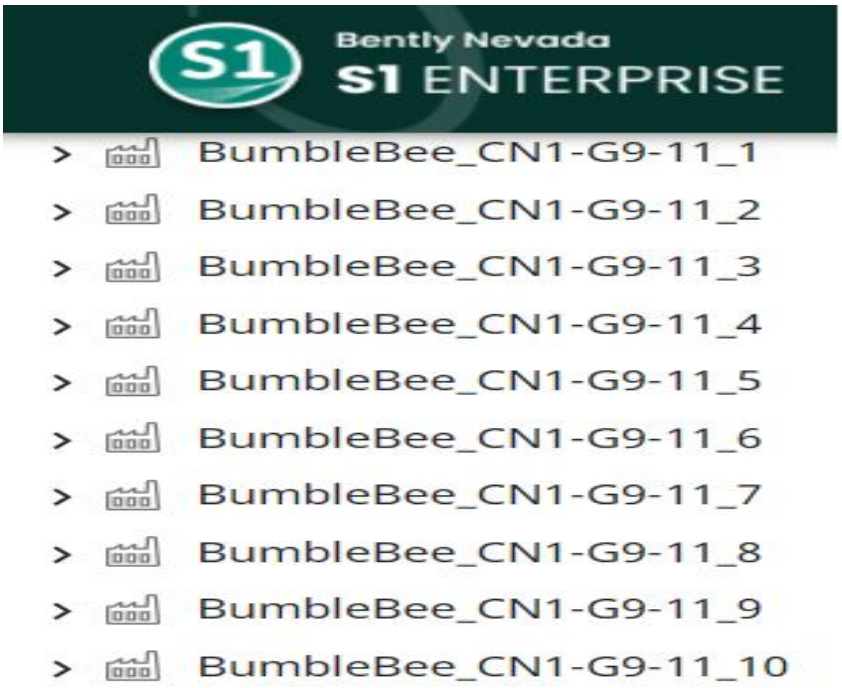

Figure 4.1: simulator 10 bumbleBee simulation.

4.5 Leaf level expansion of simulated Enterprise(accuracy)

To validate is enterprise simulated properly we need to expand till its leaf node level hierarchy of assets. If hierarchy is expanded till leaf node level then it is considered as sign of proper ingestion.

above figure show the configuration is retrieved after reloading of System

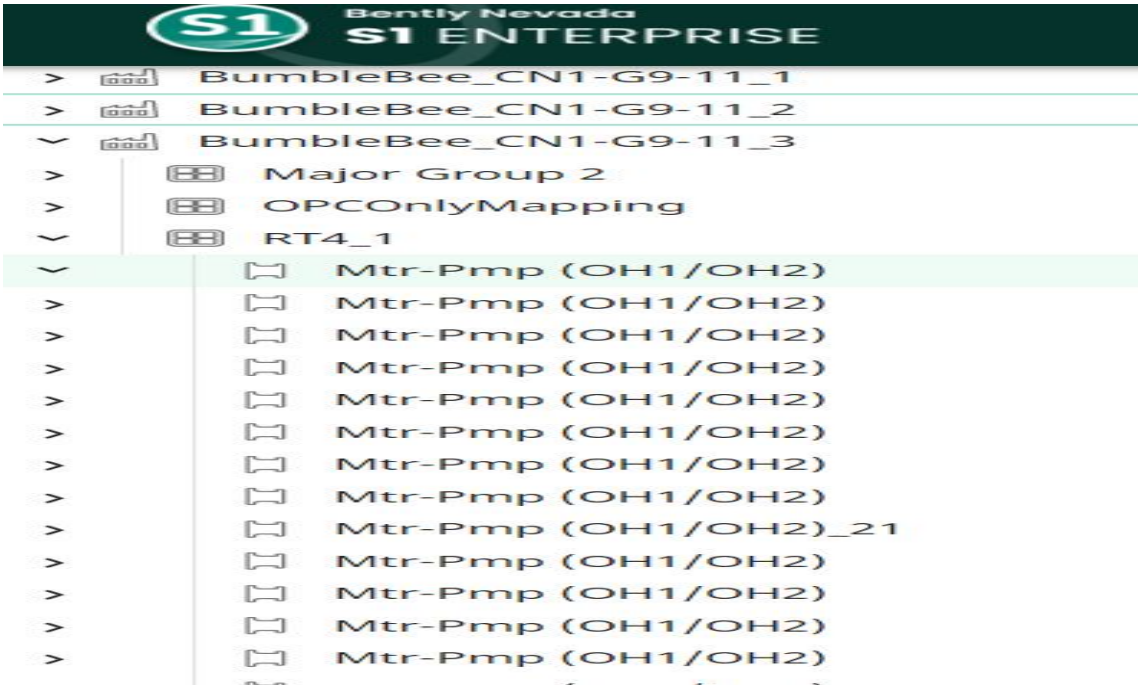

Figure 4.2: Leaf level expansion of simulated enterprise.

Chapter 5

CONCLUSION

Monitoring and interpreting machine condition has always been a great challenge. In this study, we proposed and demonstrated software simulator which can be work as system 1 DAQ which will serve to Enterprise insight. The simulator is made to simulate as much as 200 enterprises to test real world scenarios with Enterprise insight. Because of simulator dealing with real-world scenarios which will face by enterprise insight in future is tested and rectified with help of simulator before Enterprise insight become live. Simulator simulated 3 most important DHP's of system 1 viz. Asset DHP, Event DHP, Updated event and config DHP's and that is noted that simulator is properly pushing whole enterprises with connection between each asset is preserved and its validate by using real System 1. Generation update for sent enterprise gives feel to enterprise insight that it is receiving data from real system 1. This made possible by argocd pods. which generate update at interval of 10 percent of total number of assets in enterprise.

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