OAKION SYSTEMS

Distributed Computing
Network

WHO WE ARE

OAKION SYSTEMS – GROUP 9

- We specialize in Distributed Computing Solutions for the optimization of processing data across network infrastructures in the OT industry.
- Our solutions conforms to the latest trends of the industry and can be customized to our clients needs.
- We provide scalable, flexible and robust solutions for any companies business needs; large or small.

THE TEAM

OAKION SYSTEMS – GROUP 9

- CEO: Justin Singh
- CTO: Tony Tan
- CBO: Swimm Chan
- CSA: Aaron Nguyen
- CLI: Shawn Wang (Chief Lead Intern)



PURPOSE

Design, Develop, Integrate and Deploy a Solution to Optimize Data Processing in the OT Industry

4 Months

- Show the Potential for optimization
- Develop a Microservice Architecture System Implementation
- Theoretical Benchmarking
- Visualization of Performance
- Deployment of Current System

Figure 1 - Project Cycle[5]

BACKGROUND

Optigo Networks

- Targets the OT industry
- Provide network health analysis with a Software as a Service model

Oakion Systems

- Targets the OT industry
- Focuses primarily on software optimization solutions for cost efficiency

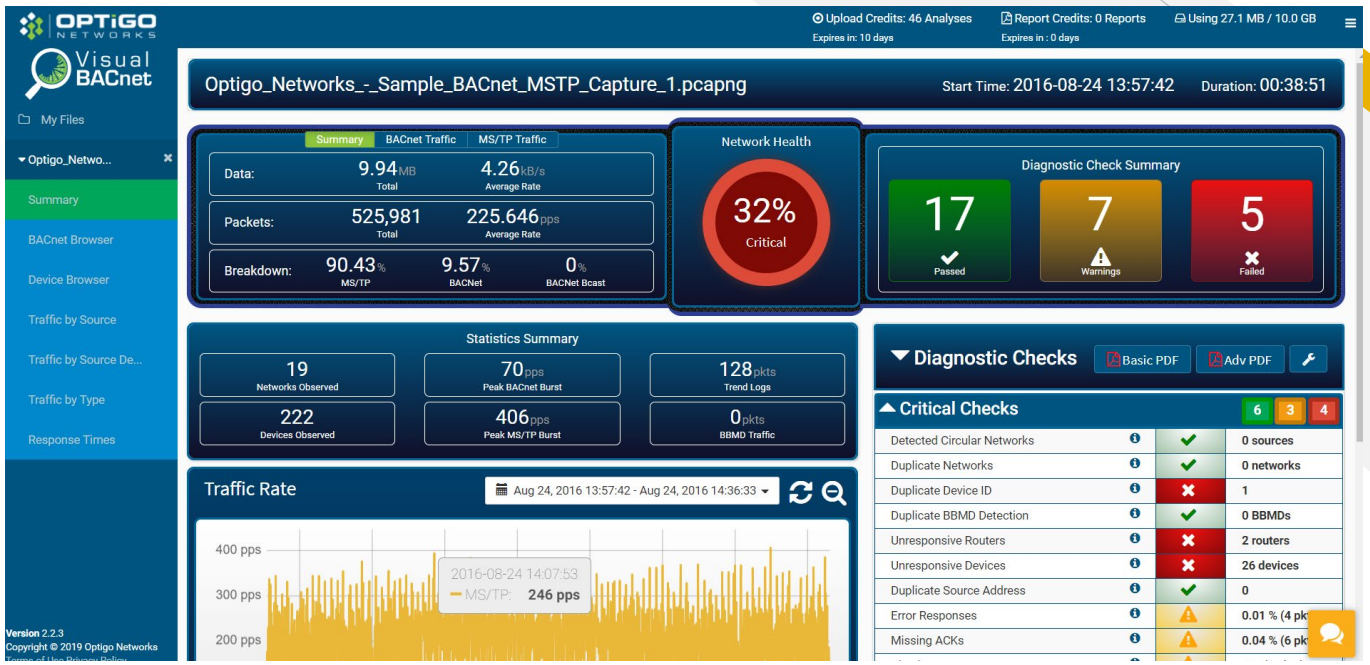


Figure 2 – Optigo's Visual BACnet

MOTIVATION

Flexible, Scalable and Robust Software Solutions

Oakion Systems

- The future is distributed
- Traditional monolithic software architecture is becoming obsolete
- It solves a real world computing problem

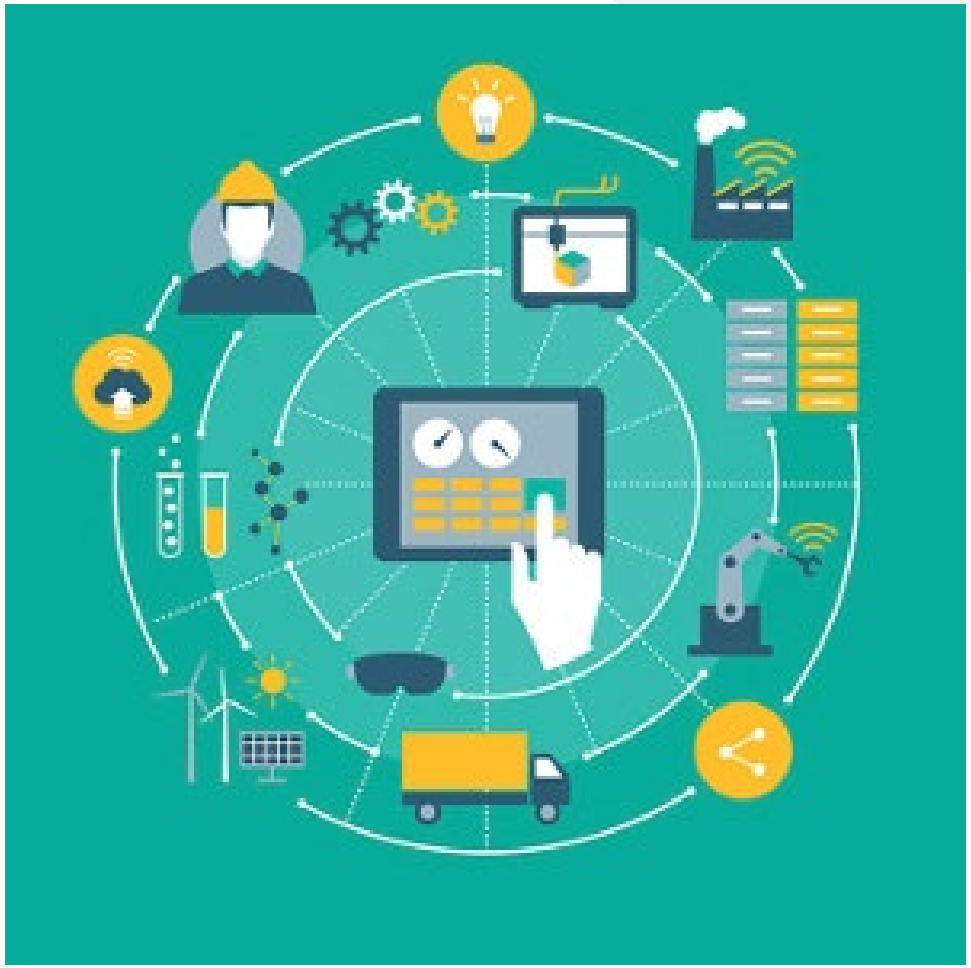
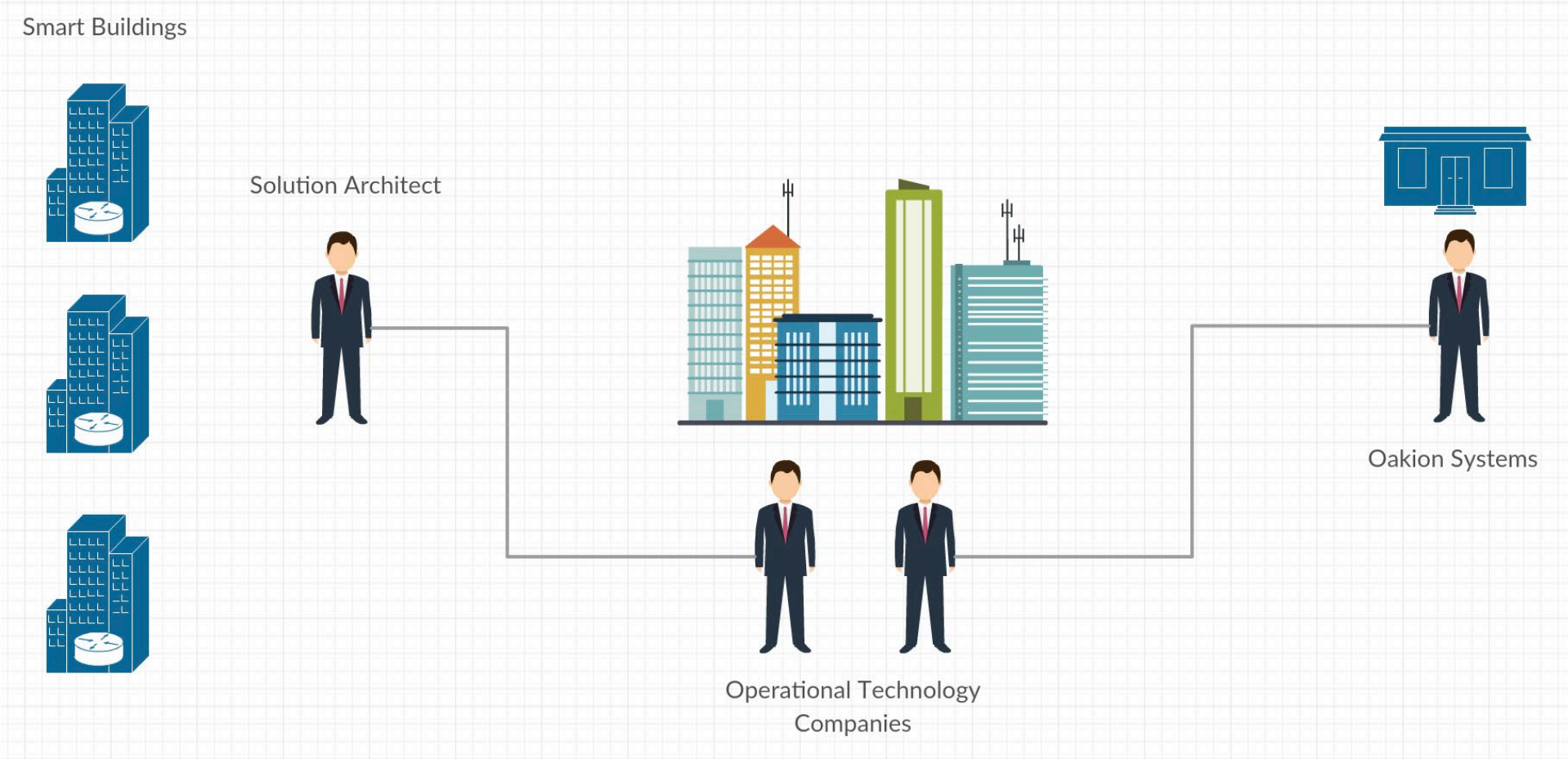


Figure 3 – IoT[1]

BUSINESS MODEL

- Market Analysis
- Competition



MARKET ANALYSIS

Ideal customers

Trackinno

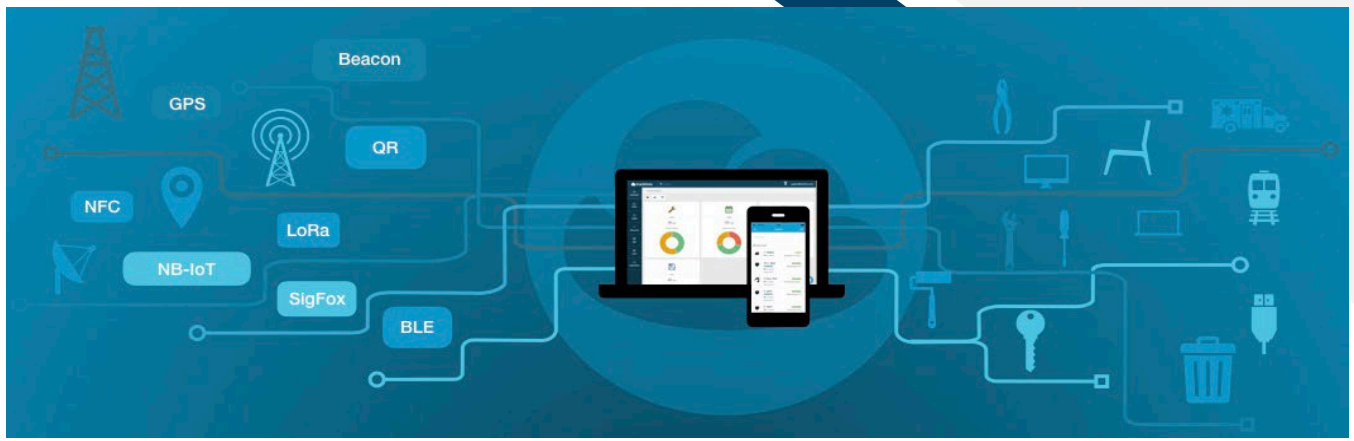
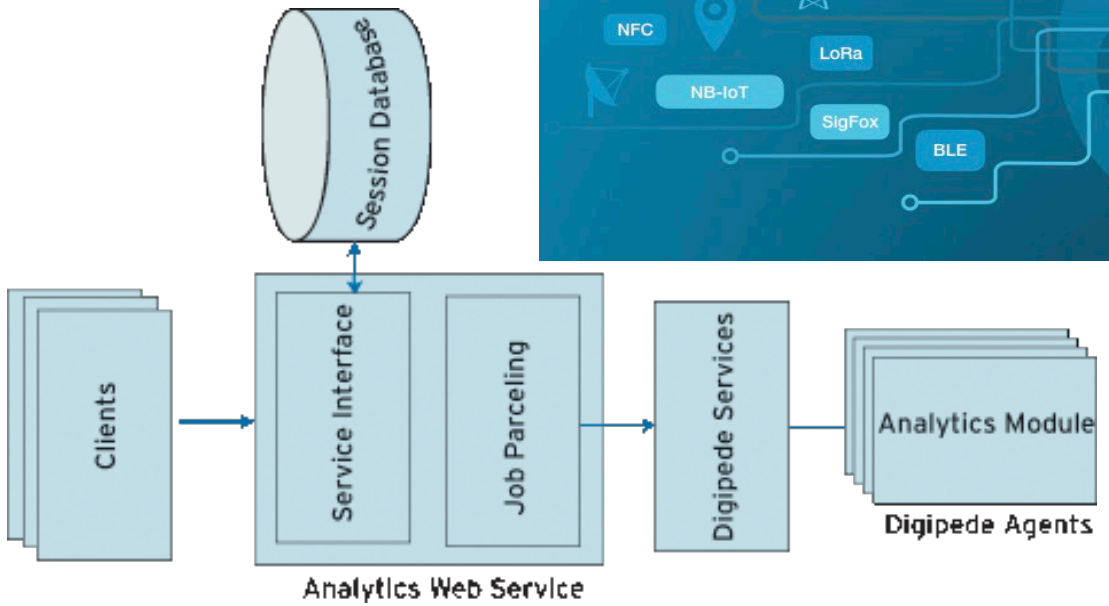


Figure 4 – Trackinno[7]



Digipede

Figure 5– Digipede[8]

COMPETITION

OT INDUSTRY DATA DRIVEN BUSINESSES

FINANCES

- Development Costs
- Operational Costs

DEVELOPMENT COST

Resources	Description	Quantity	Price per month ($)	Subtotal per month ($)
Atlassian JIRA	Issue & Project Tracking Software	5 (seats)	10.00 (for 10 seats)	10.00
Atlassian Bitbucket	A web-based version control repository hosting service[15]	5 (seats)	0.00	0.00
Development Team	The man hours needed to develop and deploy the product to a customer	est: 640 hours	5333.00	5333.00
			Total	**$5343.00 (CAD)**

Table 1 - Monthly Development Costs

OPERATIONAL COST

RESOURCES	DESCRIPTION	QUANTITY	PRICE PER MONTH ($)	SUBTOTAL PER MONTH ($)
Amazon Web Service EC2 Instance	Instance Type: r5.xlarge	1	155.63	155.63
Amazon Web Service EC2 Instance	Instance Type: t2.xlarge	2	112.55	225.10
Amazon Web Service EC2 Instance	Instance Type: i3.xlarge	1	209.44	209.44
Amazon EBS Volumes (Storage)	Volume Type: Magnetic	5	17.16	85.80
PostgreSQL	An open-source relational database	1	0	0.00
InfluxDB	An open-source Time Series Database (TSDB)[2]	1	0	0.00
Kibana	Monitors application logs for each module and visually displays the results[2]	1	0	0.00
Grafana	Monitors application metrics modularly for the entire system[2[	1	0	0.00
Nomad	Deployment tool	1	0	0.00
Docker	Tool designed to make it easier to create, deploy, and run applications by using containers.	1	0	0.00
			Total:	**$675.98 (CAD)**

Table 2 - Monthly Operational Costs

TECHNICAL MODEL

Flexible, Scalable and Robust Software Solutions

- Microservice
- Proof of Concept Design
- Performance Monitoring

MICROSERVICES

(Why we are using one)

PROOF OF CONCEPT DESIGN

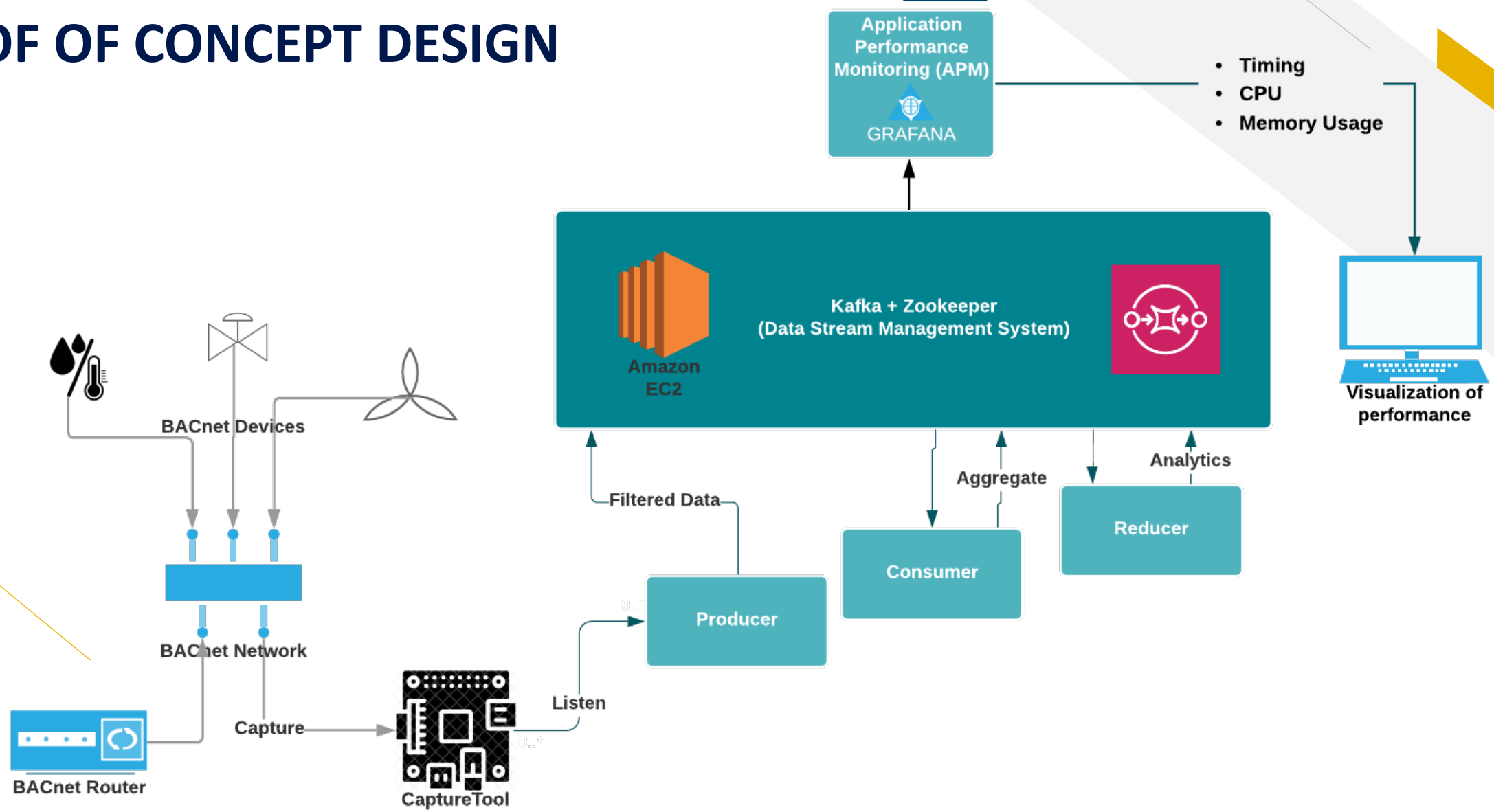


Figure 6 – PoC Design

PERFORMANCE MONITORING

Grafana

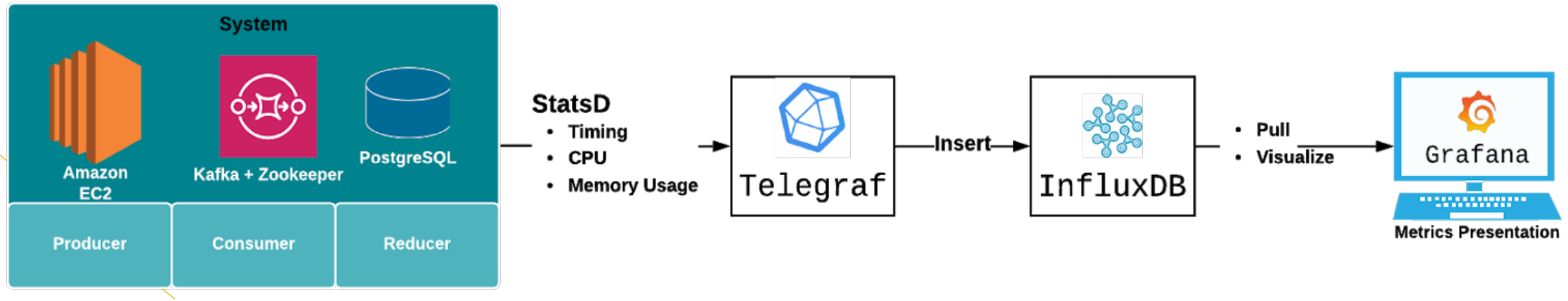


Figure 8 – Performance Monitoring with Grafana

PERFORMANCE MONITORING

Microservice Perspective

Performance Metrics

- Performance metrics is used to understand low-level system performance and behavior
- Any type of distributed system will eventually fail
- The *key* is to monitor systems over time to prevent failure and improve performance

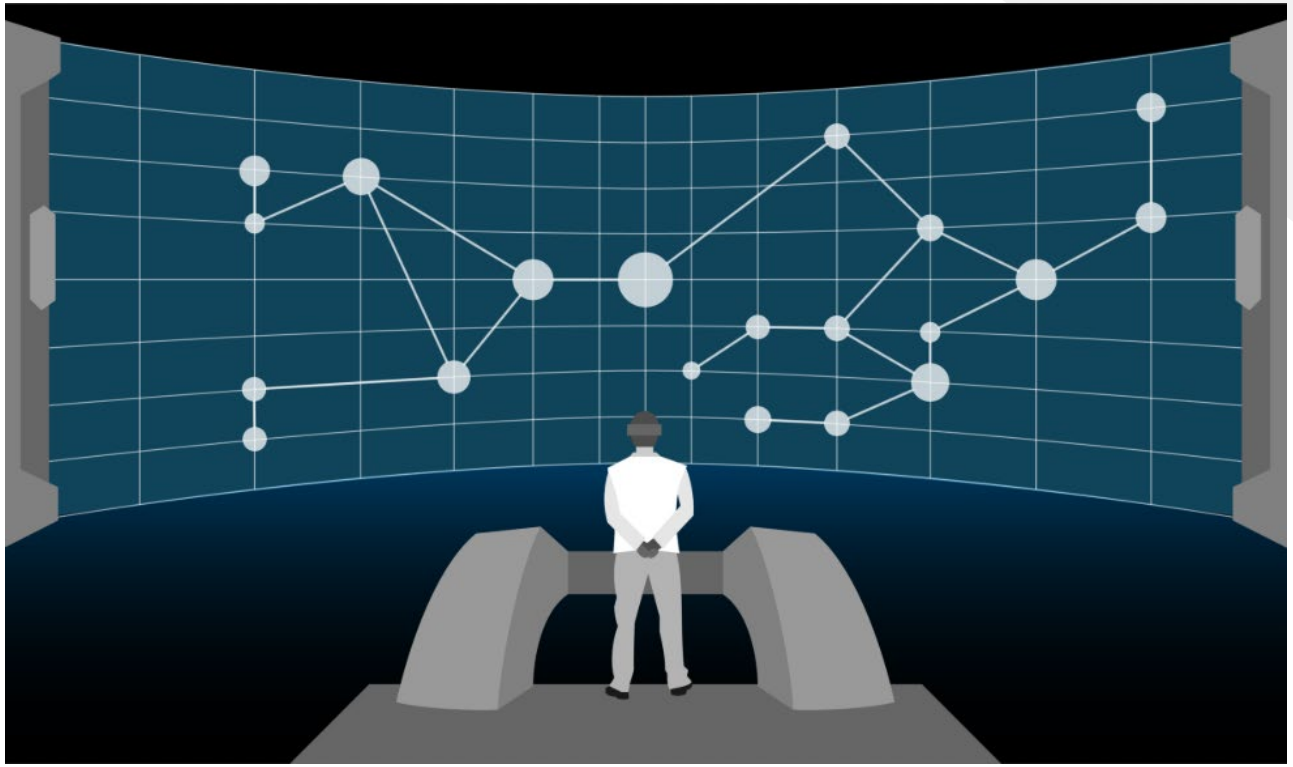


Figure 7 – Performance Monitoring

PROOF OF CONCEPT DEMO

REAL HARDWARE SETUP

What Our "NUC" Represents

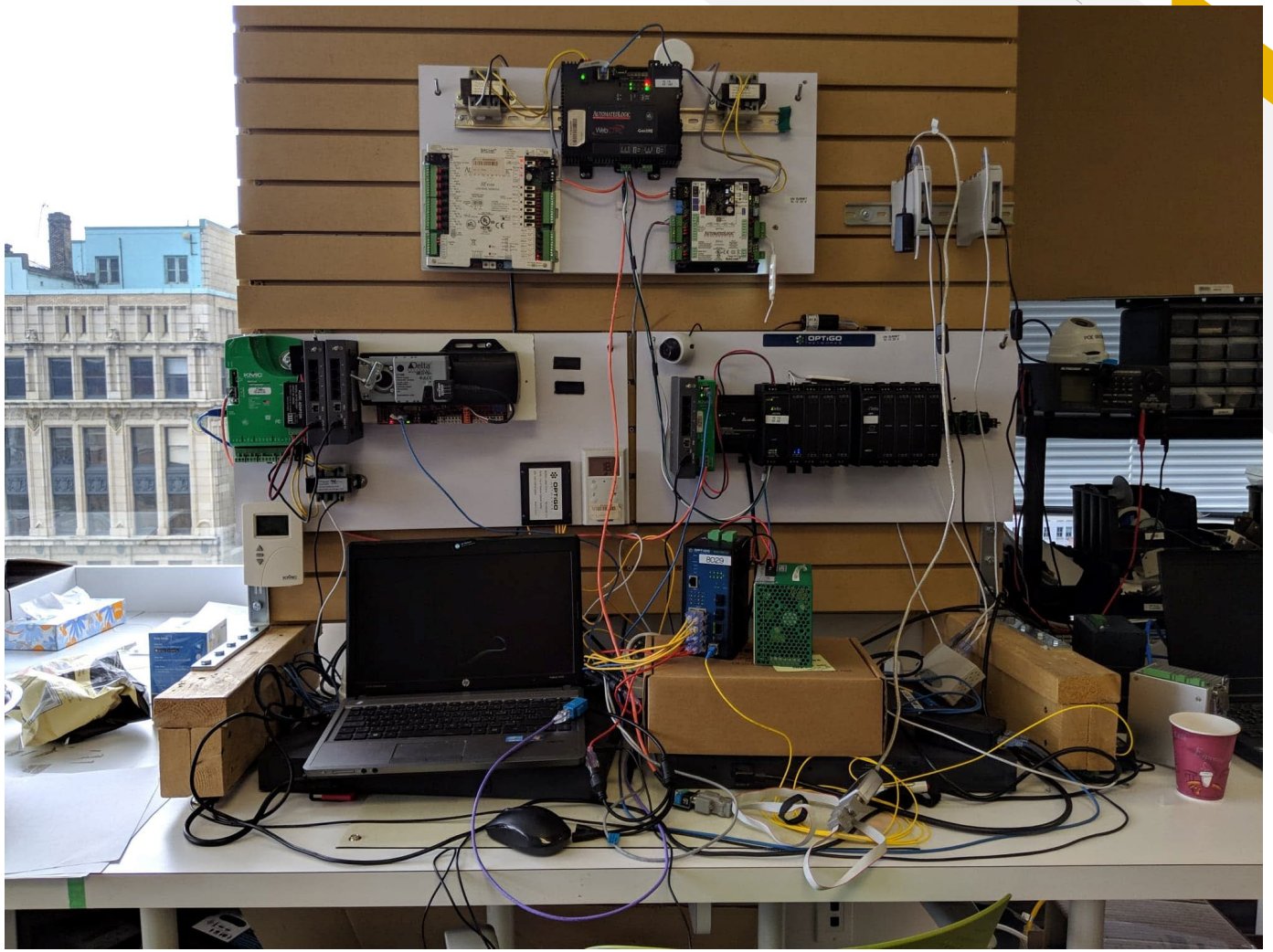


Figure 9 – Hardware Setup at Optigo Networks

SPOOFING USING A NUC

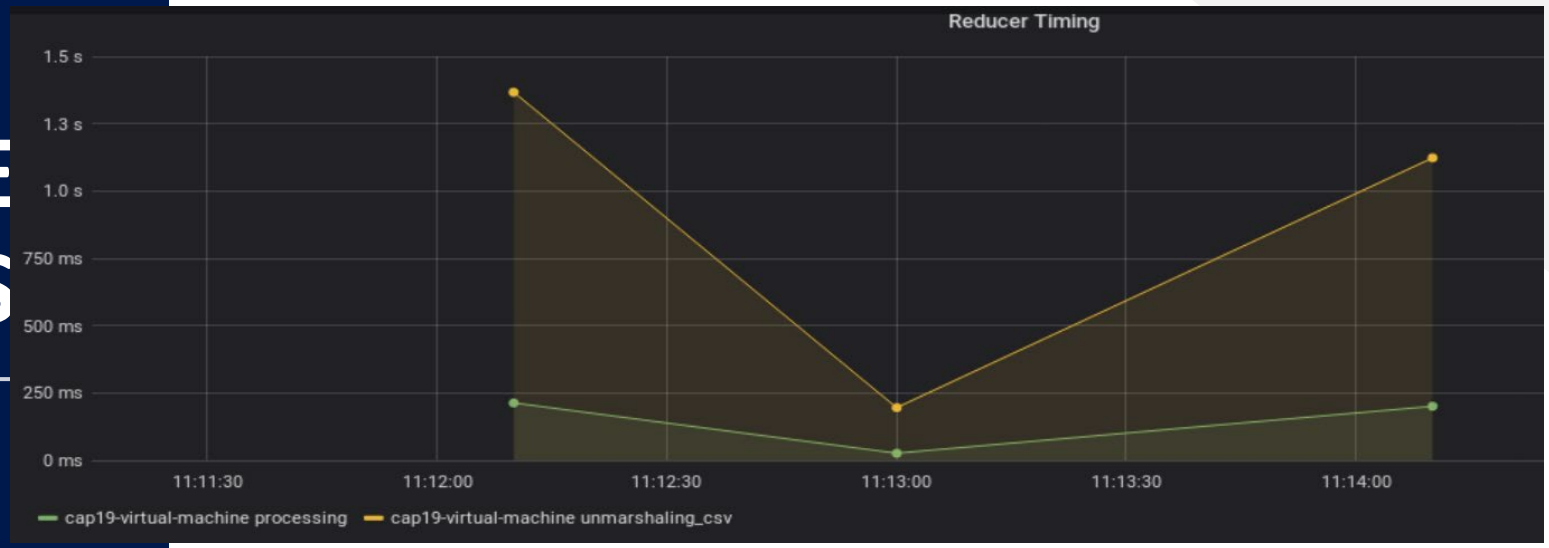
The NUC replays pre-capture traffics from BACnet devices

This simulates a real bacnet network

GRAFANA PERFORMANCE DEMO

PERFORMANCE DATA ANALYSIS

Optigo vs Oakion Syste



PERFORMANCE COMPARISON

Optigo vs Oakion Systems

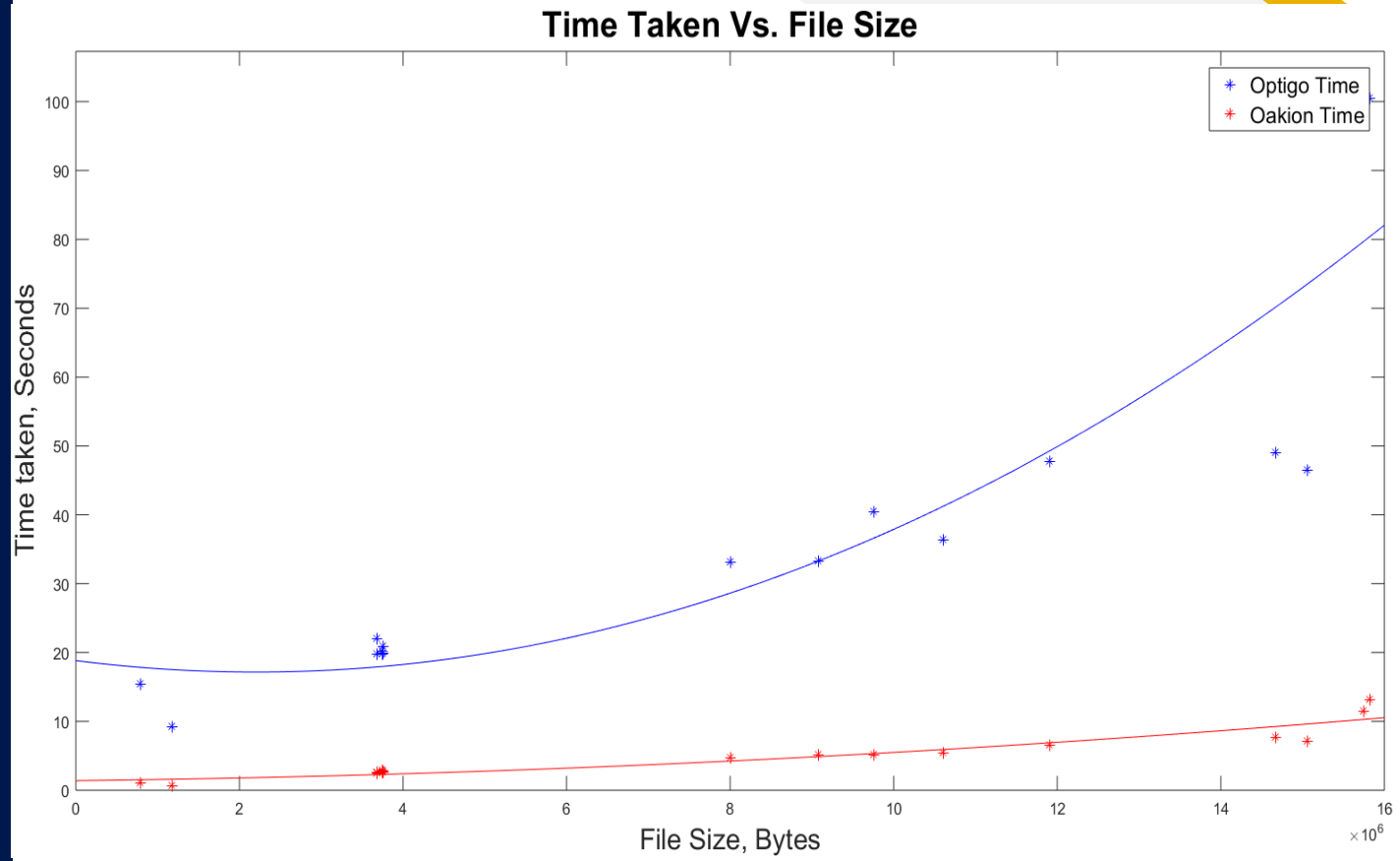


Figure 10 – Time Taken VS File Size

RISK ANALYSIS

- Product Safety
- Business Risks

PRODUCT SAFETY

- Tool Dependency
  - Version Control
- Encryption
  - Data in Transit
  - Data at Rest
- Authentication
  - SASL

Figure 11 – Strong Software quality philosophy Pyramid[9]

BUSINESS RISKS

- Companies' needs may outgrow the solution
  - Hardware resource constraint
- Adaptation needed to continuously offer high integrated solution

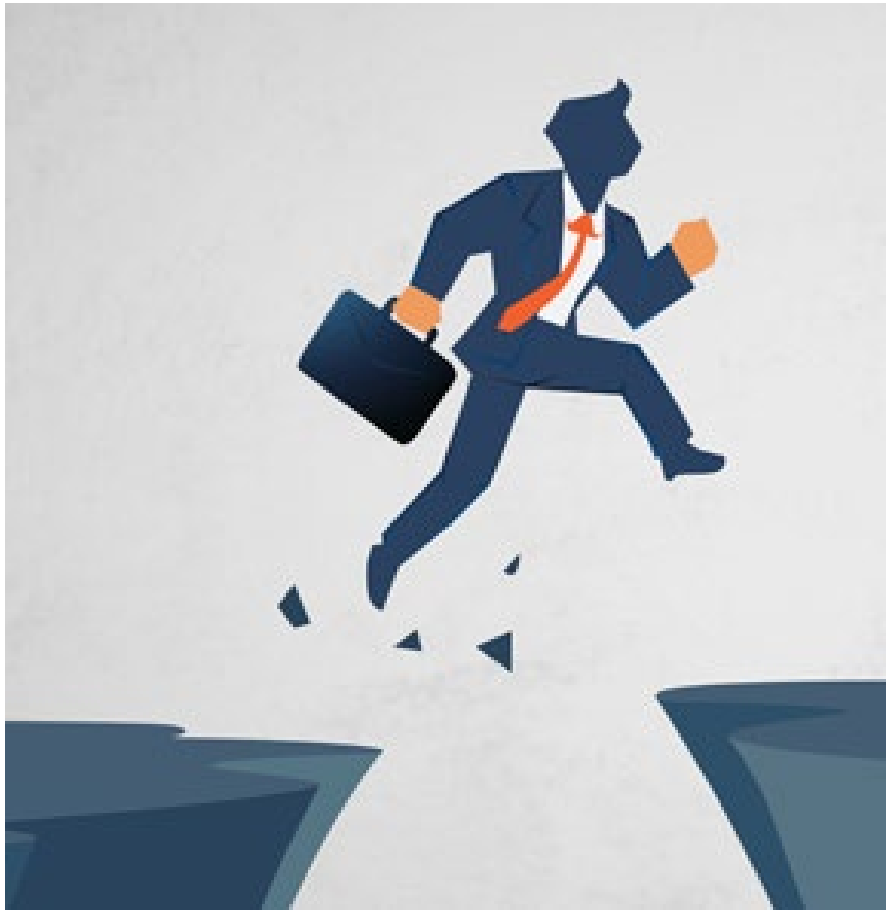


Figure 12 – Business is all about taking risks

ENGINEERING STANDARDS

- What our product complies to
- ISO and IEEE will provide regulatory guidelines for quality management

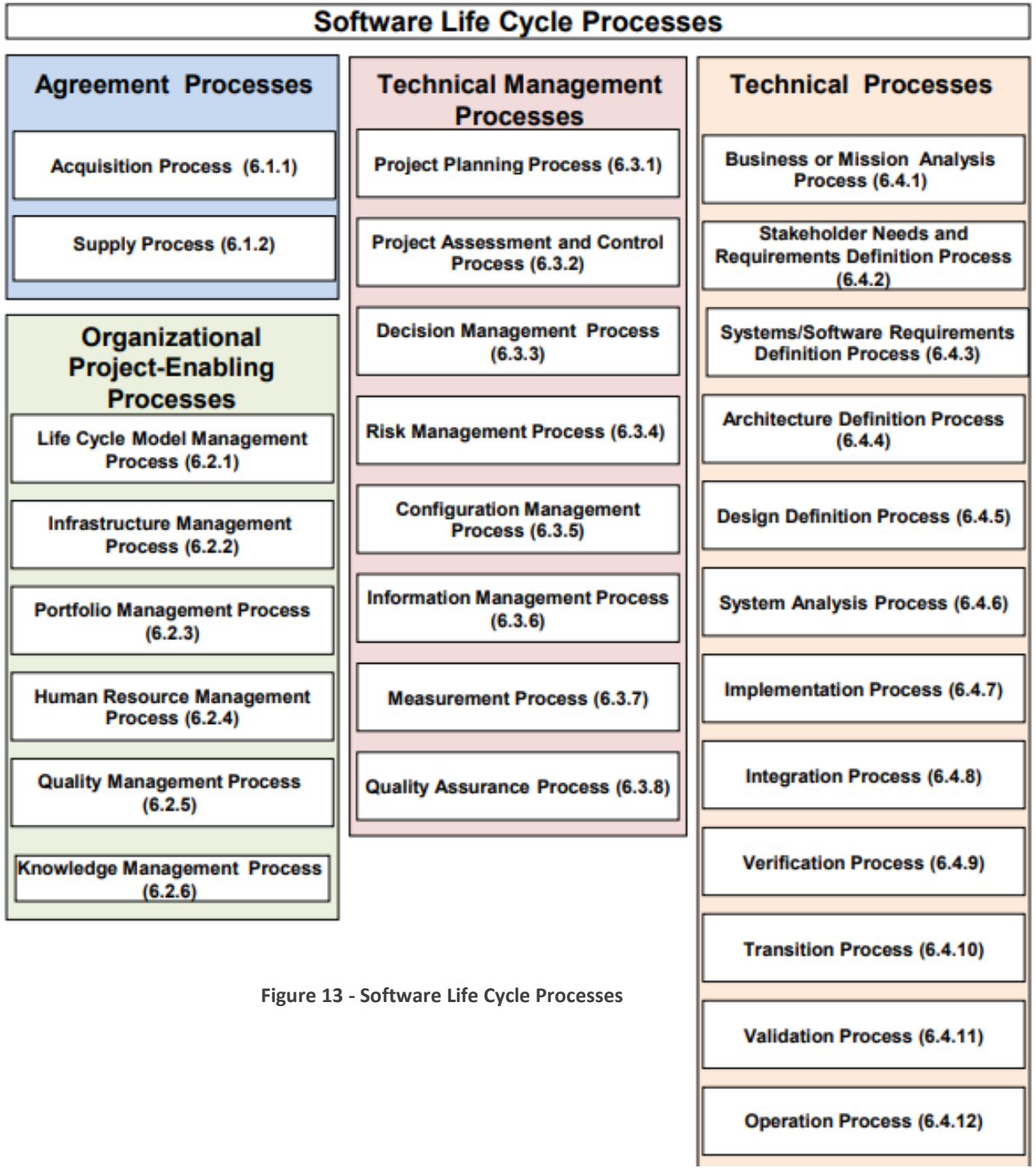


Figure 13 - Software Life Cycle Processes

ISO 12207

Software Life Cycle Processes

ISO 12207 is an international standard for the software lifecycle processes

ISO 14756

Measurement and rating of performance of computer-based software systems

Defines how user oriented performance of computer-based software systems may be measured and rated.

- Execution Time
- Throughput
- Timeliness

A simple guideline for visual user-interface elements

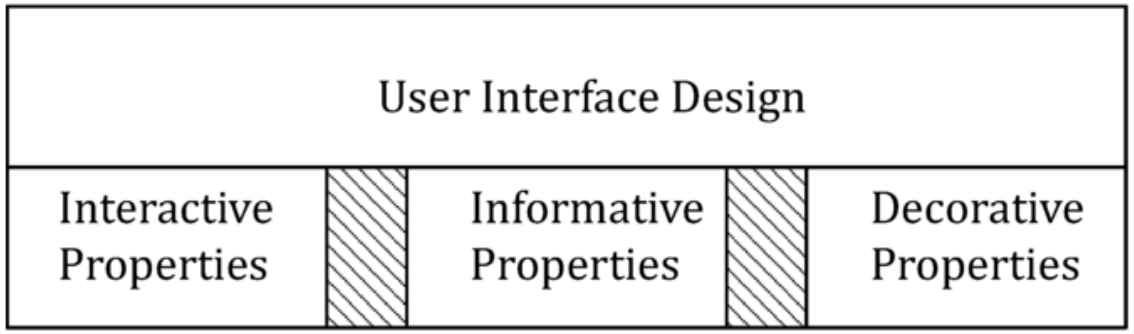


Figure 14 – User Interface Concept

ISO 9241-161

Ergonomics of human-system interaction -- Part 161: Guidance on visual user-interface elements

ACCEPTANCE TEST PLANS

PROOF OF CONCEPT TESTING

What major components are ready?

- ✓ Hardware Checks
- Security Checks **-> In EP Stage**
- ✓ Data Stream Management Service Checks
- ✓ Producer Module Checks
- Splitter Module Checks **-> In EP Stage**
- ✓ Consumer Module Checks
- ✓ Reducer Module Checks
- ✓ Performance Checks

PROOF OF CONCEPT: HARDWARE CHECKS

Acceptance Test Plan

Active State: Capture Tool is on and connected to network system

Inactive State: Capture Tool is off and disconnected to network system

Figure 15 – Capture Tool

- The capture tool is required in 2 states: active or inactive
- The Capture tool must operate under 82 °C

PROOF OF CONCEPT: DSMS CHECKS

Acceptance Test Plan

Kafka Industry Usage

- Kafka is open source
- Maintained by Apache and has an active community
- Used by large companies[10]
  - LinkedIn
  - Netflix
  - Spotify
  - Cisco

Kafka Tests

- Monitor Transaction Rate
- Monitor the Queue size of the DSMS
- Monitor System Load
- Alert when Service Down
- Unplanned shutdown

PROOF OF CONCEPT: MODULE CHECKS

Acceptance Test Plan

Functionality of Modules

- All modules cover 2 major functions
  - **Receive data from Kafka**
  - **Send data to Kafka**

Module Monitoring

- The key to the success of Oakion Systems is whether we can monitor the system per module
  - **Each module can be monitored from Grafana**

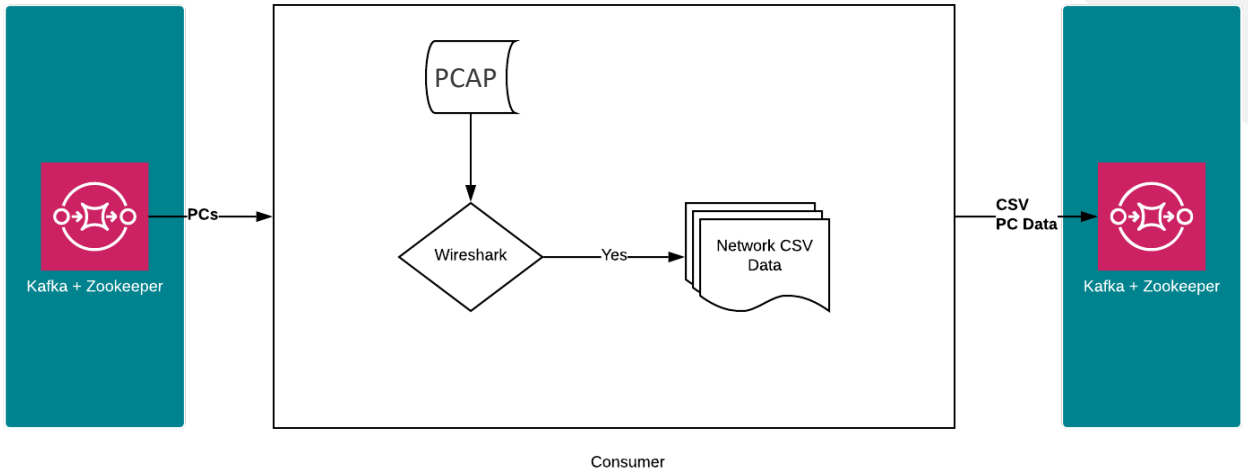
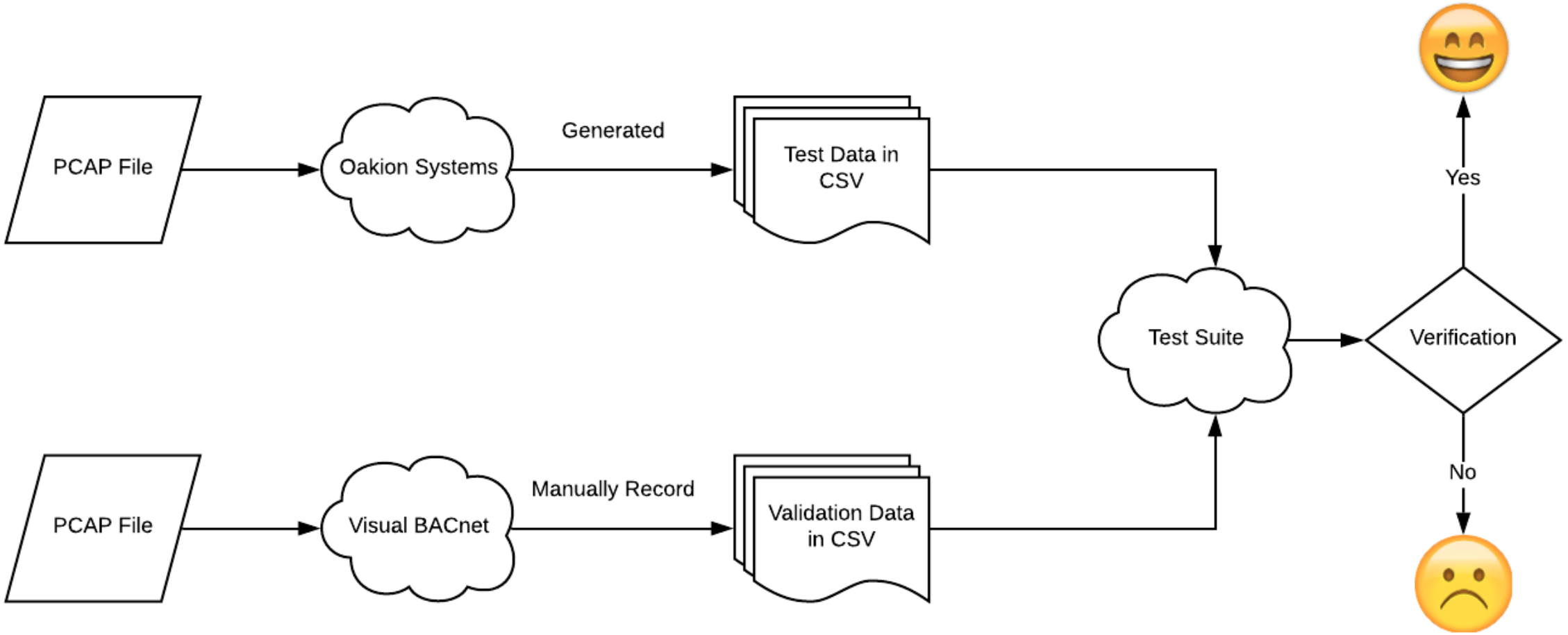


Figure 16 – Consumer Module Design for POC

PROOF OF CONCEPT: BACNET CHECKS

Currently Implemented

- Checksum Error
- Detect Circular Networks
- Duplicate Device ID
- Error Responses
- Global Who Is
- Low Hop Count
- Token Roundtrip Time
- Unresponsive Router



PROOF OF CONCEPT TEST SUITE OVERVIEW

Acceptance Test Plan

TEST SUITE EXAMPLE:

CHECKSUM

Acceptance Test Plan

What is a Checksum Check?

- Indicates the percentage of packets with checksum errors in the capture
- Indicates how healthy the network is

TEST SUITE EXAMPLE: CHECKSUM

Acceptance Test Plan

Visual BACnet

Packets for Checksum Error Type - BACnet

Show 10 entries Search:

Time	Number	Source	Destination	Service Choice	Packet Length
20:58:21	8626	28	255	Who-Is-Router-To-Network	21
20:59:21	21421	28	255	Who-Is-Router-To-Network	21

Figure 17 – Visual BACnet

Oakion Systems

```
1  8626,mstp:bacnet,21,28,255,6
2  21421,mstp:bacnet,21,28,255,6
3
```

Figure 18 - Oakion Systems

SELF REFLECTION

- Reflection
- Changes for ENSC 440

REFLECTION

What we've learned

- Key to success is good teamwork and communication
- Delegating tasks
- Making decisions
- Time management
- Standards and simplistic UI
- Online Collaboration

PLAN FOR 440

Design, Develop, Integrate and Deploy a Solution to Optimize Data Processing in the OT Industry

- Optimization of Current Performance
- Integration with Visual BACnet
- Final Deployment

DEVELOPMENT PROCESS PLAN FOR ENSC 440

Find optimal balance between: Memory, I/O and CPU usage for this problem for Optigo Networks

Load Balancing for Performance Maximization

Kibana For Log Visualization

System Integration with Optigo Networks Visual BACnet

Show System is Optimized running a 1:1 test with current system in place at Optigo Networks

ENGINEERING PROTOTYPE DESIGN

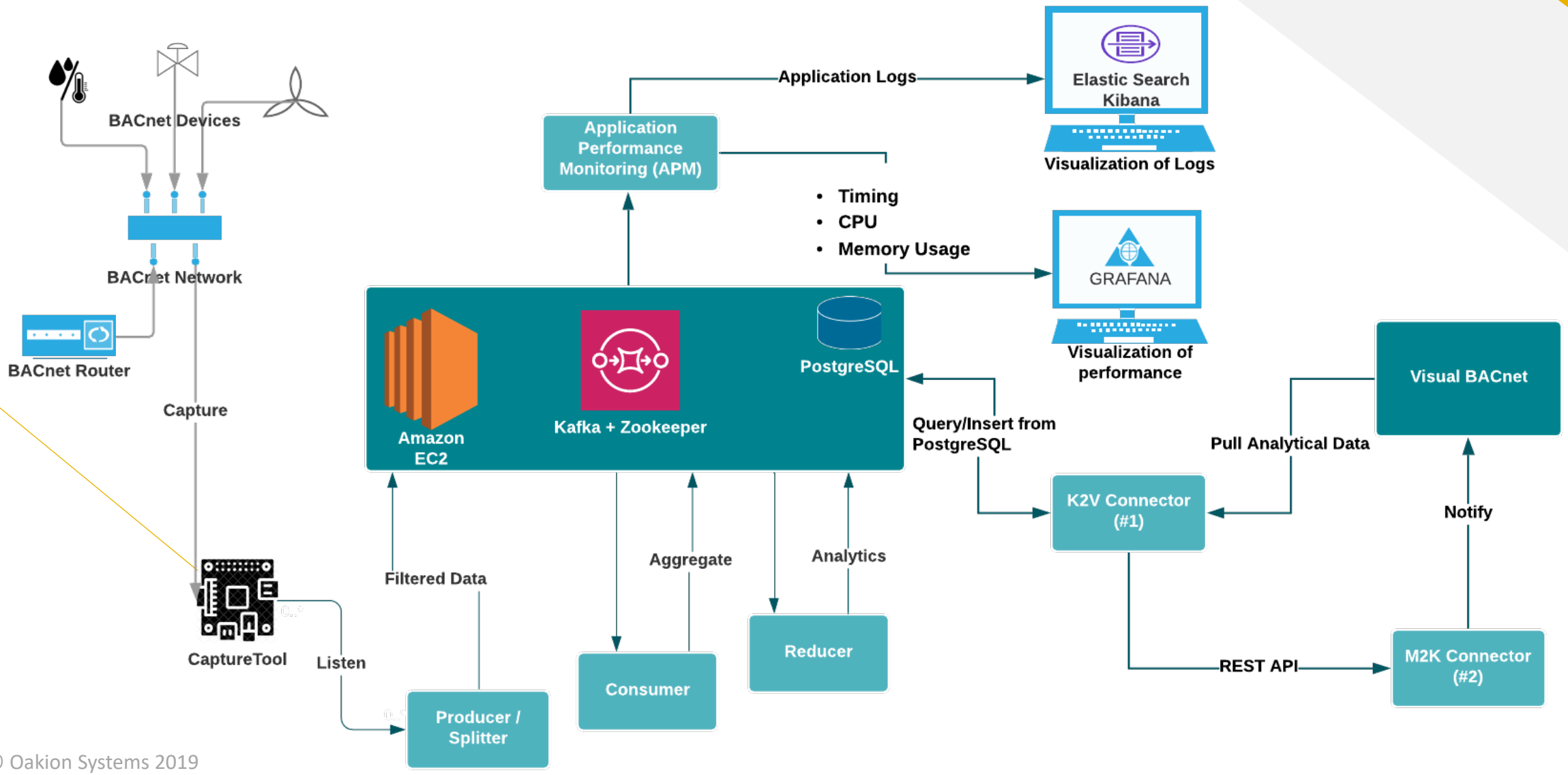
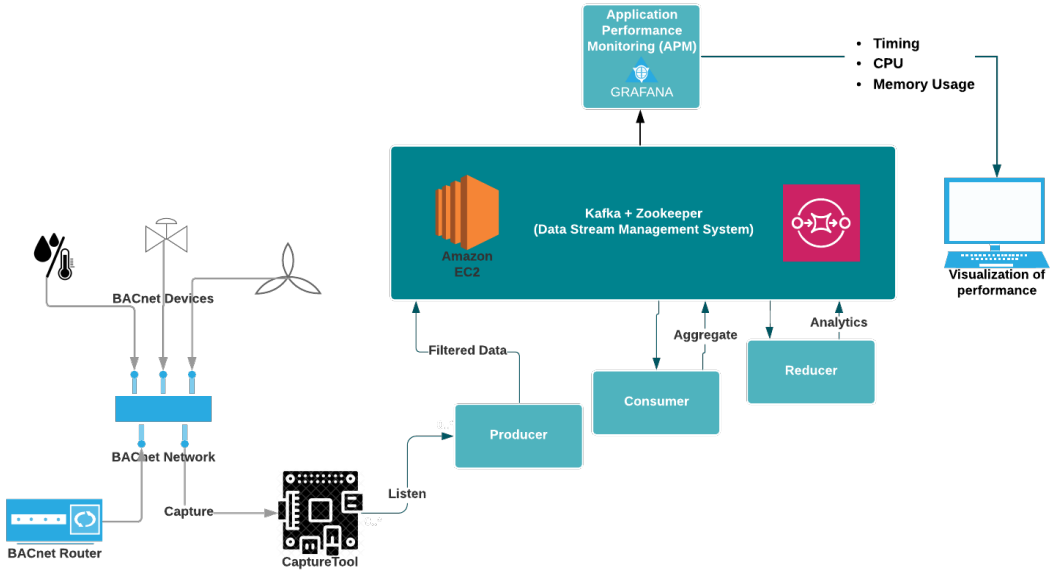
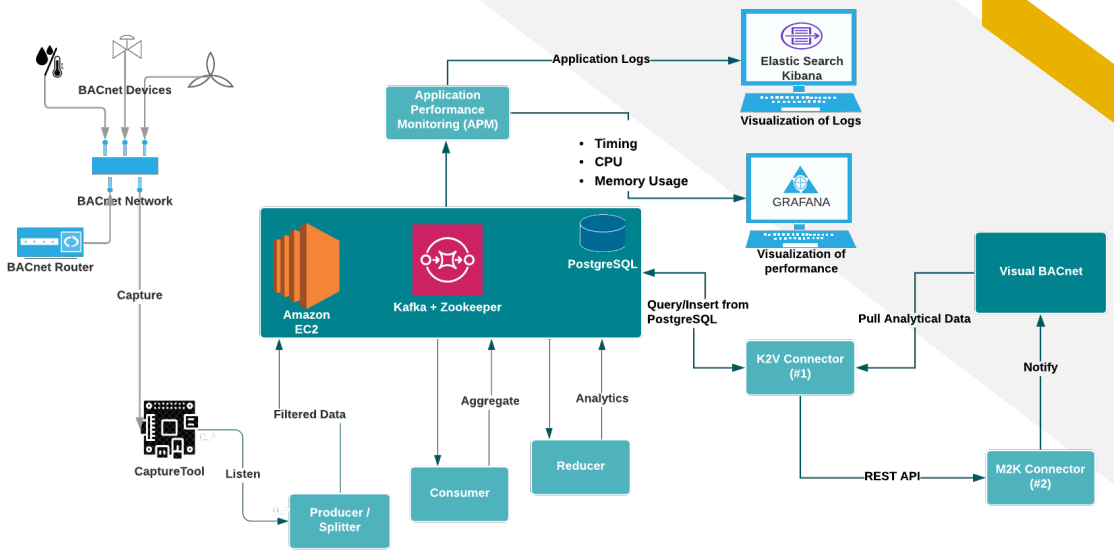


Figure 19 – Engineering Prototype Design





CONCLUSION

Prototypes

THANK YOU

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- Instructional Team here at SFU
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QUESTIONS?

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