




*Dwight Look College of*  
**ENGINEERING**  
TEXAS A&M UNIVERSITY

A photograph of a student working on a robotic arm. The student is wearing a grey shirt and is focused on the task. The robotic arm is black and has several colored wires (red, blue, green, yellow) connected to it. The background is a blurred laboratory setting.

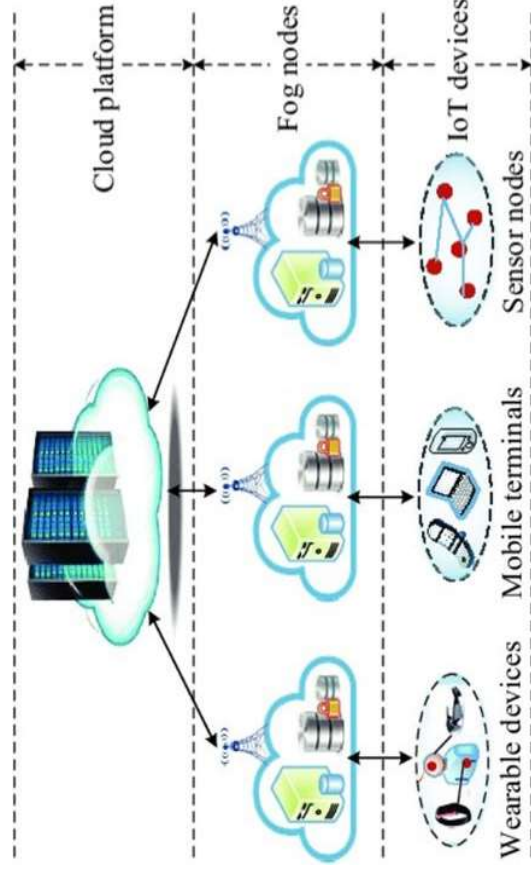
# Team 21: Load Balancing on an IoT Fog Bi-Weekly Update 5

Sebastian Correa, Christopher Gonzales  
Sponsor: Swarnabha Roy  
TA: Zhuwen Hu

# Project Summary

## Problem statement:

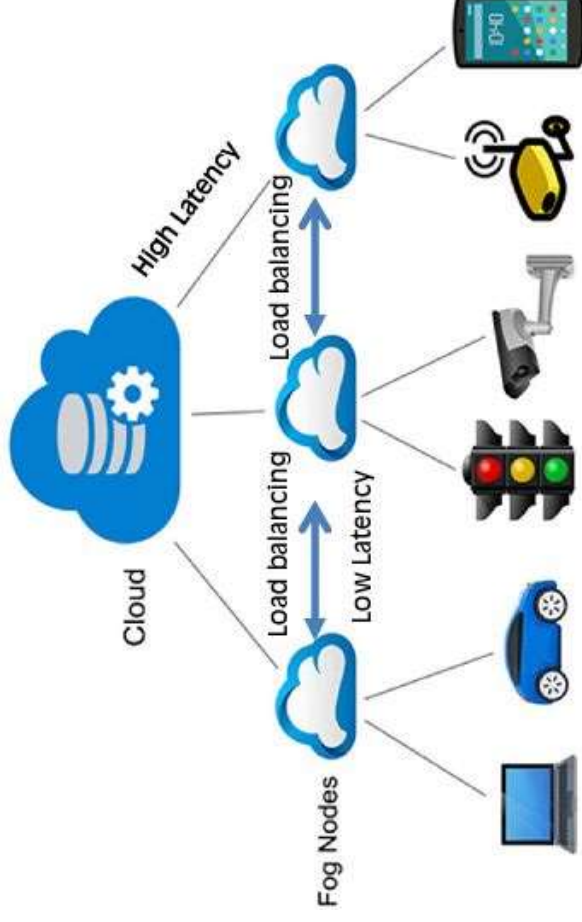
Load balancing only on the cloud is inefficient for applications, overloads virtual machines, and creates scalability issues.



# Project Summary

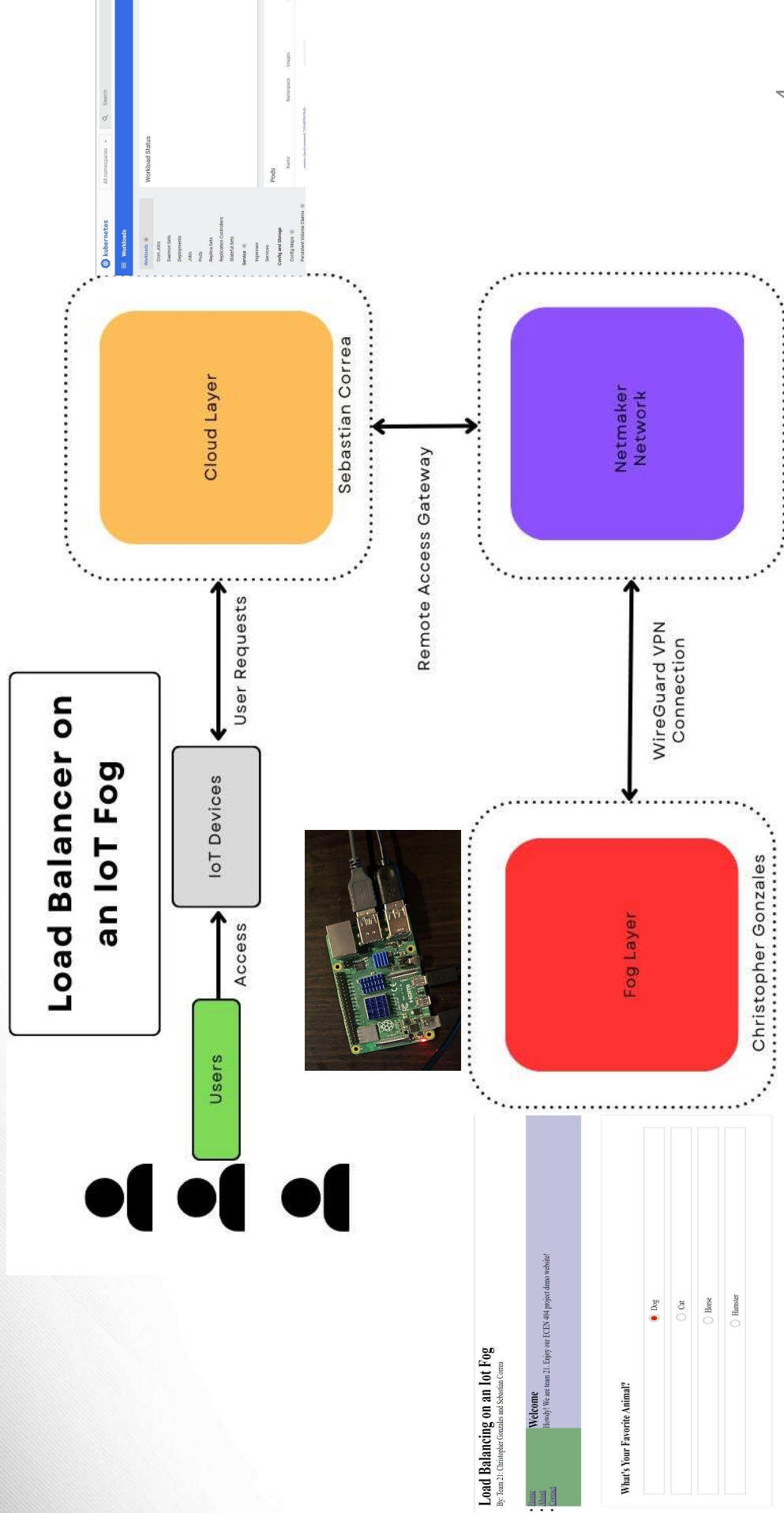
## Load-Balancing Solution:

- Takes input from IoT devices
- Distributes the workload
- Sends data to the cloud





# Integrated Subsystems Diagram



Load Balancing on an IoT Fog

By: Team 21: Christopher Gonzales and Sebastian Correa

**Welcome**  
 Gladly! We are team 21. Enjoy our ECEN 469 project demo website!

**What's Your Favorite Animal?**

☒ Dog  
☐ Cat  
☐ Bird  
☐ Hamster

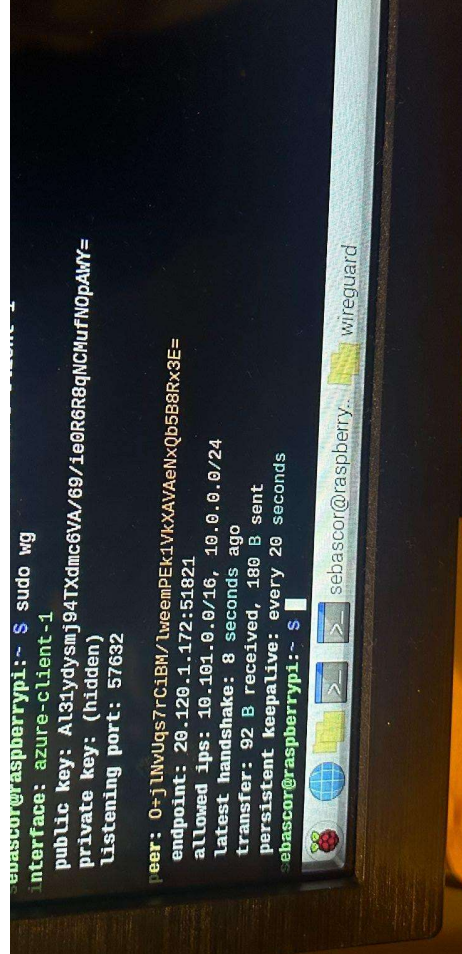
# Project Timeline

Test Pi's condition and choose new cloud service (completed 8/31/23)	Test Website on Pi and convert VM's to new cloud service (completed 9/14)	Re-establish the connection between the Pi and the cloud (to complete by 9/28)	Finalize Integration (to complete by 10/12)	Test system's capabilities (to complete by 11/2)	Validation (To complete by 11/23)	Demo and Report (To complete by 12/4)
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# Edge Node Subsystem

Christopher Gonzales

Accomplishments since last update 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> <li>Solved Network Problem</li> <li>Reflashed Pi OS</li> <li>Validated Gateway Connection</li> </ul>	<ul style="list-style-type: none"> <li>Continue Integration Tests</li> <li>Ongoing adjustment of demo application</li> <li>Add the Pi to dashboard</li> <li>Validate using test users</li> </ul>





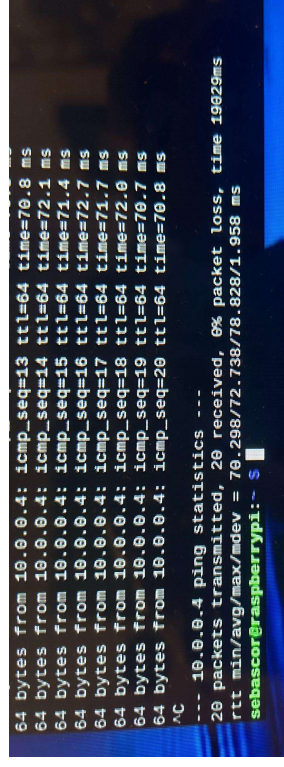
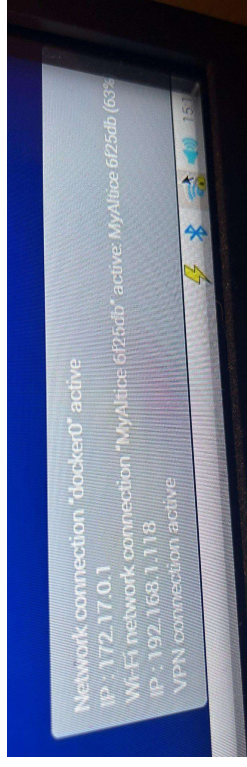
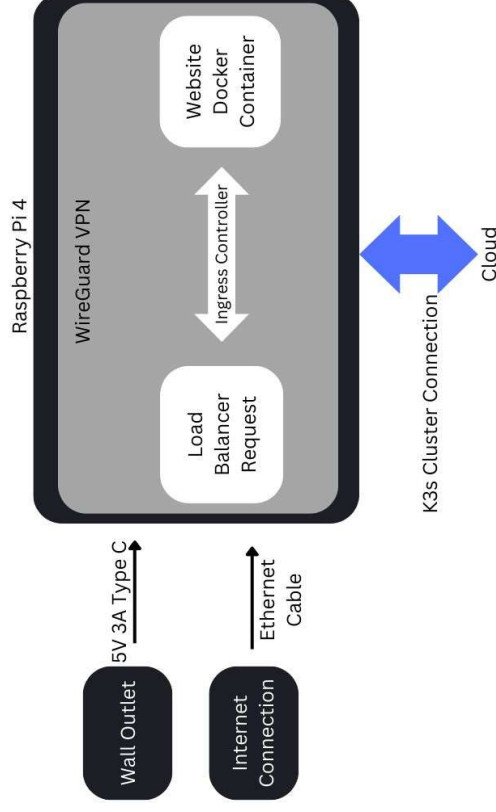
# Edge Node Subsystem

Christopher Gonzales

## Function:

- Pi Takes Requests from cloud through k3s cluster
- Request is directed to website container pod
- Request directed back to cloud and user

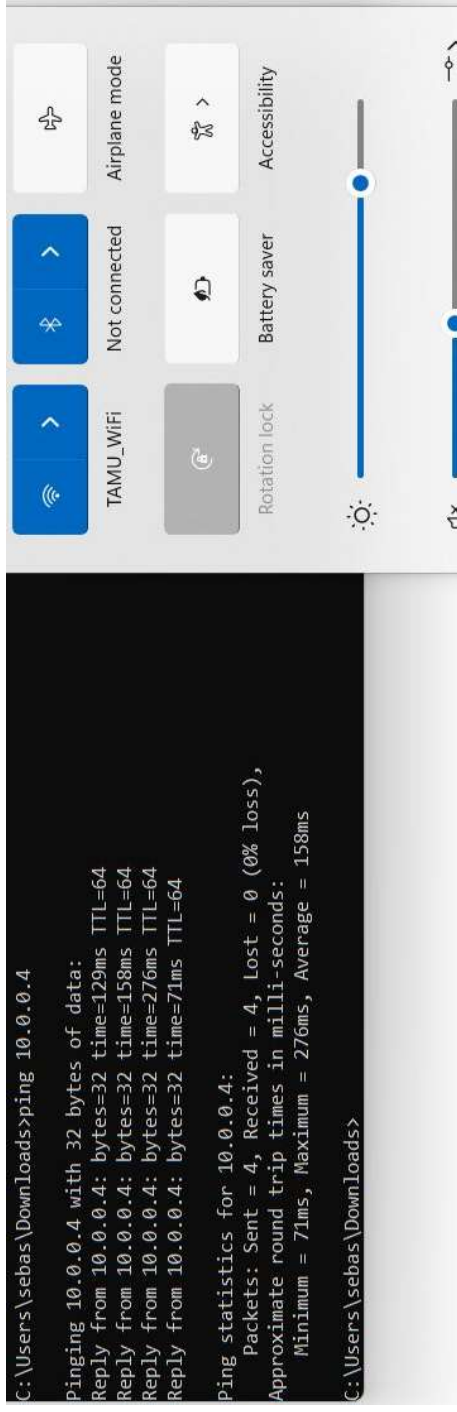
- Now able to connect to the master node IP
- VPN shows connection is up



# Cloud Integration

Sebastian Correa

Accomplishments since last update <b>30 hrs of effort</b>	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> <li>Created and Deployed Kubernetes Dashboard</li> <li>Adjusted Cluster configuration file</li> <li>Validated connection under school WiFi</li> <li>Deployed a Test Pod</li> </ul>	<ul style="list-style-type: none"> <li>Errors in Kubernetes Dashboard (Doesn't show all details)</li> <li>Working on Rancher Dashboard</li> <li>Updating Users</li> <li>Configuring NodePort Service</li> </ul>



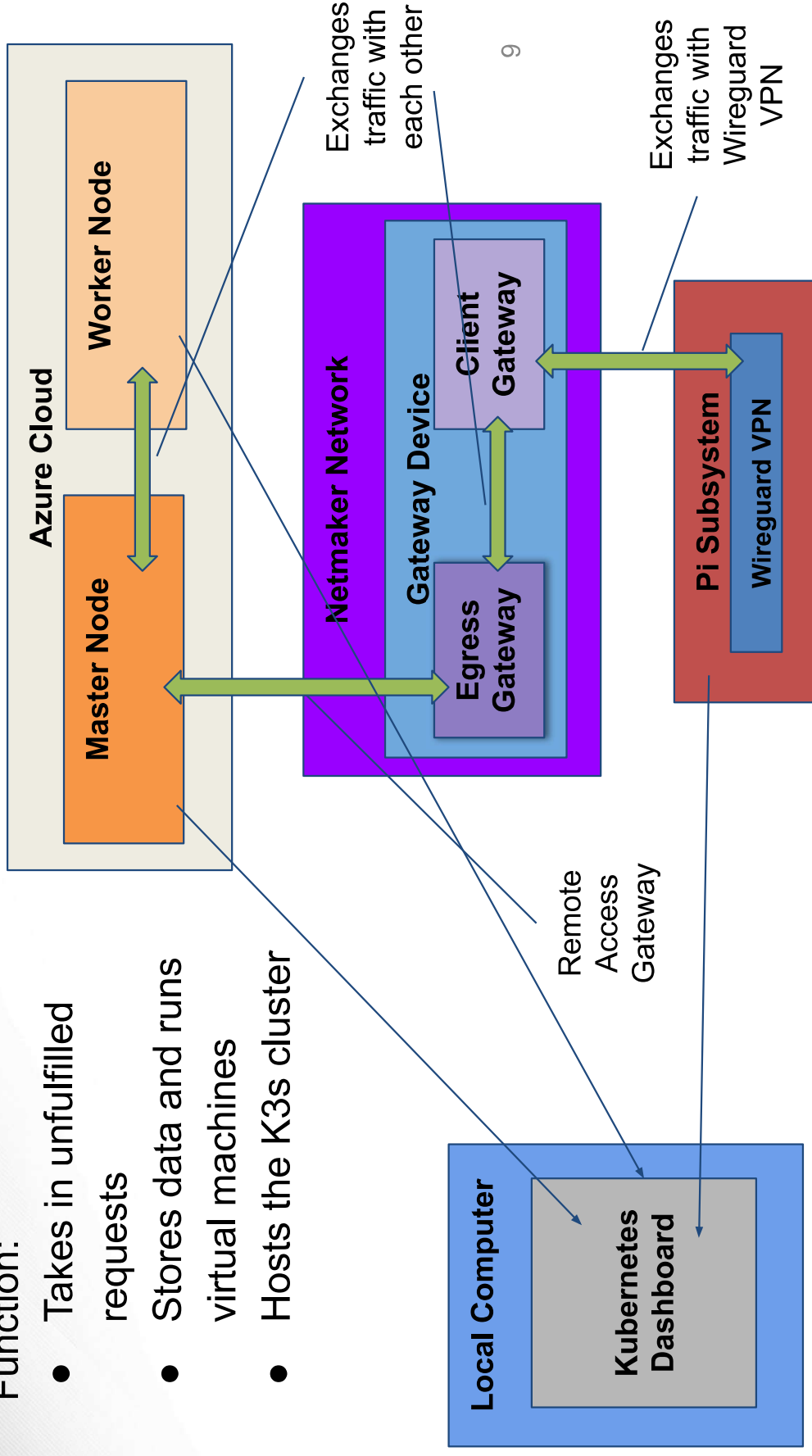


# Cloud Subsystem

Sebastian Correa

Function:

- Takes in unfulfilled requests
- Stores data and runs virtual machines
- Hosts the K3s cluster



# Kubernetes Dashboard

← → ↻ 🔍 localhost:8001/api/v1/namespaces/kubernetes-dashboard/services/https:kubernetes-dashboard/proxy/#/node?namespace=default

kubernetes

Cluster > Nodes

Cluster

Cluster Roles

Namespaces

**Nodes**

Persistent Volumes

Storage Classes

Namespace

default

Overview

Workloads

Nodes

Name	Labels	Ready	CPU requests (cores)	CPU limits (cores)	Memory requests (bytes)	Memory limits (bytes)	Age
✓ workernode	beta.kubernetes.io/arch: arm64 beta.kubernetes.io/instance-type: k3s Show all	True	0.00m (0.00%)	0.00m (0.00%)	0.00 (0.00%)	0.00 (0.00%)	14 days
✓ masternode	beta.kubernetes.io/arch: arm64 beta.kubernetes.io/instance-type: k3s Show all	True	200.00m (10.00%)	0.00m (0.00%)	140.00Mi (3.58%)	170.00Mi (4.34%)	14 days

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# Kubernetes Dashboard

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localhost:8001/api/v1/namespaces/kubernetes-dashboard/services/https:kubernetes-dashboard/proxy/#/overview?namespace=default

 **kubernetes**

Overview

Cluster

Cluster Roles

Namespaces

Nodes

Persistent Volumes

Storage Classes

Namespace

default

Overview

Workloads

Cron Jobs

Daemon Sets

Deployments

Jobs

Pods


Replica Sets

Workloads

Workload Status

Pods

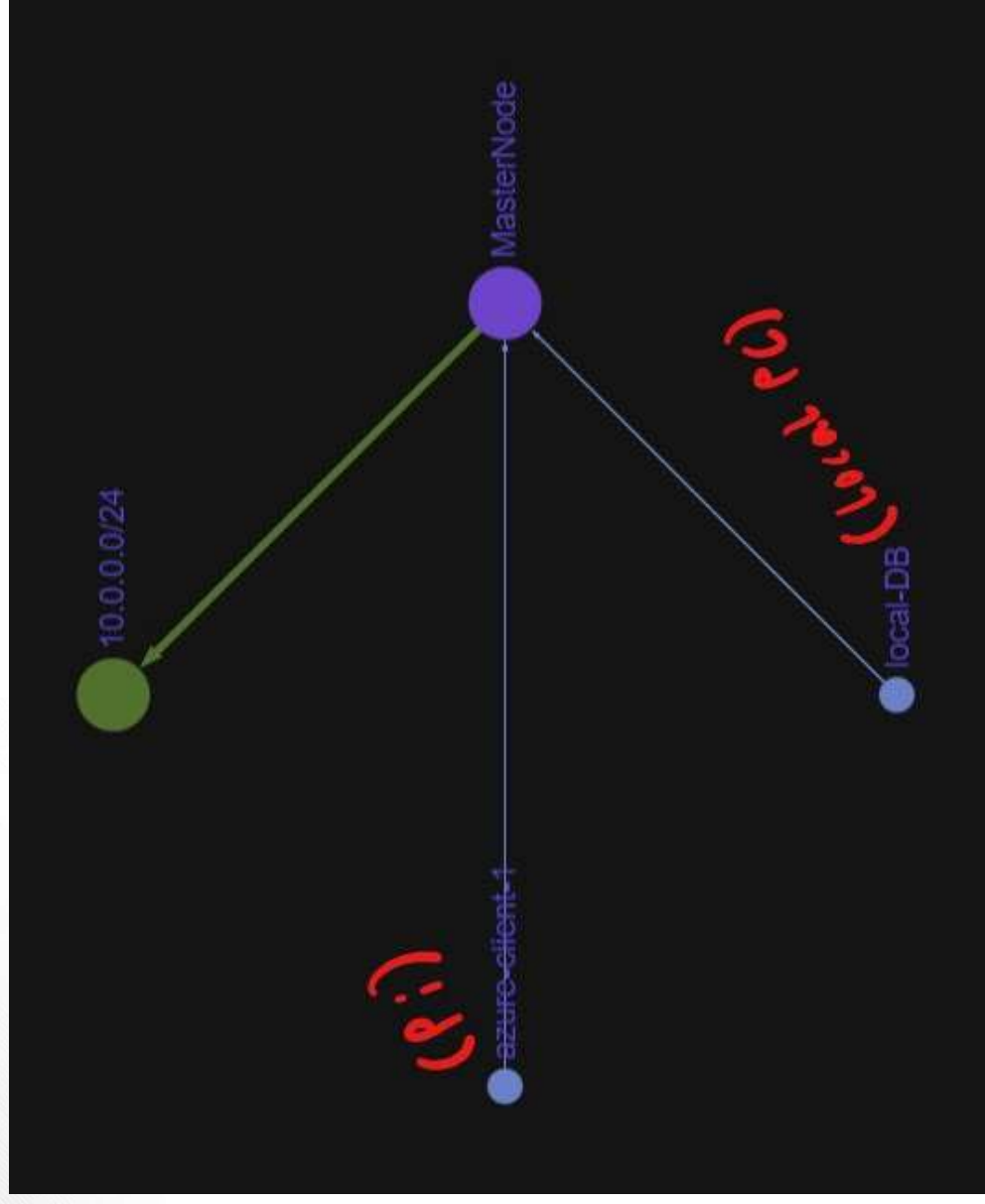
Pods

Name	Namespace	Labels	Node	Status	Restarts	CPU Usage (cores)	Memory Usage (bytes)	Age
 my-pod	default	-	workernode	Running	1	-	-	58.minutes

1 - 1 of 1



# Netmaker Graph



# Execution plan

Work	End Date	Owner	Status	Completion Date
Check pi condition	8/24	Christopher	Complete	8/24
Choose new cloud service	8/24	Sebastian	Complete	8/24
Convert all virtual machines to Microsoft Azure	9/7	Sebastian	complete	9/11
Build website	9/7	Christopher	complete	9/7
Install K3s on VMs	9/14	Sebastian	complete	9/14
Test website	9/14	Christopher	complete	9/11
Add more features to the website	9/21	Christopher	Ongoing	9/18
Create connections between VMs	9/21	Sebastian	Complete	9/21
Connect the Pi with the Cloud	9/28	Sebastian	Complete	10/1
Convert Pi connection into worker node	10/5	Sebastian	Complete	10/15
Configure containerization in Pi	10/5	Christopher	Complete	10/5
Finalize Integration	10/12	Christopher	Complete	10/15

# Execution Plan

Work	End Date	Owner	Status	Completion Date
Test Traffic transmission	10/19	Sebastian	Ongoing	N/A
Demonstrate movement of loads	10/26	Sebastian	Ongoing	N/A
Test Fault Tolerance	11/2	Christopher	Ongoing	N/A
Bug fix the VM's	11/2	Sebastian	Incomplete	N/A
Bug fix the website	11/2	Christopher	Incomplete	N/A
Configure cloud validation	11/9	Sebastian	Incomplete	N/A
Configure pi validation	11/9	Christopher	Incomplete	N/A
Finalize validation	11/23	Christopher	Incomplete	N/A



# System Validation Plan

Task	Specification	Summary	Result	Owner
Cloud Response Time	<500ms	Amount of time it takes the Cloud to respond to Load Balancer	60-62 ms	Sebastian
Edge Device Runtime	<500ms	Amount of time it takes the Edge Device to respond to Load Balancer	Avg 72.7 ms	Christopher
Edge and Cloud Transmission Time	<500ms	Amount of time it takes for the edge device and cloud to respond to one another	60-62 ms	Sebastian
Local PC and Cloud Transmission Time	<500ms	Amount of time it takes for local computer(dashboard) and cloud to respond to one another	Avg 158 ms	Sebastian
Reading Traffic	<500ms	Amount of time it takes the K3s cluster to read the incoming traffic	Ongoing	Sebastian
Minimum Number of Test Cases	50	50 test users, or traffic data, being sent to our system for testing	Ongoing	Christopher
Minimum Number of applications to run	1	Our application we're going to use for testing	Ongoing	Christopher
Load Balancing Test	40%-60%	Ensure that the load is distributed equally between rpi website container and VM container	Ongoing	Sebastian
Failover Test	<500 ms	Shut down one edge node and ensure traffic is redirected to working node within seconds	Ongoing	Christopher <sup>15</sup>



# Questions?