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ENGINEERING
TEXAS A&M UNIVERSITY

Team 21: Load Balancing on an IoT Fog
Bi-Weekly Update 3

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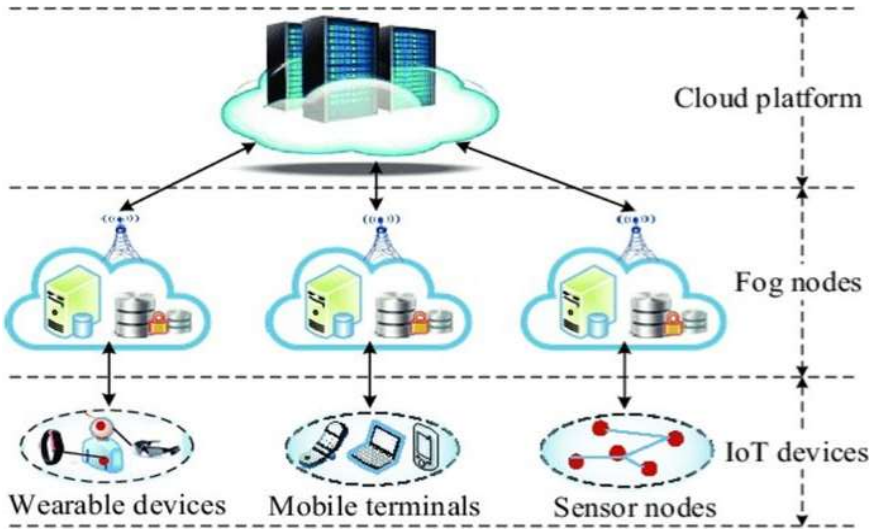
Project Summary

Problem statement:

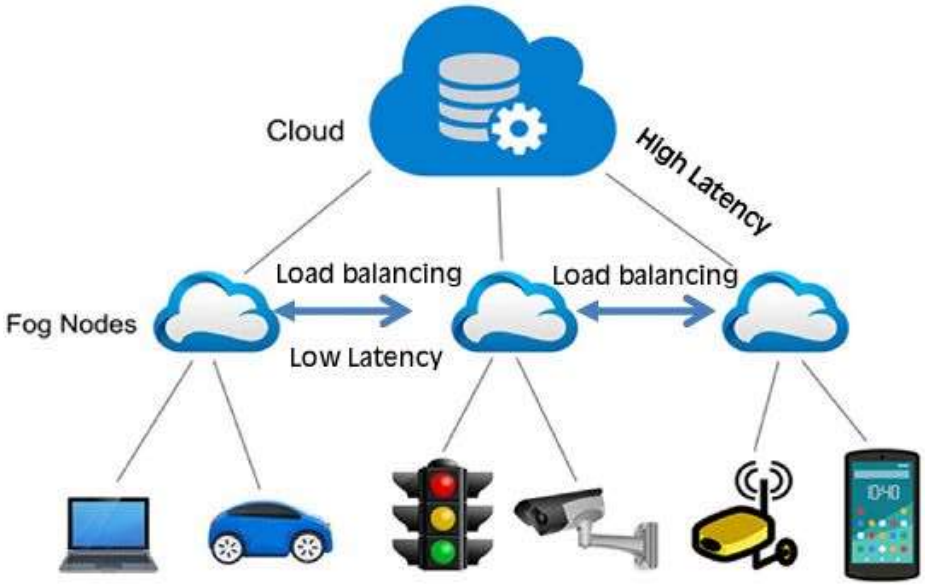
Load balancing only on the cloud is inefficient for applications, overloads virtual machines, and creates scalability issues.



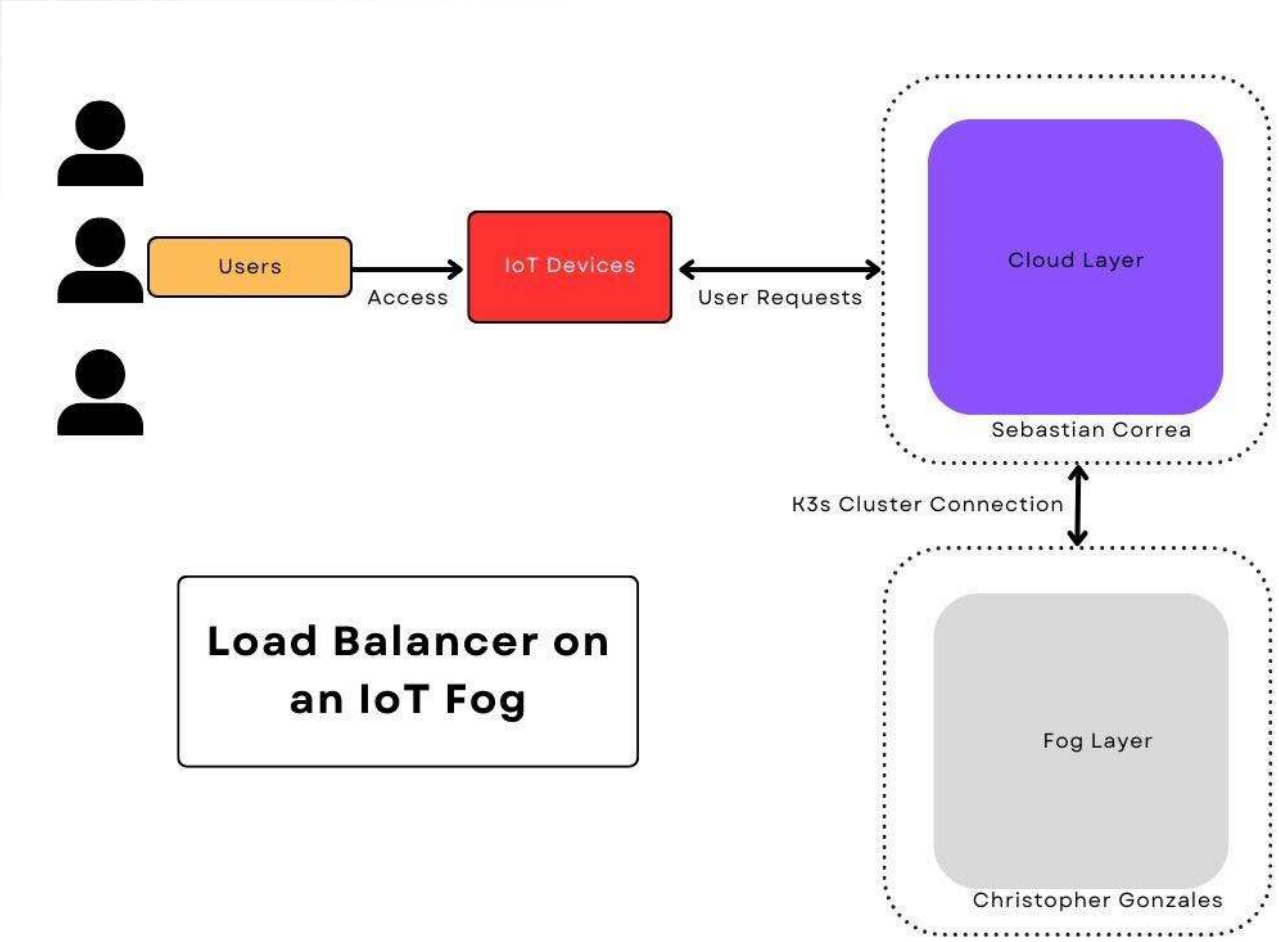
Project Summary

Load-Balancing Solution:

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



Subsystems Diagram



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

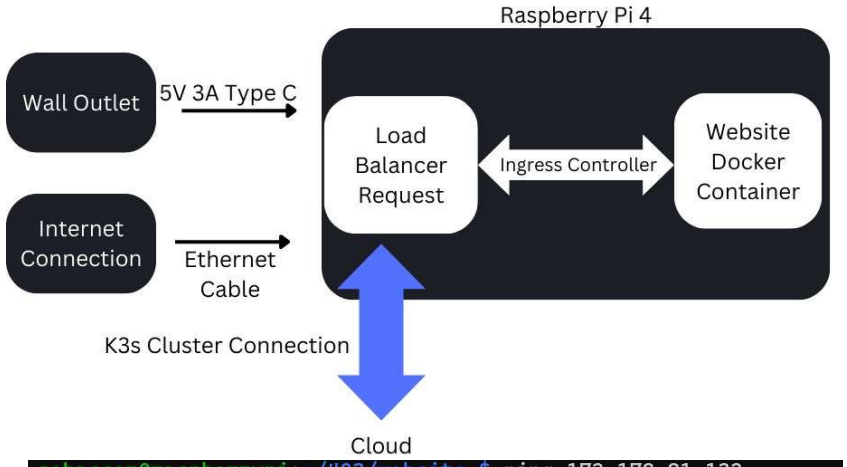
Accomplishments since 403 13 hrs of effort	Ongoing progress/problems and plans until the next presentation
- package.json and index.js file updated - added docker ignore file - completed successful website hosting - Reconfigured firewall rules	- Ongoing registering Pi as Worker Node in k3s cluster - Continue to Improve Website Functionality - Apache Benchmark to Test Website Container

```
sebascor@raspberrypi:~/403/website $ docker ps
CONTAINER ID   IMAGE                          COMMAND                  CREATED         STATUS         PORTS                                                NAMES
08f02fba4eb5   website                        "docker-entrypoint.s…"   28 minutes ago  Up 28 minutes  8080/tcp, 0.0.0.0:8080->3000/tcp, :::8080->3000/tcp  website2
cb83c44e51b2   moby/buildkit:buildx-stable-1  "buildkitd"              5 months ago    Up 35 minutes                                                       buildx_buildkit_intelligent_ramanujan0
sebascor@raspberrypi:~/403/website $
```

Edge Node Subsystem

Christopher Gonzales

- Pi Takes Requests from cloud through k3s cluster
- Load Balancer Request directed to Website container
- Request directed back to cloud and user
- Website Container Output
- Connection to vpn gateway




```
sebascor@raspberrypi:~/403/website $ ping 172.178.91.132
PING 172.178.91.132 (172.178.91.132) 56(84) bytes of data.
64 bytes from 172.178.91.132: icmp_seq=1 ttl=116 time=46.0 ms
64 bytes from 172.178.91.132: icmp_seq=2 ttl=116 time=52.3 ms
64 bytes from 172.178.91.132: icmp_seq=3 ttl=116 time=61.8 ms
64 bytes from 172.178.91.132: icmp_seq=4 ttl=116 time=62.0 ms
^C
--- 172.178.91.132 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 46.007/55.509/61.957/6.750 ms
sebascor@raspberrypi:~/403/website $
```

```
sebascor@raspberrypi:~/403/website $ docker run -d -p 8080:3000 --name website3 website
3a4bc2495a15246e6947c08752df660a97ef218436cd784b6fd542a4dc8fbc87
sebascor@raspberrypi:~/403/website $ docker logs 3a4bc2495a15246e6947c08752df660a97ef218436cd784b6fd542a4dc8fbc87

> website@1.0.0 start
> node index.js

Running on http://0.0.0.0:8080
sebascor@raspberrypi:~/403/website $
```

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Cloud Subsystem

Sebastian Correa

Accomplishments since 403 14-15 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Connected Worker Node VM • Created Kubernetes Dashboard • Updated Security Group Rules • Created VPN Gateway	• Accessing the Dashboard • Adding the Pi as a worker node • Configuring Load Balancer

```
403lbonfog@gmail.com@MasterNode:~$ sudo kubectl get nodes
NAME           STATUS   ROLES                  AGE   VERSION
masternode     Ready    control-plane,master   13d   v1.27.5+k3s1
workernodeone  Ready    <none>                 11d   v1.27.5+k3s1
```

```
403lbonfog@gmail.com@MasterNode:~$ sudo kubectl get pods -n kubernetes-dashboard
NAME                                         READY   STATUS    RESTARTS        AGE
dashboard-metrics-scraper-5cb4f4bb9c-mf56g   1/1     Running   4 (4m55s ago)   4d13h
kubernetes-dashboard-6967859bff-zsztw        1/1     Running   5 (4m18s ago)   4d13h
```

Cloud Subsystem

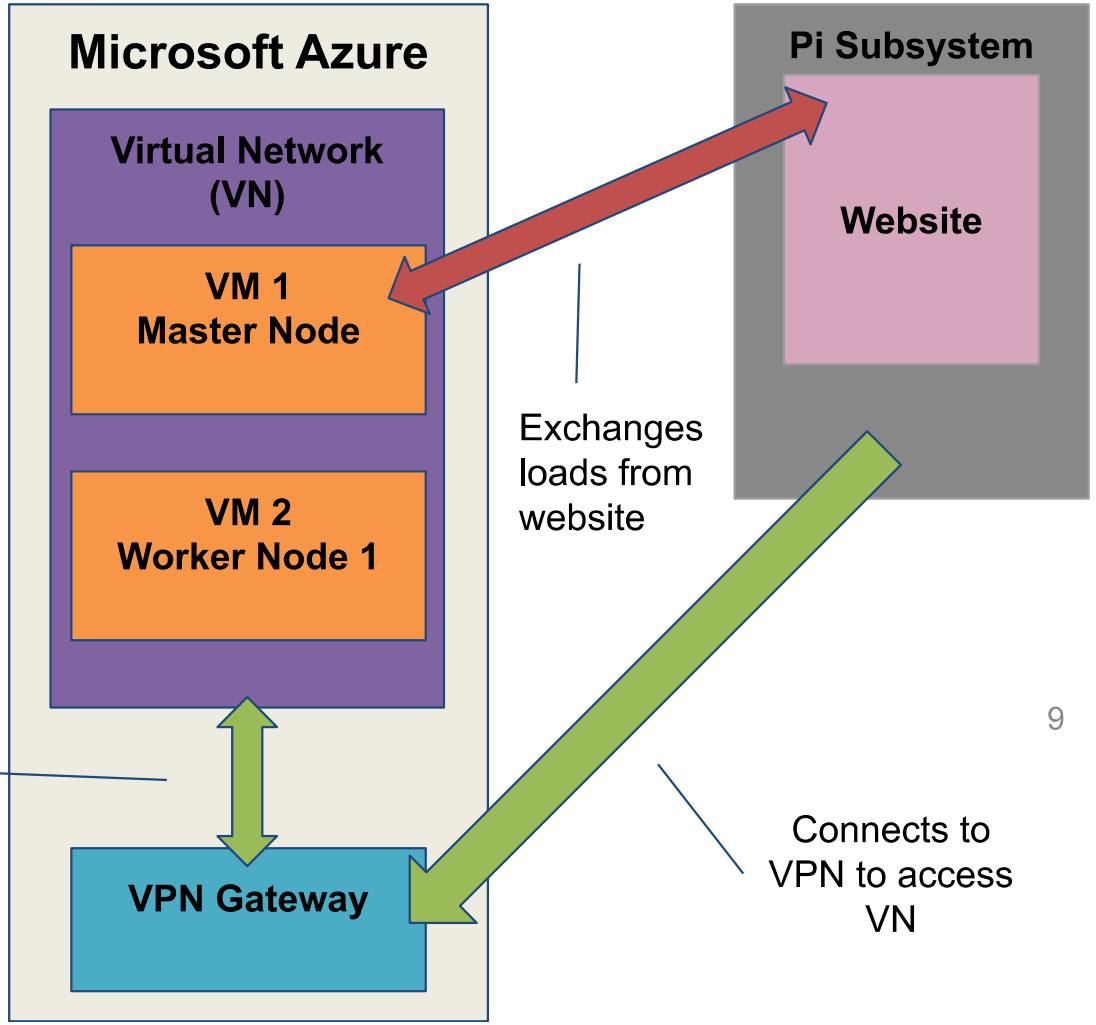
Sebastian Correa

Function:

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

Problem:

- Pi not added as a worker node yet



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	Ongoing	N/A
Configure containerization in Pi	10/5	Christopher	Incomplete	N/A
Finalize Integration	10/12	Christopher	Incomplete	N/A

Execution Plan

Work	End Date	Owner	Status	Completion Date
Test Fault Tolerance	10/19	Sebastian	Incomplete	N/A
Demonstrate movement of loads	10/26	Sebastian	Incomplete	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

Validation plan

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

Questions?