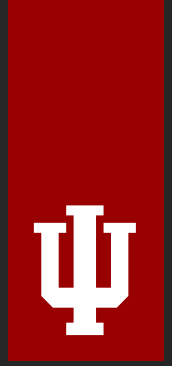

E210 Engineering Cyber-Physical Systems (Spring 2021)

Flask

Bryce Himebaugh

Weekly Focus	Reading	Monday	Wed	Lab
Exam/CPS Introduction	Ref 1 Chapter 1	**3/8:** Exam 1	**3/10:** CPS Introduction	**Project 5 Raspberry PI Setup**
Raspberry Pi	Ref 2 Chapter 1-3	**3/15:** Pi Intro/UART Bus	**3/17:** Git/Github	
I2C Bus	Ref 3	**3/22:** I2C Bus	**3/24:** Wellness Day	**Project 6 I2C Pressure Sensor**
Python/Sensor	Ref 4, Ref 5	**3/29:** Classes/Modules	**3/31:** Pressure Sensor	
SPI	Ref 6	**4/5:** SPI Bus Overview	**4/7:** SPI HDL Design	**Project 7 GPIO Connected I/O**
SPI	Ref 7 Chapter 1	**4/12:** SPI HDL Design	**4/14:** Networking Overview	
Network Interface	Ref 7 Chapter 1	**4/19:** MQTT	**4/21:** Flask II	**Project 8 MQTT**
MQTT/Flask	Ref 7 Chapter 2-4	**4/26:** Flask II	**4/29:** Open Topic	

Final Exam Wed 5/5 7:45-9:45

https://engr210.github.io/

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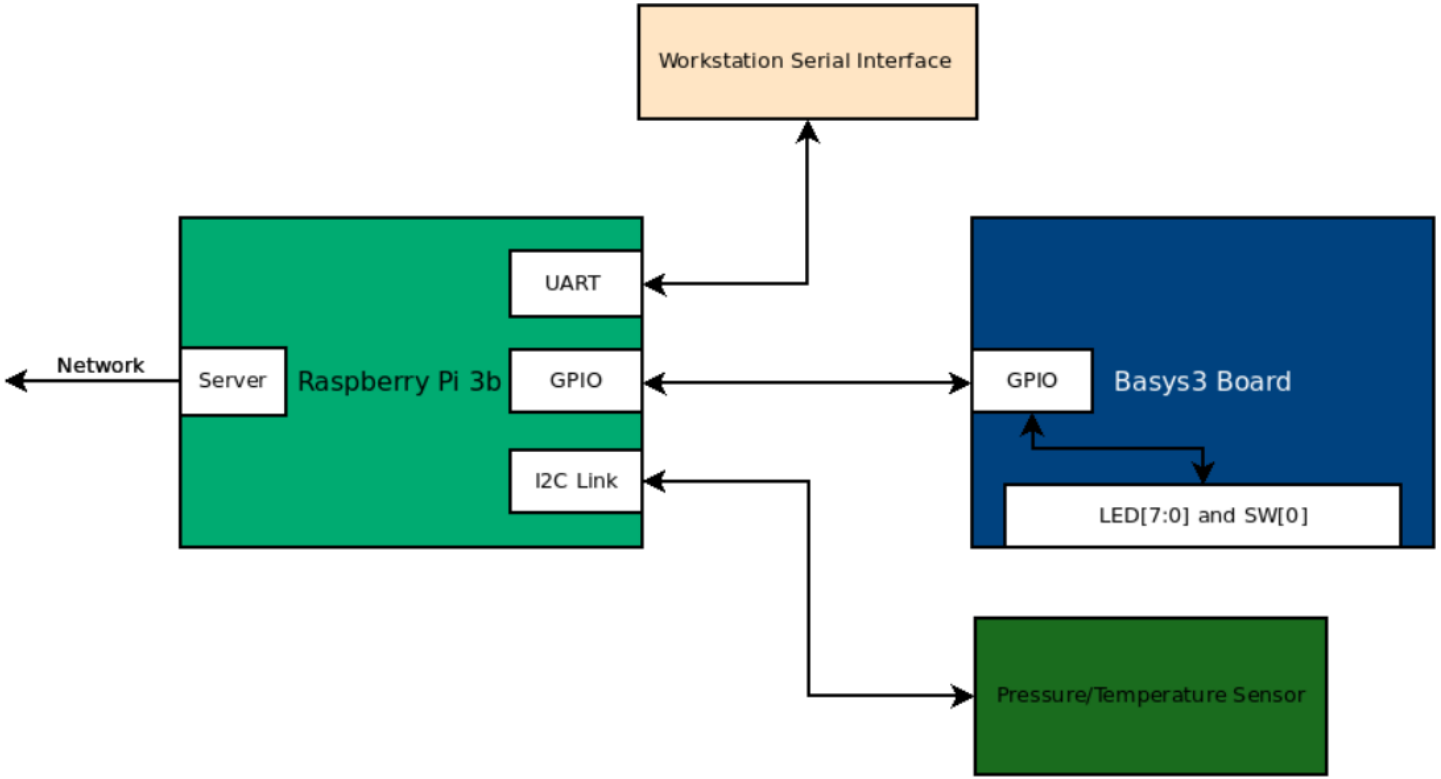
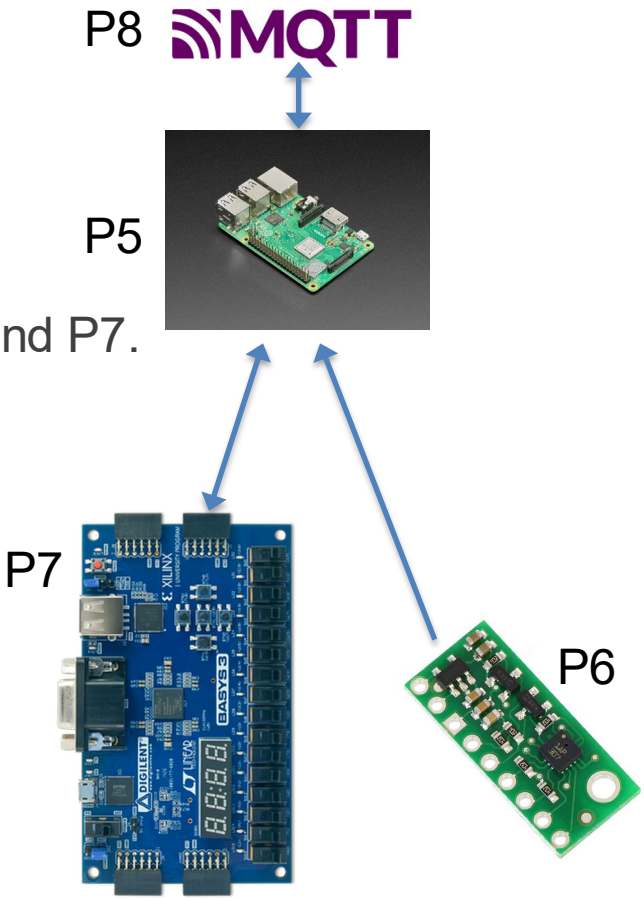
Raspberry PI/Basys3 Link



Project 8 Overview

Project 8

1. Utilize classes and hardware created in P5, P6 and P7.
   - lps331
   - Basys3_LEDSW
2. Publish MQTT Sensor Data
3. Subscribe to MQTT LED messages



Template Code

```
#!/usr/bin/env python3

import paho.mqtt.client as mqtt
import time

# White Bar Code Label Number on Each Raspberry Pi
sensor_id = 986304
temperature = 21
pressure = 31
switch = 0
```

Template Code

```
client = mqtt.Client()
client.on_message=on_message
client.on_connect=on_connect
client.connect("pivot.iuiot.org")
client.loop_start()
```

```
def on_message(client, userdata, message):
#    print("topic:", message.topic)
    print("message:", message.payload.decode('UTF-8'))
```

```
def on_connect(client,userdata,flags,rc):
    client.subscribe(f"sensors/{sensor_id}/led")
```

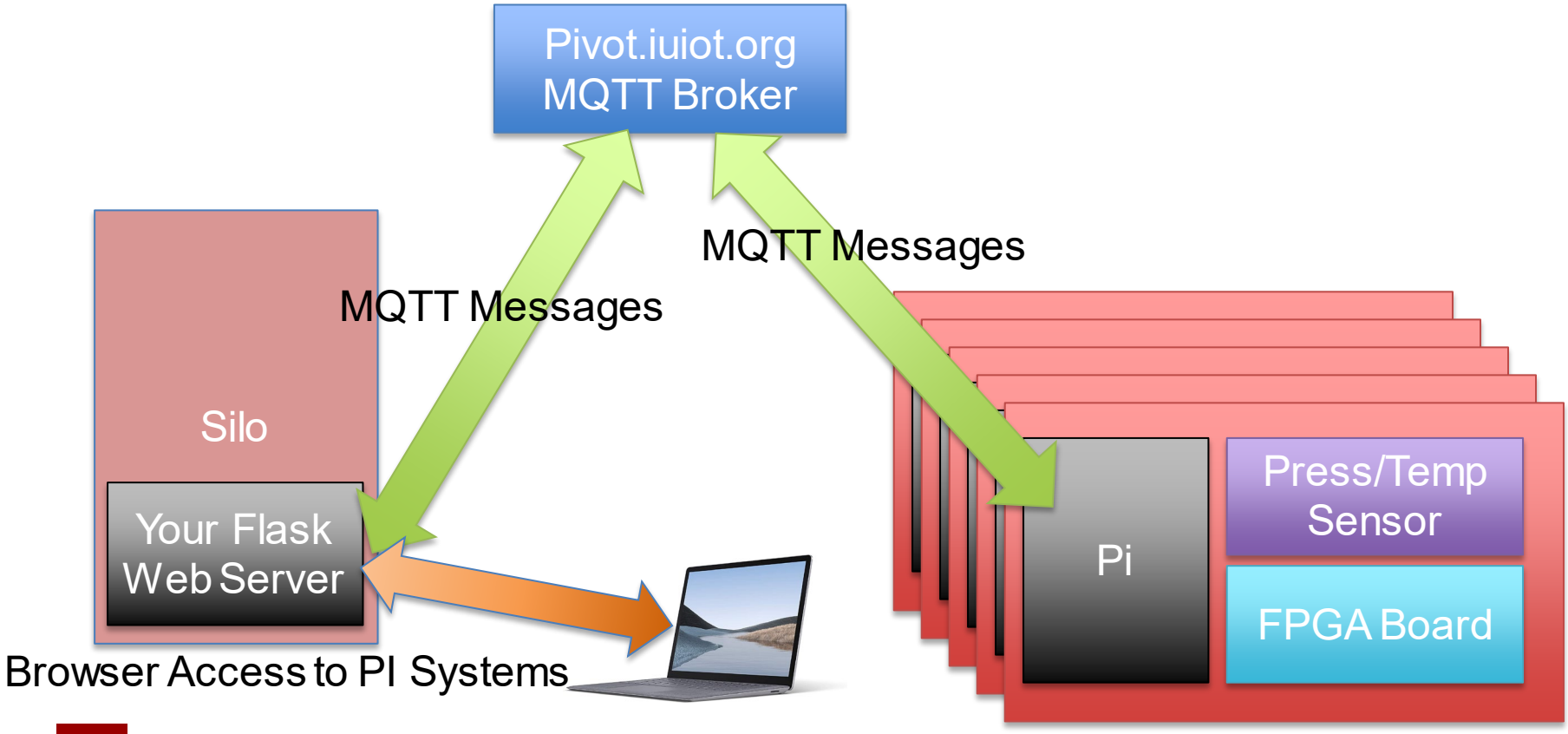
```
while(1):
    print("Publish Temperature, Pressure, and Switch Data")
    client.publish(f"sensors/{sensor_id}/temperature",f"{temperature}")
    client.publish(f"sensors/{sensor_id}/pressure",f"{pressure}")
    client.publish(f"sensors/{sensor_id}/switch",f"{switch}")
    time.sleep(15)
```

Sending and Receiving MQTT

1. Data will published from your sensor every 15 seconds
   - To view Data
     - mosquitto_sub –h pivot.iuiot.org –t sensors/<sensorid>/#
     - Replace <sensorid> with the serial number of your sensor
   - To actuate LEDs:
     - mosquito_pub –h pivot.iuiot.org –t sensors/<sensorid>/led –m <0-7>
     - Replace <sensorid> and <0-7> with actual data

Flask Discussion

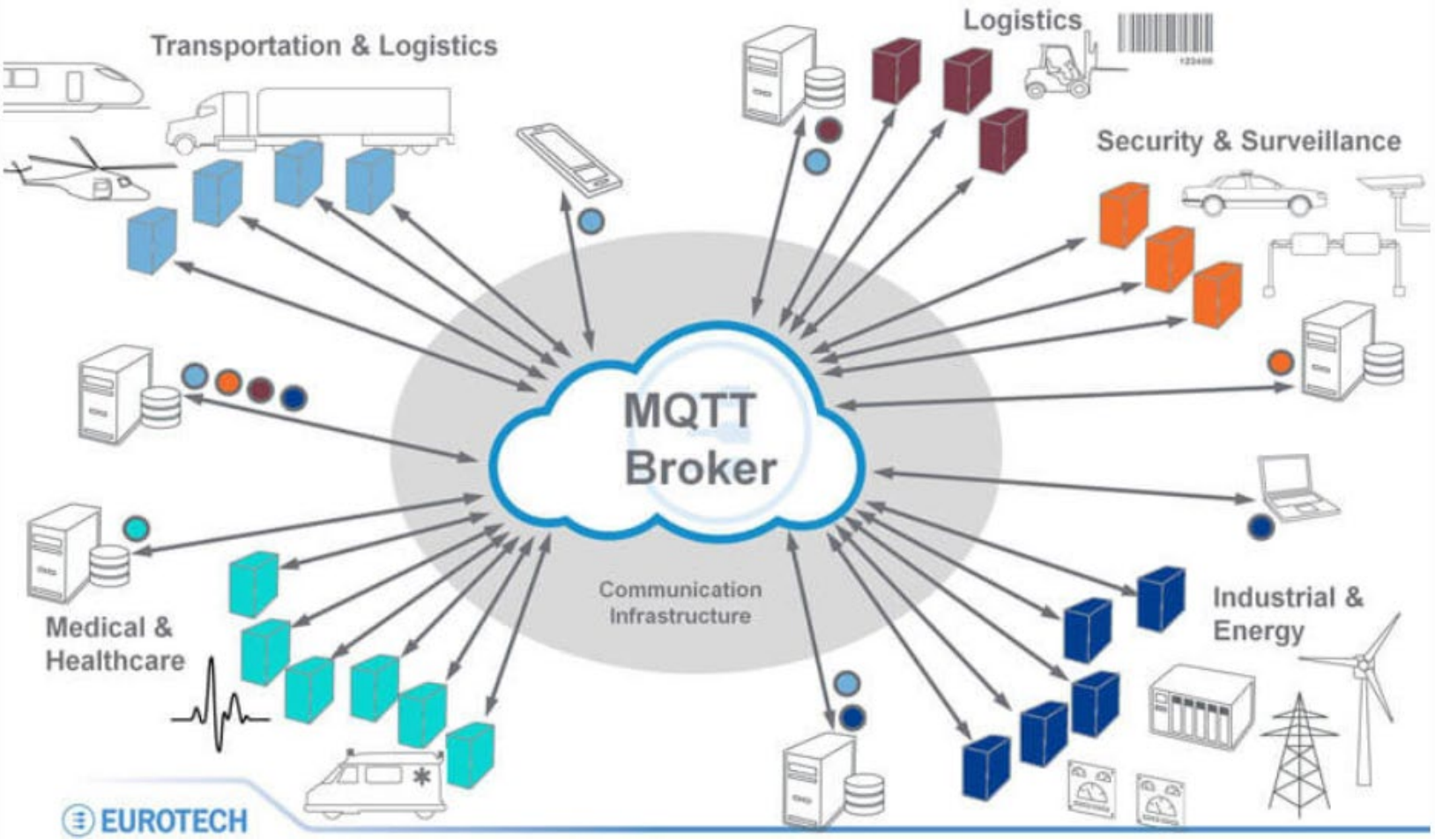
System Architecture



```python
from flask import Flask
app = Flask(__name__)
@app.route('/')
def index():
    return 'Hello world'
if __name__ == '__main__':
    app.run(debug=True, port=55346, host='0.0.0.0')
```

Connecting P5-P8 to CPS

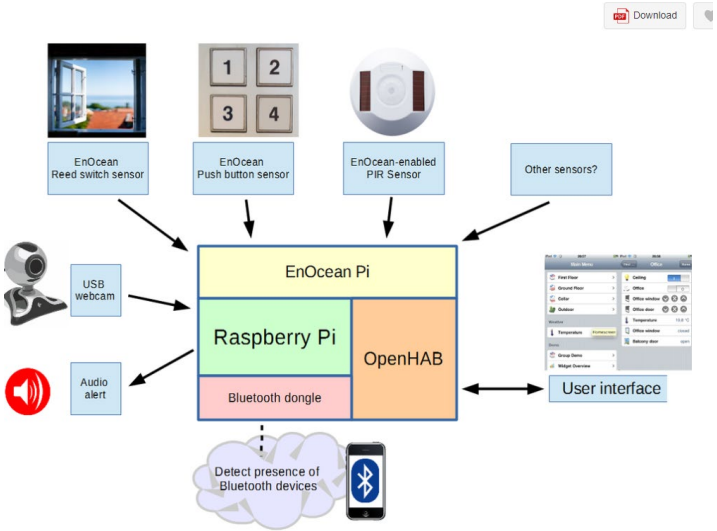
CPS Use Cases

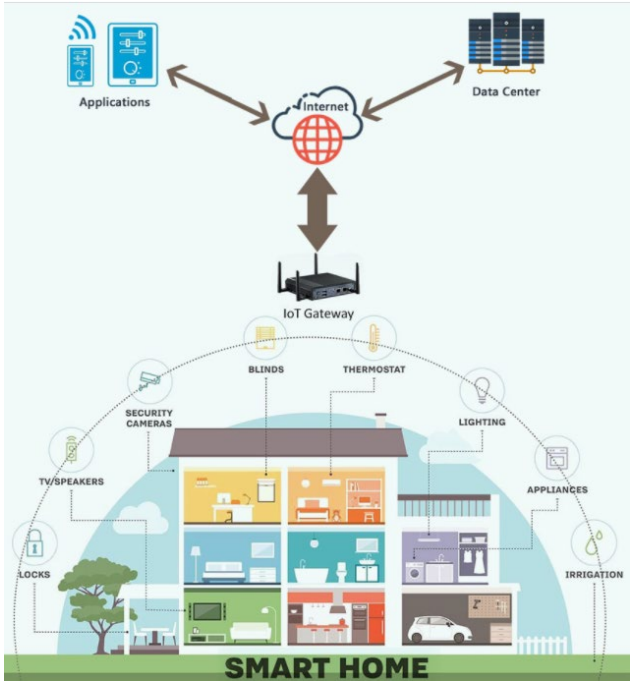

Transportation & Logistics
Logistics
Security & Surveillance
MQTT
Broker
Communication
Infrastructure
Medical &
Healthcare
Industrial &
Energy
EUROTECH

Remote Patient Monitoring

1. Low Latency
2. Security
3. Scalability
   - Topics organized by patient

Home Energy Monitoring and Control





Surveillance Systems

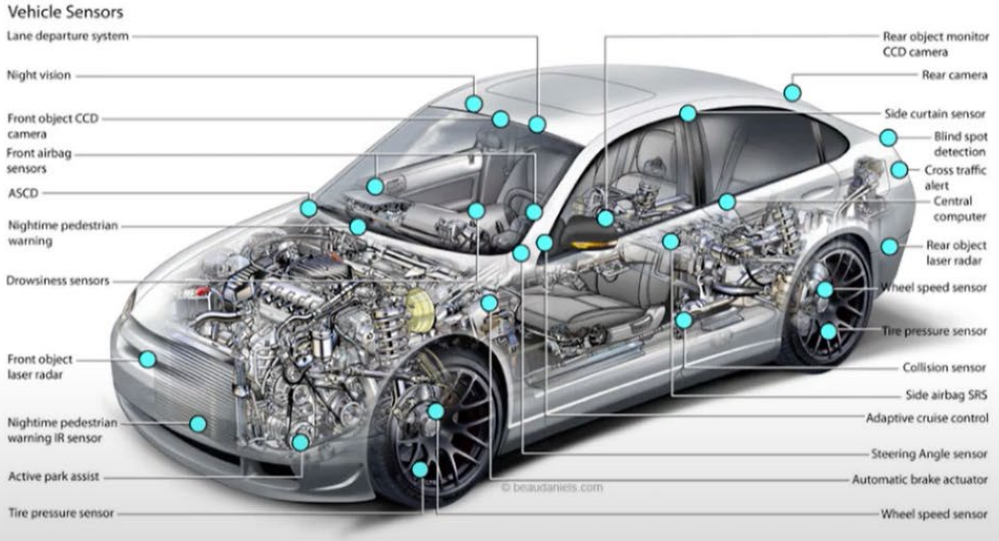
Agriculture

Automotive

By 2020, there will be **250 Million** connected vehicles on the road globally
– Gartner & Connected Vehicle Trade Association

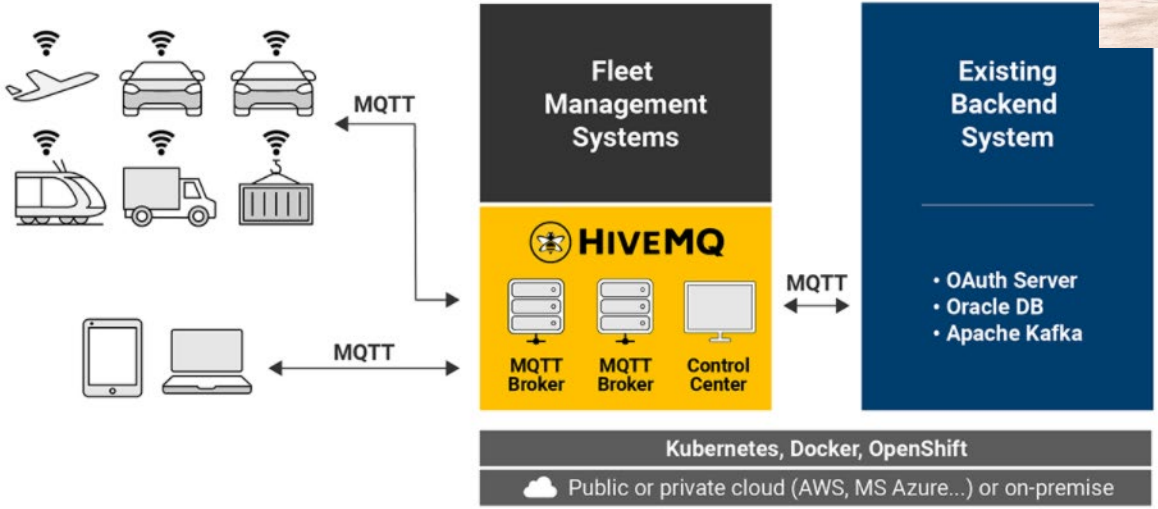
75% of new cars shipped in 2020 will have internet connectivity
- Business Intelligence

Vehicles currently on the road have **60 – 100** sensors onboard. This number is projected to increase to **200+** by the year 2020.

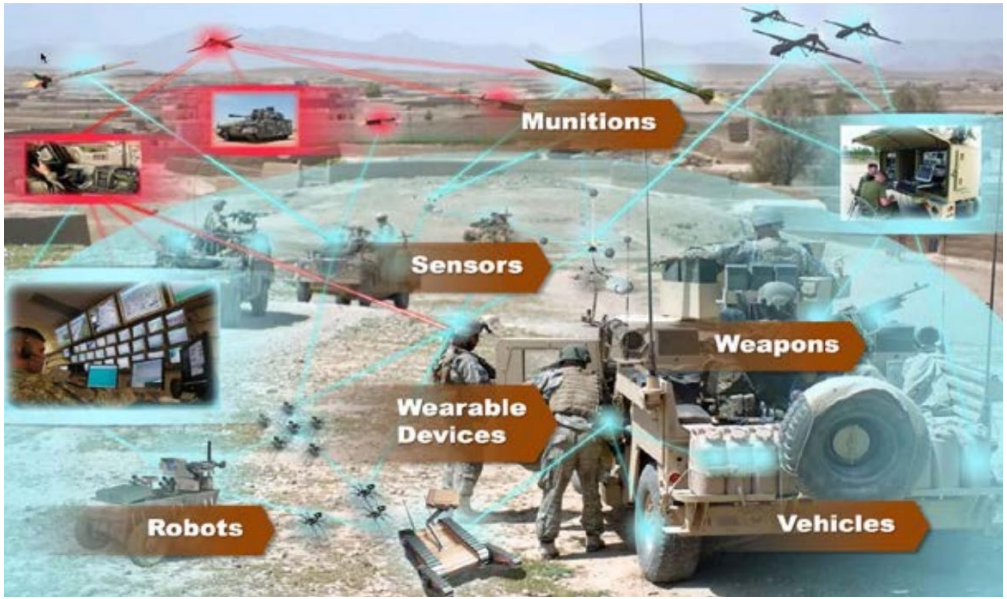


- Sources: Gartner, Strategy&, Mems Journal

Logistics

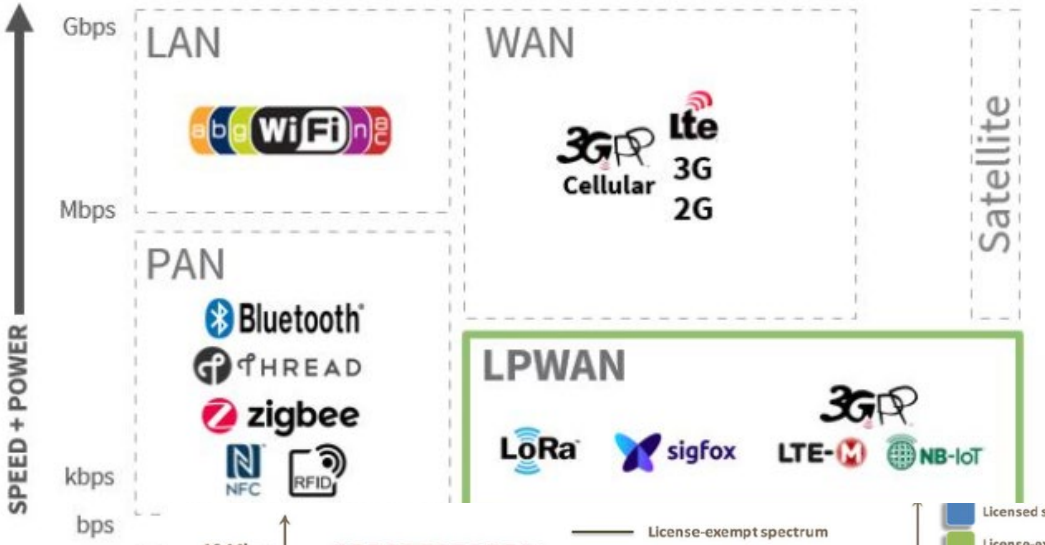

MQTT
MQTT
Fleet Management Systems
HIVEMQ
MQTT Broker
MQTT Broker
Control Center
MQTT
Existing Backend System
• OAuth Server
• Oracle DB
• Apache Kafka
Kubernetes, Docker, OpenShift
Public or private cloud (AWS, MS Azure...) or on-premise

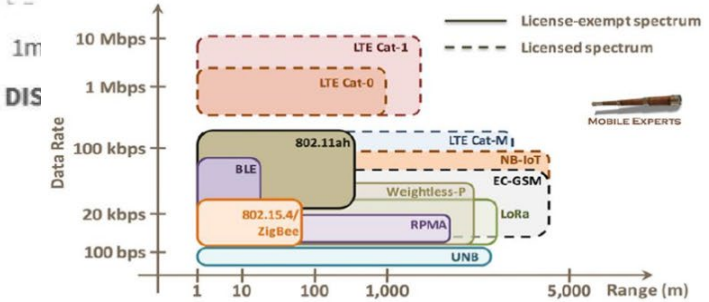
Military Application



Enabling Technologies

Wireless Networks





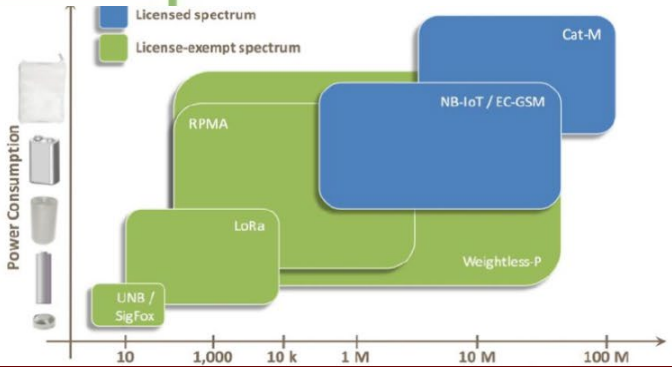


Figure 1 Range vs. data rate for IoT connectivity technologies.

Cloud Computing

Alibaba Cloud

amazon web services

Google Cloud Platform

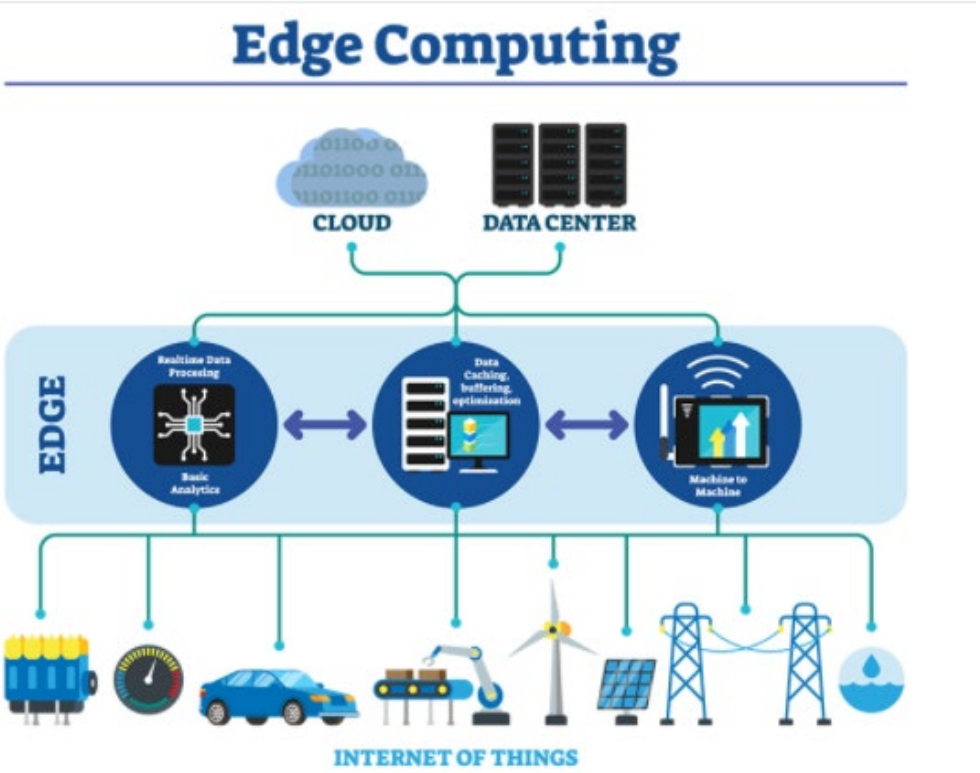
Liquid Web

vmware

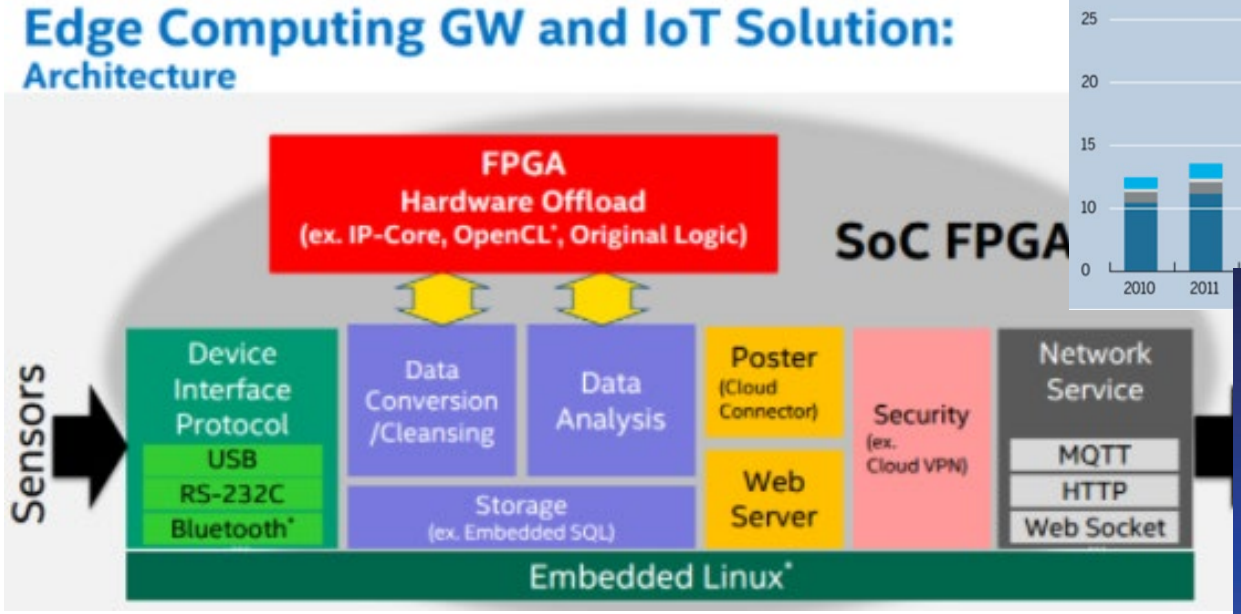
salesforce

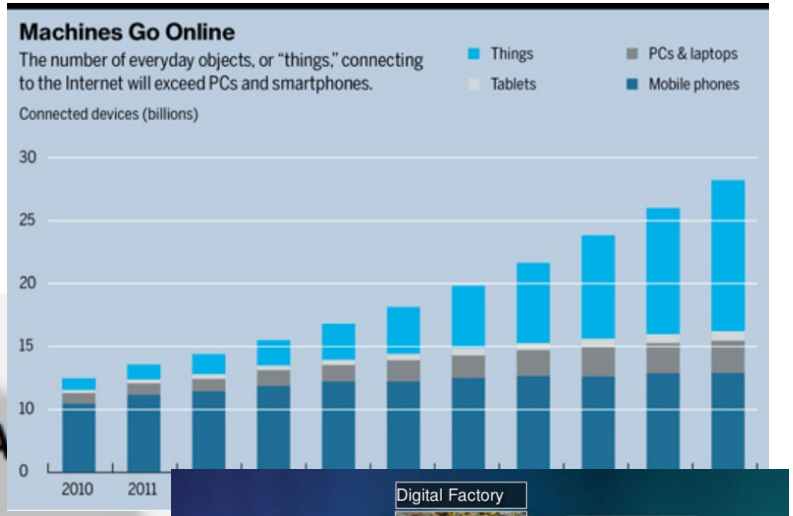
Azure

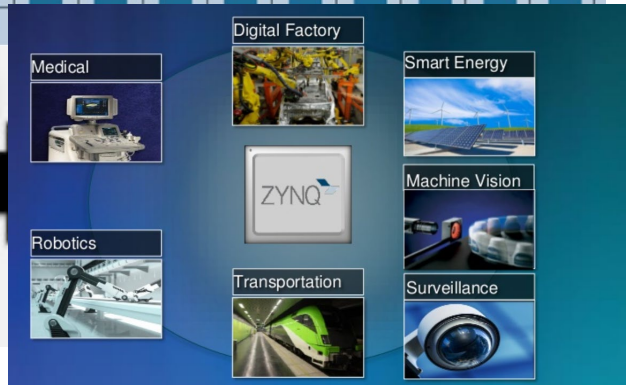
ORACLE CLOUD



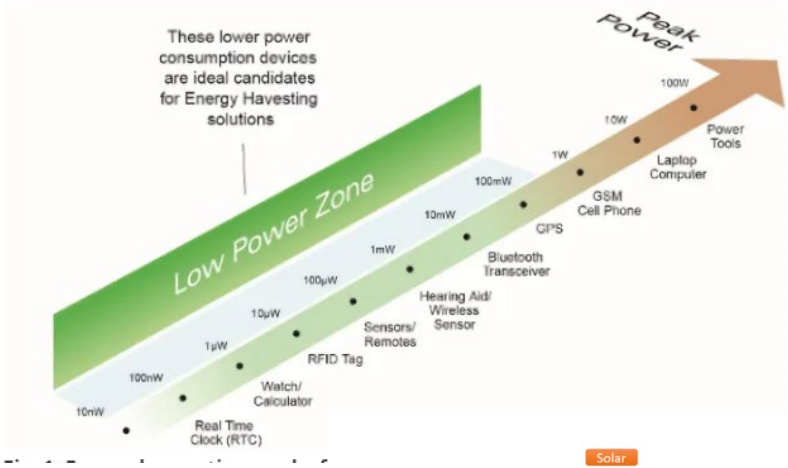
Advanced Hardware

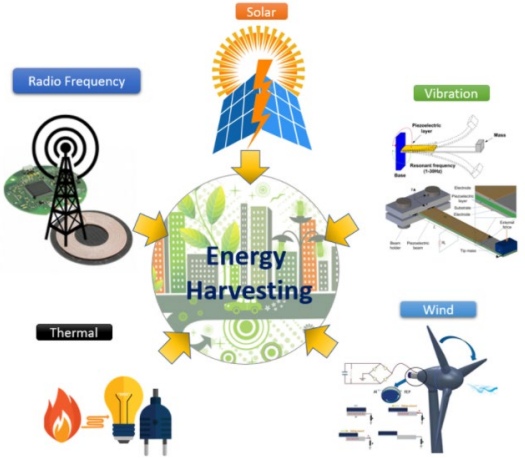






EnergyTechnologies





AI Technology