

Secure IOT Platform Using Paho & Flask

JAIMON JOSE

Agenda

About me

IoT primer and reference architecture

IoT platform design

Best practices



About Me



Jaimon Jose, Co-Founder, CTO, picoNets

- 17 Years of product development experience
- Distinguished Engineer at Novell and Core founding member at PAQS
- Continuous learner and Trainer for processes and technologies over a decade
- Engaged with academia and industries
- Patents, publications and speaking in various events
- Over a decade of experience in building solutions in identity, security, cloud, virtualization, distributed systems



I E T F[®]



(ISC)²[®]



picoNETS



<https://in.linkedin.com/in/jjaimon>



<http://jjaimon.net>

IoT: What and Why?

Internet of Things (IoT) to Internet of Everything (IoE)

- Network of physical objects that contain embedded technology to communicate and interact with their internal states or external environment

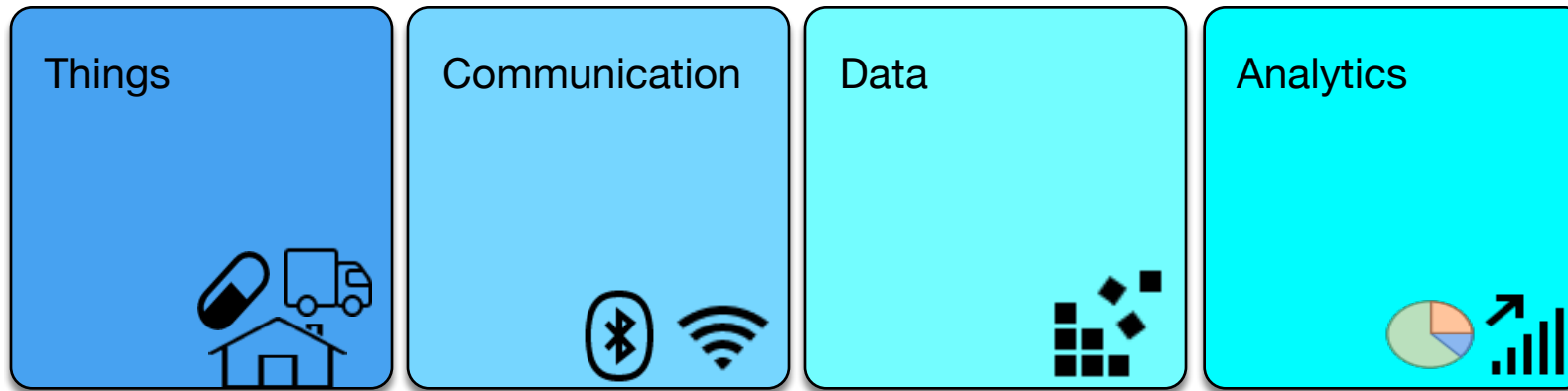
World is getting smarter

- Smarter Homes
- Smarter Logistics
- Smarter Healthcare
- Smarter Vehicles

Industrial and Home solutions

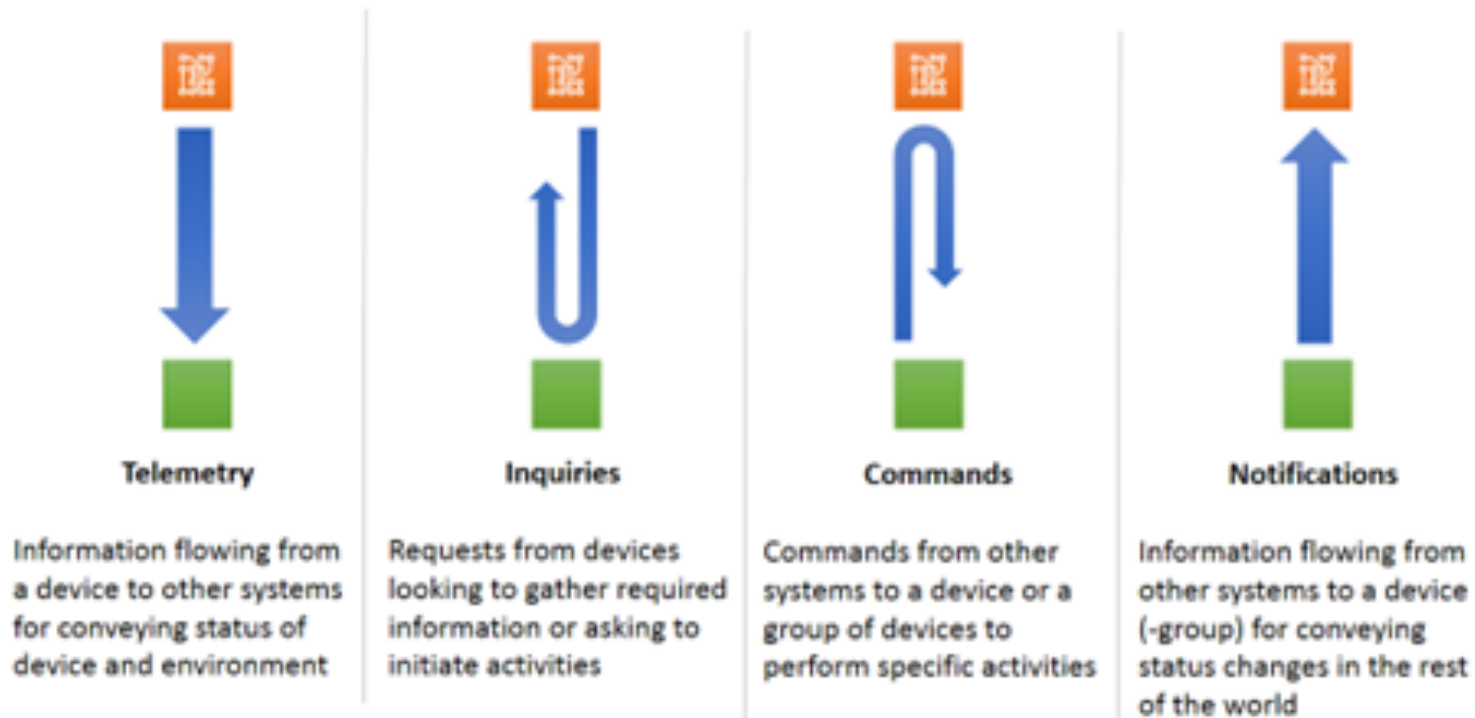
My  tells my  to open the  and start  

What is IoT About?



IoT Communication Patterns

Information Exchange Patterns

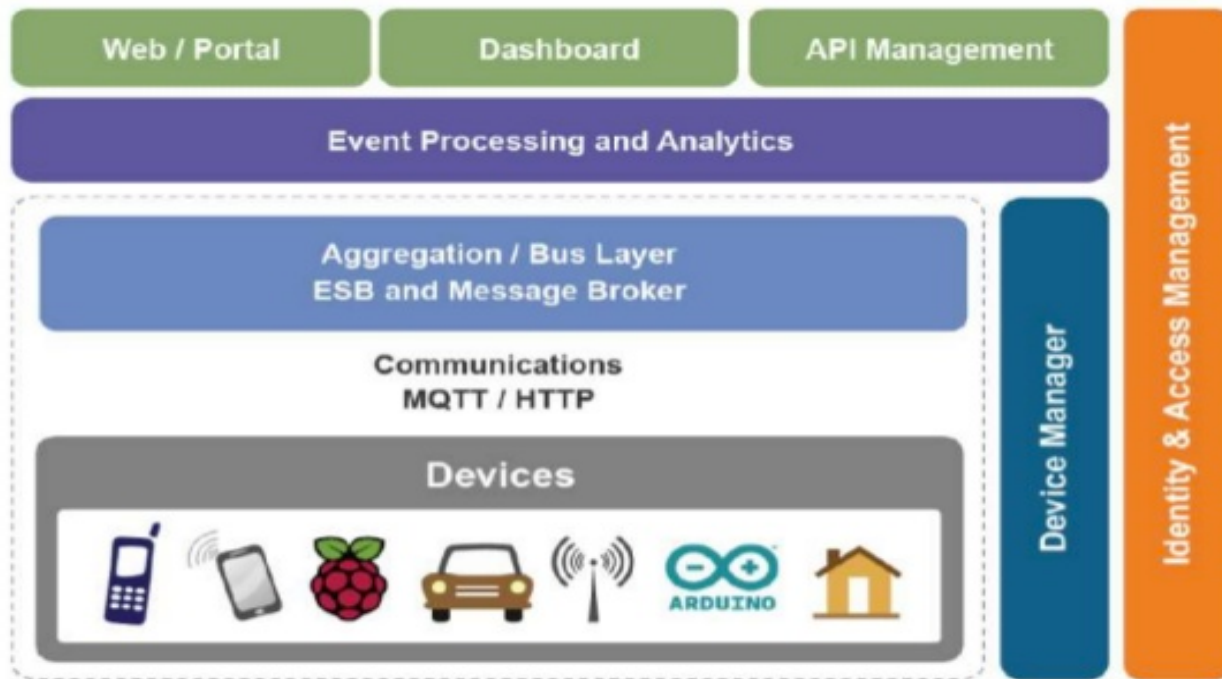


Source: <https://blogs.msdn.microsoft.com/clemensv/2014/02/09/service-assisted-communication-for-connected-devices/>

IoT Reference Architecture

Reference Architecture for the Internet of Things

<http://freo.me/iotra>





IOT Platform – A Practical Approach

Design Rationale

Secure provisioning and bootstrapping

Minimize on-the-wire footprint

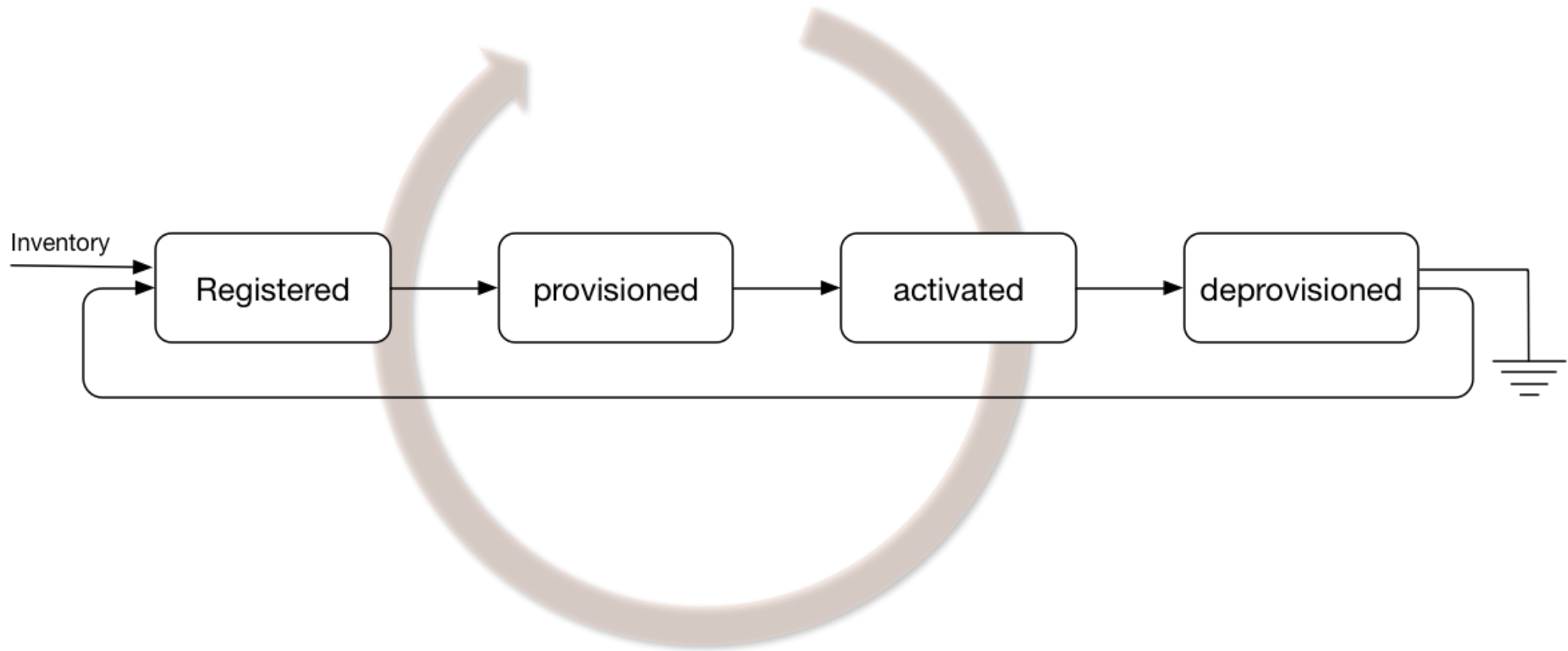
Expect network interruption. Design for resilience

Protocol support to configure the device from server

Standard and proven protocols– no reinventing

Less processing on the device – let server do the heavy lifting

Device Lifecycle



Protocols



Bootstrap on HTTPS

- Built in support for secure transport, easy to pass-through firewalls

Data on MQTT

- Developed by IBM in the late 1990s used for oil field and flood plain monitoring
- Handed over to Eclipse Foundation in 2011 as part of M2M announcement
 - IBM MQTT client code – C and Java – to new a Eclipse project “Paho”
- Simple methods – publish/subscribe/unsubscribe
- Faster than HTTP (if you compare with REST – HTTP is verbose)
- Protocol is optimized from the start for unreliable, low-bandwidth, high-latency networks
- Client must support TCP and will hold a connection to the broker at all times

Didn't consider CoAP (relatively new)

Device Server Communication

HTTPS

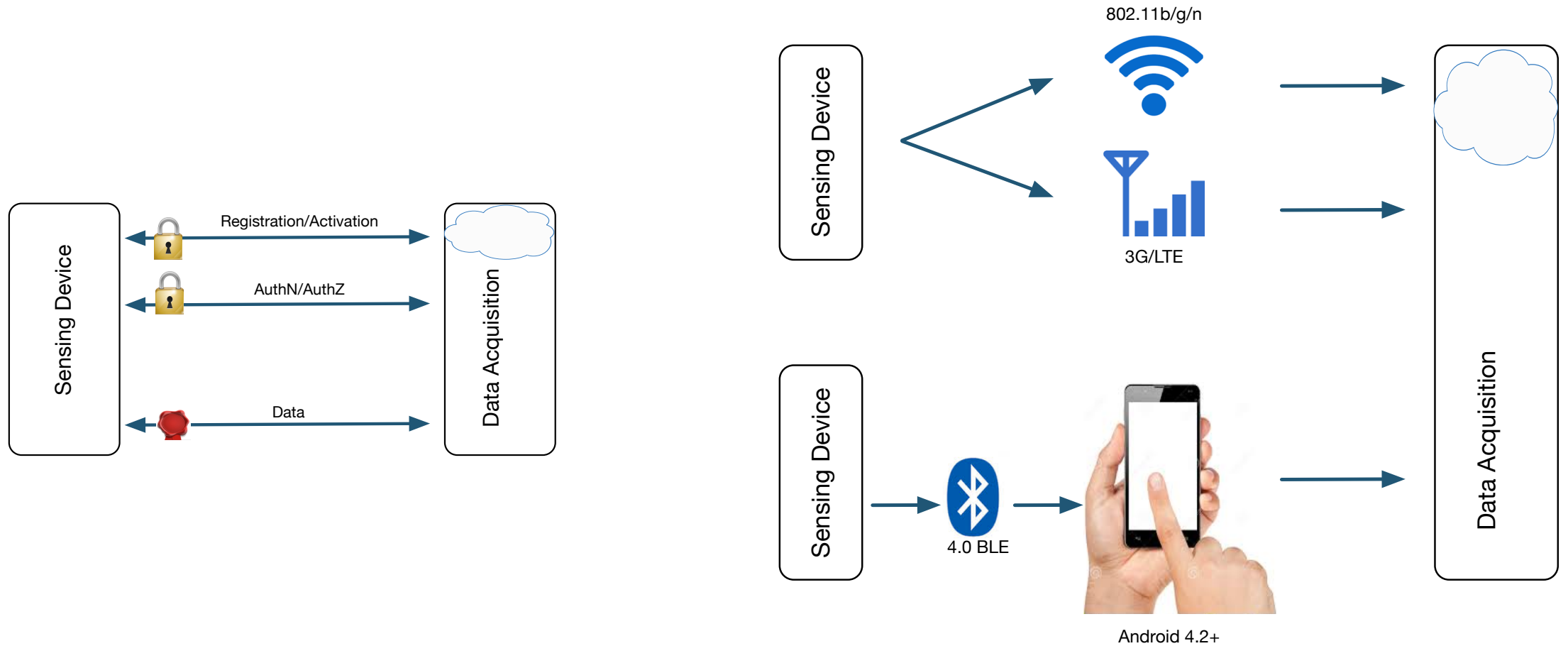
- Registration, AuthN, AuthZ and Key renewal
- Flask + Tornado

Data transfer

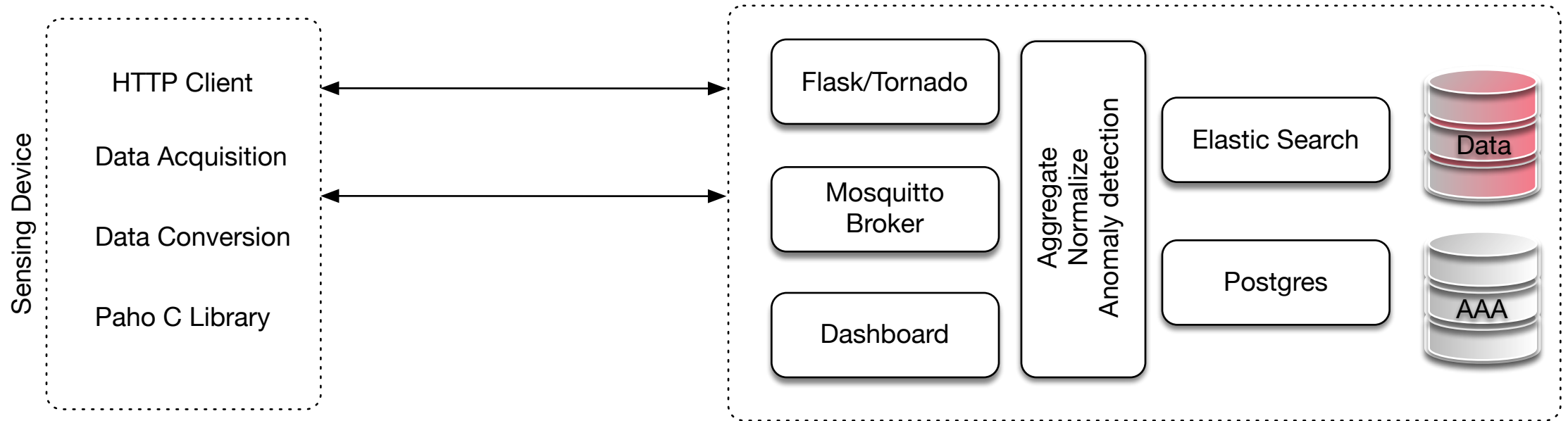
- Sensor data and errors
- Small keep alive packets to monitor device health
- Compressed and signed json payload
- mosquitto as the broker



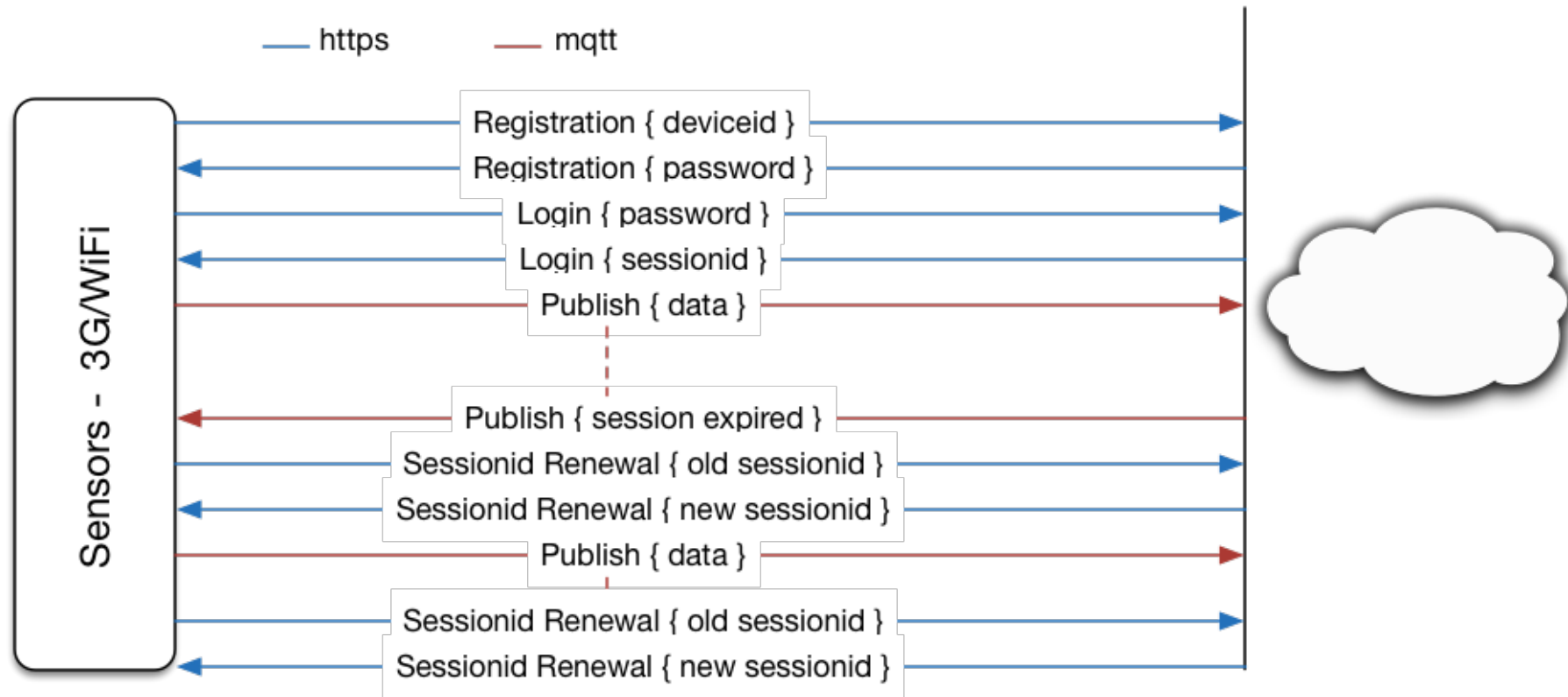
Device – Backend Interactions



Platform View



Protocol Interactions



Flask – Plugins

Flask-RESTful

- Extension for Flask that adds support for REST APIs
- Resourceful routing – ability to define methods on your resource

Flask-HTTPAuth

- Implements HTTP authentication with Flask routes
- Basic, digest and token based authentication methods
- Extensible

Flask – Pitfalls

Unreliable for long connections. Wrap your Flask app in a Tornado container to improve reliability

```
from tornado.wsgi import WSGIContainer
from tornado.httpserver import HTTPServer
from tornado.ioloop import IOLoop

server = HTTPServer(WSGIContainer(app), ssl_options={
    "certfile": "certs/server.crt",
    "keyfile": "certs/server.key"
})
server.listen(5050)
IOLoop.instance().start()
```

SSL setup is different for python 2.7 and below.

```
if (sys.version_info.major <= 2 and sys.version_info.minor <= 7 and sys.version_info.micro <= 8):
    logger.info("Starting with python 2.7.8 or less")
    context = ('certs/server.crt', 'certs/server.key')
else:
    logger.info("Starting with python 2.7.9 or greater")
    context = ssl.SSLContext(ssl.PROTOCOL_TLSv1)
    context.load_cert_chain('certs/server.crt', 'certs/server.key')
app.run(debug=True, host="0.0.0.0", port=5050, ssl_context=context)
```

Build a Dashboard (first)



Best Practices and Caveats

Log every state change, operations. Log...Log...Log...

Microservice architecture with clearly defined interfaces for interactions.

Use standards for data. Its a good idea for the device to publish temperature in C or F instead of $12\mu V$

Focus on your use case – Platform will evolve

- Keep it lean and easy to change as use case evolve
- You don't need a complex platform to validate your business

Collect as much information possible remotely for a device failure during development and field testing. You can't babysit a device in the field

Devices will fail and they'll surprise you. Validate data and handle exceptions

Questions?



@jjaimon



jaimon.jose@piconets.com