aws INNOVATE 2018 ONLINE CONFERENCE

Connecting Devices to AWS IoT Core (Level 300)

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AWS IoT Mission

If you knew the **state of every thing** and could **reason on top of that data…**

what problems would you solve?

IoT Device landscape

IoT Device landscape

Amazon FreeRTOS

Amazon FreeRTOS

Who is Amazon FreeRTOS for?

Oil pressure sensors	Smart meters	Robotics	Smart home
		Automotive	Door locks
Fitness trackers	Washing machines	Medical devices	HVAC systems
		Consumer electronics	More

Amazon FreeRTOS – Hardware Partners

Amazon FreeRTOS – Hardware Partners

Hardware Partners

IoT Device landscape. (Contd..)

Amazon FreeRTOS

IoT Device landscape. (Contd..)

Amazon FreeRTOS

AWS IoT Device SDK

AWS IoT Device SDK

Mobile SDK's and Programming Language support

AWS IoT Device SDK for Embedded C

AWS IoT C++ Device SDK

AWS IoT Device SDK for Java

AWS IoT Device SDK for JavaScript

AWS IoT Device SDK for Python

AWS Mobile SDK for Android

AWS Mobile SDK for iOS

Arduino Yún SDK

IoT Device landscape. (Contd..)

Amazon FreeRTOS

AWS IoT Device SDK

IoT Device landscape. (Contd..)

Amazon FreeRTOS

AWS IoT Device SDK

AWS Greengrass

AWS Greengrass

Architectures and OS Support

x86_64; OS: Linux; Distribution: Ubuntu 14.04 – 16.04

x86_64; OS: Linux; Distribution: Amazon Linux

ARMv7l; OS: Linux; Distribution: Raspbian

ARMv8 (AArch64); OS: Linux; Distribution: Ubuntu 14.04 – 16.04

AWS Greengrass

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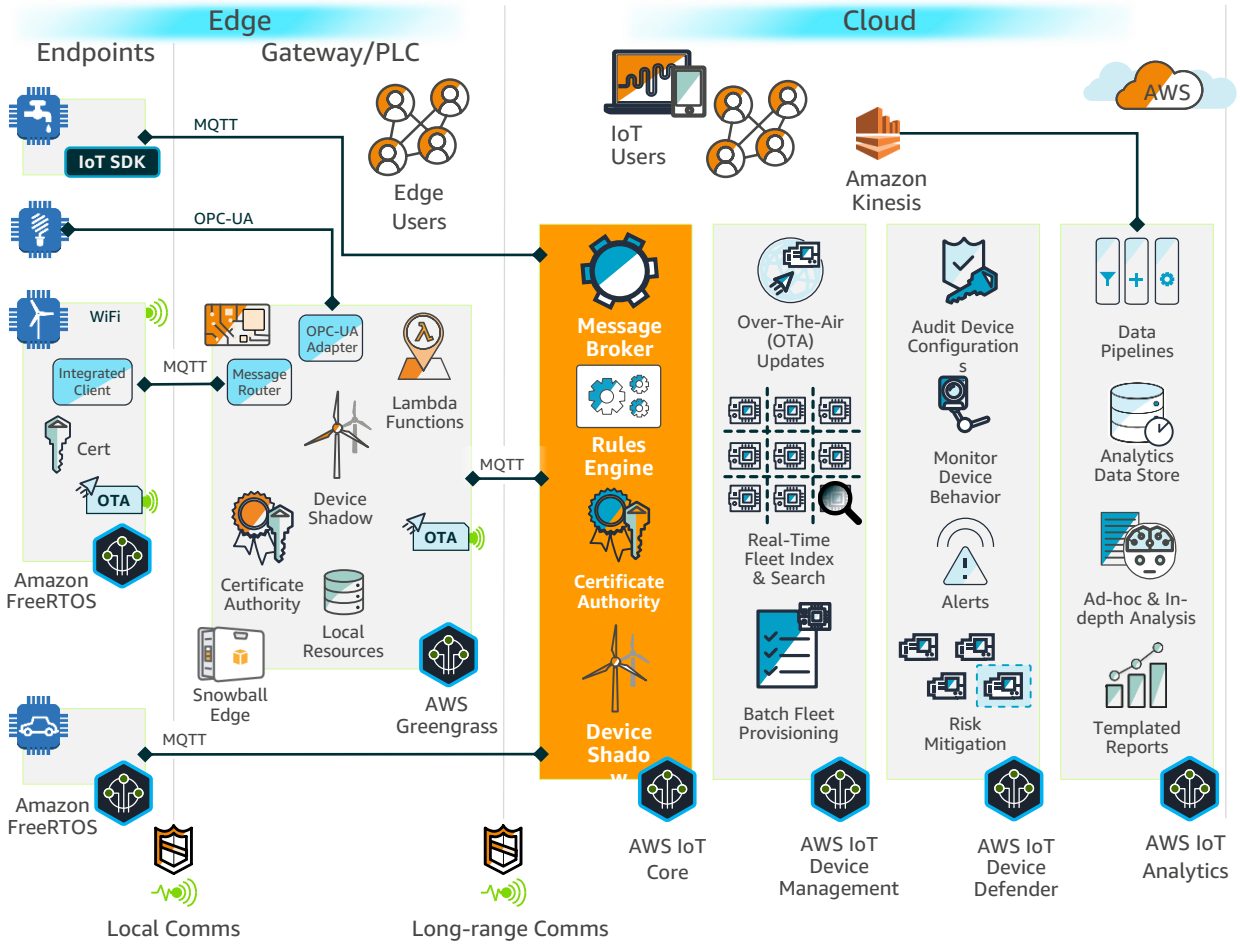
Programming languages Support for Lambdas

Python 2.7

Node.JS 6.10

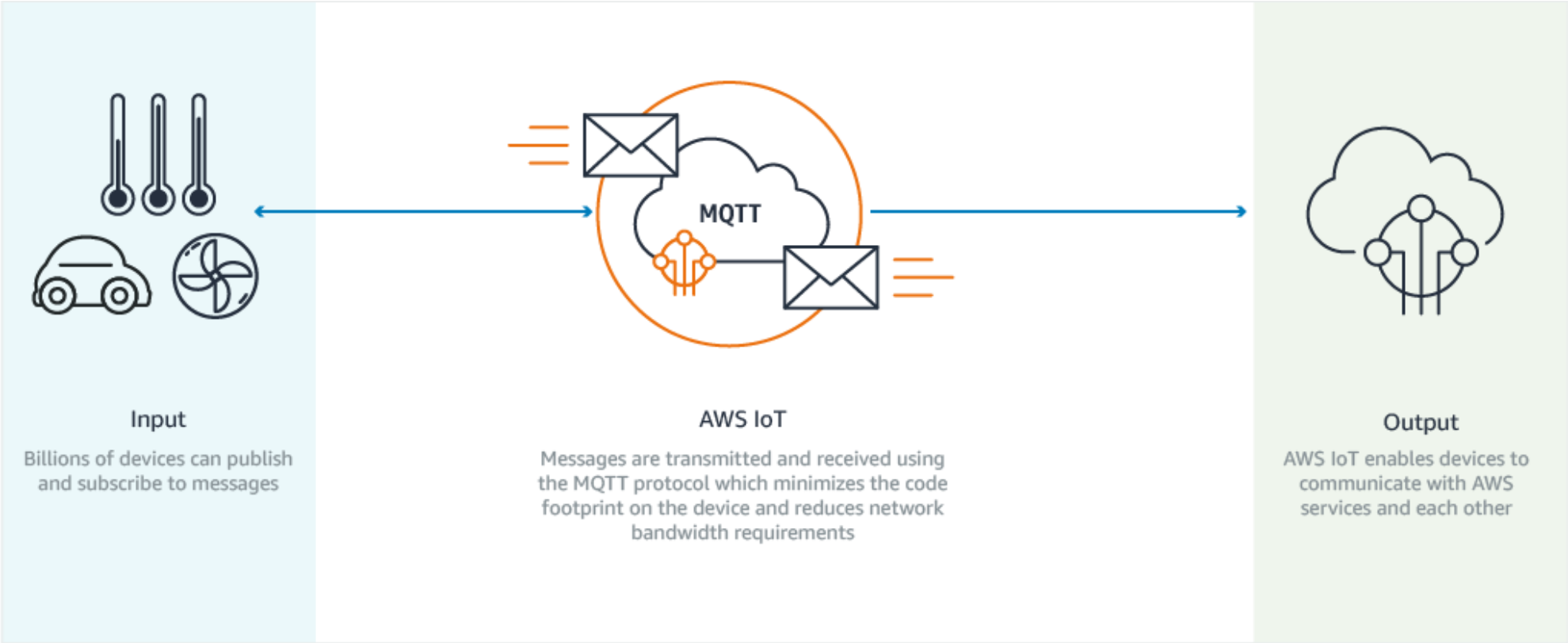
Java 8

AWS IoT - Device to Cloud Architecture



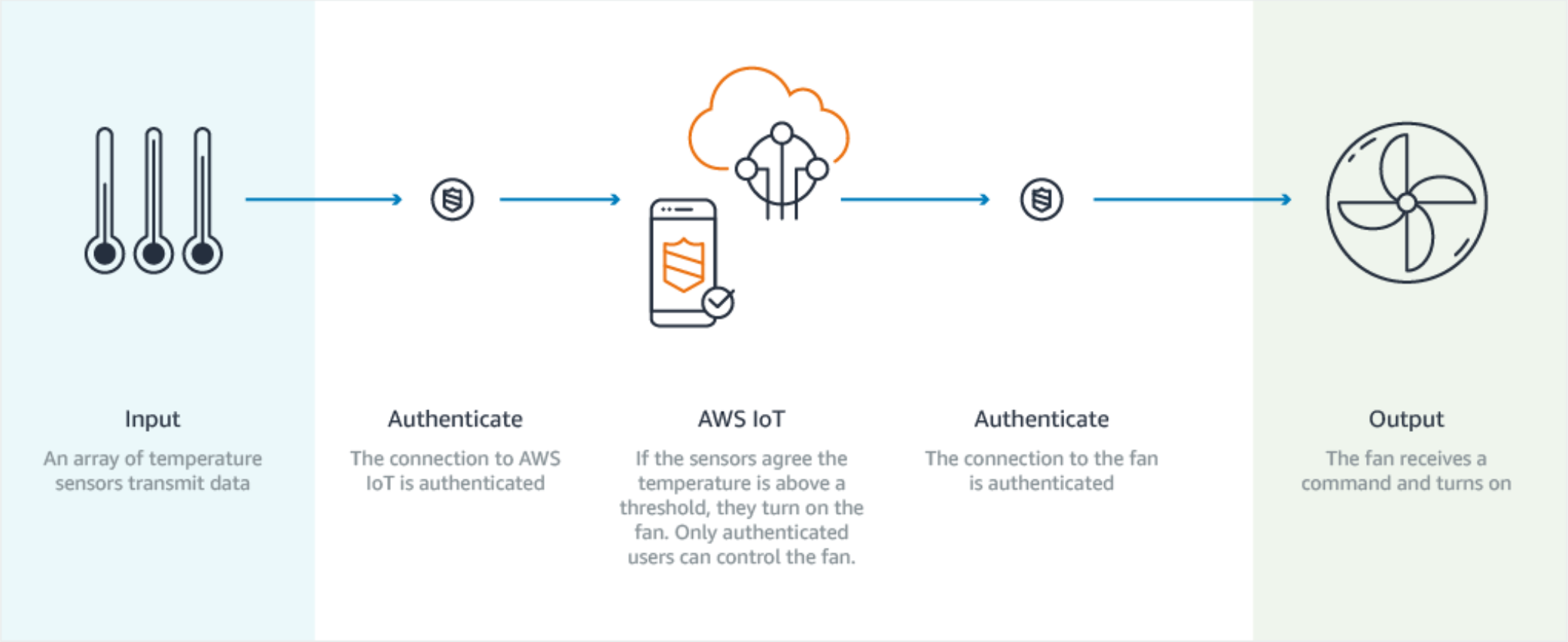
What's the AWS IoT Core?

CONNECT AND MANAGE YOUR DEVICES



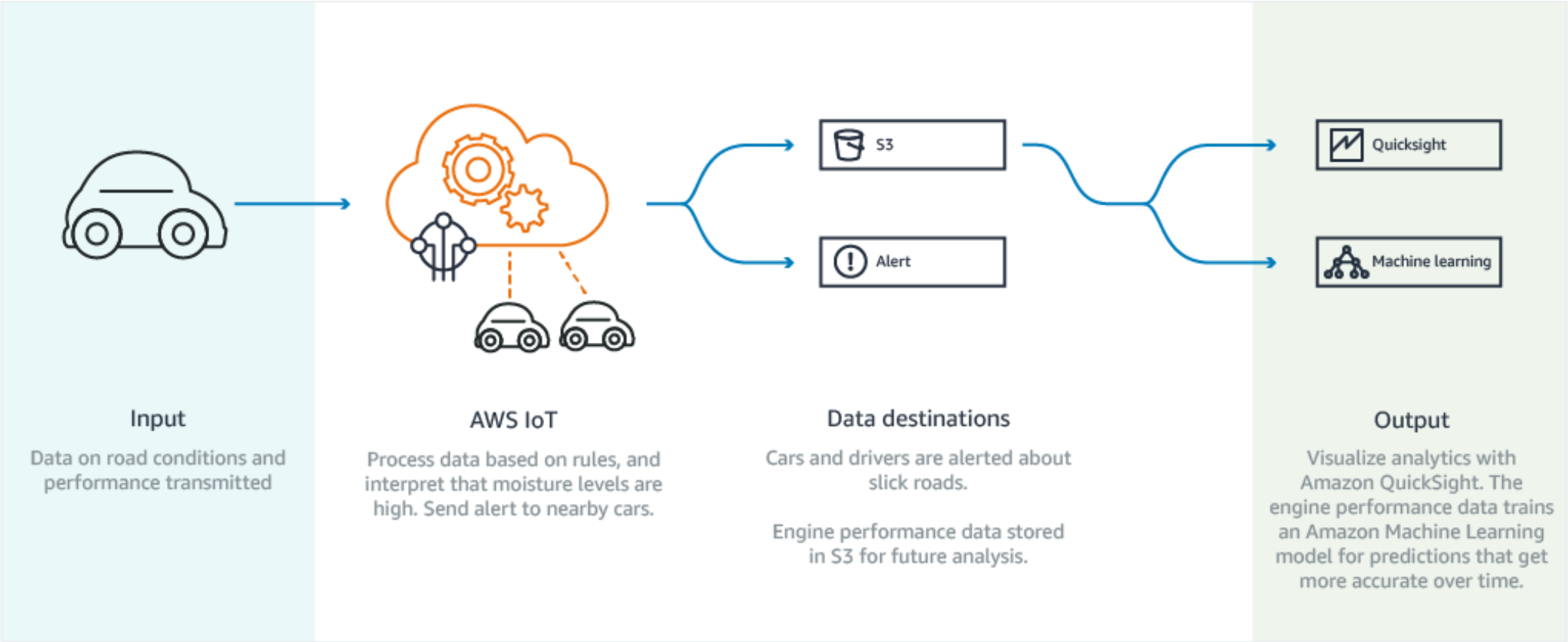
What's the AWS IoT Core? (Contd..)

SECURE DEVICE CONNECTIONS AND DATA - SECURITY



What's the AWS IoT Core? (Contd..)

PROCESS AND ACT UPON DEVICE DATA – RULES ENGINE



Rules Engine – Routing messages

Rules Engine (Some example Actions)

- Invoke a Lambda function
- Put object in an S3 bucket
- Insert, update a DynamoDB table
- Publish to an SNS topic or endpoint
- Publish to an Amazon Kinesis stream (and to EMR and Spark)
- Publish to Firehose
- Republish to AWS IoT
- Run Predictions using Amazon Machine Learning
- Publish to Amazon ES
- Write to SQS queue

Rules Engine – Routing messages (Contd..)

Rules Engine: SQL style Rules to route messages

Rules Engine – Routing messages (Contd..)

Rules Engine: SQL style Rules to route messages

SELECT * FROM ***topic or topic filter*** WHERE ***condition***

Invoke **Action**

Rules Engine – Routing messages (Contd..)

Rules Engine: SQL style Rules to route messages

SELECT * FROM ***topic or topic filter*** WHERE ***condition***

Invoke **Action**

A simplified SQL syntax to filter messages received on an MQTT topic and push the data elsewhere

Rules Engine – Routing messages (Contd..)

Rules Engine: SQL style Rules to route messages

SELECT * FROM ***topic or topic filter*** WHERE ***condition***

Invoke **Action**

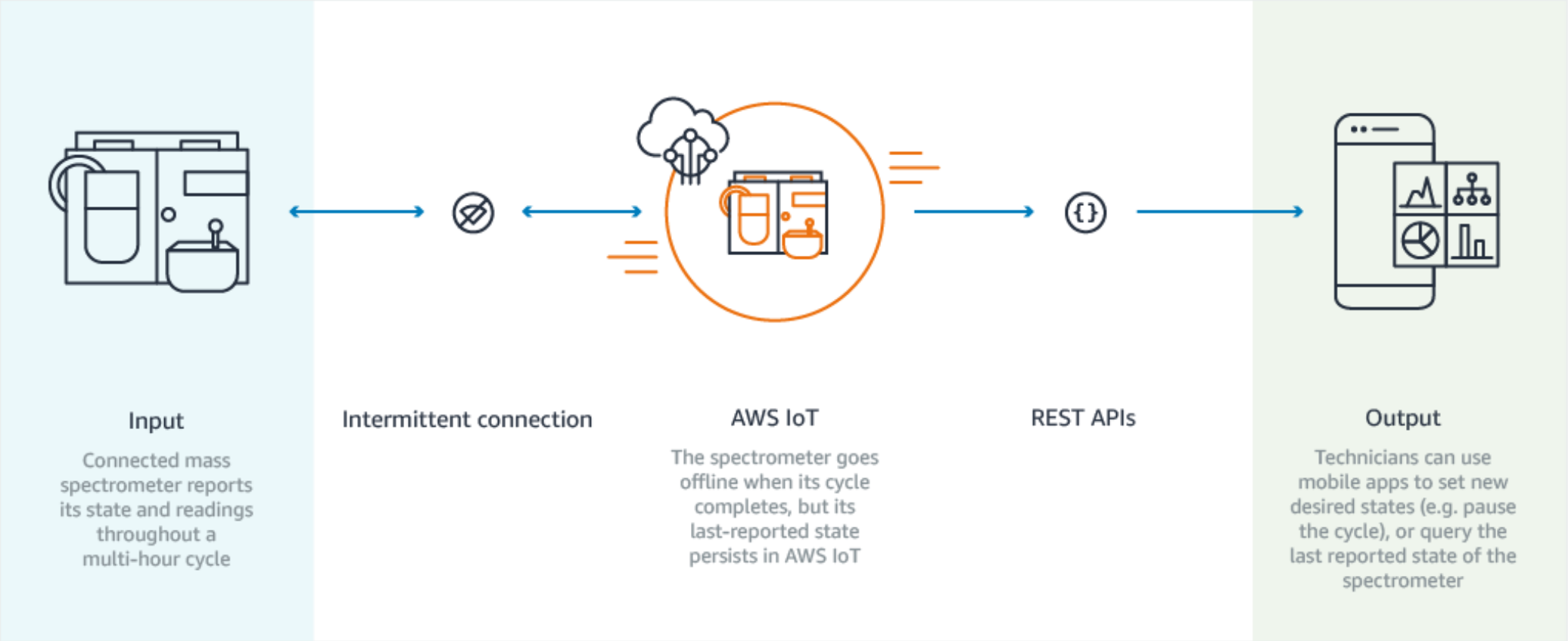
A simplified SQL syntax to filter messages received on an MQTT topic and push the data elsewhere

SELECT * FROM ***sensors/telemetry*** WHERE ***battery_level < 15***

Action: Invoke Lambda lowBatteryNotify()

What's the AWS IoT Core?

READ AND SET DEVICE STATE AT ANY TIME – DEVICE SHADOWS



3 Steps to Connect your devices to AWS IoT Core

Step 1

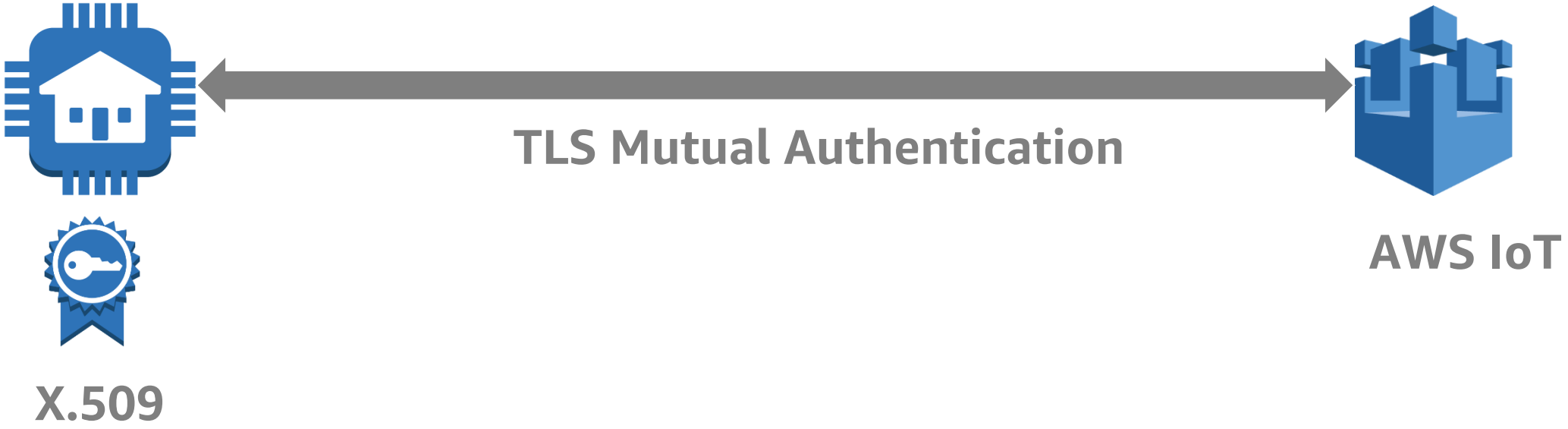
Authentication

Authorization

Use SDK's, Amazon FreeRTOS, AWS Greengrass

Step 1: Authentication

Authentication



3 Steps to Connect your devices to AWS IoT Core (Contd..)

Step 2

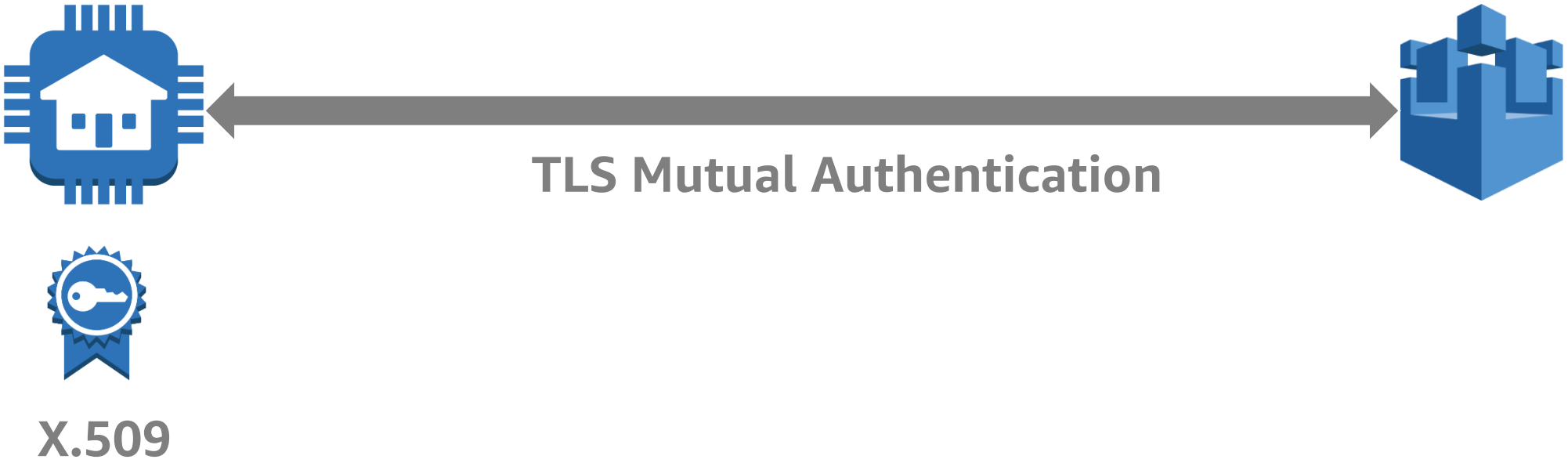
Authentication

Authorization

Use SDK's, Amazon FreeRTOS, AWS Greengrass

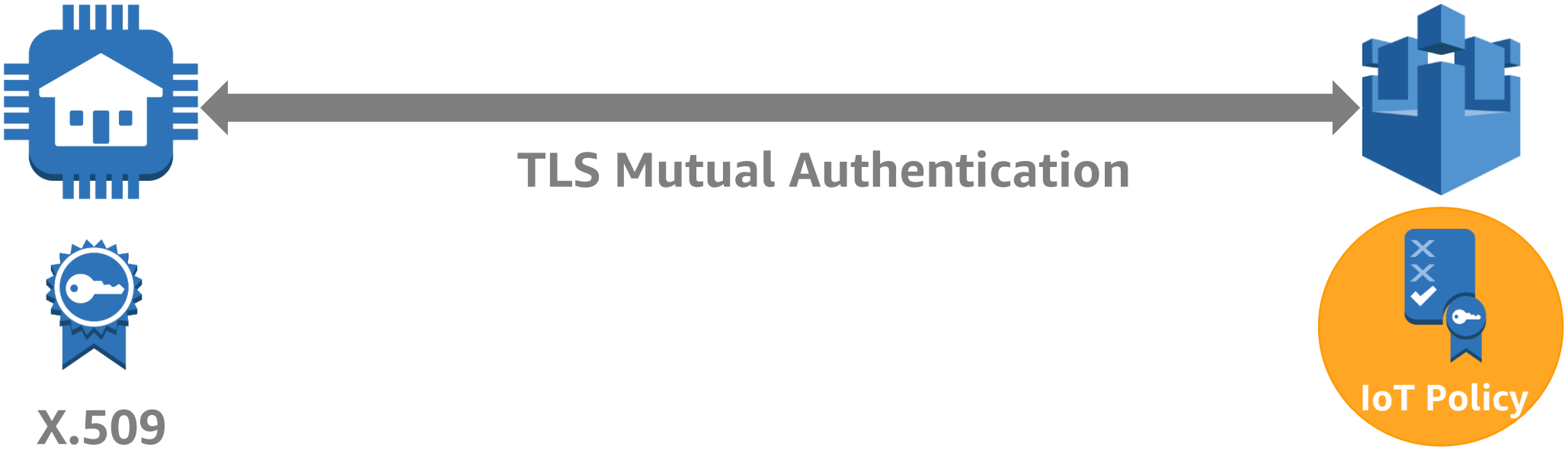
Step 2: Authorization

Authorization



Step 2: Authorization

Authorization



IoT Policies

IoT Policies are JSON Documents

```
{
    "Version": "2012-10-17",
    "Statement": [{
        "Effect": "Allow",
        "Action":["iot:Publish"],
        "Resource": ["arn:aws:iot:us-east-1:123456789012:topic/vehicle/24357a94102f/position"]
    },
    {
        "Effect": "Allow",
        "Action": ["iot:Connect"],
        "Resource": ["arn:aws:iot:us-east-1:123456789012:client/24357a94102f"]
        }]
}
```

Effect: specifies whether the action is allowed or denied

Action: specifies the action the policy is allowing or denying

Resource: specifies the resource or resources on which the action is allowed or denied

3 Steps to Connect your devices to AWS IoT Core

Step 3

Authentication

Authorization

Use SDK's, Amazon FreeRTOS, AWS Greengrass

Hello World on AWS IoT

1. Creating a Thing called ’ohBike’ using the AWS CLI (command line interface)

```
$aws iot create-thing --thing-name "ohBike"
{
    "thingArn": "arn:aws:iot:ap-southeast-1:001234567890:thing/ohBike",
    "thingName": "ohBike",
    "thingId": "0ae5a05c-a4d2-4914-adb3-a7188ae8046c"
}
```

Hello World on AWS IoT

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    "thingName": "ohBike",
    "thingId": "0ae5a05c-a4d2-4914-adb3-a7188ae8046c"
}
```

2. Creating a Private, Public Key and Certificate to Authenticate with AWS IoT Core

```
$aws iot create-keys-and-certificate  --set-as-active
{
    "certificateArn": "arn:aws:iot:ap-southeast-1:001234567890:cert/672e63fe966b8f1e0e54cadfb69e31
    "certificatePem": "-----BEGIN CERTIFICATE-----\nMIIDWjCCAkKgAwIBAgIVAMltURSqBbphovYty0cIm9nCEA
    "keyPair": {
        "PublicKey": "-----BEGIN PUBLIC KEY-----\nMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEA0Xqi
        "PrivateKey": "-----BEGIN RSA PRIVATE KEY-----\nMIIEowIBAAKCAQEA0XqiZxrG9iIfwEVu0SUqCOSH3Y
    },
    "certificateId": "672e63fe966b8f1e0e54cadfb69e3112632c87723e474a1633b3034199275b36"
}
```

Hello World on AWS IoT (Contd.)

3. Creating an IoT Policy for Authorization

```
$aws iot create-policy --policy-name "ohBike_Policy"  --policy-document file://ohBike_Policy.json
{
    "policyName": "ohBike_Policy",
    "policyArn": "arn:aws:iot:ap-southeast-1:001234567890:policy/ohBike_Policy",
    "policyDocument": "{\n  \"Version\": \"2012-10-17\",\n  \"Statement\": [\n    {\n      \"Effect\": \"Allow\",\n
    "policyVersionId": "1"
}
```

Policy Document

```
ohBike_Policy.json
=================
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "iot:*",
      "Resource": "*"
    }
  ]
}
```

Hello World on AWS IoT (Contd.)

3. Creating an IoT Policy for Authorization

```
$aws iot create-policy --policy-name "ohBike_Policy"  --policy-document file://ohBike_Policy.json
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Policy Document

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  "Version": "2012-10-17",
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      "Action": "iot:*",
      "Resource": "*"
    }
  ]
}
```

4. Attach the Policy to the Principal (Certificates)

```
$aws iot attach-principal-policy --policy-name "ohBike_Policy" --principal "arn:aws:iot:ap-southeast-1:001234567890:cer
```

Hello World on AWS IoT (Contd.)

5. Finally, let's attach the Thing to the Principal

```
$aws iot attach-thing-principal --cli-input-json file://ohBike_thing_principal.json
```

```
ohBike_thing_principal.json
===========================
{
    "thingName": "ohBike",
    "principal": "arn:aws:iot:ap-southeast-1:001234567890:cert/672e63fe966b8f1e0e54cadfb69e3112632c87723e474a1633b30341
}
```

Hello World on AWS IoT (Contd.)

CERTIFICATE

672e63fe966b8f1e0e54cadfb69e3112632c87723e474a1633b3034199275b36

ACTIVE

Actions

Details

Policies

Things

Things

ohBike

CERTIFICATE

672e63fe966b8f1e0e54cadfb69e3112632c87723e474a1633b3034199275b36

ACTIVE

Actions

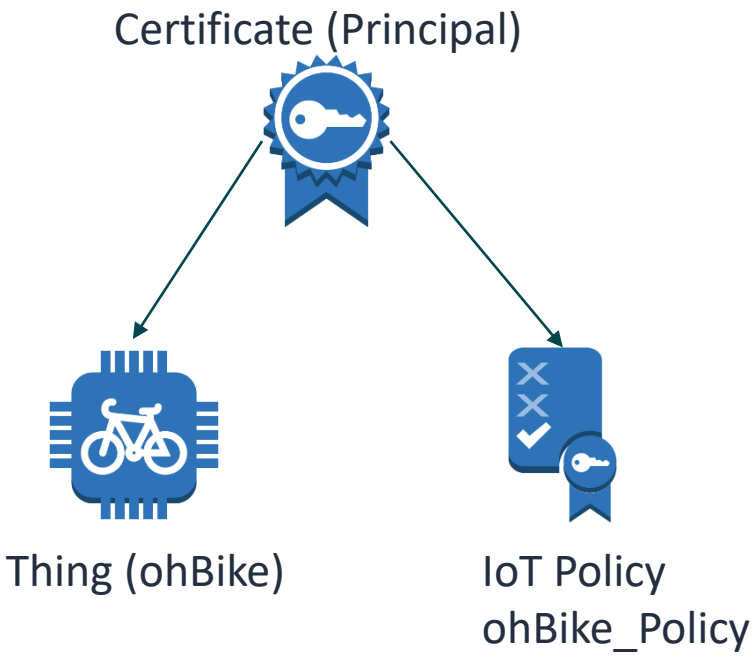
Details

Policies

Things

Policies

ohBike_Policy



Hello World on AWS IoT (Contd.)

Python Code to connect to AWS IoT Core on the Thing or Device

```python
#!/usr/bin/python

import sys
import ssl
from AWSIoTPythonSDK.MQTTLib import AWSIoTMQTTClient
import json
import time

#Setup our MQTT client and security certificates
mqttc = AWSIoTMQTTClient("24357a94102f")

#Use the endpoint from the settings page in the IoT console
mqttc.configureEndpoint("a1bb7j6i6u8ivh.iot.ap-southeast-1.amazonaws.com",8883)
mqttc.configureCredentials("./rootCA.pem","./privateKey.pem","./certificate.pem")
mqttc.connect()


#Loop until terminated
while True:
    mqttc.publish("vehicle/24357a94102f/position",'{"message":"hello world"}', 0)
    time.sleep(1)
    print("PUBLISH'ed")

mqttc.disconnect()
```

AWS IoT Policy on AWS IoT Core

```json
{
    "Version": "2012-10-17",
    "Statement": [{
        "Effect": "Allow",
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        }]
}
```

AWS IoT Endpoint

a1bb8y7i5uiivj.iot.ap-southeast-1.amazonaws.com

Hello World on AWS IoT (Contd.)

MQTT client

Connected as iotconsole-1526951277584-0

Subscriptions

Subscribe to a topic

Publish to a topic

Subscribe

Devices publish MQTT messages on topics. You can use this client to subscribe to a topic and receive these messages.

Subscription topic

vehicle/24357a94102f/position

Subscribe to topic

Max message capture

100

Quality of Service

- (●) 0 - This client will not acknowledge to the Device Gateway that messages are received
- ( ) 1 - This client will acknowledge to the Device Gateway that messages are received

Hello World on AWS IoT (Contd.)

Subscribe to a topic

Publish to a topic

vehicle/24357a94102f/posi... ✖

Publish

Specify a topic and a message to publish with a QoS of 0.

vehicle/24357a94102f/position

Publish to topic

```
1 {
2   "message": "Hello from AWS IoT console"
3 }
```

vehicle/24357a94102f/position May 22, 2018 9:10:29 AM +0800 Export Hide

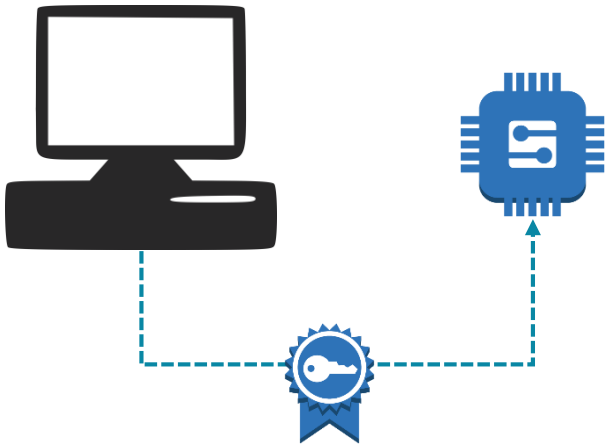
```
{
  "message": "hello world"
}
```

vehicle/24357a94102f/position May 22, 2018 9:10:28 AM +0800 Export Hide

```
{
  "message": "hello world"
}
```

Provisioning Device certificates

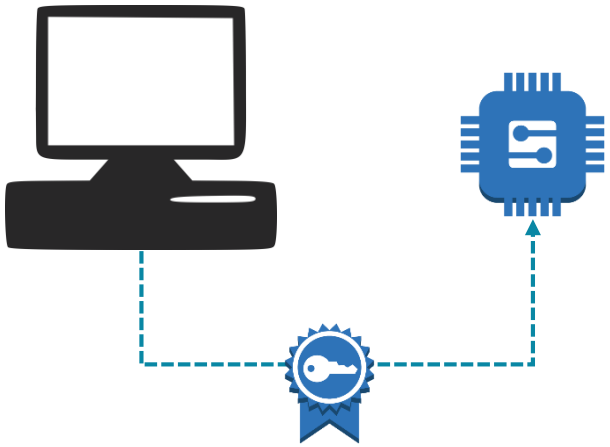
Prototyping → Production



Copying AWS IoT Device certificates to a Thing

Provisioning Device certificates

Prototyping → Production



Copying AWS IoT Device certificates to a Thing

Factory Provisioning

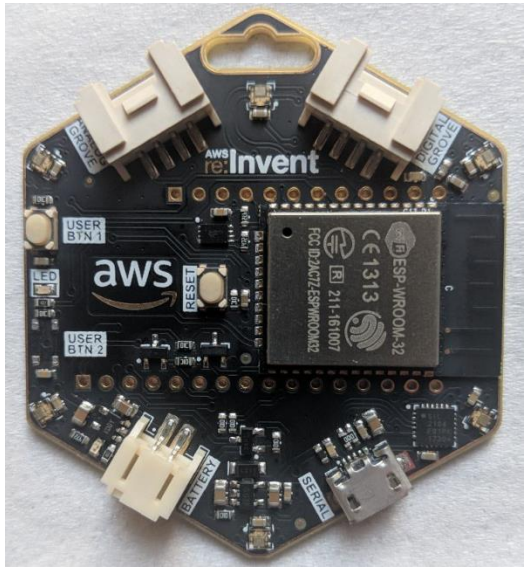
JITR – Just-In-time Registration

JITP– Just-In-time Provisioning

Demo

ESPRESSIF

Amazon FreeRTOS on ESP32

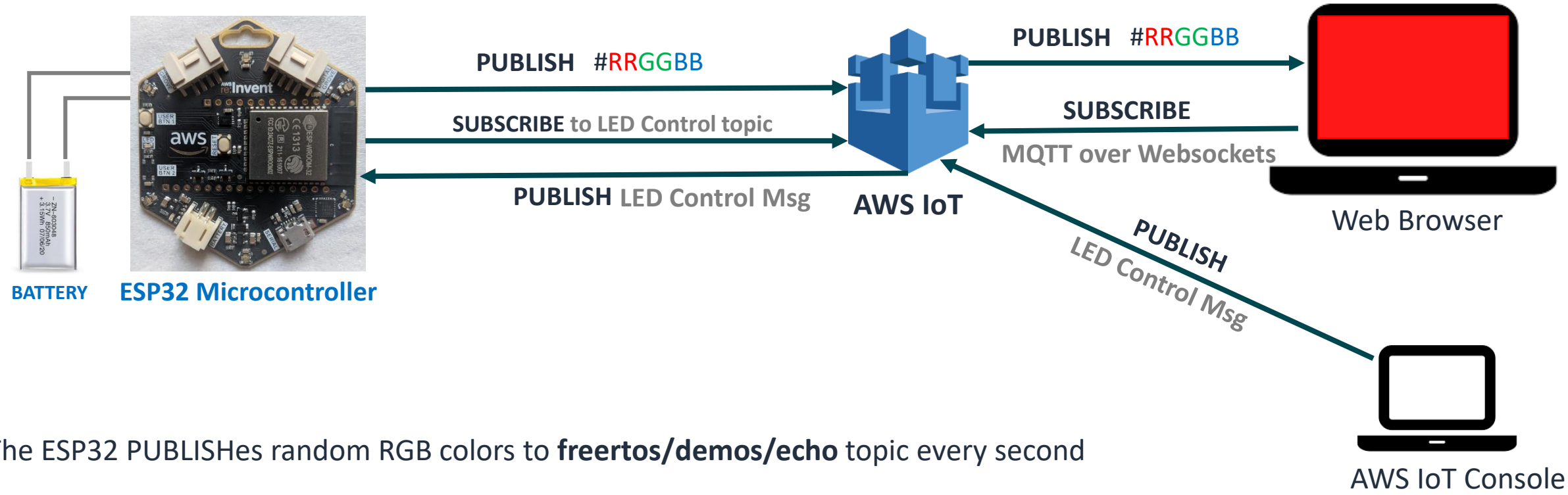


Source code: https://github.com/aws/amazon-freertos

Demo

ESPRESSIF

RGB Color Publisher Demo



The ESP32 PUBLISHes random RGB colors to **freertos/demos/echo** topic every second

A web browser SUSBSCRIBEs to the **freertos/demos/echo** topic and displays the RGB color it receives

AWS IoT Console is used to control the ESP32 LED

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