

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

# Publishing sensor readings to AWS IoT using MQTT

Luka Boljević, Matjaž Zupančič Muc

June 14, 2022

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

- Introduction
- MQTT
- Amazon Web Services (AWS)
- Testing
- Conclusions

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

## This project

- ▶ Goal: send temperature and pressure readings to **AWS**
- ▶ Use **MQTT** protocol
- ▶ *Why* would we want to do this?

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

## MQTT or Message Queuing Telemetry Transport

- ▶ Lightweight publish-subscribe protocol
- ▶ Utilized when system resources are limited
- ▶ MQTT clients (who publish or subscribe) are small!

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

## General information

1. Easy connection of devices to the cloud
2. Supports HTTP, web-sockets and MQTT connections
3. Provides mutual authentication and encryption at all points of connection
4. Connections using MQTT use **certificate based authentication**
5. Traffic from and to AWS IoT Core is encrypted over **TLS**

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

## Connecting a device

1. Create a device (*thing*).
2. Create a private and public key, and certificate.
3. Create a policy.
4. Attach the policy to the certificate.
5. Attach the *thing* to the policy.

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

bso\_project\_thing [Info](#)

### Thing details

Name

bso\_project\_thing

ARN



arn:aws:iot:us-east-1:068865942799:thing/bso\_project\_thing

**Figure:** Created device (*thing*)

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions


bso_project_policy <a href="#">Info</a>		
Details		
Policy ARN  arn:aws:iot:us-east-1:068865942799:policy/bso_project_policy	Active version 1	Created April 19, 2022, 21:44:29 (UTC+0200)
Versions	Targets	Noncompliance
Tags		
Active version: 1 <a href="#">Info</a>		
Policy effect	Policy action	Policy resource
Allow	iot:*	*

Figure: Created policy



Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

## Details

Certificate ID

c9a9bad16b94fe502e05c960f0190deaa08d29d3fa95e5cae5d61ff5aed605a4f2

Certificate ARN

arn:aws:iot:us-east-1:0688615942799:ca:ca/ba/bad16b94fe502e05c960f0190deaa08d29d3fa95e5cae5d61ff5aed605a4f2

Subject

CN=FRI

Issuer

OU=Amazon Web Services O=Amazon.com Inc. L=Seattle ST=Washington C=US

Policies

Things

Noncompliance

### Policies (1) [Info](#)

AWS IoT policies allow you to control access to the AWS IoT Core data plane operations.



Name



bso\_project\_policy

Figure: Certificate

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

## Temperature test:

- ▶ Get baseline readings in a room
- ▶ Put the board in the freezer
- ▶ Then, put it in a working oven

## Pressure test:

- ▶ Get baseline readings on the first floor
- ▶ Go one floor down to see if change is detected

# Baseline readings

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 21:24:19 (UTC+0200)

```
{'T': 28.91 C, 'P': 982.65 mbar, 'Avg T': 28.97 C, 'Avg P': 982.63 mbar}
```

▼ esp8266/temp

May 17, 2022, 21:24:13 (UTC+0200)

```
{'T': 28.92 C, 'P': 982.63 mbar, 'Avg T': 28.98 C, 'Avg P': 982.63 mbar}
```

▼ esp8266/temp

May 17, 2022, 21:24:09 (UTC+0200)

```
{'T': 28.95 C, 'P': 982.61 mbar, 'Avg T': 28.99 C, 'Avg P': 982.62 mbar}
```

**Figure:** Baseline (primarily temp) readings

# Dropping temperatures

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

```
{'T': 20.22 C, 'P': 981.89 mbar, 'Avg T': 23.94 C, 'Avg P': 981.85 mbar}
```

▼ esp8266/temp

```
{'T': 21.06 C, 'P': 981.86 mbar, 'Avg T': 24.35 C, 'Avg P': 981.85 mbar}
```

▼ esp8266/temp

```
{'T': 21.94 C, 'P': 981.90 mbar, 'Avg T': 24.76 C, 'Avg P': 981.85 mbar}
```

**Figure:** Slowly dropping temperatures in the freezer

# Lowest freezer temperature

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 20:42:26 (UTC+0200)

```
{'T': 5.10 C, 'P': 982.24 mbar, 'Avg T': 14.41 C, 'Avg P': 982.03 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:42:20 (UTC+0200)

```
{'T': 5.05 C, 'P': 982.20 mbar, 'Avg T': 14.65 C, 'Avg P': 982.03 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:42:16 (UTC+0200)

```
{'T': 5.43 C, 'P': 982.20 mbar, 'Avg T': 14.90 C, 'Avg P': 982.02 mbar}
```

Figure: "Lowest" temperature in the freezer

# Highest oven temperature

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 20:46:28 (UTC+0200)

```
{'T': 39.37 C, 'P': 981.75 mbar, 'Avg T': 17.56 C, 'Avg P': 982.09 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:46:22 (UTC+0200)

```
{'T': 38.36 C, 'P': 981.70 mbar, 'Avg T': 17.31 C, 'Avg P': 982.09 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:46:17 (UTC+0200)

```
{'T': 37.18 C, 'P': 981.71 mbar, 'Avg T': 17.07 C, 'Avg P': 982.10 mbar}
```

Figure: "Highest" temperature in the oven

# Increasing pressure

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 20:52:00 (UTC+0200)

```
{'T': 31.62 C, 'P': 982.20 mbar, 'Avg T': 24.38 C, 'Avg P': 982.04 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:51:55 (UTC+0200)

```
{'T': 31.84 C, 'P': 982.18 mbar, 'Avg T': 24.34 C, 'Avg P': 982.04 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:51:49 (UTC+0200)

```
{'T': 31.99 C, 'P': 982.04 mbar, 'Avg T': 24.29 C, 'Avg P': 982.04 mbar}
```

Figure: Increasing pressure going down the stairs

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 20:54:12 (UTC+0200)

```
{'T': 29.95 C, 'P': 982.65 mbar, 'Avg T': 25.28 C, 'Avg P': 982.12 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:54:05 (UTC+0200)

```
{'T': 29.97 C, 'P': 982.67 mbar, 'Avg T': 25.26 C, 'Avg P': 982.12 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:54:01 (UTC+0200)

```
{'T': 30.02 C, 'P': 982.62 mbar, 'Avg T': 25.23 C, 'Avg P': 982.11 mbar}
```

Figure: Highest pressure on ground floor



Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

▼ esp8266/temp

May 17, 2022, 21:06:21 (UTC+0200)

```
{'T': 29.38 C, 'P': 982.31 mbar, 'Avg T': 28.50 C, 'Avg P': 982.31 mbar}
```

▼ esp8266/temp

May 17, 2022, 21:06:17 (UTC+0200)

```
{'T': 29.34 C, 'P': 982.31 mbar, 'Avg T': 28.28 C, 'Avg P': 982.31 mbar}
```

▼ esp8266/temp

May 17, 2022, 20:56:07 (UTC+0200)

```
{'T': 30.02 C, 'P': 982.15 mbar, 'Avg T': 25.81 C, 'Avg P': 982.12 mbar}
```

**Figure:** The board still sends data, even after about 10 minutes

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

- ▶ Humidity readings did not work :(
- ▶ Unable to keep track of average pressure and temp "over time"
- ▶ Still, we achieved our original goal

Publishing  
sensor  
readings to  
AWS IoT  
using MQTT

L. Boljević,  
M. Zupančič

Outline

Introduction

MQTT

Amazon Web  
Services  
(AWS)

Testing

Conclusions

# Thank you for your attention!