Hands-On with IoT Standards & Protocols

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Cisco Spark

Questions?

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Agenda

• Standards Overview
• Introduction to WebSockets
  • Hands-On
• Introduction to Message Brokers
  • Hands-On with MQTT
  • Hands-On with AMQP
• Q&A
IoT Standards Overview

- **Transport** (ex: 6LowPAN, LoraWan, Zigbee, Wifi, Bluetooth)
- **Service Discovery** (ex: mDNS, Bonjour, SSDP)
- **Data Protocols** (ex: HTTP, WebSockets, HTTP/2)
- **Data Constructs** (ex: JSON, XML, YAML)
- **Messaging Brokers** (ex: MQTT, CoAP, AMQP, RabbitMQ)
Introduction to WebSockets
But first!

git clone https://github.com/geekbleek/iot-protocols

```shell
cd ./iot-protocols/websockets
npm install
```

Add Chrome extension “Simple Websocket Client”
WebSocket Basics

- Layer 7 Protocol Leveraging persistent TCP connections
  - Original HTML5 spec referenced as “TCPConnection”

- Separate and distinct from HTTP, but interoperates with HTTP
  - Supports TLS encryption
  - Follows re-directs for SSL offloading, proxy support, load balancing
  - HTTP 101 Upgrade Header
  - Port 80 & 443

- Lower overheads ideal for real-time data transfer
- Bi-directional messaging
- Full web browser support today (Chrome, Edge, IE, FF, Safari, Opera)
Hand On With WebSockets
Setup
Hands On Demo

cd ./iot-protocols/websockets
node app.js

Open Chrome Browser Extension & follow along
Introduction to Message Brokers
Setup
Hands On Demo

brew install mosquitto

pip install paho-mqtt
Introduction

What’s a Messaging Broker?

• Definition: A intermediary platform when it comes to processing communication between two applications.

• Way of sending data over the internet (HTTP, SMTP).

• Send data to multiple applications (clients) at the same time.

• Queueing and buffering for later delivery.

• Fundamental infrastructure for cloud application signaling, scaling, and service discovery. (monitor, communicate)
MQTT
MQTT

What is MQTT?

- MQTT is Lightweight message queueing and transport protocol.
- Stands for Message Queue Telemetry Transport.
- Suited for Mobile to Mobile (M2M), Wireless Sensor Network (WSN) and IoT Scenarios
MQTT

Characteristics

• Asynchronous
• Low overhead (2 byte header)
• Publish / Subscribe (PubSub) Model
• Low complexity protocol for simple devices
• Runs on TCP to be used with 6loWPan
MQTT Standard Packet Structure

- **Control Header**: 1 Byte
- **Packet Length**: 1 to 4 Bytes
- **Variable length Header**: 0-Y Bytes
- **Payload**: 0-X bytes

**Fixed Header**
- **Always Present**

**Not always Present**
- and size depends on message type

**Not always Present**
- This contains the data being sent.
- E.g. A connect Message doesn't have a payload
MQTT

Model

- Clients Subscribe to topics to publish and receive messages
- Broker (MQTT Server) receives subscriptions from client topics.
- Broker receives messages from clients and forwards to interested clients
Hand On
MQTT

Hands On Demo

- Using Mosquito Students to subscribe Instructor to publish
  - `mosquitto_sub -h mqtt.cisco.com -p 1883 -t devnetzone/topic`

- Students to publish to Instructor
  - `mosquitto_pub -h mqtt.cisco.com -p 1883 -t devnetzone/topic -m "hello world"`

- Real life scenario (Connect City Scenario - Wildcards & Verbosity)
  - `mosquitto_sub -h mqtt.cisco.com -p 1883 -t "devnet/city/#"`

- Let’s do it in python!
MQTT

Features To Be Aware Of

• QoS:
  • QoS 0 : At Most Once (fire and forget)
    • A message won’t be acknowledged by the receiver or stored and redelivered by the sender
  
  • QoS 1 : At Least Once
    • Guaranteed that a message will be delivered at least once to the receiver.
    • Sender will store the message until it gets an ACK.

  • QoS 2 : Exactly Once
    • Guarantees that each message is received only once by the counterpart.
    • The receiver will store a reference to the packet identifier until it has send ACK.
MQTT

Features To Be Aware Of

• Last Will & Testament
  • Message to be delivered if “DISCONNECT” not appropriately received by a client

• MQTT Tunneled over WebSockets
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