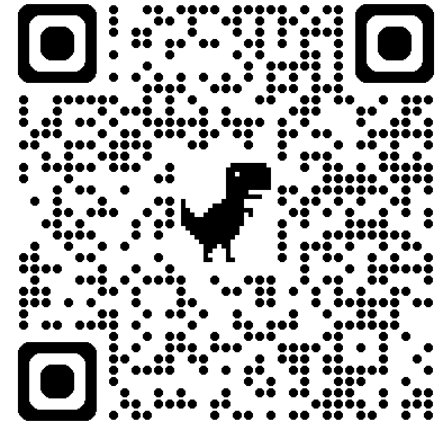


IoT Sensor Data Analytics and Smart Health Systems

Omar Boursalie, Ph.D.



Mock Lecture

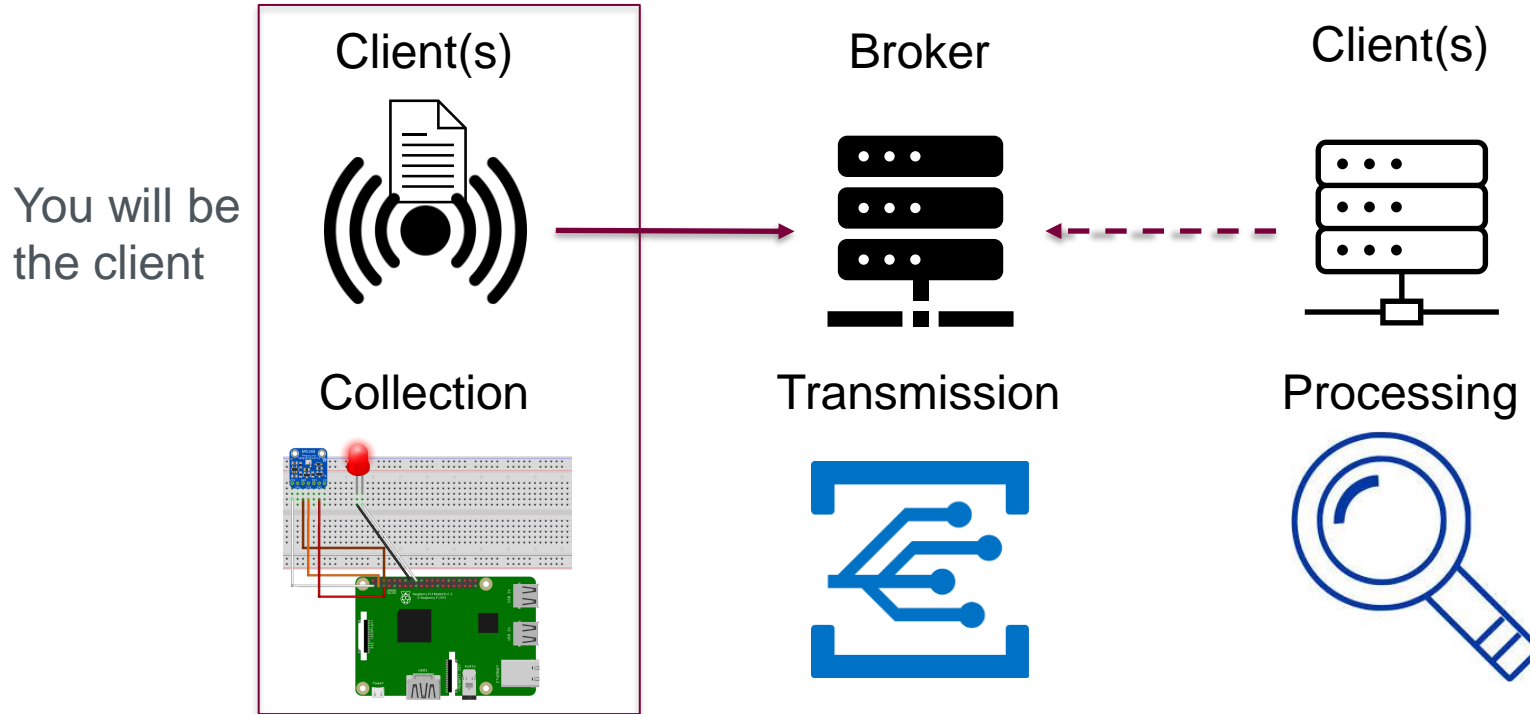


Lecture Slides, Code, and Data:

https://github.com/OBoursalie/McMaster_Lecture

Today's Activity: Setup and Run a Simulated IoT Device to Record Temperature

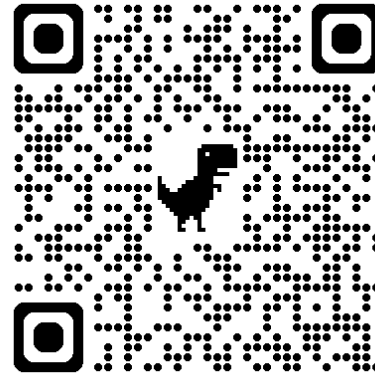
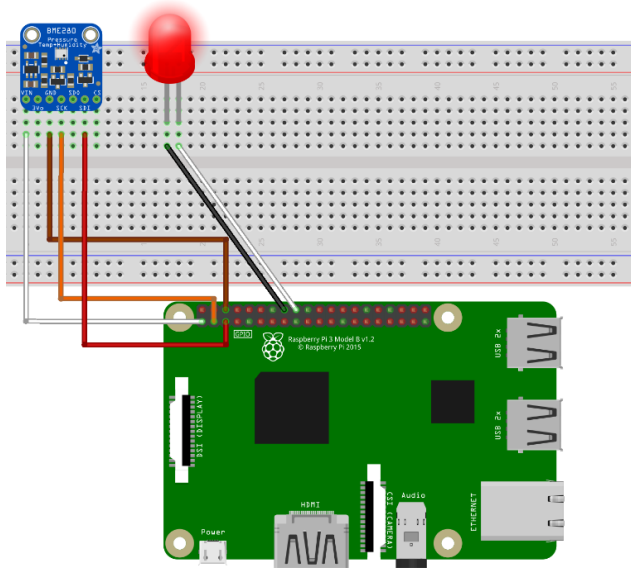
The Internet of Things (IoT) is a network of physically embedded sensors ("things") that can connect and exchange data over the Internet or other communications networks





Data Collection is a Temperature Sensor Connected to Raspberry Pi

Get Temperature Values



Lecture Slides, Code, and Data:

https://github.com/OBoursalie/SMRTTECH_4HM3

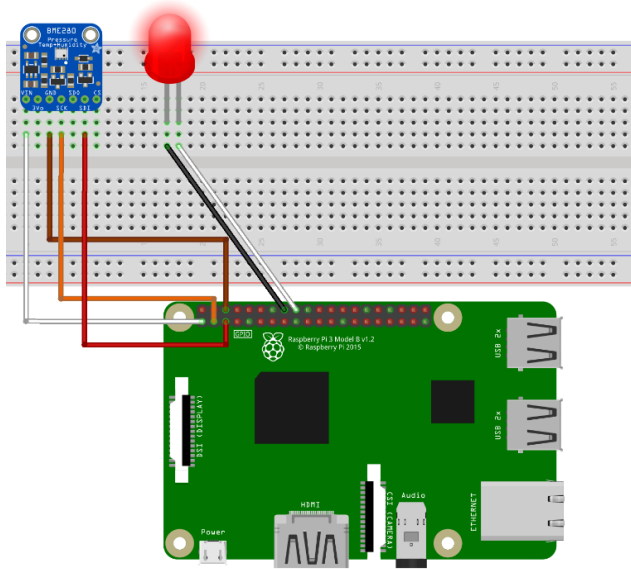
This could be any mobile device with sensors

- Record temperature
- Set up the Raspberry Pi as an IoT client
- Publish temperature information to the broker
- Microsoft open-source code will work on a real Raspberry Pi



Data Collection is a Temperature Sensor Connected to Raspberry Pi

Get Temperature Values

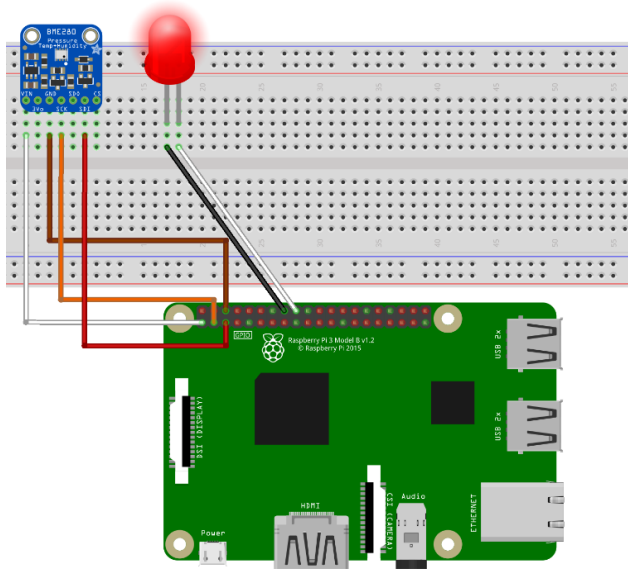


```
"temperature":20.511996560971788,  
  
,"temperature":21.274506294825684,  
  
,"temperature":28.917938926369718,
```



Set Up MQTT Client On Sensor

Code enables the sensor to communicate with our broker

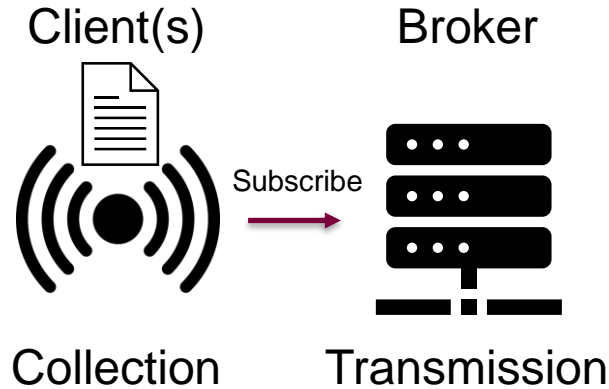


```
1 //Library and Setup
2 const Client = require('azure-iot-device').Client;
3 const Protocol = require('azure-iot-device-mqtt').Mqtt;
4
5 const connectionString = '[Your IoT hub device connection string]';
6
7 // Create a client
8 client = Client.fromConnectionString(connectionString, Protocol);
```



Publish data from client to broker

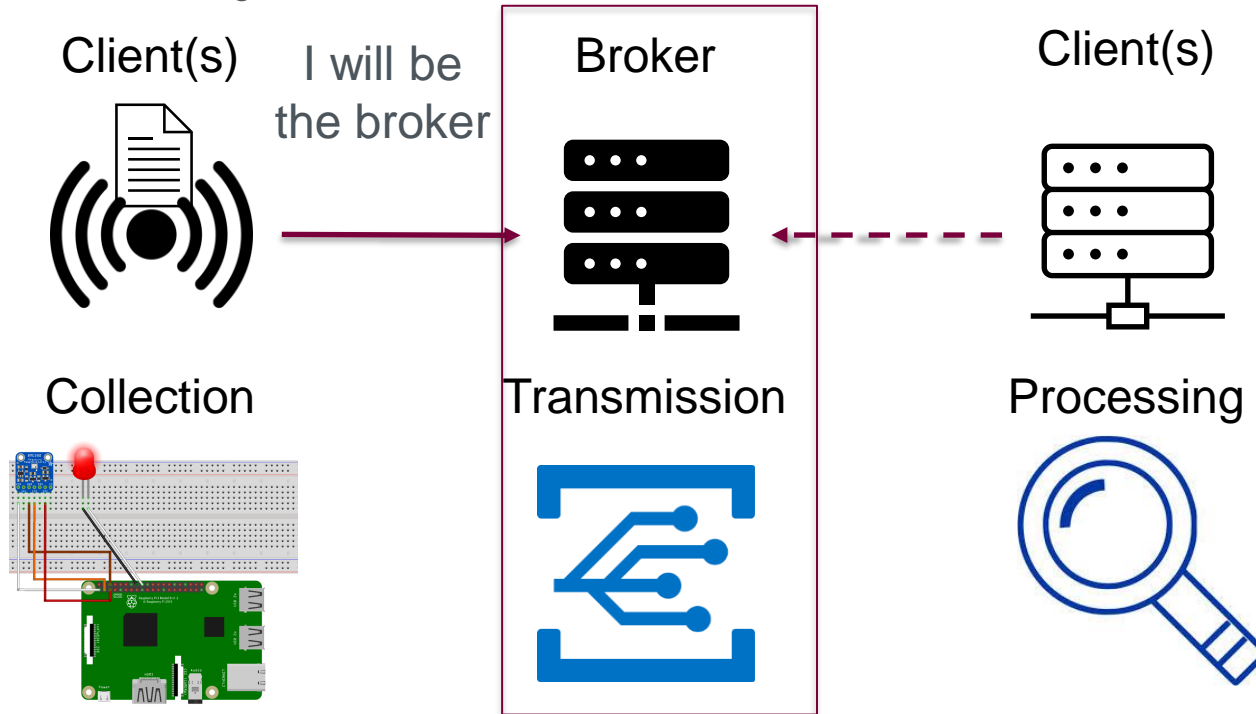
Function is called sendMessage()

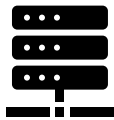


```
1 function sendMessage() {  
2   if (!sendMessage) { return; }  
3  
4   getMessage(function (content, temperatureAlert) {  
5     var message = new Message(content);  
6     message.properties.add('temperatureAlert', temperatureAlert.toString());  
7     console.log('Sending message: ' + content);  
8     client.sendEvent(message, function (err) {  
9       if (err) {  
10        console.error('Failed to send message to Azure IoT Hub');  
11      } else {  
12        blinkLED();  
13        console.log('Message sent to Azure IoT Hub');  
14      }  
15    });  
16  });  
17 }
```

Today's Activity: Setup and Run a Simulated IoT System

The Internet of Things (IoT) is a network of physically embedded sensors (“things”) that can connect and exchange data over the Internet or other communications networks





Set Up Azure IoT Hub Broker

Managed broker services that let you use their hosted brokers for your IoT ecosystem

Home > WBSHubTest



WBSHubTest | Devices

IoT Hub

Search

View, create, delete, and update devices in your IoT Hub. [Learn more](#)

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems
- Events
- Device management
 - Devices

+ Add Device Edit columns Refresh Assign tags

enter device ID Types: All + Add filter

Device ID	Type
Demo	IoT Device

Home > WBSHubTest | Devices >

Create a device

Device ID *

Demo2

☐ IoT Edge Device

Authentication type

Symmetric key X.509 Self-Signed X.509 CA Signed

Auto-generate keys



Connect this device to an IoT hub

Enable Disable

Parent device

No parent device

Save

This could be any managed broker service

- Add device
- Name device
- Save
- Broker generates a connection string that we add to the code to enable the sensor to communicate with the broker

Home > WBSHubTest | Devices >

Demo

WBSHubTest

Save Message to Device Direct method + Add Module Identity Device twin Refresh

Device ID

Demo

Primary key

Secondary key

Primary connection string

Secondary connection string

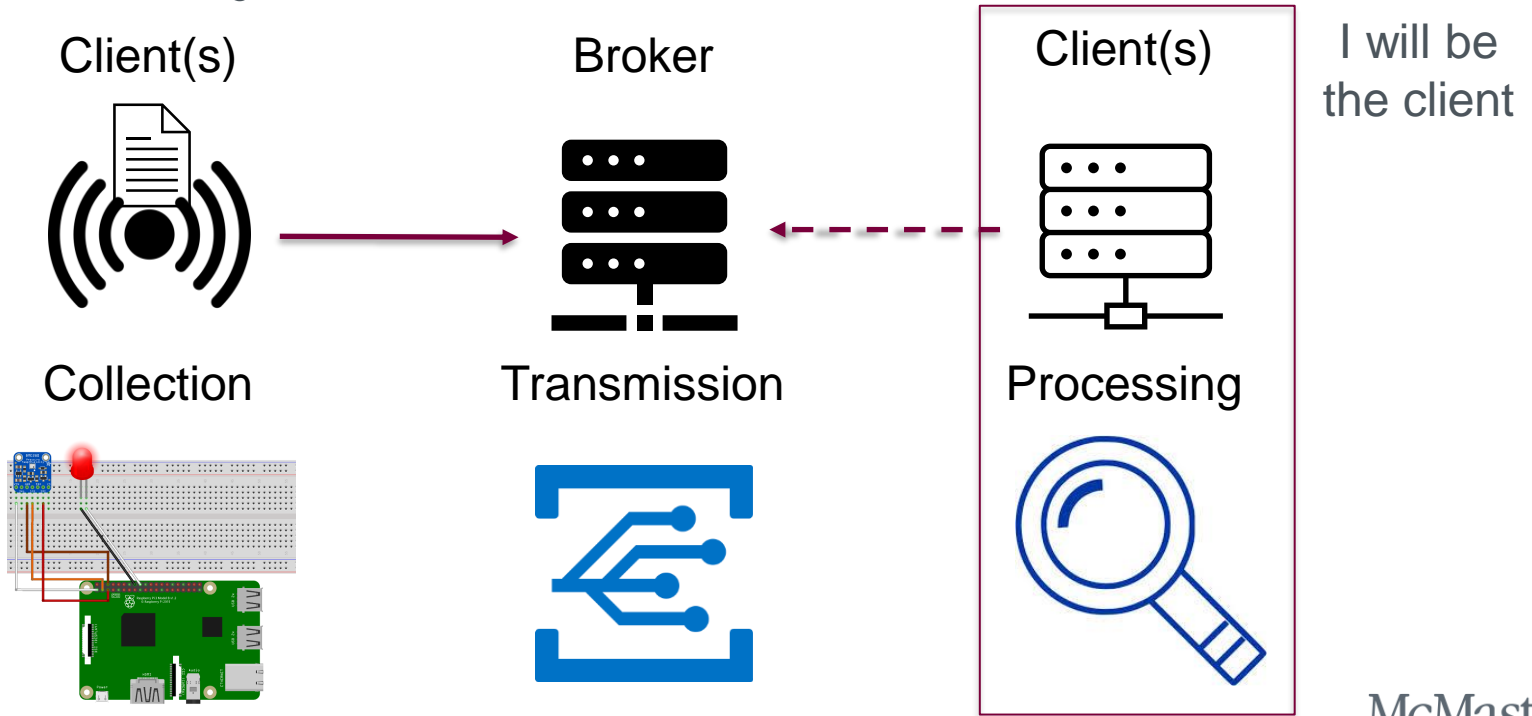
.....

.....

HostName=WBSHubTest.azure-devices.net;DeviceId=Demo;SharedAccessKey=1xCboSBPCoq/a04wTNypPwIF1102+ph8Al0tHP53xA=

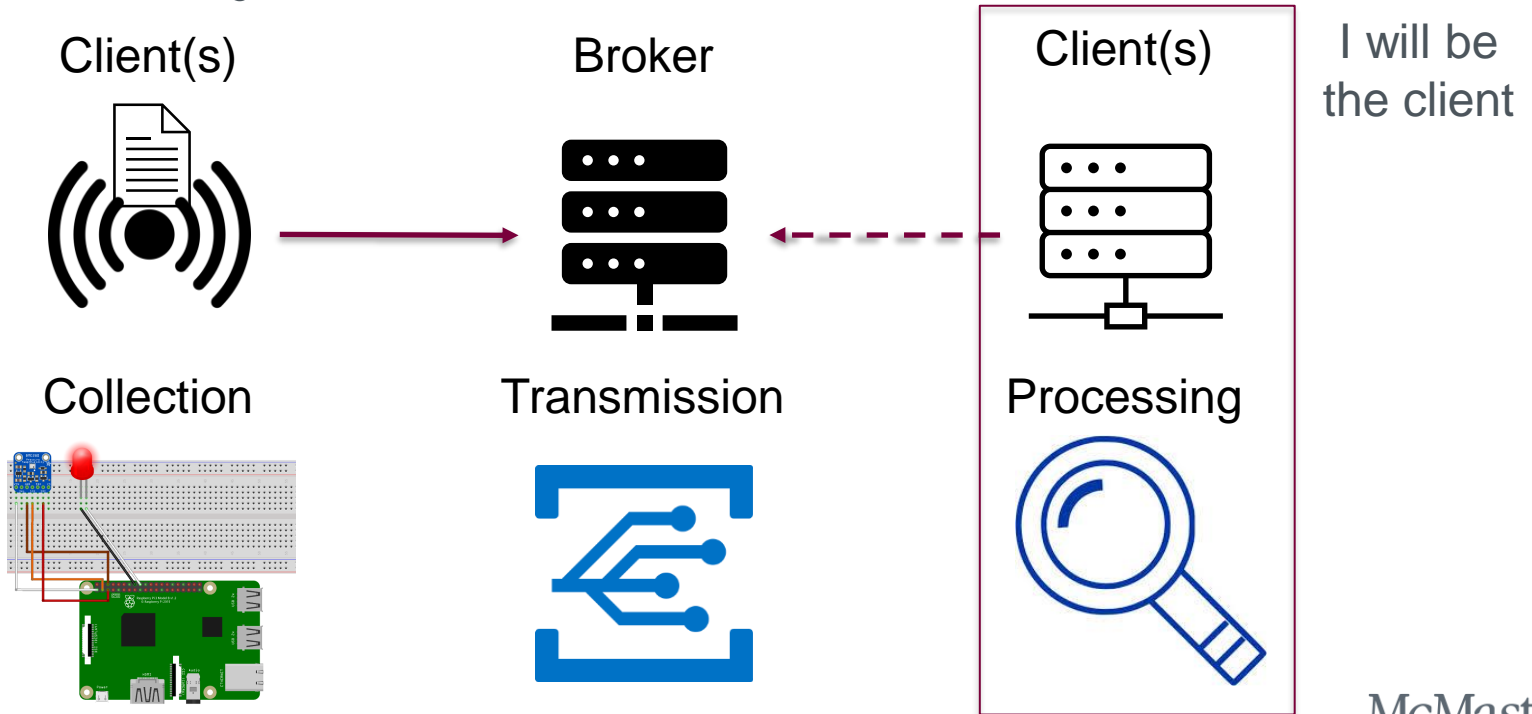
Today's Activity: Setup and Run a Simulated IoT System

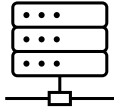
The Internet of Things (IoT) is a network of physically embedded sensors (“things”) that can connect and exchange data over the Internet or other communications networks



Today's Activity: Setup and Run a Simulated IoT System

The Internet of Things (IoT) is a network of physically embedded sensors (“things”) that can connect and exchange data over the Internet or other communications networks





Set Up Azure IoT Explorer

Interact with IoT clients connected to IoT hub

Azure IoT Explorer
(preview)

Home > IoT hubs

+ Add connection ⚙ Switch authentication method

IoT hubs

IoT Plug and Play Settings

Notification Center

WBSHubTest

Host name

WBSHubTest.azure-devices.net

Shared access policy name

iothubowner

Shared access policy key

.....

Connection String

.....

→ View devices in this hub

This could be any processing program

- Add connection
- Add broker connection string
- Find the device
- Telemetry
- Start

Home > WBSHubTest > Devices > Demo > Telemetry

▶ Start ☐ Show system properties

Telemetry *You can monitor telemet...*

Consumer group ⓘ \$Default

Specify enqueue time ⓘ

☐ No

Use built-in event hub ☒ Yes

Device identity

Device twin

Telemetry

Direct method

Cloud-to-device message

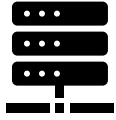
Module identities

IoT Plug and Play components



Demo: Sensor

```
>
Sending message: {"messageId":9,"deviceId":"Demo","temperature":20.511996560971788,"humidity":20.511996560971788}
>
Message sent to Azure IoT Hub
>
Sending message: {"messageId":10,"deviceId":"Demo","temperature":21.274506294825684,"humidity":21.274506294825684}
>
Message sent to Azure IoT Hub
>
Sending message: {"messageId":11,"deviceId":"Demo","temperature":28.917938926369718,"humidity":28.917938926369718}
>
```



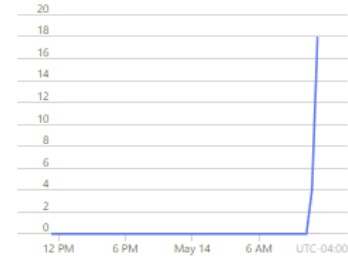
Demo: Broker



IoT Hub Usage

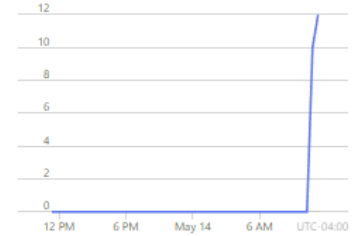
- Messages used today: 30
- Daily messages quota: 8000 ⓘ
- IoT Devices: 1

Number of messages used



■ Total number of messages used (Max), wbs... | 18

Device to cloud messages



■ Telemetry messages sent (Sum), wbshtubtest | 22

Connected Devices

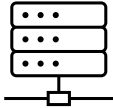


■ Connected devices (Max), wbshtubtest | 1

Total IoT Devices



■ Total devices (Max), wbshtubtest | 1



Demo: Receiving Client

Tue May 14 2024 11:20:01 GMT-0400 (Eastern Daylight Time):

```
{
  "body": {
    "messageId": 11,
    "deviceId": "Demo",
    "temperature": 28.917938926369718,
    "humidity": 79.1669979800193
  },
  "enqueuedTime": "Tue May 14 2024 11:20:01 GMT-0400 (Eastern Daylight Time)",
  "properties": {
    "temperatureAlert": "false"
  }
}
```

Tue May 14 2024 11:19:59 GMT-0400 (Eastern Daylight Time):

```
{
  "body": {
    "messageId": 10,
    "deviceId": "Demo",
    "temperature": 21.274506294825684,
    "humidity": 68.9571214294603
  },
  "enqueuedTime": "Tue May 14 2024 11:19:59 GMT-0400 (Eastern Daylight Time)",
  "properties": {
    "temperatureAlert": "false"
  }
}
```

Tue May 14 2024 11:19:58 GMT-0400 (Eastern Daylight Time):

```
{
  "body": {
    "messageId": 9,
    "deviceId": "Demo",
    "temperature": 20.511996560971788,
    "humidity": 61.0247687908586
  },
  "enqueuedTime": "Tue May 14 2024 11:19:58 GMT-0400 (Eastern Daylight Time)",
  "properties": {
    "temperatureAlert": "false"
  }
}
```

Thank You!

Omar Boursalie, Ph.D.

- Happy to chat more at 3:30 PM in ETB 223
- boursao@mcmaster.ca