Connecting and Building the Internet of Things

Gerald Goh
Technical Evangelist
DX Singapore

Microsoft

What is the Internet of Things?

As defined by Wikipedia

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.
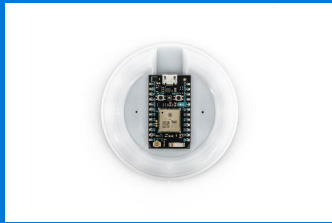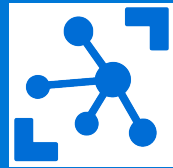
A basic IoT Setup
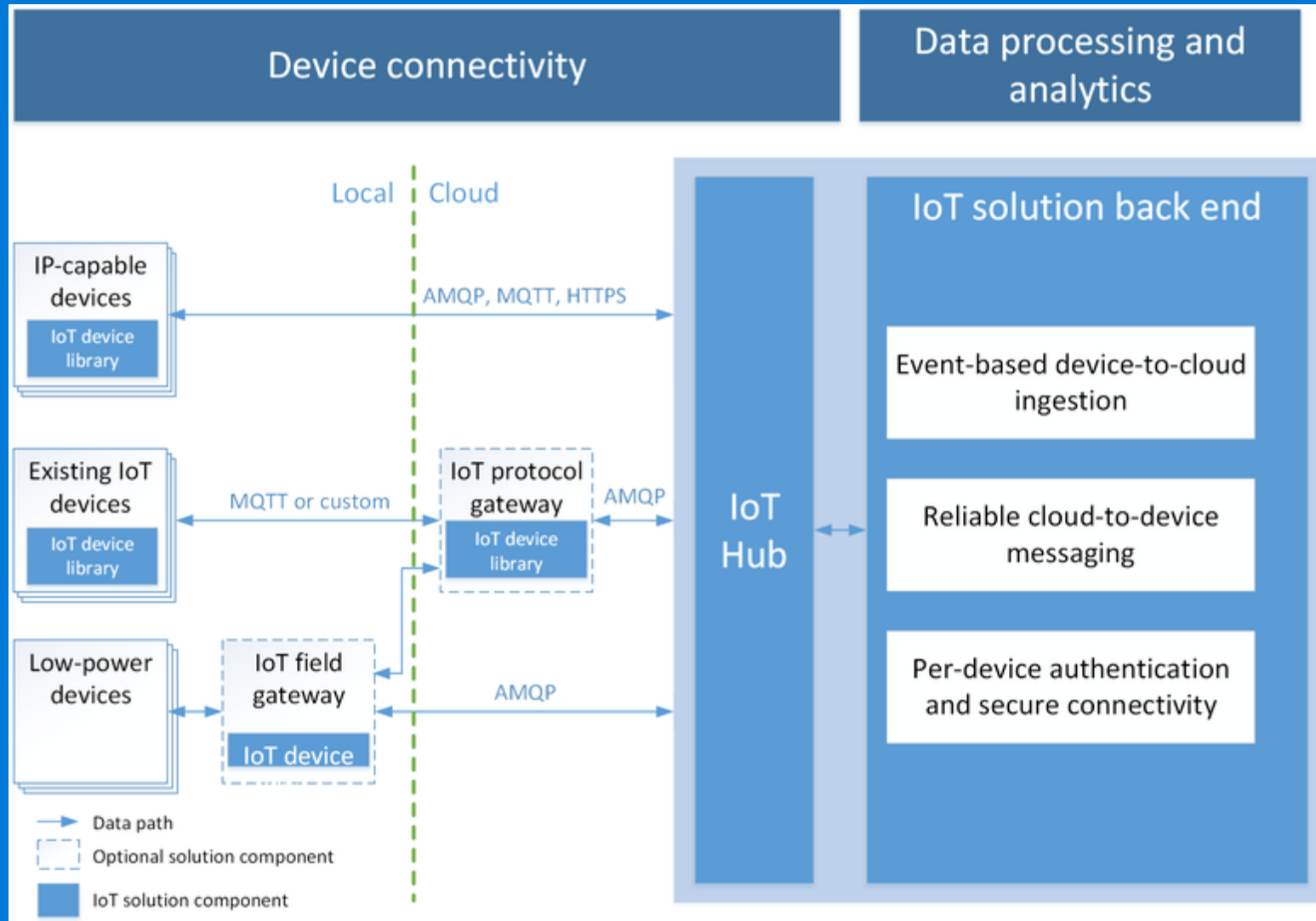
A basic IoT Setup
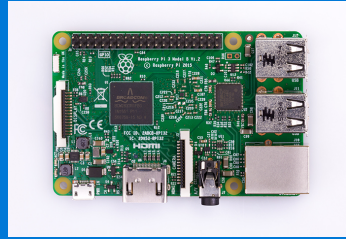
Raspberry Pi 3

Particle IoT Button

IoT Device

MQTT
AMQP
HTTP

RabbitMQ™

Azure IoT Hub

Mosquitto

Message Broker

Azure Event Hub

Spark™

Apache STORM™
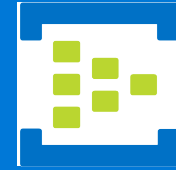
Consumers

Component Breakdown

IoT Device

- Any device with
  - An internet connection
  - A connection to another device with internet connection (Field Gateway) i.e. a phone
- Examples
  - Raspberry Pi
  - Particle Electron
  - Particle IoT Button

Communication Protocols

- MQTT/MQTT over WebSockets
- AMQP/AMQP over WebSockets
- HTTP

Communication Protocols
MQTT/MQTT over WebSockets

- When should you choose this protocol
  - Use for all devices that do not require to connect multiple devices (each with it's own per-device credentials) over the same TLS connection.
  - Lower footprint vs AMQP, useful for devices with low amounts of RAM(< 1MB for example).
  - More compact payloads as MQTT is a binary protocol.
- Caveats
  - MQTT uses port 8883 which can cause problems on networks that are closed to non-HTTP protocols. So you can use MQTT over WebSockets to get around this.

Communication Protocols
AMQP/AMQP over WebSockets

- When should you choose this protocol
  - Use on field and cloud gateways to take advantage of connection multiplexing across devices.
  - More compact payloads as AMQP is a binary protocol.
- Caveats
  - Larger footprint vs MQTT and HTTP, may not be suitable for low RAM devices.
  - AMQP uses port 5671 which can cause problems on networks that are closed to non-HTTP protocols. So you can use AMQP over WebSockets to get around this.

Communication Protocols
HTTP

- When should you choose this protocol
  - For devices that cannot support any other protocol
- Caveats
  - Does not have an efficient way to implement server push. HTTP devices have to poll IoT hub for cloud to device messages, this method is highly inefficient. Based on current HTTP guidelines, each device should poll for messages every 25 minutes.

Message Broker
Event Hub

- Event Hub is limited to 5000 concurrent AMQP connections.

- Event Hub does not authenticate individual device connections, but rather all the devices essentially share the same (or few) access keys. You also cannot enable/disable communication from a single device.

- Event Hub is ingestion only and has no facility for sending traffic back to the devices

- Event Hub does not support MQTT.

Message Broker
IoT Hub

- Scale out connections. A single IoT Hub has been tested to more than a million concurrent connections

- IoT Hub does individual device authentication (via either a device-specific key, or x.509 certificate) and you can enable/disable individual devices

- Bi-directional communication, allowing you to either do asynchronous or synchronous commands to the device

- Supports AMQP and HTTP, like Event Hub, but also adds support for MQTT as a transport protocol

Message Broker
IoT Hub

- Device Management – the ability to orchestrate firmware updates and desired and reported configuration management with devices
- Device Twins – A queryable cloud-side representation of the state of a device, allowing customers to group and manage their devices "at IoT scale"
- File update – orchestrate file uploads from device through the hub

Consumers
Event Hub, Spark, Storm and More

- Connect event hub to IoT hub to ingest messages and do further processing i.e. Stream Analytics
- Iot Hub exposes an Event Hub compatible endpoint for other services to ingest messages
- Spark Integration
- Storm Spout

Demo

Extra Links

- https://github.com/azure/azure-iot-sdks
- https://github.com/azure/azure-iot-sdk-node
- https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-what-is-iot-hub
- https://github.com/MSFTImagine/computerscience/