



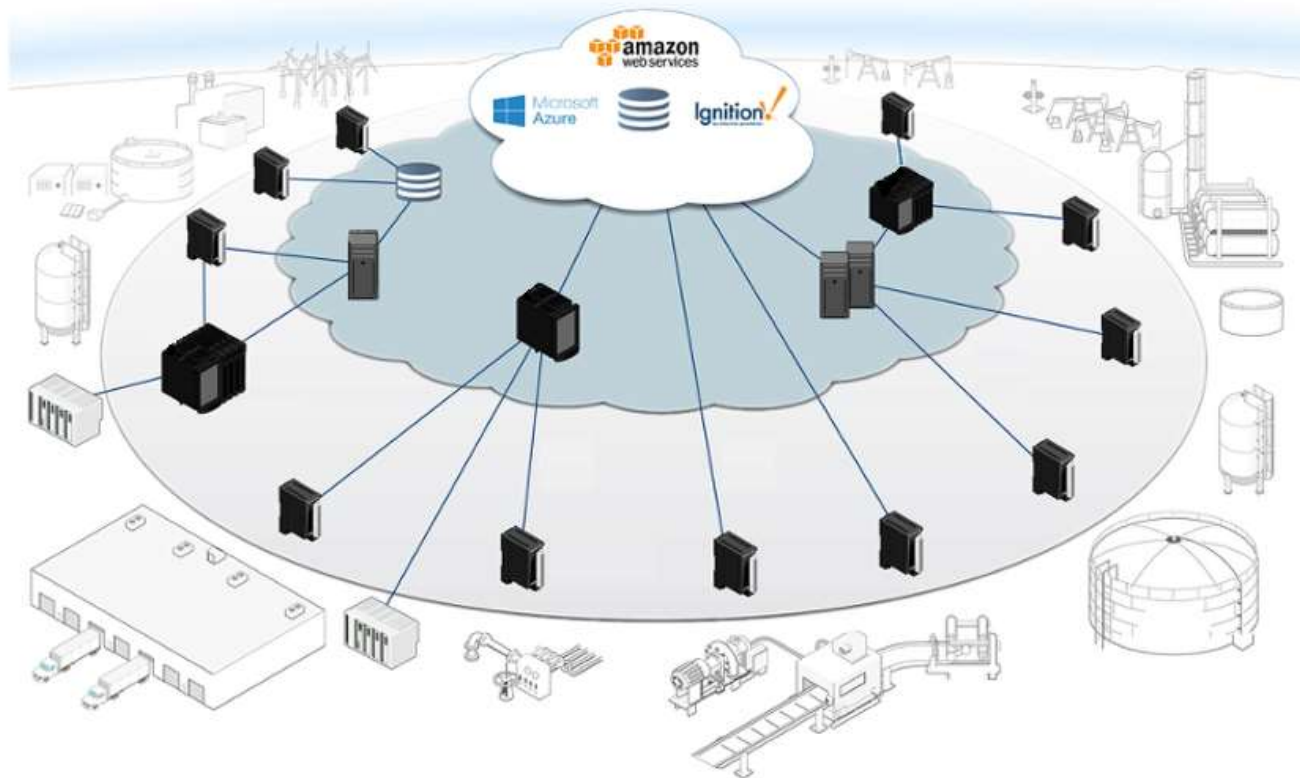
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MQTT: A Future for Smart Cities?

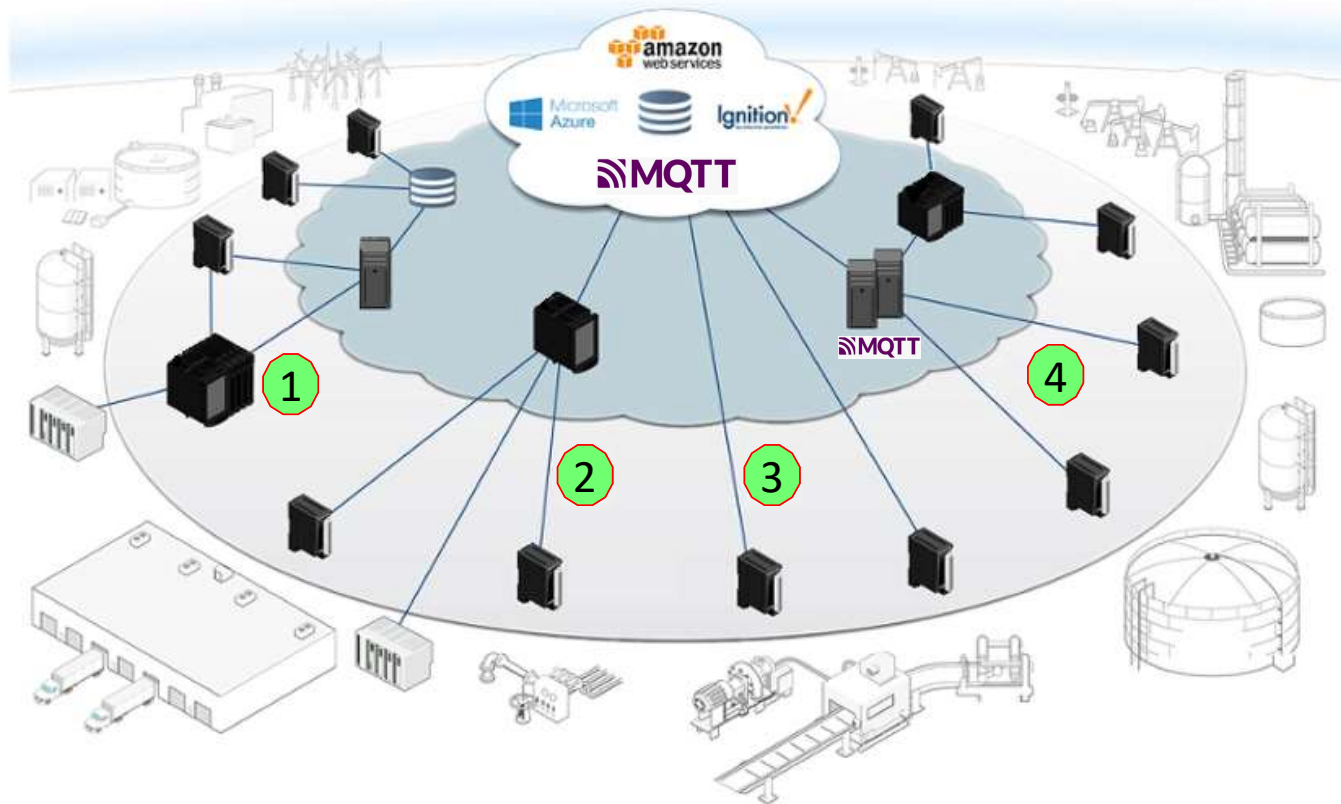
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Let's go back in time - Telemetry / SCADA (IIoT)

Edge controllers and edge I/O enable new information architectures in which devices can share data locally and across the organization, through Edge, Fog and Cloud:



IIoT Summary: Building Industrial IIoT from Edge to Cloud



1 Shared infrastructure with edge data processing

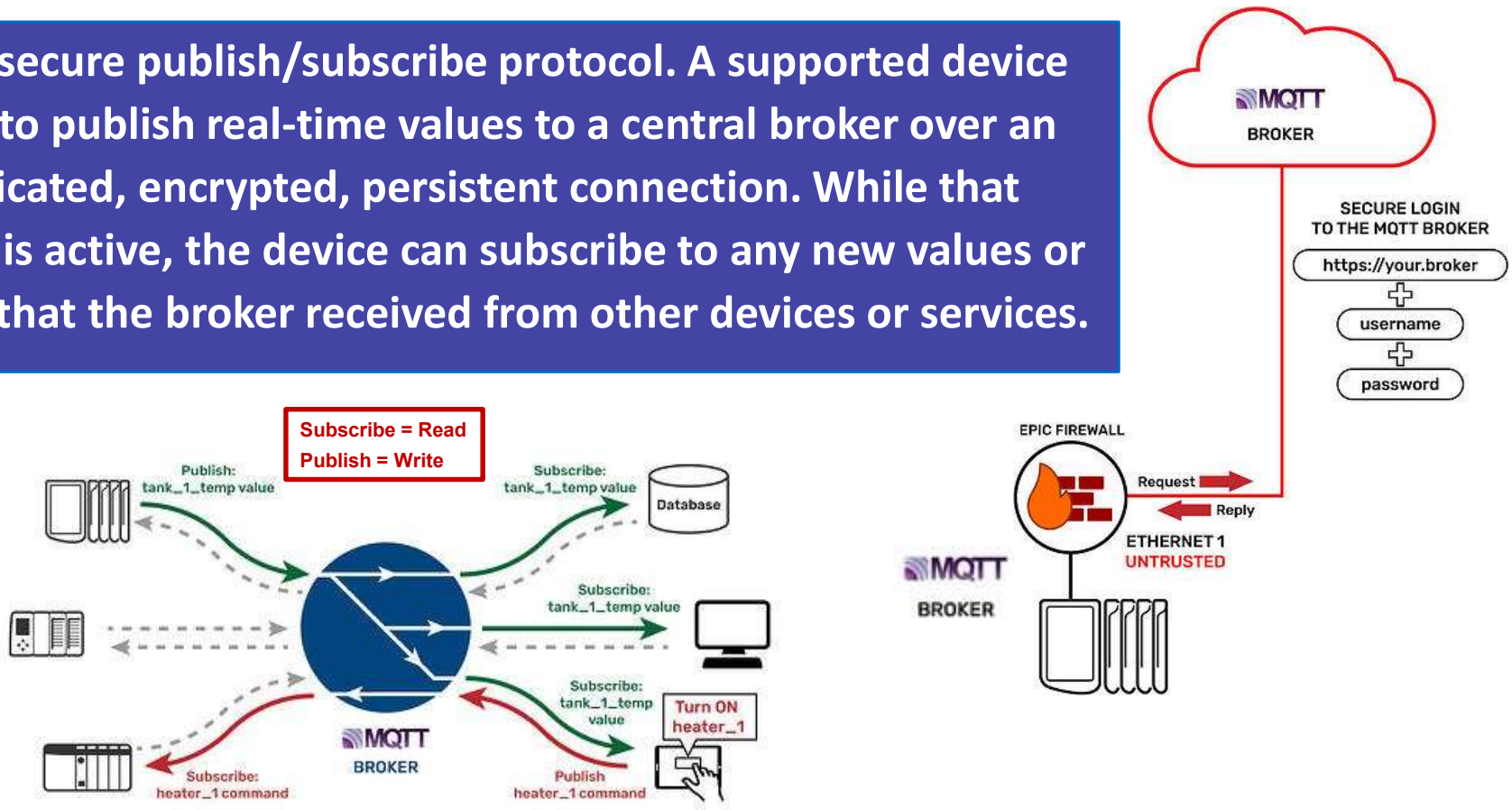
2 Legacy device integration with edge controller as IoT gateway

3 Direct-to-cloud I/O network

4 Many-to-many MQTT infrastructure

Network Architecture: Communication Solution – MQTT IoT Protocol

MQTT is a secure publish/subscribe protocol. A supported device can use it to publish real-time values to a central broker over an authenticated, encrypted, persistent connection. While that connection is active, the device can subscribe to any new values or commands that the broker received from other devices or services.



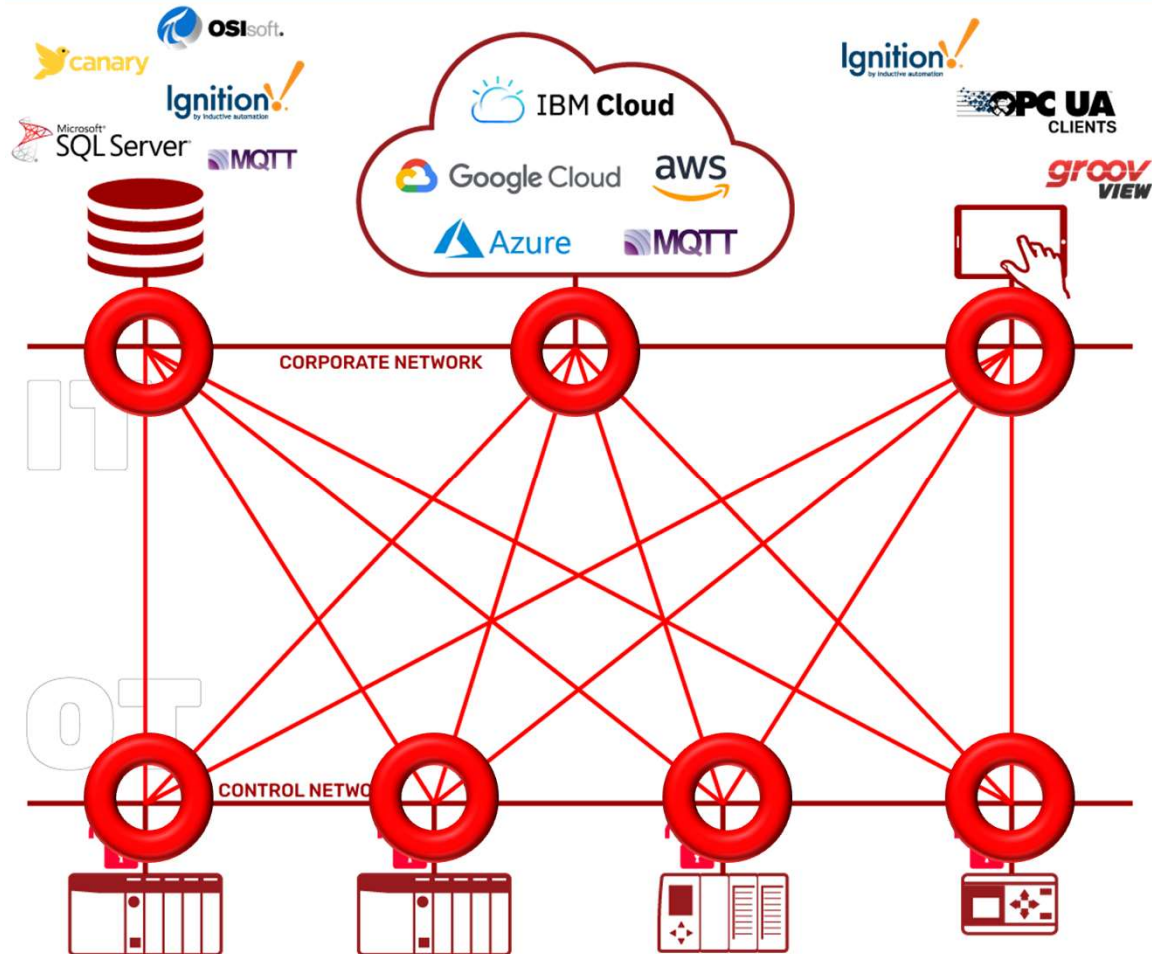
Cybersecurity: Communication Solution

**So, what about
performance and
security?**

PROBLEM

Applications Tightly Coupled to Devices

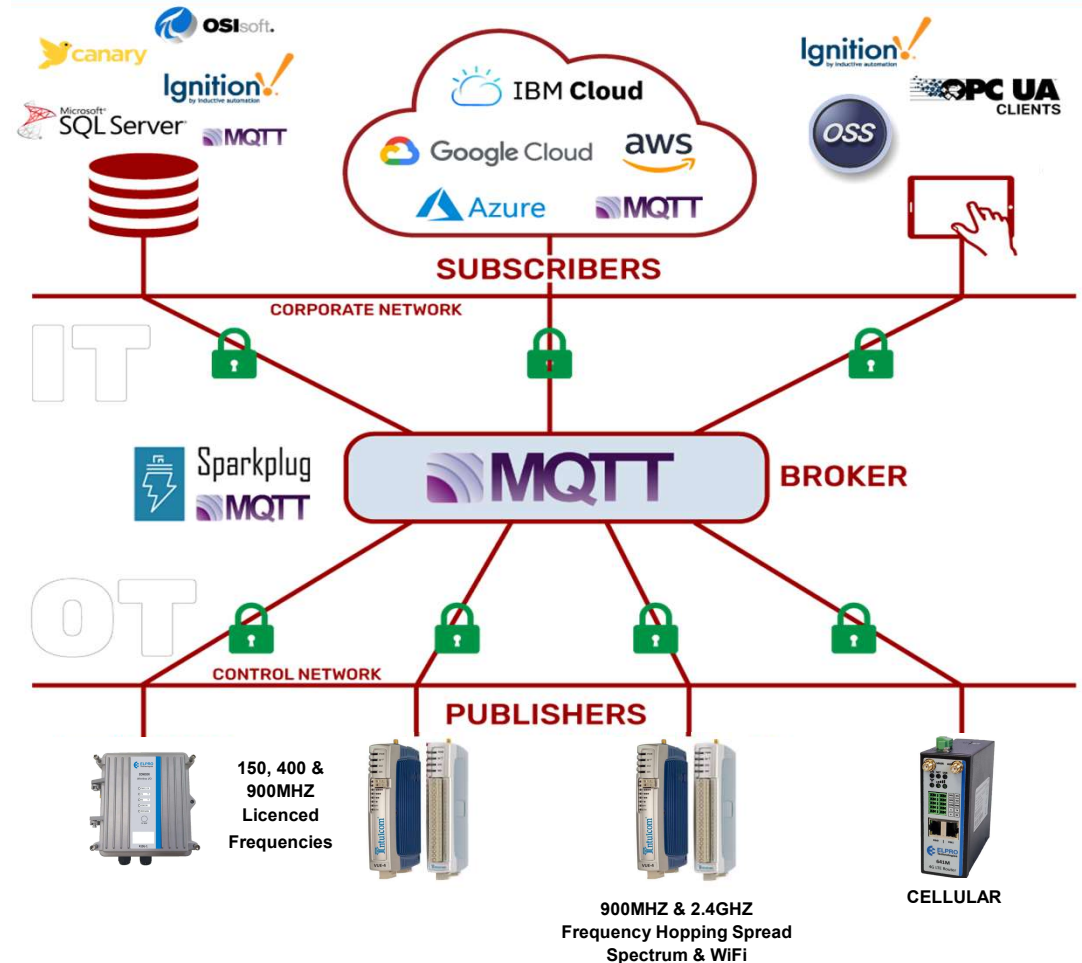
- ◆ Inefficient poll-response
- ◆ Point-to-point connections
- ◆ Unencrypted traffic
- ◆ Complex architecture
- ◆ Difficult to manage & maintain
- ◆ Multiple, insecure open ports
- ◆ Shifts responsibility to IT



SOLUTION

- Applications Decoupled from Devices

- Efficient
 - Publish-subscribe, bi-directional
- High performance
 - Data transmit only on change
- Secure
 - Only ONE secure open port
 - Only ONE place to manage & maintain user and data access
 - TLS v1.2 encryption optional. Multiple cipher suites and end to end authentication.
- Simpler to manage & maintain
 - Single source of truth at the edge (publishers)
 - No need to re-enter tags in clients (subscribers)



MQTT IoT Protocol: Unified Name Space

MQTT Standard (Plain) Topic and payload

Configured for standard MQTT the gateway uses a similar format and structure to sparkplug operation and includes timestamp and data values. See MQTT example below.

Topic: spBv1.0/ELPRO-WaterCo/DDATA/LatheSt Res/Local Inputs

Payload JSON:

```
{"timestamp":947124413831,"metrics":[{"name":"IO-Digital/Pump Running","alias":10002,"timestamp":947124413831,"dataType":"Boolean","value":true}], "seq":67}
```

MQTT Sparkplug B Topic and payload

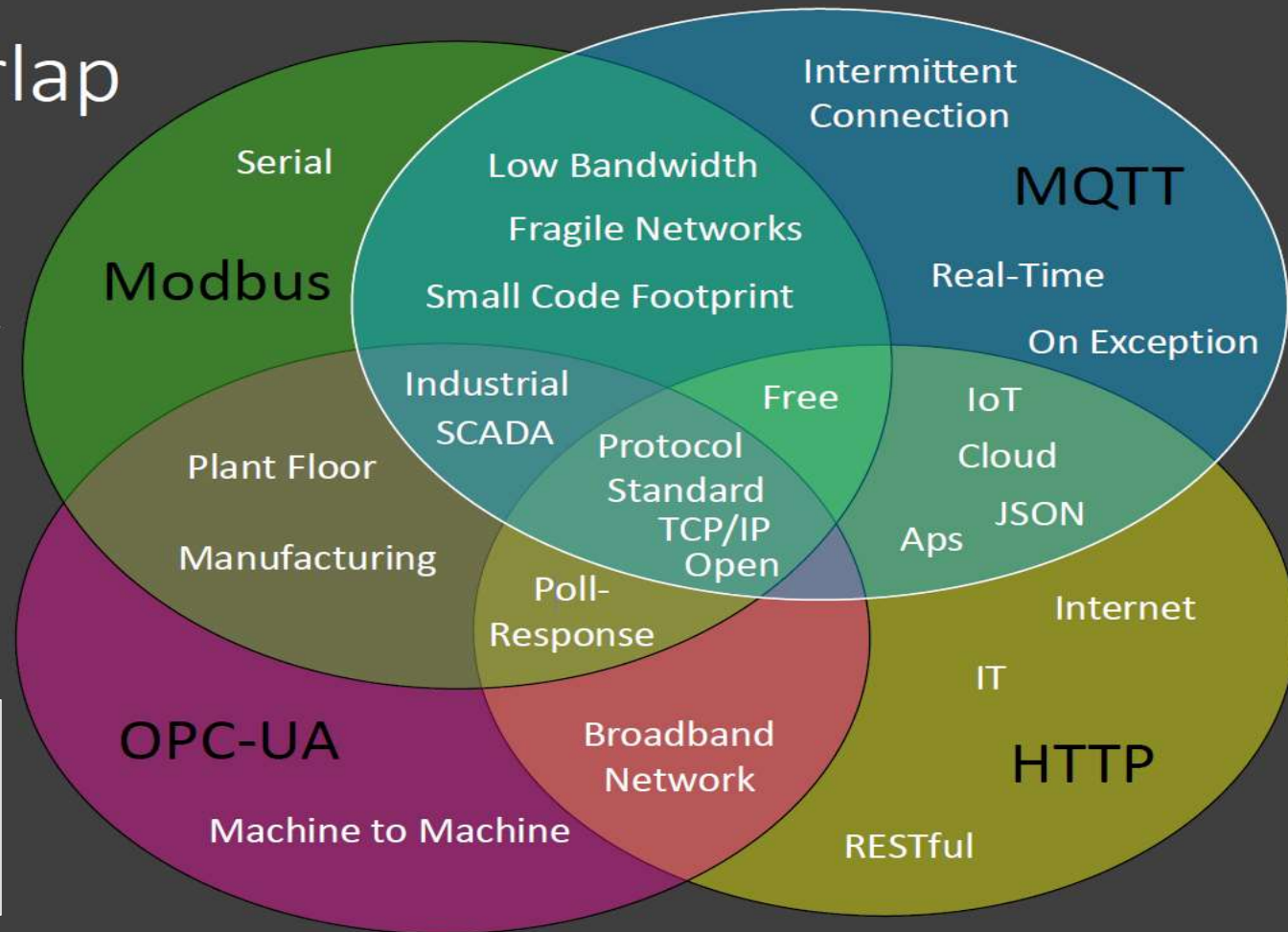
Sparkplug is commonly used in OT applications and provides significant advantages with a state-based protocol additions when working with industrial devices. [Sparkplug defines the structure of the topic](#) (Namespace) and the payload which includes message timestamp. The metrics are structure to include elements for timestamp, data point name, an alias reference, data type and value. The final part of the payload is a message sequence number with sequence 0 reserved for special messages. [The payload is encoded as part of the Sparkplug standard.](#)

MQTT Sparkplug B Communications:

Efficient IIoT Communications - OPC-UA, HTTP, Modbus and MQTT Benchmarking

Protocol Use Overlap

- Many protocols can be used in similar scenarios – that doesn't mean they're a perfect fit for them all
- What are your applications most important requirements?



Presentation By:
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April 30, 2019

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MQTT Sparkplug B Communications:

Efficient IIoT Communications - OPC-UA, HTTP, Modbus and MQTT Benchmarking

What type of SCADA/IoT/IIoT application is yours?

- Best for the Plant floor?
- Best for Interoperable interfaces on a wired network?
- Best for IIoT Constrained networks?
- Best for battery powered devices?
- Best for distributed real time SCADA?
- Best for IoT wireless networks → [Smart Cities](#)?

Each of these questions has a different answer...The answers may not be straight forward...

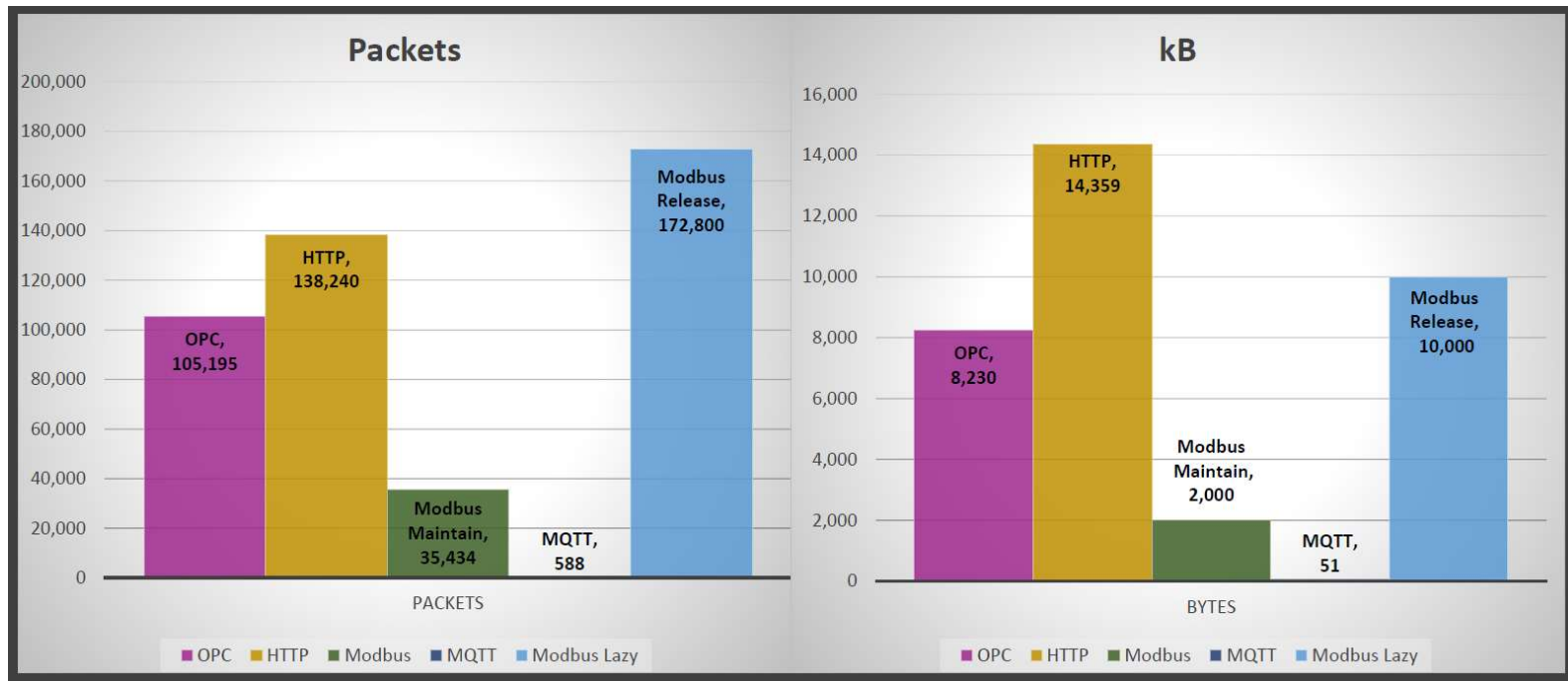
Use Case Scenarios:

- 1) Sending a single value
- 2) Sending nine (9) values and data concentration
- 3) Oil & Gas RTU Data On Change Retrieve 389 tags for a wellsite

MQTT Sparkplug B Communications:

Use Case #1 - Sending a single value – what is the actual cost

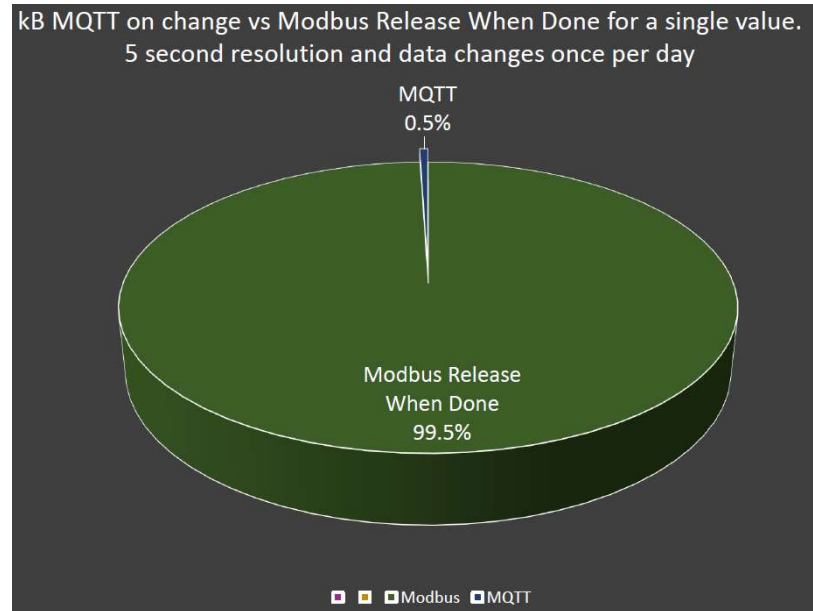
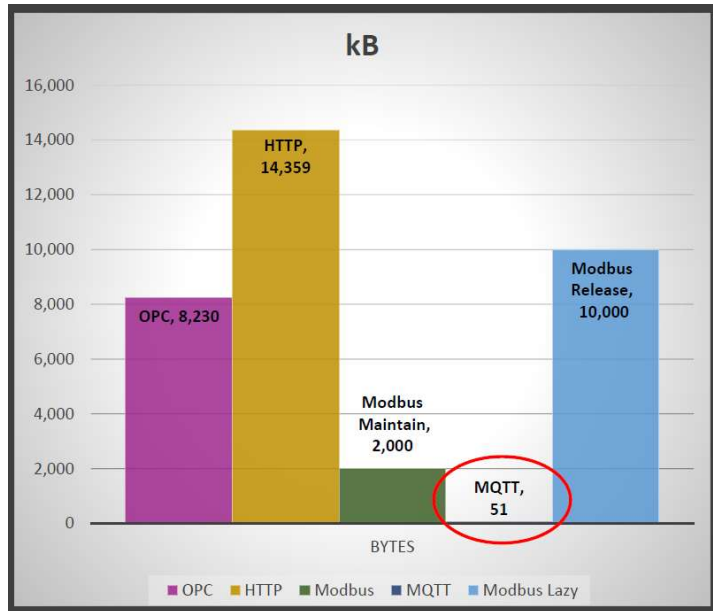
Application Description: Retrieve 1 value via OPC, HTTP, Modbus RTU Encapsulated, and MQTT



MQTT Sparkplug B Communications:

Use Case #1 - Sending a single value –what is the actual cost

MQTT data consumption is significantly lower than the others in this case because the data is event driven (only sent when the value changes).



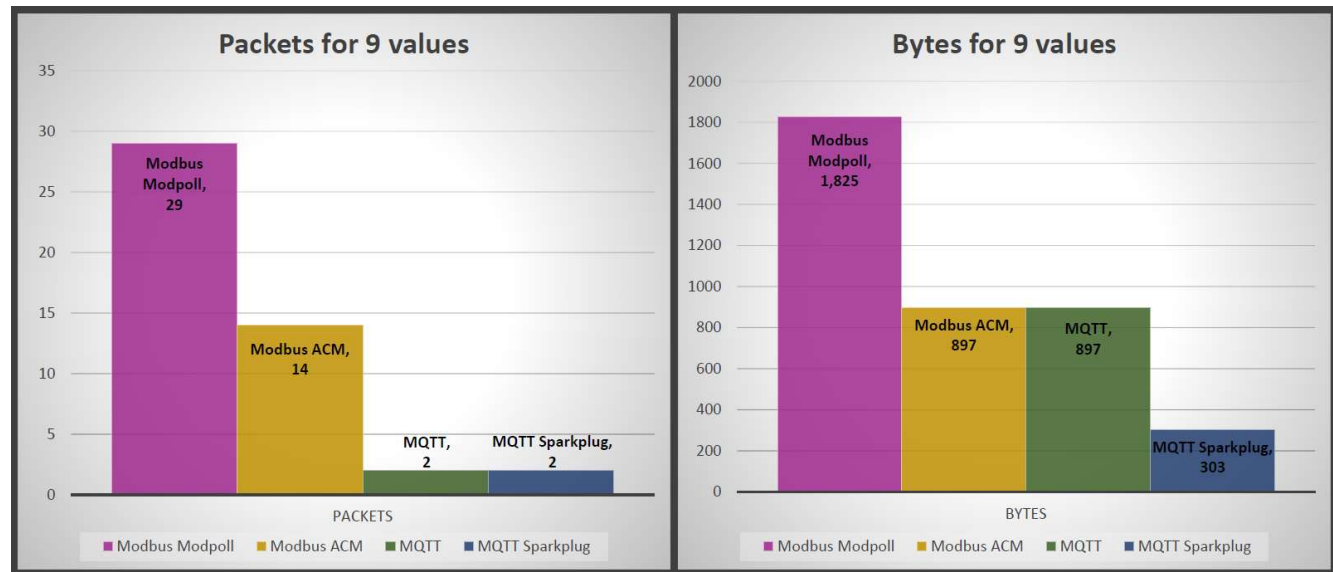
MQTT Sparkplug B Communications:

Use Case #2 - Sending Nine values and data concentration

Application Description: Retrieve 9 values every minute via Modbus RTU Encapsulated vs MQTT vs MQTT Sparkplug B

Considerations:

- These values are not in a contiguous Modbus block, so Modbus has to poll three different ranges of registers
- Not all drivers for the same protocol will give the same results
- Sparkplug can be more efficient if it is implemented as intended vs sending unnecessary data



MQTT Sparkplug B Communications:

Use Case #2 - Sending Nine values and data concentration

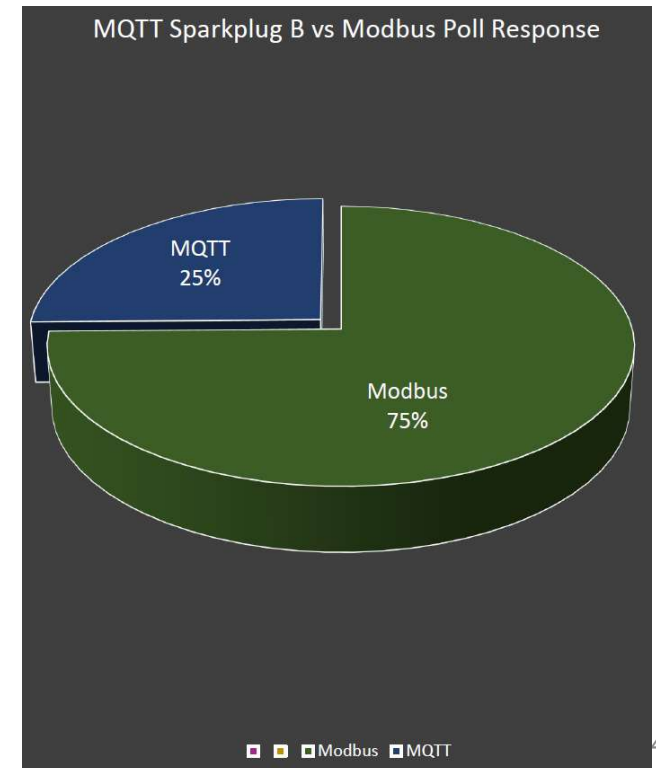
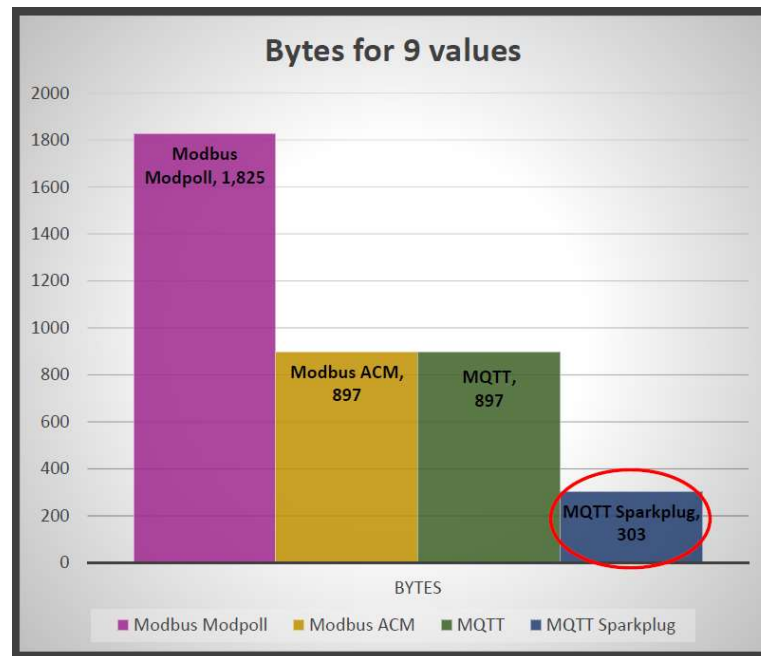
Modbus Poll vs ACM Drivers

Different Modbus drivers seem to return different results, in this case Modbus Poll seems to send the data twice

MQTT vs Modbus

MQTT Uses the same amount of bandwidth as Modbus ACM, even though it is sending 3x more data (timestamp, alias, and value) that Sparkplug B.

MQTT Sparkplug B is 3x more efficient than regular MQTT sending the exact same payload because It compresses the data.



MQTT Sparkplug B Communications:

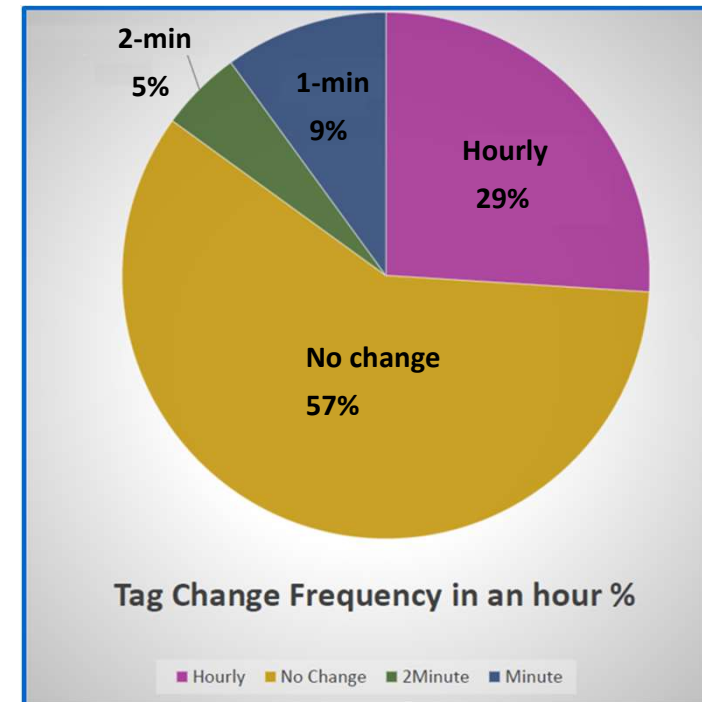
Use Case #3 - Oil & Gas RTU Data On Change Retrieve 389 tags for a wellsite

Application Description:

Sample data on a real Thermo AutoPilot Pro RTU with plunger tags Total 389 tags. Estimated how often the values would change based on usual activity and theoretical deadbands. Data on exception and limited to minute resolution Modbus vs MQTT on change.

Data Summary:

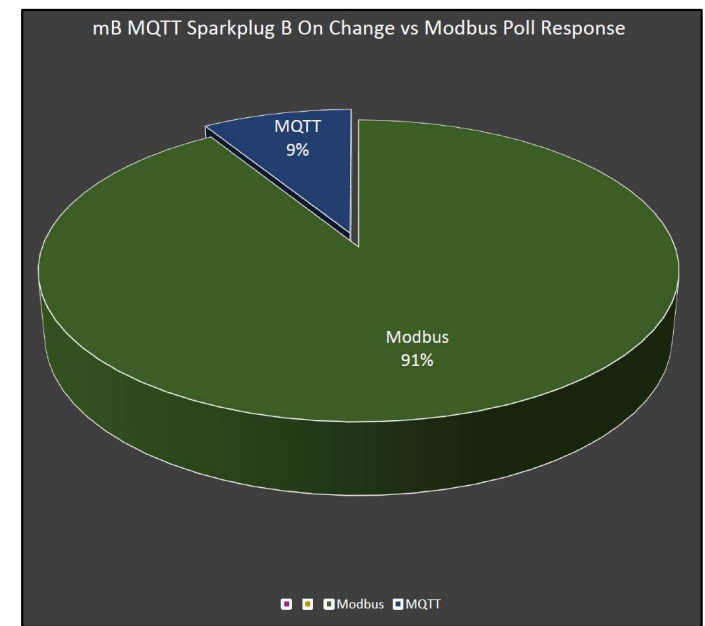
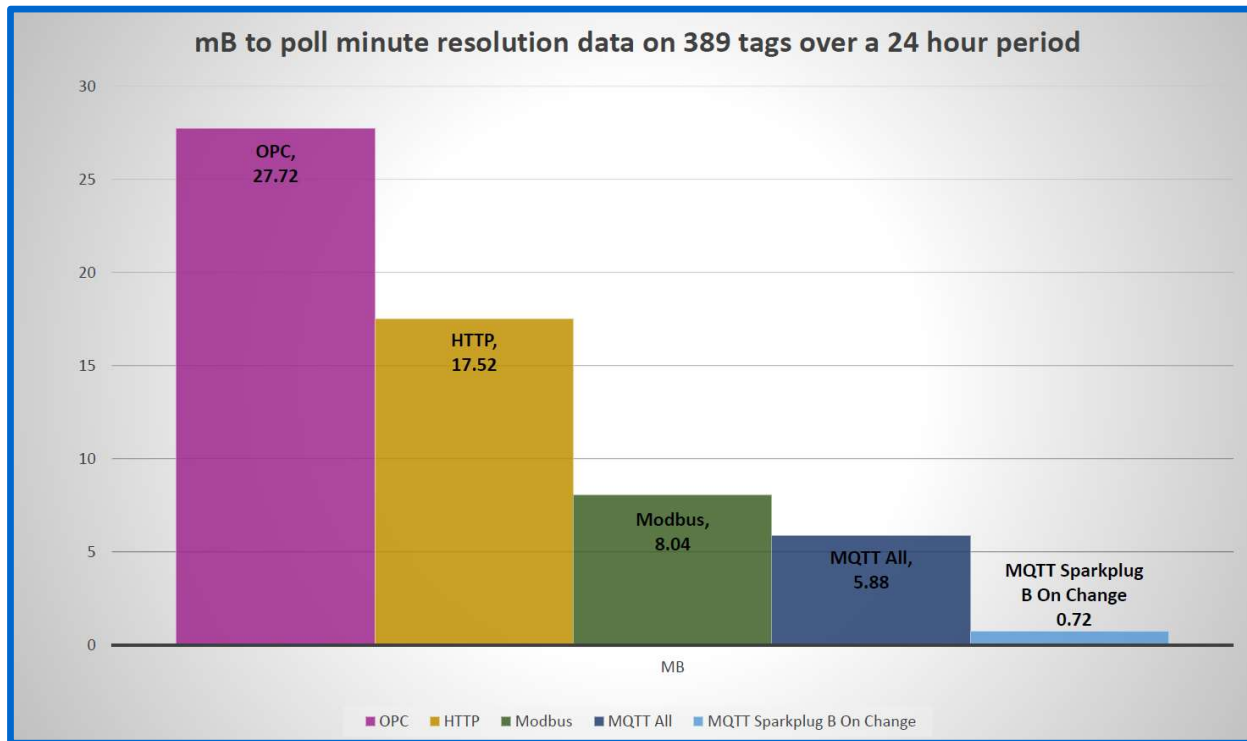
- 223 discrete tags that would not change in an hour
- 111 tags would change hourly
- 19 intermittently used analog values
- 36 analog values would change each minute



57% of the data doesn't change even once in an hour So, why poll for it each time...

MQTT Sparkplug B Communications:

Use Case #3 - Oil & Gas RTU Data On Change Retrieve 389 tags for a wellsite



MQTT Sparkplug B Communications:

Efficient IIoT Communications - OPC-UA, HTTP, Modbus and MQTT Benchmarking

Benchmarking Summary:

- Most of the bandwidth savings come from report by exception
- Sparkplug B compresses 3x
- Trading Modbus for MQTT/SparkplugB on exception can result in ~75% to ~99.5% network bandwidth savings but it will depend on your application, number of points, criticality of the data, and other factors
- **Network bandwidth savings is always an estimate until you actually implement and test in the real world...**

MQTT / Sparkplug B : A Future for Smart Cities?



**CITY OF
PARRAMATTA**

(Close to Sydney!)

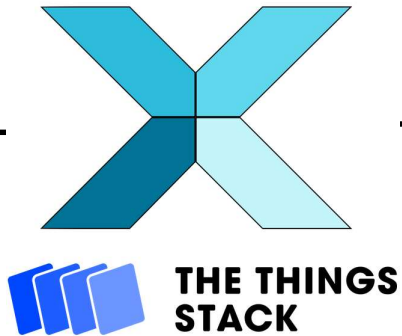
MQTT

LoRaWAN



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Questions



40+ Years and Still Transmitting!

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