HBK
HOTTINGER BRÜEL & KJÆR

CLOUD AND AUTOMATION PROTOCOLS

MQTT vs. REST vs. OPC UA: Choosing the right industrial communication protocol

Learn the key differences between MQTT, REST, and OPC UA and how to choose the right one for your system.

Networking machines, sensors, and other systems efficiently, securely, and scalably can be a complex business.

Choosing the right communication protocol might seem like a small thing at first, but it's easy to get lost when choosing between MQTT, REST, and OPC UA.

In this article, we'll explore the most common communication protocols, from how they work to where they thrive and their biggest limitations.

So it's easy for you to find the right standard – and ensure your application works as smoothly, efficiently, and reliably as possible.

WHAT ARE MQTT, REST, AND OPC UA?

Choosing the right communication standard can be confusing at first. But finding the right protocol really comes down to understanding the unique characteristics of MQTT, REST, and OPC UA – and matching those characteristics to your application.

MQTT

What is it?
A lightweight network protocol for IoT communication.

MQTT is based on a public-subscribe model, meaning that devices and applications (or 'MQTT clients') publish data on 'topics' to a central broker.

Other applications or clients can subscribe to these topics via to broker in order to receive the associated messages.

Main characteristics
- Asynchronous communication
- Low bandwidth and device resource requirements
- A variety of quality of service (QoS) levels (ranging from 0-2) allows users to find the perfect balance between reliability and network efficiency. QoS 0 can be used for frequent, non-critical data, while 1 and 2 can be used for messages where delivery confirmation is essential.

When should it be used?
MQTT is perfect for smaller IoT devices and platforms.

It's also a powerful protocol for use in sensor networks.

As a result, it's often used as a communication protocol in predictive maintenance contexts. That's why MQTT plays a crucial role in our digiBOX amplifier; by using MQTT in combination with openDAQ, we've made it easy to integrate the digiBOX with a wide range of cloud applications and analytics processes.

MQTT in action
The scenario: An automotive manufacturer wants to record sensor data from its machines in real time, so that it can detect anomalies earlier.

MQTT's publish-subscribe principle makes it the ideal communication protocol.

The sensors continuously send data to a central MQTT broker, which distributes it to the relevant systems. Engineers use this data to monitor both machine performance and environmental parameters, allowing them to optimise every aspect of the machine's operations.

Crucially, the data moves fast and reliably. As a result, engineers can move fast to fix issues – and have peace of mind that they're never missing a red flag or a chance to optimise their products.

REST

What is it?
An architectural style, based on HTTP requests, for web interfaces.

When using REST, a server provides resources via a web interface – the REST API.

Client applications then address a resource using a unique address. The applications then use HTTP methods like GET, POST, PUT, or DELETE to retrieve, create, change, or delete data.

Main characteristics
- Client-server model
- Stateless – All API requests are self-contained and independent of each other
- Multi-layer architectures support scalability. Since the client only knows the interface, the actual technological implementation remains hidden.

When should it be used?
Since REST is based on commonly used internet technology, it's much easier to use and integrate into existing infrastructures than other protocols.

As a result, REST APIs are used by a wide variety of web services, web applications, and cloud platforms.

However, you can also use REST APIs to communicate with industrial devices – as you'll see below.

REST in action
The scenario: A manufacturer of sensors for industrial equipment is looking for a way to transfer sensor data from a production hall to a central cloud platform.

In this situation, REST APIs make standardised HTTP communication between the machines and the cloud simple. They're also easy to integrate with existing MES and ERP systems, allowing the manufacturer to get up and running quickly and with minimal disruption.

And, if the manufacturer's production scales up, REST ensures that the manufacturer's analysis and optimisation processes can scale with it.

OPC UA

What is it?
An industrial communication standard for data exchange between automation devices and software systems. It has established itself as one of the most important standards in industrial automation, spanning industries and applications.

Machines and devices from different manufacturers can use OPC UA to provide data in a standardised format, or receive it for control purposes.

To work, OPC UA requires an OPC UA server that can 'translate' between proprietary interfaces and the OPC UA standard.

Main characteristics:
- Platform-independent and expandable
- Integrated authentication and encryption security mechanisms
- Supports complex information modelling
- Technology abstraction

When should it be used?
Software applications like MES or ERP systems use OPC UA clients to retrieve data and transmit it to controllers.

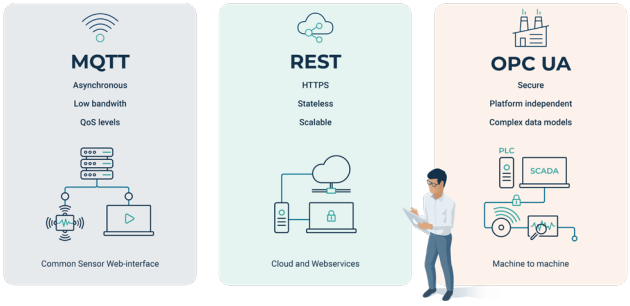
OPC UA is used in our ClipX one-channel signal conditioner, allowing it to connect industrial equipment into one cohesive, communicative system – all built around seamless data collection.

OPC UA in action
The scenario: A manufacturing company wants seamless communication between the PLC and SCADA control systems in its production hall.

OPC UA's ability to standardise the transfer of machine data makes it the perfect match for this application. It's also able to map complex data models ensuring that the right information reaches the right place every time, no matter how complex the manufacturer's ecosystem becomes. Thanks to OPC UA's integrated security layer, the manufacturer knows that its data is safe from cybercriminals, too.

WHICH COMMUNICATION PROTOCOL SHOULD YOU CHOOSE?

Here's a quick summary of the communication protocols and which applications they're most suitable for.



Of course, these communication standards don't work completely independently. They are often combined with one another, allowing the strengths of one protocol to balance out the challenges of another.

For example, you'll often see 'OPC UA over MQTT', where OPC UA data is transmitted in the form of MQTT messages in order to improve security while saving bandwidth.

SEAMLESS COMMUNICATION BUILDS SMARTER SYSTEMS

There's no one-size-fits-all when it comes to communication protocols.

MQTT offers lightweight efficiency for IoT networks, REST delivers simplicity and scalability for web-based infrastructures, and OPC UA brings robust, secure data exchange for industrial environments.

Sometimes, the smartest approach is a hybrid one – layering protocols to combine their strengths and balance out their weaknesses.

Whether you're connecting machines, sensors, or cloud systems, understanding the protocols behind them helps you build smarter, faster, and more secure systems.

HBK – Hottinger Brüel & Kjær
www.hbkworld.com
info@hbkworld.com