

Combine MQTT and OPC UA to optimize IIoT solutions

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Introduction

MQTT as an open network protocol and OPC UA as an industry standard for data exchange are the two most common players in the IIoT sphere. Often, MQTT (Message Queuing Telemetry Transport) is used to connect various applications and systems, while OPC UA (Open Platform Communications Unified Architecture) is used to connect machines. Additionally, there are also applications and systems that support OPC UA, just as there are machines or devices that support MQTT. Therefore, when it comes to providing communication between multiple machines/devices and applications that support different protocols, a couple of questions might arise. First, how to bridge the gap between the two protocols, and second, how to do it in an efficient, sustainable, secure and extensible way.

This article discusses the main aspects of MQTT and OPC UA and illustrates how these protocols can be combined for IIoT solutions. The information presented here would thus be useful for IIoT architects.

MQTT and OPC UA: origins and characteristics

Both protocols are the most supported and most utilized in the IIoT. MQTT originated in the IT sphere and is supported by major IoT cloud providers, such as Azure, AWS, Google, but also by players specialized in industrial use cases, e.g. Adamos, Mindsphere, Bosch IoT, to name a few. The idea behind MQTT was to invent a very simple yet highly reliable protocol that can be used in various scenarios (for more information on MQTT see MQTT Basics). OPC UA, on the contrary, was created by an industry consortium to boost interoperability between machines of different manufacturers. As MQTT, this protocol covers core aspects of security (authentication, authorization and encryption of the data) and, besides, meets all essential industrial security standards (see BSI-study).

The nature of IIoT use cases

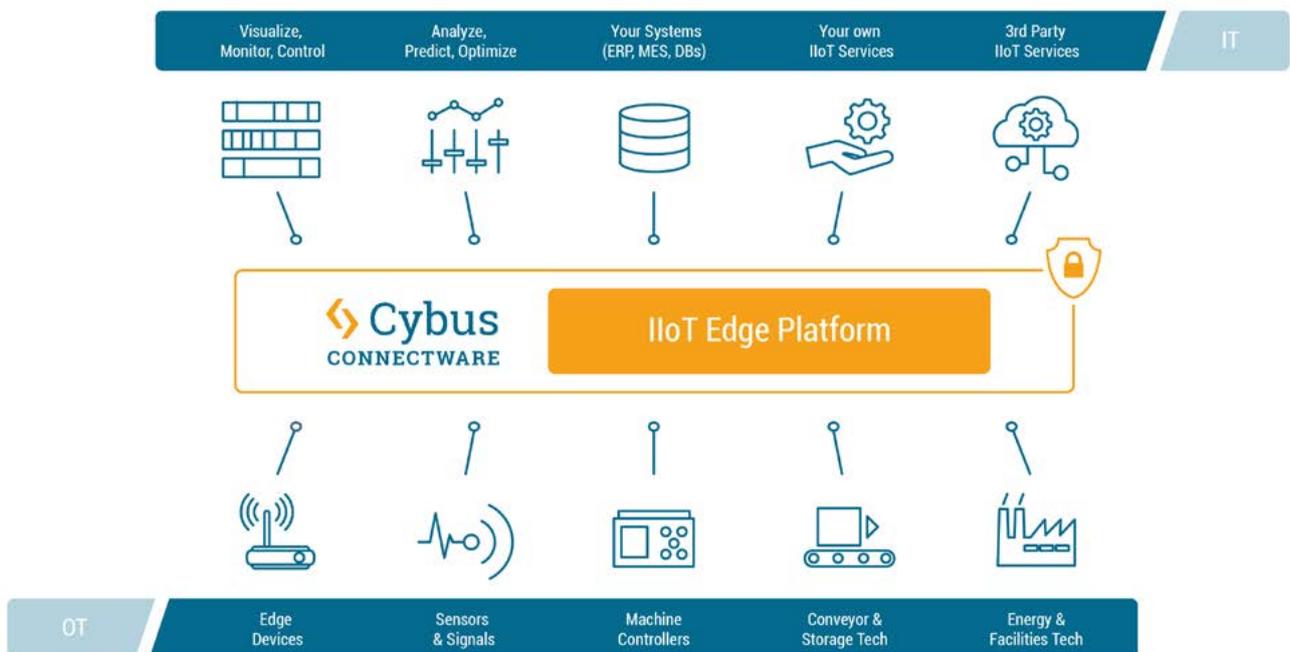
IIoT use cases are complex, because they bring together two distinct environments – Information Technology (IT) and Operational Technology (OT). Traditionally, the IT and OT worlds were separated from each other, had different needs and thus developed very different practices. One of such dissimilarities is the dependence on different communication protocols. The IT world is primarily influenced by higher level applications, web technology and server infrastructure, so the adoption of MQTT as an alternative to HTTP is on the rise there. At the same time, in the OT world, OPC UA is the preferable choice due to its ability of providing a perfectly described interface to industrial equipment.

Today, however, the IT and OT worlds gradually converge as the machine data generated on the shopfloor (OT) is needed for IIoT use cases such as predictive maintenance or optimization services that run in specialized IT applications and often in the cloud. Companies can therefore benefit from combining elements from both fields. For example, speaking of communication protocols, they can use MQTT and OPC UA along with each other. A company can choose what suits well for its use case's endpoint and then bridge the protocols accordingly. If used properly, the combination of both protocols ensures greatest performance and flexibility.

Bringing MQTT and OPC UA together

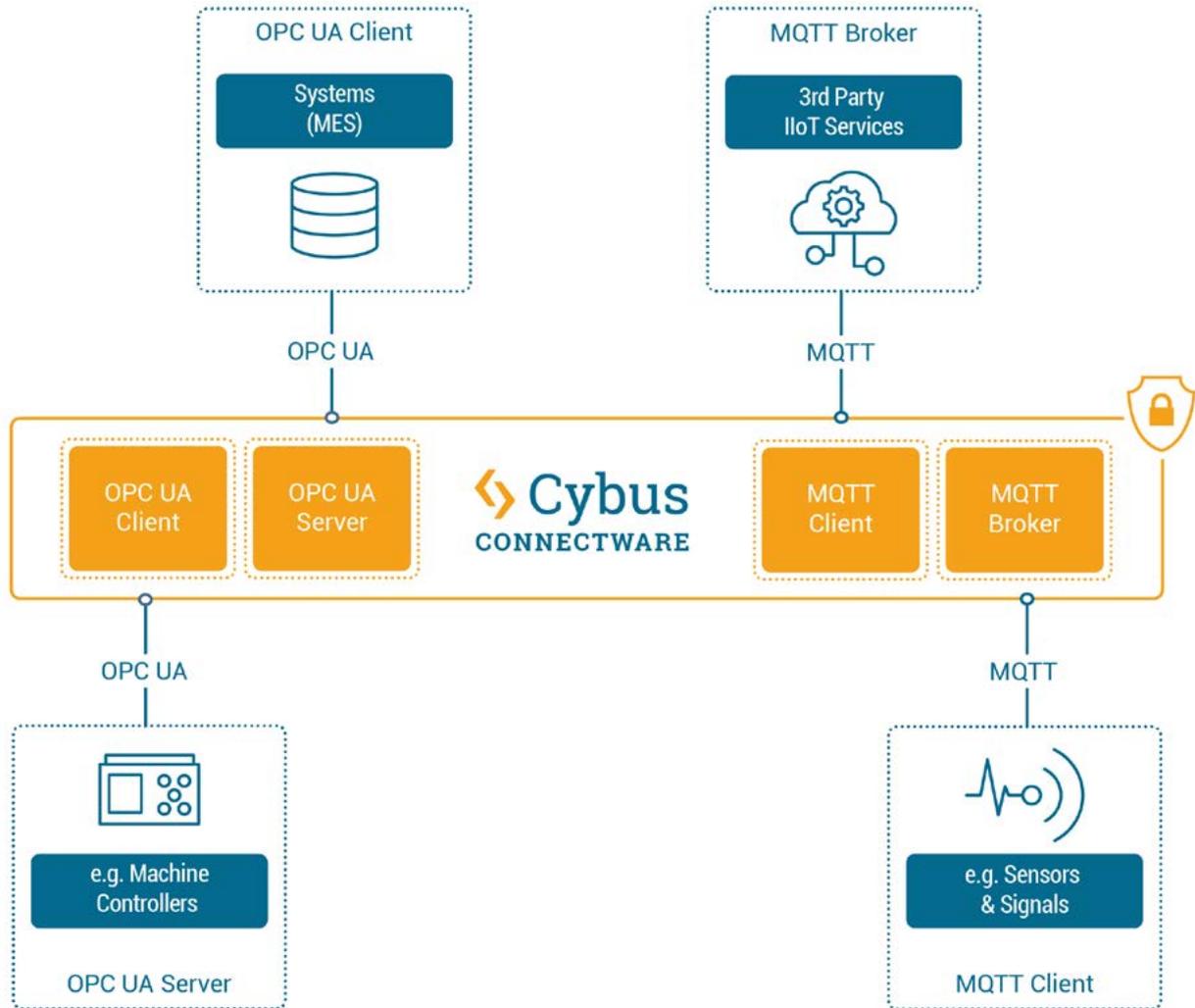
As already mentioned above, applications usually rely on MQTT and machines on OPC UA. However, it is not always that straightforward. Equipment may also speak MQTT and MES systems may support OPC UA. Some equipment and systems may even support both protocols. On top of that, there are also numerous other protocols apart from MQTT and OPC UA. All this adds more dimensions to the challenge of using data in the factory.

This IIoT challenge can, however, be solved with the help of middleware. The middleware closes the gap between the IT and OT levels, it enables and optimises their interaction. The Cybus Connectware is such a middleware.



General Illustration of the Cybus Connectware.

The Cybus Connectware supports a broad variety of protocols – including MQTT and OPC UA – and thus makes it possible to connect nearly any sort of IT application with nearly any sort of OT equipment. In the case of OPC UA and MQTT, the bridging of two protocols is achieved through connecting four parties: OPC UA Client, OPC UA Server, MQTT Client and MQTT Broker. The graphic below illustrates how the Cybus Connectware incorporates these four parties.



Cybus Connectware incorporates the four parties OPC UA Client, OPC UA Server, MQTT Client and MQTT Broker.

On the machines layer, different equipment can be connected to the Connectware. For example, if a device such as a CNC controller (e.g. Siemens SINUMERIK) that uses OPC UA should be connected, then the Connectware will serve as the OPC UA Client and the controller as the OPC UA Server. While connecting a device that supports MQTT (e.g. a retrofit sensor), the Connectware will act as the MQTT broker, and the sensor will be the MQTT client.

Likewise, various applications can be connected to the Connectware on the applications layer. In case of connecting services that support MQTT (e.g. Azure IoT Hub or AWS IoT / Greengrass), the Connectware will

act as the MQTT client, while those services will act as MQTT brokers. If connecting systems that support OPC UA (e.g. MES), the Connectware will play the role of the OPC UA Server, while the systems will act as OPC UA clients.

The question may arise as to why not connect applications or systems that support a specific protocol directly to devices that support the same protocol, e.g. a SINUMERIK machine controller to a MES (which both “speak” OPC UA), or a retrofit sensor to the Azure IoT Hub (which both can communicate via MQTT)? Although this is theoretically possible, in practice it comes with fundamental disadvantages that can quickly become costly problems. A tightly coupled system like this requires far more effort as well as in depth protocol and programming skills. Such a system is then cumbersome to administer and not scalable. Most importantly, it lacks agility when introducing changes such as adding new data sources, services or applications. Thus a “pragmatic” 1:1 connectivity approach actually slows down the IIoT responsables’ ability for business enablement where it is really needed to accelerate.

At this point, it is worth moving from the very detailed example of MQTT and OPC UA to a broader picture, because IIoT is a topic full of diversity and dynamics.

In contrast to the 1:1 connectivity approach, the Connectware IIoT Edge Platform enables (m)any-to-(m) any connectivity between pretty much any OT and IT data endpoints. From a strategic point of view, the Connectware, acting as a “technology-neutral layer”, provides limitless compatibility in the IIoT ecosystem while maintaining convenient independence from powerful providers and platforms. It provides a unified, standardised and systematic environment that is made to fit expert users’ preferences. On this basis, IIoT responsables can leverage key tactical benefits such as data governance, workflow automation and advanced security. You can read more about these aspects and dive into more operational capabilities in related articles.

If you have any further questions or require some additional information on the topic, please do not hesitate to contact our experts directly via hello@cybus.io.

Links to dive deeper

- >> [How to connect and integrate an OPC UA server](#)
- >> [How to connect an MQTT client to publish and subscribe data](#)
- >> [Connectware & Azure IoT Hub Integration](#)
- >> [Connectware & AWS IoT \(Greengrass\) Integration](#)

Cybus is a specialist for secure IIoT Edge software, headquartered in Germany. Cybus Connectware serves smart factories as a universal Edge and DevOps hub. Machine builders and providers of IIoT services use the Cybus Connectware as a software-based gateway. As early as 2017, Cybus published the first secure industrial connector for machine data according to today's DIN SPEC 27070 standard. Industry analyst Gartner named Cybus a worldwide „Cool Vendor“. Today, the company counts medium-sized and large companies from numerous industrial sectors such as mechanical engineering, automotive and aviation among its customers.

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