WHITE PAPER

Smoothing Out the Interoperability Issues in Smart Factories

Edward Lin
Product Manager

MOXA®

Abstract

Data mining is transforming the face of factory automation. As factory automation is all about faster, smarter, and more efficient production, unlocking the vast, untapped potential of data on shop floors has been the driving force behind factory automation's transformation for some time now. The most striking change on factory floors is the evolution of machine-to-machine (M2M) communication into system-to-system communication. M2M communication still propels automation significantly when it comes to point-to-point communication between hardware, but it takes a backseat to system-to-system communication when data needs to be transferred from sensors and devices to the cloud. Consequently, establishing connections between subsystems in network architectures adds new communications paths and network platforms, bringing new complexities and challenges.

Introduction

While discussions about the Industrial Internet of Things (IIoT) and its promises of cost-efficient, nonstop operations carry an opportunistic tone among executives, it is system integrators (SIs) who have to grapple with the reality of figuring out how the different platforms in a network can communicate with each other. What turns SIs' world upside down is the hodgepodge of protocols in the three divergent domains of network architecture: Operation Technology (OT), Information Technology (IT), and the IIoT. Each domain comes with its own set of protocols that effectively creates non-interoperable silos, making it impossible for useful data to reach those who need it on an enterprise level to make important decisions, and leaving SIs at their wit's end. Matters are further complicated by the fact that both the OT and IT departments are unfamiliar with the protocols used in each other's domains. This trend must be reversed quickly, because as the IIoT makes inroads into automation, OT and IT are converging.

There is good news, though. Solutions are available to bridge these interoperability issues through a variety of protocol conversions. This white paper sets out to take a closer look at the challenges that SIs face with OT-to-OT, OT-to-IT, and OT-to-IIoT interoperability, as well as the solutions available to ensure nonstop connectivity throughout converged networks.

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Moxa is a leading provider of edge connectivity, industrial networking, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things. With over 30 years of industry experience, Moxa has connected more than 50 million devices worldwide and has a distribution and service network that reaches customers in more than 70 countries. Moxa delivers lasting business value by empowering industry with reliable networks and sincere service for industrial communications infrastructures. Information about Moxa's solutions is available at www.moxa.com.

How to contact Moxa
Tel: 1-714-528-6777
Fax: 1-714-528-6778

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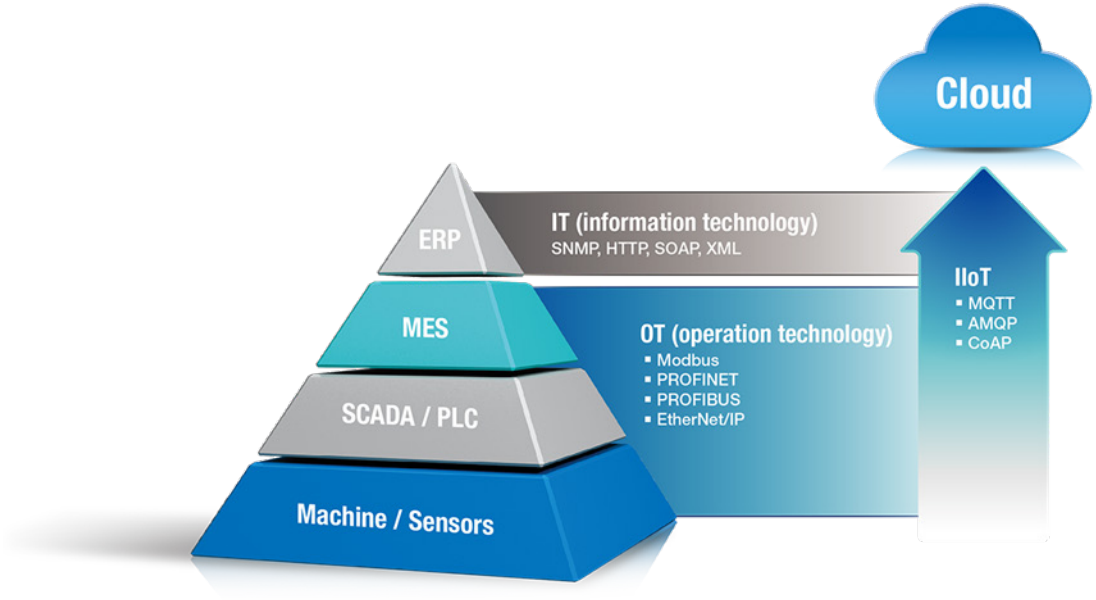


OT-to-OT Interoperability

OT-to-OT communications in factories are not as simple as they used to be. This can mostly be attributed to the IIoT, which has brought gazillions of sensors and machines to the Internet on a massive scale. These types of communications are not going to get simpler anytime soon, as the rise in connected IoT devices is expected to jump by 15% in 2017 to reach a whopping 20 billion, according to a new report from IHS Market. This surge to get connected is impacting factory floors in such a big way that M2M communications have evolved into communications between divergent operational subsystems to fulfill data collection and analytics. The snag, however, is that the heterogeneous systems that fall under OT, such as manufacturing executive systems (MESs), supervisory control and data acquisition (SCADA) systems, programmable logic controllers (PLCs), and the machines and sensors on the plant floor, all run their own protocols; consequently, the age-old issue of non-operability rears its head again and a multitude of protocol conversions are required.

A good example of where efficient communications between disparate OT systems on the factory floor benefit operations is having the heater, ventilation, and air-conditioning (HVAC) system work in sync with the production system. When the latter's workload increases, it alerts the former to start up to ensure that production will not be interrupted by overheating or freezing temperatures.

Challenge: An Alphabet Soup of Protocols

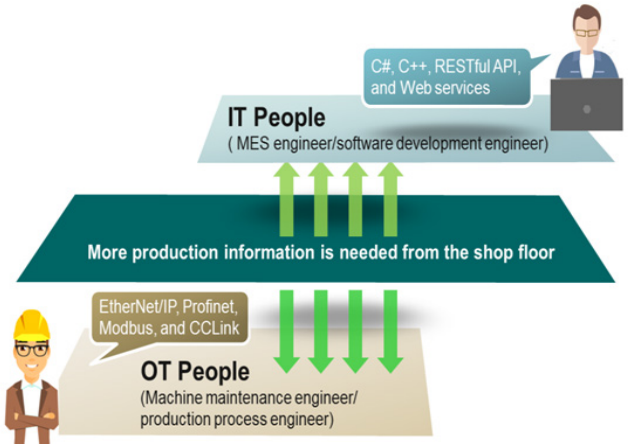
The growing complexity of operations processes brings more and more heterogeneous systems into the equation. This means more devices and more protocols. Installation and setup require more time to plan the architecture and perform device commissioning. For SIs, it is all about saving time and costs. They don't want to spend long hours on device commissioning and configuration, or on protocol conversions. However, it is not uncommon for them to spend

hours on communication and troubleshooting programming when using communication modules or small PLCs. Thus, SIs want an easy way to simplify protocol conversions so that they can rather spend their limited time on their core tasks, such as programming.

Solution

More and more operators are taking advantage of industrial protocol gateways to accomplish the mass configuration of devices and protocol conversions between different devices to keep operations running smoothly. For example, in an electricity room, bridging a large number of Modbus RTU power meters to a Modbus TCP network is usually extremely time-consuming due to the configuration of the slave ID routing table. A convenient solution includes an auto device routing function that automatically detects the commands from a SCADA system and sets up the slave ID routing table. With only one click, this configuration can be achieved within a minute. Furthermore, a ready-to-use protocol gateway that supports the multiple industrial protocols commonly used in OT (such as PROFINET, PROFIBUS, EtherNet/IP, and Modbus) simplifies protocol conversions, resulting in significant cost- and time-savings.

OT-to-IT Interoperability



Close cooperation between IT and OT professionals is fundamental to leverage any smart application's IIoT platform. Although OT and IT's approaches to problem-solving differ vastly, they both work towards the same goal: optimized production. To be successful, both domains need access to industrial data. IT departments, which oversee Enterprise resource planning (ERP) and sometimes MES, need to review this data to form the bigger picture and then develop solutions for each of the issues that hamper an operation's reliability. OT professionals are more closely involved with the physical operations on the factory floor and have to figure out how to make all the divergent systems, fitted mostly with proprietary technologies, work together. On the other hand, a positive trend in the era of Industry 4.0 is OT staff's increasing recognition of the importance and convenience of IT technology as it helps them achieve their goals.

Challenge 1: The Big Divide

IT departments face an increasing demand to collect production data from shop floors in order to optimize production. For IT staff, this is not an easy task as they are not familiar with the process of collecting data via industrial protocols. Concurrently, OT staff members face a similar predicament in that once they have transferred OT data to the IT layer, IT departments often request interfaces they are not familiar with. This can potentially spark a power struggle between the domains over interfaces and protocols. In the age of Industry 4.0, it is not in any organization's best interest to keep the OT and IT domains apart; therefore, eliminating the knowledge gap between them and aligning them more closely deserve operation managers' undivided attention.

Solution

A multi-protocol integrated device will make the lives of SIs much easier here. For example, a smart I/O that supports various protocols—such as Modbus/TCP and EtherNet/IP for IA engineers, and SNMP and RESTful API for IT engineers—allow communications with different interfaces, which is certainly a step in the right direction to bridge the divide between OT and IT. This solution makes it possible for both IT and industrial automation (IA) engineers to conveniently retrieve data from the same I/O device.

Challenge 2: A View to Stay Ahead

Demonstrating just how much OT and IT are worlds apart from each other is the fact that OT network devices are always treated as transparent, making it difficult to monitor them—even in the case of emergencies. This adds to the frustration of network operators as troubleshooting becomes almost pointless when they are experiencing downtime. Of course, this situation cannot be accepted as situational awareness is very important for network operators in order to ensure continuous production and prevent abnormal situations. Ensuring continuous visibility of all network devices and the status of a network in a control room is top priority. However, to capture abnormal events on the shop floor and then interpret the information about these perceived events in real time is quite challenging due to the complexity of the protocols and networks.

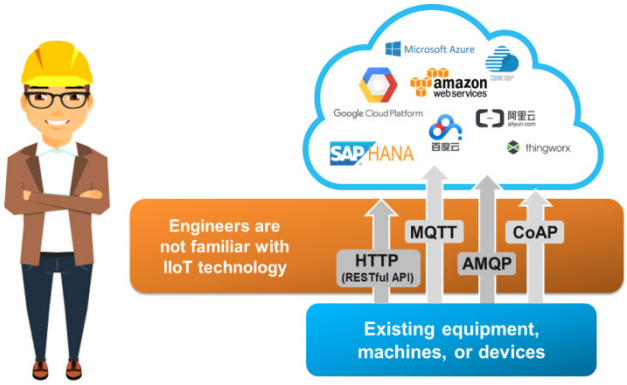
Solution

For production lines that employ OT protocols, Ethernet switches that support PROFINET, Modbus TCP, and EtherNet/IP protocols enable engineers to simultaneously view data and the network status at a central site on a SCADA system or locally on an HMI. If an industrial protocol fails, the switch reports it, and the PLC sends an alarm so that the situation can get fixed immediately.

Leveraging IT's expertise and sensibilities can speed up troubleshooting, reduce system downtime, and increase situational awareness.

OT-to-IIoT Interoperability

In boardrooms, executives expect data mining and analytics to pay dividends in reduced operation costs, optimized production, and predictive maintenance to minimize downtime. As one would expect, this data needs to be collected from field sites, and it has become the job of OT engineers to transfer this data from the devices in the field to the cloud, where it is stored for analytics purposes. This new addition to their job description takes OT engineers somewhat out of their comfort zone as they would rather focus on programming that adds value to their specific field instead of communications tasks.



Challenge: The Need for Speed

OT engineers' lack of IT knowledge is definitely their Achilles' heel. As it is, sending data from an edge device to the cloud can be time-consuming, and OT engineers' unfamiliarity with IT technology only compounds the process. In the race to IIoT connectivity, the biggest challenge for them is to cut down on the time to set up and program the networking connections between edge devices in the field and the cloud.

Solution

To spare engineers lots of programming effort and reduce time and costs, an embedded computing platform that supports versatile interfaces, coupled with a software suite that integrates a ready-to-use Modbus engine and cloud connections such as AWS, enables fast integration between devices in the field and the applications required for the IIoT. Furthermore, for those who want to adopt OPC UA in order to unify automation interfaces, a software suite solution is available that provides both an OPC UA server as well as cloud connection capabilities. The beauty of this solution is that it requires no extra costs to implement additional architecture for cloud connectivity.

Moxa's Solutions

For more information about Moxa's comprehensive portfolio of solutions to make interoperability smoother in factory automation, visit http://www.moxa.com/Event/integrated-solutions/smart-factory/industry-4.0/protocol-interoperability.htm