WHITE PAPER

Getting IT Engineers Up To Speed in the OT World

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MOXA®

Abstract

With factories around the world jumping onto the IT bandwagon, IT engineers are on the lookout for products and solutions that allow them to easily connect their factory's OT systems to IT networks. Although IT engineers are generally well versed in the various IT protocols used to transmit data across a network, they are less familiar the many OT protocols used in their factories. In this white paper, we review the key issues that IT engineers face in pursuit of this goal, and suggest products and solutions they can use to quickly get up to speed on how to convert from the various OT protocols to familiar IT protocols, such as RESTful APIs.

Introduction

Imagine the following scenario: it's 5:00 p.m. on a Thursday afternoon and all of the employees in a 40-year-old CNC components factory are hard at work preparing a huge batch of products scheduled for shipment the following week. It's one the biggest orders the company has ever had to fill and everyone is investing a great deal of effort to ensure that all of the products in the shipment will be top quality and shipped on time. The factory foreman understands full well that if the project succeeds, the company will further strengthen its standing in the eyes of their key customers, and they will meet or exceed that year's sales goal. It goes without saying that to ensure success, the shipment needs to go off without a hitch.

However, some of the factory's production lines went offline unexpectedly during the two-week time period before the products were to be shipped, jeopardizing the completion schedule. Fortunately for the factory foreman, the problem was solved quickly, and they were able to stay on schedule. Faced with the prospect of encountering similar problems in the future, perhaps without the benefit of happening to detect the problem quickly, the CEO of this OT (operation technology) company decided to connect the factory to the cloud to ensure that the status of all of the devices on the factory floor could be monitored in real time. Since such an implementation involves connecting the OT network to the company's IT (information technology) network, the next step is to determine the best way to implement the IT to OT data connection.

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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.

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What Does an OT System Look Like?

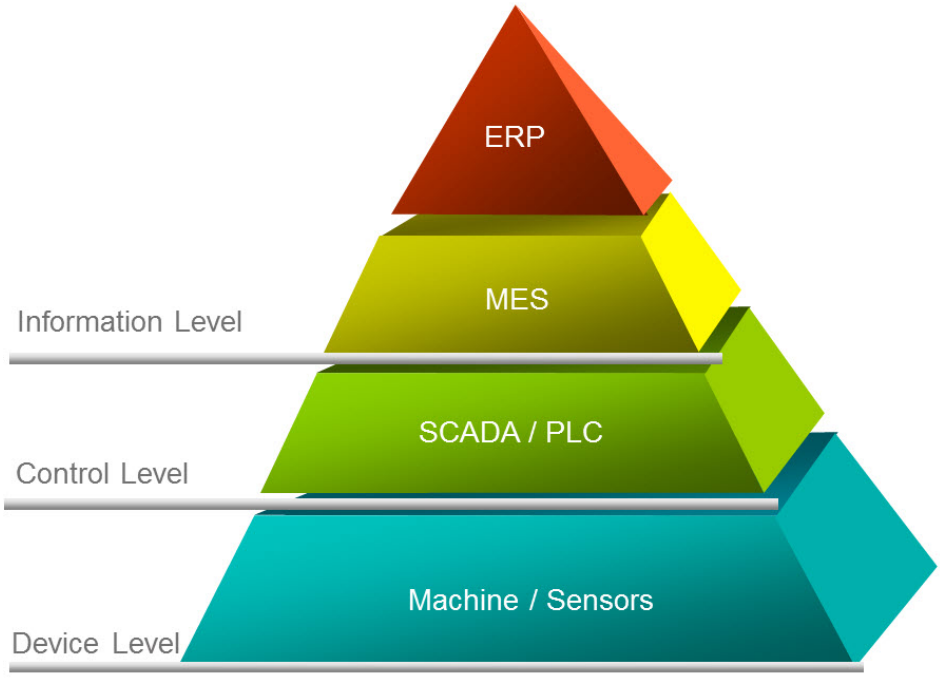
Before going into detail about how to get OT data from an IT system, let's take a closer look at the structure of a typical OT system.

System Structure

In general, data in an OT system is organized hierarchically, with the data transmitted from the very bottom of the hierarchy all the way to the top. OT systems are generally divided into three layers:

- **Device Level:** This level includes machines, sensors, loads, meters, and I/O devices.
- **Control Level:** This level includes PLCs (programmable logic controllers), controllers, and SCADA (supervisory control and data acquisition) software.
- **Information Level:** This level includes MES (manufacturing execution system) and ERP (enterprise resource planning) applications.

Sensor readings (e.g., current, voltage, pressure, and temperature) are acquired by sensors or meters, and then I/O devices collect the raw engineering data and pass it up to PLCs and controllers. The data is used by the MES and ERP applications to make decisions related to the operation of the factory as well as for further analysis.



OT System Characteristics

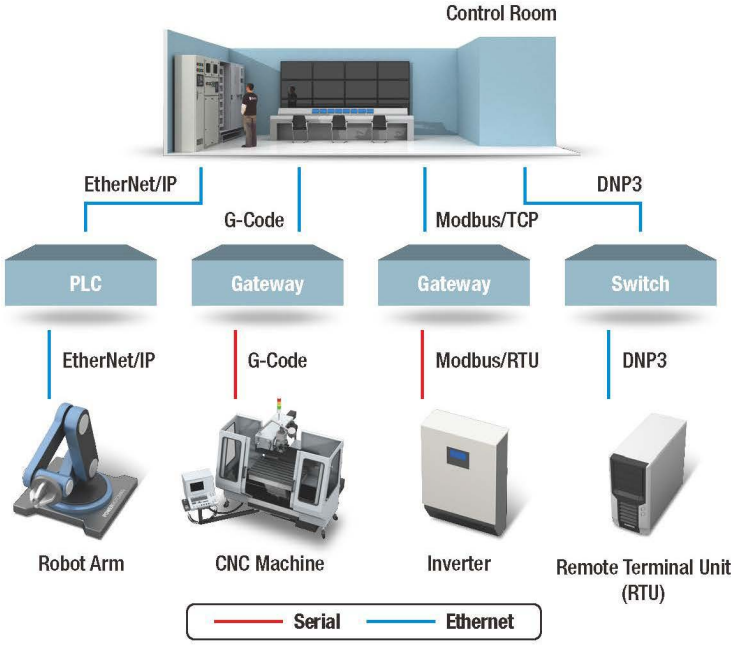
A variety of proprietary and often incompatible protocols are used in the field

Most people are at least peripherally familiar with IT systems, which utilize universal metadata and document identification formats. For example, HTTP messages can be easily sent and received over the Internet. OT systems, on the other hand, are a completely different type of animal. Proprietary protocols that operate over special-purpose topologies have been developed over the years to perform very specific tasks at field sites. As a result, OT systems

are less open, less accessible, and are not readily able to connect to devices or networks that do not support their proprietary protocols. The need to integrate incompatible subsystems in an OT setting is a situation unfamiliar to most IT engineers.

Distributed Design

Due to the fact that many field devices support a full bevy of proprietary protocols, OT systems tend to operate over distributed topologies. OT systems are purpose-driven to support specific applications, with particular devices and protocols deployed to improve efficiency and accuracy. For example, the PLCs and devices used inside a factory often communicate via the EtherNet/IP protocol. In addition, CNC machines communicate using proprietary protocols such as G-code, the inverters used in many solar power systems communicate via Modbus, and DNP3 (Distributed Network Protocol) is frequently used in electric and water systems. IT engineers are faced with the task of removing the isolation caused by such a diverse range of protocols, and imposed on the various devices which form the building blocks of the OT system.



Difficulties Encountered when Transmitting Data from OT Systems to the Cloud

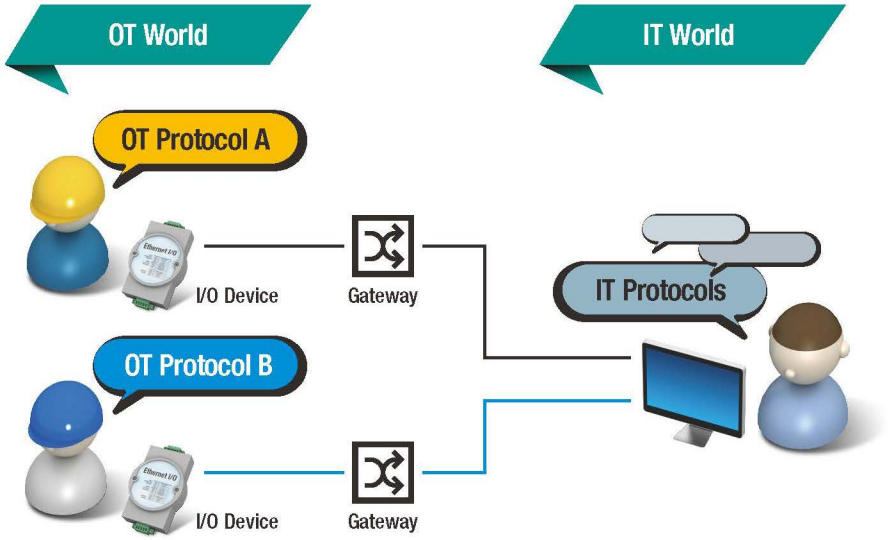
Taking into consideration the characteristics and limitations of OT systems, what difficulties can IT experts expect to encounter when it comes time to connect the data to the cloud, and how can these difficulties be overcome?

Lack of Familiarity with OT Protocols

Protocols are like human languages, except that they are used by devices instead of by people. If IT engineers are unable to interpret the various OT protocols they encounter, they won't be able to parse the data, let alone convert it into useful information.

Solution: Incorporate OT protocols into IT protocol gateways

In order to create a data transmission bridge from the OT world to the IT world, protocol gateways are used to translate from OT protocols to IT protocols. However, you may find that you need to install a different gateway for each OT protocol, increasing both the cost and the amount of time needed to test and configure the gateways. Furthermore, the more devices you employ, the greater the chance that you will encounter compatibility and inventory issues.



IT Engineers Are Not Adept at Programming OT Devices

As we mentioned above, OT devices are designed to handle particular operational needs, and consequently, OT devices only support a limited number of functions and lack the versatility needed for users to implement customized solutions. In addition, programming languages that IT engineers are accustomed to using are not supported by most OT products. Although PLCs support ladder logic, ladder logic is only applicable to OT field applications.

Solution: Find devices that can meet the IT engineers' needs

To overcome the difficulties of implementation, embedded computers are often put into system topologies as an OT to IT gateway and/or a data concentrator to collect information from I/O devices. These embedded computers are also capable of providing environments for further software development and programming. Apart from this, a few I/O devices that support IT

protocols (RESTful APIs, for example) are already available on the market. These solutions are much friendlier to IT engineers compared with other options.

Moxa Can Help You Deploy OT Data to the IT Cloud

At this point, it should be clear that OT systems in general, as well as the devices in the field that make up the systems, communicate predominantly with proprietary protocols. Since IT engineers are usually completely unfamiliar with OT systems, can we find ready-made devices on the market that can fulfill the IT programmer's needs?

Moxa's Solutions

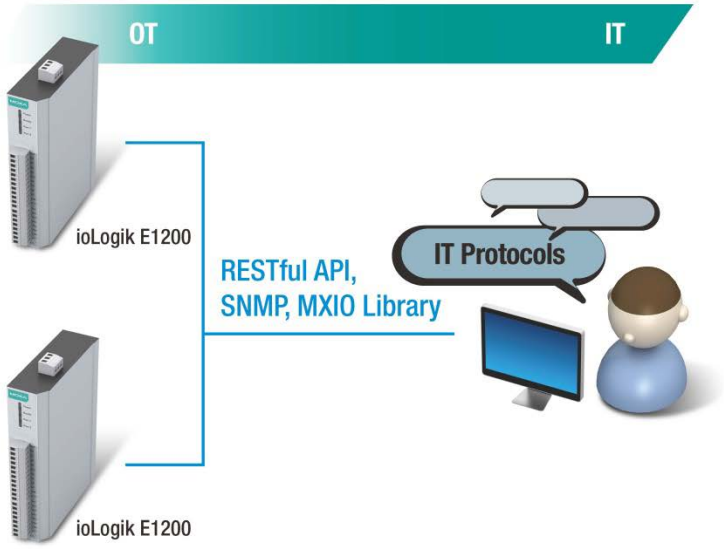
Moxa's remote I/O devices and smart remote I/O devices extend beyond the realm of OT engineers by supporting IT protocols that are useful for OT applications. The modular remote I/O (ioThinx 4510 Series) and the stand-alone remote I/O (ioLogik E1200/E2200/2500 Series), for example, were designed based on IT experts' best practices.

In fact, with Moxa's OT to IT solutions, you will no longer need to invest in additional gateways. Moxa's solutions support a user-friendly programming environment to provide engineers with greater flexibility. We introduce two particular form factors below.

Built-in IT protocols eliminate the cost of purchasing additional protocol gateways

Moxa's ioThinx and ioLogik product families are embedded with multiple protocols, including IT protocols such as RESTful APIs and SNMP Trap. Regardless of whether users want to use a Network Management System (NMS) to manage the entire system, or send/receive RESTful API requests to get/change values or statuses, or even make use of predefined commands for customized development, all of these actions can be achieved with a single I/O device.

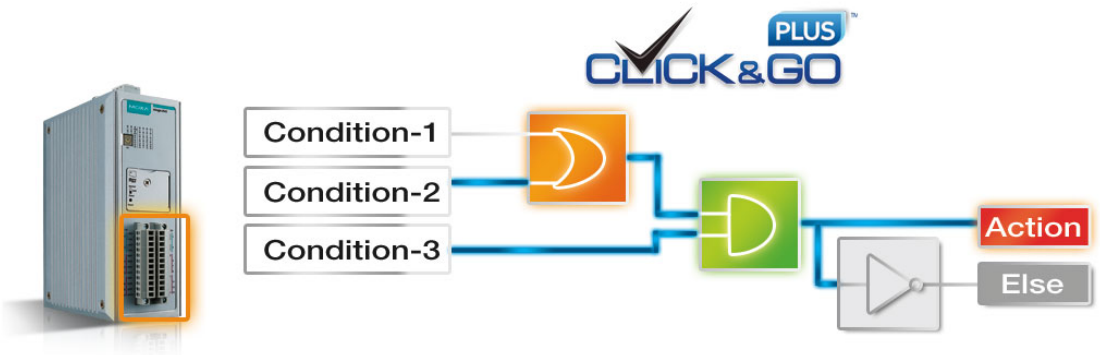
- **RESTful APIs**: RESTful APIs are suitable for cross-application and cross-device topologies due to the large number of frameworks, drivers, and other resources that leverage the HTTP protocol. With the high degree of accessibility and convenience RESTful APIs provide to web connectivity, they have become one of the best options for IIoT device-to-cloud communications.
- **SNMP Trap**: Moxa's ioLogik products support SNMPv1/v2c to allow monitoring of the network and I/O devices with SNMP Network Management software. SNMP Traps can be used for sending user-defined messages containing date, time, server name, MAC, IP address, and other parameters, making them useful for building automation and telecom applications.
- **MXIO Library**: The Moxa MXIO library supports WinCE and Linux, as well as C++, VB/VC, and .NET development platforms. The MXIO library makes it easy to use high-level computer languages to manage I/O devices and data transfer operations over an Ethernet or RS-485 network. Linux programmers can easily develop custom applications to establish transparent communications between the host and the entire ioLogik product family.



Moxa's Patented Click&Go lets you quickly configure control logic and data logging

Moxa's ioLogik E2200 Series and ioLogik 2500 Series are smart I/O devices designed for smart monitoring applications over Ethernet and wireless interfaces. With Click&Go intelligence built in, the ioLogik E2200 Series and ioLogik 2500 Series can be configured for simple outputs paired with simple input triggers, without using a PC controller. Click&Go intelligence allows the ioLogik E2200 Series and ioLogik 2500 Series to be configured to automatically report I/O events according to user-specified conditions. Simple If-Then-Else statements are used to specify conditions that are required for certain actions to take place.

One of the available actions is TCP/UDP active messaging. This feature enables you to configure one or more IP addresses for the message servers to which Click&Go logic sends generated event messages. Click&Go logic sends the defined active message to all the addresses listed. The contents can be sent as ASCII, UNICODE, or HEX, depending on what is needed for the particular application.



About Moxa Smart I/O

As an innovative solution provider of industrial automation applications, Moxa provides a wide range of I/O products for industrial automation. In 2006, Moxa was the first company to introduce the Smart I/O methodology in the industrial automation market. Now, Moxa is applying its innovative technical expertise to transform remote I/O into something even better. The Smart I/O concept has three major features: push functionality with retransmit capabilities, configurable control logic, and an all-in-one design. A Smart I/O solution merges IT and IA technologies to create more possibilities for the automation world. With over 10 years of experience in industrial automation, Moxa's solutions are now widely used in factory automation, security, telecom, ITS, oil and gas, and renewable energy. For more information, visit https://www.moxa.com/Event/controller-and-io/iiot-smart-io/index.htm.