IOT NOW ANALYST REPORT

INDUSTRIAL IOT

How industrial connectivity is driving Industry 4.0 use cases

ANALYST REPORT

Prepared by

IOT ANALYTICS

SPONSOR

SIERRA WIRELESS

New industrial connectivity architectures are driving three key Industry 4.0 use cases

While conducting research for the recently released Industry 4.0 and Smart Manufacturing Market Report, IoT Analytics identified new industrial connectivity architectures driving key Industry 4.0 use cases. In this article Matthew Wopata, a senior analyst at IoT Analytics, sheds some light on this emerging topic

Matthew Wopata, IoT Analytics

Forward-thinking manufacturers and OEMs are using new technologies to realize key Industry 4.0 use cases that improve operational efficiencies and provide differentiated products and services. Many of these use cases require new and innovative connectivity architectures that challenge the existing status quo of the five-layer automation pyramid. This article explores four new industrial connectivity architectures and highlights three Industry 4.0 use cases that utilise these architectures to improve operational efficiencies and/or provide differentiated products and services.

Four industrial connectivity architectures

Industrial edge devices and gateways are incorporating new protocols that bypass the traditional automation pyramid and enable direct cloud connectivity.

Traditional architecture

The traditional five-layer automation pyramid typically relies on open platform communications (OPC) servers to translate Industrial Ethernet and fieldbus protocols into OPC compatible protocols that communicate via a poll/response architecture. Remote connectivity to industrial assets is typically achieved using existing infrastructure and the traditional five-layer automation pyramid communications stack:

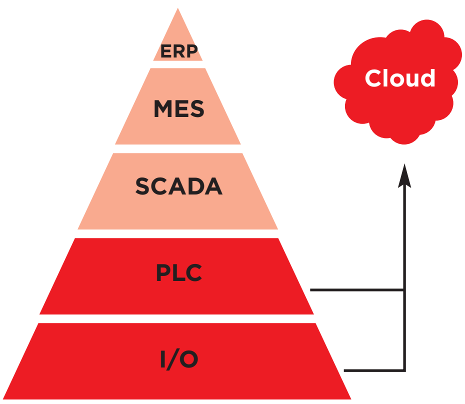

Figure 1: Industrial edge devices now support protocols that enable direct cloud connectivity

While this architecture works for many manufacturing companies around the world, there are a number of issues that new Industrial IoT (IIoT) architectures address. Issues with the traditional architecture include:

- **Bandwidth inefficiency**. Polling engines, such as OPC servers, are configured to request data from devices on regular intervals, regardless of whether or not the value has changed. By implementing publish/subscribe protocols, operational technology (OT) networks can save on bandwidth and infrastructure costs by only receiving and/or recording values as they are reported from the edge devices, which can filter and curate the data before publishing.
- **Scalability**. The server infrastructure for supervisory control and data acquisition (SCADA)/ manufacturing execution system (MES) systems must grow as the number of SCADA/MES clients and/or data points grows. While many of the large manufacturers have fully virtualised and scalable on-premise or private cloud server rooms, which make scaling more seamless, many smaller companies do not have the sophisticated infrastructure required to cost-effectively scale OT server capacity as demand grows. By using IIoT platforms and hosting applications in the cloud, manufacturers are better equipped to scale their infrastructure as their needs grow.
- **Maintainability**. On-premise server infrastructure can be expensive to maintain, especially for smaller manufacturers who do not have large IT departments. Also, the traditional poll/response architecture requires each device and data point to be added to a poll table in the central polling engine, typically an OPC server. These polling tables can also be expensive to maintain, as changes to IP addresses or tag names in the field can break the communications path. With publish/subscribe protocols, devices register with centralised message brokers, and clients - such as SCADA, MES, ERP, or IIoT platforms - subscribe to the data that is published. This publish/subscribe architecture removes the overhead associated with building and maintaining complicated polling engines. ▶

New architectures

IoT platforms and modern SCADA systems now support end-device initiated communications protocols - such as HTTP, message queuing telemetry transport (MQTT), and open platform communications unified architecture (OPC UA PubSub) - which are more scalable and bandwidth efficient than the traditional poll/response protocols. Figures 2, 3, 4 and 5 highlight industrial connectivity architectures that utilise these protocols:

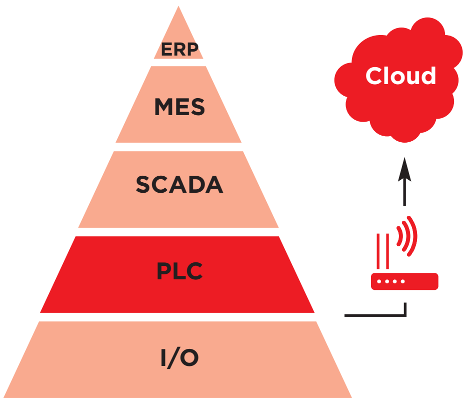

Figure 2: PLC to cloud (gateway)

The vast majority of existing programmable logic controllers (PLCs) typically support either Fieldbus or Industrial Ethernet protocols, and industrial gateways can be used to convert these OT protocols into protocols that can be easily consumed by cloud-based SCADA/MES systems and IIoT platforms, such as HTTP, MQTT, or OPC UA PubSub.

Example: Hilscher gateways

Hilscher is a leading manufacturer of edge gateways for manufacturing environments. The netIOT Edge line of IoT gateways converts Industrial Ethernet protocols such as EtherNet/IP or Profinet into cloud-friendly protocols like MQTT and HTTP. The gateways also can run Node-RED, the web-based IoT wiring editor used to perform logic functions and data manipulation at the edge.

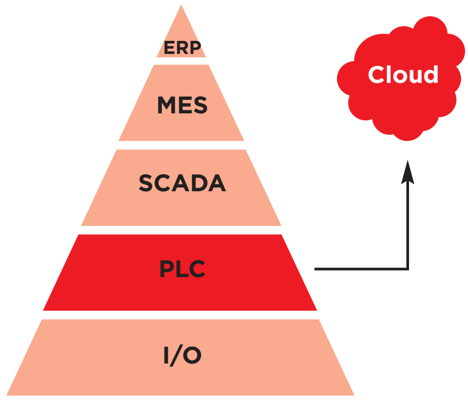

Figure 3: PLC to cloud (direct)

Almost all PLC manufacturers have incorporated Industrial Ethernet protocols in their PLCs, and many provide PLCs that come with built-in OPC UA servers. Most of the IoT platform providers - except for Microsoft - have not yet adopted the OPC UA PubSub protocol and have instead developed native support for more mature IIoT protocols such as MQTT and HTTP.

Example: Wago PFC PLCs

German automation company Wago released a software update for its PFC family of PLCs enabling communications with cloud platforms from Microsoft, Amazon and IBM. Secure connections are established using transport layer security (TLS), and the data is sent in a JavaScript Object Notation (JSON) payload using the MQTT protocol.

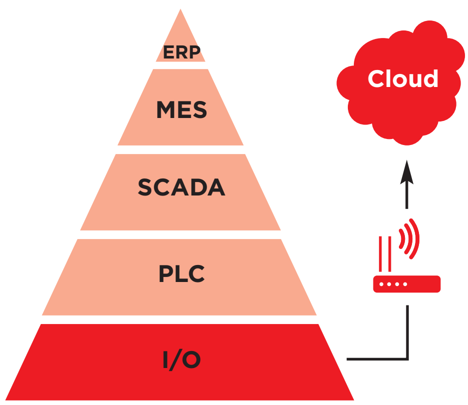

Figure 4: Sensor to cloud (gateway)

The majority of sensors installed in the field still rely on analog signals to communicate with higher level systems. Smart remote input/output (I/O) modules equipped with Fieldbus or Industrial Ethernet communications modules now support cloud connectivity protocols like HTTP and MQTT. This enables direct connectivity to cloud-hosted industrial applications.

Example: Moxa Smart Ethernet I/O

Moxa, a Taiwanese manufacturer of industrial connectivity hardware, recently released a line of Smart Ethernet I/O modules. The modules can collect data from both serial Modbus and traditional analog/digital sensors in the field, and it includes a simple rules engine for running logic at the edge. Sensor data can either be polled via Modbus/TCP (traditional architecture) or pushed to an IIoT platform as the values change or based on pre-defined rules using HTTP methods.

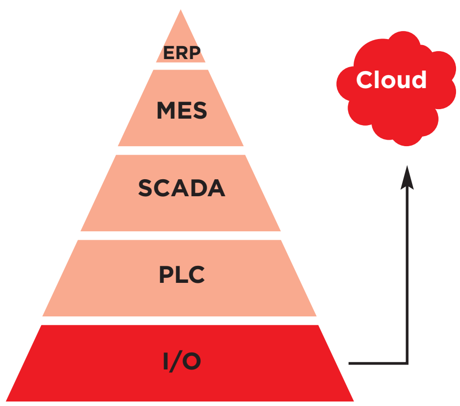

Figure 5: Sensor to cloud (direct)

I/O and end device manufacturers are taking advantage of Moore's Law and creating more powerful and smarter devices. These devices now support a number Industrial Ethernet protocols, and an increasing number of devices are adding support for protocols like MQTT.

Example: Ham-Let connected valves

Industrial instrumentation supplier Ham-Let recently demonstrated a line of new valves that natively support the MQTT protocol. The valves come equipped with Ethernet connectivity and can connect to any TCP/IP-based MQTT broker. The data is published in a JSON format that can be easily parsed and integrated with a number of SCADA and IIoT platforms.

Three Industry 4.0 use cases that use new industrial connectivity architectures

Many – if not most – Industry 4.0 use cases rely on new industrial connectivity architectures to achieve more flexible and efficient connectivity to higher level systems. This section highlights three specific Industry 4.0 use cases with examples that use new connectivity methods to improve operations and provide differentiated products and services.

1. Everything-as-a-Service business models

Everything-as-a-Service refers to selling products as services instead of or in combination with physical products. Enabled by Industry 4.0 technologies, OEMs, such as Heller, are now allowing end-users to pay for usage of the equipment as an opex versus a large up-front capex. This arrangement more closely aligns an OEM with the customer's desired outcome because the OEM is paid based on an outcome metric such as machine uptime, cubic feet of compressed air or other outcomes. Manufacturing-as-a-Service is a particularly intriguing as-a-service business model where customers can upload digital designs of parts and receive custom manufactured parts in a matter of a few days. Everything-as-a-Service business models will continue to increase in popularity as it becomes increasingly viable – via low cost connectivity and analytics – for customers to pay for specific outcomes.

Traditional methods
- Manufacturers make capital expenditures and own the equipment supplied by OEMs, which shows up on manufacturers' balance sheets
- OEMs lack visibility of their deployed equipment and warranty service is performed on an ad-hoc basis
- Receiving quotes from contract manufacturing vendors is labor intensive and time consuming

Industry 4.0 methods
- Manufacturers pay for the output of a machine as an operating expense while the OEM or a third party retains ownership of the equipment
- OEMs have visibility to the performance of their deployed equipment and are compensated based on the performance of the machine, not the upfront capital expenditure
- End users can receive instant quotes for manufactured parts by uploading digital designs over the internet ▶

Case Study: Heller differentiates product offering with machine-as-a-service

SIEMENS

Industry 4.0 Technology: Connected Industry

Siemens
www.siemens.com
Munich, Germany
100K+ employees

HELLER

Improvements: Increased Revenue

Heller
www.heller-us.com
Gaithersburg, Nürtingen, Germany
2,000 employees

German machine tool manufacturer Heller has partnered with Siemens to connect all of its new machines to the Mindsphere platform. Each connected Heller machine comes with a Siemens controller that sends data via TCP/IP to the Mindsphere platform. This connectivity has enabled Heller to offer a machine-as-a-service (MaaS) product to customers.

The machine-as-a-service (MaaS) model gives Heller customers the option to pay an initial setup fee plus a monthly fee and an hourly usage fee. Customers may rent for between six and 72 months and they may upgrade to the latest machinery by paying the one-time setup fee.

2. Data-driven inventory optimisation

Data-driven inventory optimisation refers to use cases that implement Industry 4.0 technologies to reduce the costs associated with managing inventory. Companies like Assembly Fasteners are adding connectivity to their vendor-managed inventory management systems to reduce operational costs and improve customer experience. As Industry 4.0 technology matures, companies in a variety of industries will utilize the technology to optimise the amount of capital tied up in inventory and reduce the costs associated with handling the inventory.

Traditional methods

- Manual collection and/or integration of data from disparate software systems such as warehouse/ inventory management (WHM), supply chain management (SCM), customer relationship management (CRM), and enterprise resource planning (ERP)

Industry 4.0 methods

- Automated collection and/or integration of disparate datasets enabling analytics that provide real-time forecasting and inventory optimization

Case Study: AFI saves two man-months per year with smart bin system

apex

Industry 4.0 Technology: Connected Industry

Apex Supply Chain Technologies
www.apexsupplychain.com
Mason, OH, USA
200+ employees

AFI ASSEMBLY FASTENERS, INC.

Improvement: Lowered Costs

Assembly Fasteners Inc.
www.afi.cc
Apopka FL, USA
50+ employees

Assembly Fasteners is a global distributor of industrial products and services, specialising in vendor-managed inventory management (VMI) programmes. The VMI programmes were very labour intensive, requiring a technician to go to the job site and check every single bin with a scanner to determine what to order for restocks. The human factor interfered with the system on multiple levels, as technicians filled the containers above limits or client employees withdrew more parts than they needed, causing demand fluctuation, high inventory levels and high rates of bound capital.

To tackle this problem, Apex Supply Chain Technologies installed a vendor managed inventory container system for Assembly Fasteners at the client's manual assembly lines. The system consists of smart material containers that automatically send current stock levels to a cloud platform and trigger replenishment warnings when certain thresholds are reached. As a result, Assembly Fasteners now possesses real-time inventory data which is used to fill all smart bins with the correct amount of material in a single visit. Furthermore, the connected system reduces overall inventory levels while ensuring smooth picking operations at the manufacturing lines. This also helps Assembly Fasteners avoid contract penalties that sometimes occur if items are not available at the customer sites.

3. Remote service

Remote service refers to the use of Industry 4.0 technologies to provide remote troubleshooting and optimisation services to customers and maintenance personnel. OEMs such as Heidelberg are realizing new revenues by offering an increasing number of connected services to their customers. Other companies, such as thyssenkrupp, are utilising augmented reality (AR) technology to increase the productivity of their field service technicians. Remote service will continue to be a popular I4.0 use case as OEMs look to increase service revenues and the cost of connectivity continues to fall.

Traditional methods

- On-site field service personnel directly connected to assets needing service
- Limited visibility to operational data once manufactured products are deployed in the field

Industry 4.0 methods

- Remote field service personnel and subject matter experts digitally connected to assets that require service or performance optimisation
- Visibility of operational data of manufactured assets through internet connectivity

Case Study: Heidelberg uses remote service to reduce costs & offer new services

HEIDELBERG

Industry 4.0 Technology: Connected Industry
Heidelberger Druckmaschinen AG
www.heidelberg.com
Heidelberg, Germany
11,000+ employees

Improvement: Lowered Costs, Increased Revenue

Heidelberg introduced eCall in 2008 to connect its printing machinery to the internet and offer new remote services. The remote service is offered at no charge during the first year after the machine is sold as part of the warranty programme. By including eCall for free during the first year of the warranty customers were more likely to pay for eCall after the one-year period expired.

With eCall, the machinery automatically contacts the service team at Heidelberg when a fault occurs. Thanks to the remote connection, service engineers can log into the customer's systems and quickly provide targeted support. This approach has reduced the response time by 50% and dramatically reduced the number of on-site service calls since approximately 70% of electronic problems and about 90% of software problems can be solved remotely. If a remote resolution is not possible, a diagnostic function ensures that the correct spare parts are brought on-site for the maintenance.

Conclusion

Industrial connectivity architectures will continue to evolve as manufacturers and OEMs learn how to use data and remote connectivity to improve their operations and provide differentiated products and services. New industrial use cases will emerge as technologies such as 5G, artificial intelligence (AI) and low power wide area networks (LPWAN) mature and gain market traction. Prudent manufacturers and OEMs will keep a close eye on these new technologies and the subsequent use cases they enable while remaining hyper-focused on achieving specific outcomes that deliver a high ROI. For more information on industrial connectivity architectures check out our Industry 4.0 and Smart Manufacturing Market Report at: **www.iot-analytics.com**

About IoT Analytics

IoT Analytics is a provider of market insights for the Internet of Things (IoT), M2M, and Industry 4.0. More than 40,000 IoT decision makers rely on our data-driven market research every month. Our products and services portfolio includes free insights on IoT markets and companies, focused market reports on specific IoT segments and Go-to-Market services for emerging IoT companies.

IoT Analytics is a leading IoT market research and industry analyst firm, focused on the Internet of Things (IoT), M2M, and Industry 4.0. Our aim is to bring you the best and latest market insights around the IoT ecosystem so that you can better understand IoT markets. While we monitor the general technology business environment and general trends around digital transformation, most of our work is focused on the analysis of IoT markets and IoT companies.

www.iot-analytics.com

IOT ANALYTICS