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Liberating Data from the Factory with Industrial IoT Gateways

Intel's Cyclone V SoC – based EXOR multiprotocol Industrial Internet of Things (IoT) gateway with cloud connectivity accelerates transformation to smart and connected Industry 4.0

EXOR

Introduction

Industry 4.0 and evolution to Smart Factories promise to bring immense business benefits by improving energy consumption, productivity and throughput, quality, reliability and uptime, and creating new business models. These improvements are derived from the analysis of data, but this data is often not easily available. For a variety of reasons, the data is either not exposed by the machines in the factory or is not accessible by the higher-level edge analytics devices. The Cyclone® V-based EXOR eXware 707 series multiprotocol IIoT gateway provides connectivity for both brownfield (existing) and greenfield (new) devices by facilitating the consolidation of data from varied industrial communication protocols, enabling cloud connectivity, and performing edge analytics. This allows factories and other installations to be digitalized, freeing the valuable data and enabling the benefits to be realized.
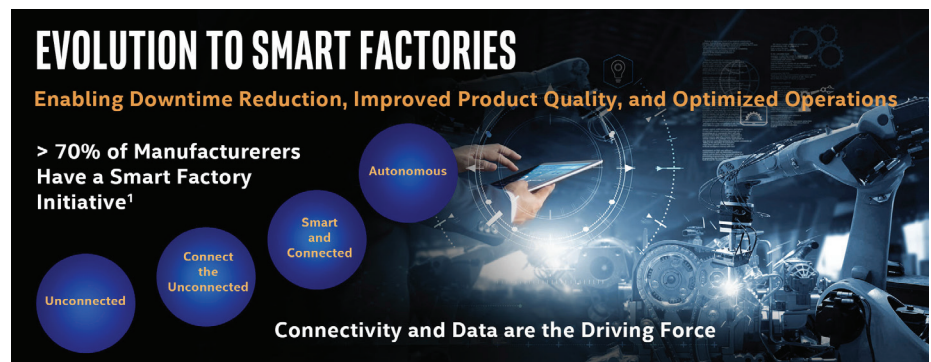
The EXOR multi-protocol IIoT gateway with cloud connectivity presents a unique value proposition for factory owners to achieve the above improvements through data analytics, while providing the time-to-market advantage, easy deployment, and a secure solution. It brings convergence to the previously siloed Operational Technology (OT) and Information Technology (IT) domains. The solution can be easily deployed to connect the factory floor to the Cloud without the need for complex programming or hardware configuration.

Intel® SoC provides a unique advantage, combining the software programmability of a CPU with the flexability of the FPGA fabric to deliver the required determinism, low latency, security, and flexibility for such an Industrial IoT gateway. In many Industrial applications, low latency and high determinism are critical, and the FPGA is well suited to meet those requirements. While leveraging the benefits of using an FPGA, the solution abstracts the complexity of programming. The easy-to-use JMobile configuration tool enables deployment with minimal effort and makes it easy for Machine Builders to connect machines, collect data, and compute for insights. This allows them to spend more time innovating in their area of expertise, leaving the complexity of IoT data collection and cloud connectivity to this solution.

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EVOLUTION TO SMART FACTORIES
Enabling Downtime Reduction, Improved Product Quality, and Optimized Operations

> 70% of Manufacturerers Have a Smart Factory Initiative[1]

Unconnected · Connect the Unconnected · Smart and Connected · Autonomous

Connectivity and Data are the Driving Force

Note 1:   Source: www.capgemini.com/wp-content/uploads/2017/05/dti-smart-factories-full-report-rebranded-web-version_16032018.pdf

Business Challenge

Industrial manufacturing is undergoing its fourth revolution, Industry 4.0, where digitalization and connectivity are enabling a path from smart manufacturing to intelligent factories with greater machine automation and agility. The IIoT is extending the benefits seen in the transformation of IT to the OT – adding intelligence to manufacturing equipment, processes, and management. Smart manufacturing solutions use connected sensors and devices at the network edge to improve machine and human performance in real time, while passing data on to on-premises data centres or the Cloud for deeper analysis and insight.

The benefits of this transformation include:

- Reduced energy consumption
- Increased productivity and throughput
- Improved production quality
- Higher levels of reliability and uptime
- Creation of new business models based on data collection

These advances are enabled through access to data from which insights can be gleaned and actions instigated. However, this data is seldom available – typically it is siloed inside of machines and on networks that use special proprietary industrial protocols. Often a single machine could contain many of these networks with different protocols.

Machines in brownfield installations may have many years of useful life remaining but lack the necessary connectivity. There is a need for non-invasive solutions to connect and digitalize this legacy equipment, so that the benefits can be realized without the cost of replacing these machines or upgrading their controllers.

Solution Value

The EXOR eXware 707 series field gateway is such a solution. This device acts as a bridge between the OT and IT, enabling bi-directional communication. The gateway acquires data from endpoints in the factory and relays this for processing and analysis. It also receives commands from the factory data centre or Cloud and converts these into control actions at the endpoints. These endpoints can be sensors, input/output (I/O) devices, programmable logic controllers (PLCs) and other machinery controllers.

Key values of this solution:

- Deterministic connectivity with flexibility
- Complete, out-of-box, ready to deploy
- Reduce deployment time with wireless connectivity and compatibility with legacy equipment
- Ease of use and configuration
- Scales easily with plug-in modules for system expansion
- Improved security with secure Cloud connection

Solution Architecture: Cyclone V SoC-Based EXOR eXware 707 Series Gateway

- Cloud connectivity: EXOR Corvina and public clouds such as Amazon Web Services (AWS) and Microsoft Azure
- AWS IoT Greengrass Qualified
- Supports many network stacks and offers local I/O expandability
- Secure communication (HTTPS) based on TLS
- Configurability through a web browser
- SoftPLC compatible with CODESYS V3
- OPC-UA Pub/Sub over TSN

The gateway supports 200 Industrial Ethernet and Fieldbus protocols, enabling communication with endpoints from all major manufacturers, so allowing the vast majority of machines to be retrofitted. IT interface support enables seamless integration with software (including legacy systems such as SCADA and production planning) and major cloud service roviders (CSPs) including AWS, Google Cloud, IBM Bluemix, and Microsoft Azure.

The gateway can perform pre-processing of data and can trigger alarms if parameters are outside of acceptable limits. A built-in IEC 61131-3 PLC (Codesys) can be enabled for real-time control at the network edge with IT connectivity, facilitating machine-to-machine control.

It is designed for industrial use, supporting 24/7 operation, extended temperature ranges, IP20 protection, and worldwide certification. It has a compact form factor and is DIN rail mountable.

EXOR JMobile software facilitates easy configuration of the complete functionality of the gateway, including locally hosted dashboards. EXOR Corvina Cloud enables remote management, analytics, and live cloud dashboard. It is cloud neutral and can be hosted on-premises.

Figure 1 illustrates the gateway connection into the OT. The controller in Machine 1 can be configured to connect directly to the gateway. This is not the case for Machine 2, where the gateway must be connected into the internal networking of the machine to intercept data. The gateway's built-in controller is configured to connect the two machines together, allowing information from one to be used to control the other. An additional sensor is also shown above Machine 2, this could be added into the machine (e.g. a vibration sensor attached to a motor), or in the factory environment (e.g. a temperature or humidity sensor).

In Figure 2a and Figure 2b, the gateway is shown connected into an on-premises data centre and the Cloud. In practice, a combination of these two approaches may be taken.

Use Cases

Reducing Energy Consumption with Equipment Monitoring and Control

The EXOR gateway is being used by manufacturing consultants to monitor and control the state of machines in customer's production lines. In addition to improvements in reliability and productivity, a significant reduction in energy consumption is achieved, realising a return on investment in only three months.

Increasing Uptime through Predictive Maintenance

A leading manufacturer of automatic bar feeders used the gateway to produce the first Industry 4.0 enabled bar feeder. Data collected from the machine is transmitted to the cloud for analysis, identifying when maintenance is required and increasing uptime.

Improving Productivity with Insight-Driven Decisions

Lean manufacturing consultants are using the EXOR gateway to digitalize brownfield factories to improve their operating efficiency. Data can be automatically acquired directly from the production line, recorded, and managed. This facilitates enhanced data quality and freshness and minimizes manual intervention. It can be integrated into legacy production management systems and analyzed to derive insights that can be used to improve productivity.

Quality Improvement by Equipment Monitoring

The gateway is being used by machine builders to digitalize their machines, collecting process parameters that can be analyzed to yield improvements in the production quality achieved by their machines.
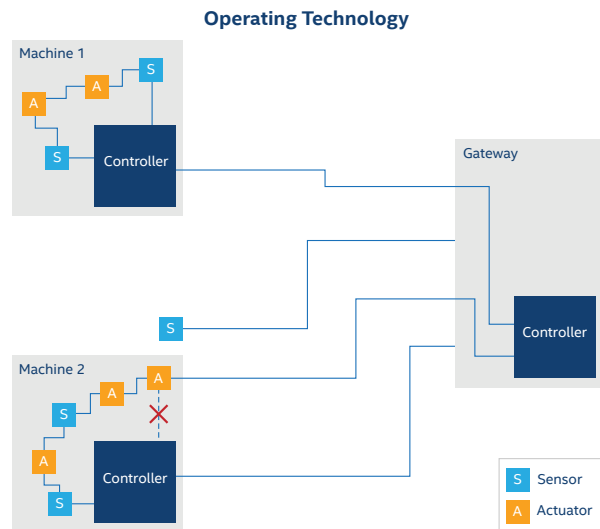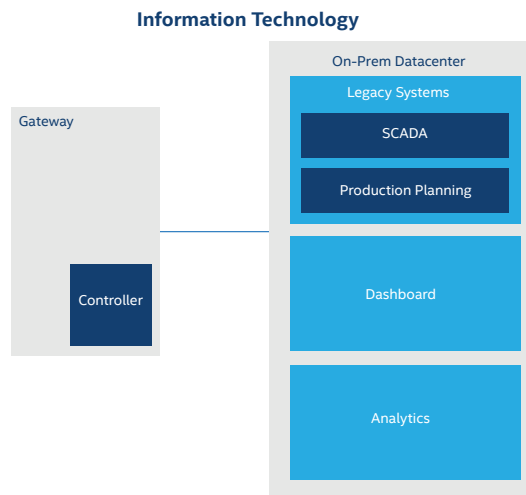

Figure 1. The Gateway Connection into the OT

Figure 2a. The gateway connection into the IT with on-premises data centre. Legacy systems, such as SCADA and production planning, can be integrated, and new applications like dashboards and analytics added.
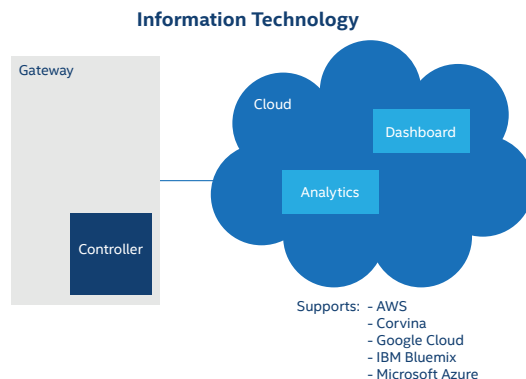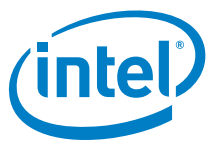

Figure 2b. The gateway connection into the IT with cloud hosting of applications (e.g. dashboard and analytics).

Summary

The EXOR eXware 707 series field gateway enables retrofitting of Industry 4.0 technology to brownfield factories, facilitating significant improvements in energy consumption, productivity and throughput, quality, and reliability and uptime.

The gateway is available from EXOR as a production-ready solution with the necessary firmware and software tools. It is recently released as a fully approved Intel RFP Ready Kit (RRK), which is available at www.iotgresources.intel.com.

For additional information, please contact EXOR or Intel technical sales specialists.