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INDUSTRIAL IOT AUTOMATION:
UPGRADING SCADA WITH IOT

Introduction

Adoption of field management systems — also referred to as supervisory control and data acquisition systems, or SCADA — has exploded as enterprises seek solutions that allow legions of field devices to be configured, maintained, and diagnosed from a central location. In fact, according to Verified Research, the Field Device Management Market size was valued at USD 1.24 Billion in 2020 and is projected to reach USD 1.82 Billion by 2028, growing at a CAGR of 4.88%.[1]

Users across industries like energy and utilities, oil and gas, metals and mining, and chemicals and pharmaceuticals are utilizing smart field systems to monitor and control their devices safely and remotely. Legacy protocols can create a reactive and costly framework for any enterprise. But today, using sophisticated field devices like sensors and controls enables proactive and preventative monitoring and maintenance. In the age of mass production and speedy product lifecycles, sensor-based automation is crucial for optimizing assets already installed in the field. An increase in adoption of these field management systems has caused a drop in legacy technology use and a massive uptick in automation and Internet of Things (IoT) technology. In the Industrial IoT (IIoT), new technologies are ever more robust to manage challenging conditions, while supporting the demand for extended communication range.

Legacy Industrial Solutions

Current legacy protocols simply cannot keep up with the rate at which the IoT landscape is evolving. Modbus may come to mind when you think of "legacy" IIoT technology. Created in the 1970s, Modbus is the most highly deployed Industrial IoT protocol on field devices like machinery, actuators and sophisticated sensors.

While this protocol offers attractive features such as no licensing fees and easy deployment, Modbus comes with a number of limitations and security vulnerabilities. With a few exceptions, Modbus is limited to how many devices it can address on one data link and is limited by polling of slaves. Another challenge of the Modbus protocol has traditionally been a lack of security from outside data exploits. With cyberthreats increasing constantly, it is critical to leverage smarter and safer systems to connect your IoT devices and your enterprise's application platforms.

Challenges with Industrial IoT Deployments

Where does this leave automation engineers taking on enterprise-scale IIoT projects? The most common barriers to starting IIoT projects or converting to a new system are cost, security and complexity.

- **Cost:** Two of the biggest challenges that companies face when starting an IIoT project are monetary and time costs. Traditional SCADA systems are very expensive and take months to configure for a company's specific needs as well as the added time of site deployment.

  When switching to a new system or software package, preparing for a learning curve and employee training time is inevitable. But choosing to stay with an insecure or outdated system will cost a company more in the long run for not meeting changing business requirements. Legacy systems were designed with the tools available at the time. Modern software comes with tools that can help companies build more intelligent future-proof solutions that offer excellent ROI over time.

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[1] Field Device Management Market Size And Forecast
https://www.verifiedmarketresearch.com/product/field-device-management-market
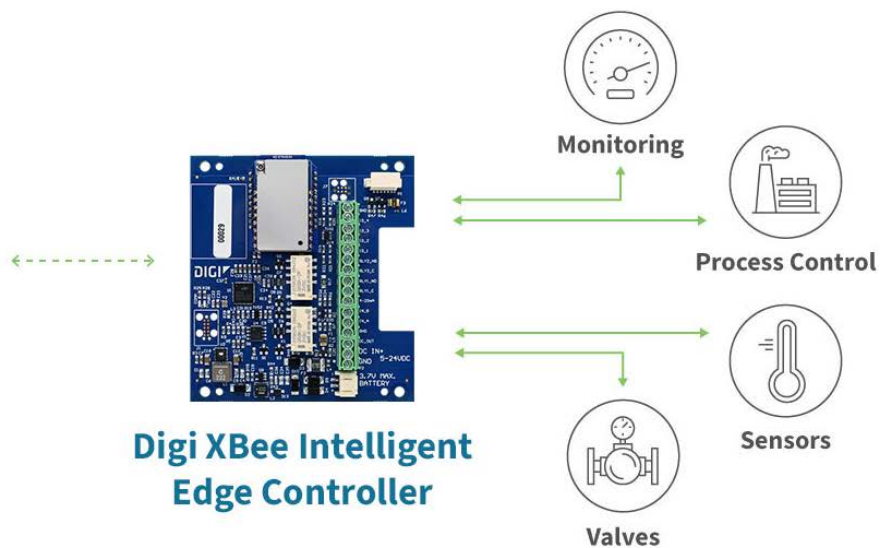
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- **Security:** Traditional SCADA systems typically require a lot of middleware such as gateways, software, and licenses. The more middleware involved, the higher the risk of data accessibility, and thus, a higher risk of a security breach. Industrial IoT protocols added security as an after-thought and often have none of these features enabled.

- **Complexity:** A combination of complex technology infrastructure, communications infrastructure, and immature IoT standards creates a perfect storm for automation engineers. Additionally, standard SCADA and PLCs often require high network bandwidth and cloud capacity to provide sub-second monitoring.

Digi XBee Intelligent Edge Controller vs. SCADA

The Digi XBee® Intelligent Edge Controller (IEC) system brings together a networking architecture that closes the gap between field devices and the cloud to provide powerful asset monitoring and control.

- **Seamless integration:** The Digi XBee IEC system is compatible with 90% of the existing industrial sensors and machinery. It enables long-range wireless monitoring and control of your industrial assets. The Digi X-ON cloud solution also converts complex IIoT protocols into simplified data APIs so communications can be disseminated easily to other tools and systems.

  - Retrofit or new install

  - Compatible with RS-485 and 4-20 mA sensors and controls

  - Sub-second alarms and events

- **Wireless connectivity:** Long Range Low Power Wide Area Network (LoRaWAN) technology has become the fastest growing IoT connectivity standard and is fully supported by Digi's X-ON platform. Digi's Low Power Wide Area Network (LPWAN) systems provide extended wireless range compared to traditional monitoring systems like mesh or Wi-Fi. Whether your company requires a new deployment or a retrofit, Digi can address your needs.

- **Cost-effective:** Tracking an entire supply chain of warehouses, distribution centers and manufacturing centers can be cost-effective when using Low Power Wide Area Network systems. Avoid installing expensive copper for new installations and wirelessly manage remote assets over multiple miles.

- **Short deployment time:** What if your field deployment time could be reduced by 95% over traditional SCADA and PLC deployments? Legacy SCADA systems have a large footprint and can take multiple months to properly configure and deploy on site. Digi's systems can be deployed on site in mere minutes, followed by remote, ongoing configuration. The key to shorter deployment times is simplified cloud/mobile-based provisioning and deployment testing.

- **Top-of-the-line security:** IEC systems are built with Advanced Encryption Standard (AES) security, so your company's data is safe from outside interference. Edge computing features create a defined separation between data generated at the edge and data generated in the cloud. This separation reduces the risk of security breaches during the transfer of data.

Digi X-ON

Digi XBee Intelligent Edge Controller

Monitoring

Process Control

Sensors

Valves

- **Improved efficiency:** Digi XBee IEC edge compute technology improves responsiveness and capacity of your IIoT systems. Distributed agents monitor assets for faults and changes in real time, adjacent to the asset. This proximity eliminates most of the bandwidth and connectivity requirements that come with traditional SCADA systems. The numbers speak for themselves: bandwidth and storage efficiency is improved by >99.7% with Digi XBee IEC solutions.

	Traditional SCADA Systems		Digi XBee Intelligent Edge Controller
Capacity	Polling interval	15 min	0.1 seconds (or user-defined)
	Message size	100+ bytes	11 bytes
Network	Cost	Fiber/LTE ($$$$$)	LPWAN ($)
	Traffic	High	Low (99.99% reduction)
	Security	TLS	AES encryption and rotating keys
Operational Benefits	Detection speed	Delayed	Rapid (sub-second)
	Polling method	Static polling interval	Dynamic polling interval (on demand/rule-based)
	Configuration	On-site only	Over-the-air (OTA)
	Deployment staging	Required	Not required
	Installation	Large and complex	Small and simple (scan and go)

- **Sub-second notifications:** SCADA systems and PLCs require massive network bandwidth to provide sub-second monitoring needed to build a proactive environment. Meanwhile, Digi XBee IEC brings sub-second notifications and control to the sensor and gateway level empowering sub-second monitoring at a fraction of the cost and bandwidth of centralized SCADA / PLC systems.

- **Edge computing:** The Digi X-ON platform provides edge computing capabilities to improve monitoring and alarm reporting. The major benefit is increased network efficiency by only transmitting valuable information. An example is shown below where the Digi XBee IEC or gateway can run intelligent edge rules to operate cloud-independent process control using wireless sensor input and wireless actuator control. When sensors and control devices are connected via a single IEC, this can be done locally. When sensors and control devices are far apart, intelligent edge rules can be implemented on the gateway.

Digi XBee IEC System in Action: Case Study 1

Digi's system can empower enterprises across numerous industrial use cases. Here are a few highlights of what the Intelligent Edge Controller system can do when deployed in verticals such as energy and utilities, oil and gas, metals and mining, and chemicals and pharmaceuticals.

Off-shore Oil and Gas Test Wells

Problem: An oil and gas company had a single-staffed offshore platform with 22 surrounding unmanned platforms up to 20 kilometers away that needed to schedule production testing for their government regulatory agency.

Approach: Digi stepped in to develop a system for offshore oil and gas production. Digi XBee IEC was the smallest, lowest-power option at the time. Using Digi X-ON, the test procedure workflow was fully automated. Each IEC connected 11 different industrial control and monitoring devices, including actuated valves.

Benefits:
- Retrofit to existing equipment
- Long-range secure wireless
- Real-time monitoring and control of pressure sensors and actuators
- Simple installation
- Dramatically reduced on-site visits
- Real-time detection of equipment failure or issue

Digi XBee IEC System in Action: Case Study 2

A city in the north Dallas-Fort Worth area required a new solution to provide monitoring and control of water towers and multiple pump stations. Digi XBee IEC was retrofitted to the existing system to provide remote monitoring and control, as well as important historical data of the water usage information for regulatory reporting.

Smart City Water Management

Problem: For a water tower and pump deployment, a city needed connectivity to two water towers and four pump locations that would provide monitoring and control functions. The city also needed a basic dashboard for monitoring, control and historical data.

Approach: Digi developed a system for the city that was robust in connectivity and monitoring features, but with an interface simple enough for non-technical city employees to gather and understand data.

Benefits:
- Converged utility network with multiple services
- Automated water level/pump process control
- Extended pump lifetime and reduced electricity consumption
- Real-time monitoring and control of water system status
- Real-time alerts and notifications
- Historical data for compliance reporting

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within seconds. This is particularly important for measuring the impact of weather, fires and accidents often before an outage even occurs in an electrical transmission network.

- Previously not commercially feasible with SCADA or legacy O&M systems deployed in high-value utility operators' active stations.

Digi XBee IEC System in Action: Case Study 3

The electricity transmission grids are increasingly becoming the primary source of energy for transport, industry, commercial and retail as the economy decarbonizes. The increased demands on reliability are in stark contrast to the challenges in the industry of remote, inaccessible infrastructure, increasing natural disasters and an aging workforce.

Electrical Grid Smart Operations

Problem: Traditionally, the electrical grid infrastructure is managed annually or on a post-incident, reactive basis. The addition of Industrial Internet of Things (IIoT) monitoring using Digi XBee IEC is revolutionizing electricity infrastructure, operations and maintenance. The goal of smart grid operations is to increase reliability of the grid through proactive and reactive monitoring of the underlying infrastructure on a continuous basis.

Approach: Digi XBee IEC is being deployed for real-time monitoring of electrical towers using maintenance drones. This makes it possible to perform upgrades and maintenance without switching off power or using expensive equipment and personnel, which saves costs and prevents loss of revenue.

Benefits:

- Integrated real-time sensing to monitor and report on tower angle, vibration and shock in real-time.

- Real-time status on towers, allowing utility customers the ability to see where the network is under stress or has failed

Digi XBee IEC System in Action: Additional Use Cases

REMOTE ASSET PREDICTIVE MAINTENANCE —
Automated predictive and planned maintenance for distributed assets using real-time IoT data.

IOT/SCADA UPGRADE —
Suitable for most traditional industrial PLC systems as an alternative to expensive SCADA solutions.

WATER MANAGEMENT —
Water treatment plants currently consume 1% of the United States' electrical grid. Manage and optimize wastewater treatment plants to save power.

OIL AND GAS TANK FARMS —
Monitor chemical or feed levels in tanks in real time.

UTILITIES —
Monitor remote assets, networks and tank levels in real time for optimized maintenance response and reduced site visits.

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Why Digi?

Digi is a complete IoT solutions provider, supporting every aspect of your project, from mission-critical communications equipment to design and deployment services to get your application designed, installed, tested, and functioning securely, reliably and at peak performance.

Digi builds its products for high reliability, high performance, security, scalability, and versatility so customers can expect extended service life, quickly adapt to evolving system requirements, and adopt future technologies as they emerge. Digi embedded modules, routers, gateways, and infrastructure management solutions support the latest connected applications across verticals, from the enterprise to transportation, energy, industrial and smart cities use cases.

Our solutions enable connectivity to standards-based and proprietary equipment, devices, and sensors, and ensure reliable communications over virtually every form of wireless or wired systems. Our integrated remote management platform helps accelerate deployment and provide optimal

security using highly efficient network operations for mission-critical functions such as mass configuration and firmware updates, as well as system-wide monitoring with dashboards, alarms, and performance metrics.

Company Background

- Digi has been connecting the "Internet of Things" — devices, vehicles, equipment and assets – since 1985

- Digi is publicly traded on the NASDAQ stock exchange: DGII

- Headquartered in the Twin Cities of Minnesota, Digi employs over 700 people globally, and has connected over 100 million devices worldwide

As an IoT solutions provider, Digi puts proven technology to work for our customers so they can light up networks and launch new products. Machine connectivity that's relentlessly reliable, secure, scalable and managed — and always comes through when you need it most. That's Digi.

Learn more on our About Digi page.

Contact a Digi expert and get started today

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