Requirements for Enabling the Industrial IoT Edge on Automation Network Infrastructure

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Keywords

Industrial IoT Edge, Edge Orchestration, IT/OT Convergence, Belden

Summary

Customers pursuing digitally enabled business improvement strategies understand the need for deeper and more extensive data connectivity and management throughout the enterprise. Cloud-based solutions for analytics, machine learning, and numerous other applications need data from assets, processes, and personnel, as well as automation and control equipment, in order to generate meaningful business value. This reality has led to widespread industry recognition of the importance of the Industrial IoT edge in achieving desired business outcomes as well as its increasing role as the flashpoint for IT/OT convergence.

Success in implementing industrial IoT edge technologies to achieve business improvements requires careful consideration of core operational requirements. Industrial automation suppliers are responding with solutions that enable customers to take advantage of the benefits of Industrial IoT while respecting the core tenets of the OT environment.

Edge capabilities are necessary to enable the full spectrum of connected products, processes, and services and provide rapid time-to-value for digital transformation applications. Edge devices play a critical role in supporting the OT environment by providing integration with, and insulation from, higher levels of the architecture. The industrial network infrastructure portion of the Industrial IoT edge is the nexus for delivery and, increasingly, conversion of data and information between the IT and OT environments. Success in these endeavors is predicated on balancing the downward trajectory of IT technology with the unique requirements and competencies necessary to maintain the integrity of the OT environment.

Defining the Industrial IoT Edge

The Industrial IoT edge is where physical devices, assets, machines, processes, and applications intersect with the internet and/or intranets. Edge devices provide a broad range of functionality, including ingesting, forwarding, pre-processing, analyzing, and mining locally generated data, as well as device management and centralized application deployment, updating, and version control.

Edge functionality is relied upon for important tasks such as reducing response latency, enabling remote and mobile capabilities, and ensuring operational security. The edge tier can also be used to generate, access, and process data that is too difficult, expensive, or slow to access, or to bypass control system architectures and send data to outside applications. Industrial IoT edge functionality can be integrated into IT devices, network infrastructure, and/or automation devices.

Edge capabilities typically include vertical functionality, such as north and southbound connectivity, as well as ingesting and processing data flowing between the OT environment and higher-level portions of the architecture. Horizontal functionality typically includes the ability to perform cloud-native tasks, such as virtualization and edge container orchestration, independent of the underlying infrastructure.

Ongoing Descent of IT Technologies and Cloud-native Architecture to the OT Environment

Digitally transformed enterprises have more opportunities to distribute functionality throughout the architecture as IT, cloud-native technologies, and IP-based networking descend closer to the edge. Enterprise cloud architectures are likewise descending in pursuit of their primary data sources and to overcome the limitations of cloud execution, particularly latency.

Industrial network edge functionality is migrating from tightly coupled hardware running specific applications to a software-enabled compute destination for a variety of OT applications. Edge orchestration makes it easy to deploy and monitor edge applications and ensures that target hardware meets application requirements.

Descent of cloud-native architectures to the edge has brought improvements in scalability, flexibility, ease of use, self-service, and centralized management, among other benefits. The cloud-native edge and its associated use of containers and microservices enables desirable capabilities such as agile software development, deployment,

management, and scalability, regardless of the target system's network topology, geography, or hardware diversity. Edge software orchestration capabilities make it easy to deploy applications on edge devices, monitor application performance and availability, and ensure that edge hardware meets application requirements. At the same time, standardization on IP-based networks is eliminating the need for hardware-based protocol conversion and creating converged plantwide network architectures.

Industrial Ethernet adoption is one example of where IT technology had to be tailored to meet OT constraints, particularly in terms of performance latency.

As a result, industrial network infrastructure is evolving from single purpose devices to software-defined platforms for IT/OT convergence, edge-to-cloud integration, and edge computing. Incorporation of standard CPUs from ARM or Intel, the Linux OS, and large amounts of memory and storage make them increasingly ideal vessels for low latency OT compute workloads and software-enabled functionality. This exponentially increases vendor and architecture flexibility, while simultaneously lowering project costs, through availability of application-independent edge-enabled hardware and hardware-independent edge software as noted in the figure below.

Industrial Network Infrastructure's Critical Role in Ensuring IT Technology Meets OT Requirements

Introduction of IT technologies into the OT environment is not without its challenges. Initial obstacles include the ability to access, collect, convert, transmit, and secure data from the large installed base of OT assets and processes, some of which have been functioning for decades using an array of legacy proprietary protocols.

The age of the target industrial installed base speaks to one of the first requirements that must be met when implementing IT technology in the OT environment: aligning the often decades-long service lifecycles of industrial assets with the typically short lifespans, and frequent updating, characteristic of IT technology. Pursuit of maximum availability, minimal downtime, and flexibility of operational assets and processes is inherent in the OT perspective and remain primary drivers behind adoption of industrial digital transformation strategies.

Industrial Ethernet adoption is indicative of the need to tailor IT technologies to OT requirements. Standard Ethernet was attractive due to its pervasive

use outside of automation, but most industrial applications required full duplex switched implementations, automation-specific protocols, and industrial form factors to meet automation requirements. Industry now awaits the promise of standard real-time Ethernet via TSN, which will continue to require use of automation-specific protocols in most installations.

As IP-based networks continue their descent in the automation architecture, the industrial network infrastructure portion of the Industrial IoT edge remains the flashpoint for IT/OT convergence, including delivery and, increasingly, conversion of data and information between physical assets and processes for use by digital transformation applications. As descent of IT and cloud-native technologies continue, infrastructure devices are responding by adding edge-to-cloud integration and edge compute to their
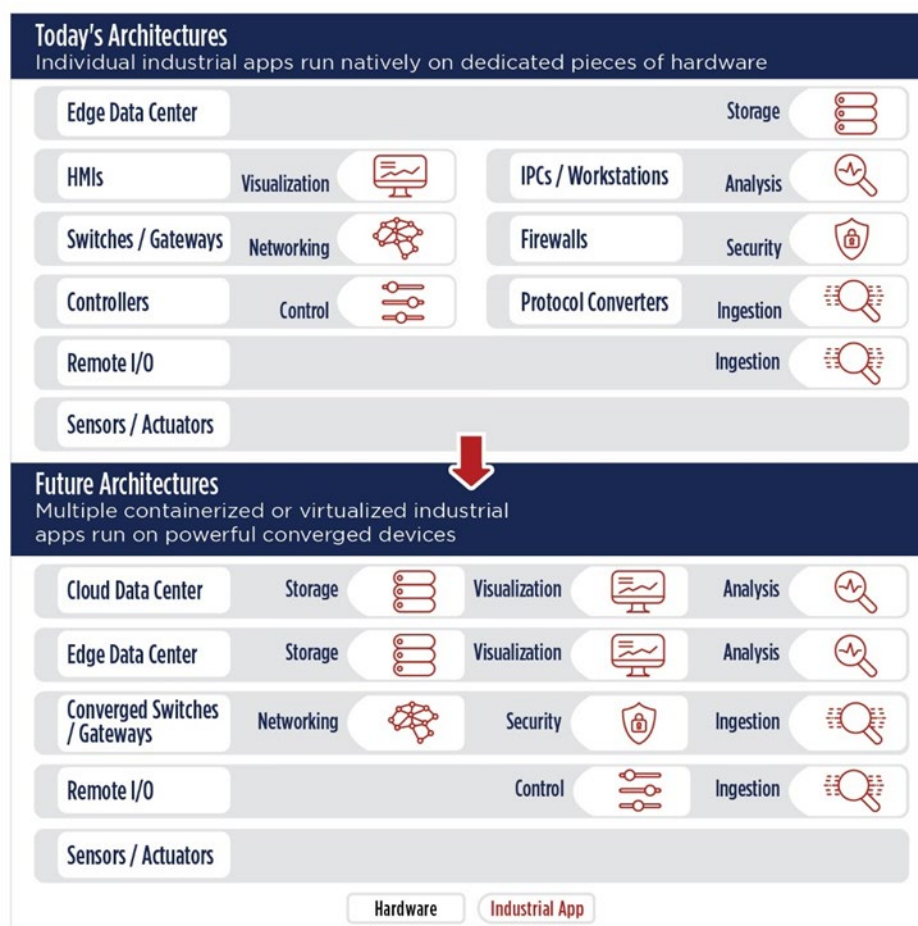
Industrial IoT Edge Architectures Reduce Project Costs and Increase Vendor and Architecture Flexibility through Software-enabled Multi-function Hardware (Source: Belden)

primary role in data communications. Like the experience with industrial Ethernet, attention to the specific needs of automation applications will be required for successful implementation of these technologies in the production environment.

Security Is Paramount

Customer demands for robust cybersecurity defenses at the edge are likewise transforming the role of industrial network infrastructure devices. Networks can provide the first line of defense against external attackers by controlling network access, providing visibility into assets and vulnerabilities, detecting unauthorized devices and messages, and enabling defenders to quickly block suspicious actors and isolate assets.

Current and Emerging Industrial IoT Edge Use Cases

The breadth of the Industrial IoT edge value proposition extends from visualization, monitoring, access, and management to sophisticated edge orchestration and execution of AI, ML, analytical and other applications. These and similar applications require significant data collection, conversion, management, and compute capabilities in a low-latency environment that makes direct integration with enterprise clouds prohibitive from the perspective of both cost and performance. Extensive data pre-processing and reliability requirements, as well as the need for on-prem output, are driving execution of these applications to the edge.

Examples of current and emerging industrial edge use cases include:

- *Connected operations*: using incremental edge capabilities to ensure maximum availability of production assets via reduced or eliminated unplanned downtime, including access and management of remote and mobile installations.

- *Connected products*: embedding edge capabilities in end products to enable remote management, updates, and incremental compute functionality at scale.

- *Connected services*: enabling machine builders, OEMs, system integrators, and other solution providers to build innovative incremental service revenues via subscription-based services and applications.

As these use cases indicate, success in implementing IT-oriented industrial IoT technologies to achieve these ends requires careful consideration of core operational requirements. Industrial network infrastructure suppliers are uniquely qualified to meet these emerging requirements and are responding with solutions that enable customers to take advantage of the benefits of Industrial IoT while respecting the core tenets of the OT environment.
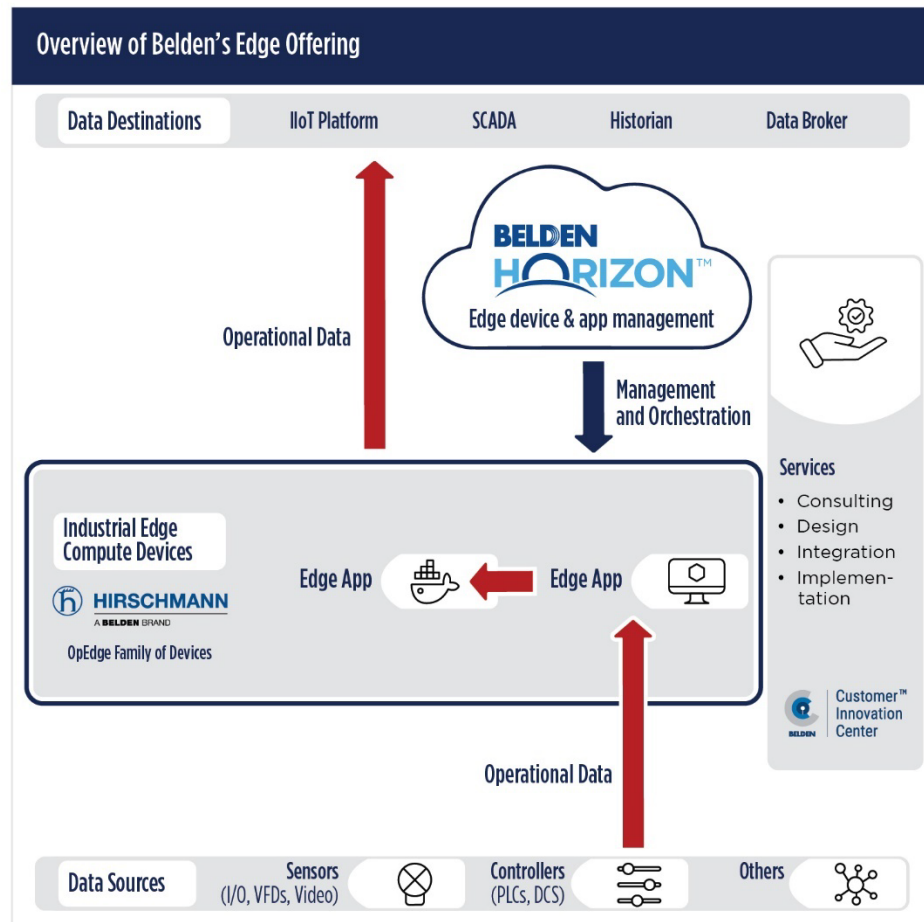
Belden Industrial IoT Edge Solutions

Leading industrial network infrastructure supplier Belden, whose brands include Hirschmann, GarrettCom, ProSoft, Lumberg Automation, Tofino Security, NetModule, Macmon Secure, OTN Systems, and others, has for years been at the forefront of converting standard IT technologies to the OT environment while continuing to meet the mission-critical network infrastructure needs of industrial customers.

Belden's Industrial Solutions build the foundation for real-time decisions, with a comprehensive portfolio of networking, connectivity, and network security products to support industrial networks and ensure the secure transmission of data. With an emphasis on serving the needs of key industrial verticals across discrete manufacturing, process facilities, energy and mass transit, Belden is focused on enabling customer outcomes and solving their biggest challenges.

The company is now introducing comprehensive Industrial IoT edge solutions that respond to evolving IT/OT convergence requirements from an OT perspective. This initiative expands the company's legacy capabilities in moving and protecting data into areas such as network management, security, and edge compute and orchestration to generate meaningful insights for both OT and IT alike.

Belden's Industrial IoT edge solutions include a converged ecosystem of hardware, software, and services designed to deliver useful business outcomes. The industrial hardware provides a runtime for executing virtualized and/or containerized edge applications. Useability and scalability are enabled in an open, multi-vendor environment through cloud orchestration for application and data management, container orchestration and execution,

VM support, low-code visualization, and a catalog of pre-certified applications from leading OT software vendors.

Belden's Industrial Edge Solutions Combine Hardware, Management Software, Edge Applications, and Services to Help OT Users Connect Data from Any Data Source to Any Data Destination
(Source: Belden)

Improving OEE in a Brownfield Plant

Improvement of operational KPIs, such as OEE, is a typical objective for today's digital transformation strategies. Applying the Belden Industrial IoT edge solution can improve these metrics by supplementing existing automation infrastructure with minimal investment and no downtime.

The ability to securely collect, integrate, and generate useful data from disparate OT and IT sources resident on different networks is a core challenge of digital transformation. This task necessitates transforming sensor and other data transmitted via OT protocols, such as EtherNet/IP or PROFINET,

as well as data transmitted over IT protocols like MQTT, so that data from one source can be consumed by the user's preferred ingestion and analysis applications throughout the architecture. In a brownfield environment, this must be achieved by deploying the least amount of new hardware.

The Belden industrial gateway's support for both OT and IT networks enables easy integration with both plant and enterprise networks while providing security for both the attached devices and their networks. Adding the gateway's edge compute capability to the existing installation further enables deployment of incremental edge applications running on either containers or virtual machines.

Applications running on the edge device provide connectivity with both the OT and IT data sources, convert the data into the proper format, and generate conceptualized data capable of being ingested throughout the architecture. This data in turn provides the increased visibility and management capabilities needed to drive improvements in operational KPIs without any disruptions to ongoing operations.

Further information on the Belden Industrial Edge Strategy is available here.

A global team of engineers and consultants are the pillars of Belden's Customer Innovation Centers (CICs), offering technical consulting, project management, service, and support as well as custom solutions for complex customer problems. Learn more by visiting their website: https://www.belden.com/solutions/industrial-automation.

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