How Will the Industrial IoT Architecture Evolve?

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Today, thanks to industrial IoT (IIoT) technologies, companies are already reaping benefits related to production optimization and reduced maintenance costs. As mundane as these benefits may sound, they are driving investments into the IIoT infrastructure. As we look ahead, it's time to assess what shape the IIoT will take as manufacturing becomes increasingly digitized.

A manufacturing process yields high volumes of data that can be tapped to predict faults, optimize equipment lifetimes, derive new revenue streams, optimize the production process to better align with market needs, and more. Of course, for the data to generate these benefits, it must be collected, processed locally in real-time and/or stored offline for later use, and acted upon. What's driving the need for a different type of edge computing device, however, is the need to process the data locally.

In this post, I'll discuss the need and the increasing capability to move data processing to the edge of the network to create a different type of industrial IoT network. Such a network may not possess a strict hierarchy. Instead, it will exhibit a variety of connectivity and processing options amongst many forms of edge devices.

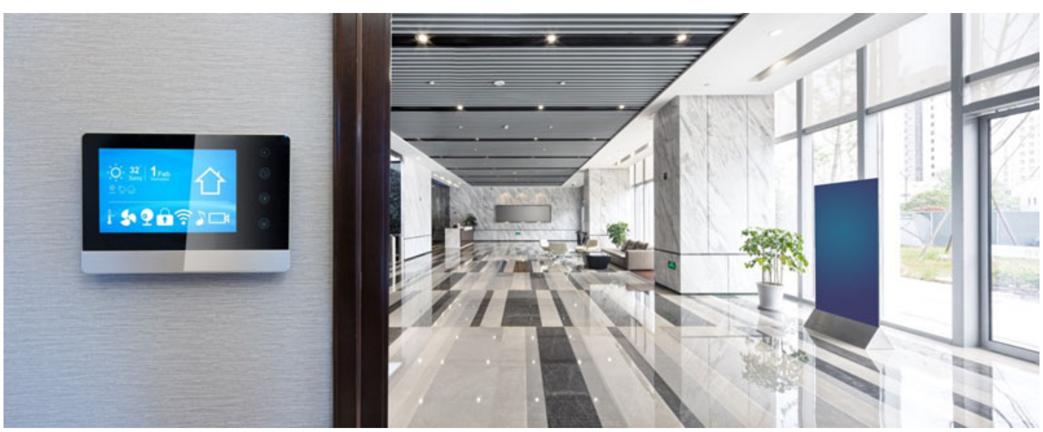

Figure 1. Edge devices used in building control applications (pictured) will vary from those used in industrial processing, precision agriculture, and other industrial applications. As a result, the IIoT architecture will change from the traditional IoT architecture.

Shifting Data Processing to the Edge
We are seeing now, in industrial environments, a shift of data processing to the edge. For example:

- Sensors can accurately measure and log temperature locally, replacing a traditional temperature sensor that trips when the temperature goes above a certain threshold. Such sensors may never communicate with the central control system. But through data comparisons, they can send out alerts for preventative maintenance, having determined that the equipment is showing signs of wear and tear.
- A vibration sensor can continuously record the vibration of a servo motor. Through local fast Fourier transform (FFT) analysis on the vibration data and comparisons of the dominant vibration frequencies, this sensor can flag the controller if the vibration frequency is out of spec.

Another Way to Look at the IIoT
When you look at a traditional IoT architecture, the sensors and hardware are at the bottom. They collect data and send it up the stack to an IoT server or platform. The collected data is analyzed and visualized, and other application development happens on it. The resulting insights can be used to determine whether equipment needs maintenance, to optimize the production process, or for some other action. Figure 2 illustrates this flow.

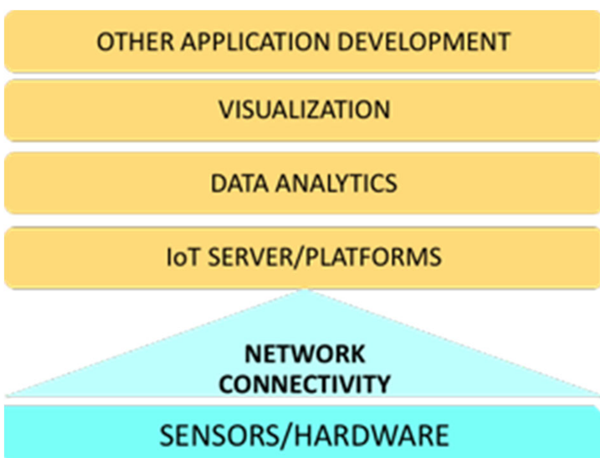

Figure 2. Traditionally Hierarchical IoT Model.

Networks in industrial environments do not fit this flow. For one thing, it’s simply impractical to put a 5G radio or WiFi in each sensor, especially given the harsh operating conditions of some of these environments. Also, most of the real-time data that the sensor collects has value only in that particular moment. For example, when a proximity detector senses that a person is dangerously close to a piece of equipment, it needs to shut off the motor or bring it down to a safe speed. This data doesn’t need to be sent up the stack for a management decision. There are also situations involving bandwidth waste, such as sending second-by-second vibration data via a network. In these scenarios, having a summary report (on the FFT analysis) may be more useful for later analysis. Figure 3 provides an example of an IIoT network.

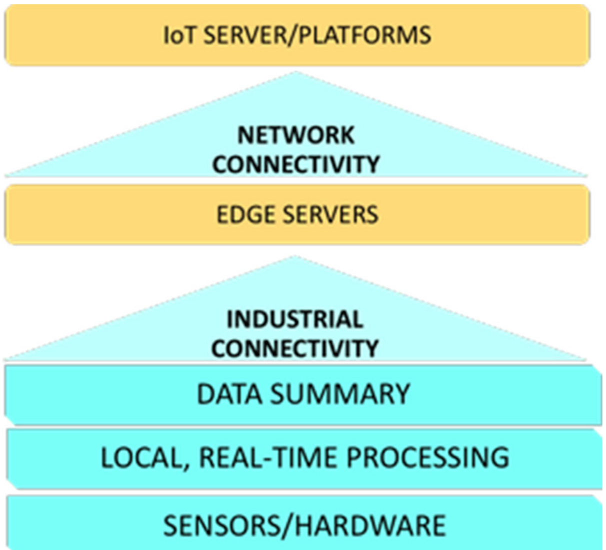

Figure 3. Real-life IIoT network example.

In the example displayed in Figure 3, a lot of the data processing is handled locally; multiple sensor data might be analyzed using edge servers. Rugged industrial networks (such as industrial fieldbus, RS-485, or BACNet) are used instead of a TCP/IP network connection. The summary data is placed on the network from the edge servers. The data is then stored on the IoT servers to be analyzed and visualized and for which different applications can be developed.

Summary

As edge processing becomes more integral in different IIoT applications, the underlying technologies have the common need to meet requirements for small form factor and low power. Aside from these specifications, however, the systems themselves can vary quite a bit based on the purposes and requirements of the end application. Companies that specialize in particular fields will develop edge devices for their areas. As we see more of these edge devices in the field, we'll see how the IIoT architecture will change from what has generally been promoted. Indeed, much of the value will flow from cloud equipment makers to companies that are experts in a particular type of edge equipment for a particular application.