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Smart Edge Gateways for IIoT Applications

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The industrial Internet of Things, the IIoT, is booming. That presents problems for those who manage legacy devices that lack a suitable connection capability. Fortunately, there is a cost-effective solution in the form of an ultra-small industrial PC that acts as an IoT gateway. This approach allows such benefits as communication, big data analytics, and proactive maintenance.

There is clear evidence that the IIoT is rapidly expanding in its reach. For instance, the number of devices connecting to the Internet is growing at 15-20 percent a year and the total of connected objects will reach 25 billion by 2020, according to the research and advisory company Gartner. Another confirming data point is that RNR Market Research predicts that IoT data management demands will increase by 19.3 percent a year through 2022.

There are several reasons for the advance of the IIoT. One is that the cost of connecting a device has fallen, thanks, in part, to the continuing drop in price for semiconductor technology. Another driver for the growth of the IIoT is that a benefit of communication is an increase in available data. This means that manufacturing floors have access to sensor and other data that machines generate. In turn, this allows better decision making about the health of a machine and a process. There can be, for example, big data analytics of a factory, which raises the possibility of tuning production to skew it to higher end output with a resulting lower failure rate. Connectivity also enables two-way communication, with remote access, monitoring and control of manufacturing devices and systems. This could then move a factory from reactive repair method of operation to one of proactive maintenance, resulting in less unplanned downtime, greater productivity and lower costs.

Those benefits, however, run into a stumbling block. According to IMS Research, about 85 percent of devices in use currently are legacy systems and often run stand-alone, isolated applications. Industrial systems tend to have long life spans, with many in use for decades. Thus, many of these legacy systems lack any connection capability, have some sort of proprietary one, or are otherwise unable to link up with the modern IIoT. In the Industrial Internet of Things, communication is typically built on Ethernet and web-derived technologies like HTML5.

To overcome this legacy device barrier, deploy an IoT Gateway. This will serve as a bridge between legacy devices and the wider world of systems, the cloud and the Internet of Things. However, be sure to select one with the right physical and communication characteristics.

The Legacy Challenge

However, before getting into the parameters of an IoT Gateway, first let us look at the nature of legacy systems. Consumer goods have a life expectancy that ranges from at 10 or so years for major appliances and systems down to as little as perhaps 12 or 18 months for mobile technology. Thus, new technology and related standards tend to propagate through consumer goods in relatively short order. That is one reason why some companies are turning to BYOD, or bring your own device, IT strategies. This leverages the latest technology, which workers already possess, without requiring an IT procurement/deployment/support cycle.

Industrial equipment, in contrast, tends to have much longer life cycles. For instance, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the life expectancy of heating, ventilation and air-conditioning equipment is 15-35 years.

A similar difference is found in the information processing space. Processors for consumer products may have a production life span of five or so years. However, processors for industrial systems from major manufacturers have much longer production runs and industrial board makers, such as Advantech, take pains to keep any engineering changes to a minimum. This reduces the high cost of design changes, costly maintenance, and upgrade efforts.

There are good reasons to take this approach. Industrial systems are subject to greater temperature changes, more vibration, increased dust, and other environmental extremes than is the case for consumer applications. Thus, industrial equipment and IT require special qualification and careful design to function. What’s more, these control and automation systems must often carry out tasks in a manner that can be certified to be safe. Once a certification is obtained, there is even more reason not to make changes. Finally, for many applications that are only concerned with machine control, a simpler and less powerful processor may be more than enough, as proven by the still widespread use of 8- and 16-bit controllers in industrial applications.

What this means in the context of the IIoT is that many legacy systems were designed a decade or more ago. While the IIoT was certainly a possibility then, the basics of connectivity, protocols, and programming languages were still being worked out. Consequently, industrial system designers frequently opted not to include any communication capabilities. Doing so simplified the design, saving money and increasing security. After all, a system that is not connected cannot be hacked or otherwise compromised by an outsider.

Those designs and applications that did include a communication capability had to settle on one of several competing approaches that were popular years ago. The choice might be right or wrong in light of subsequent evolution of technology. But whatever the selection was, it constrained the communication channel and capabilities available to the system for the life of its use in the application.

Still, linking these legacy systems to the IIoT would bring substantial benefits. One is that this would break the barriers that separate operational and information technologies. If the connection is done correctly, one result will be the distance between the automation and control systems on one hand and the data analytics packages on the other would be erased. Data could then flow from the factory floor, be analyzed, and appropriate actions and adjustments to manufacturing made. There also could be remote access and monitoring of systems in a plant, leading not only to better control but also better maintenance.

Bridging the Gap

An IoT gateway can overcome the legacy challenge by linking systems on the factory floor with the IoT and on to the cloud. In effect, it supplies the missing communication capability. What's more, since it is a single and separate add-on unit, it can be upgraded and changed out as need be. It also is possible to install such a solution in stages, deploying it first to those systems that provide the greatest return on investment and then rolling it out to others when doing so makes the most sense.

An IoT Gateway, like any communication solution, must be cost-effective. To see why, consider that it will be applied to legacy systems. So, it may be going into situations where the other equipment is substantially or fully depreciated. That helps the bottom line of a manufacturing process but places constraints on any upgrade or add-on. After all, any addition to an existing system could have a significant impact on the bottom line and profitability. That makes it imperative that the IoT Gateway be cost effective.

In addition, a gateway must offer a wide and comprehensive protocol support. As an add-on, a gateway will have to successfully interface with a variety of PLCs and other devices, which may communicate via different interfaces and protocols. The gateway must be able to deal with all of these. The gateway should also handle data acquisition and protocol conversion of the data into an appropriate format.

There is, on one hand, a benefit to increasing computing power at what is the edge of the network, particularly if it can be done without changing the entire structure and architecture of a system or machine. A gateway need not, on the other hand, necessarily offer extensive computing capabilities. This is because heavy-duty analysis can best be done elsewhere, such as in the cloud where compute power can be added on an ad-hoc basis.

An industrial PC can meet these IoT Gateway requirements and satisfy several other important parameters. Critically, an IPC can be both rugged and compact. The first is a necessity because the application is an industrial one, and so any device will be exposed to temperature, humidity, vibration and dust extremes. An IPC is designed and built to work reliably in such conditions.

As for the requirement that a solution be compact, that arises because any gateway will be an add-on to a legacy system. The amount of available space may be very limited, which means that a communication solution should take up as little volume as possible.

A related point is that a gateway must be modular. Given what can be a need to fit into a small and arbitrarily sized space, it may be necessary for a solution to be tailored so that it offers only the bare minimum of functionality. That is easier to do if a gateway has as flexible a form factor and configuration as possible.

Finally, any IoT gateway must provide web and cloud access, as well as offering support for an HMI. The first option is important for any remote access, such as when connectivity from a distance is desired. The second is extremely useful when changes are going to be made locally. Again, a solution based on an IPC can offer such capabilities.

Reaping the Benefits

Advantech's various UNO offerings are examples of such IoT Gateways. This product family includes X86 systems (UNO-2271G / UNO-2272G) as well as others based on RISC and QUARK processors (UNO-1251G and UNO-1252G respectively). These compact designs support 3G, 4G LTE, and low power WAN connectivity. They also offer more than 450 types of PLC and I/O driver support.

When installed, an IoT Gateway makes it possible to acquire, store, filter and analyze the data generated daily by systems on a factory floor. Such information can prove extremely valuable.

Consider, for example, a lathe used to process a metal part or a laser that welds two pieces together. Either machine could tally up how many parts are processed in an hour or a day, how long the operation takes, and various other bits of information, such as a sensor reading as to how successful the material processing is.

This data can be combined with other inputs from machines or systems. These can be earlier in the production process. They also can come in later in the sequence, such as a final quality control sensor and associated QC check.

This information can go through analysis, allowing, for instance, the spotting of trends. One machine may consistently output product that has a greater likelihood of being in spec and a lower chance of being rejected. A second may do just the opposite. Big data analytics can reveal such trends, particularly those that involve interaction between machines or conditions that only arise in specific machine processing sequences. The insights possible with this type and volume of data include determining which machine or set of machines make the best product and offer the highest productivity. Such information, in turn, can lead to better and more streamlined processes, thereby increasing throughput, reducing cost, improving quality and even cutting energy consumption.

Beyond that, more data can improve machine maintenance. For example, linking information on the status of a system with the quality of its output and analyzing this data can uncover patterns that can be used to predict machine health – even if there is not active machine health monitoring going on. These patterns and the associated data could then lead to proactive maintenance, allowing manufacturers to move from a reactive stance in which problems are fixed after they happen to one in which issues are resolved before a machine goes down and product is possibly ruined.

There are many benefits to such a proactive approach. Maintenance can, for one thing, be scheduled in advance and at those times when the impact on output is minimized. It also could turn out that maintenance can be reduced, thanks to only fixing machines when there is a need and not according to some rigid schedule. Finally, the chance that production will be out-of-spec and therefore either reworked or scrapped can be lessened. Together with less unplanned downtime, these benefits can yield a substantial payback.

Conclusion

As pointed out earlier, the IIoT, the Industrial Internet of Things, is growing rapidly, but there is a significant barrier: the substantial number of legacy systems that lack the required connectivity. Since these devices still function and represent a substantial investment, they are not going to be discarded. Therefore, to realize the full benefits of the IIoT, a way to bring these systems into it must be implemented.

That can be done with an IoT Gateway. It must, however, be cost-effective, support a wide variety of connection protocols and standards and provide for remote access, as well as being rugged and compact. An ultra-small industrial PC has the required form factor and can offer the needed capabilities. Deploying such a system, particularly if it is modular and can be rolled out as needed in stages, can be an efficient way to implement the IIoT.

The benefits of doing so include the acquisition, storage, filtering and analysis of data. This information can increase throughput, reduce costs and improve quality – thereby helping realize all that the IIoT has to offer.