Ethernet based instrumentation

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From time to time we have looked at one of the great divides of industrial automation, that of extending Ethernet connectivity below the PLC barrier. While extending Ethernet to a PLC or DCS I/O block is very common, the idea of using it to connect to individual process or discrete sensing devices is relatively rare. But is that assessment changing?

Some suppliers see demand based on customers that are tired of multiple platforms. "The most frequent demand from users is to implement one network for everything in the facility," says Brian Oulton, director of networks business for Rockwell Automation. "When evaluating device-level networks, customers and instrument vendors frequently question and consider many attributes, including cost, use in hazardous areas, choices for media and topologies, and the protocol's robustness. The popularity and volumes of standard, commercial Ethernet, as well as its application into broader industrial application spaces have dramatically driven down the cost of embedding EtherNet/IP into instruments. Now, EtherNet/IP nears the cost levels of traditional process networks such as Foundation Fieldbus or Profibus PA."

> **"Power over Ethernet improvements are coming. The PoE+ standard, which is still in the works, will support 25.5 W and even 40 W power levels, and at least one company has begun manufacturing compliant devices."**

Carl Henning, deputy director, Profibus Trade Organization, has typically suggested using multiple tools for networking applications. Is Ethernet driven instrumentation coming? "The cost does nothing but go down as usage goes up," he says. "It's going to become less expensive and therefore more practical to put industrial Ethernet into more devices. The limits you run up against are either environmental, such as the need for intrinsically safe instruments, or when the overhead associated with Ethernet is simply too much. It's nonsensical to use it to carry a one bit data load."

The question remains, will enough customers demand Ethernet connectivity to motivate instrumentation suppliers to produce it? While Ethernet networking and power over Ethernet (PoE) have spread to end devices in home, office, and commercial environments, industrial applications are still rare. There are several main constraints:

Bandwidth overkill—Most process and discrete sensors do not put out huge amounts of data, so they do not need the kind of bandwidth Ethernet offers. "Ethernet's primary advantage is that it is fast and can move large amounts of data quickly," says Charles Larson, director of

Below left: A data concentrator gathers information from multiple field devices and sends it back on one Ethernet cable. Source: Moore Industries

Right: This device for robotic applications can deliver its data via Ethernet, but it is effectively six sensors in one. Source: ATI Industrial Automation

technology for Moore Industries. "With typical process sensors, such as temperature and pressure transmitters, the data is not changing so rapidly that the speed advantage of Ethernet has any value. Compared to other options such as 4-20 mA with HART, Foundation Fieldbus, and Profibus, Ethernet requires faster and more costly microprocessors to support it. It is also limited to 100 m cable length without repeaters."

Additional transmitter cost—Having that bandwidth requires more sophisticated electronics than most process devices need, and that makes the transmitter more expensive than customers want to pay for. Perhaps the cost differential isn't as great now as a few years ago, but there is still a gap.

Hazardous environment limitations—One aspect that will limit process applications is that Ethernet is not intrinsically safe. More traditional fieldbus platforms such as Foundation Fieldbus and Profibus PA are better suited for those environments.

Appropriate DCS and PLC I/O hardware—Typical control systems, whether in discrete or process applications, do not have appropriate I/O hardware for high populations of Ethernet based devices. While most systems have flexibility to accept many different types of input signals via appropriate I/O cards, there is little capability to accept direct Ethernet inputs when there are hundreds and potentially thousands of field devices. This undoubtedly reflects a lack of demand rather than any particular technical constraint, but it is still a practical problem.

Wiring topology—Ethernet wiring to field devices is similar to traditional analog wiring using a star topology, which is one of the drawbacks when compared to a fieldbus. However, some platforms allow adding a two-port Ethernet switch to each device which facilitates a linear topology of a sort, if latency isn't a serious concern.

Peculiarities of PoE—Historically PoE has not been compatible with industrial devices and available power levels are below typical fieldbus offerings. The conventional wisdom is that devices that generate enough data to need an Ethernet connection, such as process analyzers, usually also need external power. Devices that can run on PoE usually don't need the bandwidth. Beckhoff makes an I/O junction that uses PoE for discrete sensors communicating via EtherCAT. The junction converts normal PoE voltage to 24 V for the devices, but the maximum device power consumption is 350 mA with a total available of 15.4 W.

PoE improvements

PoE improvements are in the works including the coming PoE+ standard. IEEE 802.3at is still a draft, but nearing completion and will support 25.5 W and even 40 W power levels. At least one company, ON Semiconductor, feels

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the standard is far enough along and has begun manufacturing support devices that it expects will be compliant with the final version.

While not used to supply power, there are devices that compile information from a cluster of remote instruments and sensors. A common configuration is an I/O junction that collects data from a group of conventional devices, such as process sensors, and sends the data back on one Ethernet cable. For example, companies such as Moore Industries and Dataforth make remote I/O data collectors that can gather and process information from remote devices and send data back on one Ethernet cable. But these do not power devices using PoE.

All that said, there are Ethernet-based devices available, particularly those with complex output. Analyzers in process applications are a common example. In the discrete manufacturing world, complex sensors such as the force and torque measuring device for robotic applications (see photo) can deliver its output via Ethernet and operate on PoE. The device generates six measurements (force and torque for x, y, and z axis) and is configurable via a Web interface. Compared to a typical process sensor, that is probably equivalent to six garden-variety pressure transmitters.

There is also quiet development going on in a number of areas. For example, one protocol traditionally associated with hard-wired analog devices has expanded to include wireless and soon Ethernet. "The HART Communication Foundation continues to move the technology forward," says Ed Ladd, director of technology programs for the foundation. "We're extending the gateway interface specification to include HART over IP based networks (TCP/UDP). This next step allows a HART enabled device to be built using POE that could be immediately integrated into HART systems the incorporate the HART server technology. This new addition to the standard is complete but still must be approved by the membership."

For the moment Ethernet may still not be a serious contender below the PLC divide, but don't count it out completely.

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