Innovative Insights

Evaluate network plant floor coverage before using Ethernet ❯

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According to industry analysts, numerous business imperatives are driving the convergence of industrial-commercial networks within an enterprise. Uptime and production optimization, product quality, workflow speed and efficiency and customer service demands are often cited. Global competition and dwindling profit margins have precipitated network integration for many manufacturers striving to streamline operations, increase productivity and reduce overall costs.

Just as the adoption of machine control over industrial networks broadened over a period of years, so too is the pool of companies now looking at leveraging the power of Ethernet to gain a competitive edge by linking their manufacturing and business levels.

Network convergence architecture

Network convergence necessitates the integration of the cabling; connectivity; controllers; switches and other components; and the software interface to transmit and mine data between commercial and industrial functions. Benefits derived from convergence depend largely on the network configuration and specific strategies behind a company's decision to integrate a network. In device-level networks, a plant floor controller communicates with devices on a machine using one of several open or proprietary protocols. The trend today is toward implementing Ethernet as the link-layer protocol to one of the legacy protocol applications, and even Ethernet right down to the device level on the machine.

With the right architecture and industrial grade components, Ethernet convergence can offer significant advantages for:

- Enterprise-wide access and increased business intelligence

- Data transmission speed for faster information flow

- Improved energy efficiency and resource management

- Improved equipment performance

- Coordinated monitoring and control for optimized production

Ethernet convergence offers the ability to meet real-time data traffic requirements with proven reliability, security and ease of integration. That is why the trend toward operating on an enterprise-wide technology platform has steadily been growing, especially among larger manufacturers.

Technology, industry in lockstep?

Formerly considered solely as plant-floor functions, equipment performance and production metrics are now widely recognized as important strategic business tools that can help to reduce expenses and optimize uptime. Technology advancements have set the pace, offering network tools to effectively link machine processes, control systems and plant-wide information to the enterprise with unparalleled scalability, functionality and options.

However, technology and industry seldom advance in lockstep. Despite the analyst community's often bullish predictions of an industry-wide shift to commercial-industrial network convergence, the reality is that adoption has been moving at a more measured and strategic pace - and wisely so. In a slow economy, trends are neither swift moving nor obvious.

Nevertheless, it is a fact that plant environments are gradually migrating away from proprietary protocols to the most prevalent current standards: Communication protocols that use Transmission Control Protocol/Internet Protocol (TCP/IP) and standard Ethernet network structures.

Industrial Ethernet uses twisted pair cable, fiber optics, wireless networks and in the future, power-line carrier (Ethernet over the power signal). Common industrial Ethernet protocols, including EtherNet/IP, Profinet and other conforming open systems - are road tested to manage myriad automation scenarios requiring real-time performance and multiple communication channels on the same network.

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TCP/IP, a set of protocols developed to allow computers to share resources across a network, has been widely adopted in commercial offices as a networking standard to enable communication between networks and computers. Multiple computers can use TCP/IP and other protocols on a single local area network with the IP providing routing access to the Internet. TCP/IP facilitates rapid and accurate file transfer and user communications in a commercial network. Plant transmissions occurring via Ethernet and TCP/IP enable ready integration into a common commercial network and office applications.

Plant, enterprise information needs differ

In most cases, industrial network needs to diverge from those of the office suite. At the plant level, process control and automation often necessitate more stringent real-time data transmission rates. In addition to speed, Ethernet is able to span distances and accept more devices without performance degradation seen in prior network technology.

Ethernet is expected to be the mainstream communication technology well into the future, which ensures that the technology will continue to be enhanced and refined. Those deploying Ethernet today benefit from critical lessons learned in the past. Network architecture, security and data management must be carefully planned to work efficiently today and allow for future expansion with minimal integration effort. Another fallacy to be dispelled is that openness always equates with seamless interoperability. Despite the commonality of 100 Mbps Ethernet chips, incompatibility of selected protocol implementations is a reality. An Ethernet I/O label does not mean all products are compatible within the same protocol stack. Interoperability is an important factor that needs to be carefully evaluated.

Getting the right information

Plant floor controllers such as PLCs, PACs and PCs control the operation of and collect data from machines and devices. The right network architecture can effectively link business management to the plant floor PLCs and down to the device level.

However, ubiquitous data transparency can be both empowering and overwhelming. Filtering and selecting data is key to successful network convergence. Various types of executive dashboards and other business intelligence and analysis software applications can focus on key metrics, key performance indicators and other data needed for high-level decision-making.

Fast information flow?

Unlike the delays typically experienced when surfing the web or sending a document to a nearby printer, the immediacy of machine-to-machine communication demands more bandwidth. But the value of speed is relative. With technology advancing swiftly, ultimately, the industry can expect network speeds in the Gigabits-per-second range, which equates to transfer of more data faster.

Data speed alone will not necessarily increase the speed of processes, although near real-time data flow can contribute to greater collaboration and more efficient workflow. The full value of high speed information can be fully realized only when commensurate processes and network components keep pace.

Typically, only extremely rapid manufacturing operations involving motion control and precision automation require bandwidth for high vision, complex movement and algorithms. Ethernet in its simplest form (10-100 Mbps) is usually fast enough for most manufacturing and process applications. Although every plant needs high efficiency in today's world, emphasis should be on throughput rather than speed. For any given manufacturer, the right network structure needs to operate properly at the desired speed to achieve the desired throughput.

Consider these issues

Real-time raw data from the plant typically doesn't reach management level, nor does it need to in most cases. Corporate culture in the past often positioned manufacturing and administration as separate entities with unique environments and objectives. Enterprise-level integration can offer significant benefits to a manufacturer by providing real-time data snapshots or dashboards providing intelligence for diagnostics, quality control, customer service and efficient production planning, scheduling and expediting.

The amount of data that can be transmitted in one packet also makes Ethernet an ideal tool for diagnostic monitoring and troubleshooting. The rising demand for advanced monitoring and plant diagnostics will accelerate data traveling per cycle, which could push speed capacities.

Standard Ethernet is widely touted as non-proprietary and cheaper. In theory, that's true. However, industrial Ethernet components used in plant process areas are designed to operate in harsh environments, withstanding temperature extremes, humidity and vibration well beyond conditions found in controlled environment installations.

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Because they are more ruggedly made, industrial-grade components can cost more initially. However, they are built to perform reliably for a significantly longer service life, so total cost of ownership may actually be reduced.

Extended usage of Ethernet applications from office floors to the factory level requires RJ-45 connectors with an enhanced protection level and a minimum of Category 5e (100 Mbit/s Fast Ethernet) performance. Newer M12 circular connectors are becoming more common in the market in a D Code configuration specific to EtherNet/IP, Profinet, and EtherCAT. Wireless can be used to cover distances and can also be deployed in industrial areas not easily wired. In petrochemical plants, wireless communication is becoming more the norm. Some newer designs are powered by small solar panels. Ethernet will benefit from the advent of new wireless technologies.

Many companies opt to deploy optical fiber technology for harsh industrial applications. Fiber optic cables provide greater speed, greater bandwidth, distance and noise immunity than copper-based cables. Although in most cases, fiber optic system costs are higher and compatibility issues with legacy systems can be problematic, industrial fiber optic cabling solutions may offer the key to data integrity on the plant floor in the future as more companies migrate toward enterprise-wide convergence.

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