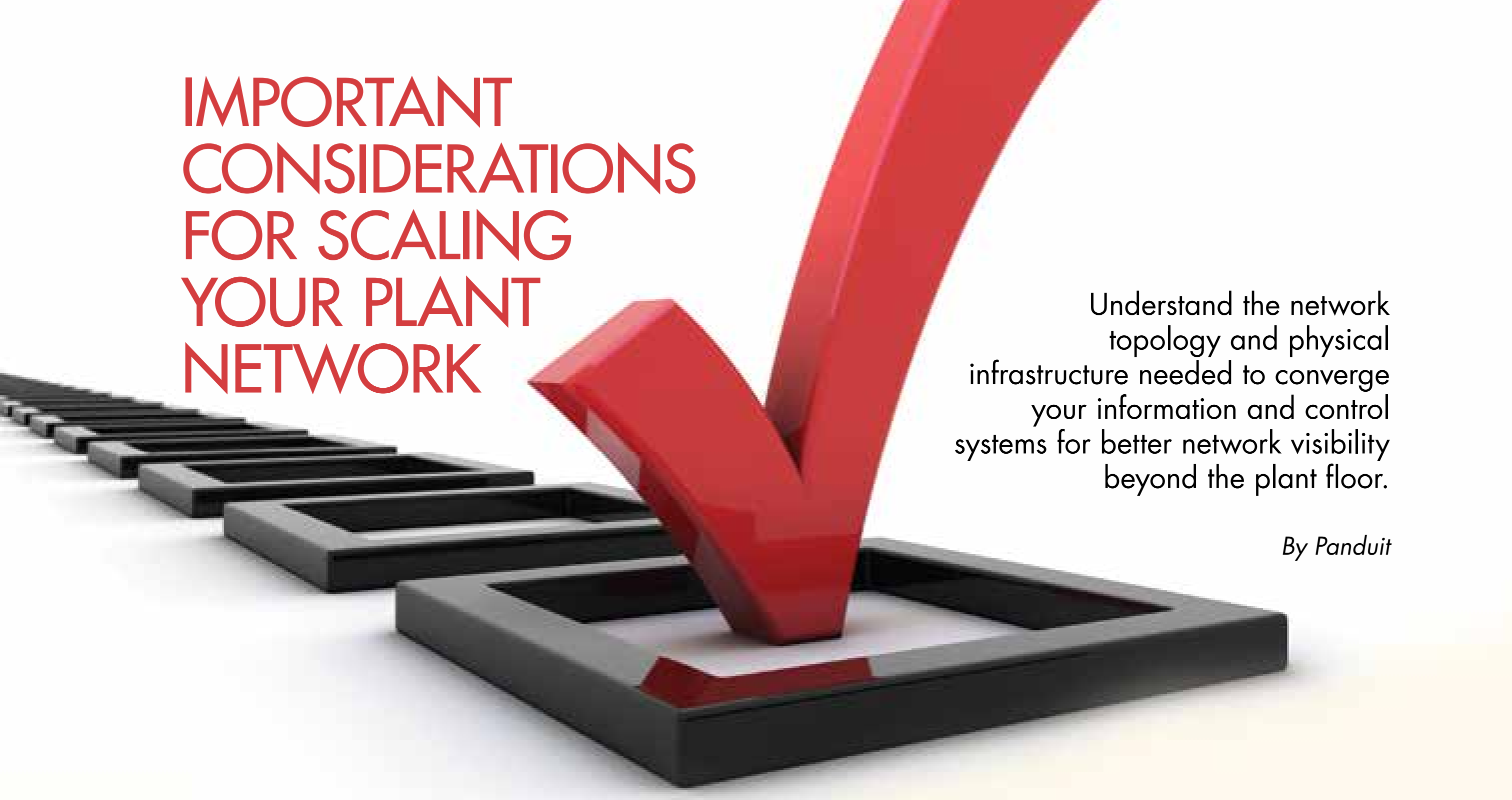
IMPORTANT CONSIDERATIONS FOR SCALING YOUR PLANT NETWORK



Understand the network topology and physical infrastructure needed to converge your information and control systems for better network visibility beyond the plant floor.

By Panduit

Editor's Note: This article is adapted from a comprehensive white paper, "Scaling the Plant Network: An Approach to Industrial Network Convergence." Visit http://goo.gl/YyJAgj to download the free, full white paper with additional information about industry trends and challenges that affect industrial network design; how to deploy a zone physical architecture; total cost of ownership; IP convergence; and zone industrial network topology and integrated solutions.

>> As rapid advancements in networking, computing, data storage and software capabilities increase the value potential of automation systems, controls engineers and IT organizations are pressured to update their plant network architectures with solutions that securely merge information and control data. As a result, the plant networks need to deploy connectivity to automation devices critical to both machine and process line systems while supporting connectivity to nonautomation devices such as wireless access points, digital signage, video surveillance, energy and building automation systems nodes.

To address this challenge, validated architectures and tested physical solutions that integrate information and control systems are growing in importance. This article describes how industrial network deployment solutions can improve reliability and security of automation systems.

Network Architectures

Considering the plant network architecture is important to understand and articulate how and what type of data flows between various nodes within the plantwide network. This helps to optimize the network's efficiency; it enables visibility to potential security flaws; and it can help to provide guidance for how the network can be scaled as the plant expands and as systems are updated. Ultimately, this architecture will affect the physical realization of the network infrastructure.

When considering logical architectures for plant-floor Ethernet deployment, a number of options are available that range from complete separation between different networks to a fully converged plantwide Ethernet network.

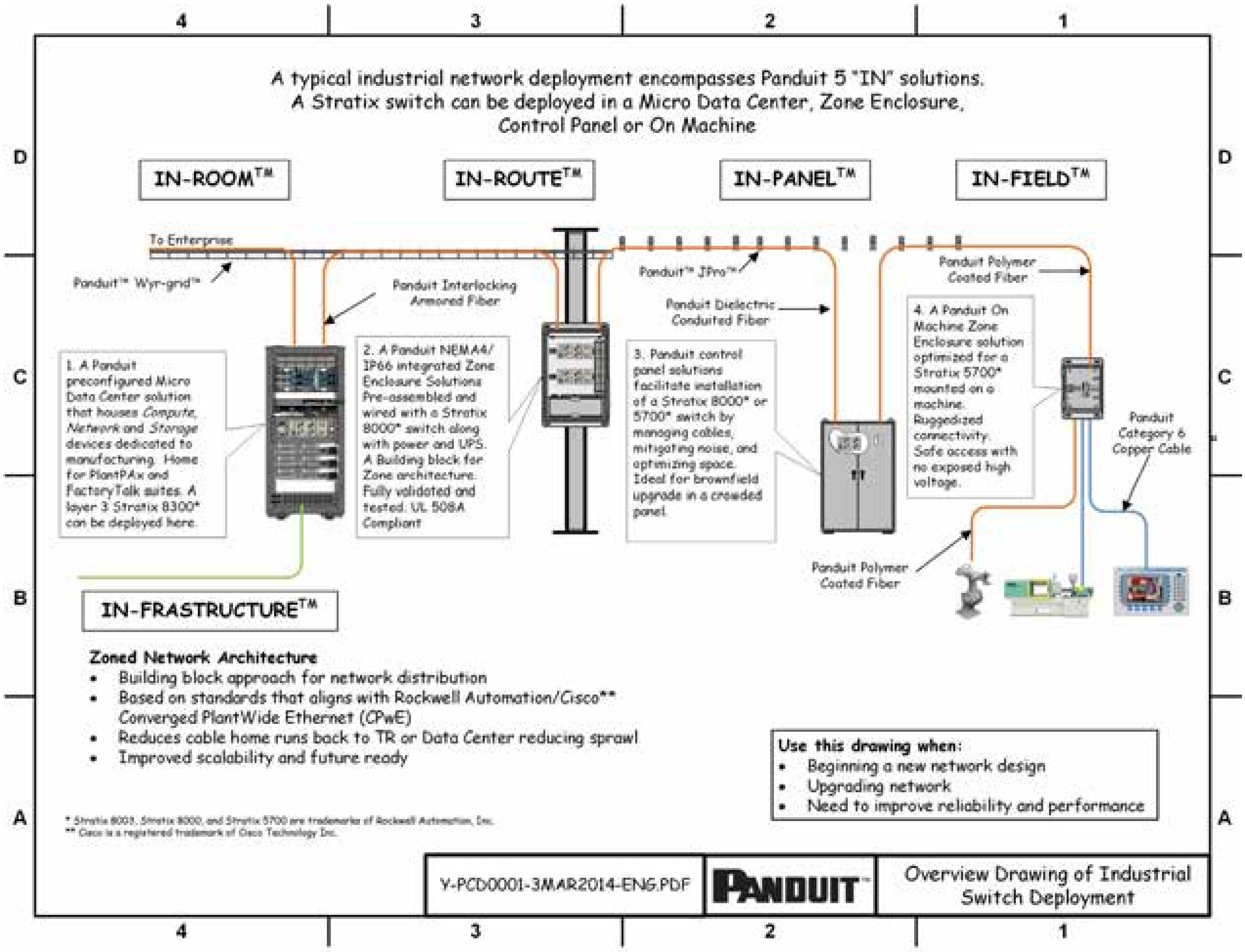
The architecture where networks are separated completely is commonly deployed in a plant environment. In this architecture, networks operate on different hardware and different physical layers, so there is no communication between these networks on the plant floor or in the control room.

This often is selected as the solution for maintaining the security and independence of the manufacturing controls network apart from networks intended to distribute order management, quality and security operations systems to areas within the plant. To maintain consistent separation between the plant floor network and enterprise networks using this architecture, a firewall or alternative gateway that restricts unauthorized access to the control system typically is implemented.

When coupled with a robust physical topology, this option can be a secure method to deploy an Ethernet network for a manufacturing plant. This architecture closely models the historical plant controls networks in which proprietary and enterprise networks were separated, except where custom-designed gateways enabled data sharing between the networks.

This approach becomes challenging because it requires separate server and storage infrastructure that requires its own maintenance. While conceptually simple to plan, it's not scalable and becomes expensive and challenging to deploy, because each new network-enabled system, such as VDI, human-machine interfaces (HMIs) or security video, requires new home run or backbone cabling to deploy.

Besides the increased effort associated with network



A plant network layout using zone architecture reduces cabling installation, localizes network traffic to improve network resiliency, improves capability for network redundancy and reduces cost of future expansion. To learn more about this zone cabling system, visit http://goo.gl/6NSUwV.

installation and maintenance, a key limitation of this architecture is that it restricts the ability to share data between the different areas of the plant network. Given the need to improve operational efficiency and visibility across the enterprise, an effective architecture to securely and efficiently enable integration of data is required. This architecture will simplify the integration effort required to develop reports on operational efficiency, quality and regulatory metrics.

Unified Network

Attempts to converge and simplify deployment of separate networks have taken several forms. One method involves the use of the same fiber backbone infrastructure that operates completely divergent networks. In this network topology, the same physical conduit (or distribution cable) and Intermediate Distribution Frame (IDF) infrastructure is used to deploy two completely separate networks. Therefore, the actual infrastructure and cabling on which the network operates are different, although they're housed in the same conduit and networking cabinets.

Structuring the network this way doesn't allow for efficient switch utilization because separate switches are required to segment functional areas. For this reason, virtual local area networks (VLANs) commonly are used to enable efficient traffic segmentation across a group of Ethernet switches. However, both of these topologies introduce the risk of circumventing plant network security layers through simple cross-patching or other installation errors, which can create gaping security holes in a plant network.

The potential for these security holes has led to the development of a new architecture that addresses security and simplifies convergence within the plant using a standards-based Ethernet network. The Converged Plant-wide Ethernet Architecture (www.rockwellautomation.com/go/tjarch), a logical networking architecture, was developed by Rockwell Automation and Cisco, and extended to the physical layer as described in the *Panduit Industrial Ethernet Physical Infrastructure Reference Architecture Design Guide* (http://goo.gl/RrHo8j).

These resources are proposed as a model for unifying the many disparate plant networks into a single network that helps address the challenges around implementing, maintaining and scaling the factory network. This architecture uses VLANs to efficiently segment traffic across the Layer 2 and Layer 3 network infrastructure. However, all plant control traffic stays below the Demilitarized Zone (DMZ) layer, while any information needed in the enterprise zone is accessed through a server in the DMZ rather than allowing direct traffic between the enterprise and manufacturing computer systems.

The implementation of this architecture has a significant impact on how the physical layer is deployed, because a unified architecture can be deployed on a unified physical layer. A unified physical layer translates into lower total cost of ownership in the implementation of the backbone infrastructure, pathways, equipment frames, computer resources and their associated labor costs.

Expanding a Flat Network

In addition to security, give consideration to planned and unplanned future growth of the network. Each plant environment is different. There may be an opportunity for future greenfield plant expansion at one facility, while another may experience frequent manufacturing line teardown and rebuild, or simply growth of Ethernet-enabled devices organically added to a machine.

Regardless of the type of growth, the plant manager usually will prefer to avoid putting a large down payment on future growth by installing expensive infrastructure that isn't yet needed, choosing instead to carefully consider the structure of the plant network.

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The most important characteristic that will help the future scalability of the network distributed across the plant floor is its topology. A zone network topology describes how managed network switches are distributed across the plant, and is generally contrasted to a flat network in which most switches reside in centralized locations or in control rooms.

The zone layout shown in the **diagram on page 36** distributes managed network switches closer to the endpoint device within an automation cell or process skid. This approach allows the network to follow modular layouts to the plant floor. Therefore, as the plant is expanded, the network infrastructure can grow organically with the plant. Design and implementation of these plant expansions can be simplified by using a building block approach to the network which complements the modular plant layout.

It's About Network Visibility

As rapid advancements in networking, computing, data storage and software capabilities increase the value of automation systems, engineers are under pressure to refresh machine and plant-wide system designs with solutions that merge information and control data. To address this challenge, validated architectures and tested physical solutions that integrate information and control systems are growing in importance.

Network convergence is about understanding the trends, challenges and opportunities around the needs of an Ethernet network being distributed to the plant floor. Developing visibility to the network beyond the control room and across the plant floor requires you to view the network differently. □

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Based in Tinley Park, Illinois, Panduit is a Rockwell Automation Strategic Alliance Partner. The company provides solutions that help customers optimize the physical infrastructure through simplification, increased agility and operational efficiency, including the company's Unified Physical Infrastructure℠ (UPI)-based solutions.

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