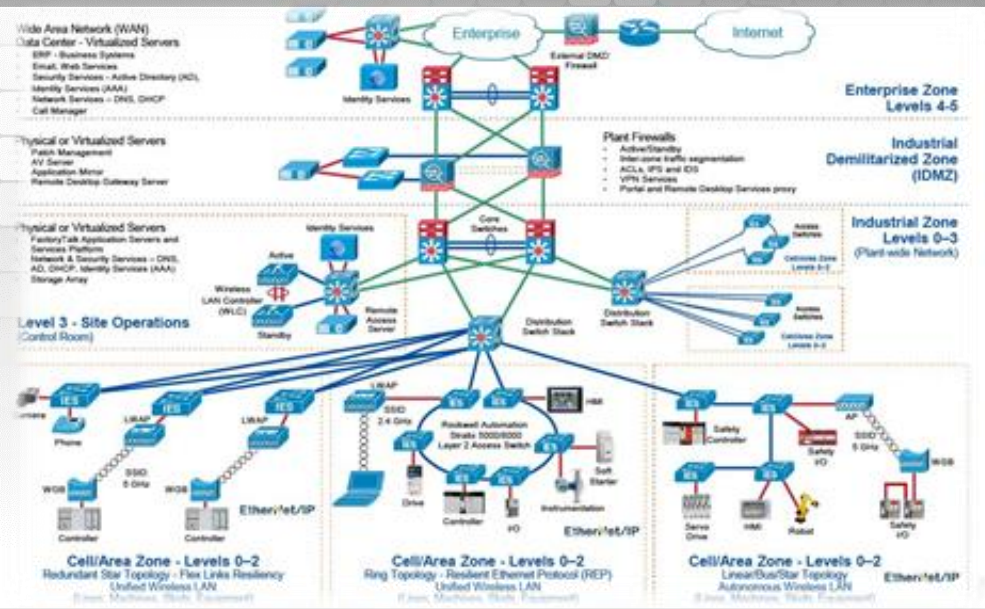

White Paper

March 2017

Physical Infrastructure for a Resilient Converged Plantwide Ethernet Architecture

Successful deployment of CPwE logical architecture depends on a robust physical infrastructure network design that addresses environmental, performance, reliability, and security challenges with best practices from Operational Technology (OT) and Information Technology (IT).

PANDUIT®

Introduction

Industrial Ethernet networking is advancing technology applications throughout the plant. These applications are rapidly being deployed from the plant floor to the enterprise. The integration of IT and Industrial Automation and Control System (IACS) Operational Technology (OT) introduces the need for increased security, ease of use, rapid deployment, and network management support. Panduit is collaborating with industry leaders, including Rockwell Automation and Cisco, to provide industry-leading solutions, architectures, and services that help companies reduce risk, enhance operational performance, improve reliability, and successfully implement EtherNet/IP™ solutions and architectures through:

- Optimized physical network infrastructure solutions from Panduit® that have been developed to align with the Cisco and Rockwell Automation "Deploying a Resilient Converged Plantwide Ethernet Architecture" Cisco Validated Design (CVD)
- Design guidance for aligning logical and physical industrial network architectures that utilize industry best practices. Strategic design guidance facilitates effective collaboration between OT and IT
- Integrated solutions, tools, and services to simplify design and implementation for better equipment optimization and broader risk management

Deploying the Physical Infrastructure to Build a Resilient Network

Converged Plantwide Ethernet Architecture (CPwE), a collection of tested and validated architectures, is the underlying architecture that provides standard network services for control and information disciplines, devices, and equipment found in modern IACS applications. The CPwE architecture (Figure 1) consists of documented architectures, best practices, guidance and configuration settings to help manufacturers with design and deployment of a scalable, reliable, secure and future-ready plant-wide industrial network infrastructure.

Successful deployment of CPwE logical architecture depends on a robust physical infrastructure network design that addresses environmental, performance, and physical security challenges with best practices from Operational Technology (OT) and Information Technology (IT).

Physical Infrastructure Design for Resilient Networks

Increasing the resilience of an industrial Ethernet network requires identifying the challenges and risks for underperforming networks and network disruptions, and defining appropriate countermeasures to achieve high resiliency.

Logical to Physical Mapping

The challenge for network designers is to implement a scalable, reliable, secure, and future-ready network infrastructure across the varied, harsh environments of industrial plants. The networking assets must be

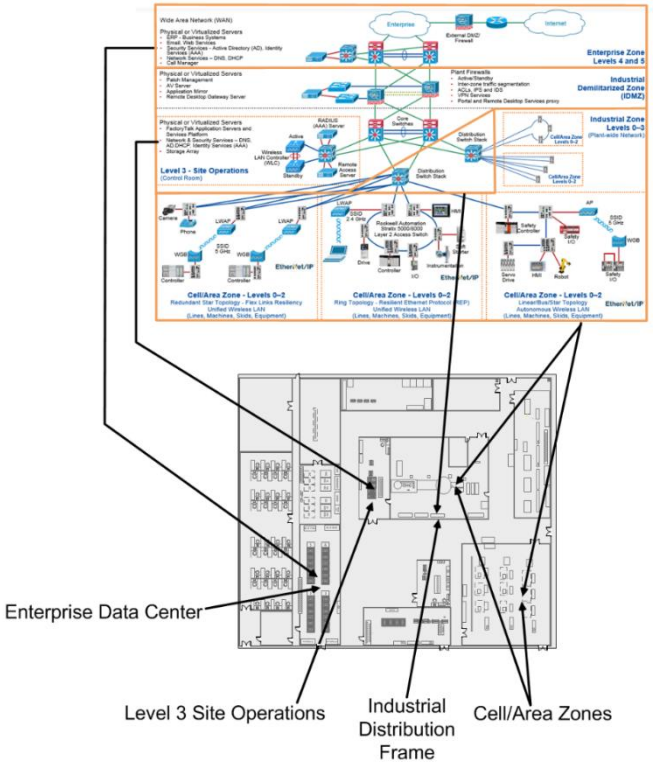

Figure 1. Mapping CPwE Logical to Physical.

placed across the plant floor with consideration of challenging environmental factors such as long distances, temperature extremes, humidity, shock/vibration, chemical/climatic conditions, water/dust ingress, and electromagnetic threats. These challenges present threats that can potentially degrade network performance, impact network reliability, and/or shorten asset longevity. Figure 1 shows the CPwE logical framework mapped to a hypothetical plant footprint.

Resilient Design Considerations:

- Resilient network topologies
- Network channel layout and distribution
- Structured cabling
- Physical network zone architecture
- Network channel endurance as assessed using TIA-1005 M.I.C.E. criteria

In harsh environments, industrial Ethernet networked communications systems must be extremely durable to avoid physical deterioration in cabling infrastructure. Physical deterioration results in defective network performance and leads to loss of data transfer, costly downtime, or catastrophic failure. Therefore, strategic selection of cable jackets and connectors for industrial environments is essential.

Physical Infrastructure Network Building Block Systems

Industrial physical infrastructure network building block systems comprised of integrated active gear can be deployed at most levels of the CPwE logical architecture. An industrial network building block system simplifies deployment of the network infrastructure required at each Level and Zone of the CPwE.

The building block system, (Zoning) provides resiliency by containing the specified switching, routing, computing, and/or storage elements required for a given Zone in an enclosure, cabinet, or rack that is complete with cabling, cable management, identification, grounding, and power. These building block systems can be implemented in three ways:

- **Integrated** – Fully integrated, assembled and thermally tested building block solution including CPwE equipment and components delivered onsite for rapid deployment
- **Pre-configured** – Pre-assembled building block solution incorporating CPwE equipment and components to be assembled onsite
- **Switch Ready** – Pre-assembled building block solution including power supplies, fusing equipment, cabling etc., delivered onsite and ready for CPwE equipment and component implementation

The network building blocks are comprised of the following:

- **Physical Network Zone System** – A Physical Network Zone System within the CPwE Cell/Area Zone provides environmental protection for the industrial Ethernet switch (IES) and serves as a consolidation point for multiple network connections
- **Industrial Data Center (IDC)** – The CPwE Level 3 Site Operations, or Industrial Data Center (IDC), include the proper IT assets housed in an appropriate cabinet with patching, power, grounding/bonding, identification and physical security considerations already addressed a plug and play solution
- **Industrial Distribution Frame (IDF)** – For consolidation points of commercial, off-the-shelf rack mount switches, an IDF solution may be used to house rack mounted IES to route traffic between the Cell/Area Zone IES and the Level 3 Site Operations IDC

CPwE Physical Infrastructure

Industrial Zone

The CPwE plant network backbone consists of the distribution layer that converges one or more Cell/Area Zones to the overall plant network, IACS controllers, and connections to the edge IACS devices. Figure 2 illustrates the logical building blocks diagram and Figure 3 illustrates the CPwE architecture below the Core Switches down to Level 0 IACS endpoints.

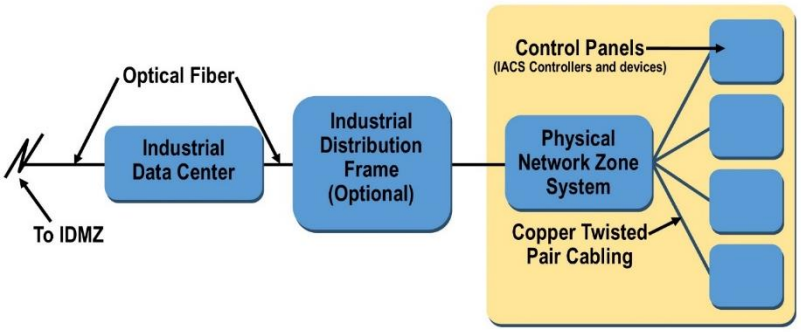

Figure 2. Logical Building Blocks Diagram

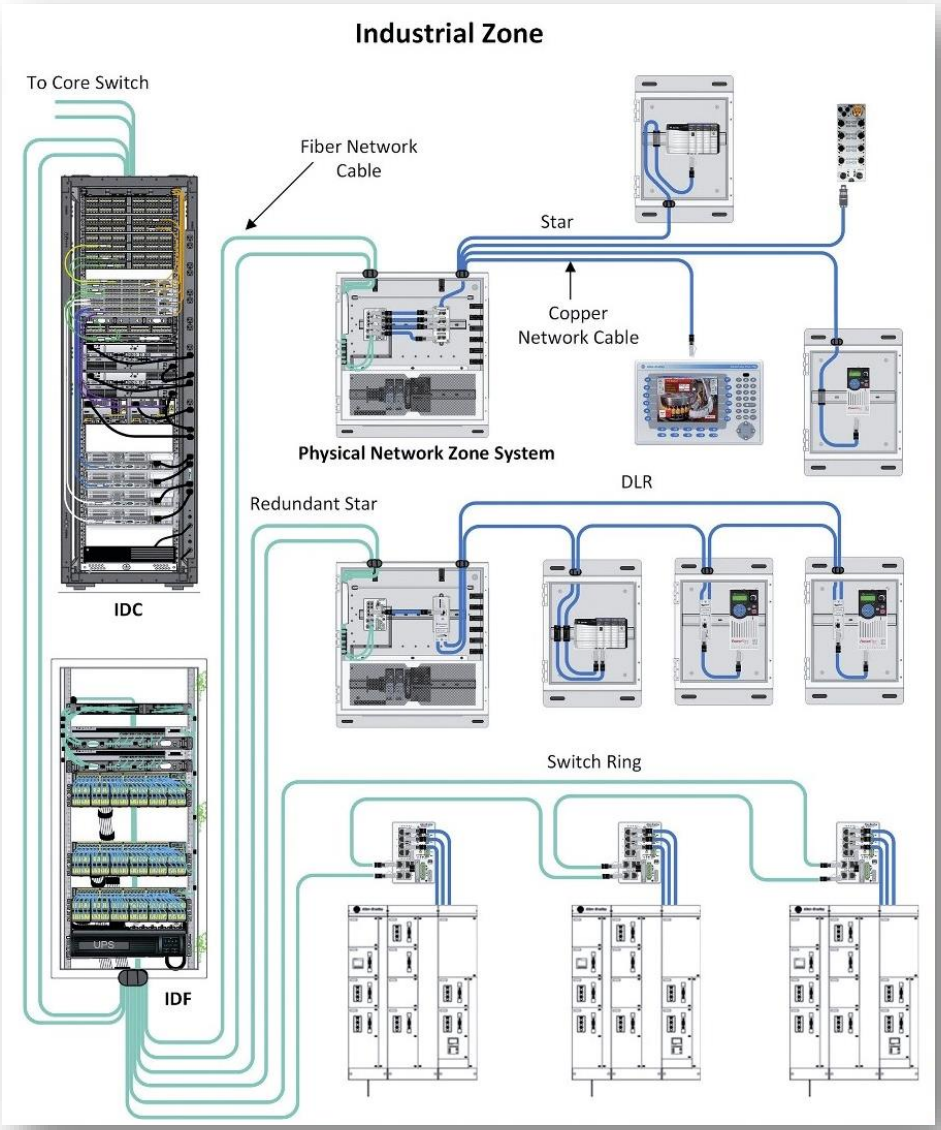

Figure 3. Physical Layout of Block Diagram

Cell/Area Zone

The Cell/Area Zone represents the outer reaches of the network and provides the network connections to the machines, skids and equipment to be monitored, managed, and controlled. Figure 4 details the physical connectivity of an example switch-level ring topology.

Figure 5 is an example of a switch-level redundant star topology.

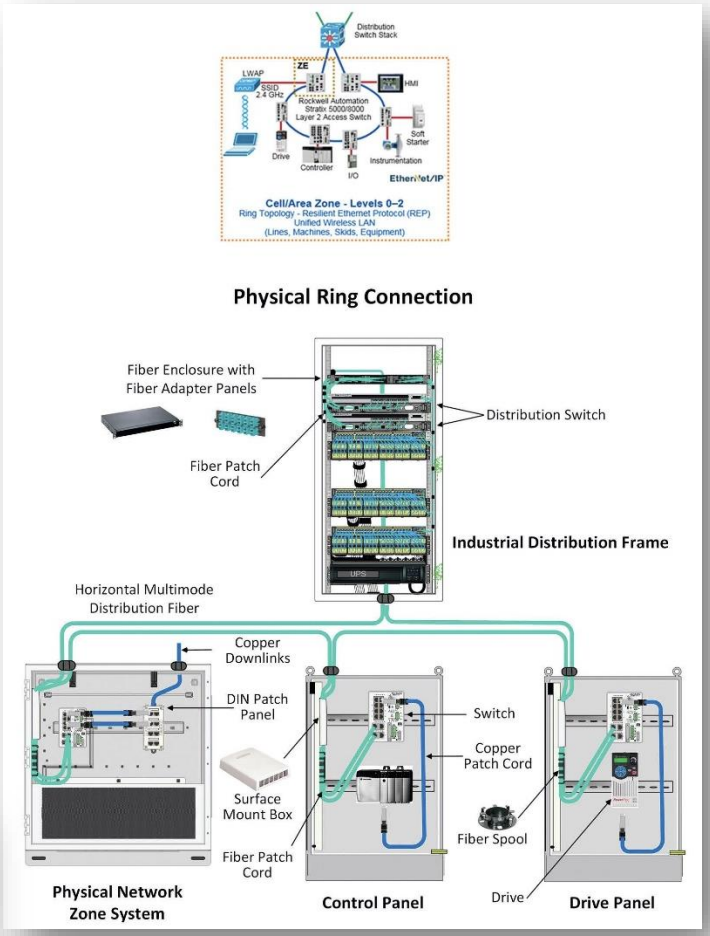

Figure 4. Example Switch-level Ring Topology

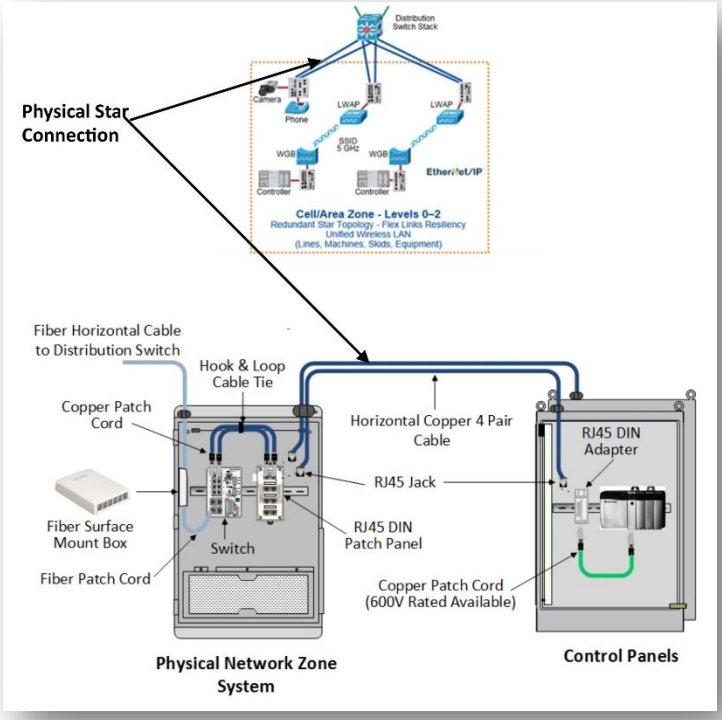

Figure 5. Example Switch-level Redundant Star Topology

Level 3 Site Operations

The Level 3 Site Operations includes virtual IACS application servers, security and network services, and a robust physical layer that addresses the environmental, performance, and security challenges present when deploying IT assets (e.g., servers, storage arrays, and switching, Figure 6).

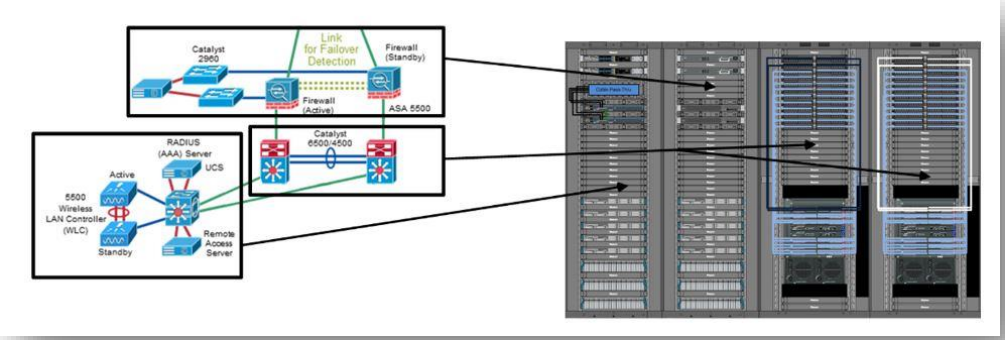

Figure 6. Level 3 Site Operations Layout

Summary

Resilient plant-wide network architectures serve a crucial role in achieving overall plant uptime and productivity. The CPwE architecture provides standard network services to the applications, devices, and equipment in modern IACS applications, and integrates them into the wider enterprise network. It also provides design and implementation guidance to achieve the real-time communication and requirements of the IACS as well as the scalability, reliability and resiliency required by those IACS applications. The CPwE Resiliency Panduit solution can help provide manufacturers the guidance needed to meet the challenges of a fully integrated IACS and realize the business benefits offered by standard networking.

This paper specifically focuses on the physical infrastructure deployment for CPwE using best practices and a building block approach from Panduit. The methodology is reflected in the physical infrastructure details that complement Deploying A Resilient Converged Plantwide Ethernet Architecture, white paper and Design and Implementation Guide, a collaboration between Panduit, Cisco and Rockwell Automation.