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Panduit Deploys Converged Plantwide Ethernet Architecture to Improve Network Performance and Management

Case Study

September 2019

Rockwell Automation and Cisco Four Key Initiatives:

- **Common Technology View:**
  A single scalable architecture, using open EtherNet/IP™ standard networking technologies, is paramount to enable the Industrial Internet of Things for achieving the flexibility, visibility, and efficiency required in a competitive manufacturing environment.

- **Converged Plantwide Ethernet Architectures:**
  Collection of tested and validated architectures developed by subject matter authorities at Cisco, Panduit, and Rockwell Automation. The content of CPwE is relevant to both Operational Technology (OT) and Information Technology (IT) disciplines and consists of documented architectures, best practices, guidance, and configuration settings to help manufacturers with design and deployment of a scalable, reliable, safe, secure, and future-ready plant-wide industrial network infrastructure.

- **Joint Product Collaboration:**
  Stratix® 5950 industrial firewall, FactoryTalk® Network Manager™ software, Stratix 5700, Stratix 5400, Stratix 5410, and Stratix 5800 Industrial Ethernet Switches, incorporating the best of Cisco and the best of Rockwell Automation.

- **People and Process Optimization:**
  Education and services to facilitate Operational Technology (OT) and Information Technology (IT) convergence, which can assist with successful architecture deployment, and helps to enable efficient operations that allow critical resources to focus on increasing innovation and productivity.

Panduit Deploys Converged Plantwide Ethernet Architecture to Improve Network Performance and Management

Panduit implements a plant-wide network technology upgrade in its Costa Rica facility to achieve optimized plant uptime and productivity.

Business Challenges

The Panduit Costa Rica manufacturing facility was experiencing various challenges relating to its industrial network. The manufacturing equipment was running on legacy PLCs, which caused reliability and uptime issues. In addition, the network architecture had outgrown its originally planned scale and was creating challenges with upgrades and maintenance. Finally, network security was a major concern due to dated network security equipment and unmonitored access to the network on the plant floor.

To resolve these challenges, Panduit decided to implement a network refresh and transition plan for the Costa Rica facility. The best way to achieve this was to use the best practices and guidelines set forth by Converged Plantwide Ethernet (CPwE), employing equipment from Panduit, Cisco, and Rockwell Automation. The Rockwell Automation® Network and Security Services Group (NSS) was contracted to create the bill of materials for the network equipment and a transition plan required to best deploy CPwE. The Panduit team would implement the transition plan and integrate the new network equipment.

The transition plan would help the Panduit Costa Rica manufacturing facility achieve a more redundant and robust network infrastructure starting with the installation of brand new Allen-Bradley® PLCs and network equipment from Panduit, Cisco, and Rockwell Automation. As part of the network upgrade, the manufacturing equipment would be migrated off the old network and transferred to the new network.

This approach would separate the industrial network from the enterprise network to help protect the industrial network from downtime, while improving reliability in the process. It would also offer more scalability and maintainability. Finally, hardened enclosures for the switches would provide improved physical security, while improved network architecture and equipment would provide upgraded logical security.

Strategic Objectives

The most important goal for this project was to deploy a secure and reliable industrial network to connect each machine/operation to the manufacturing execution system (MES) to gather data for the main production key performance indicators (KPIs). A dedicated, hardened, and secure network would show the value of the industrial network and it would allow Panduit to improve network uptime and production equipment availability.

Another essential goal was to provide a path for future network growth which would enable equipment expansions and enhanced data gathering to improve processes. This would enhance the company's ability to scale and upgrade the network, as needed, in the future. The improved data-gathering process allows for better and more consistent analysis of valuable manufacturing statistics.

"The CPwE deployment at our Costa Rica manufacturing facility has enabled a drastic improvement in our network reliability, scalability, and maintainability. This deployment is the template for all future network upgrades in our manufacturing facilities," said Mike Kimbrell, Manager IT, Panduit.

Solution Deployed by Panduit

Panduit has a legacy of excellence when it comes to creating network and physical infrastructure solutions. In keeping with this standard, Panduit deployed a resilient plant-wide network architecture in its Costa Rica facility to increase overall plant uptime and productivity. The CPwE architecture provides standard network and security services to the applications, devices, and equipment in modern industrial automation and control system (IACS) applications and integrates them into the wider enterprise network. Brought to market through an ecosystem of industry thought leaders (Rockwell Automation, Cisco Systems, and Panduit), the CPwE architecture helps customers achieve the real-time communication and deterministic requirements of the IACS, including the reliability and resiliency required by those systems.

Successful deployment of IIoT IACS applications within CPwE Architectures (Figure 1) depends on a network infrastructure design that addresses IACS application requirements. The content of CPwE, which is relevant to both OT and IT disciplines, consists of documented architectures and key tenets from OT and IT to help achieve reliable, secure and real-time communications to support IIoT IACS applications. CPwE key tenets include:

- **Smart IIoT devices**—controllers, I/O, drives, instrumentation, actuators, and analytics
- **Zoning (segmentation)**—smaller connected LANs, functional areas, and security groups
- **Managed infrastructure**—managed industrial Ethernet switches (IES) and industrial firewalls
- **Resiliency**—robust physical layer and resilient or redundant topologies with resiliency protocols
- **Time-critical data**—data prioritization and time synchronization via CIP Sync™ protocol and IEEE-1588 Precision Time Protocol (PTP)
- **Wireless**—unified wireless LAN (WLAN) to enable mobility for personnel and equipment
- **Holistic defense-in-depth security**—multiple layers of diverse technologies for threat detection and prevention, implemented by different persona (e.g. OT and IT) and applied at different levels of the plant-wide IACS architecture
- **Convergence-ready**—seamless plant-wide integration by trusted partner applications
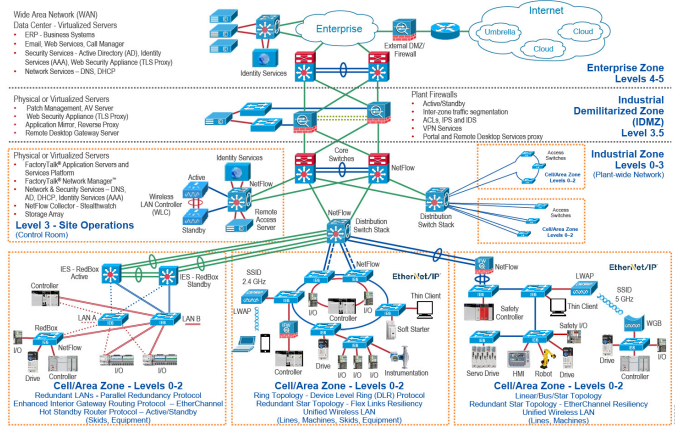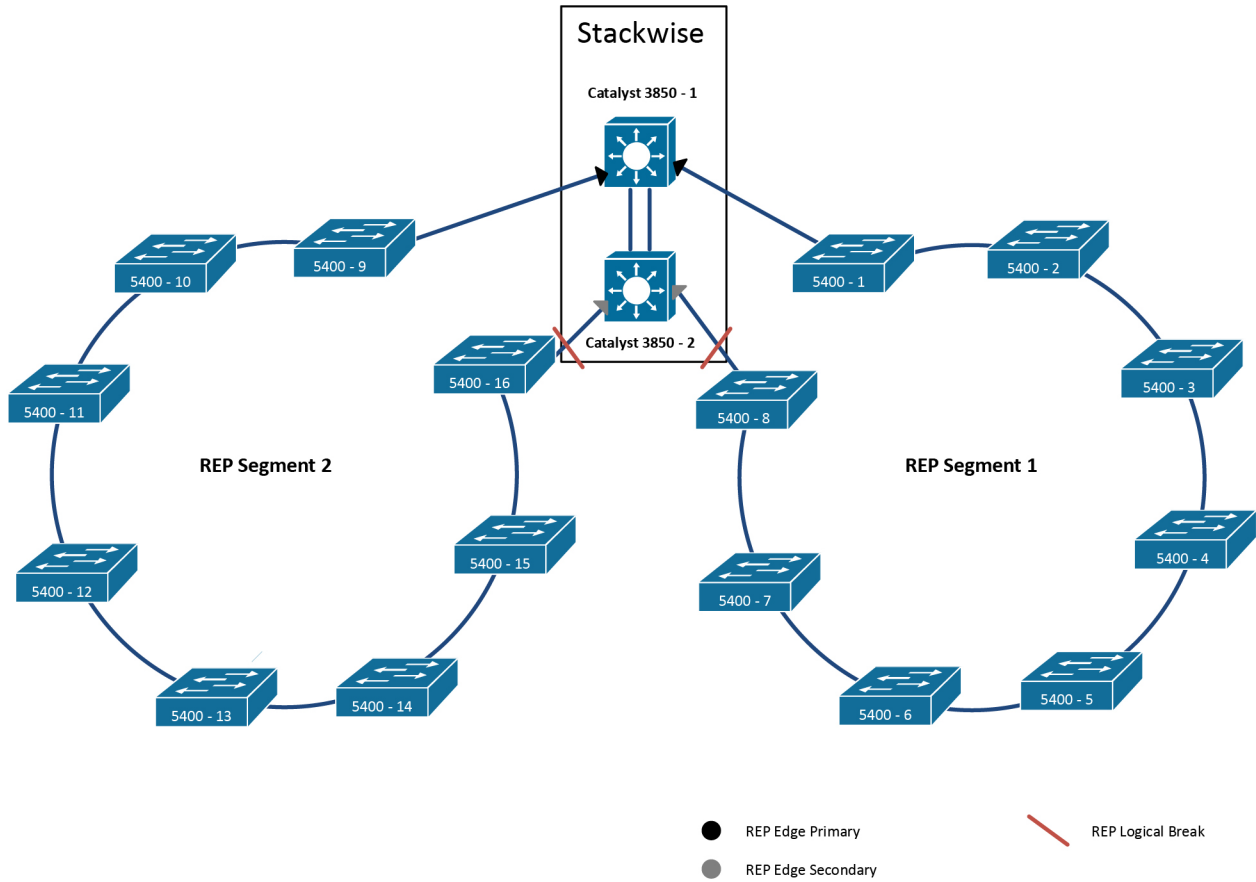
Figure 1   CPwE Architectures

Figure 2   Panduit Costa Rica Facility REP Ring Architecture

To meet the demands of its network refresh and transition plan, the solution for the Costa Rica facility was to deploy a new Resilient Ethernet Protocol (REP) switch ring network (Figure 2). Cisco Catalyst 3850 distribution switches and Allen-Bradley Stratix 5400 industrial Ethernet switches were used for the REP ring switches. The Switch Ready Network Zone System, Pre-Configured Industrial Distribution Frame (IDF), and fiber and copper connectivity and accessories from Panduit were also installed. For more information on REP, see the *Deploying A Resilient Converged Plantwide Ethernet Architecture Design and Implementation Guide* (www.panduit.com/cpwe).

Figure 3   Cisco Catalyst 3850 Switch

Two Cisco Catalyst 3850 switches were installed at the CPwE distribution layer. The Cisco Catalyst 3850 switch (Figure 3) is the first stackable switching platform that enables wired plus wireless services on a single Cisco IOS XE software-based platform. The single console port for Command-Line Interface (CLI)

management reduces the number of touch points to manage for wired plus wireless services, which reduced the facility's network complexity, simplifying network operations, and lowering the TCO to manage the infrastructure.

Figure 4   Allen-Bradley Stratix 5400 Industrial Ethernet Switch
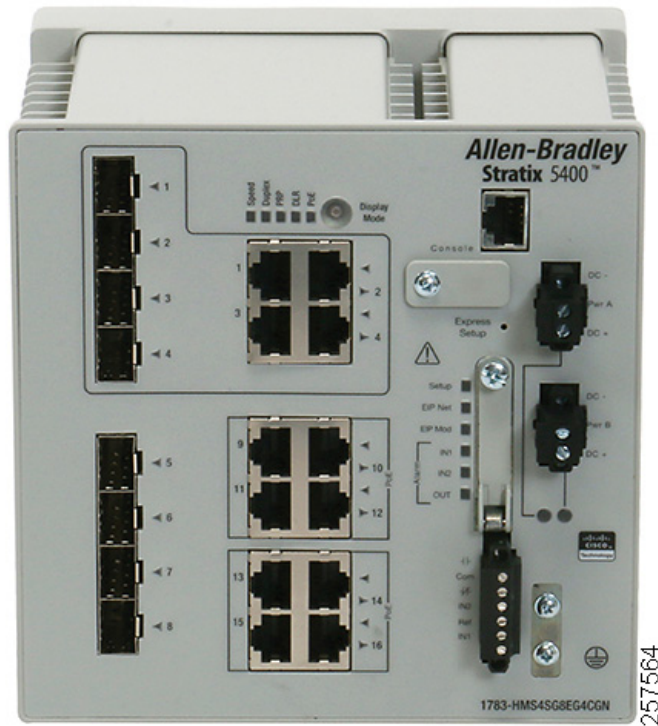
Multiple Allen-Bradley Stratix 5400 (Figure 4) Industrial Ethernet switches were installed to aggregate the IACS EtherNet/IP devices and to connect to the REP switch ring. The Stratix 5400 industrial Ethernet managed switches support Layer 2 and Layer 3 switching using a combination of Gigabit Ethernet (GE), Power over Ethernet (PoE), and GE fiber ports to help offer enhanced scalability. In addition, this industrial Ethernet switch offers support for dual media GE switch ring configurations, which enabled high performance network resiliency within the facility.

Figure 5   Panduit Pre-Configured IDF

The Panduit Pre-Configured IDF (Figure 5) was selected for quick deployment and protection of the facility's rack-mount Cisco StackWise™ Ethernet switches, which serve as the distribution switches. The IDF also helped achieve rapid and easy maintenance of network switch equipment. Centrally locating the IDF, and therefore the switches, aided in establishing shorter fiber runs from the network core to the various Cell/Area Zones in the process areas. The facility used Panduit OS2 single-mode fiber patch cords and structured cabling. In addition, various cable managers were utilized to connect the Cisco distribution switches to the Allen-Bradley Stratix industrial Ethernet switches, which resulted in a well-managed, easy-to-maintain enclosure.

Tested and thermally verified by Panduit Laboratories, the IDF achieves 25% faster installation than a non-pre-configured IDF installation. The additional back-end space allows for 3X the cooling capacity over typical deployments for increased reliability. The optional AC units were used to ensure the optimal environmental parameters were maintained.

Figure 6   Panduit Switch Ready Network Zone System (PNZS)

The Panduit Switch Ready Network Zone System (PNZS) (Figure 6) allows for rapid deployment of the industrial networking equipment required to connect the plant floor. It includes copper and fiber connectivity, patching for the uplinks and downlinks, and a steel enclosure for reliability and improved security. It also includes power features to minimize engineering and installation time for faster implementation.

As an integral component of the end-to-end solution for industrial networks, the PNZS includes two industrial switches, 16 Category 6A STP copper patch cords and jacks, four MM LC fiber uplink patch cords with six adapters, redundant power supplies, and two Panduit maintenance-free 100W UPS devices.

Figure 7   Panduit TX6A™ UTP Copper Cable with Vari-MaTrix Technology

The industrial network's backbone consists of OS2 single-mode fiber-optic cabling and enhanced Category 6A UTP copper cabling (Figure 7) with Vari-MaTrix Technology. Panduit OS2 single-mode fiber-optic cabling is an essential part of the Panduit end-to-end fiber-optic solution, designed to support today's data

needs while meeting tomorrow's ever-advancing network requirements. Panduit Category 6A UTP copper cabling with Vari-MaTrix Technology provides industry-leading cable diameter and performance. The Vari-MaTrix tape minimizes the cable diameter and suppresses the effects of alien crosstalk while retaining UTP electromagnetic interference immunity. This innovative cable design provides installation flexibility as cables are routed in tight bundles through pathways and spaces. In addition to the cabling, DIN Rail mounted patch panels were used for optimized cable management within the enclosures.

Business Benefits

The Panduit manufacturing team has observed a substantial increase in productivity through the enhanced performance of the new and improved industrial network. Upon the successful upgrade of the equipment and migration to the new network, outages (which were occurring far too often on the old network) have been completely eliminated. In the previous six months before the network was upgraded, 17 outages had occurred. In the eight months since the migration, no network outages have been reported. This significant decrease in downtime has resulted in up to $500,000 cost savings per incident.

"The new CPwE network has provided us the stability and reliability that we need from our industrial network infrastructure to operate at full capacity. We have had no network issues since we migrated to the new network," said Elí Rodríguez, Senior Engineering Manager (Costa Rica).

By using CPwE best practices, the Costa Rica facility now has a reliable, secure, and robust solution. Panduit's industrial physical infrastructure solutions aligned with CPwE guidelines greatly simplifies the design, implementation, and support of the new industrial networks. This practice provides the best alternative with the greatest total cost of ownership.

Panduit's collaboration with industry leaders such as Rockwell Automation and Cisco helps customers address deployment complexities associated with plant-wide Industrial Ethernet and Industrial IoT Architectures. As a result, this allows customers to achieve a resilient, scalable network that supports proven and flexible logical CPwE architectures designed to optimize industrial network performance.

More information on CPwE Design and Implementation Guides can be found at the following URLs:

- Rockwell Automation site:
    - http://www.rockwellautomation.com/rockwellautomation/products-technologies/network-technology/architectures.page?
- Cisco site:
    - http://www.cisco.com/c/en/us/solutions/enterprise/design-zone-manufacturing/landing_ettf.html

Panduit Corp. is a world-class provider of engineered, flexible, end-to-end electrical and network connectivity infrastructure solutions that provides businesses with the ability to keep pace with a connected world. Our robust partner ecosystem, global staff, and unmatched service and support make Panduit a valuable and trusted partner.

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Rockwell Automation is a leading provider of power, control and information solutions that enable customers to be more productive and the world more sustainable. In support of smart manufacturing concepts, Rockwell Automation helps customers maximize value and prepare for their future by building a Connected Enterprise.

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