Device Level Ring within a Converged Plantwide Ethernet Architecture

White Paper

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Rockwell Automation and Cisco Four Key Initiatives:

• **Common Technology View:**
  A single scalable architecture, using open EtherCAT® and EtherCAT® 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:**

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

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Device Level Ring within a Converged Plantwide Ethernet Architecture

The prevailing trend in Industrial Automation and Control System (IACS) networking is the convergence of technology, specifically IACS operational technology (OT) with information technology (IT). Converged Plantwide Ethernet (CPwE) helps to enable IACS network and security technology and OT-IT persona convergence through the use of standard Ethernet, Internet Protocol (IP), network services, security services, and EtherNet/IP. A reliable converged plant-wide IACS architecture helps to enable the Industrial Internet of Things (IIoT).

Business practices, corporate standards, policies, industry standards, and tolerance to risk are key factors in determining the degree of resiliency and application availability required within an IACS plant-wide architecture. A resilient network architecture within an IACS application plays a pivotal role in helping to minimize the risk of IACS application shutdowns while helping to maximize overall plant uptime.

A holistic resilient plant-wide network architecture is made up of multiple technologies (logical and physical) deployed at different levels within the plant. When selecting a resiliency technology, various plant application factors should be evaluated, including the physical layout of IACS devices (geographic dispersion), resiliency performance, uplink media type, tolerance to data latency and jitter, and future-ready requirements. For more information on resiliency technology, refer to Deploying a Resilient Converged Plantwide Ethernet Architecture (CPwE Resiliency) Design and Implementation Guide (DIG).

The ODVA, Inc. Device Level Ring (DLR) technology is optimized to provide ring topology resiliency for time critical IACS applications. DLR supports fast ring convergence (single-fault tolerant) in the event of an IACS device or link failure. DLR also supports flexible topologies such as IACS device-level (embedded switch), switch-level (Layer 2, IES only), and hybrid topologies for OEM (equipment, skid, machine) and plant-wide IACS deployments. DLR is standard Ethernet (OT-IT convergence) with standard network services such as quality of service (QoS) and IEEE 1588 PTP (Precision Time Protocol).

Deploying Device Level Ring within a Converged Plantwide Ethernet Architecture Design Guide (CPwE DLR) outlines several use cases for designing and deploying DLR technology with IACS device-level, switch-level, and mixed device/switch-level ring topologies across OEM and plant-wide IACS applications. CPwE DLR is an extension to CPwE Resiliency and was architected, tested and validated by Cisco Systems and Rockwell Automation with assistance by Panduit.

CPwE is the underlying architecture that provides standard network and security services for control and information disciplines, devices, and equipment found in modern IACS applications. The CPwE architectures (Figure 1) were architected, tested and validated to provide design and implementation guidance, test results, and documented configuration settings. This can help to achieve the real-time communication, reliability, scalability, security, and resiliency requirements of modern IACS applications.
CPwE Device Level Ring within a Converged Plantwide Ethernet (CPwE) architecture is designed to address the industrial hardening of standard Ethernet and IP-converged IACS networking technologies to take advantage of the business benefits associated with IIoT. A resilient network architecture (Figure 2) can help to increase the overall equipment effectiveness (OEE) of the IACS by helping to reduce the impact of a failure and speed recovery from an outage which lowers Mean-Time-To-Repair (MTTR).

This release of the CPwE architecture focuses on EtherNet/IP, which uses the ODVA, Inc. Common Industrial Protocol (CIP™), and is ready for the Industrial Internet of Things (IIoT). For more information on EtherNet/IP, CIP Sync™, CIP Motion™, CIP Safety™, and DLR, see odva.org at the following URL:

CPwE DLR outlines the concepts, requirements, and technology solutions for reference designs developed around a specific set of priority use cases that were architected and tested for solution functional verification with limited scale by Cisco Systems and Rockwell Automation with assistance by Panduit to help support a resilient and converged plant-wide EtherNet/IP IACS architecture. The CPwE DLR Design Guide includes:

- Device Level Ring technology overview
- Design and configuration considerations for plant-wide IACS device-level, switch-level, and mixed device/switch-level DLR deployments
- Selection of Industrial Ethernet Switches (IES)
  - Allen-Bradley® Stratix® 5700 and Stratix 5400 managed IES
- The following represent a portion of the DLR application use cases;
  - Single ring of IES
  - Single mixed device/switch-level ring
  - Multiple mixed device/switch-level rings
  - Multiple distribution switch choices
  - DLR support for Dynamic Host Configuration Protocol (DHCP)

**Release Notes**

This section summarizes the extensions to CPwE DLR in the April 2019 release:

- Quality of Service (QoS) requirements
- Multiple ring specifications
- Dynamic Host Configuration Protocol (DHCP) for ring nodes
- Internet Group Management Protocol (IGMP) enhancement features
- DLR application use cases including single mixed IACS device/IES ring and multiple mixed IACS device/IES rings
Summary

CPwE is a collection of tested and validated architectures. The testing and validation follow the Cisco Validated Design (CVD) and Cisco Reference Design (CRD) methodologies. The content of CPwE, which is relevant to both operational technology (OT) and informational technology (IT) disciplines, consists of documented architectures, best practices, guidance, and configuration settings to help industrial operations and OEMs with the design and deployment of a scalable, reliable, secure, and future-ready plant-wide industrial network infrastructure. CPwE can also help industrial operations and OEMs achieve cost reduction benefits using proven designs that can facilitate quicker deployment while helping to minimize risk in deploying new technology. CPwE is brought to market through a CPwE ecosystem consisting of Cisco, Panduit, and Rockwell Automation emergent from the strategic alliance between Cisco Systems and Rockwell Automation.

The Deploying Device Level Ring within a Converged Plantwide Ethernet Architecture Design Guide outlines several use cases for designing and deploying the ODVA, Inc. Device Level Ring (DLR) technology throughout a plant-wide Industrial Automation and Control System (IACS) network infrastructure. The CPwE DLR Design Guide highlights the key IACS application requirements, technology, and supporting design considerations to help with the successful design and deployment of these specific use cases within the CPwE framework. CPwE DLR was architected, tested and validated by Cisco Systems and Rockwell Automation with assistance by Panduit.
More information on CPwE Design and Implementation Guides can be found at the following URLs:


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