



A Resilient Converged Plantwide Ethernet Architecture

Rockwell Automation and Cisco Four Key Initiatives:

- **Common Technology View:**
A single system architecture, using open, industry standard networking technologies, such as Ethernet and IP, is paramount for achieving the flexibility, visibility and efficiency required in a competitive manufacturing environment.
- **Converged Plantwide Ethernet Architectures:**
These manufacturing focused reference architectures, comprised of the Rockwell Automation Integrated Architecture® and Cisco's Ethernet to the Factory, provide users with the foundation for success to deploy the latest technology by addressing topics relevant to both engineering and IT professionals.
- **Joint Product and Solution Collaboration:**
Stratix 5700™, Stratix 5400™ and Stratix 5410™ 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 and allow successful architecture deployment and efficient operations allowing critical resources to focus on increasing innovation and productivity.

White Paper

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

An IACS is deployed in a wide variety of industries such as automotive, pharmaceuticals, consumer goods, pulp and paper, oil and gas, mining and energy. IACS applications are made up of multiple control and information disciplines such as continuous process, batch, discrete and hybrid combinations. A resilient network architecture can help to increase overall equipment effectiveness (OEE) of the IACS by reducing the impact of a failure and speed recovery from an outage which lowers mean-time-to-repair (MTTR).

A holistic resilient plant-wide network architecture is made up of multiple technologies (logical and physical) deployed at different levels within the plant:

- Robust physical infrastructure
- Topologies and protocols
- Switching and routing
- Wireless LAN Controllers (WLC)
- Firewalls
- Network and device management

Converged Plantwide Ethernet (CPwE) 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](#)) provides design and implementation guidance to achieve the real-time communication, reliability, scalability, security and resiliency requirements of the IACS.

CPwE Resiliency for IACS applications is brought to market through a strategic alliance between Cisco Systems® and Rockwell Automation.

Wide Area Network (WAN)

- Physical or Virtualized Servers
 - ERP - Business Systems
 - Email, Web Services
 - Security Services - Active Directory (AD), Identity Services (AAA)
 - Network Services - DNS, DHCP
 - Call Manager

Enterprise Levels 4 and 5

- Physical or Virtualized Servers
 - Patch Management
 - AV Server
 - Application Mirror
 - Remote Desktop Gateway Server

Industrial Demilitarized Zone (IDMZ)

- Plant Firewalls
 - Active/Standby
 - Inter-zone traffic segmentation
 - ACLs, IPS and IDS
 - VPN Services
 - Portal and Remote Desktop Services proxy

Industrial Zones Levels 0-3 (Plant-wide Network)

- Physical or Virtualized Servers
 - FactoryTalk Application Servers and Services Platform
 - Network & Security Services - DNS, AD, DHCP, Identity Services (AAA)
 - Storage Array

Level 3 - Site Operations (Control Room)

- RADIUS (AAA) Server
- Wireless LAN Controller (WLC) - Active/Standby
- Remote Access Server
- Distribution Switch Stack

Cell/Area Zone Levels 0-2

- Camera
- Phone
- LWAP
- SSID 5 GHz
- WGB
- Controller
- EtherNet/IP
- Drive
- Controller
- I/O
- Instrumentation
- HMI
- Soft Starter
- Servo Drive
- HMI
- Robot
- Safety I/O
- SSID 5 GHz
- WGB
- Safety I/O
- EtherNet/IP

Cell/Area Zone - Levels 0-2

Redundant Star Topology - Flex Links Resiliency
Unified Wireless LAN
(Lines, Machines, Skids, Equipment)

Cell/Area Zone - Levels 0-2

Ring Topology - Resilient Ethernet Protocol (REP)
Unified Wireless LAN
(Lines, Machines, Skids, Equipment)

Cell/Area Zone - Levels 0-2

Linear/Bus/Star Topology
Autonomous Wireless LAN
(Lines, Machines, Skids, Equipment)

The *Deploying a Resilient Converged Plantwide Ethernet Architecture Cisco Validated Design (CVD)*, which is documented in the *Deploying a Resilient Converged Plantwide Ethernet Architecture Design and Implementation Guide (DIG)* outlines key requirements and design considerations to help with successfully designing and deploying a holistic resilient plant-wide network architecture.

- ## A Resilient Converged Plantwide Ethernet Architecture

- Robust Physical Infrastructure

**Note**

This release of the CPwE architecture focuses on EtherNet/IP™, which is driven by the ODVA Common Industrial Protocol (CIP™), and is ready for the Industrial Internet of Things. For more information on EtherNet/IP, see [odva.org](http://www.odva.org) at the following URL:

- <http://www.odva.org/Technology-Standards/EtherNet-IP/Overview>

CPwE Resiliency Use Cases

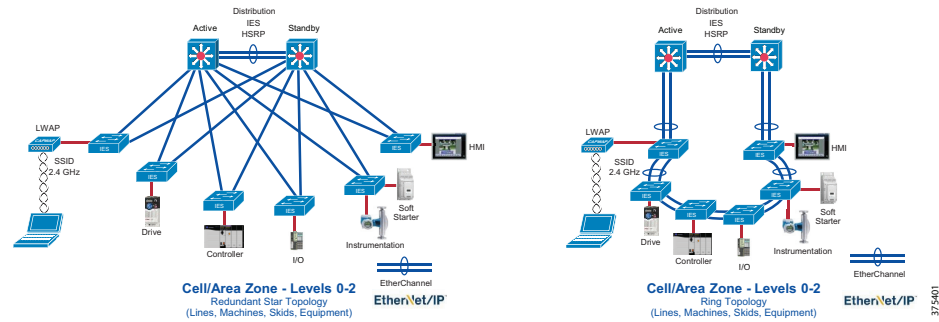
The CPwE architecture supports scalability which includes the degree of resiliency applied to a plant-wide network architecture. Scalable resiliency comes in many forms; that is, technology choices in topology and distribution switch. For the *Deploying a Resilient Converged Plantwide Ethernet Architecture CVD*, the following represents a portion of the use cases that were tested, validated and documented by Cisco and Rockwell Automation. For more details, refer to the *Deploying a Resilient Converged Plantwide Ethernet Architecture DIG*.

Allen-Bradley® Stratix™ and Cisco Industrial Ethernet Switches (IES)

Refer to [Figure 2](#).

- Form factor:
 - DIN rail / panel mount
 - 19" rack mount - 1 RU (rack unit)
- Hot Standby Routing Protocol (HSRP) first hop redundancy protocol
- Redundant star switch-level topology:
 - Flex Links resiliency protocol
 - MSTP resiliency protocol
- Ring switch-level topology:
 - Resilient Ethernet Protocol (REP)
 - Multiple Spanning Tree Protocol (MSTP) resiliency protocol
 - Single and dual media ring:
 - EtherChannel for dual media ring only

Figure 2 IES Aggregation/Distribution Switch

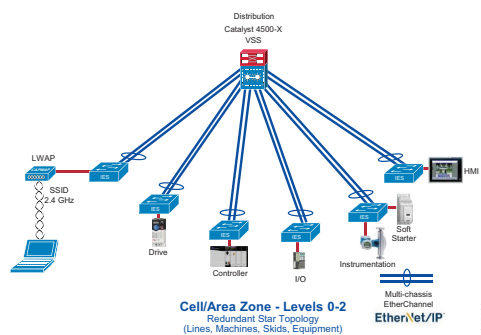


Catalyst 4500-X Aggregation/Distribution Switches

Refer to [Figure 3](#).

- Virtual Switching System (VSS) virtualization technology that pools two physical switch chassis into one virtual switch, with Stateful Switch Over (SSO) and Non-Stop Forwarding (NSF)
- Redundant star switch-level topology:
 - Multi-chassis EtherChannel (MEC) port aggregation
 - Flex Links resiliency protocol
 - MSTP resiliency protocol
- Ring switch-level topology:
 - REP
 - MSTP resiliency protocol
 - Single and dual media ring

Figure 3 Catalyst 4500-X Aggregation/Distribution Switch



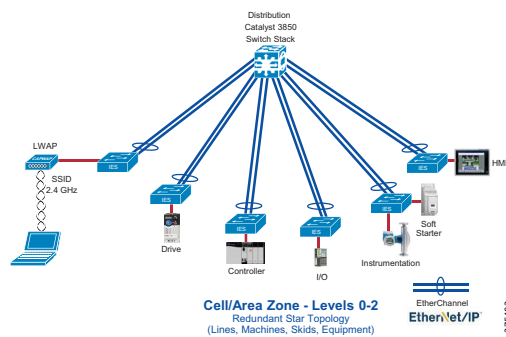
Catalyst 3850 StackWise Aggregation/Distribution Switch

Refer to [Figure 4](#).

- Switch stack, which is a set of up to nine stacking-capable switches, connected through their StackWise Plus or StackWise-480 ports, and united to form a logical unit
- Redundant star switch-level topology:

- MEC port aggregation
- Flex Links resiliency protocol
- MSTP resiliency protocol
- Ring switch-level topology:
 - REP
 - MSTP resiliency protocol
 - Single and dual media ring

Figure 4 Catalyst 3850 Aggregation/Distribution Switch

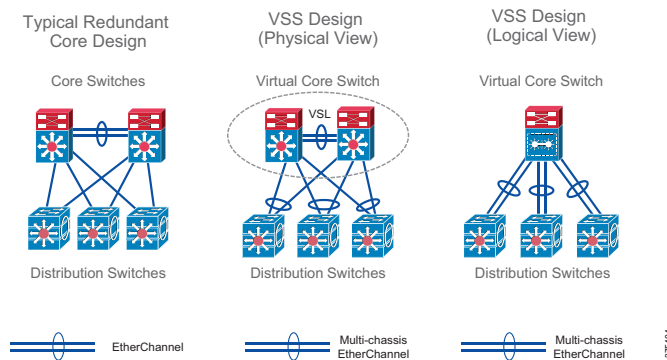


Catalyst 6500-E Core Switches

Refer to [Figure 5](#).

- VSS virtualization technology that pools two physical switch chassis into one virtual switch, with SSO

Figure 5 Core Switches - Traditional vs. VSS Design

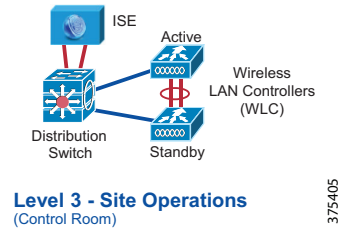


5508 Wireless LAN Controller (WLC)

Refer to [Figure 6](#).

- Unified WLC, which supports the Stateful Switchover of APs and Clients. AP establishes a Control and Provisioning of Wireless Access Points (CAPWAP) tunnel with the Active WLC and shares a mirror copy of the AP database with the Standby WLC.

Figure 6 Active/Standby Wireless LAN Controllers (WLC)

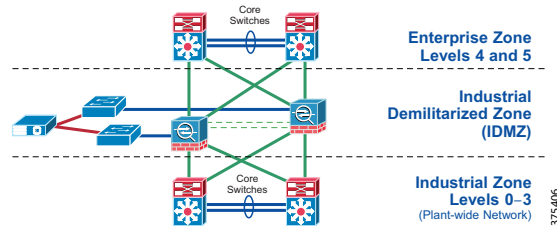


Adaptive Security Appliance 5500-X Firewalls with FirePOWER

Refer to [Figure 7](#).

- Active/Standby stateful failover mechanism enabling a standby Adaptive Security Appliance (ASA) to take over the functionality of a failed unit. When the active unit fails, the standby unit changes to the active state and the failed unit becomes standby when it comes up
- Adaptive Security Device Manager (ADSM)

Figure 7 Active/Standby Firewalls



Robust Physical Infrastructure

Refer to [Figure 8](#).

Successful deployment of CPwE logical architectures depends on a robust physical infrastructure network design that addresses environmental and performance challenges with best practices from Operational Technology (OT) and Information Technology (IT). For the *Deploying a Resilient Converged Plantwide Ethernet Architecture CVD*, Cisco and Rockwell Automation have collaborated with Panduit® to include their building block approach for physical infrastructure deployment. This approach helps customers address the physical deployment associated with converged plant-wide EtherNet/IP from the plant to the enterprise. As a result, users can achieve resilient, scalable networks that support proven and flexible CPwE logical architectures designed to optimize plant-wide IACS network performance.

For the *Deploying a Resilient Converged Plantwide Ethernet Architecture DIG*, the following use cases were documented by Panduit:

- Robust physical infrastructure design considerations and best practices
- Control Panel:
 - Electromagnetic interference (EMI) noise mitigation through bonding, shielding and grounding
 - IES deployment within the Cell/Area Zone
- Physical Network Zone System:
 - IES and AP deployment within the Cell/Area Zone

- Figure 8 Robust Physical Infrastructure for the CPwE Architecture



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Rockwell Automation is a leading provider of power, control and information solutions that enable customers to get products to market faster, reduce their total cost of ownership, better utilize plant assets, and minimize risks in their manufacturing environments.

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