Managing Industrial Networks for Manufacturing with Cisco Technologies 2 v1.2 (IMINS2)

COURSE OVERVIEW:
Managing Industrial Networks for Manufacturing with Cisco® Technologies (IMINS2) Version 1.2 is a lab-intensive course, which helps students with the skills required to successfully implement and troubleshoot the most common industry standard protocols while leveraging best practices needed in Security and Wireless technologies for today’s industrial networks. The IMINS2 course, developed in conjunction with Rockwell Automation, helps plant administrators, control system engineers and traditional network engineers in the manufacturing, process control, and oil and gas industries, who will be involved with the convergence of IT and Industrial networks. This course also helps you prepare for the Managing Industrial Networks for Manufacturing with Cisco Technologies Certification exam (exam ID 200-601) and (having completed required prerequisites) qualify for the Cisco Certified Network Associate Industrial (CCNA Industrial) certification.

This course is job-role specific and enables you to achieve competency and skills to configure, maintain, and troubleshoot industry standard network protocols as well as wireless and security technologies to ensure that current infrastructures are maximized while developing a converged platform for flexibility to support future business outcomes. Students will be exposed to multiple industrial network technologies as well as products from Cisco and other industrial suppliers including Rockwell Automation.

WHO WILL BENEFIT FROM THIS COURSE?
This course is designed for IT and operations technology (OT) professionals and control engineers who will be involved with the installation, configuration, and troubleshooting of networked industrial products and solutions for the following industries:
- Manufacturing
- Process control
- Oil and gas
- Other industries as applicable

PREREQUISITES:
The knowledge and skills that a learner must have before attending this course are as follows:
- Describe network fundamentals and build simple LANs
- Establish Internet connectivity
- Manage network device security
- Expand small- to medium-sized networks with WAN connectivity
- Describe IPv6 basics
- Identify Cisco industrial networking solutions
- Describe Cisco Industrial Ethernet switches, Rockwell Automation Stratix switches, and Cisco Connected Grid switches and routers
- Interpret design and drawings
• Recognize zone and cell topologies
• Install industrial network components
• Deploy industrial network components
• Perform basic maintenance tasks on the network
• Troubleshoot network and control issues

COURSE OBJECTIVES:
After completion of this course, students will be able to...
• Upon completing this course, you will be able to meet these objectives
• Understand the functions of the OSI Layers and TCP/IP Model and recognize the differences between Enterprise and Industrial Networks
• Troubleshoot common issues found in Layers 1, 2, 3, of the OSI Model
• Describe the functions and components of EtherNet/IP Protocols
• Configure and troubleshoot CIP on Cisco and Stratix Switches
• Describe the functions and components of the PROFINET protocol
• Configure PROFINET Protocols on Cisco Industrial Ethernet Devices
• Troubleshoot common PROFINET Issues
• Identify common network threats and resolutions and configure basic security components (Access Lists and AAA Features)
• Configure a wireless network within an industrial environment

COURSE OUTLINE:

Module 1: Industrial Networking Concepts and Components

Lesson 1: Contrasting Enterprise and Industrial Environments
• Industrial Ethernet Architecture
• IACS Network Design Requirements
• CPwE Composition
• Summary

Hardware Lab 1: Connecting to the Remote Lab Environment
• Install the Cisco AnyConnect mobility client
• Connect to the remote LAB VPN environment
• Connect to the remote PC Using Remote Desktop Client
• Connect to the terminal Server for device console access using PuTTY remote software
• Connect to the console port of a device
Lesson 2: Configuration Tools for Industrial Ethernet Switches
- Industrial Ethernet Switch Types
- Industrial Ethernet CLI Tools
- Industrial Ethernet GUI Tools
- Summary

Lesson 3: Exploring Layer 2 Considerations
- Unicast, Multicast, and Broadcast Overview
- Planning VLANs for the Industrial Network
- 802.1q VLAN Trunking
- Smartports Macros
- Summary

Discovery 1: Plan and Configure VLANs

Hardware Lab 2: Configuring 802.1q Trunks
- Plan inter-switch trunk requirements
- Configure the switch port to perform 802.1q trunk operations
- Verify the switch port 802.1q trunk operations

Lesson 4: Layer 2 Resiliency Using Spanning Tree Protocol
- Layer 2 Resiliency in the IACS Network.
- Managing Spanning Tree Protocol
- Types of Spanning Tree Protocols
- Spanning Tree Operation Review
- Changing STP Priority
- PVRST+ Configuration
- RSTP Port Roles
- Spanning-Tree Port Types and States
- PortFast Configuration
- Verifying PVRST+
- Introducing MSTP
- Implementing MSTP
- Summary

Discovery 2: Verify and Configure STP Settings
Discovery 3: Configuring the STP priority
Discovery 4: STP Path Manipulation

Lesson 5: Layer 2 Resiliency Considerations
- Unidirectional Link Failure
- Configuring UDLD
- FlexLinks in the Access Layer
- Configuring Link Aggregation using Etherchannel
- Describe EtherChannel
- Configuring Port Channels Using EtherChannel
- Verify EtherChannel
Discovery 5: Switch Alarm Configuration

Discovery 6: Configure Power Supply Alarm to Monitor Dual Power Supplies

Discovery 7: Configure and Apply Alarm Profile to Port

Hardware Lab 3: Configuring and Applying Smartports Macros
- Apply Smartports macro on Cisco switches
- Configure Smartports macro on the Rockwell Automation (Allen-Bradley) Stratix 5700 Switch

Hardware Lab 4: Configuring and Applying Custom Smartports Macros
- Configure Custom Smartports Macro on Industrial Ethernet Switches

Hardware Lab 5: Configuring and Applying EtherChannel
- Apply EtherChannel Configuration

Hardware Lab 6: Configuring Resilient Ethernet Protocol
- Configure the REP Administrative VLAN
- Configure the REP Segment edge ports
- Configure the REP Segment ports
- Verify the REP Segment topology

Hardware Lab 7: Configuring Resilient Ethernet Protocol Features
- Configure the REP VLAN load balancing
- Configure the REP SNMP mib

Hardware Lab 8: Configuring and Verifying Storm Control
- Verify the current interface storm control settings
- Configure the interface storm control settings on Stratix 5700

Lesson 6: Layer 2 Multicast Control and QoS
- Multicast Traffic Management
- Layer 2 Traffic Forwarding Review
- Multicast Addressing
- Internet Group Management Protocol
- IGMP Snooping
- Configuring IGMP and IGMP Snooping
- Verify IGMP and IGMP Snooping
- Layer 2 Quality of Service in the IACS
- Configuring QoS in the IACS
- Summary

Hardware Lab 9: Verify IP IGMP Snooping
- Verify the IGMP Snooping configuration
- Configure the IGMP Snooping address
Hardware Lab 10: Configure QoS settings
- Verify the current configuration QoS status
- Apply and verify the Smartports macro QoS configuration

Lesson 7: Exploring Layer 3 Considerations
- IP Address Usage in the IACS
- IP Routing Overview
- Dynamic Routing Protocol Overview
- Classful vs. Classless routing protocols
- Traditional Network Address Translation
- Layer 2 Network Address Translation
- VRF Lite
- Summary

Discovery 8: Configure and Verify Static Route
Discovery 9: Configure Static IP route
Discovery 10: Configure Static default IP route
Discovery 11: Configure and Verify Layer 2 NAT

Lesson 8: Module Summary

Lesson 9: Module Self-Check

Module 2: General Troubleshooting Issues

Lesson 1: Troubleshooting Methodologies
- Troubleshooting Method
- Common Troubleshooting Approaches
- Built-in IOS Troubleshooting Tools
- CPU Utilization
- Troubleshoot Memory Issues
- Network Management System (NMS)
- View Syslog
- Read Log Messages
- Summary

Lesson 2: Troubleshooting Layer 1
- Knowledge as a Tool
- Media Testing Tools
- Troubleshooting Physical Media
- Show Interface Error Counters
- Troubleshoot Copper Cables
- Summary
**Hardware Lab 11: Using IOS Troubleshooting Tools**
- Examine IOS Output
- View CPU utilization in Device Manager

**Lesson 3: Troubleshooting Layer 2 Issues**
- Layer 2 Troubleshooting Tools
- Troubleshooting Endpoint Device Connectivity
- Troubleshooting Inter-Switch Connectivity
- Troubleshoot STP Topology
- Troubleshooting REP
- Troubleshoot Error Disabled Ports
- Common Layer 2 Issues
- Configuration Issues
- Traffic Issues
- Switch Hardware Failure
- Summary

**Hardware Lab 12: Troubleshooting Layer 2 Endpoint Device Connectivity**
- Verify endpoint device physical port connection using the port status LED
- Verify endpoint device physical port configuration using the show running-config interface IOS command
- Verify endpoint device connection and layer 2 communication using the “show mac-address table” IOS command
- Verify the endpoint device switch interface is associated to the correct vlan using the “show vlan” IOS command
- Verify the switchport operational status using the “show interfaces” IOS command
- View the active configuration by using the “show running-config” IOS command

**Hardware Lab 13: Troubleshooting Layer 2 Inter-Switch Connectivity**
- Verify layer 2 switch to switch communication by using the “show cdp neighbor” IOS command
- Verify layer 2 switch to switch communication by using the “show interface trunk” IOS command
- Verify endpoint device layer 2 traffic flow using the “show mac address-table” command.
- Verify the status of the Etherchannel configured n the PODx_IE3K switch

**Hardware Lab 14: Troubleshooting Broken REP Segment**
- Verify functional REP segment topology status
- Introduce a Simulated Link Failure
- Troubleshoot, repair and normalize the REP topology

**Lesson 4: Troubleshooting Layer 3 Issues**
- Layer 3 Troubleshooting Tools
- Identify Layer 3 Routes
- Determine the Communication Path
- Nonfunctional Network Nodes
- Troubleshoot Packet Loss
- Perform a Packet Capture
- Information About SPAN and RSPAN
- Summary
Hardware Lab 15: Troubleshooting Layer 3
- Verify layer 3 network reachability using the “show ip route” command
- Troubleshoot layer 3 connections using PING
- Verify Layer 3 Reachability with Telnet
- Verify the layer path with Traceroute

Hardware Lab 16: Perform a Packet Capture
- Configure SPAN Port Session
- Launch Wireshark and perform packet capture

Hardware Lab 17: Troubleshoot Network Issues
- Load Network Issues
- Find the Network Fault

Lesson 5: Module Summary

Lesson 6: Module Self-Check

Module 3: Ethernet/IP

Lesson 1: Exploring Ethernet/IP Communications
- Exploring EtherNet/IP™ Communications
- CIP
- EtherNet/IP
- CIP Protocol Characteristics
- CIP Connection Types
- Object Modeling
- CIP Communications
- CIP Messaging
- CIP Models
- Producer/Consumer Model
- Unicast vs. Multicast—Factors
- CIP Data Flow – Consumer
- Consumer and Producer I/O Communications
- Summary

Lesson 2: Exploring Hardware Capabilities
- EtherNet/IP Endpoints
- Implicit vs. Explicit Messaging
- CIP I/O Connections
- ControlLogix Redundancy
- Device Profiles
- I/O Assembly Instances
- Add-On Profiles
Lesson 3: Exploring CIP Sync, CIP Motion, and CIP Safety

- CIP Sync
- Precision Time Protocol
- CIP Sync
- CIP Sync Requirements
- Quality of Service
- Clock Types and Precision Time Protocol Modes
- Best Master Clock
- Precision Time Protocol Messages
- Precision Time Protocol Priority
- Troubleshooting Precision Time Protocol
- CIP Motion
- CIP Safety
- CIP Safety Wireshark
- Summary

Discovery 12: Configure and Verify Precision Time Protocol on the Cisco IE 2000 Series Switch
Discovery 13: Configure and Verify Precision Time Protocol on the Cisco IE 3000 Series Switch

Lesson 4: Exploring Embedded Switch Technology

- Embedded Switch Technology
- Device-Level Ring Network
- Layer 2 Resiliency Protocols Compared
- Embedded Switch Technology Use Cases
- Embedded Switch Technology Features
- Embedded Switch Technology Considerations
- Summary

Lesson 5: Configuring Stratix Switches

- Add-On Profiles
- Stratix Switch Configuration
- SD Flash Sync
- Save/Restore
- Summary

Discovery 14: Add a Stratix 5700 Switch Add-On Profile (AOP) to a Studio 5000 Logix Designer Application
Discovery 15: Configure a Stratix 5700 Switch Using an Add-On Profile (AOP) in a Studio 5000 Logix Designer Application

Hardware Lab 18: Configure CIP on Industrial Switches

- Configure CIP on a Cisco IE 2000 Switch Using Command Line Interface
- Configure CIP on a Cisco IE 3000 Switch Using Command Line Interface
- Configure an IP Address for CIP VLAN 25 on a Stratix 5700 Switch Using the Device Manager Web Interface
- Configure Precision Time Protocol (PTP) on a Stratix 5700 Switch using the Cisco Device Manager Web Interface
Lesson 6: Module Summary

Lesson 7: Module Self-Check

Module 4: Troubleshooting Ethernet/IP

Lesson 1: Identifying Common EtherNet/IP Issues
- Connectivity Issues
- Troubleshooting Device-Level Ring (DLR) Networks
- Performance Issues
- Summary

Lesson 2: EtherNet/IP Troubleshooting Methods and Tools
- Troubleshooting Methods Review
- RSLinx Classic
- Studio 5000 Logix Designer
- Command Line Interface
- HMI
- Device Manager Web Interface
- Wireshark
- Summary

Hardware Lab 19: Troubleshooting EtherNet/IP Communication Issues
- Load CIP Configuration Error into Industrial Switches
- Troubleshoot a CIP Configuration Error in a Cisco IE 2000 Series Switch
- Apply Corrective Action to Restore CIP Communication
- Verify Restored CIP Communication
- Troubleshoot CIP Configuration Error in a Stratix 5700 Series Switch
- Troubleshoot a CIP Configuration Error in a Cisco IE 3000 Series Switch

Lesson 3: Module Summary

Lesson 4: Module Self-Check

Module 5: PROFINET

Lesson 1: Describe PROFINET Functionality and Connection Method
- Protocol Characteristics
- Discovery and Configuration Protocol
- PROFINET Communications
- PROFINET Models
- Optimizing PROFINET
- PROFIsafe
- Summary
Lesson 2: Describing Basic PROFINET Devices
- Conformance Classes Build on One Another
- Conformance Class C is synchronous, while Conformance Classes A and B are cyclic.
- Conformance Class A
- Conformance Class B
- Conformance Class C
- Summary

Lesson 3: Understanding Ring Network Requirements
- Network Redundancy
- Controller Redundancy
- Device Redundancy
- Summary

Lesson 4: Module Summary

Lesson 5: Module Self-Check

Module 6: Configuring PROFINET

Lesson 1: Enabling and Prioritizing PROFINET at L2
- Configure a Switch for PROFINET Communication
- Configure Layer 2 QoS
- Summary

Discovery 16: Disable and Enable PROFINET
Discovery 17: Configure L2 Quality of Service

Lesson 2: Integrating Cisco Industrial Ethernet Switches
- Cisco Switch Configuration
- Cisco Switch Validation
- Summary

Lesson 3: Configuring PROFINET Alarms
- Configure an Alarm
- Summary

Discovery 18: Configure an Alarm
Discovery 19: Verify an Alarm

Hardware Lab 20: Configuring PROFINET Support
- Change the Default Gateway for the Switches
- Copy a GSD File from a Switch
- Install a GSD File into TIA Portal Software
- Configure PROFINET Management Support on a Cisco IE 2000 Switch
- Configure PROFINET Management Support on a Cisco IE 3000 Switch
Lesson 4: Module Summary

Lesson 5: Module Self-Check

Module 7: Troubleshooting PROFINET

Lesson 1: Identifying PROFINET Troubleshooting Methods
- Review: Troubleshooting Method
- Connectivity Issues
- Performance Issues
- Summary

Discovery 20: Adjust the Update Time for a Switch

Lesson 2: Exploring PROFINET Troubleshooting Tools
- Discovery 21: CLI/Prompt Commands
- Web Interface
- SNMP-OPC Server
- Summary

Discovery 22: Analyze PROFINET Traffic using Wireshark

Hardware Lab 21: Troubleshoot PROFINET Communication Issues
- Troubleshoot PROFINET Communication Problem 1
- Troubleshoot PROFINET Communication Problem 2
- Troubleshoot PROFINET Communication Problem 3

Lesson 3: Module Summary

Lesson 4: Module Self-Check

Module 8: Exploring Security Concerns

Lesson 1: Overview Of Defense-in-Depth Strategy
- Identify Threats in the IACS network
- Attack Continuum
- New Security Model Approach
- Define the Defense-in-Depth Strategy
- Integrated Security Features for Industrial Ethernet Products
- Security Policy Lifecycle
- Summary
Lesson 2: Controlling Access and Network Traffic

- User and Device Access Control
- Using AAA features
- Using Access Control Lists
- ACL Operation
- Discovery 23: Examine Basic traffic Control using ACL
- Using 802.1x and Cisco ISE
- Cisco Identity Services Engine
- Using Port Security
- Using DHCP Snooping
- Using Dynamic ARP Inspection
- Using Unicast Reverse Path Forwarding
- Using VLANs as Security
- Using Firewalls
- Using Secure Remote Access
- Using IPS/IDS
- Summary

Hardware Lab 22: Configure Port Security Mechanisms

- Remove SPAN Session (port mirroring) from IE3K
- Verify PC2 Connectivity
- Configure Port Security using the Device Manager
- Configure IP DHCP Snooping
- Configure Dynamic ARP Inspection

Hardware Lab 23: Configure AAA Authentication using Cisco ISE and 802.1x

- Configure AAA authentication on PODx_IE3K switch
- Configure Client PC 802.1X Supplicant
- Test employee authentication/authorization
- Configure Client PC2 to disable 802.1X Supplicant
- Test Guest Authentication/Authorization

Lesson 3: Module Summary

Lesson 4: Module Self-Check

Module 9: 802.11 Industrial Ethernet Wireless Networking

Lesson 1: Understanding 802.11 Networks

- 802.11 Overview
- Wireless Infrastructure Devices
- Ad Hoc Networks
- Infrastructure Mode
- Service Set Identifiers
- Workgroup Bridges
- Repeaters
• Non-802.11 Radio Interferers
• 802.11 Standards for Channels and Speeds
• Describing Wireless Security Components
• Key Management
• 802.1X/EAP Framework
• Summary

Lesson 2: Industrial WLAN Design Considerations
• Industrial Wireless Introduction
• Industrial Wireless IACS Use Cases
• WLAN Architecture Types
• Wireless Client Types
• WLAN Equipment Topologies
• Performing a Wireless Site Survey
• Autonomous and Unified CPwE WLAN Architectures
• Configure Workgroup Bridge Mode on Access Point
• Summary

Discovery 24: Explore Wireless LAN Controller
Discovery 25: Configure Wireless Workgroup Bridge on Stratix 5100

Lesson 3: Module Summary

Lesson 4: Module Self-Check
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