Rockwell Automation

Innovation & Technology Forum

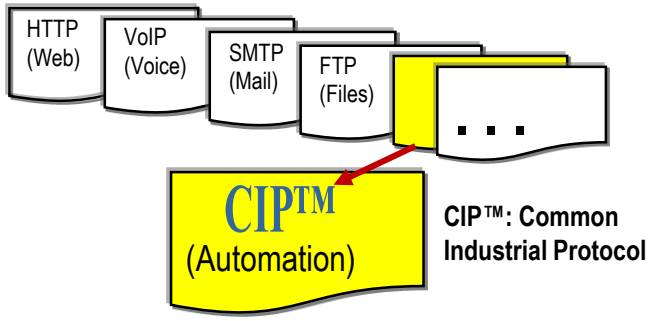
NT03 - Basic Stratix® Switch and EtherNet/IP Features in Converged Plantwide Ethernet (CPwE) Architectures

Petr DRAHOTA

Commercial Engineer Power & Components

EtherNet/IP Technology

- The same Ethernet technology…
  - as email, voice, video, the Internet, web pages
  - as the corporate network
  - known by IT professionals
  - on your home and office computers
- Running Common Industrial Protocol (CIP™):
  - The most widely used standard, application layer industrial protocol globally
  - Standardized through IEC, ISO, ODVA, and others
  - Same technology as DeviceNet and ControlNet
  - Rockwell Automation® and Cisco and other major vendors like Schneider, Omron, Bosch-Rexroth & 300+



Standard application-layer protocol

EtherNet/IP™

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Convergence of Operational Technology (OT) with Information Technology (IT)

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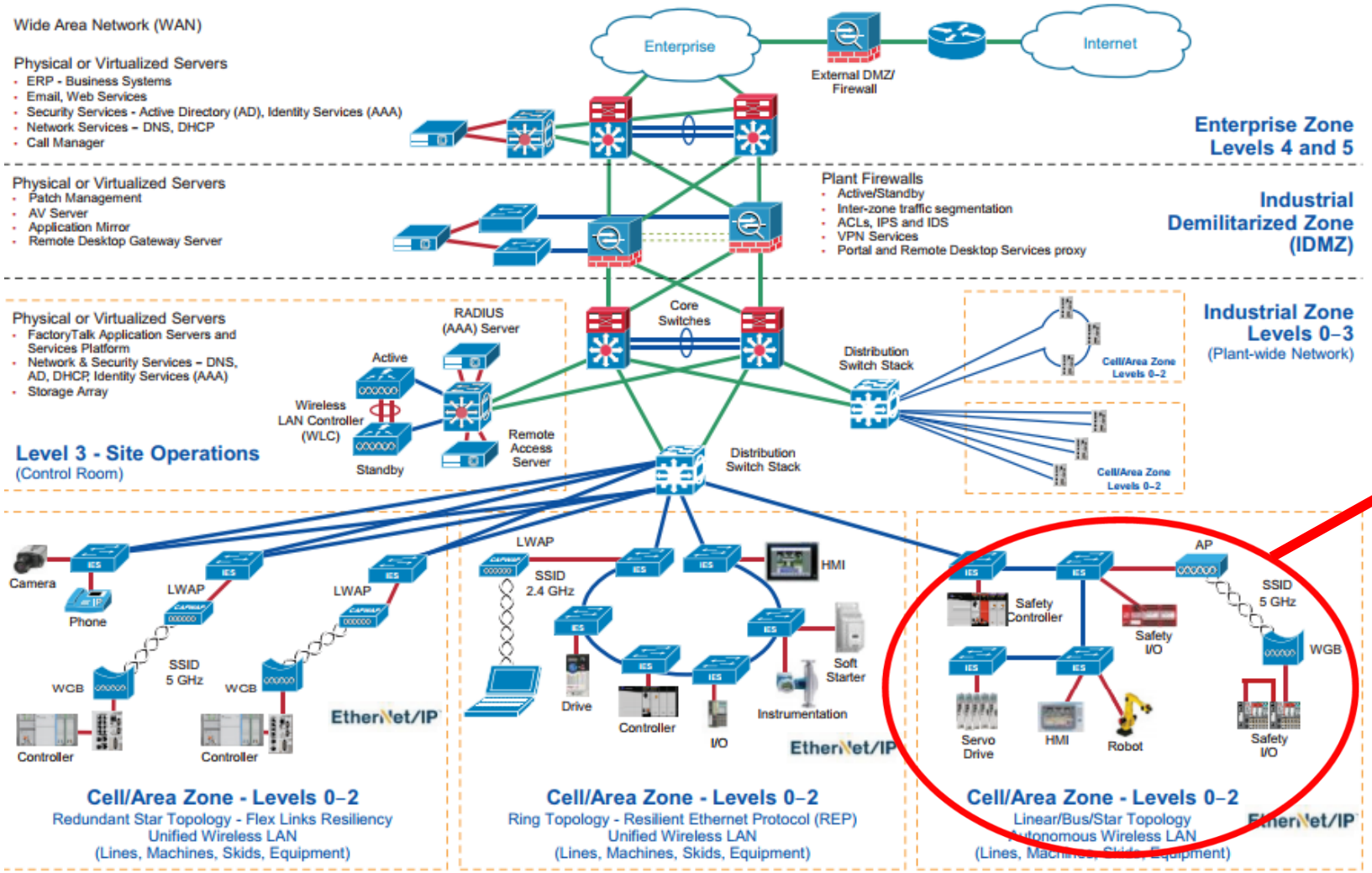
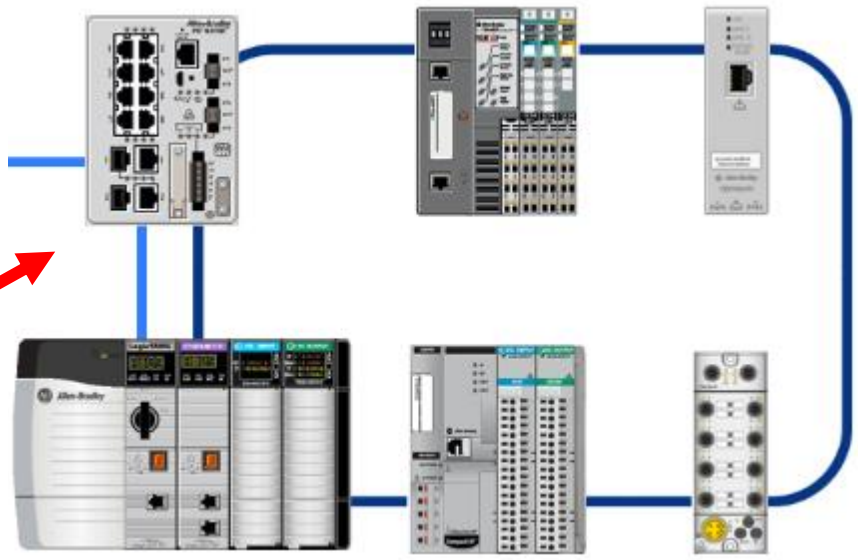
Cell/Area Zone Within CPwE



Cell/Area Zone



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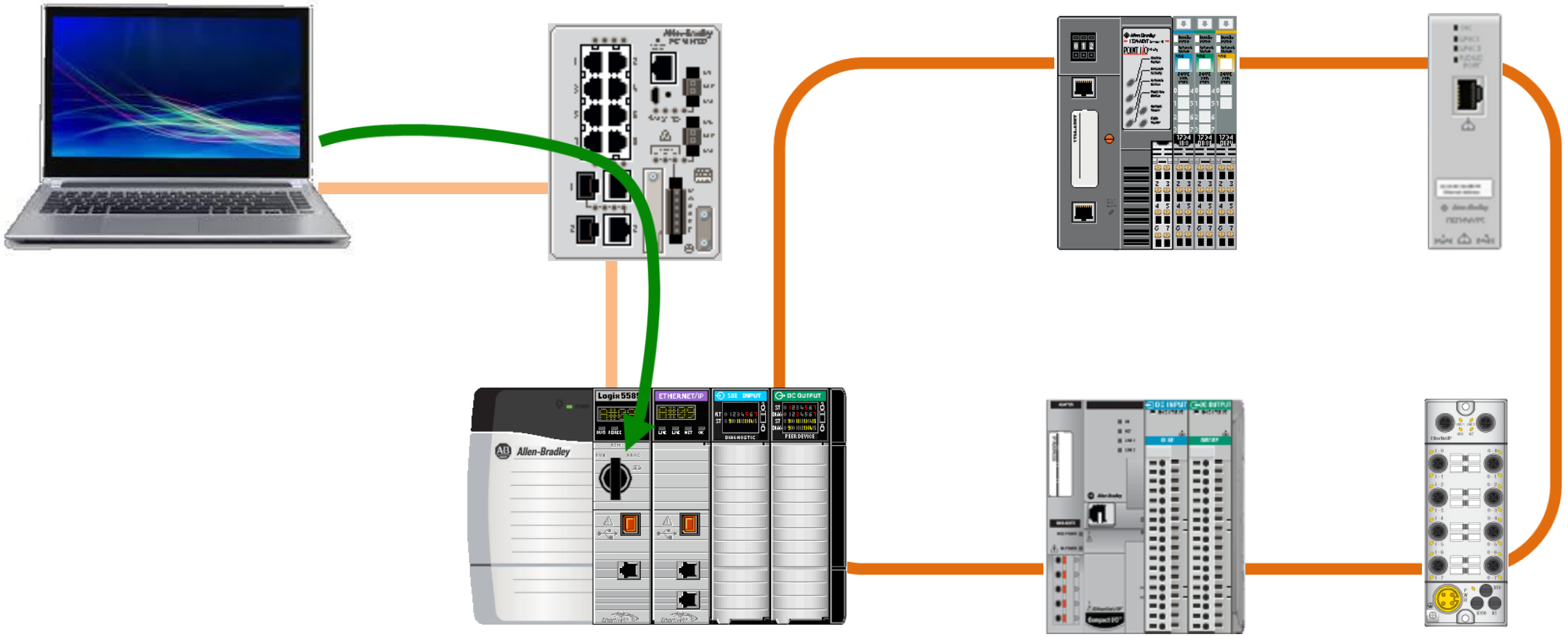
Traditional Cell/Area Zone Network Architecture



- Controller can be accessed from the local or enterprise network

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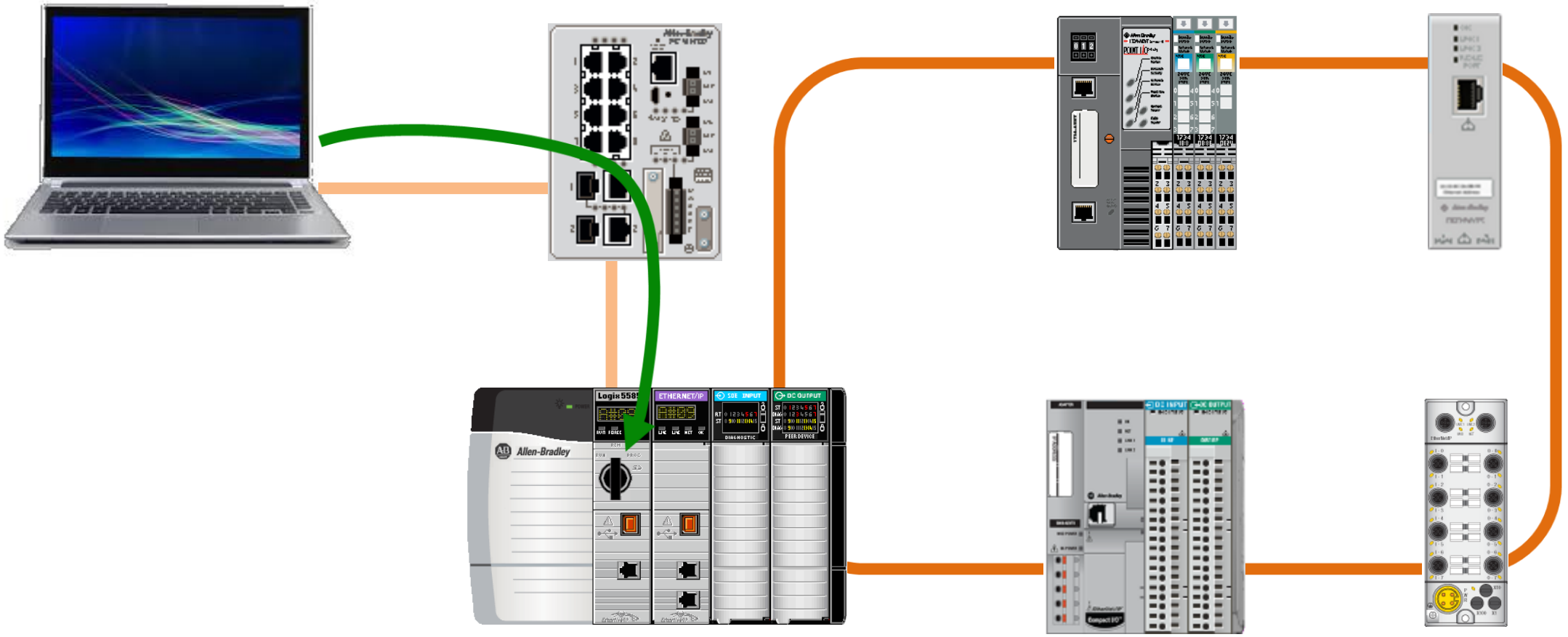
Traditional Cell/Area Zone Network Architecture



- Studio 5000® environment access
- HMI and data collection access
- Use of diagnostic tools and web page

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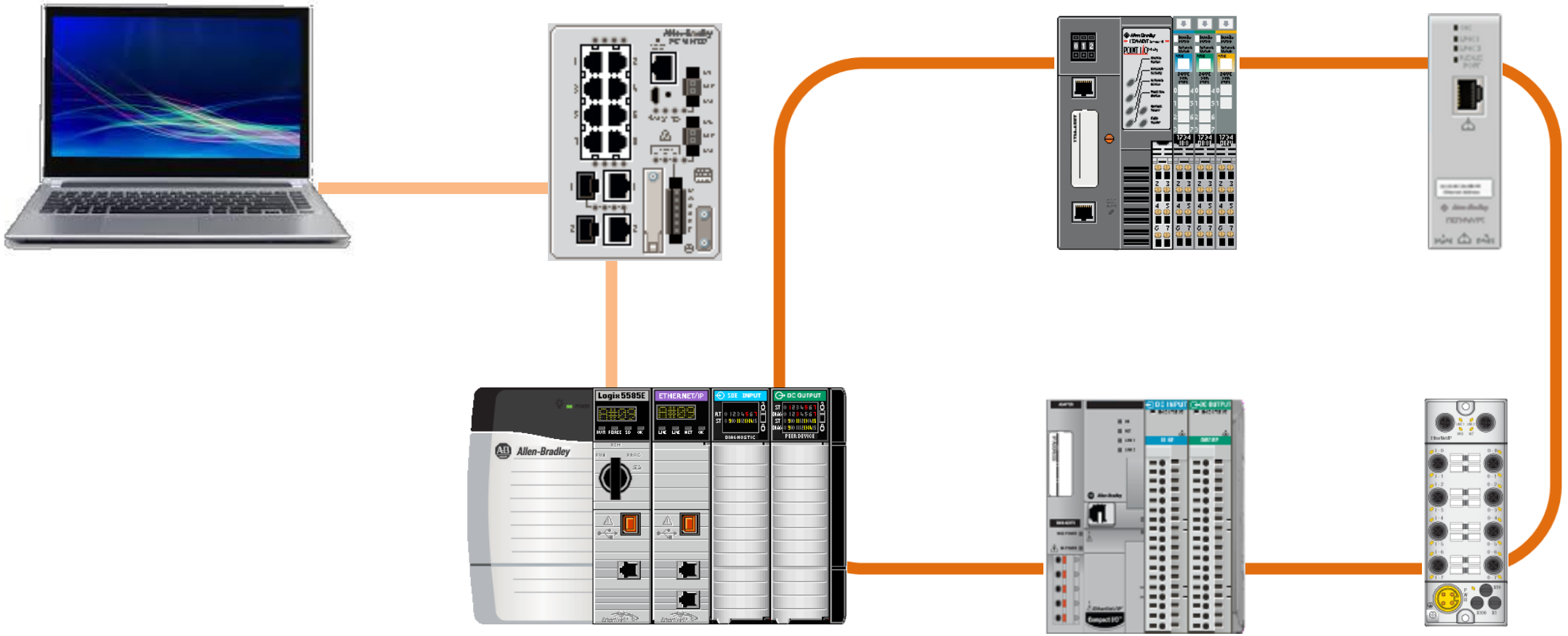
Traditional Cell/Area Zone Network Architecture



- I/O network is isolated

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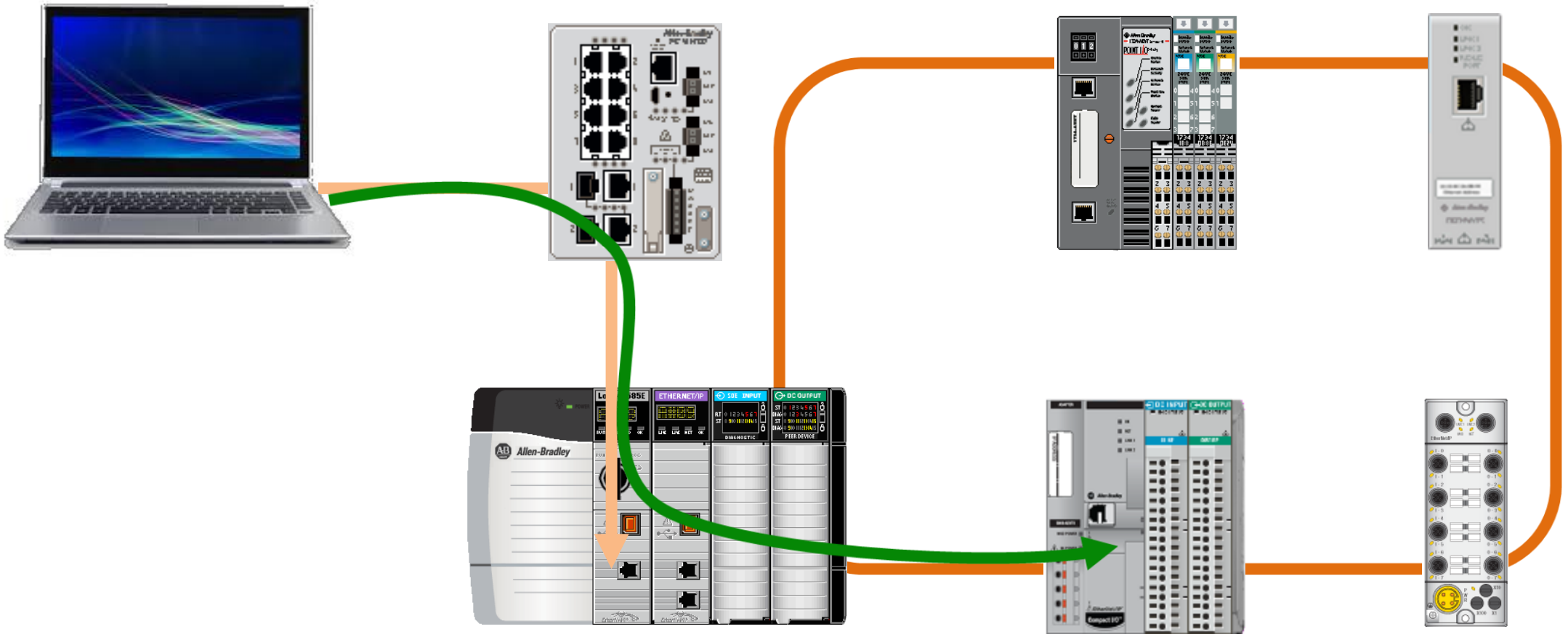
Traditional Cell/Area Zone Network Architecture



- Device access is limited by the backplane to CIP™ traffic only

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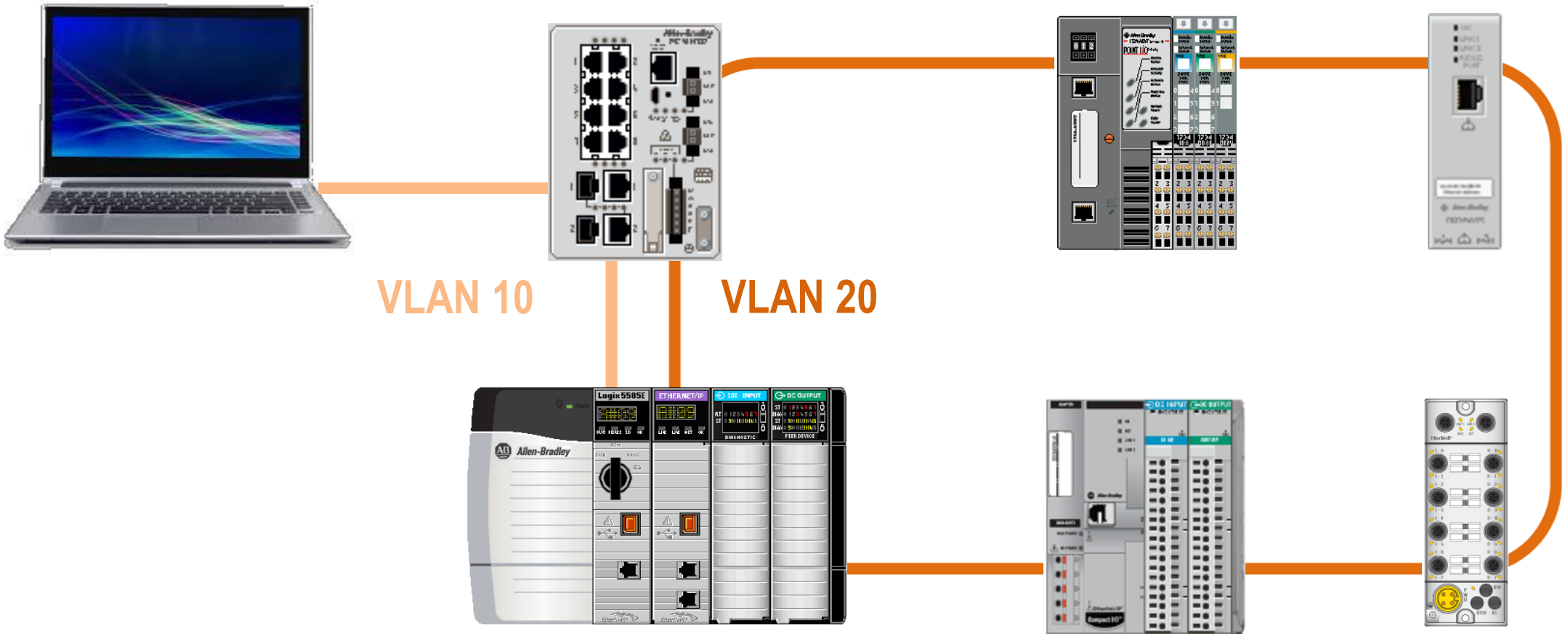
Converged Cell/Area Zone Network Architecture



- Stratix® Switch can be a part of the I/O network
- Logical segmentation using VLANs

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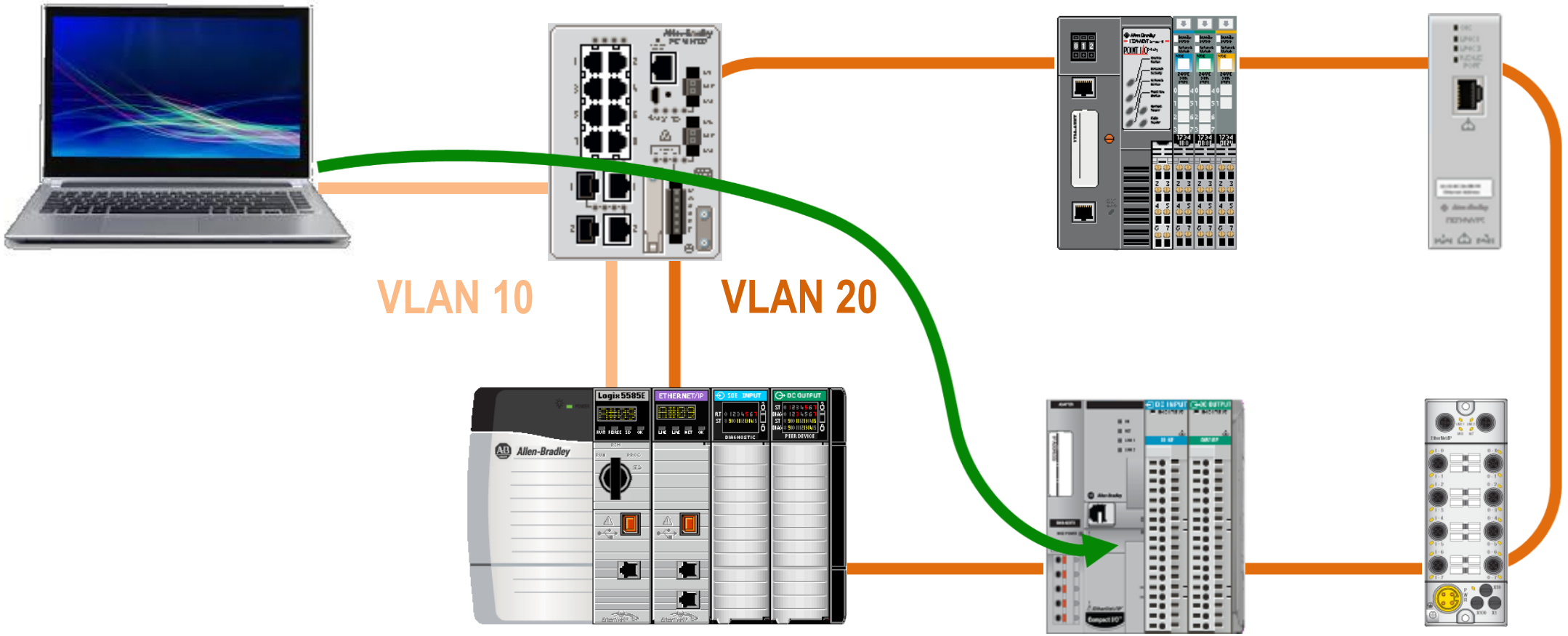
Converged Cell/Area Zone Network Architecture



- Allows full device access bypassing the controller
- Connected Routing allows communication between VLANs

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Basic Stratix® Switch and EtherNet/IP Features in Converged Plantwide Ethernet (CPwE) Architectures

The following lab will demonstrate how EtherNet/IP and Stratix® managed switches improve reliability, manageability and overall ease of use through simplified integration

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Lab Agenda

- 6 Short Labs, 5–10 minutes each
  - Stratix® 5700 hardware familiarization and commissioning
  - EtherNet/IP I/O and Stratix® 5700 in Studio 5000® environment
  - Stratix® Diagnostic faceplates
  - Device Level Ring (DLR) topology, configuration and diagnostic tools.

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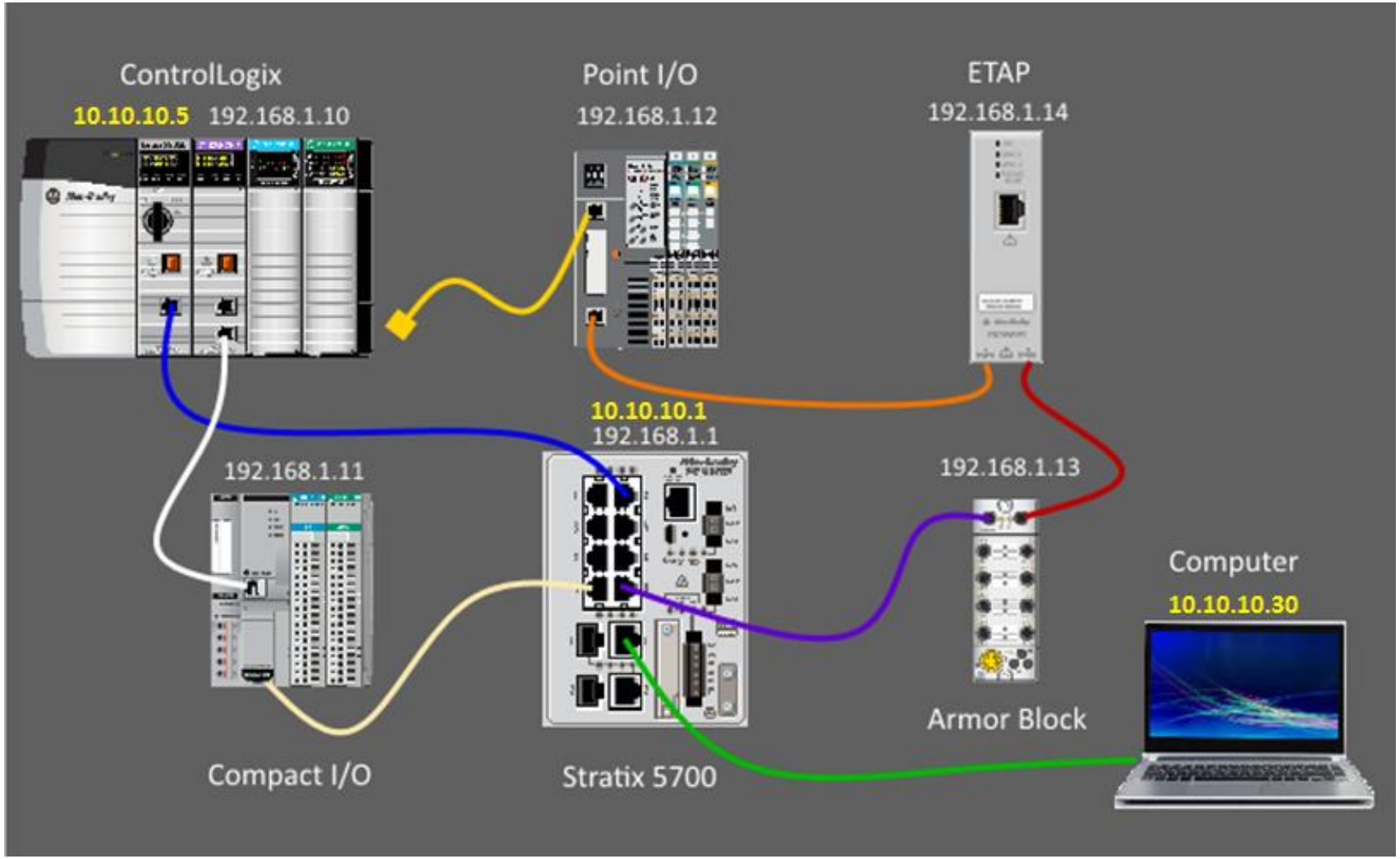
Lab Architecture



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Agenda

Lab 1: Stratix® 5700 Familiarization

Lab 2: Loading Stratix® Switch Configuration

Lab 3: EtherNet/IP devices and Stratix® switches in Studio 5000® Logix Editor

Lab 4: Stratix® 5700 Diagnostic Faceplate

Lab 5: Device Level Ring (DLR) Topology

Lab 6: Stratix® 5700 DLR DHCP Functionality

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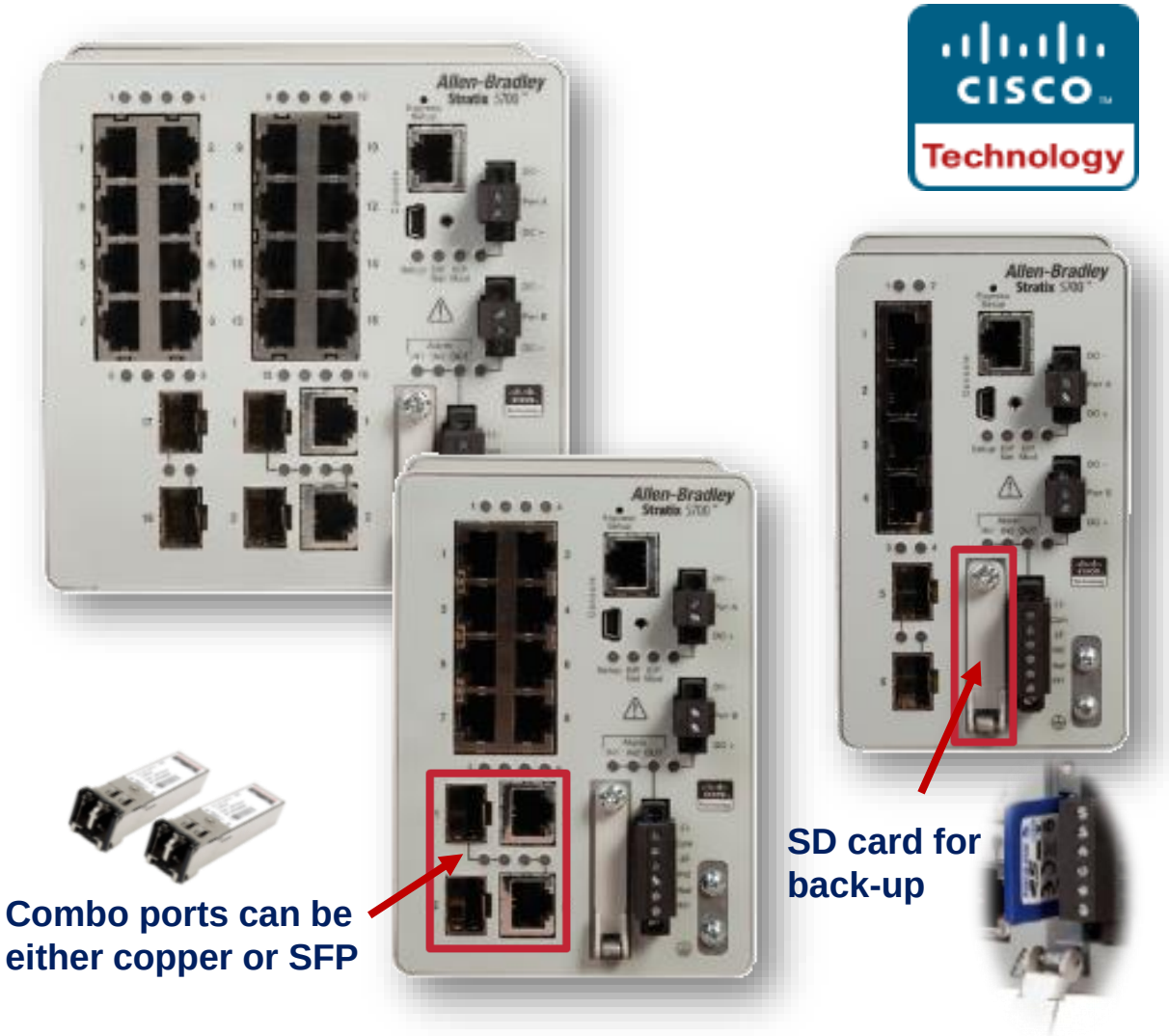
Stratix® 5700 Managed Ethernet Switch

- 4 base platforms that offer 25 configurations
  - 6, 10, 18 and 20-port base units
  - 2 Gig port option
- SFP slots support multi- and single mode fiber
  - Wide variety of SFPs available
- Secure Digital update card (optional)
  - Stores configuration and IOS of switch
- Power over Ethernet (PoE)
  - 4 ports PoE and PoE+ (port configurable)
- Two software packages
  - Lite and Full software versions
- Advanced feature set
  - Integrated DLR (on select versions)
  - Integrated NAT functionality (selected versions)
  - Connected and static routing



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Network Switch Product Overview







Stratix® 2000	Stratix® 2500	Stratix® 6000	Stratix® 5700/ ArmorStratix™ 5700	Stratix® 8000/8300	Stratix® 5400	Stratix® 5410

UNMANAGED

LIGHTLY MANAGED

FULLY MANAGED

HIGH PERFORMANCE MANAGED

100M/1G ← - - - - - - - - - - - - - - - - - - → 100M ← - → 100M/1G ← - → 1G/10G

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Network & Security Portfolio

Unmanaged,
Stratix®

- Low-cost, compact solutions
- Automatically negotiates speed and duplex settings
- No configuration required

Lightly Managed
Stratix®

- Low-cost, compact solutions
- Automatically negotiates speed and duplex settings
- No configuration required, or can be configured to support security, resiliency and bandwidth optimization

Managed Switches
Stratix®

- Access switches & distribution switches
- High Performance switching up to 10 GB
- Integrated Network Address Translation
- Integrated DLR with 3 ring support
- IT and OT configuration and support tools

Security Appliances
Stratix®

- Secure real-time control communication
- Intrusion prevention using Deep Packet Inspection capabilities
- Routing and firewall capabilities
- Access control lists

Communication Modules
1756

- Communication links between devices and ControlLogix® controller
- Can use EtherNet/IP, ControlNet, and DeviceNet network protocols
- Supports real-time I/O & exchange messaging

Embedded Switch &
Linking Devices

- Connects control networks to device level networks
- Leverages existing network structures for migrations

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Lab 6: Stratix® 5700 DLR DHCP Functionality

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Express Setup

- Express Setup enables the switch to operate as a managed switch with a default configuration that supports industrial automation applications.
- Use Express Setup to perform these initial setup tasks
  - Assign the switch an initial IP address.
  - Run the global macro to set initial configuration parameters.

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Multi-mode Express Setup

- Short Press mode
  - Assign the initial IP address of the switch.
- Medium Press mode
  - Use a DHCP server to assign IP address.
- Long Press mode:
  - Reset to factory default settings.

- Details are in the User Manual, publication 1783-UM007I-EN-P

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Loading Stratix® Switch Configuration

- In this lab:
  - Will use the Stratix® 5700 Device Manager web page.
  - Will load pre-defined switch configurations.
- This feature can be used when:
  - It’s necessary to replace a switch.
  - Duplicate a known good configuration into the new application.
- Device Manager is just a one way to accomplish this task
  - We will explore a few more later on.

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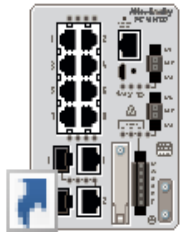
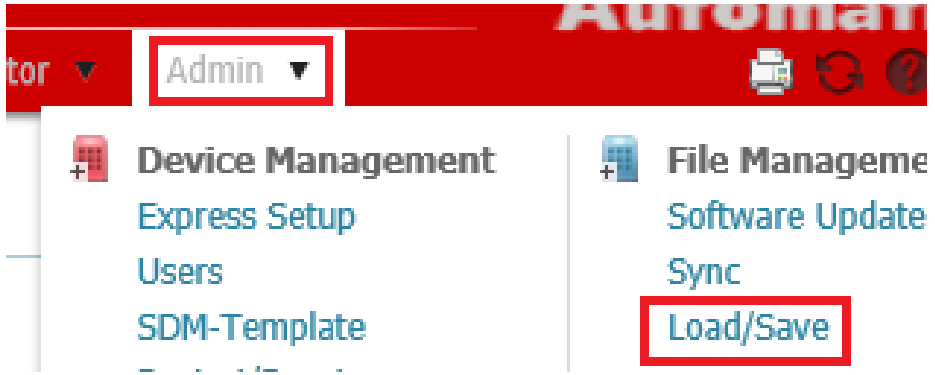
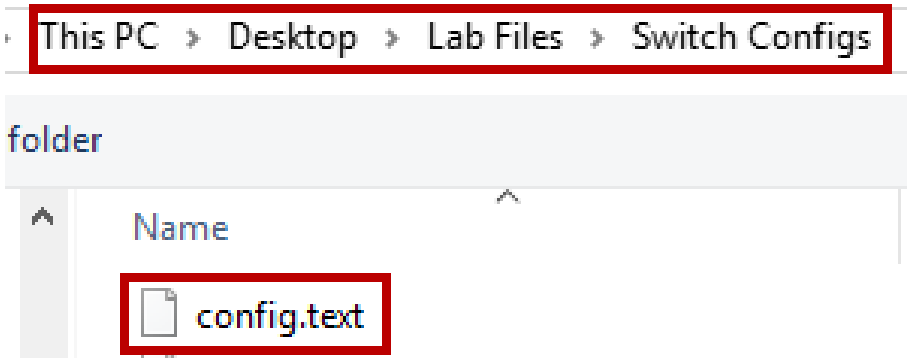
Loading Stratix® Switch Configuration

- Click the Stratix® icon located in the Desktop
- Security Certificate window will come up
  - Select **“Continue to this website…”**
- Use credentials
  - user name ***admin***
  - password ***rockwell*** (low case)
- Select **Admin -> Load/Save**
- Click **Browse** and navigate to

  This PC > Desktop > Lab Files > Switch Configs
- Select the **config.text** file then click **Upload**
- Cycle box power







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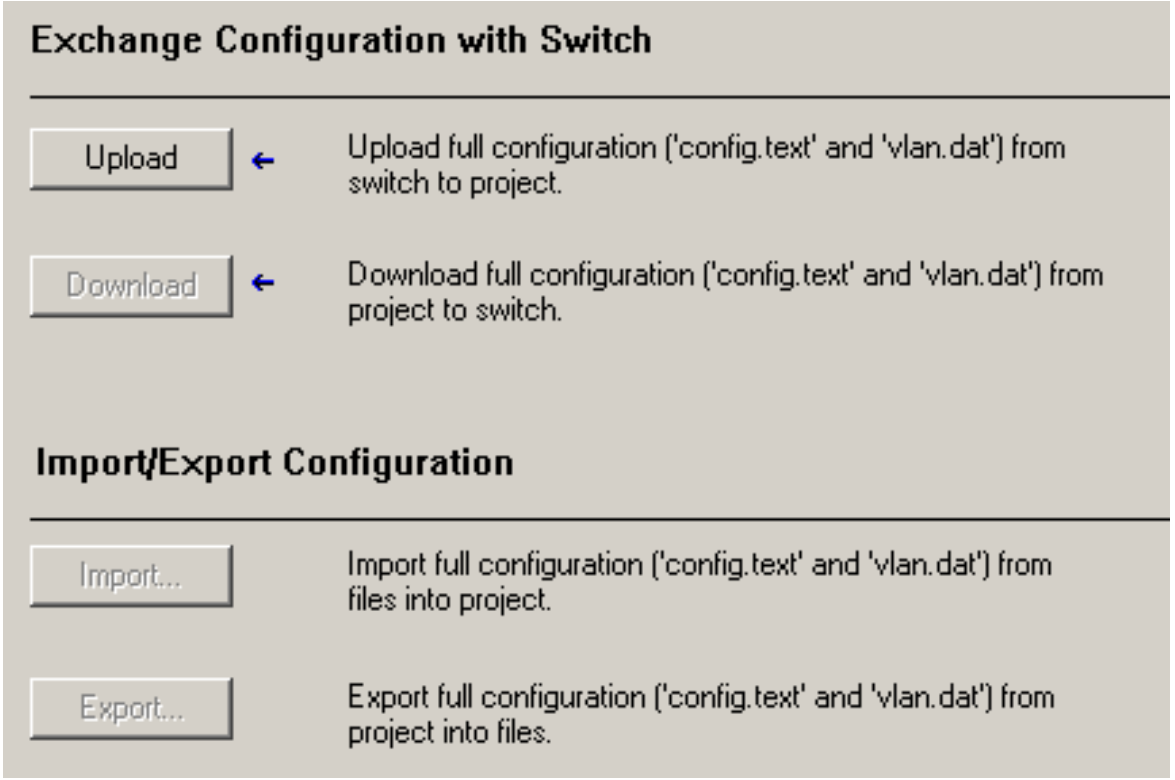
Other Backup/Restore Options

- SD Card
- Back up and Restore Switch configuration using Add-on Profile
  - **Save/Restore** tab
- Command Line Interface (CLI)
- Cisco tools
  - Cisco Network Assistant
  - Cisco Prime



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EtherNet/IP Devices and Stratix® Switches in Studio 5000® Logix Editor

- Import I/O modules - new way to manage I/O
  - Studio 5000® software version 30
  - Import predefined I/O modules and complete chassis into the project
  - Allows quick migration from project to project.
- In this lab:
  - Will use **Import** functionality to add Compact I/O™ rack into the project.
  - Explore the Stratix® 5700 Add-on Profile navigation and functionality it adds.

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EtherNet/IP Devices and Stratix® Switches in Studio 5000® Logix Editor

- Common Industrial Protocol (CIP™) is implemented all Stratix® managed switch product families
  - Allows retrieval of switch and network diagnostic data directly from the switch via its Add-On Profiles (AOPs) into the controller
  - Additional information can be obtained via CIP™ Messaging
- Helps user make informed decisions
  - Problem troubleshooting
  - Minimize the downtime

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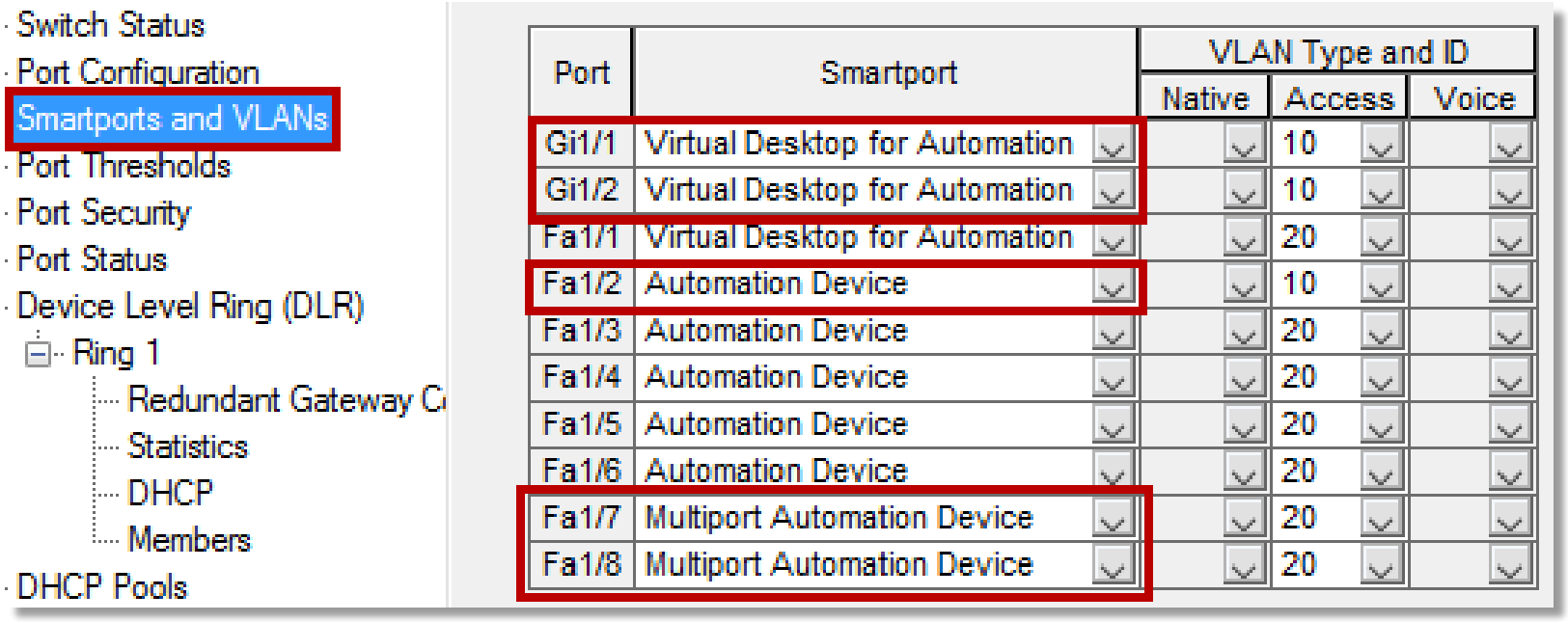
EtherNet/IP Devices and Stratix® Switches in Studio 5000® Logix Editor

- "Must Have" steps in any Stratix® Switch configuration
  - Express Setup
  - Enable CIP™
  - Set Smartports



Port	Smartport	VLAN Type and ID		
		Native	Access	Voice
Gi1/1	Virtual Desktop for Automation		10	
Gi1/2	Virtual Desktop for Automation		10	
Fa1/1	Virtual Desktop for Automation		20	
Fa1/2	Automation Device		10	
Fa1/3	Automation Device		20	
Fa1/4	Automation Device		20	
Fa1/5	Automation Device		20	
Fa1/6	Automation Device		20	
Fa1/7	Multiport Automation Device		20	
Fa1/8	Multiport Automation Device		20	

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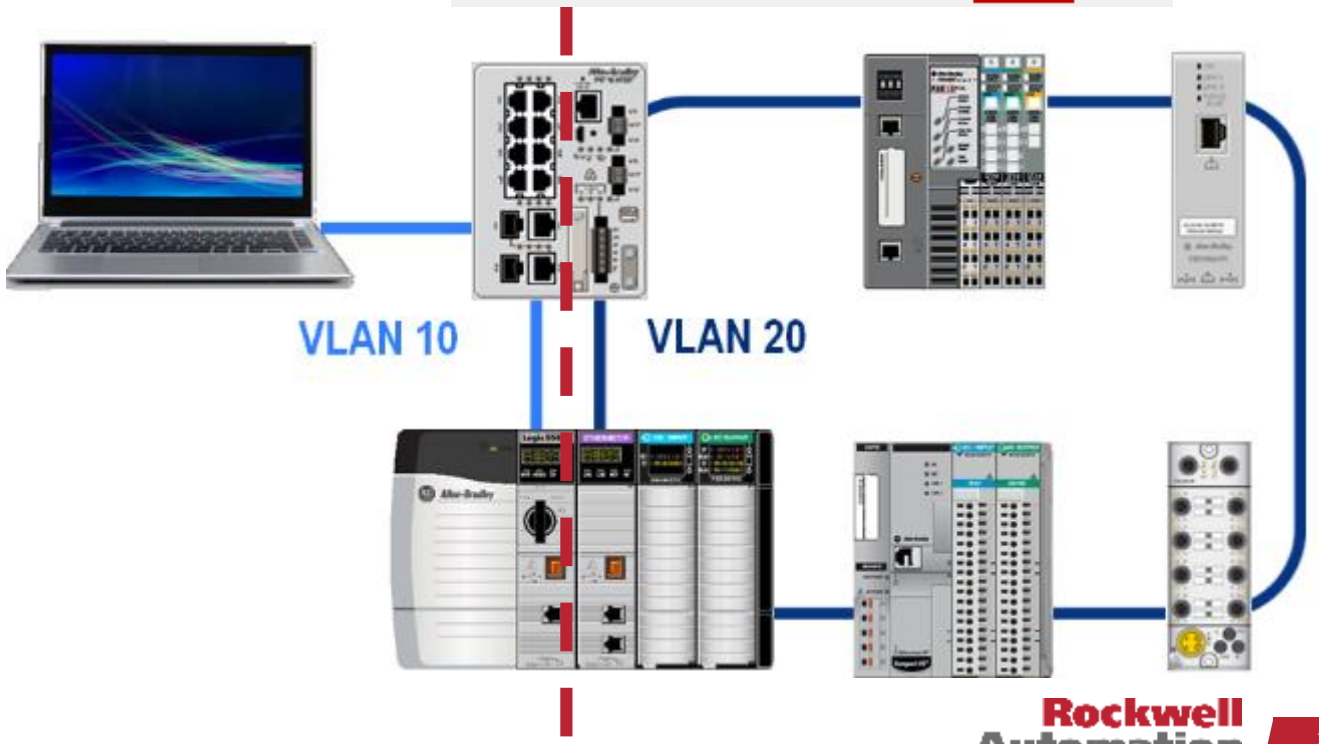
VLAN Concept

- VLAN provides logical segmentation instead of physical segmentation
- VLAN defined as
  - A group of devices on the same Ethernet network
  - Logically separated from the rest of the network
- Benefits
  - Better network organization
  - Limit broadcasts
  - Improve the overall network performance

Port	Smartport	VLAN Type and ID		
		Native	Access	Voice
Gi1/1	Virtual Desktop for Automation		10	
Gi1/2	Virtual Desktop for Automation		10	
Fa1/1	Virtual Desktop for Automation		20	
Fa1/2	Automation Device		10	
Fa1/3	Automation Device		20	
Fa1/4	Automation Device		20	
Fa1/5	Automation Device		20	
Fa1/6	Automation Device		20	
Fa1/7	Multiport Automation Device		20	
Fa1/8	Multiport Automation Device		20	



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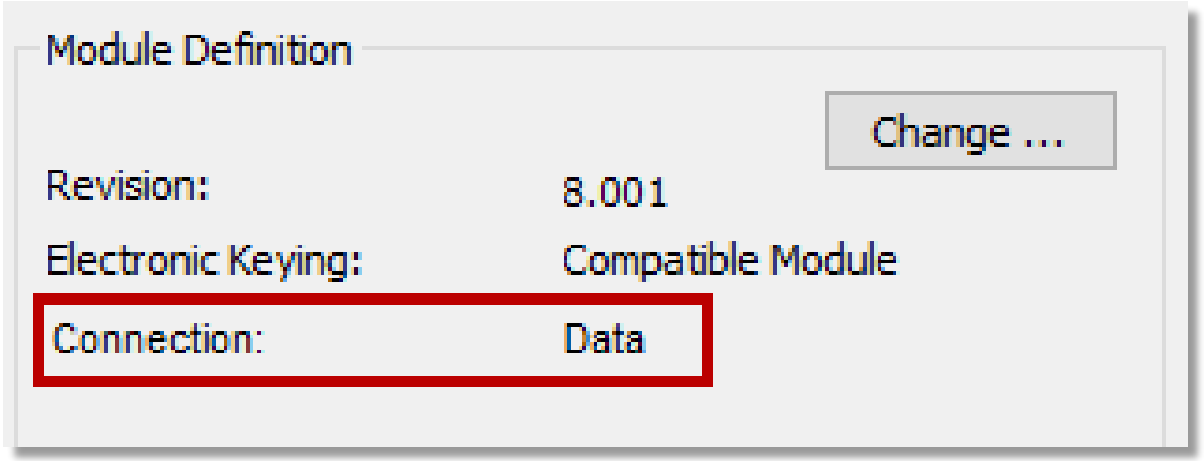
EtherNet/IP Devices and Stratix® Switches in Studio 5000® Logix Editor

- Connection Type “Data”
  - Configure switch parameters
  - Use Output tags to control switch functionality
- Default Connection Type: “Input Data”
  - Read-only information



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Lab 6: Stratix® 5700 DLR DHCP Functionality

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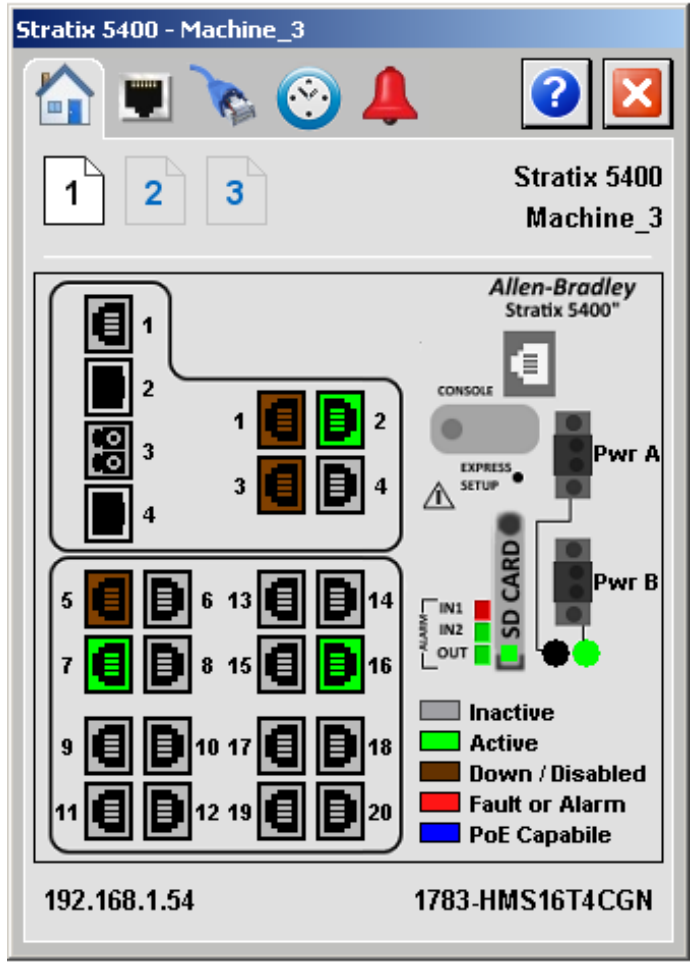
What Is FactoryTalk® View Faceplate?

- Faceplate is a pre-configured set of screens for FactoryTalk® View SE or ME
  - Interfaces with a specific device of feature
  - Provide HMI functionality and integration
- Can be added to a new or existing FactoryTalk® View application
- Provides real time data from a device on a single screen in an organized manner.
- Faceplate allows users to use preconfigured elements
  - Status
  - Control
  - Alarms



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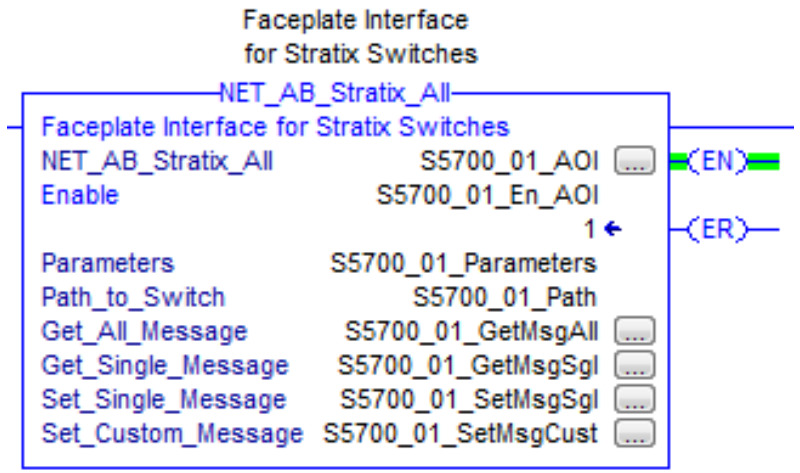
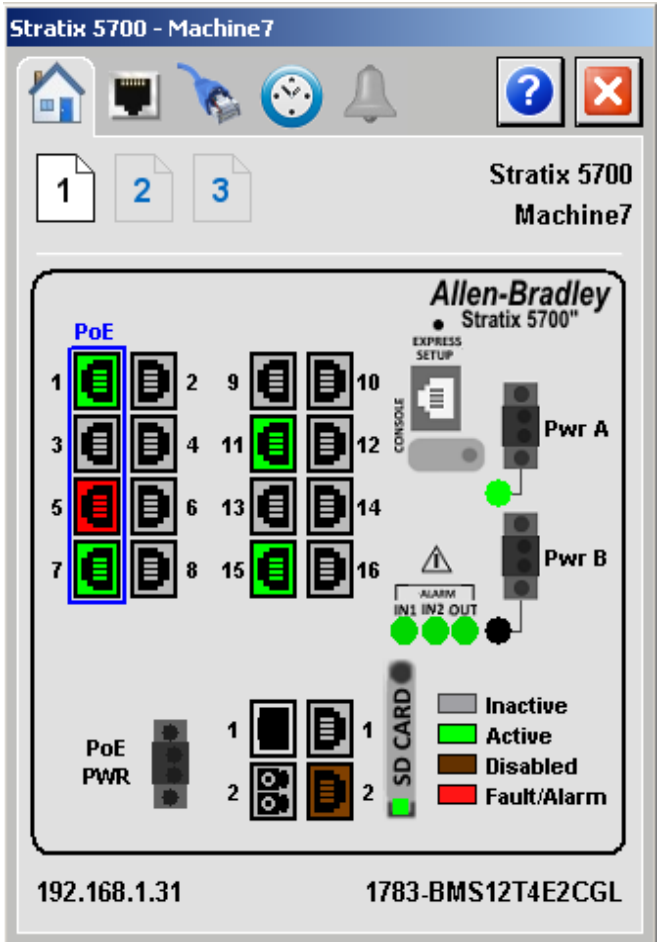
What Is FactoryTalk® View Faceplate?

- Typically a Faceplate consists of
  - An Add-On Instruction that brings device data into the Logix environment
  - A pre-configured screen displayed in FactoryTalk® View SE or FactoryTalk® View ME that interfaces with the Add-On Instruction
  - Implementation instructions and display overview manual





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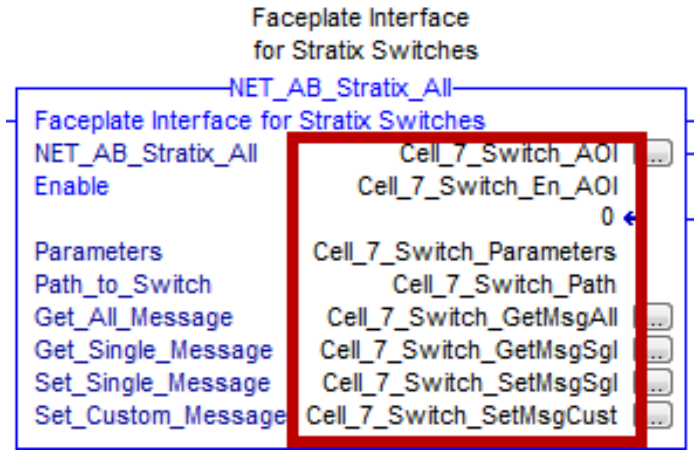
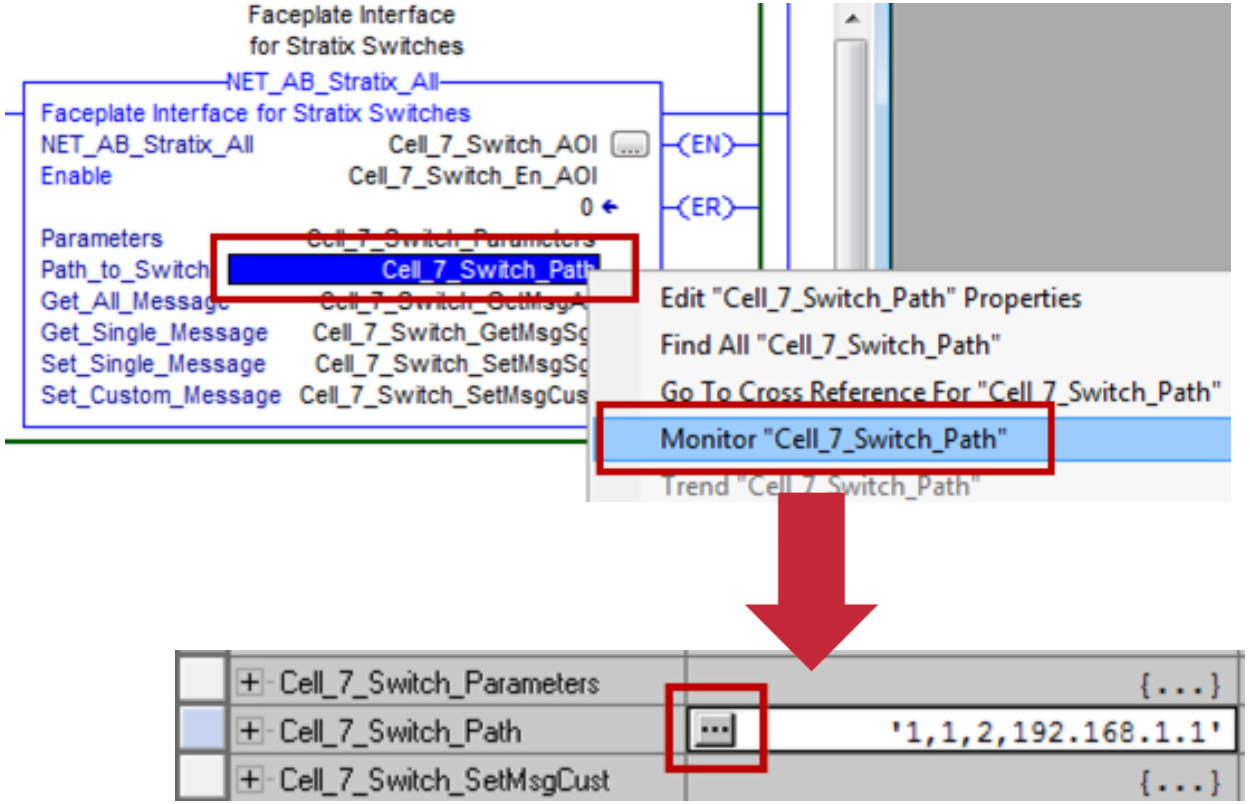
Faceplate Implementation - Logix

- Import Logix Rung
  - Customize Tag names during import process
  - Point Add-On Instruction path to the Switch





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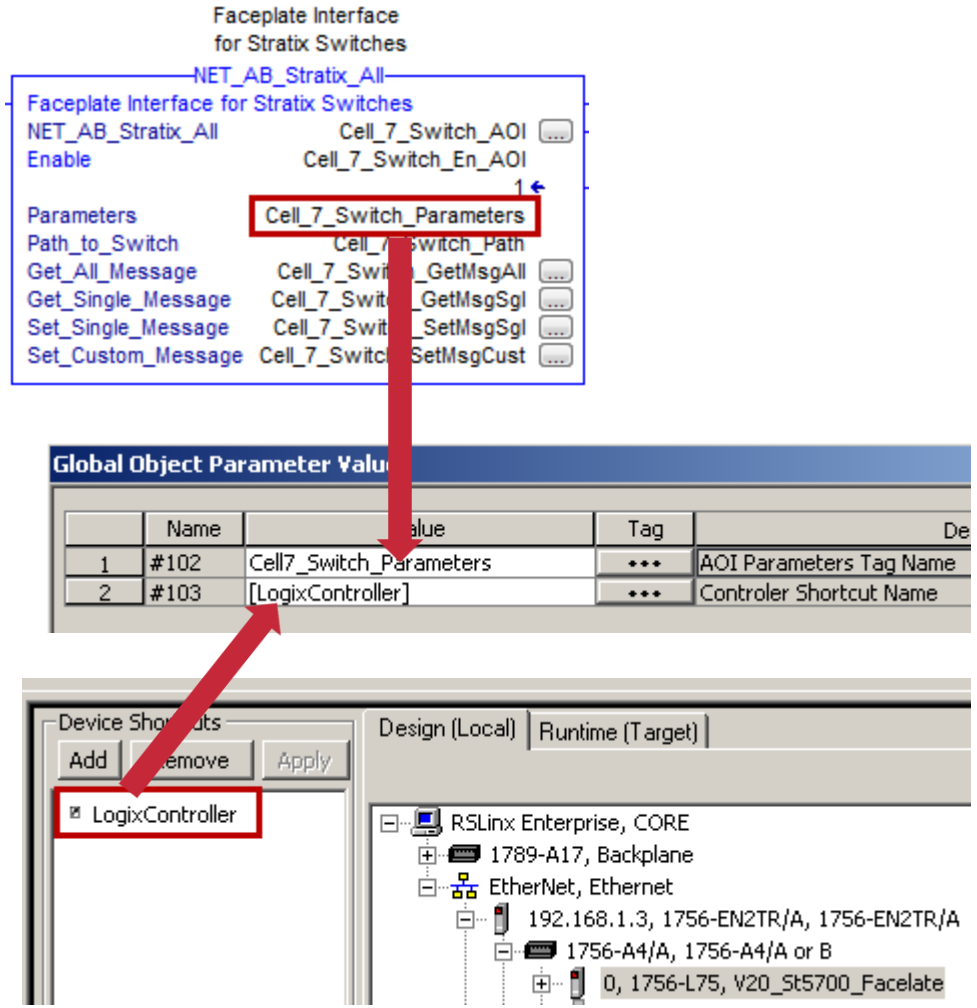
Faceplate Implementation – FactoryTalk® View

- Import FactoryTalk® View Components
  - Images
  - Global Objects
  - Faceplate and Help Displays
- Point OPC Topic to the Controller
- Link Parameters tag with FactoryTalk® View



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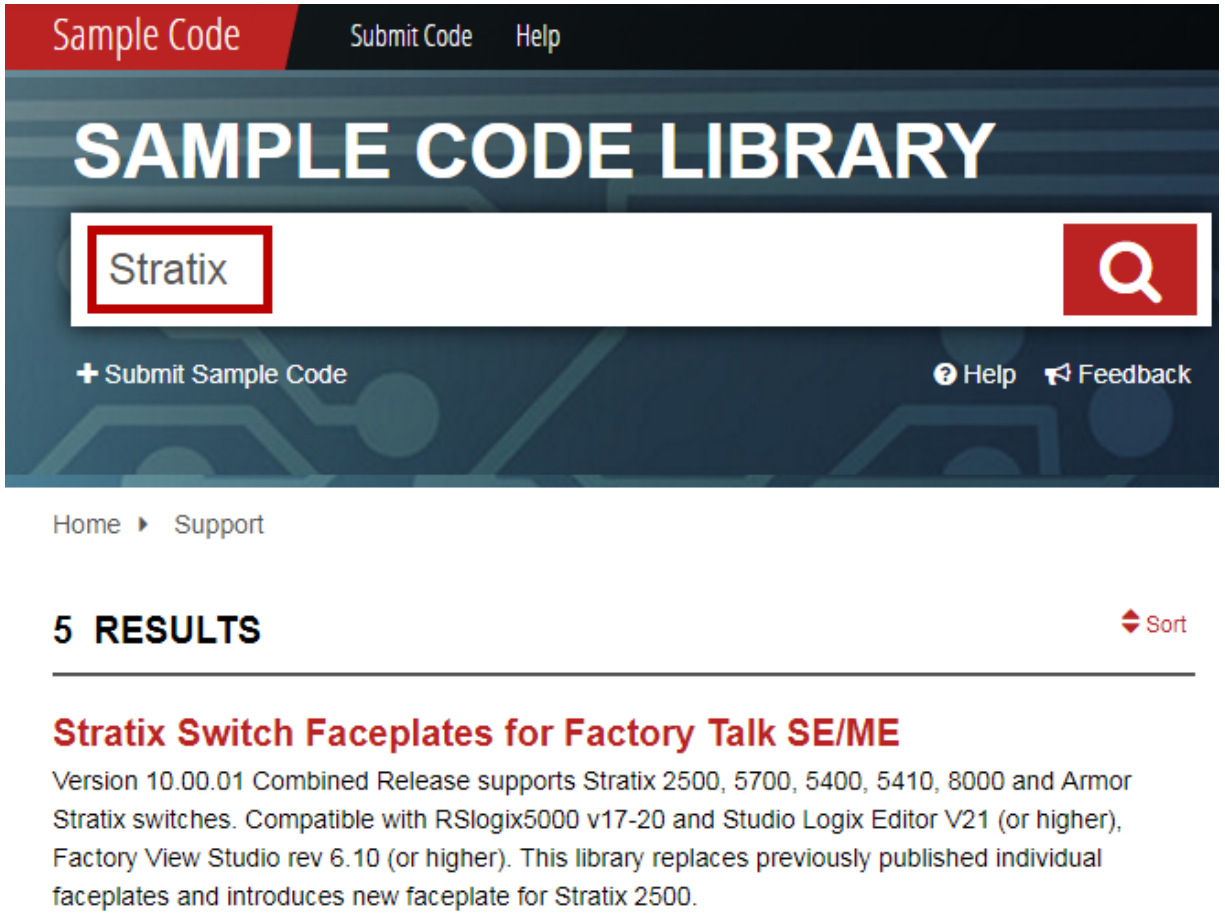
How to Get Stratix® Faceplates?

- Stratix® Faceplate Library is available as a Web Download from the Rockwell Automation® Sample Code Library: http://www.rockwellautomation.com/global/sample-code/overview.page



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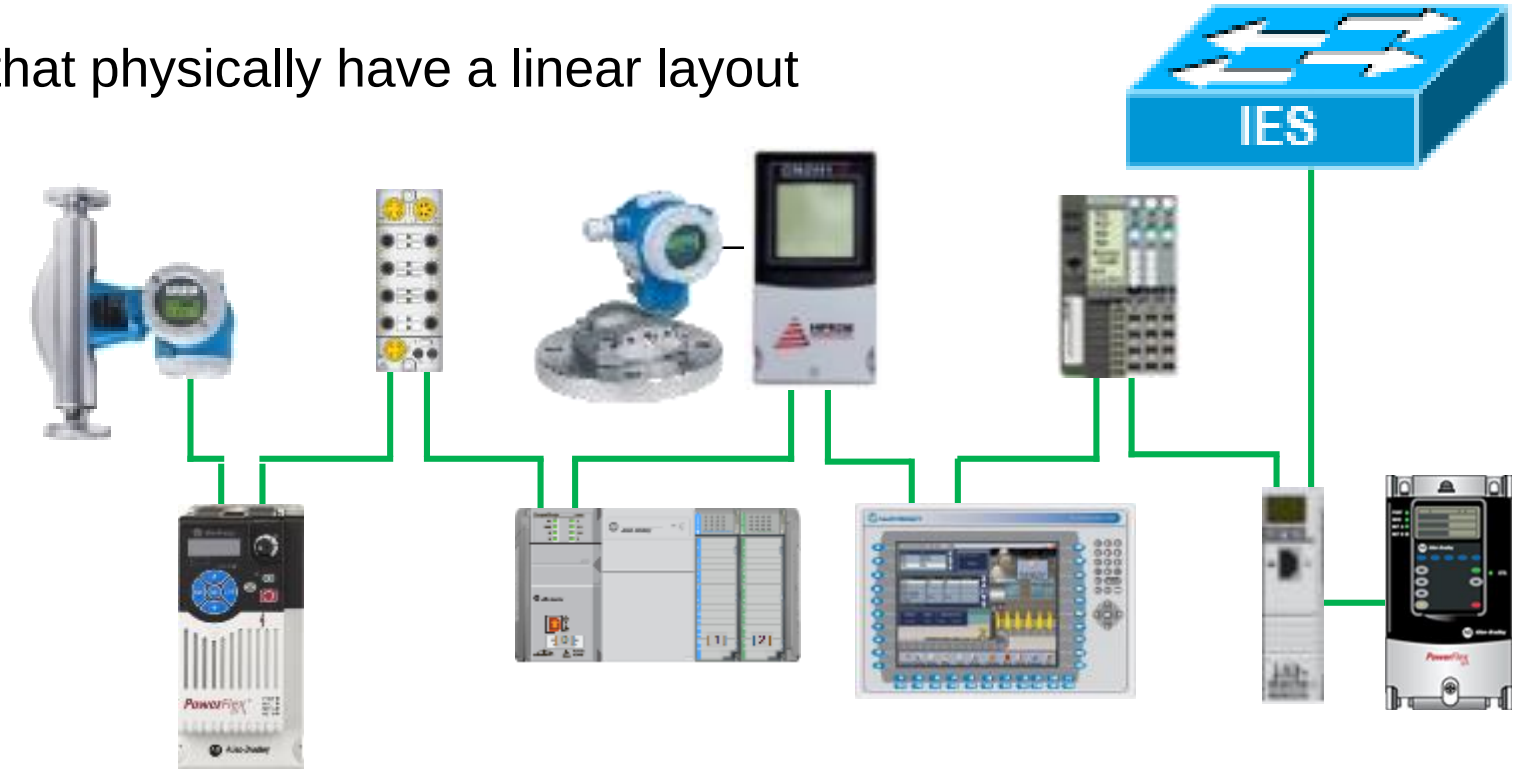
Device-level Topology - Linear

- Comfort level with traditional field bus topology
- Eliminate cost of additional switches
- Simplify network cabling
- Applicable for certain applications that physically have a linear layout
  - Conveyor applications
  - Material handling application



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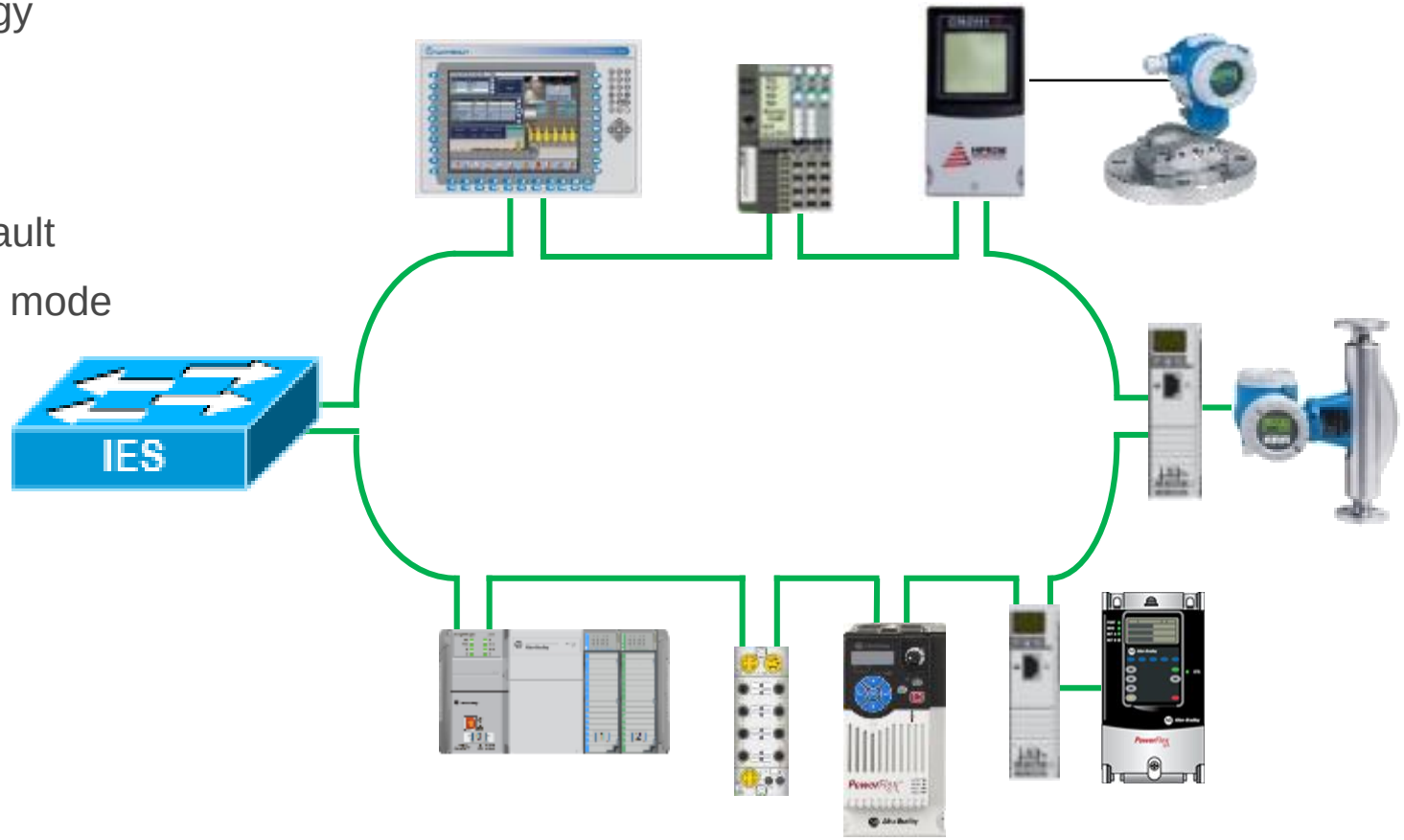
Device-level Topology - Ring

- Making the Linear topology into a ring provides single fault tolerance
  - Network still functions if there is a (single) break
  - Better fault tolerance over normal Star topology
- A resiliency protocol is needed to:
  - Keep packets from circling the ring forever
  - Reconfigure to Linear topology in event of a fault
  - Detect ring restoration and reconfigure to ring mode



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Device Level Ring Topology

- ODVA - open standard
- Support for Ring and Linear topologies
- Fiber and copper implementations
- Single fault tolerant network
- Designed for 1-3 ms convergence for simple device networks

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Device Level Ring Topology

Device Level Ring Protocol

- Ring Supervisor
  - Manages the ring
  - One or more supervisors per ring
  - Normally a scanner, controller or a dedicated supervisor
- Ring Node, Beacon-based
  - Member of the ring
  - Normally an adapter
  - Usually a hardware assisted solution
- Ring Node, Announce-based
  - Member of the ring
  - Normally an adapter
  - Software implementation based on a commercial switch

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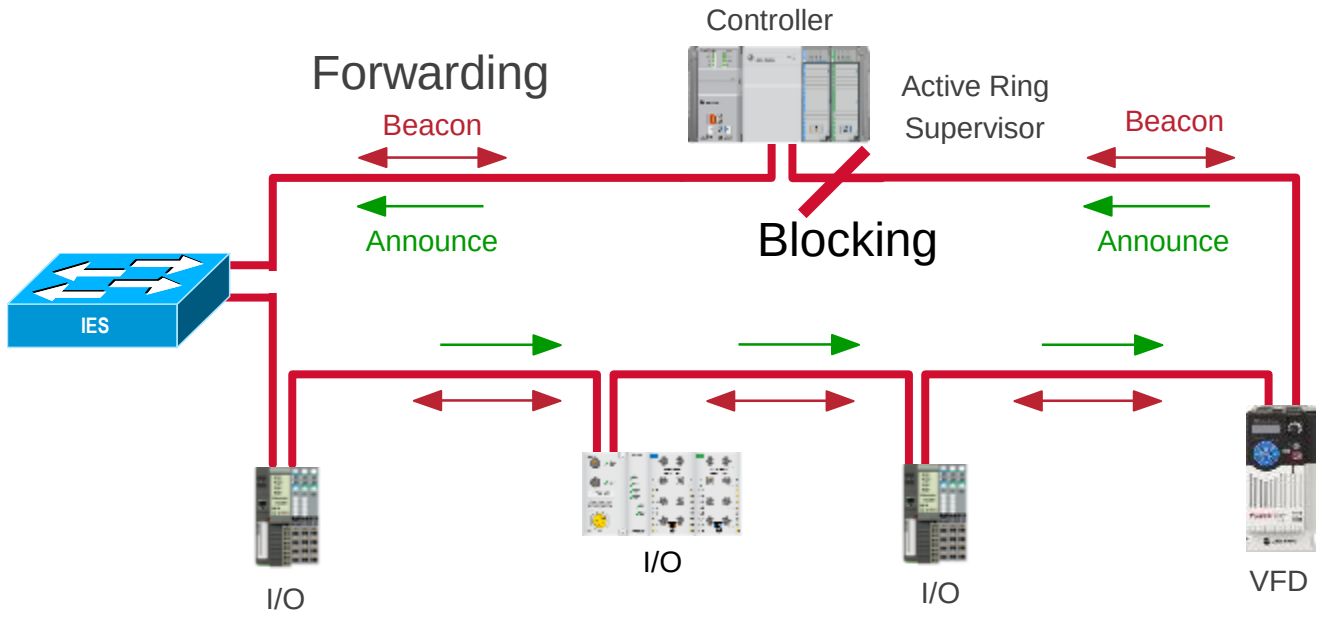
Device Level Ring Topology

Device Level Ring Protocol

- Supervisor blocks traffic on one port
- Sends Beacon frames on both ports to detect break in the ring
- Supervisor hears beacon on both ports indicating the normal ring mode



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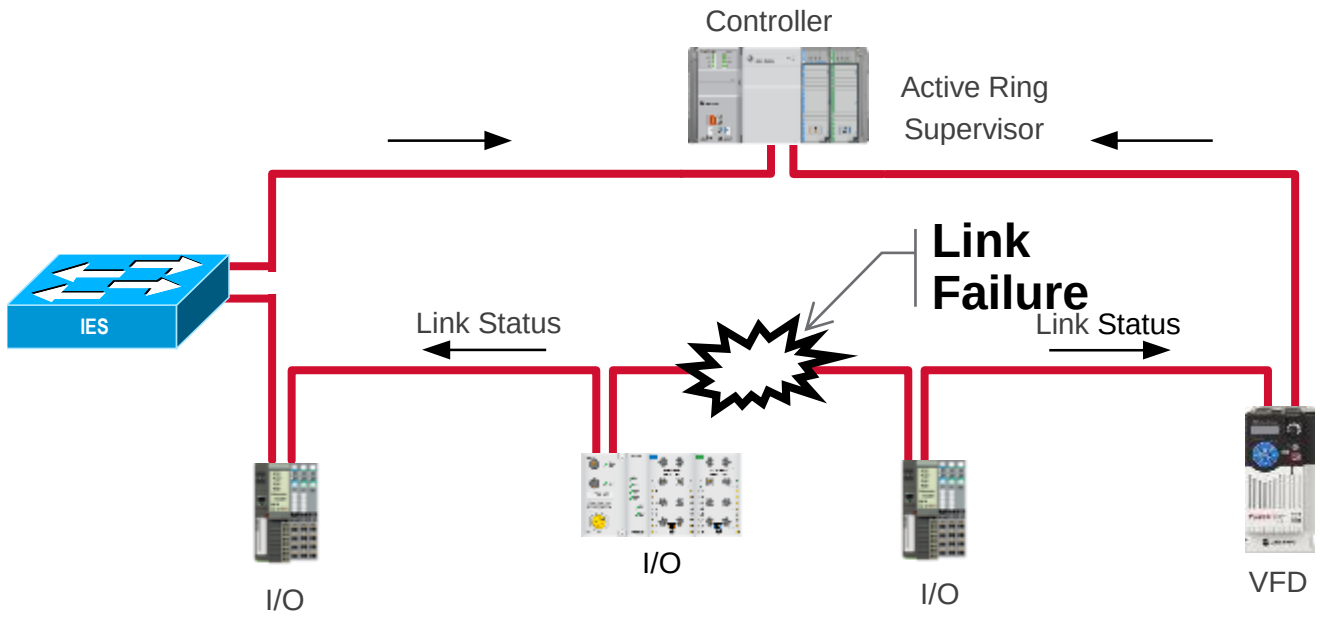
Device Level Ring Topology

Device Level Ring Protocol

- All faults that are detectable at physical layer
- Physical layer failure detected by protocol-aware node
- Status message sent by ring node and received by ring supervisor



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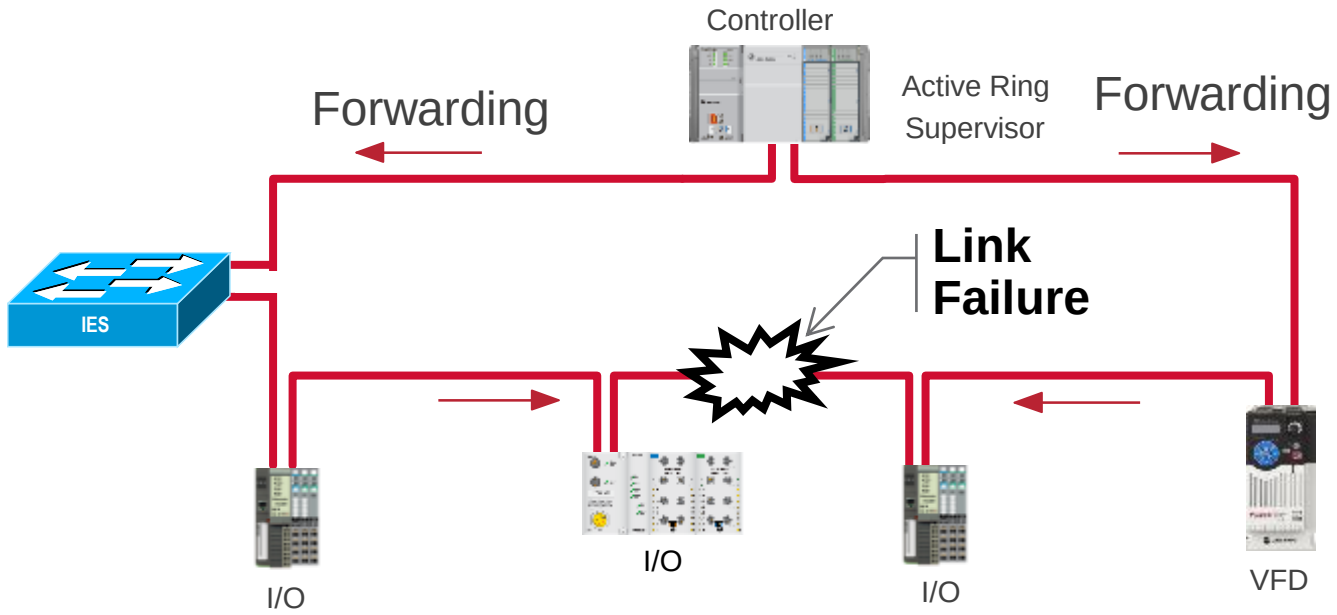
Device Level Ring Topology

Device Level Ring Protocol

- After failure detection, ring supervisor unblocks blocked port
- Network configuration is now a Linear topology
- Fault location is readily available via diagnostics



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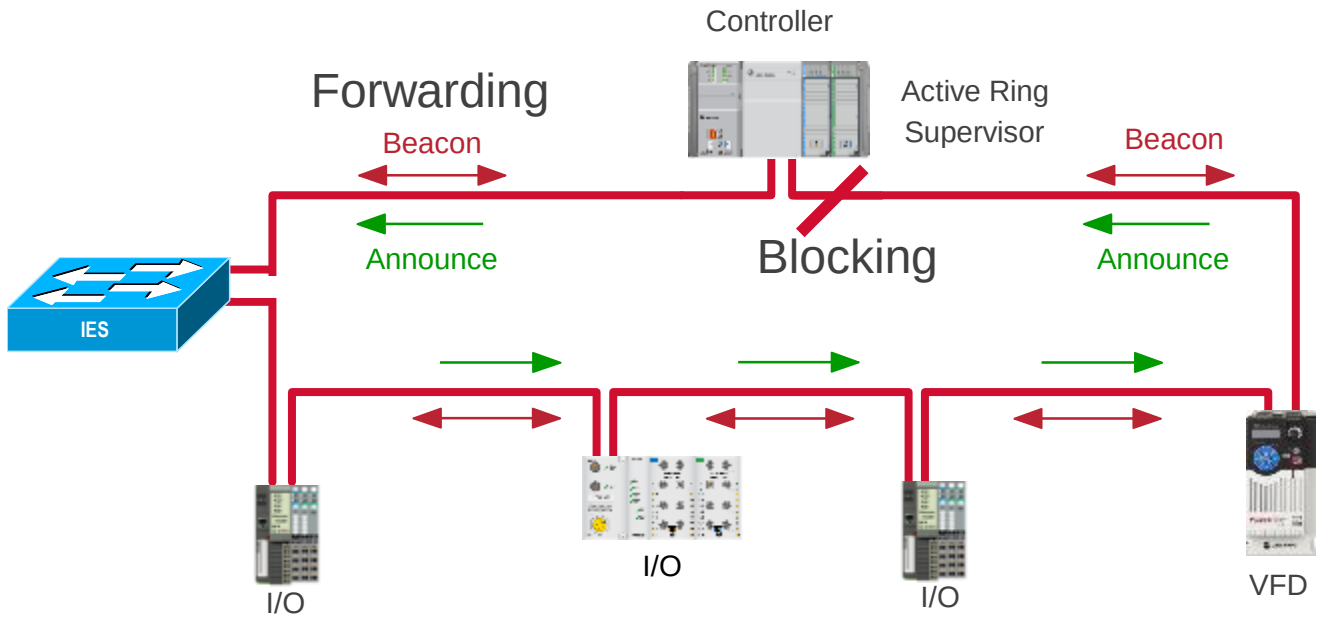
Device Level Ring Topology

Device Level Ring Protocol

- Once ring is restored, supervisor hears beacon on both ports, and transitions to normal ring mode, blocking one port



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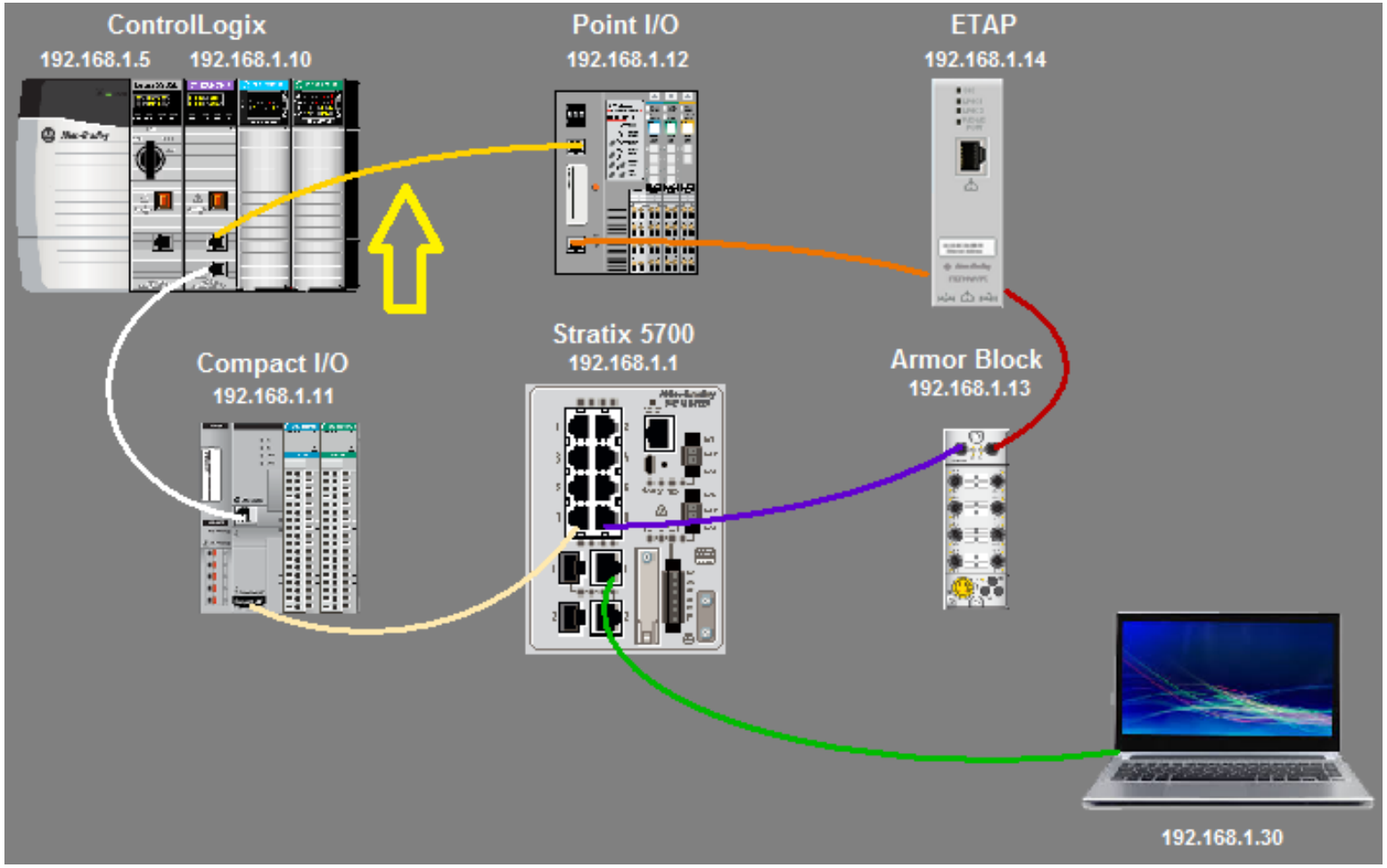
Device Level Ring (DLR) Topology



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Device Level Ring (DLR) Topology

- What Stratix® switches support DLR functionality?
  - All Stratix® 5400 switches
    - Support up to three rings
  - Stratix® 5700 switches
    - All 20-Port models
    - All 18 Port Models
    - Two 10-port models (catalog numbers ending with GP or GN)
  - ArmorStratix™ 5700 switches
    - All 10 Port Models
    - All 18 Port Models

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Device Level Ring (DLR) Topology

- What is the difference between DLR Tool and DLR faceplate?
  - DLR Tool
    - Windows application that requires RSLinx® only
  - DLR Faceplate
    - An HMI display component
    - To be used with FactoryTalk® View SE or ME

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Agenda

Lab 1: Stratix® 5700 Familiarization

Lab 2: Loading Stratix® Switch Configuration

Lab 3: EtherNet/IP devices and Stratix® switches in Studio 5000® Logix Editor

Lab 4: Stratix® 5700 Diagnostic Faceplate

Lab 5: Device Level Ring (DLR) Topology

Lab 6: Stratix® 5700 DLR DHCP Functionality

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What Is DHCP?

- Dynamic Host Configuration Protocol (**DHCP**)
  - Protocol for assigning dynamic IP addresses to devices on a network.
- **DHCP Server** functionality
  - Assigns IP address from a pool of available addresses to the devices (**DHCP Clients**)
  - If a device leaves and then rejoins the network, it may not get the same address.
- **DHCP Persistence**
  - Can be used to assign specific IP addresses.

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DHCP in Stratix® 5700 Switches

- Can function as a DHCP server on the network
- Supports DHCP Persistency
  - Per port
  - Based on device location on DLR network

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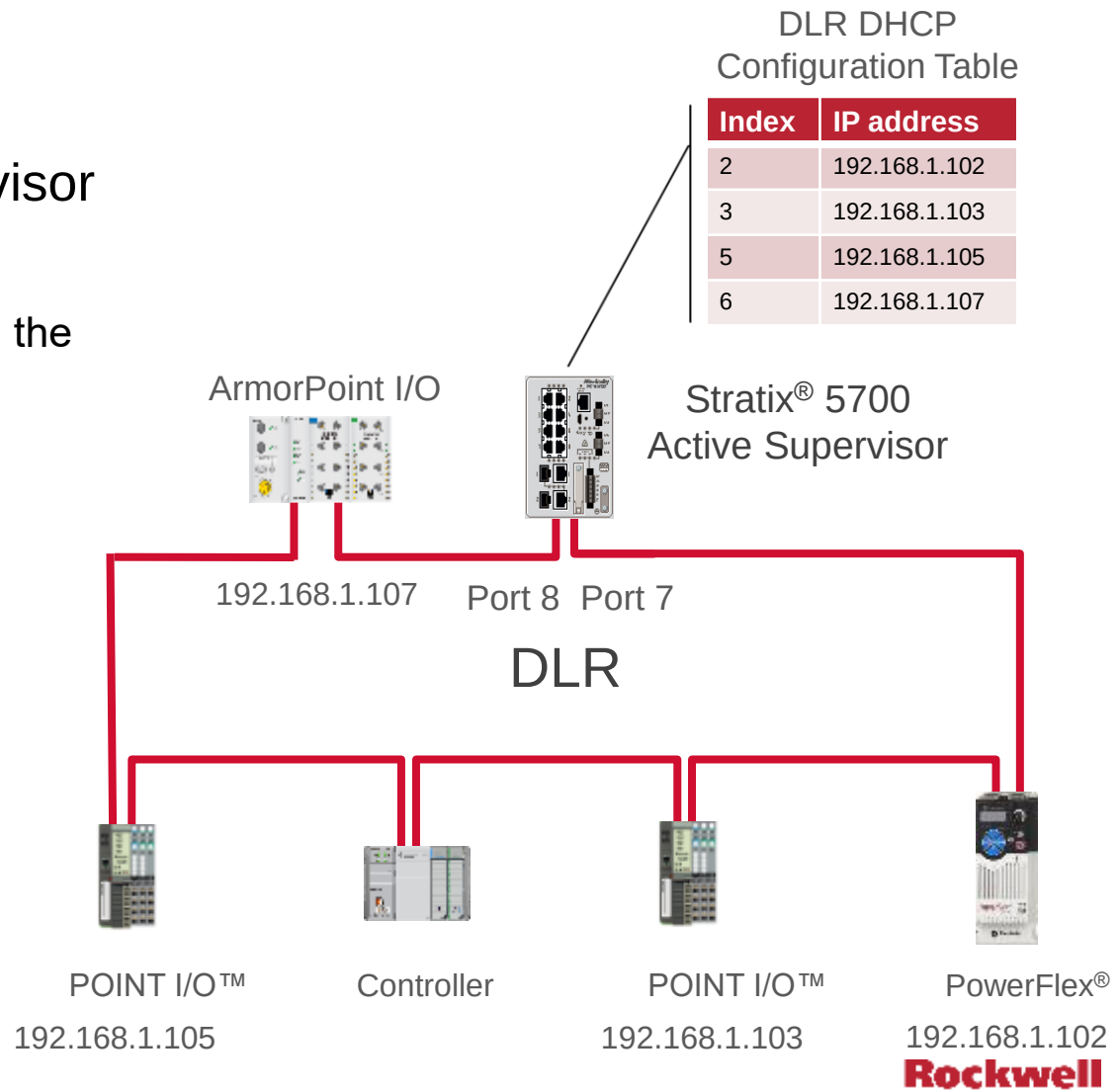
Device Level Ring and DHCP

- Provides assignment of fixed IP addresses to devices on the ring
- DHCP configuration table is defined in active supervisor
  - Table does not have to include all devices on the ring
  - Configuration table “Index” increments around the ring using the lowest switch ring port number as the starting point
- Switch creates reference table by combining configuration table and DLR participant table



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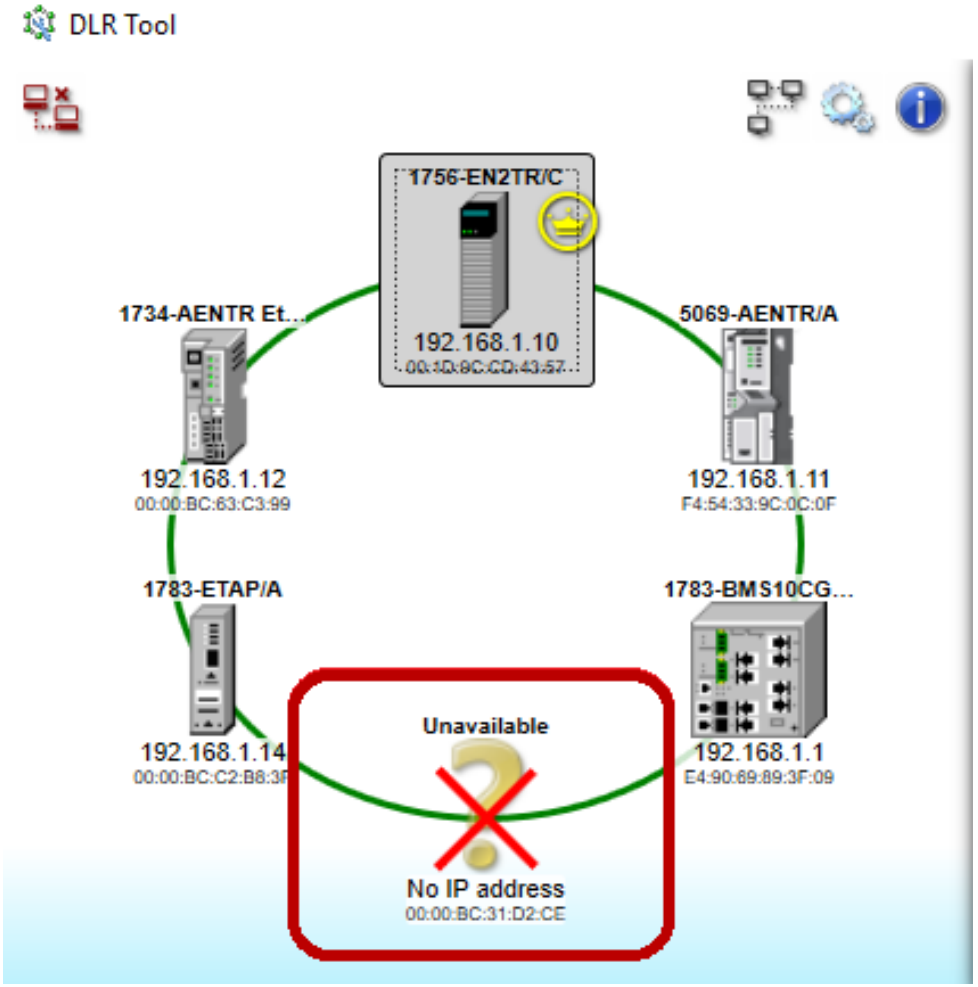
Stratix® 5700 DLR DHCP Functionality

- Lab will demonstrate how to assign IP address to the ArmorBlock® module using DLR DHCP functionality
- Steps to follow:
  - Set Stratix® 5700 as a Primary Supervisor
  - Specify IP address for ArmorBlock® in the Node Table
  - Enable DLR DHCP



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Conclusion

- Stratix® managed switches
  - Improve manageability
  - Ease of use
  - Simplified integration
  - Improve reliability

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