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ELECTRICAL SUPPLY

User Group
Online Seminars

Logix Network Architectures

June 22, 2022

Technical Seminars from TRC

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THE REYNOLDS COMPANY
ELECTRICAL SUPPLY

TECH TALK

- **Remote Access Solutions - July**

USER GROUP

- **Modernization - July**

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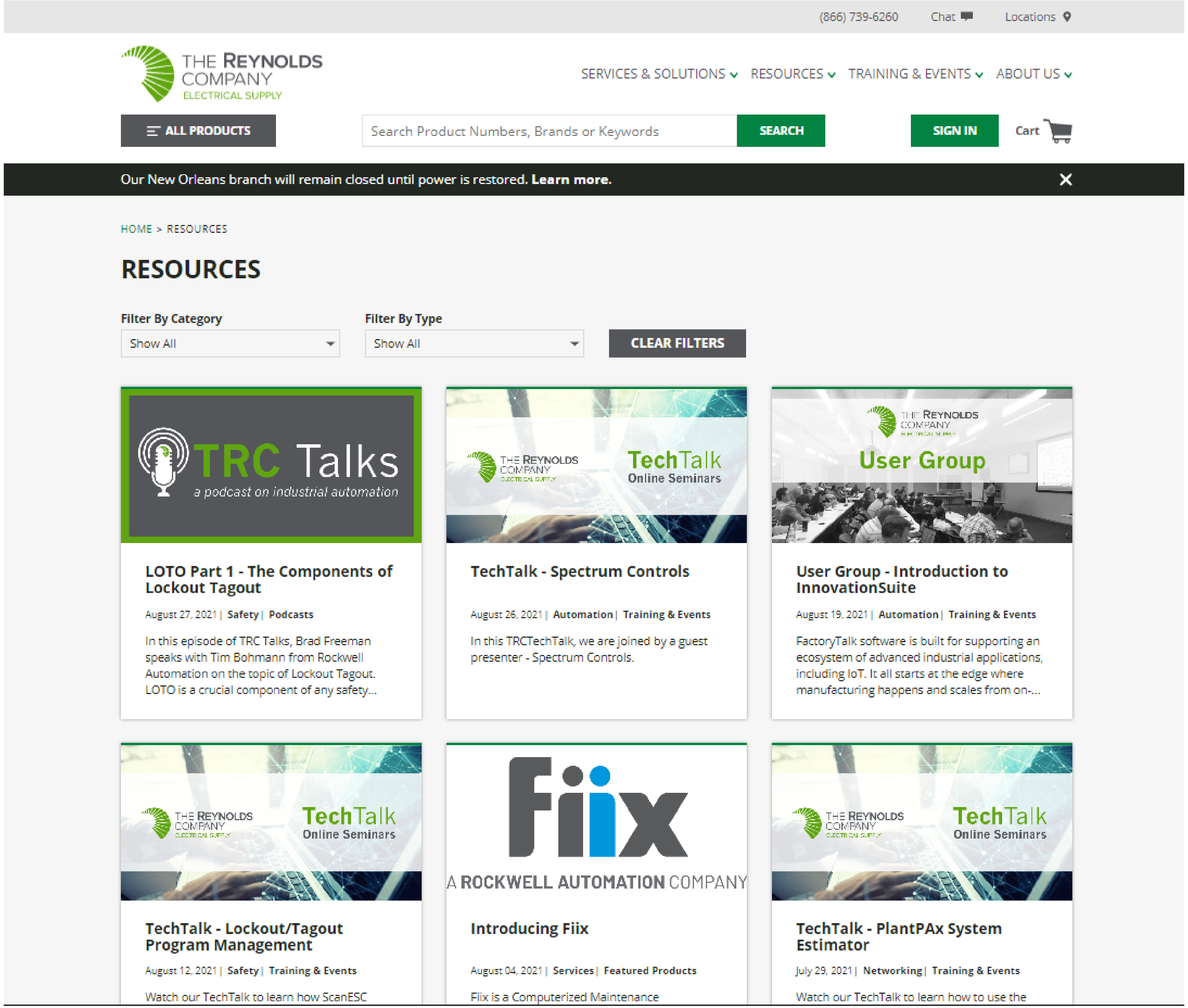
Updated Website

ReynoldsOnline.com

Resources Section includes

- Blog articles
- Podcast
- Videos
- News



Our New Orleans branch will remain closed until power is restored. **Learn more.**

RESOURCES

LOTO Part 1 - The Components of Lockout Tagout

August 27, 2021 | **Safety** | **Podcasts**

In this episode of TRC Talks, Brad Freeman speaks with Tim Bohmann from Rockwell Automation on the topic of Lockout Tagout. LOTO is a crucial component of any safety...

TechTalk - Spectrum Controls

August 26, 2021 | **Automation** | **Training & Events**

In this TRCTechTalk, we are joined by a guest presenter - Spectrum Controls.

User Group - Introduction to InnovationSuite

August 19, 2021 | **Automation** | **Training & Events**

FactoryTalk software is built for supporting an ecosystem of advanced industrial applications, including IoT. It all starts at the edge where manufacturing happens and scales from on-...

TechTalk - Lockout/Tagout Program Management

August 12, 2021 | **Safety** | **Training & Events**

Watch our TechTalk to learn how ScanESC

Introducing Fiix

August 04, 2021 | **Services** | **Featured Products**

Fiix is a Computerized Maintenance

TechTalk - PlantPAx System Estimator

July 29, 2021 | **Networking** | **Training & Events**

Watch our TechTalk to learn how to use the

Our Presenters

Wayne Welk
Automation Specialist
The Reynolds Company
New Orleans

Mike Masterson
Automation Specialist
The Reynolds Company
Houston

Agenda

1 Network Topologies

2 CPWE

3 Segmentation

4 DLR

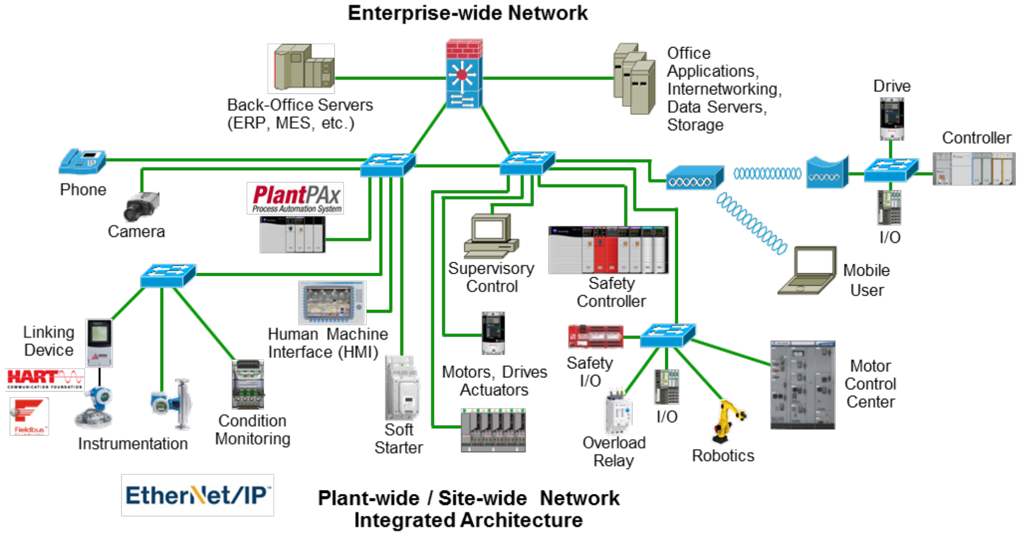
5 PRP

Network Topologies

Industrial IoT (IIoT) – IACS Convergence

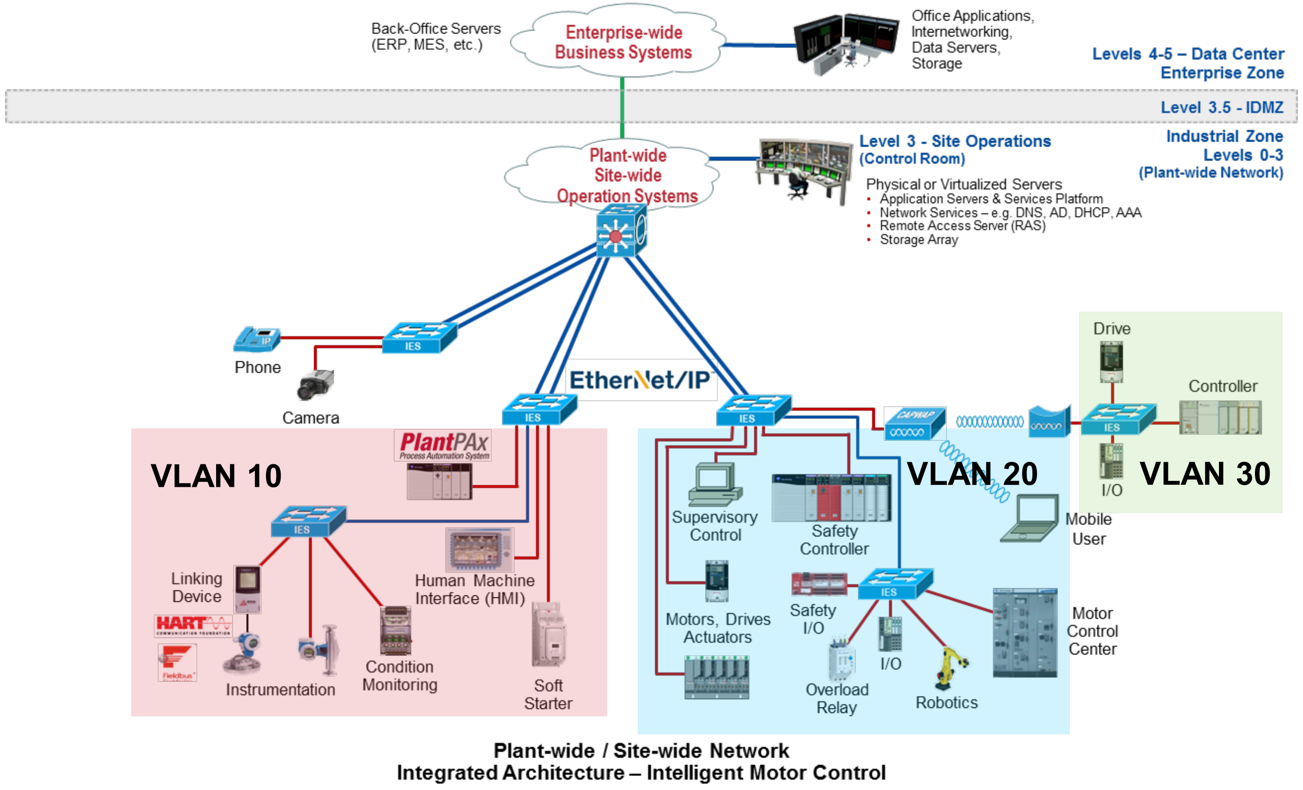
Migrating Legacy Networks to Segmentate Network

Large LAN, Lacking Natural Boundaries and Segmentation



Flat, Open and Non-Resilient IACS Network Infrastructure

Smaller Connected LANs to Create Boundaries and Segmentation



Back-Office Servers (ERP, MES, etc.)
Enterprise-wide Business Systems
Office Applications, Internetworking, Data Servers, Storage
Levels 4-5 – Data Center Enterprise Zone
Level 3.5 - IDMZ
Industrial Zone Levels 0-3 (Plant-wide Network)
Plant-wide Site-wide Operation Systems
Level 3 - Site Operations (Control Room)
Physical or Virtualized Servers
Application Servers & Services Platform
Network Services – e.g. DNS, AD, DHCP, AAA
Remote Access Server (RAS)
Storage Array
Phone
Camera
IES
EtherNet/IP
Drive
Controller
CAPWAP
VLAN 10
VLAN 20
VLAN 30
PlantPAx Process Automation System
I/O
Mobile User
Supervisory Control
Safety Controller
Linking Device
HART
Human Machine Interface (HMI)
Motors, Drives Actuators
Safety I/O
Motor Control Center
Instrumentation
Condition Monitoring
Soft Starter
Overload Relay
I/O
Robotics
Plant-wide / Site-wide Network Integrated Architecture – Intelligent Motor Control

Structured and Hardened IACS Network Infrastructure

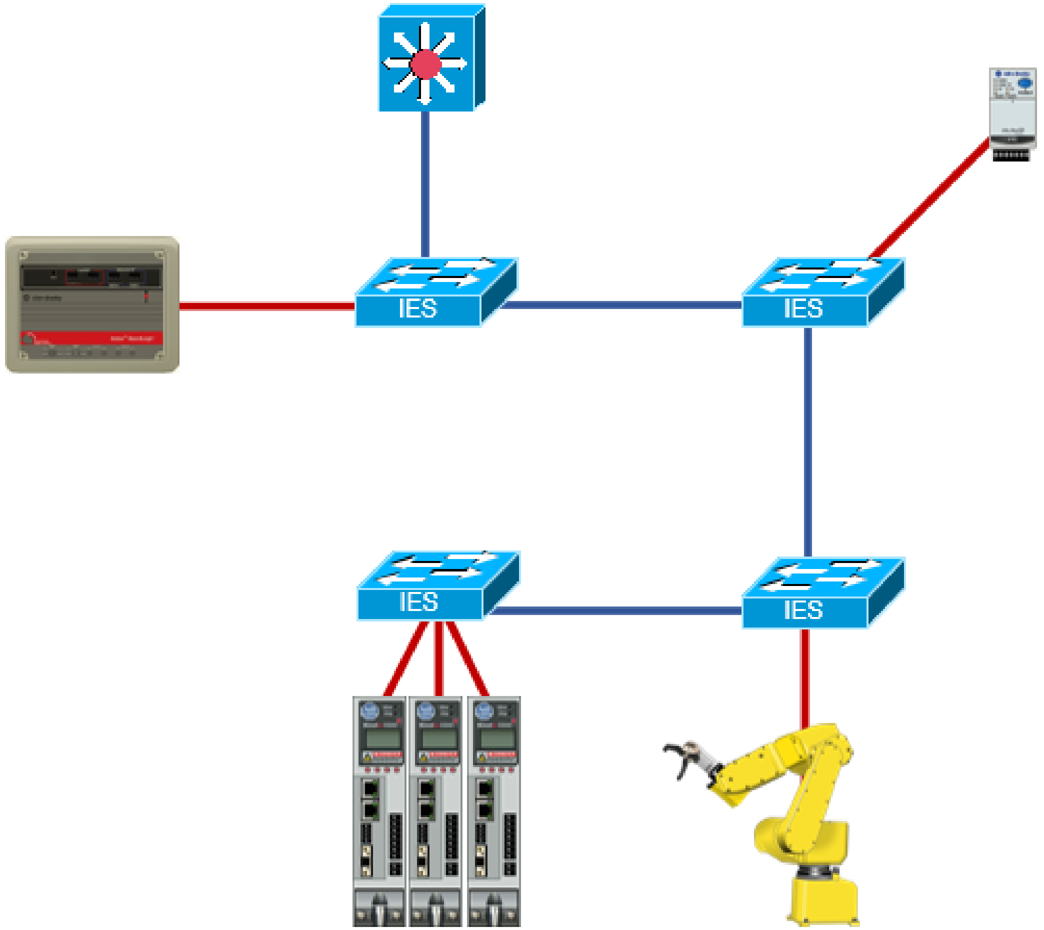
Topologies and switch selection

	Advantages	Disadvantages
Managed switches	• Segmentation services (VLANs) • Diagnostic information • Security services • Prioritization services (QoS) • Multicast management services • Network resiliency • Loop prevention	• More expensive • Requires some level of support and configuration to start up
Unmanaged switches	• Lower initial investment • Simple to configure • Ideal for small, isolated networks	• No management capabilities • No security • No diagnostic information • Difficult to troubleshoot • No resiliency support • No loop prevention
Embedded switches	• Diagnostic information • Prioritization services (QoS) • Time sync services (1588/PTP) • Network resiliency • Loop prevention (DLR)	• Limited management capabilities • Sometimes requires minimal configuration • No security features

Network Topologies – Linear

- Advantages
  - Easy to design, configure and implement
  - Least amount of cabling and associated cost

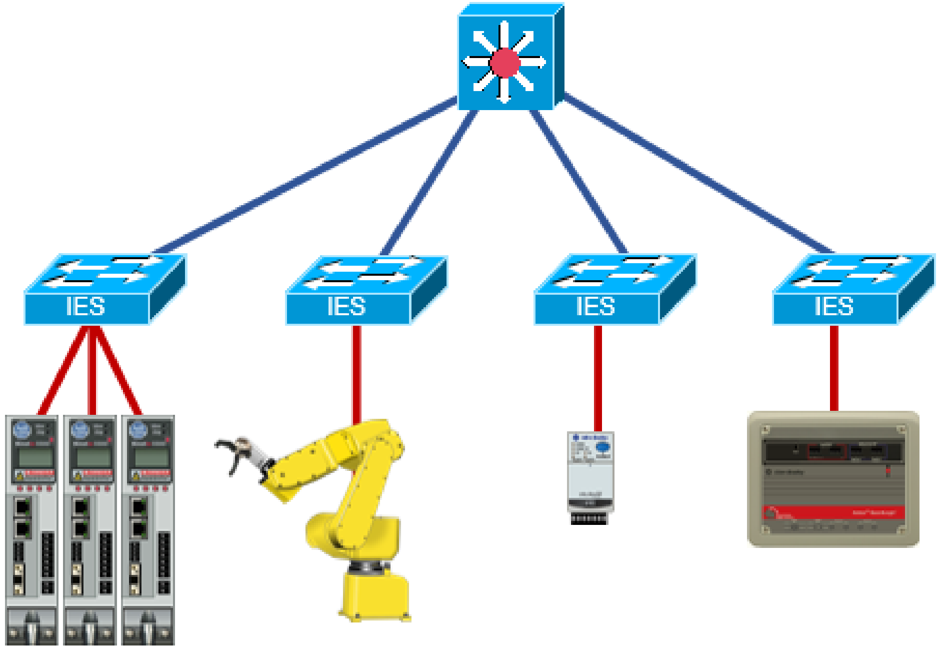
- Disadvantages
  - Loss of network service in case of connection failure (no resiliency)
  - Potential to create bottlenecks on the links closest to Layer 3 devices
  - Varying number of hops makes it more difficult to produce reliable performance



Network Topologies – Star

- Advantages
  - Easy to design configure and implement
  - Least amount of cabling and associated cost

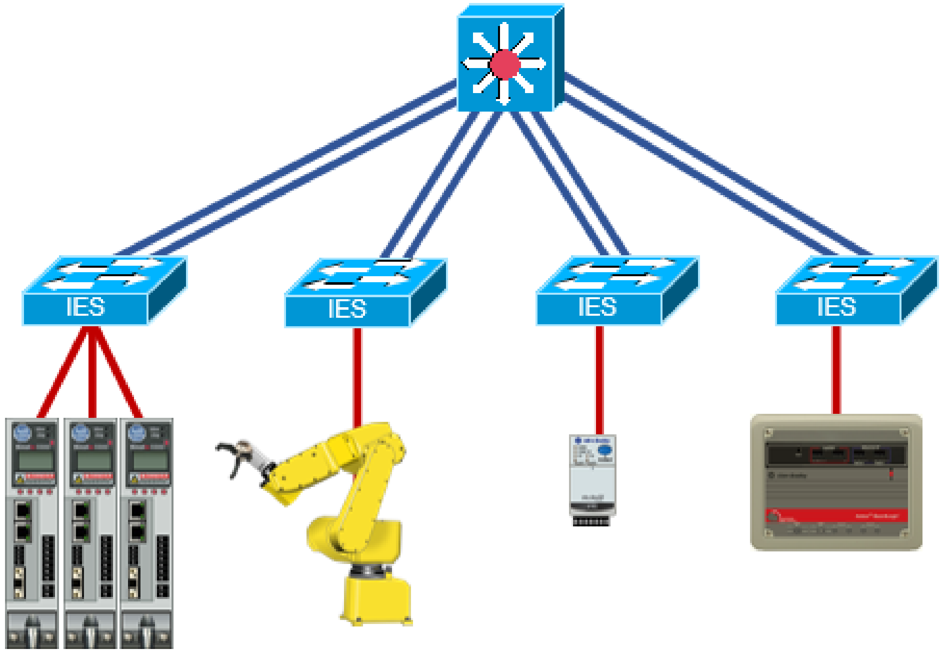
- Disadvantages
  - Loss of network service in case of connection failure (no resiliency)



Network Topologies – Redundant Star

- Advantages
  - Resiliency from connection failure
  - Fast convergence to link loss
  - Consistent number of hops
  - Fewer bottlenecks

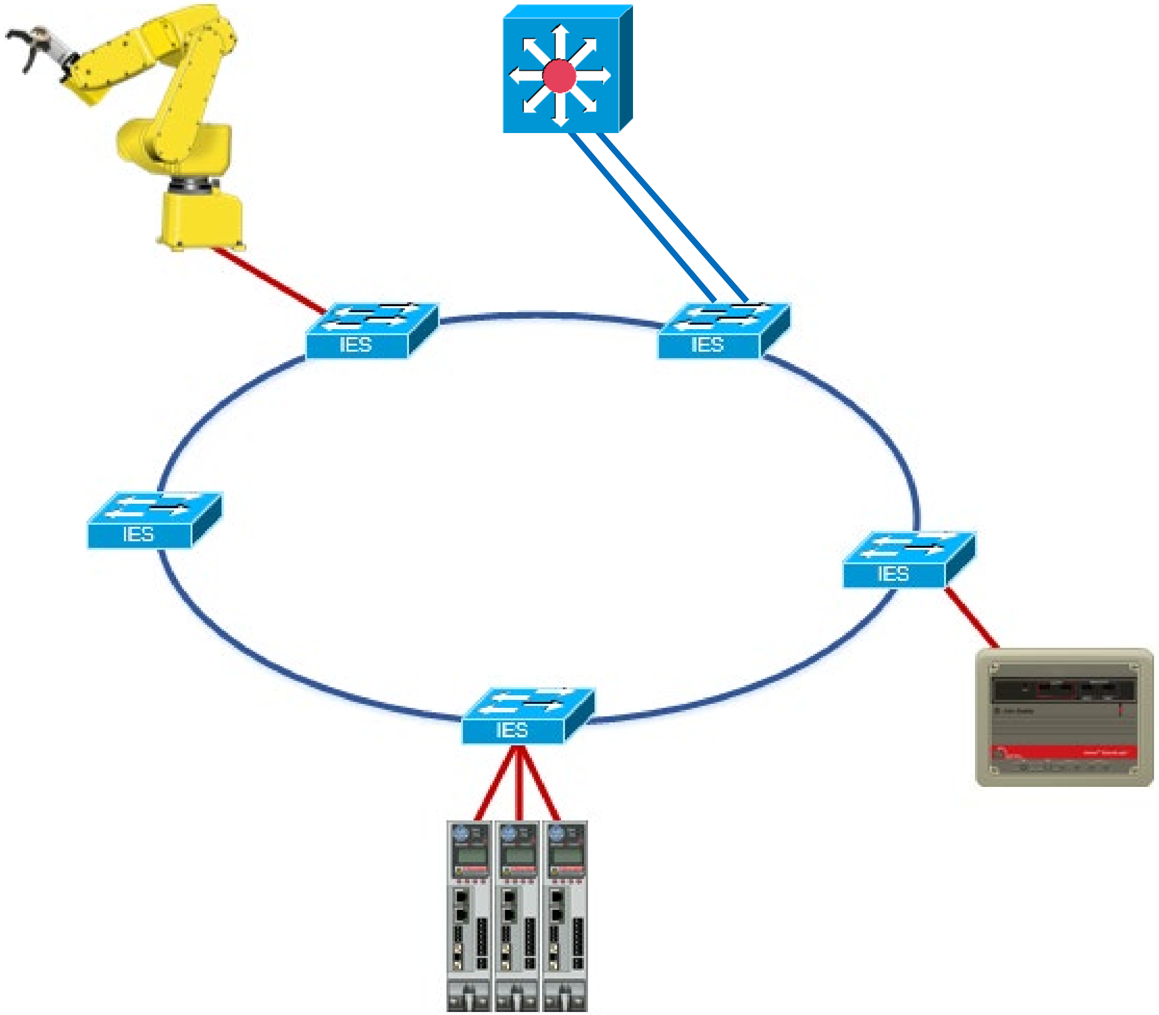
- Disadvantages
  - Additional wiring and costs required to connect switches
  - Additional configuration complexity



Network Topologies – Ring

- Advantages
  - Resiliency from single connection failure
  - Faster convergence to connection loss (DLR)
  - Less cabling complexity in some plant floor layouts

- Disadvantages
  - Additional configuration complexity (REP)
  - Potential to create bottlenecks on the links closest to Layer 3 devices
  - Varying number of hops makes it more difficult to produce reliable performance

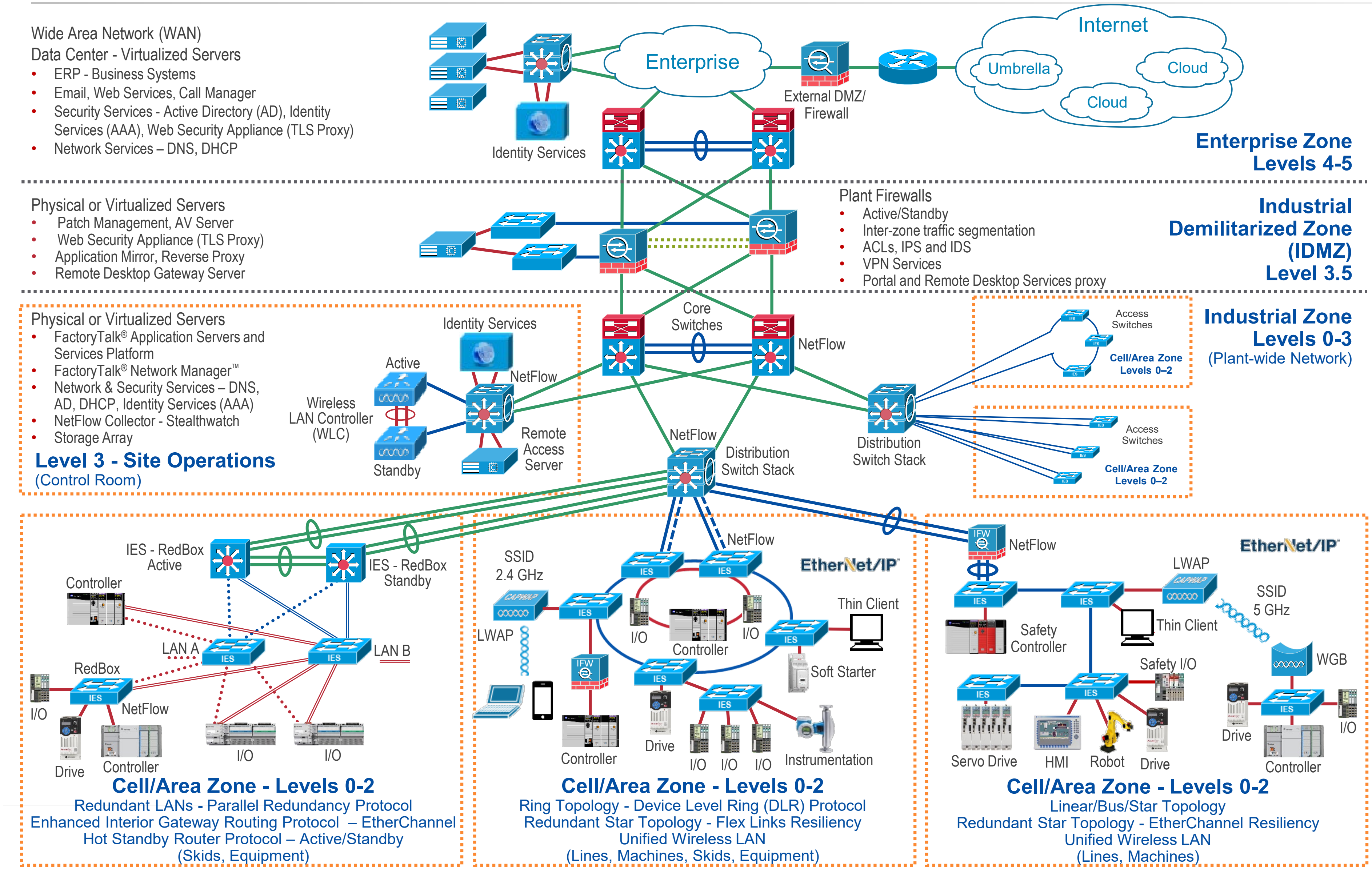


Rockwell Automation

Validated Logical and Physical Network Designs – CPwE

Network Infrastructure

CPwE Reference Architecture – A holistic blueprint for digital transformation



Wide Area Network (WAN)
Data Center - Virtualized Servers
- ERP - Business Systems
- Email, Web Services, Call Manager
- Security Services - Active Directory (AD), Identity Services (AAA), Web Security Appliance (TLS Proxy)
- Network Services – DNS, DHCP

Enterprise Zone Levels 4-5

Physical or Virtualized Servers
- Patch Management, AV Server
- Web Security Appliance (TLS Proxy)
- Application Mirror, Reverse Proxy
- Remote Desktop Gateway Server

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

Industrial Demilitarized Zone (IDMZ) Level 3.5

Physical or Virtualized Servers
- FactoryTalk® Application Servers and Services Platform
- FactoryTalk® Network Manager™
- Network & Security Services – DNS, AD, DHCP, Identity Services (AAA)
- NetFlow Collector - Stealthwatch
- Storage Array

Level 3 - Site Operations
(Control Room)

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

Cell/Area Zone - Levels 0-2
Redundant LANs - Parallel Redundancy Protocol
Enhanced Interior Gateway Routing Protocol – EtherChannel
Hot Standby Router Protocol – Active/Standby
(Skids, Equipment)

Cell/Area Zone - Levels 0-2
Ring Topology - Device Level Ring (DLR) Protocol
Redundant Star Topology - Flex Links Resiliency
Unified Wireless LAN
(Lines, Machines, Skids, Equipment)

Cell/Area Zone - Levels 0-2
Linear/Bus/Star Topology
Redundant Star Topology - EtherChannel Resiliency
Unified Wireless LAN
(Lines, Machines)

Collection of tested and validated network and security architectures

Simplify network and security design by connecting industrial operations and business systems

An open solution that adheres to regulatory standards creates flexibility and scalability

A converged infrastructure built on a common architecture framework makes the network data-ready

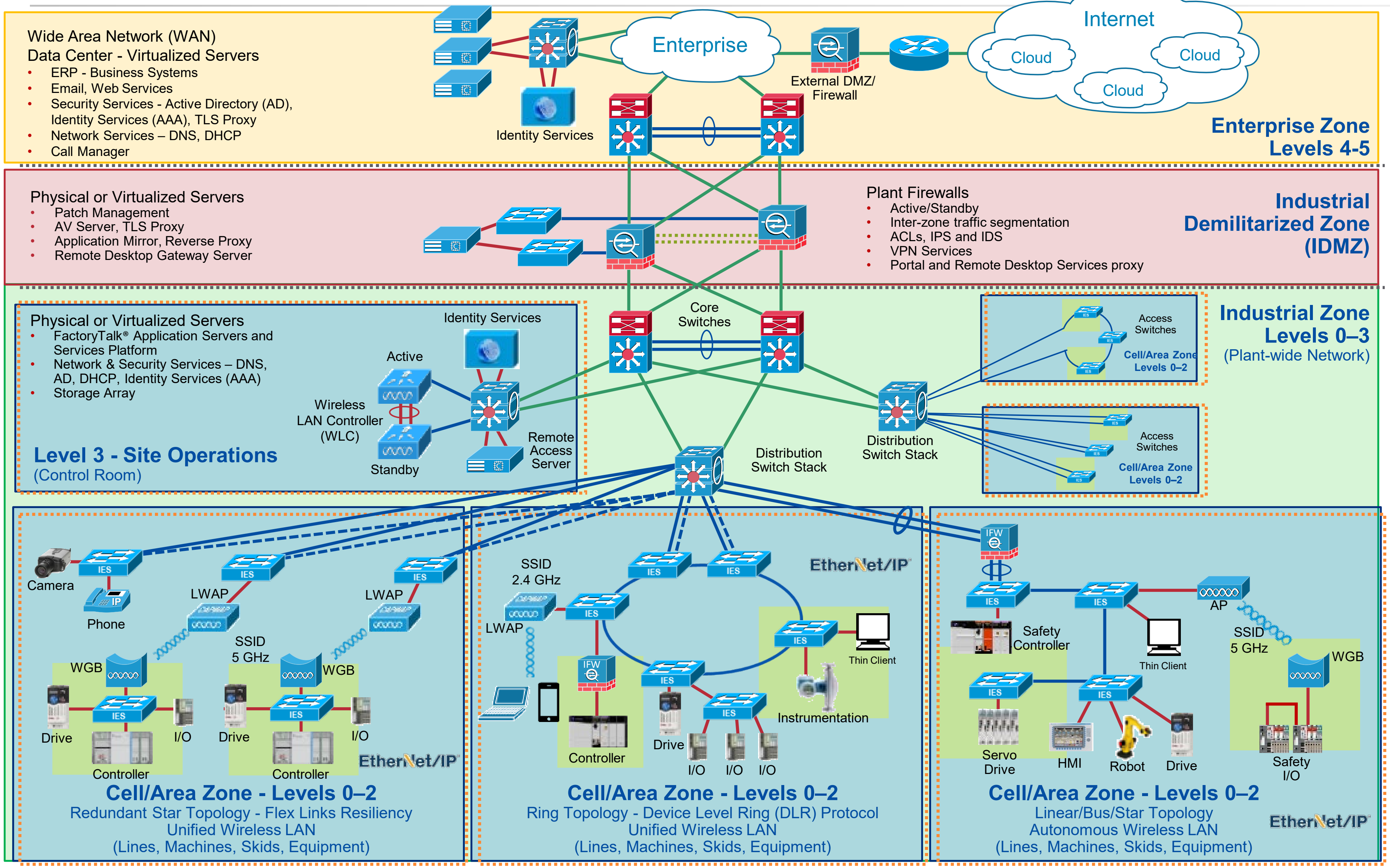
CPwE architectures

Additional material

Topic	Design Guide	White paper
Converged Plantwide Ethernet – Baseline Document	ENET-TD001E-EN-P	N/A
Deploying 802.11 Wireless LAN Technology within a Converged Plantwide Ethernet Architecture	ENET-TD006A-EN-P	ENET-WP034A-EN-P
Deploying Identity and Mobility Services within a Converged Plantwide Ethernet Architecture	ENET-TD008B-EN-P	ENET-WP037C-EN-P
Securely Traversing IACS Data Across the Industrial Demilitarized Zone (IDMZ)	ENET-TD009B-EN-P	ENET-WP038B-EN-P
Deploying Network Address Translation within a Converged Plantwide Ethernet Architecture	ENET-TD007B-EN-P	ENET-WP036A-EN-P
Migrating Legacy IACS Networks to a Converged Plantwide Ethernet Architecture	ENET-TD011A-EN-P	ENET-WP040A-EN-P
Deploying A Resilient Converged Plantwide Ethernet Architecture	ENET-TD010C-EN-P	ENET-WP039E-EN-P
Deploying Industrial Firewalls within a Converged Plantwide Ethernet Architecture	ENET-TD002A-EN-P	ENET-WP011B-EN-P
Deploying Device Level Ring within a Converged Plantwide Ethernet Architecture	ENET-TD015E-EN-P	ENET-WP016E-EN-P
OEM Networking within a Converged Plantwide Ethernet Architecture	ENET-TD018A-EN-P	ENET-WP018A-EN-P
Deploying a Fiber-Optic Physical Infrastructure within a Converged Plantwide Ethernet Architecture – Application Guide	ENET-TD003C-EN-P	ENET-WP028A-EN-P
Cloud Connectivity to a Converged Plantwide Ethernet Architecture	ENET-TD017B-EN-P	ENET-WP019C-EN-P
Deploying Industrial Data Center within a Converged Plantwide Ethernet Architecture	ENET-TD014A-EN-P	ENET-WP013A-EN-P
Deploying Scalable Time Distribution within a Converged Plantwide Ethernet Architecture	ENET-TD016A-EN-P	ENET-WP017B-EN-P
Deploying Network Security within a Converged Plantwide Ethernet Architecture	ENET-TD019A-EN-P	ENET-WP023B-EN-P
Deploying Parallel Redundancy Protocol within a Converged Plantwide Ethernet Architecture	ENET-TD021A-EN-P	ENET-WP041B-EN-P
Deploying CIP Security within a Converged Plantwide Ethernet Architecture	ENET-TD022A-EN-P	ENET-WP043B-EN-P
Physical Infrastructure for the Converged Plantwide Ethernet Architecture – Application Guide	ENET-TD020A-EN-P	ENET-WP028A-EN-P

Logical Zoning - Segmentation

CPwE Logical Framework – Modular Building Blocks



Wide Area Network (WAN)
Data Center - Virtualized Servers

- ERP - Business Systems
- Email, Web Services
- Security Services - Active Directory (AD), Identity Services (AAA), TLS Proxy
- Network Services – DNS, DHCP
- Call Manager

Identity Services

Enterprise

External DMZ/ Firewall

Internet

Cloud

Cloud

Cloud

Enterprise Zone Levels 4-5

Physical or Virtualized Servers

- Patch Management
- AV Server, TLS Proxy
- Application Mirror, Reverse Proxy
- Remote Desktop Gateway Server

Plant Firewalls

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

Industrial Demilitarized Zone (IDMZ)

Physical or Virtualized Servers

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

Identity Services

Active

Wireless LAN Controller (WLC)

Standby

Remote Access Server

Level 3 - Site Operations
(Control Room)

Core Switches

Distribution Switch Stack

Distribution Switch Stack

Access Switches

Cell/Area Zone Levels 0–2

Access Switches

Cell/Area Zone Levels 0–2

Industrial Zone Levels 0–3
(Plant-wide Network)

Camera

Phone

LWAP

LWAP

SSID 5 GHz

WGB

WGB

Drive

I/O

Drive

I/O

Controller

Controller

Cell/Area Zone - Levels 0–2
Redundant Star Topology - Flex Links Resiliency
Unified Wireless LAN
(Lines, Machines, Skids, Equipment)

SSID 2.4 GHz

LWAP

Thin Client

Instrumentation

Controller

Drive

I/O

I/O

I/O

Cell/Area Zone - Levels 0–2
Ring Topology - Device Level Ring (DLR) Protocol
Unified Wireless LAN
(Lines, Machines, Skids, Equipment)

Safety Controller

Thin Client

AP

SSID 5 GHz

WGB

Servo Drive

HMI

Robot

Drive

Safety I/O

Cell/Area Zone - Levels 0–2
Linear/Bus/Star Topology
Autonomous Wireless LAN
(Lines, Machines, Skids, Equipment)

Key Tenets:

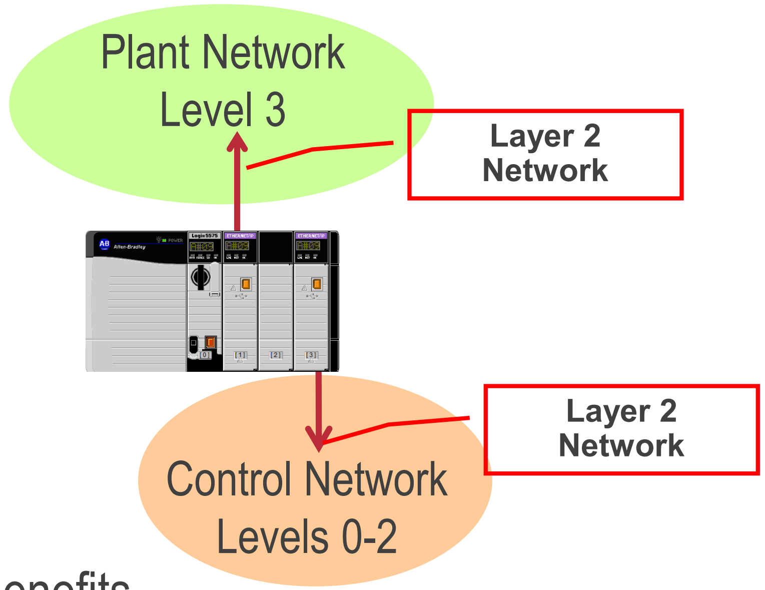
- Smart IIoT Devices
- Zoning (Segmentation)
- Managed Infrastructure
- Resiliency
- Time-critical Data
- Wireless - Mobility
- Holistic and Diverse Defense-in-Depth Security
- Convergence-ready

Segmentation Options

Segmentation

Multiple Network Interface Cards (NICs)

- Isolated networks - two NICs for physical network segmentation



Plant Network Level 3

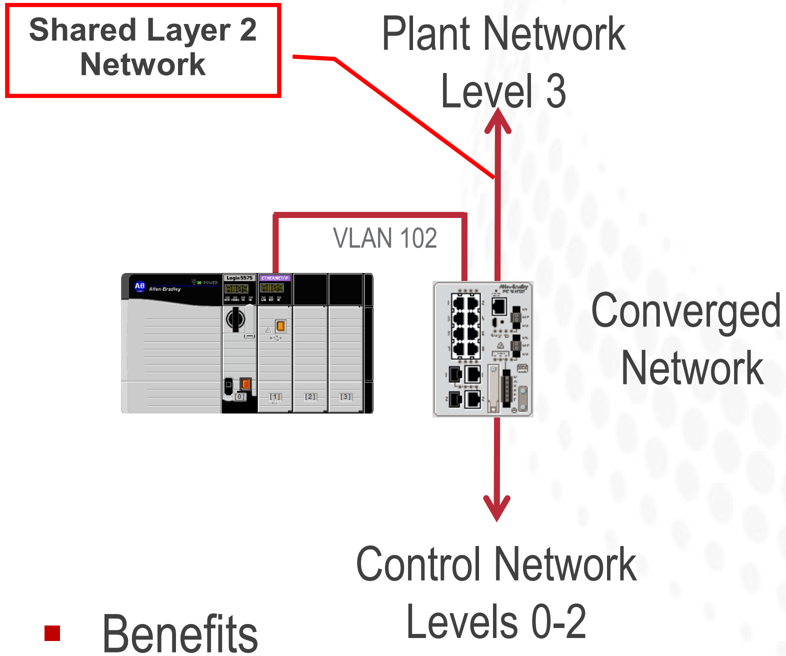
Layer 2 Network

Layer 2 Network

Control Network Levels 0-2

- Benefits
  - Clear network ownership demarcation line
- Challenges
  - Limited visibility to control network devices for asset management
  - Limited future-ready capability
  - Supported on ControlLogix and 5380’s
  - Only CIP bridging

- Converged networks – logical segmentation



Shared Layer 2 Network

Plant Network Level 3

VLAN 102

Converged Network

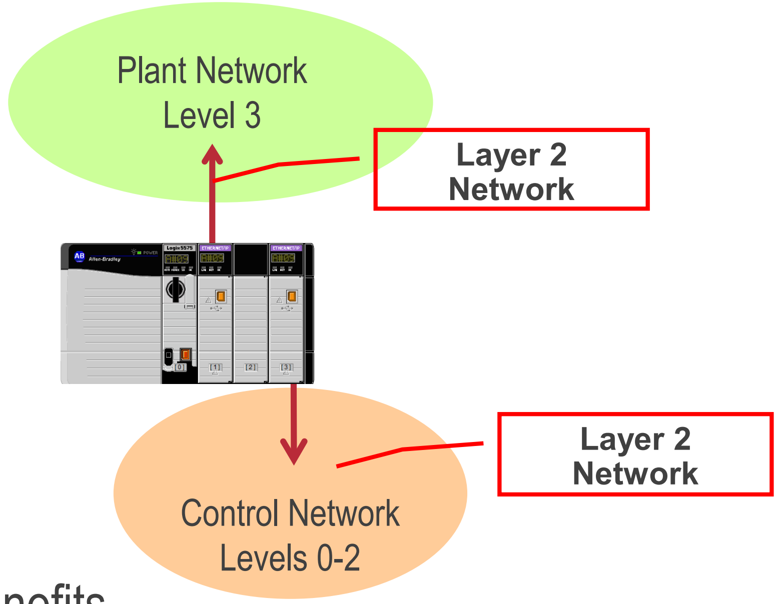
Control Network Levels 0-2

- Benefits
  - Plant-wide information sharing for data collection and asset management
  - Future-ready
- Challenges
  - Blurred network ownership demarcation line

Segmentation

Multiple Network Interface Cards (NICs)

- Isolated networks - two NICs for physical network segmentation



Plant Network
Level 3

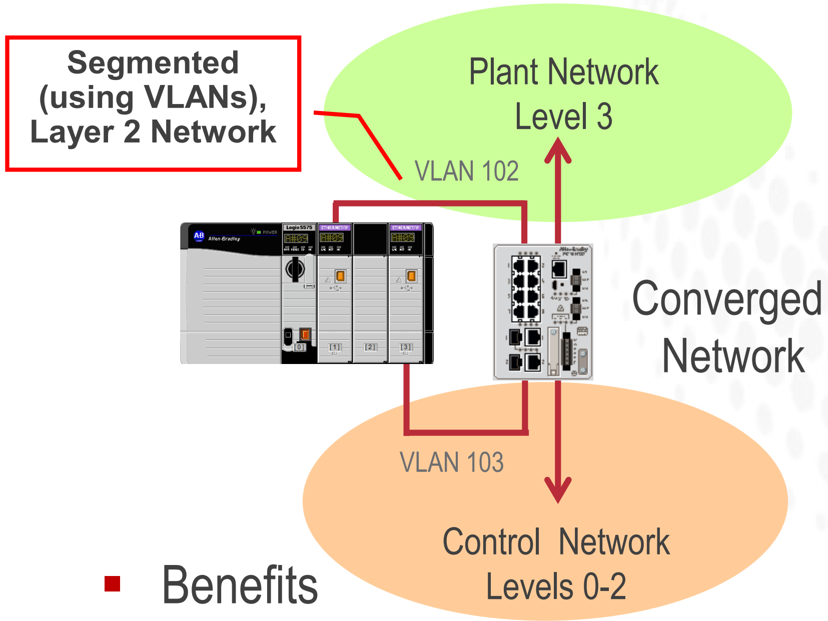
Layer 2 Network

Layer 2 Network

Control Network
Levels 0-2

- Benefits
  - Clear network ownership demarcation line
- Challenges
  - Limited visibility to control network devices for asset management
  - Limited future-ready capability

- Converged networks - logical segmentation - two NICs for scalability, performance, capacity and flexibility



Segmented (using VLANs), Layer 2 Network

Plant Network
Level 3

VLAN 102

Converged Network

VLAN 103

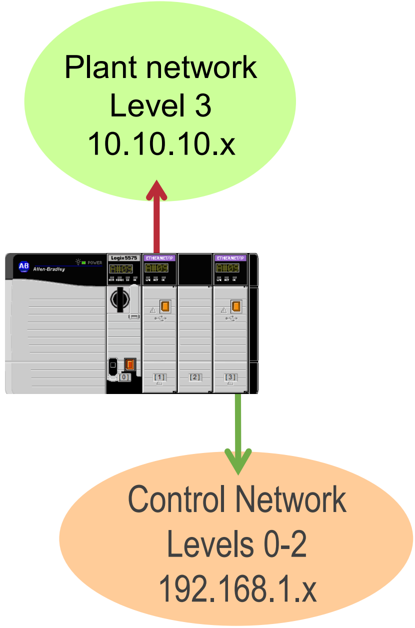
Control Network
Levels 0-2

- Benefits
  - Plant-wide information sharing for data collection and asset management
  - Future-ready
- Challenges
  - Blurred network ownership demarcation line

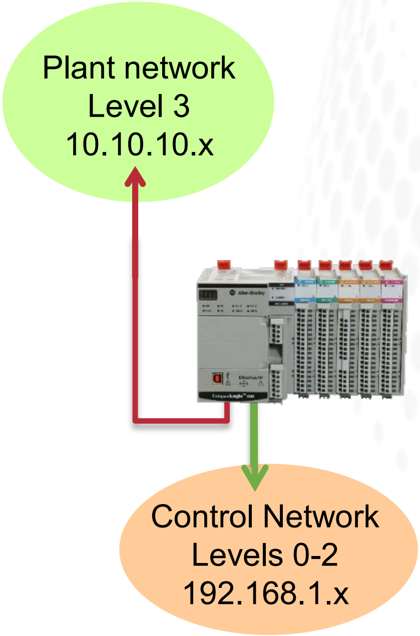
Segmentation

Multiple Network Interface Cards (NICs) – ControlLogix & CompactLogix 5380 Limitations

- Isolated networks – two or more NICs for physical network segmentation



- Segment Networks – Enable Dual IP Mode (>= V29)



ControlLogix & 5380 controllers do not support the following functions:

- TCP routing or switching between networks.
- CIP bridging of Class 0/1 packets between networks.

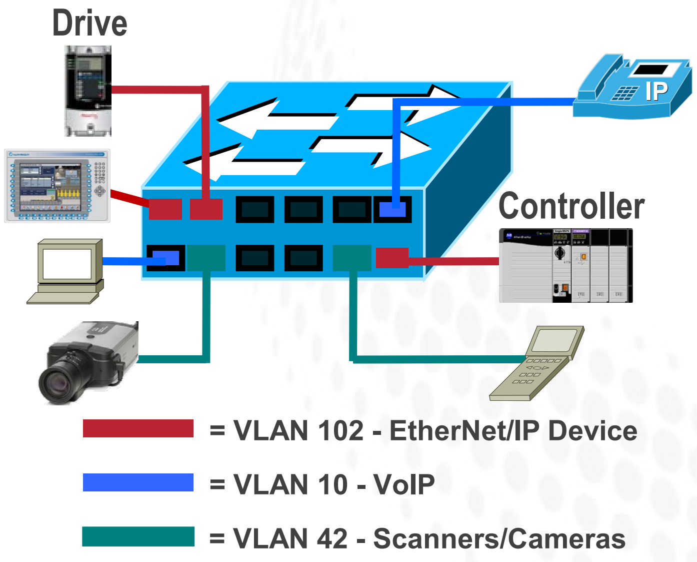
ControlLogix & 5380 will support the following functions:

- CIP bridging for Class 3 CIP messages between networks.
- CIP bridging for Unconnected CIP messages between networks.
- Bridging for HMI communications (class 3) between networks.

Segmentation

Virtual Local Area Networks (VLANs)

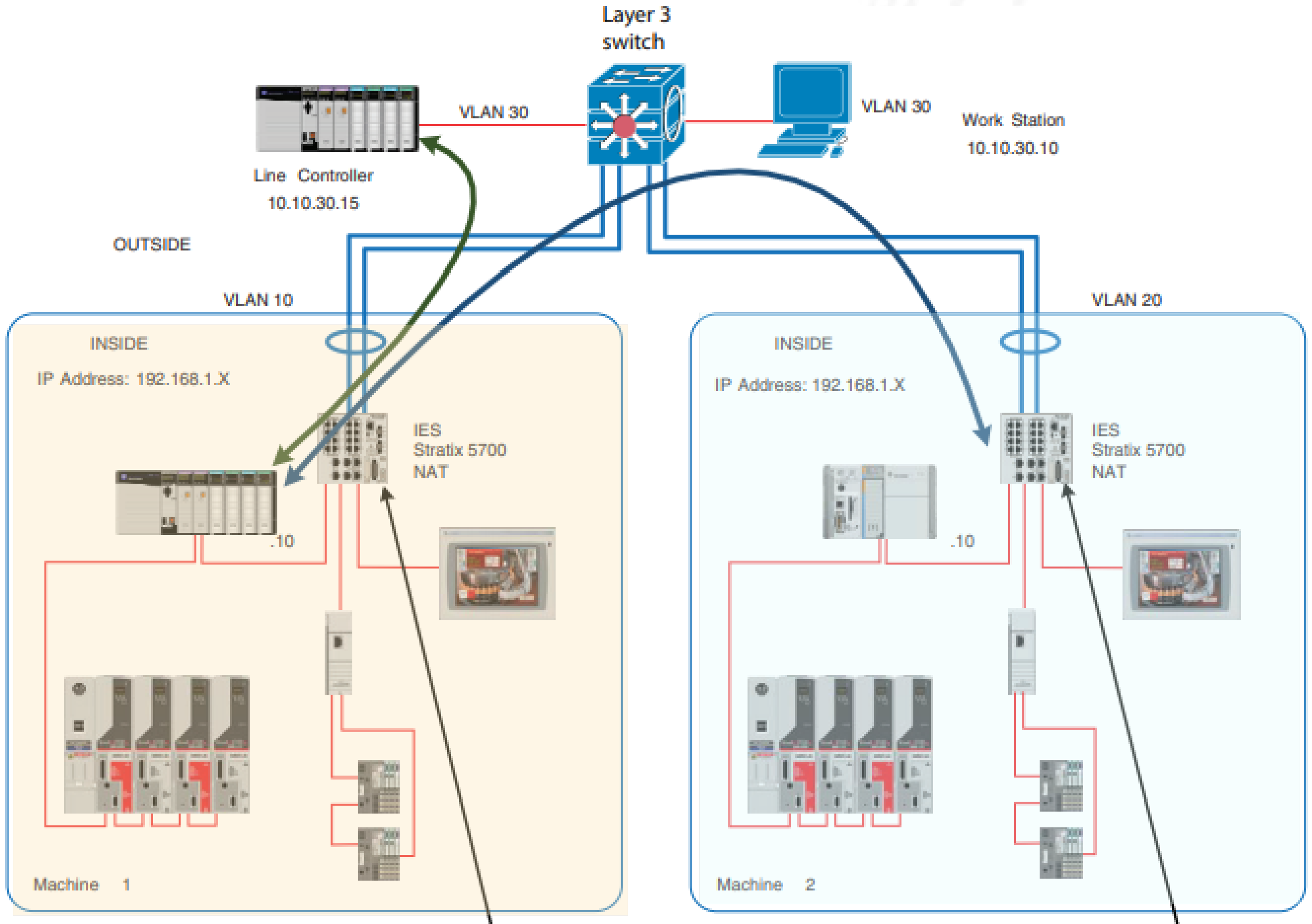
- Layer 2 network service, VLANs segment a network logically without being restricted by physical connections
  - VLAN established within or across switches
- Data is only forwarded to ports within the same VLAN
  - Devices within each VLAN can only communicate with other devices on the same VLAN
- Segments traffic to restrict unwanted broadcast and multicast traffic
- Software configurable using managed switches
- Benefits
  - Ease network changes – minimize network cabling
  - Simplifies network security management - domains of trust
  - Increase efficiency



Segmentation

NAT – Multiple Machines/Skids, Different VLANs, same internal IP range

- Segmented Networks - Layer 2 (e.g. VLAN) and Layer 3 (e.g. subnet)
- Smaller Layer 2 building blocks
- Simplified Machine/Process deployment and machine duplication
- Reduction in “outside” IP’s – translate only IP’s required for outside communication.



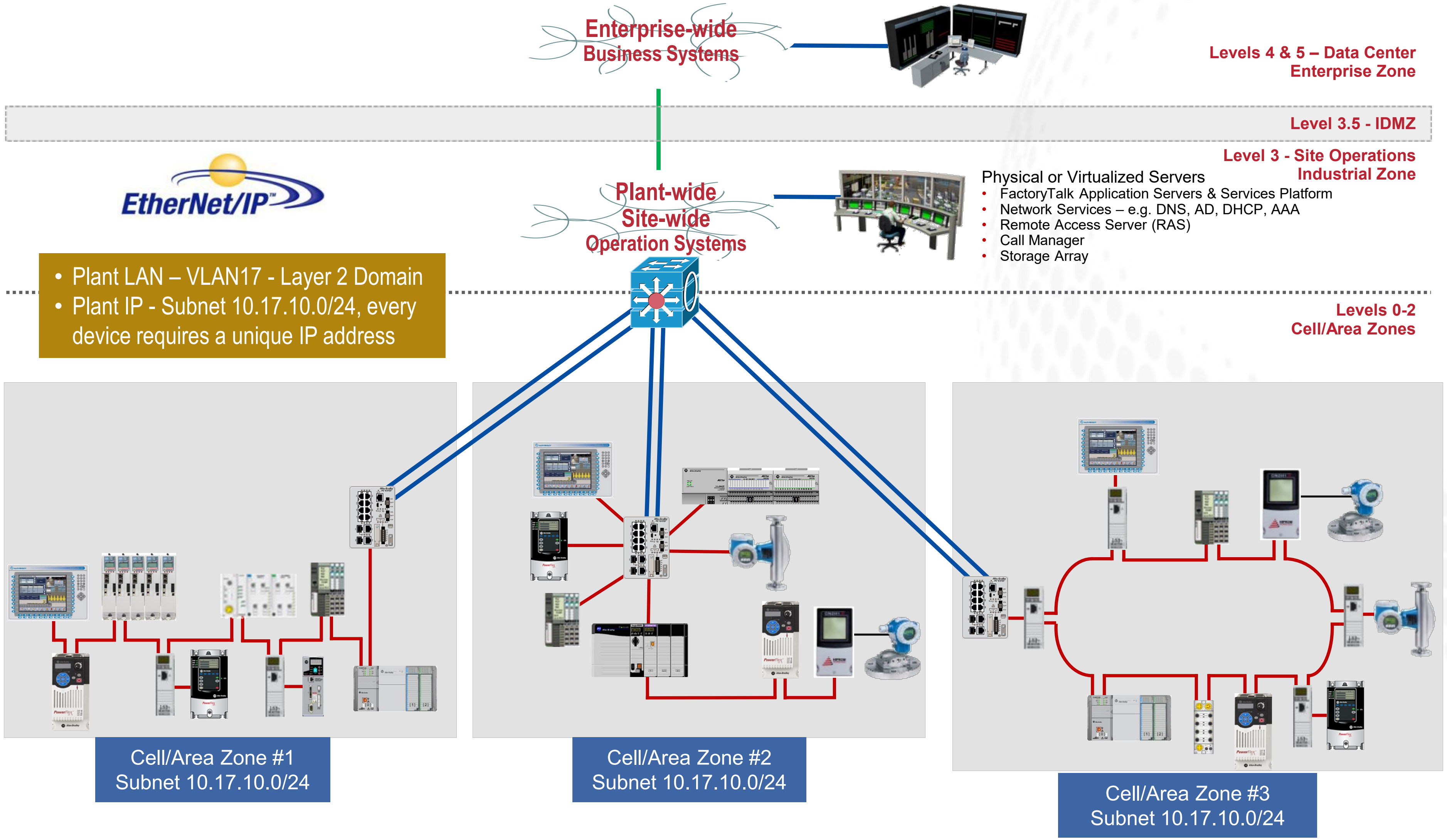
Inside to Outside NAT Table	Inside	Outside
	192.168.1.10	10.10.10.10
Gateway Translation	Outside	Inside
	10.10.10.1	192.168.1.1

Inside to Outside NAT Table	Inside	Outside
	192.168.1.10	10.10.20.10
Gateway Translation	Outside	Inside
	10.10.20.1	192.168.1.1

Segmentation

NONE – Not recommended

- All three areas are on the same subnet and broadcast domain
- Flat network
- Difficult to troubleshoot
- Problematic to secure



Enterprise-wide Business Systems
Levels 4 & 5 – Data Center Enterprise Zone
Level 3.5 - IDMZ
Level 3 - Site Operations Industrial Zone
EtherNet/IP
Plant-wide Site-wide Operation Systems
Levels 0-2 Cell/Area Zones

Physical or Virtualized Servers

- FactoryTalk Application Servers & Services Platform
- Network Services – e.g. DNS, AD, DHCP, AAA
- Remote Access Server (RAS)
- Call Manager
- Storage Array

- Plant LAN – VLAN17 - Layer 2 Domain
- Plant IP - Subnet 10.17.10.0/24, every device requires a unique IP address

Cell/Area Zone #1
Subnet 10.17.10.0/24

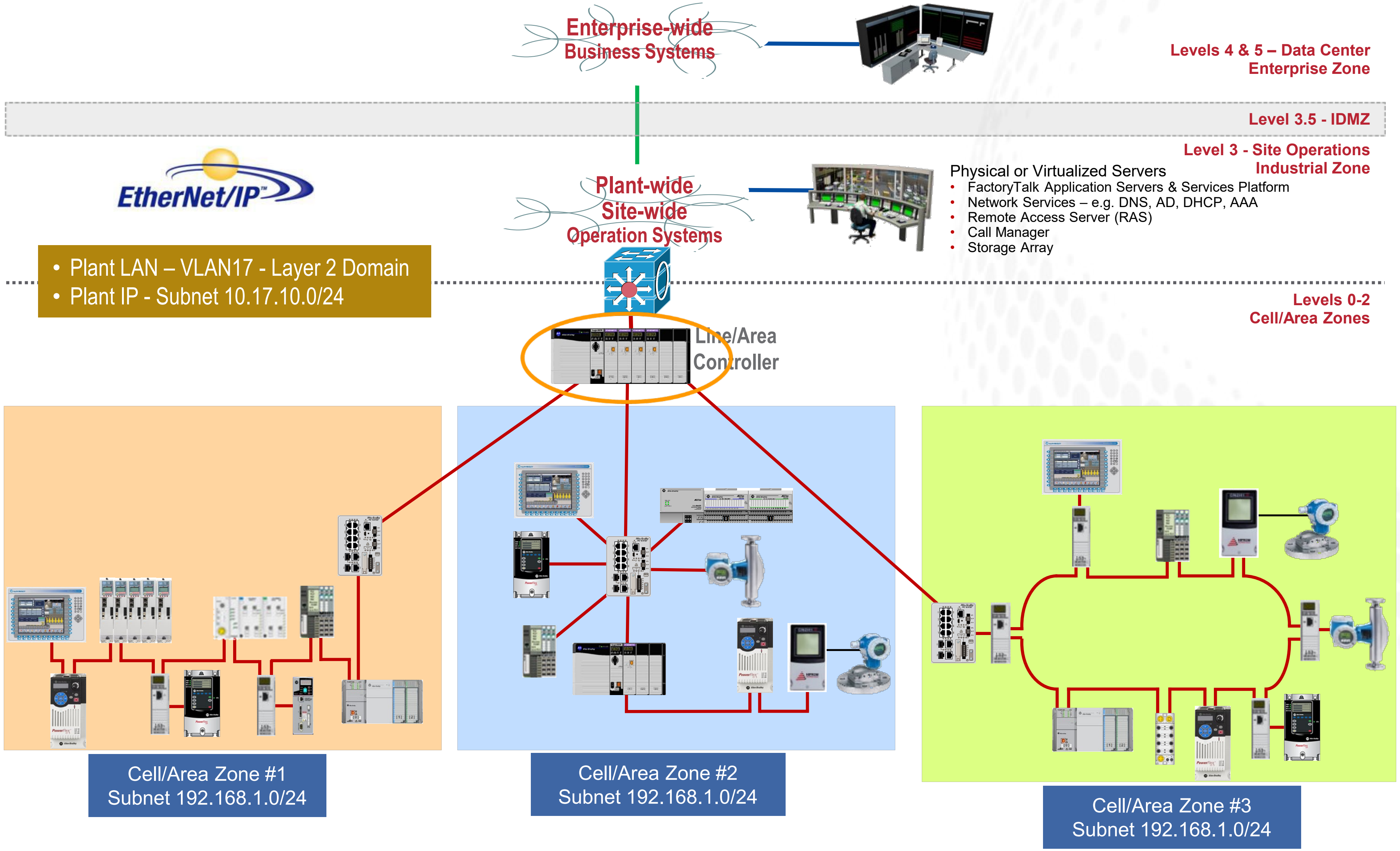
Cell/Area Zone #2
Subnet 10.17.10.0/24

Cell/Area Zone #3
Subnet 10.17.10.0/24

Segmentation

Multiple Logix NIC Segmentation – Non-Converged

- Allows for IP reuse
- Challenging to secure
- Does provide Zone segmentation through the Logix Chassis
- Better implementation would be to have different subnets for supportability.



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- Plant LAN – VLAN17 - Layer 2 Domain
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Cell/Area Zone #1
Subnet 192.168.1.0/24

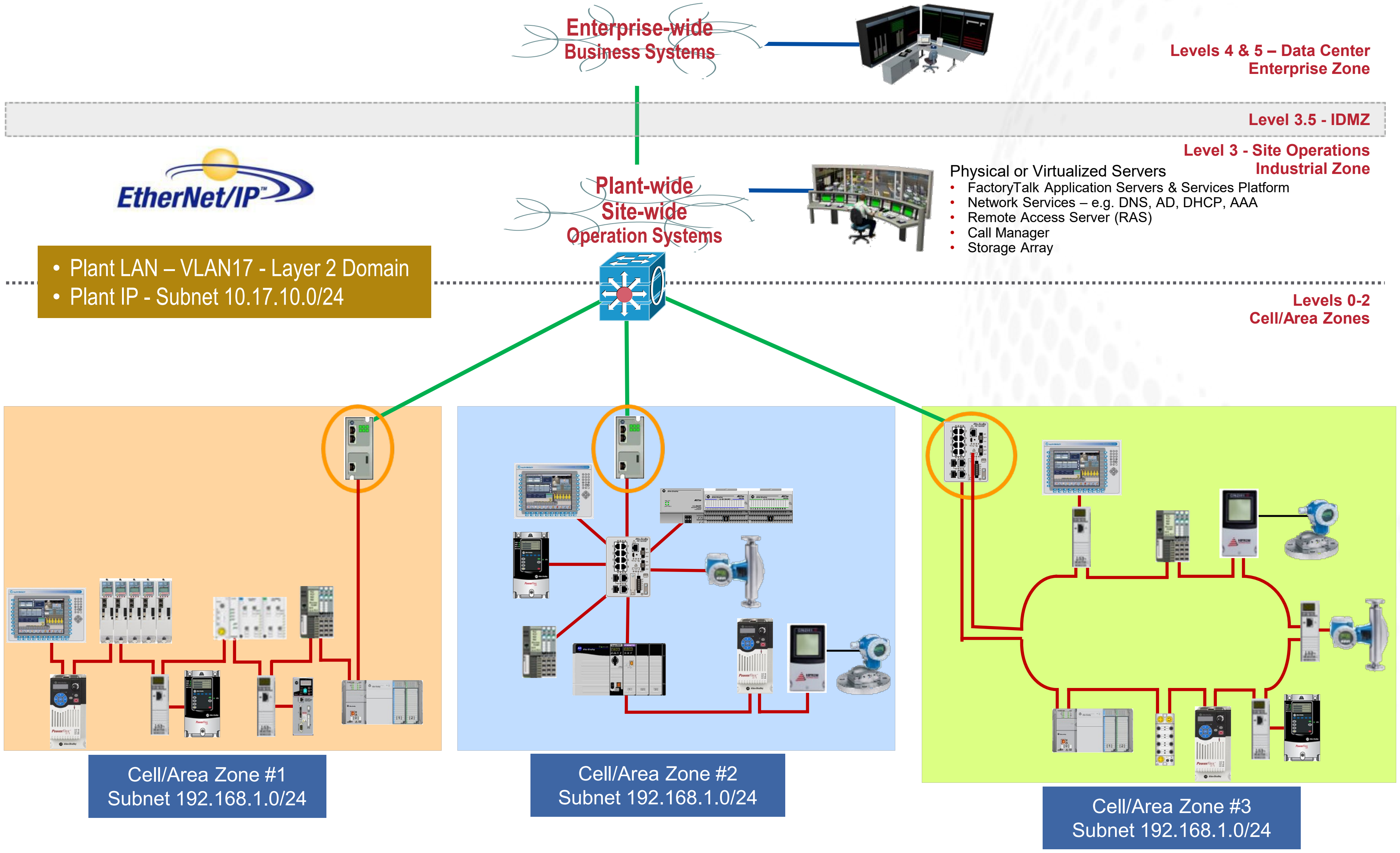
Cell/Area Zone #2
Subnet 192.168.1.0/24

Cell/Area Zone #3
Subnet 192.168.1.0/24

Segmentation

NAT Segmentation

- Allows for IP/subnet duplication at Cell/Area level
- Majority of TCP/IP services can traverse the NAT boundary (unlike CIP backplane bridge)
- Translate only IP's required to communicate with devices outside of Area/Zone



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Cell/Area Zone #1
Subnet 192.168.1.0/24

Cell/Area Zone #2
Subnet 192.168.1.0/24

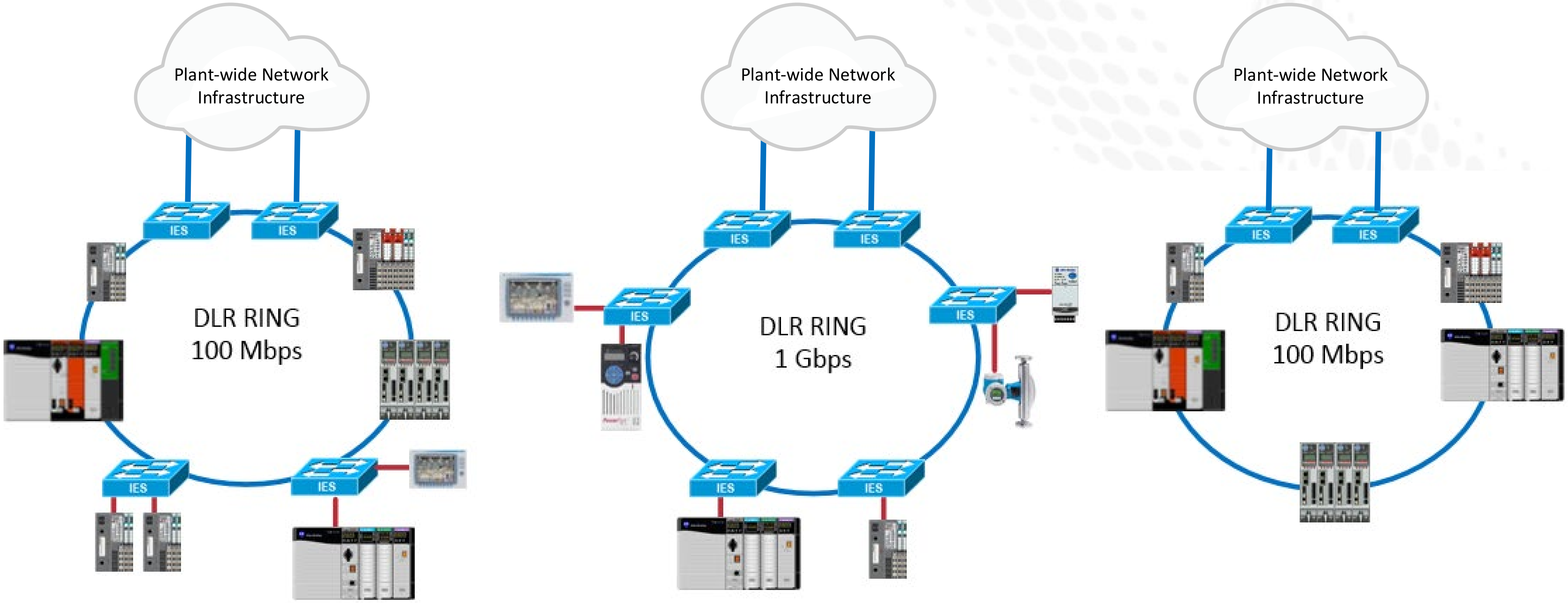
Cell/Area Zone #3
Subnet 192.168.1.0/24

DLR Design Considerations

DLR Design Considerations

Single Device Level Ring

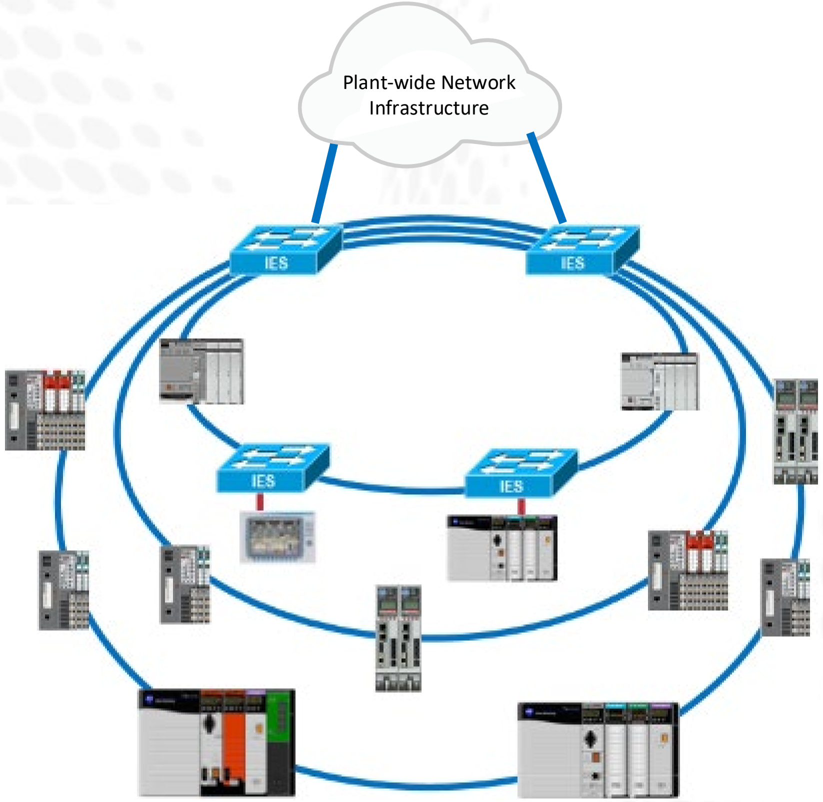
- Single DLR rings can be either mixed device/switch-level , switch-level, or device-level.
- A single DLR ring speed can be set to either 100 Mbps/full duplex or 1 Gbps/full duplex but may not be intermixed between ring participants within a single ring. The entire single ring must run at the same speed and cannot be intermixed.
- A single DLR ring media can be either copper, fiber (single-mode or multi-mode), or a combination of both.


Plant-wide Network Infrastructure
IES
IES
DLR RING
100 Mbps
IES
IES
Plant-wide Network Infrastructure
IES
IES
IES
IES
DLR RING
1 Gbps
IES
IES
Plant-wide Network Infrastructure
IES
IES
DLR RING
100 Mbps

DLR Design Considerations

Multiple Device Level Rings only on Stratix 5400

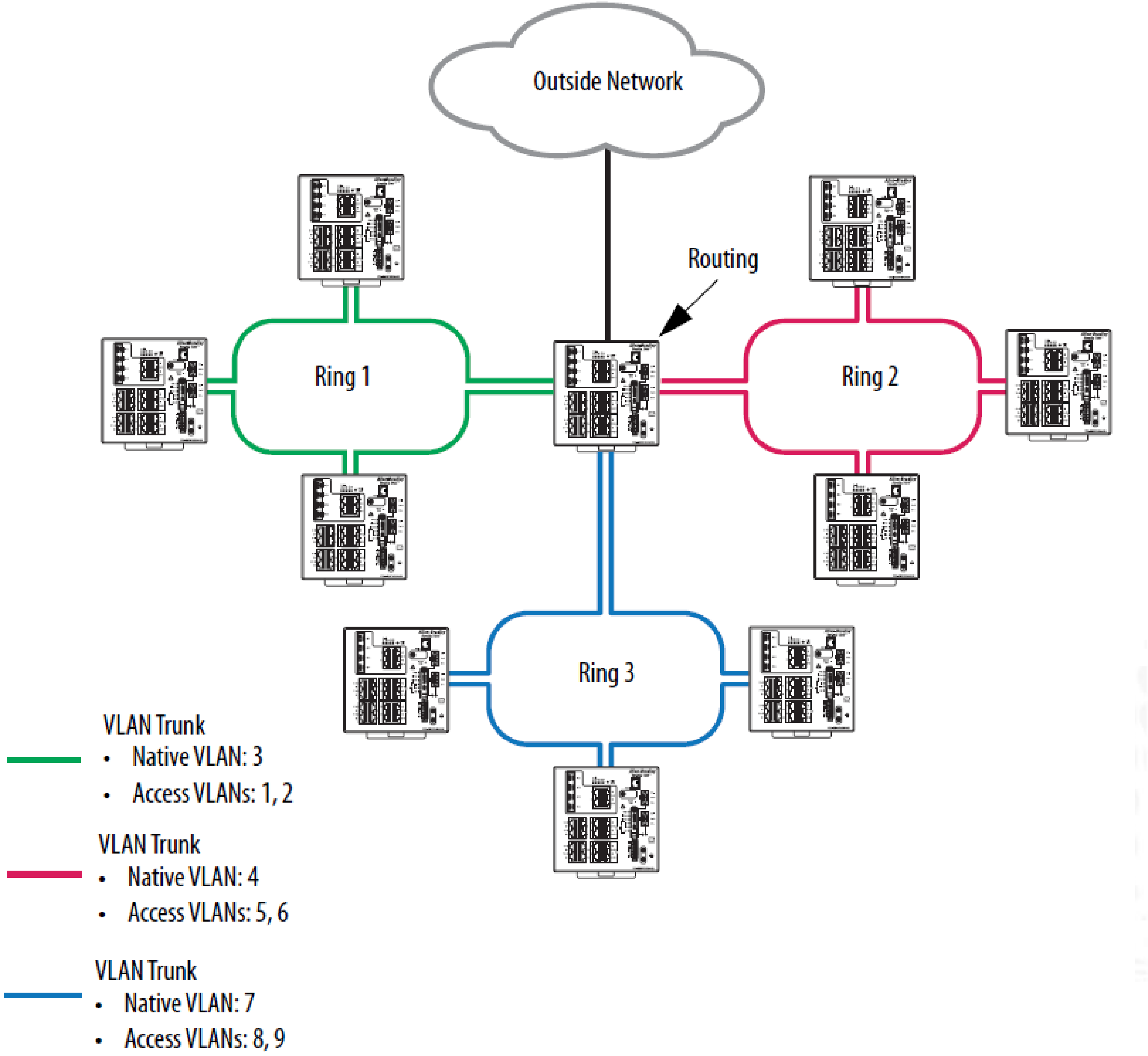
- The Stratix 5400 has six dedicated DLR ring ports for up to three DLR Rings.
- Each ring can be logically isolated using VLANs.
- IES that can support multiple pairs of DLR ports must conform to the following rules:
    - Each pair of DLR ports will operate independently from each other.
- A single DLR ring speed can be set to either 100 Mbps/full duplex or 1 Gbps/full duplex but may not be intermixed between ring participants within a single ring.
- A single DLR ring media can be either copper, fiber (single-mode or multi-mode), or a combination of both..



DLR Design Considerations

VLAN Trunking

- All devices in DLR network must be switches
- All switches in DLR network must have DLR-enabled trunk ports
- You cannot extend the same VLAN across more than one ring
- To avoid problems with Spanning Tree Protocol (STP), you must specify which VLANs to allow on each DLR-enabled trunk ports.
- Redundant gateways are not supported in a DLR network with VLAN trunking

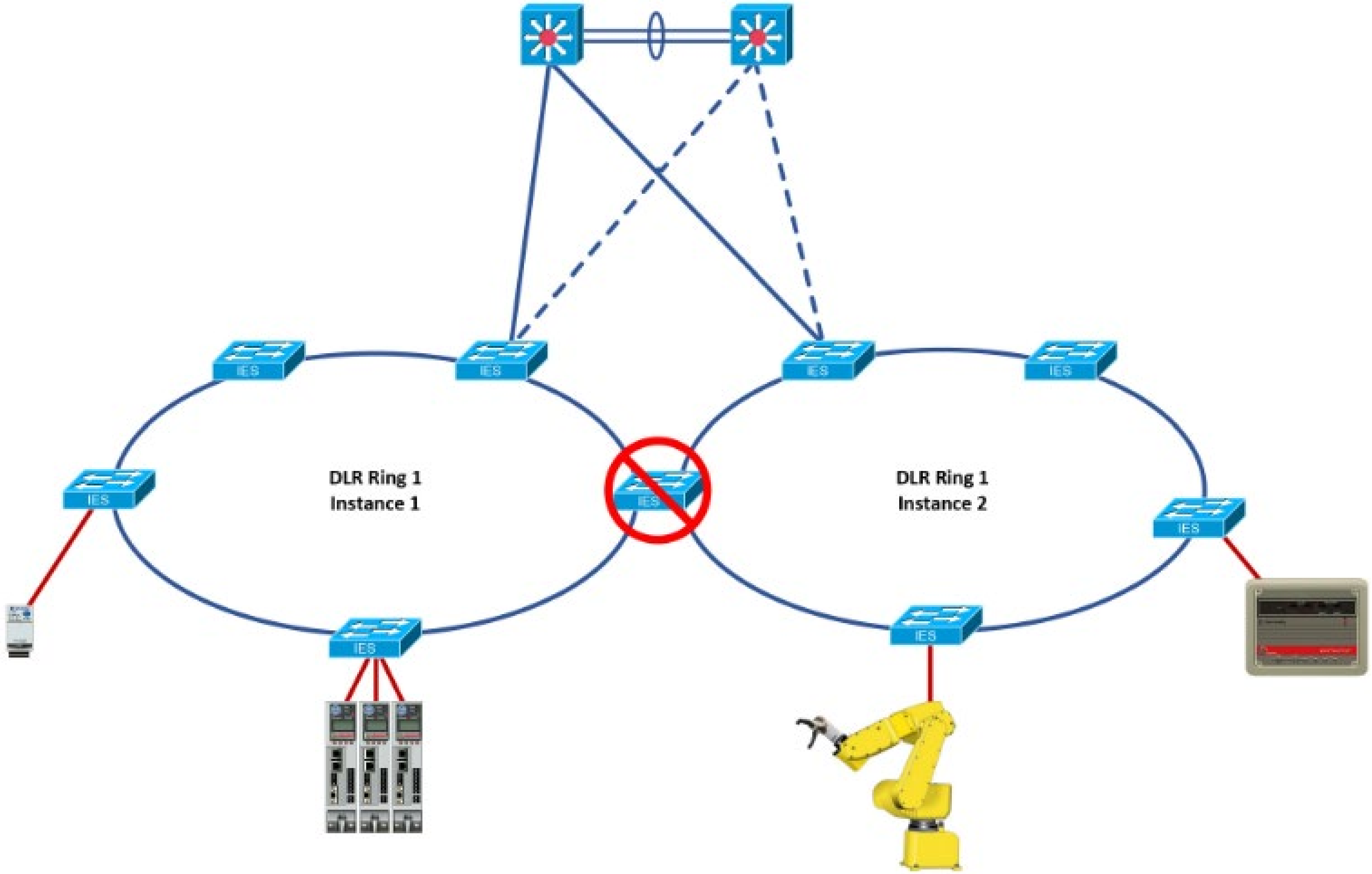


DLR Design Considerations

Unsupported Topologies

- The DLR protocol does not support sharing the same ring between two nodes

- This is not to be confused with the Stratix 5400 multi-ring feature

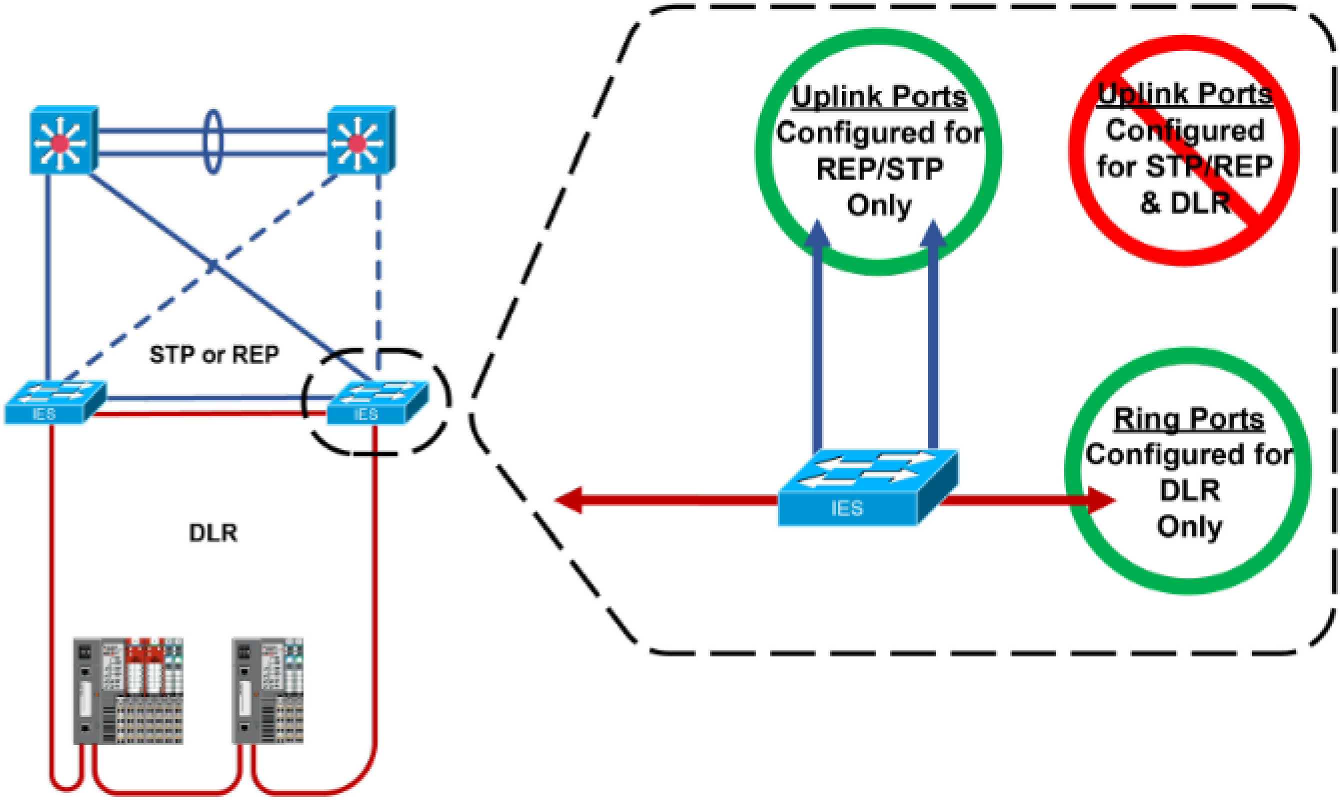


DLR Design Considerations

Unsupported Topologies

- The DLR protocol cannot be implemented on the same ports as other resiliency protocols

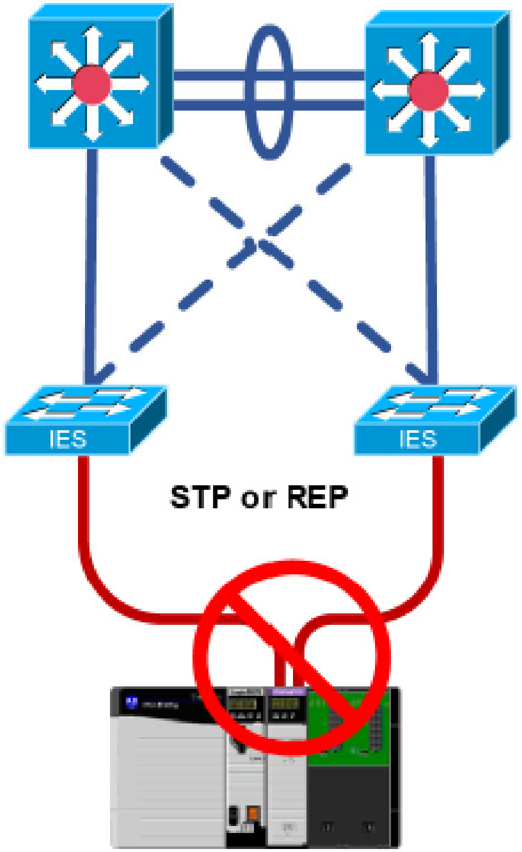
- For example:
  - Uplink ports cannot be configured for STP/REP and DLR
  - Ring ports cannot be configured for STP/REP and DLR


STP or REP
IES
IES
DLR
Uplink Ports Configured for REP/STP Only
Uplink Ports Configured for STP/REP & DLR
Ring Ports Configured for DLR Only
IES

DLR Design Considerations

Unsupported Topologies

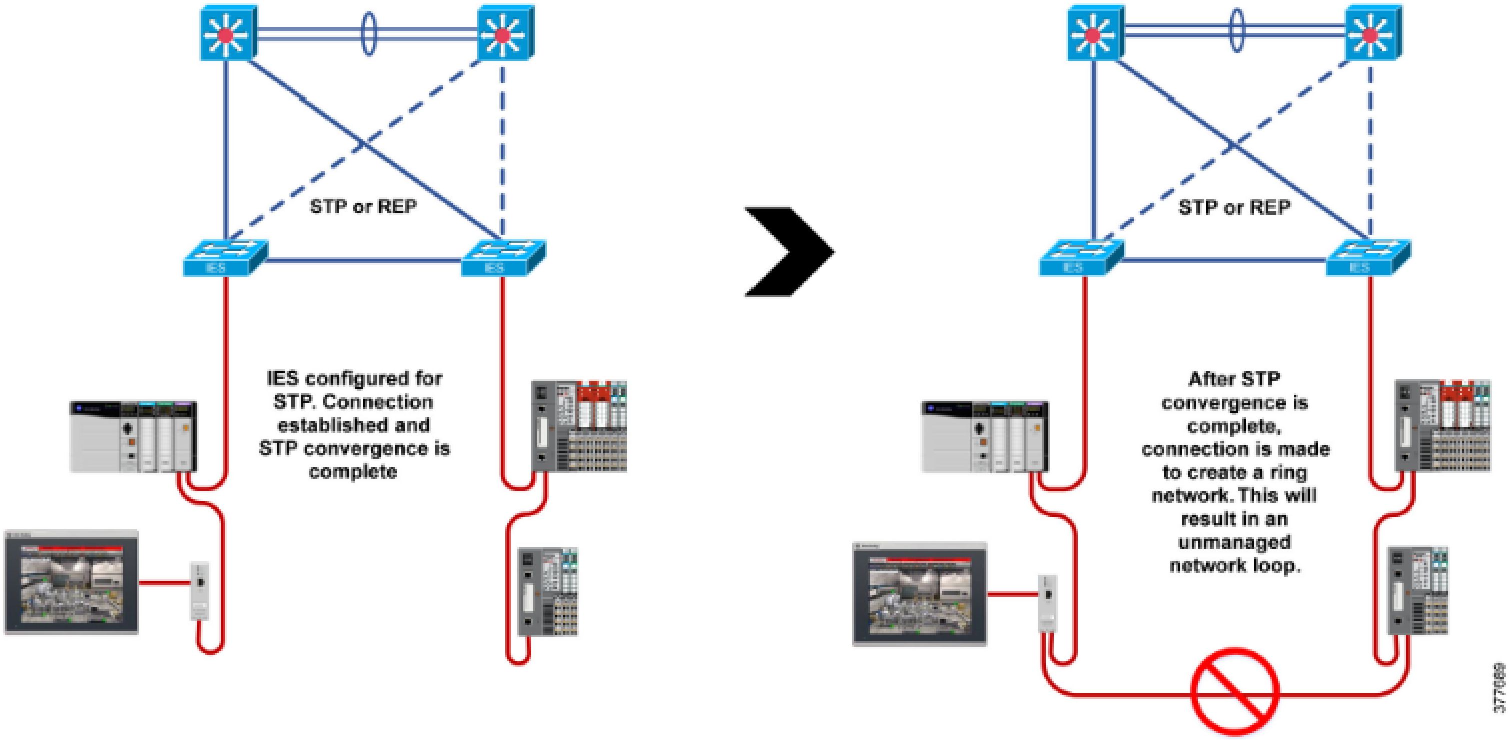
- Embedded switch devices cannot have each port connected to a Stratix switch without implementing the DLR protocol



DLR Design Considerations

Unsupported Topologies

- Two separately configured linear topologies cannot be connected together without the DLR protocol



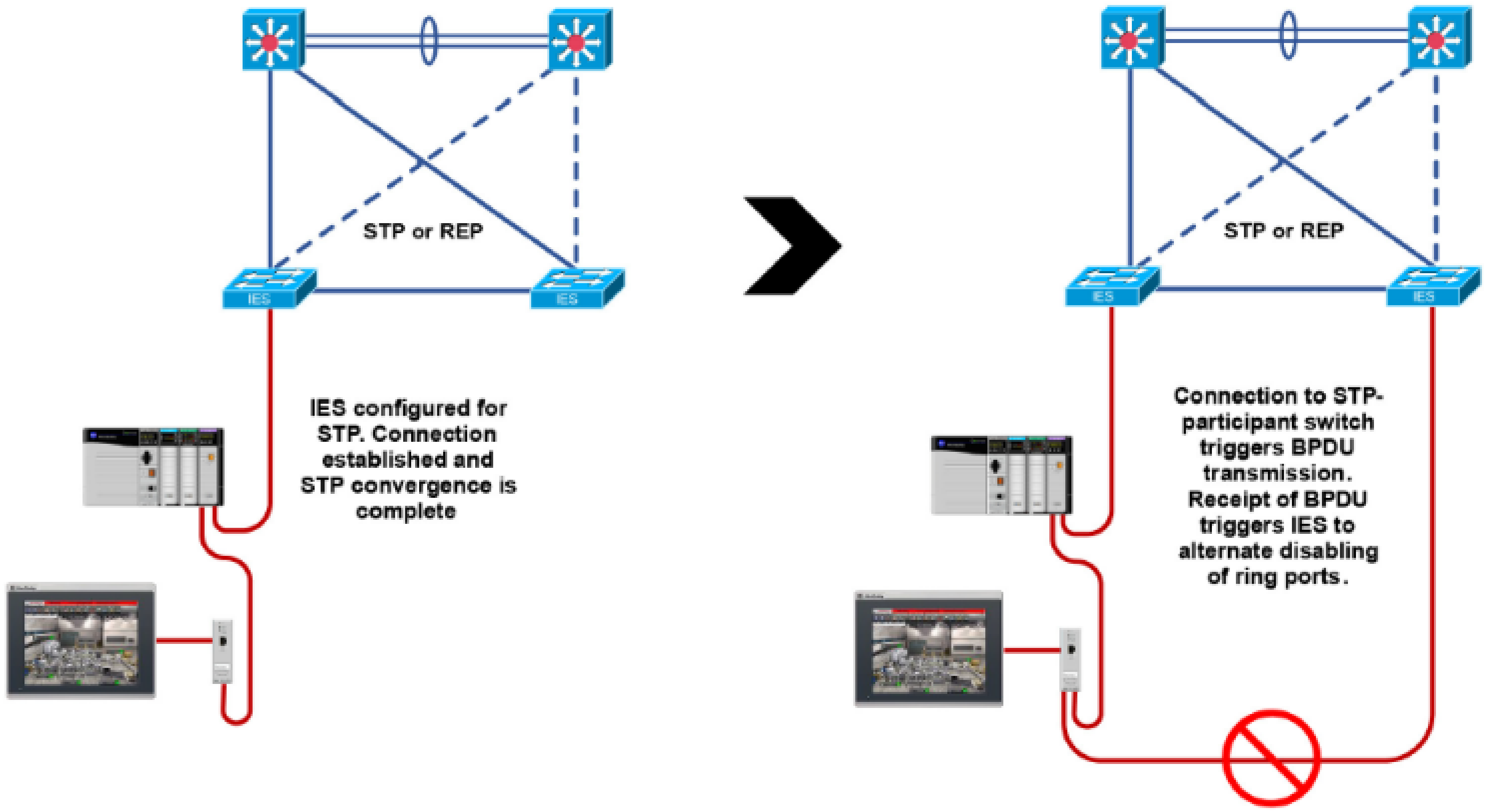
IES configured for STP. Connection established and STP convergence is complete

After STP convergence is complete, connection is made to create a ring network. This will result in an unmanaged network loop.

DLR Design Considerations

Unsupported Topologies

- A linear topology cannot be connected into a ring without the DLR protocol

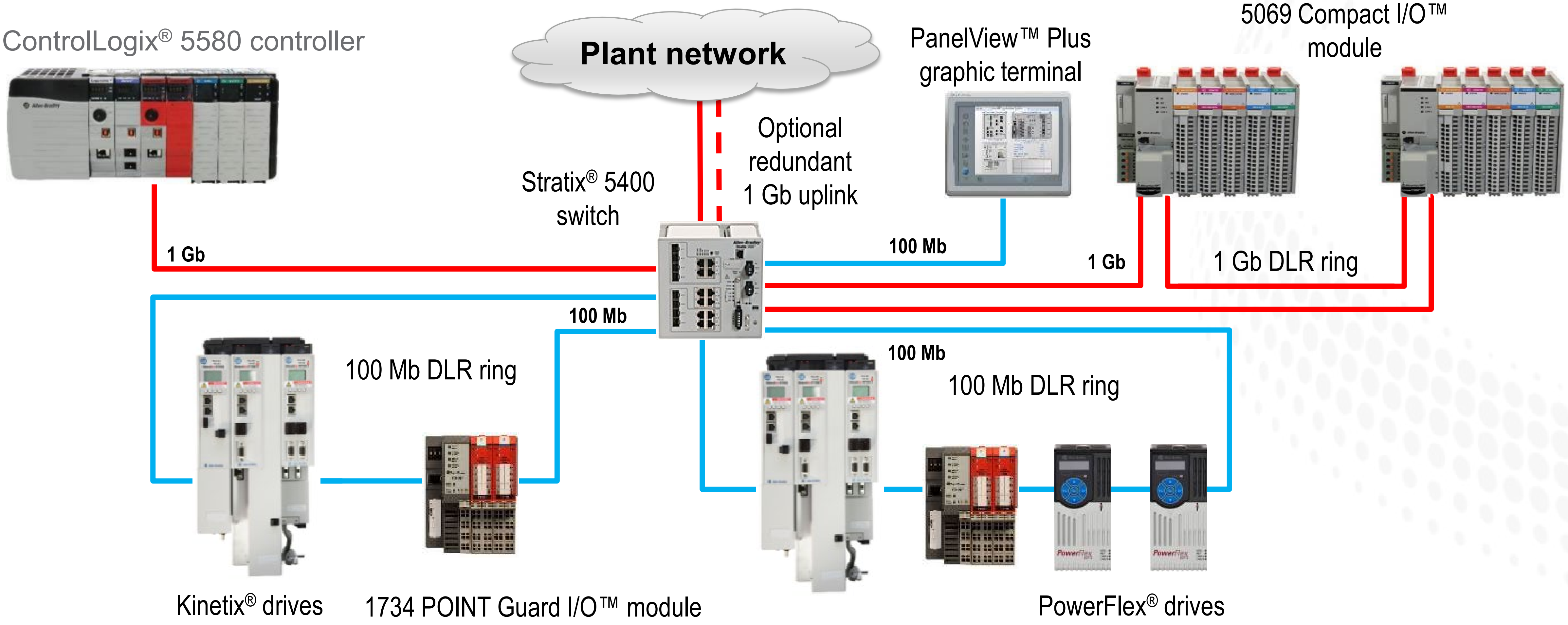


IES configured for STP. Connection established and STP convergence is complete

Connection to STP-participant switch triggers BPDU transmission. Receipt of BPDU triggers IES to alternate disabling of ring ports.

DLR considerations

Star topology recommended for mixed 100 Mb and 1 Gb devices

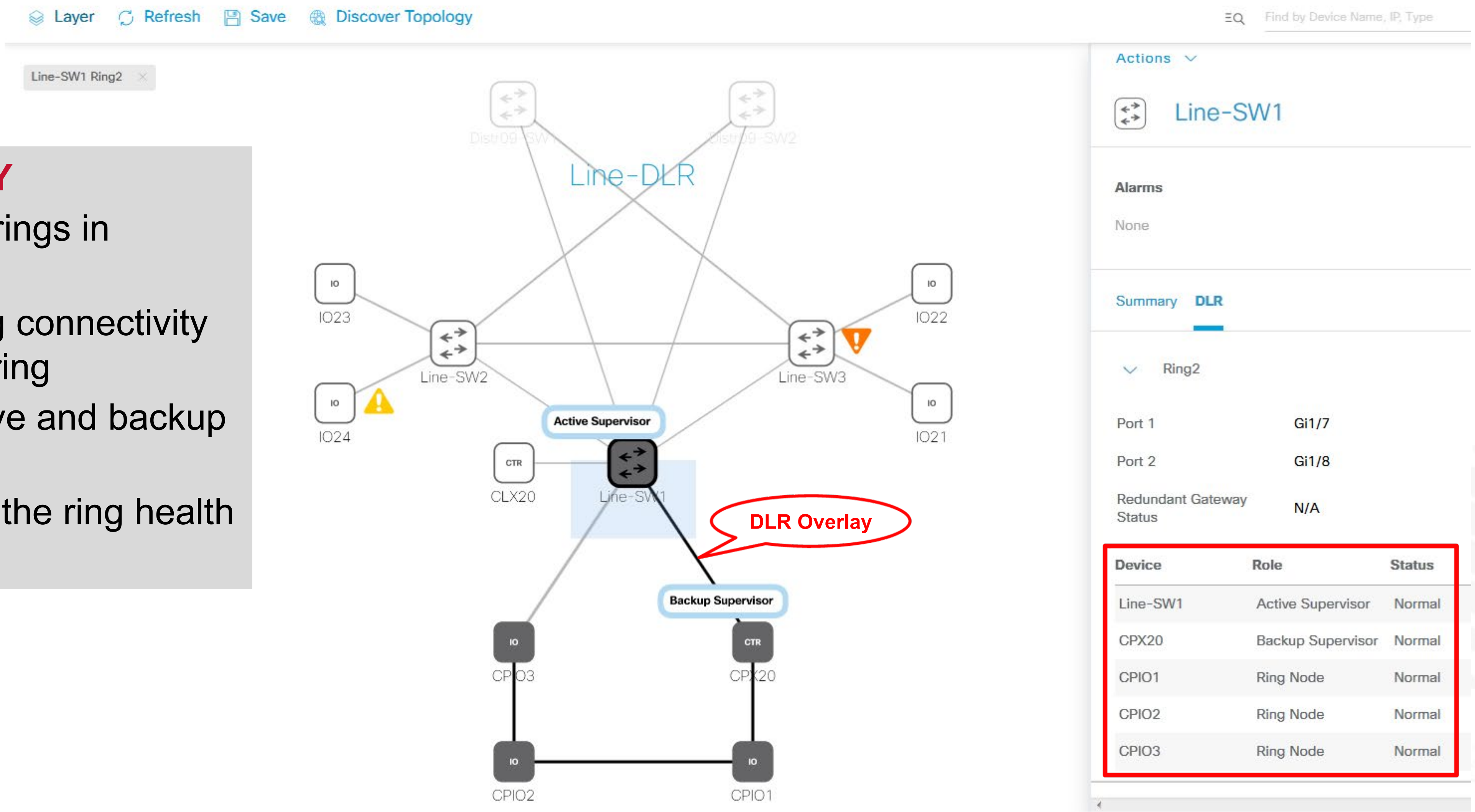


Up to (3) DLR Rings are supported at 100 Mb or 1 Gb on Stratix® 5400 switches

Network Visibility with FTNM - Device Level Ring (DLR) Overlay

DLR OVERLAY

- Discovers all rings in network
- Highlights ring connectivity for a specific ring
- Identifies active and backup supervisor
- Quick view of the ring health and node list



DLR Overlay

Alarms

None

Port 1	Gi1/7
Port 2	Gi1/8
Redundant Gateway Status	N/A

Device	Role	Status
Line-SW1	Active Supervisor	Normal
CPX20	Backup Supervisor	Normal
CPIO1	Ring Node	Normal
CPIO2	Ring Node	Normal
CPIO3	Ring Node	Normal

Direct DLR Non-converged

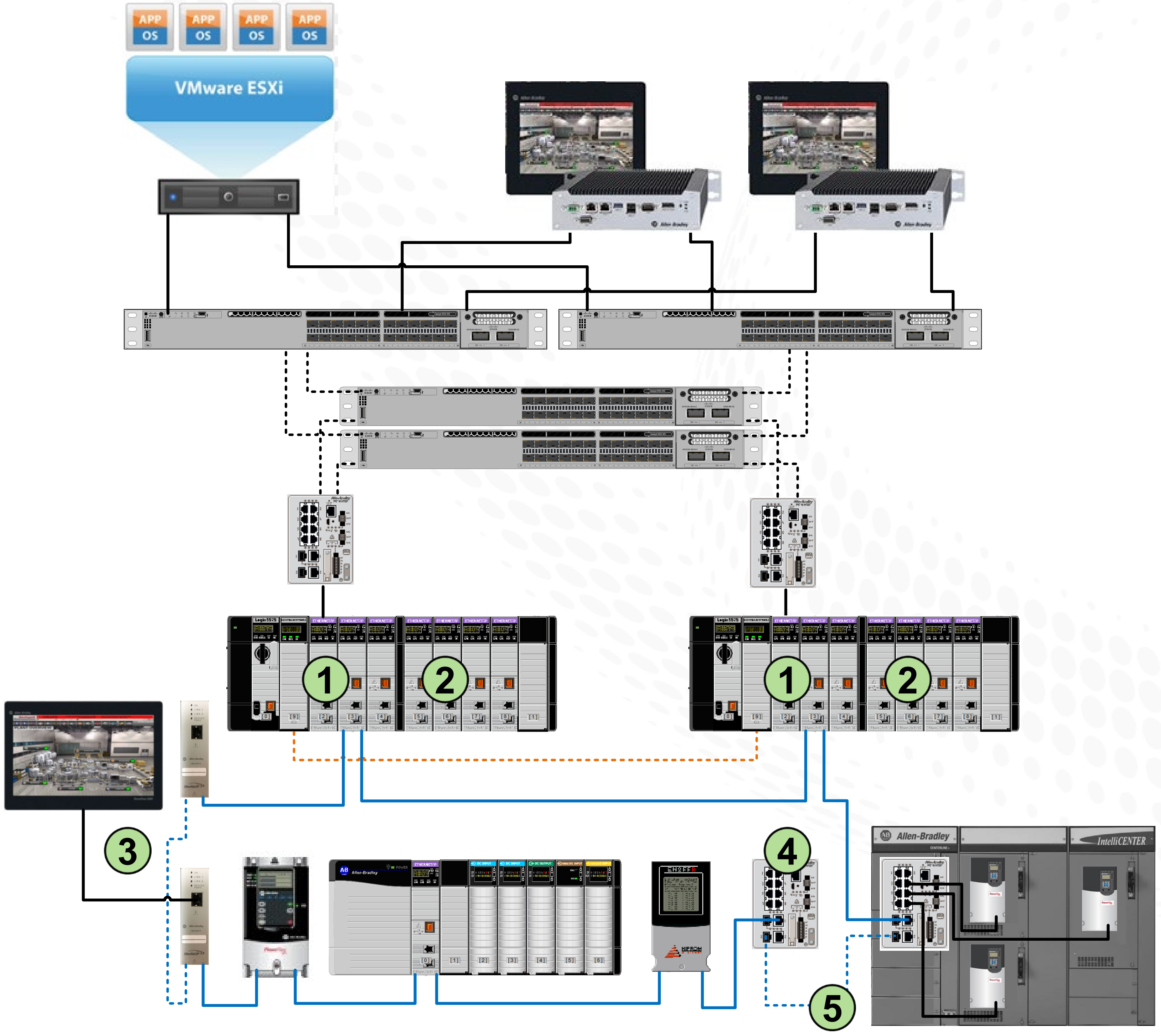
1. One Ethernet Module dedicated to upstream communications.

2. Up to six Ethernet Modules available for separate DLR I/O networks. 50 nodes max per DLR network, ∴ 50 nodes x 6 DLR networks = 300 DLR nodes possible. Please note that for switch-only rings other restrictions may apply.

3. 1783-ETAP*F modules allow for multimode fiber segments.

4. DLR capable Stratix switches can be included in the DLR ring, but they must not be connected to the upstream network.

5. DLR capable Stratix switches allow for multimode <u>or</u> single mode fiber segments.



ControlLogix Redundancy Network Design Guidance

Direct DLR Non-converged

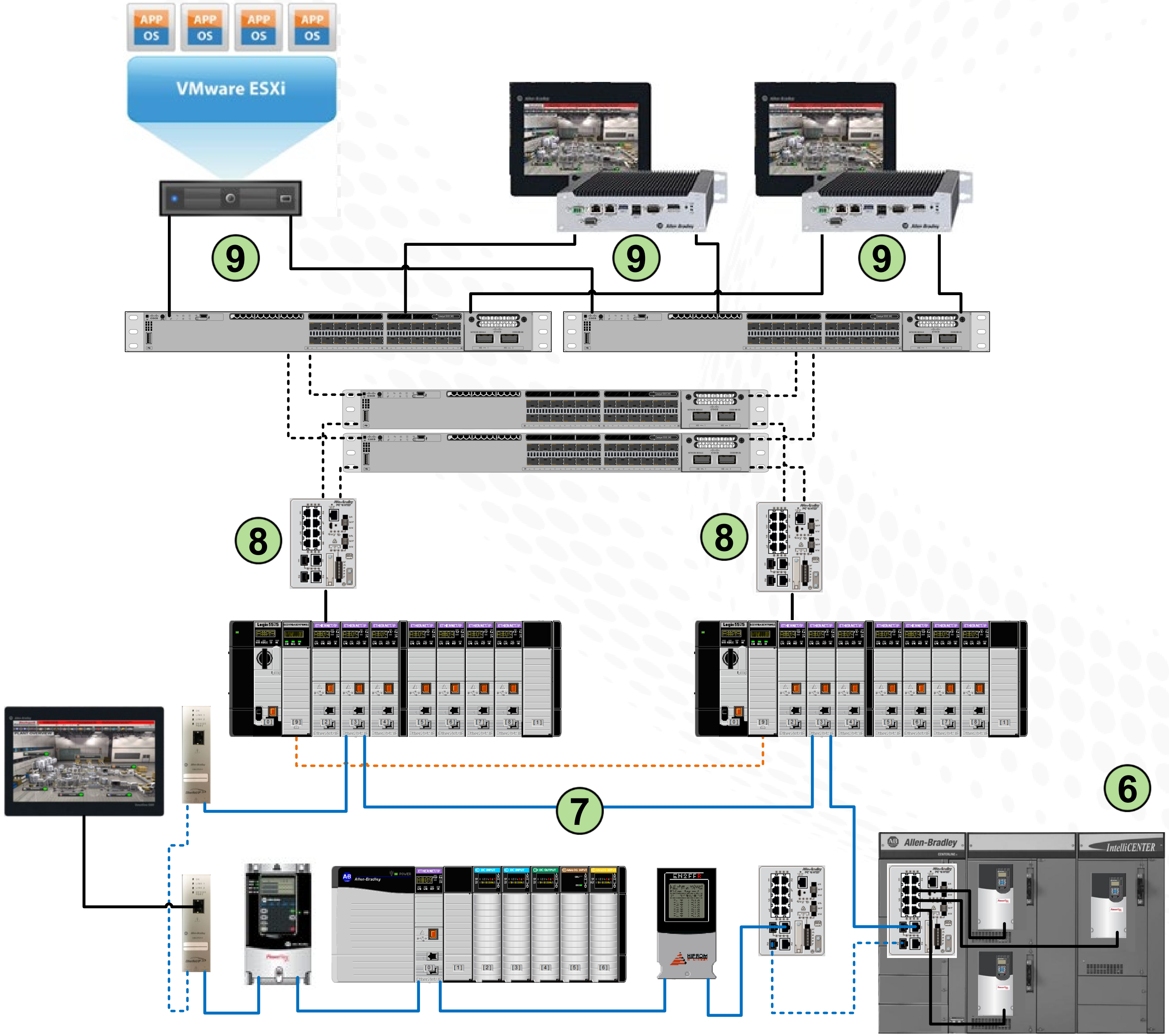
Continued…

6. Devices connected to non-DLR configured ports of a Stratix will be in a star topology, ∴ there exists single points of failure for those devices.

7. DLR I/O networks can be on the same or separate VLANs.

8. It is recommended that the PRI and SEC redundant controller racks connect to separate upstream switches. If the upstream switches are in a REP ring, please refer to the notes section of this slide.

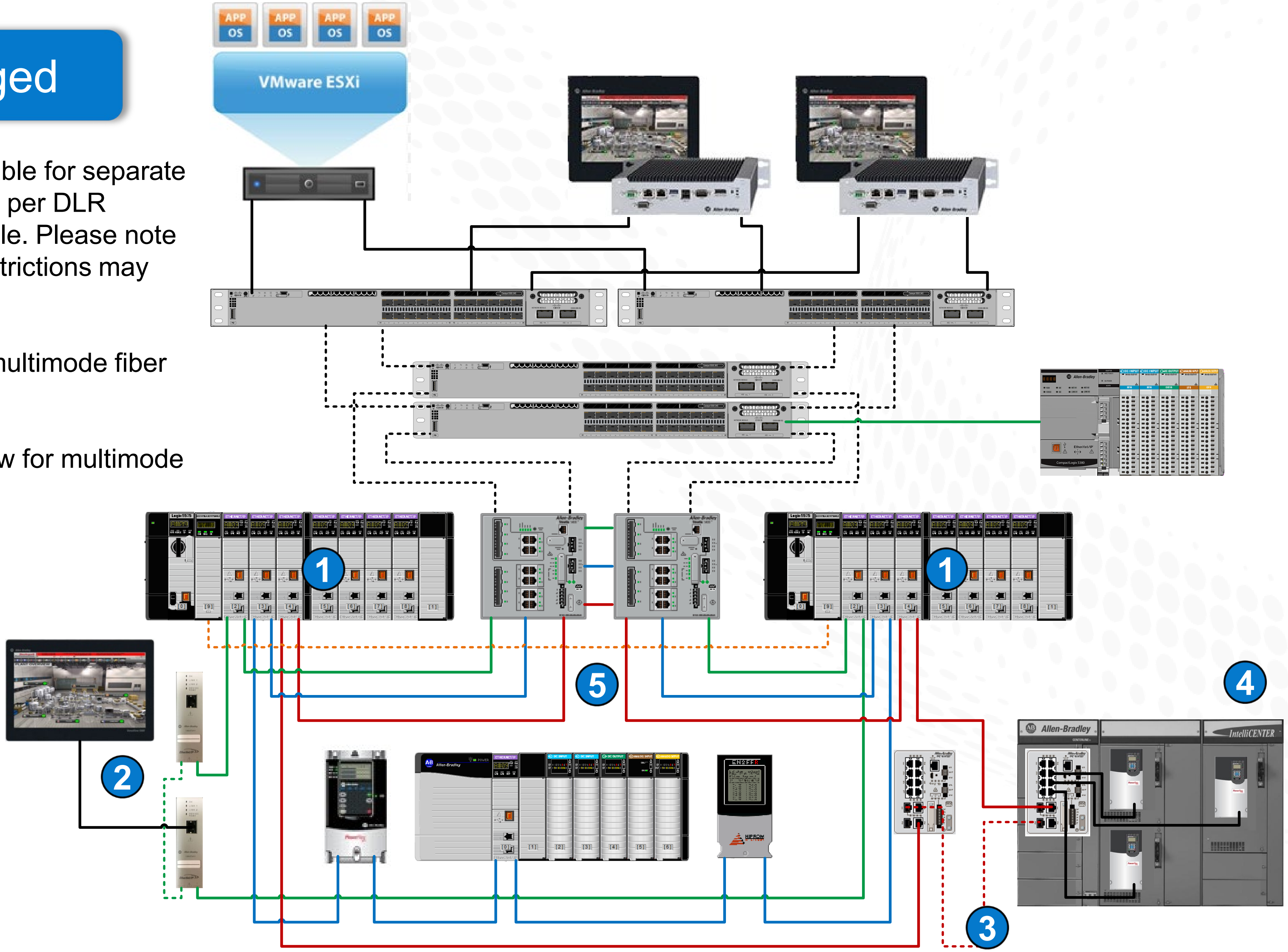
9. NIC teaming on servers and clients for additional resiliency.



ControlLogix Redundancy Network Design Guidance

Direct DLR Converged

1. All seven Ethernet modules available for separate DLR I/O networks. 50 nodes max per DLR network, ∴ 350 DLR nodes possible. Please note that for switch-only rings other restrictions may apply.
2. 1783-ETAP*F modules allow for multimode fiber segments.
3. DLR capable Stratix switches allow for multimode or single mode fiber segments.
4. Devices connected to non-DLR configured ports of a Stratix will be in a star topology, ∴ there exists single points of failure for those devices.
5. DLR I/O networks can be on the same **or** separate VLANs and all devices within the same ring must be at the same network speed.



[ControlLogix Redundancy Network Design Guidance](#)

Direct DLR Converged

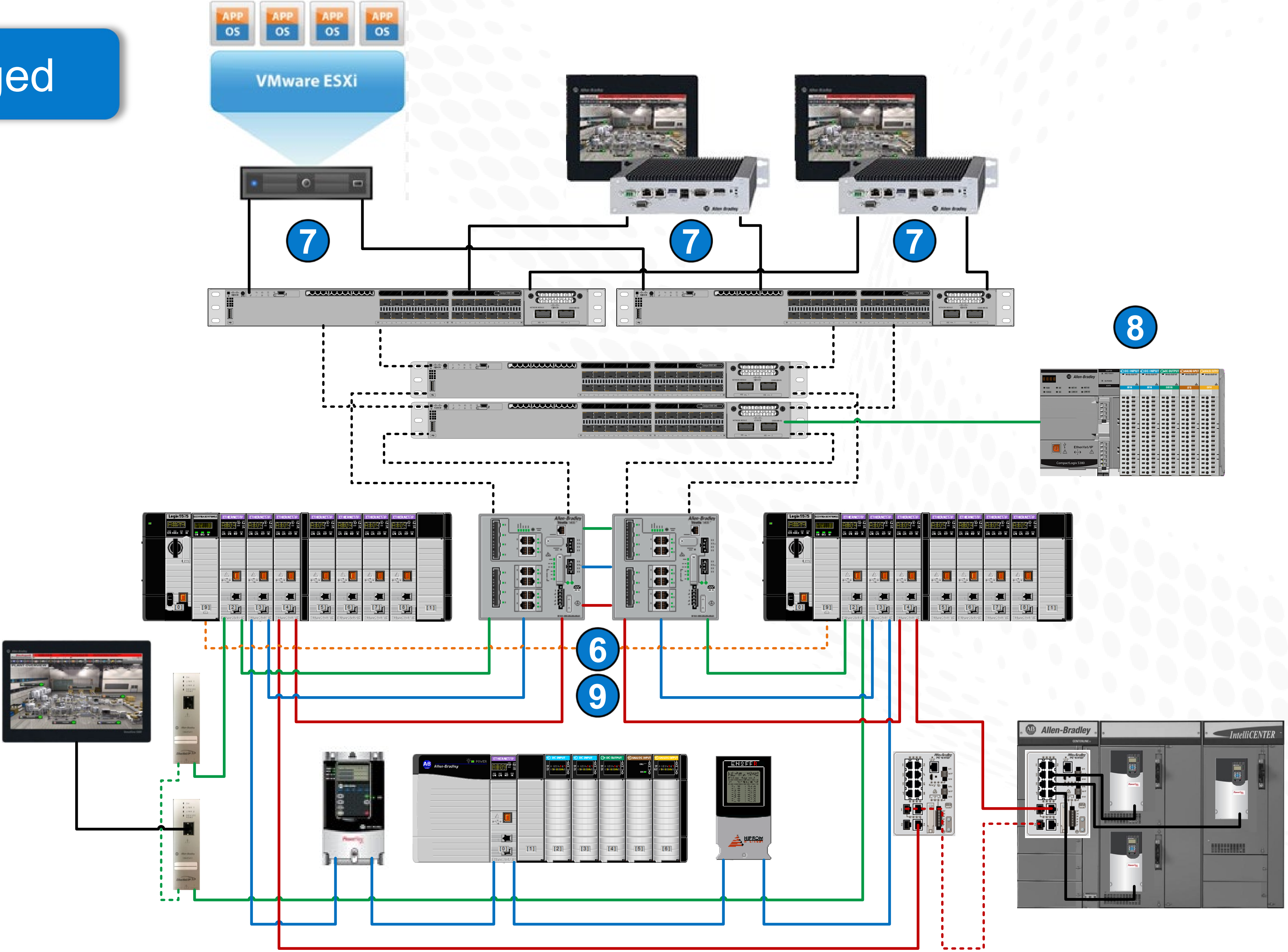
Continued…

6. The two Stratix switches used as DLR redundant gateways should be between the PRI and SEC redundant rack in each DLR I/O network. In addition, no other devices can be connected to these switches.

7. NIC teaming on servers and clients for additional resiliency.

8. When a DLR redundant gateway switchover event occurs, note that there is chance that traffic traversing the gateways will be interrupted during the gateway switchover and/or recovery phases.

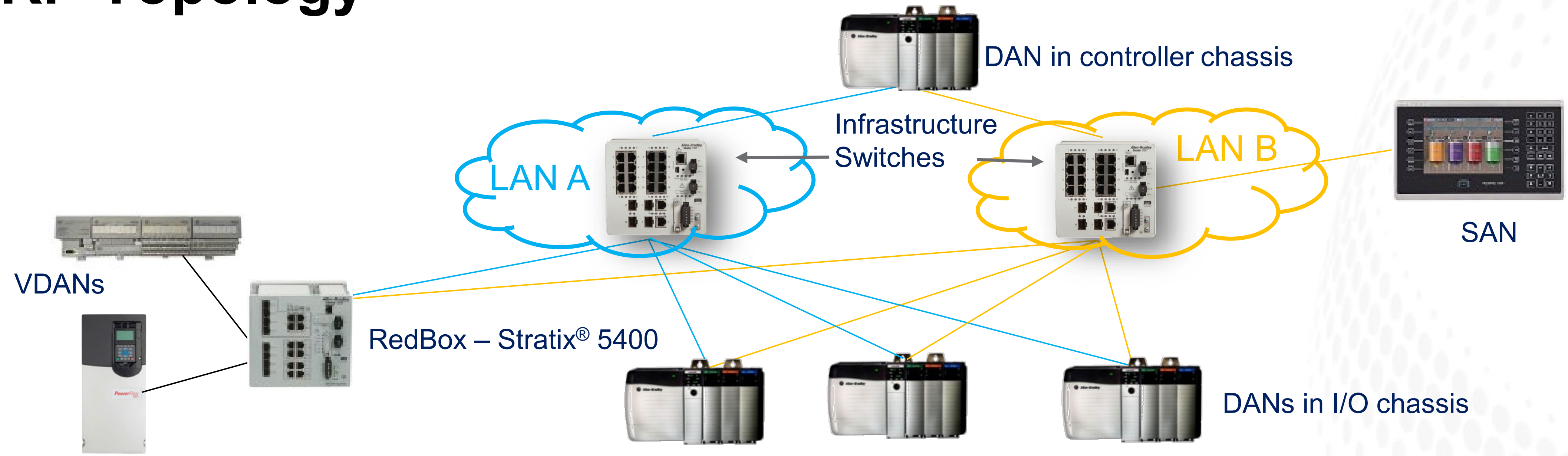
9. Requires Stratix Firmware 15.2 (7)EA or higher due to anomaly in earlier versions.



ControlLogix Redundancy Network Design Guidance

Parallel Redundancy Protocol (PRP)

PRP Topology

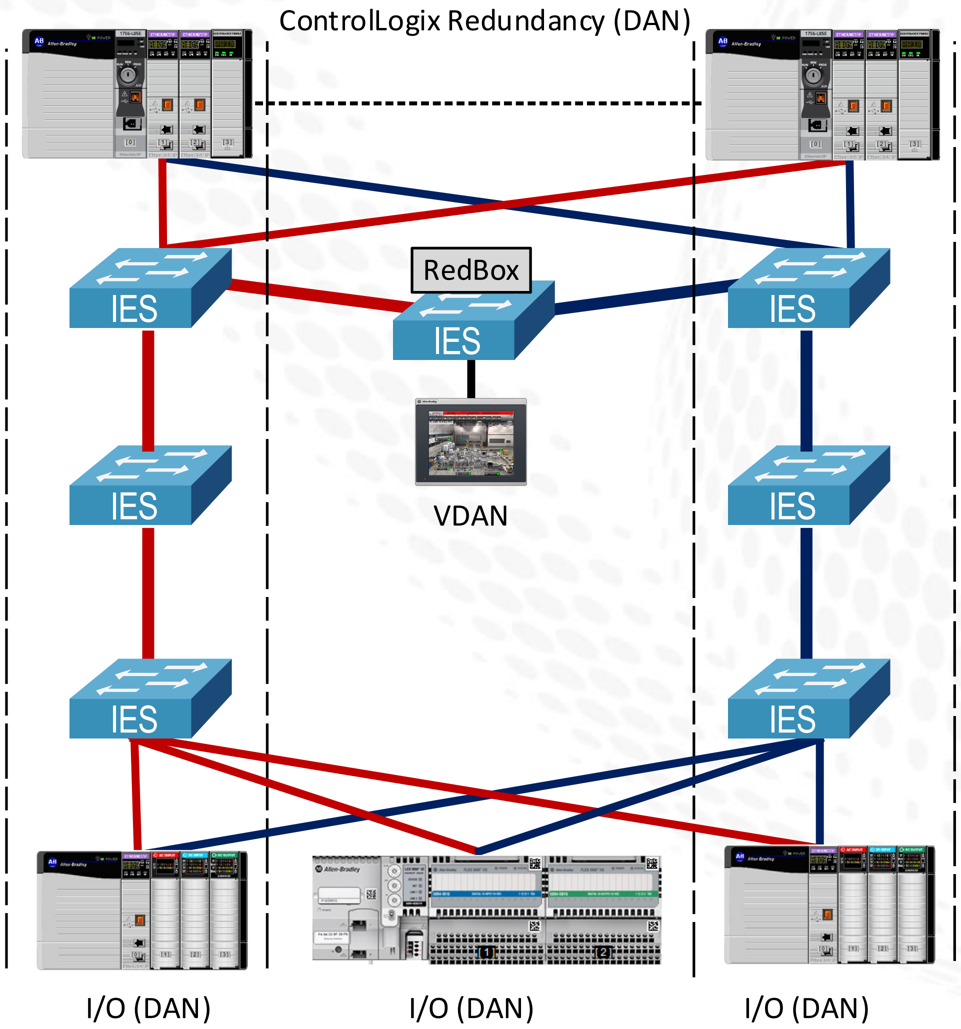


- Supports any LAN A/B topology where LANs are fault-independent
- LAN switches pass the PRP-marked frames just like any other Ethernet traffic
- Must be able to configure MTU size 1506 bytes or more (typically managed switches)
- Network monitoring is critical to detect LAN faults
    - Infrastructure devices must have unique IP addresses for monitoring
- Best practices for physical media, network design and security still apply!

PRP Topology Example

Parallel Paths – Linear LAN Topology

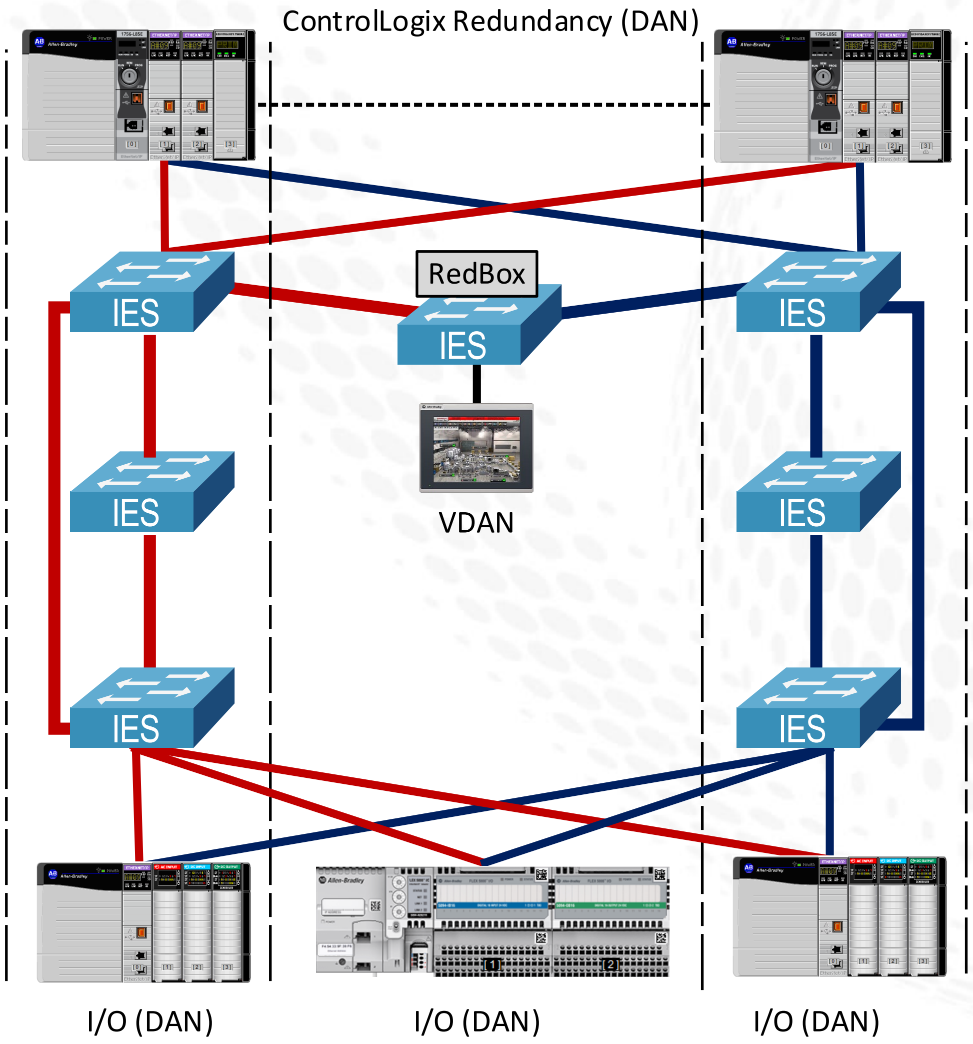
- Examples: transportation tunnels, mining tunnels, two sides of a machine or a ship
- Two sides must be fault independent (power, cable path)
- Linear LAN topologies are simple but non-resilient
  - A LAN fault makes the network non-resilient until the fault is repaired



PRP Topology Example

Parallel Paths – Ring LAN Topology

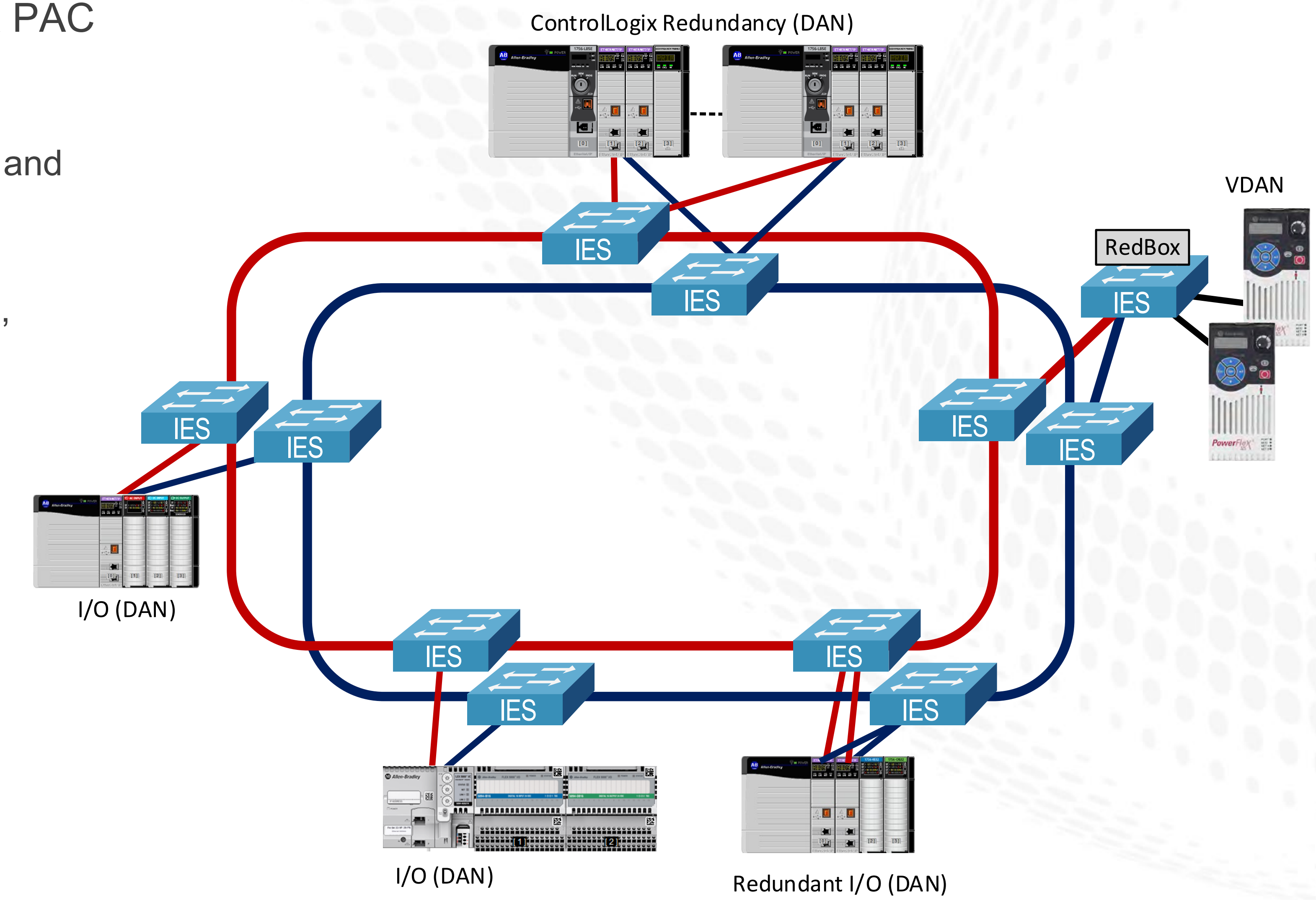
- Resilient ring protocol in each LAN (REP, DLR, Spanning Tree)
- LAN A or B recovers after the fault
- Cost of additional cabling to make a ring could be minimal for a new installation



PRP Topology Example

Dual Ring LAN Topology – Redundant PAC

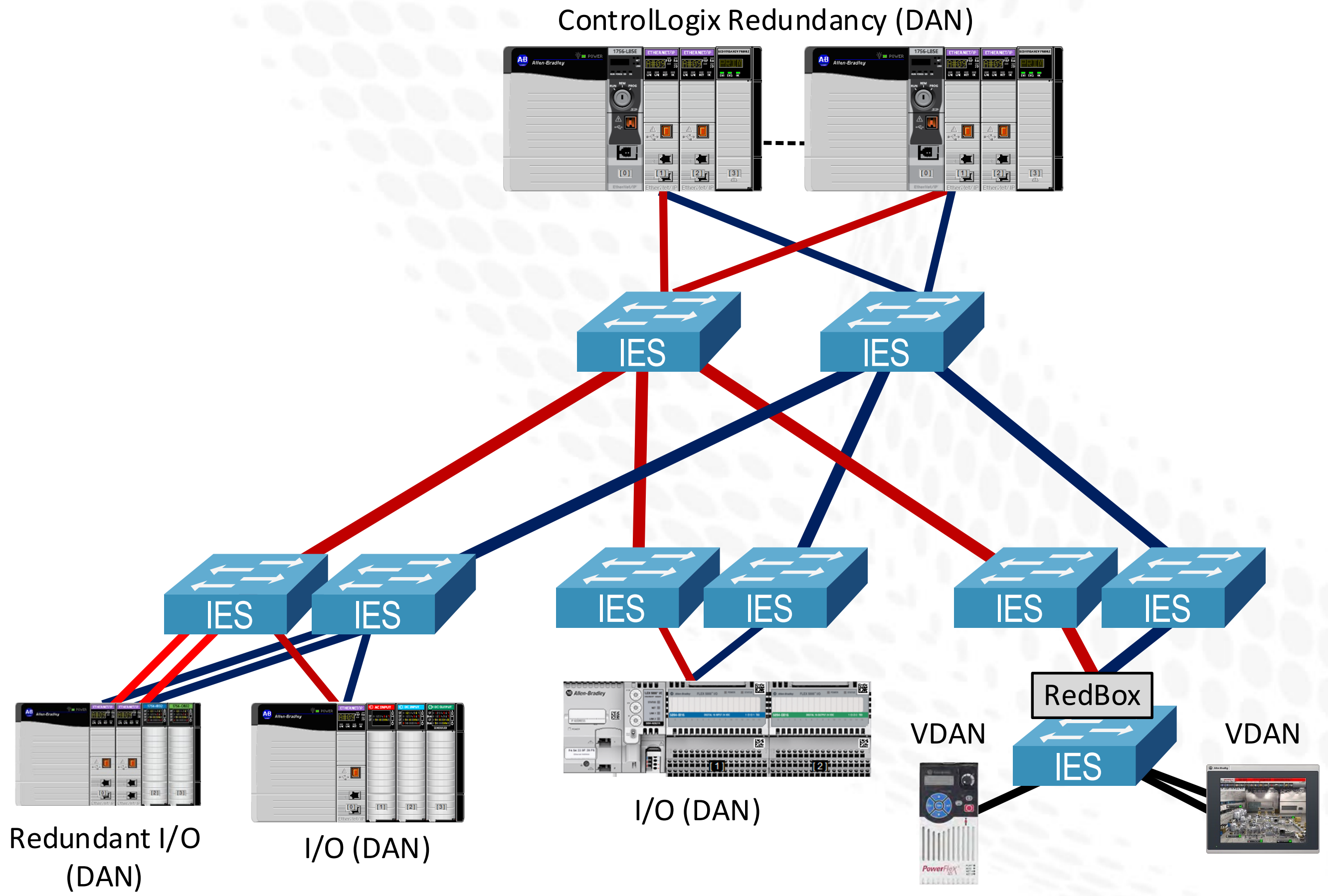
- Examples: water/wastewater, mining, oil and gas, and similar applications over large geographical area
- Resilient ring protocol in each LAN (REP, DLR, Spanning Tree)
- Rings must be fault independent (power, cable path)
- LAN A or B recovers after the fault



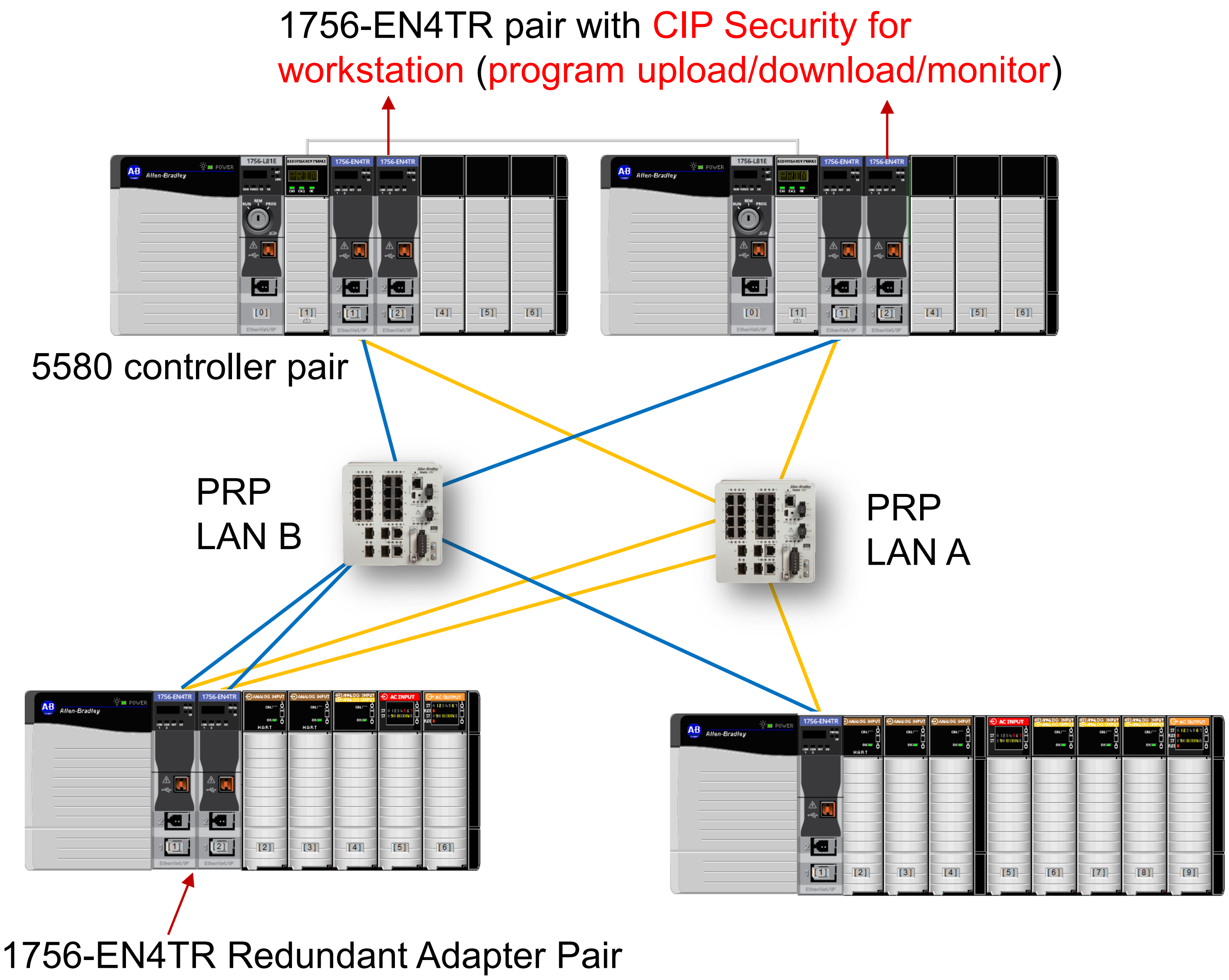
PRP Topology Example

Star LAN Topology – Redundant PAC

- Access and aggregation switches must be fault independent (power, cable path)
- Can be redundant star (EtherChannels) for additional resiliency



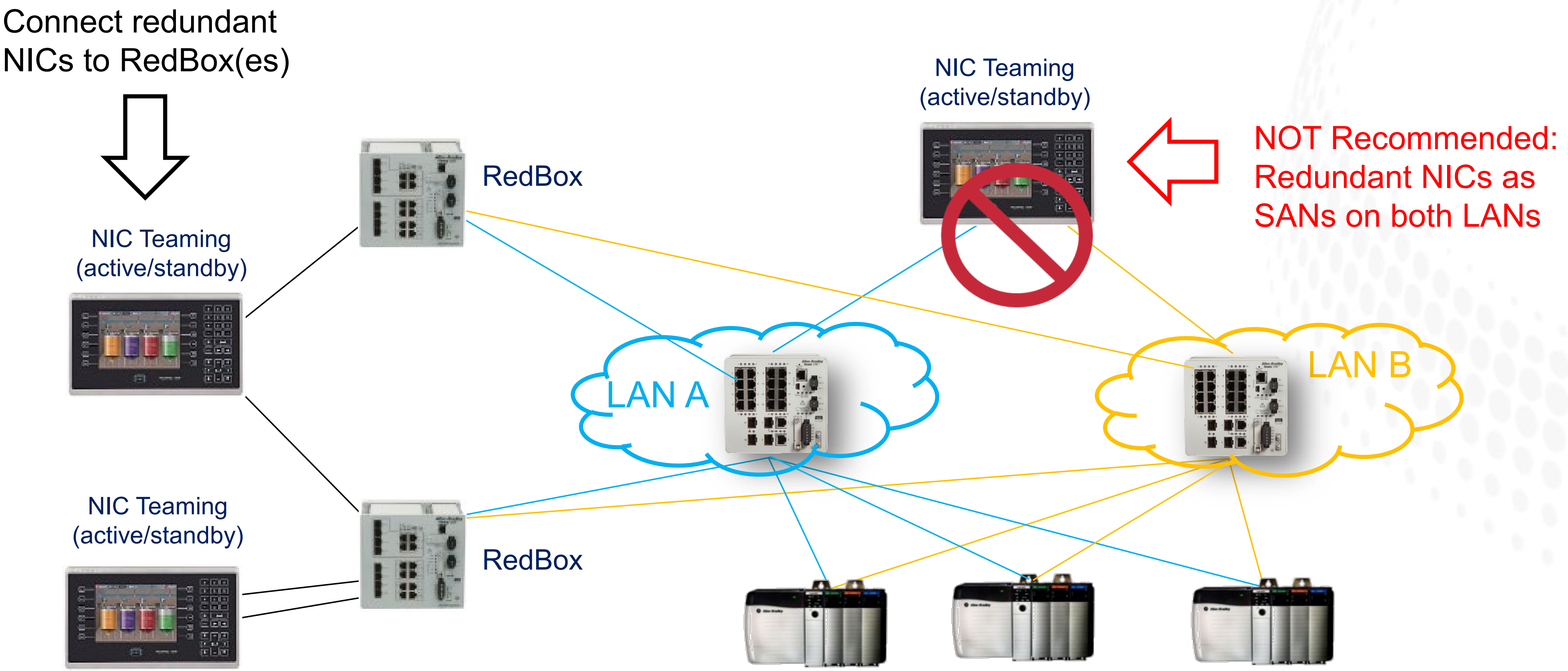
PRP Ref Architecture with CIP Security



1756-EN4TR pair with CIP Security for workstation (program upload/download/monitor)
5580 controller pair
PRP LAN B
PRP LAN A
1756-EN4TR Redundant Adapter Pair

- Previously released in FW 3.001: a pair of 1756-EN4TR can be used as a redundant pair of adapters for I/O
- 1756-EN4TR FW 4.001 supports redundant V34 5580 ControlLogix controllers
- 1756-EN4TR FW 4.001 supports PRP in addition to DLR
- 1756-EN4TR FW 4.001 supports CIP Security with 1756-EN4TR pair with redundant V34 ControlLogix 5580 controllers for program upload/download/monitor (not I/O)
  - This pair must be configured for non-IP address swapping

PRP – NIC Teaming


Connect redundant NICs to RedBox(es)
NIC Teaming (active/standby)
RedBox
NIC Teaming (active/standby)
RedBox
NIC Teaming (active/standby)
LAN A
LAN B

NOT Recommended: Redundant NICs as SANs on both LANs

PRP Non-Converged

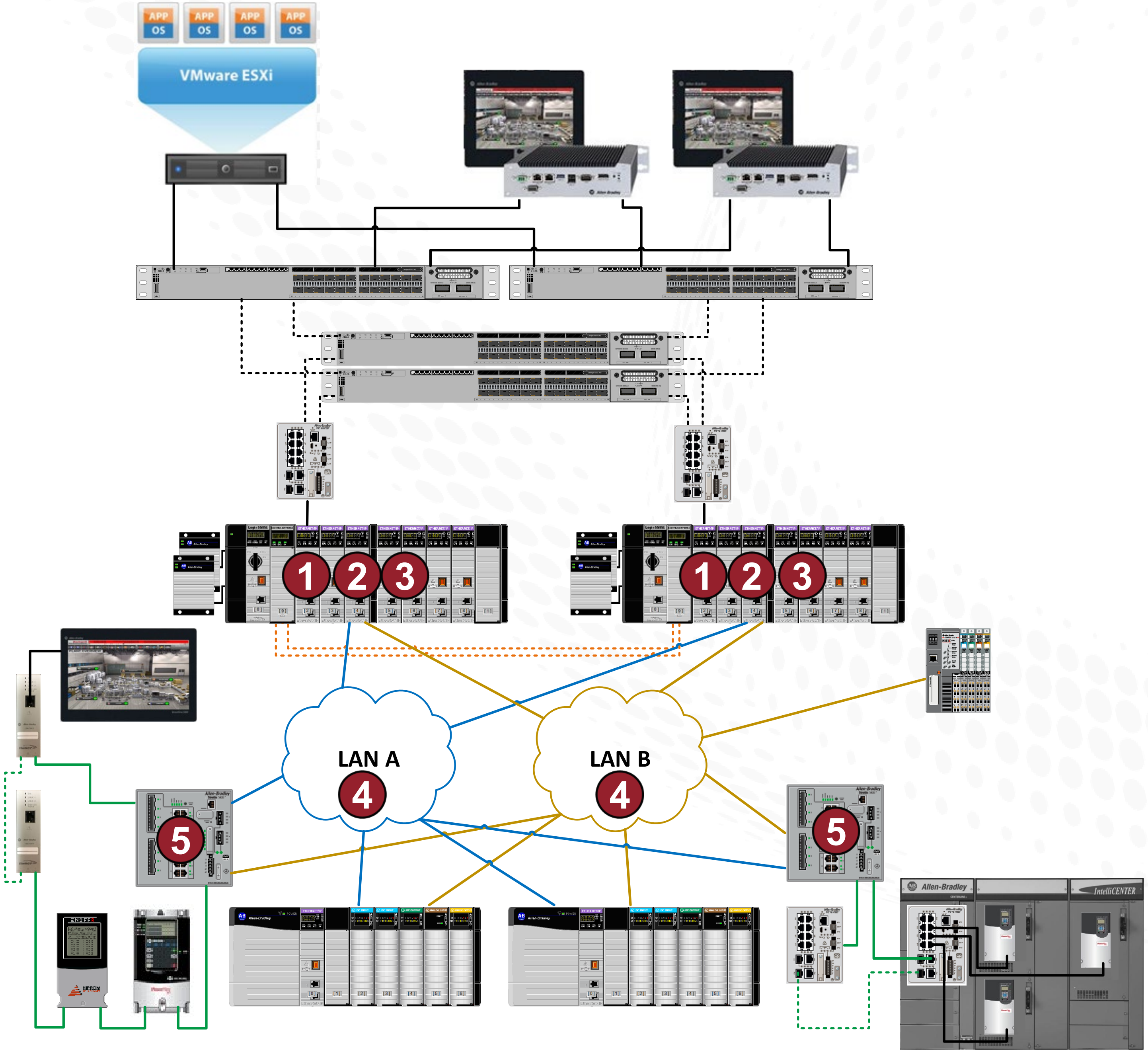
1. One Ethernet Module dedicated to upstream communications.

2. Connect the redundant Controller rack directly to the PRP network with PRP capable 1756-EN2TP modules.

3. Up to six other Ethernet Modules available for separate PRP or DLR networks. This drawing shows a single PRP network. Note: a pair of 1756-EN2TPs in the same chassis cannot be used as redundant adapters.

4. Infrastructure switches do NOT need PRP functionality built in; they only must support a baby jumbo frame size of 1506 bytes. It is recommended that all switches have unique IP addresses. LAN A and LAB B can have different topologies. See the notes section of this slide below regarding multi-fault tolerance guidelines.

5. A Redundancy Box (RedBox) can be used to connect non-PRP devices to the PRP networks.



ControlLogix Redundancy Network Design Guidance

PRP Non-Converged

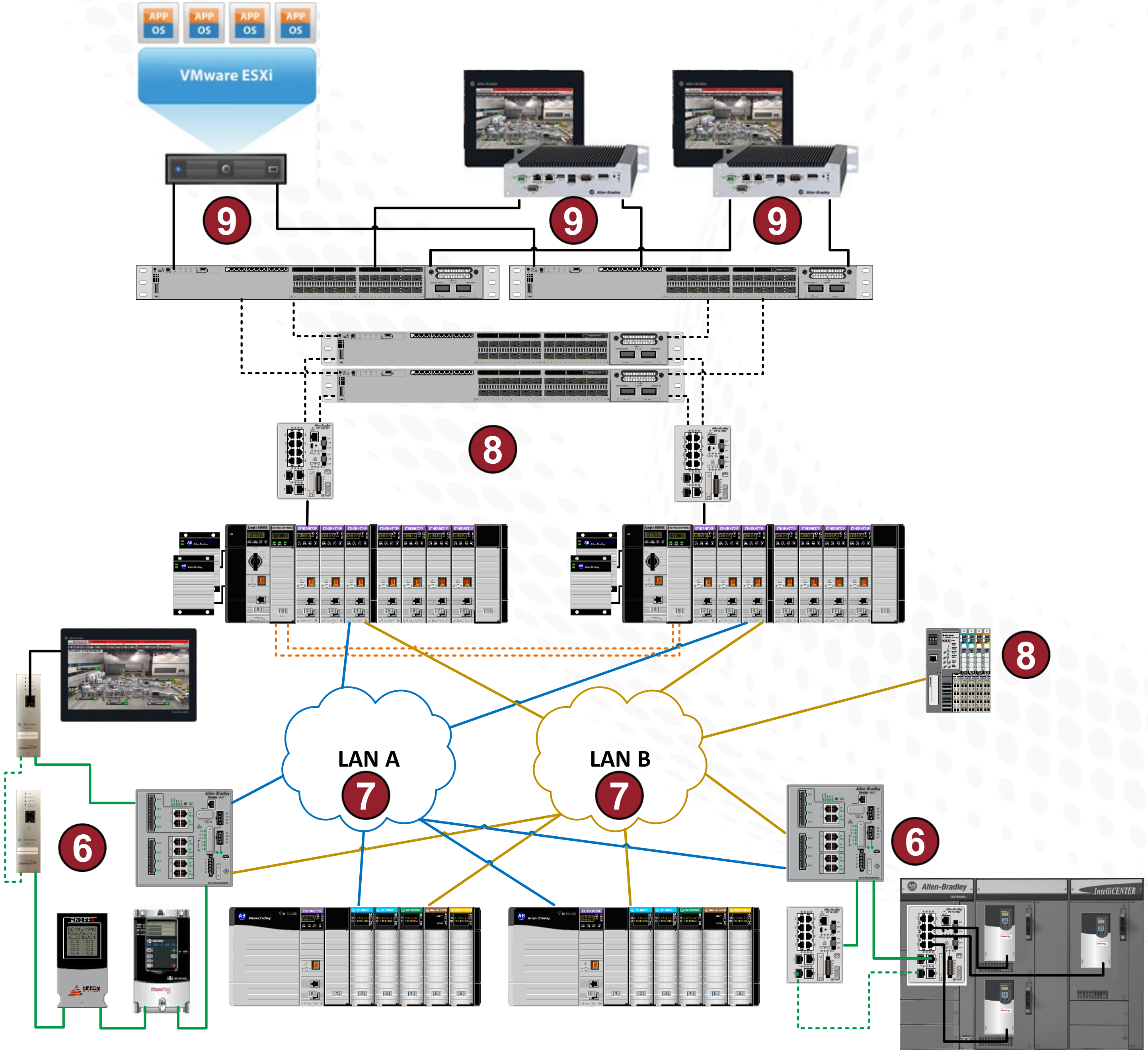
Continued…

6. By using a Stratix 5400 as a RedBox, you can configure as many as three DLR rings that can have redundancy through the RedBox.

7. Both PRP LANs must on the same subnet, same VLAN, and must be physically separate. VLAN and subnet should contain < 250 nodes to limit broadcasts.

8. Non-PRP devices can be added to either LAN A or LAB B, but not both. Only devices on that same LAN will be able to communicate with it.

9. NIC teaming on servers and clients for additional resiliency. Teamed NICs within the PRP network should only connect to Redboxes.



ControlLogix Redundancy Network Design Guidance

PRP Converged

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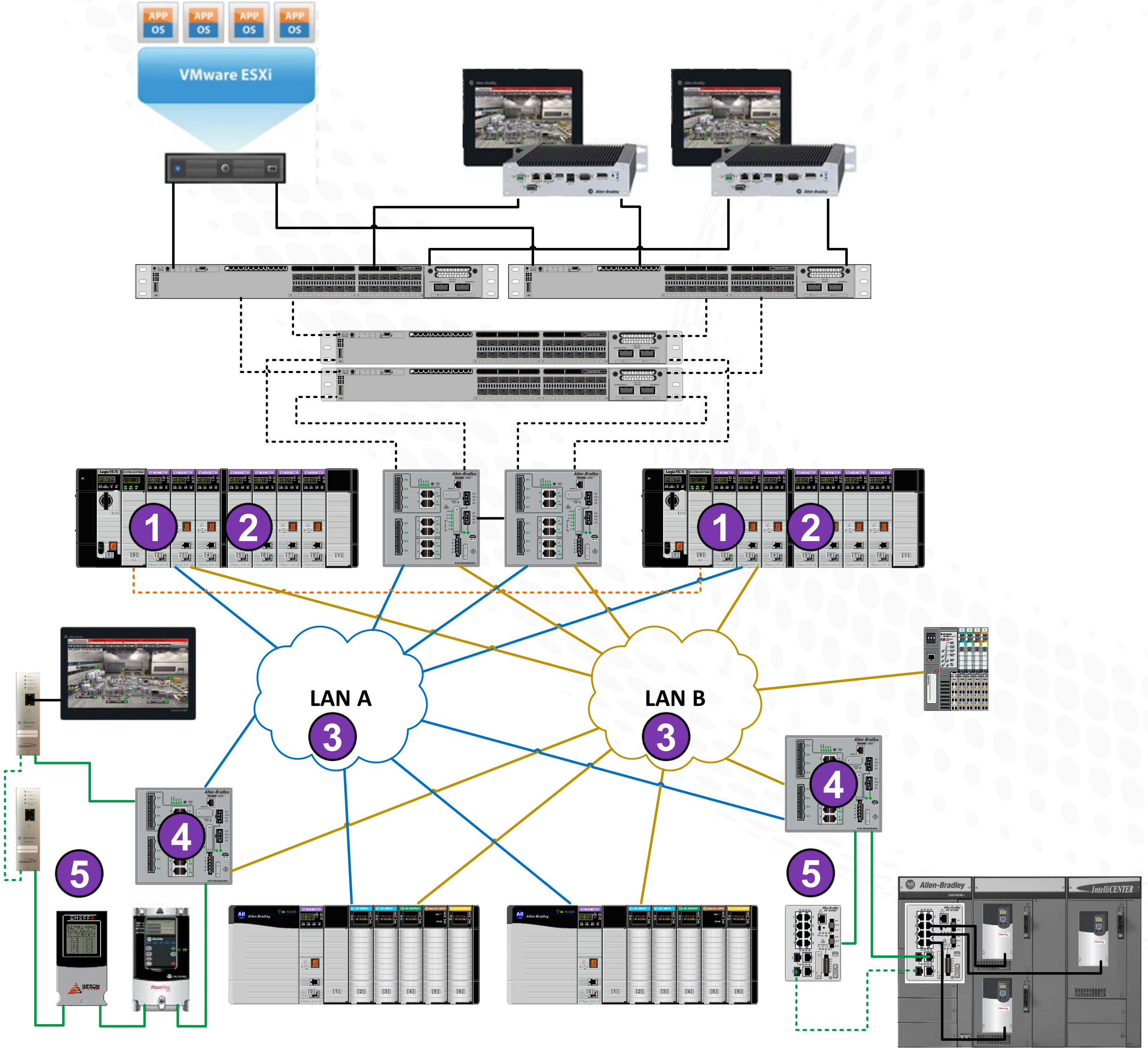


ControlLogix Redundancy Network Design Guidance

PRP Converged

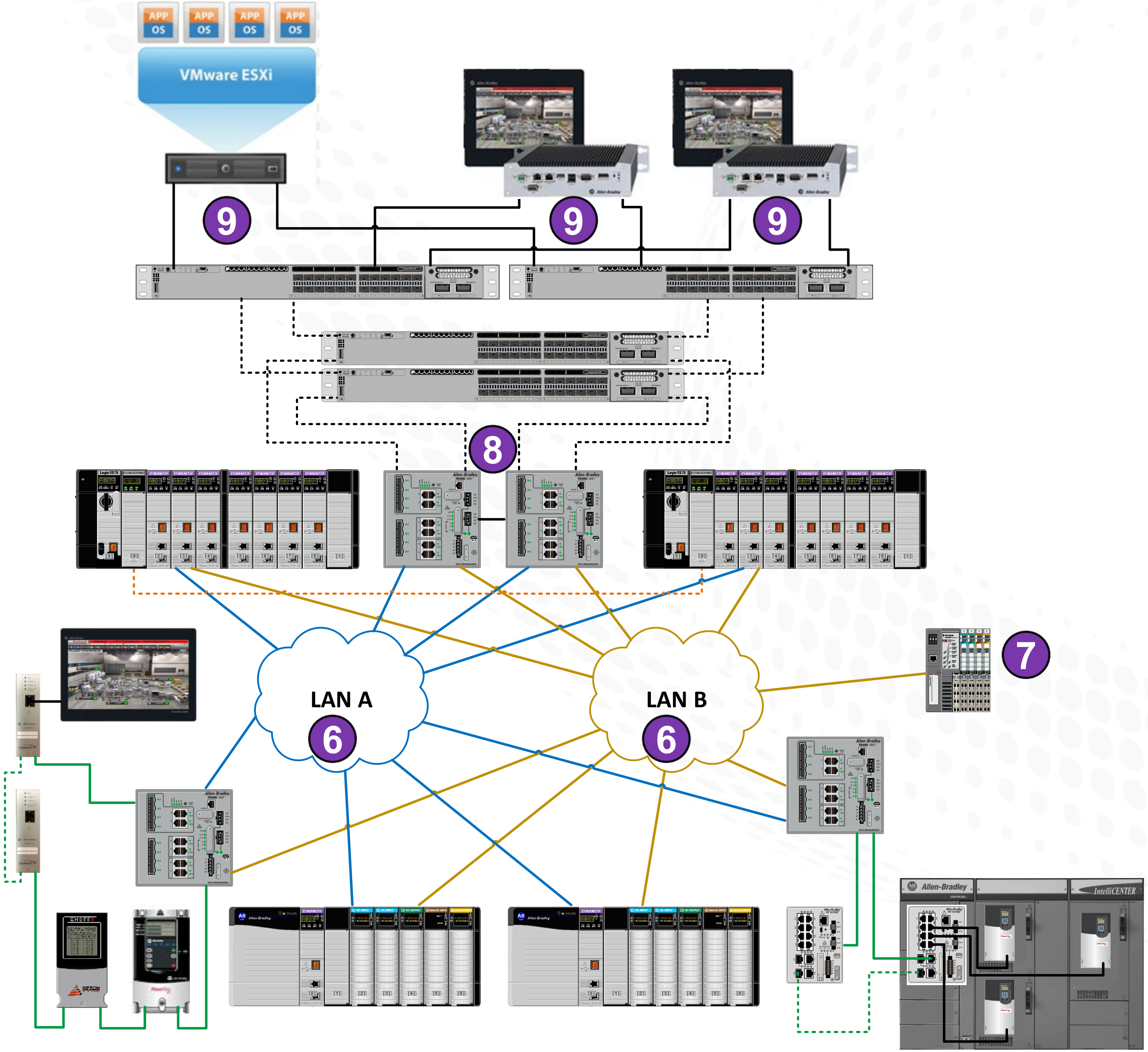
Continued…

6. Both PRP LANs must on the same subnet, same VLAN, and must be physically separate. VLAN and subnet should contain < 250 nodes to limit broadcasts.

7. Non-PRP devices can be added to either LAN A or LAB B, but not both. Only devices on that same LAN will be able to communicate with it.

8. Stratix 5400 RedBoxes can be used to connect PRP network to the supervisory network. Connections from Redboxes to infrastructure and between RedBoxes must be layer 3 routed connections. No additional layer 2 connections are allowed. Hot Standby Routing Protocol (HSRP) can be configured on redundant RedBoxes for Layer 3 redundancy in the PRP network.

9. NIC teaming on servers and clients for additional resiliency. Teamed NICs within the PRP network should only connect to Redboxes.



ControlLogix Redundancy Network Design Guidance

Questions?

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