Application Technique

Original Instructions

EtherNet/IP Parallel Redundancy Protocol

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Added FLEX 5000 I/O to topology drawings	throughout
Revised topology example for redundancy between a PRP network and Layer 3 network	15
Specified port type for infrastructure switch ports that connect to RedBoxes	16
Added unsupported topologies	17...19
Added configuration requirement for LAN A and LAN B infrastructure switches	16, 33, 38
Revised guidance for infrastructure switches in PRP systems using Precision Time Protocol (PTP)	23
Add CLI configuration for UTC offset value in certain PTP configurations	24
Added publications to Additional Resources table	43

About This Publication

This manual describes how you can configure a Parallel Redundancy Protocol (PRP) network with a compatible device or switch.

Be sure to understand these concepts and tools:

- EtherNet/IP™ network design
- Studio 5000 Logix Designer® application
- Linx-based software
- Device Manager or WebUI for Stratix® switches

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Notes:

Parallel Redundancy Protocol

Parallel Redundancy Protocol (PRP) is defined in international standard IEC 62439-3 and provides high availability in Ethernet networks. PRP technology creates seamless redundancy by sending duplicate frames to two independent network infrastructures, which are known as LAN A and LAN B.

A PRP network includes the following components.

Component	Description
LAN A and LAN B	Redundant, active Ethernet networks that operate in parallel.
Double attached node (DAN)	An end device with PRP technology that connects to both LAN A and LAN B.
Single attached node (SAN)	An end device without PRP technology that connects to either LAN A or LAN B. A SAN does not have PRP redundancy.
Redundancy box (RedBox)	A switch with PRP technology that connects devices without PRP technology to both LAN A and LAN B.
Virtual double attached node (VDAN)	An end device without PRP technology that connects to both LAN A and LAN B through a RedBox. A VDAN has PRP redundancy and appears to other nodes in the network as a DAN.
Infrastructure switches	Switches connected to either LAN A or LAN B that are not configured as a RedBox.

PRP Network Operation

A device with PRP technology has two ports that operate in parallel and attach to LAN A and LAN B. This end device is known as a double attached node (DAN). During normal network operation, a DAN simultaneously sends and receives duplicate Ethernet frames through both LAN A and LAN B ports. The receiving node accepts whichever frame arrives first and discards the subsequent copy. If a failure occurs in one of the paths, traffic continues to flow through the other path uninterrupted with no recovery time.

Unlike other redundancy protocols, such as Spanning Tree Protocol (STP), PRP does not require network reconfiguration.

Comparison of PRP and DLR

PRP is distinct from Device Level Ring (DLR) protocol. The following table summarizes some of the differences between the protocols.

Attribute	DLR	PRP
Standards organization	ODVA	International Electrotechnical Commission (IEC)
Fault tolerance	Single-fault tolerance	Multiple -fault tolerance, depending on topology or single-fault tolerance in the worst case
Infrastructure	Duplication of infrastructure not required	Duplication of infrastructure required
Switches	No minimum requirement	Twice as many switches as one network
Topology	Ring topology	Any topology
Switchover time	Fast recovery time	Zero recovery time

PRP Network Topologies

A PRP network can have many topologies. This section shows examples of PRP network topologies with these features:

- Basic PRP topology with two switches
- LANs as clouds
- SAN and VDANs
- Device Level Ring for VDANs
- Multiple VLANs
- VLAN trunking
- ControlLogix® redundancy system
- Network redundancy between PRP and a Layer 3 network

Basic PRP Network Topology

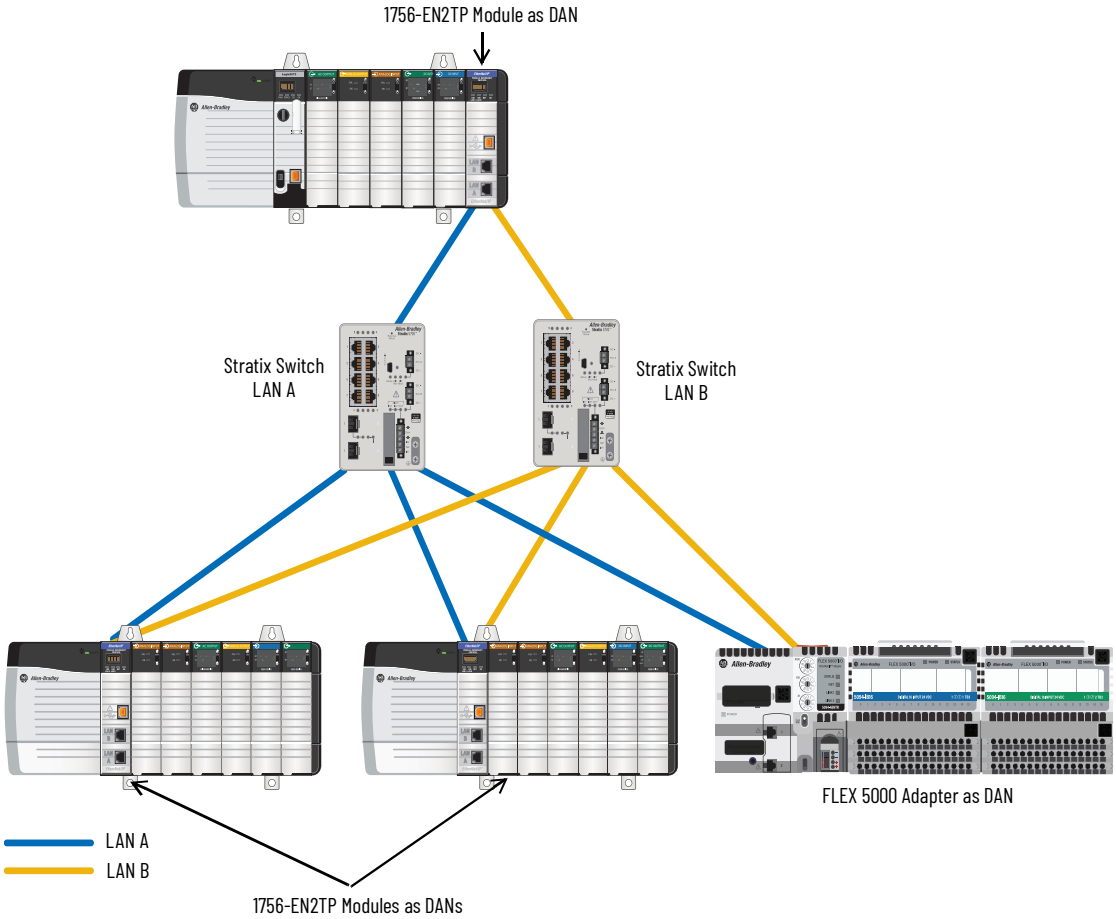
The most basic network topology is the same as a star topology, but adds these components:

- End nodes with PRP technology, such as 1756-EN2TP modules and FLEX 5000™ EtherNet/IP™ adapters

IMPORTANT	Be sure to configure all devices for PRP before connecting them to the PRP network. For example, FLEX 5000 adapters have different modes for DLR and PRP and must be manually set to PRP mode.

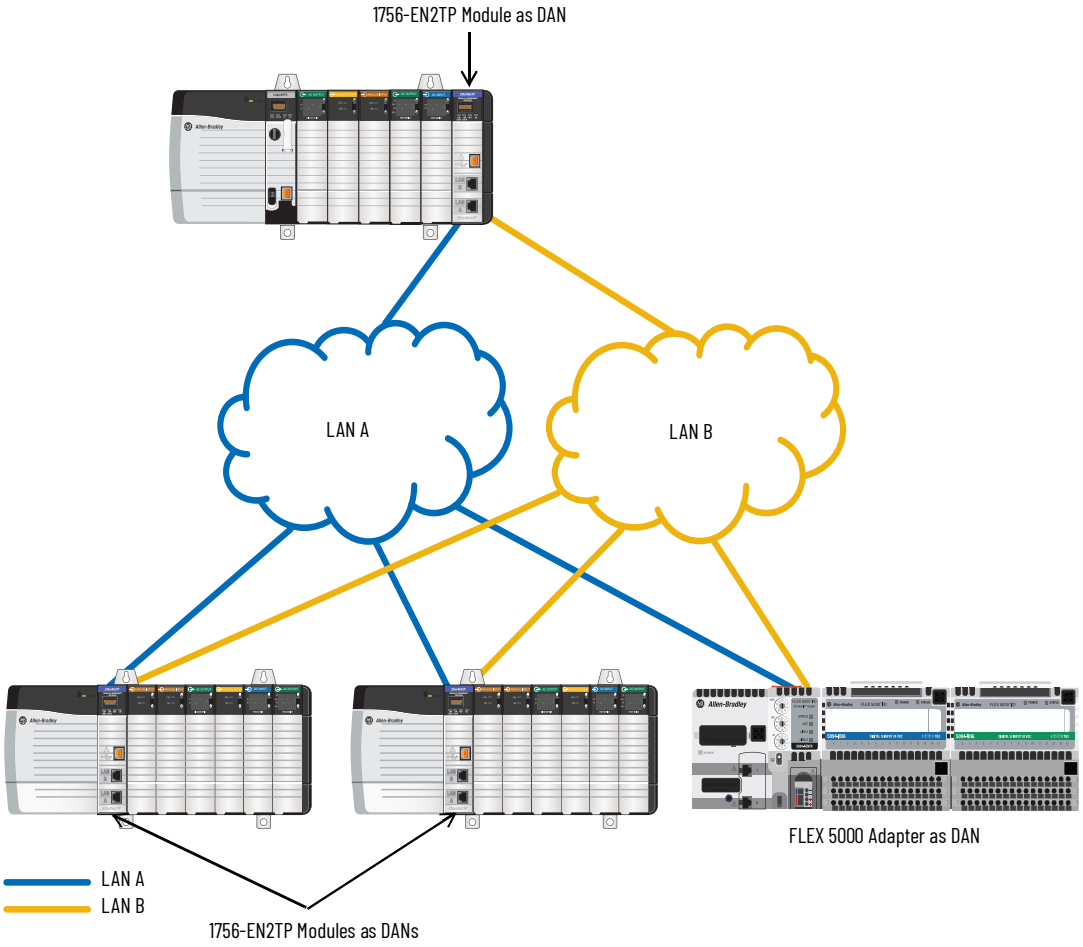
- A second, independent LAN

You can use the 1756-EN2TP in a standard star topology and add a second local area network (LAN) for redundancy later.



PRP Network Topology with LANs as Clouds

Each LAN can be more complex than one switch. In the following topology, LAN A and LAN B are clouds to show that they can have different infrastructures. For example, one LAN can have a few switches in series. The other LAN can have a ring of switches.



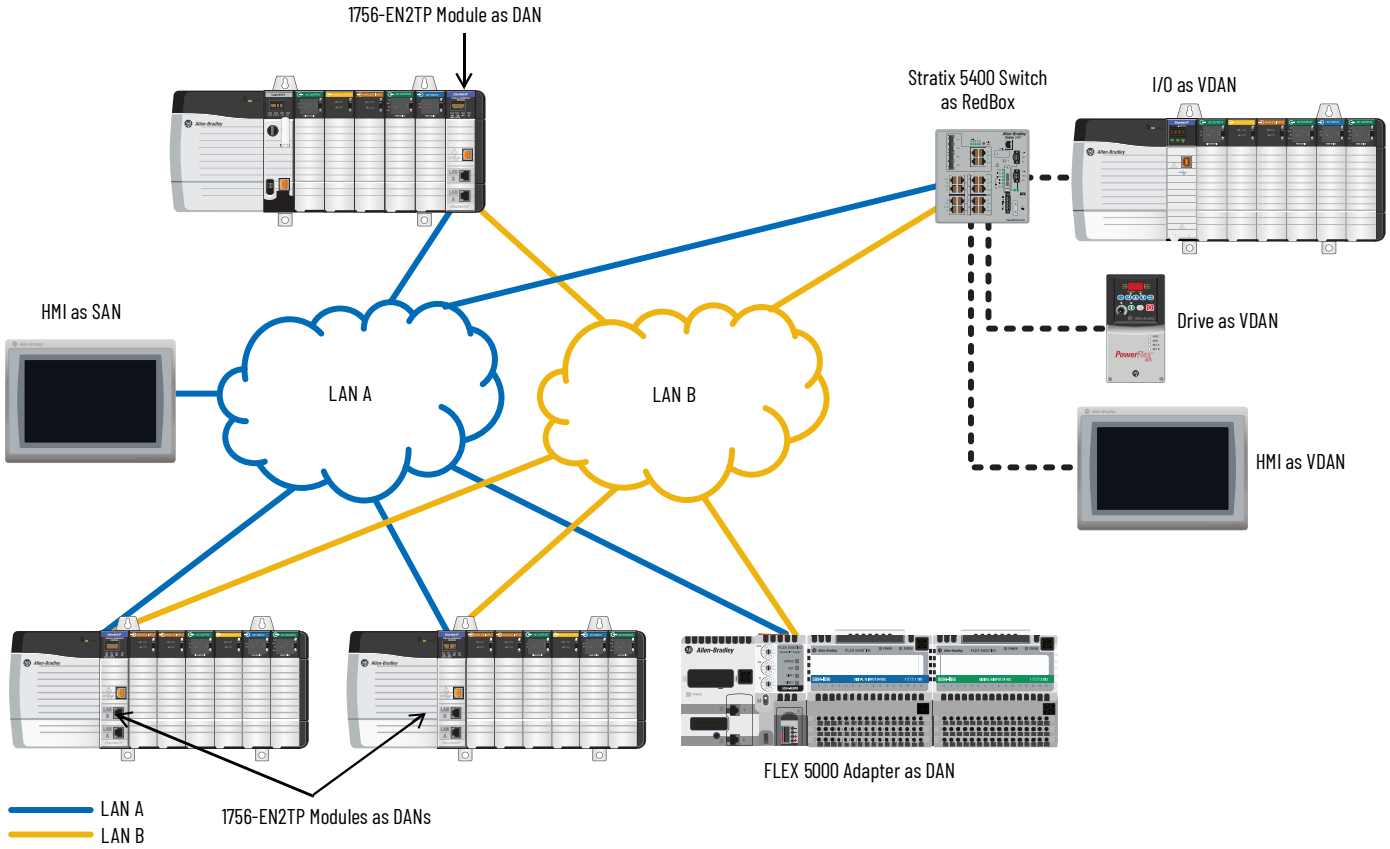
PRP Network Topology with SAN and VDANs

The following network example shows that you can connect devices without PRP technology to either one or both LANs:

- The HMI device is a SAN that connects only to LAN A.

  A SAN does not have PRP network redundancy.
- The I/O, drive, and HMI devices are VDANs that connect to both LAN A and LAN B through a Stratix® 5400 switch that is configured as a RedBox.

  In a star topology, VDANs have PRP network redundancy from the RedBox to both LANs, but not from themselves to the RedBox, as shown with dotted lines in the following example.

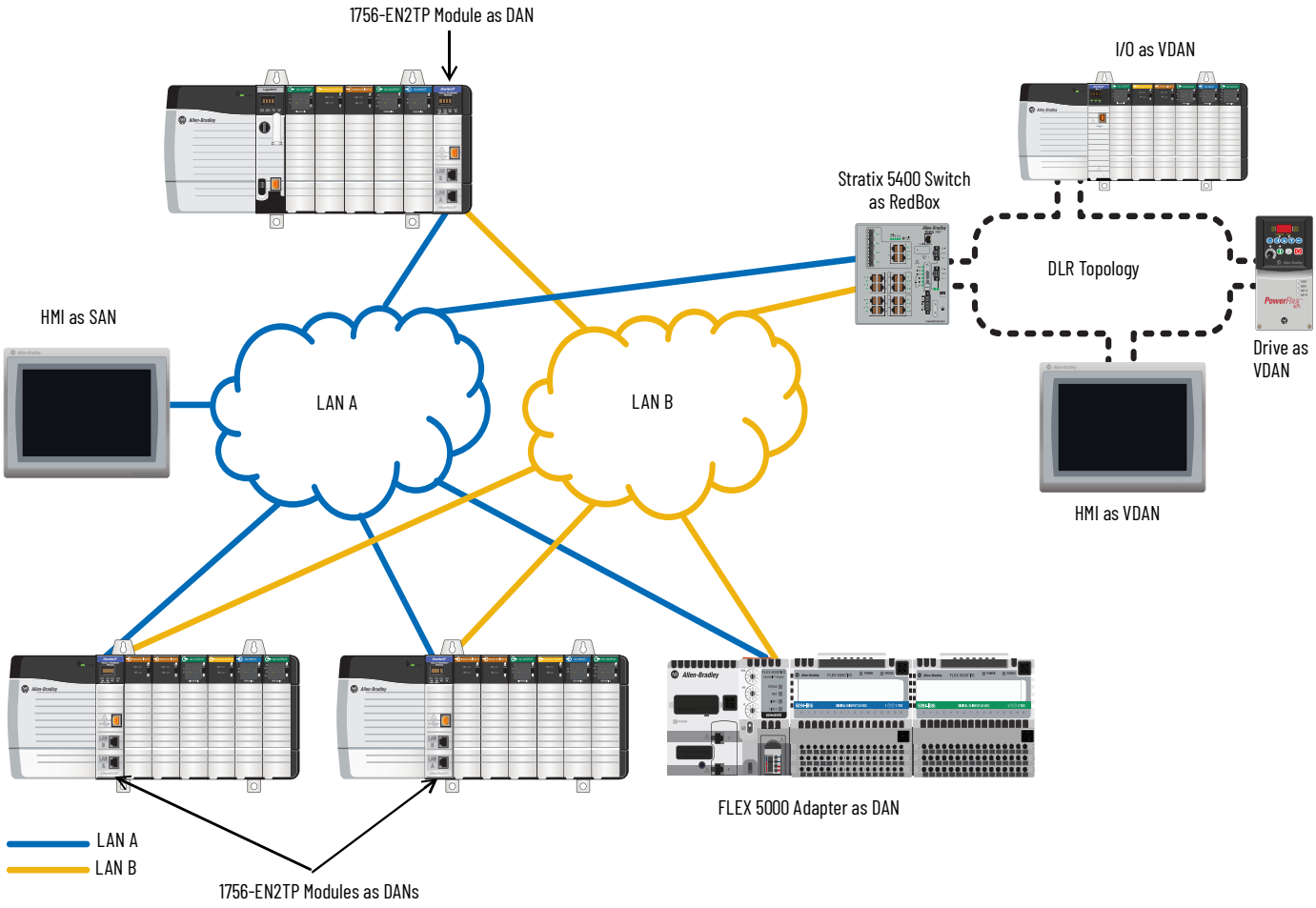


PRP Network Topology with VDANs in a Device Level Ring

The following network example shows that you can connect a DLR topology to the VDAN side of the RedBox. Each node in the ring becomes a VDAN.

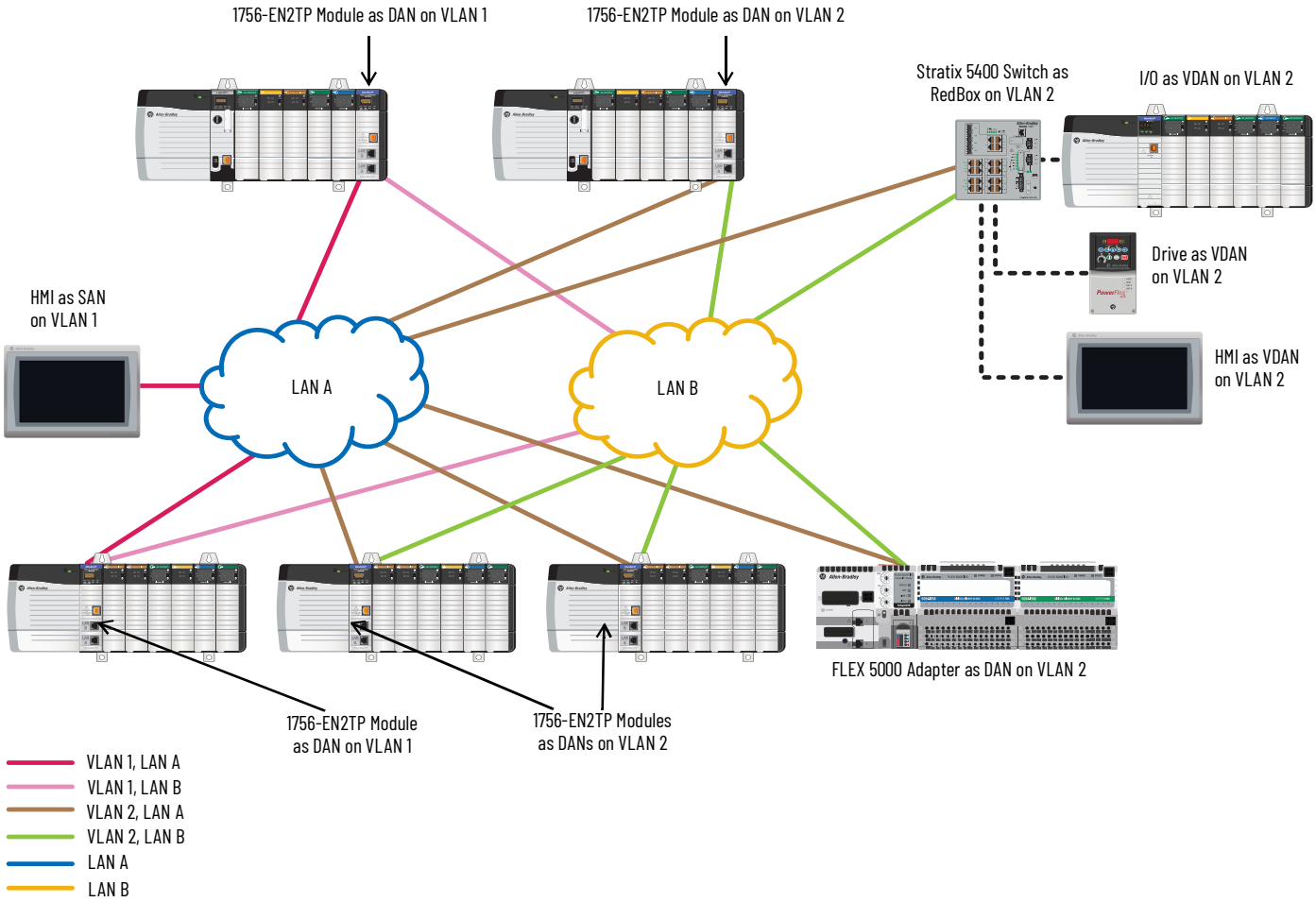
By using a Stratix 5400 switch as a RedBox, you can configure as many as three rings that can have redundancy through the RedBox.

The 1756-EN2TP module does not have DLR protocol and cannot operate as part of a ring.



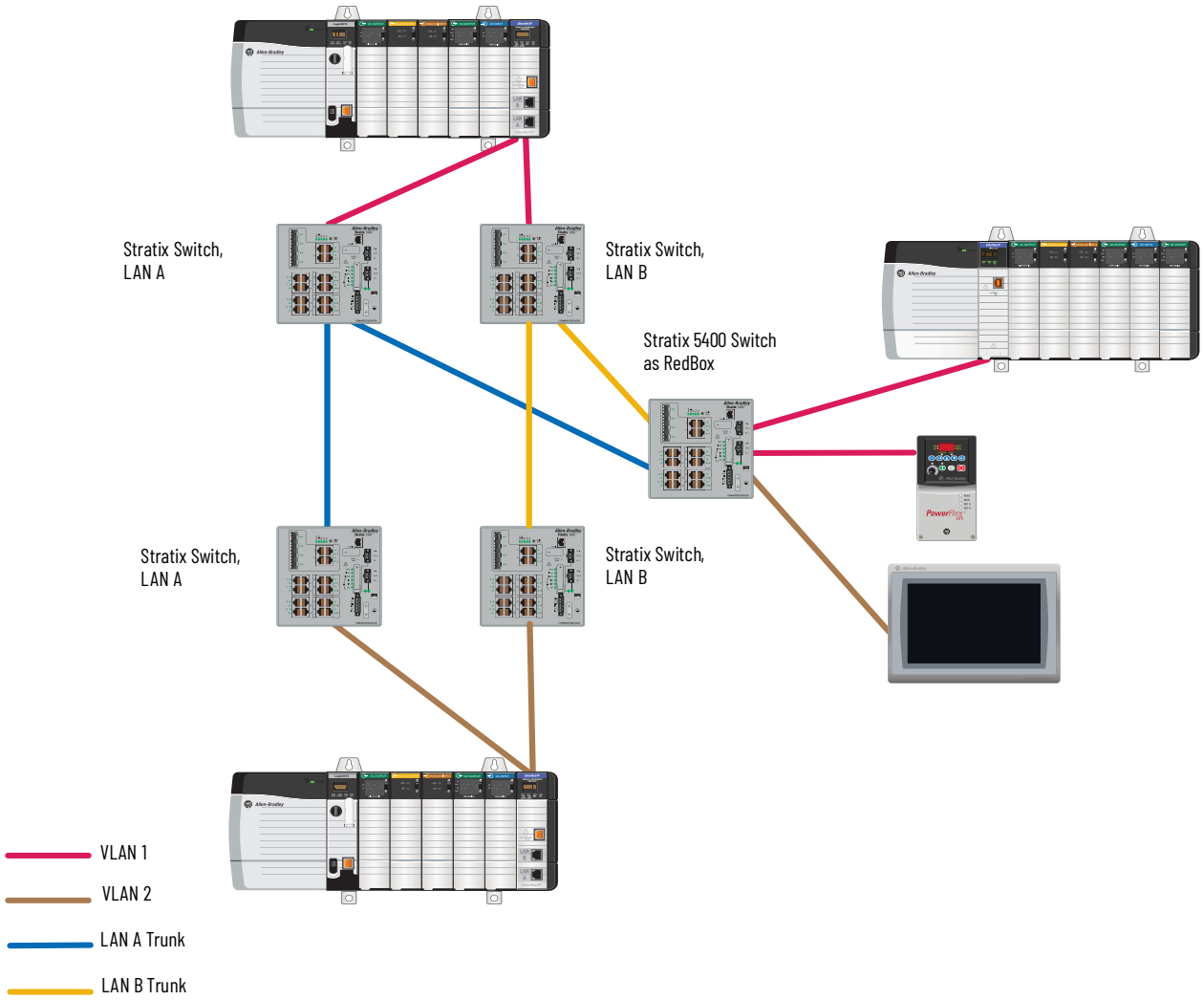
PRP Network Topology with Multiple VLANs

You can segment your PRP network into multiple VLANs. Be sure that both PRP ports of a DAN are connected to the same VLAN. For example, in the following topology, both PRP ports on the 1756-EN2TP module on the left are on VLAN 1. Both PRP ports of the 1756-EN2TP module on the right are on VLAN 2.



PRP Network Topology with VLAN Trunking

A VLAN trunk is a connection between two devices that carries traffic for multiple VLANs. The following example shows a Stratix 5400 RedBox with PRP ports configured as trunk ports that carry traffic for both VLANs 1 and 2, and access ports that carry traffic for either VLAN 1 or 2.

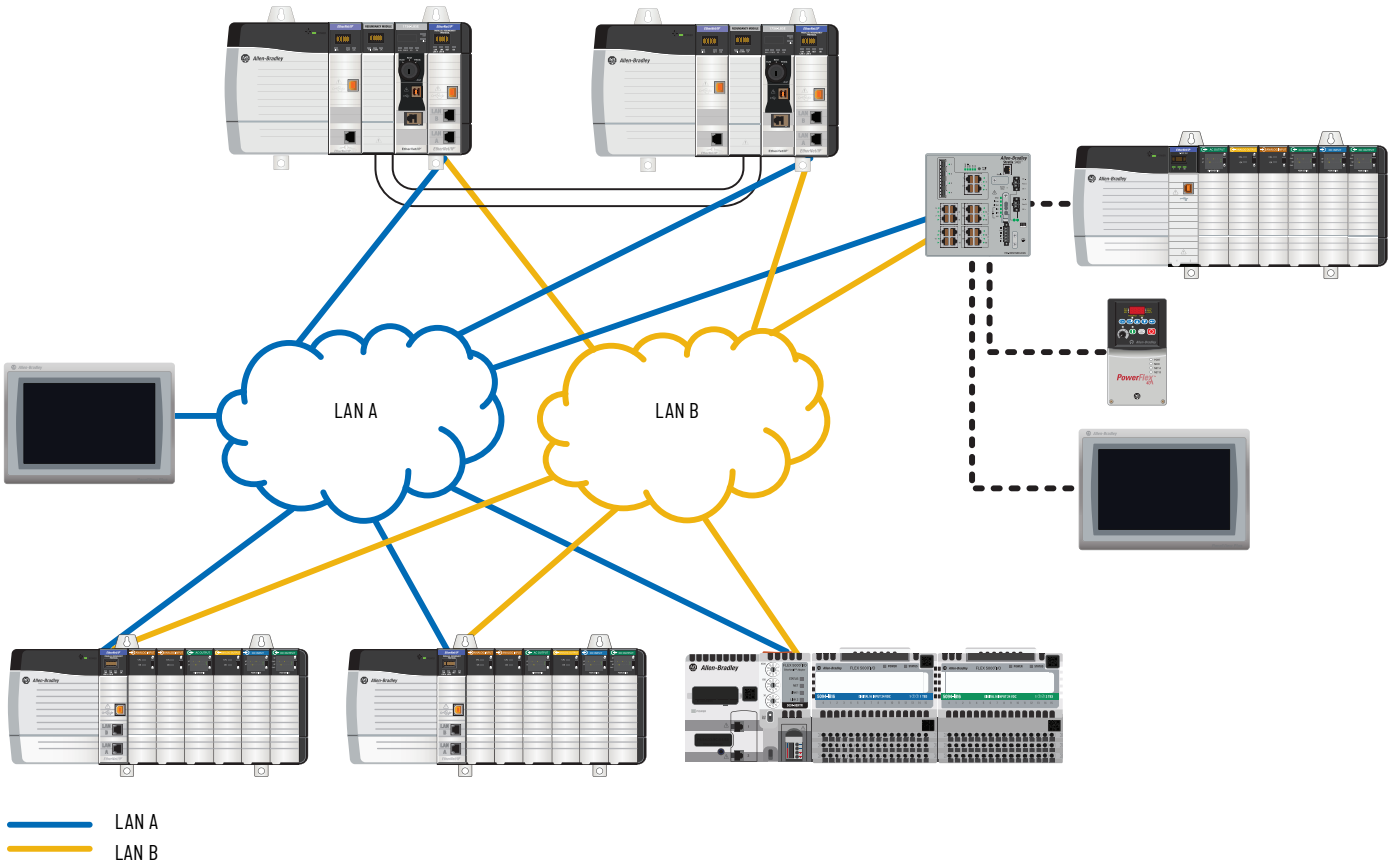


PRP Network Topology with a ControlLogix Redundancy System

With redundancy firmware bundle version 31.051, you can use partnered 1756-EN2TP modules in a ControlLogix redundancy system with PRP. In the following illustration, both LAN A and LAN B are connected to a redundant chassis pair.

For more information about ControlLogix redundancy with PRP networks, see the High Availability Systems Reference Manual, publication HIGHAV-RM002.

Redundant Chassis Pair with 1756-ENT2P Modules



Network Redundancy Between PRP Network and Layer 3 Network

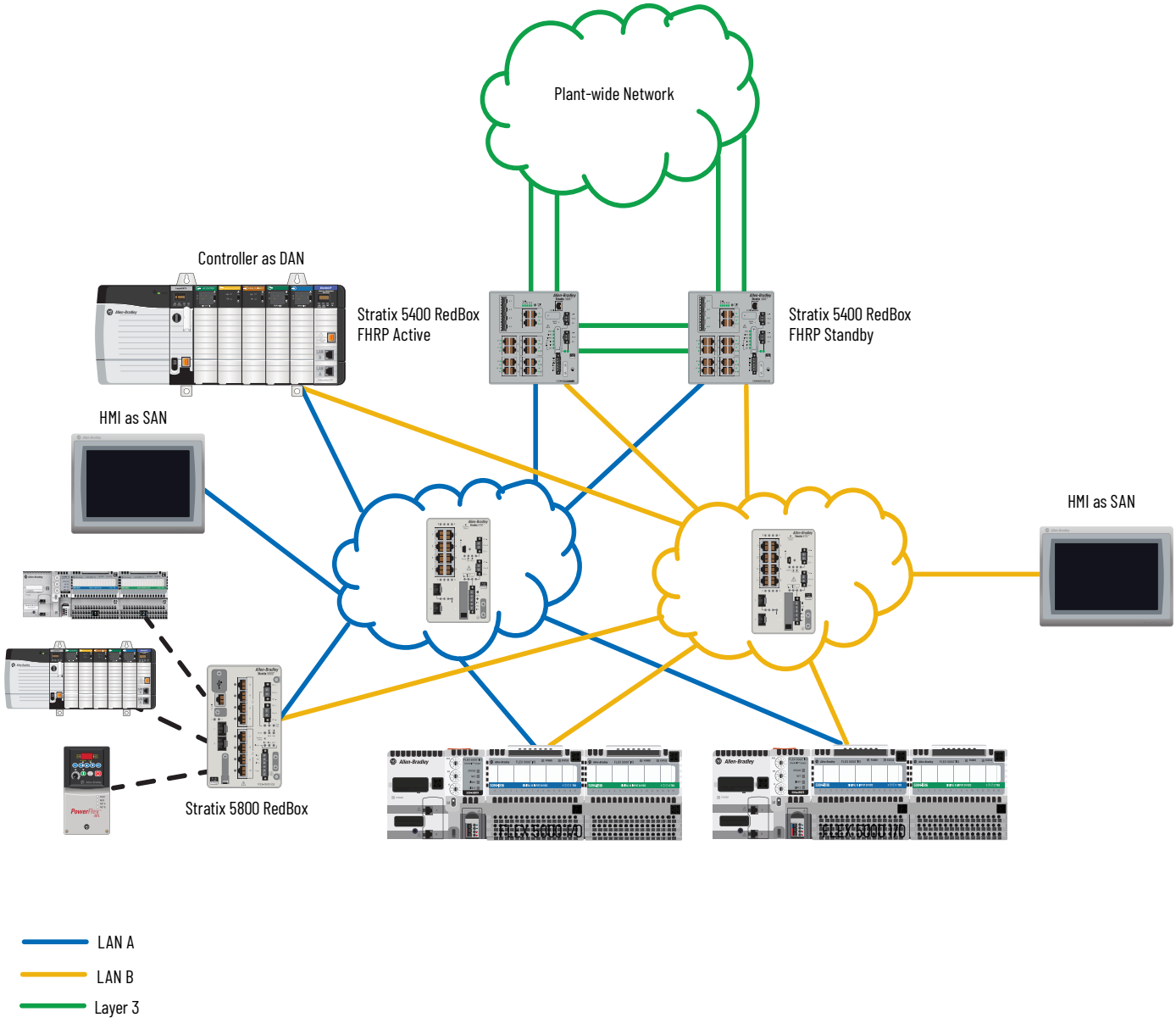
The topology example in Figure 1 uses Layer 3 RedBoxes that are configured for first hop redundancy protocol (FHRP) and routing. This configuration provides the resilient connectivity between the Layer 2 PRP segment and the higher-level network. In this type of topology, follow these guidelines:

- To avoid a single point of failure, do not use RedBoxes that are configured for FHRP to create VDANs with other end devices.
- Connections between the RedBoxes and PRP segments carry a system size limitation. Be sure to limit the use of these connections.

For details about how to configure this type of topology, see the following publications:

- PlantPAx DCS Configuration and Implementation User Manual, publication PROCES-UM100
- Deploying Parallel Redundancy Protocol within a Converged Plantwide Ethernet Architecture, ENET-TD021

Figure 1 - PRP and Layer 3 Network

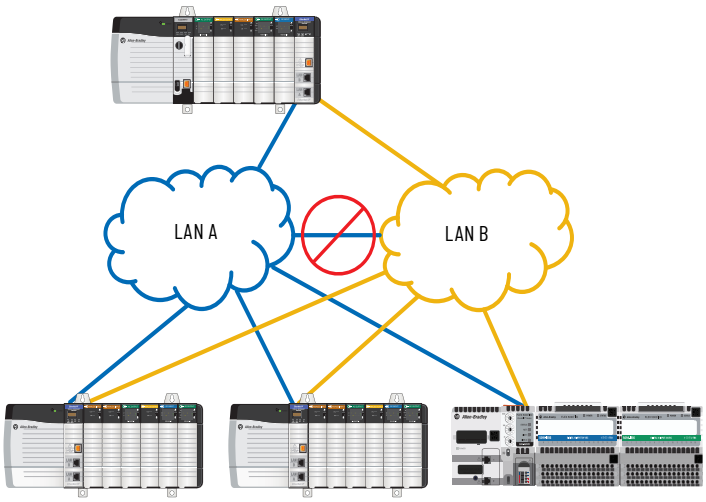


LAN A and LAN B Topologies

LAN A and LAN B can have different topologies that are comprised of different network components. Optimal results depend on many factors, such as network bandwidth, network speed, switch performance, and the rate of transfer for PRP packets.

Requirements

IMPORTANT To maintain network redundancy, never connect LAN A and LAN B directly to each other. A PRP network converges only at a DAN or a RedBox.



Be sure that your LAN A and LAN B topologies follow these requirements:

- A DAN must be connected to the same IP subnet in LAN A and LAN B. For example, you cannot use the two ports on the 1756-EN2TP as two NICs connected to two different subnets.
- LAN A and LAN B must have separate, independent infrastructures. For example, both LANs cannot share a switch.

Recommendations

As a best practice, follow these recommendations for LAN A and LAN B topologies:

- Keep both LANs similar in topology, network speed, network latency, and hops.
- Use either wired or wireless networks for both LANs. For example, do not use a wired network for LAN A and wireless network for LAN B.
- If you use a DLR topology within LAN A or LAN B, be sure to validate your DLR topology within the larger network before production use. Depending on your network architecture, DLR topology limitations can exist.

LAN A and LAN B Infrastructure Switches

An infrastructure switch is part of either LAN A or LAN B, but not both. Unlike a RedBox, an infrastructure switch does not require built-in PRP technology. Follow these guidelines:

- On switch downlink ports, enable the PortFast feature for Spanning Tree Protocol (STP) to improve recovery time.
- As a best practice, use managed switches as infrastructure switches for their network diagnostic and configuration capabilities.
- You must use infrastructure switches that support the maximum transmission time (MTU) of 1506 bytes or greater.

Unsupported Topologies

IMPORTANT Depending on your network architecture, PRP topology limitations can exist.
Be sure to validate your PRP topology within the larger network before production use.

Invalid Connections Between LAN A and LAN B

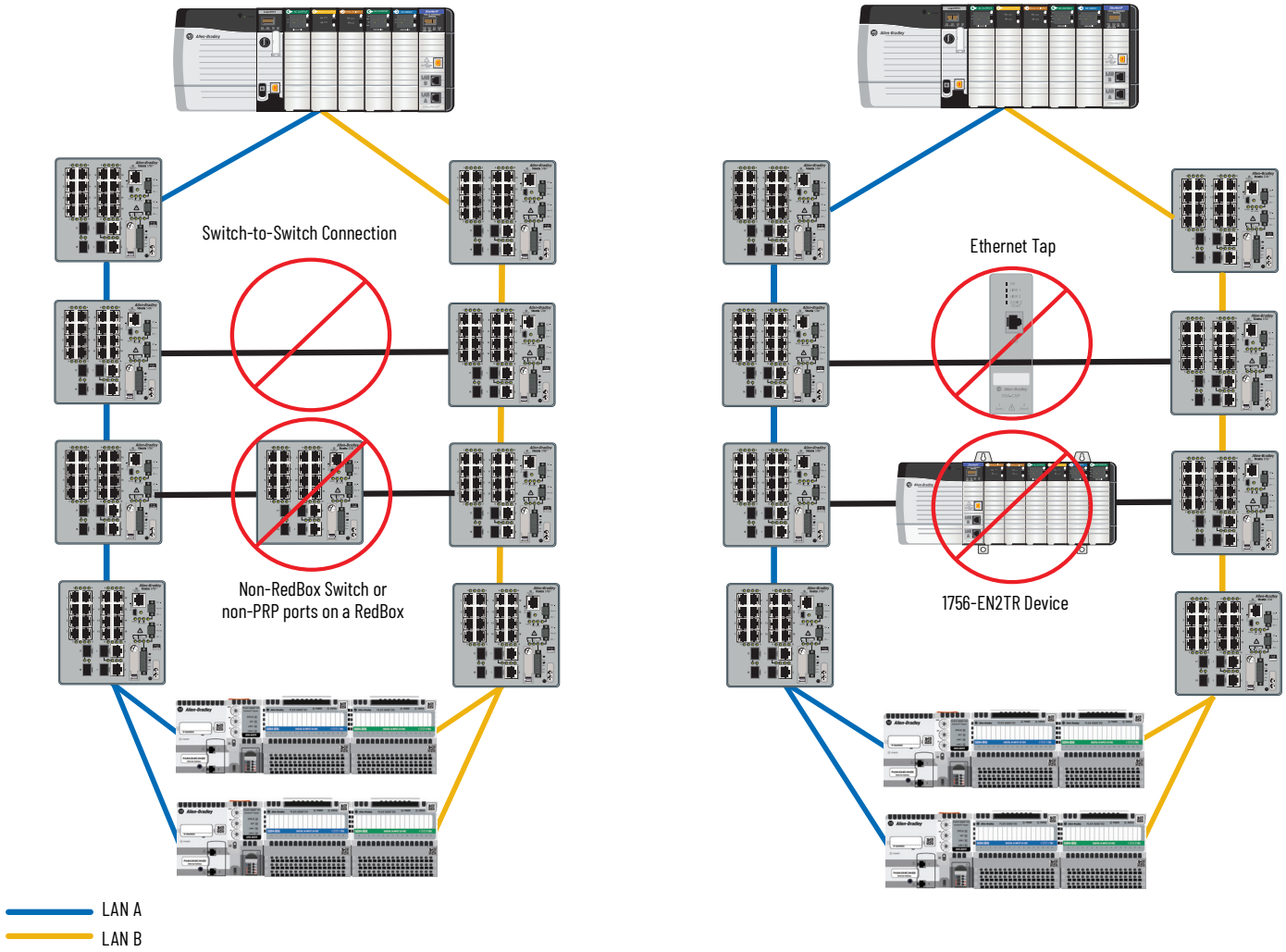
Only connect LAN A and LAN B with the following:

- DAN devices configured for PRP
- RedBoxes on PRP-enabled ports

Figure 2 illustrates three types of invalid connections between LAN A and LAN B:

- Do not connect a switch in LAN A to a switch in LAN B.
- Do not use a non-RedBox switch or non-PRP ports on a RedBox switch to connect LAN A and LAN B.
- Do not use an EtherNet/IP device that does not support PRP, such as an Ethernet tap or 1756-EN2TR device, to connect LAN A and LAN B.

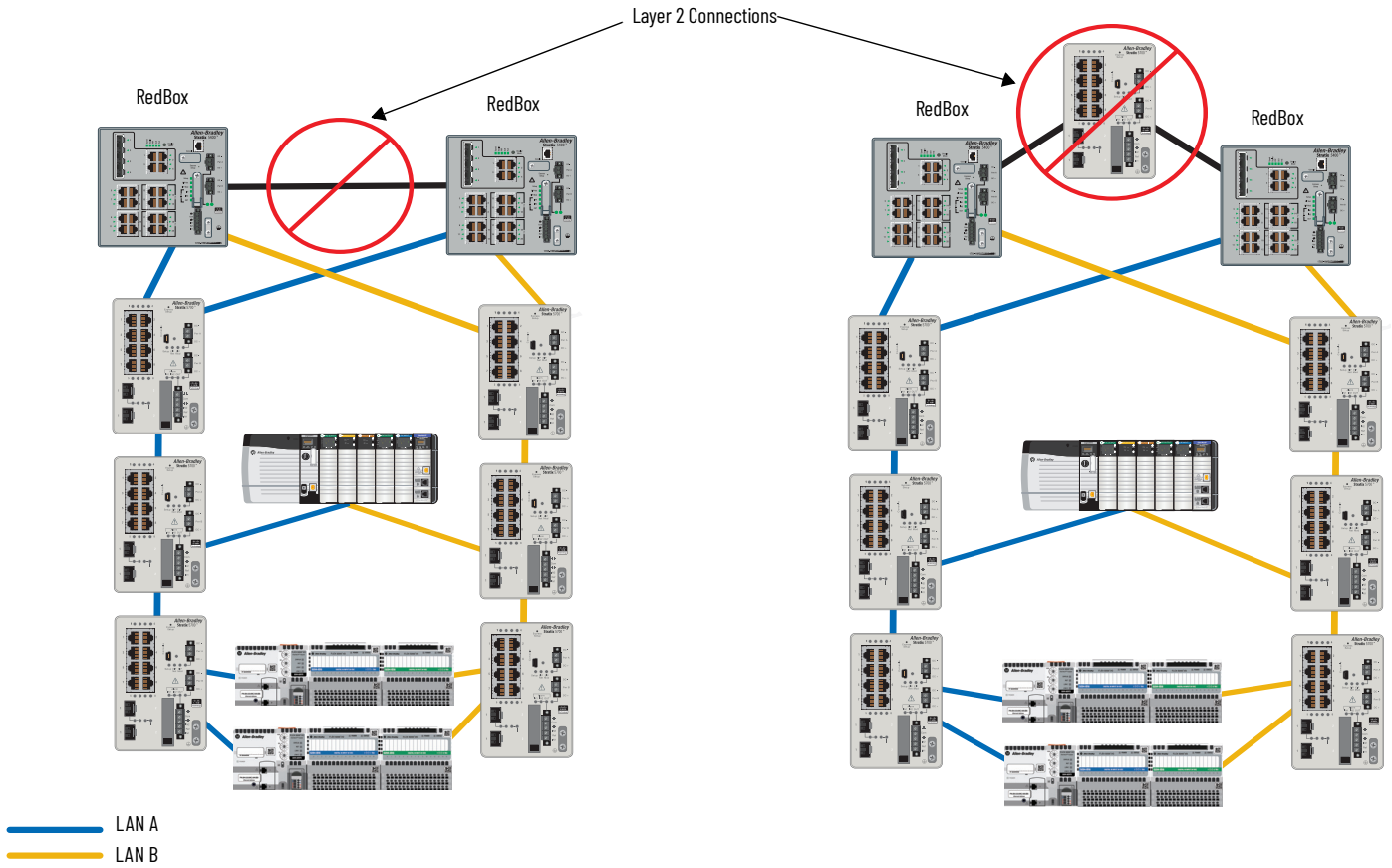
Figure 2 - Invalid Connections between LAN A and LAN B



Invalid Layer 2 Connections

Figure 3 shows unsupported Layer 2 connections. If RedBoxes connect either directly or through additional infrastructure via Layer 2, your network can experience uncontrollable loop and broadcast storms.

Figure 3 - Invalid Layer 2 Connections between RedBoxes

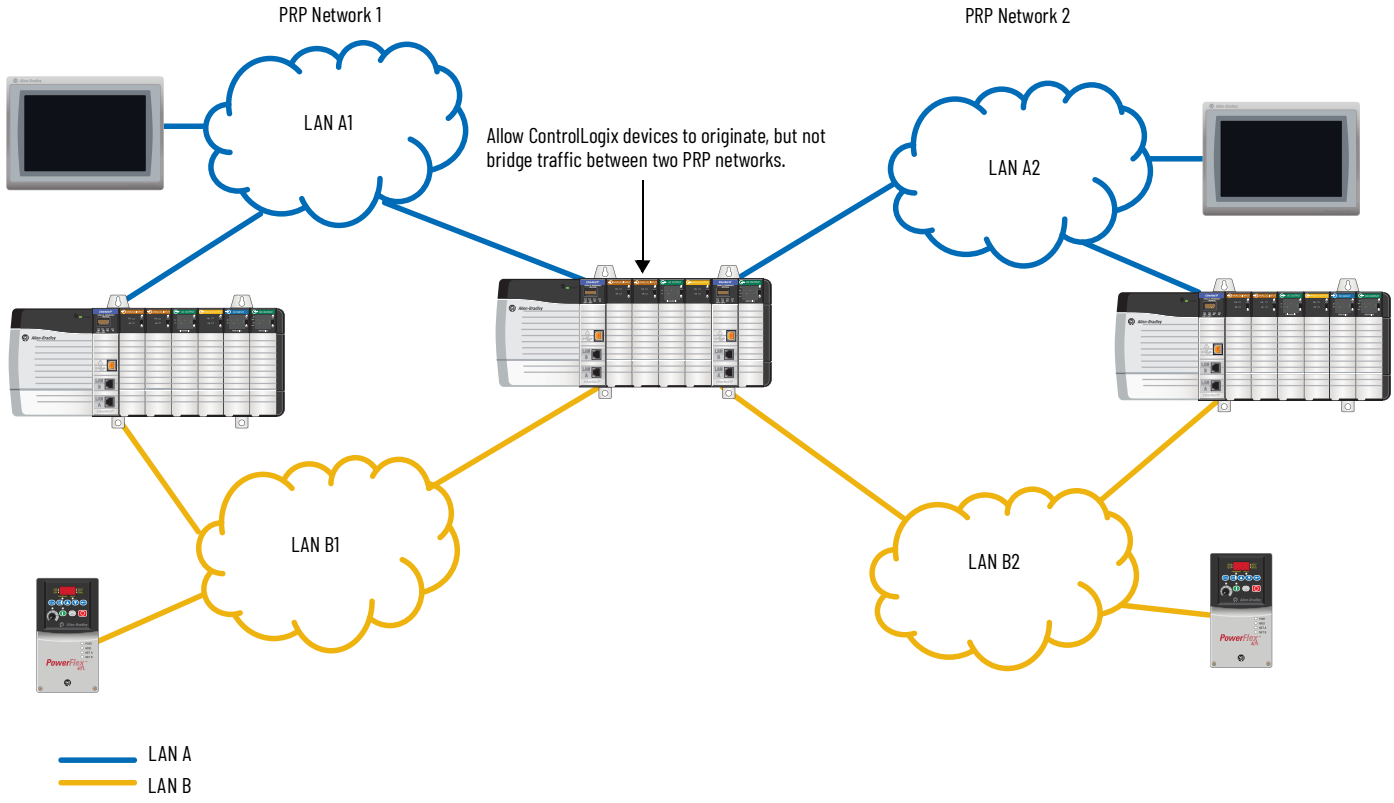


Single Points of Failure Between Adjacent PRP Networks

Figure 4 shows two PRP networks that are connected to the same ControlLogix chassis. To avoid single points of failure in a redundant system, be aware of these communication limitations:

- Allow the ControlLogix chassis that is connected to both PRP networks to originate, but not bridge traffic between PRP networks.
- Do not allow devices in PRP network 1 communicate with devices in PRP network 2.

Figure 4 - Avoid Single Points of Failure with Adjacent PRP Networks



Notes:

Configure a PRP Network

A PRP network has requirements and restrictions for the following:

- Device IP addresses
- Frame sizes
- LAN A and LAN B infrastructure switches
- Spanning Tree Protocol (STP)
- Multicast traffic and IGMP querier
- CIP Sync™ time synchronization (Precision Time Protocol)

IMPORTANT Be sure that all Stratix® switches in your PRP network follow the network guidelines that are described in the user manual for the switches.

Device IP Addresses

To enable devices to communicate with each other across a PRP network, device IP addresses must meet these requirements:

- To communicate with each other, double attached nodes (DANs) and single attached nodes (SANs) must have unique IP addresses within the same subnet.
- Devices in LAN A and LAN B, including SANs and infrastructure switches, must have unique IP addresses within and between each LAN.

Unique IP address assignments also enable you to access each device for monitoring and diagnostics.

Frame Sizes for LAN A and LAN B Devices

PRP adds to the size of Ethernet frames that flow through devices in LAN A and LAN B. If PRP causes frames to exceed the size limit on a device, the frames are dropped. To accommodate a full-sized packet with the PRP trailer attached, set the maximum transmission unit (MTU) size on all infrastructure devices to at least 1506 bytes. This MTU value is not required for a switch that is configured as a RedBox.

If you cannot configure the MTU for an infrastructure device, we recommend that you exclude the device from the path of PRP traffic.

Configuration for LAN A and LAN B Infrastructure Switches

On all ports of LAN A and LAN B infrastructure switches that are in the possible path to the IGMP querier, you must specify the multicast router VLAN ID and the interface to the multicast router.

To configure this information on a switch, use the Cisco® command-line interface (CLI) to run the following command:

```
switch(config)#ip igmp snooping vlan <vlan id> mrouter interface <port name>
```

Spanning Tree Protocol (STP)

You must enable the following STP features:

- Enable BPDU Filtering on the RedBox ports that belong to the PRP channel.

  When you configure PRP ports on the RedBox, BPDU Filtering is automatically enabled.
- Enable PortFast on the following ports:
  - On downlink ports that connect to end devices (not switches)
  - On ports that connect RedBoxes to infrastructure switches

  PortFast is not recommended on ports between infrastructure switches.

  PortFast is enabled by default on Stratix managed switches. Also, the following Smartport roles on Stratix managed switches automatically enable PortFast:
  - Automation Device
  - Multiport Automation Device
  - Desktop for Automation
  - Virtual Desktop for Automation
  - Router for Automation
  - Phone for Automation

Multicast Traffic and IGMP Querier

For PRP networks with multicast traffic, follow these guidelines:

- If your PRP network includes a RedBox and you want to enable multicast traffic filtering on both LANs, configure IGMP querier on the RedBox.
- To avoid one point of failure with the loss of a querier, configure at least two queriers in the PRP network.
- Disable IGMP querier on each infrastructure switch in LAN A and LAN B. This requirement applies to PRP networks with or without a RedBox.

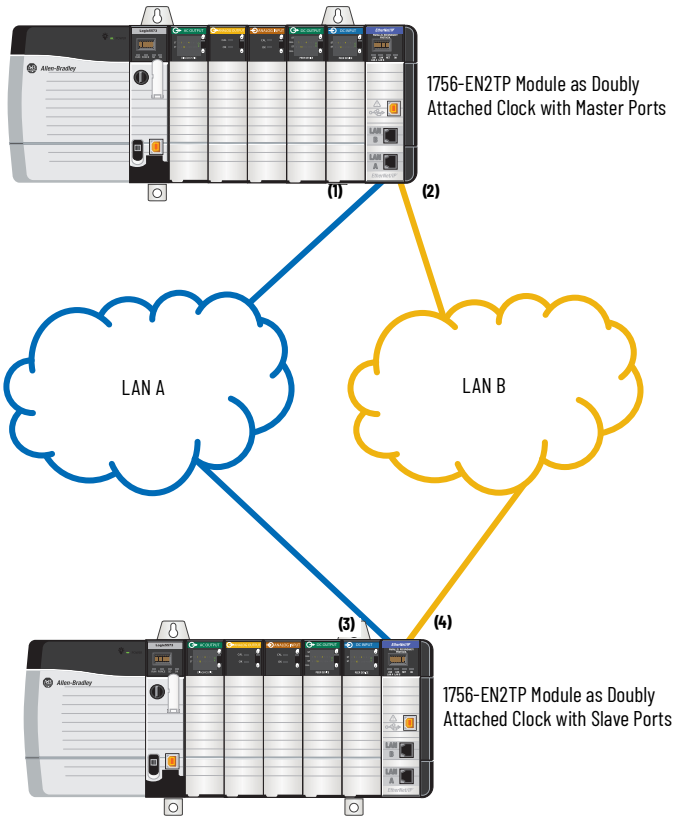
IMPORTANT	After a LAN in a PRP network encounters a fault and is then repaired, there is a delay in multicast traffic redundancy. The delay lasts until the IGMP querier reinstates the multicast traffic. Multicast traffic redundancy is typically restored within 2 minutes after the LAN is repaired.

CIP Sync Time Synchronization (Precision Time Protocol)

EtherNet/IP™ networks configured for Parallel Redundancy Protocol (PRP) support CIP Sync. CIP Sync devices implement the doubly attached clock model with Layer 3 End-to-End protocol, as specified in IEC 62439-3, Annex A and C.

In the following illustration, two 1756-EN2TP modules operate as doubly attached clocks operating on LAN A and LAN B redundant networks:

- In the 1756-EN2TP module at the top, both ports A and B are paired and function as CIP Sync master ports. For master operation, both ports A and B operate as master ports as defined by the IEEE-1588 PTP protocol.
- In the 1756-EN2TP module at the bottom, both ports A and B are paired and function as CIP Sync slave ports. For slave operation, one port is the active port and operates as defined by the IEEE-1588 Precision Time Protocol (PTP). The active port tunes the clock and reports its state as SLAVE. The other port is passive and reports its state as PASSIVE_SLAVE. The passive port also measures path delay and maintains close synchronization to the active port. A network failure on the active port results in a smooth clock transition from passive to active slave.



Note	Port PTP Role
1	Master
2	Master
3	Slave active
4	Slave passive

For PRP systems with CIP Sync time synchronization, follow these guidelines:

- Grandmaster—The Grandmaster for a PRP network can be one of the following:
  - A DAN that functions as a doubly attached clock
  - A controller that accesses the PRP network via a DAN
  - A VDAN that connects to a RedBox
  - A switch that is configured as a DAN or RedBox

  For time sync critical applications, consider adding redundant Grandmasters.
- Infrastructure switches—Set the PTP clock mode on infrastructure switches in LAN A and LAN B that support CIP Sync as follows:
  - For a single VLAN, use Transparent mode.
  - For multiple VLANs, use Boundary mode. Also, make the PTP priority lower (higher numerical value) than any other dual connected device.
- RedBox switch—On each switch you configure as a RedBox, be sure that the PTP mode is set to Boundary or NTP-PTP Clock mode. These modes are the only PTP modes that are supported on a switch that is configured as a RedBox. Typically, NTP-PTP mode is configured on the Layer 3 RedBox switches that are connected to the plant-wide network.

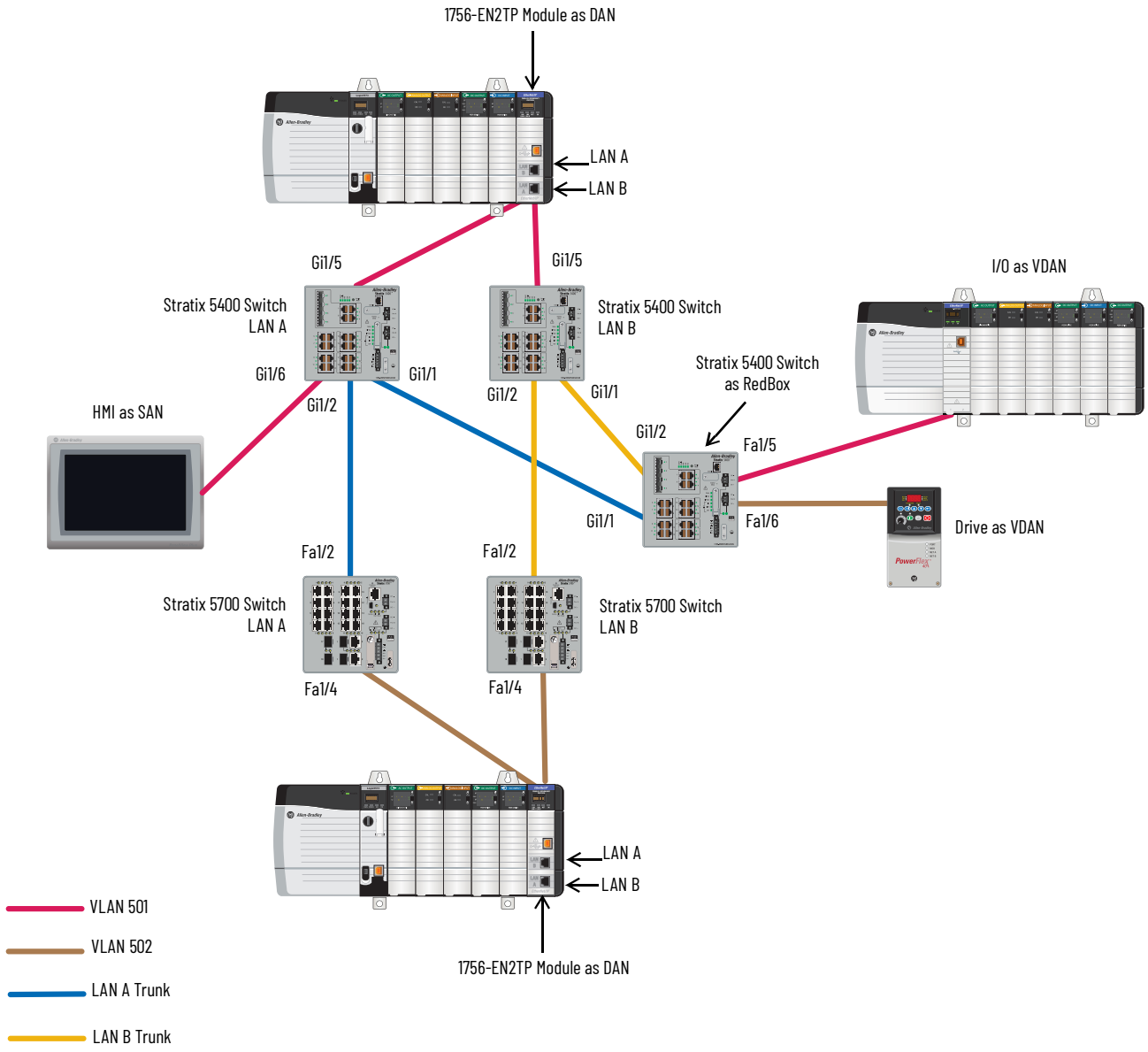
  If the PTP mode on the RedBox is NTP-PTP Clock mode, use the Cisco command-line interface (CLI) to configure the UTC offset value to 37 seconds: switch(config)#utc-offset 37
- Time Sync object—Additional support for PRP is provided by the CIP™ Time Sync object:
  - A port in the PASSIVE_SLAVE state is reported as enumeration 10 in attribute 12 of the Time Sync Object.
  - A doubly attached clock on the PRP network reports the profile identity in attribute 24 as 00-15-4e-00-01-50.

Configuration Example

This configuration example shows you how to configure the PRP system shown in the following illustration:

- The system includes DANs, a SAN, a RedBox, VDANs, and multiple VLANs.
- Because a drive is part of the PRP system, PTP is required.

This example shows the simplest method for configuring PRP trunking with two VLANs. For details on how to configure management interfaces, native VLANs, and data VLANs, see the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication PROCES-UM001.



To configure the example PRP network, complete the following procedures. For more configuration details, see these publications:

- EtherNet/IP Network Configuration User Manual, ENET-UM001
- Stratix Managed Switches User Manual, publication 1783-UM007

IMPORTANT Before you connect cables between devices in a PRP system, complete the configuration of all devices. For example, if your system includes a FLEX 5000 EtherNet/IP adapter, make sure that the adapter is in PRP mode.

IMPORTANT Before you begin, be sure to update the devices with the latest firmware.

Configure the Stratix 5400 RedBox

The RedBox in the example on page 25 uses the port configurations that are shown in the following table. Also, because the RedBox is connected to a drive, PTP must be enabled and set to Boundary mode.

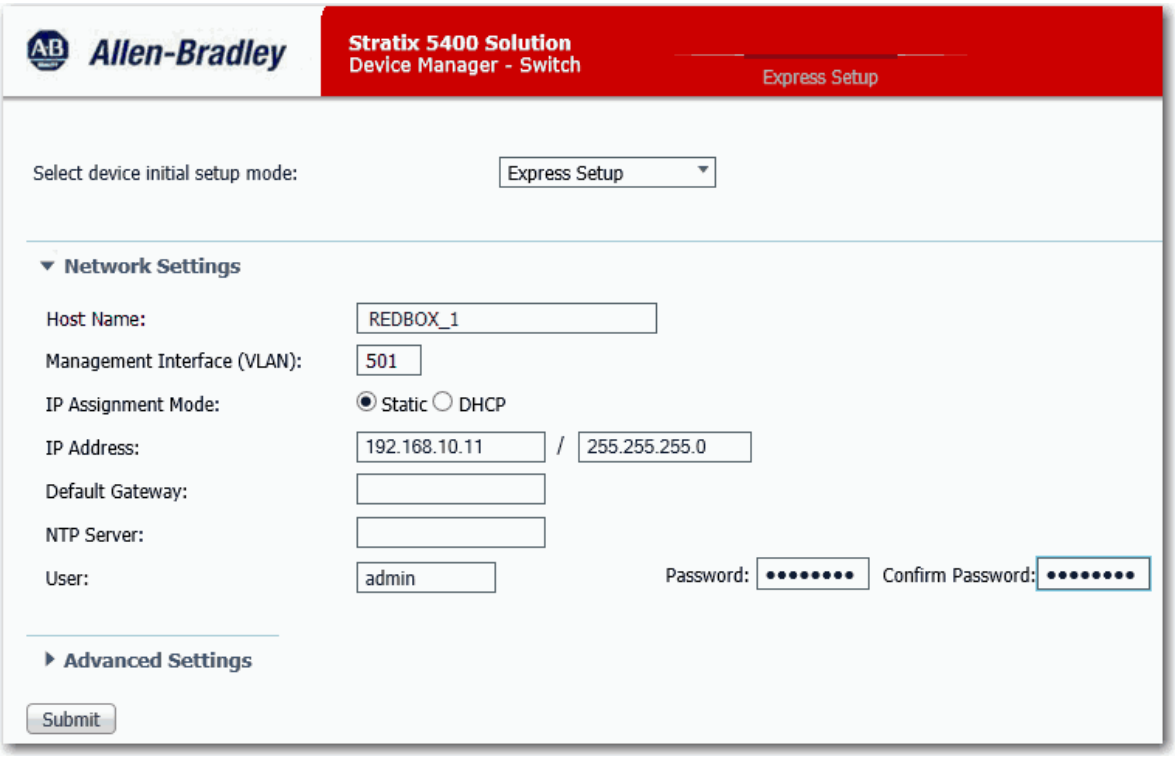
Table 1 -

Port	Connected Device	VLAN	IP Address with Subnet Mask	Native VLAN(1)	Administrative Mode	Smartport Role	PortFast
Gi1/1	Stratix 5400 switch, LAN A	501 502	192.168.10.14/24 192.168.20.24/24	301	Trunk	–	–
Gi1/2	Stratix 5400 switch, LAN B	501 502	192.168.10.12/24 192.168.20.22/24	301	Trunk	–	–
Fa1/5	I/O, VDAN	501	192.168.10.101/24	–	Access	Automation Device	Enabled
Fa1/6	Drive, VDAN	502	192.168.20.201/24	–	Access	Automation Device	Enabled

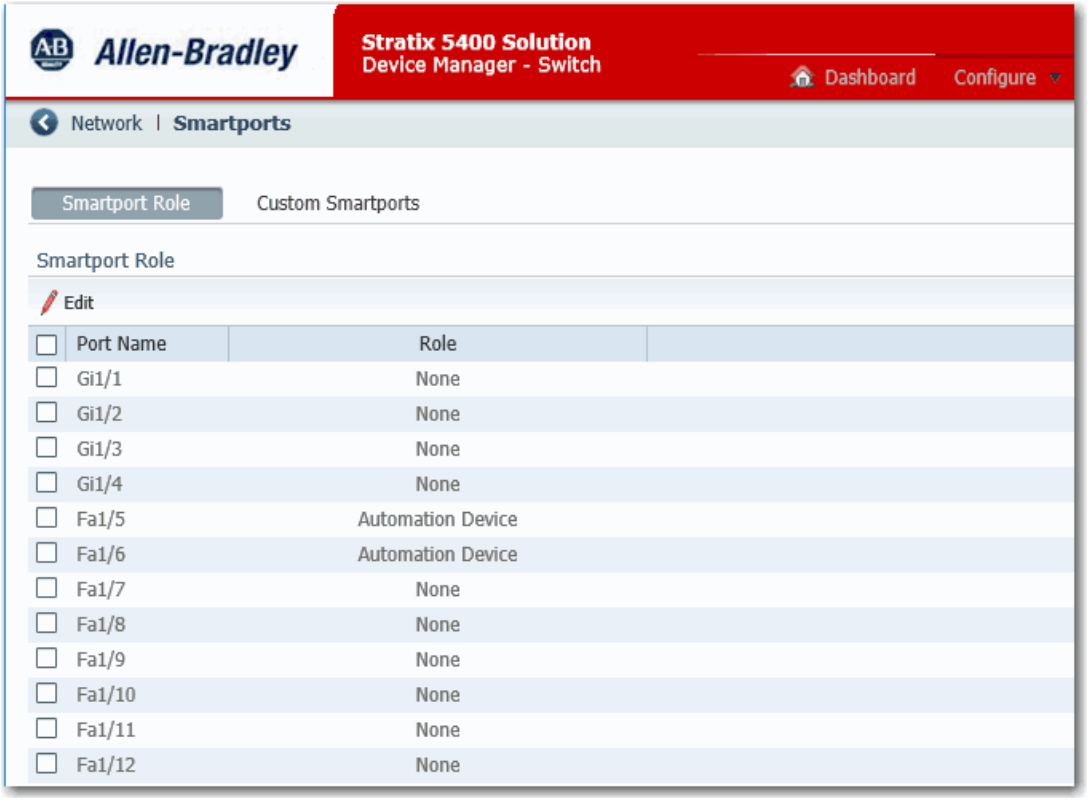
(1) All trunk ports require the same native VLAN.

To configure this example, follow these steps.

1. Run Express Setup in Short Press mode and assign a default IP address of 192.168.10.11.

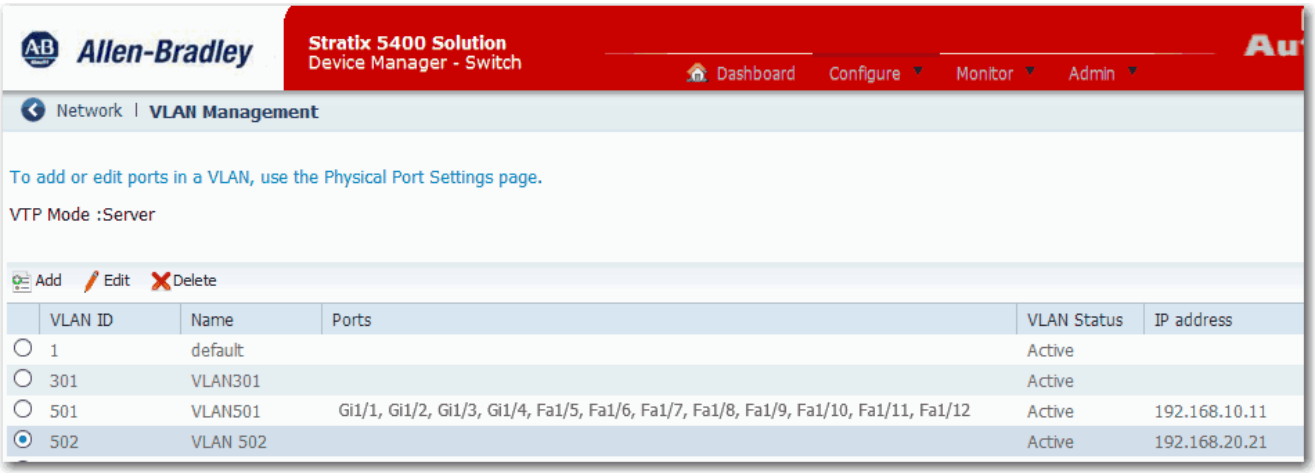


2. Assign the Automation Device Smartport role to the switch ports connected to the VDANs (Fa1/5 and Fa1/6).
   The Smartport role enables PortFast on the ports. PortFast is required to be enabled on ports that are connected to end devices.



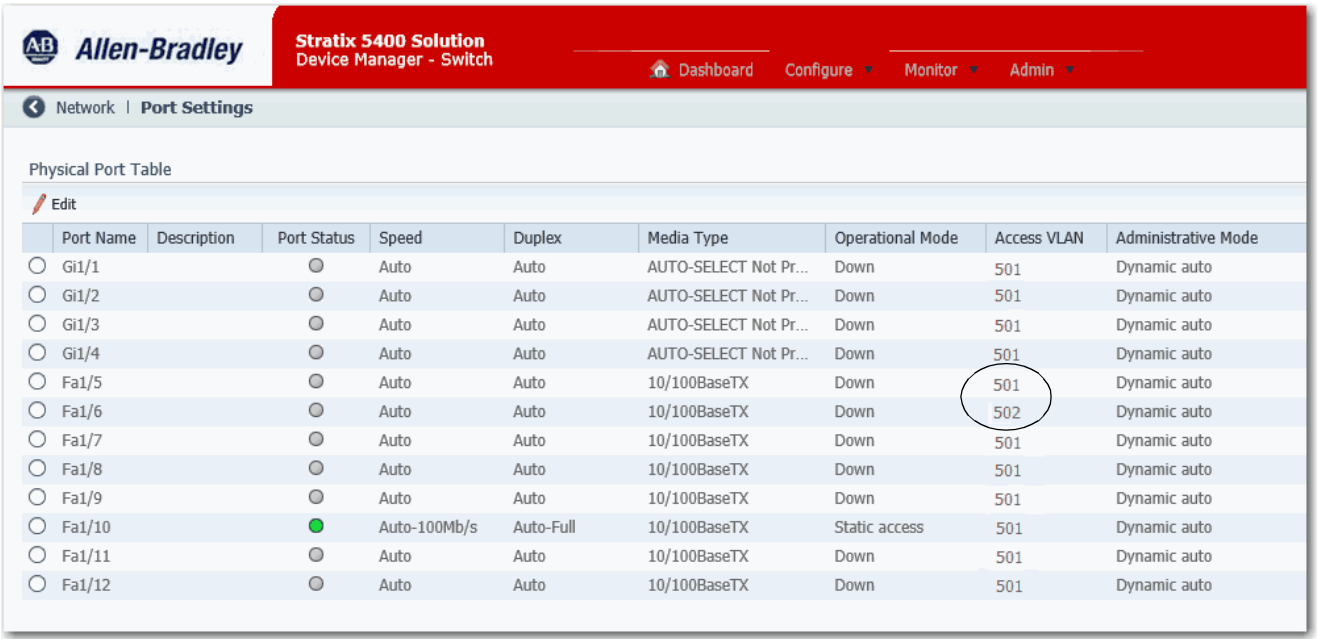
Port Name	Role
Gi1/1	None
Gi1/2	None
Gi1/3	None
Gi1/4	None
Fa1/5	Automation Device
Fa1/6	Automation Device
Fa1/7	None
Fa1/8	None
Fa1/9	None
Fa1/10	None
Fa1/11	None
Fa1/12	None

3. Add VLANs 301 and 502.
   VLAN 502 has a unique IP address of 192.168.20.21.



VLAN ID	Name	Ports	VLAN Status	IP address
1	default		Active	
301	VLAN301		Active	
501	VLAN501	Gi1/1, Gi1/2, Gi1/3, Gi1/4, Fa1/5, Fa1/6, Fa1/7, Fa1/8, Fa1/9, Fa1/10, Fa1/11, Fa1/12	Active	192.168.10.11
502	VLAN 502		Active	192.168.20.21

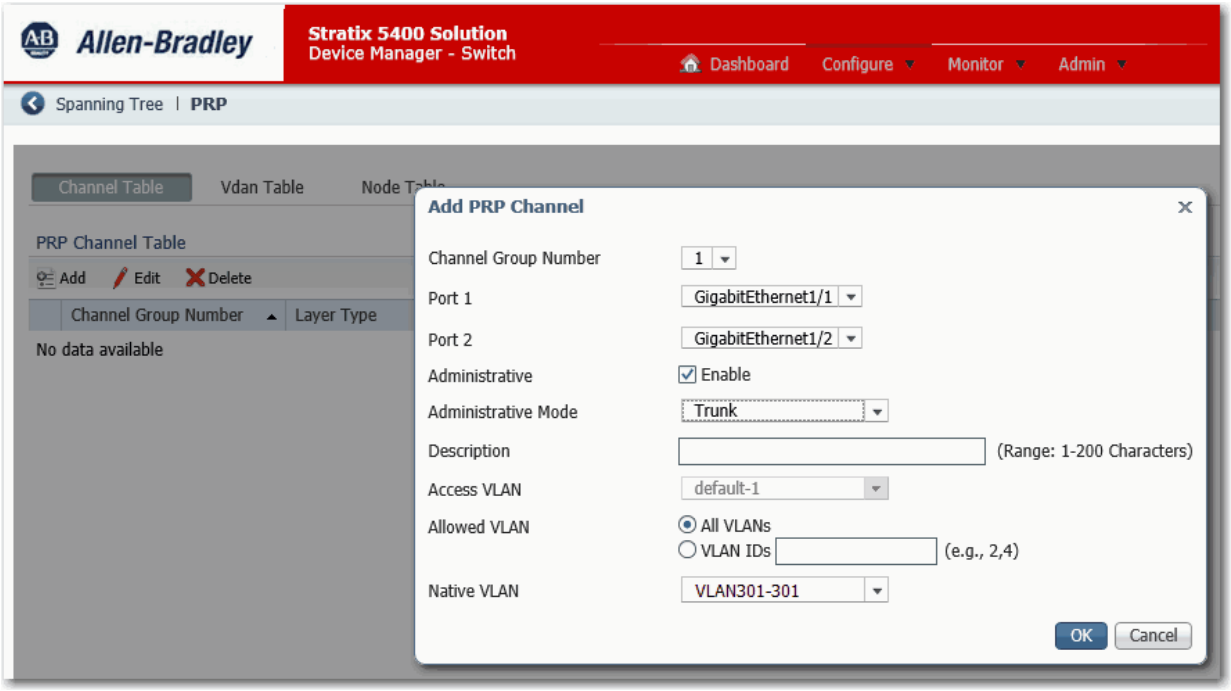
4. Assign VLAN 501 to port Fa1/5 connected to the I/O (VDAN) and assign VLAN 502 to port Fa1/6 connected to the drive (VDAN).



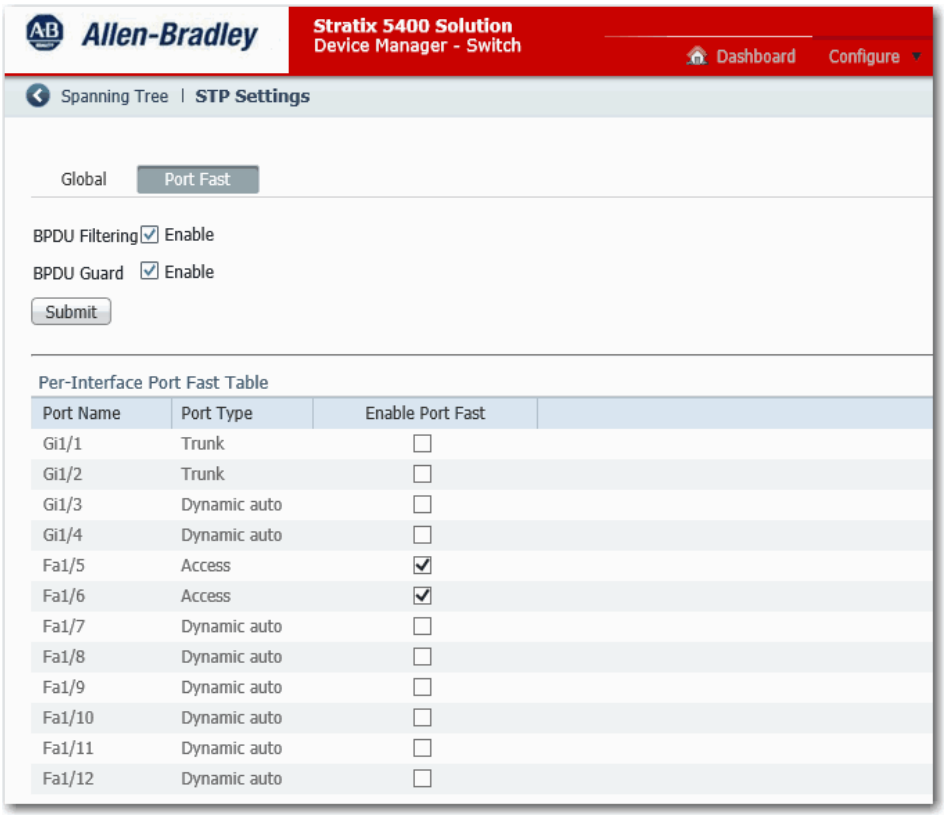
	Port Name	Description	Port Status	Speed	Duplex	Media Type	Operational Mode	Access VLAN	Administrative Mode
○	Gi1/1			Auto	Auto	AUTO-SELECT Not Pr...	Down	501	Dynamic auto
○	Gi1/2			Auto	Auto	AUTO-SELECT Not Pr...	Down	501	Dynamic auto
○	Gi1/3			Auto	Auto	AUTO-SELECT Not Pr...	Down	501	Dynamic auto
○	Gi1/4			Auto	Auto	AUTO-SELECT Not Pr...	Down	501	Dynamic auto
○	Fa1/5			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/6			Auto	Auto	10/100BaseTX	Down	502	Dynamic auto
○	Fa1/7			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/8			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/9			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/10			Auto-100Mb/s	Auto-Full	10/100BaseTX	Static access	501	Dynamic auto
○	Fa1/11			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/12			Auto	Auto	10/100BaseTX	Down	501	Dynamic auto

5. Choose Boundary mode for PTP.

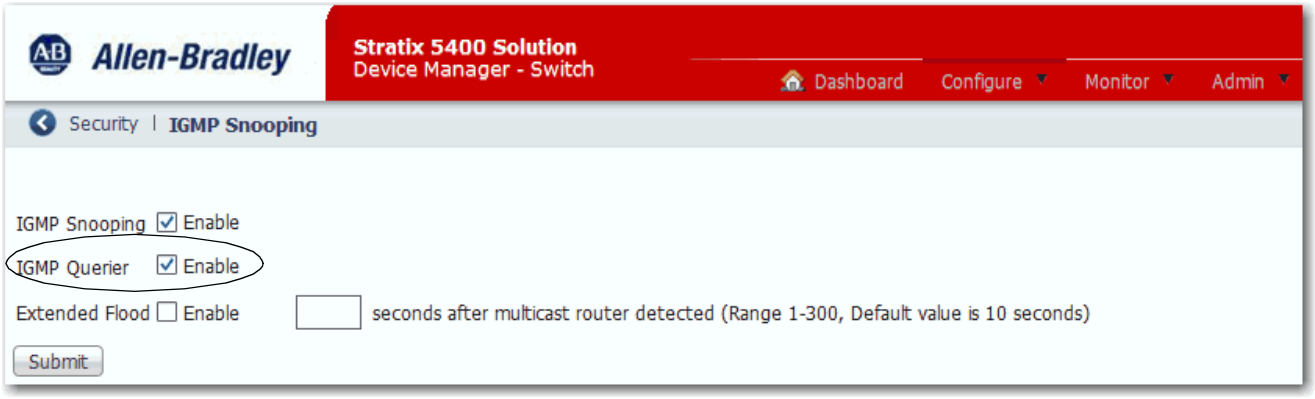
6. Add a PRP channel group with this configuration:
   - Choose Trunk as the Administrative mode because the ports carry traffic for VLANs 501 and 502.
   - Choose 301 as the native VLAN.



7. Verify that the Automation Device Smartport role automatically enabled PortFast on the ports that are connected to end devices.



8. Enable IGMP querier.



Configure the Stratix 5400 Switch in LAN A

The Stratix 5400 switch in LAN A in the example on page 25 uses the port configurations that are shown in the following table. Also, the system and jumbo MTU values on the switch must be set to 1506. PTP must be enabled and set to End to End Transparent mode.

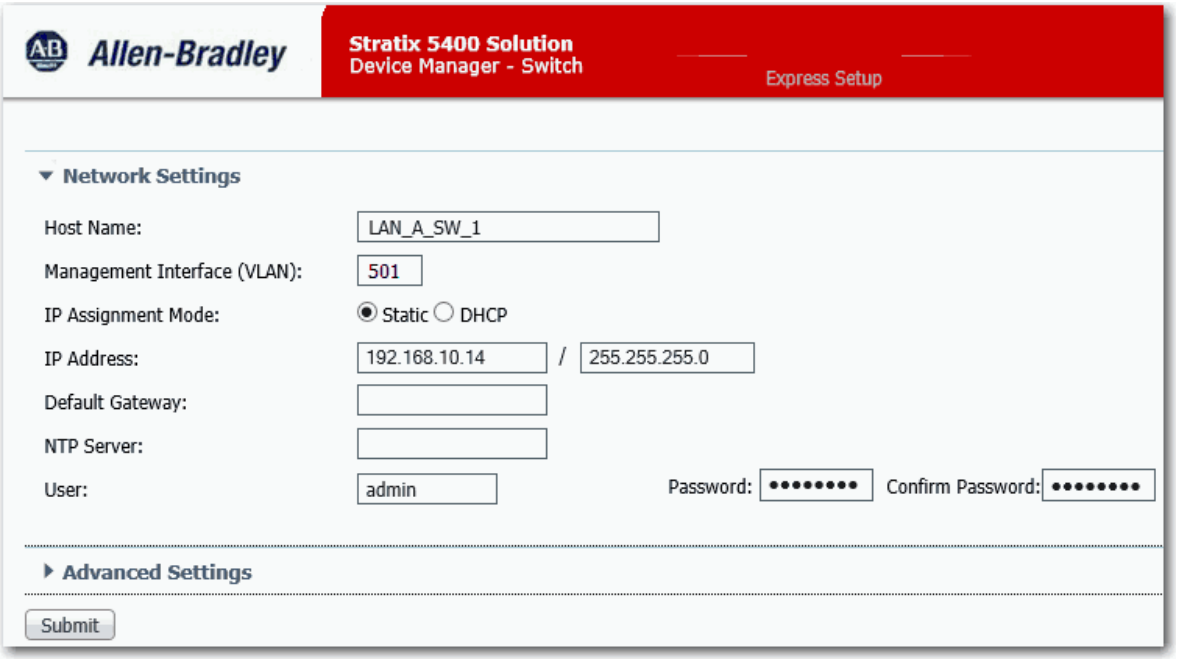
Table 2 -

Port	Connected Device	VLAN	IP Address with Subnet Mask	Native VLAN(1)	Administrative Mode	Smartport Role	PortFast
Gi1/1	Stratix 5400 RedBox	501 502	192.168.10.11/24 192.168.20.21/24	301	Trunk	–	–
G1/2	Stratix 5700 switch, LAN A	501 502	192.168.10.15/24 192.168.20.25/24	301	Trunk	–	–
Gi1/5	1756-EN2TP as DAN	501	192.168.10.102/24	–	Access	Automation Device	Enabled
Gi1/6	HMI as SAN	501	192.168.10.103/24	–	Access	Automation Device	Enabled

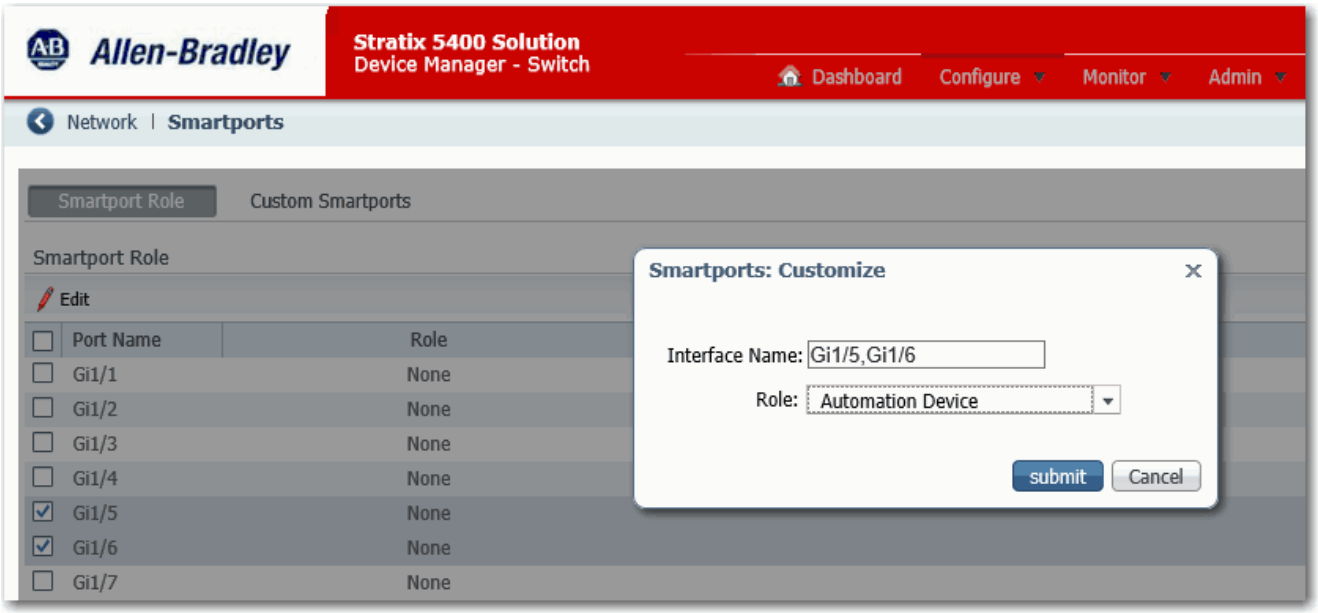
(1) All trunk ports require the same native VLAN.

To configure this example, follow these steps.

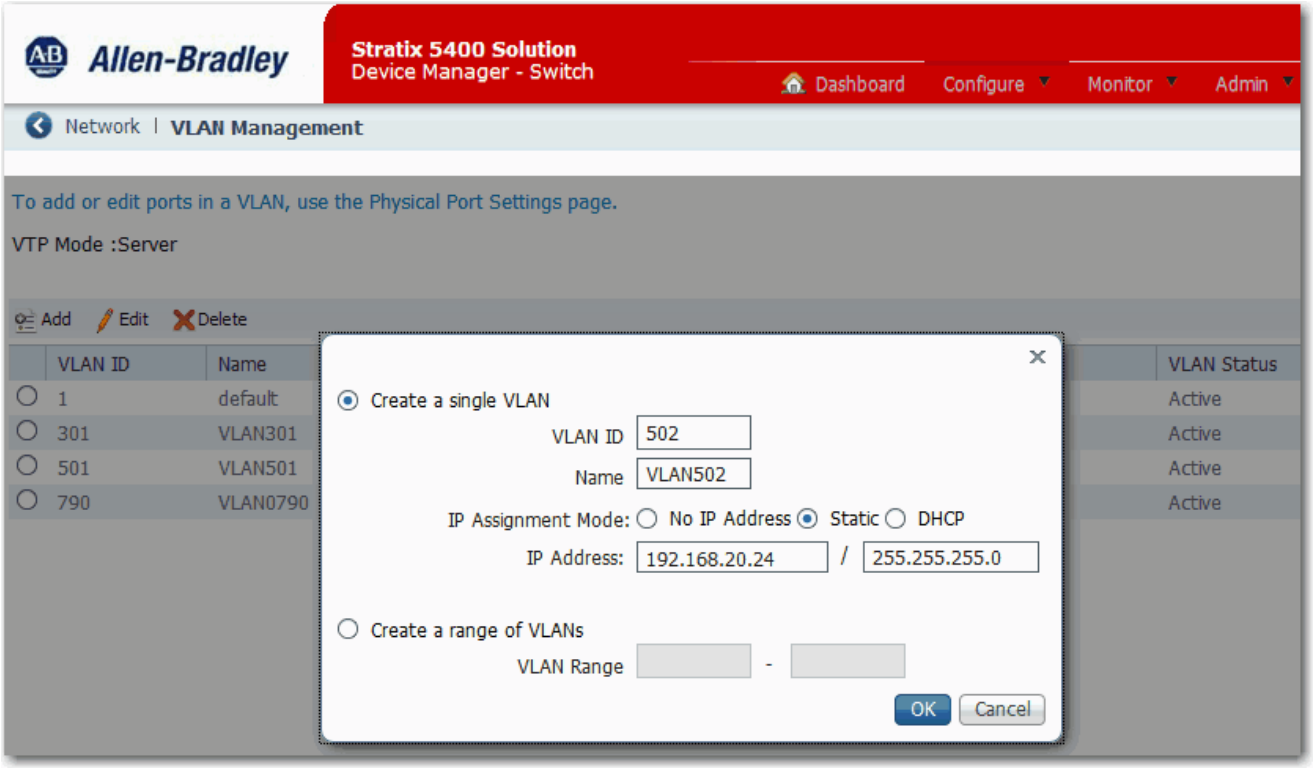
1. Run Express Setup in Short Press mode and assign a default IP address of 192.168.10.14.



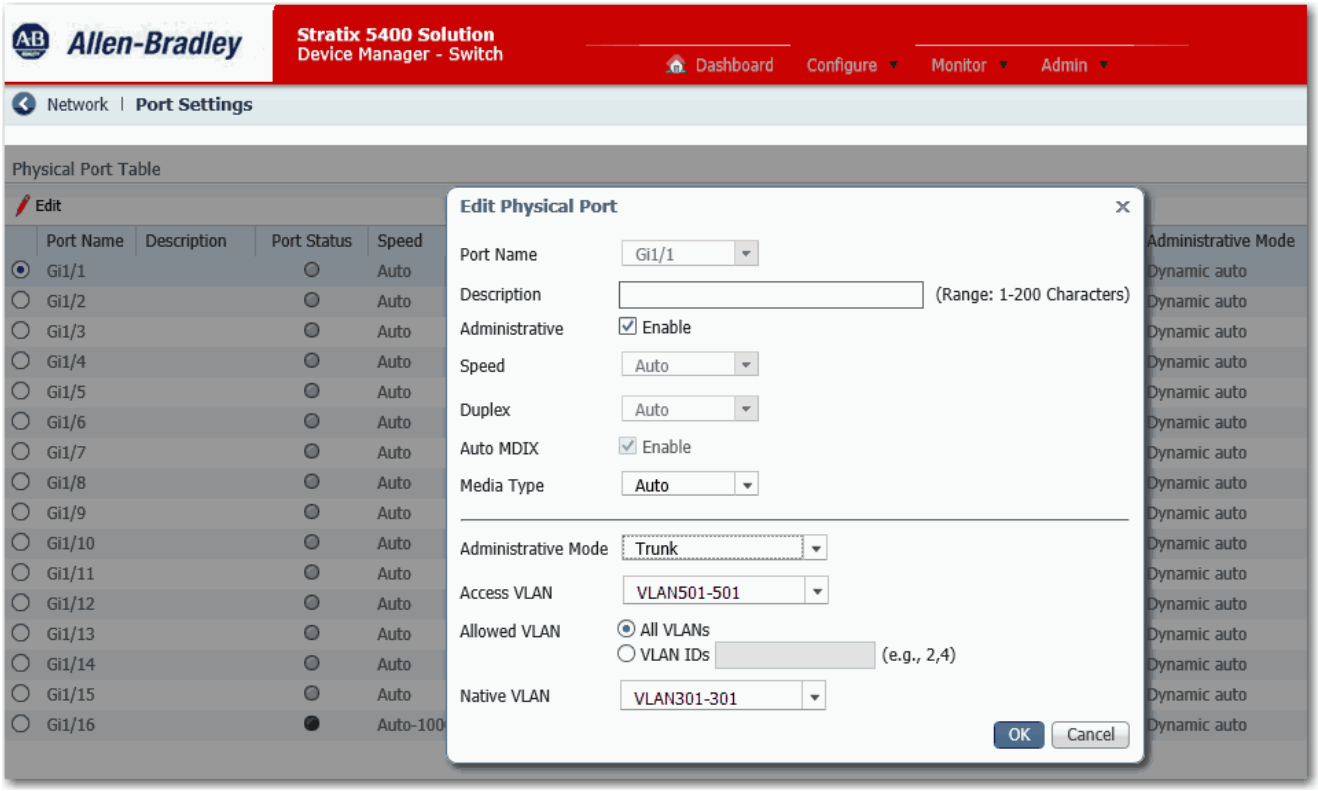
2. Assign the Automation Device Smartport role to the switch ports connected to end devices (Gi1/5 and Gi1/6).
   The Smartport role enables PortFast on the ports. PortFast must be enabled on ports that are connected to end devices.



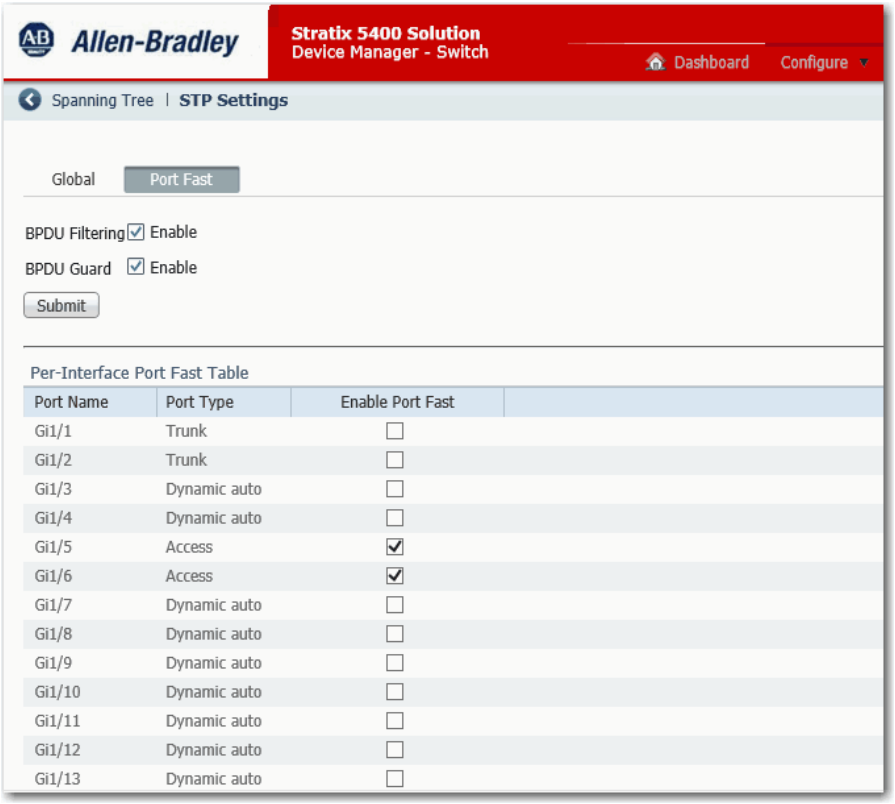
3. Add VLANs 301 and 502.
   VLAN 502 has a unique IP address of 192.168.20.24.



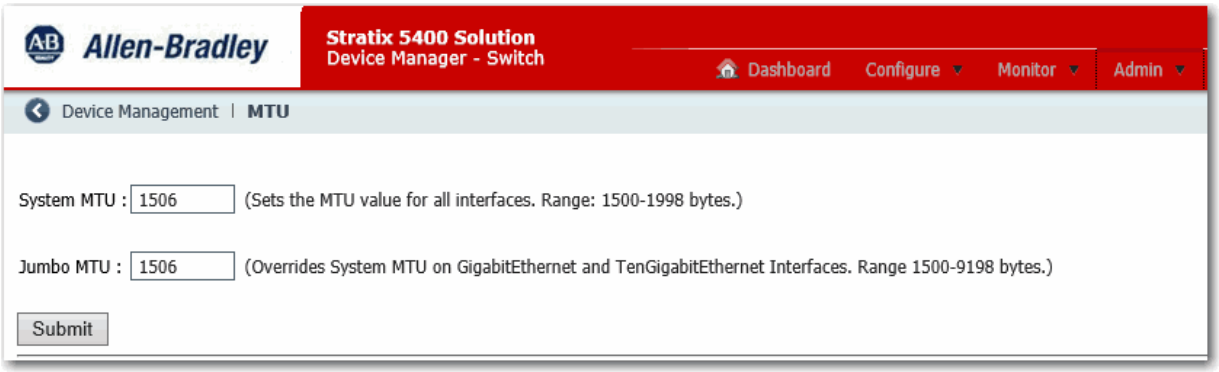
4. For ports Gi1/1 and Gi1/2, configure these settings:
   - Choose Trunk as the Administrative mode because the ports carry traffic for VLANs 501 and 502.
   - Choose 301 as the native VLAN.



5. Verify that the Automation Device Smartport role automatically enabled PortFast on the ports that are connected to end devices.

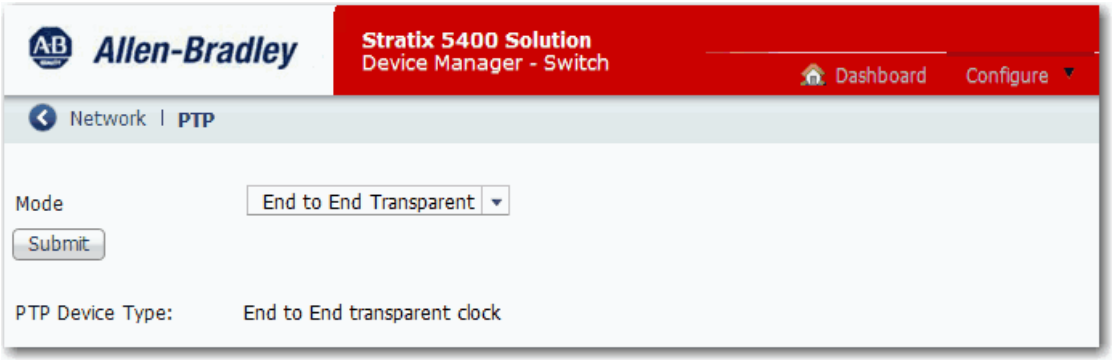


6. Set the system and jumbo MTU value to 1506, and when prompted, restart the switch.



7. Choose End to End Transparent mode for PTP over one VLAN.

To support PTP over multiple VLANs, you can configure a LAN switch in Boundary clock mode. In Boundary clock mode, the PTP priority must be lower (higher numerical value) than any other DAN or RedBox.



8. Disable IGMP querier.

9. On all ports that are in the possible path to the IGMP querier, specify the multicast router VLAN ID and the interface to the multicast router with the following CLI command:

   switch(config)#ip igmp snooping vlan <vlan id> mrouter interface <port name>

Configure the Stratix 5400 Switch in LAN B

The Stratix 5400 switch in LAN B in the example on page 25 uses the port configurations that are shown in the following table. Also, the system and jumbo MTU values on the switch must be set to 1506. PTP must be enabled and set to End to End Transparent mode.

To configure this example, use the same procedure as described in Configure the Stratix 5400 Switch in LAN A on page 30 with these port configurations.

Table 3 -

Port	Connected Device	VLAN	IP Address with Subnet Mask	Native VLAN(1)	Administrative Mode	Smartport Role	PortFast
Gi1/1	Stratix 5400 RedBox	501 502	192.168.10.11/24 192.168.20.21/24	301	Trunk	–	–
G1/2	Stratix 5700 switch, LAN B	501 502	192.168.10.13/24 192.168.20.23/24	301	Trunk	–	–
Gi1/5	1756-EN2TP as DAN	501	192.168.10.102/24	–	Access	Automation Device	Enabled

(1) All trunk ports require the same native VLAN.

Configure the Stratix 5700 Switch in LAN A

The Stratix 5700 switch in LAN A in the example on page 25 uses the port configurations that are shown in the following table. Also, the system and jumbo MTU values on the switch must be set to 1506. PTP must be enabled and set to End to End Transparent mode.

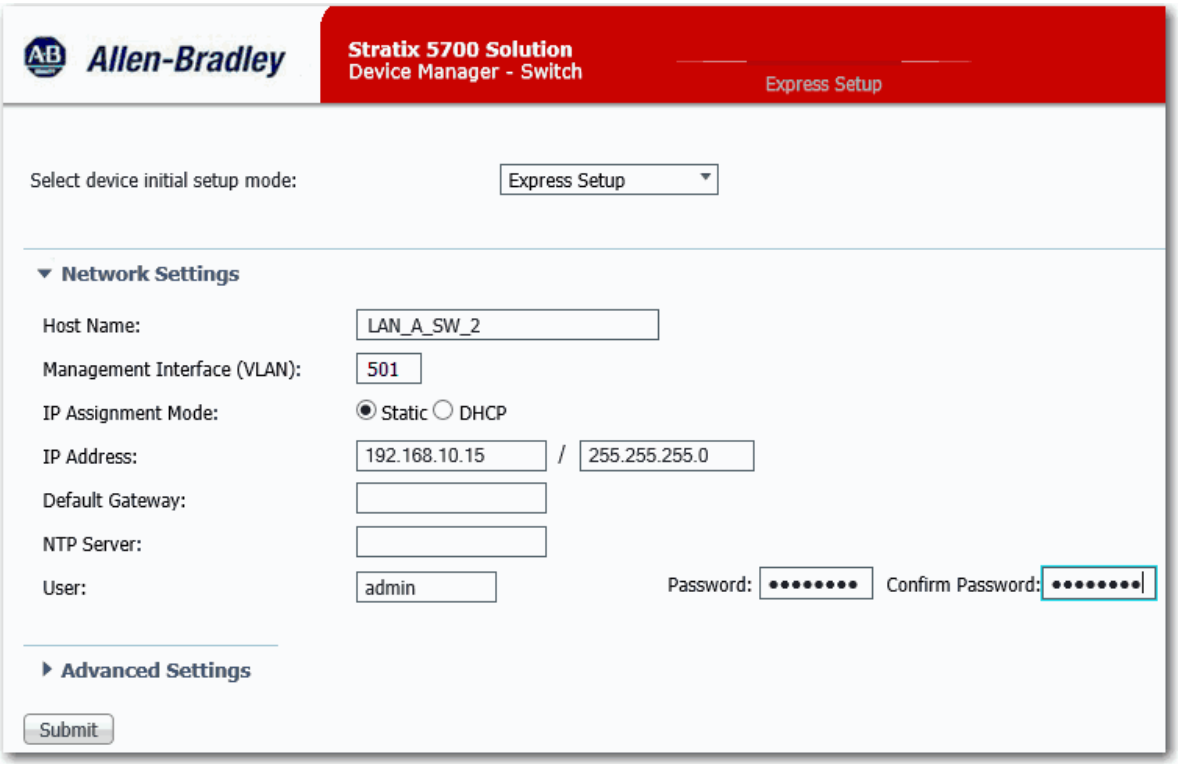
Table 4 -

Port	Connected Device	VLAN	IP Address with Subnet Mask	Native VLAN(1)	Administrative Mode	Smartport Role	PortFast
Gi1/2	Stratix 5400 switch, LAN A	501 502	192.168.10.14/24 192.168.20.24/24	301	Trunk	–	–
Fa1/4	1756-EN2TP as DAN	502	192.168.20.202/24	–	Access	Automation Device	Enabled

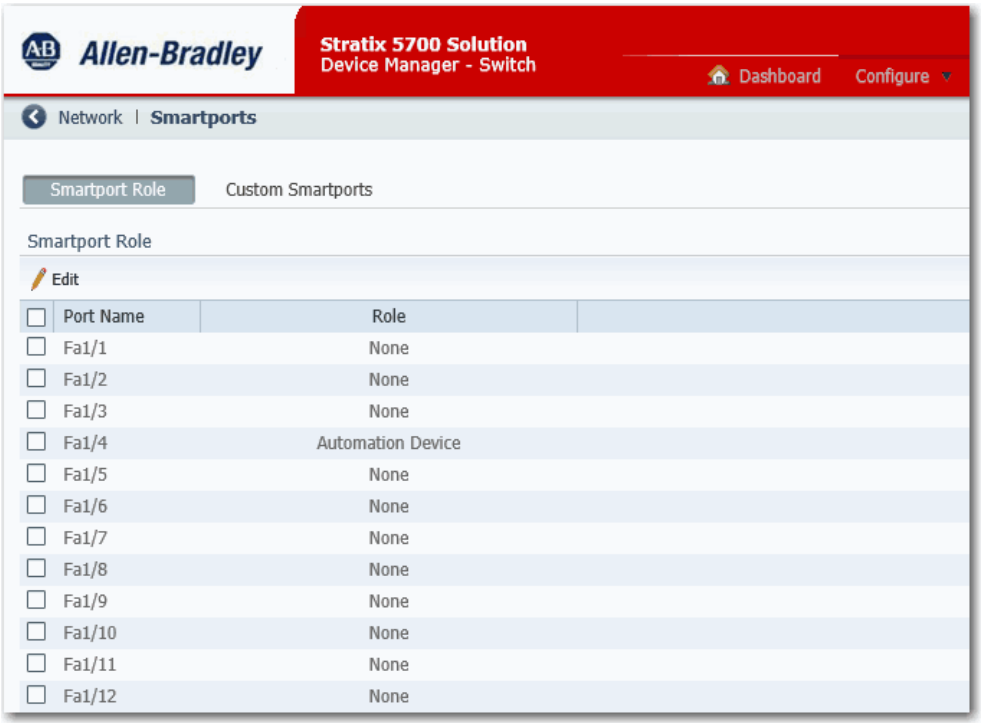
(1) All trunk ports require the same native VLAN.

To configure this example, follow these steps.

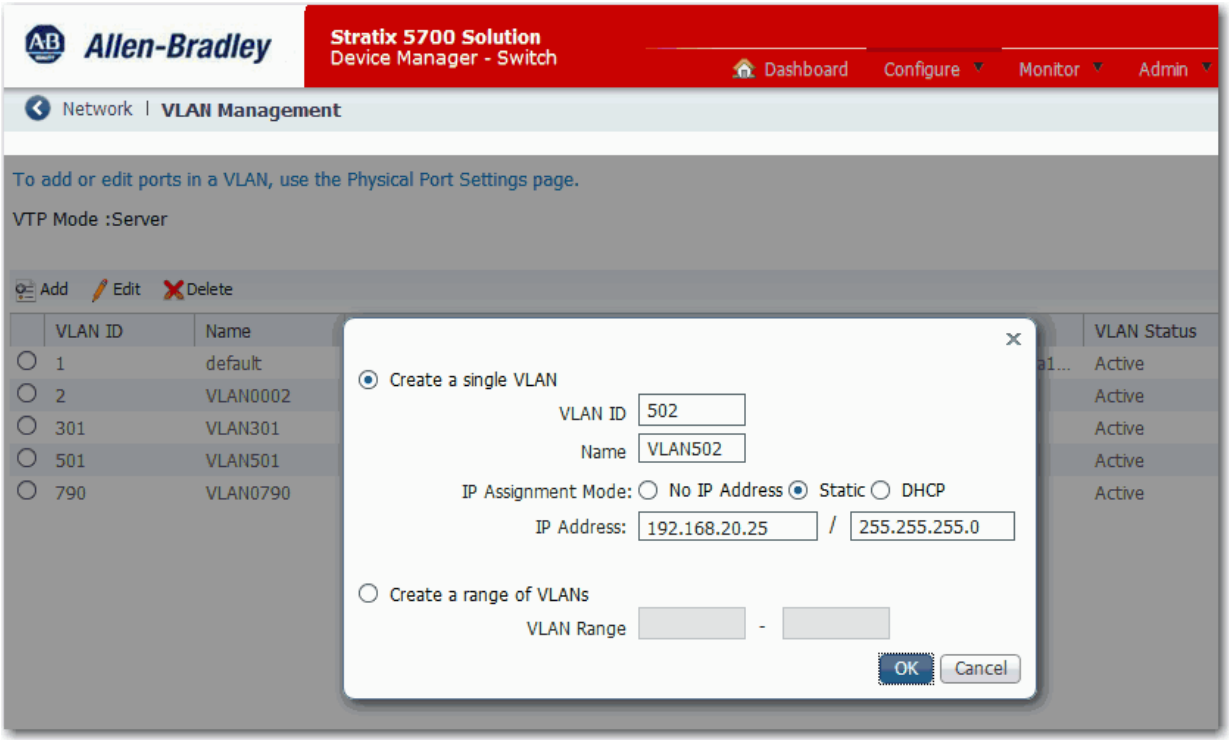
1. Run Short Press mode Express Setup and assign an IP address of 192.168.10.15.



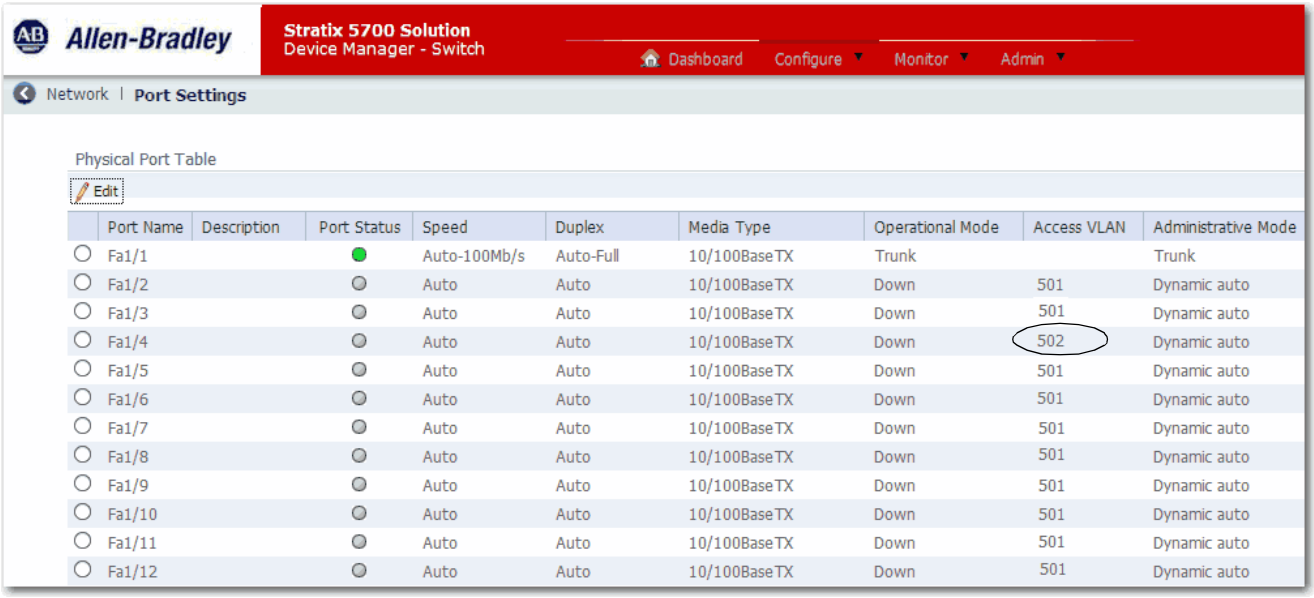
2. Assign the Automation Device Smartport role to the switch port connected to the 1756-EN2TP module (Fa1/4).
   The Smartport role enables PortFast on the ports. PortFast must be enabled on all ports that are connected to end devices.



3. Add VLANs 502 and 301.
   VLAN 502 has a unique IP address of 192.168.21.25.

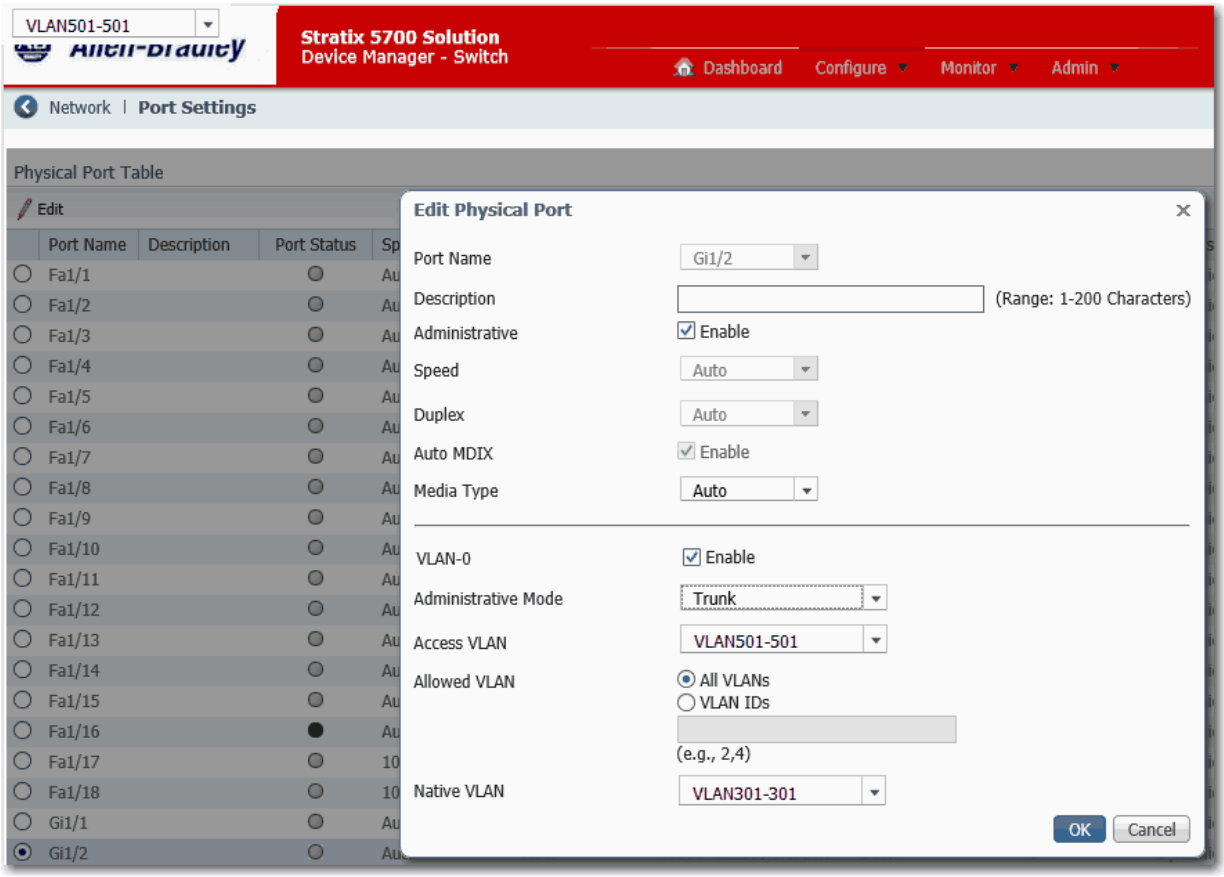


4. Assign VLAN 502 to port Fa1/4 connected to the 1756-EN2TP module.

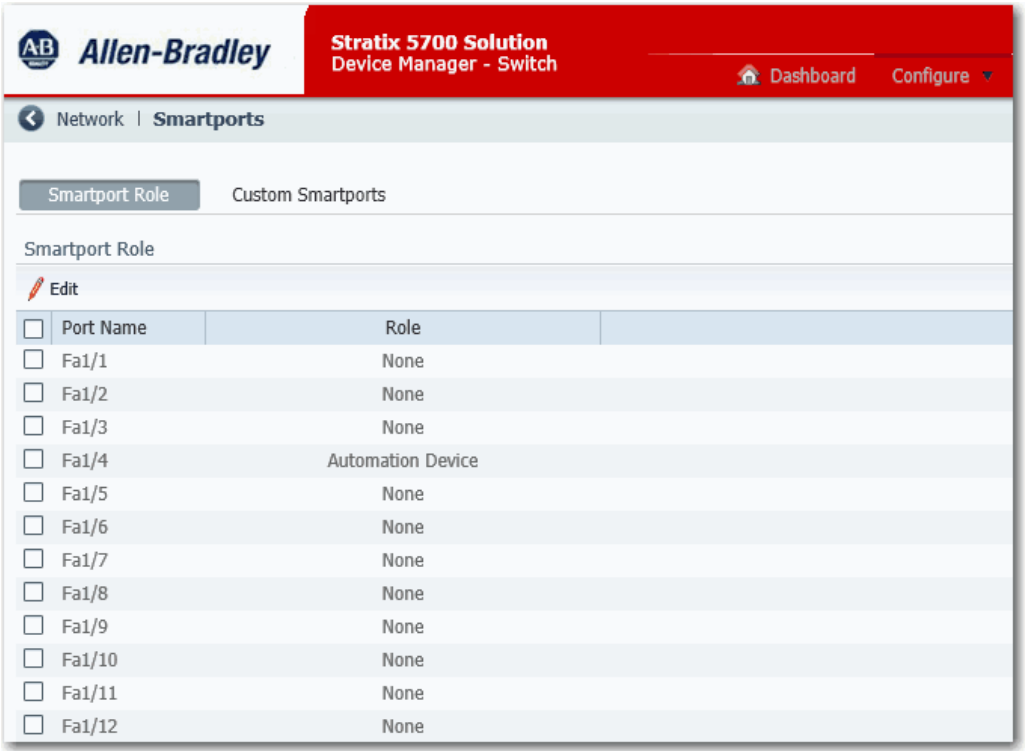


	Port Name	Description	Port Status	Speed	Duplex	Media Type	Operational Mode	Access VLAN	Administrative Mode
○	Fa1/1		●	Auto-100Mb/s	Auto-Full	10/100BaseTX	Trunk		Trunk
○	Fa1/2		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/3		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/4		○	Auto	Auto	10/100BaseTX	Down	502	Dynamic auto
○	Fa1/5		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/6		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/7		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/8		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/9		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/10		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/11		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto
○	Fa1/12		○	Auto	Auto	10/100BaseTX	Down	501	Dynamic auto

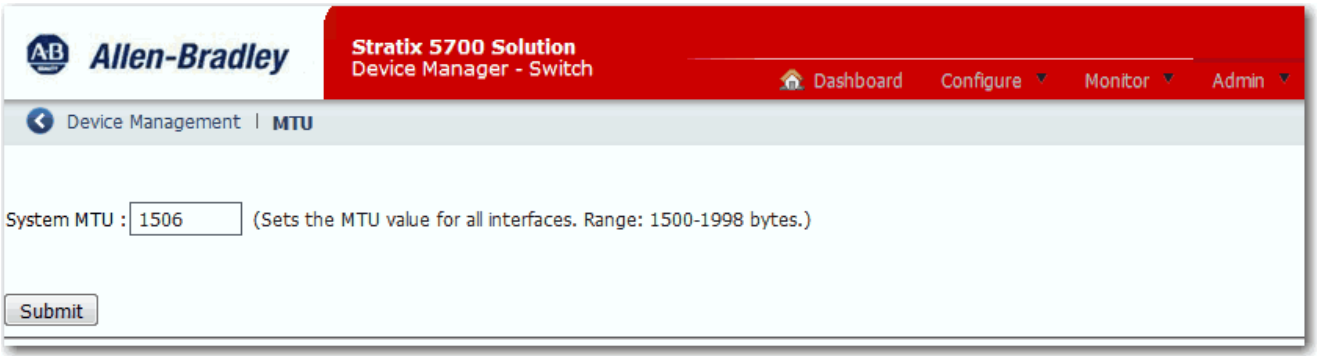
5. For port Gi1/2, configure these settings:
   - Choose Trunk as the Administrative mode because the port carries traffic for VLANs 501 and 502.
   - Choose 301 as the native VLAN.



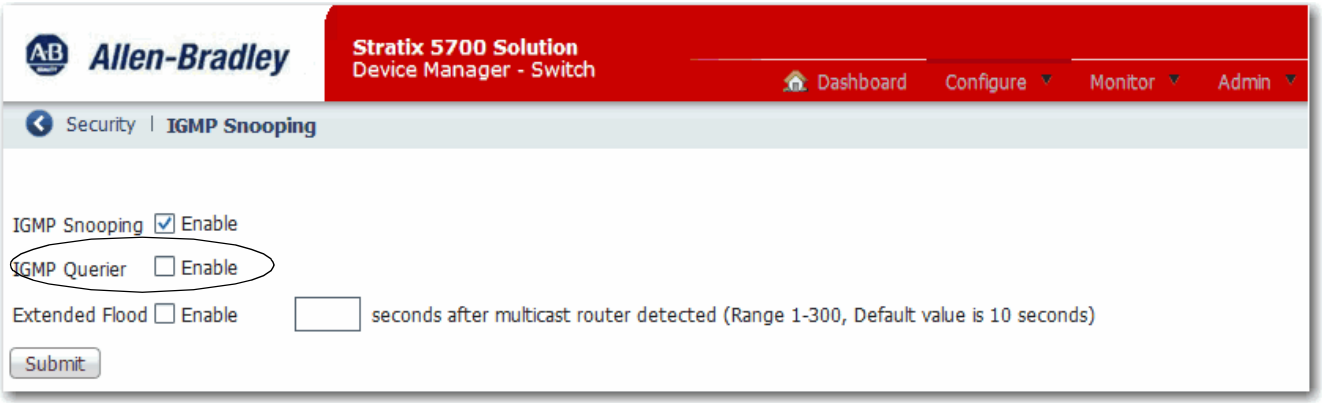
6. Verify that the Automation Device Smartport role automatically enabled PortFast on the port that is connected to an end device.



7. Set the system MTU value to 1506, and then prompted, restart the switch.

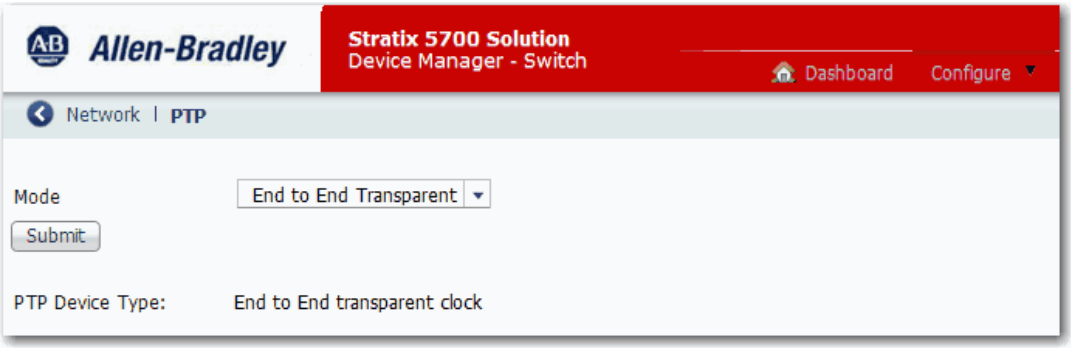


8. Disable IGMP querier.



9. Choose End to End Transparent mode for PTP over one VLAN.

To support PTP over multiple VLANs, you can configure a LAN switch in Boundary clock mode. In Boundary clock mode, the PTP priority must be lower (higher numerical value) than any other DAN or RedBox.



10. On all ports that are in the possible path to the IGMP querier, specify the multicast router VLAN ID and the interface to the multicast router with the following CLI command:

    switch(config)#ip igmp snooping vlan <vlan id> mrouter interface <port name>

Configure the Stratix 5700 Switch in LAN B

The Stratix 5700 switch in LAN B in the example on page 25 uses the port configurations that are shown in the following table. Also, the system and jumbo MTU values on the switch must be set to 1506. PTP must be enabled and set to End to End Transparent mode.

To configure this example, use the same procedure as described in Configure the Stratix 5700 Switch in LAN A on page 34 with these port configurations.

Table 5 -

Port	Connected Devices	VLAN	IP Address with Subnet Mask	Administrative Mode	Smartport Role	PortFast
Gi1/2	Stratix 5400 switch, LAN B	501 502	192.168.10.12/24 192.168.20.22/24	Trunk	–	–
Fa1/4	1756-EN2TP as DAN	502	192.168.20.202/24	Access	Automation Device	Enabled

Assign IP Addresses to the SAN and VDANs

The SAN and VDAN devices in the example on page 25 use the configurations that are shown in the following table.

Assign IP addresses to the devices. No further configuration is required.

Table 6 -

Device	IP Address with Subnet Mask	Connected Device	VLAN
HMI as SAN	192.168.10.103/24	Stratix 5400 switch, LAN A	501
I/O as VDAN	192.168.10.101/24	Stratix 5400 RedBox	501
Drive as VDAN	192.168.20.201/24	Stratix 5400 RedBox	502

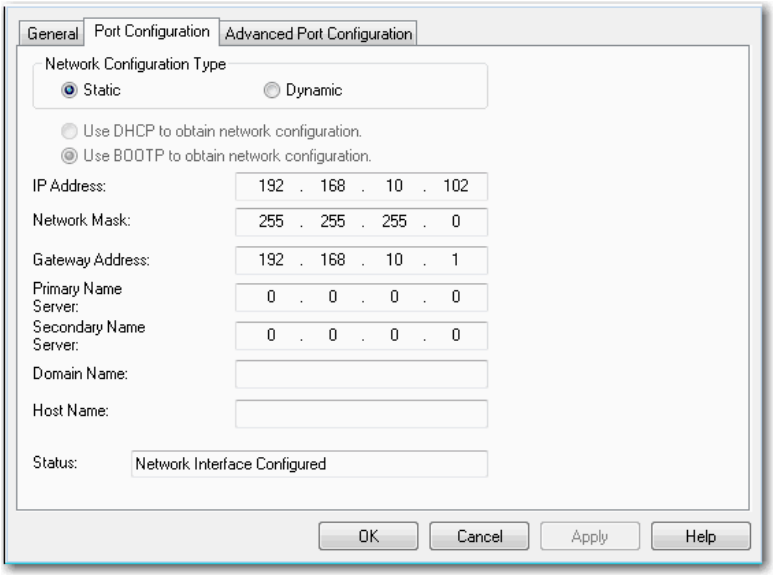
Assign IP Addresses to the 1756-EN2TP Devices (DANs)

The 1756-EN2TP devices in the example on page 25 use the port configurations shown in the following tables.

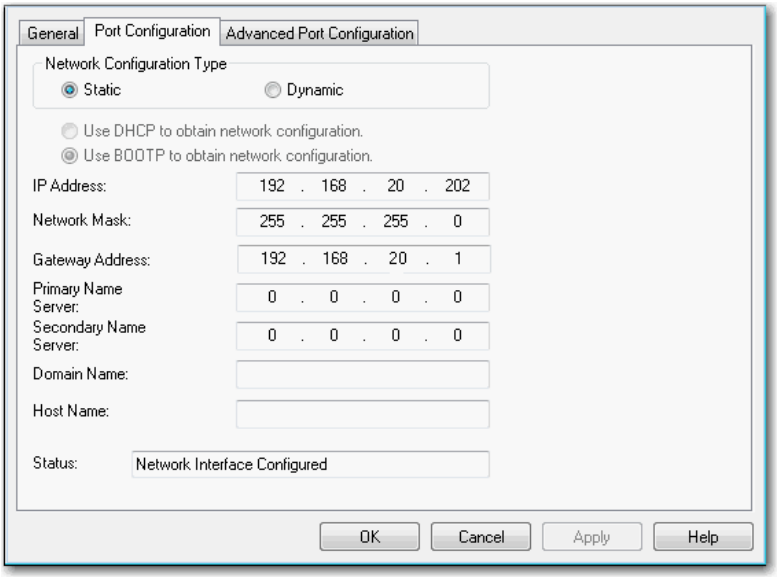
Assign IP addresses to the devices. No further configuration is required.

Table 7 -

Device	IP Address with Subnet Mask	Port	Connected Device	VLAN
1756-EN2TP	192.168.10.102/24	LAN A	Stratix 5400 switch, LAN A	501
		LAN B	Stratix 5400 switch, LAN B	501

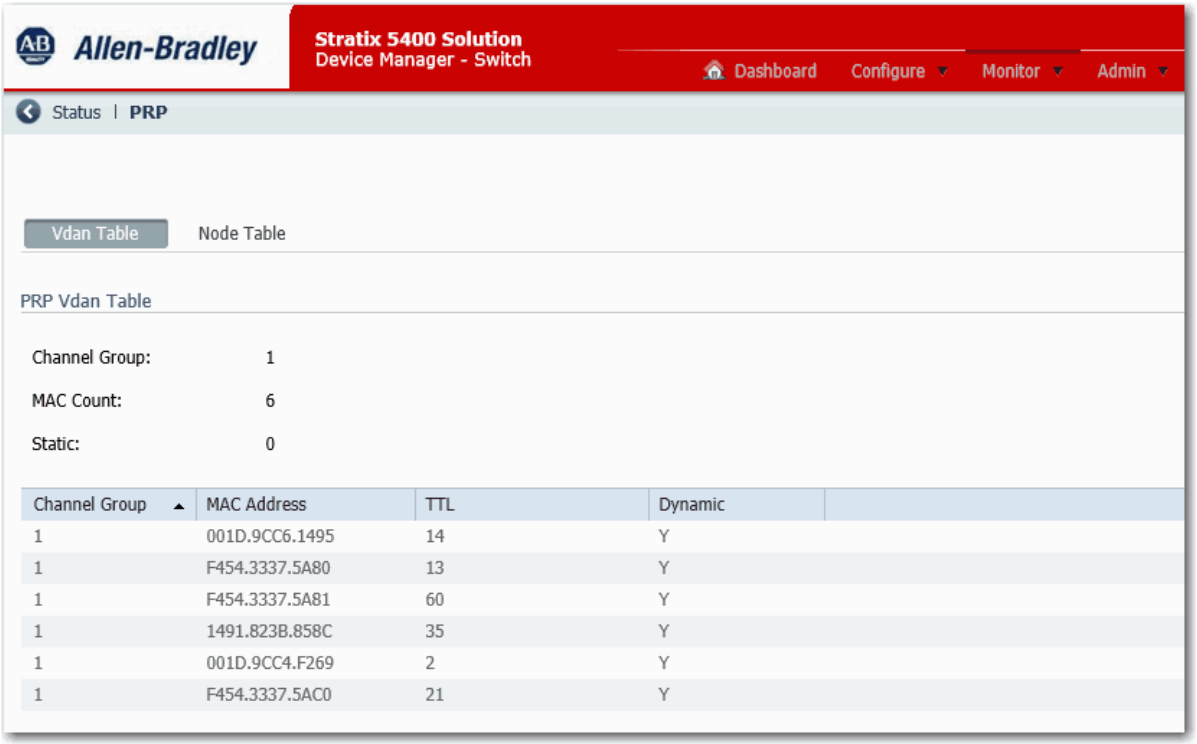


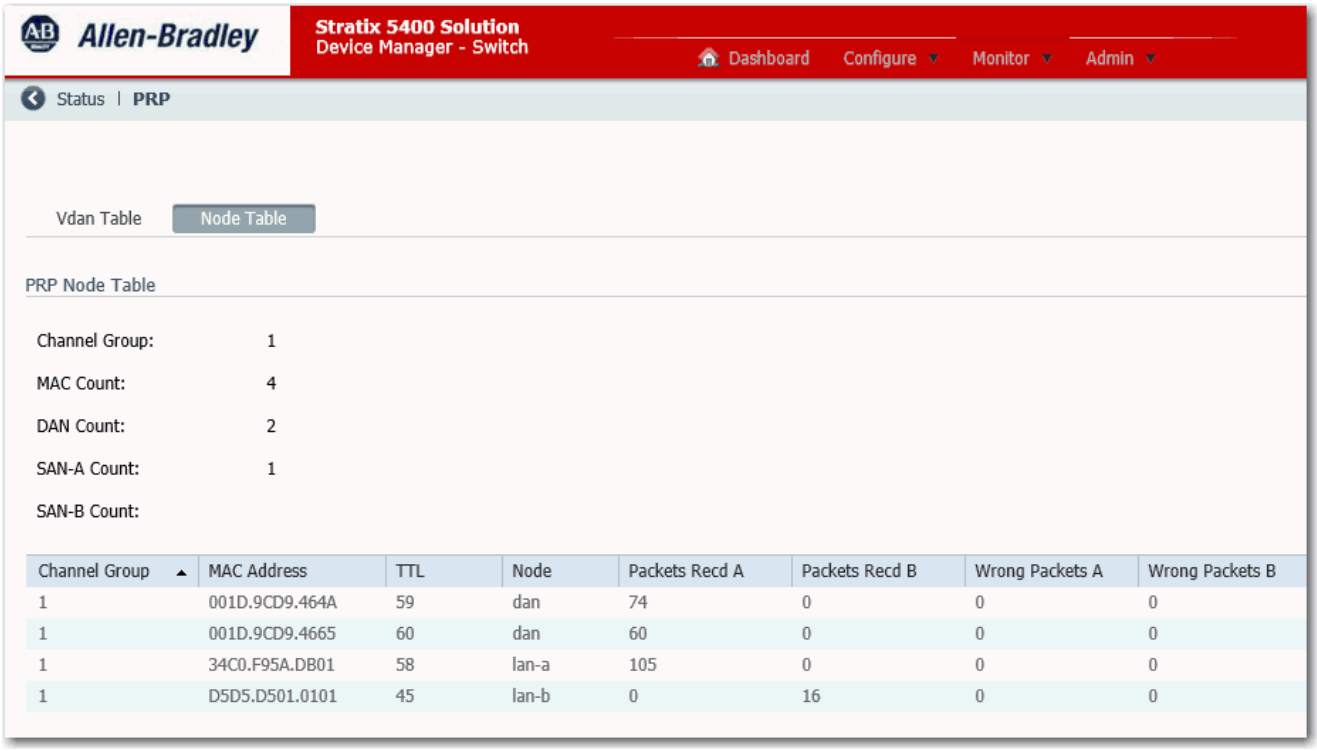
Device	IP Address with Subnet Mask	Port	Connected Device	VLAN
1756-EN2TP	192.168.20.202/24	LAN A	Stratix 5700 switch, LAN A	502
		LAN B	Stratix 5700 switch, LAN B	502



Verify Nodes

Once your PRP network configuration is complete and cables are connected between the devices, the RedBox automatically learns the MAC IDs of connected devices. You can verify and monitor these connected devices in the Device Manager web interface for the RedBox.





Diagnostics

These diagnostic methods are available for a PRP network:

- For a Stratix® 5400 or 5410 switch that is configured as a RedBox, the Device Manager web interface provides statistics for PRP nodes. For more information, see the Stratix Managed Switches User Manual, publication 1783-UM007.
- For a Stratix 5800 switch that is configured as a RedBox, the WebUI provides statistics for PRP nodes. For more information, see the Stratix 5800 Managed Switches User Manual, 1783-UM012.
- For a 1756-EN2TP module operating as a DAN, the diagnostic webpages provide statistics for ports A and B. For more information, see the EtherNet/IP Network Configuration User Manual, publication ENET-UM001.
- For LAN A and LAN B status, you can configure the controller to send a message to the 1756-EN2TP module as described in page 41.

For more diagnostic attributes, see the ODVA documentation at www.odva.org.

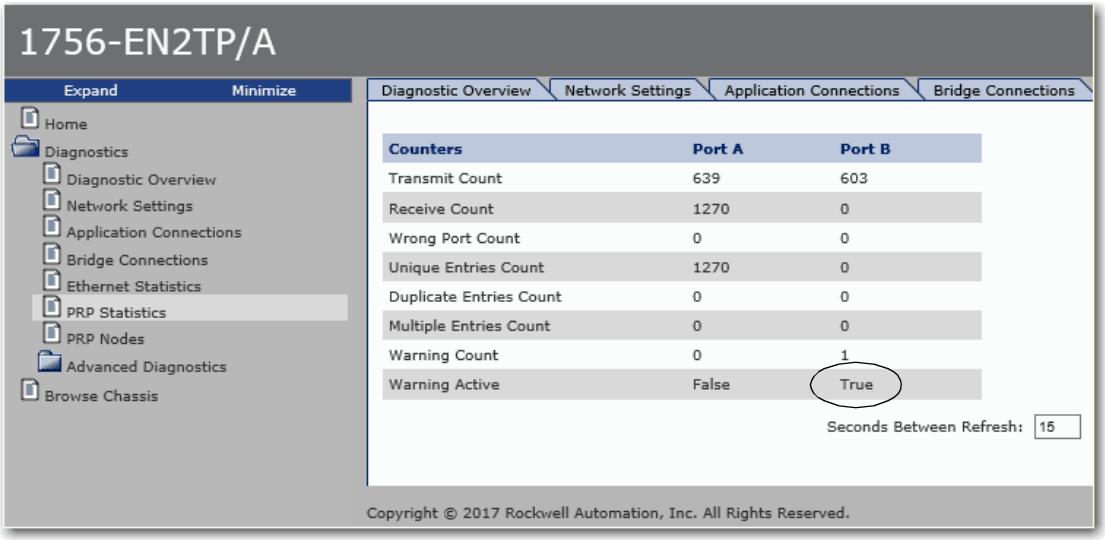
Warning Status for LAN A and LAN B

In the Studio 5000 Logix Designer® application, you can configure a controller message to determine a warning status for these conditions in LAN A and LAN B:

- Loss of communication for 3 seconds on one LAN, but not the other. This condition applies to traffic from all nodes. The condition is cleared once communication is restored for 3 seconds.
- Node status is active on one LAN but not the other. This condition indicates that no packets were received from one of the nodes on one of the LANs for 3 seconds. The condition is cleared once packets are received again within 3 seconds.
- Packets from a wrong LAN were received on one of the ports in the past second. The condition is cleared once no wrong packets are received for 1 second.

IMPORTANT Cycling power to a device can trigger a PRP warning on the network or the device until the connections to all Ethernet ports are re-established and packets are exchanged for 3 seconds.

When the warning status is active for one of the LANs, the Warning Active indicator displays True in the 1756-EN2TP web interface.



To obtain a warning status for LAN A and LAN B, configure a controller message to send to the 1756-EN2TP module. Use the following parameters. The data type for this CIP™ message is DINT.

Field	Parameter
Message Type	CIP Generic
Service Type	Get Attribute Single
Class	56 (Hex)
Instance	1
Attribute	11 (Hex) for LAN A 12 (Hex) for LAN B

Figure 5 - LAN A Warning Message

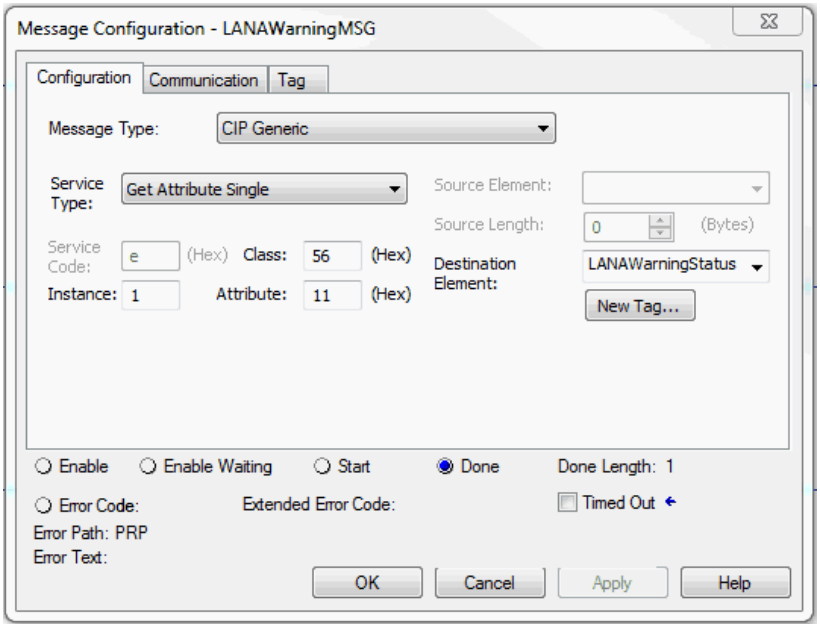
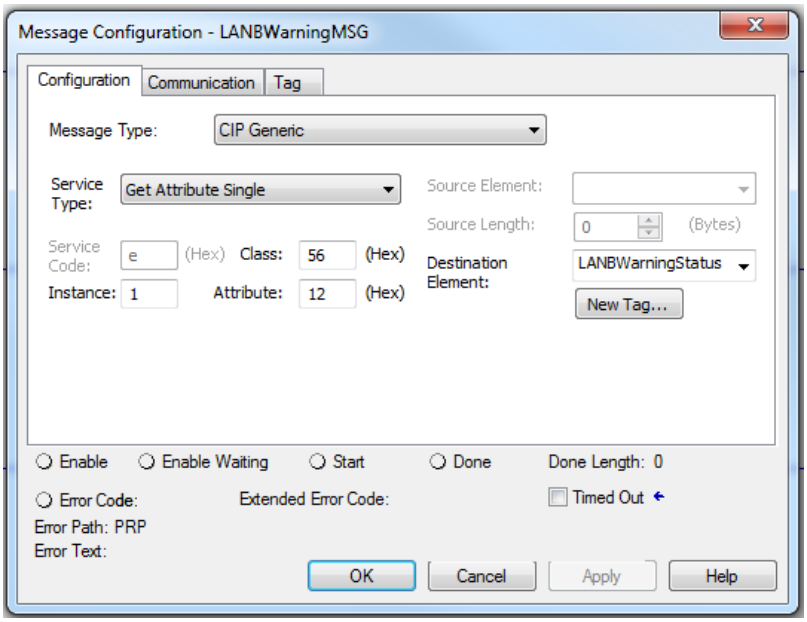


Figure 6 - LAN B Warning Message



Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Stratix Ethernet Device Specifications Technical Data, 1783-TD001	Provides specifications for Stratix® Ethernet switches and other devices.
High Availability Systems Reference Manual, HIGHAV-RM002	Provides guidelines for high availability systems, including redundant system components, networks, and other hardware and software considerations.
Deploying Parallel Redundancy Protocol within a Converged Plantwide Ethernet Architecture, ENET-TD021	Highlights key application requirements, technology, and supporting design considerations to help with the successful design and deployment of specific use cases within the Converged Plantwide Ethernet (CPwE) framework. CPwE PRP was architected, tested, and validated by Cisco® Systems and Rockwell Automation with assistance by Panduit.
EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007	Describes Device Level Ring (DLR) topologies, configuration considerations, and diagnostic methods.
PlantPAx DCS Configuration and Implementation User Manual, publication PROCES-UM100	Provides guidelines and procedures for the implementation and configuration of a PlantPAx® distributed control system, including PRP topologies.
Stratix Managed Switches User Manual, 1783-UM007	Describes how to configure, monitor, and troubleshoot Stratix® 5400, 5410, 5700, 8000, 8300, and ArmorStratix™ 5700 managed switches.
Stratix 5800 Managed Switches User Manual, 1783-UM012	Describes how to configure, monitor, and troubleshoot Stratix 5800 managed switches.
FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005	Provides information on how to configure and operate FLEX 5000 EtherNet/IP adapters.
ControlLogix EtherNet/IP Network Devices User Manual, ENET-UM004	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, publication ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
Troubleshoot EtherNet/IP Networks Application Technique, publication ENET-AT003	Describes troubleshooting techniques for Integrated Architecture products on EtherNet/IP networks.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
EtherNet/IP Media Planning and Installation Manual This manual is available from the Open DeviceNet® Vendor Association (ODVA) at http://www.odva.org.	Describes the required media components for an EtherNet/IP network and how to plan, install, verify, troubleshoot, and certify your network.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general installation guidelines for a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

Rockwell Otomasyon Ticaret A.Ş. Kar Plaza İş Merkezi E Blok Kat:6 34752, İçerenköy, İstanbul, Tel: +90 (216) 5698400 EEE Yönetmeliğine Uygundur

Connect with us.

rockwellautomation.com — expanding **human possibility**®

AMERICAS: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
EUROPE/MIDDLE EAST/AFRICA: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
ASIA PACIFIC: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication ENET-AT006D-EN-P - August 2021
ENET-AT006C-EN-P - April 2019