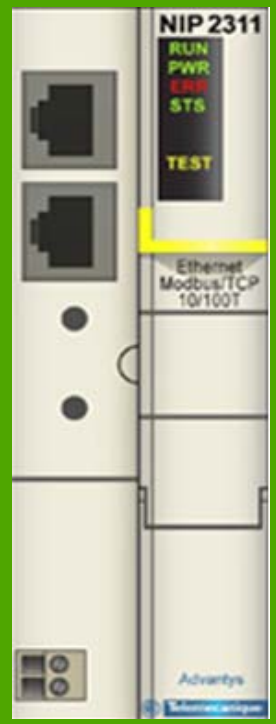
Dual Port STB Connectivity

STB NIP 2311

July 2010

Technical Note on Ethernet Topologies using the
STB NIP 2311 v3.0



Schneider Electric

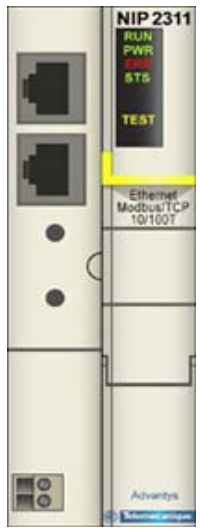
Contents

Contents

STB NIP 2311

The NEWest module for the STB Family

- A ***NEW*** DIO Network Interface Module for the STB family that provides dual-port Ethernet Modbus TCP/IP connectivity
- Supports network topologies that include star, daisy-chain and daisy-chain loop (or ring)
- Reduces media costs and increases design flexibility
- Provides robust connectivity options for complex system architectures



Contents

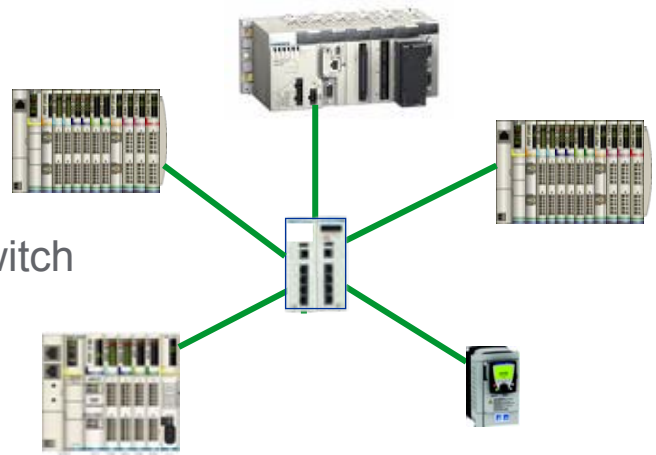
STAR Topology

Fundamental operation

- Each device connects to a central connection point on the network

- Advantages:
  - Easy to install and wire
  - No disruptions to the network when connecting or removing devices
  - Easy to expand and troubleshoot

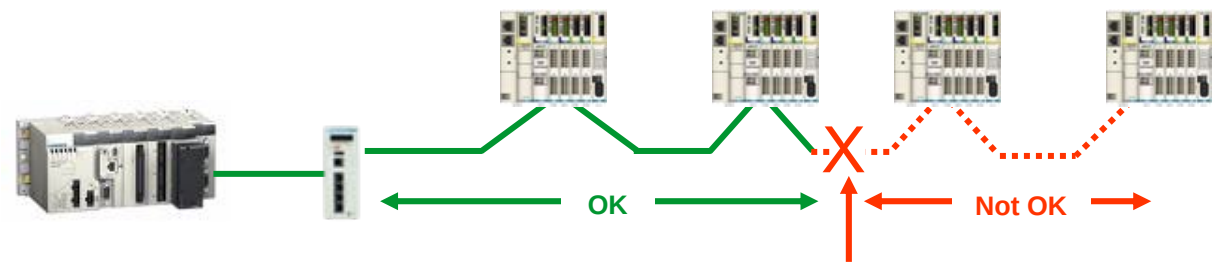
- Disadvantages:
  - Requires more cable length than other topologies
  - The health of the entire network depends on the switch



Daisy Chain Topology

Fundamental operation

- Devices are connected in a bus. Each device connects to its neighbour
  - Up to 32 devices can be connected
  - Can be used with a managed or an unmanaged ConneXium switch
- Advantages:
  - Scalability - Easy to add on STB and other dual port devices
  - Reduced infrastructure costs
- Disadvantages:
  - A cable break or a power loss for a device on the bus results in loss of communications for all downstream devices



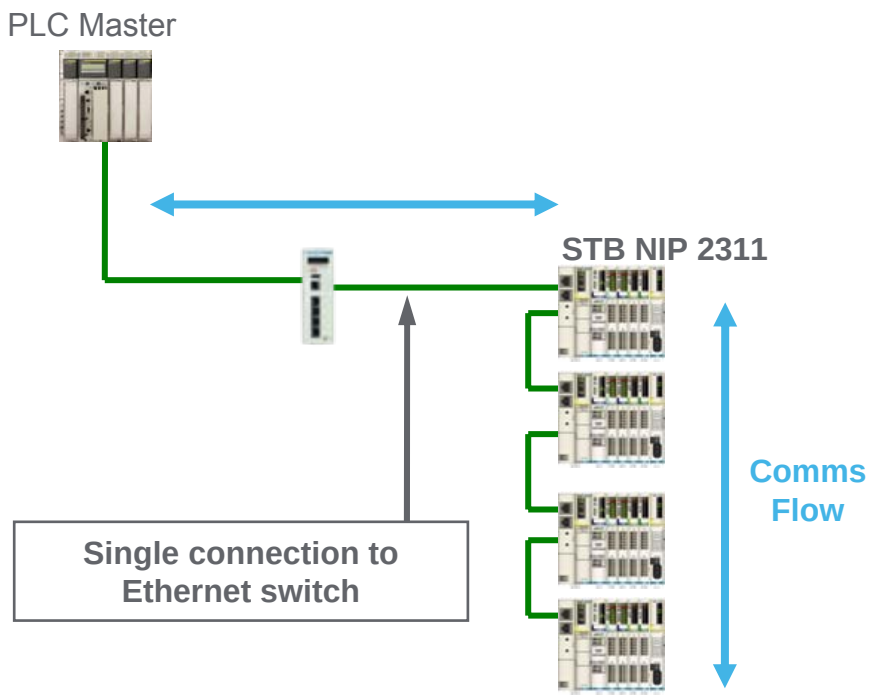
Note

A cable failure in the bus will interrupt communication to devices downstream in the chain.

Daisy Chain Topology

Simple architecture and design

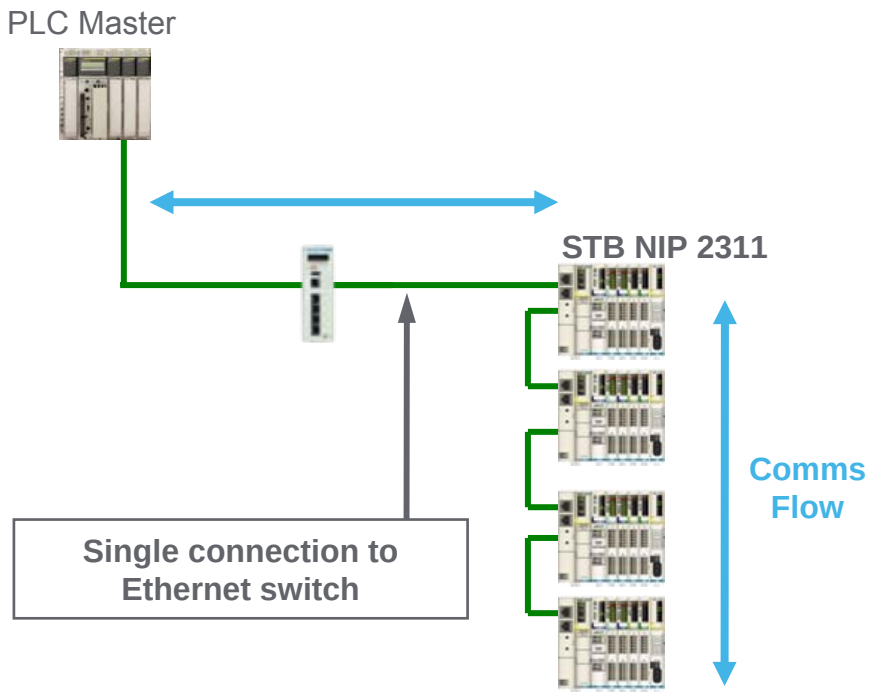
- Reduce media costs and increase design flexibility for competitive, non critical operations
- Use just 1 port connection to a single ConneXium Ethernet switch
- Bus topology offers no redundancy with cable break in the bus
- Can use low cost, unmanaged ConneXium switches



Daisy Chain Topology

Performance considerations

- Data flows from the PLC master through each of the daisy chain devices
- Each device introduces a forwarding delay when data passes through it
- The end devices in the daisy chain will experience the most delay in receiving the messages, the sum of the forwarding delays of all devices in the chain
- Note the ConneXium switch forwarding delay is 38 microseconds. The STB dual port device introduces a delay of 15 microseconds
- For other devices in the daisy chain, please refer to their documentation for the exact forwarding delays

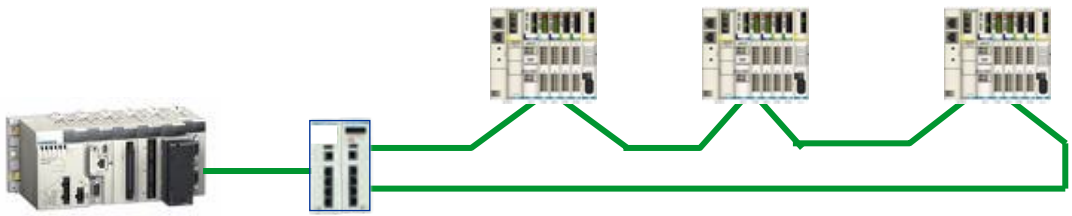


Contents

Ring Topology using Redundancy Manager

Fundamental operation

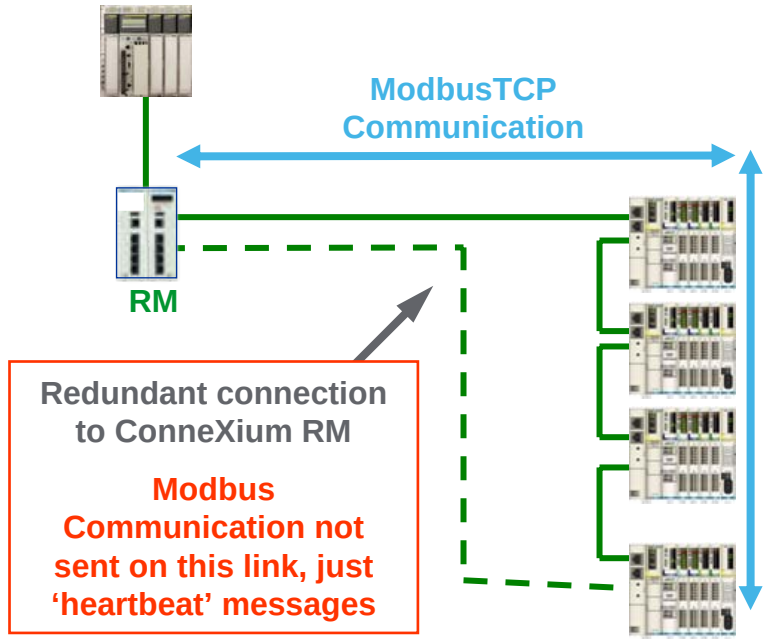
- Devices are connected in a loop or a ring. One port of the device gets connected to one port of the second device and the loop gets closed at the switch
  - Up to 32 devices can be connected
  - Must be used with a ConneXium managed switch to maintain an unbroken loop
- Advantages:
  - Provides scalability (Easy to add STB and other dual port devices)
  - Reduces infrastructure costs (less wiring, fewer switches)
  - Provides higher availability in the case of cable breaks or inoperable devices
- Disadvantages:
  - Switches need to be properly configured to ensure the ring's functionality



Ring Topology using Redundancy Manager

Increase availability

- The daisy chain loop ***must*** connect to ConneXium TCSEM managed Ethernet switch with a redundancy protocol, HIPER Ring or MRP
- One switch in the loop must be configured as a Redundancy Manager (RM)
- Maximum 32 devices in the loop including the switches. Devices do not have any redundancy protocol in them
- Connect only passive or client devices in the loop. The PLC controller must be outside the daisy chain loop
- The redundant switch link does not forward communications unless a break is detected

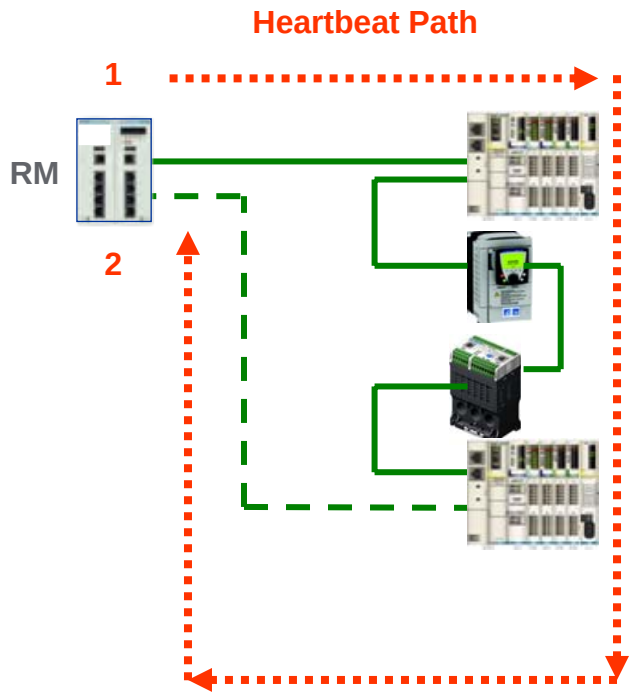


- 'Heartbeat' messages are sent on the daisy chain loop to verify Loop integrity

Media Redundancy

Theory of operation

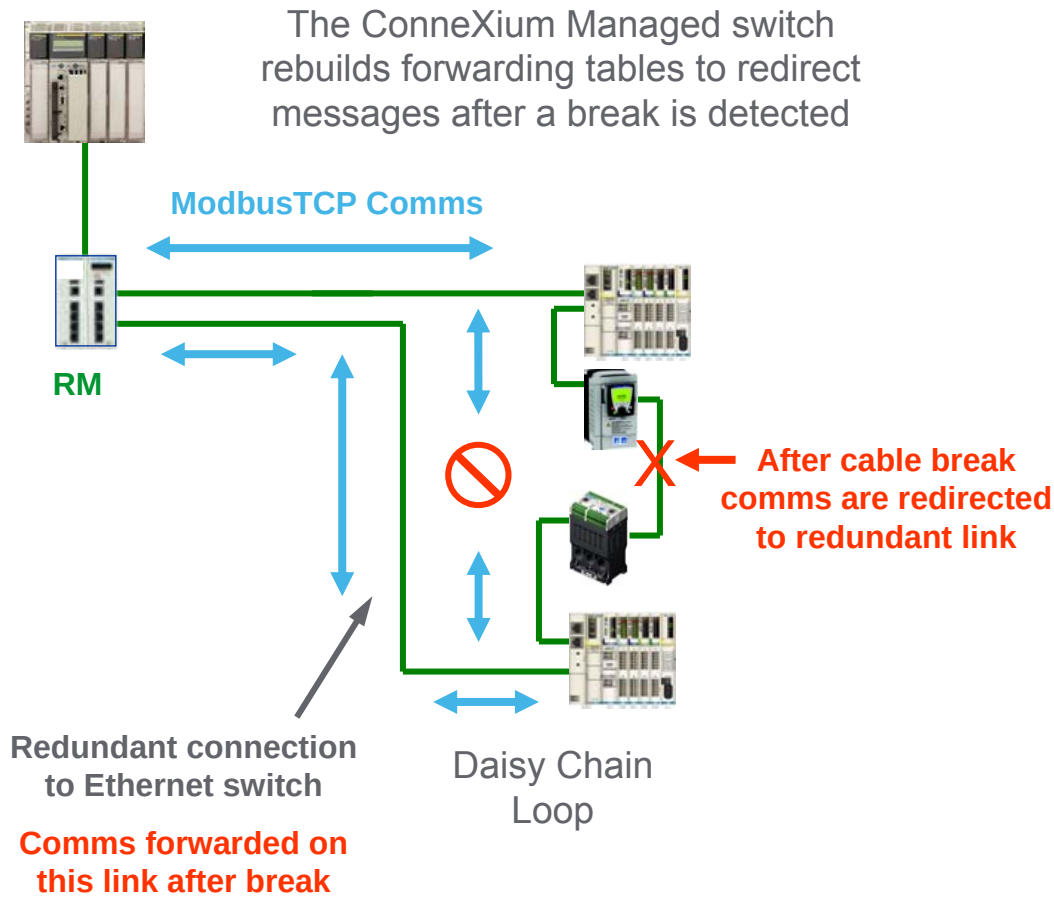
- **Only 1 switch per loop** can be configured as the Redundancy Manager
- Use the two ports on redundancy manager that are configured for redundancy
- The Redundancy Manager sends out a heartbeat packet on port 1 and waits for the packet to return on port 2
- If the heartbeat packet is not received on port 2, the switch assumes a break in the network and begins forwarding communication on the redundant link around the break
- The Redundancy Manager will continue to send heartbeat messages to detect when the broken cable has been restored, then revert back to standard operation
- The loop can recover only if there is one break. When multiple breaks occur, it will not be possible to recover communication to all devices in the loop



Ring Topology using Redundancy Manager

Network & Application recovery

- After a cable break or a disconnected device in the loop, the switch detects the condition and redirects communications
- The network recovery time (time it takes for the network to become available after a failure detection) is typically less than one second for the recommended configurations
- Impact on application response time will vary depending on the system, and is a function of many parameters independent from the loop (PLC type, versions, etc…).



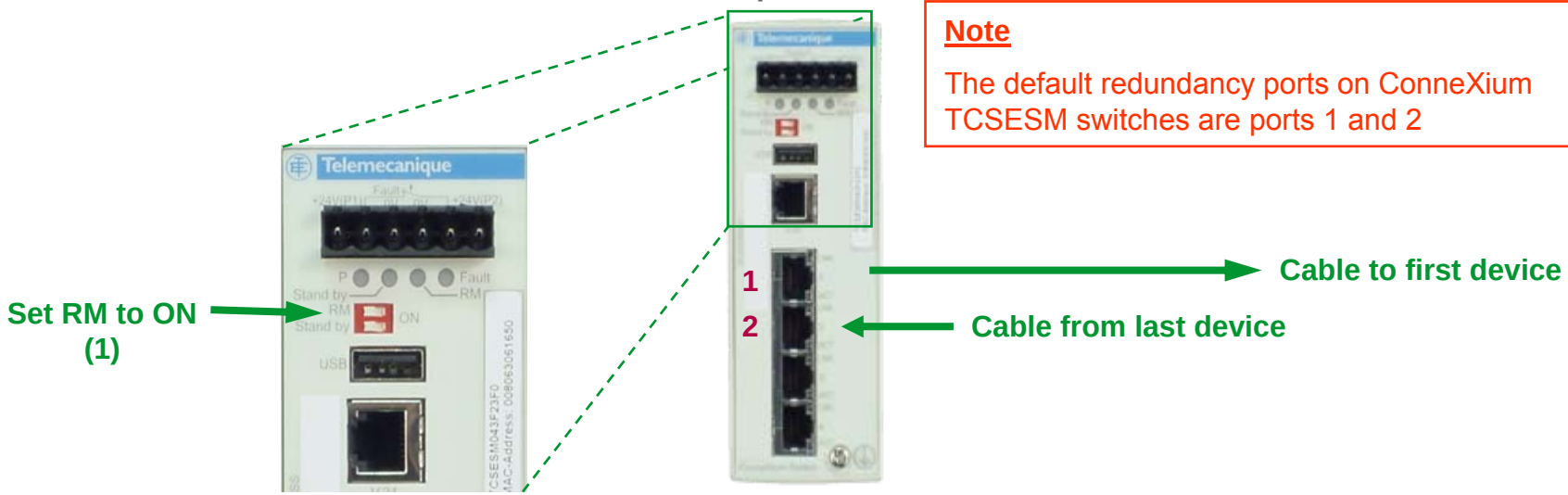
Ring Topology using Redundancy Manager

Configuration of the Redundancy Manager

- ConneXium TCSESM switches are recommended for use in daisy chain with loop configurations
- ConneXium TCSESM switches can be used with HIPER-ring or MRP redundancy ring protocols in the daisy chain with loop system
  - Default configuration for the switches is HIPER-ring.
    - oSimple to setup
  - Use MRP for
    - oImproved network recovery
    - oSupport for advanced architectures like dual ring
    - oSoftware configuration required for setup
- The devices at each end of the loop, connecting to the switch must be set for 100MB, full duplex and manual

Basic Switch Configuration

- Step 1
  - **Set the Redundancy Manager (RM) and Standby DIP switch on the ConneXium switch to ON.**
- Step 2
  - **Connect the first device in the loop to ConneXium switch port #1**
- Step 3
  - **Cable first device and other dual port devices together in serial fashion**
- Step 4
  - **Connect the last device to ConneXium switch port #2**

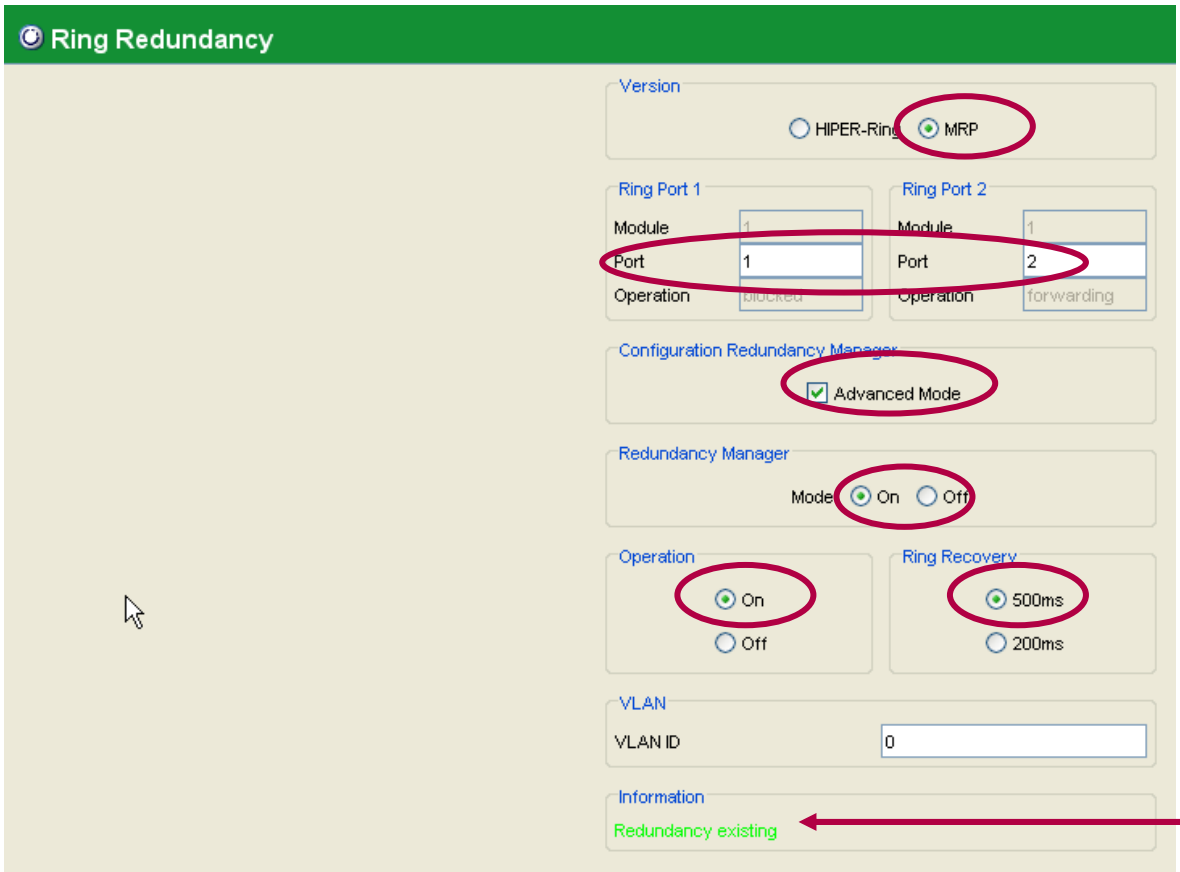


Note

The default redundancy ports on ConneXium TCSESM switches are ports 1 and 2

Configuring the switch for MRP

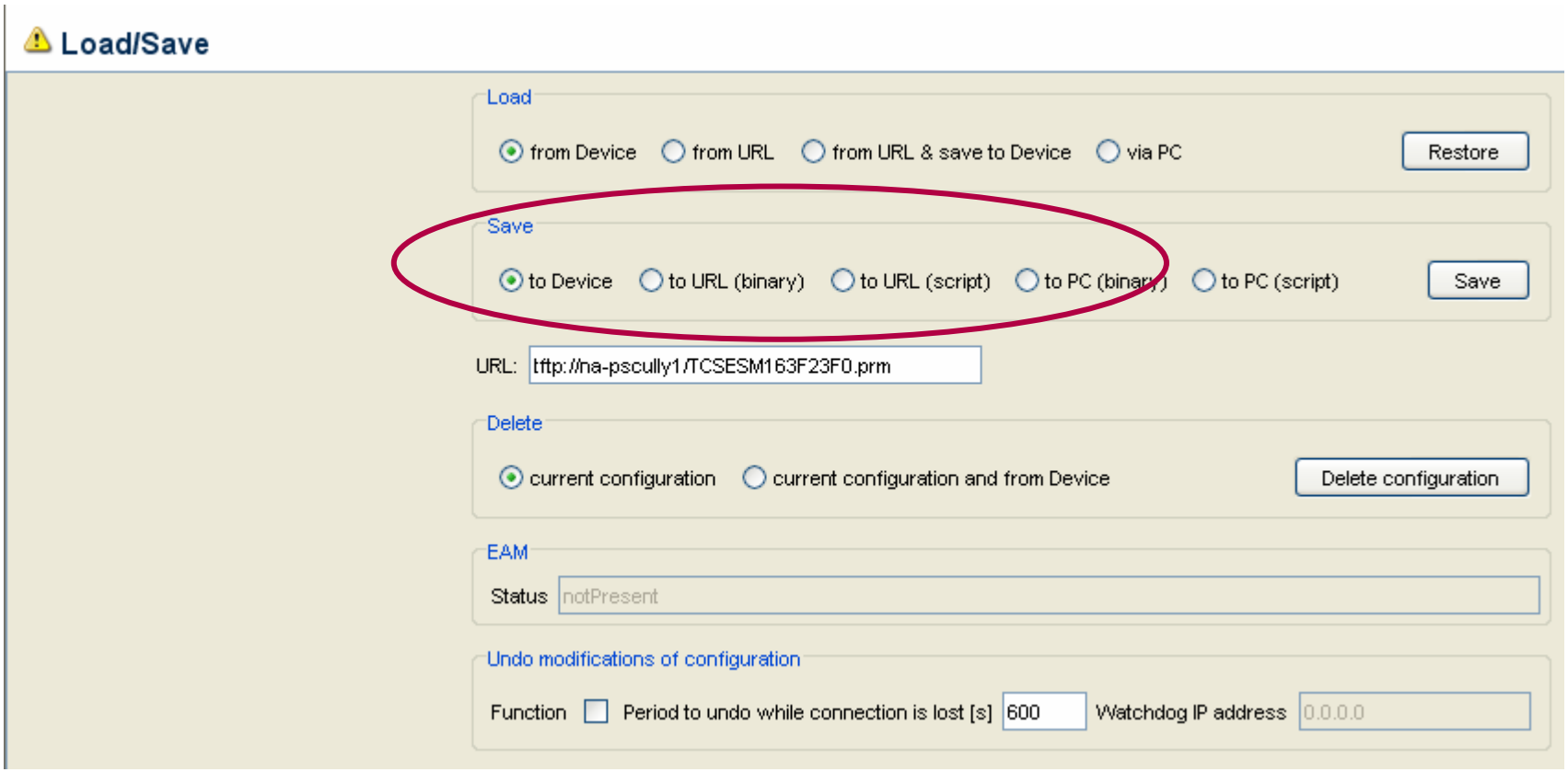
- Before starting the ring configuration, be sure that the physical ring is NOT connected
- Set the Ring Redundancy page as shown below
- Set the Redundancy Manager (RM) and Standby DIP switch on the ConneXium switch to ON



After connecting the physical ring, this will appear

Configuring the switch for MRP

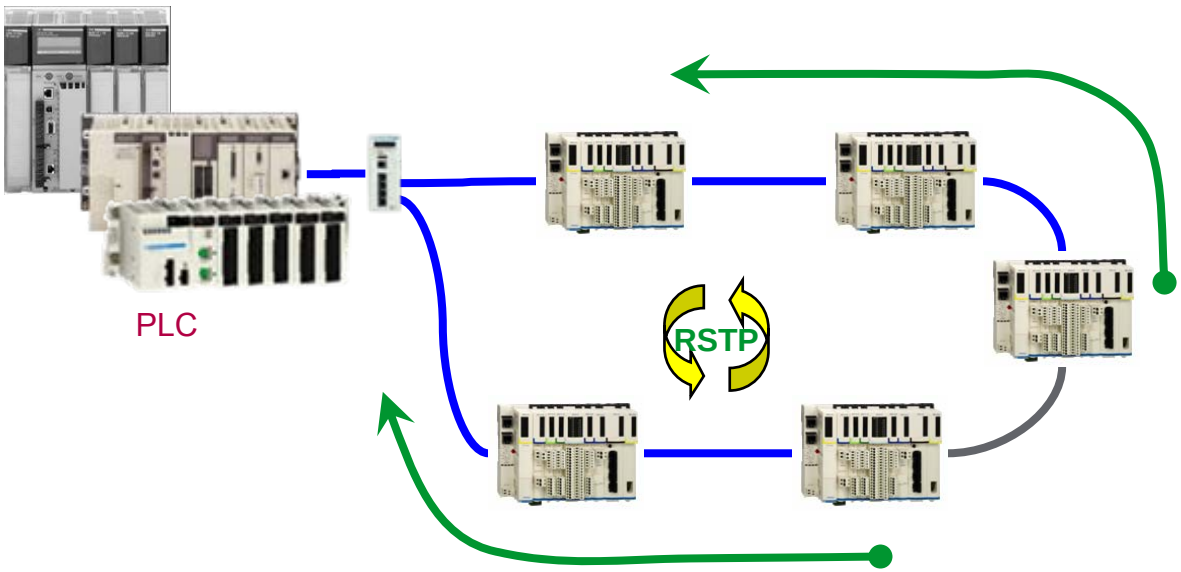
- Be sure to save the settings in the ConneXium switch



Contents

Ring Topology using RSTP

Fundamental operation



Loop detection

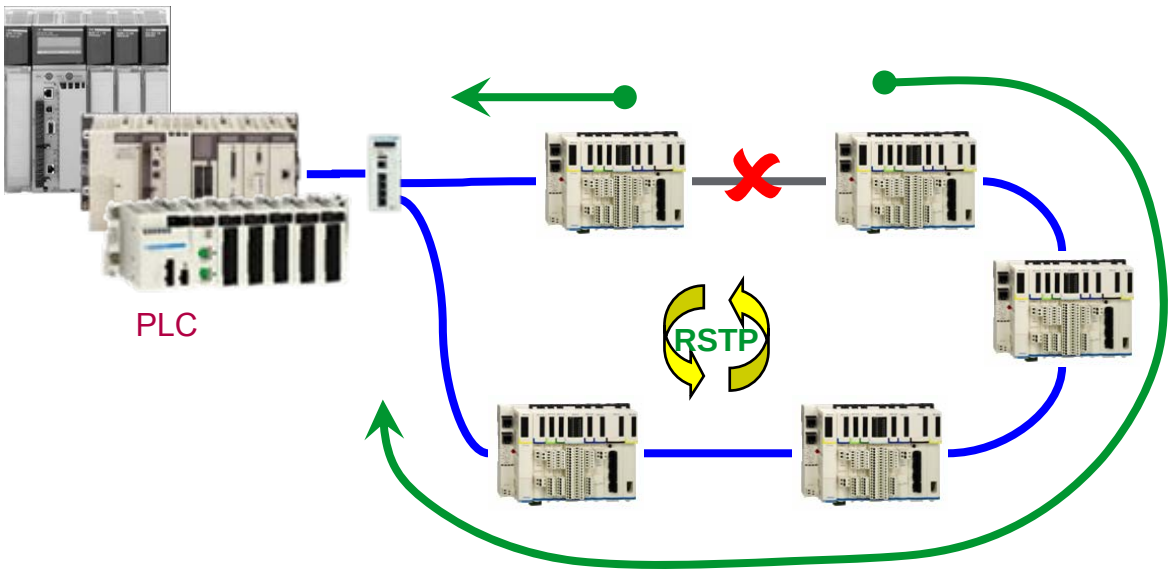
RSTP-enabled devices detect the presence of a loop

Topology definition

Optimal paths are chosen to serve all nodes

Ring Topology using RSTP

Fundamental operation



Loop detection

RSTP-enabled devices detect the presence of a loop

Topology definition

Optimal paths are chosen to serve all nodes

Failure Detection

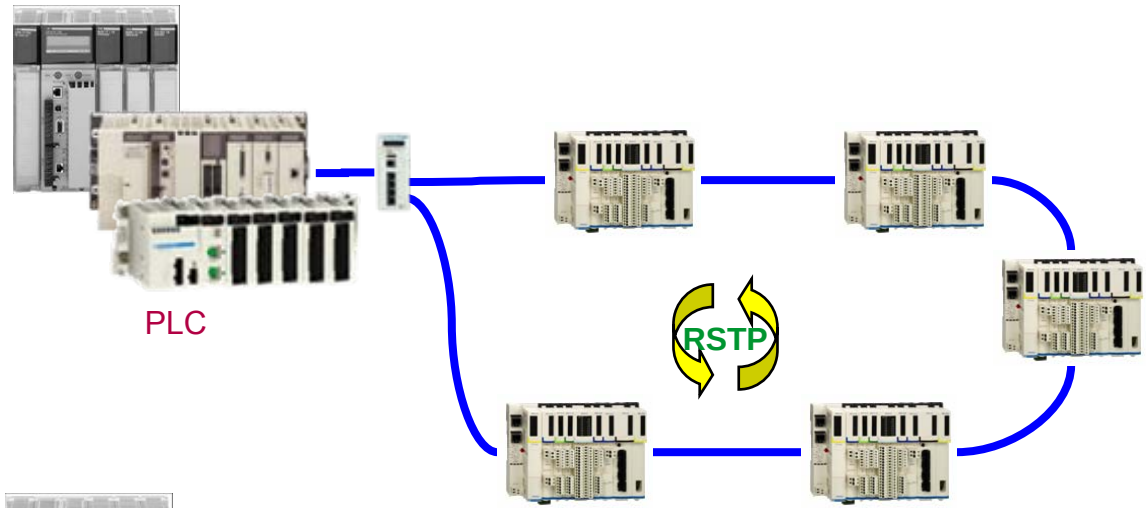
Path interruption is detected and communicated to nodes

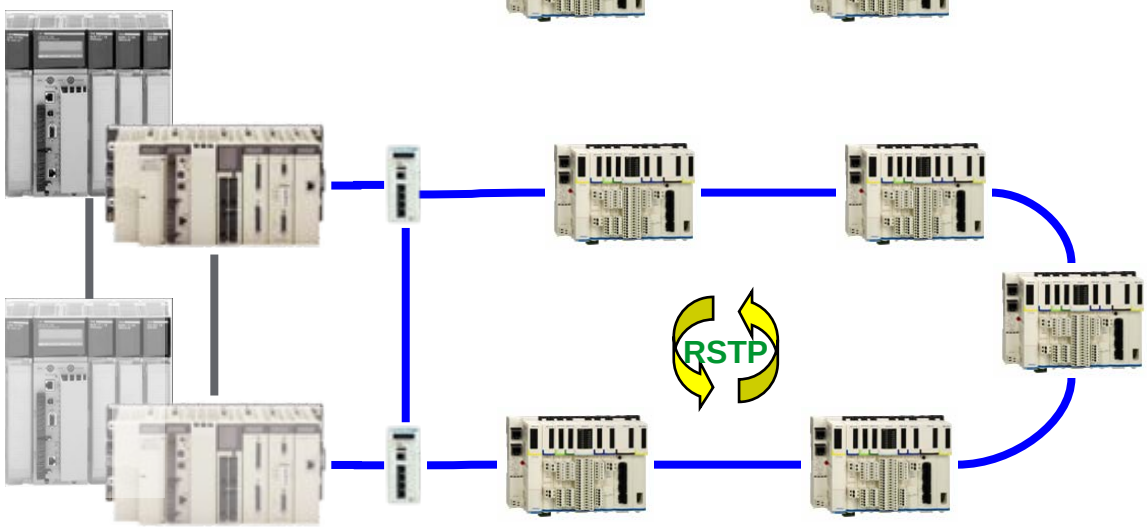
Topology re-establishment

New optimal paths are chosen to serve all nodes

Switch-based architectures

Performance considerations





Quantum or Premium
Hot Stand-by System

ConneXium Switches

Use TCSESMxxx or TCSESMxxx-E switches

Recovery performance

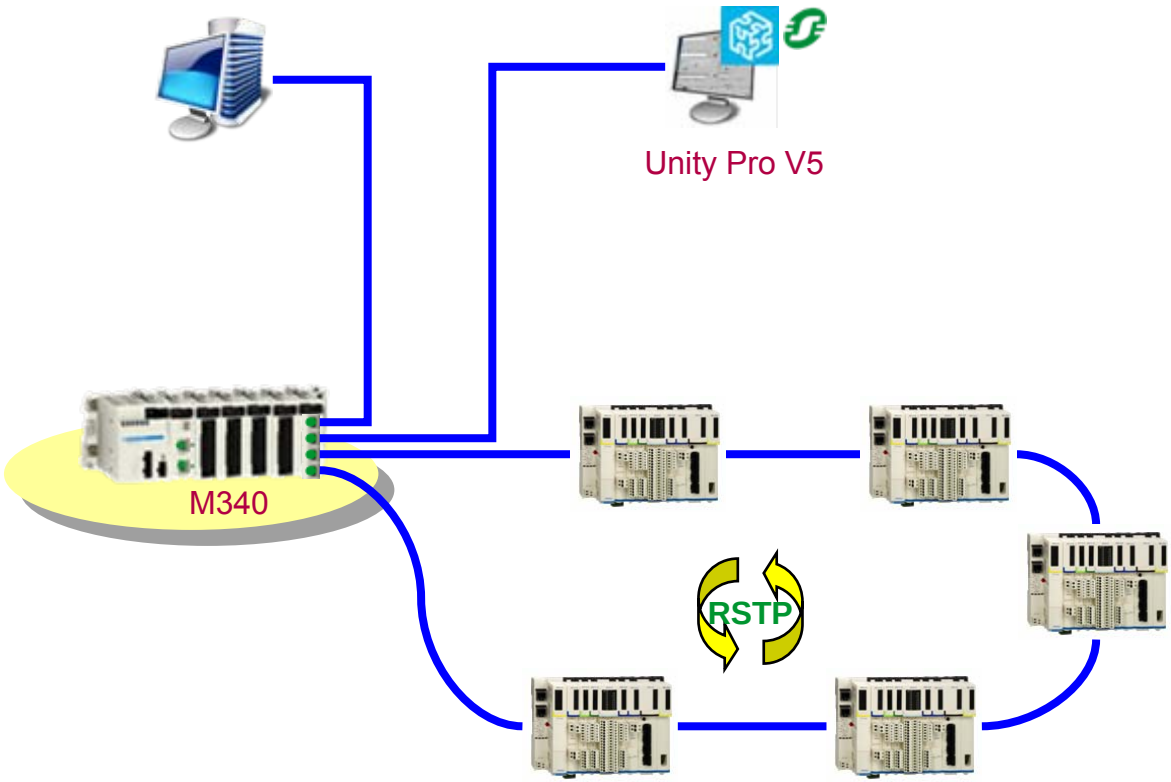
Network recovery*:

- 50ms for 32-node ring of STB NIP 2311 and up to 2 ConneXium switches
- 50ms for 16-node ring of STB NIP 2311 and more than 2 ConneXium switches

**Performance will vary under different conditions*

M340-based architectures

Performance considerations



New M340 NOC module:

- EtherNet/IP and Modbus TCP simultaneously
- Multiple ports
- 2 ports support RSTP

Recovery performance:

Network Recovery*:

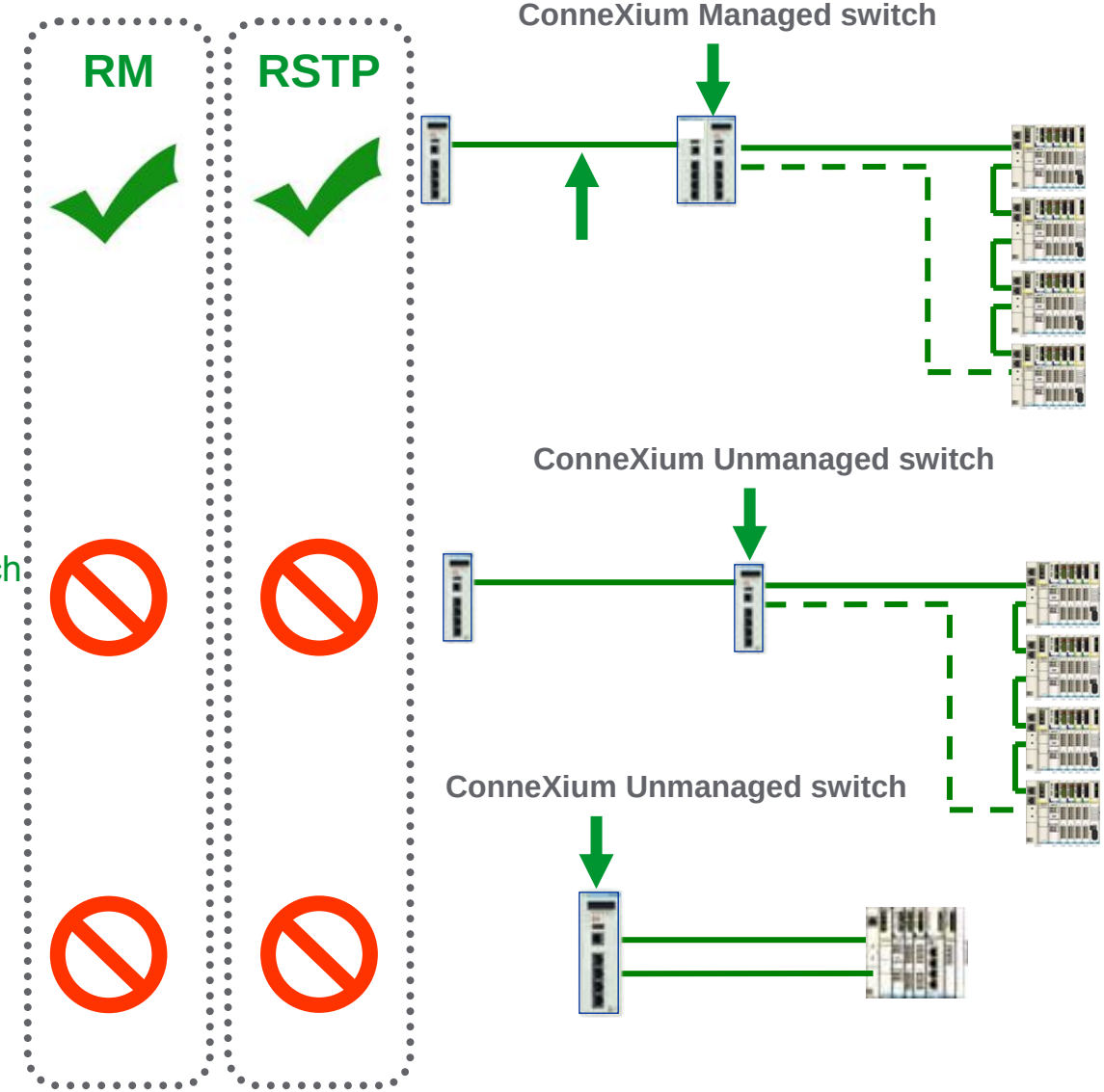
50ms for 32-node ring of M340 NOCs and STB NIP 2311 NIMs

**Performance will vary under different conditions*

Contents

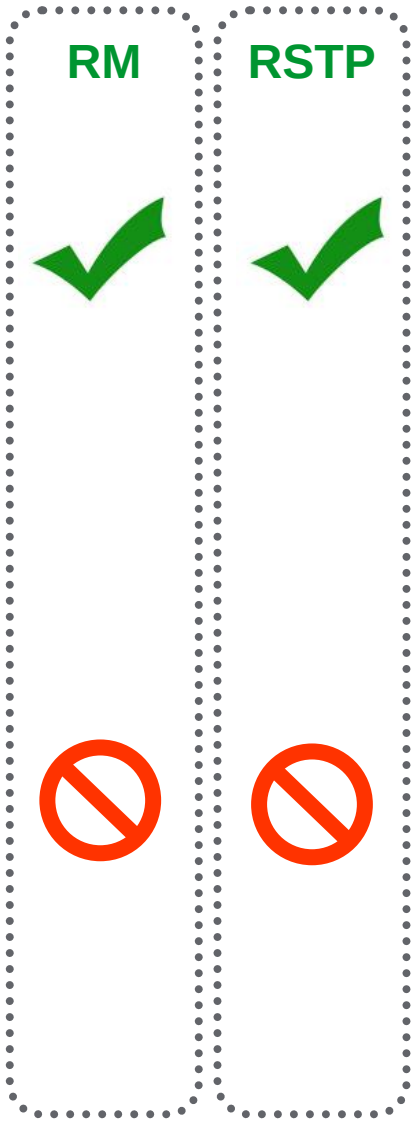
Topology Guidelines

- Single connection from Daisy Chain loop to the rest of the network
- Using an UN-Managed switch with a Daisy Chain loop
- Multiple connections from the same dual port device to the same **unmanaged** switch

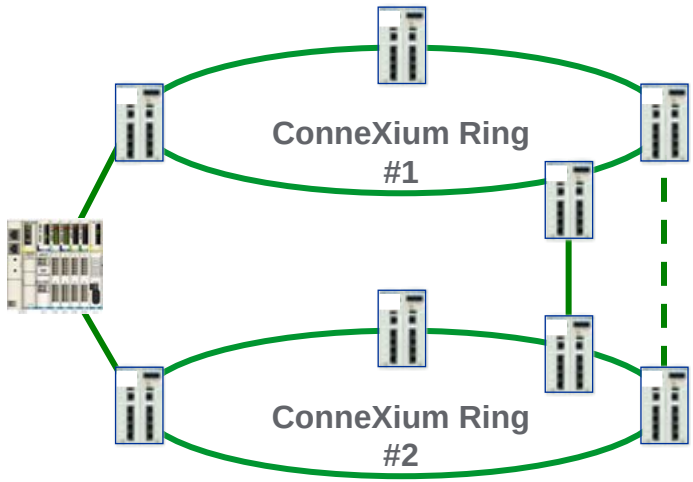


Topology Guidelines

- Multiple connections from the same dual port device to the same **managed** switch



- Multiple connections from the same dual port device to different ConneXium HIPER-Rings



Do’s and Don’ts

- DO assign IP parameters using the Advantys Configuration Software (ACS). These parameters can then be saved to a SIM card for use in the event of a faulty device replacement (FDR)

- DO assign IP parameters to a new NIM through the serial port. This avoids the need for a BOOTP/DHCP server or using the MAC derived address

- If you are using I/O Scanner in Unity Pro, DO launch the ACS from within Unity to configure an STB island after an IP address has been assigned. This ensures island sizes are correctly calculated and user defined labels can be inserted as symbols into your Unity project

Contents

FAQ's

Q. What is the advantage of Daisy Chain Loop or ring topology?

A. In a daisy chain loop configuration, devices are connected to form a loop or a ring. It does reduce the infrastructure cost when compared with a star topology. It also provides higher availability of other devices in case of a cable break or an inoperable device.

Q. Can I use RSTP instead of HIPER-Ring in the daisy chain loop?

A. Yes, version 3.0 of the STB NIP 2311 supports RSTP. All nodes of the ring must also have RSTP enabled.

Q. How many devices from a daisy chain loop can I remove from service without disrupting other devices?

A. You can have a maximum of 32 devices in a daisy chain loop configuration including any switches in the loop. Any number of devices can be removed as long as they are consecutive nodes without affecting connectivity to the remaining devices.

FAQ's

Q. Which ConneXium switch part numbers can be used to manage the Daisy Chain Loop?

A. ConneXium TCSESM model switches with firmware 4.1 or greater are recommended due to the redundancy options available.

Q. Do I need a managed switch for a Daisy Chain Bus?

A. No, if the topology is a straight bus, any switch, managed or unmanaged can be used.

FAQ’s

Q. How can I tell if my ConneXium switch is a managed switch?

A. All switches from the TCSESM series of ConneXium switches are managed switches.

Q. What is the easiest way to configure an IP address in a ConneXium managed switch?

A. Schneider recommends using the Ethernet Switch Configurator which is available on the CD shipped with all ConneXium managed switches. You can also obtain the latest version on the Schneider Electric web site.

FAQ's

Q. What is the typical recovery time if communications are lost in a HIPER-ring or MRP enabled ring?

A. During the removal or replacement of single cable or device in the loop, the typical maximum network recovery time is less than 3 seconds.

Q. What is the typical recovery time if communications are lost in an RSTP enabled ring?

A. During the removal or replacement of single cable or device in the loop, the typical maximum network recovery time is less than 50ms.

FAQ's

Q. What will be the recovery time if I need to replace a device in the loop?

A. This can be affected by many factors as your device MAC ID has changed. Testing of your particular installation is recommended.

Q. Can I use a Concept or Proworx Ethernet Scanner with the new STB dual port NIM?

A. Yes, you can use Unity, Concept, PL7 or ProWORX configured Ethernet I/O Scanners.

Q. What families of PLC scanners have been tested with STBNIP2311?

A. Quantum, Premium, M340 and Momentum Ethernet scanners have been tested.

FAQ's

Q. Can I use managed switches from other vendors?

A. We have tested the configurations with TCSESM ConneXium line of switches only. Please contact your switch vendor for information regarding daisy chain operation.

Q. Can I use unshielded Ethernet cable?

A. Yes, you can use unshielded twisted pair cable. However, for high EMC or high noise environments, shielded cable is recommended.

Q. Which ConneXium switches support MRP?

A. TCSESM ConneXium switches with a firmware version 4.1 or greater support the MRP protocol.

Q. Which ConneXium switches support RSTP?

A. TCSESM ConneXium switches with a firmware version 4.1 or greater support the RSTP protocol.

FAQ's

Q. Why do I have to set the ConneXium ring ports manually to 100Mbit/s FDX when using HIPER-Ring or an MRP ring?

A. It is mandatory that ConneXium ring ports be set to 100MB Full duplex manual

Q. Does this mean that all devices within the ring should be manually set to 100Mbit/s FDX?

A. Yes, in order to comply with the requirements of either the HIPER-Ring or MRP ring configurations, the devices connected to the ConneXium ring ports should be manually set to 100 FDX.

Q. Why is it I see an External Failure – check fieldbus connection In the ACS log window even when I'm connected via Ethernet?

A. Both ports must be connected to keep this message from appearing in the log window. Also Bit 10 of the Common NIM status bits will be set to 1 showing an External Failure and either bit 4 or 5 of the Specific NIM Status Bits will be set to 1 to indicate which port has no link.

FAQ's

Q. If I have checked the enable edits checkbox on the Ethernet Parameters page of the ACS can I still change the IP address from the web pages?

A. No, checking this box, saving and downloading the configuration keeps control of the Ethernet parameters in the ACS. Any changes must be made here.

Q. Are the cable length limits between STB devices the same as other Ethernet products?

A. Yes, the maximum cable distance between STB NIP 2311's or other devices is 100m.

FAQ's

Q. Why can't I configure a STB NIP 2311 via the serial port when the Advantys Configuration Software (ACS) is launched from within Unity?

A. Since the ACS is launched from the Ethernet I/O scanner configuration page, it's assumed that the STB NIP 2311 is already assigned an address and the configuration then can be downloaded to the proper STB NIM.

Q. Can I still use the same SIM card to configure an array of identical STB islands?

A. Yes you can, provided you are aware that identical IP parameters will be written to each STB NIP 2311 flash memory if those parameters were configured from within the ACS.

Q. Are configured SIM cards interchangeable between the STB NIP 2212 and the STB NIP 2311?

A. No, if you are replacing an STB NIP 2212 containing a SIM card with an STB NIP 2311, you must use the ACS to reconfigure the island with an STB NIP 2311 and download the new configuration.

Thank you

Schneider Electric