Reliable Industrial Networking with SCALANCE

SIPEC Event

SIEMENS

Instructions and Tips for Presentation / Labs

- Please copy the PDF of this presentation onto the digital desktop of each PG prior to the workshop. In this way, attendees will be able to follow along during the lecture as well as reference during the labs.
- Please print out copies of slide 23 (IP addresses of stations) and slide 80 (Things to Try) for each attendee if it makes sense – alternatively the attendees can rely on the digital version on the PG desktop.
- The lecture material has a gray background in the header. The labs have a tan background in the header. The entire deck with labs is targeted at 4 – 5 hours.
- There are speaker notes for all the lecture slides. The labs are detailed step by step, so only a brief introduction to each lab is required. There is no intention that the presenter must comment on each lab slide.
- Prior to each lecture and lab section, the agenda slide is inserted, and the forthcoming section is highlighted in bold.
- The presentation is prepared and marked as “Unrestricted” so it can be shared with the attendees
- The last section (Network Monitoring) is optional, and the slides are hidden by default.

Agenda

1	**Introduction - Network Concepts**
2	Comparing Office and Industrial Networks
3	Portfolio Overview
4	Hands On • Setup and Pre-work • PRONETA • Switch Diagnostics and Best Practices ✓ Information Folder ✓ System Folder ✓ Layer 2 Folder • Configuring a redundant ring • Coupling redundant rings
5	Interconnecting to IT – Passive Listening
6	Review Network Monitoring (Optional)

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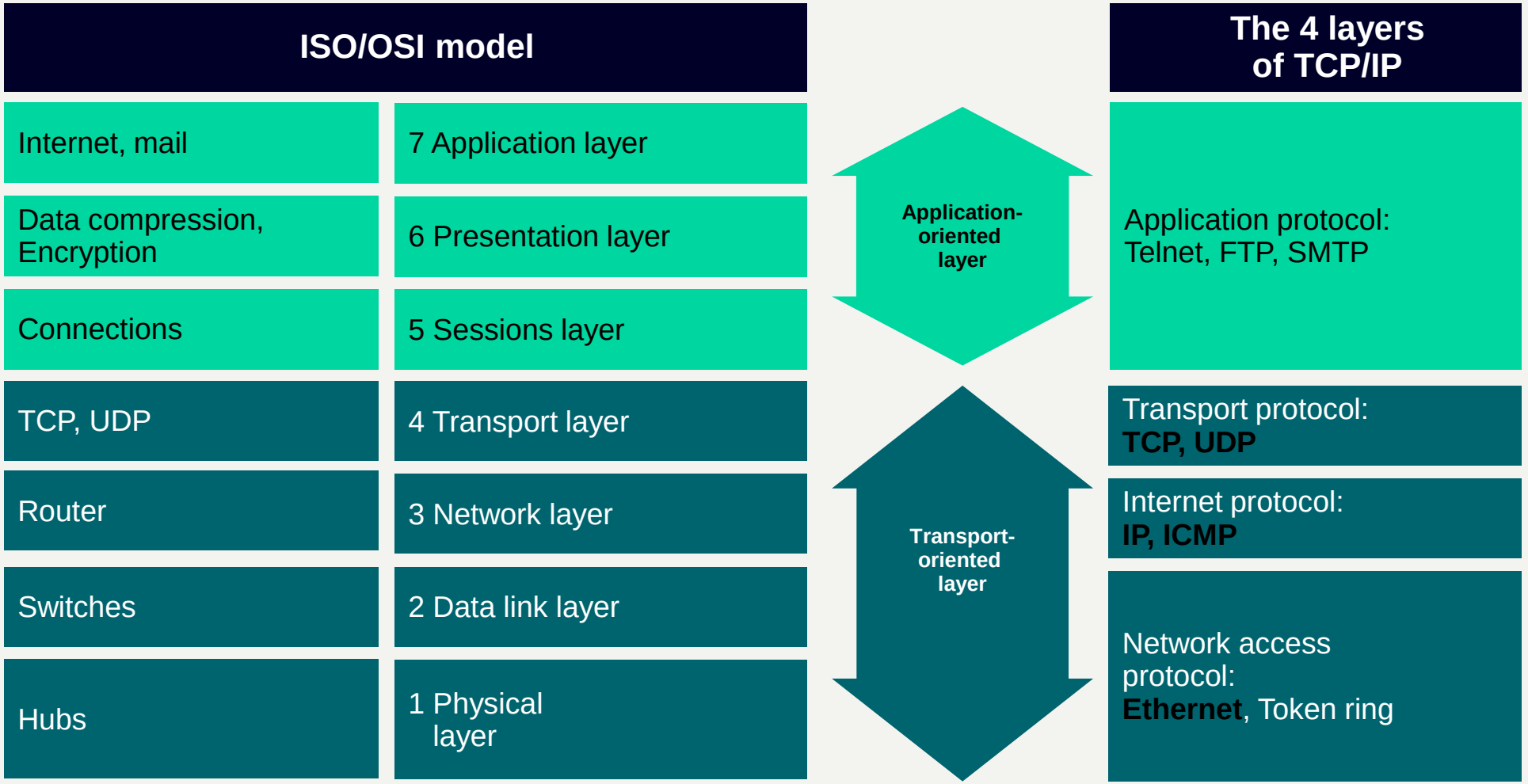
Network Concepts – OSI Model



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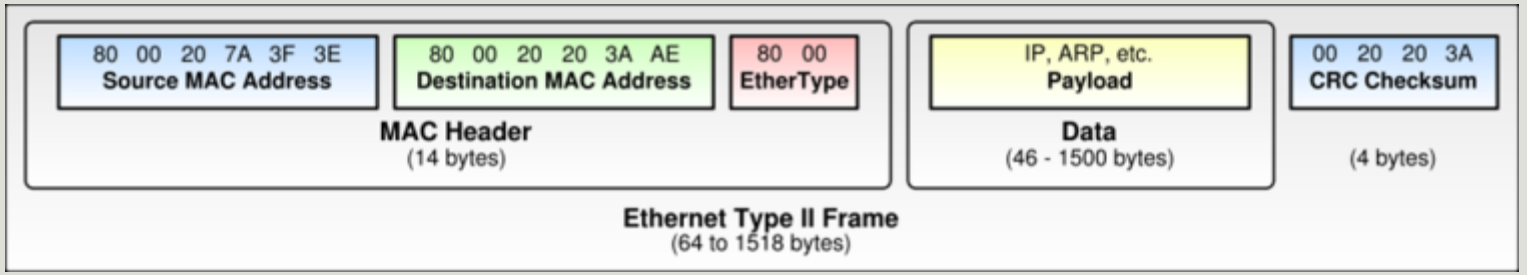
Network Basics – MAC Addressing and the Ethernet frame

- Network Adapter can be a network card in the PC, Switch, Router, S7-Ethernet CP, S7-PN-CPU,…..
- Each Network Adapter has a globally unique address called the MAC address (Media Access Control).
- The MAC address is made up of 6 Bytes which are used to send and receive packets. The first three bytes are the vendor ID (OUI) and the last three bytes are unique to the device. e.g. 08-00-06-6F-F1-59
- Siemens has nearly 50 OUIs. Common ones amongst networking and automation products are “**08-00-06**-xx-xx-xx”, “**00-1B-1B**-xx-xx-xx”, and “**20-87-56**-xx-xx-xx”.
- Every Ethernet frame has a field for source and destination MAC address



Network Basics
IP Addressing

	Decimal	Binary
Network Address	192.168.52.0	11000000.10101000.00110100.00000000
Subnet Mask	255.255.255.0	11111111.11111111.11111111.00000000

- 32 Bit IPv4 address is defined in 4 decimal digits (0..255) which are separated with a dot, i.e. 141.73.4.238
- A subnet mask is defined for every IP address. The subnet mask is also like the IP address, a 32-bit value.
- A device can only communicate directly with another device on the same subnet.
- IP Network Classes include:
  - Class A: 1.0 - 127.0 up to 16 Mio. hosts
  - Class B: 128.0 - 191.255 up to 65.000 hosts
  - Class C: 192.0 - 223.255.255 254 hosts
- Each Host within a network has a unique IP-Address

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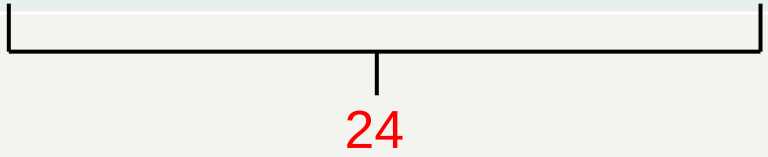
Networking Basics
Subnetting Example #1

This table shows a standard Class C network address that is NOT subnetted.

	Decimal	Binary
Host Address	192.168.52.2	11000000.10101000.00110100.00000010
Subnet Mask	255.255.255.0	11111111.11111111.11111111.00000000



Resulting network address with subnet mask expressed as prefix length: 192.168.52.0/24

Parameters of this network:

- Network Address: 192.168.52.0
- Subnet Mask: 255.255.255.0
- Number of available host addresses: 256 – 2 = 254
- First host address: 192.168.52.1
- Last host address: 192.168.52.254
- Broadcast address: 192.168.52.255

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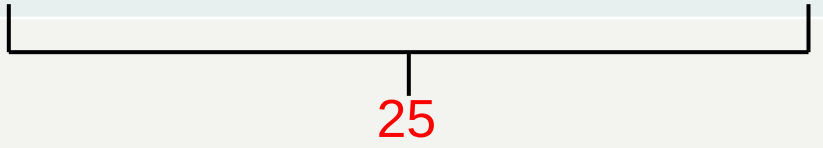
Networking Basics
Subnetting Example #2

This table shows the previous address after it is subnetted by borrowing one host bit, creating two subnets.

	Decimal	Binary
Network Address	192.168.52.0	11000000.10101000.00110100.00000000
Subnet Mask	255.255.255.128	11111111.11111111.11111111.10000000



Network address with subnet mask expressed as prefix length: 192.168.52.0/25

Parameters of this network:

- Network Address: 192.168.52.0
- Subnet Mask: 255.255.255.128
- Number of available host addresses: 128 – 2 = 126
- First host address: 192.168.52.1
- Last host address: 192.168.52.126
- Broadcast address: 192.168.52.127

Parameters of the other network:

- Network Address: 192.168.52.128
- Subnet Mask: 255.255.255.128
- Number of available host addresses: 128 – 2 = 126
- First host address: 192.168.52.129
- Last host address: 192.168.52.254
- Broadcast address: 192.168.52.255

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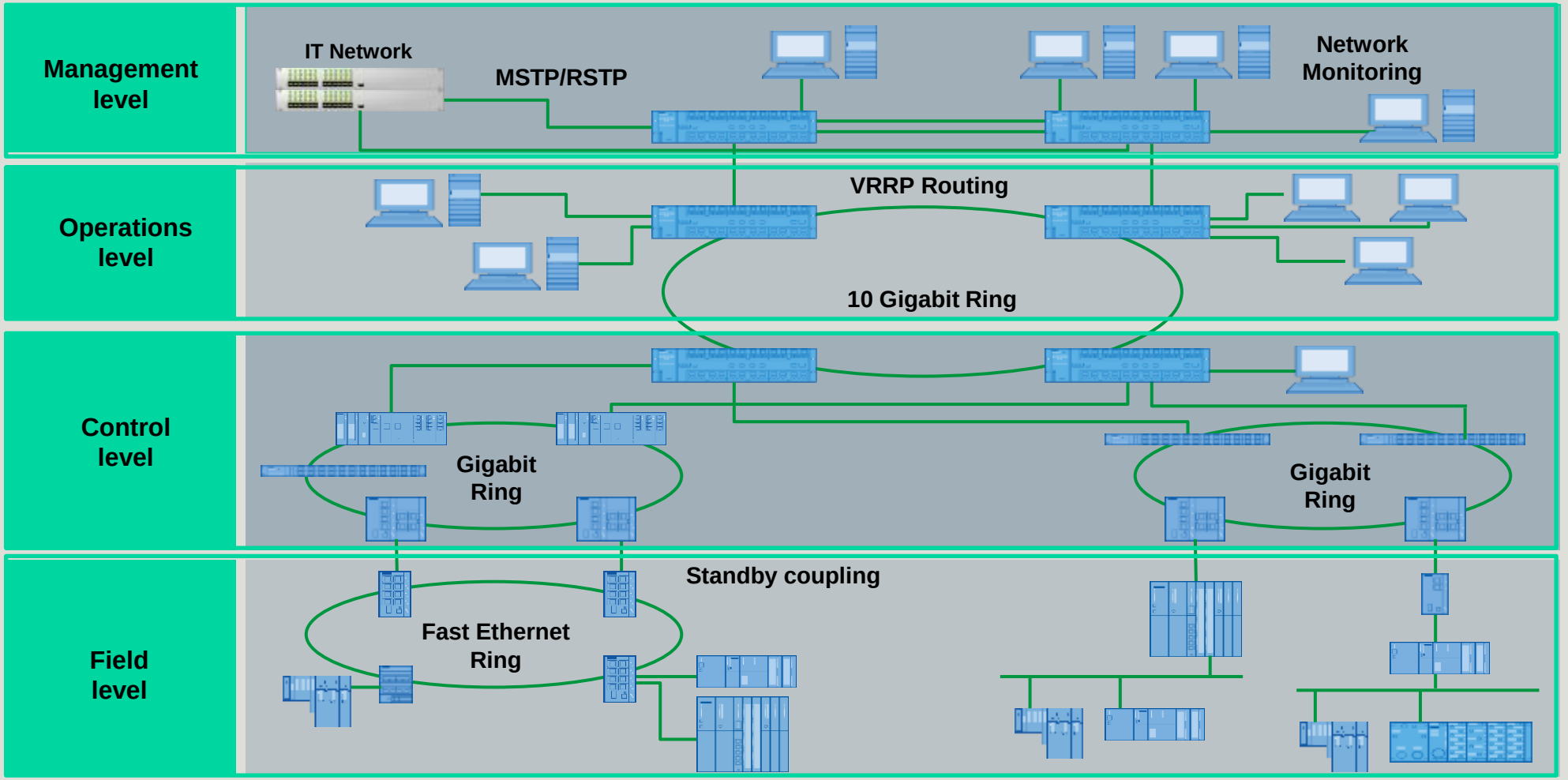
Plant Wide Network Architectures



Technical integration into IT system sharing production data

Redundant layer 3 routing with the VRRP function, optional: Dynamic routing protocols OSPF and RIP

Division of large Ethernet networks into smaller networks with their own IP address spaces (subnets) and to allow creation of VLANs

Growing number of Ethernet end devices with transmission rates of 100 Mbps and 1000 Mbps

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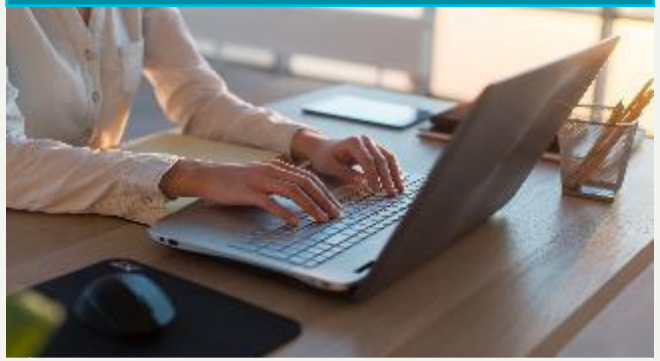
Differences Between Office and Industrial Networks

	Industry	Office
		
Environment	Harsh environment temperature, moisture, EMI	Climate-controlled offices
Installation	Field - commissioned cables	Pre-fabricated cables
Topology	Plant-specific structure line, star, ring, tree	Star-shaped structure
Availability	No Network downtimes	Downtimes up to several minutes
Redundancy Mechanism	MRP, High Speed Redundancy, Standby	Link aggregation, RSTP, MSTP
Network Administration	Engineer	Certified IT specialist

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The Benefits of Industrial Grade Products

High Availability	• To avoid significant economic losses or other damages
Robustness	• Extreme temperatures, dusty or corrosive environments
Flexibility	• Optimization and innovation causes changing production layouts
Determinism	• Real-time requirements of automation tasks
Security	• Threat of unauthorized access; secure remote access, e.g. for OEMS
Mobile Applications	• Reliable communication, e.g. for automated guided vehicles, monorails
Safety	• Fail-safe communication to provide safety for operators and assets

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Industrial Communications
SCALANCE

SCALANCE X – Industrial Ethernet Infrastructure Switches

Control Level / Operations Level

Field Level

Managed L2/L3

Managed L2

unmanaged

XR500		Networking and structuring of plant areas and interfacing to IT
XM400		Networking and structuring of subsystems / plant areas
XR300		Networking of Subsystems / plant areas
XB/XC-200		Applications at the machine in networked subsystems
XC100		
XB000		Small machines

SCALANCE W – Industrial Wireless

Access Points, Clients
IP30, IP65, Outdoor
802.11 a/b/g/n

SCALANCE S – Industrial Security

Firewall & VPN Products
Secure Remote Access

FastConnect – Industrial Cables and Connectors

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Highlights
Fast Connect

- Minimal installation time
- Easy stripping of outer sheath and braided shield in one step
- Simple connection method for Industrial Ethernet FastConnect cables
- Easy assembly thanks to preset FastConnect stripping tool
- Reliable shield contacting and strain relief
- M12 and RJ45 connection method for Industrial Ethernet/PROFINET and PROFIBUS

Highlights
Unmanaged XB, XC

XB000 Family

- To implement simple machine networks or small Ethernet networks

XC100 Family

- For setting up electrical and/or fiber-optic networks and star structures in applications close to machines
- To turn off nodes during operation
- For high climatic requirements (-40(-40 °C to +70 °C)
- Various fiber-optic port versions (ST/BFOC, SC)

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Highlights
Managed XC, XP

XC200 Family

- Extended temperature range from -40 °C to +70 °C
- Gigabit-capable, can be equipped with SFPs, PROFINET and EtherNet/IP
- Certifications for trackside railway applications, marine applications
- Additional FW functionalities: Fiber monitoring, VLANs, HRP standby

XP200 Family

- High degree of protection (IP65/67) for use outside of the control cabinet and in extreme ambient conditions from -40 °C to +70 °C
- PROFINET, EtherNet/IP applications with up to 1 Gbit/s and
  IEEE 802.3at Type 2 (max. 120 W)
- Certifications for railway, motor vehicles, marine applications

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Highlights
Managed XC, XP

XR300

- For modular network structures, up to 12 x 2-port media modules
- For use in railway applications, EN 50155 and e1/E1
- SCALANCE XR324-12M TS
- SCALANCE XR324-12M PoE TS)
- Extended temperature range from -40 °C to +70 °C

XR300 WG

- Cost-optimized rack-switch with appropriate range of functions for industrial environments or control rooms
- Versions with 10/100 Mbps and 1 Gbps
- Fiber optic via combo ports
- Temperature range: 0 to +60 °C

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Highlights
Managed L3 XM400, XR500

XM400 Family

- Flexible and structured networking of plants / plant areas
- Modular expandability using Port Extenders (PE)
- Mobile diagnostics and dynamic device data access with NFC
- Constructed in SIMATIC Design (S7-1500)
- Combo ports provide alternative connectors (RJ45 or SFP)
- Layer 3 optionally configured
- Serial RJ11 Console Port interface

XR500 Family

- Networking/structuring of high-performance industrial networks
- Modular adaptability with media modules
- Extended IT functionality: Layer 3, router redundancy
- SNMP, Web server, STEP 7, and on-site diagnostics
- Support of high (1 Gbps) or very high (10 Gbps) bandwidth
- Variants with different and optionally redundant power supplies
- Combo ports provide alternative connectors (RJ45 or SFP)

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Highlights
SCALANCE W

- Support of IEEE 802.11n with up to 450 Mbps gross data rate eliminates existing capacity limits
- All SCALANCE W products support 2.4 and 5 GHz
- Some of the products support Multiple In Multiple Out (MIMO): Higher bandwidth, greater reliability
- Thanks to the iFeatures iPCF and iPCF-MC, industrial requirements such as real-time data transfer can be met trouble-free
- Some of the products can be extended using the KEY-PLUG which enables iFeatures
- SCALANCE W700 is now available as a compact device in the SIMATIC design for even better integration in the cabinet
- Selected products are particularly suitable for the transportation sector and have the relevant approvals
- Extensive antenna portfolio suitable for every application

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Highlights
Scalance M/SRC

Management of Devices and Users

- User management with the configuration of rights
- Device and user management with group management

Connection Management:

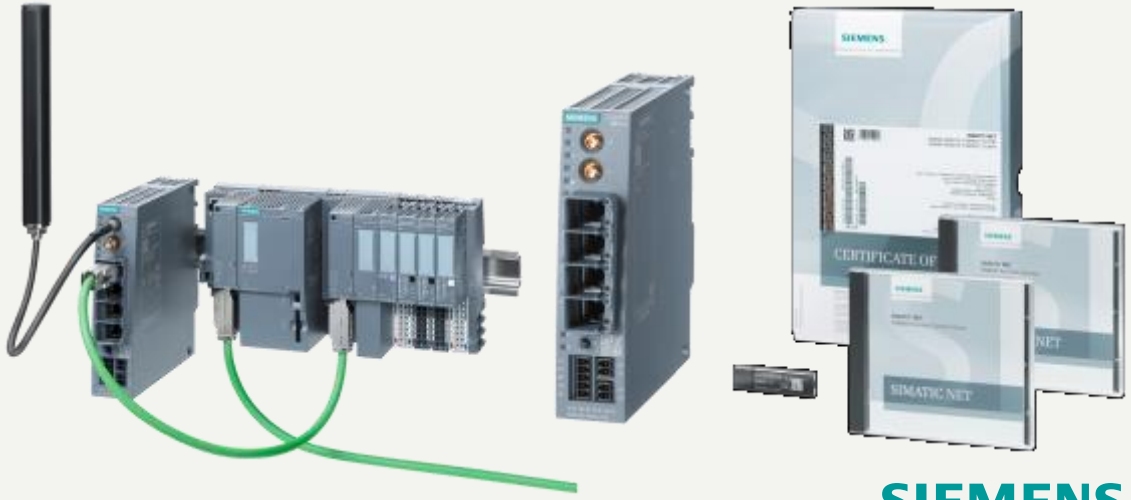
- Establishment of encrypted connections with OpenVPN and IPsec
- Establishment of permanent or event-based connections (establishment by wake-up SMS or digital input (DI))

Support during commissioning

- Interface for auto configuration of devices and users
- Support of SCALANCE M-800 mobile wireless devices, SCALANCE S615 and SINEMA RC Client
  Support of SCALANCE M-800 DSL devices planned for the beginning of 2016

Connecting subnets downstream from SCALANCE M /SCALANCE S:

- Support of routing
- Support of 1:1 NAT for mapping locally identical subnets
- Support of NAT for mapping dedicated local IP addresses
- Support of multiple subnets downstream from a SCALANCE M or SCALANCE S



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Host and Device IP Addressing

* Subnet mask for all addresses is 255.255.0.0

Station 1a **PG:172.16.1.1 SW: 172.16.1.5**	**Station 1b** **PG:172.16.1.2 SW: 172.16.1.10**
Station 2a **PG:172.16.2.1 SW: 172.16.2.5**	**Station 2b** **PG:172.16.2.2 SW: 172.16.2.10**
Station 3a **PG:172.16.3.1 SW: 172.16.3.5**	**Station 3b** **PG:172.16.3.2 SW: 172.16.3.10**
Station 4a **PG:172.16.4.1 SW: 172.16.4.5**	**Station 4b** **PG:172.16.4.2 SW: 172.16.4.10**
Station 5a **PG:172.16.5.1 SW: 172.16.5.5**	**Station 5b** **PG:172.16.5.2 SW: 172.16.5.10**

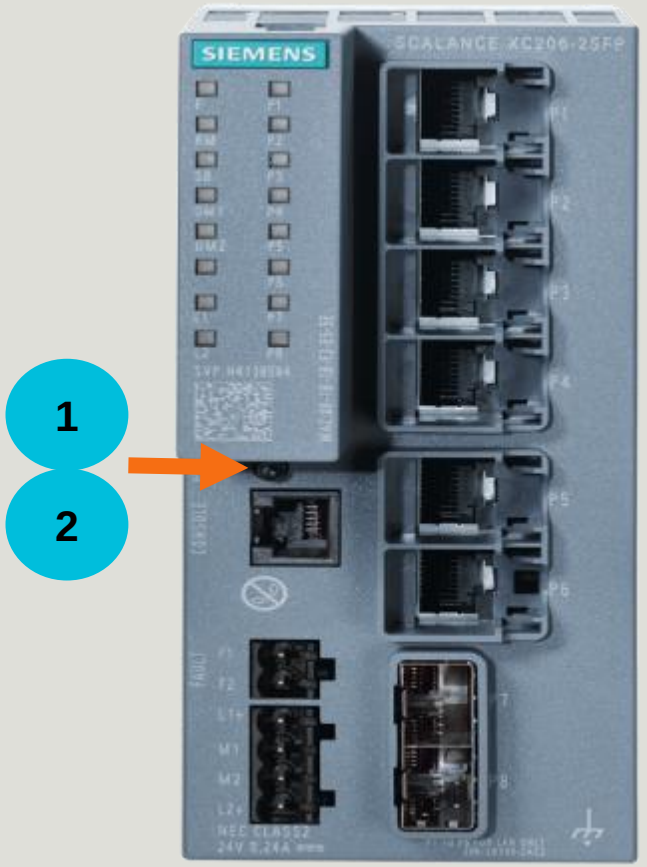
LAB 1
Setup - Restore Factory Defaults to the Switch

We want to start the labs with no previous configuration on the switch. Therefore, we will restore the factory default settings.

With Power On:

1. Toggle to display mode A.
   - Display mode A is active if the LEDS "DM1" and "DM2" are UNLIT.
   - If the "DM1" and "DM2" LEDs are lit or flashing, you will need to press the "SET/SELECT" repeatedly until the "DM1" and "DM2" LEDs go off.

2. Hold down the "SELECT/SET" button for 12 seconds.
   - After 9 seconds, the "DM1" and "DM2" LEDs start to flash for 3 seconds.
   - After you have held down the button for 12 seconds, the device restarts and the factory defaults are restored.



- The switch can also be reset while power is initially off
- The SELECT/SET button can be disabled via Web Based Management

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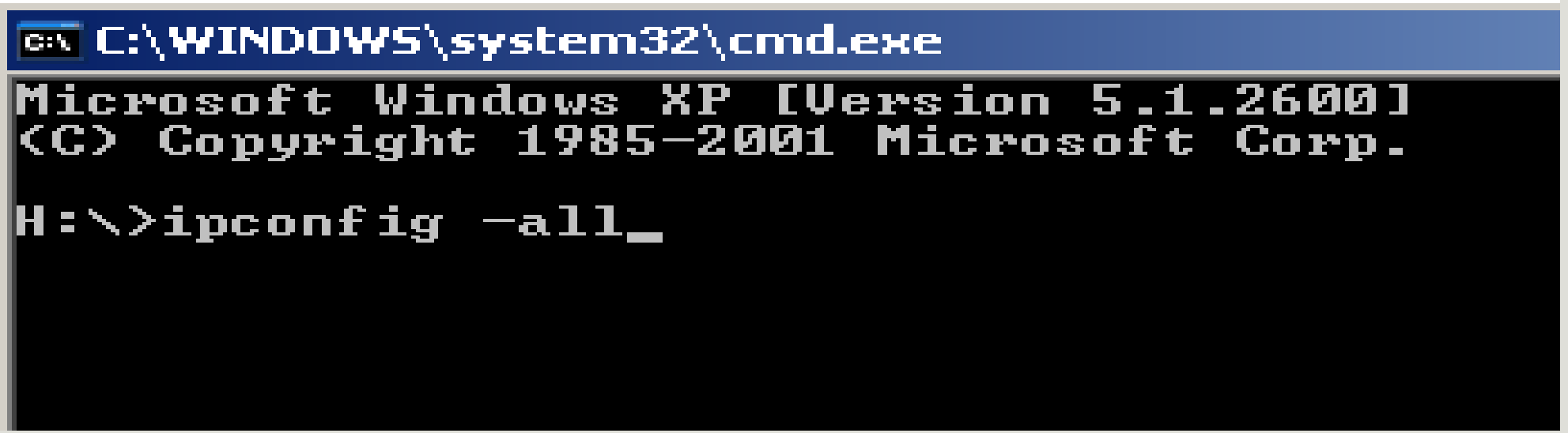
LAB 1

Setup - Configure PC IP Address

Before we start, check if your PC has the correct IP address for your subnet

The easiest way to confirm this is using the command line interface and the “ipconfig – all” command

**If the IP address is not correct for your station, then use the following two slides to set the correct IP address. Otherwise, proceed to the slide titled “Review Web Based Management”.



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LAB 1
Setup - Configure PC IP Address

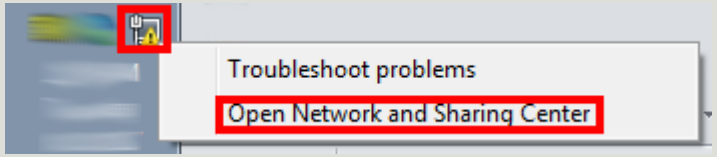
1) Right Click on the Network Icon in the Notification Area

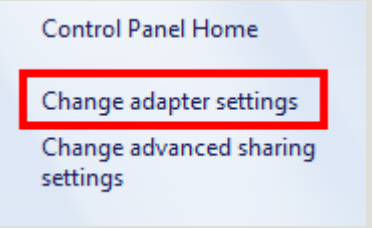
2) Click on Open Network and Sharing Center

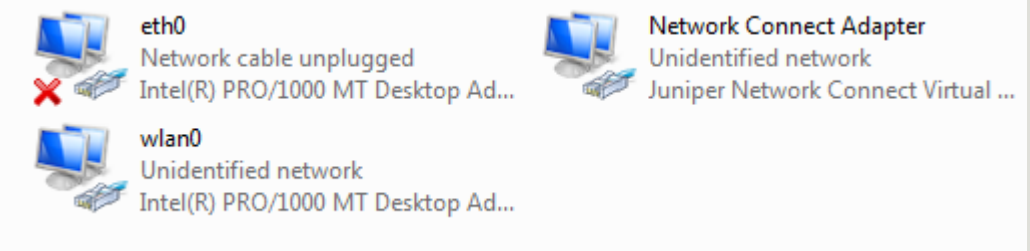
3) Click Change adapter settings

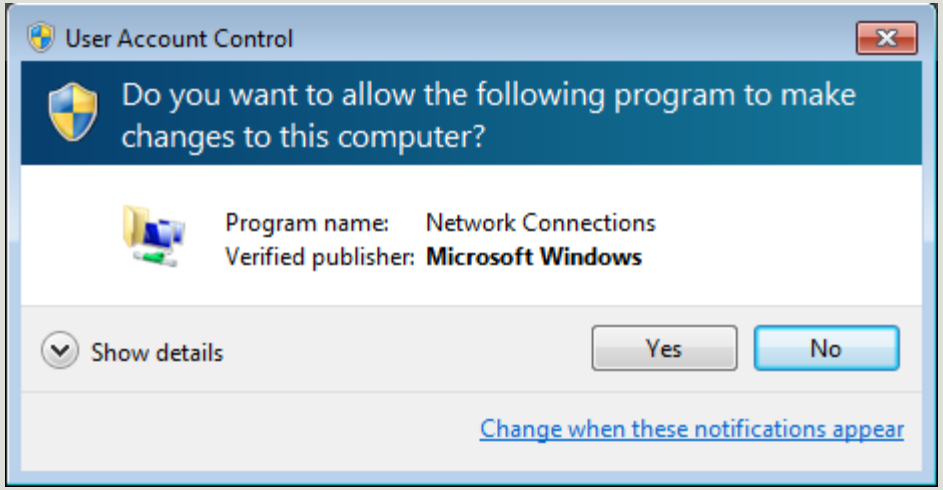
4) Select the connected network and double click

5) Accept the Windows warning by clicking Yes









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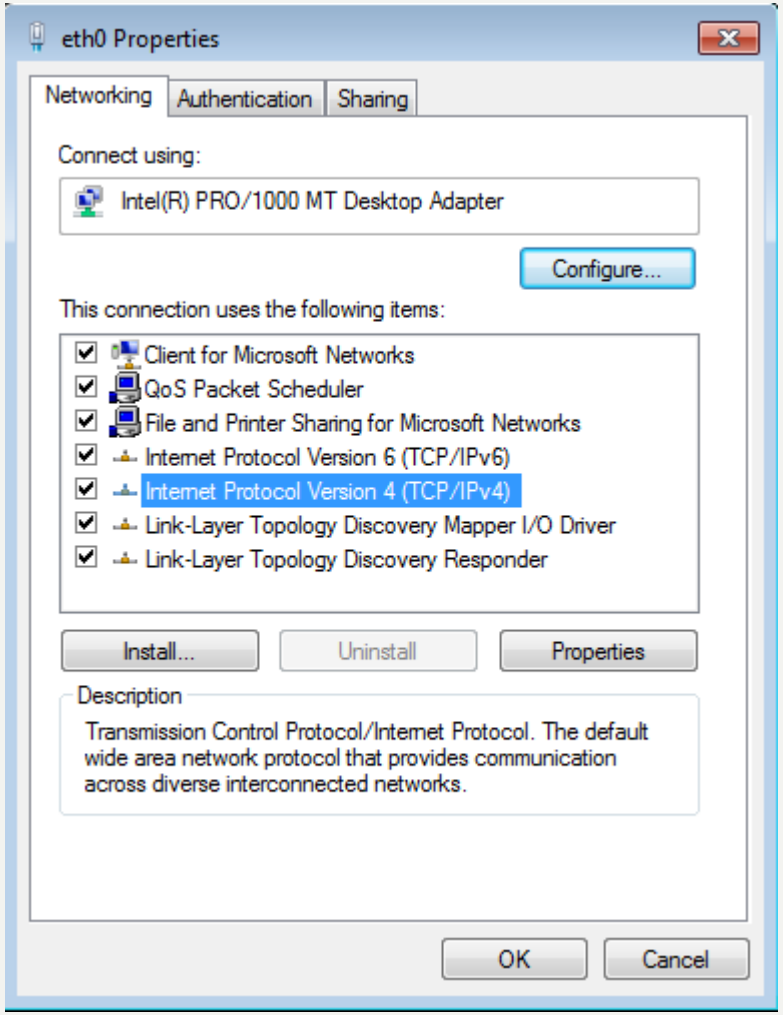
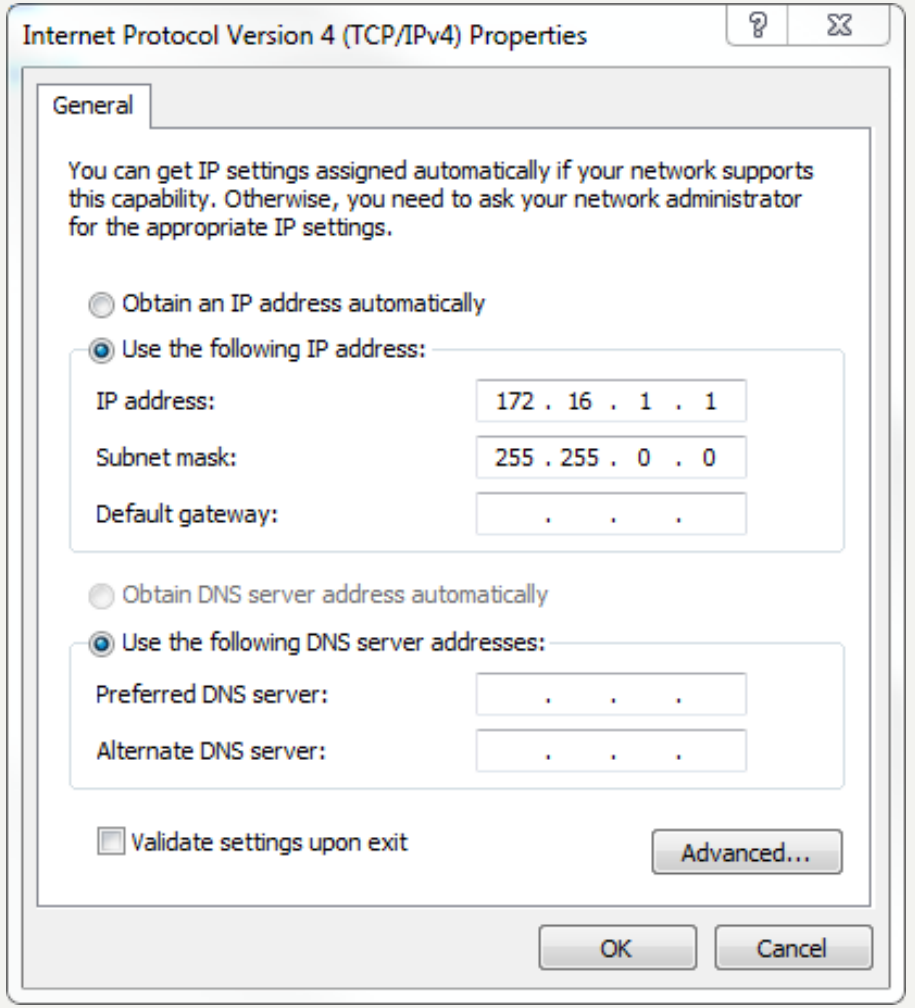
LAB 1
Setup - Configure PC IP Address

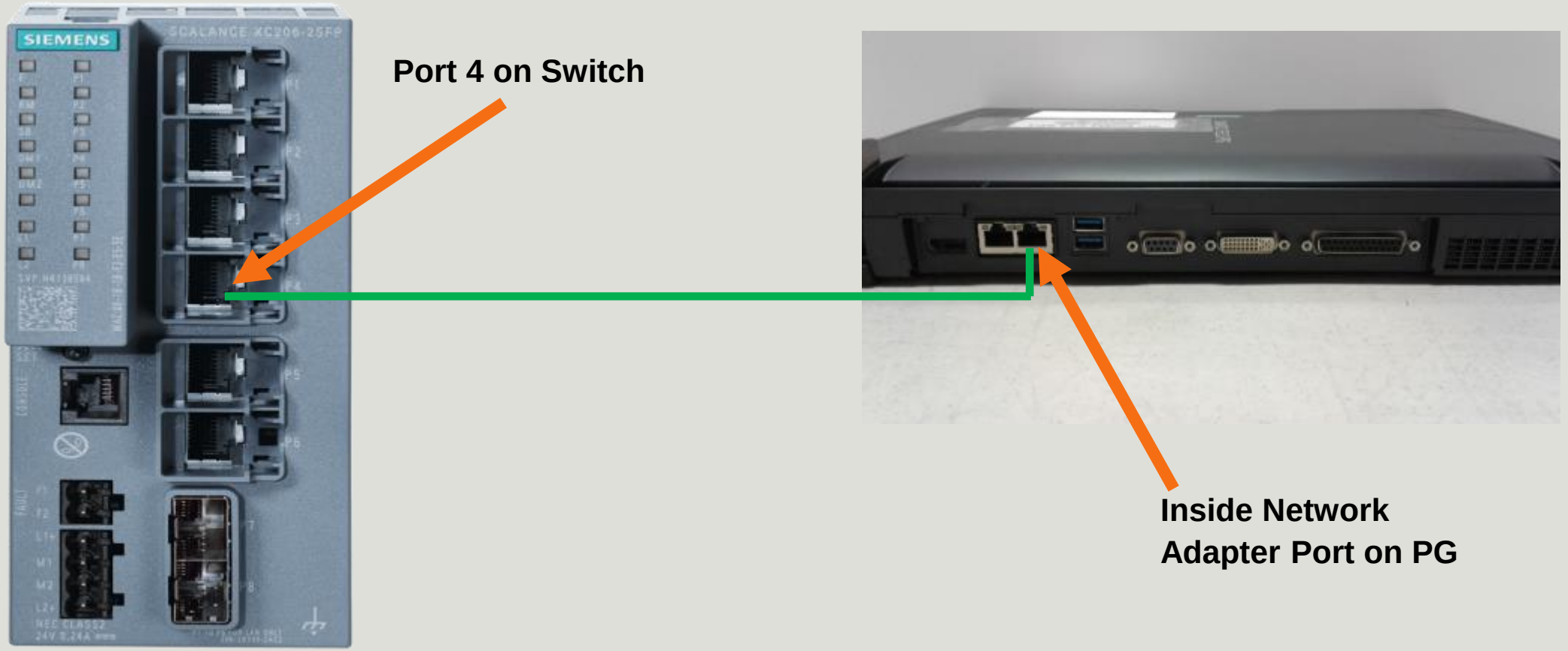
1) Click on Internet Protocol Version 4 (TCP/IPv4)
2) Click Properties
3) Select Use the following IP address:
4) Enter IP and Subnet Mask Only as shown
5) Click OK until all the way out of the network properties screens.
6) Close any remaining open screens.





LAB 1
Setup - Review Web Based Management

Now please connect your PC “L” Port (inside network adapter) to the marked port



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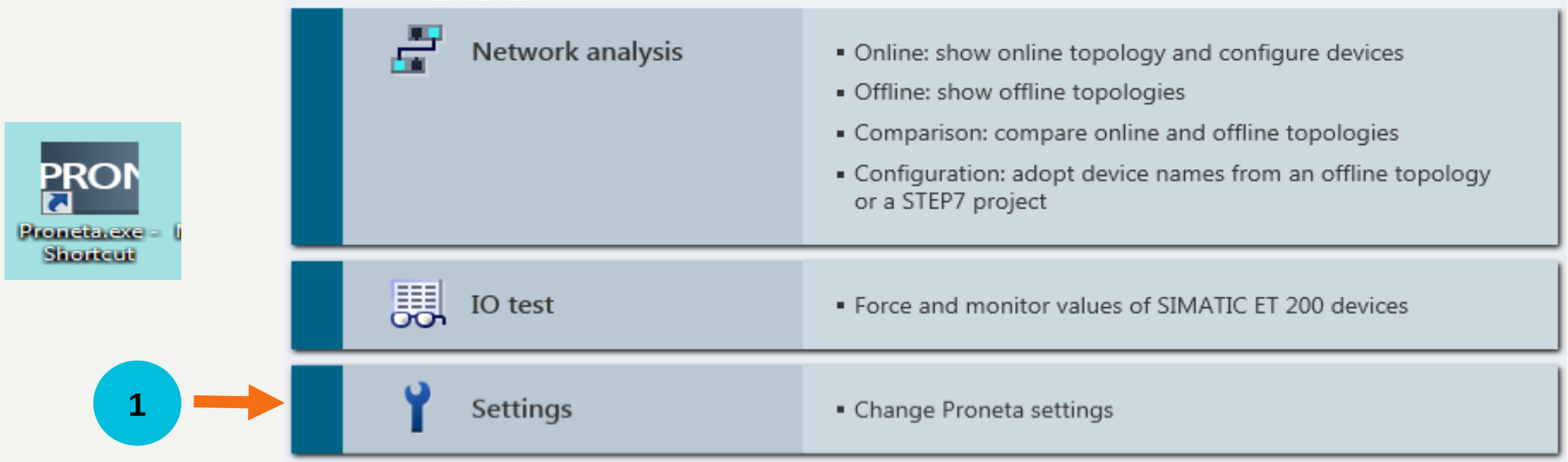
LAB 2
PRONETA – Set the Network Adapter

PRONETA is a no cost Industrial Ethernet Analyzer tool from Siemens that can be used to set the IP address of our switches, as well as scan the topology of the network.

After starting PRONETA, we want to ensure that it points to the right NIC card that is connected to the switch.

1. *Click on Settings*



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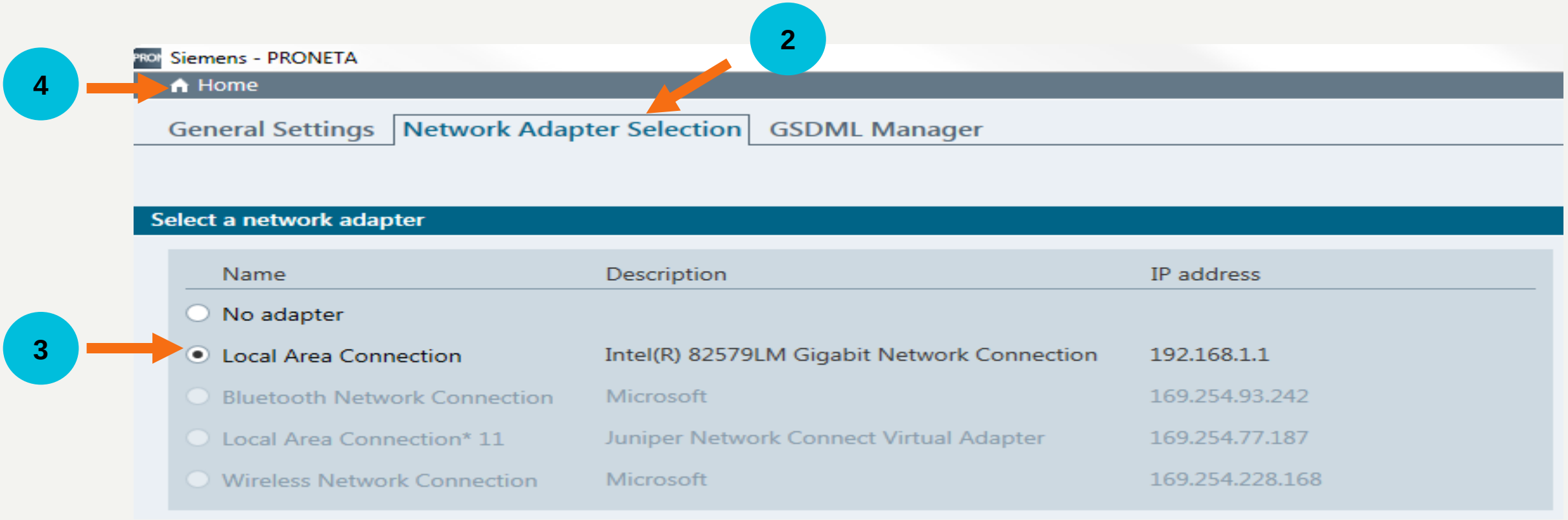
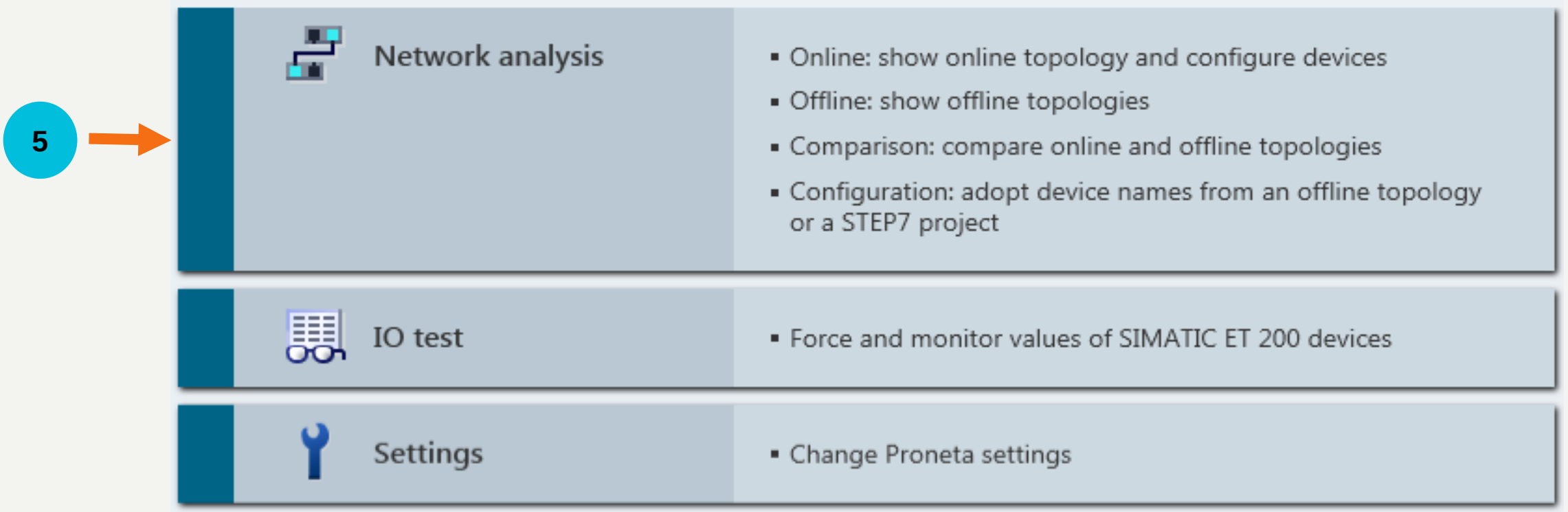
LAB 2
PRONETA – Set the Network Adapter

2. *Click on the second tab, Network Adapter Selection.*
3. *Select the Network Adapter that corresponds to your connection*
4. *Click on Home to complete setting up the Network Adapter*



LAB 2
PRONETA – Set the Network Adapter

5. *To scan the network and find our switch, click on Network Analysis*.



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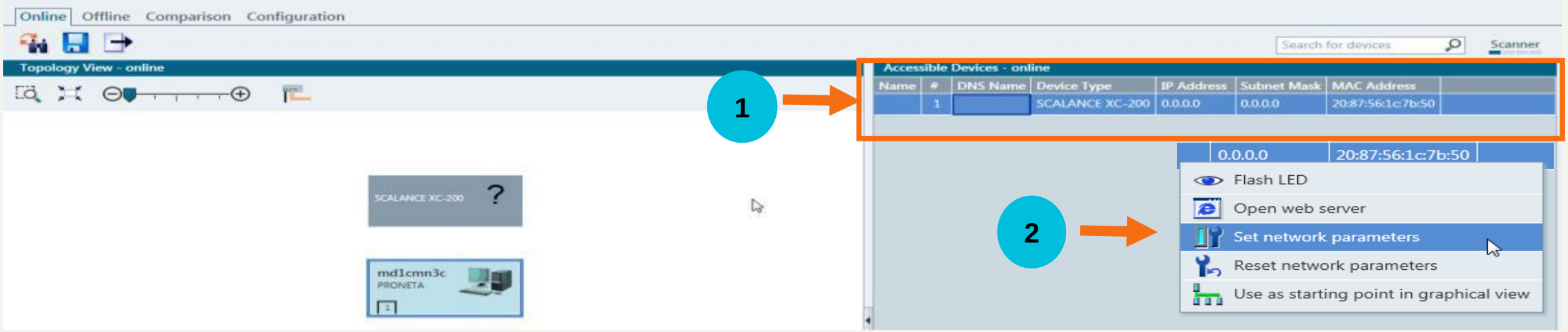
LAB 2
PRONETA – Set the Switch IP Address

Notice the left window displays your PC and the switch, while the right window displays the switch details and fields which can be managed.

1. Right mouse click anywhere on the switch line in the right window
2. Select “Set network parameters” from the drop down menu

- Notice other options in the menu such as flash LED, Open web server, and Reset network parameters.



LAB 2
PRONETA – Set the Switch IP Address

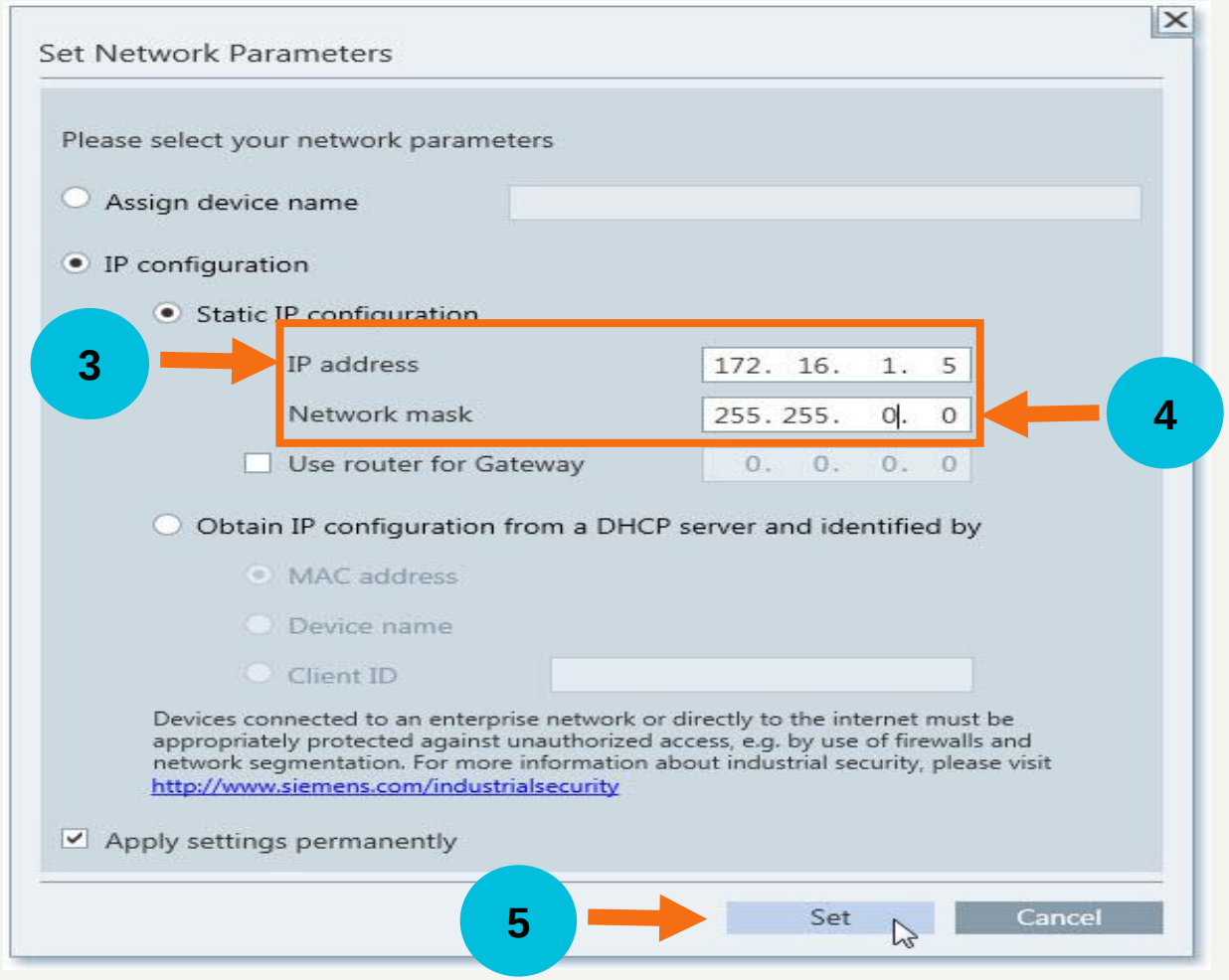
3. Set the IP address for your switch:

Station Xa	172.16.X.5
Station Xb	172.16.X.10
[Station# (X)]	1…5

4. Set the Network subnet mask

Network mask	255.255.0.0

5. Click the Set button to apply the network address settings.



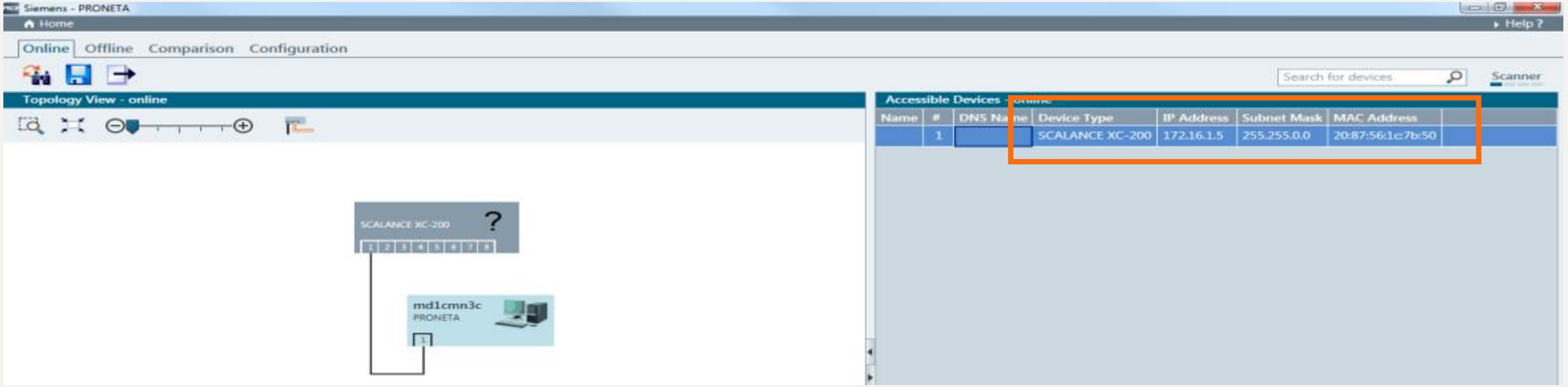
LAB 2
PRONETA – Set the Switch IP Address

The network address settings are now updated in the right window.

Now the switch can be accessed opening a browser and typing in the IP address

OR

Alternatively by selecting the Web Server option in the drop down menu



LAB 2
Login to the switch

From a web browser, **type in the IP address** and access the switch with the username **admin** and password **admin.** Click **Login.**

When prompted, please change the password to Admin!123

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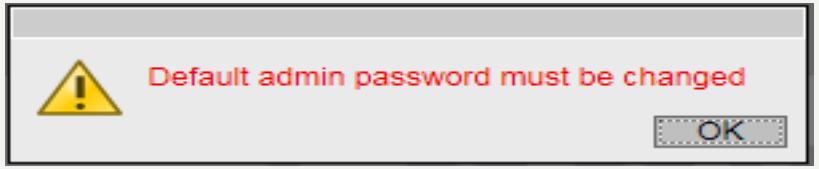
LAB 2
Login to the switch

When logging in after a factory reset, the switch requires that the default password be changed.



High password policy requires at least 8 characters including at least 1 digit, 1 uppercase letter and 1 special character.

Change the new password to **Admin!123**
Click **Set Values**

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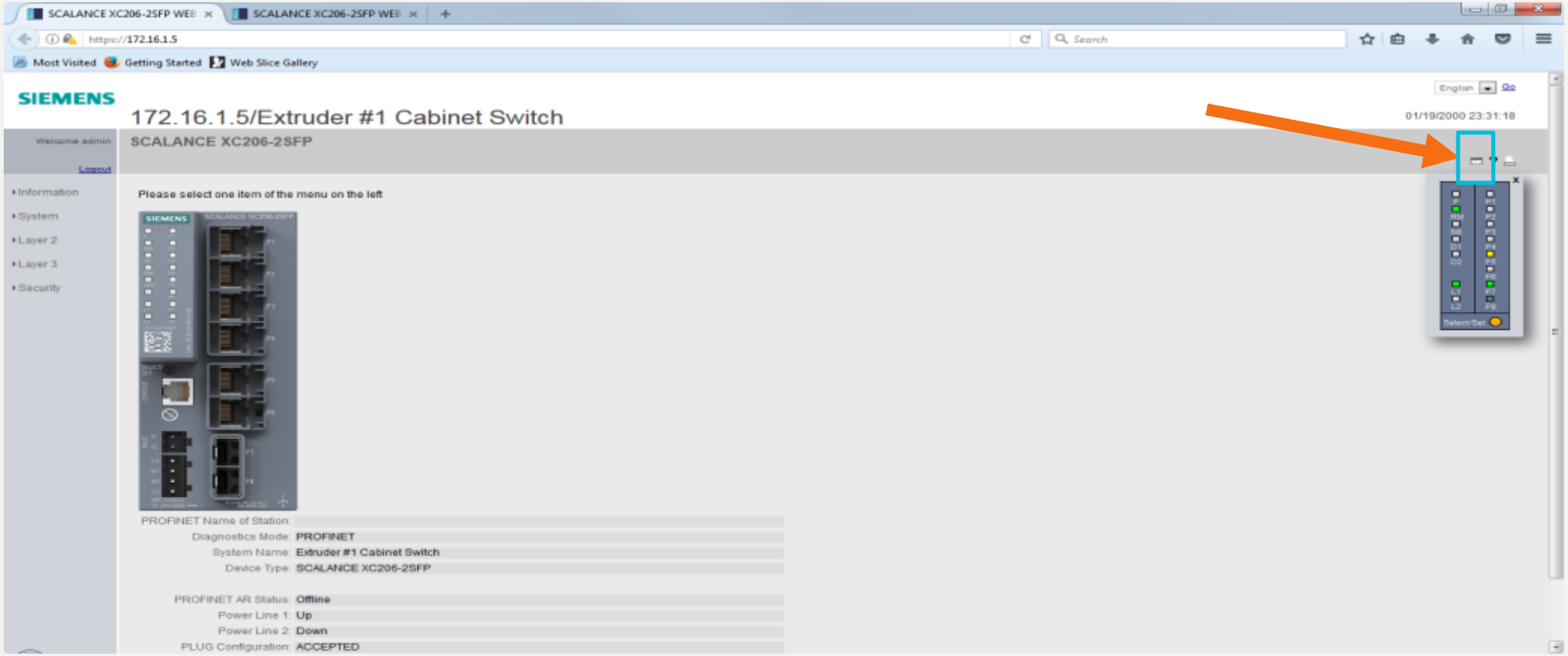
Diagnostic Approaches

Diagnosing the SCALANCE XC switch configuration *may* require multiple approaches:

- Which connections are down?
- Where is the cable break located in the cable?
- Which ports are Half or Full duplex?
- Which port(s) are assigned to which VLAN?
- Does PRONETA find the switch from a VLAN port?
- Is it possible to get to the Web based Management from a VLAN port?
- What is the ring mode: Active or Passive?
- Which switches are on the ring?
- Which ports are ring ports?
- What is the reconfiguration time for the ring?
- Which ports are blocked, and which ports are in forwarding mode?

XC2xx LED Diagnostic Island

Click on the LED icon to display the LED Diagnostic Island for the switch



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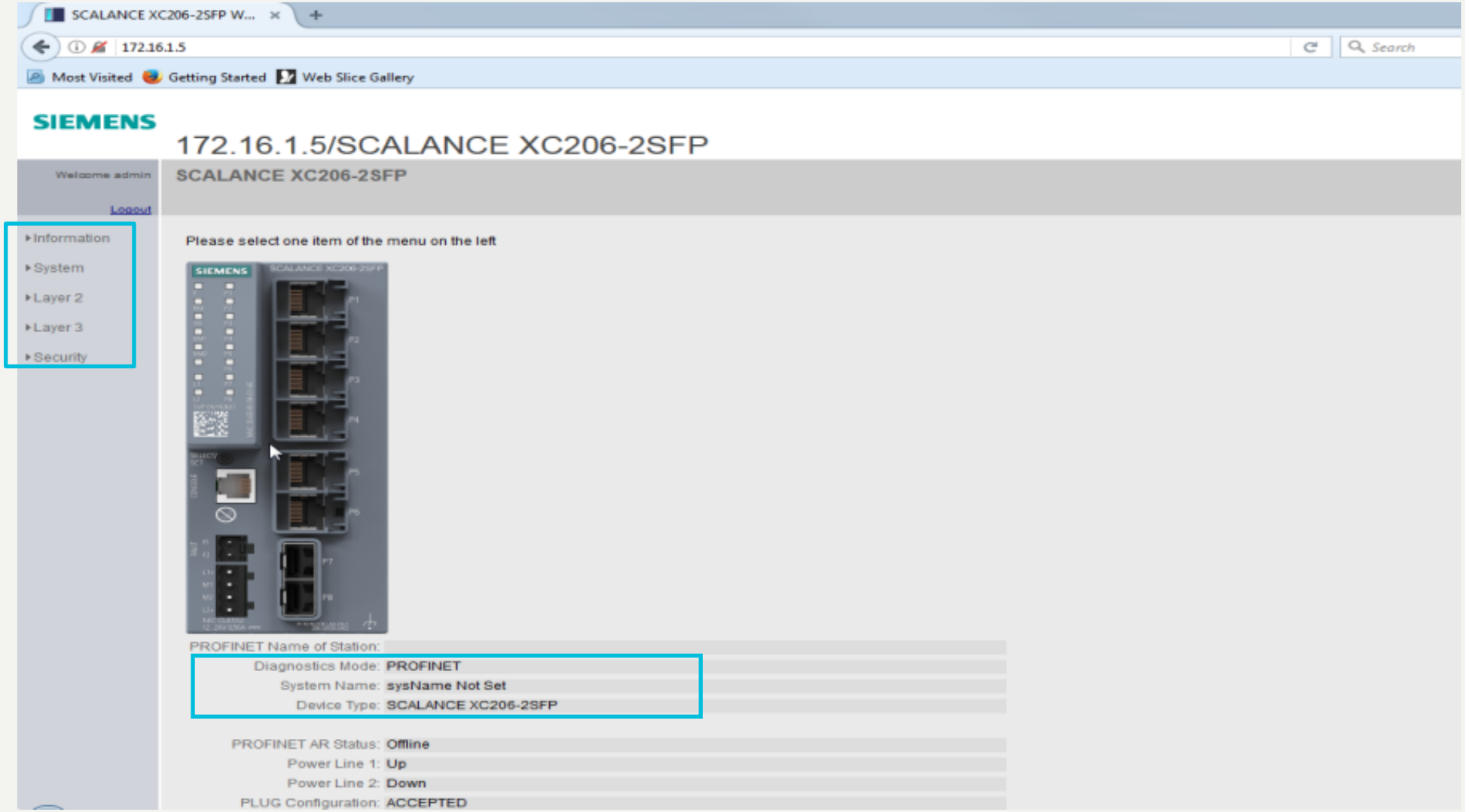
XC2xx WBM Menu Structure



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Agenda

1	Introduction - Network Concepts
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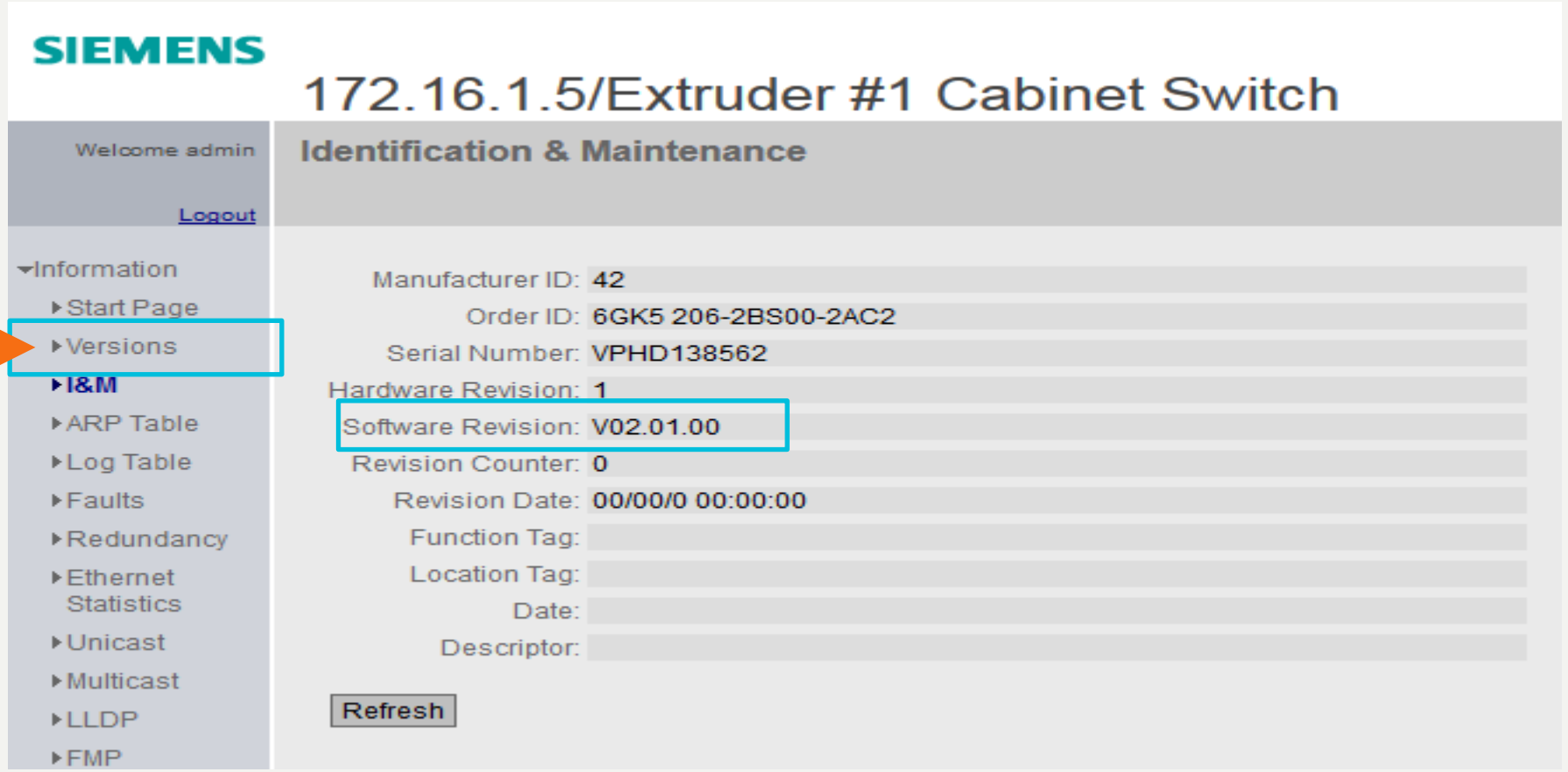
Identification and Maintenance



Alternatively, the Versions folder can be used to see the FW version

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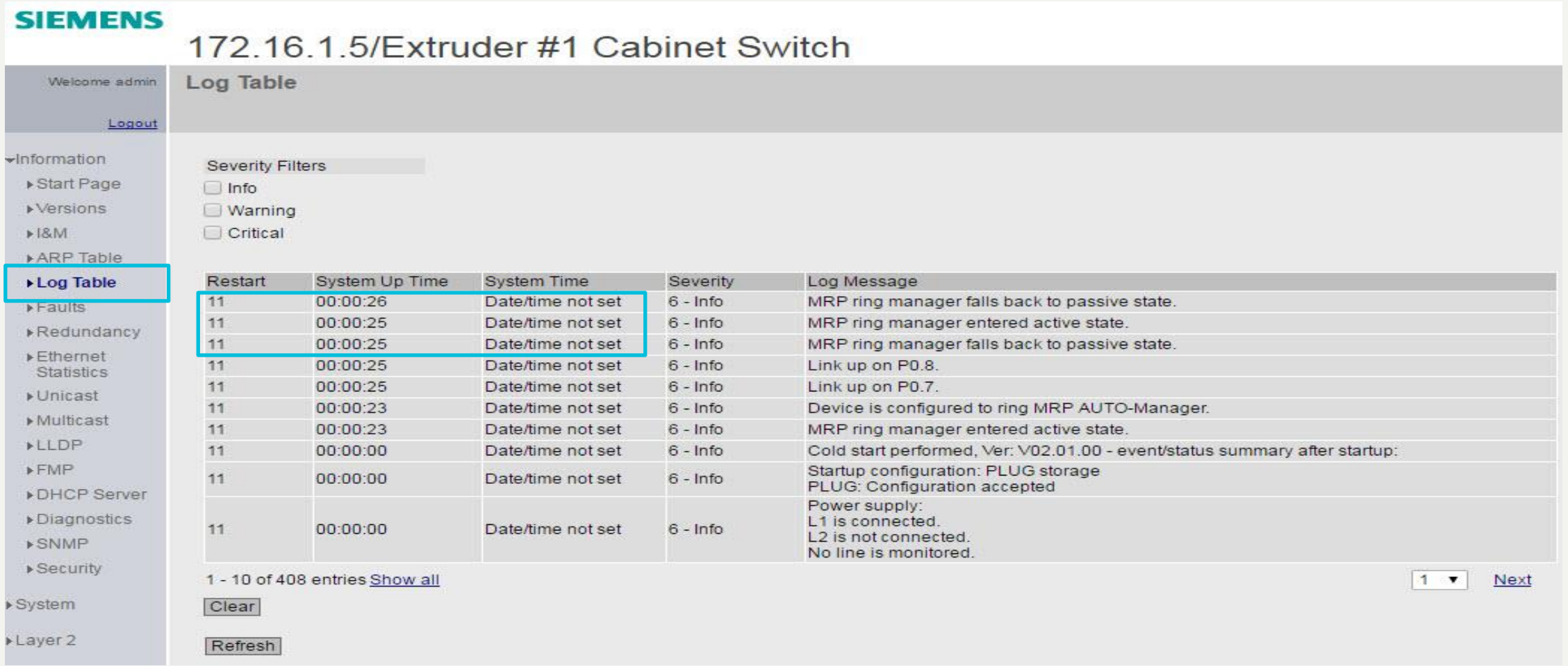
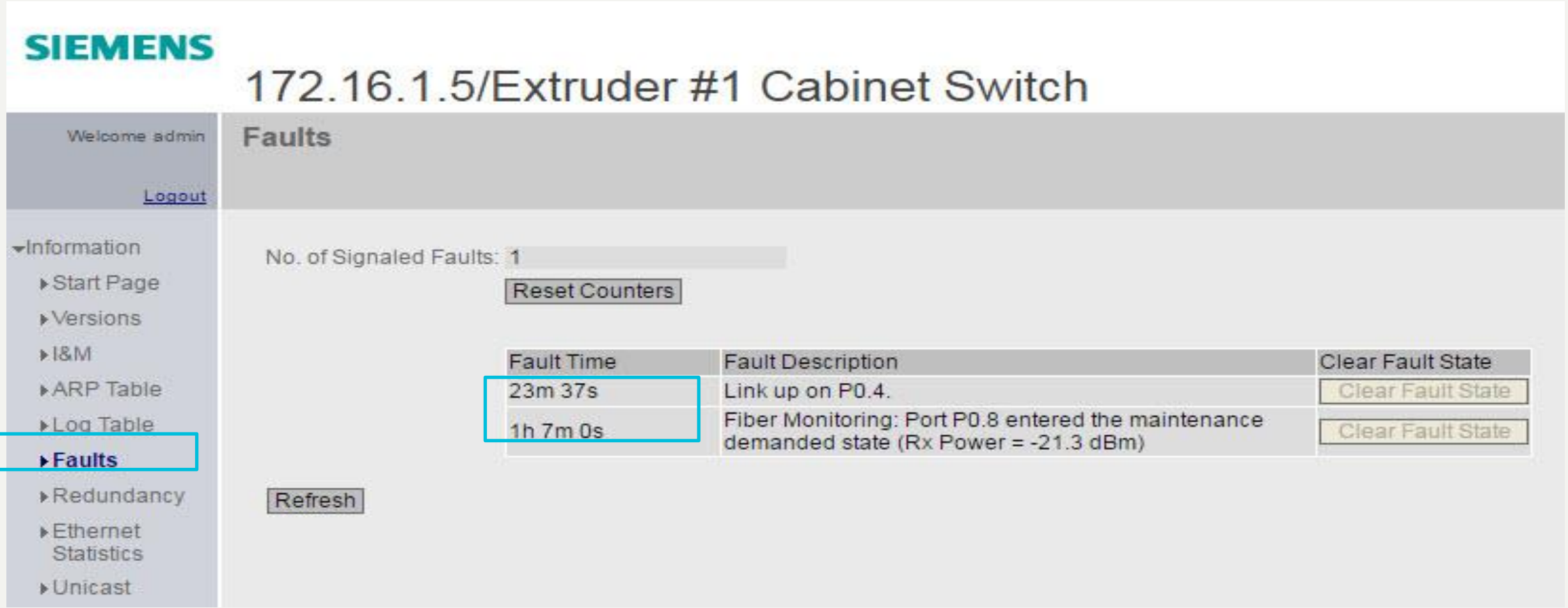
Event Log Table
View



System Event Log Table can be reviewed on the Information > Log Table page

Faults



Example of Link Up and FMP faults (both configured). Note the Fault Time is equal to the system uptime since the device system time has not yet been set.

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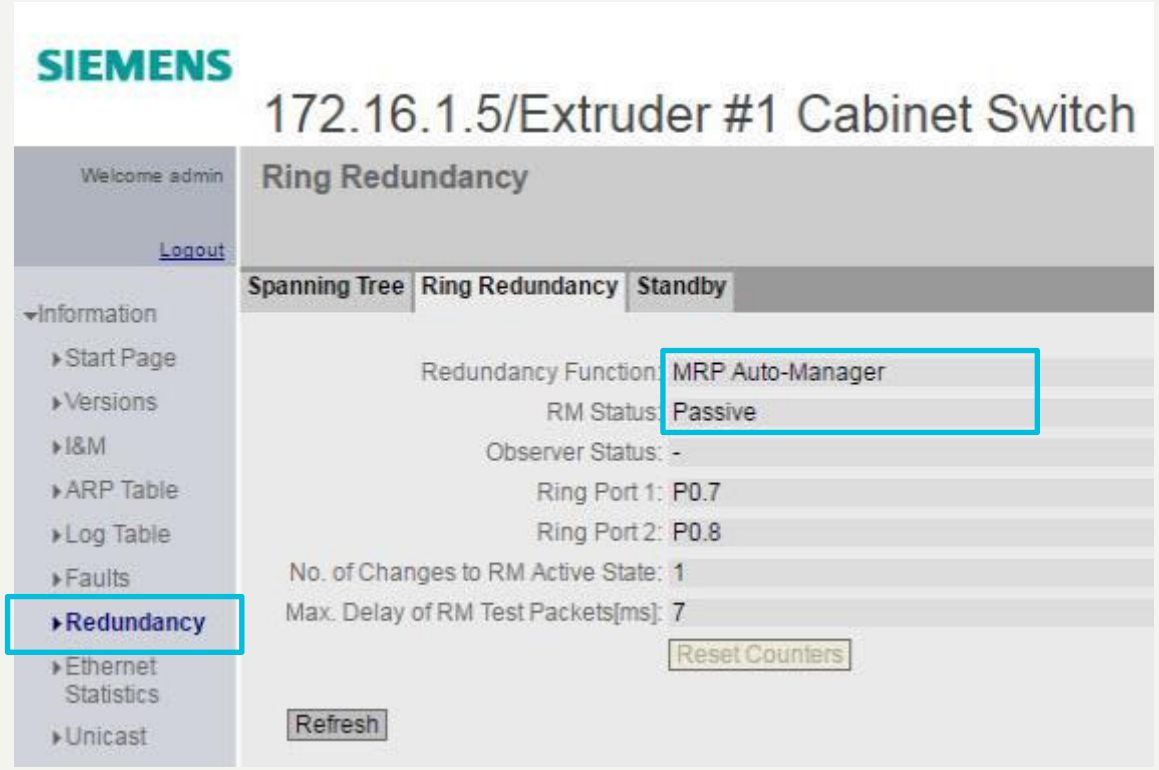
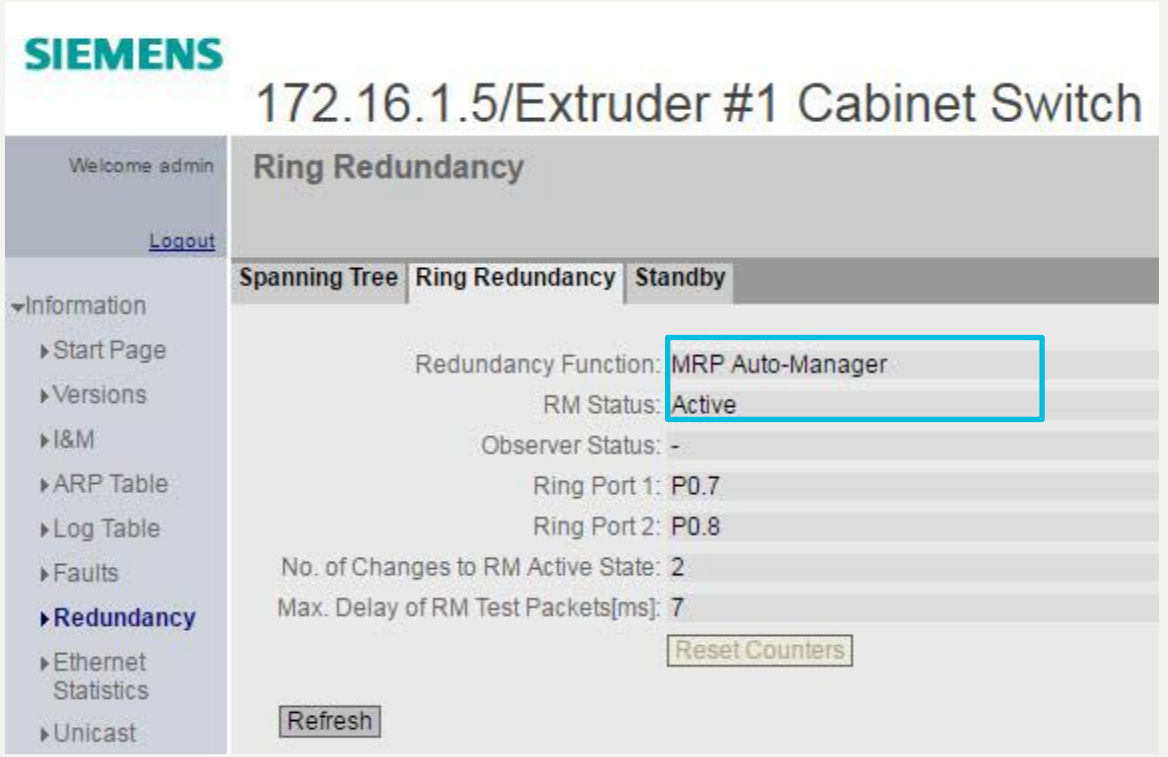
Redundancy Status





- Example showing in-tact ring (left, passive) and broken ring (right, active).
- If this were an MRP Client, the name under the Redundancy Function would say MRP Client

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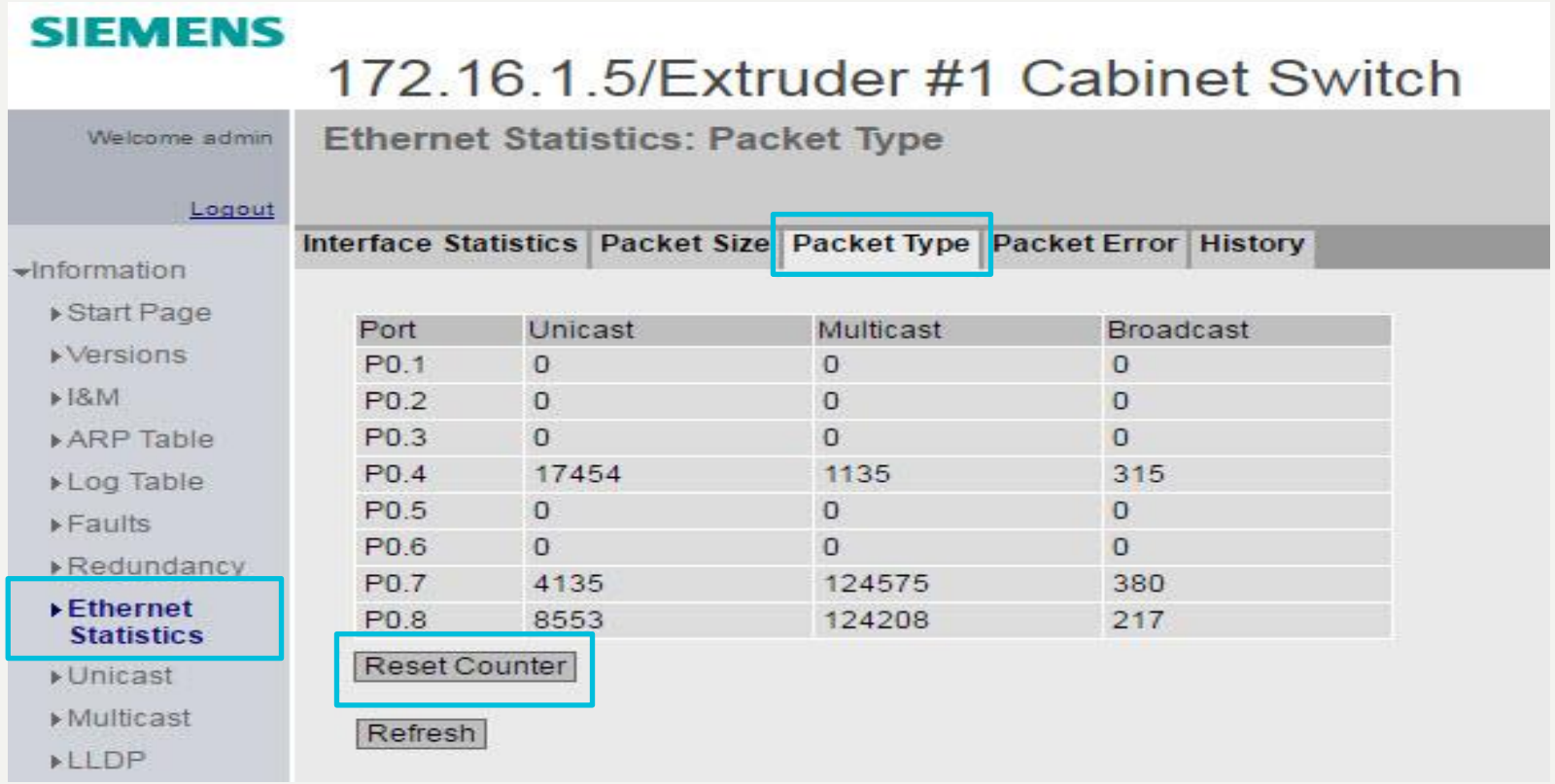
Ethernet Statistics



Use the Packet Type statistics to verify there is not an overly weighted volume of the wrong type of traffic.

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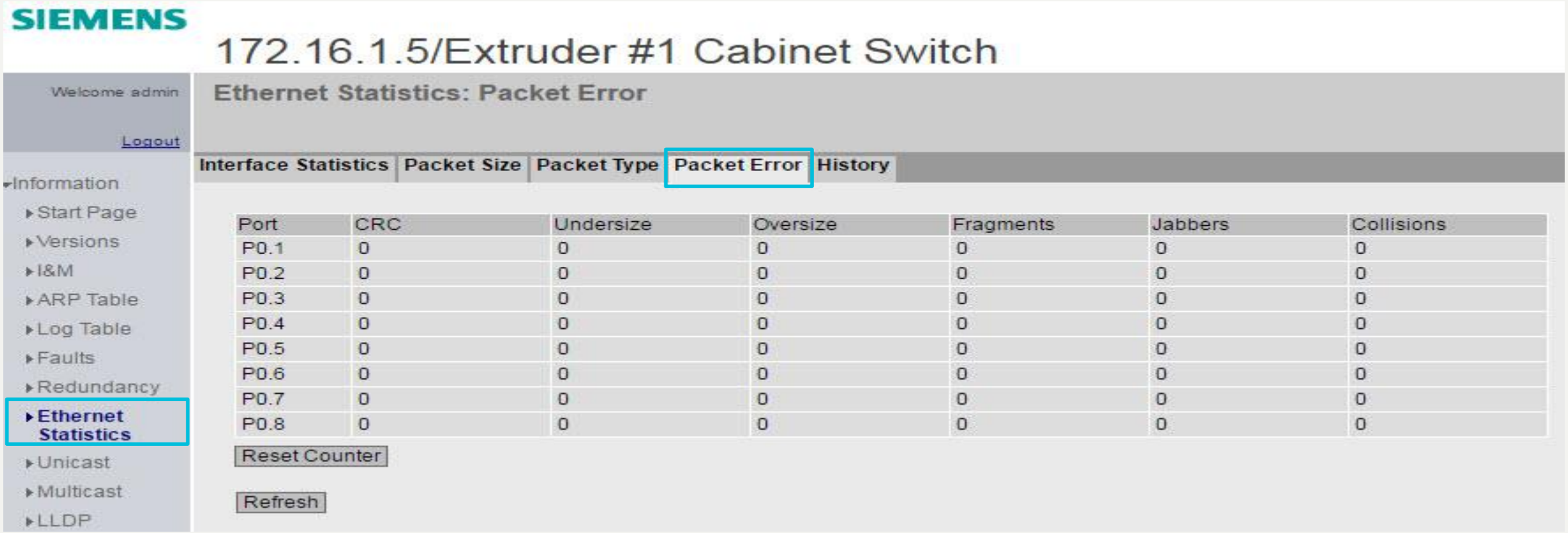
Ethernet Statistics



Verify that no port(s) are experiencing re-occurring errors. Reset the counters if required.

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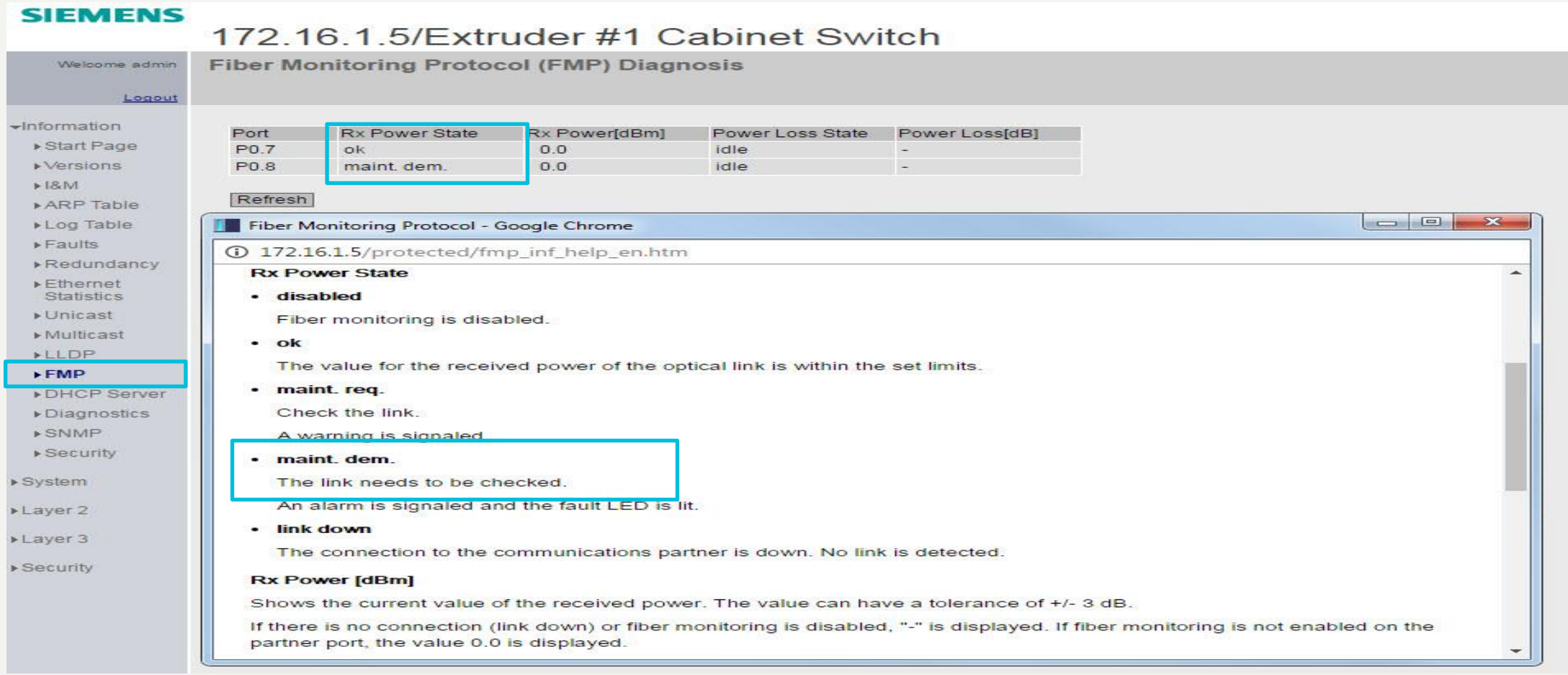
Fiber Monitoring Protocol



To receive FMP results, FMP must be enabled under Layer 2 > FMP.

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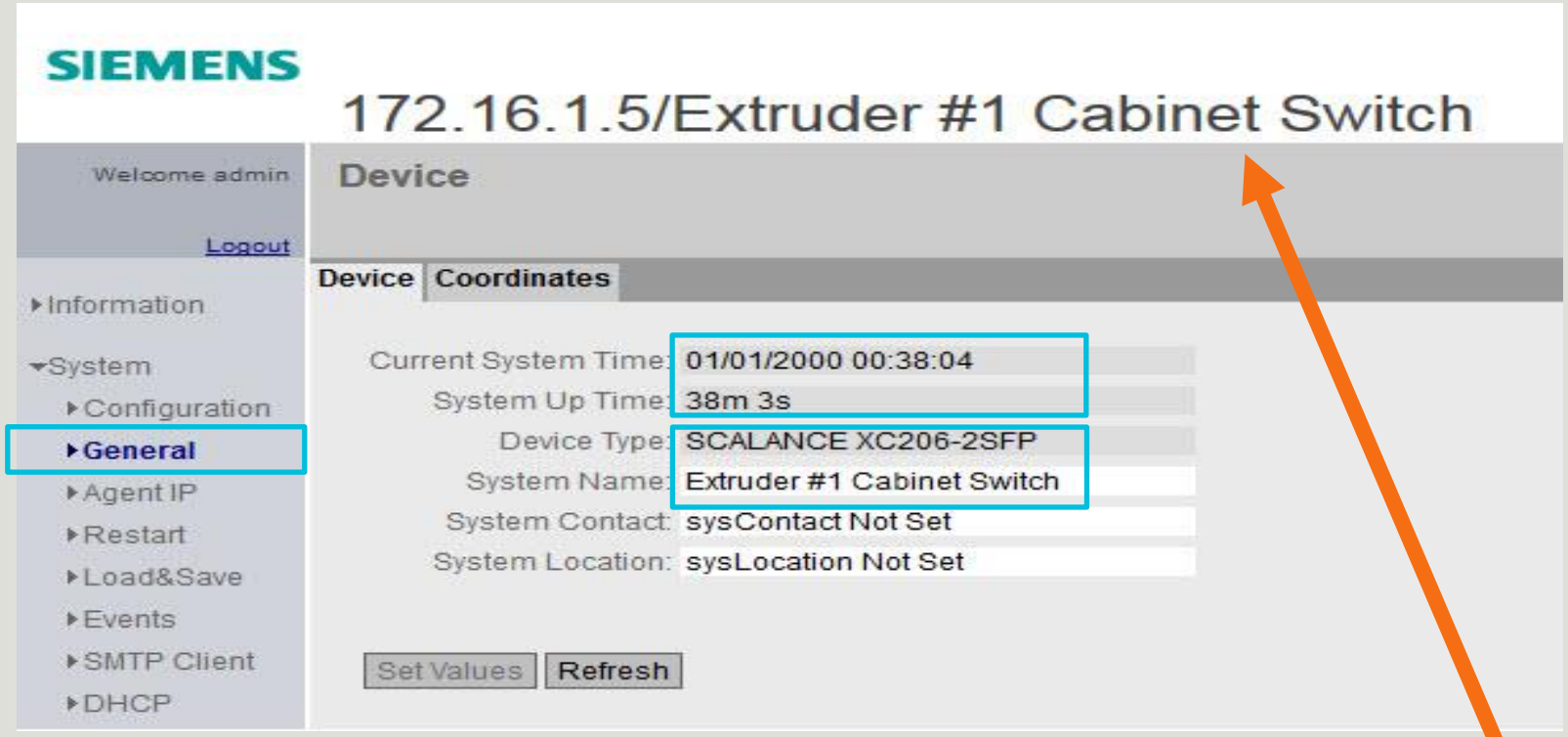
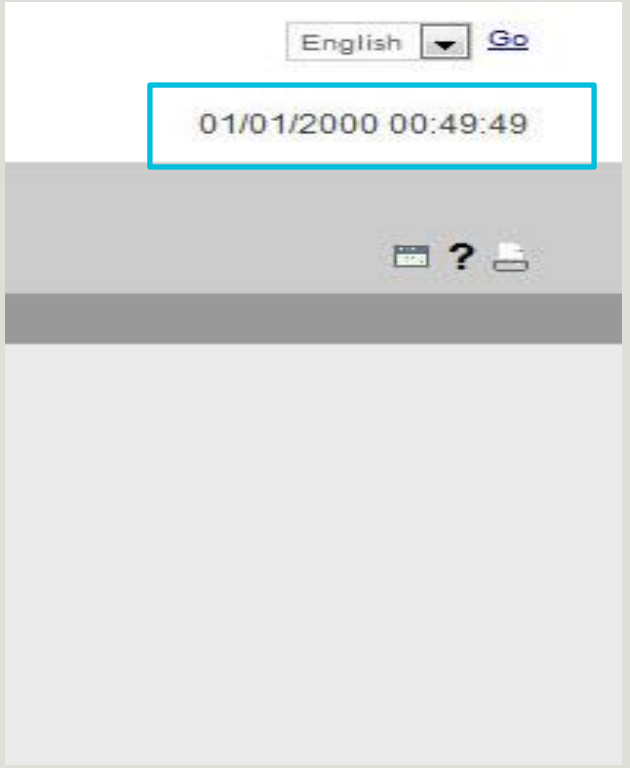
System Folder
General Information





- If no System Name is assigned, the device name is displayed; e.g. SCALANCE XC206-2SFP
- If System Time is not synchronized with a master clock, it will restart after every reboot from Jan 1st 2000, zero out the System Up Time, and increment the restart counter

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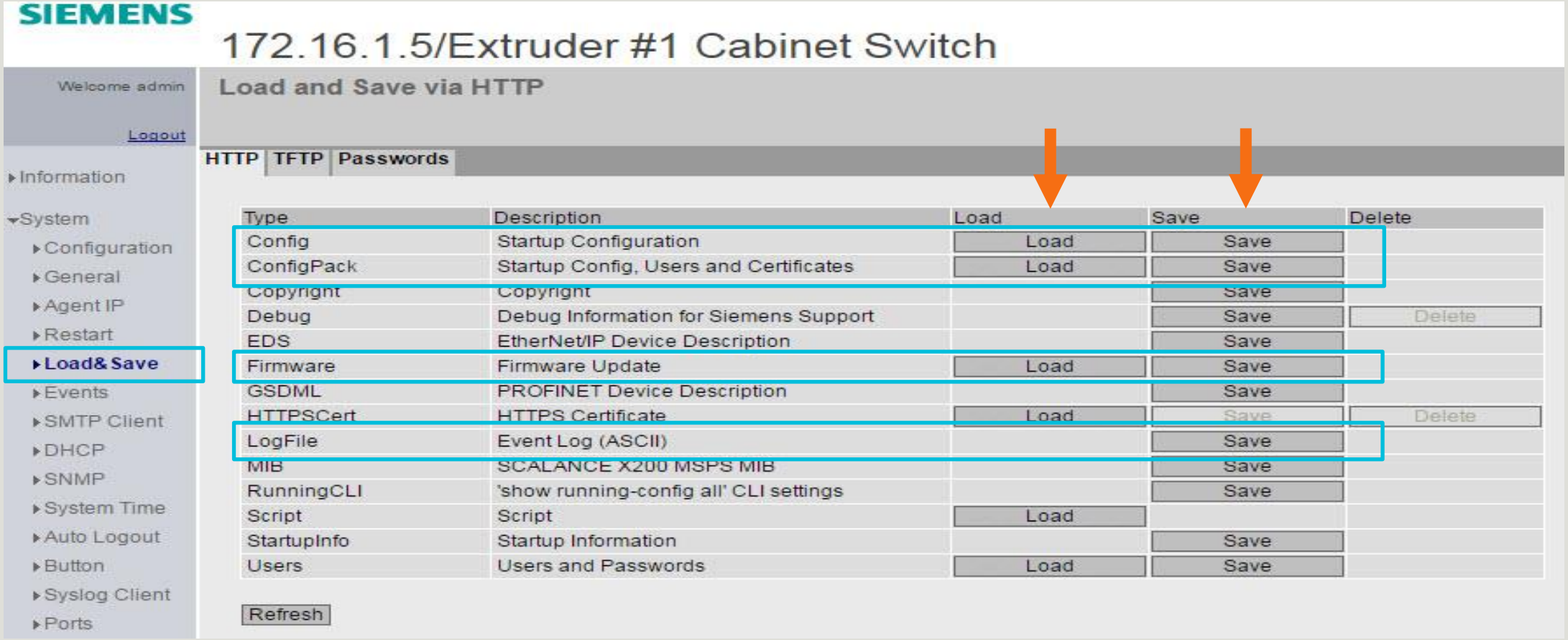
System Folder
Load & Save



- * Config Files, Firmware, and System Event Log Table can be downloaded on the System > Load & Save page
- * Config Files and Firmware can be loaded onto the switch.

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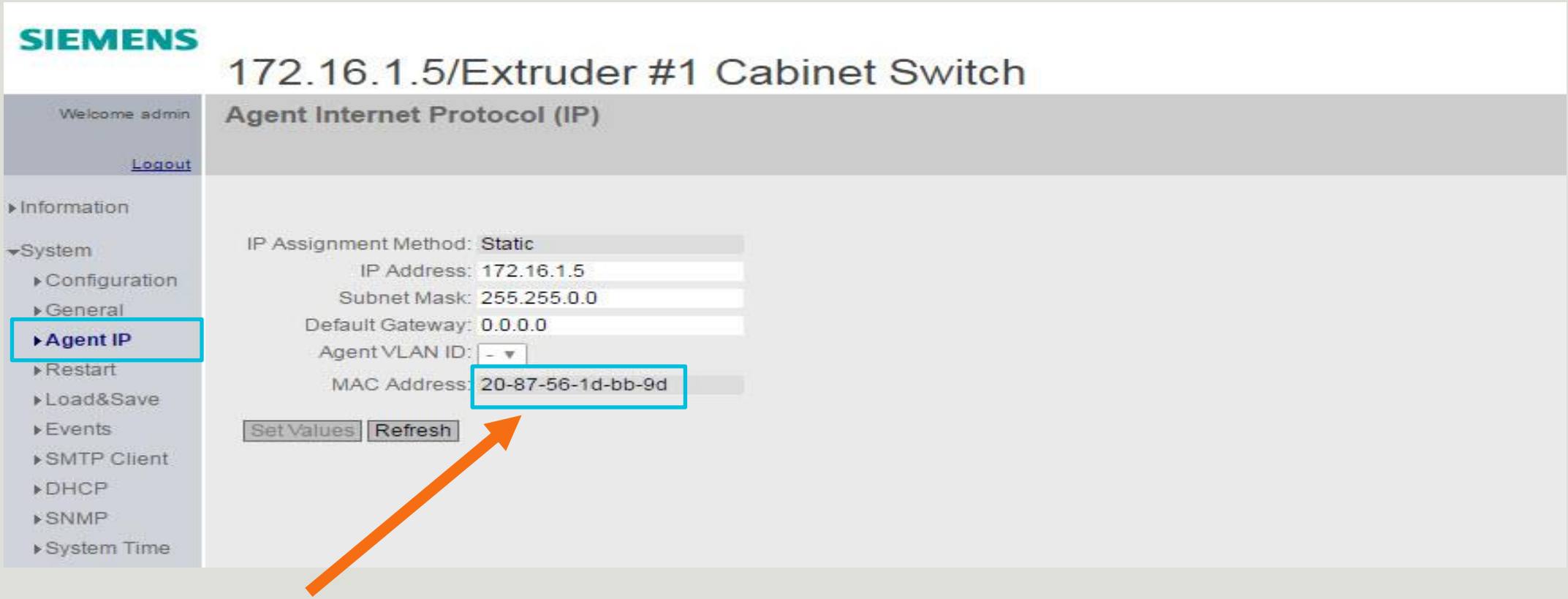
System Folder
Agent IP



- The MAC Address of the overall switch can be found at System > Agent IP
- Be careful changing the IP address from this menu.

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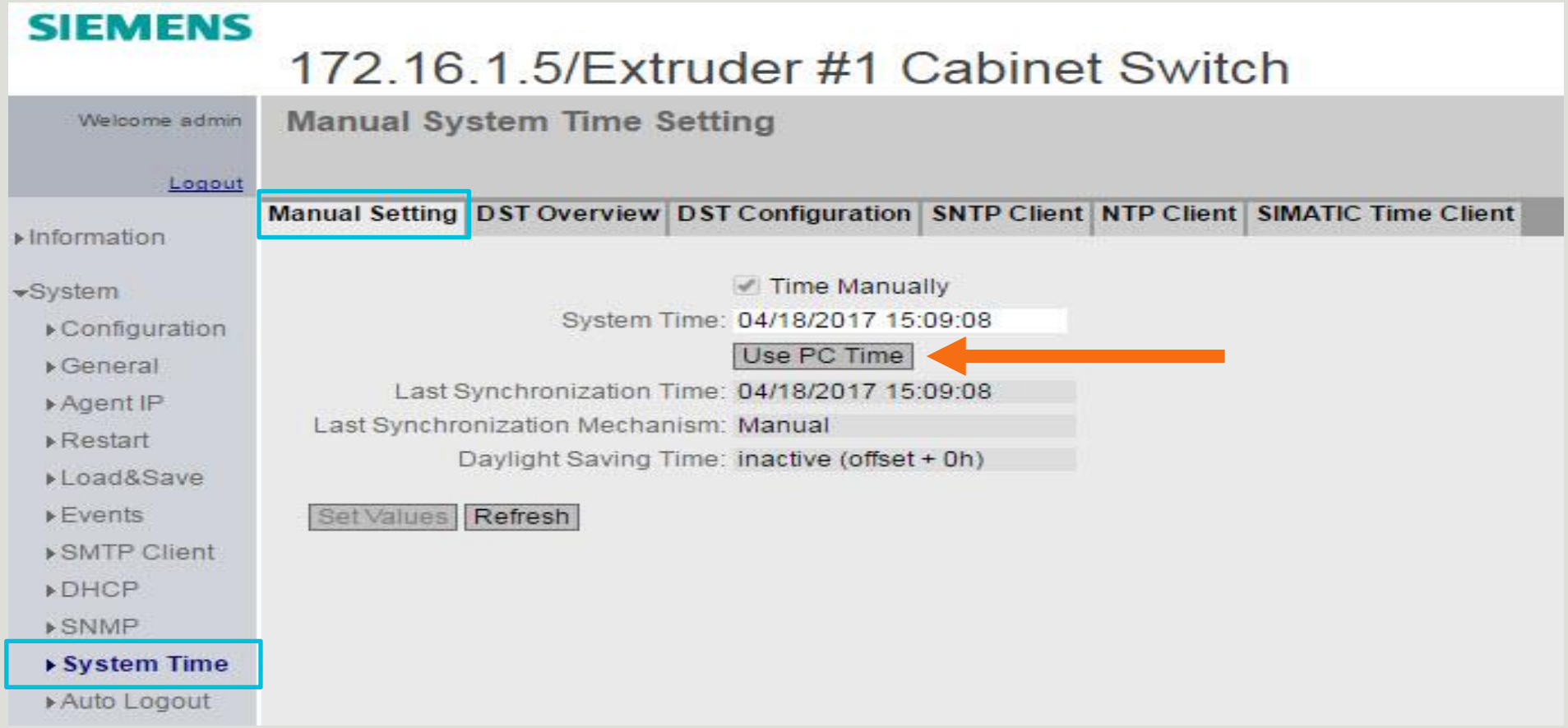
System Folder
System Time



If none of the synchronized time settings (e.g. NTP, SNTP, Simatic Time, etc.) are feasible, use the PC Time under the Manual Setting tab.

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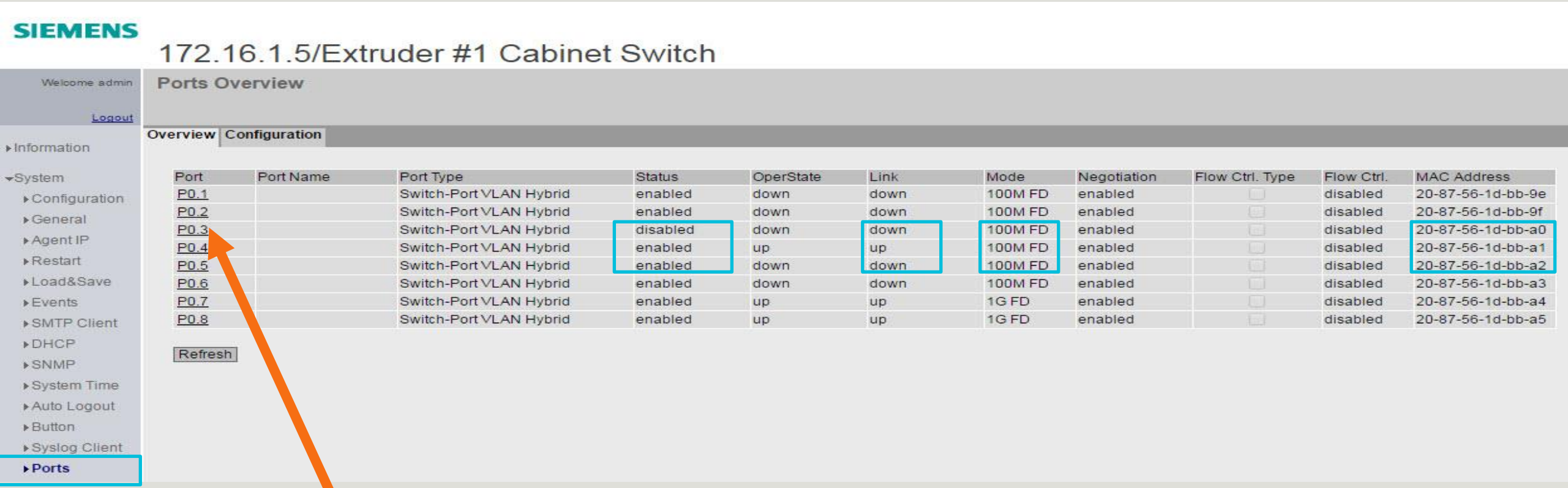
System Folder
Ports Overview



Port	Port Name	Port Type	Status	OperState	Link	Mode	Negotiation	Flow Ctrl. Type	Flow Ctrl.	MAC Address
P0.1		Switch-Port VLAN Hybrid	enabled	down	down	100M FD	enabled		disabled	20-87-56-1d-bb-9e
P0.2		Switch-Port VLAN Hybrid	enabled	down	down	100M FD	enabled		disabled	20-87-56-1d-bb-9f
P0.3		Switch-Port VLAN Hybrid	disabled	down	down	100M FD	enabled		disabled	20-87-56-1d-bb-a0
P0.4		Switch-Port VLAN Hybrid	enabled	up	up	100M FD	enabled		disabled	20-87-56-1d-bb-a1
P0.5		Switch-Port VLAN Hybrid	enabled	down	down	100M FD	enabled		disabled	20-87-56-1d-bb-a2
P0.6		Switch-Port VLAN Hybrid	enabled	down	down	100M FD	enabled		disabled	20-87-56-1d-bb-a3
P0.7		Switch-Port VLAN Hybrid	enabled	up	up	1G FD	enabled		disabled	20-87-56-1d-bb-a4
P0.8		Switch-Port VLAN Hybrid	enabled	up	up	1G FD	enabled		disabled	20-87-56-1d-bb-a5

- An overview of all ports can be reviewed on the System > Ports page.
- Individual Port settings can be selected by clicking on the Port number.
- The individual MAC Address of each port is also listed.

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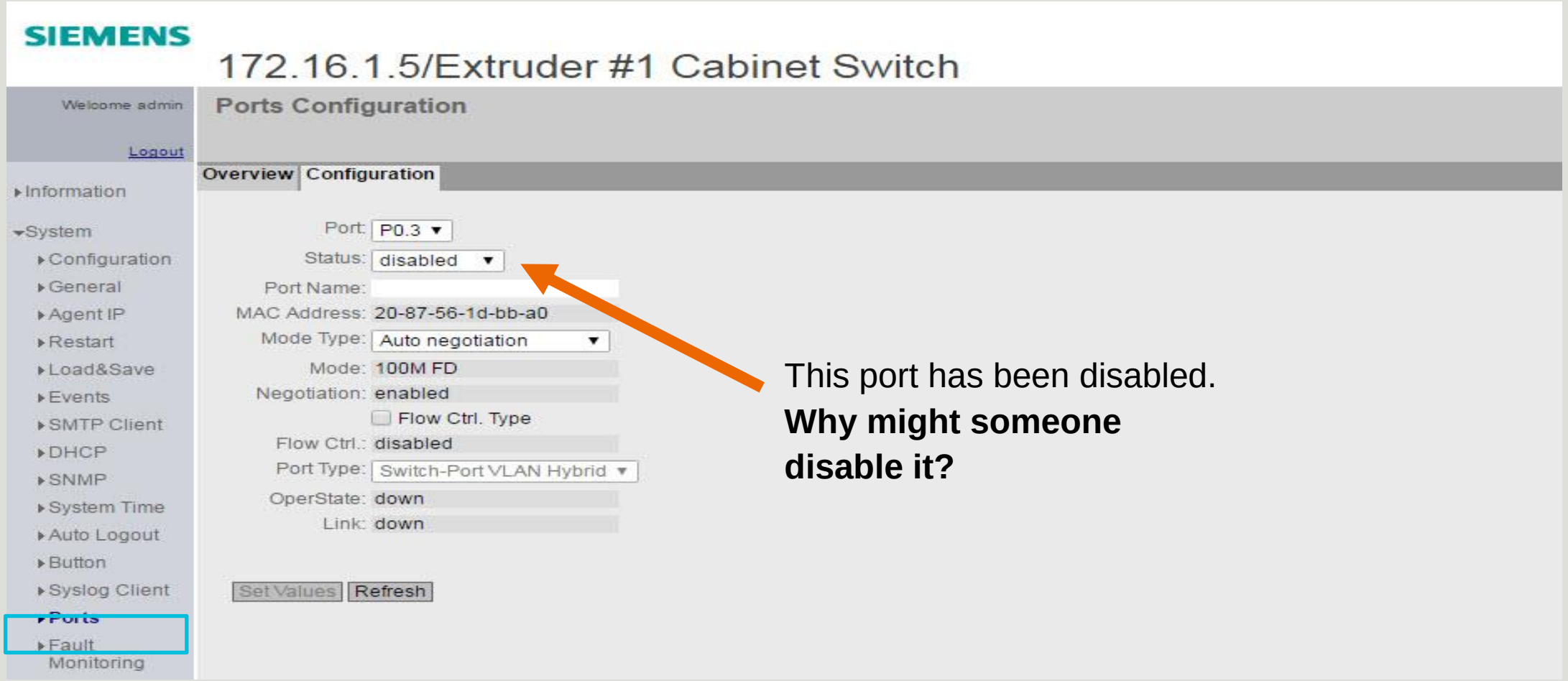
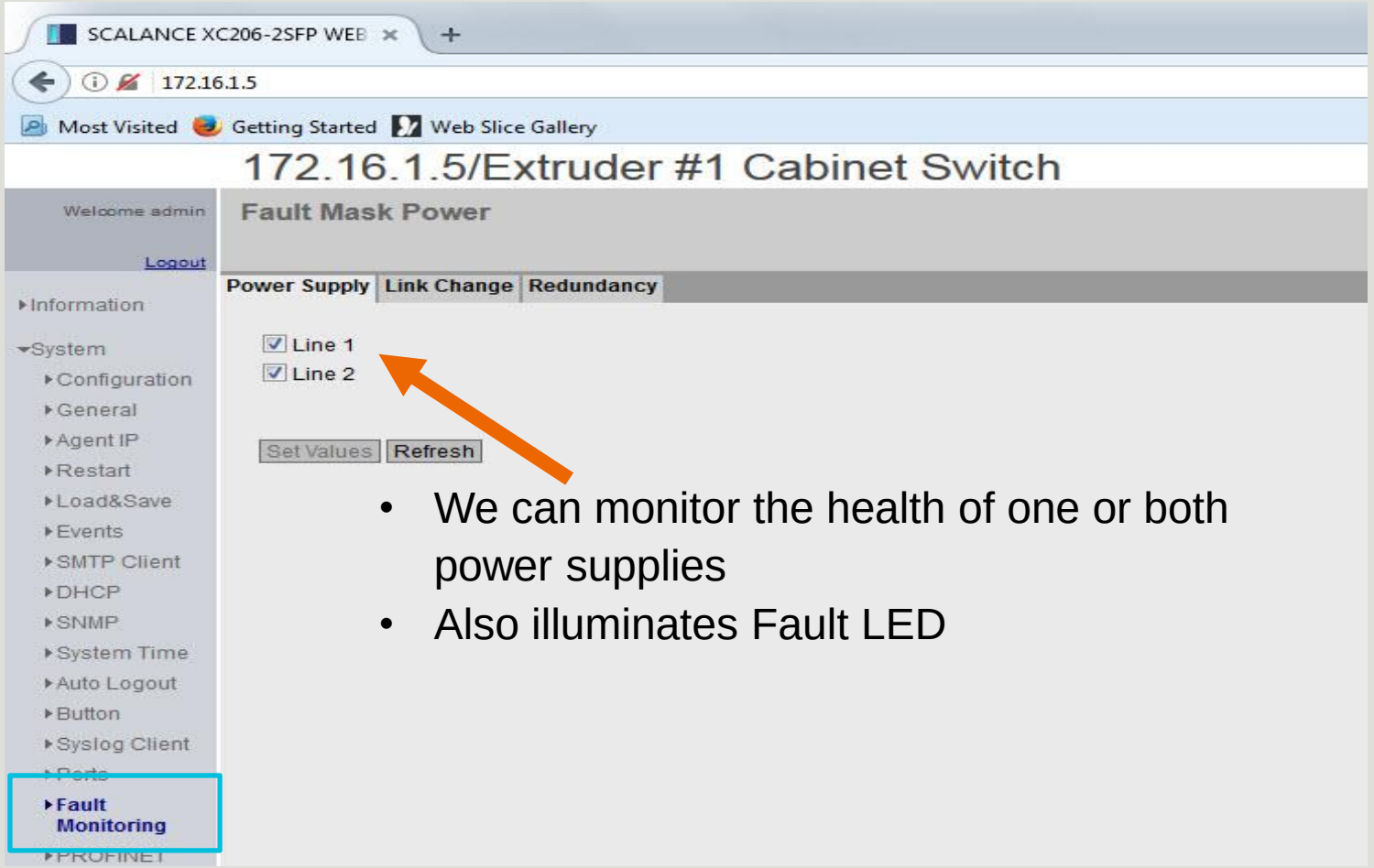
System Folder
Ports Status & Settings



This port has been disabled.

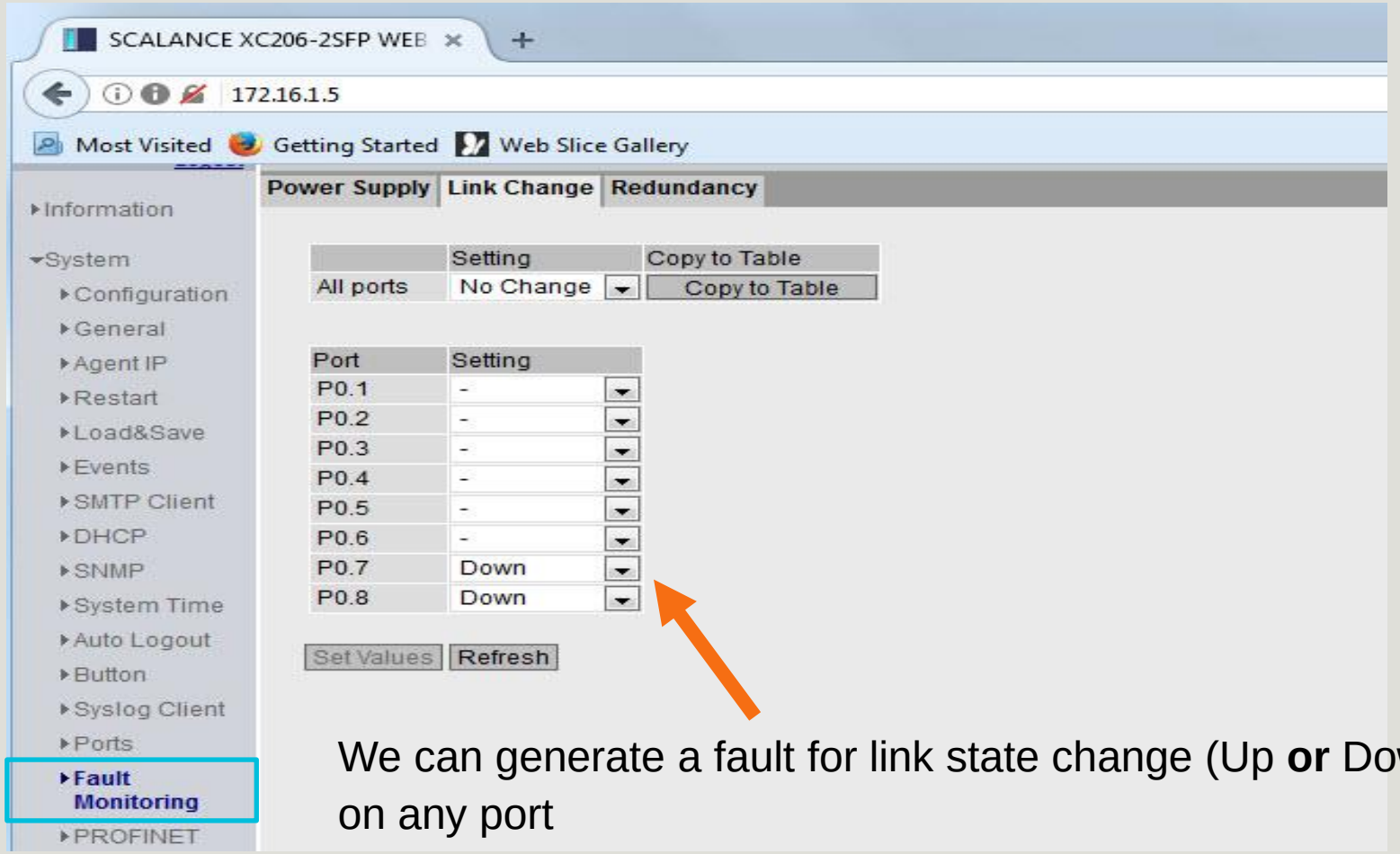
Why might someone disable it?

System Folder
Fault Monitoring Power Supply



- We can monitor the health of one or both power supplies
- Also illuminates Fault LED

System Folder
Fault Monitoring - Link Status



We can generate a fault for link state change (Up **or** Down) on any port

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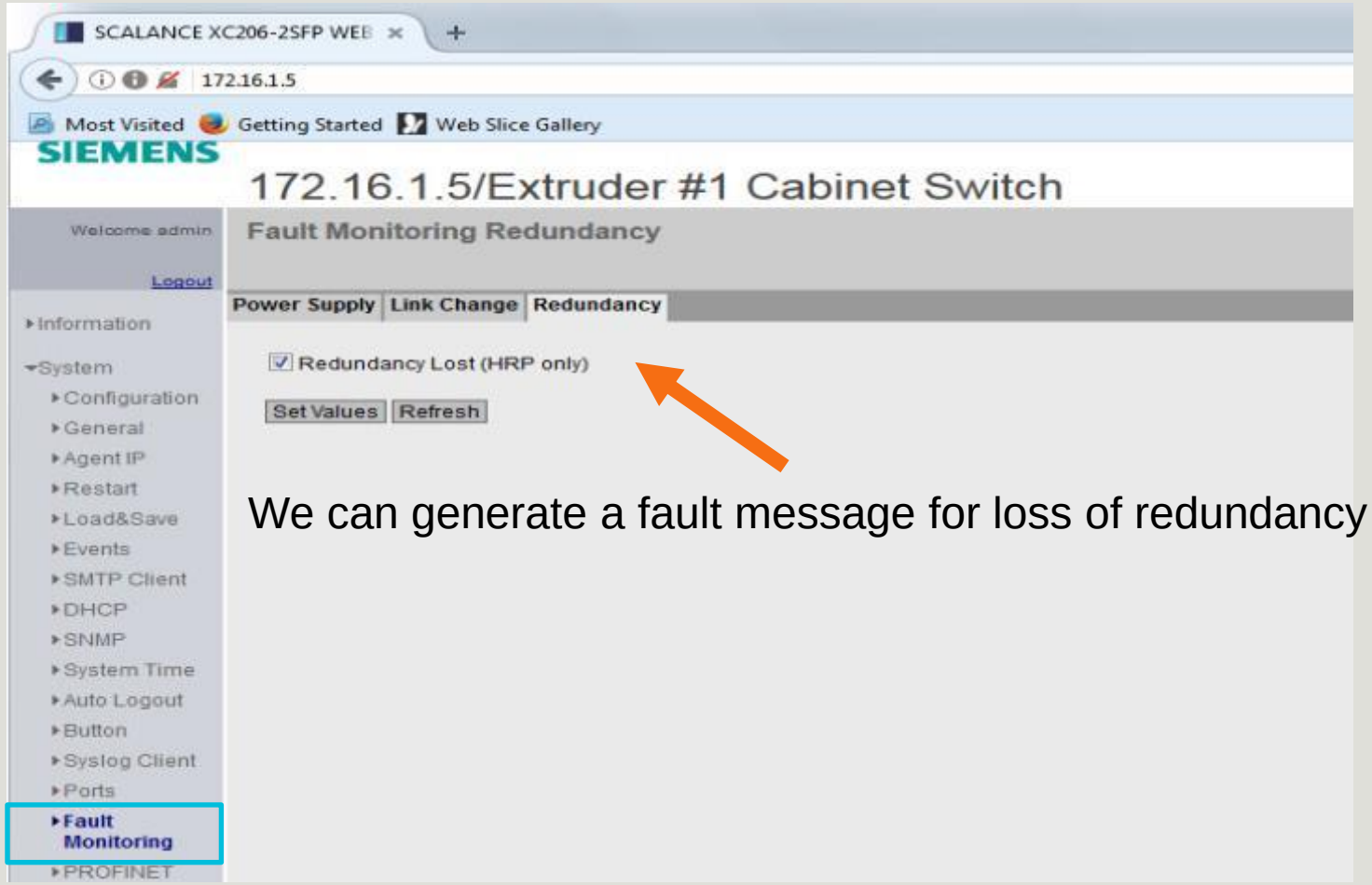
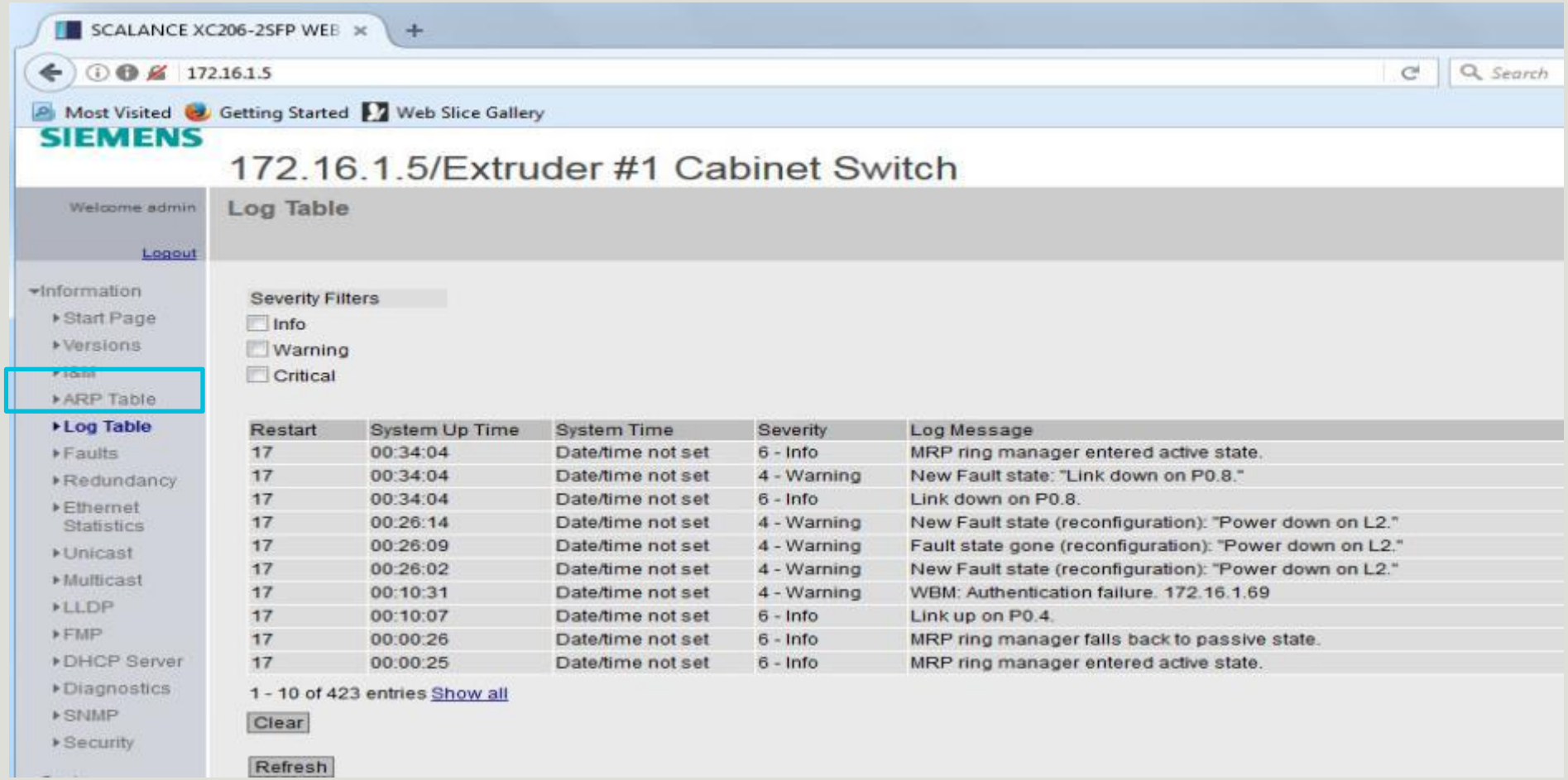
System Folder
Fault Monitoring - Redundancy



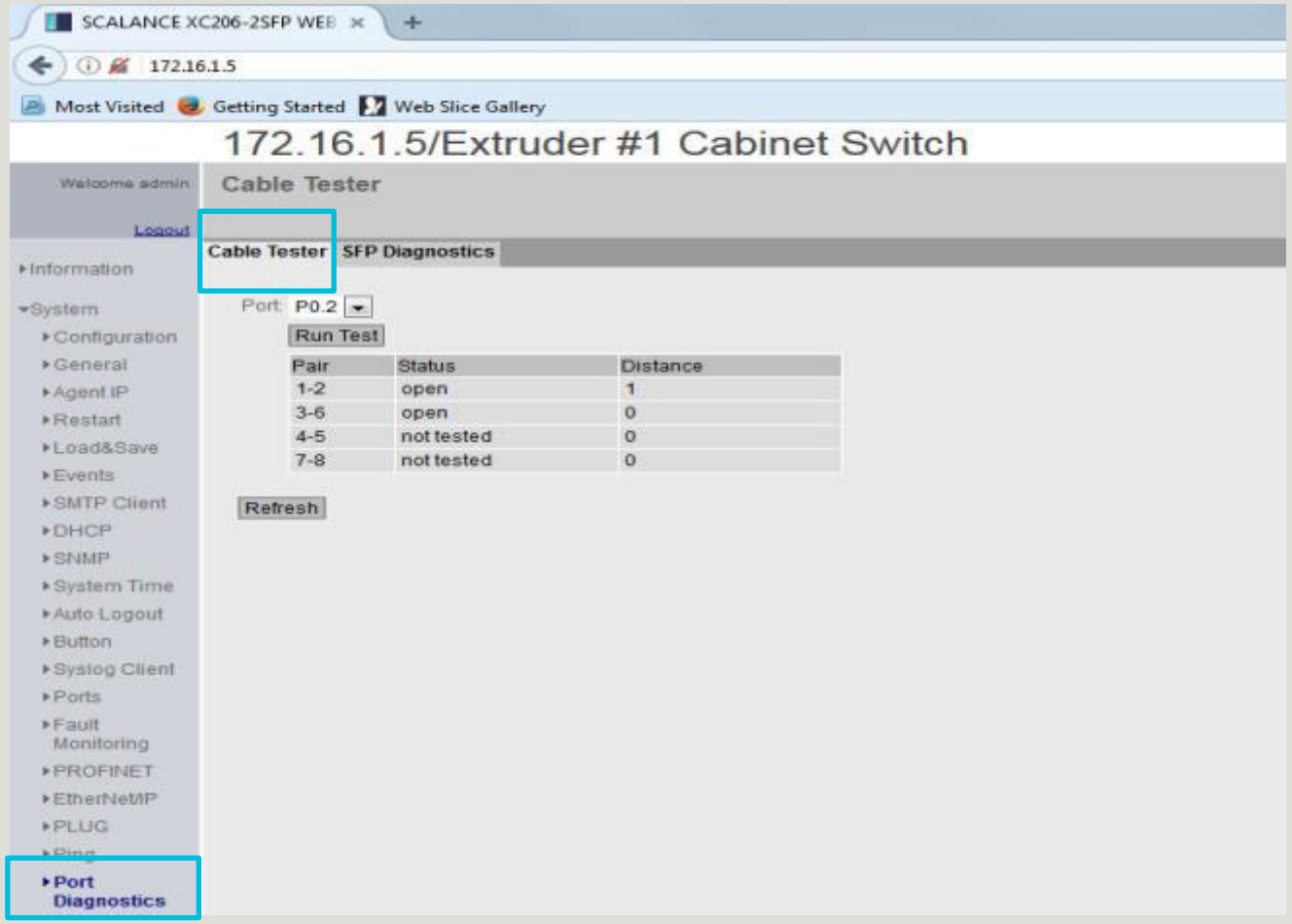
We can generate a fault message for loss of redundancy (HRP only)

System Folder
Log Table Fault Messages Review

To view the generated faults, we need to return to the Log Table under Information



System Folder
Port Diagnostics Cable Tester - Copper



- For testing copper cables only
- Do not test on data connection used for WBM interface
- 10/100MB cables only test pairs 1-2 and 3-6.
- Status can be Open, Wire Break, Short Circuit, Not Tested, and OK
- Distance value will show the distance to the cable end, cable break, or short-circuit in meters with a tolerance of +/- 1M

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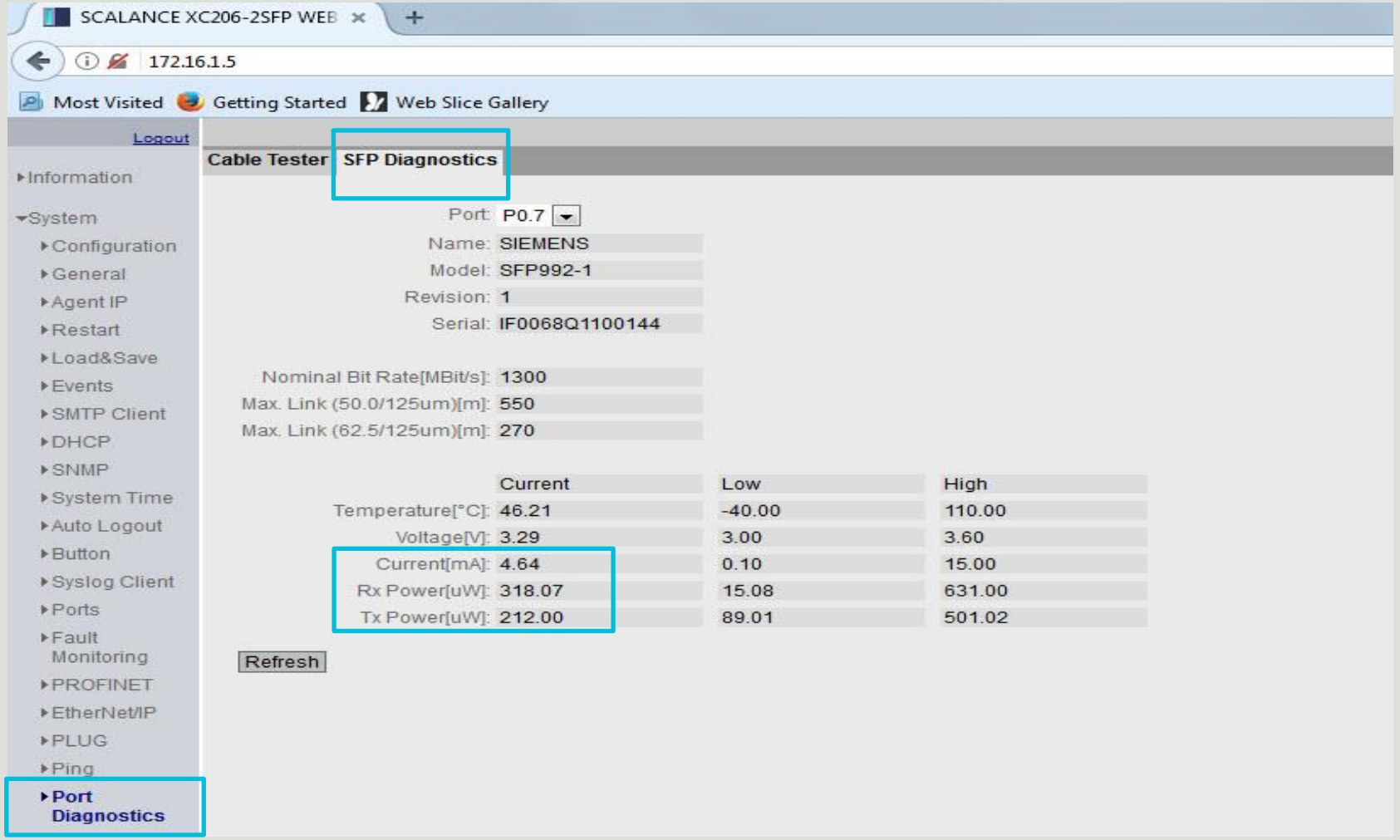
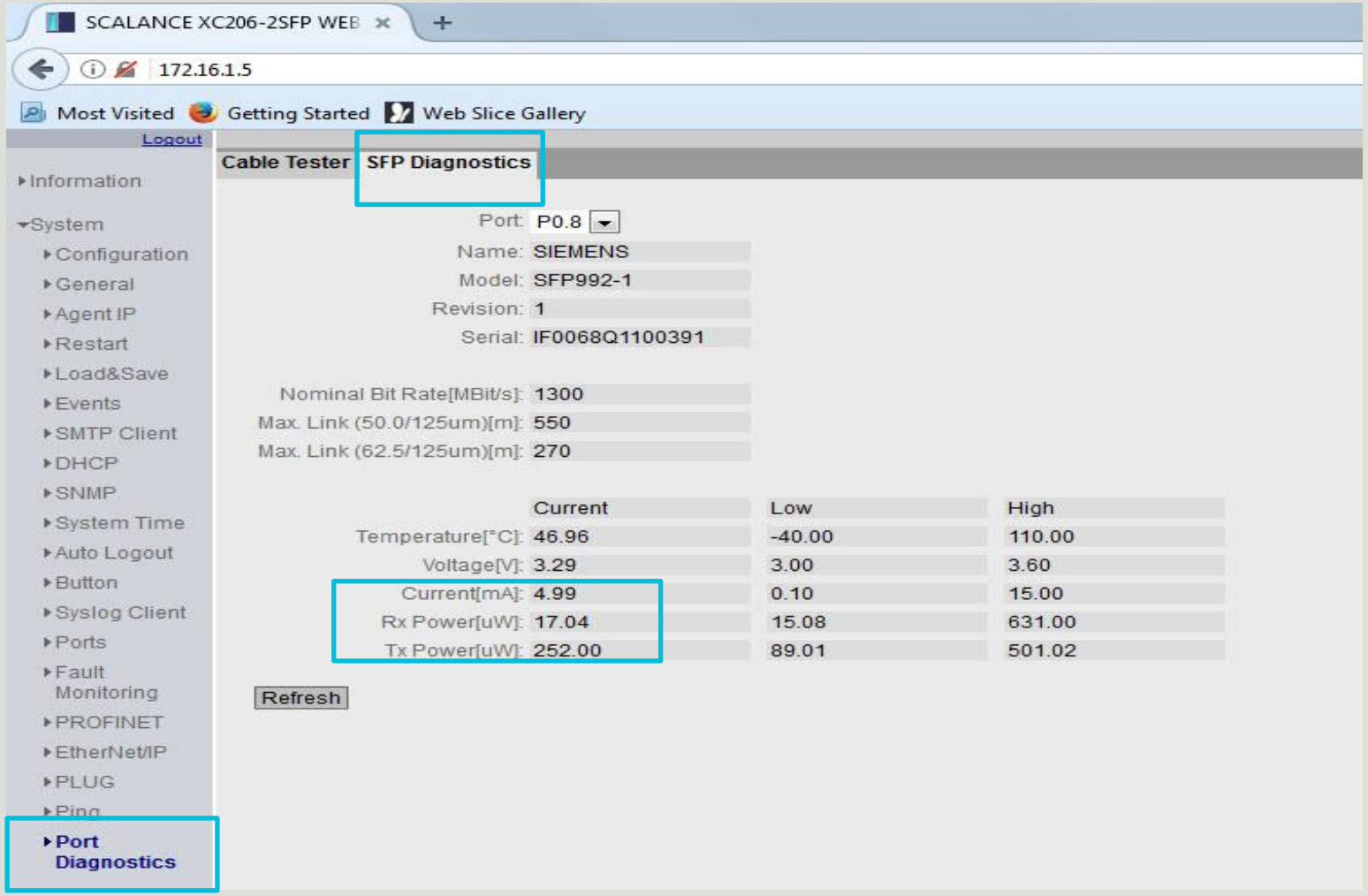
System Folder
Port Diagnostics Cable Tester – SFP



- **Good connection**
- Link Up
- Ring Functional
- Receive power well within low/high limits

System Folder
Port Diagnostics Cable Tester - SFP



- **Fiber Connection slightly pulled out**
- Link Up (still)
- Ring Functional (still)
- Fault from low receive power

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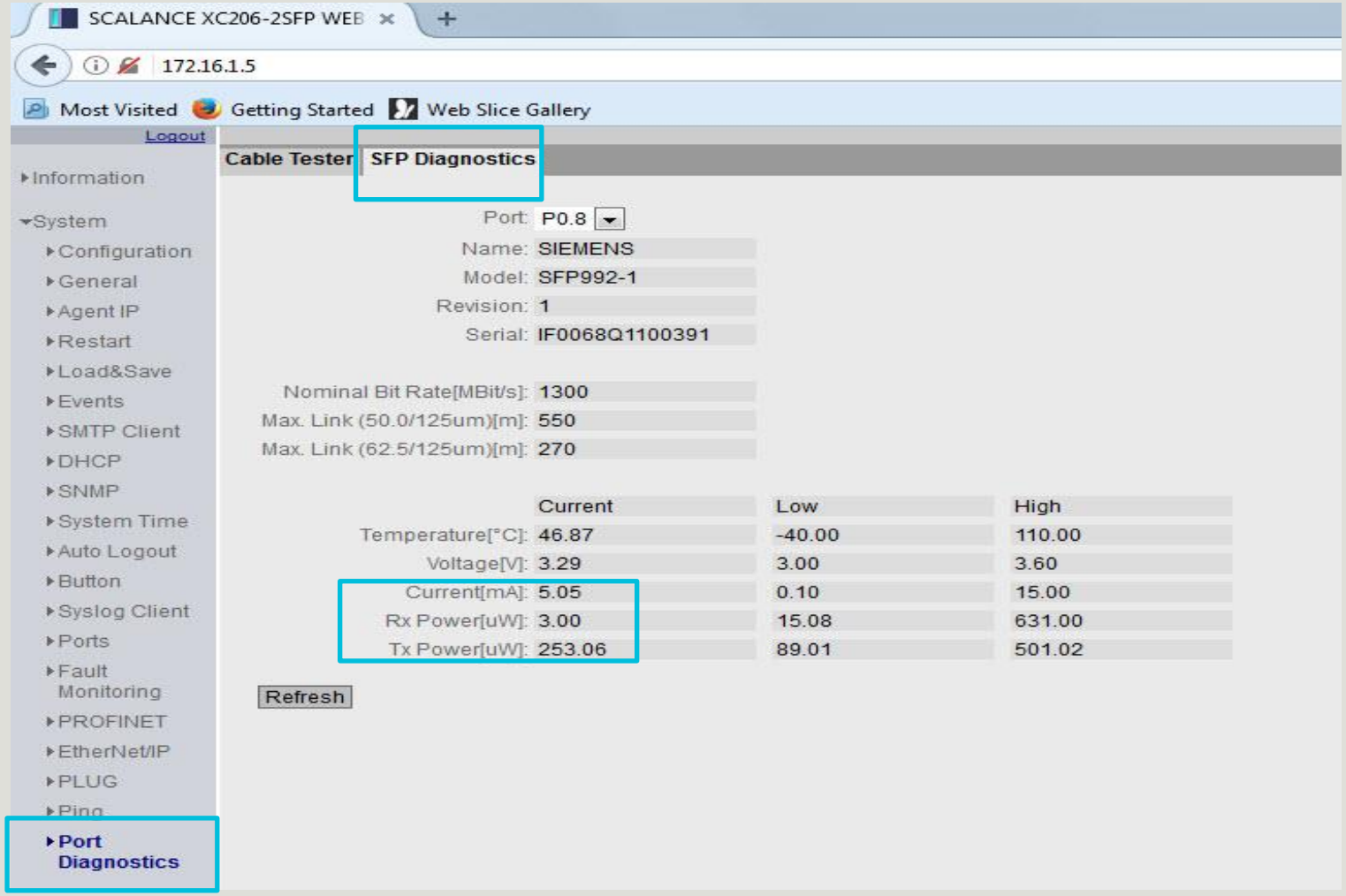
System Folder
Port Diagnostics Cable Tester - SFP



- **Fiber Connection pulled mostly out**
- Link Down
- Ring Active
- Receive power outside of acceptable tolerances

Agenda

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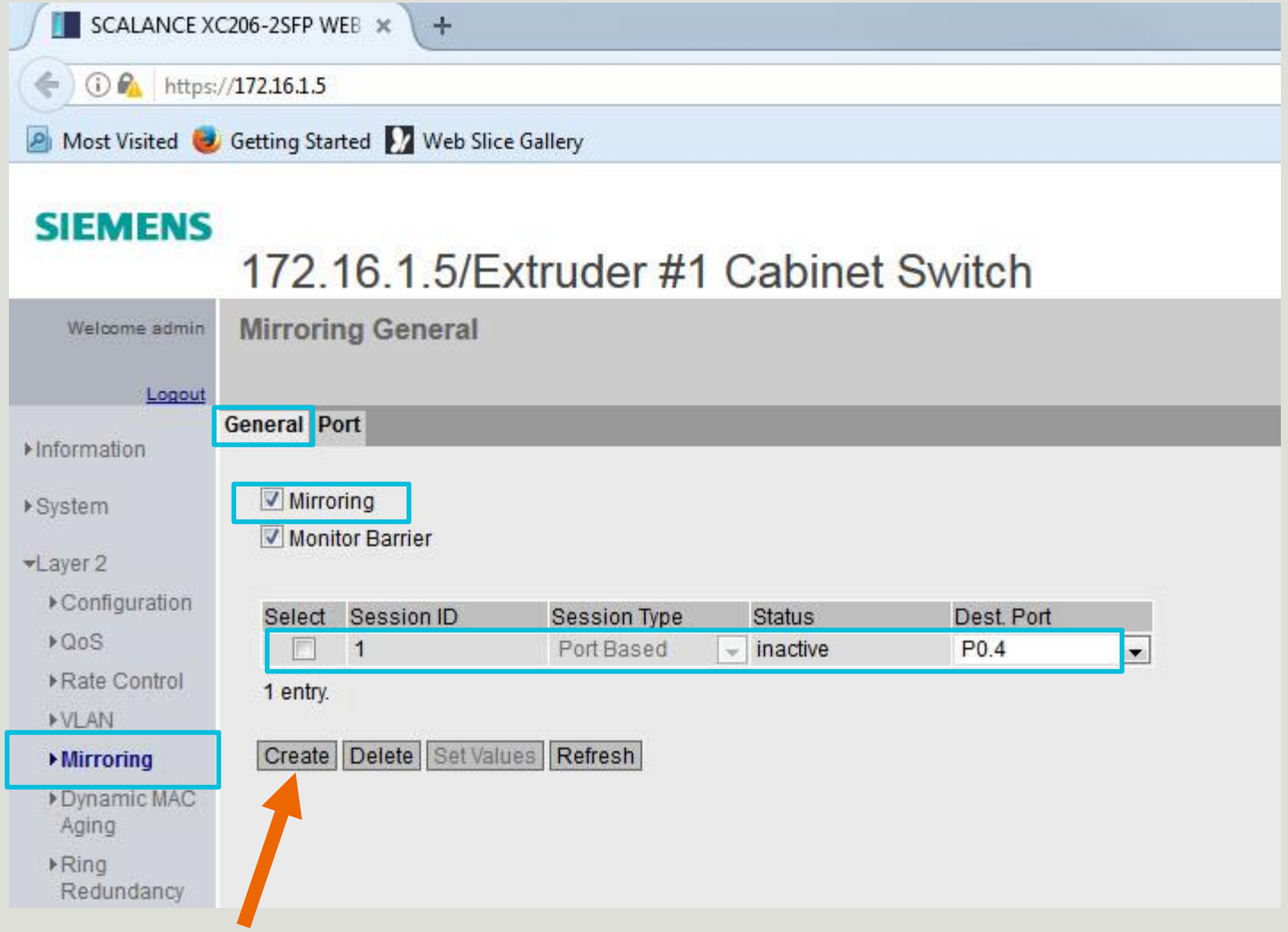
   - Switch Diagnostics and Best Practices
     - ✓ Information Folder
     - ✓ System Folder
     - ✓ **Layer 2 Folder**
   - Configuring a redundant ring
   - Coupling redundant rings
5. Interconnecting to IT – Passive Listening
6. Review Network Monitoring (Optional)

Layer 2 Folder
Mirroring (General)

Required Steps:

1. Create a Session (General Tab)
2. Assign Ingress and Egress of the Port(s) to the Session (Port Tab)
3. Enable Mirroring (General Tab)



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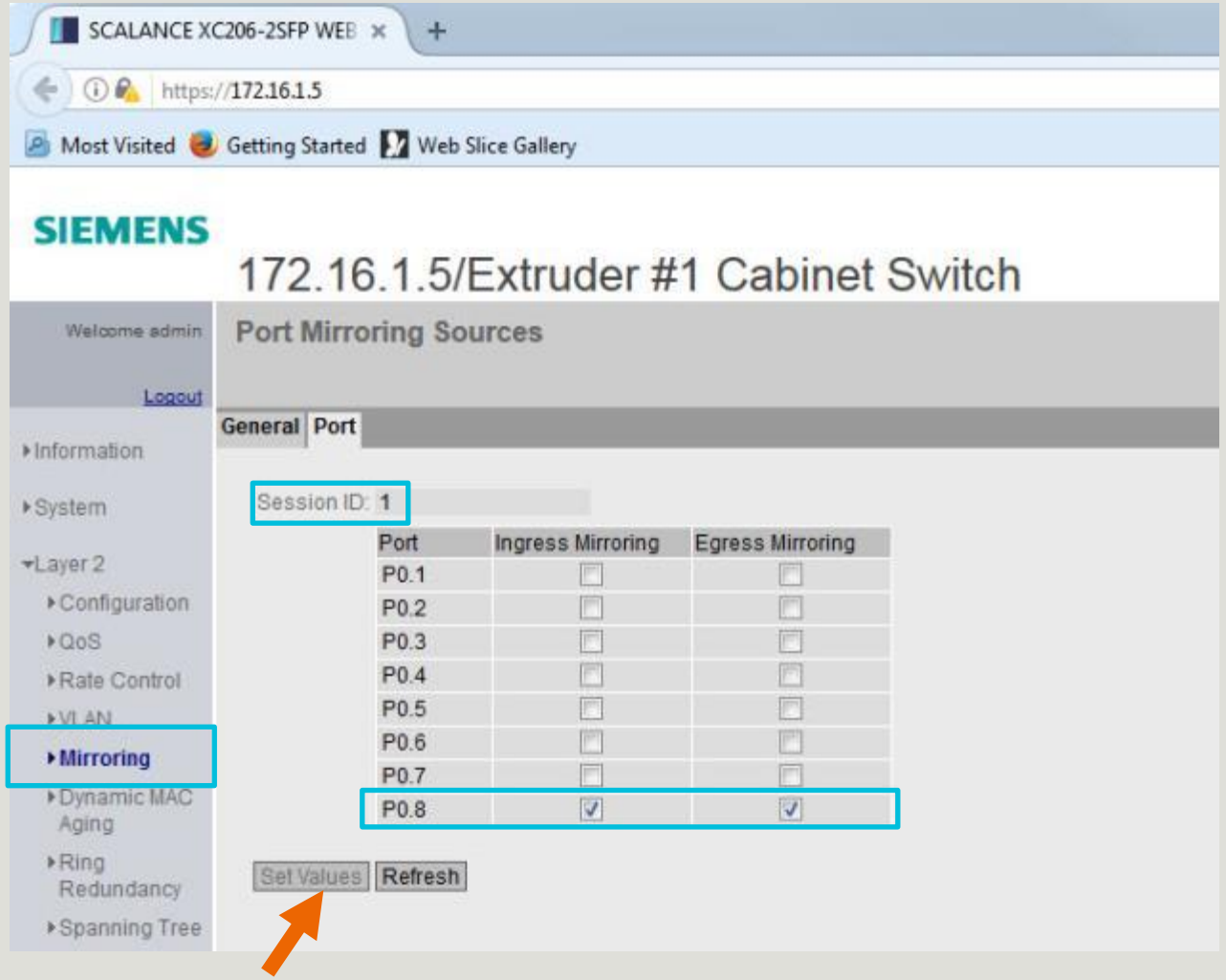
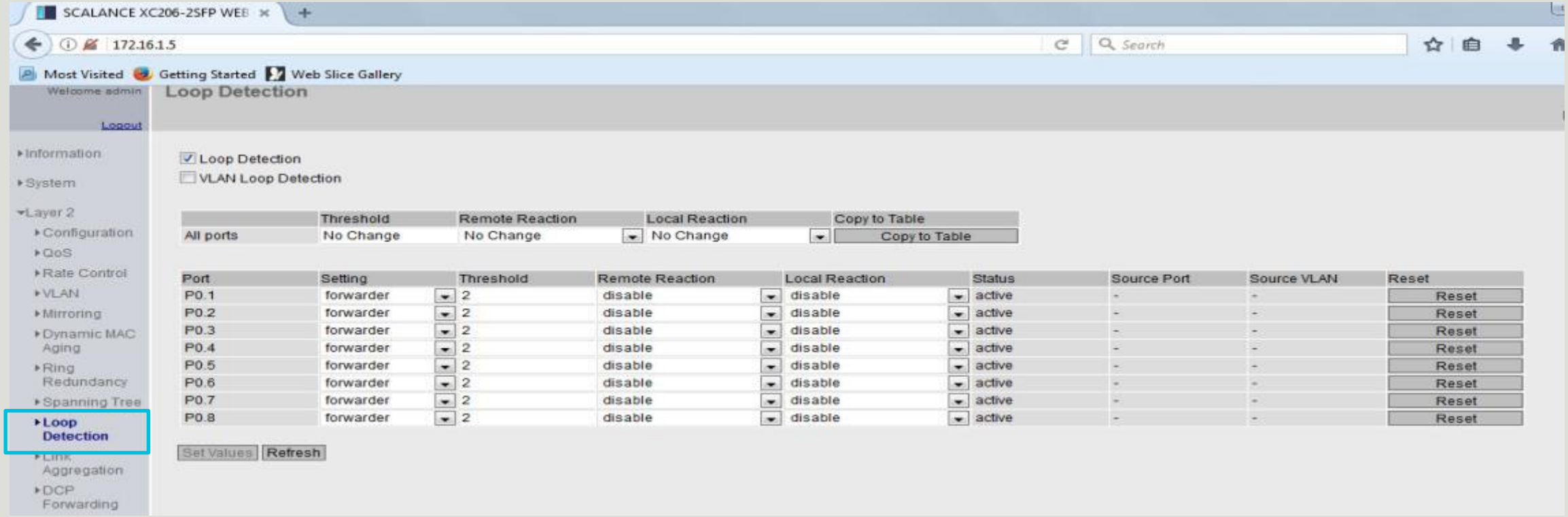
Layer 2 Folder
Mirroring (Port)



Layer 2 Folder
Loop Detection



- Special loop detection frames are used to check whether loops exist on the suspected ports
- Only possible at ports that were not configured as ring ports or standby ports
- Helps to find the loop more quickly but does not eliminate it
- Creates additional load: use the sender, forwarder, and blocked functions appropriately

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Network Availability
Requirement

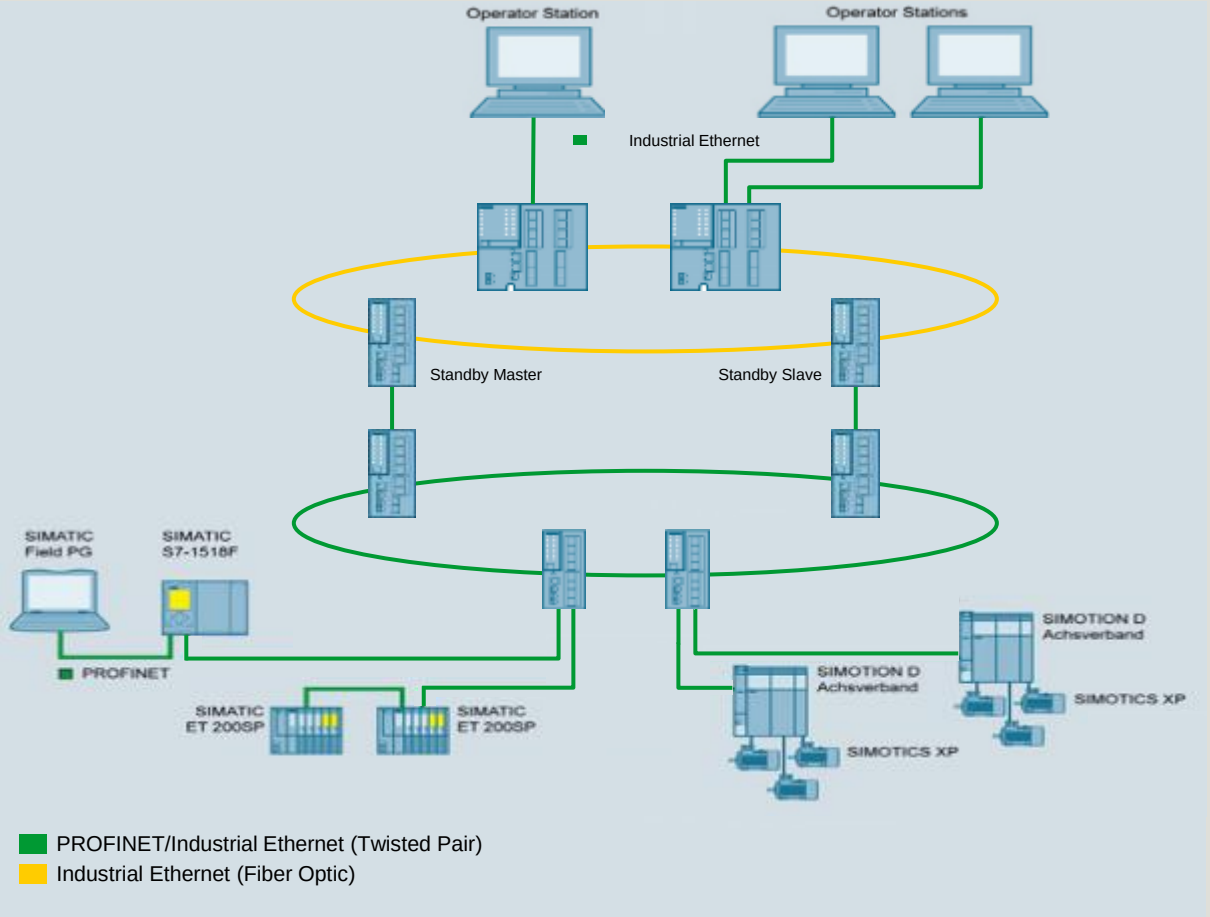
Reliable networks, capable of withstanding failures are achieved by:

- Reliable devices
- Fault-tolerant systems
- Redundancy

The network should have a topology that allows fast convergence following a fault.

Requirements:

- Automatic reconfiguration following line failure
- Automatic reconfiguration following port deactivation
- Automatic reconfiguration following component failure
- Monitoring of redundancy mechanisms



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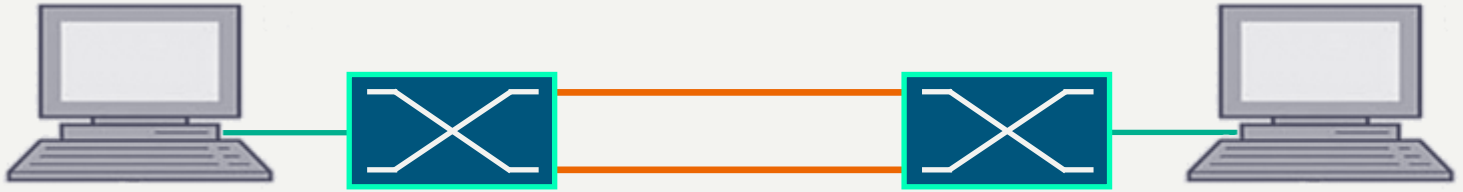
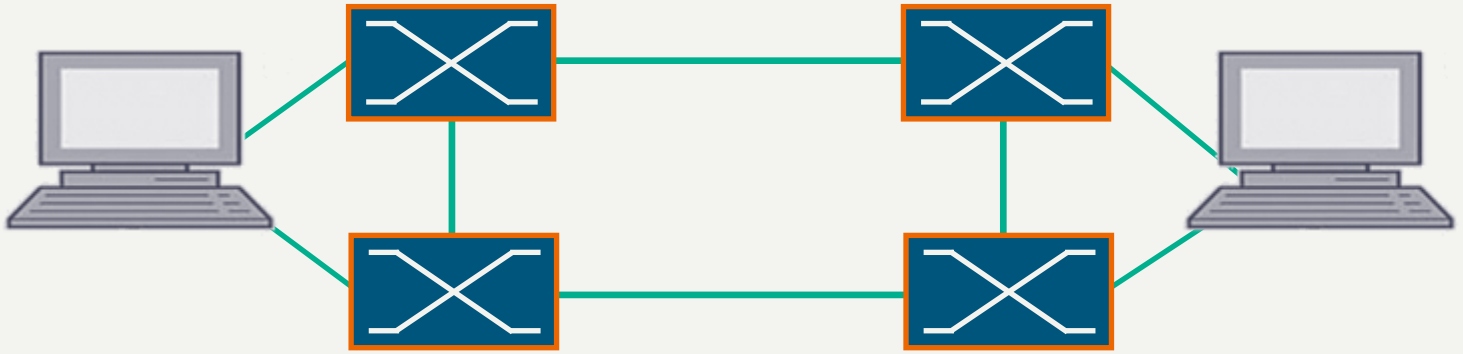
Network Availability
Solutions

Line-Redundancy:



Device-Redundancy:



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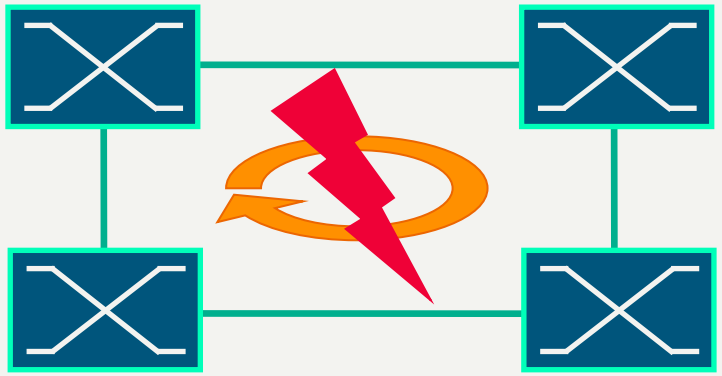
Network Availability
Problem

Problem: Loops

If there are loops in a network, Broadcast-Frames will circle around the loop.

This causes a very high network load, which makes all useful communication impossible.

→ **In Ethernet Networks, Loops are not allowed!**



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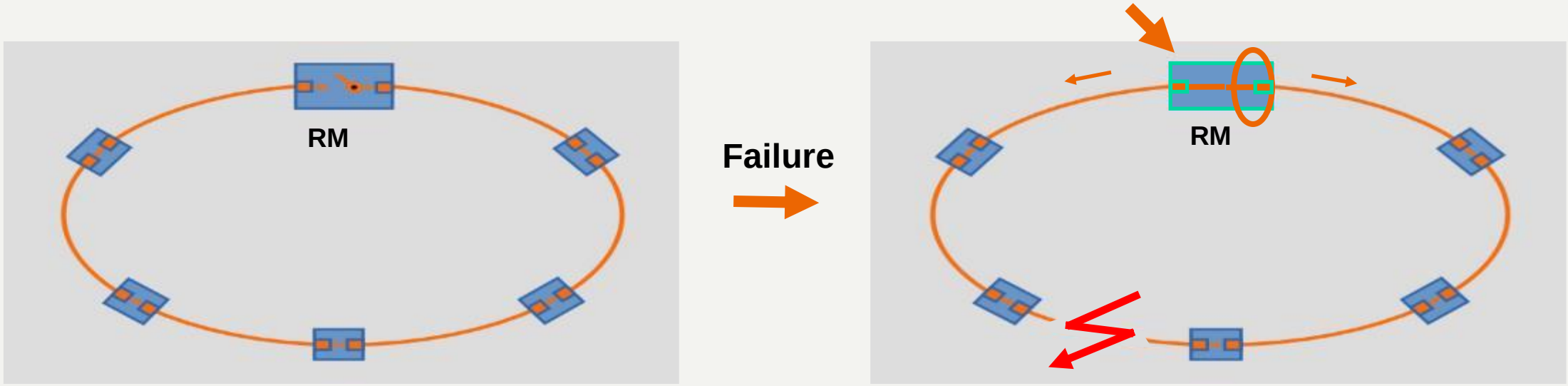
Redundant Rings
How it Works

Starting with our XC200 series you have a Ring Redundancy Manager included.

- The Ring manager opens the ring in no failure cases
- Looking at the data transmission, the bus is now linear
- Cyclic test frames are used to check ring status
- As soon as there is a failure the ring manager connects through and informs Ring clients



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Redundant Rings

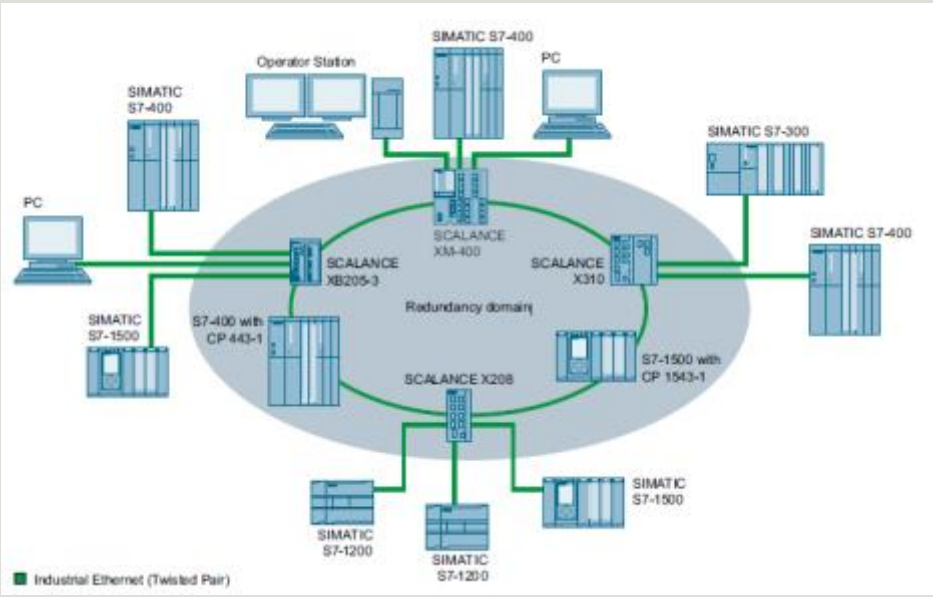
Siemens switches offer different protocols for using redundant rings:

High Speed Redundancy Protocol (HRP):

- typical reconfiguration < 300ms with up to 100 ring nodes
- only devices that support the HRP function can be used in the ring
- devices that do not support HRP must be linked to the ring using special devices with HRP capability

Media Redundancy Protocol (MRP):

- typical reconfiguration < 200ms with up to 50 ring nodes
- conforms to the Media Redundancy Protocol (MRP) specified in IE 62439-2 Release 1.0 (2010-02)
- only devices that support the MRP function can be used in the ring
- MRP is part of the PROFINET standard



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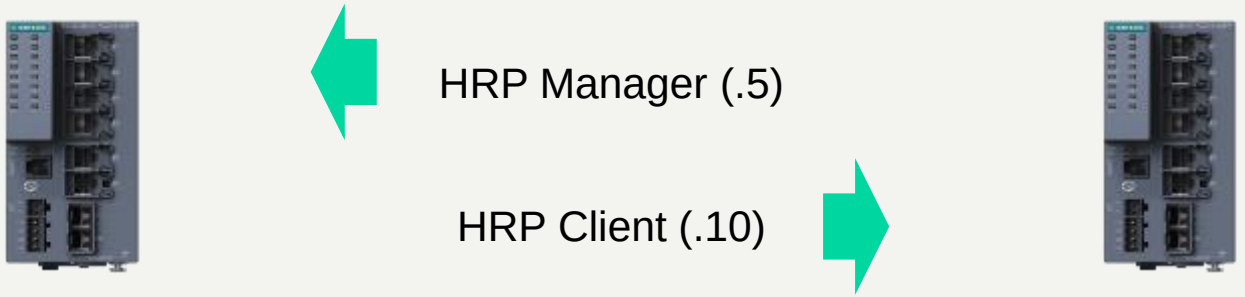
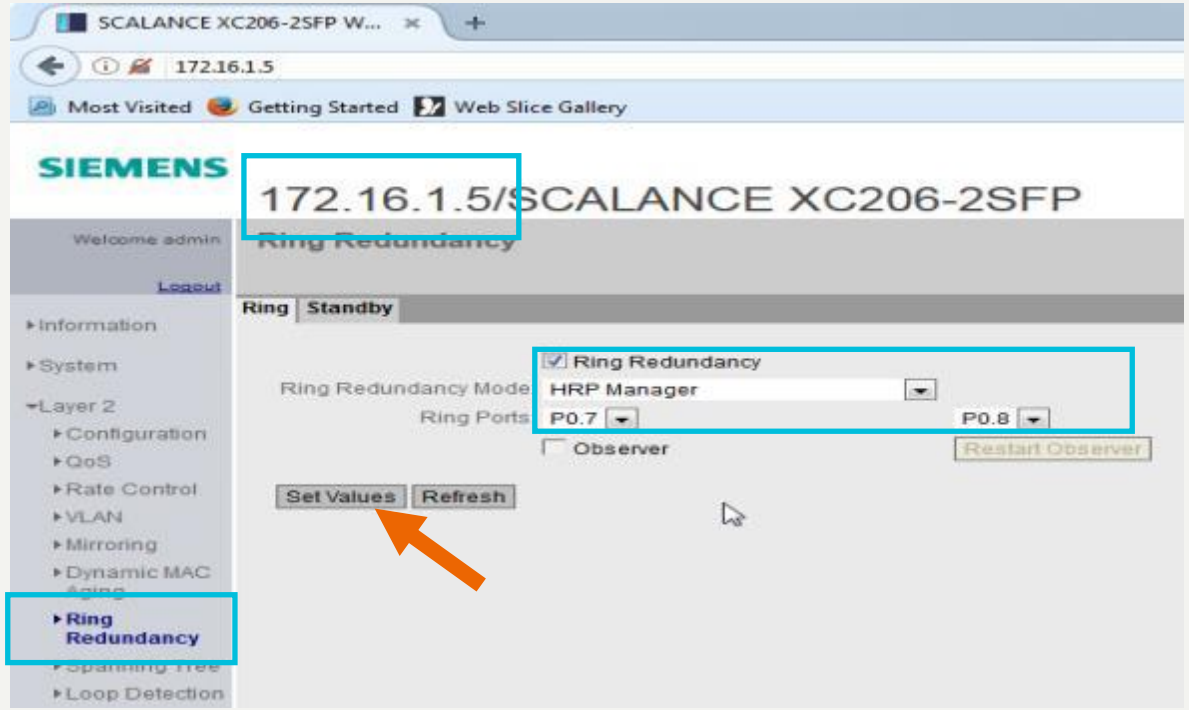
LAB 3: Pre-Lab Notes
(Configure High Speed Redundancy Protocol)

- Configure High Speed Ring Redundancy on your switch according to the pictures on the next page.
- We will be using Ring Ports 7 and 8.
- When changing from the default ring ports (1 and 2) we will get a message after changing ring port 1 that the ring ports are different types. This is normal since we are moving from copper to fiber.
- Note: Ring Redundancy Mode can be selected on the Configuration Menu as well (but not ring ports).

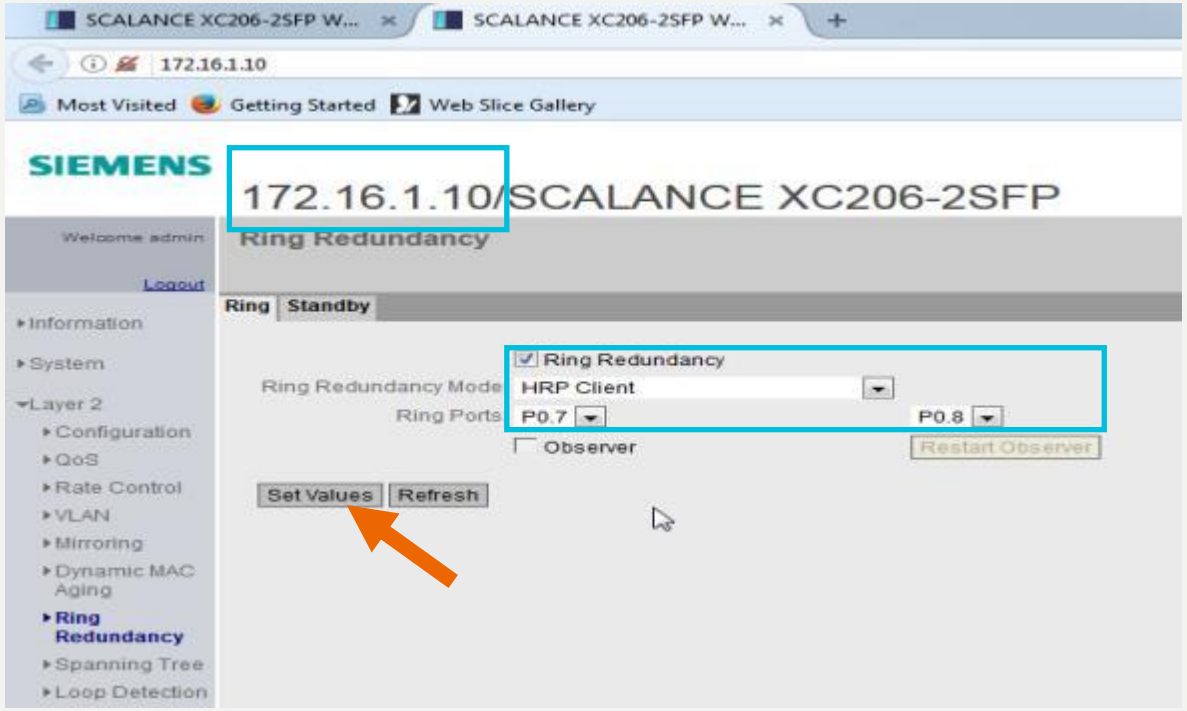


LAB 3
Configure High Speed Redundancy Protocol

HRP Manager Station nA



HRP Client Station nB



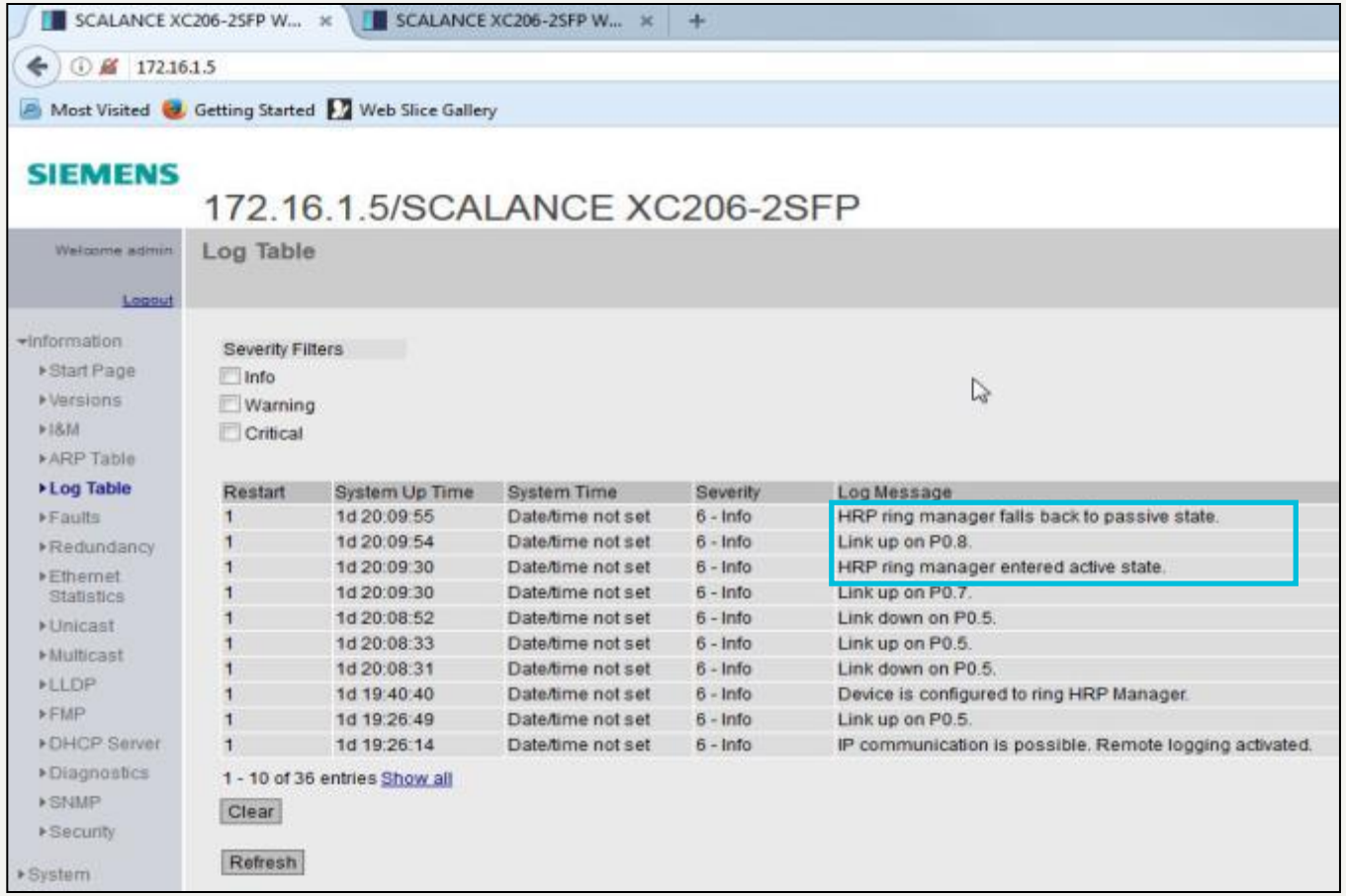
- Be sure to click Set Values after you have completed the settings.
- The settings will take effect in 1 minute, but you click on the link to take you directly to the Write Startup Config page to bypass the delay.
- **Do not connect switches together until the configuration is complete**

LAB 3
Configure High Speed Redundancy Protocol

- After the configuration of the High-Speed Redundancy in your switch, please **connect the ring as shown below**.
- In this 2-switch ring, we could also connect ports 7 together and ports 8 together, however for more than 2 switches, best practices (for debugging) would be to connect 7 to 8, 7 to 8, 7 to 8, and so on back to the first switch.
- After a short time, the ring will be established.

LAB 3
Check the status of the Ring Manager

- Using the Ring Manager switch (.5), go to **Information > Log Table** page to view the events that took place when the ring connections were made.
- Notice the Ring Manager was Active when the first connection was made, and that it changed to passive after the second connection was made
- Check the FMP Page



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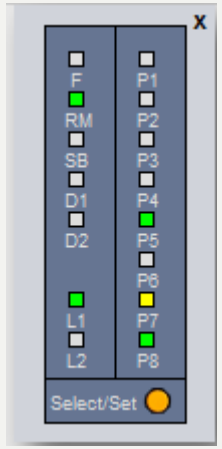
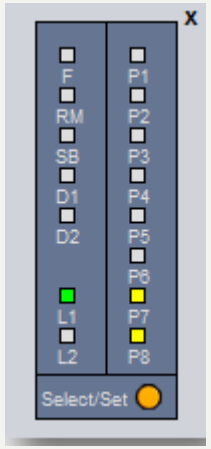
LAB 3
Check the status of the Ring Manager

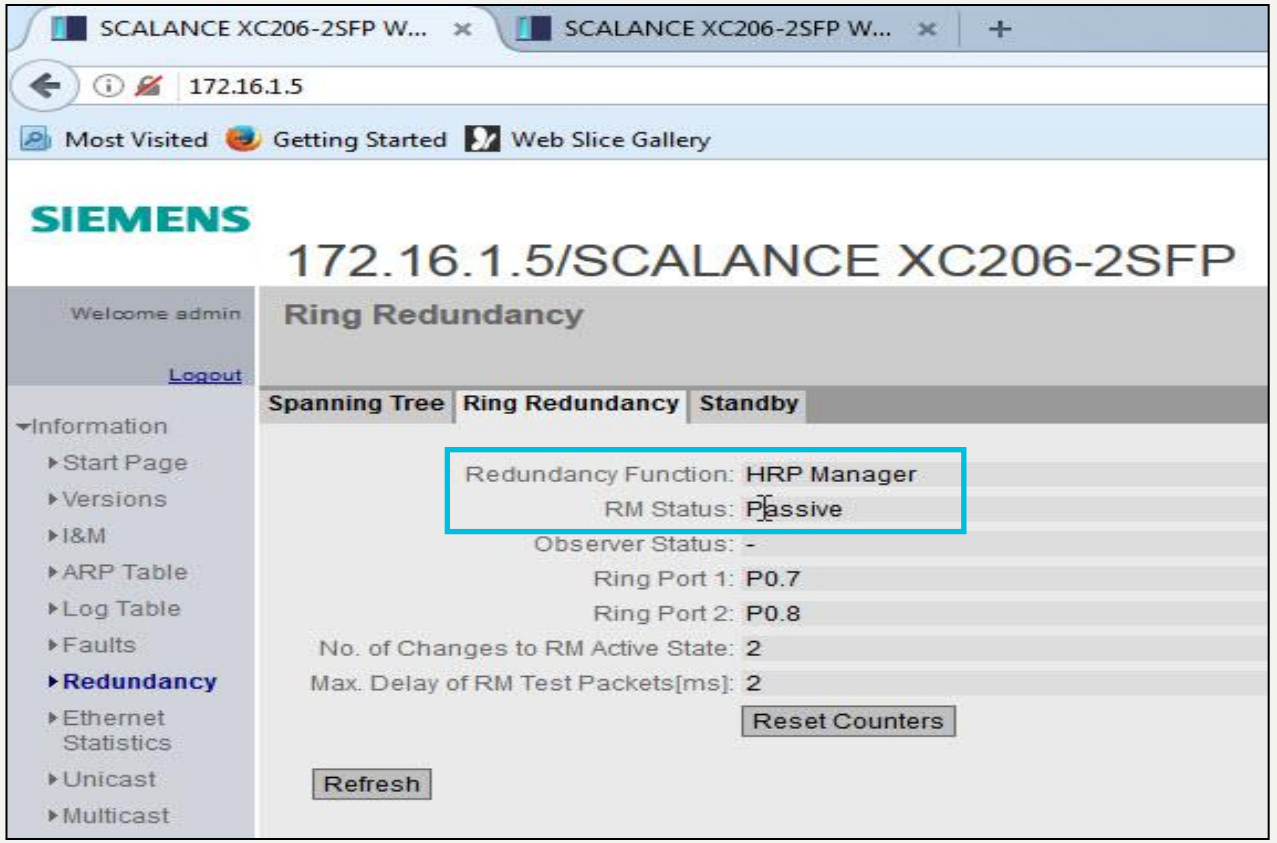
- Using the Ring Manager switch (.5), go to **Information > Redundancy > Ring Redundancy** to view an overview of the Redundancy Role/Function and the status.
- Notice the RM Led on the Ring Manager switch is solid green when passive and blinking green when active.
- What about the port 7 and 8 LEDs on both the HRP Manager and HRP Client?



HRP Manager LED Diagnostic Island



HRP Client LED Diagnostic Island



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LAB 3
Ring Redundancy – Things to Try

Disconnect one of the fiber cables:

- What happens to the RM LED on the Ring Manager?
- What events are logged in the Event Log?
- How does the status change on the Ring Redundancy tab?

Switch to the HRP Client and perform the same tasks:

- What events are logged in the Event Log?
- How does the RM LED behave?
- How does the status change on the Ring Redundancy tab?

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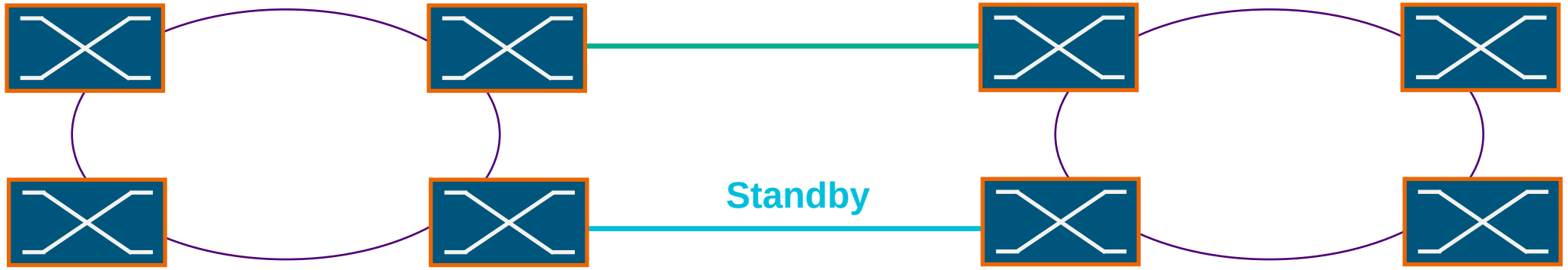
Coupling Redundant Rings

How do we couple redundant rings without giving up the high performance in case of a failure or switch over?



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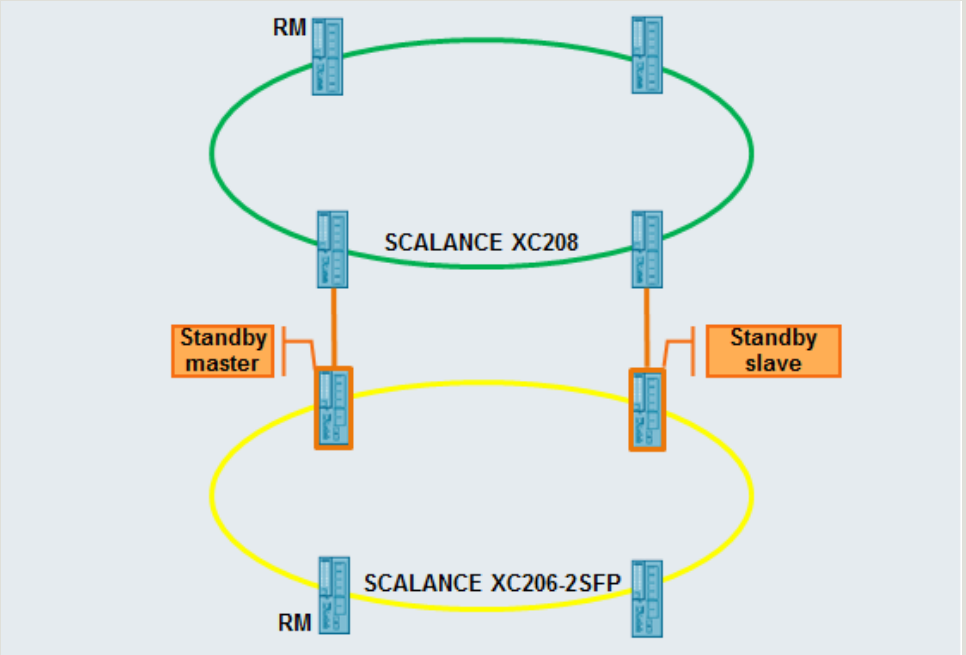
Standby Connection Functionality

The Standby-Connection allows to couple two High Speed Redundancy rings

- Available in X200IRT, XC200, XP200, X300, X400, XM400, X500, and XR500 switches
- Two switches are defined as standby master and standby slave
- In the best case scenario, the master connection is used and the slave blocked

Note:

Standby works only in High Speed Redundancy Networks, no support for MRP



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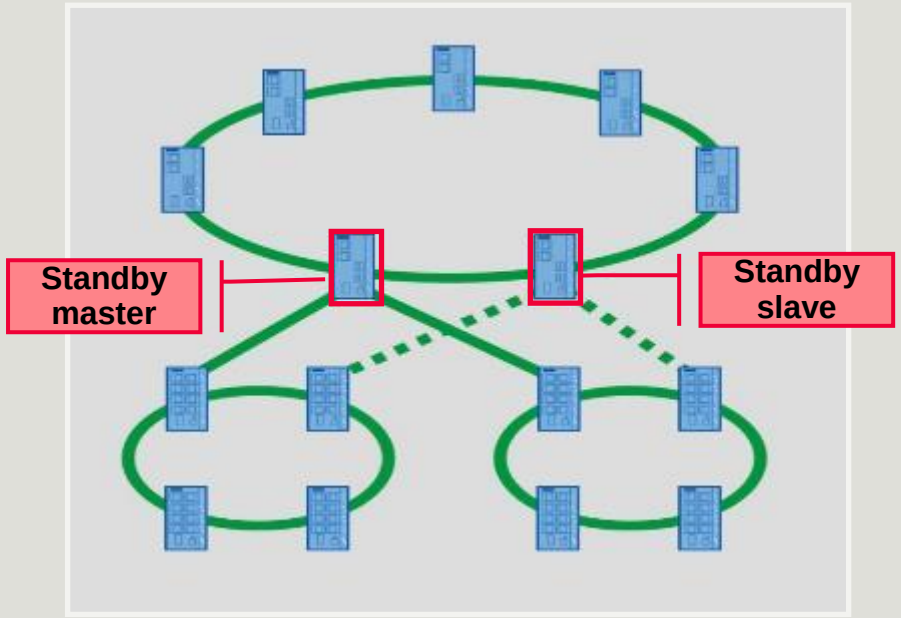
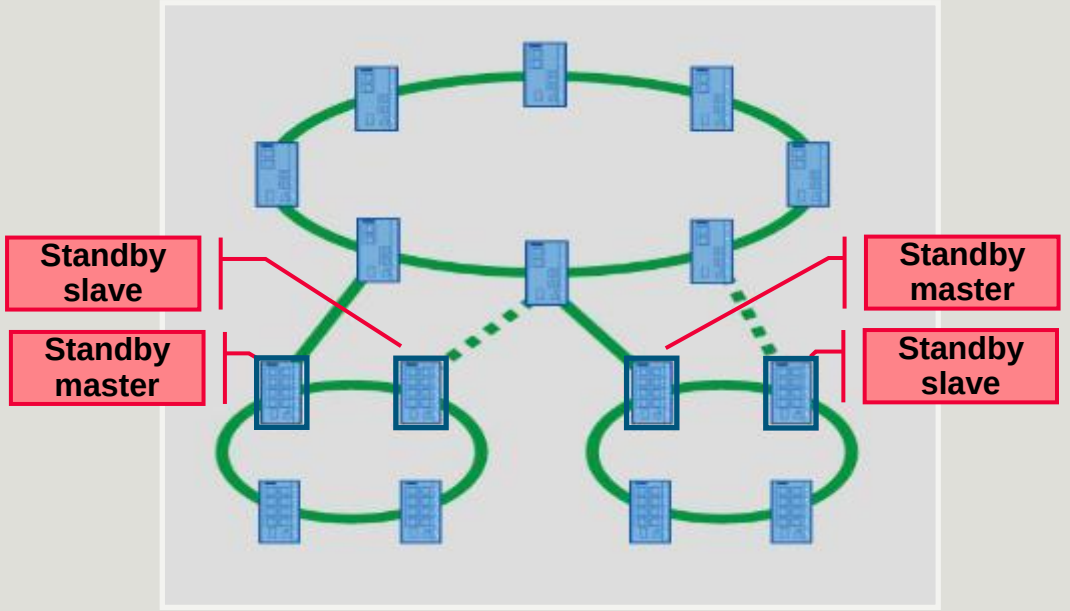
Standby Connection
Details

Standby - Connection from Central Ring



Advantage:
Less costly solution, because only two switches in the central ring must support the standby-function, e.g.X200IRT, XC200, X300, XR500
Disadvantage:
The switch-over of the standby-master works for all standby-connections, but not individually
→ **Causes conflicts**

Standby - Connection from Sub-Rings



Advantage:
The switch-over of the standby-master will be performed from every sub-ring individually
→ **No conflicts**
Disadvantage:
More expensive solution, because two switches in each of the sub-rings must support the Standby-function, e.g.X200IRT, XC200, X300, XR500

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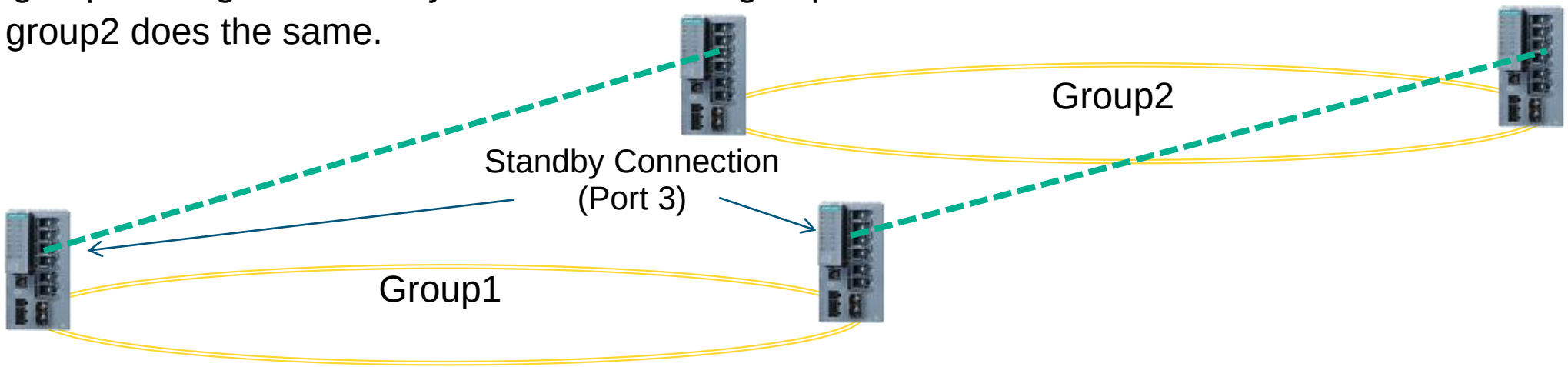
LAB 4
Configure a Standby Connection

- Before we can use the standby functionality, we have to configure the standby master and standby slave.
- Please choose your partner-ring to connect using the standby functionality
- Define a name for the standby connection, i.e. standby-teamX ; X = team number. The standby connection name **must exactly match** for the master and slave.

Standby must only be configured in one ring, therefore we will do this in two steps. First only group1 configures standby, after evaluation, group1 will switch off standby and group2 does the same.



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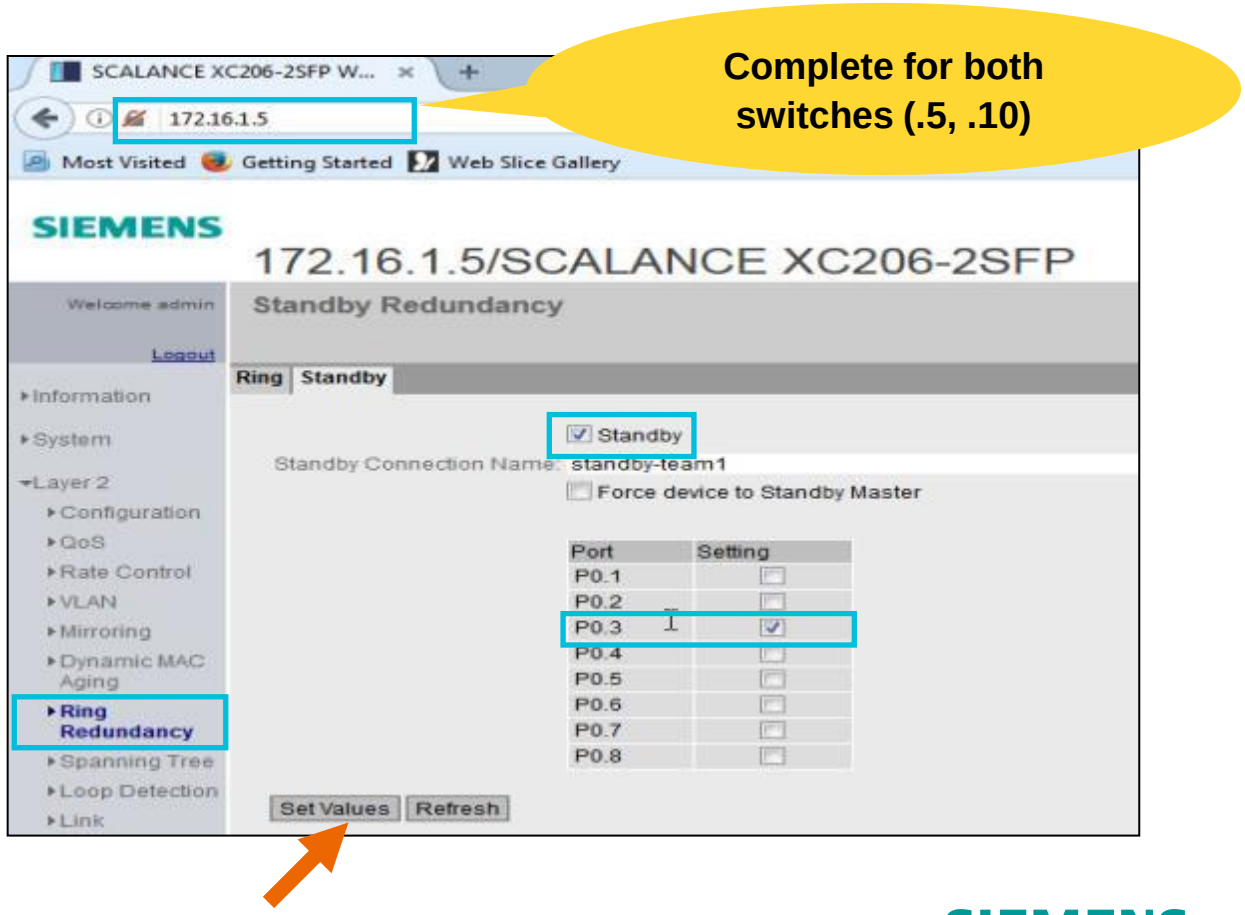
LAB 4
Configuring Standby Functionality

BEFORE making the physical connections, please configure standby on both switches in the same ring using port 3 and a name according to the previous slide.

REMEMBER: The names have to match exactly.

- We will not configure “Force device to Standby Master”, **therefore the switch with the higher MAC address will become the Standby Master**.
- Be sure to click **Set Values** after completing the configuration changes.
- Take a look at the Log Table under the Information menu after completing each switch to see the switch behavior.



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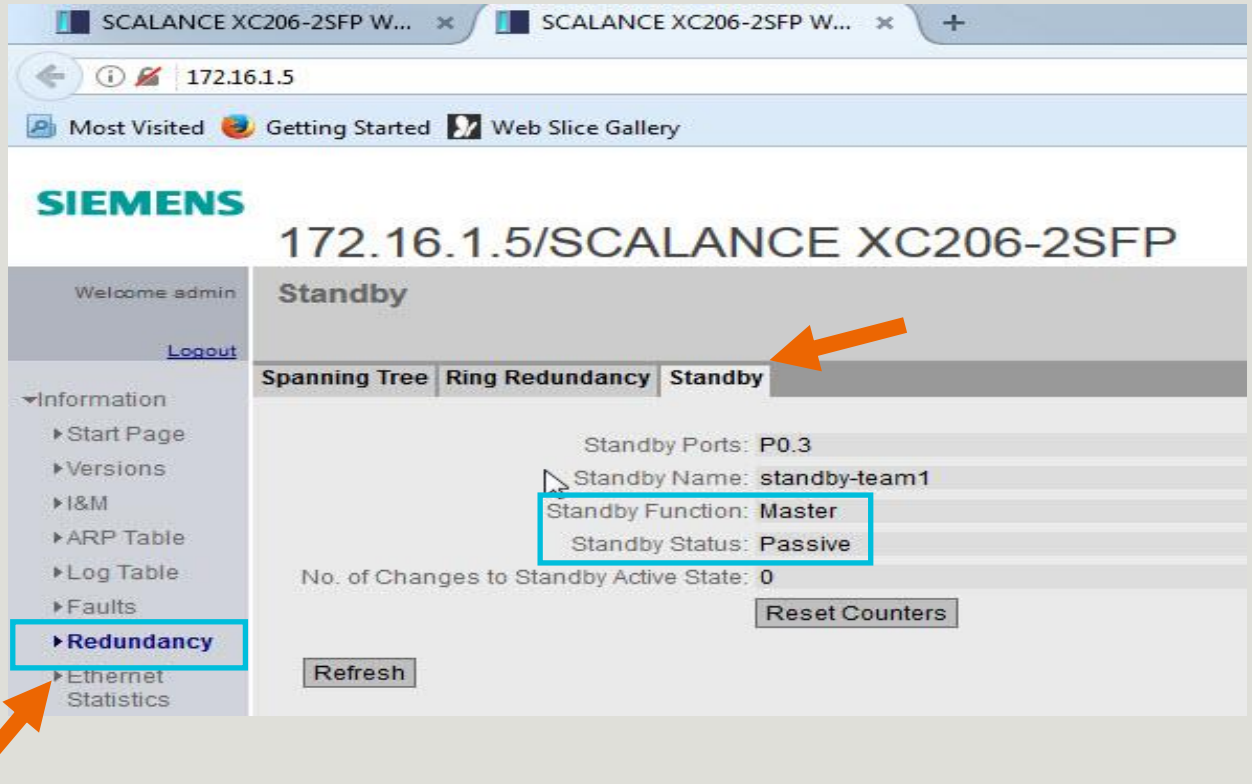
LAB 4
Configuring Standby Functionality

- We can also tell who is the Standby Master or Standby Slave as well as the status of the Redundancy by looking in the Information tab under Ring Redundancy.

- Now connect one cable to the respective port 3 on one of the switches in the partner ring. Can you ping the other switches using the Ping feature under the System menu?

- Now connect the second cable to the respective port 3 on the remaining switch in the partner ring. Can you still ping the other switches? This should be possible (with no loop) if it is configured correctly.



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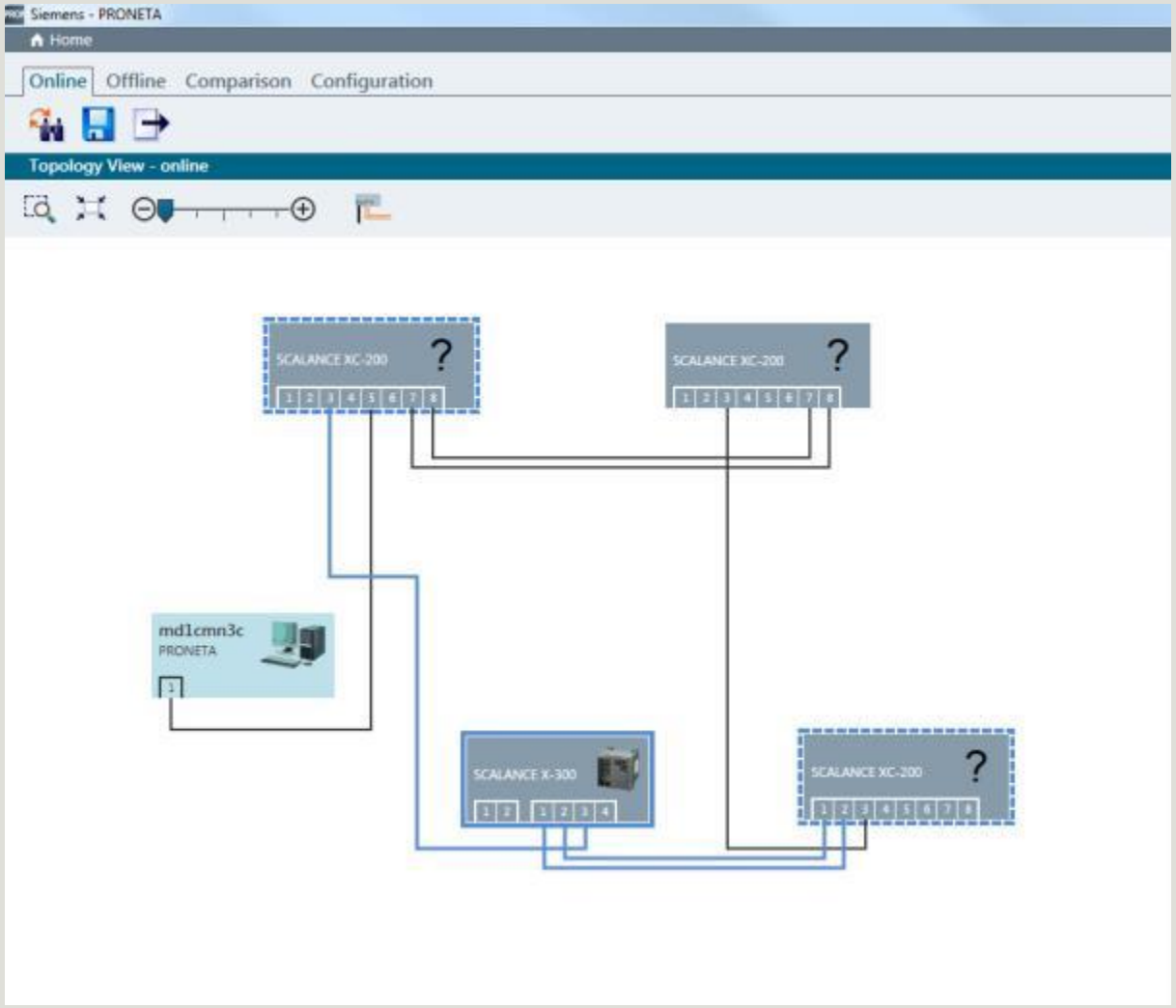
PRONETA
Screen Capture of Standby Rings



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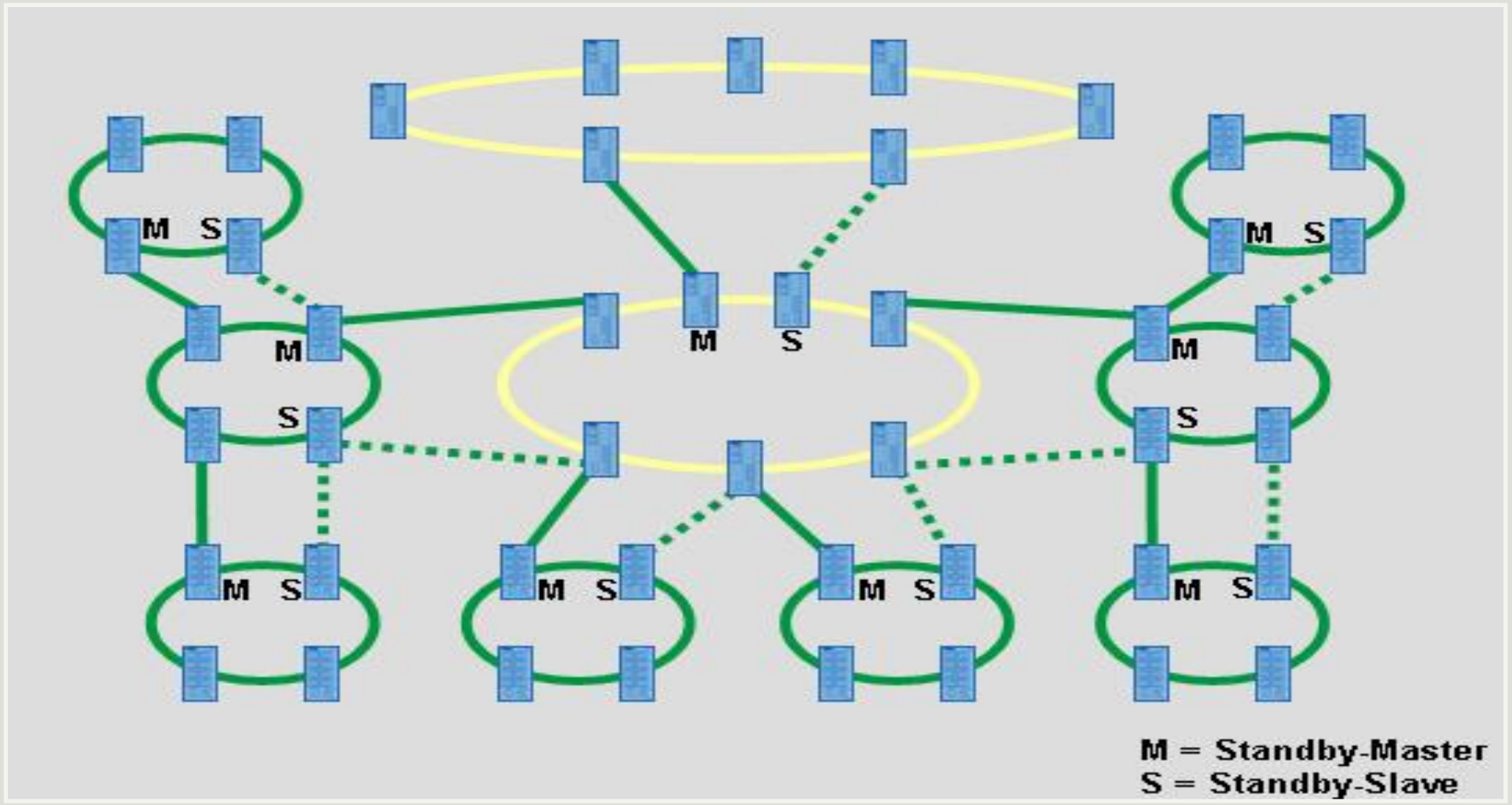
Higher Availability and Fast Reconfiguration in a Structured Industrial Ethernet Network



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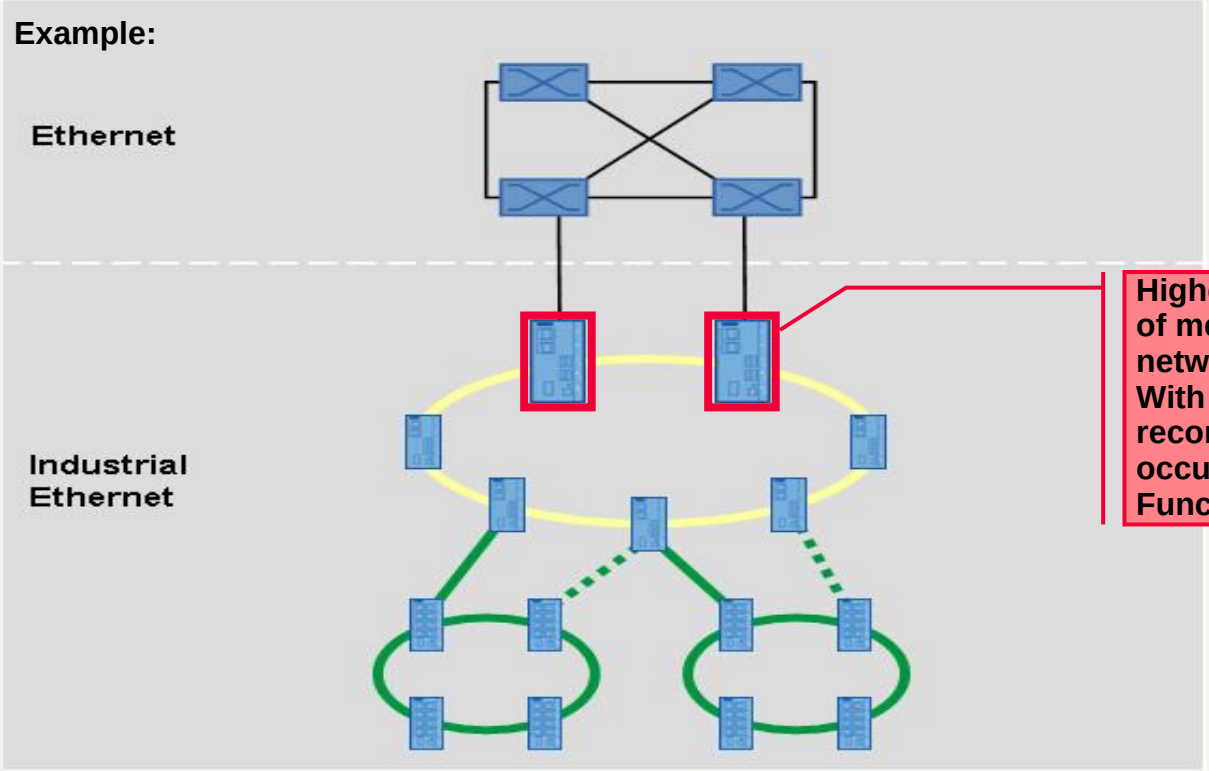
Passive Listening

Siemens developed Passive Listening to support redundant connections with fast recovery between SCALANCE Industrial Ethernet Networks with IT-networks supporting STP/RSTP **without having to understand RSTP.**



Higher availability due to redundant connection of meshed IT networks with Industrial Ethernet networks.
With expansion to achieve optimized reconfiguration if changes are made or errors occur.
Function: Passive listening

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Passive Listening
Parametrization

The passive listening function is activated by default in the “Layer 2 Configuration" menu.

All ring nodes in a ring coupled to an (R)STP must have Passive Listening activated

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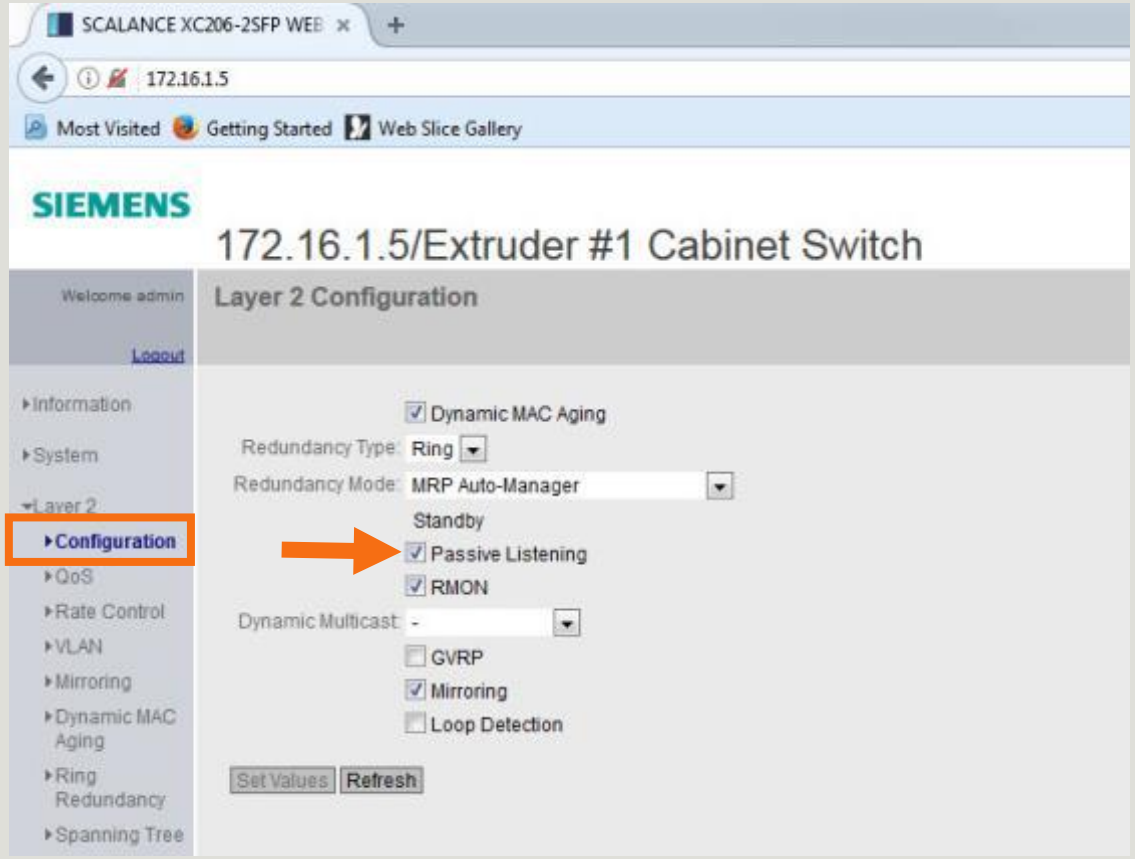

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Summary

- Industrial grade network products offer significant advantages and overcome pitfalls and hidden costs of office grade products when applied in an industrial environment.
- The SCALANCE family of industrial grade network products offers a comprehensive portfolio to cover requirements from unmanaged L2 switches to managed L2/L3, as well as wireless WiFi and Cellular, security appliances, and cables and connectors.
- The built-in information and diagnostic features of the SCALANCE X family promote simple and efficient troubleshooting.
- In important differentiation between industrial network applications and office network applications is the requirement for reliable networks capable of withstanding failures. This is achieved by reliable devices, fault-tolerant systems, and network redundancy.
- With the growing demand for networks to be vertically integrated, the features and functionality of an industrial network should be capable of connecting to the office network without disruption to the time sensitive industrial network.

Thank you for your attention!

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