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Profinet

PROFINET on 100% Ethernet

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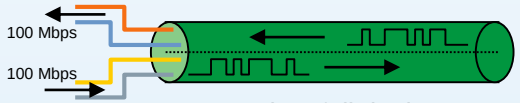
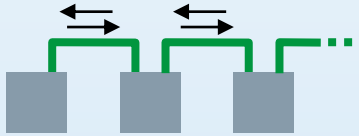
PROFINET is Ethernet

- Ethernet is an established standard in the IT world for fast data transfer (IEEE 802.3)
- PROFINET is always full duplex → simultaneous communication in both directions

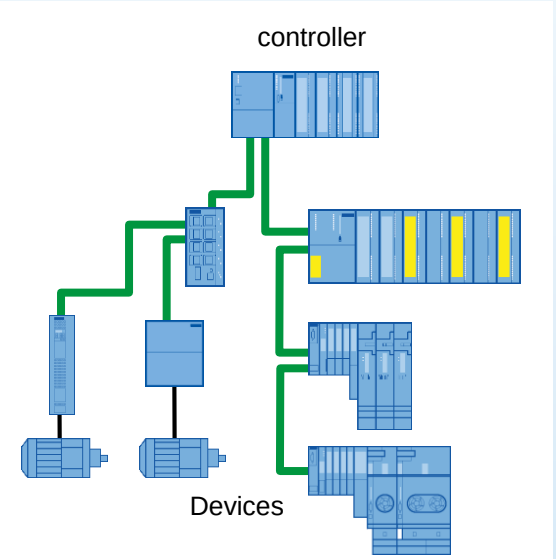


100 Mbps full duplex

- PROFINET is always "switched Ethernet"

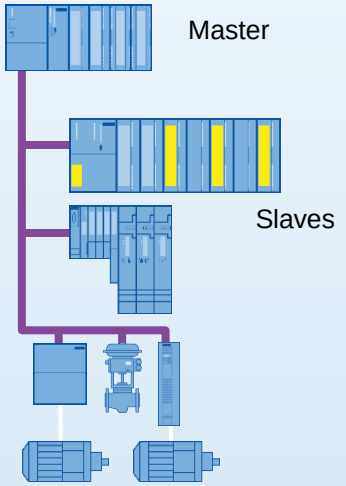

Switches connected into a line

➔The topology can be influenced network load



For comparison: PROFIBUS

- One line of “cable” to which everyone is connected
- ➔ Performance depends on the number of devices



PROFINET take full advantage of the possibilities offered by Ethernet

Profinet Vs. Profibus

Profinet works on the same principle as Profibus.
Except :

- Higher carrier frequency100-600MHz (3-20MHz)
- 2-4 twisted pair cable
- Bandwidth 10-1000Mbps (0,184-12Mbps)
- Different cables can be used in the same application
- Maximum length 100m and with flexible cables 80m

Cable technology – FastConnect (electric/twisted pair) Industrial Ethernet/PROFINET

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Industrial Ethernet/PROFINET:

For quick installation

- **RJ45 liittimet 2 x 2 and 4 x 2**

  Stripping Tools!

Link to Video:
https://youtu.be/9e4G5DPPXHM

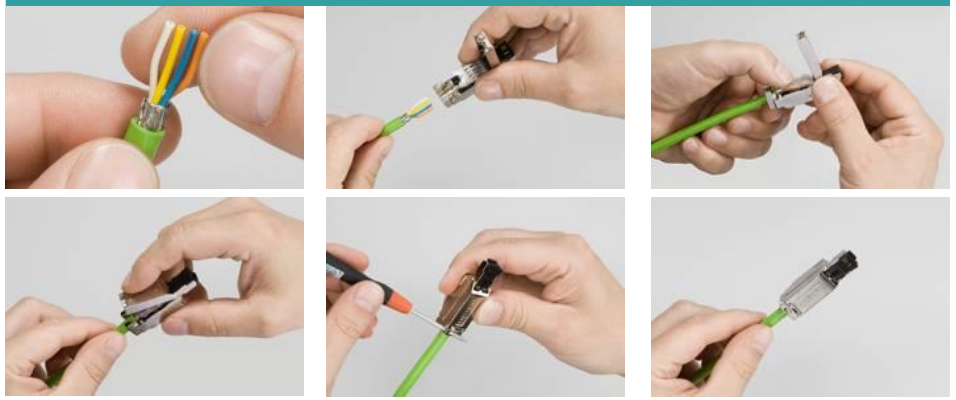
Link to Video:
https://youtu.be/XQjVYFMR8Mk

- **M12 plugs** (using stripping tool)
  IE FC cables: 4 ja 8- wires

Link to Video:
https://youtu.be/CSwDQptuIds

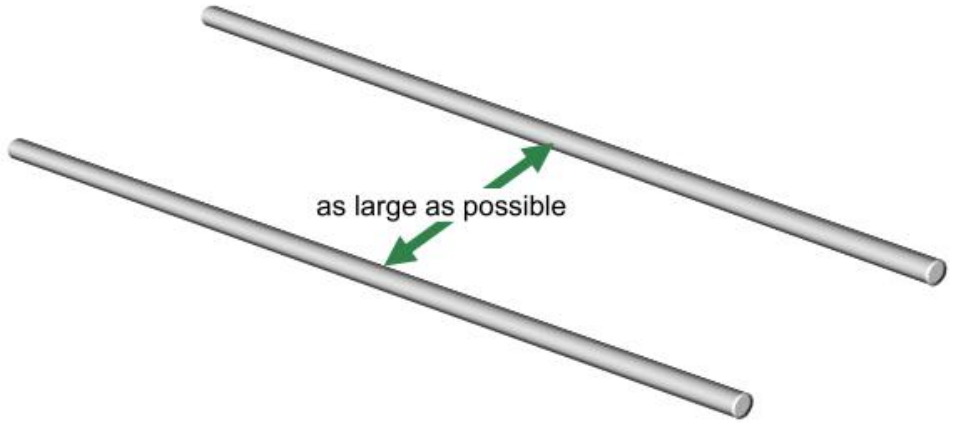
Stripping

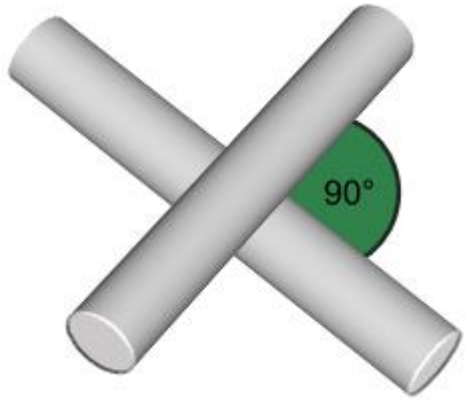
Install RJ45

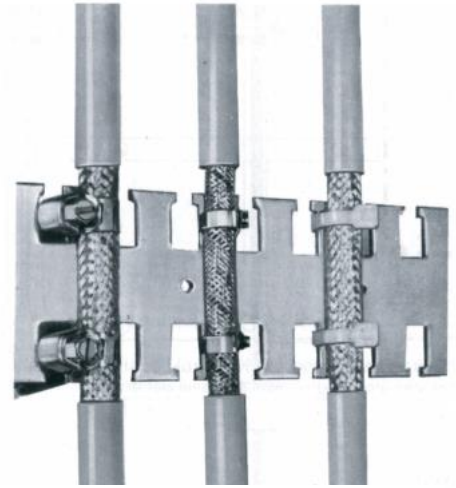


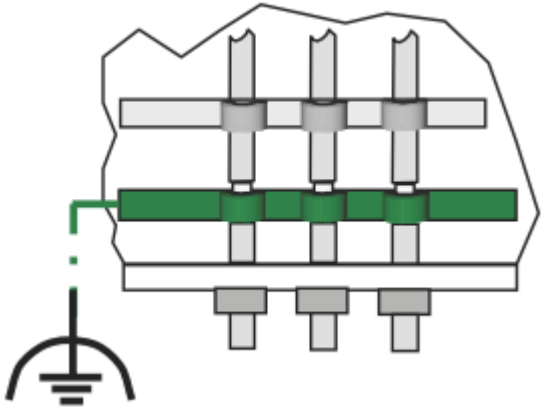
Install M12

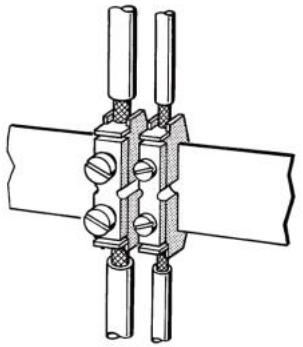
Installation and grounding

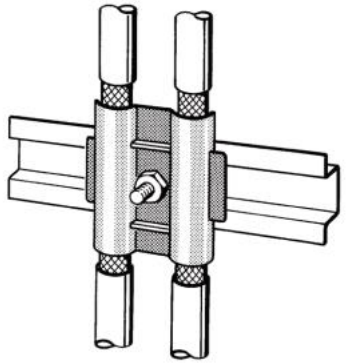


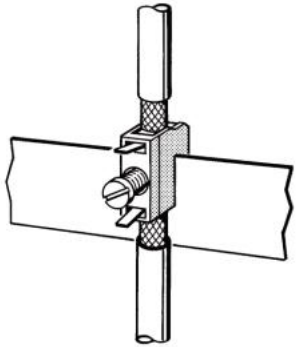


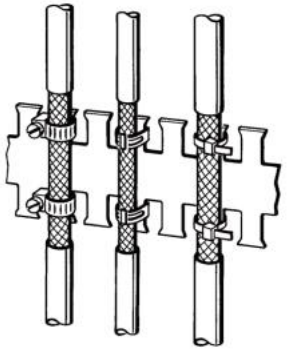




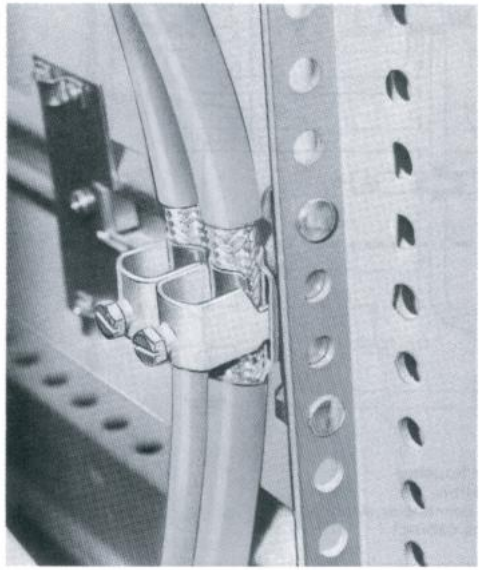


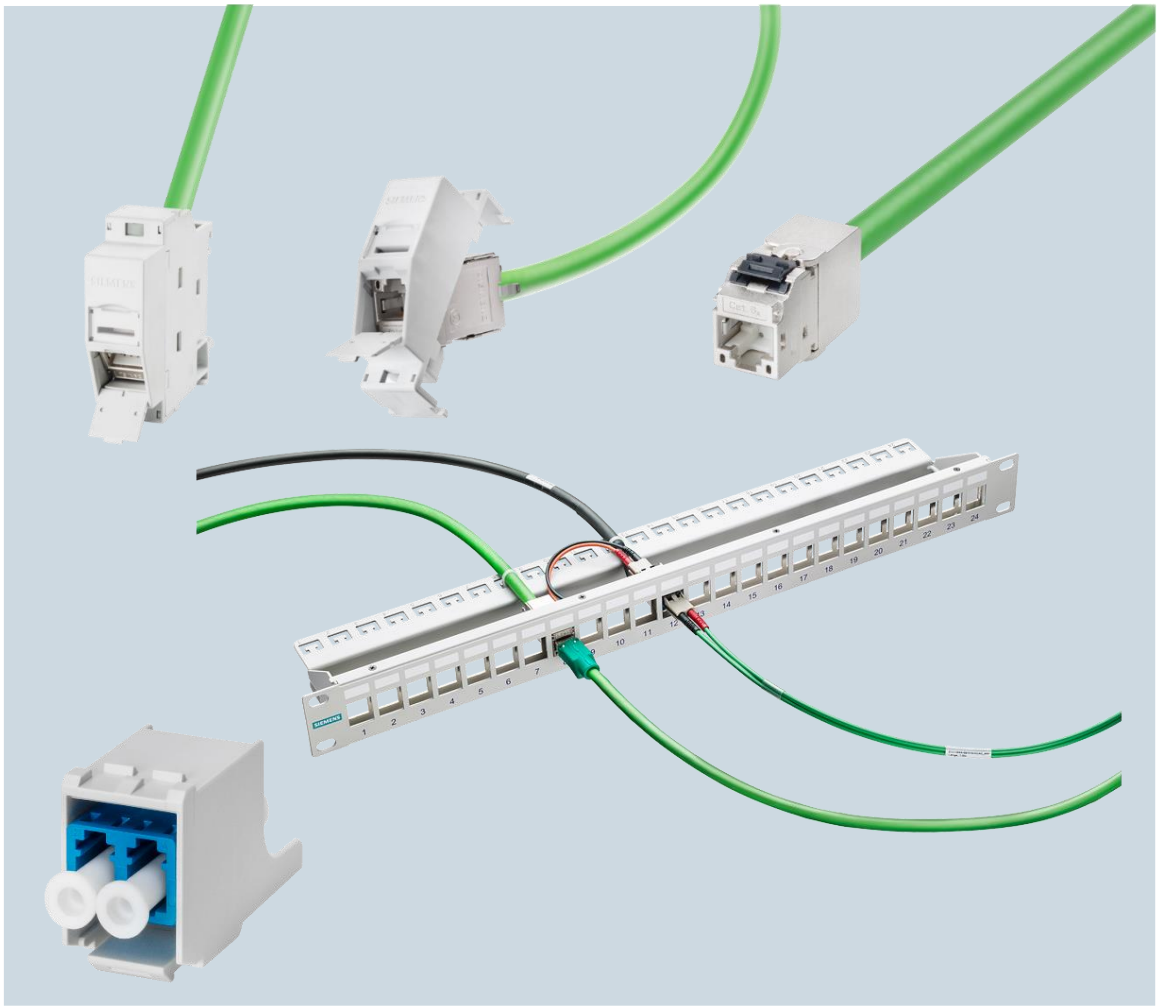




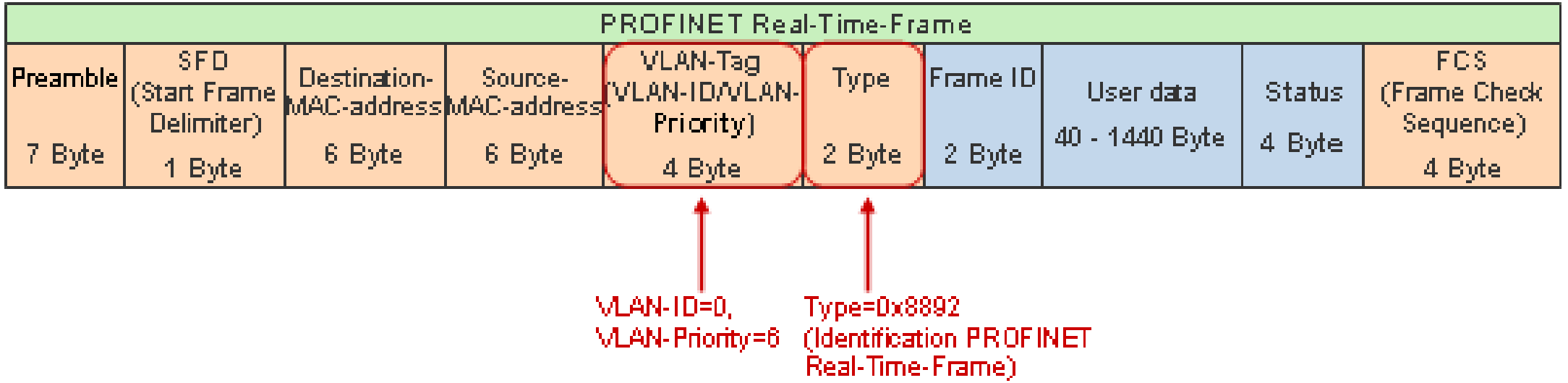


Installation and grounding





Profinet telegram – no TCP/IP frame – no roaming



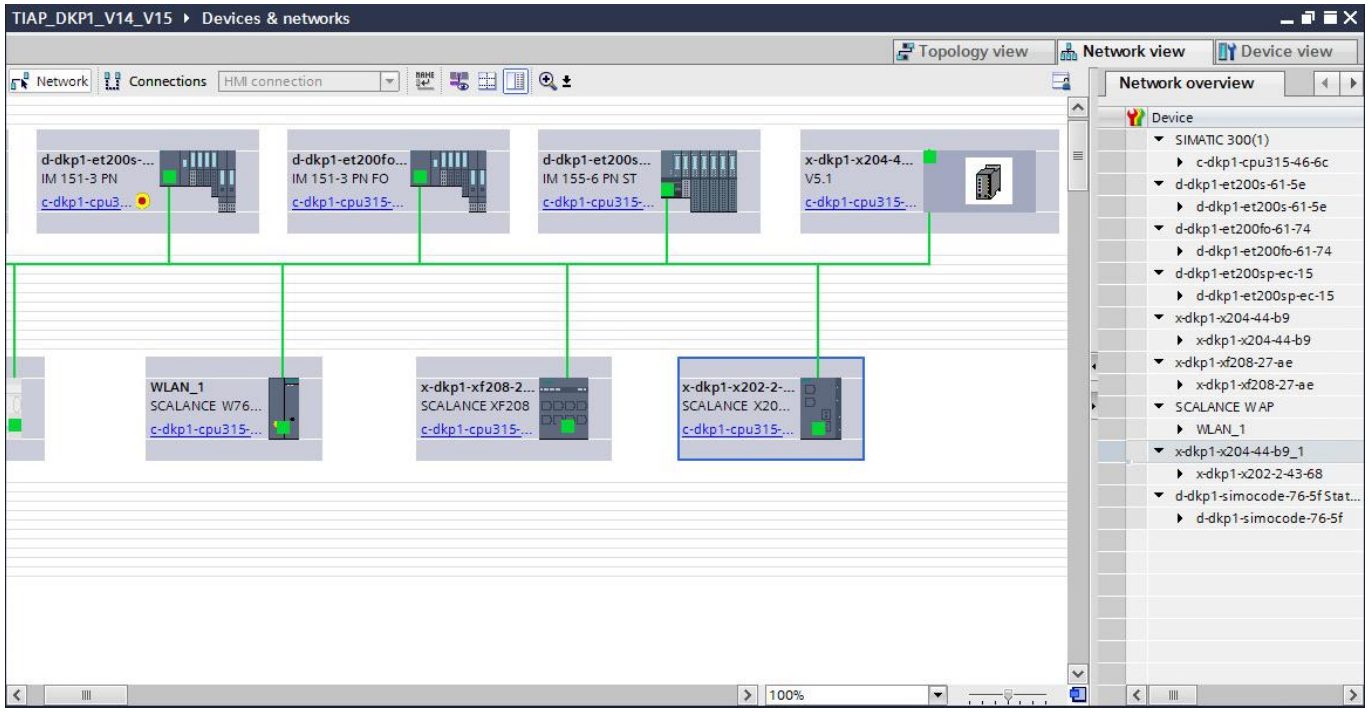
PROFINET device configurations and topology in TIA Portal

TIA Portal – PROFINET

- PROFINET devices (including network products) are configured using the TIA Portal.
- These settings are transferred to the SIMATIC CPU and from there to the PROFINET devices.
- The CPU defines IP addresses and PN names according to the topology made in the TIA Portal. Also for network devices.
- In the topology, all devices must support the Profinet mechanism.

PROFINET TIA in Portal

All parameters relevant to PROFINET are defined in the TIA portal and then transferred to the SIMATIC CPU.



Topology definition allows automatic configuration

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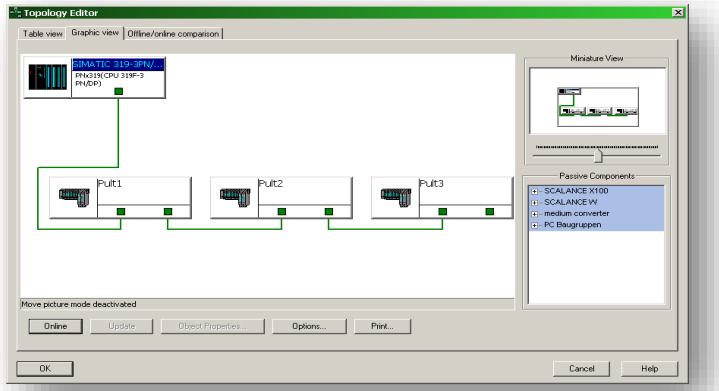
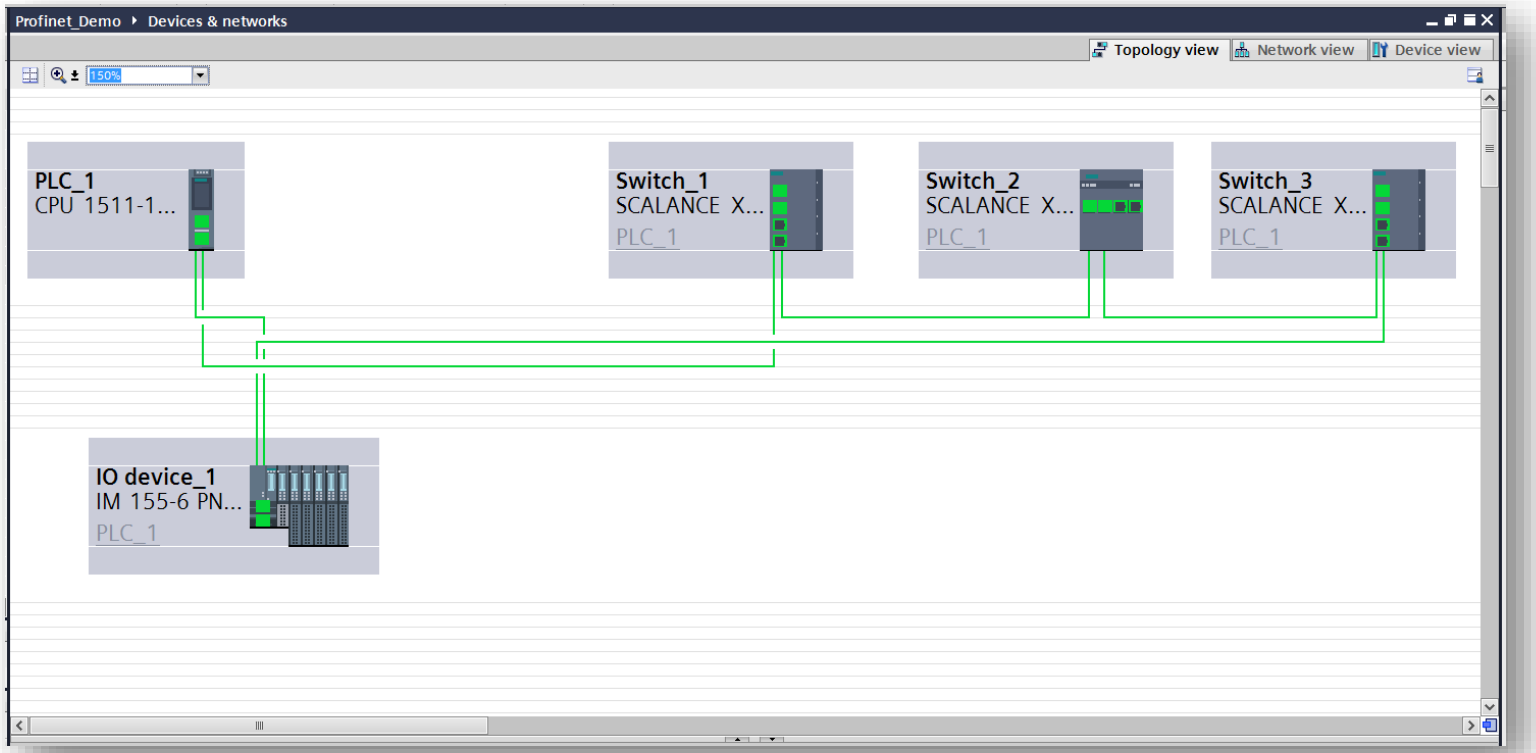
Topology editory (Classic STEP7)

- Define cabling

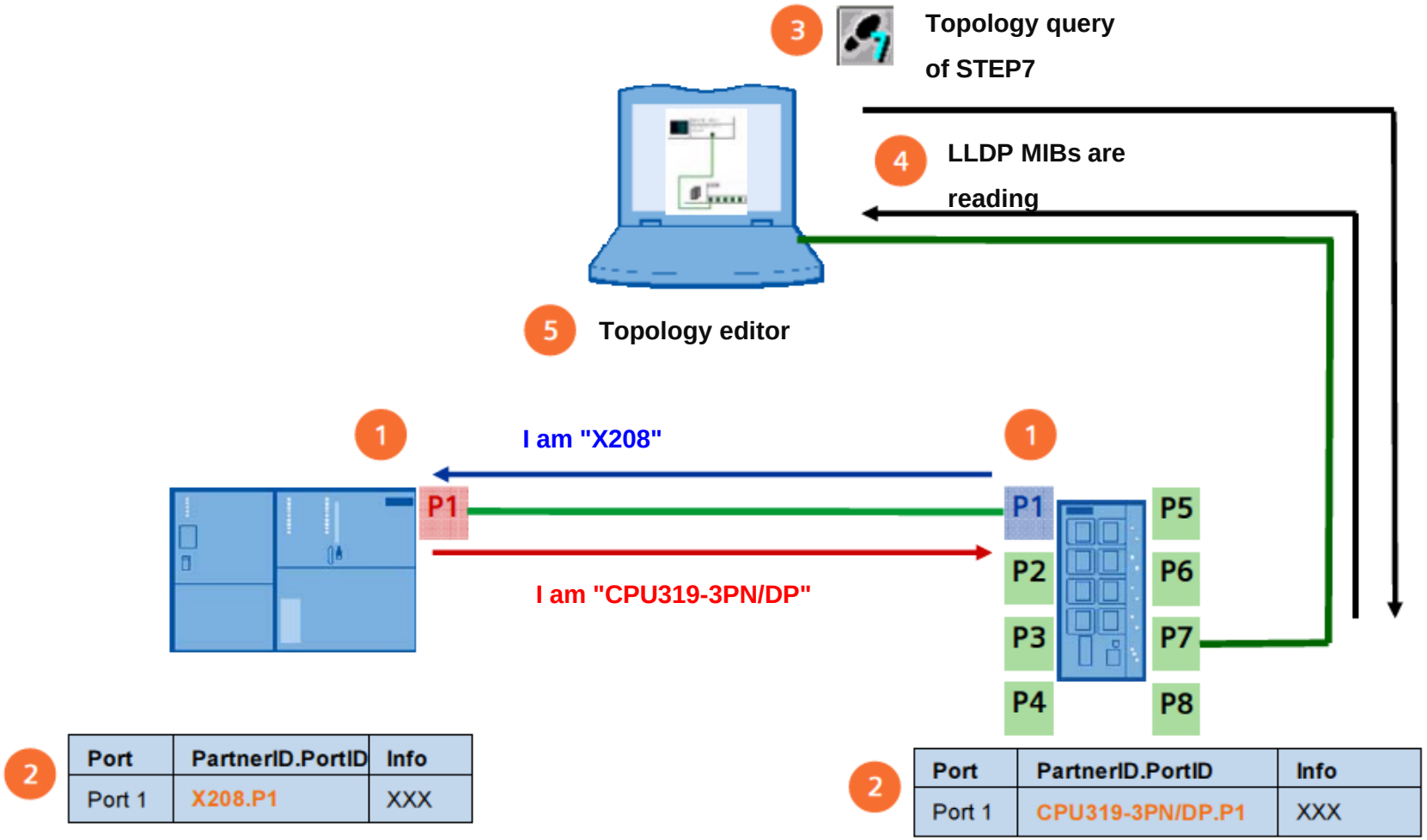


Topology editory (STEP7 – TIA Portal)

- Define cabling



Topology detection uses LLDP communication



Topology Defined - Automatic Configuration

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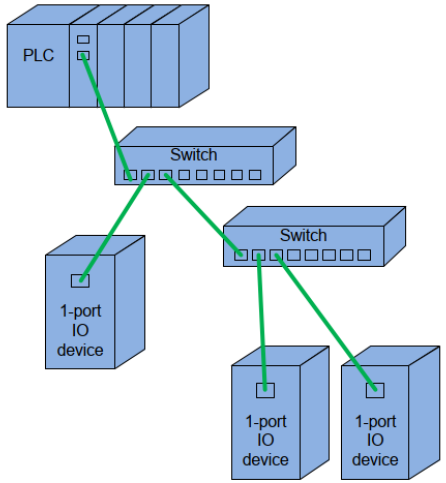
- WITH PROFINET YOU ALWAYS HAVE USE MANAGERED SWITCHES!

- Automatic configuration saves time and minimizes errors

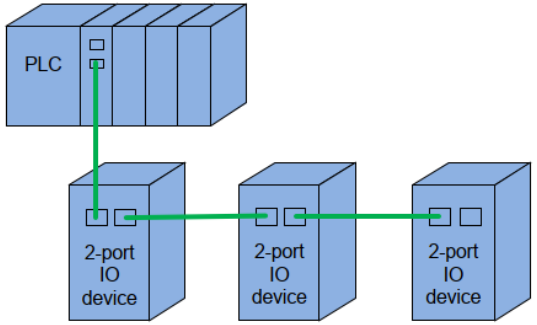
- With this function, the PROFINET IO controller automatically enters the IP address and device name of the PROFINET IO devices without a programming device (PG).

- The requirements for automatic configuration are :
  - The IO controller and IO devices must support the PROFINET function "Device replacement without exchangeable medium / PG".
  - In STEP7, you must select the option "Replacing the device without removable media" –"Device replacement without exchangeable medium"
  - The devices must be reset to factory settings – factory reset.
  - **Profinet GSDxml device description must be found on all devices - including switches!**
  - **The configured topology must correspond to the actual topology!**

Profinet network topologies

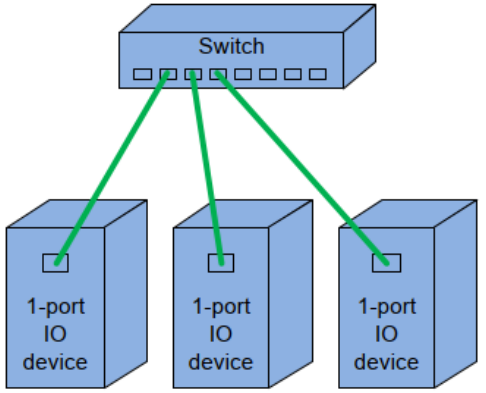


Tree



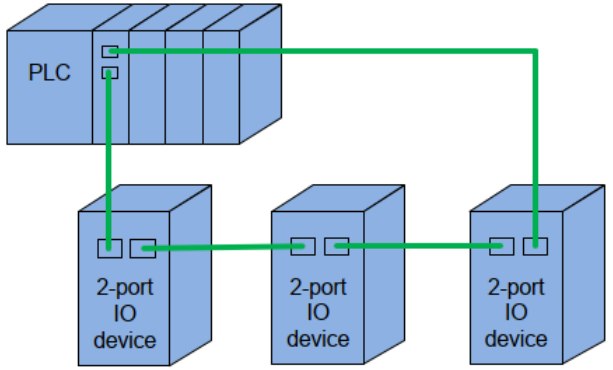
Linear topology

Linear



Star

(typically motor centers - Simocode)



Ring topology

Ring - MRP

Response time in line topology – 14 stations (1.8 ms) Siemens Profinet IO device with “cut through” switch – Ertec Asics circuit has been used for interface.

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Tt = Transmission time of minimum frame = approximately 7
µs
Rtb =Run time of bit on the cable at 100 Mbps and 100 m cable between two nodes -> 0,5 µs
TPTswitch = Throughput time through a switch. For RT_Class_1 approximately 10 µs (in GSD file)

Basic calculation:

Length of minimum frame:	64 bytes including process data
Including preamble and SFD:	08 bytes as header
Idle time:	12 bytes after each Ethernet frame
Total:	**84 bytes**

RT Minimum/maximun transmission time without wait times

Bytes	Tt [µs]	Nn (asemien määrä ketjussa)	Rtb [µs]	TPTswitch [µs]	Tt_min [ms]	Tt_max [ms]
84	6,7	14	0,5	10	0,154	1,729

TPTswitch [µs]	Tx [µs]
10	153,72

This calculation can only be used with Siemens devices. It has been found that some other manufacturers has used standard “store and forward” switches in device Profinet interface. These do not guarantee a stable response time.

Response time in line topology – 20 stations (2,6 ms) Siemens Profinet IO device with “cut through” switch – Ertec Asics circuit has been used for interface.

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Tt = Transmission time of minimum frame = approximately
7 µs
Rtb =Run time of bit on the cable at 100 Mbps and 100 m cable between two nodes -> 0,5 µs
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RT Minimum/maximun transmission time without wait times

Bytes	Tt [µs]	Nn (asemien määrä ketjussa)	Rtb [µs]	TPTswitch [µs]	Tt_min [ms]	Tt_max [ms]
84	6,7	20	0,5	10	0,217	2,527

TPTswitch [µs]	Tx [µs]
10	216,72

This calculation can only be used with Siemens devices. It has been found that some other manufacturers has used standard “store and forward” switches in device Profinet interface. These do not guarantee a stable response time.

RT: Media Redundancy Protocol (MRP) 1/2

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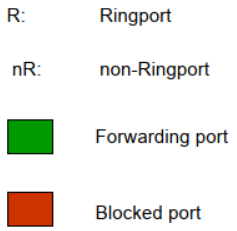
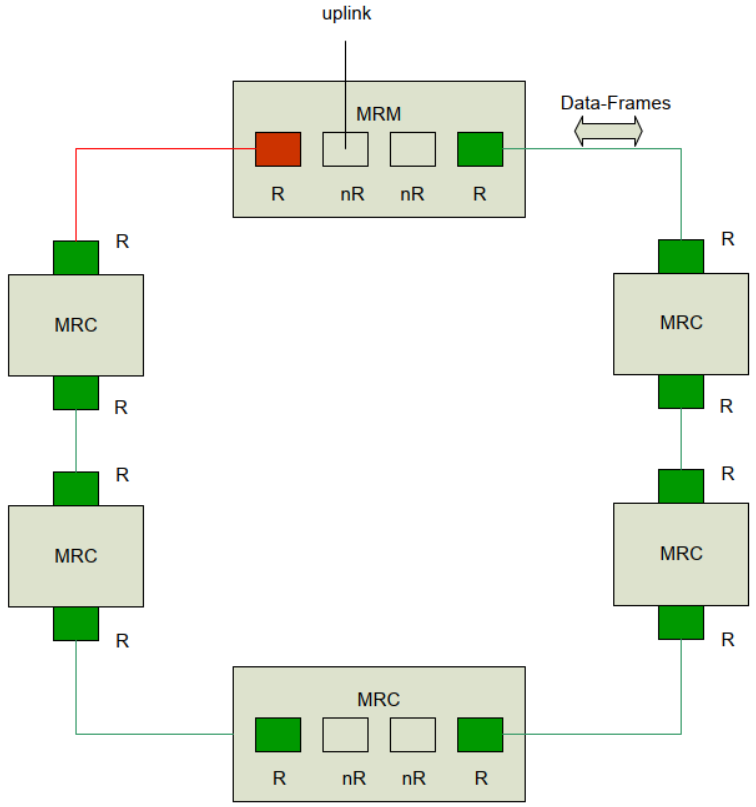
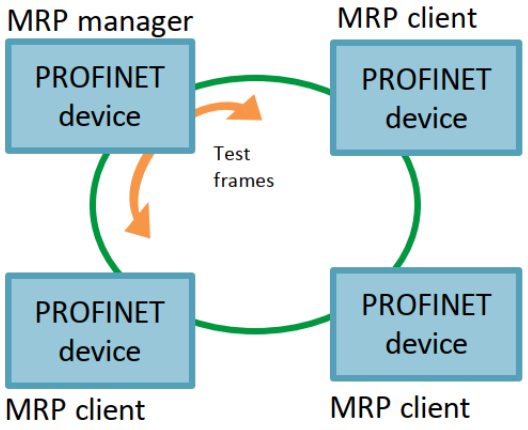
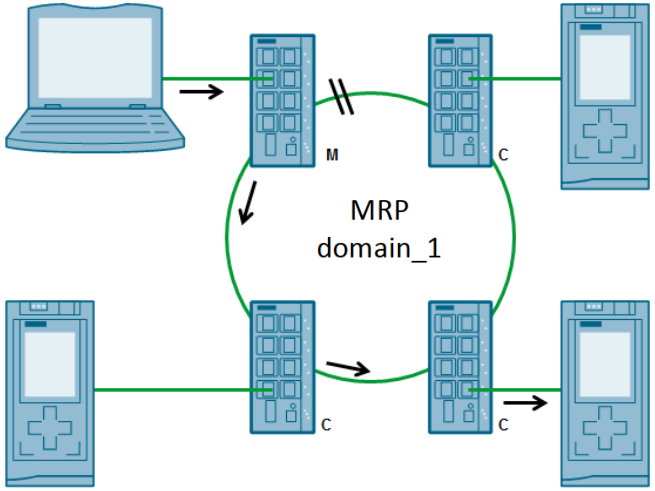
MRP is a ring redundancy method used in Profinet applications. The redundancy manager sends test messages from each of its ring ports as long as the messages arrive at the other ring port. This way the manager knows that the ring is intact. At the same time, it prevents messages from circulating indefinite in the ring, closing one of the ring ports.



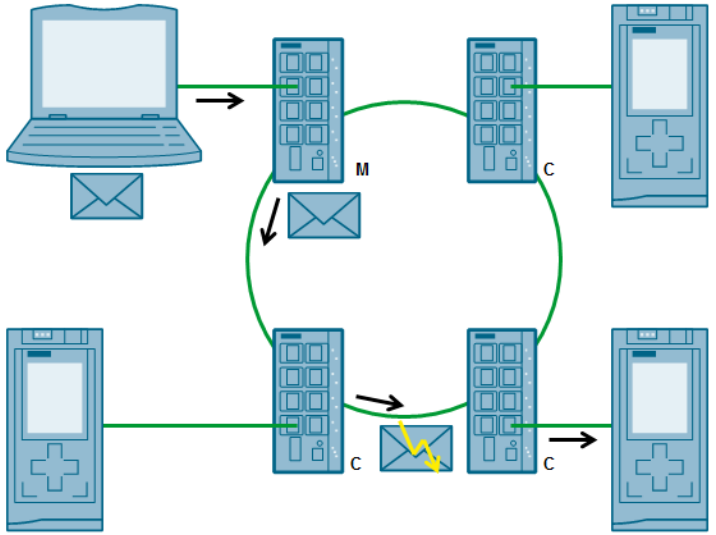






RT: Media Redundancy Protocol (MRP) 2/2

When test messages no longer arrive at another ring port, such as a damaged cable, the manager opens the closed ring port. In this case, post-break subscribers are available.
Network recovery (reconfiguration) takes up to 200 m (50 subscribers).

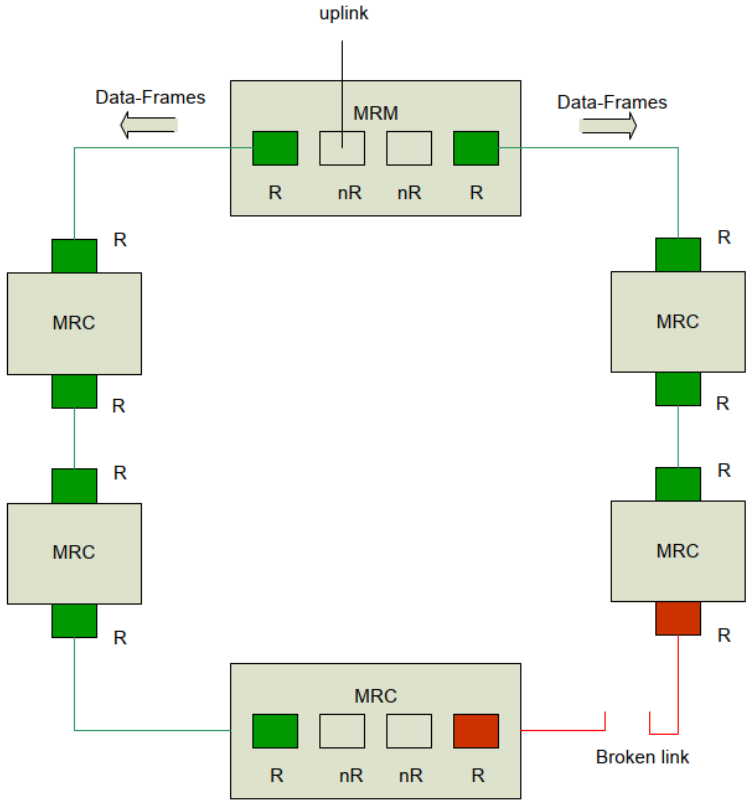


R: Ringport

nR: non-Ringport

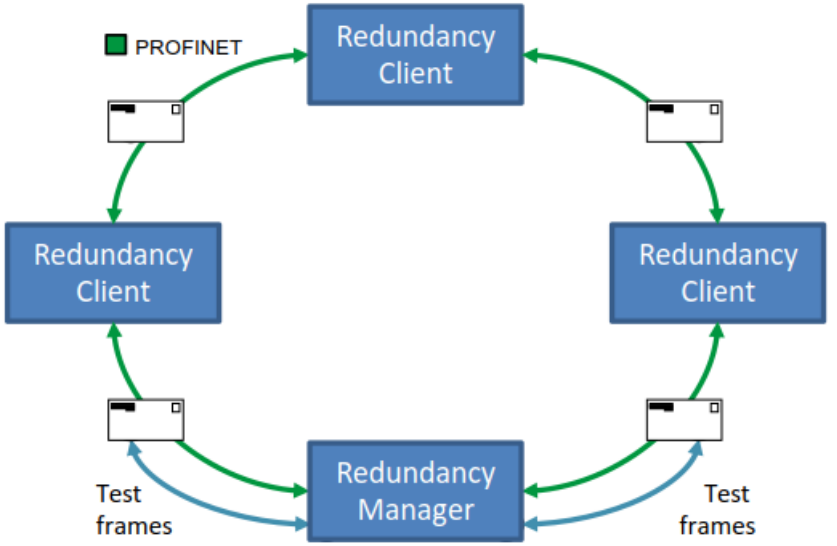
Forwarding port

Blocked port



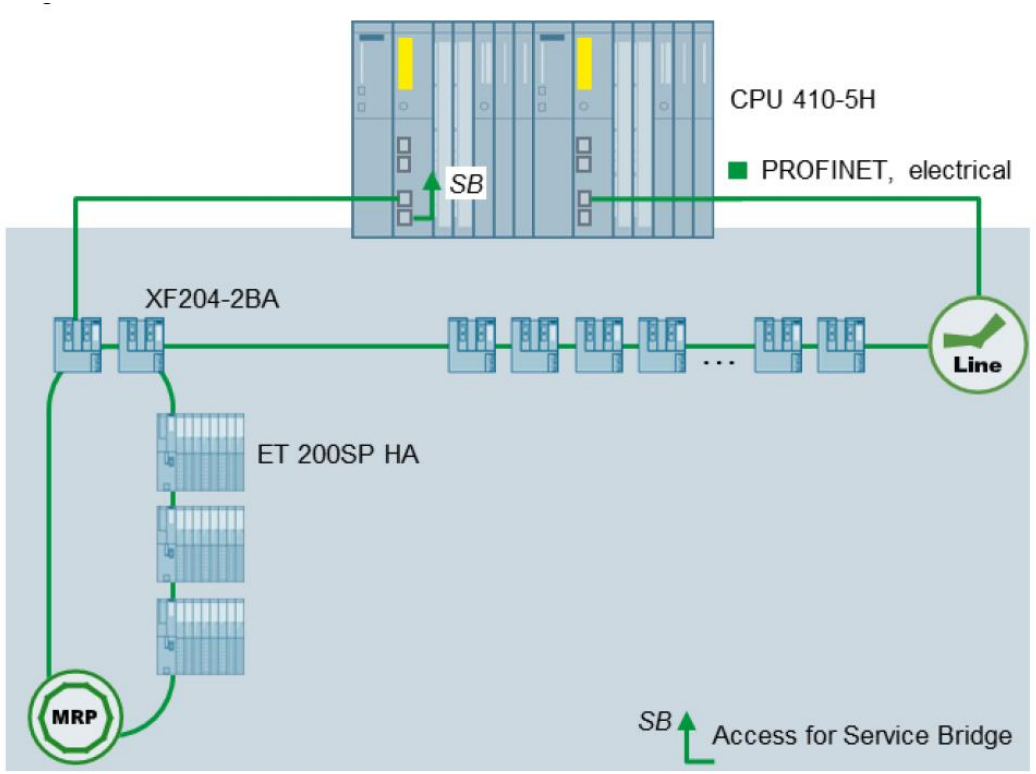
IRT: MRPD seamless ring. Max. 32 devices

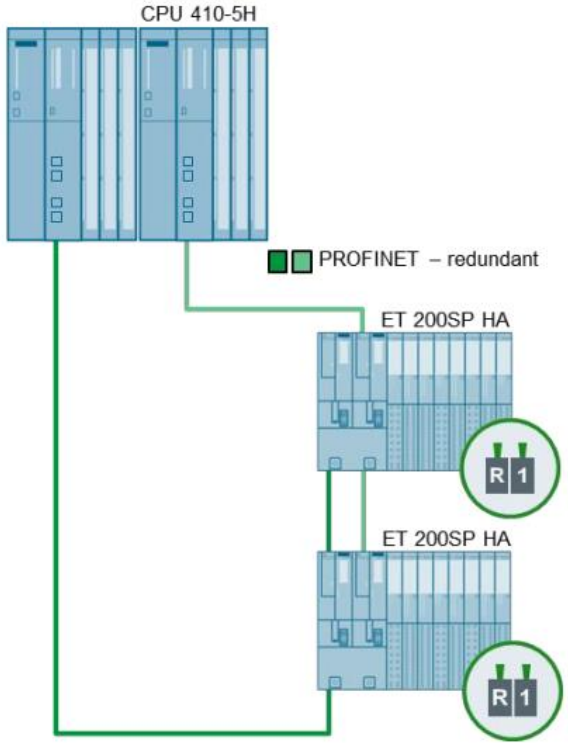
The MRPD mechanism is based on IRT and MRP. A reconfiguration time of 0ms is possible by sending cyclic IRT packets duplicated in both directions on the ring. The recipient receives the same IRT frame twice if there are no errors on the network.



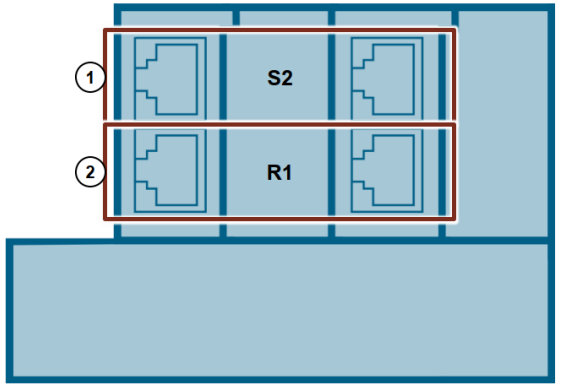
The devices receive this information on both ring ports, so there is no ring remodeling time. As with MRP, redundancy management prevents loops.

Redundancy example





Symbols	PROFINET function
S1	Single PROFINET configuration S1
MRP	Media redundancy with MRP
S2	System redundancy S2
R 1	Redundant PROFINET configuration R1
CiR	Configuration in RUN (CiR)
SoE	High-precision time stamping (SoE - Sequence of Events)
PA ready	PA ready



Segmented production network – PN/PN Coupler

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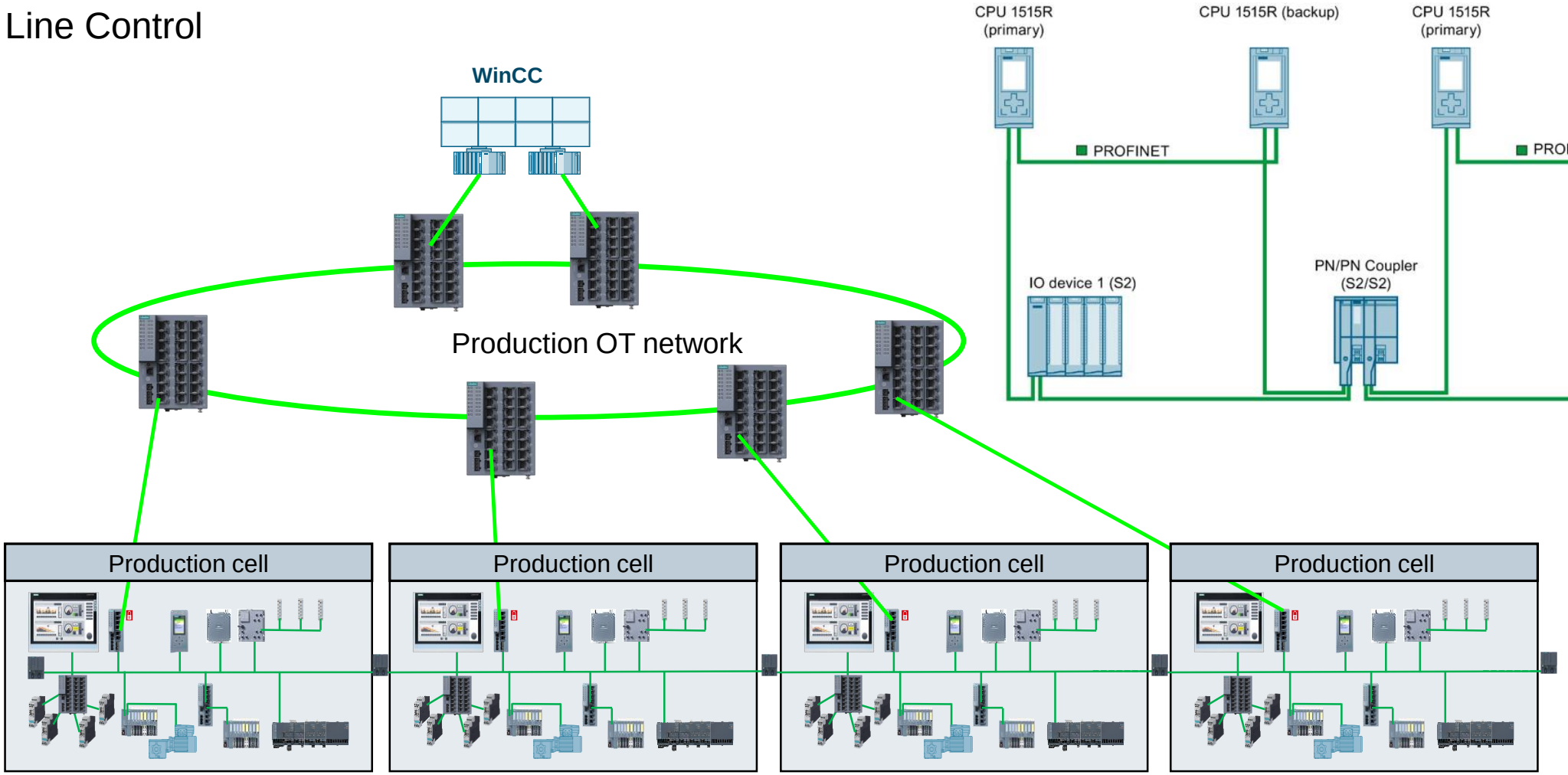
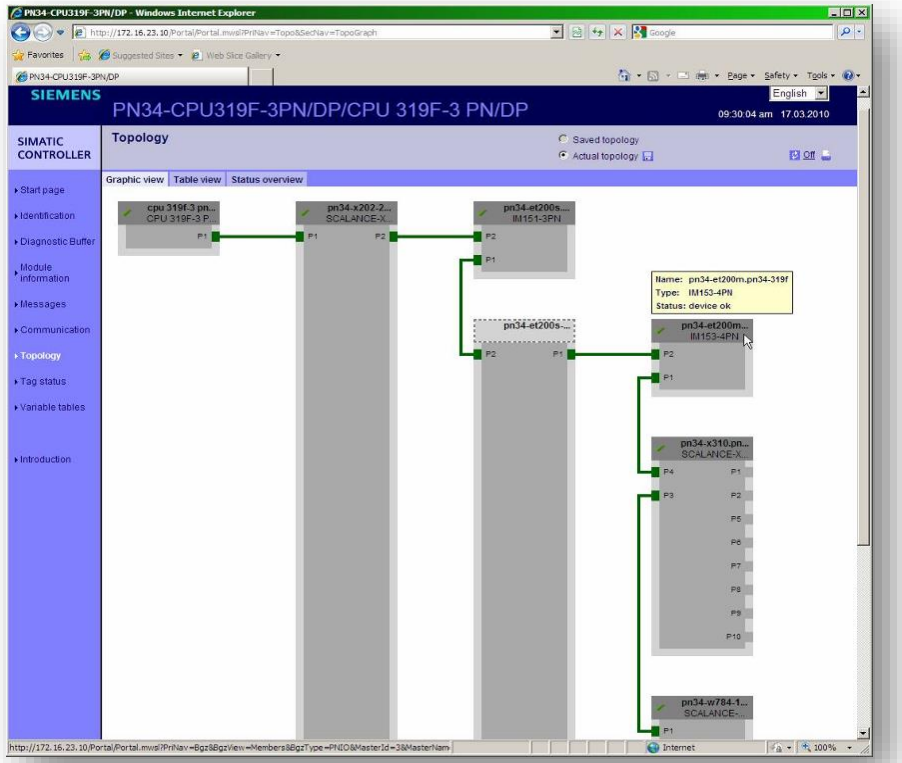
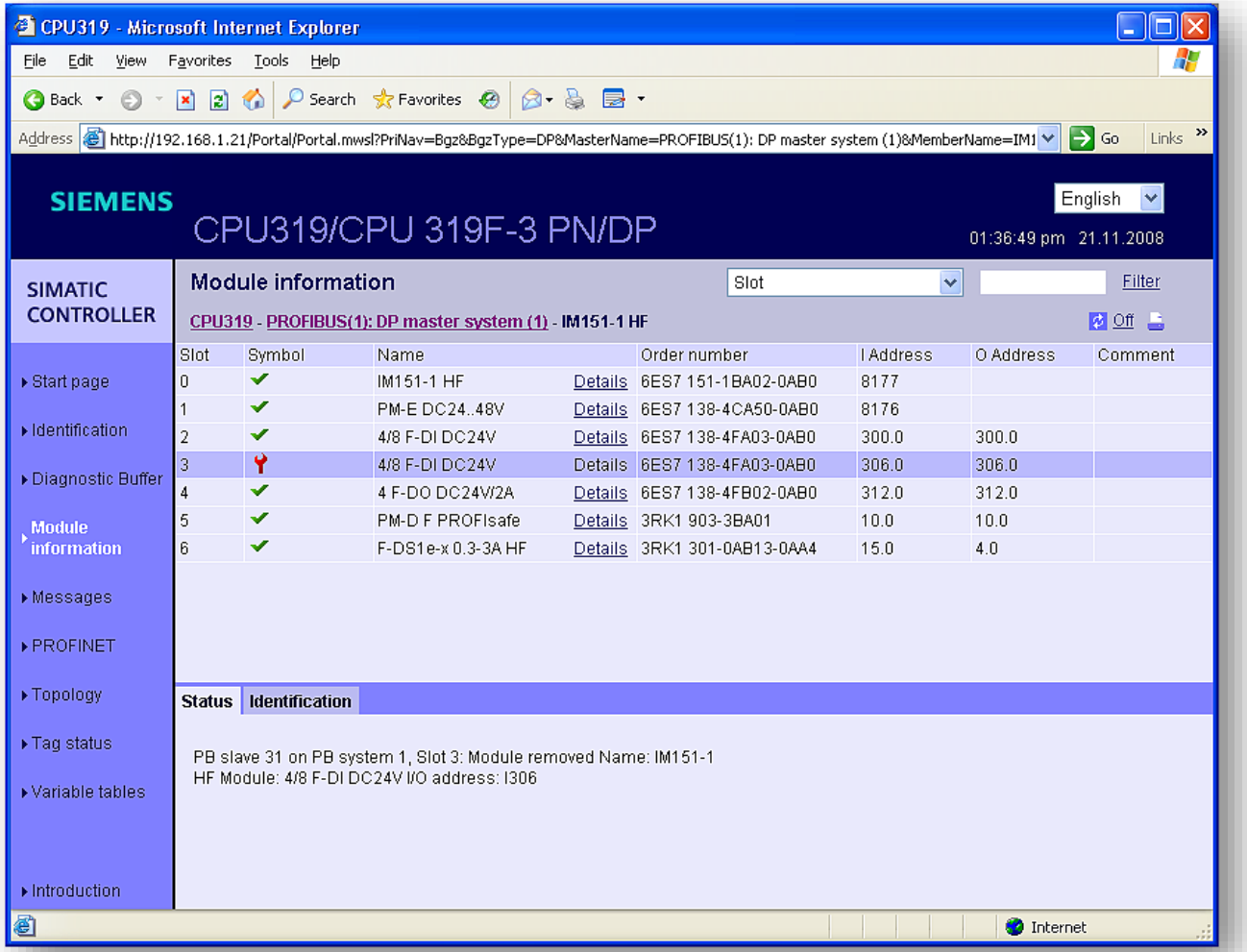
Line Control

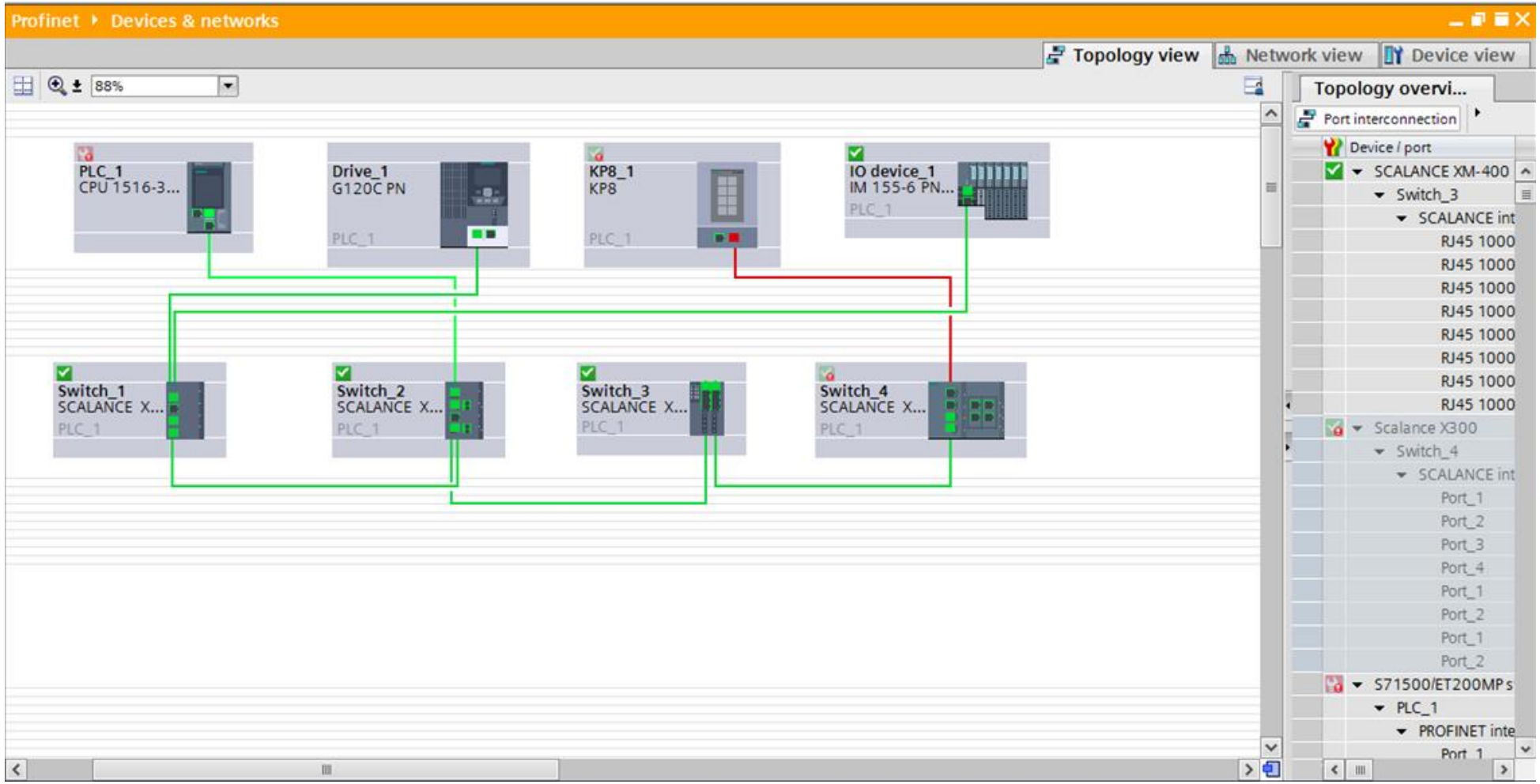


Web extension - Network topology - graphical view

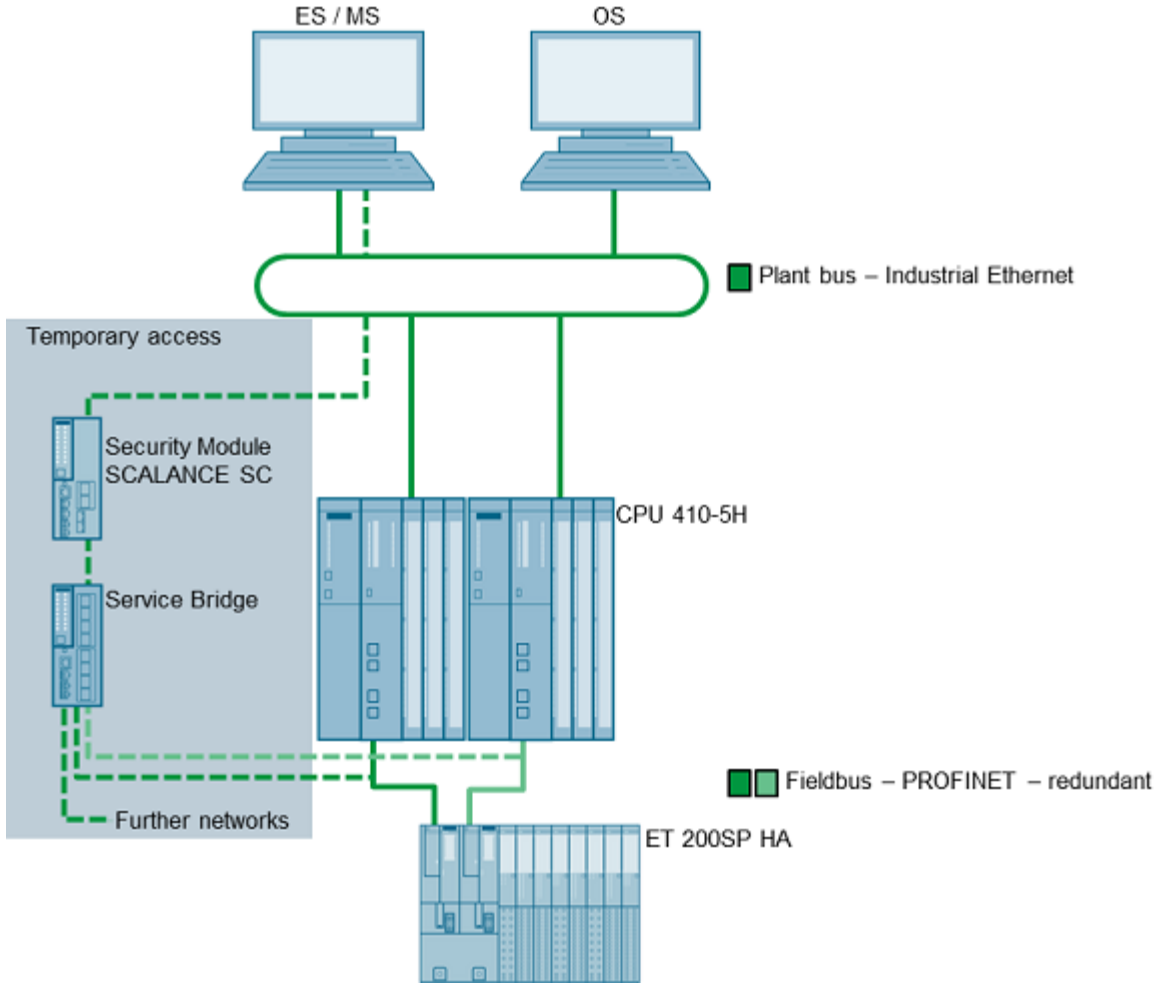


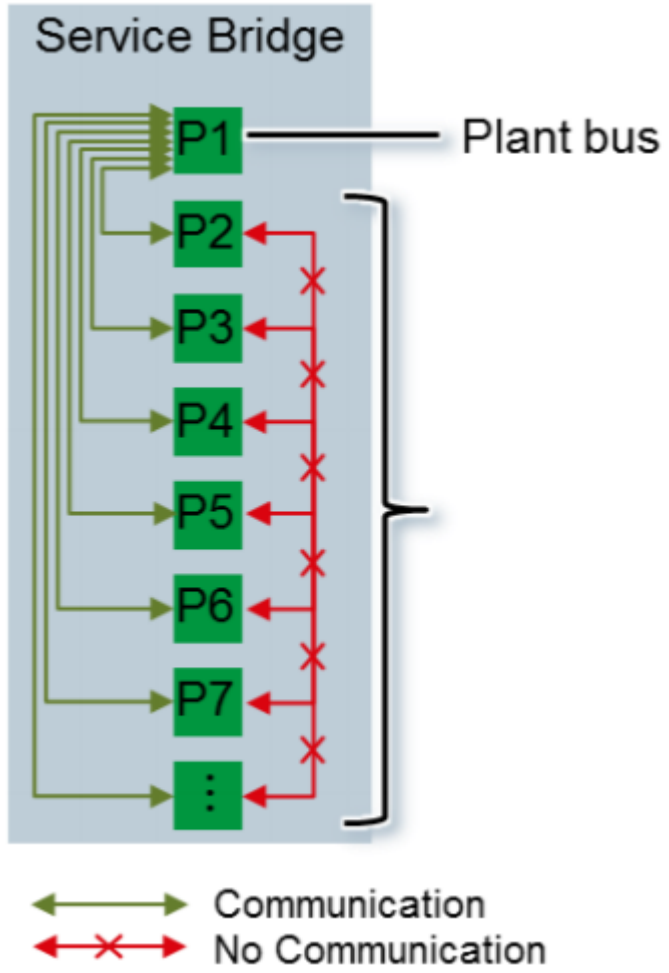


Online view on the TIA Portal.

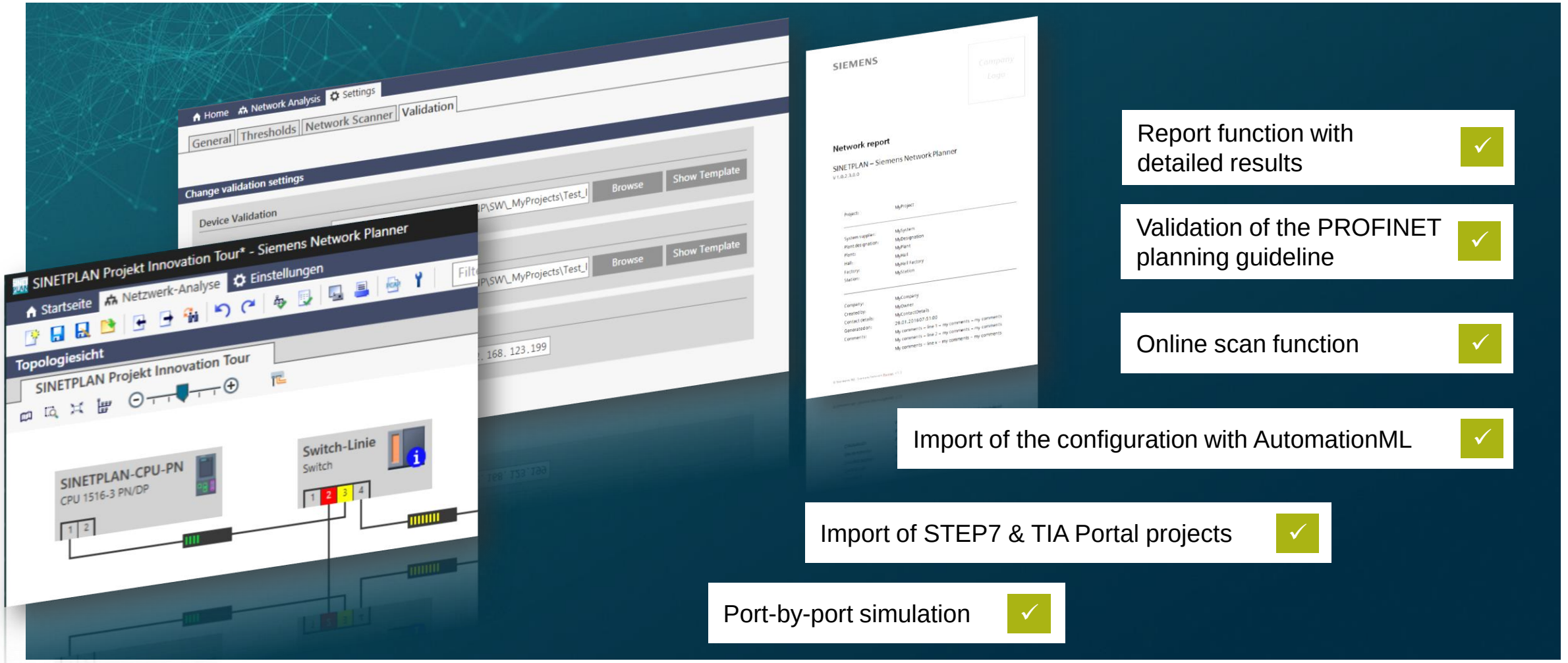


Service bridge (Scalance XC200 series)



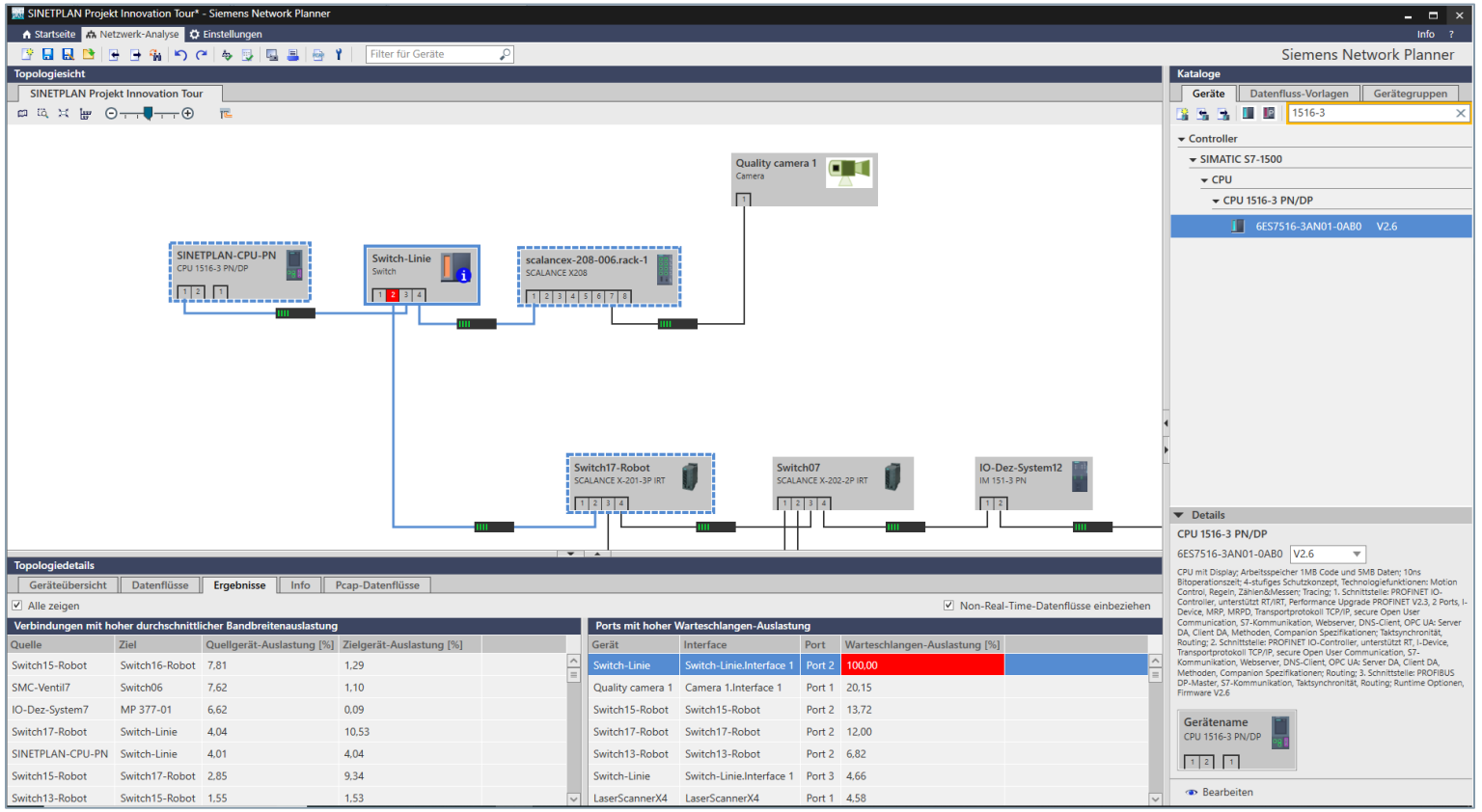


Sinetplan – Offline simulation for load in Profinet network



- Report function with detailed results ✓
- Validation of the PROFINET planning guideline ✓
- Online scan function ✓
- Import of the configuration with AutomationML ✓
- Import of STEP7 & TIA Portal projects ✓
- Port-by-port simulation ✓

Sinetplan



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Network report

SINETPLAN - Siemens Network Planner
01.00.00.00_19.01

Project:	SINETPLAN Example Projekt_v4
System supplier:	My system supplier
Plant designation:	My plant designation
Plant:	My plant
Hall:	My hall
Factory:	My factory
Station:	My station
Company:	Siemens AG
Author:	M. Himmler
Contact details:	DF FA AS E&C-PRM 6 Gleiwitzer Str. 555 90475 Nürnberg, Deutschland mailto: matthias.himmler@siemens.com
Generated on:	6/14/2016
Comments:	SINETPLAN - a great tool for network simulation!

Proneta (PROFINET network analyzer - free!)

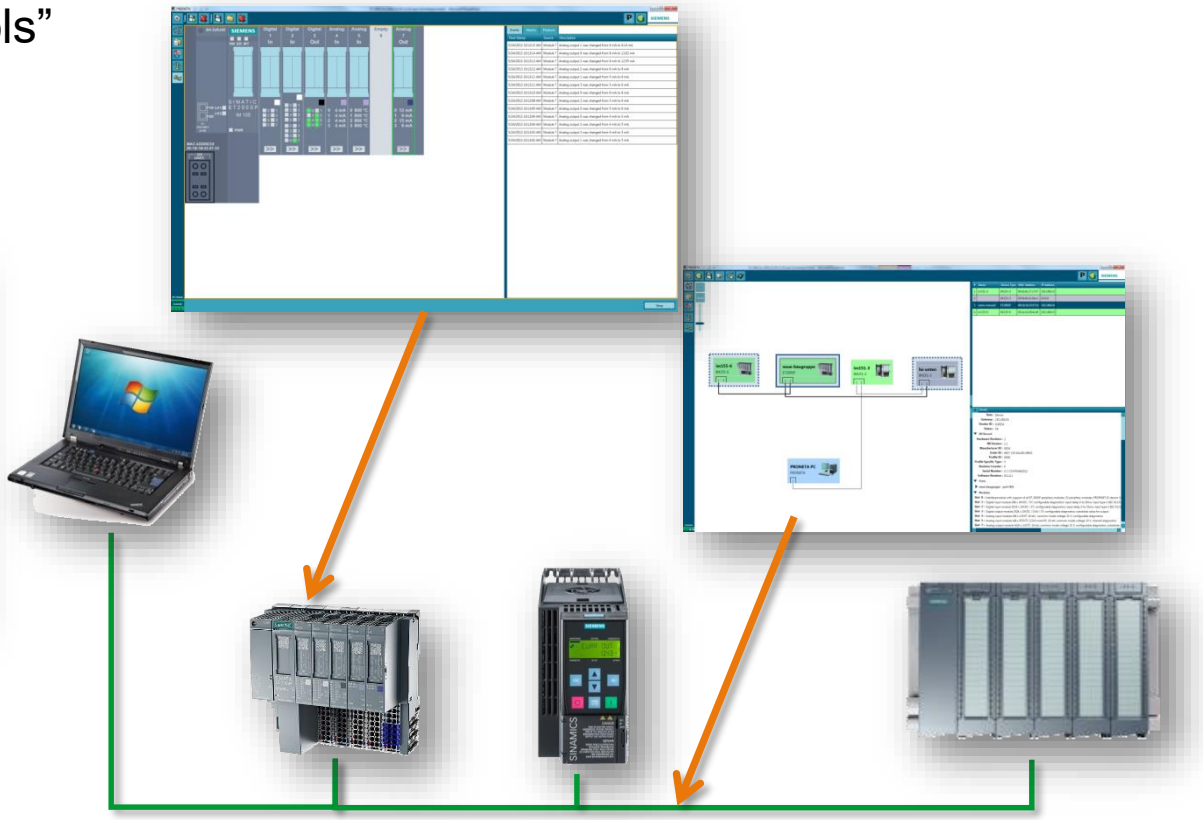
Requirements

- Easy to set up devices and network without PLC “tools”
- Detects devices and topology automatically
- Address settings
- IO testing

Used to

- cabinet manufacture
- Commissioning

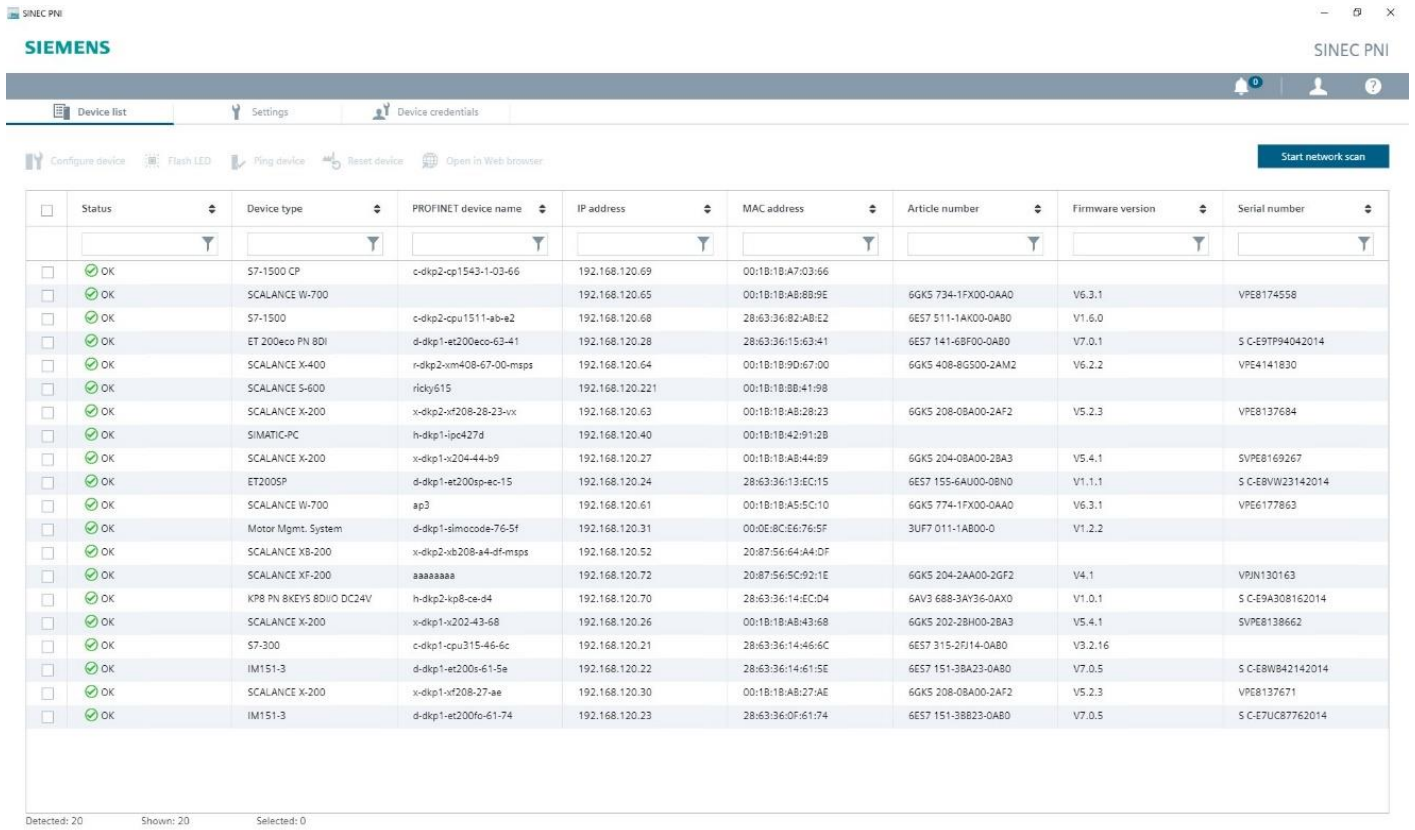
OEM



- www.siemens.com/proneta

SINEC PNI Basic – for free

SINEC PNI is a program that can be set for a network-specific parameter to SCALANCE and RUGGEDCOM devices



The configuration can be performed simultaneously for multiple devices.

- Network Scanning of all PROFINET and RUGGEDCOM devices
- Initialization by setting the following parameters for the devices :
  - address, subnet and gateway
  - Initial password change (Scalance ja Ruggedcom)
  - name (PROFINET)
  - I&M information to identify the device (PROFINET)
  - SysName, sysContact and sysLocation
- Activate DHCP-client
- Resets to factory settings
- Resets to the default PROFINET settings
- ping
- Flashes LEDs
- Open Web Based Management

SINEC PNI
Product editions

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	SINEC PNI Basic (02/2020)	**SINEC PNI Advanced (11/2020)**	**SINEC PNI Professional (03/2021)**

Features	• Step 1
	  • Scan network
	  • Set IP, subnet, gateway
	  • Set DHCP Client
	  • Set PROFINET / System name
	  • Set I&M Data
	  • Reset to factory
	  • Change Default Password
	  • Flash LED
	  • Ping
	• Step 2
	  • Firmware Update
	  • Diagnostic Downloads (logs with config)
	  • Configuration copy (up/down)
	  • Set SNMP (V1, V2C, V3)
		• + Set Time
		• + Set DNS Proxy
		• + Set Syslog-Client
		• + Set NTP-Client
		• + Set RADIUS-Client
		• + Configure DHCP Server
		• + Set SSID
		• + Set WLAN Mode
		• + Set Country
		• + Set Channel
		• + Set frequency
		• + Set SSID Security
		• + Set static VLANs
		• + Set VLAN IP addresses
			• + Generate SSL and SSH Keys
			• + Set Hardening profile
			• + Set NAT/ NAPT
			• + Set Firewall / ACLs
			• + Set SINEMA RC Client
			• + Password protection

Price	Free of charge	xxx €	xxx €

SINEMA Server V14

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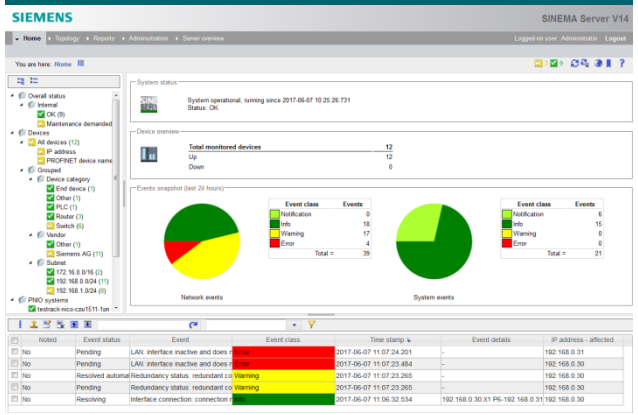
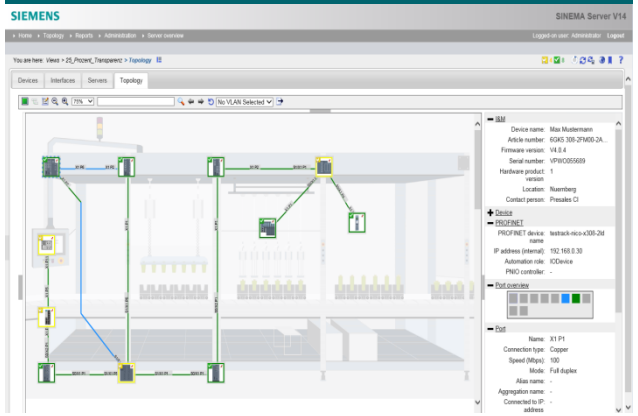
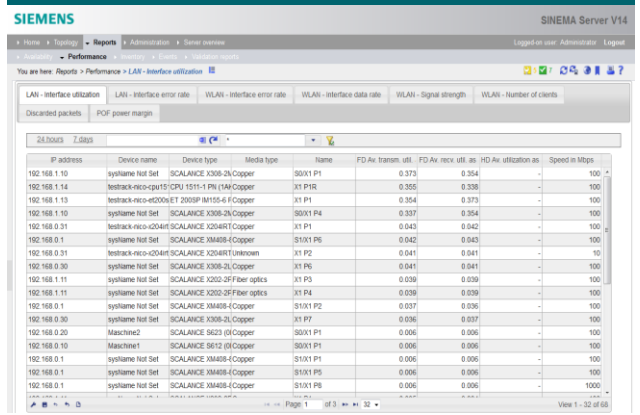
Home screen



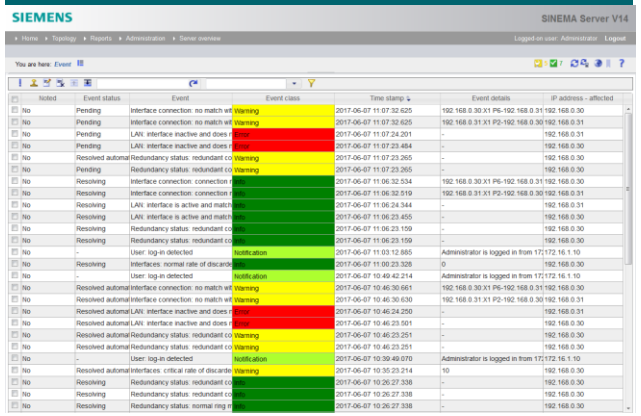
Topology



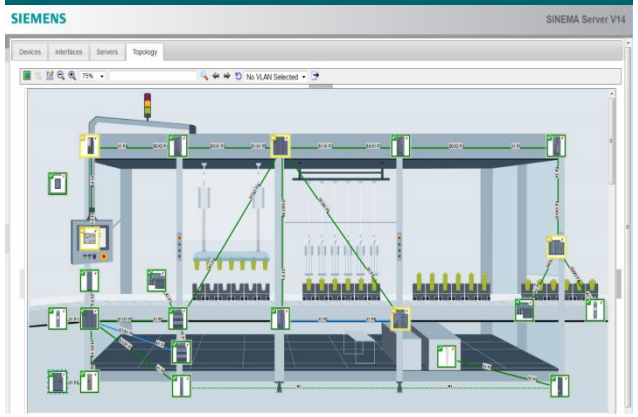
Event list



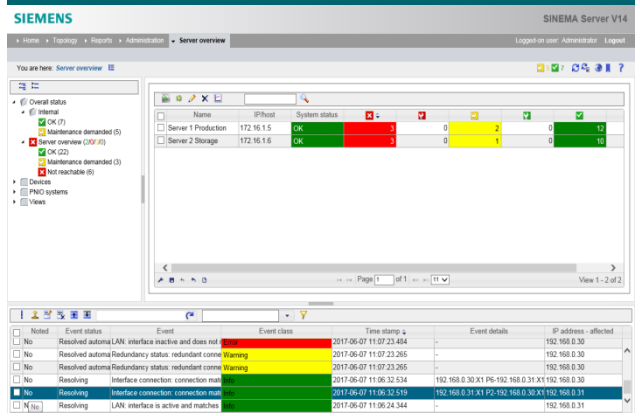
Reports



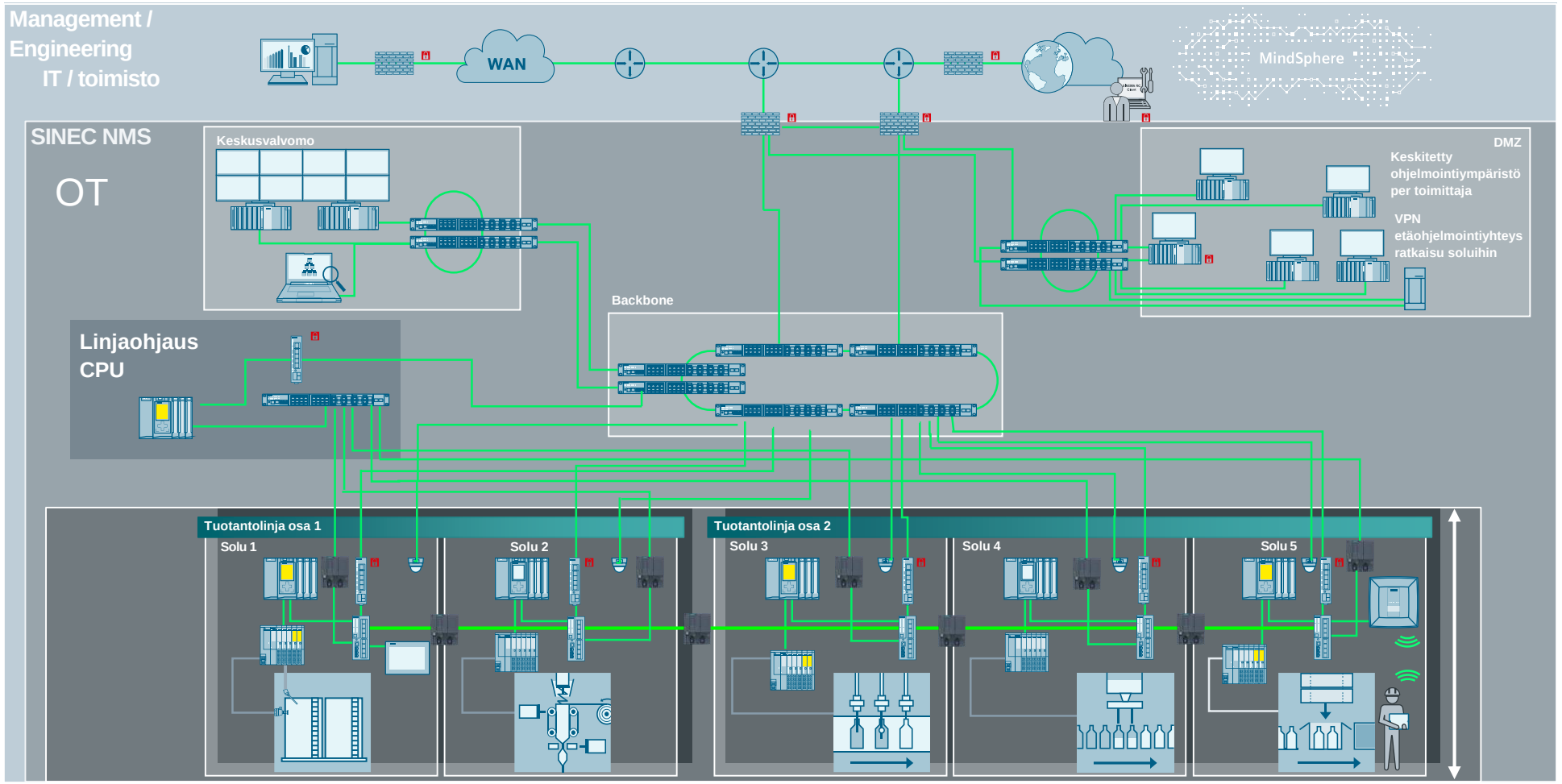
Customer-specific view



Server overview



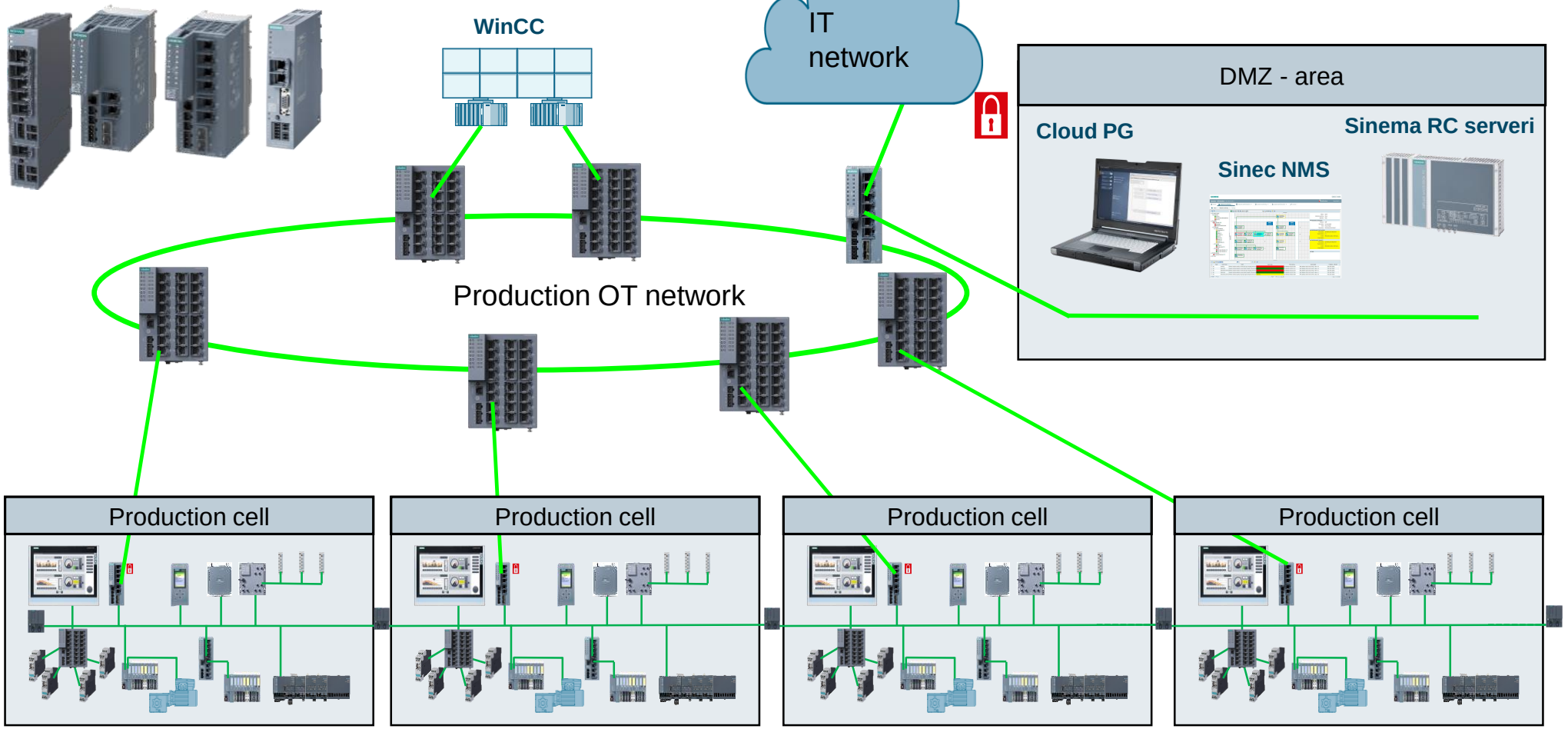
The automation network is connected to the OT network, not directly to the IT network. ADVANTAGE: A more secure data transfer to the entire production line is achieved.



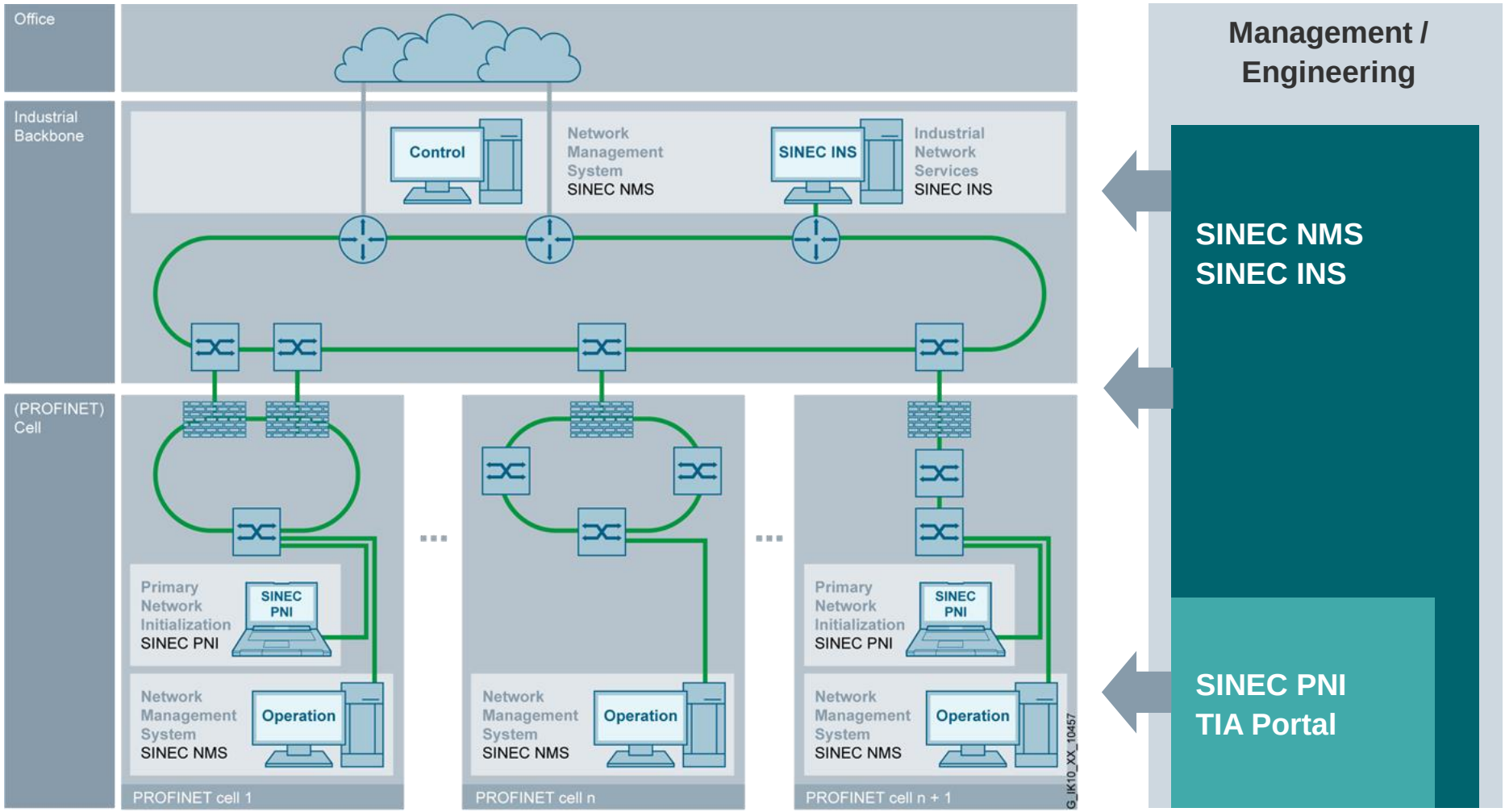
- The production cells are connected to each other with PN / PN Couplers
- Each cell is connected to the OT network with its own Firewall / VPN module
- VPN modules can be used to build a horizontal remote connection within the production line -> network monitoring and maintenance of the entire production line and, if necessary, a-cyclic data transfer between cells
- The devices on the OT network are managed and controlled centrally by Sinec NMS.
- Production network protected from IT network vulnerabilities -> trouble-free production
- The line control CPU is connected to an OT network or a separate network

Segmented production network (IEC62443)

Scalance S/SC VPN

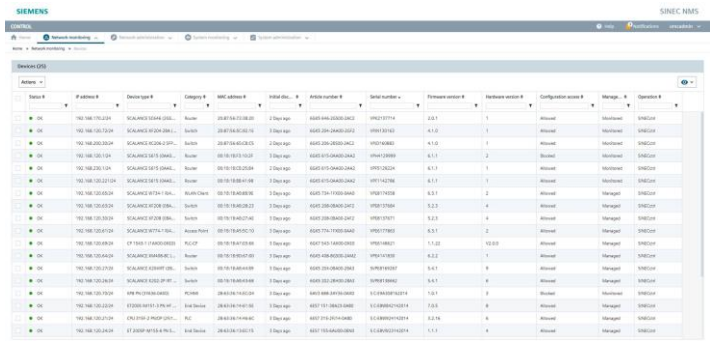


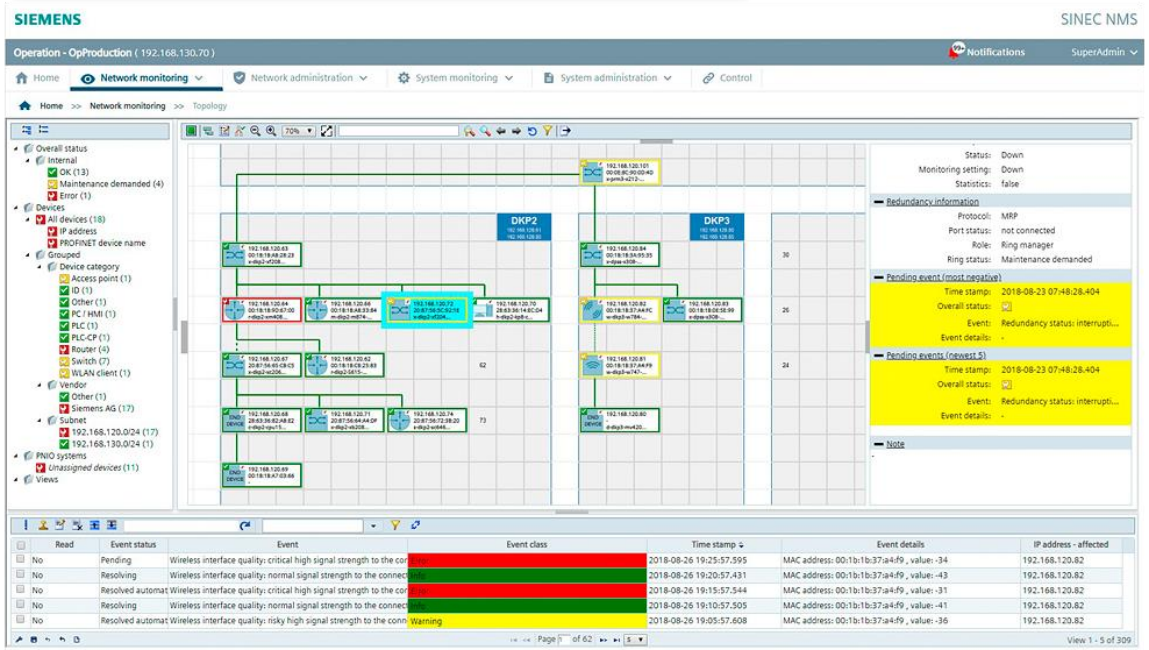
SINEC software family (NMS, PNI & INS)
Network levels (OT) – Factory automation

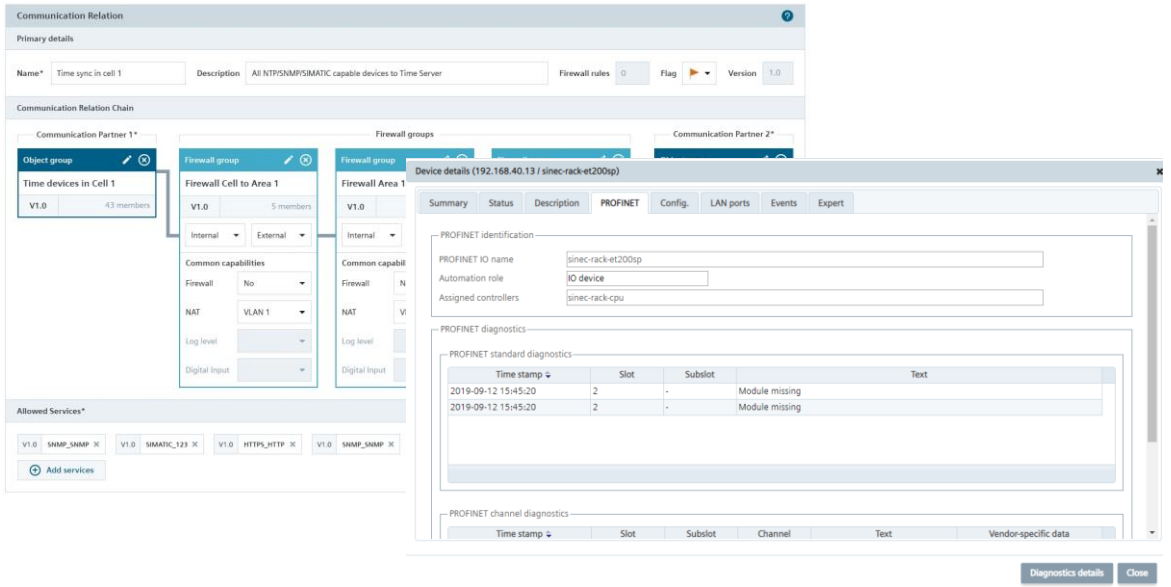


Sinec NMS

https://siemens.com/sinec-NMS







SCALANCE X managered switches
Layer 2 applications (Profinet)

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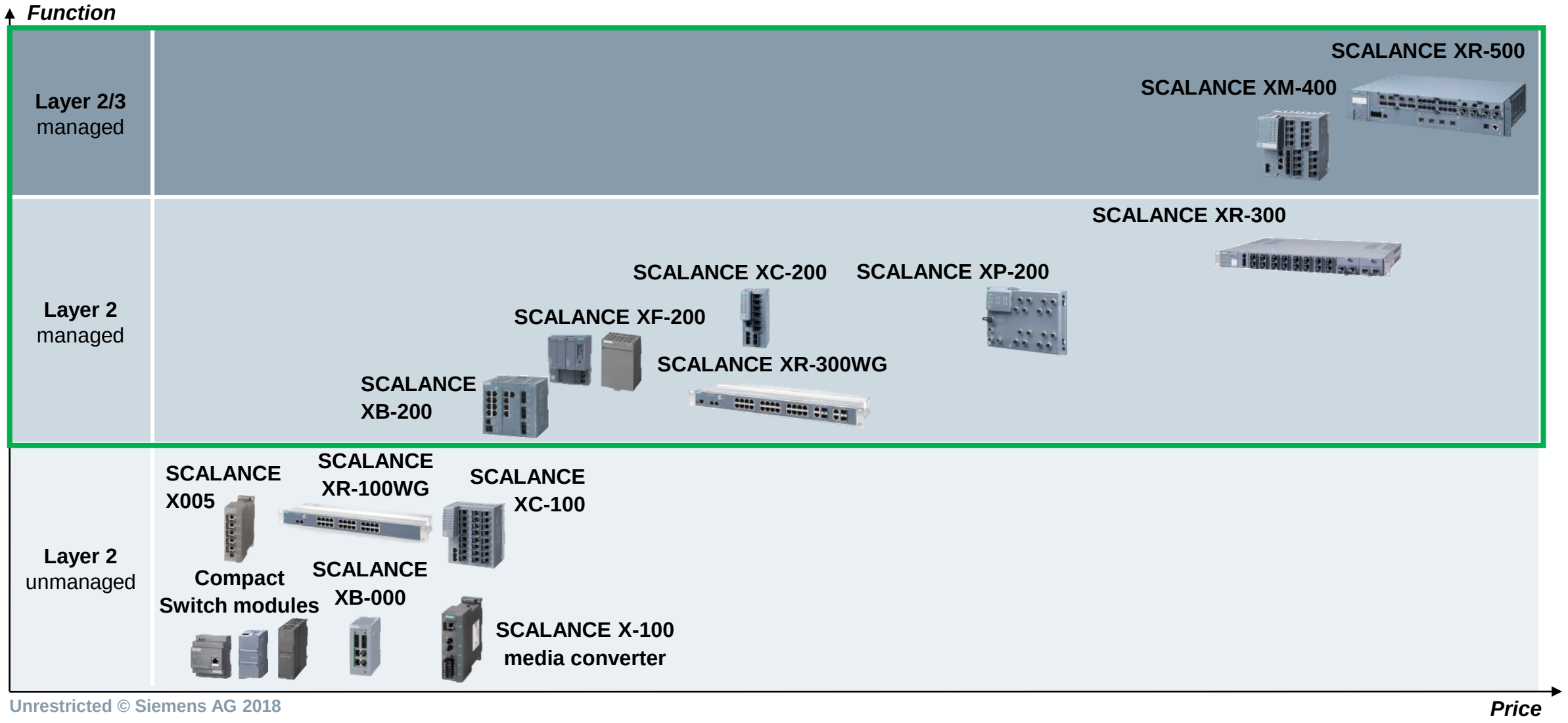

Thank you for your interest!

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