SIMATIC S7-1500R/H Technical Slides

siemens.com/S7-1500

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Ingenuity for life

- Motivation and Product Strategy
- System Overview
- Synchronization Principle
- System Redundancy and Network Configuration
- Failure Scenarios
- Communication
- S7-1500R/H and Safety
- HMI Connection
- Restrictions 1st Release Step
- Ordering Information

Redundant systems
Motivation

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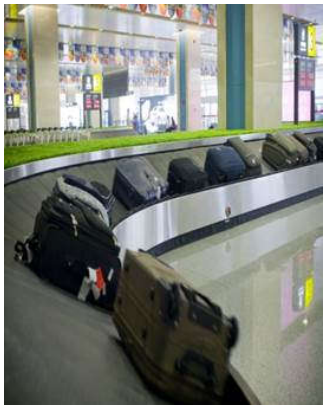
Preventing plant downtime
High availability during operation, Avoidance of loss of production



Prevention of data losses
The data remain intact and long restart times after a failure are eliminated.

Prevention of damages
Avoidance of unplanned production stops where the product to be processed would be permanently damaged

Operation without persons locally
Maintenance trips can be better planned

Save on maintenance
Application solutions are mostly complicated and difficult to maintain

Redundant systems reduce costs

SIMATIC High Available Systems
Product Strategy S7-1500R/H

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Based on Standard S7-1500 CPUs and PROFINET

- Basis Hardware Standard-CPUs/Fail-safe CPUs

Transparent Programming

- Standard Engineering Tool TIA Portal V15.1
  - Redundancy functions fully integrated in TIA Portal
  - General handling like standard
  - No deep Redundancy Know-How needed

Extensive Scalability

- Scalability of switch-over time
- Scalability of the Redundancy Architecture
- Scalability of the CPU Performance (1513 → 1517)

Step by Step Product Launch Strategy

- First release with basic redundancy functions
- First release will not include all standard and redundancy functions
- Step by Step increasing of feature set in future versions

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SIMATIC S7-1500 Redundant systems
System overview (1st Release step)

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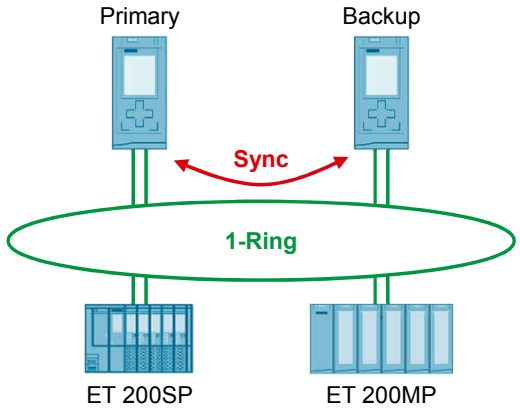
Consistent concept –
Identical synchronization process

Scaling of the switching performance over the **available bandwidth** of the sync connection

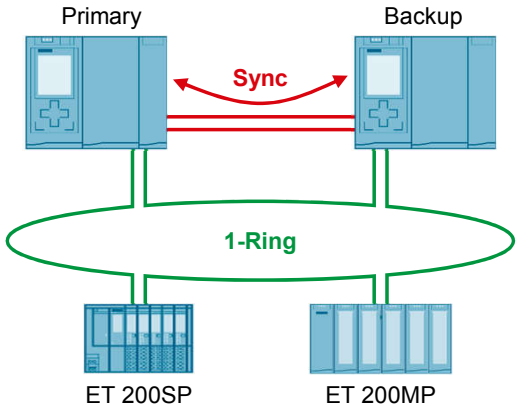
CPU type
Synchronization
Switchover time
I/O systems
Type of connection

Redundant – S7-1500R



CPU 1513R/CPU 1515R
via **PROFINET Ring (MRP)**
200 – 500ms
ET 200SP and ET 200MP
Single connection (PN redundancy S2)

High available – S7-1500H



CPU 1517H
via **Sync-Module**
<100ms
ET 200SP and ET 200MP
Single connection (PN redundancy S2)

SIMATIC S7-1500R/H
PLC Hardware in 1st Release step

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	S7-1513R-1PN 6ES7513-1RL00-0AB0	S7-1515R-2PN 6ES7515-2RM00-0AB0	S7-1517H-3PN 6ES7517-3HP00-0AB0
Program / memory	350 kB code 1,5 MB data	500 kB code 3 MB data	2 MB code 8 MB data
Interfaces	X1	X2 X1	X2 X1 X3 X4
Firmware	V2.6	V2.6	V2.6

Short Distance <= 10m	Long Distance <= 10km
Fiber Optic Cable	
Plastic	Glass fiber
Sync module SFP	
6ES7960-1CB00-0AA5	6ES7960-1FB00-0AA5





X1: PROFINET IO Controller, Supports RT, MRP, Transport Protocol TCP/IP, Open User Communication
X2: PROFINET Basic Services, Transport Protocol TCP/IP, Open User Communication

SFP = Small Form-factor Pluggable

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Periphery in 1st Release step

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	IM 155-6PN HF ET 200SP 6ES7-155-6AU00-0CN0	IM 155-5PN HF ET 200MP 6ES7-155-5AA00-0AC0	PN/PN coupler 6ES7-158-3AD10-0XA0	SINAMICS S120
Firmware	>=V4.2	>=V4.2	>=V4.2	>=V5.1
Address range (S2)	1000Byte IN / OUT	512Byte IN 512 Byte OUT	1000Byte IN 1000Byte OUT	---

SFP = Small Form-factor Pluggable

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Synchronization Principle – Event Synchronization
Comparison S7-400H ↔ S7-1500H

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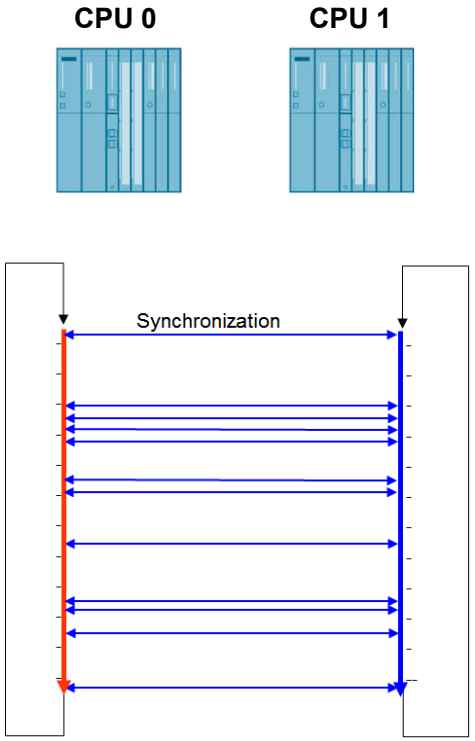
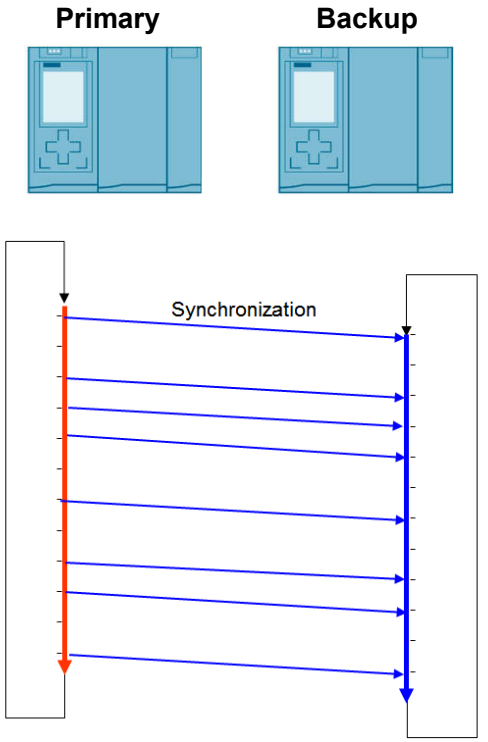
Synchronization events:

- Cycle control point (R/W process images)
- Periphery direct access
- Interrupts/Alarms
- Timer modules
- Communication

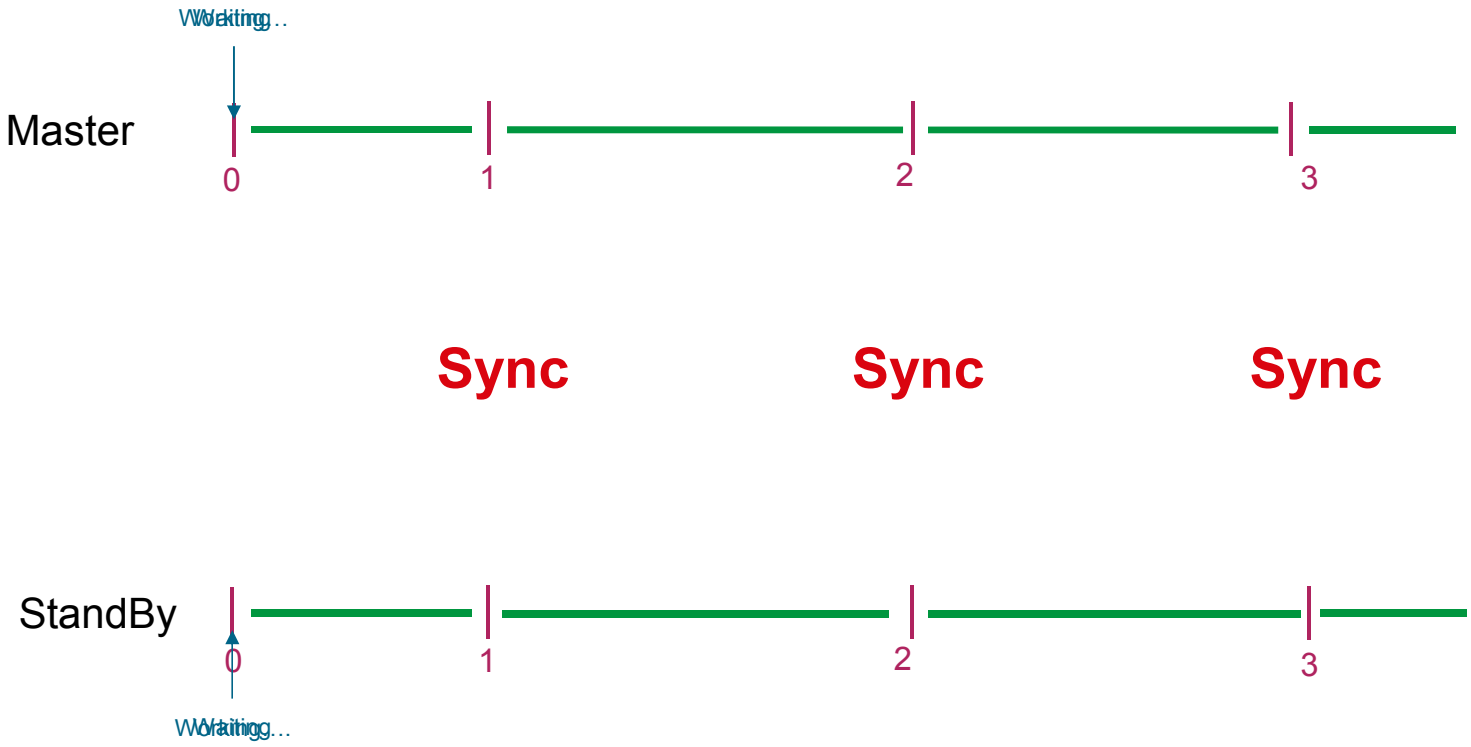
S7-400H – Synchronous Principle



S7-1500H – Asynchronous Principle



S7-400H – Synchronous adjustment (interrupted)



S7-1500H – Asynchronous adjustment (continuous)

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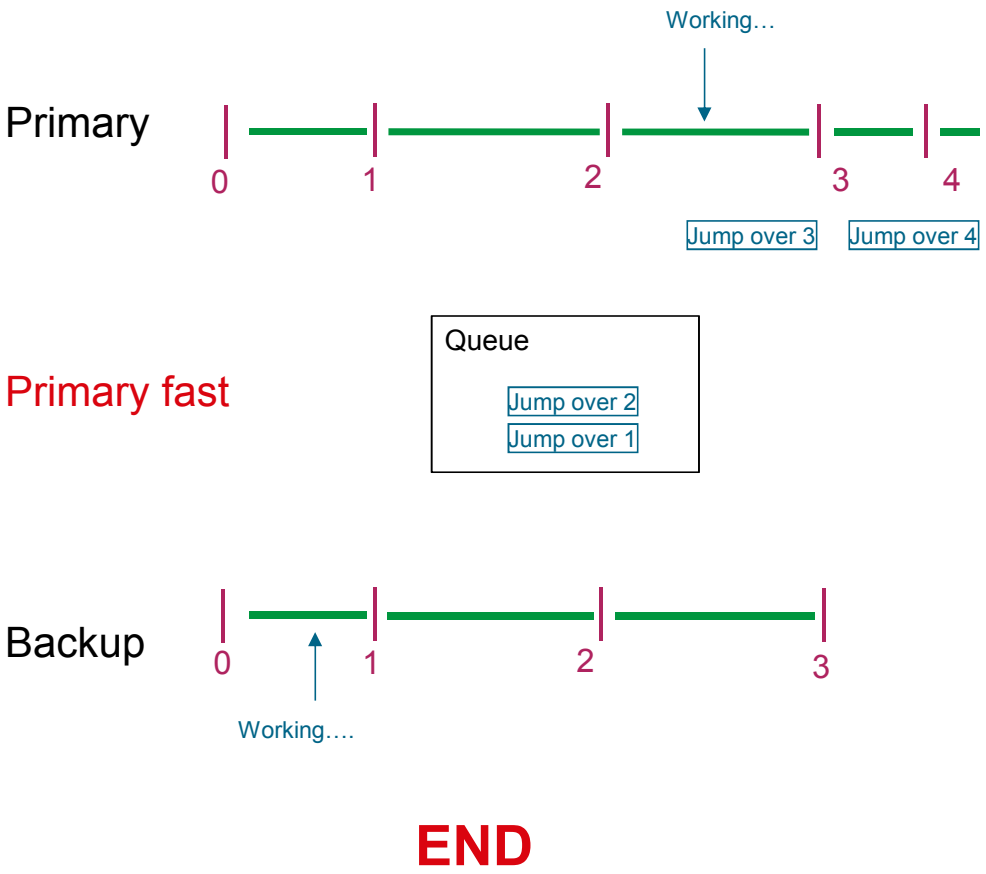

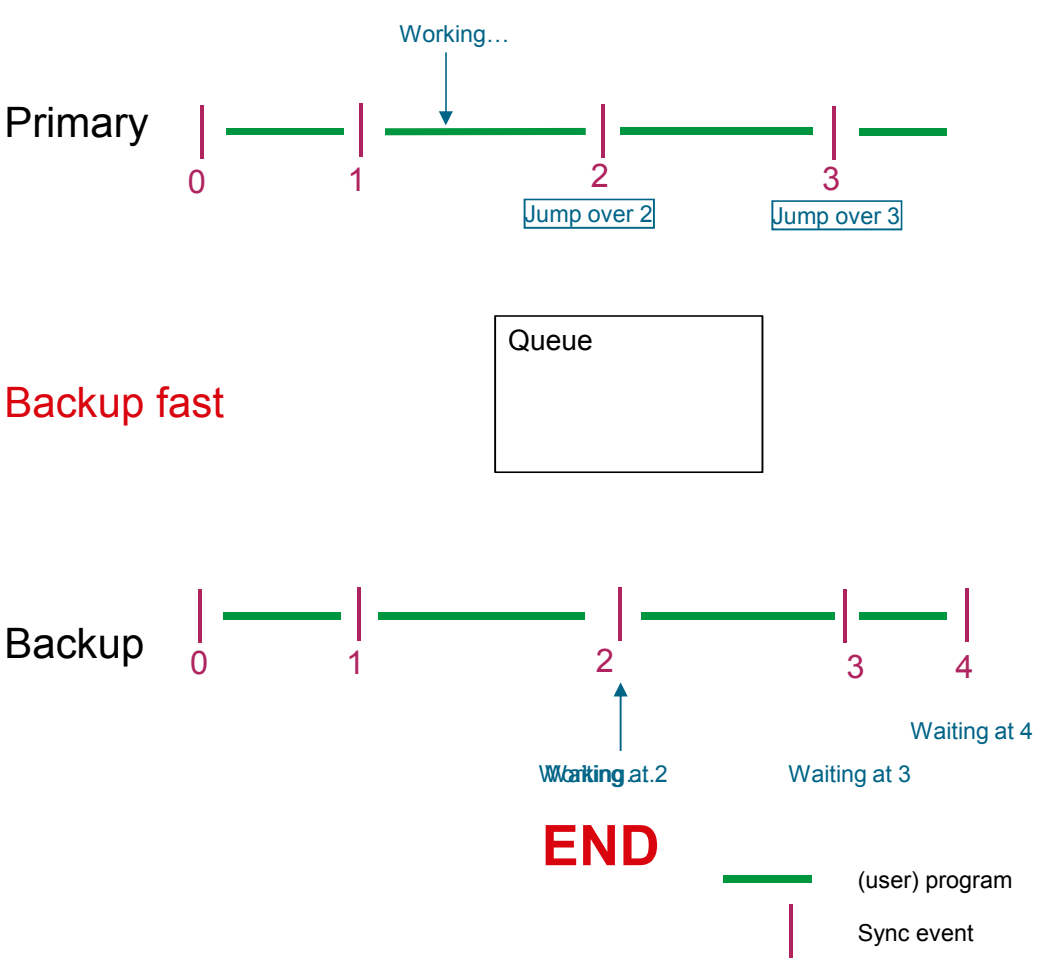

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PNO PROFINET System redundancy

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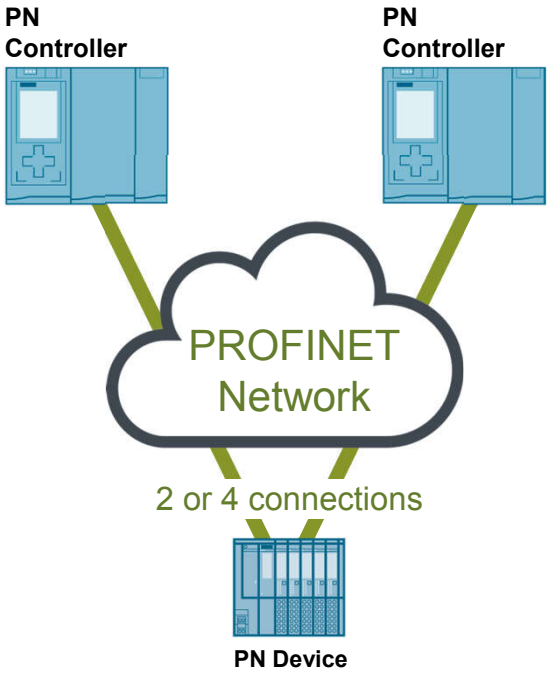
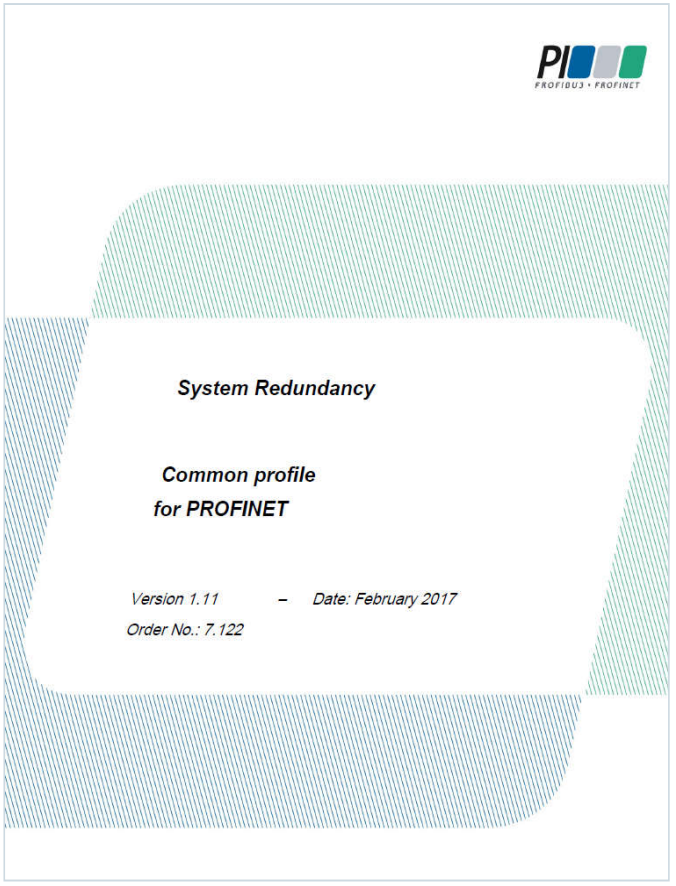
PROFINET SR

- A System with redundant PN controllers and single or redundant PN devices.
- 3 Level:
  - PN Controller,
  - PROFINET Bus
  - PN-device.
- Redundancy at one level is independent of redundancy at each other level.





PNO PROFINET System redundancy

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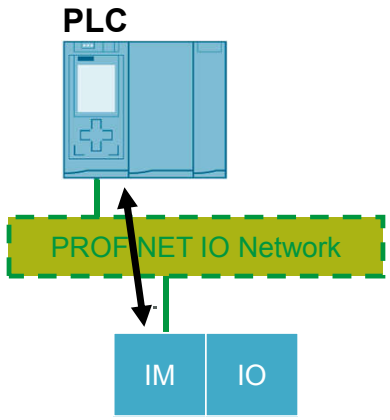
S1 Mode



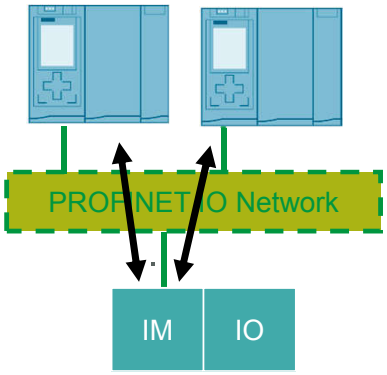
S1 Device

S → Single interface

1 → one connection to one PLC

Standard PLC

S2 Mode



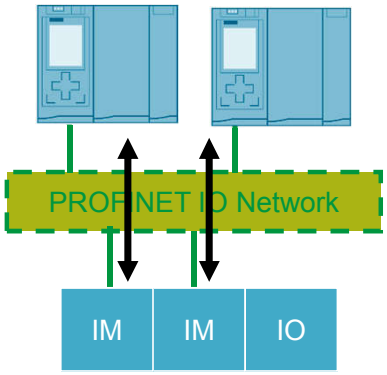
S2 Device

S → Single interface

2 → can switch between two connections

For R/H Release 1

R1 Mode



R1 Device

R → Redundant interface

1 → each interface has one connection to one PLC

Future 1500H release

SIMATIC S7-1500R/H
PROFINET Network configuration

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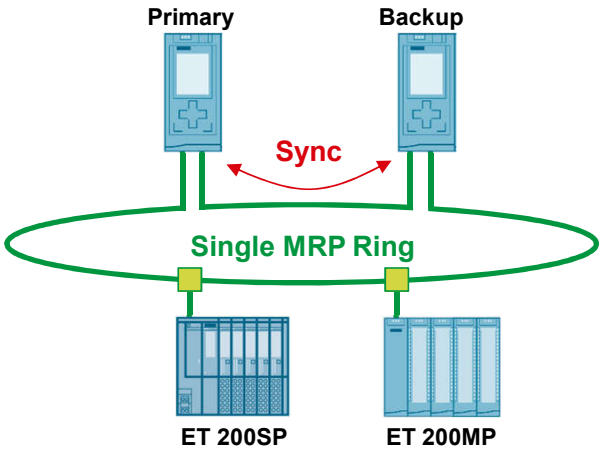
Requirements for the PROFINET network configuration

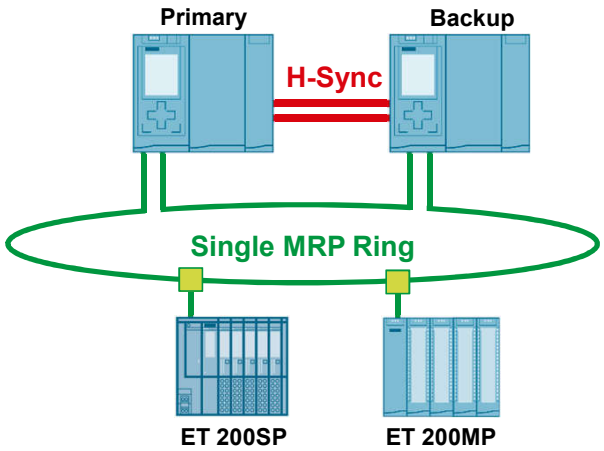
- MRP Ring (default setting in the configuration)
- PN IO only at X1 interface
- PLC's need to be part of the ring
- 1500R → no devices in the connection between the two PLC's
- PN Devices need to support PN System redundancy NAP S2 (V1.11)

Redundant 1500R



Max. 16 devices in ring*)

High Available 1500H



Max. 50 devices in ring*)

*) Recommendation

SIMATIC S7-1500R/H - PROFINET Network configuration
1513R/1515R Length of the synchronization connection

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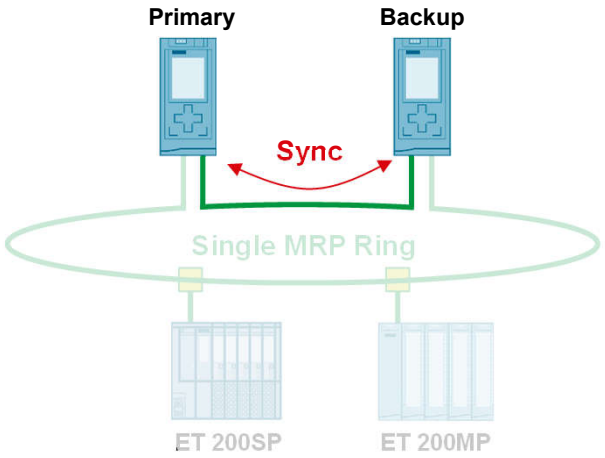
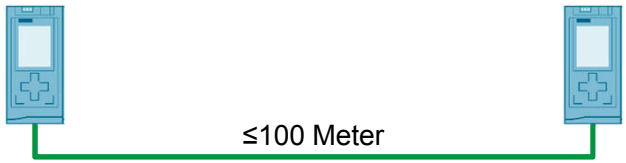
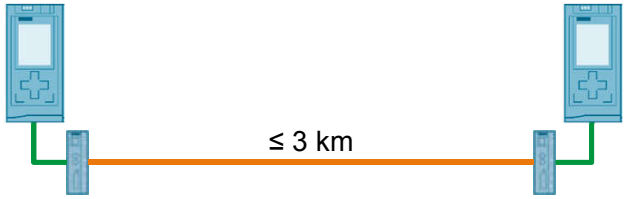


Direct link up to 100 m



Fiber optic link (media converter) up to 3 km



SIMATIC S7-1500R (1st Release step)
Basic System Configuration

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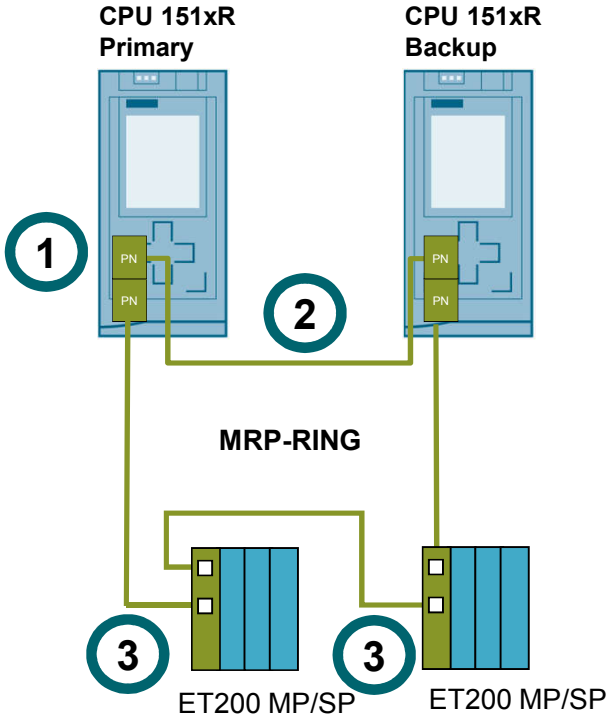

Structure

1. MRP-Ring must be connected to the X1 - Port
2. Synchronization over PN-Ring – no device in this segment
3. All PN-IO Devices must support PN S2-Redundancy

Configuration example (1st Release step)
CPU1515R

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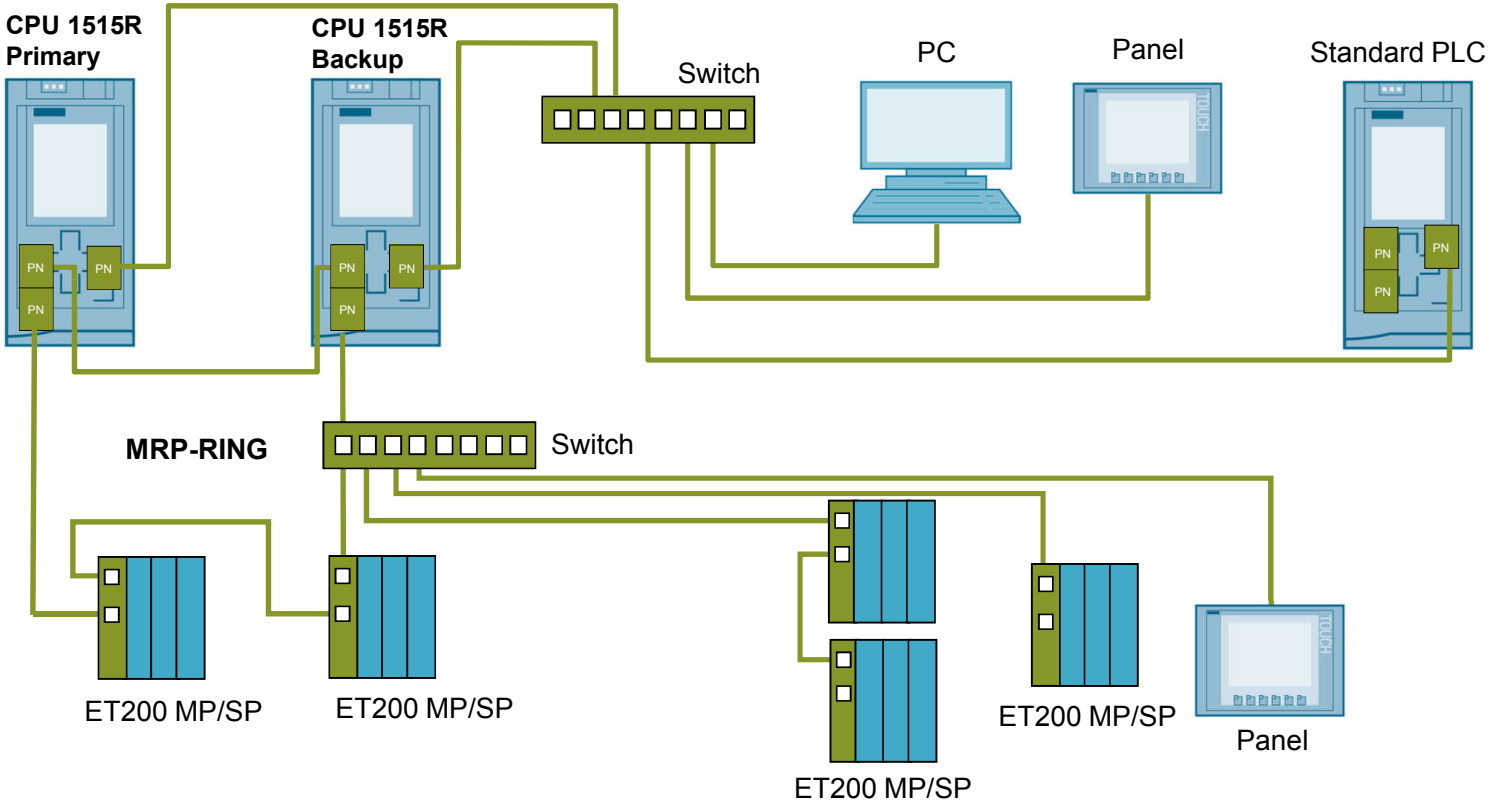

SIMATIC S7-1500R/H - PROFINET Network configuration
1517H Length of the synchronization connection

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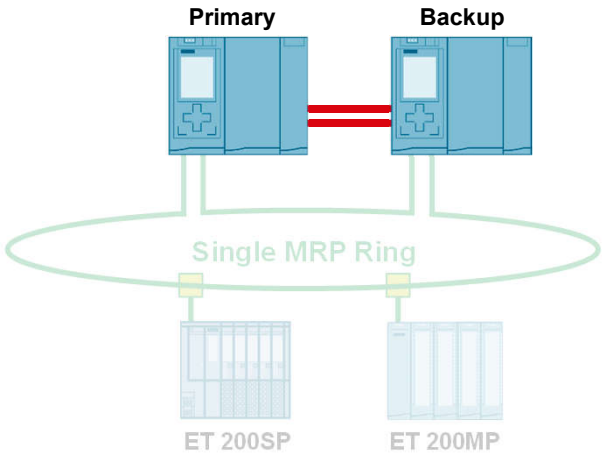
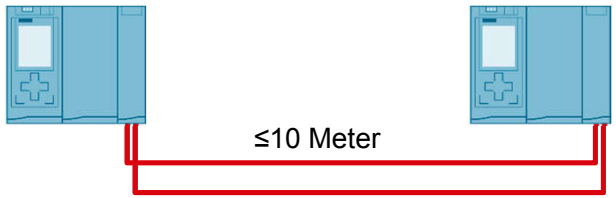
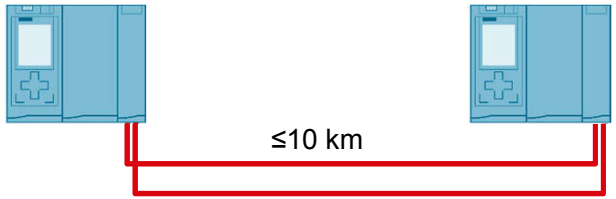


Short distance Sync modules up to 10 Meter (LED)



Long distance Sync modules up to 10 km



The sync cables are redundant.
The loss of one fiber optic cable has no impact on the runtime behavior.

SIMATIC S7-1500H (1st Release step)
Basic System Configuration

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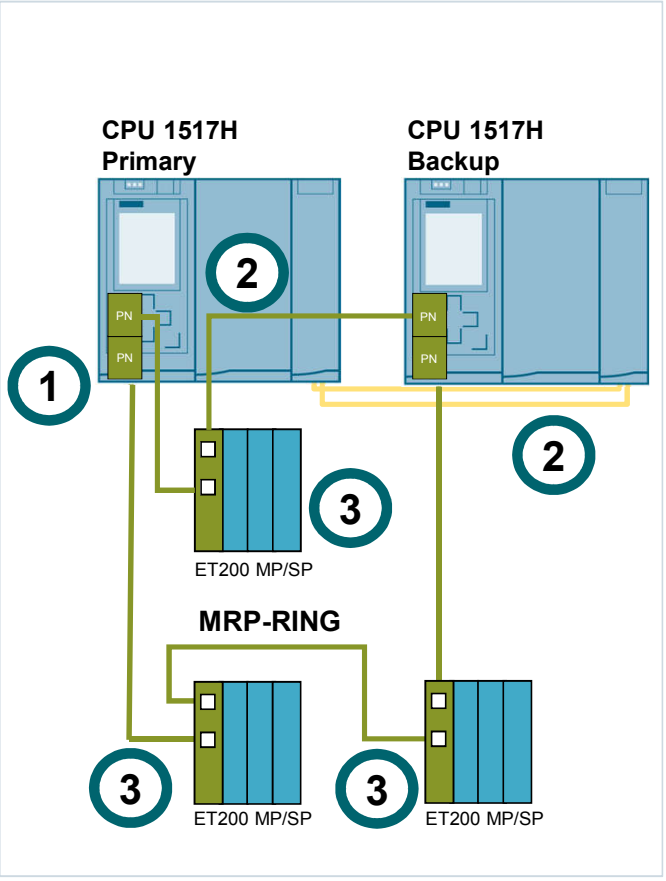

Structure

1. MRP-Ring must be connected to X1 - Port
2. Synchronization over Sync-Modules –
   Device connection possible
3. All PN-IO Devices must support PN S2-Redundancy

Configuration example SIMATIC S7-1500H (1st Release step) CPU1517H

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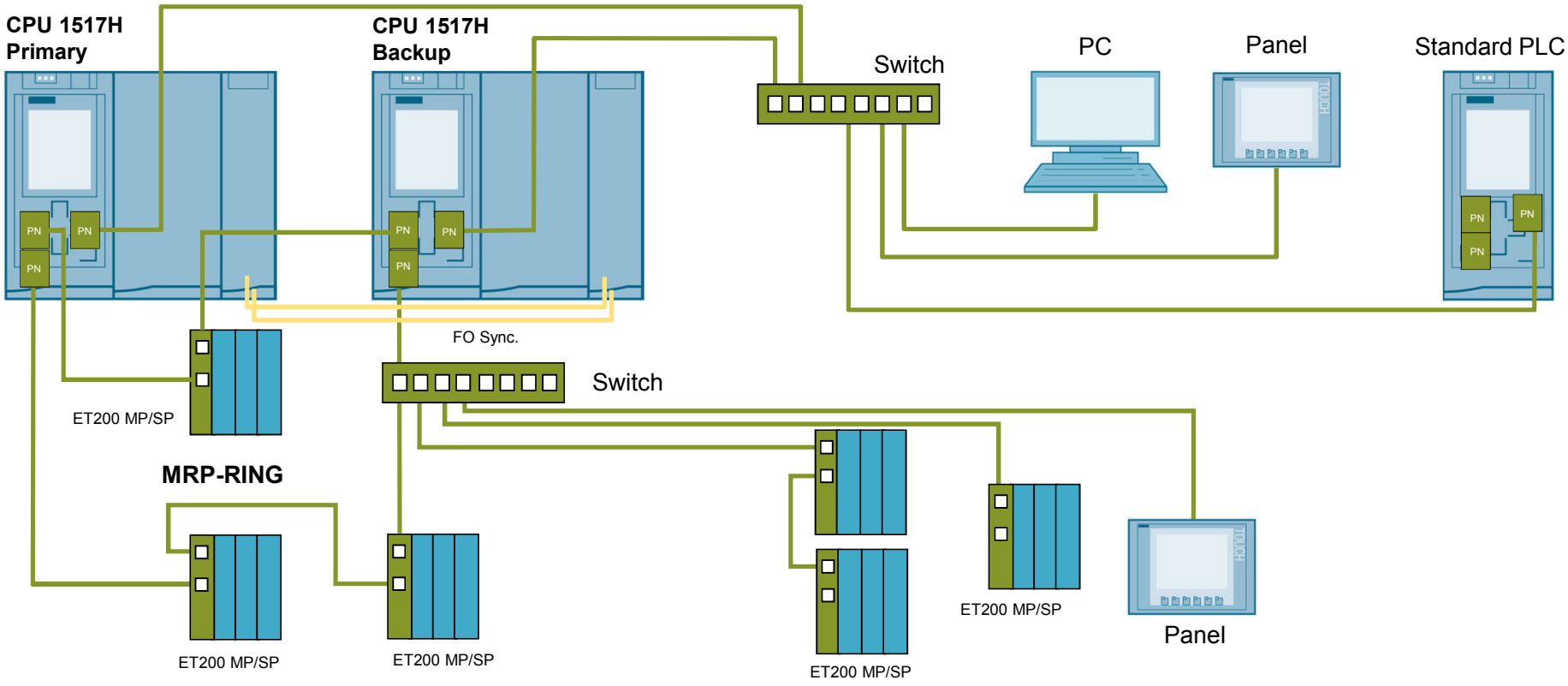

SIMATIC S7-1500R/H - PROFINET Network configuration
PROFINET Devices – System redundancy S2

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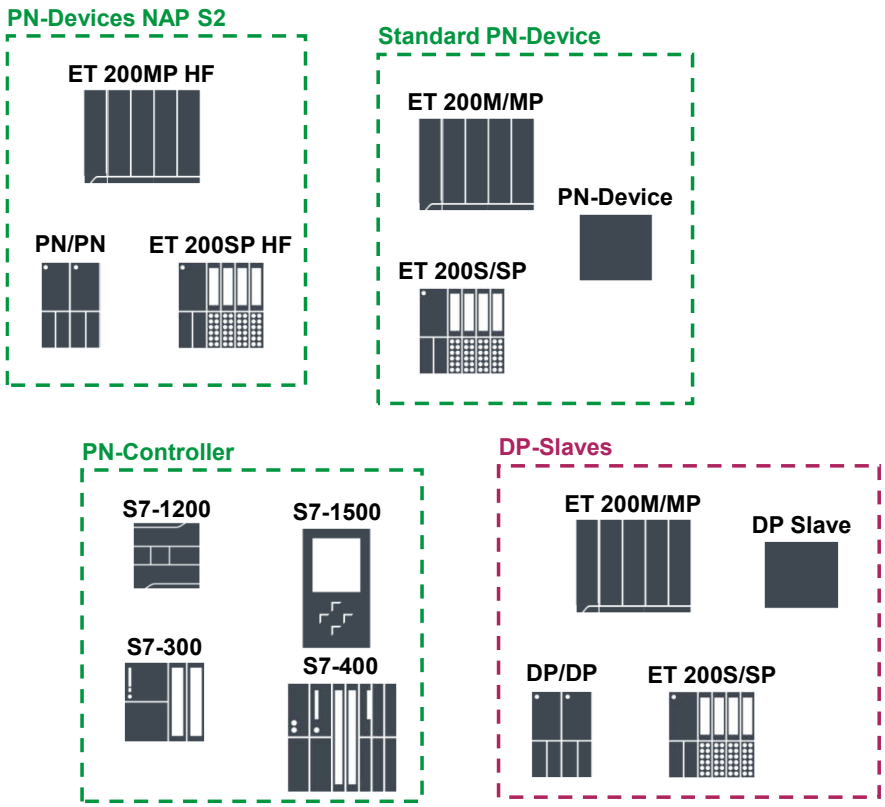
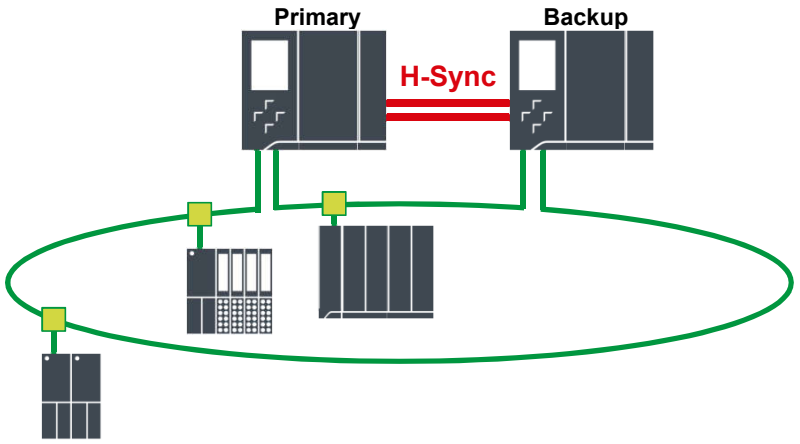


Only S2 devices are supported in the ring



SIMATIC S7-1500R/H - PROFINET Network configuration
PROFINET Devices – PN Controller

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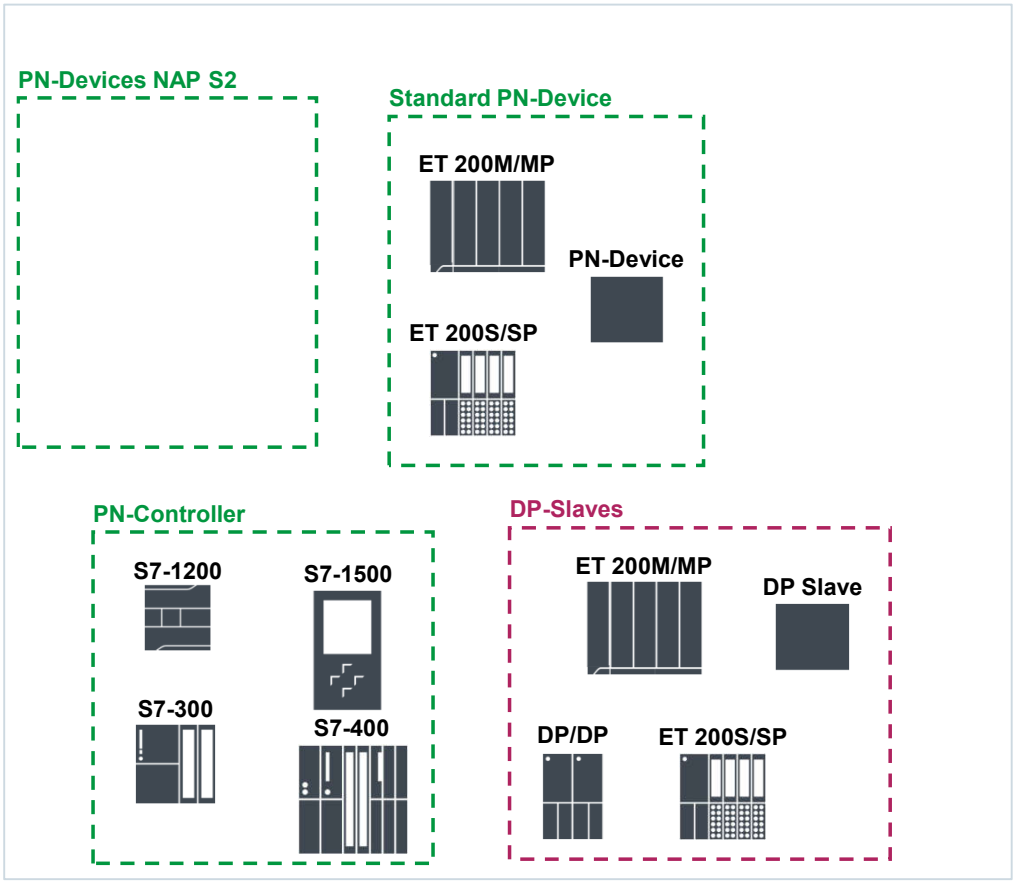
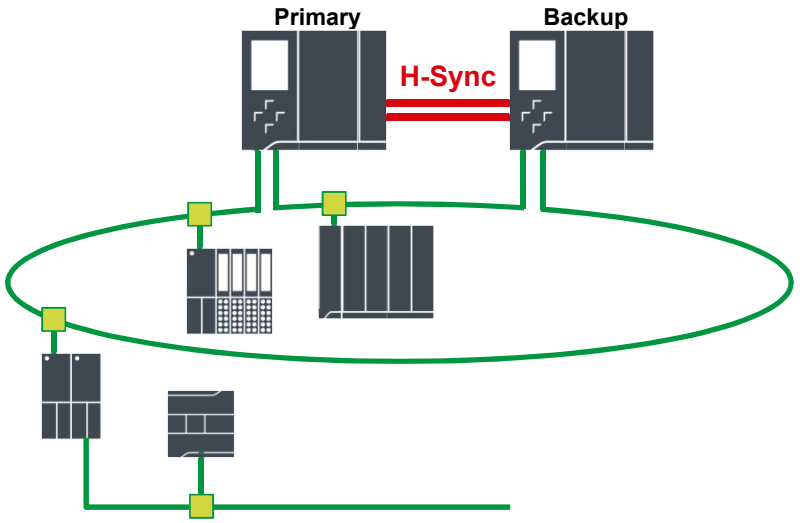


PN/PN coupler for network separation



SIMATIC S7-1500R/H - PROFINET Network configuration
PROFINET Devices – Standard Devices

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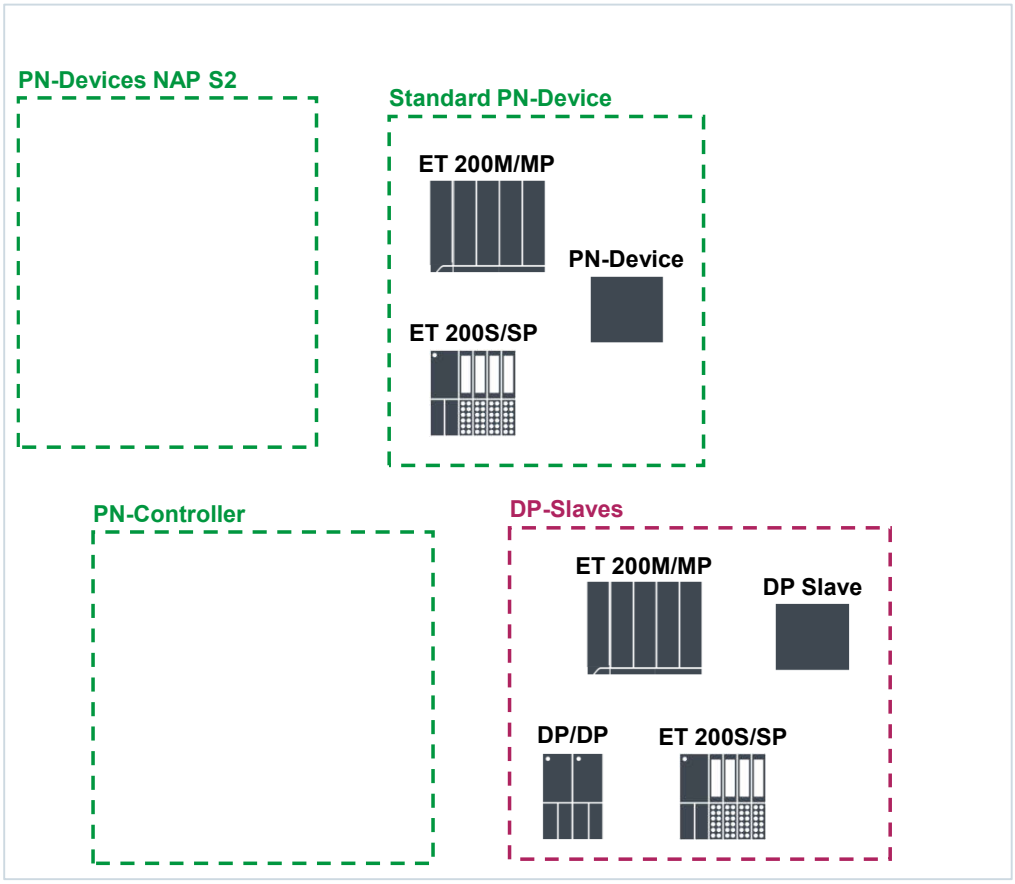
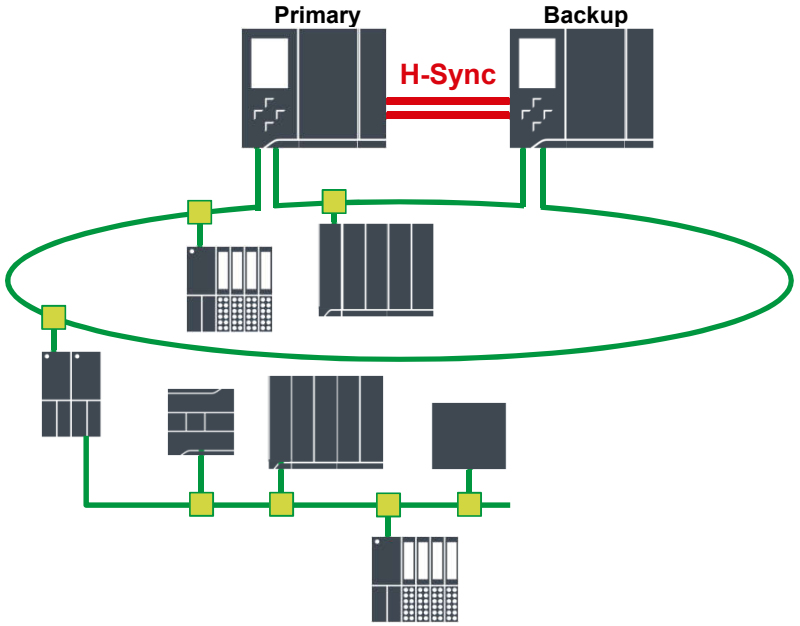


NAP S1 Devices in subordinated PN Network



SIMATIC S7-1500R/H - PROFINET Network configuration
PROFINET Devices – DP Slaves

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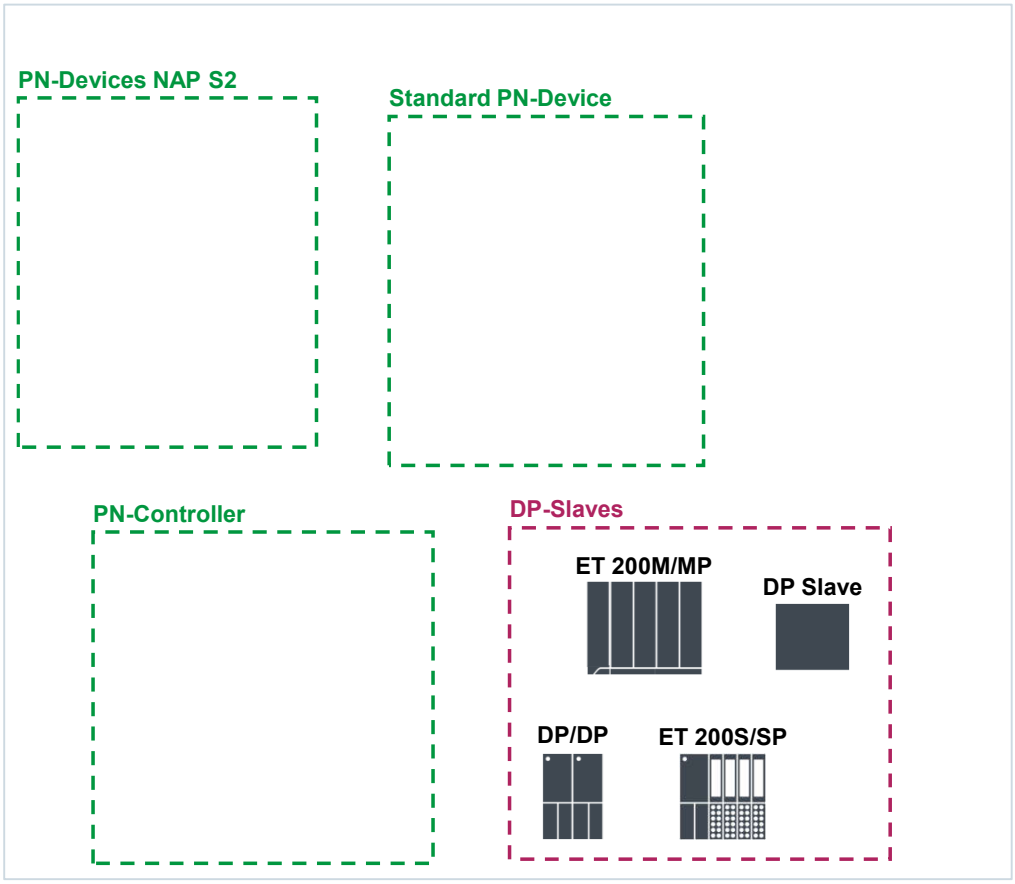
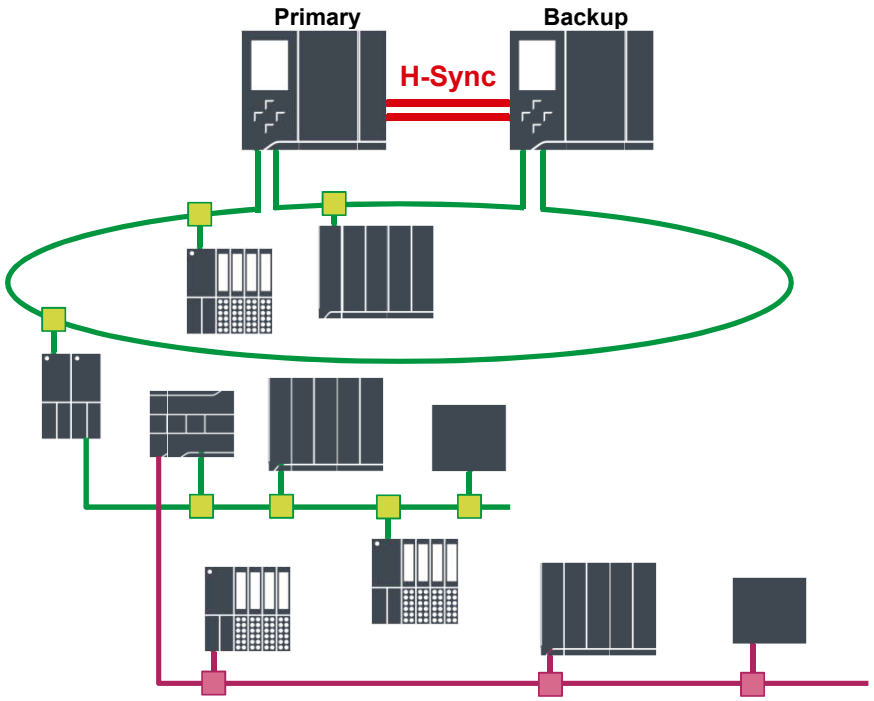


DP Slaves via DP Master of Sub-Controller



SIMATIC S7-1500R/H - PROFINET Network configuration
Network connections

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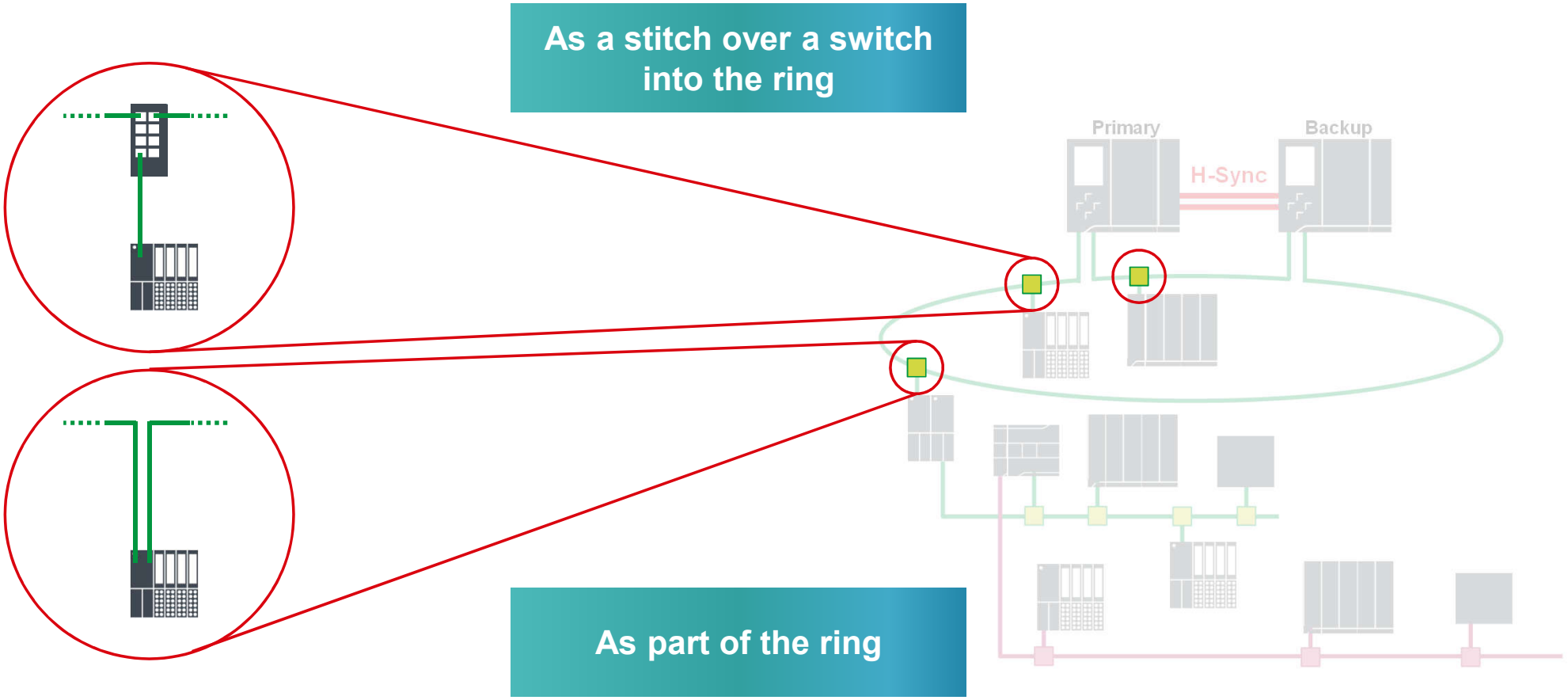

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Failure scenarios for S7-1500R/H

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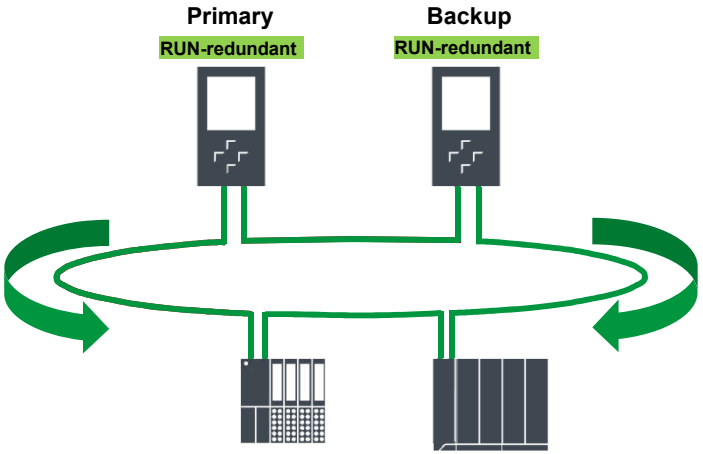
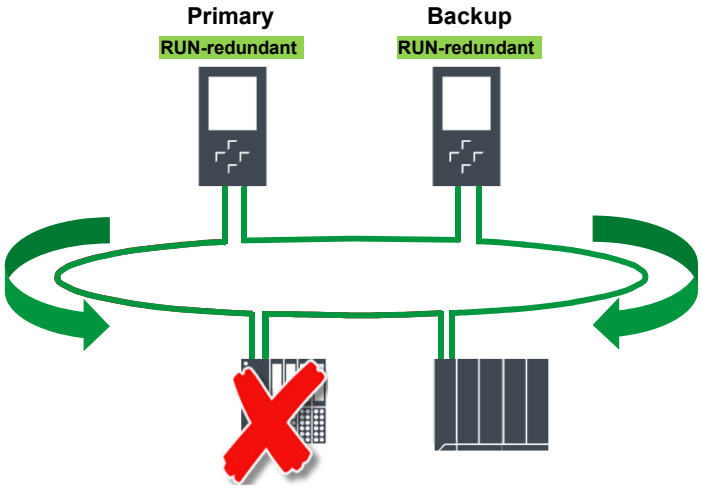
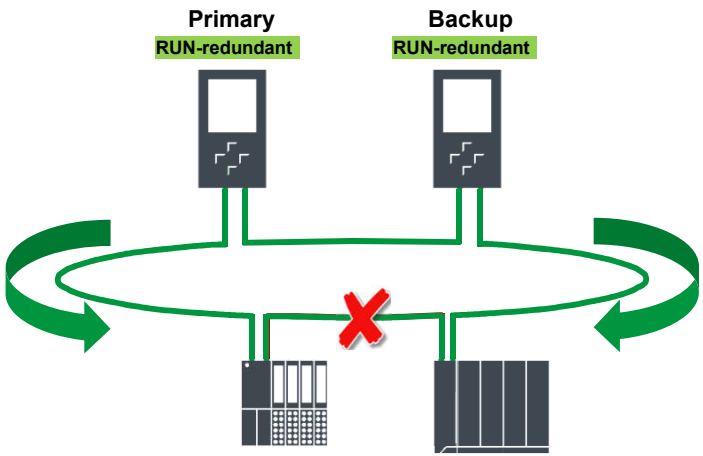
Primary or Backup CPU failure



Failure of an IO device in the PROFINET ring



Failure of the PROFINET cable in the PROFINET ring



Failure scenarios for S7-1500R/H

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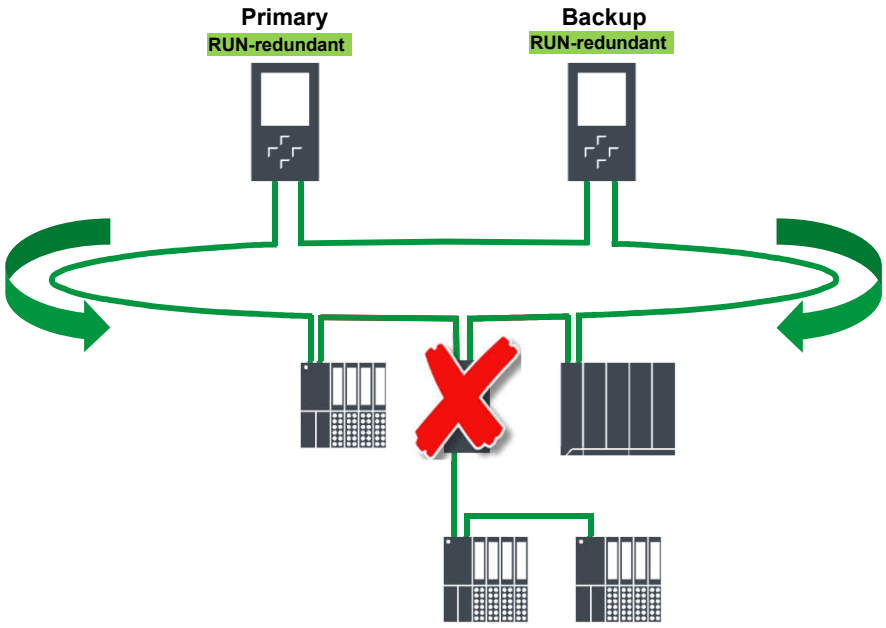
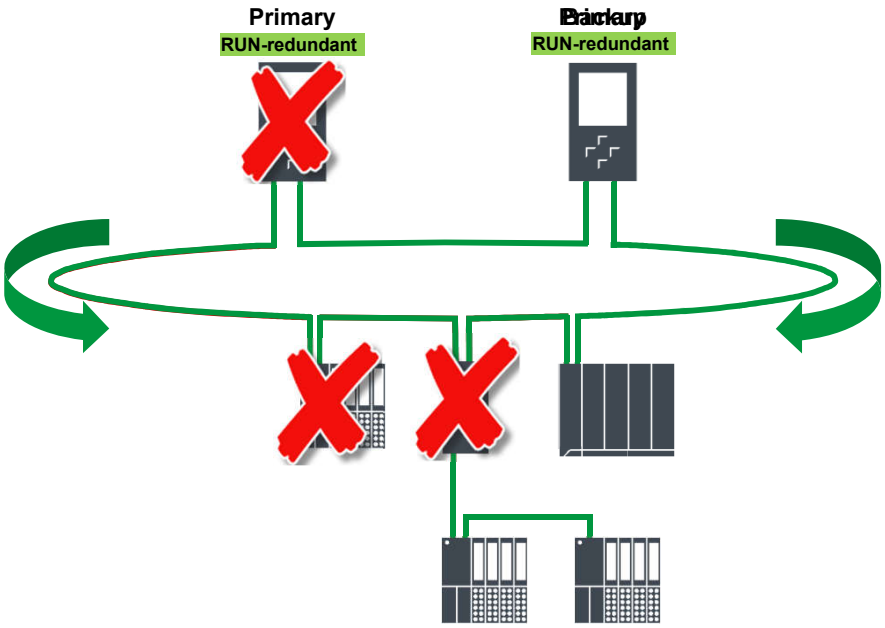
Failure of a switch in the PROFINET ring (with line topology)



Failure of an IO device in the PROFINET ring AND of the Primary CPU



Specific failure scenarios for S7-1500R

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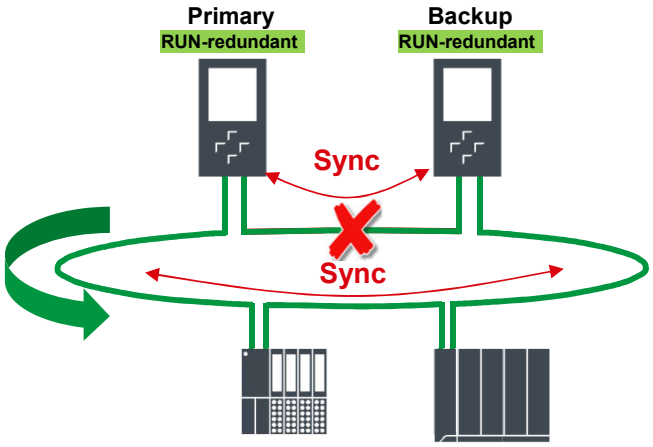
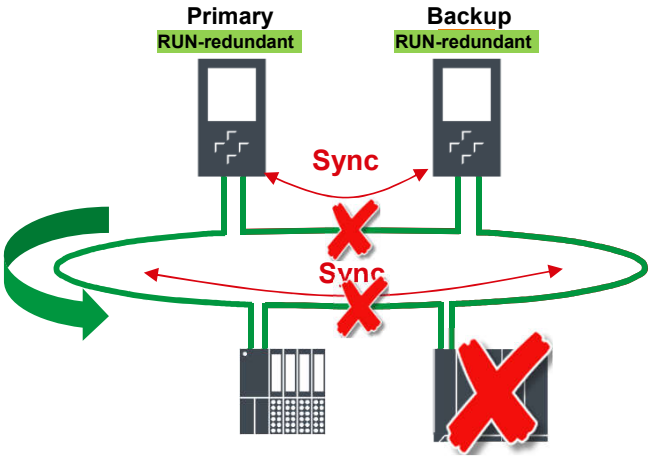
Failure of the direct redundancy connection

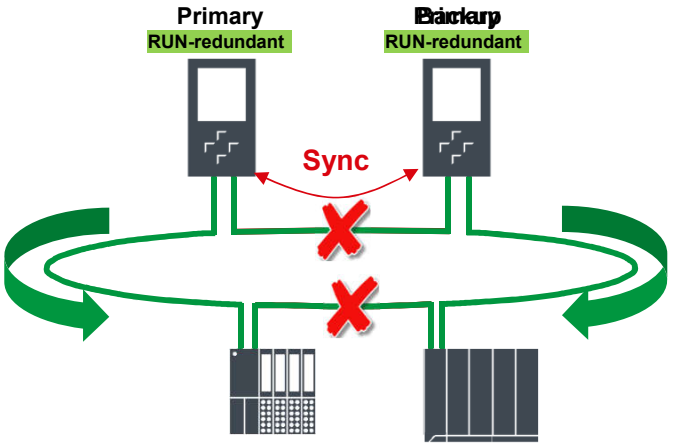


Failure of the two direct redundancy connections and PROFINET cable in the PROFINET ring



Time interval 2nd failure

> 1500ms



Time interval 2nd failure

< 100ms

Undefined condition

Specific failure scenarios for S7-1500H

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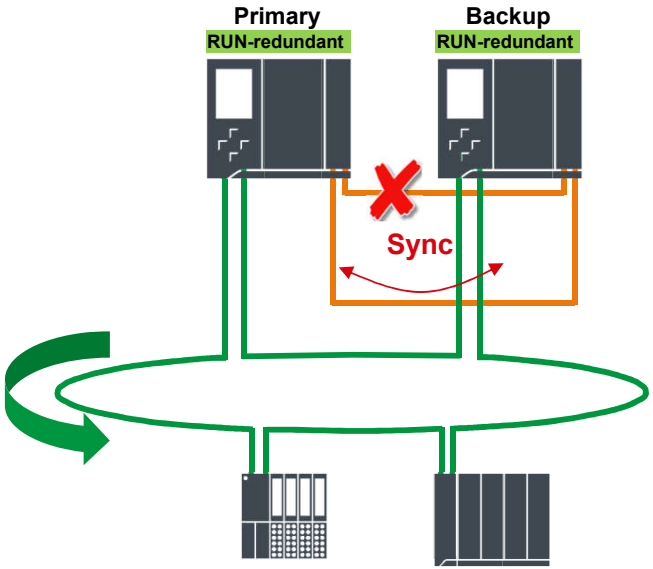
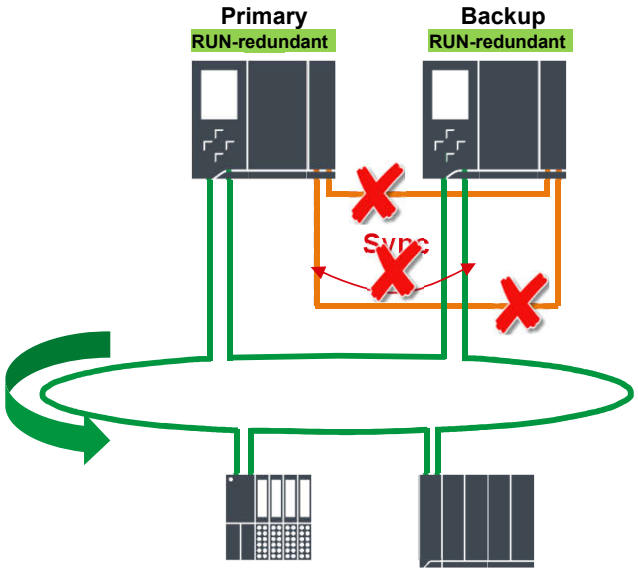
Failure of a direct redundancy connection

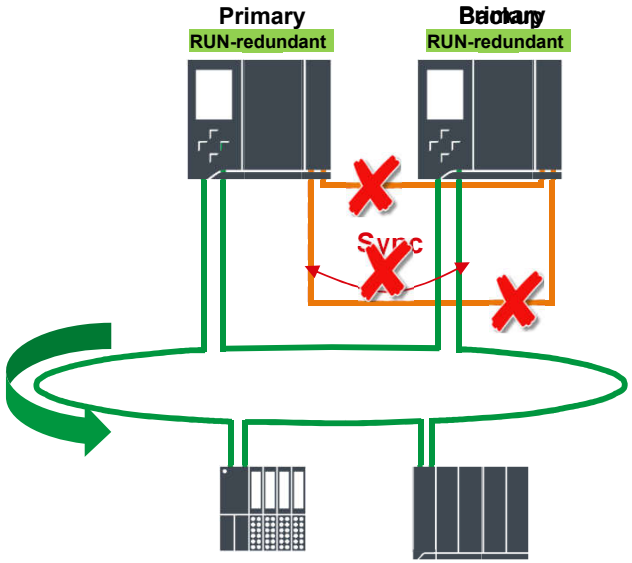


Failure of the two direct redundancy connections



Time interval 2nd failure

> 1500ms



Time interval 2nd failure

< 100ms

Undefined condition

Specific failure scenarios for S7-1500H

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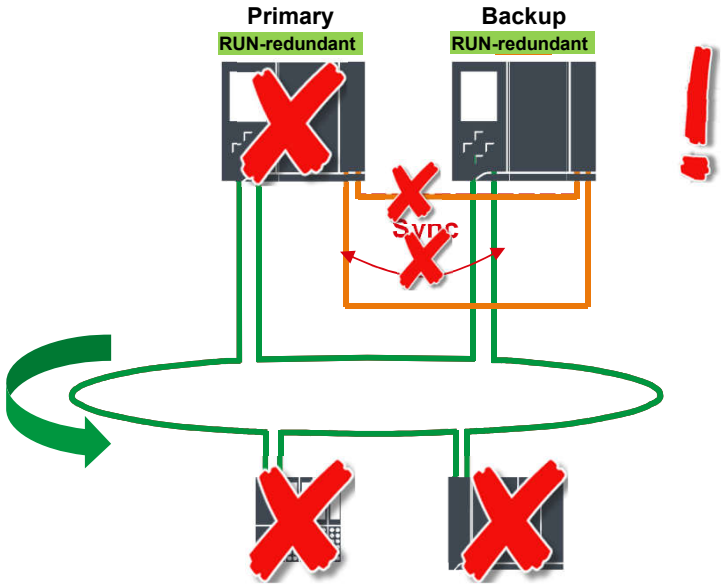
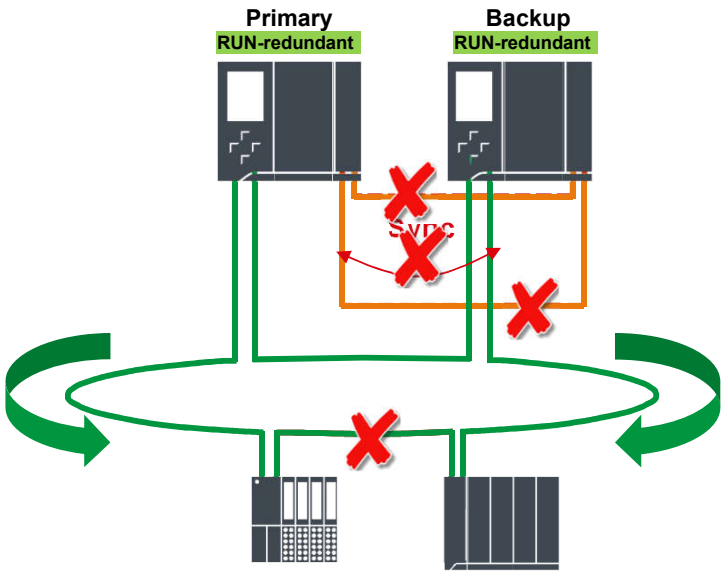
Failure of the direct redundancy connection and of the Primary CPU



Time interval 2nd failure

> 1500ms

Failure of the two direct redundancy connections and PROFINET cable in the PROFINET ring



Time interval 2nd failure

> 1500ms

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Communication

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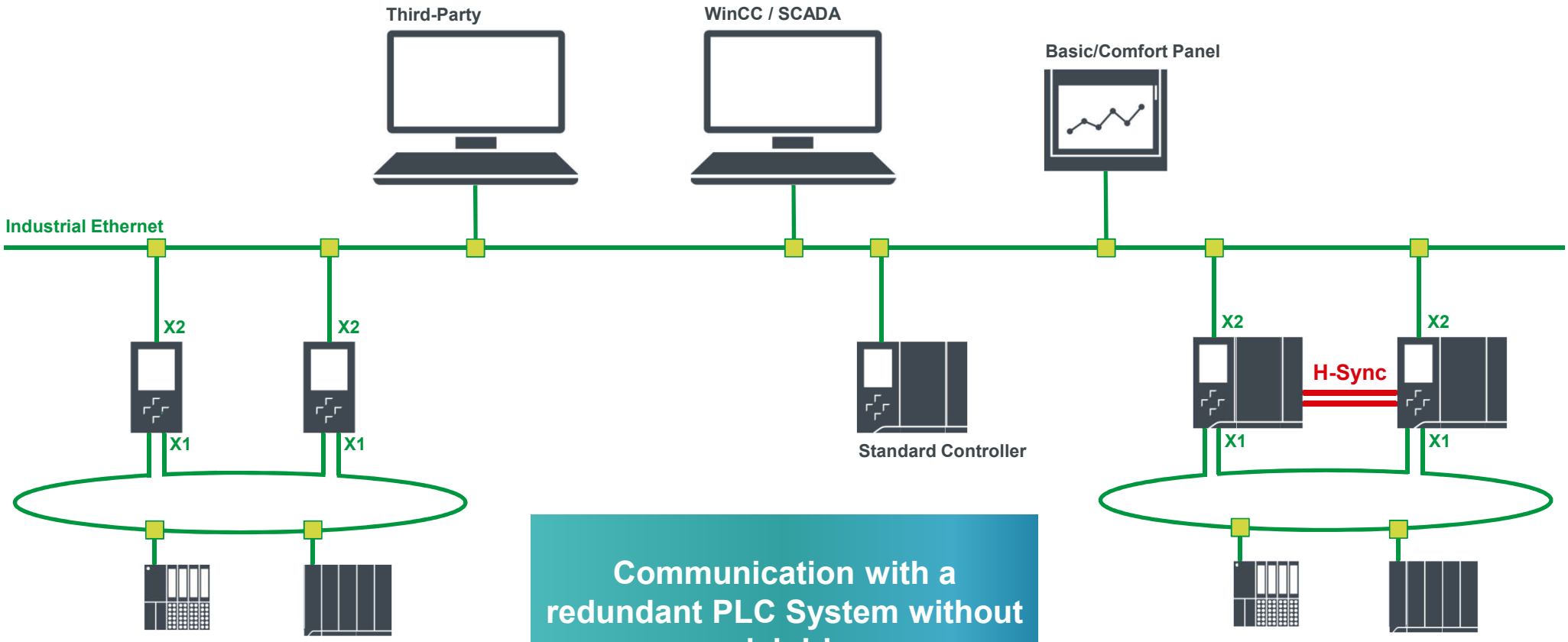

Communication with a redundant PLC System without special drivers

Communication
System IP-Address

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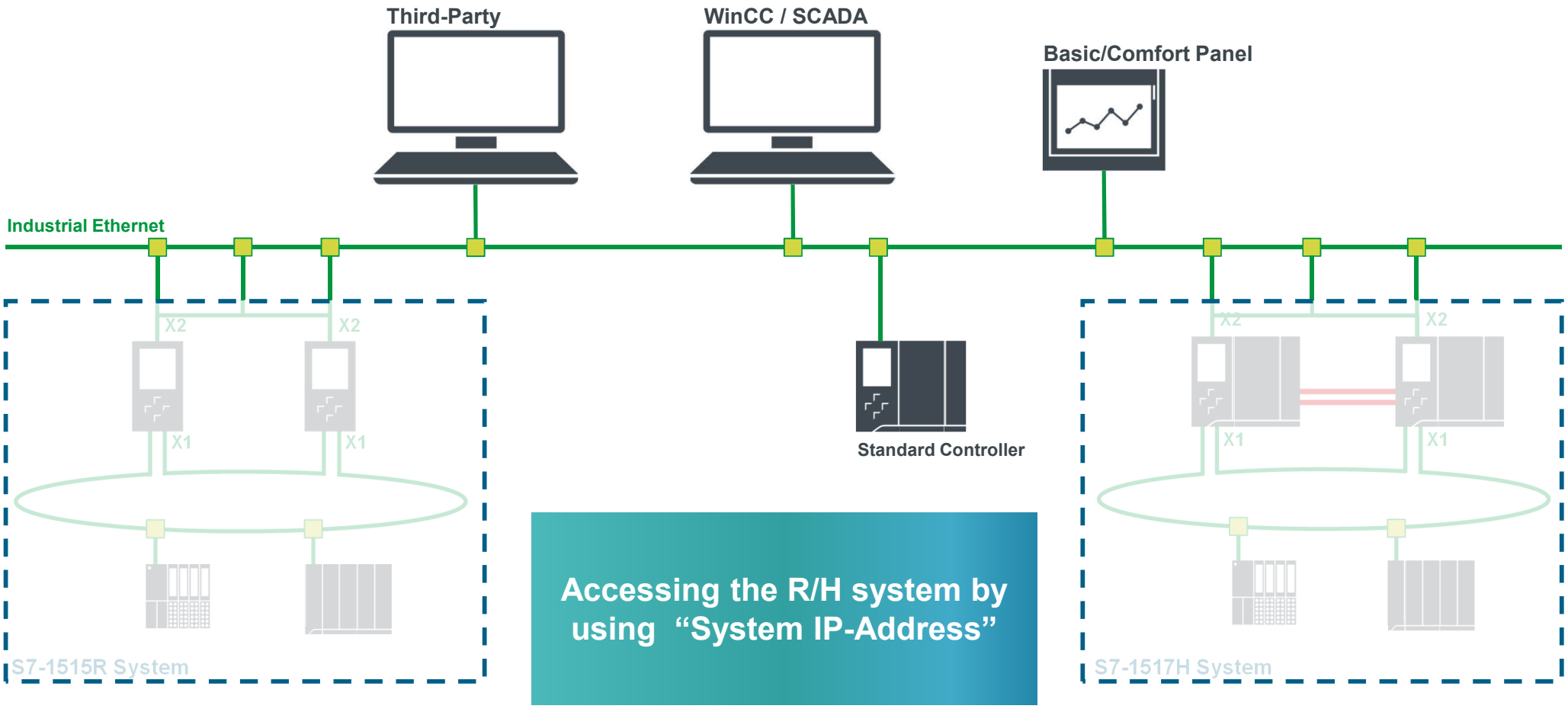

Accessing the R/H system by using "System IP-Address"

Communication
System IP-Address

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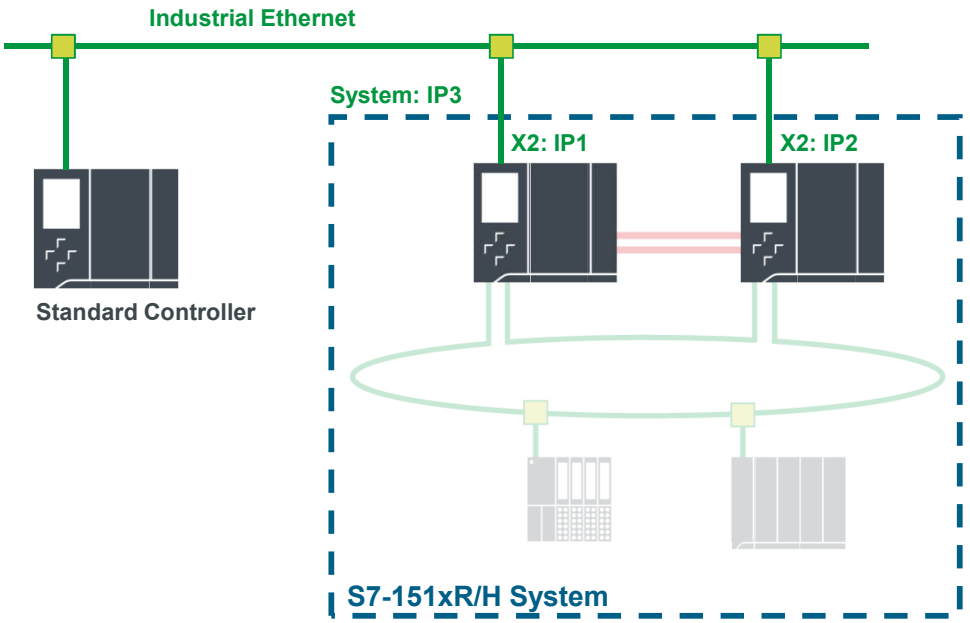
Using System IP instead of PLC interface IP

- Transparent communication between standard PLC and R/H-System
- The standard communication partner is automatically connected to the primary PLC



Communication
System IP-Address

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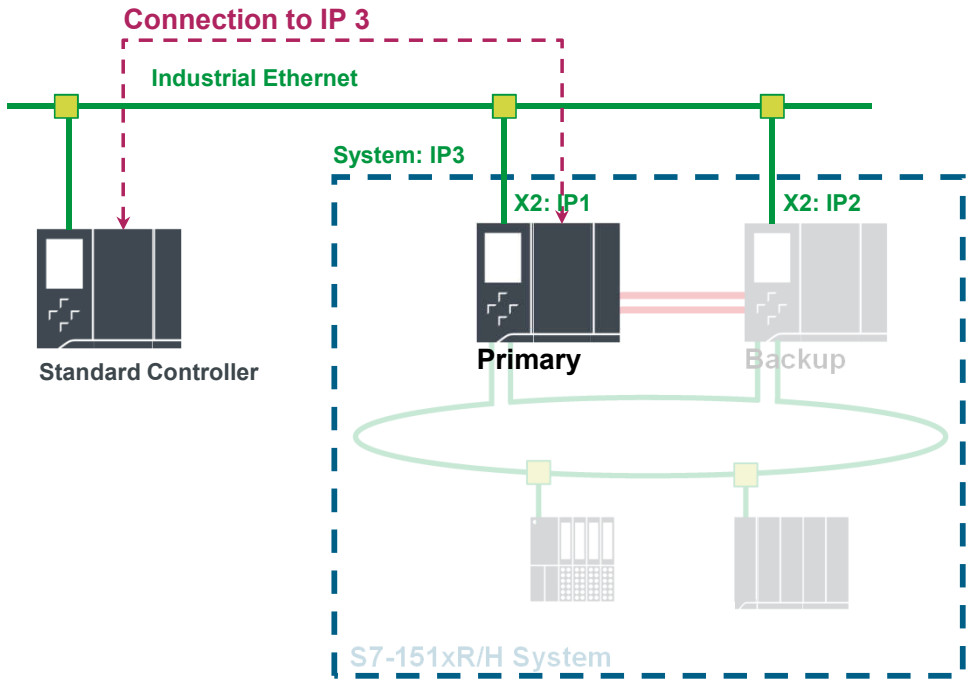
Using System IP instead of PLC interface IP

- Transparent communication between standard PLC and R/H-System
- The standard communication partner is automatically connected to the primary PLC



Communication
System IP-Address – Switching Primary

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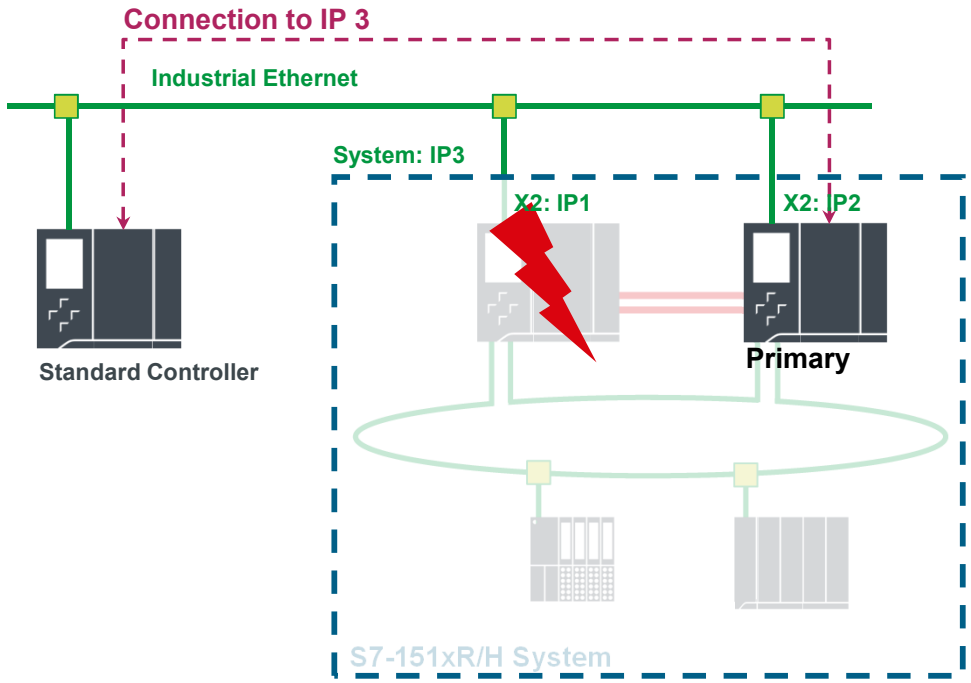
Using System IP instead of PLC interface IP

- Transparent communication between standard PLC and R/H-System
- The standard communication partner is automatically connected to the primary PLC



Communication
System IP-Address in the PN-MRP-Ring

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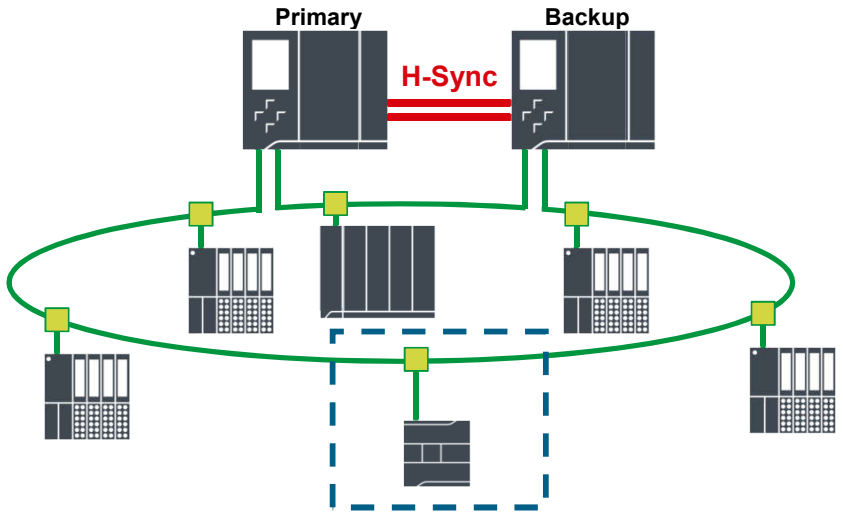
Include Standard Controllers in the MRP Ring

- The S7-1500R/H does not support Single PN Devices (S1) or iDevices.
- Nevertheless, it is possible to physically include a S7-1500/1200 per Switch or directly into the MRP Ring, to communicate to the H-System via OUC.



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R/H PROFINET Network configuration
PROFINET Devices – NAP S2

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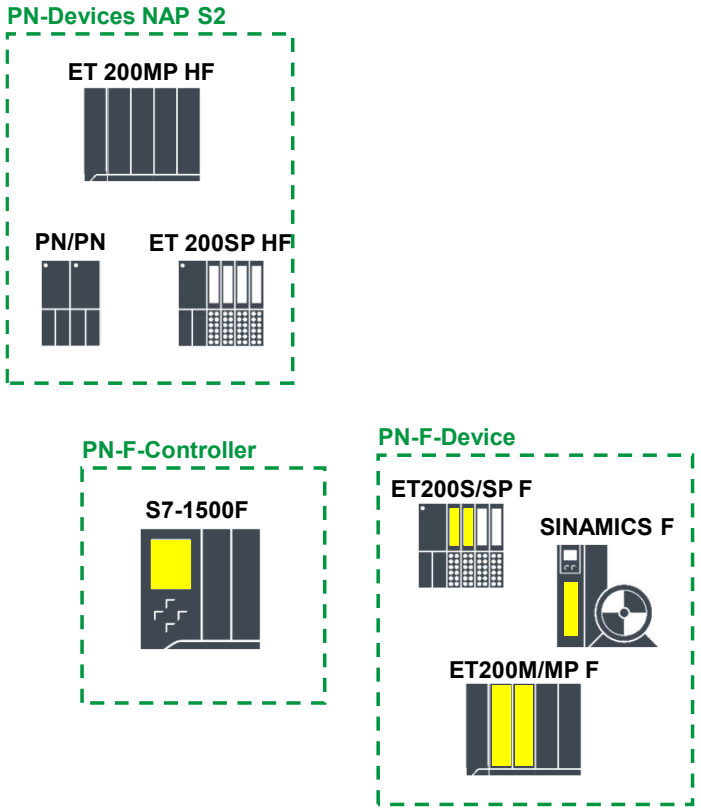
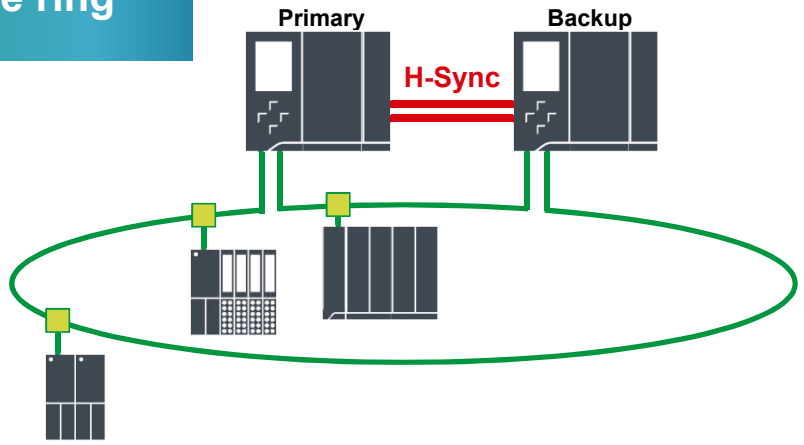


Only NAP S2 devices are supported in the ring



R/H PROFINET Network configuration
PROFINET Devices – PN F-Controller

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PN-Devices NAP S2

PN-F-Controller

S7-1500F

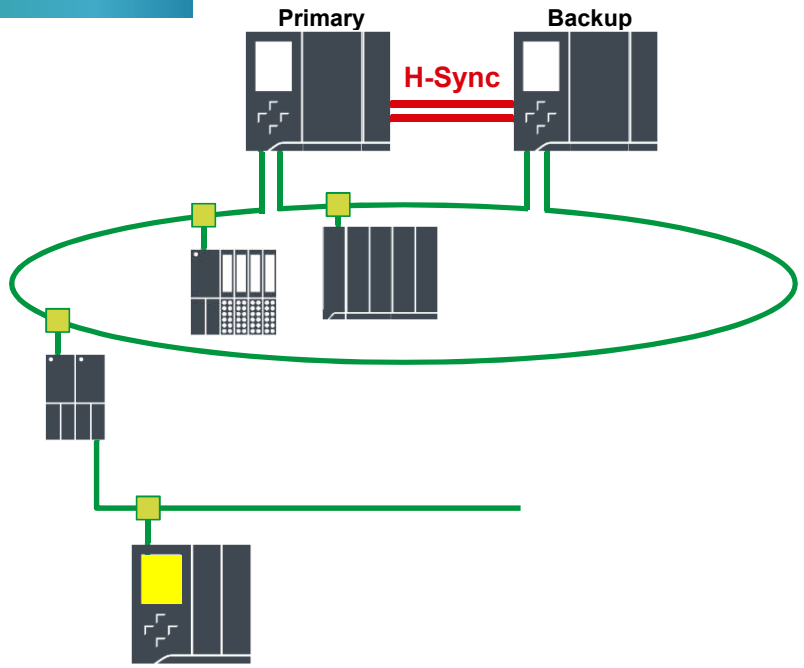
PN-F-Device

ET200S/SP F

SINAMICS F

ET200M/MP F

PN/PN coupler for network separation



R/H PROFINET Network configuration
PROFINET Devices – Safety Devices

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PN-Devices NAP S2

PN-F-Controller

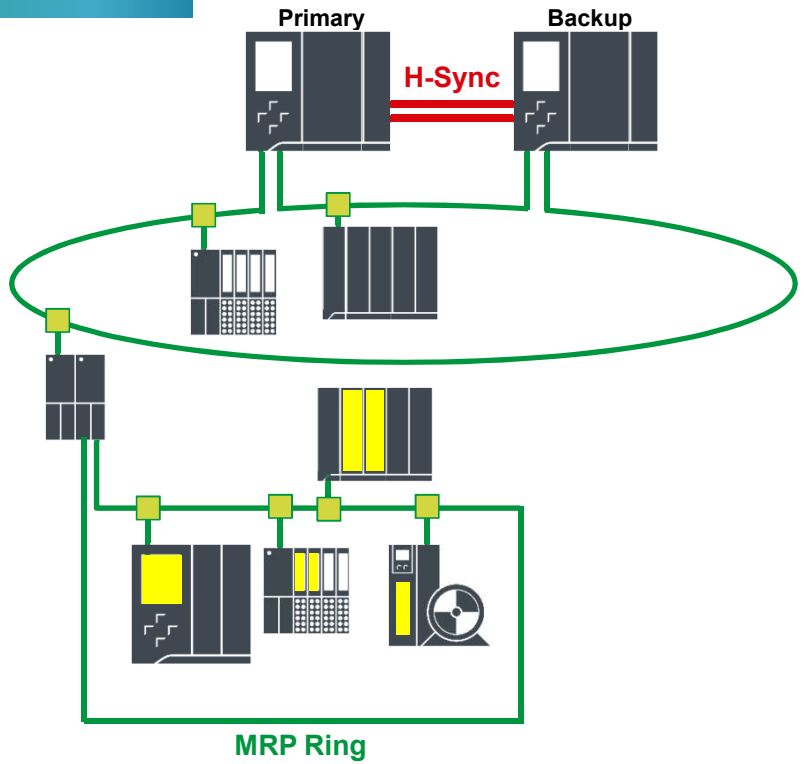
PN-F-Device

ET200S/SP F

SINAMICS F

ET200M/MP F

Devices in subordinated PN network



R/H PROFINET Network configuration
PROFINET Devices – Safety Devices

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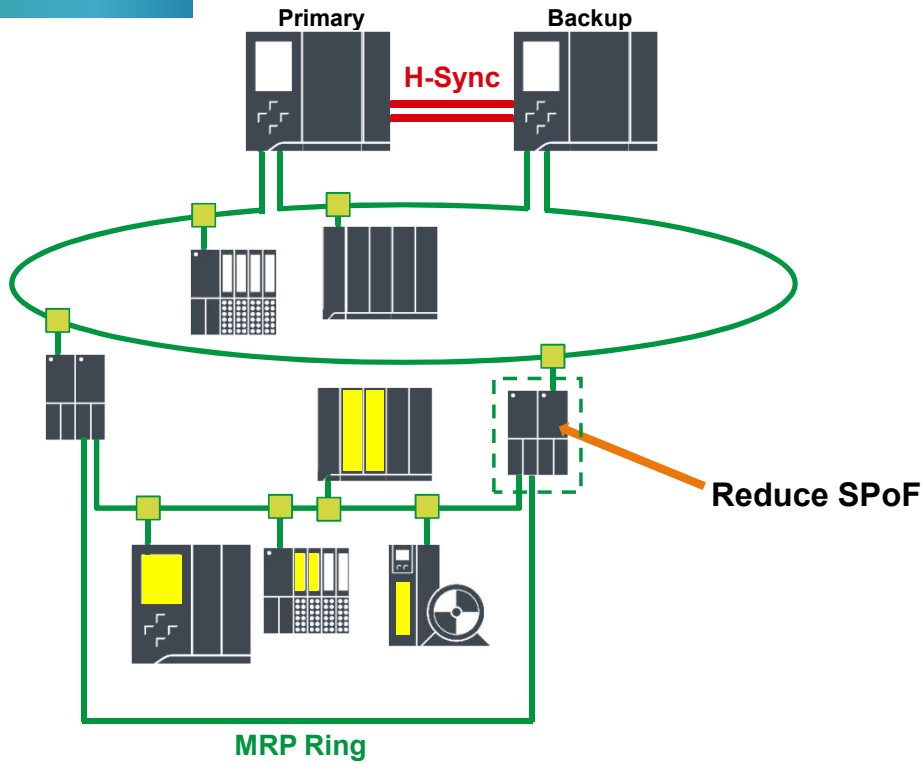
PN-Devices NAP S2

PN-F-Controller

PN-F-Device

Devices in subordinated PN network



SPoF: Single Point of Failure

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HMI Connection
via 1 Network (Ring or Line)

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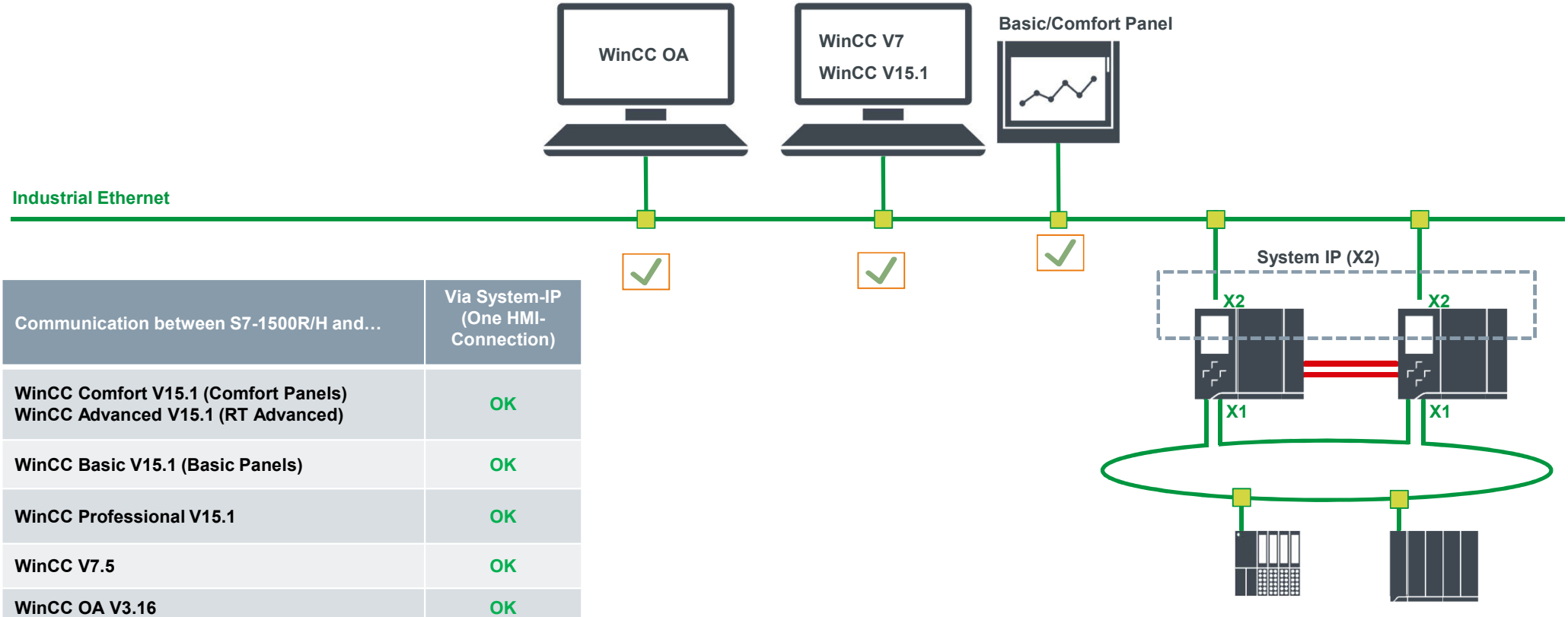
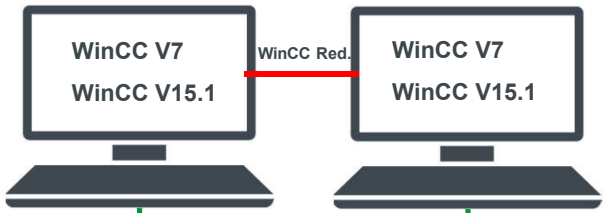


Communication between S7-1500R/H and…	Via System-IP (One HMI-Connection)
WinCC Comfort V15.1 (Comfort Panels) WinCC Advanced V15.1 (RT Advanced)	OK
WinCC Basic V15.1 (Basic Panels)	OK
WinCC Professional V15.1	OK
WinCC V7.5	OK
WinCC OA V3.16	OK

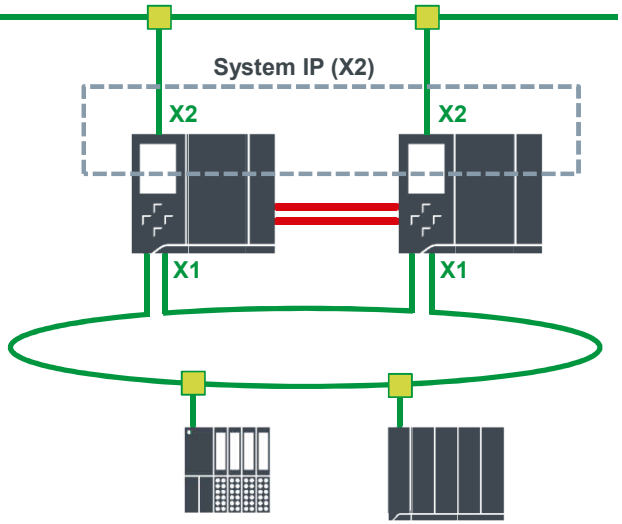
HMI Connection
via 1 Network (Ring or Line)

SIEMENS
Ingenuity for life



Industrial Ethernet

Communication between S7-1500R/H and…	Via System-IP (One HMI-Connection)
WinCC Professional V15.1	OK
WinCC V7.5	OK



HMI Connection
via redundant Network (Line or Ring)

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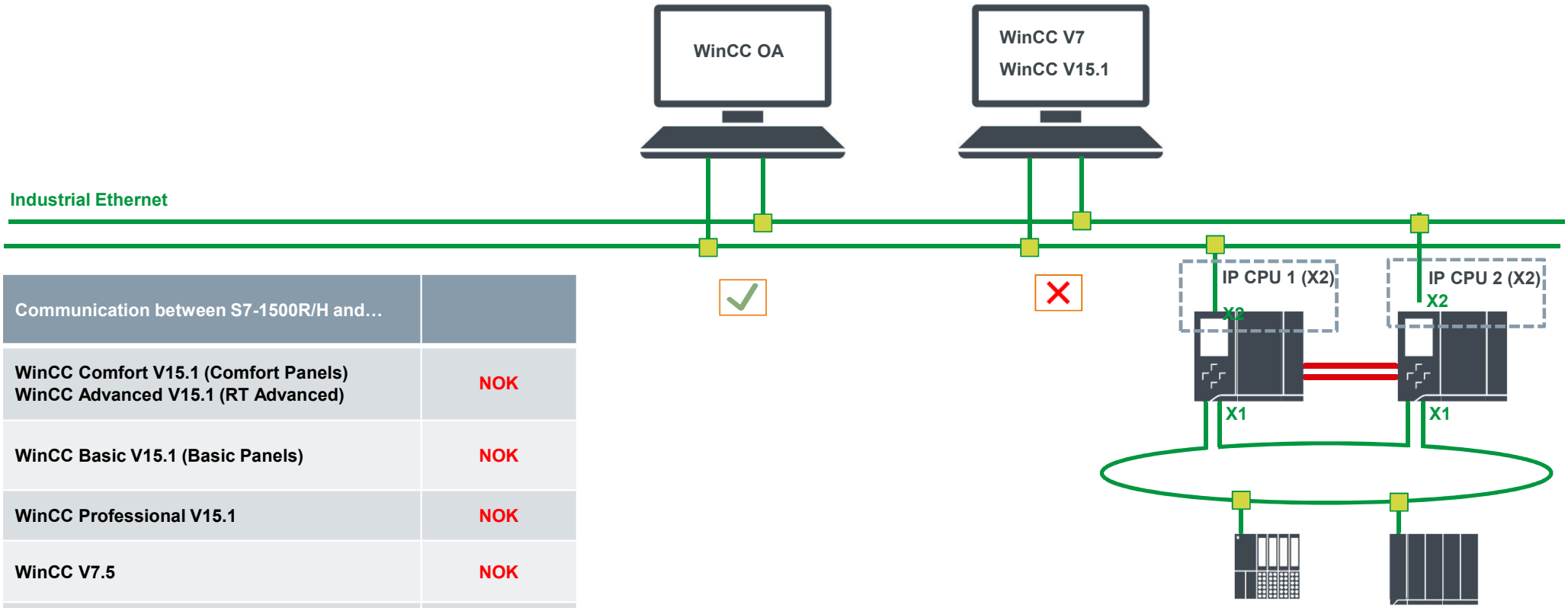

Communication between S7-1500R/H and…	
WinCC Comfort V15.1 (Comfort Panels) WinCC Advanced V15.1 (RT Advanced)	NOK
WinCC Basic V15.1 (Basic Panels)	NOK
WinCC Professional V15.1	NOK
WinCC V7.5	NOK
WinCC OA V3.16	OK

Single sided HMI Connection via redundant Network (Line or Ring)

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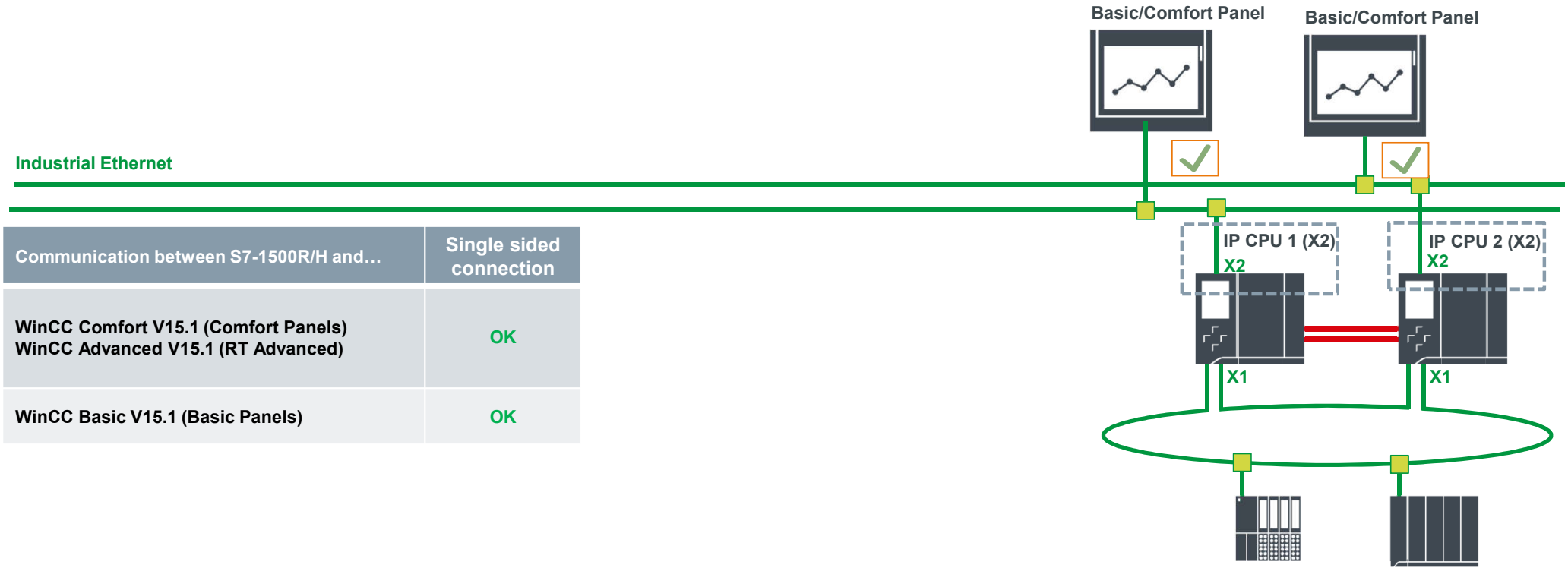

Communication between S7-1500R/H and…	Single sided connection
WinCC Comfort V15.1 (Comfort Panels) WinCC Advanced V15.1 (RT Advanced)	OK
WinCC Basic V15.1 (Basic Panels)	OK

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Restrictions for S7-1500R/H
1st Release step

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Restrictions of the configuration for S7-1500R/H

	S7-1500R/H	S7-1500	S7-400H
Single PLC projectable (H/R CPUs as redundant System only)	no	yes	yes
Central periphery or central CPs / CMs projectable	no	yes	yes
Configure System-PS	no	yes	yes
Only MRP-Ring PN-Networks are supported (no „open Ring“ like in 400H)	yes	no	no
Only PN System redundancy S2 Devices are supported (V1.11)	yes	no	S1 + S2
Shared Device	no	yes	no
I-Device	no	yes	no

Restrictions for S7-1500R/H
1st Release step

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Functional restrictions for S7-1500R/H

	S7-1500R/H	S7-1500	S7-400H
S7-Com, E-Mail, FDL, ISO, (OUC with dynamic connections is supported)	no	yes	yes
OPC UA	no	yes	no
system-supported H-communication (but the System IP-Address)	no	no	yes
webserver	no	yes	no
system-supported redundant I/Os	no	no	yes
PROFIsafe	no	F-CPU	yes
technology objects	no	yes	no
support for MRPD, clock synchrony and IRT	no	yes	no
CiR and firmware update in run is supported	no	no	yes
direct migration through hardware replacement (Import of user programs via Copy/Paste)	no	n.a.	no
PLCsim and PLCsim advanced are supported	no	yes	yes

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Ordering Information

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CPU S7-1500R

- CPU 1513R-1 PN 6ES7 513-1RL00-0AB0
- CPU 1515R-2 PN 6ES7 515-2RM00-0AB0

CPU S7-1500H

- CPU 1517H-3 PN 6ES7 517-3HP00-0AB0

Distance up to 10m between the S7-1500H PLCs Use of the Synchronization Modules for FO cables up to 10 m

- MLFB Module: 6ES7960-1CB00-0AA5
- MLFB LWL-Cable 1m: 6ES7960-1BB00-5AA5
- MLFB LWL-Cable 2m: 6ES7960-1BC00-5AA5
- MLFB LWL-Cable 10m: 6ES7960-1CB00-5AA5

Distance up to 10km between the PLCs

- MLFB Module: 6ES7960-1FB00-0AA5
- Monomode LWL-Cable LC/LC Duplex Crossed 9/125µ

S7-1500H Bundle (Consisting of 2 CPU 1517-3 PN, 4 Sync-Modules 10m and 2 Sync-Cables 1m)

- 6ES7500-0HP00-0AB0

Thank you!

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