



SIMATIC S7-1500 Redundant Systems, S7-1500 R/H

Technical Details

SIMATIC S7-1500 Redundant Systems

Index

- ▶ [Motivation and Product Strategy](#)
- ▶ [System Overview](#)
- ▶ [System Redundancy and Network Configuration](#)
- ▶ [Failure Scenarios](#)
- ▶ [Communication via System-IP and Device-IP Addressess](#)
- ▶ [Safety for Redundant Systems](#)
- ▶ [Hardware Extensions in Run with IO-Link](#)
- ▶ [HMI Connection](#)
- ▶ [Installation Recommendations](#)
- ▶ [Programming Recommendations](#)
- ▶ [New Features with Firmware V2.9](#)
- ▶ [Add-Ons](#)
- ▶ [Restrictions](#)
- ▶ [Ordering Information](#)

Motivation and Product Strategy

SIMATIC S7-1500 Redundant Systems

SIMATIC S7-1500 Redundant Systems

Motivation

Preventing plant downtime

High availability during operation,
Avoidance of loss of production



Prevention of damages

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



Save on maintenance

Application solutions are mostly complicated and difficult to maintain



Prevention of data losses

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

Operation without persons locally

Maintenance trips can be better planned

Redundant systems reduce costs

SIMATIC S7-1500 Redundant Systems

Product Strategy SIMATIC S7-1500 R/H

Based on Standard S7-1500 CPUs and PROFINET

- Basis Hardware Standard-CPU/Fail-safe CPUs
- Basis PROFINET as communication standard



Transparent Programming

- Engineering Tool TIA Portal incl. all programming languages
 - Redundancy functions fully integrated in TIA Portal
 - No special Know-How for redundancy required
 - Simple scaling: Standard → S7-1500 R → S7-1500 H



Extensive Scalability

- Scalability of switch-over time (S7-1500 R → S7-1500 H)
- Scalability of the Redundancy Architecture
- Scalability of the CPU Performance



Step by Step Product Launch Strategy

- First release with basic redundancy functions
- Step by Step increasing of feature set in future versions



| System Overview

SIMATIC S7-1500 Redundant Systems

SIMATIC S7-1500 Redundant Systems

System Overview

Consistent concept –
Identical synchronization
process

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

CPU type

Synchronization

Hot-Standby

I/O systems

Type of connection

Redundant – S7-1500 R



CPU 1513R / CPU 1515R

via **PROFINET Ring (MRP)**

Yes, fail-over time ca. 300ms

High available – S7-1500 H



CPU 1517H / CPU 1518HF

via **Sync-Modules / FO**

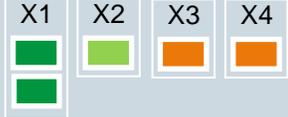
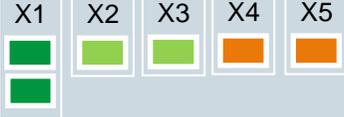
Yes, fail-over time ca. 50ms

ET 200SP and ET 200MP

Single connection (PN redundancy S2) and switched S1 ¹⁾

SIMATIC S7-1500 Redundant Systems

PLC Hardware

	CPU 1513R-1 PN 6ES7513-1RL00-0AB0	CPU 1515R-2 PN 6ES7515-2RM00-0AB0	CPU 1517H-3 PN 6ES7517-3HP00-0AB0	CPU 1518HF-4 PN 6ES7518-4JP00-0AB0
Program / Data memory	300 kB code 1,5 MB data	500 kB code 3 MB data	2 MB code 8 MB data	9 MB code 60 MB data
Interfaces	X1 	X1 X2 	X1 X2 X3 X4 	X1 X2 X3 X4 X5 
SIPLUS Type	-	6AG1515-2RM00-7AB0	6AG1517-3HP00-4AB0	-



Fail-safe

-  PROFINET IO Controller, Supports RT, MRP, Transport Protocol TCP/IP, Open User Communication
-  PROFINET Basic Services, Transport Protocol TCP/IP, Open User Communication
-  SPF Slot for H-Synchronization

SIMATIC S7-1500 Redundant Systems

Accessories for SIMATIC S7-1500 H

	For short distances up to 10m	For long distances Up to 10km	Each H-System needs
Sync Module SFP SFP = Small Form-Factor Pluggable 	6ES7960-1CB00-0AA5	6ES7960-1FB00-0AA5	4 pieces
	Plastic Fiber Optic Cable Pre-fabricated: <ul style="list-style-type: none"> • 6ES7 960-1BB00-5AA5 (1m) • 6ES7 960-1BC00-5AA5 (2m) • 6ES7 960-1CB00-5AA5 (10m) 	Glass Fiber Optic Cable <ul style="list-style-type: none"> • Monomode fiber • LC/LC connector • Duplex crossed • 9/125µm 	2 pieces

Overview: Fiber Optic Cables at Siemens:

<https://mall.industry.siemens.com/mall/en/de/Catalog/Products/10000396?tree=CatalogTree>

System Redundancy and Network Configuration

SIMATIC S7-1500 Redundant Systems

PROFINET System Redundancy Concept

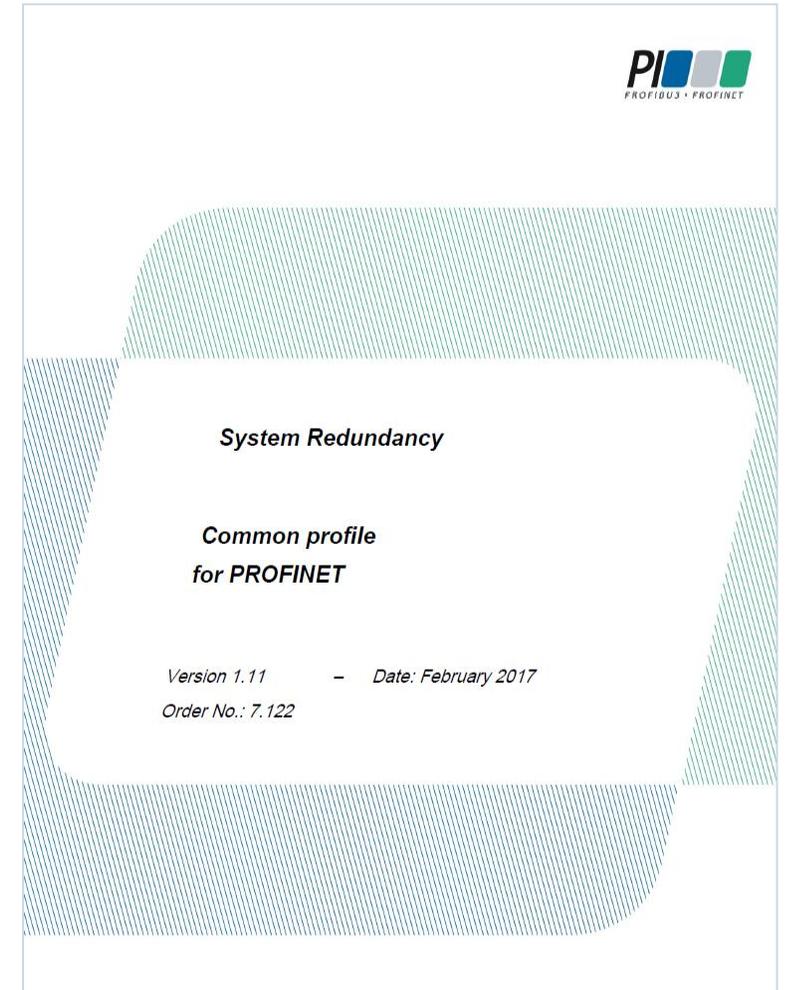
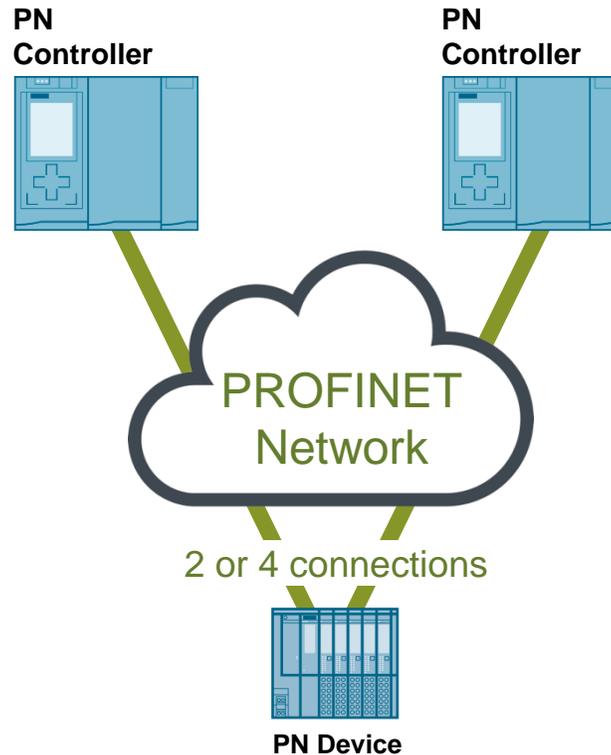
PROFINET System Redundancy

A System with redundant PN controllers and single or redundant PN devices.

Three levels:

1. PN Controller
2. PROFINET Network
3. PN Device

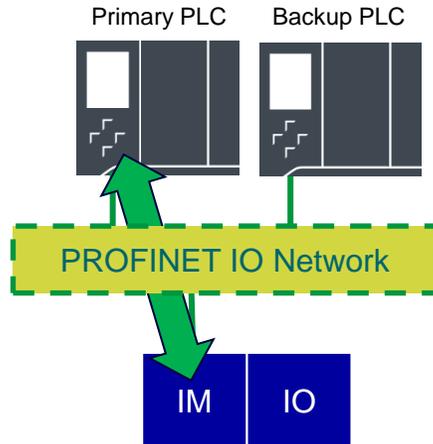
Redundancy at one level is independent of redundancy at each other level.



PROFINET System Redundancy

Redundancy Modes

S1 Mode

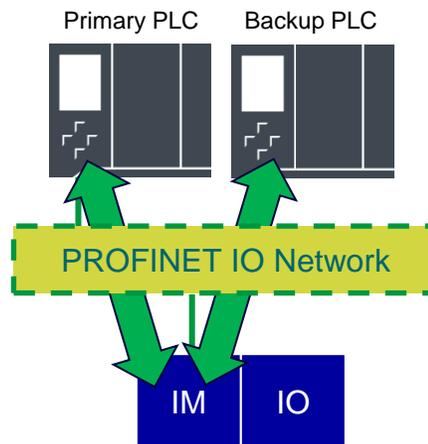


S1 Device

- S → Single interface
- 1 → one connection to one PLC

Standard PLC + R/H

S2 Mode

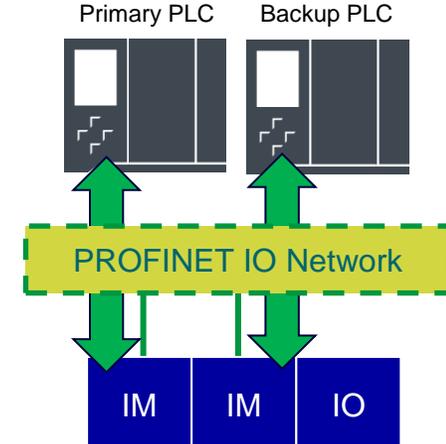


S2 Device

- S → Single interface
- 2 → can switch between two connections

For R/H PLC

R1 Mode



R1 Device

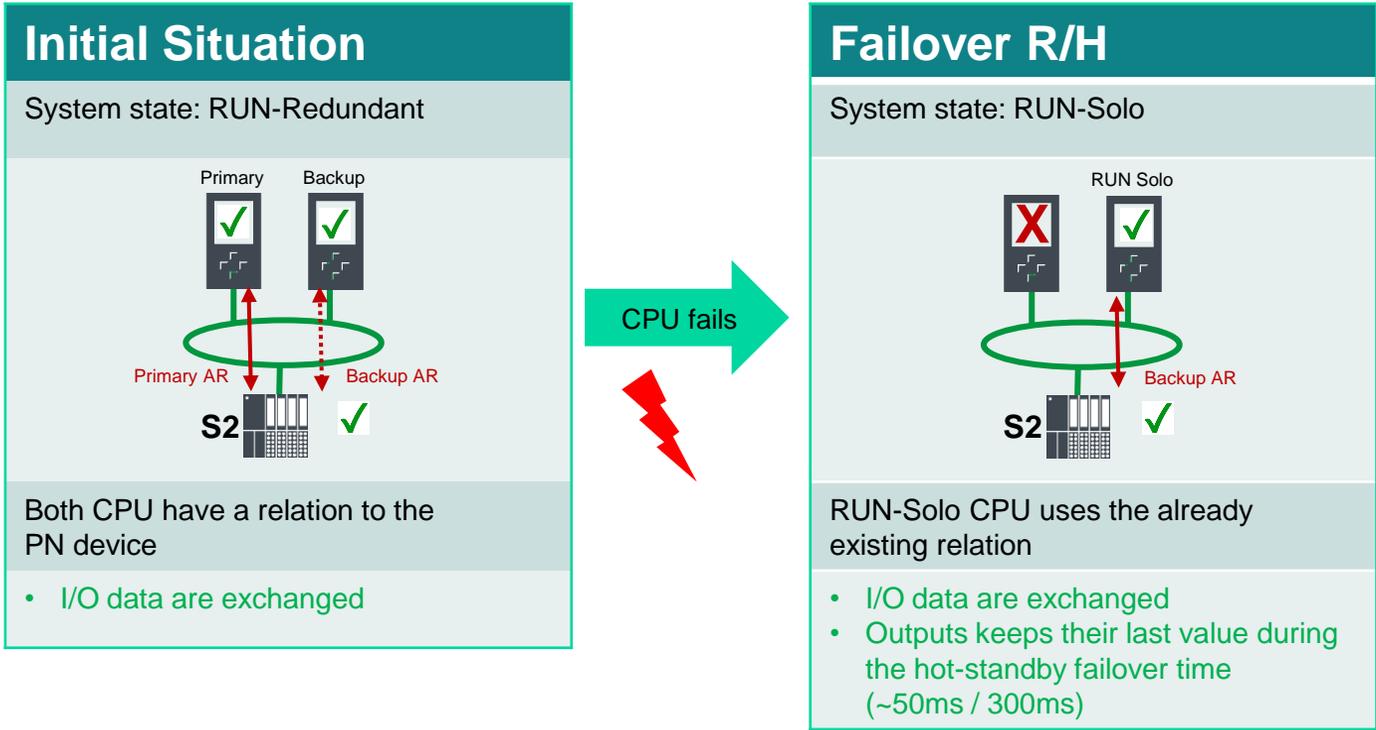
- R → Redundant interface
- 1 → each interface has one connection to one PLC

Future 1500 H release

Details about PN System Redundancy modes: See <https://support.industry.siemens.com/cs/ww/en/view/109756450>

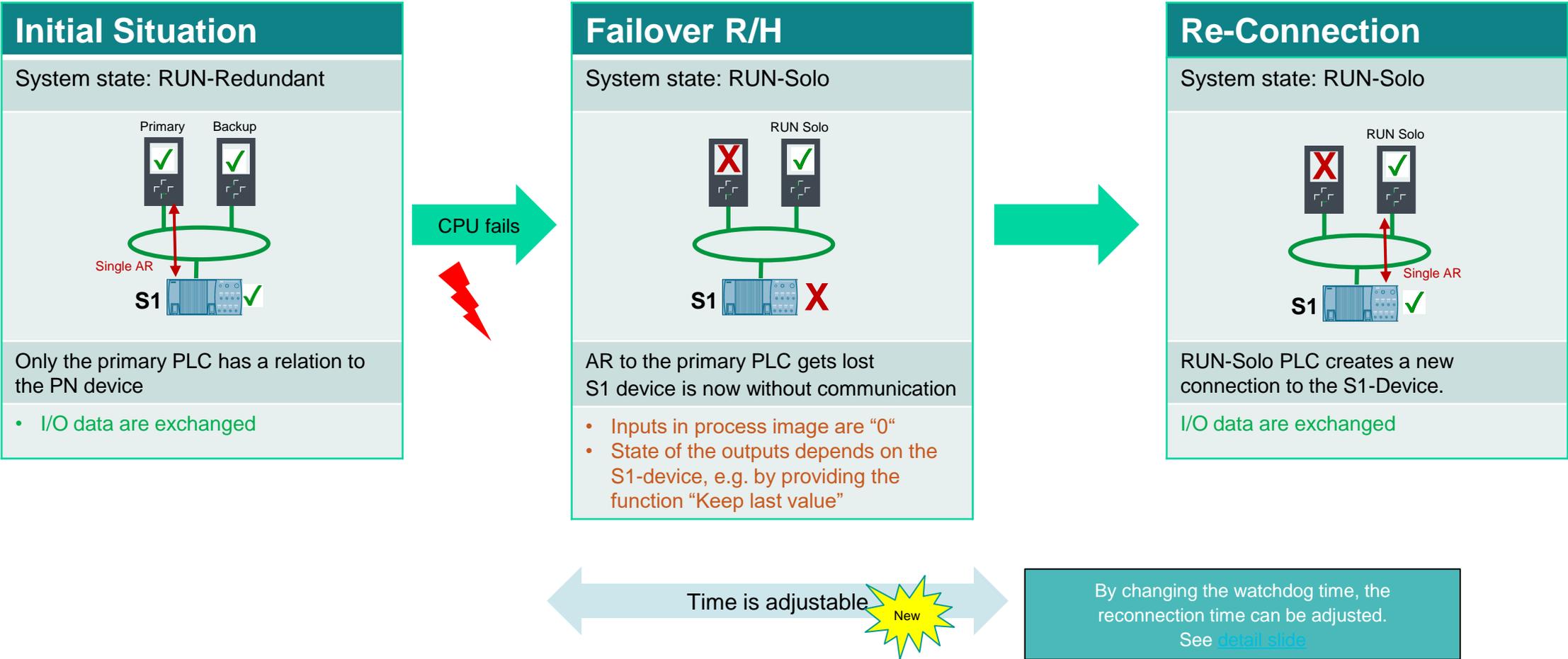
PROFINET System Redundancy

Behavior of PN Devices with System Redundancy S2



PROFINET System Redundancy

Behavior of PN Devices without System Redundancy (S1)



PROFINET System Redundancy

Visualization of redundancy modes in TIA Portal

The screenshot displays the 'Devices & networks' window in TIA Portal. On the left, a network diagram shows 'R-System_1' (S7-1500R/H-Station) connected to two I/O devices: 'et200mp-01 IM 155-5 PN HF' and 'ET200S-01 IM 151-3 PN ST'. Both devices are labeled 'Multi assigned'. On the right, the 'I/O communication' table shows the configuration for two redundant PLCs (R-PLC_1 and R-PLC_2). The table is as follows:

Partner 1	Partner 2	Interfa...	Mode	Optional...
1	▼ R-PLC_1			<input type="checkbox"/>
2	▼ PROFINET-S...			<input type="checkbox"/>
3	X1	↔ ET200SP-02	PROFIN... IO device(S2)	<input type="checkbox"/>
4	X1	↔ et200mp-01	PROFIN... IO device(S2)	<input type="checkbox"/>
5	X1	↔ ET200S-01	PROFIN... IO device(S1)	<input type="checkbox"/>
6	▼ R-PLC_2			<input type="checkbox"/>
7	▼ PROFINET-S...			<input type="checkbox"/>
8	X1	↔ ET200SP-02	PROFIN... IO device(S2)	<input type="checkbox"/>
9	X1	↔ et200mp-01	PROFIN... IO device(S2)	<input type="checkbox"/>
10	X1	↔ ET200S-01	PROFIN... IO device(S1)	<input type="checkbox"/>
11				<input type="checkbox"/>

In the network view S1 and S2 devices are marked as „Multi-assigned“

Differences are shown in the column „Mode“ of the I/O communication table. Here: ET 200MP is connected as S2 device

PROFINET System Redundancy

Siemens I/O Systems with PN S2 support

<p>ET 200SP IM155-6 PN HF (FW>=4.2)</p>		<p>6ES7155-6AU01-0CN0 6ES7155-6AU30-0CN0</p>
<p>ET 200MP IM155-5 PN HF (FW>=4.2) Also available with active backplane</p>		<p>6ES7155-5AA00-0AC0 6ES7590-0BL00-0AA0 The active backplane bus allows to pull and plug modules during operation.</p>
<p>ET 200eco PN M12-L (FW >= 1.1)</p>		<p>6ES7 14*-6**00-0BB0</p>
<p>PN/PN-Coupler</p>		<p>6ES7158-3AD10-0XA0</p>
<p>ET 200SP HA IM155-6 PN HA (with Single IM)</p>		<p>6DL1155-6AU00-0PM0</p>

PROFINET System Redundancy

Siemens Drives / Switches with PN S2 support

SINAMICS S120 CU310-2PN (FW >=5.2) (with gsdml)		6SL3040-1LA01-0AA0
SINAMICS S120 CU320-2PN (FW >=5.2) (with gsdml)		6SL3040-1MA01-0AA0

How to configure SINAMICS drives on an S7-1500R/H system? See application example: <https://support.industry.siemens.com/cs/ww/en/view/109744811>

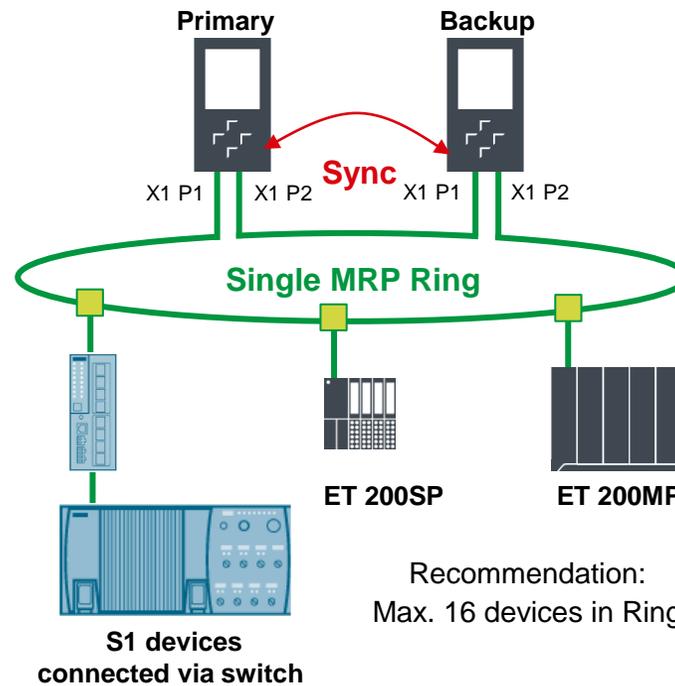
SCALANCE XC-200 Series		6GK5 2 . . - . . . 00 - 2 . C2
SCALANCE XP-200 Series		6GK5 2 . . - 0 . A00 - . . S6
SCALANCE XF204-2BA		6GK5 204-2AA00-2GF2

Network Configuration with S7-1500 R/H Requirements

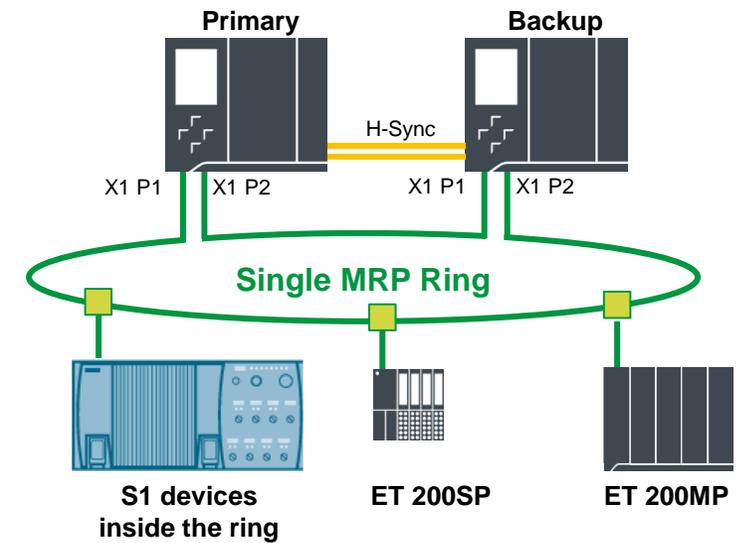
Requirements for the PROFINET network configuration

- MRP Ring (default setting in the configuration)
- PN IO only at X1 interface
- PLC's need to be part of the ring
- S7-1500 R:
 - no devices in the connection between the two PLC's
 - S1 devices should be connected via a switch ¹⁾

Redundant 1500 R



High Available 1500 H



1) Reason: S1 devices do not forward H-Sync telegrams during a reconfiguration of the MRP ring. This can lead to a high cycle time in case of an interrupt in the ring. See chapter „H-Sync Forwarding“ in the system manual of S7-1500R/H for more details

Network Configuration with S7-1500 R

Length of the synchronization connection



CPU 1513R
CPU 1515R

Direct Link
up to 100 m



Fiber optic link
(media converter) up to 3 km



Network Configuration with S7-1500 H

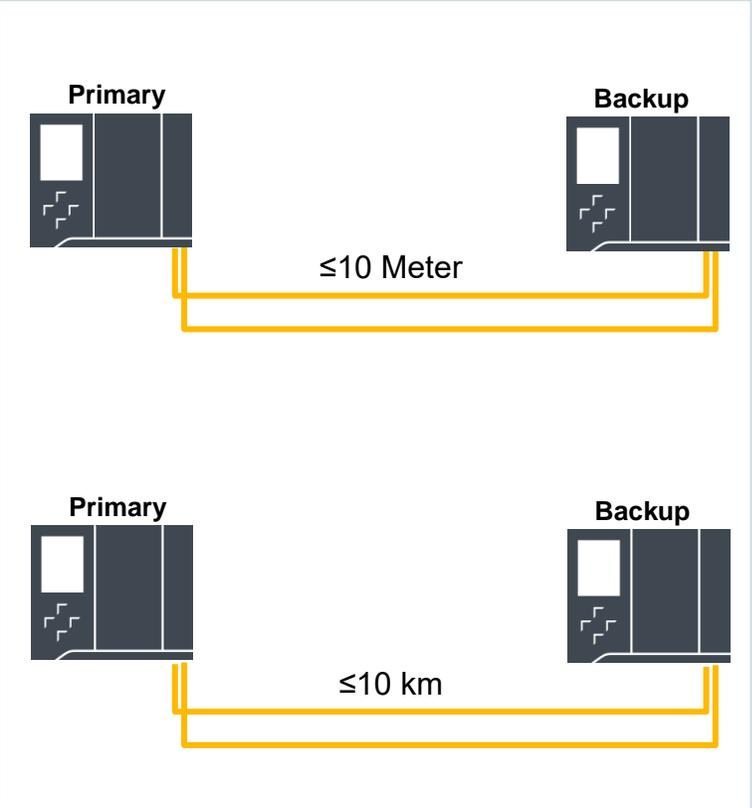
Length of the synchronization connection



CPU 1517H
CPU 1518HF

Short distance sync modules
→ up to 10 Meter

Long distance sync modules
→ up to 10 km

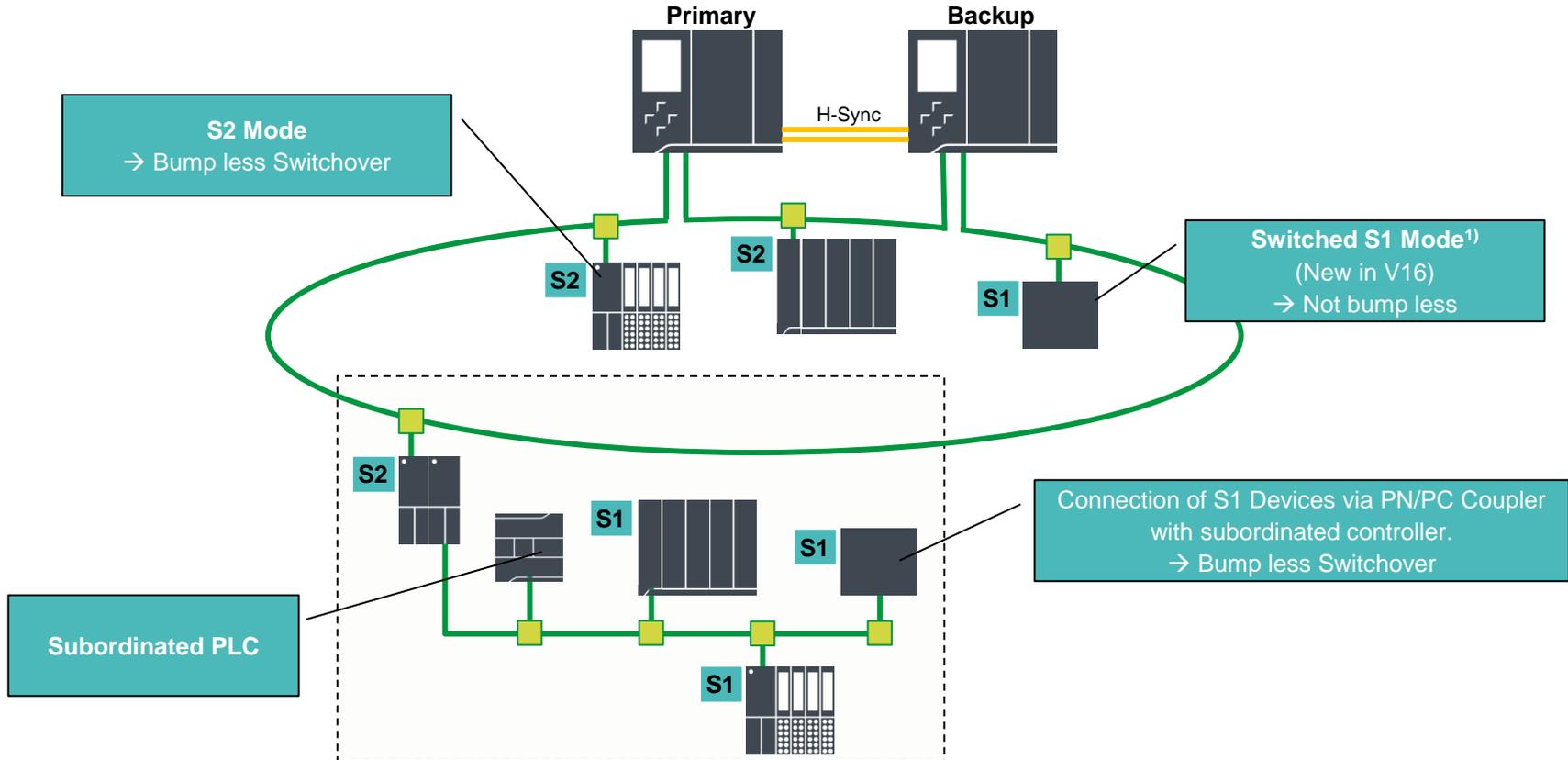


The sync cables are redundant.
The loss of one fiber optic cable has no impact on the runtime behavior..

Network Configuration with S7-1500 R/H

Connection of PROFINET Devices

S2 and S1 Devices can be connected

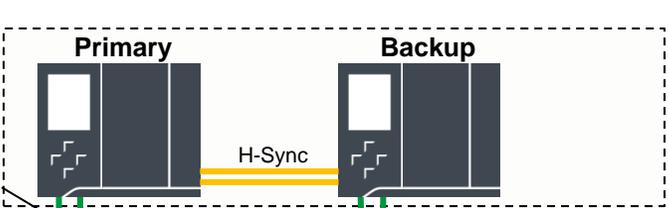


1) For S7-1500R, S1 devices should be connected via a switch to the MRP ring

Network Configuration with S7-1500 R/H

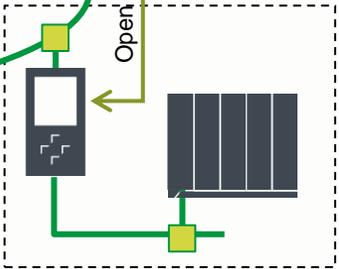
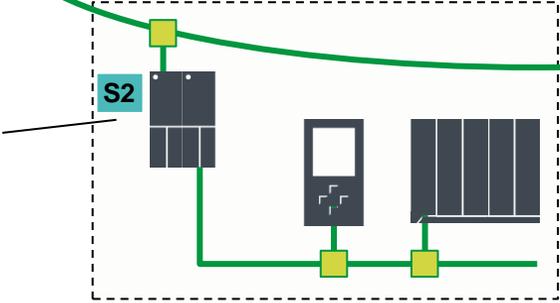
Connection of Subordinated Controller

Option 1:
 Integration as iDevice in „Switched S1 Mode“
 Currently support only with GSD
 → Communication to RH is temporarily interrupted when a RH failover occurs.



Option 3:
 Open User Communication
 between H-System and
 subordinated controller ¹⁾
 → Communication to RH is
 temporarily interrupted when a
 RH failover occurs.

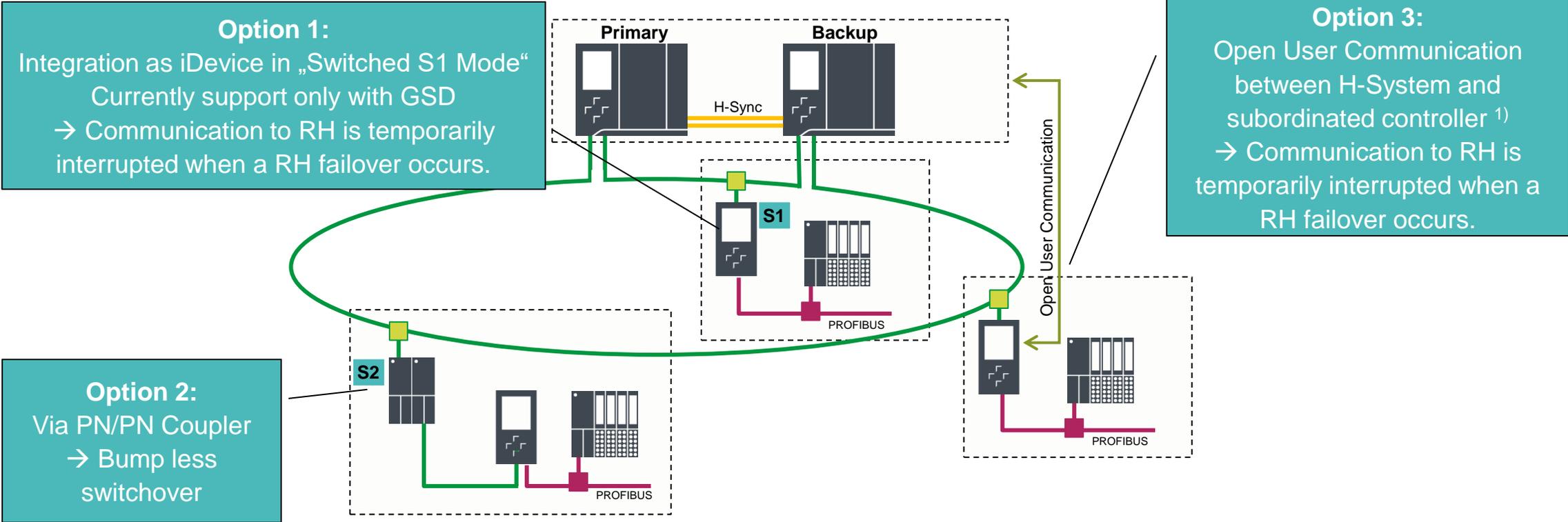
Option 2:
 Via PN/PN Coupler
 → Bump less
 switchover



1) Not recommended for S7-1500R – see [Installation recommendations for CPU 1515R-2 PN](#)

Network Configuration with S7-1500 R/H

Connection of PROFIBUS DP Slaves



Please note: IE/PB Link and IE/PB LINK HA are currently not supported

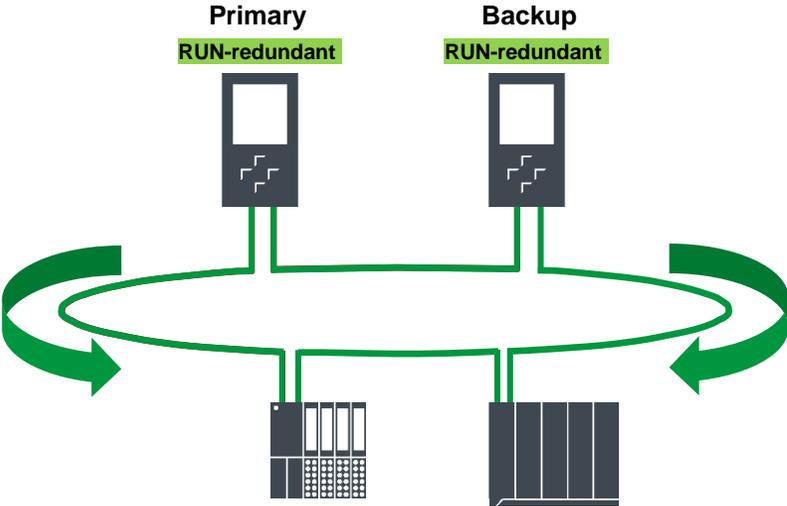
1) Not recommended for S7-1500R – see [Installation recommendations for CPU 1515R-2 PN](#)

| Failure Scenarios

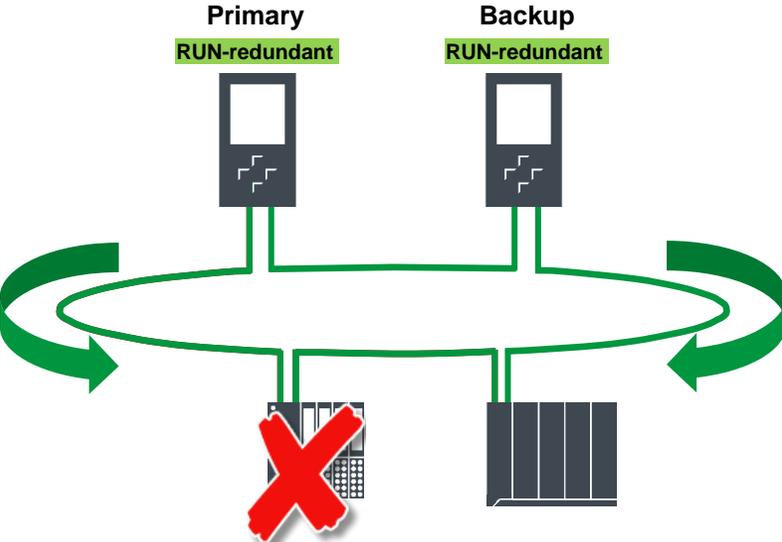
SIMATIC S7-1500 Redundant Systems

Failure scenarios for S7-1500 R/H

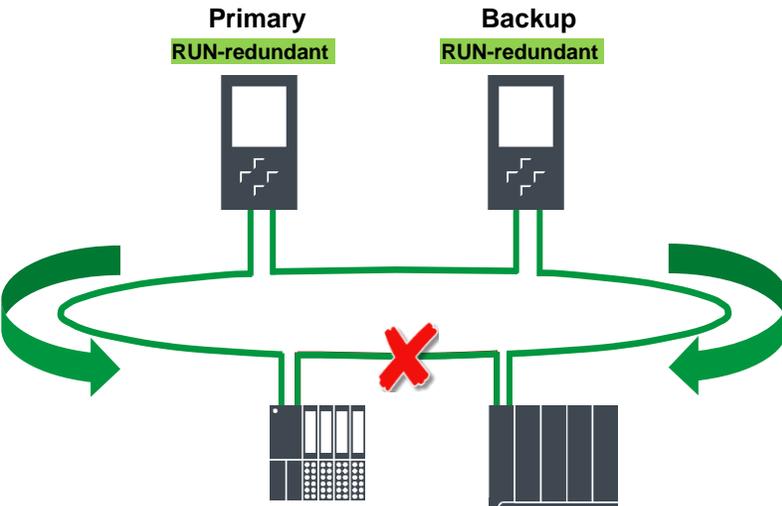
Primary or Backup CPU failure



Failure of an IO device in the PROFINET ring

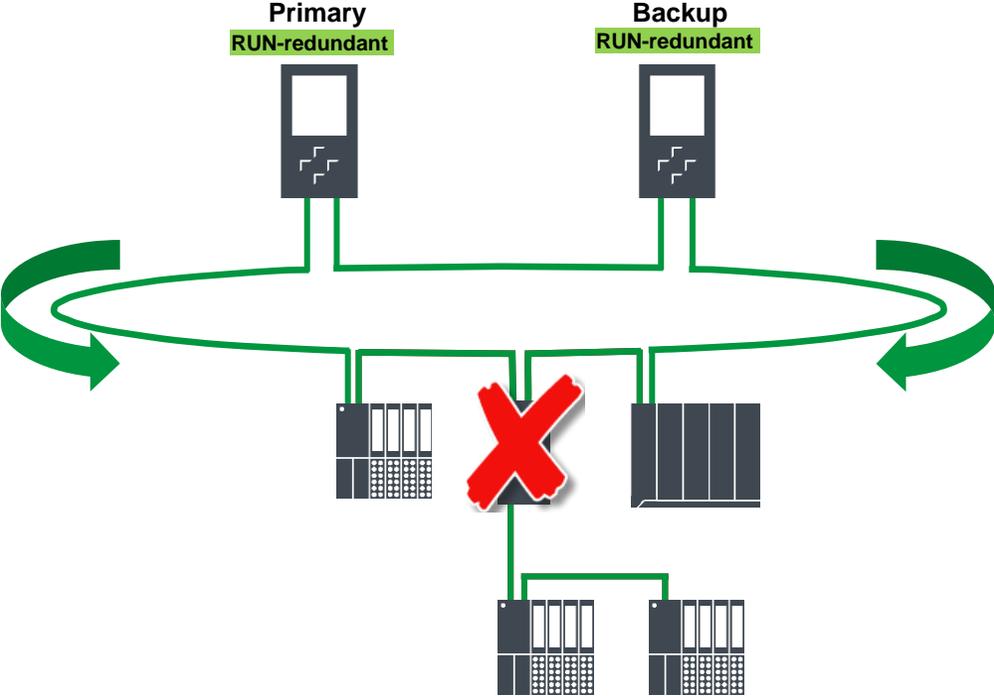


Failure of the PROFINET cable in the PROFINET ring



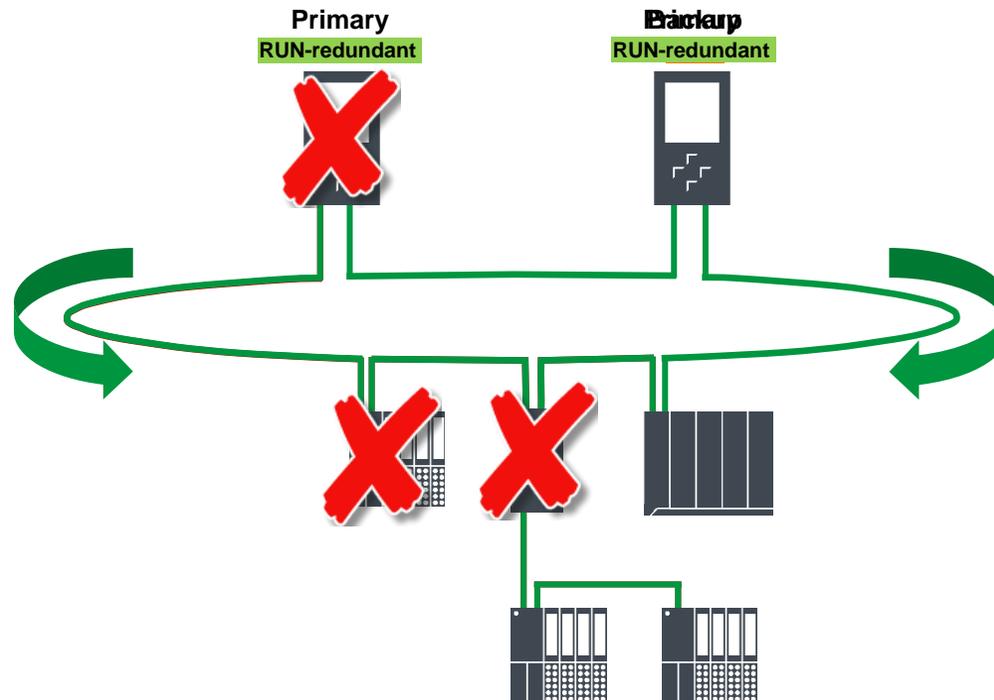
Failure scenarios for S7-1500 R/H

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



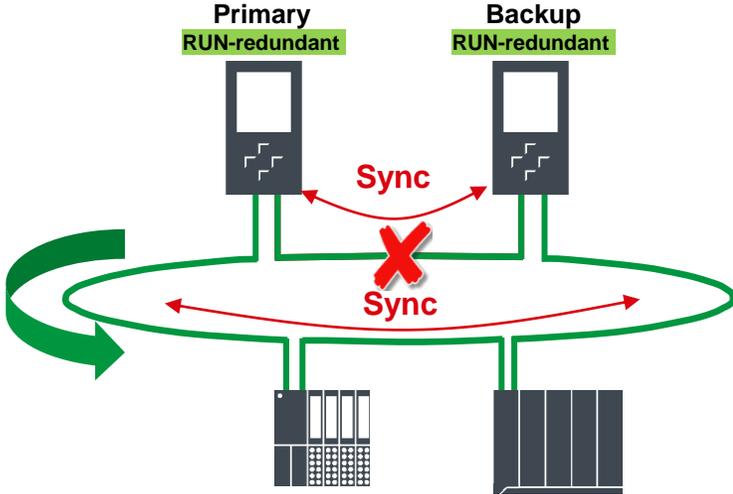
Specific failure scenarios for S7-1500 R

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

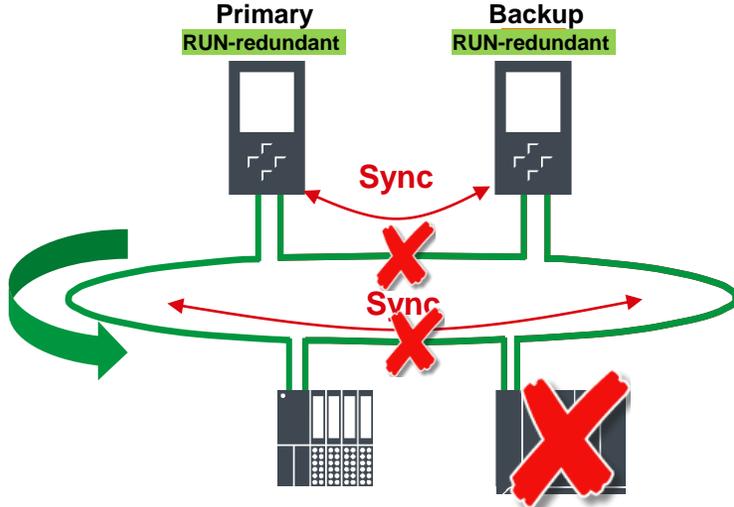


Specific failure scenarios for S7-1500 R

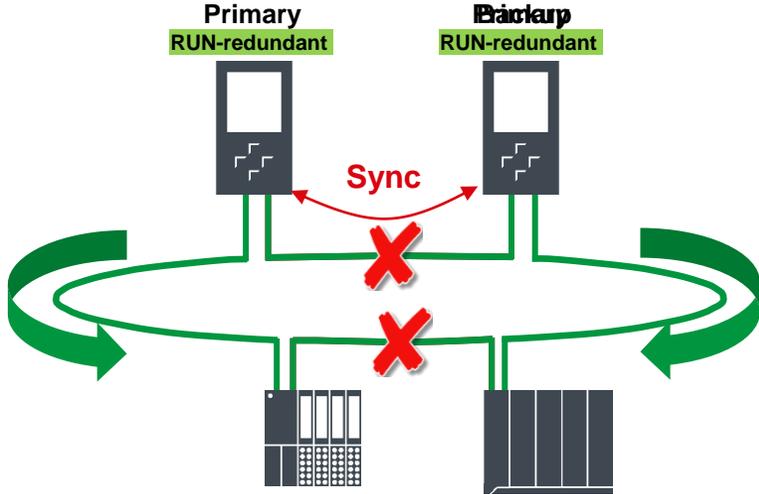
Failure of a direct redundancy connection



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



Time interval 2nd failure > 1500ms

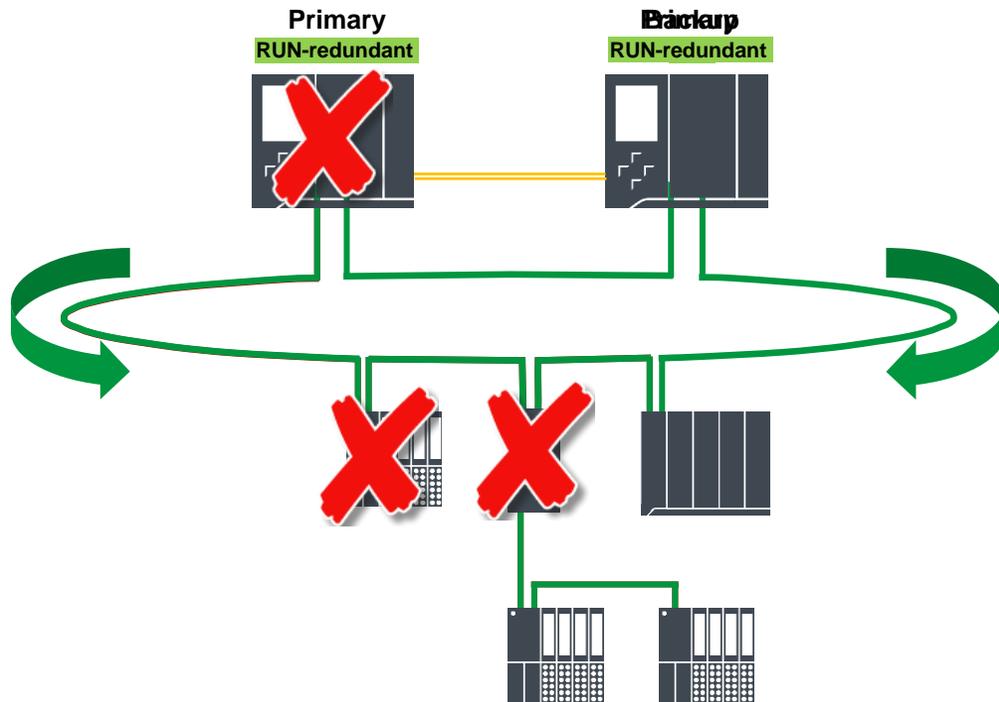


Time interval 2nd failure < 100ms

! Undefined Condition !

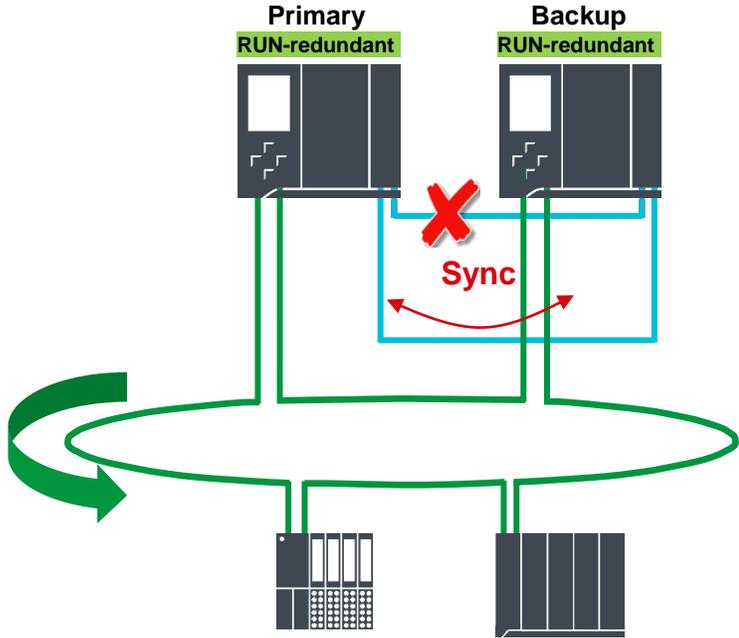
Specific failure scenarios for S7-1500 H

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

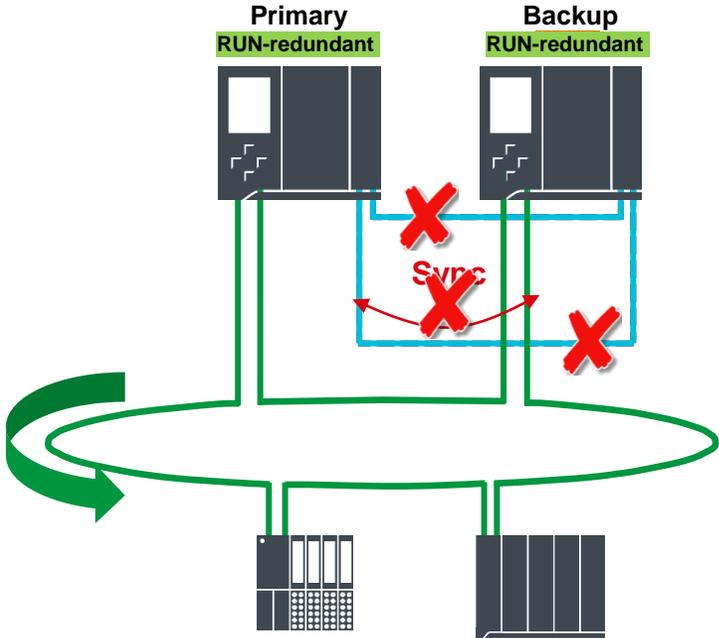


Specific failure scenarios for S7-1500 H

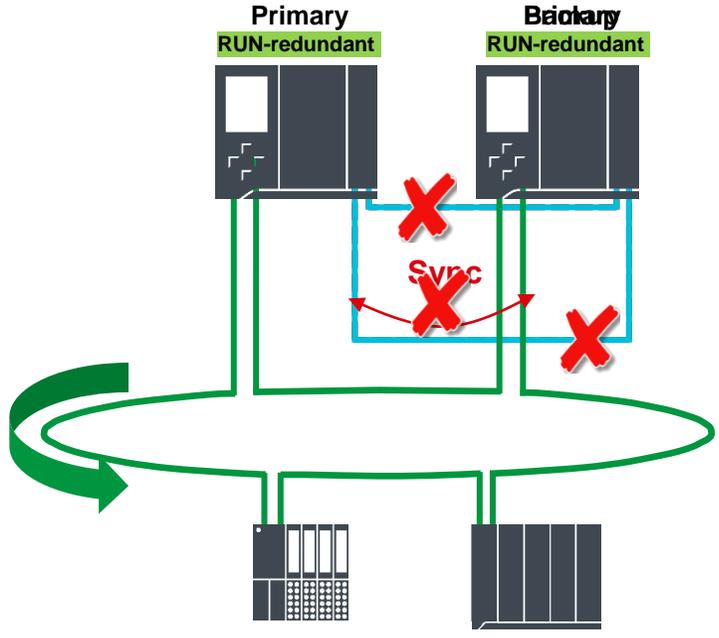
Failure of a direct redundancy connection



Failure of the two direct redundancy connections



Time interval 2nd failure > 55ms

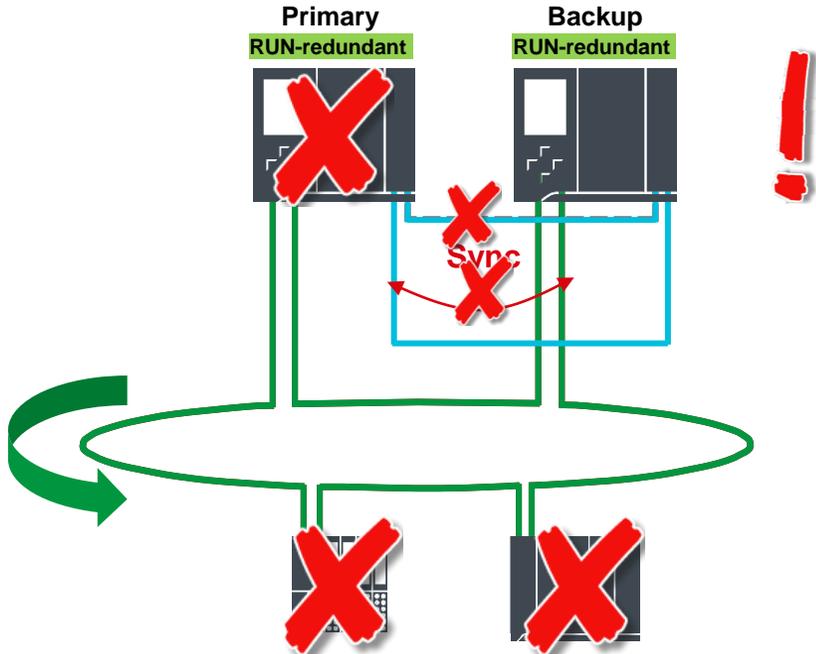


Time interval 2nd failure < 55ms

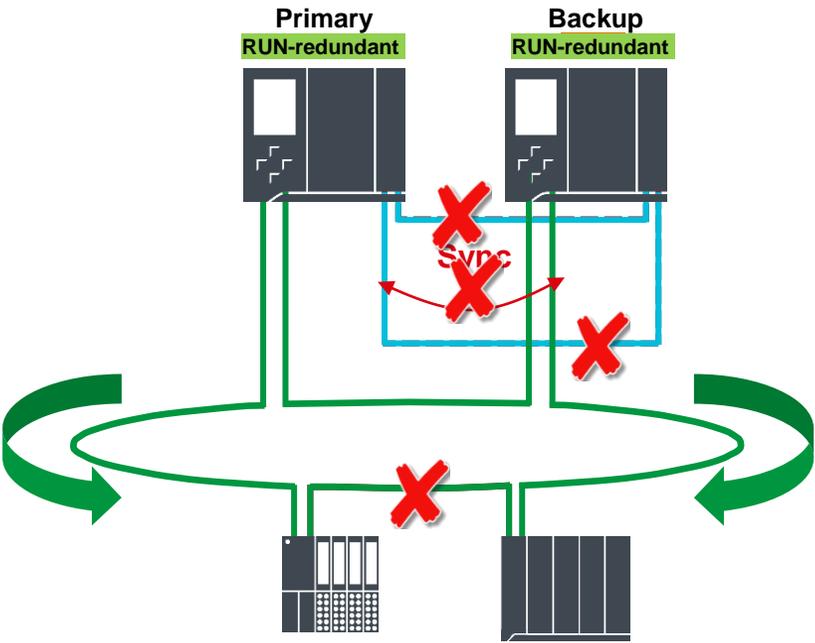
Undefined Condition

Specific failure scenarios for S7-1500 H

Failure of the direct redundancy connection and of the Primary CPU



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



Time interval 2nd failure > 55ms

Communication via System-IP and Device-IP Addresses

SIMATIC S7-1500 Redundant Systems

Communication via System-IP Addresses

IP-Addresses for R/H System

In addition to the Device-IP addresses, for each interface of the R/H system a System-IP address can be activated.

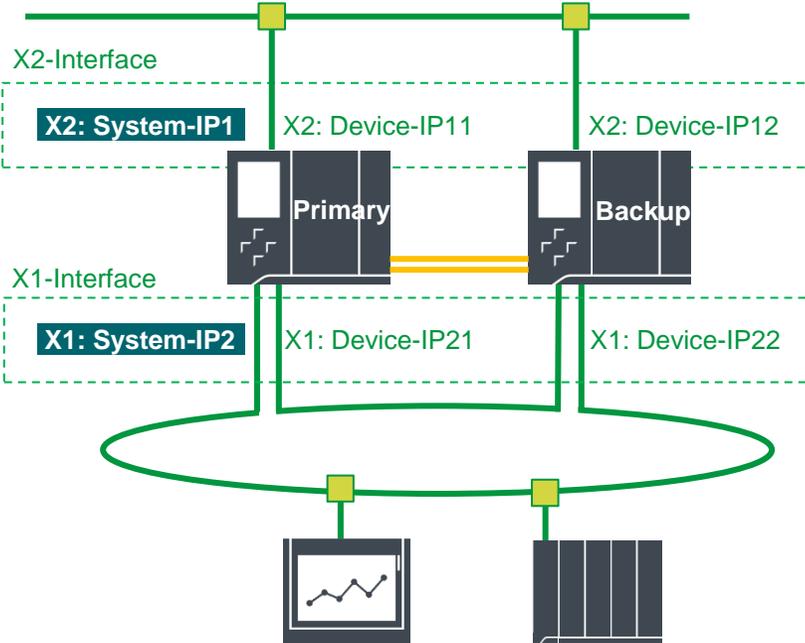
System IP address for switched communication

Enable the system IP address for switched communication

IP address: 192 . 168 . 0 . 3

Subnet mask: 255 . 255 . 255 . 0

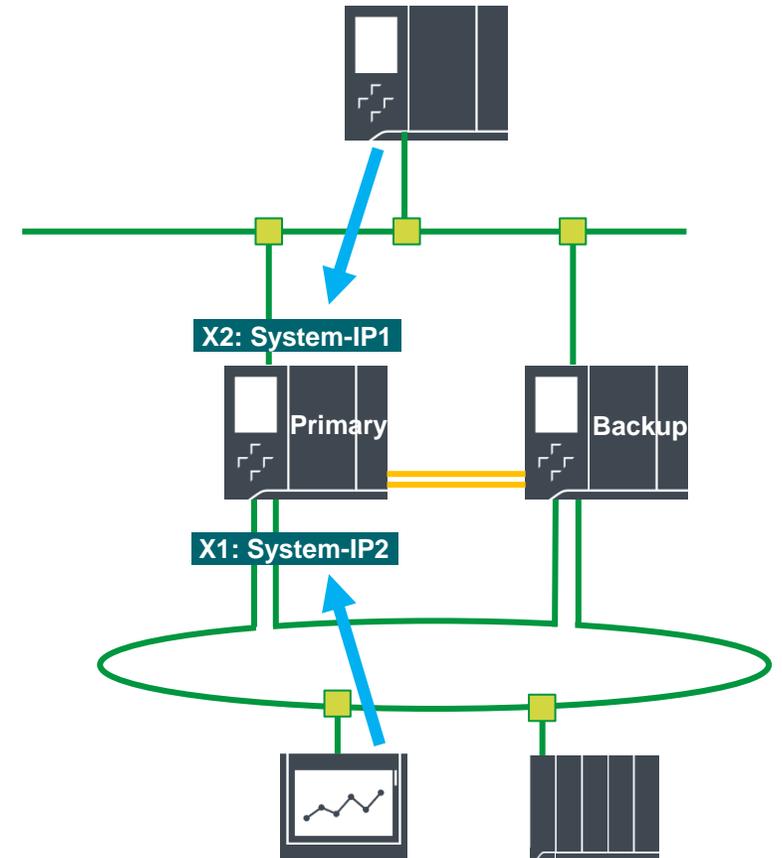
Virtual MAC address: 00- 00- 5E- 00- 01- 1



Communication via System-IP Addresses Behavior

The System-IP Address is automatically assigned to the Primary CPU

For a communication partner (e.g. a standard PLC or HMI) the R/H system behaves like a “normal” (non redundant) communication partner.

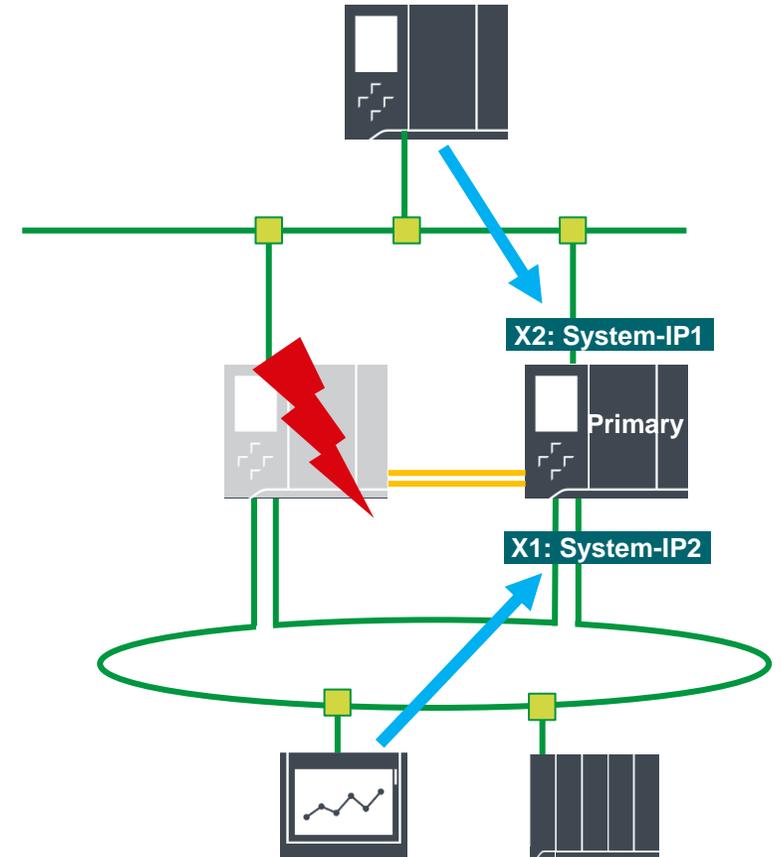


Communication via System-IP Addresses

Behavior at Primary-Backup Failover

When the Primary Controller fails, the System-IP addresses are automatically transferred to the Backup PLC.

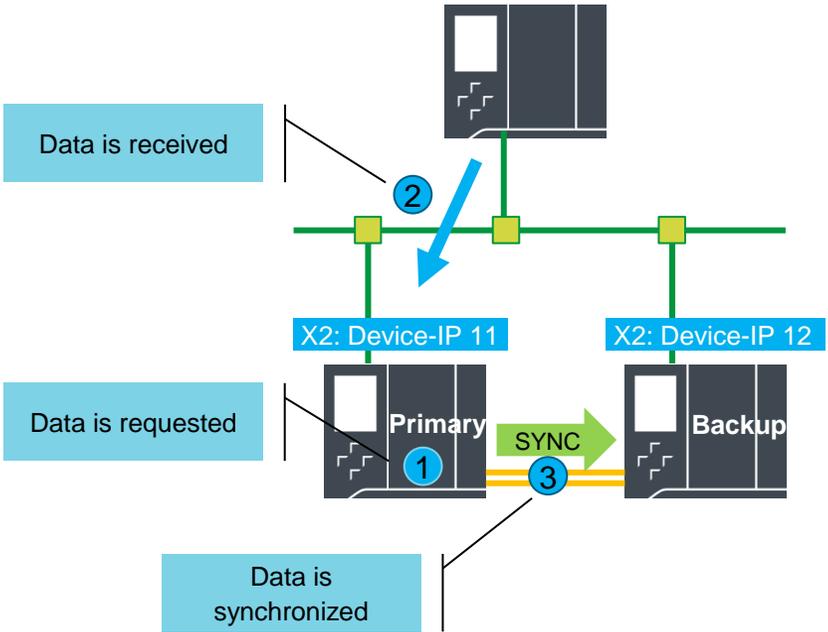
→ A Standard-Controller / HMI can continue the communication with the same IP Address.



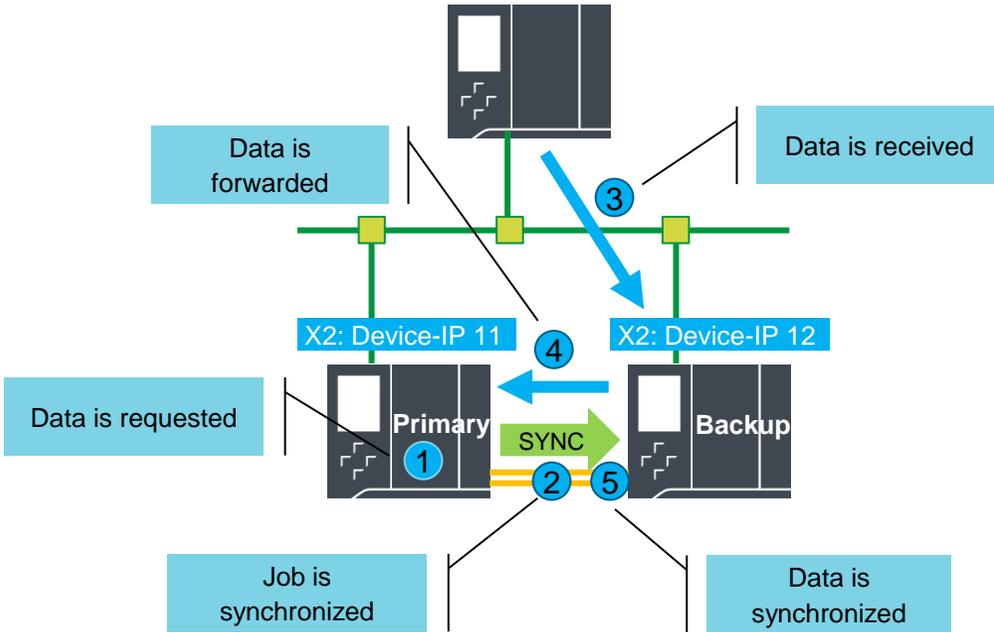
Communication via Device-IP Addresses Behavior

Communication with Device-IP addresses works via Primary-PLC as well as via the Backup-PLC. Please note: Using the connection via the Backup-PLC leads to higher sync load in the system.

Communication via the Primary PLC



Communication via the Backup PLC

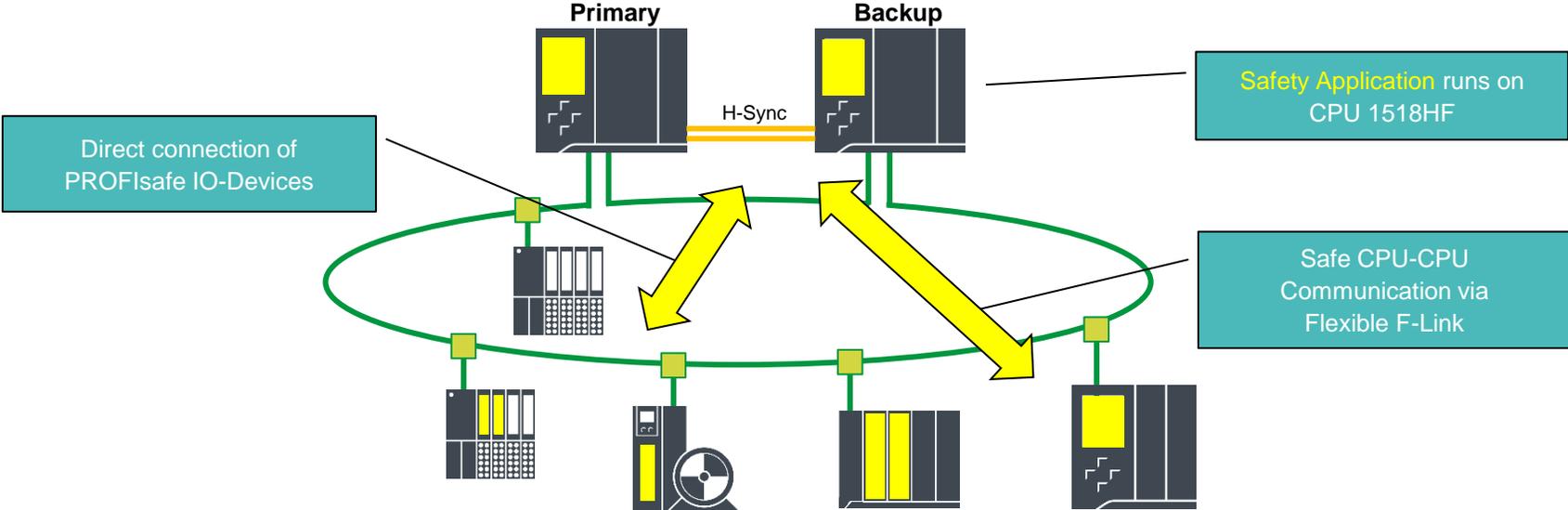


Safety for Redundant Systems

SIMATIC S7-1500 Redundant Systems

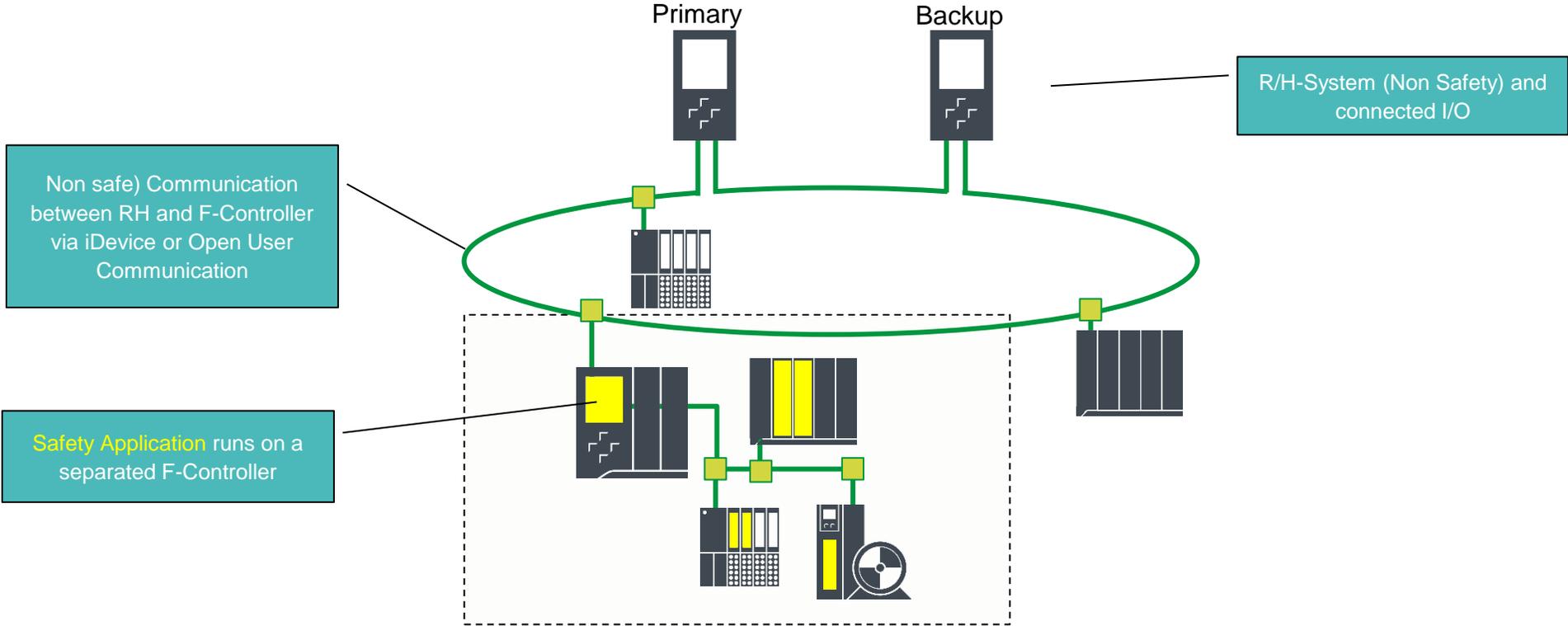
Network configuration with S7-1500 HF Safety Devices

Direct integration of safety devices with SIMATIC CPU 1518HF



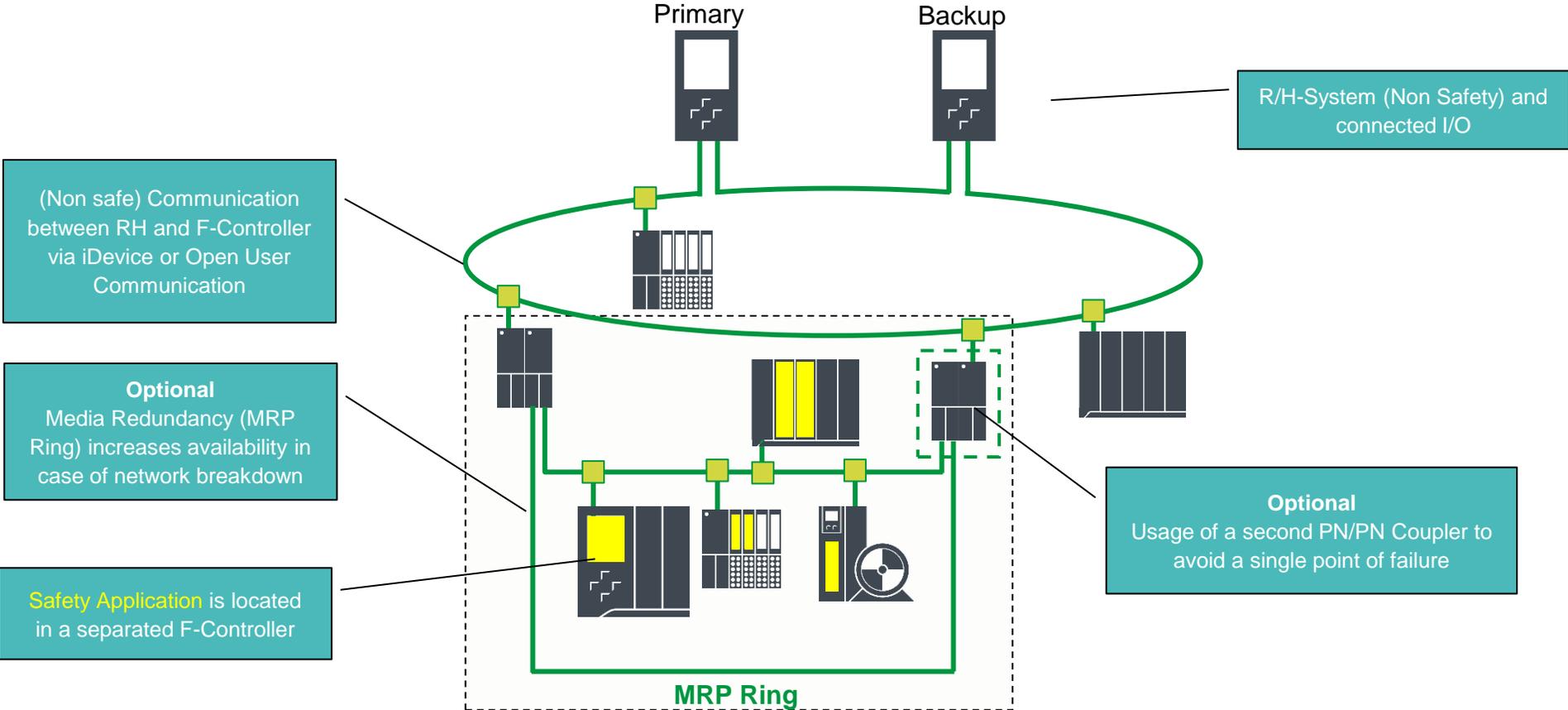
Network configuration with S7-1500 R Safety Devices

Safety Devices can be integrated via subordinated F-Controller



Network configuration with S7-1500 R Safety Devices

Safety Devices can be integrated via subordinated F-Controller, connected via PN/PN coupler



Hardware Extensions in RUN with IO-Link

SIMATIC S7-1500 Redundant Systems

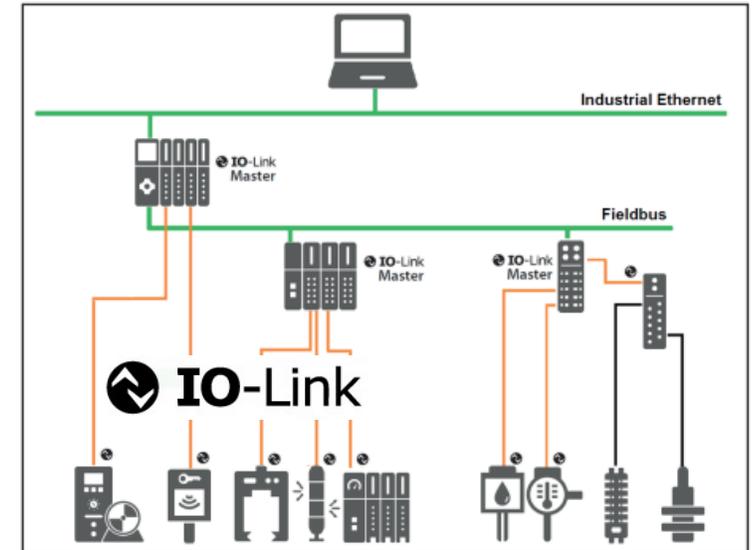
Configuration in RUN (CiR) with IO-Link Overview

What is IO-Link?

- IO-Link is a digital, point-to-point, industrial standard (IEC 61131-9) used for connecting digital sensors and actuators
- IO-Link devices are offered by most sensor manufacturers
- Siemens provides IO-Link Master modules for
 - ET 200SP
 - ET 200MP
 - ET 200eco PN
 - ET 200AL
 - ET 200pro

These CiR use cases can already be solved today with IO-Link

1. Add a new sensor or actuator
2. Change the type of a sensor or actuator
3. Configure a measuring point (e.g. measurement range)



More information about IO-Link?

See <https://www.siemens.com/io-link>

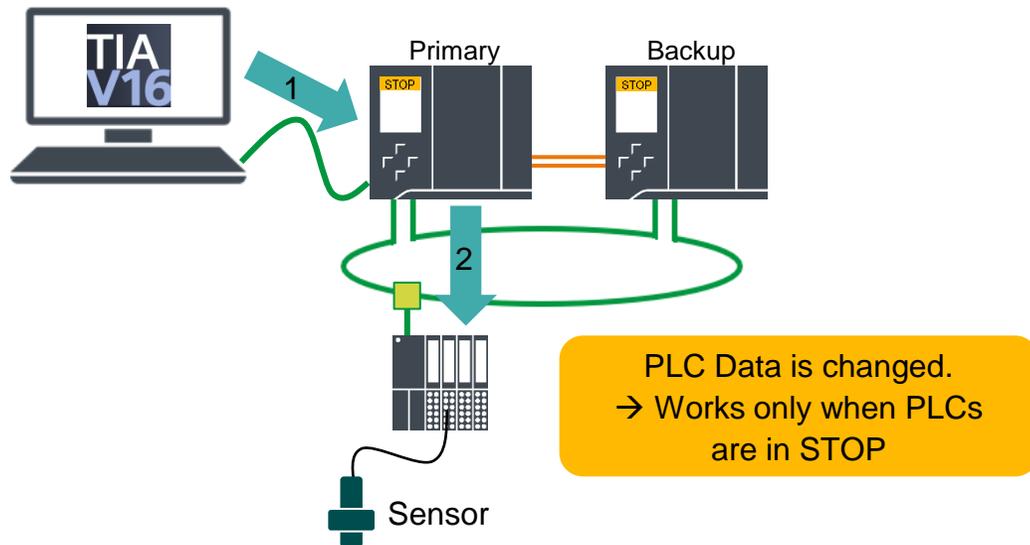
Or <https://www.io-link.com>

Configuration in RUN (CiR) with IO-Link

How does it work?

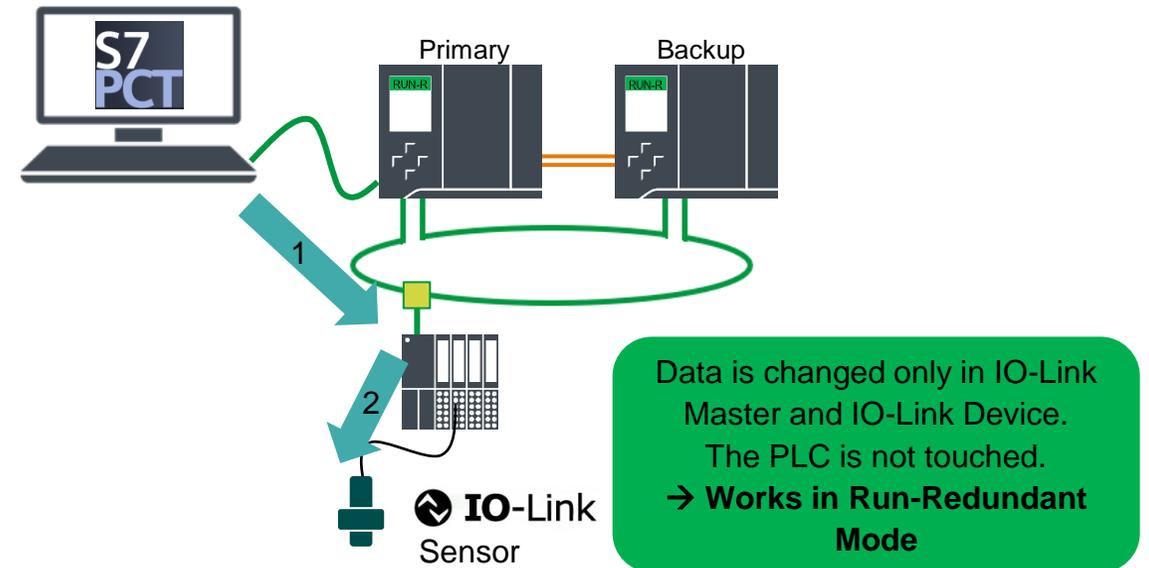
IO-Link devices (sensors or actuators) are configured via the IO-Link Master. The PLC or the H-System is not involved here.

Hardware configuration with conventional sensors



1. TIA Portal Project is loaded to PLC
2. PLC sends data to ET 200

Hardware configuration with IO-Link



1. S7-PCT Tool loads into IO-Link Master
2. IO-Link Master configures IO-Link Devices

Configuration in RUN (CiR) with IO-Link

Example: Procedure to add a new sensor

Installation

Commissioning Phase
System in STOP

1. Insert reserve ET 200 IO-Link Master
2. Configure ET 200 in TIA Portal
3. Load TIA Portal project

Benefit of IO-Link compared with conventional IO-Modules:

An IO-Link port can be used to connect to different channel types:

- Digital Input
- Digital Output
- IO-Link (analog values)

→ Only one module type for all sensor types

- ET 200SP: CM 4xIO-Link, 6ES7137-6BD00-0BA0
- ET 200MP: CM 8xIO-Link, 6ES7547-1JF00-0AB0

Hardware Extension

Production Phase
System in RUN-Redundant

1. Connect Sensor with IO-Link Master
2. Start PCT Tool from TIA Portal
3. Select IO-Link Sensor in PCT
4. Configure IO-Link Sensor in PCT
5. Load IO-Link Master

→ **Result: Process values are transferred from Sensor to PLC**

Program Extension

Production Phase
System in RUN-Redundant

1. Add program tag (symbol) in TIA Portal
2. Use tag in PLC program
3. Load PLC program to R/H PLC

→ **Result: Program reacts on input from new sensor**

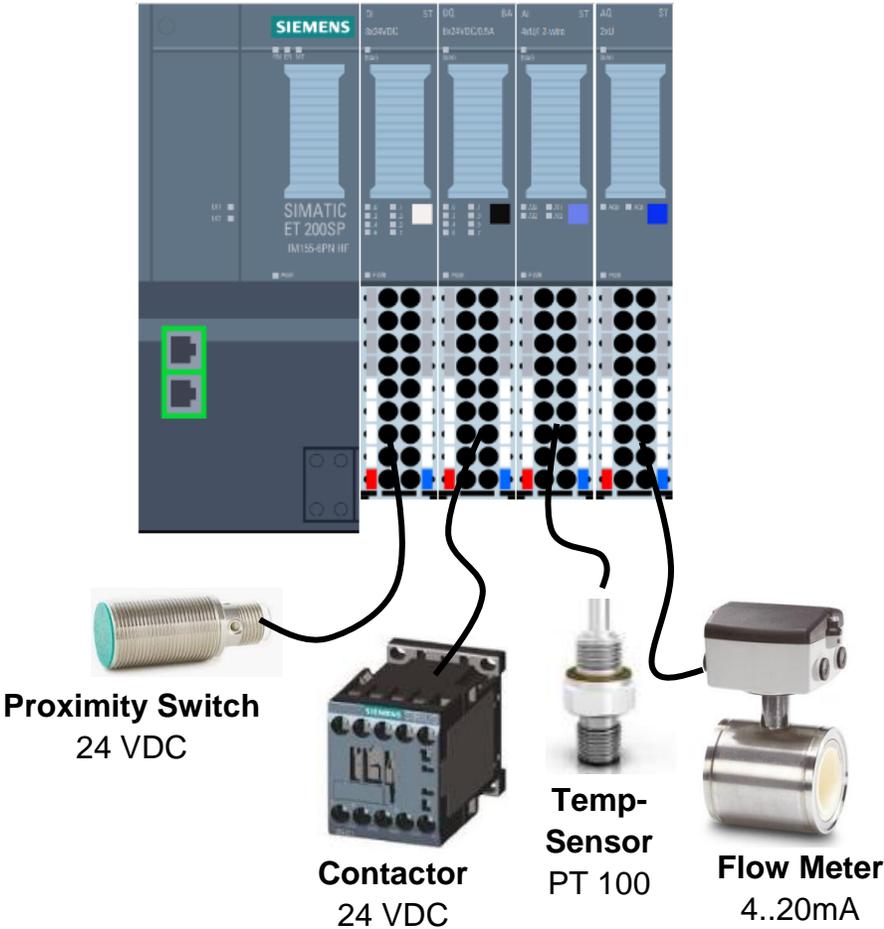
Sensor / Actuator Connection

Example for ET 200SP

Conventional

Four different module types are required

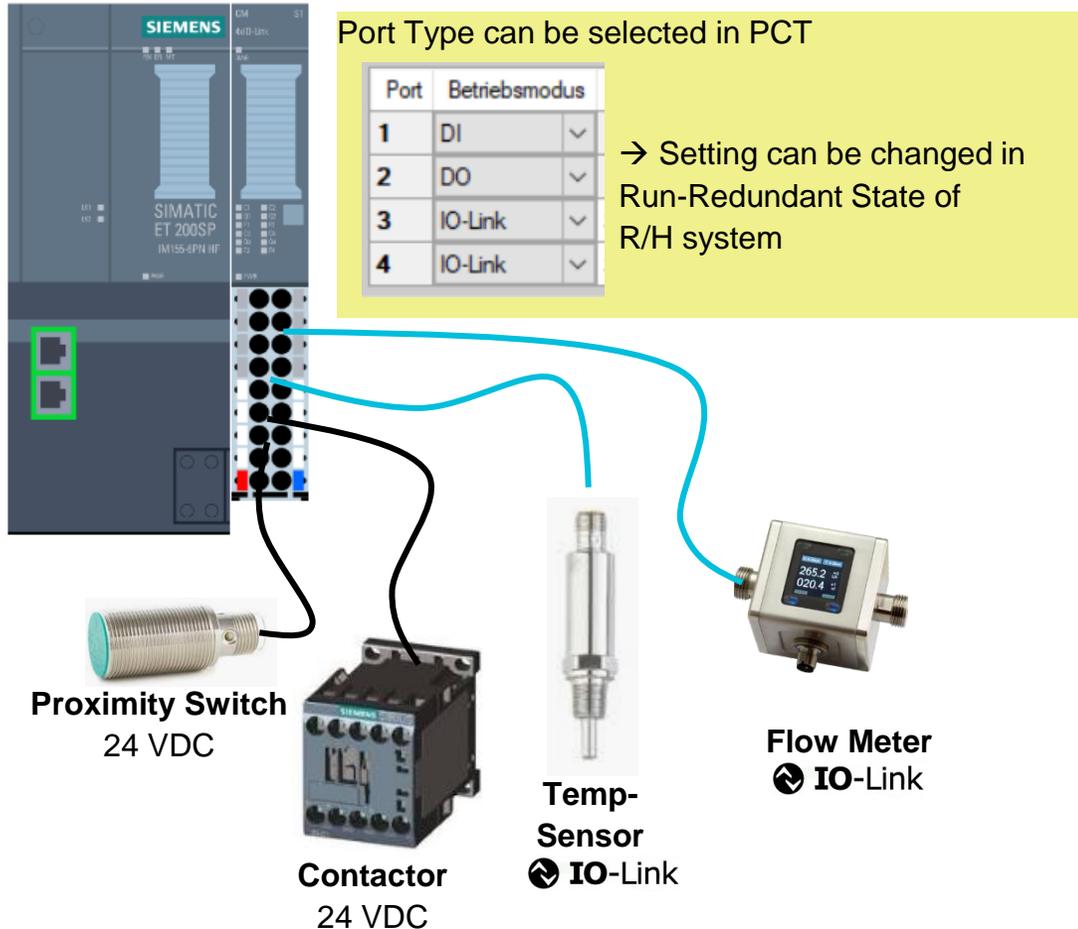
DI DQ RTD AI



With IO-Link

Only one module type required

CM IOL



Port Type can be selected in PCT

Port	Betriebsmodus
1	DI
2	DO
3	IO-Link
4	IO-Link

→ Setting can be changed in Run-Redundant State of R/H system

| HMI Connection

SIMATIC S7-1500 Redundant Systems

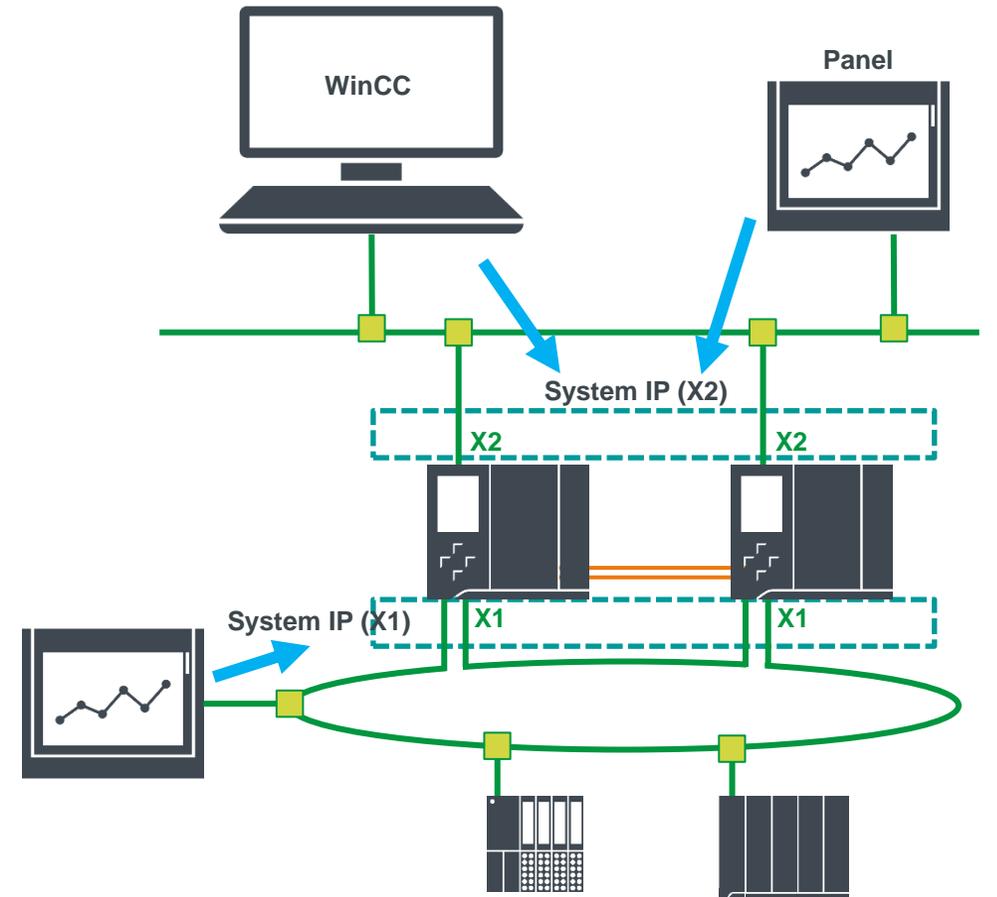
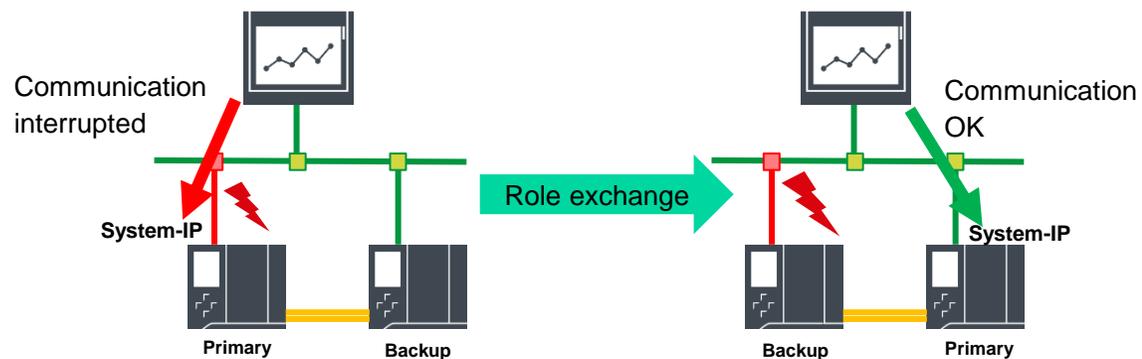
HMI Connection for R/H Systems via a non-redundant network with system IP address

A HMI connection via the system IP addresses with a non-redundant network is possible in all cases.

Note for connection via X2:

If the connection to the Primary-PLC is interrupted, communication with the system is no longer possible because the system IP address remains with the Primary-PLC. To remedy this, the role of the PLCs can be exchanged program-controlled in this case. See slide [Extension RH_CTRL](#)

[Extension RH_CTRL](#)



HMI Connection for R/H Systems

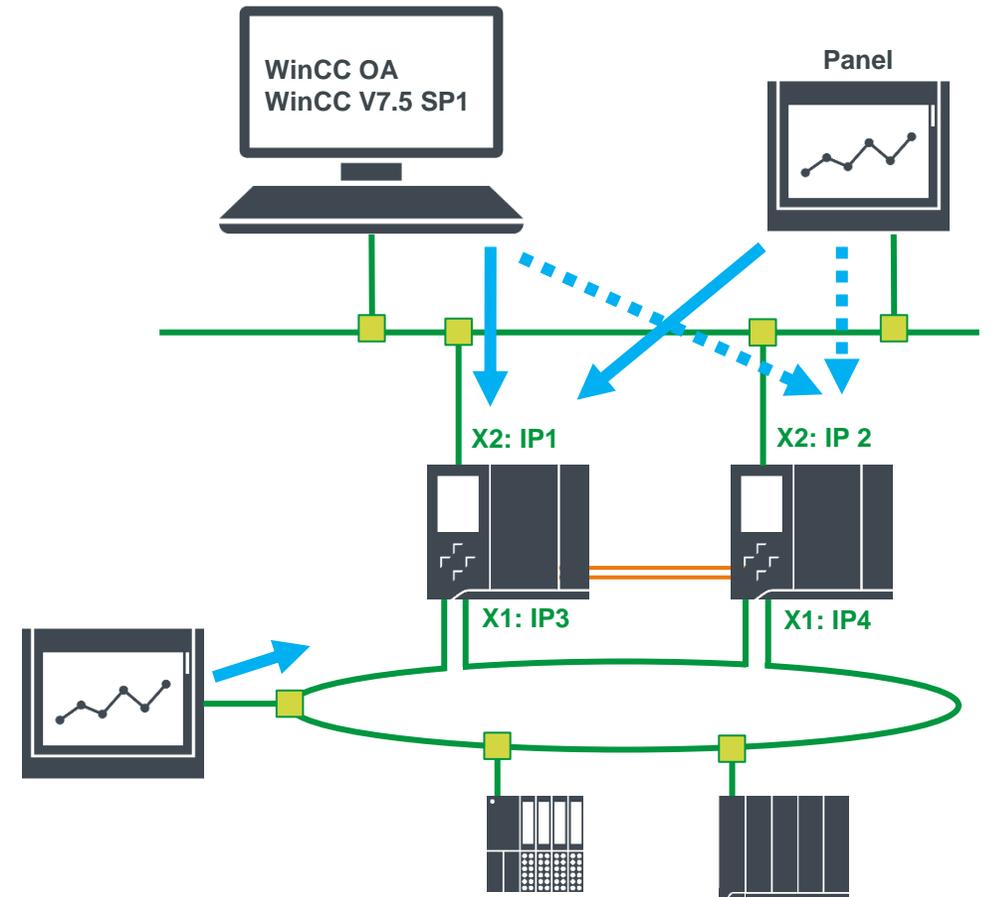
via a non-redundant network with device IP addresses

A HMI connection via the device IP addresses requires a switching option on HMI side. This is supported by

- WinCC OA from V3.17
- WinCC V7.5 SP1 via scripting
- SIMATIC Panels via scripting

The following application example is available for connecting SIMATIC panels to an R/H system:

<https://support.industry.siemens.com/cs/ww/en/view/109751687>



HMI Connection for R/H Systems

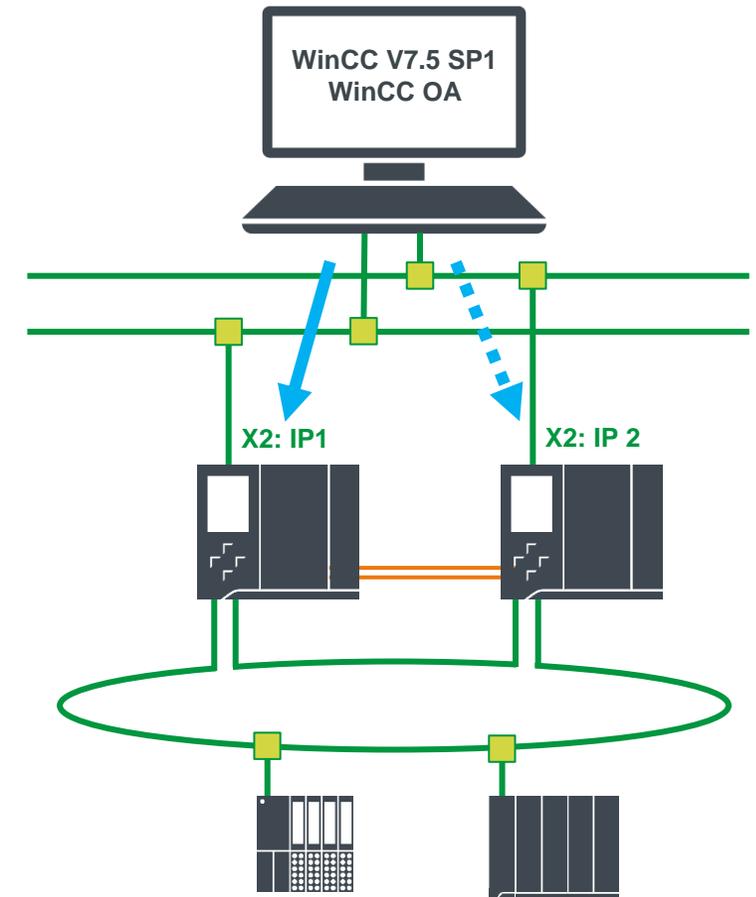
via a redundant network with device IP addresses

A HMI connection via a redundant network using device IP addresses is possible with

- WinCC OA from V3.17
- WinCC V7.5 SP1 via scripting

The switching of the communication connection in case of an error is done by WinCC. See

<https://support.industry.siemens.com/cs/ww/en/view/109773067>



HMI Connection for R/H Systems

via a redundant network with system IP addresses

A HMI connection via a redundant network using system IP addresses is possible with

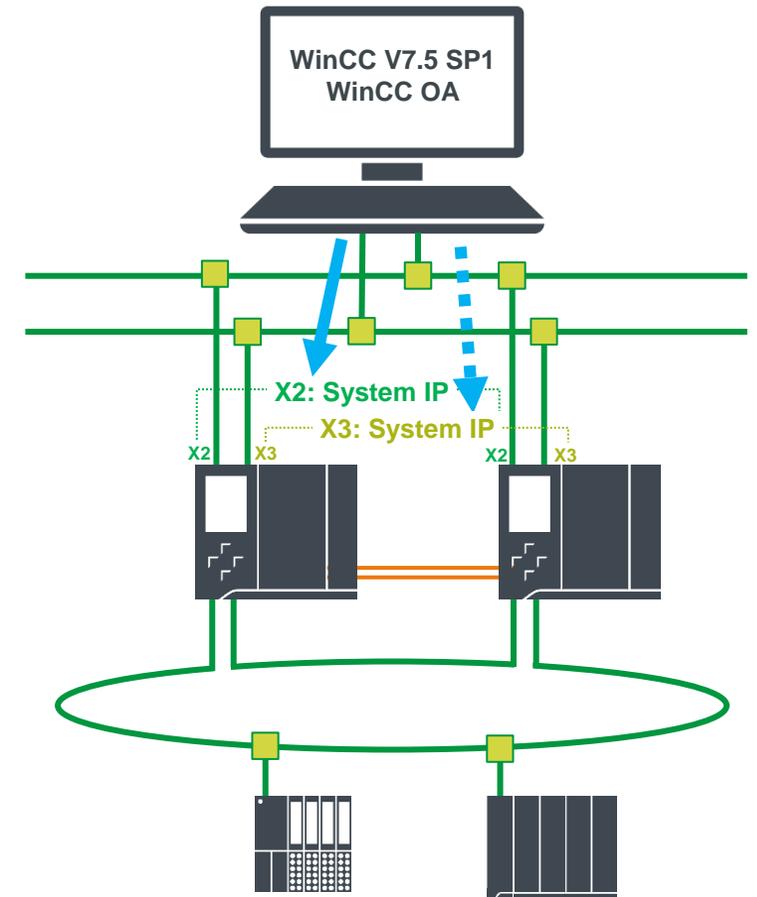
- WinCC OA from V3.17
- WinCC V7.5 SP1 via scripting

Use of the CPU interfaces:

System-IP of X1 and X2 with CPU 1515R-2 PN and CPU 1517H-3 PN
System-IP of X2 and X3 with CPU 1518HF-4 PN

Behavior in case of error

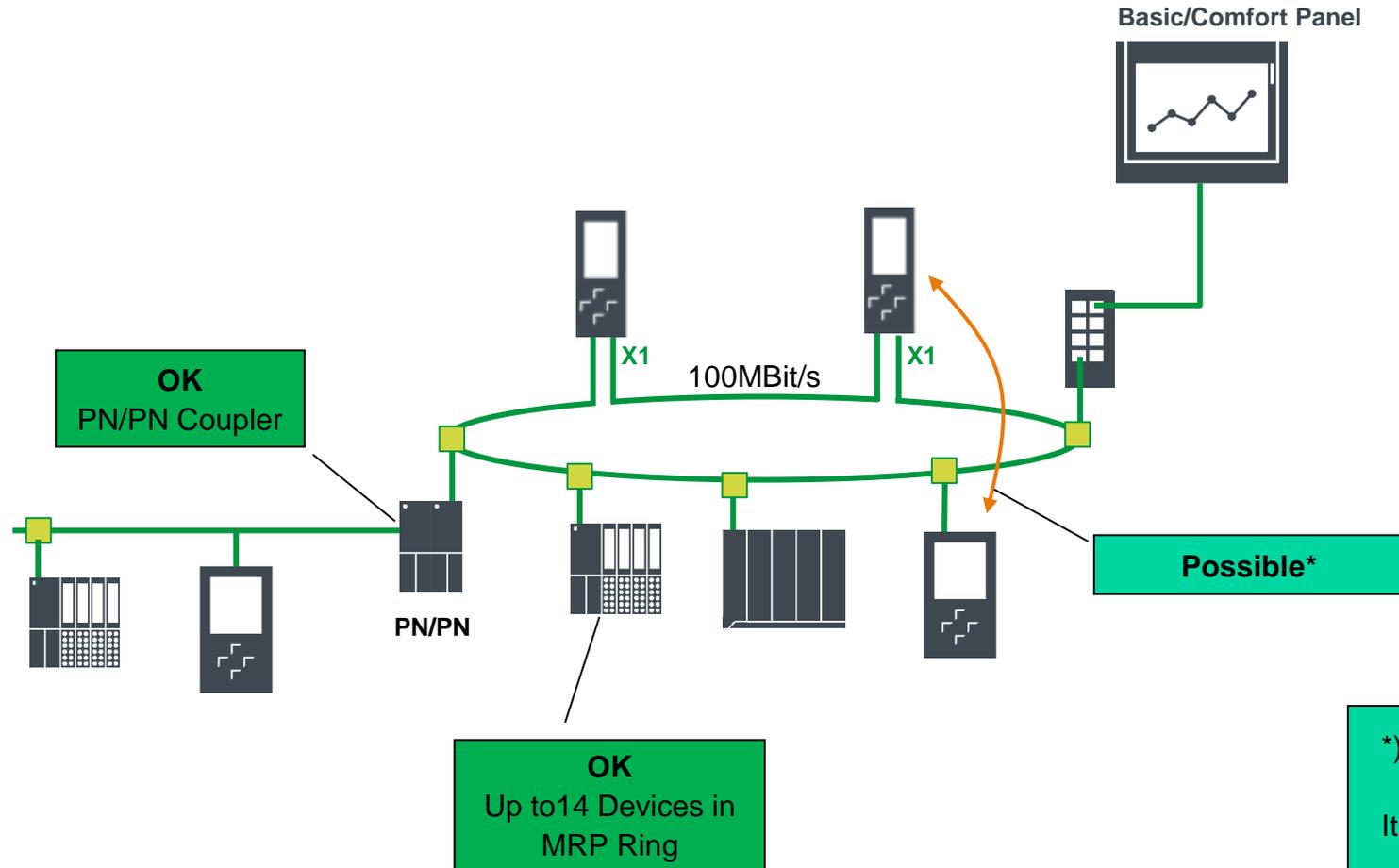
- If the Primary PLC fails, the system switches over by moving the system IP addresses.
- If one network fails, switch over is done by WinCC



Installation Recommendations

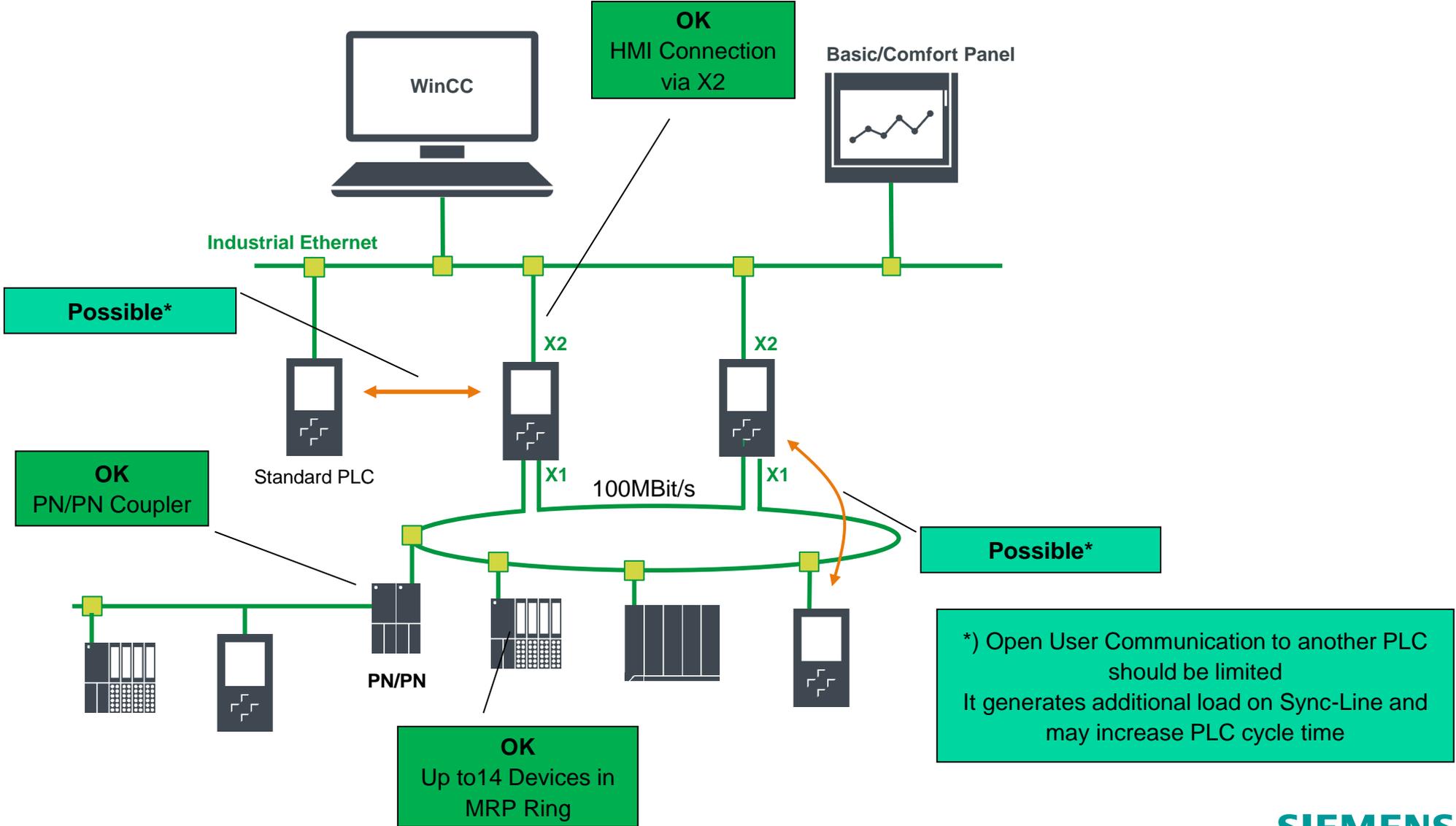
SIMATIC S7-1500 Redundant Systems

Installation Recommendations for CPU 1513R-1 PN

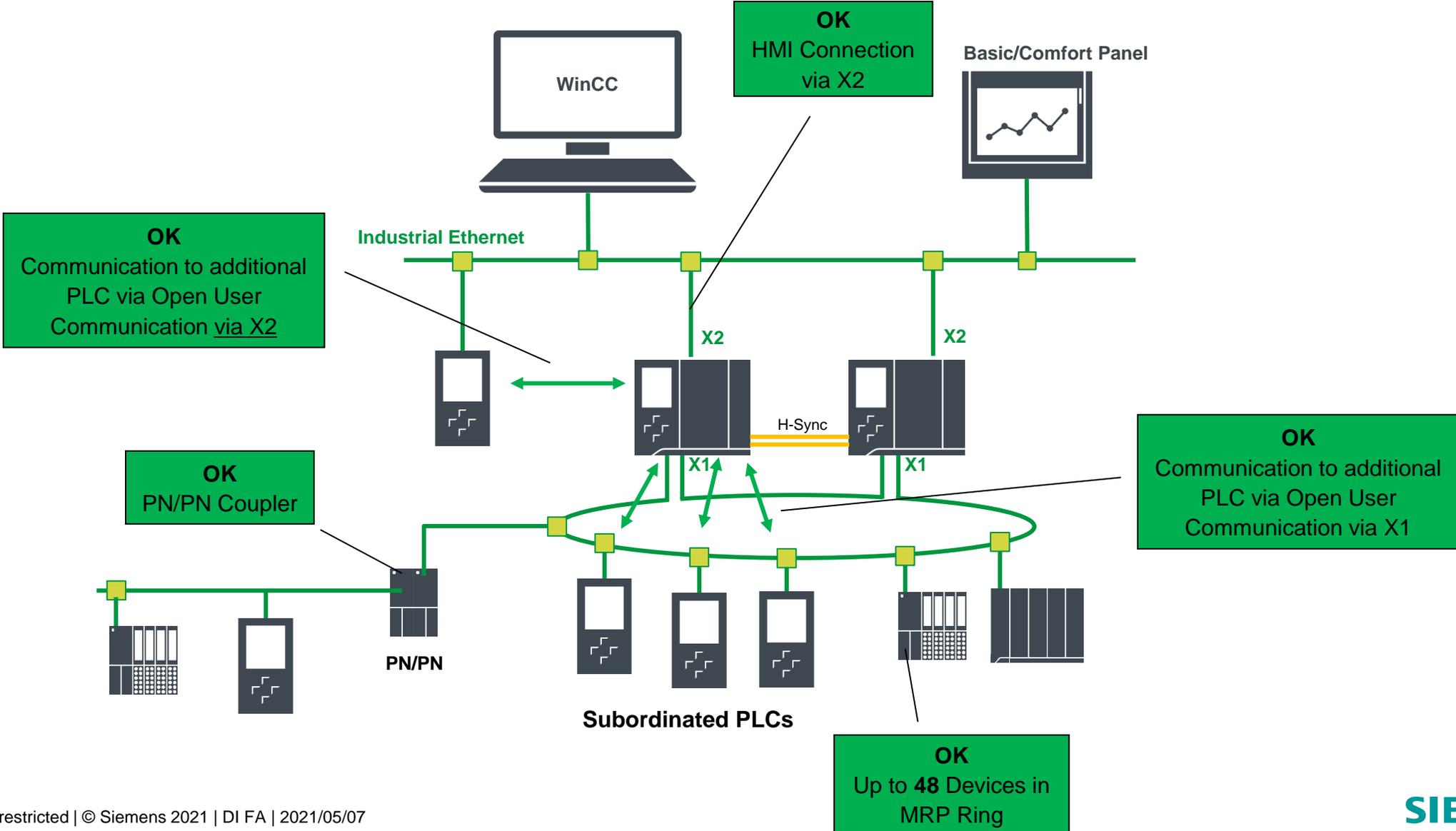


*) Open User Communication to another PLC should be limited
It generates additional load on Sync-Line and may increase PLC cycle time

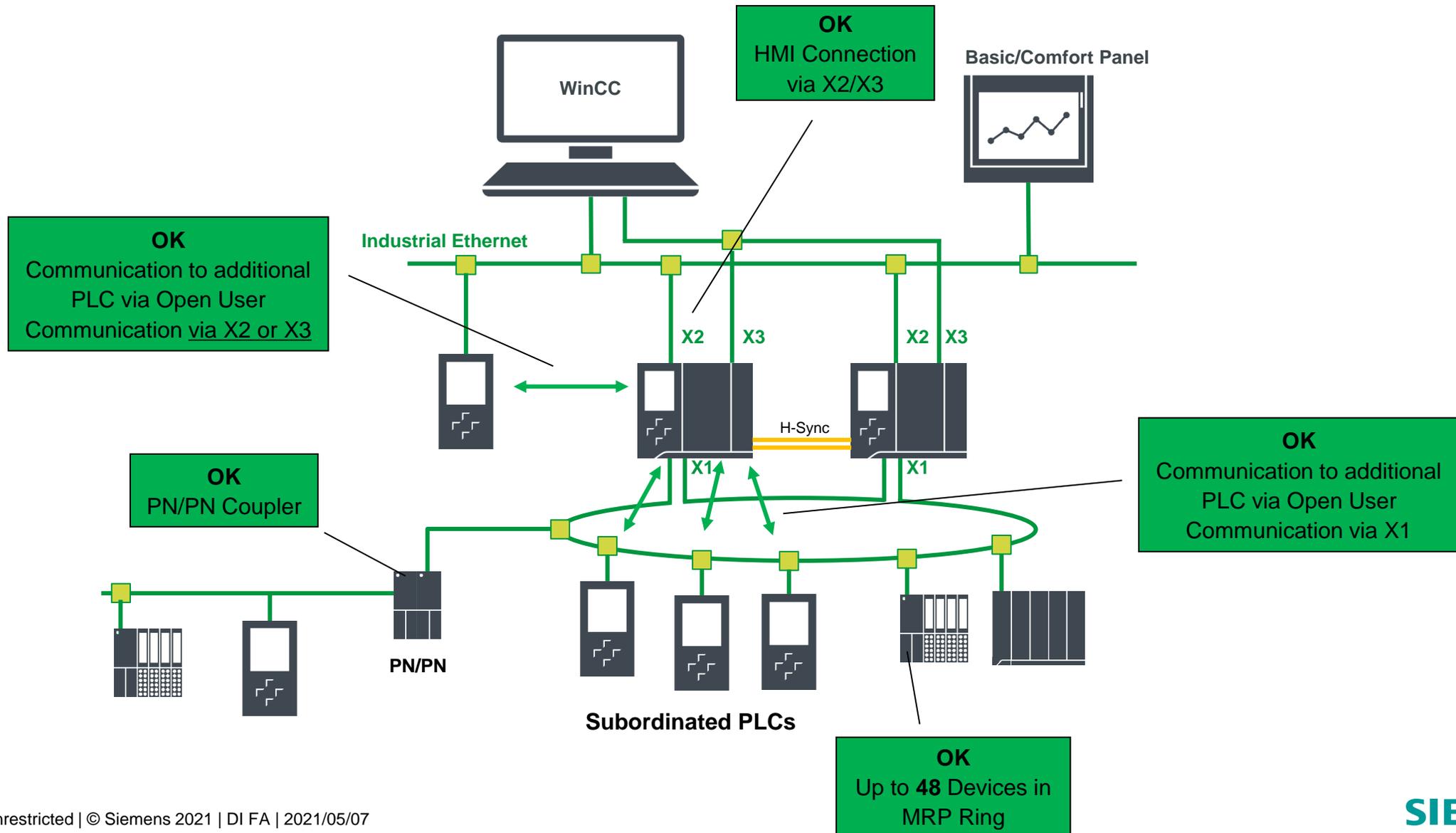
Installation Recommendations for CPU 1515R-2 PN



Installation Recommendations for CPU 1517H-3 PN



Installation Recommendations for CPU 1518HF-4 PN



Programming Recommendations

SIMATIC S7-1500 Redundant Systems

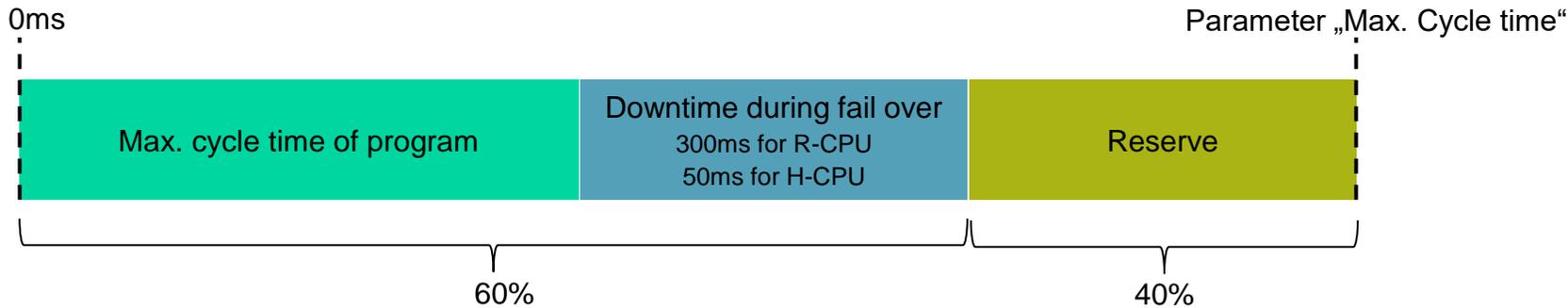
Programming recommendations for SIMATIC S7-1500R/H (I)

1) Adjust maximum cycle time

The maximum cycle time should be set as large as the process allows.

This can shorten the duration for the SYNCUP phase, since the transition to RUN-Redundant state only takes place when the actual cycle time is <80% of the maximum cycle time.

Recommendation:



2) Set minimum cycle time as high as possible

Increasing the minimum cycle time to the minimum value required for the process reduces the system load due to synchronization.

This also shortens the SYNCUP phase and leads to higher performance during communication.

Programming recommendations for SIMATIC S7-1500R/H (II)

3) Avoid direct I/O access

Each instance of direct I/O access is synchronized in the RUN-Redundant system state and results in a higher cycle time. Recommendation: Access the inputs and outputs of the IO devices over the process image or process image partitions.

4) Reduce communication load during SYNCUP

If possible, the communication load should be kept low during a SYNCUP phase. This accelerates the SYNCUP process. This can be program controlled by the SFC "GET_DIAG".

```
#RetVal := GET_DIAG(MODE := 1, LADDR := "Local1~RHSsystem", CNT_DIAG => #CNT_DIAG_temp, DIAG := #DIS);  
IF #DIS.OperatingState <> 38 (* 38 = "SYNCUP system state" *) THEN  
  // not in syncup  
  "Load";  
END_IF;
```

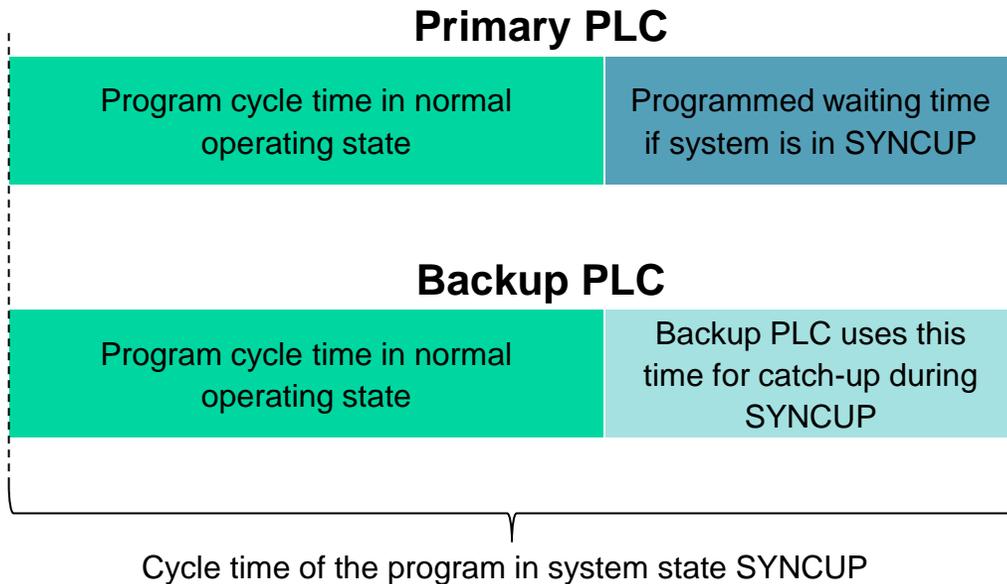
5) Reduce load of cyclic OBs during SYNCUP

If the program has considerable load in cyclic OBs, it can be temporarily reduce by calling the SFC SET_CINT for those OBs. In SYNCUP state, set the cycle time for the OB to a longer time, and restore it to its original time in all other states (solo and redundant)

Programming recommendations for SIMATIC S7-1500R/H (III)

6) Use the WAIT function when system is in state SYNCUP

If a longer cycle time is tolerable in the SYNCUP system state, the SYNCUP process can be accelerated by calling the "WAIT" system function at the end of it OB1. This is possible because the WAIT function on the backup PLC is used for the catch-up process.



```
IF #DIS.OperatingState = 38 THEN
  // if in syncup
  WAIT(30000);
END_IF;
```

New Features with Firmware V2.9 (TIA Portal V17)

SIMATIC S7-1500 Redundant Systems

SIMATIC S7-1500 Redundant Systems

New Features in with Firmware Version 2.9

New features

New CPU 1518HF-4 PN ¹⁾

Safety for redundant Systems with CPU 1518HF-4 PN ¹⁾

MRP-Interconnect

Simulation of S7-1500R/H in PLCSIM Advanced ²⁾

Extension of the RH_CTRL Instruction

Improved performance for “Switched S1” feature

OB72 call in case of redundancy loss of a sync line

Enhanced Security Features ¹⁾

New support of S7-1500 standard features

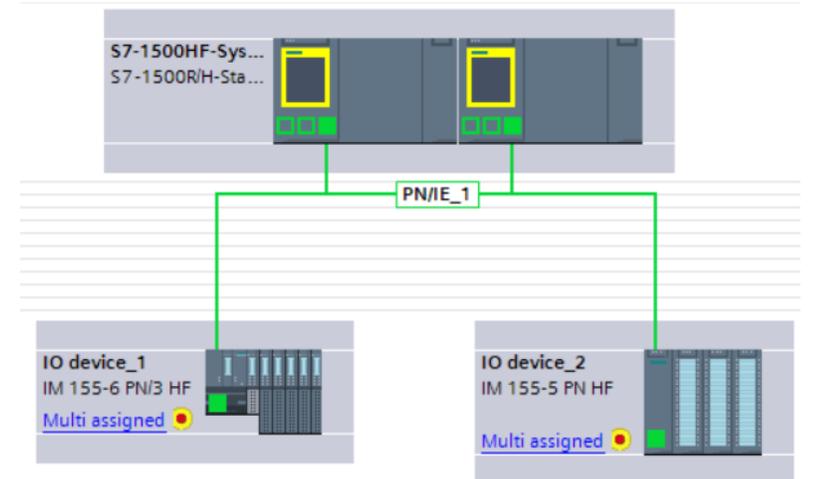
Recipe Function (Instruction RecipeExport" and "RecipeImport,) ¹⁾

New in TIA Portal V17: Safety for redundant Systems

Realize Safety Applications with redundant Controller

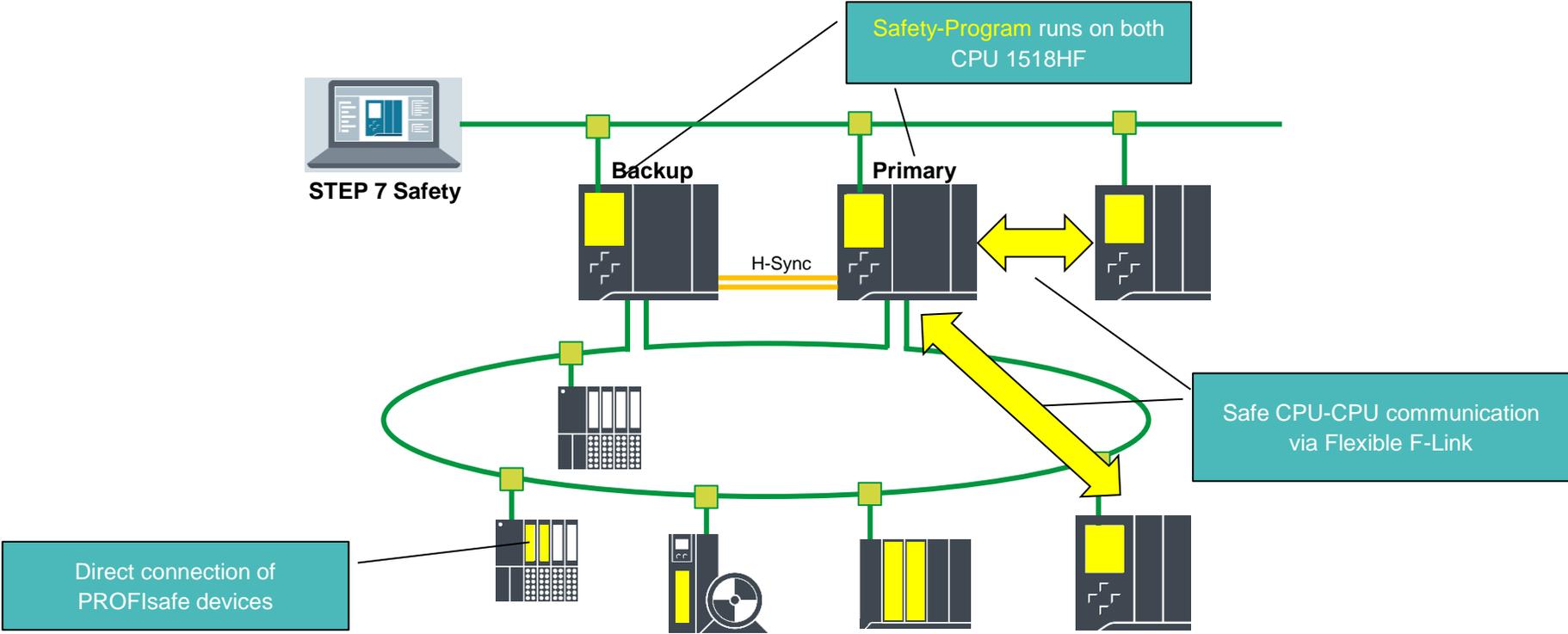
High Availability + Failsafe = CPU HF

- Engineering in STEP 7 Professional (TIA Portal) V17 and STEP 7 Safety
- Safety programming like non-redundant Fail-safe PLC
- Support of PROFI-safe communication
- Support of Flexible F-Link (safe controller/controller communication)
- Fail-Over scenario without stop of the safety program
- Fast commissioning mode reduces turnaround time
 - Fast compile of F-programs in deactivated safety mode



New in TIA Portal V17: Safety for redundant Systems

Configuration Example

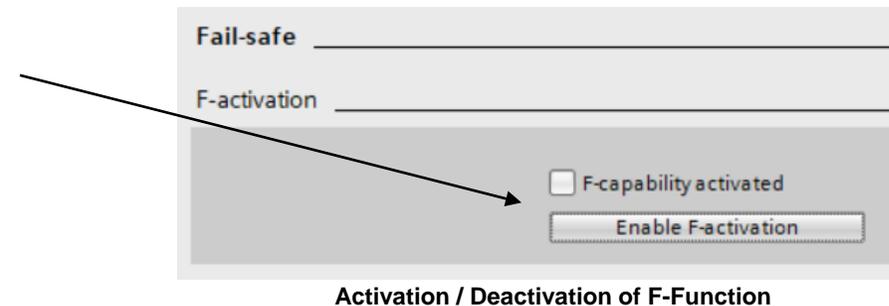


New in TIA Portal V17: CPU 1518HF-4 PN

Safety, More Memory, 3rd PN Interface

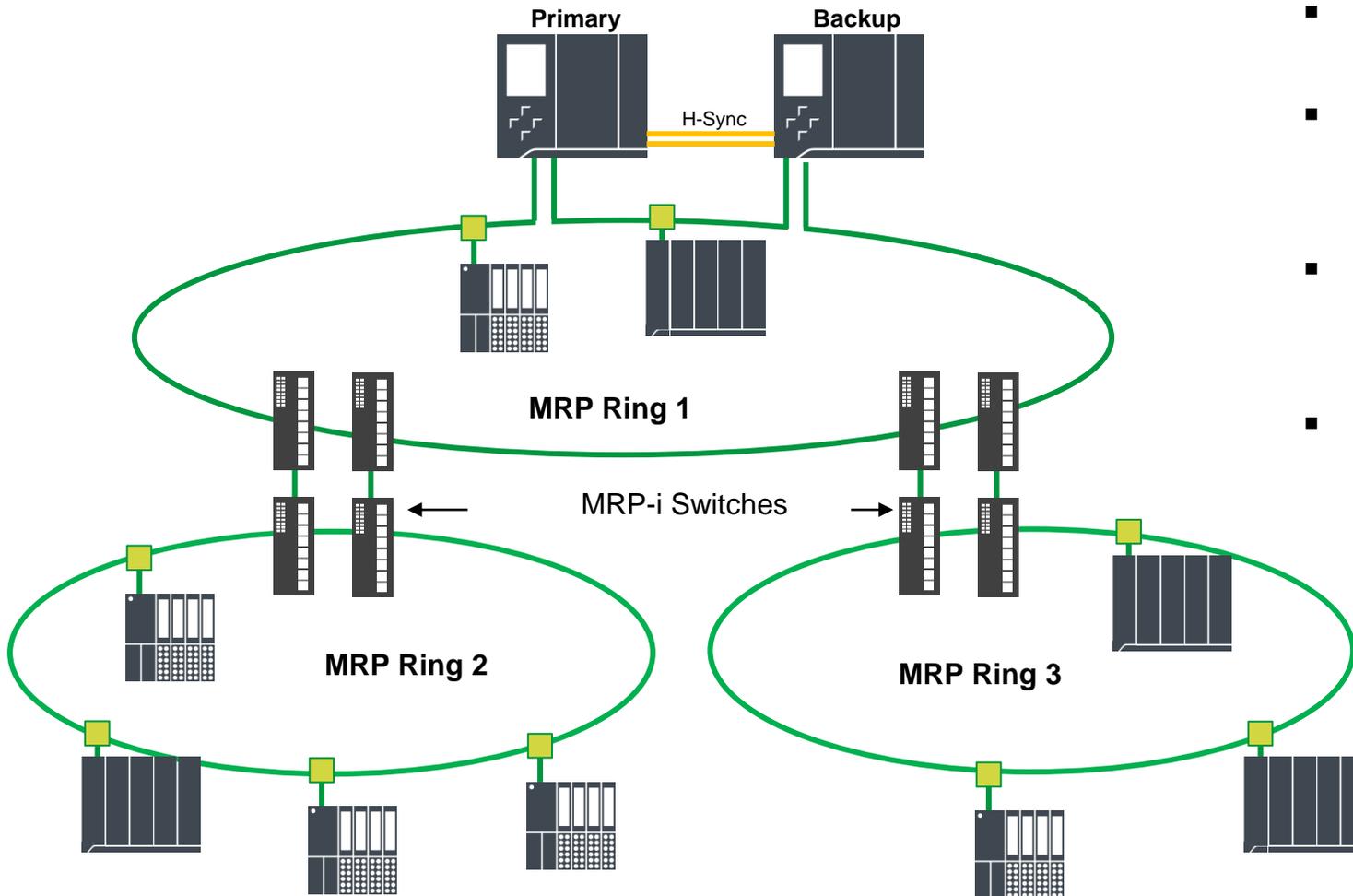
CPU 1518HF-4 PN

- For Safety- and Standard Applications
- Three Ethernet-Interfaces for Communication
 - X1 (2 Ports): PROFINET RT
 - X2 (1 Port): PROFINET Basic services, 100MBit/s
 - X3 (1 Port): PROFINET Basic services, 1 Gbit/s
- 9 MB Memory for Program
- 60 MB Memory for Data
- Can also be used as Non-Safety H-Controller
- Same size as CPU 1517H
- Same accessories as for CPU 1517H



New with FW-Version V2.9: MRP Interconnect

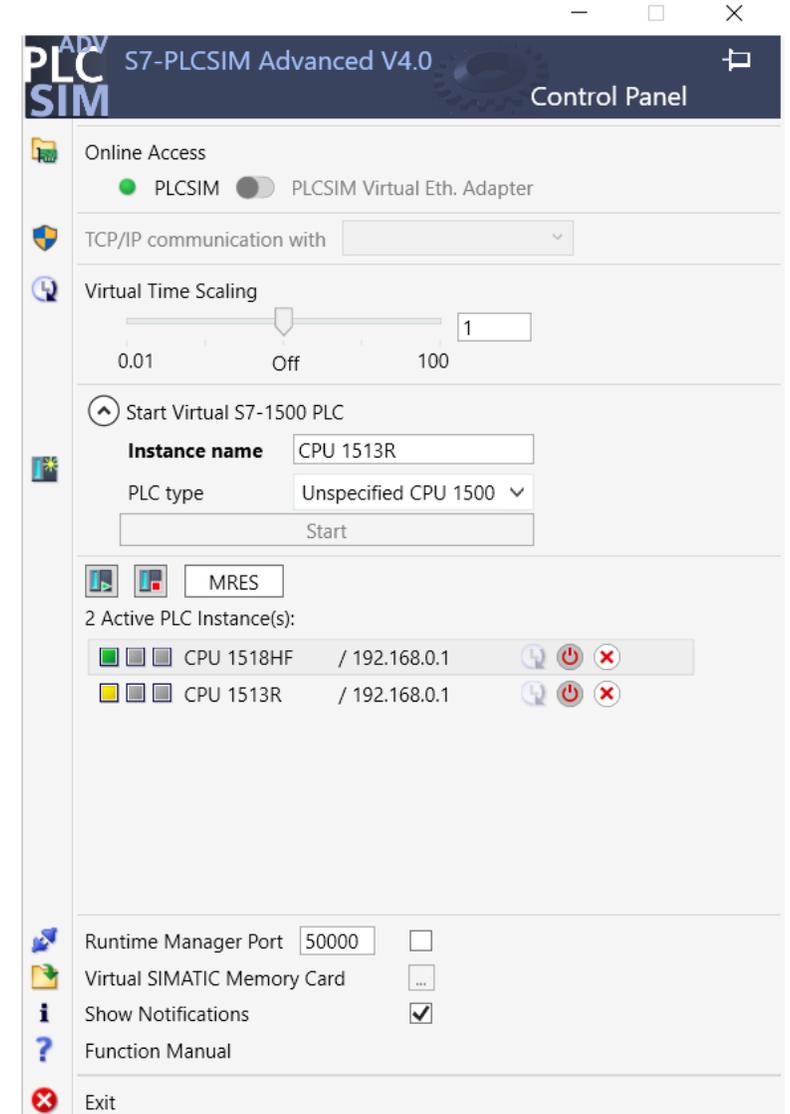
Coupling of multiple MRP rings



- MRP-Interconnect Switches allow to couple multiple MRP-Rings.
- Because redundant switches can be used, a coupled ring keeps on working even if one switch fails.
- In each ring, up to 50 devices can be used → No more need to use stitches when more than 50 devices are needed. → Increased availability.
- Can be used with the following SCALANCE Switches: XR500, XM400, XC200, XF204-2BA, XP200

New: Support of S7-1500 R/H in PLCSIM Advanced Simulation of a R/H-Program in Solo-Mode

- With PLCSIM Advanced V4.0 it is now possible to test the PLC program also for R/H/HF controller without installed hardware.
- The simulation runs only in RUN-Solo Modus of the system.
- Instructions which changes the behavior of the redundancy system (like disable SyncUp) can be used, but they do not have an effect.

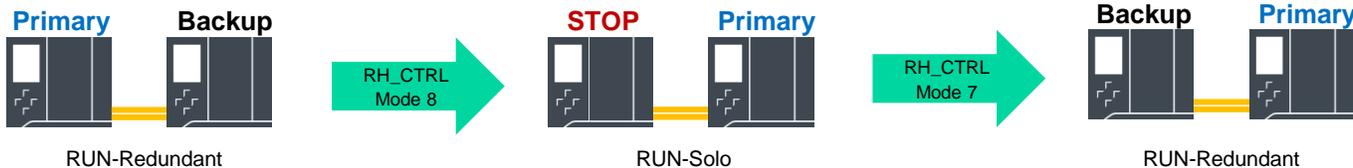
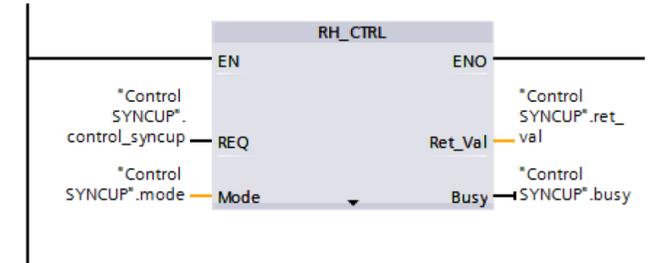


New in TIA Portal V17: Extension of RH_CTRL

Switch PLC roles in user program

Firmware V2.9 now supports three new modes of the RH_CTRL instruction:

- **Request SYNCUP:** If the system is in RUN-Solo mode, this mode restarts the SYNCUP procedure so that it changes to RUN-redundant.
- **Stop Primary-PLC:** In RUN-Redundant mode, the primary PLC is stopped and the backup PLC takes over the process. If then the Syncup-Request function is called, the system continues with **exchanged roles (Primary/Backup)** in redundant mode.
- **Stop Backup-PLC:** In RUN-Redundant mode, the backup PLC is stopped and the primary PLC continues in RUN-Solo mode.
- These functions can also be used with older TIA Portal versions! The only precondition is firmware version V2.9.



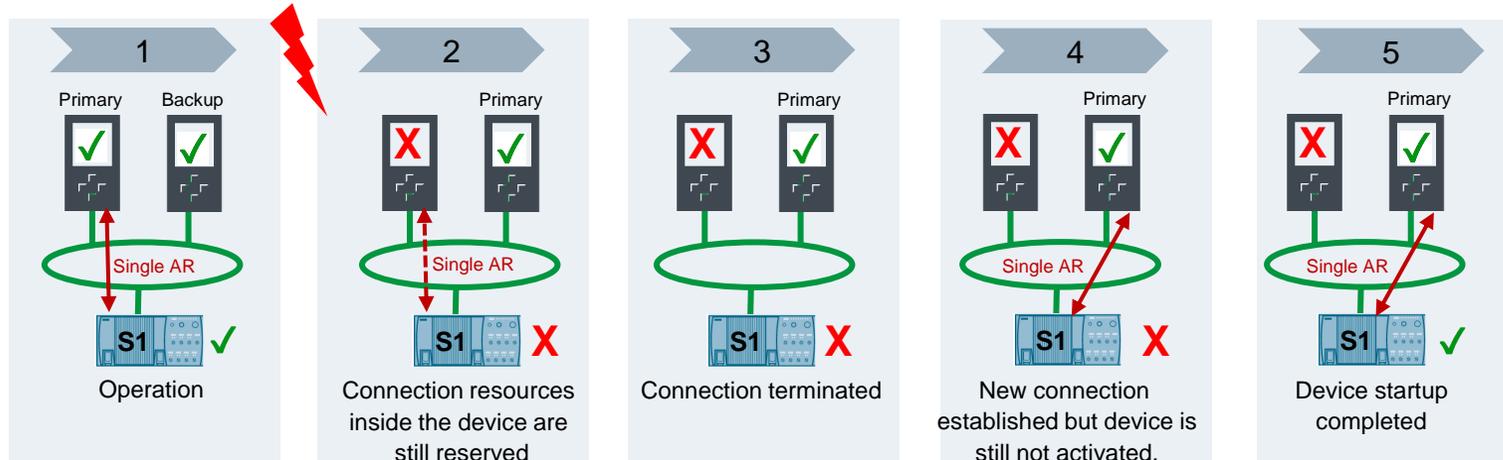
Mode	Function
3	Disable SYNCUP
4	Enable SYNCUP
7	Request SYNCUP
8	Stop Primary-PLC
9	Stop Backup-PLC



New with Firmware V2.9: Faster S1 fail-over time

Adjustable fail-over with „Switched S1“ function

Fail over procedure with S1 Devices



- 1) System in state „RUN-Redundant“ IO-data are exchanged
- 2) After fail-over: IO device still holds the connection until configured watchdog time is over.
During this time, no additional connection is possible
- 3) IO-Device is now ready for a new connection to the IO-Controller
- 4) A new connection is established; the IO-Device now begins startup
- 5) IO-Data are exchanged

AR = Application Relation (Connection between Controller and Device)

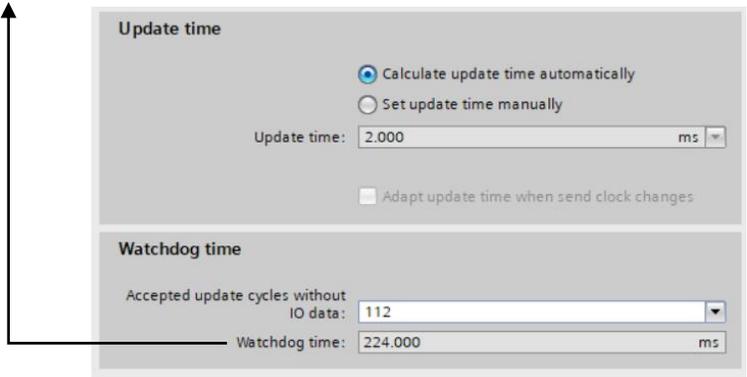
New with Firmware V2.9: Faster S1 fail-over time

Adjustable fail-over with „Switched S1“ function

Timing with FW-Version 2.8



New timing with FW-Version 2.8



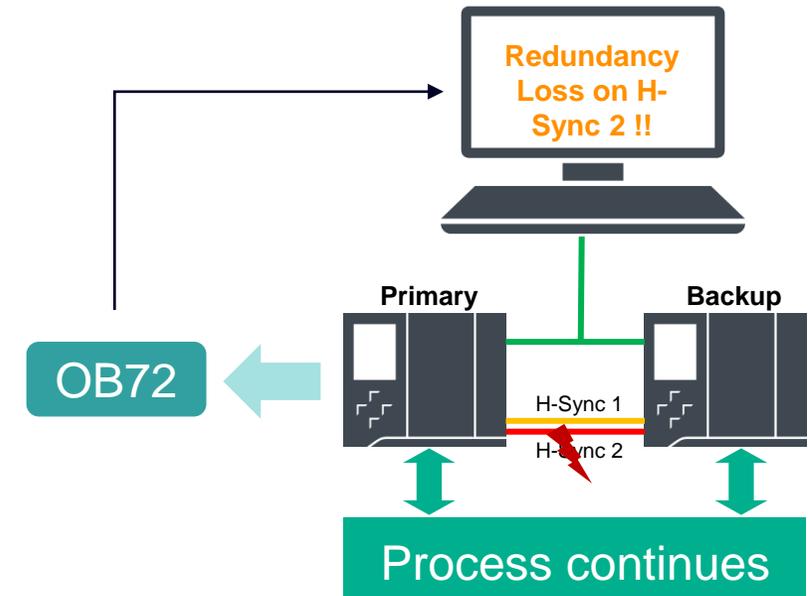
Measures example values with CPU 1517H and iDevice (short startup time inside the iDevice)

	FW V2.8	FW V2.9
IO data transfer interrupted for..	3 Seconds	0,6 Seconds

AR = Application Relation (Connection between Controller and Device)

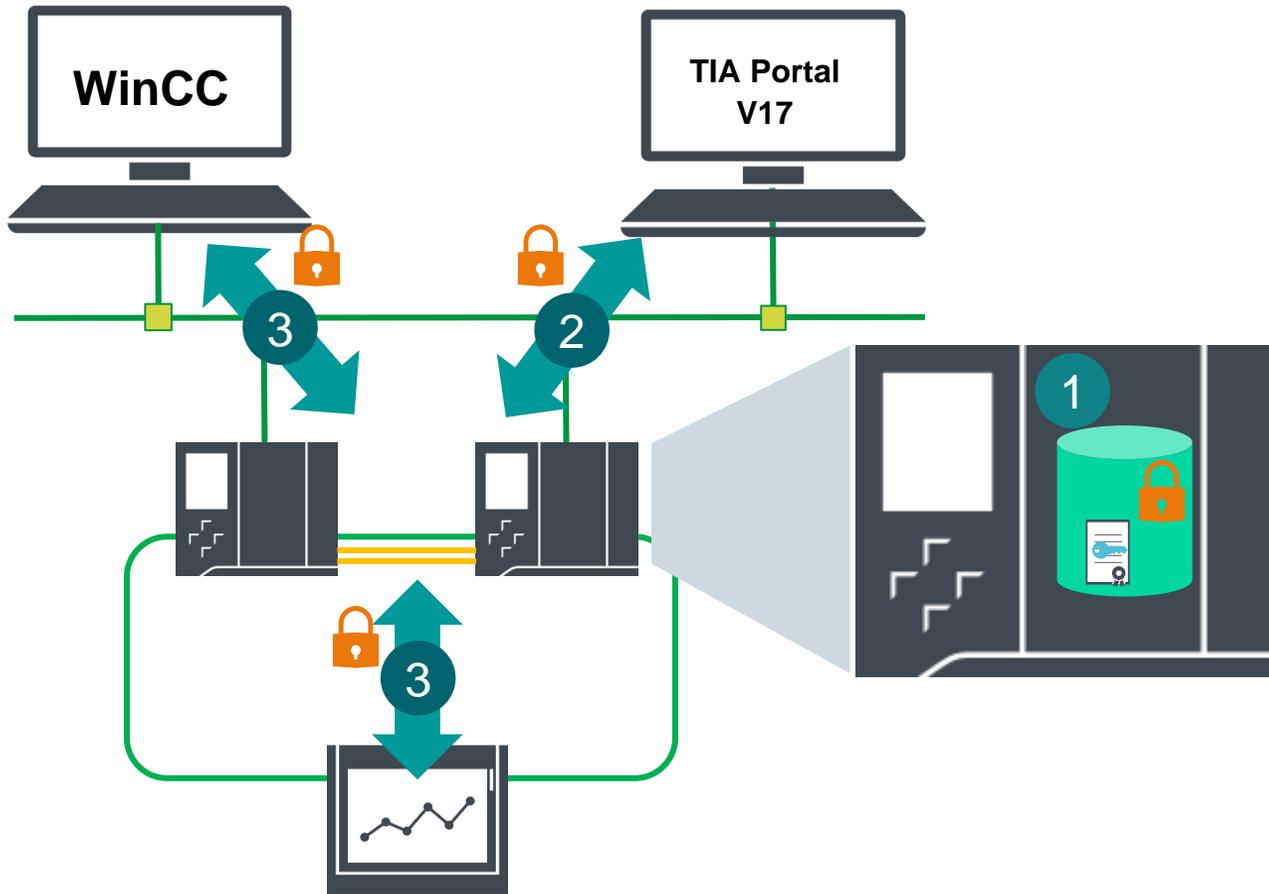
New in TIA Portal V17: Event on redundancy loss OB72 is called in case of H-Sync redundancy loss

- If one of both Sync-Lines fails, the H-System continues the operation in redundant mode but the maintenance LED is on.
- With firmware version V2.9 in this case also the OB72 (loss of redundancy) is called.
- So a maintenance request to repair the defect sync line can be generated.



New in TIA Portal V17: Security Enhancements

Protection of configuration data / Secure communication to HMI and TIA Portal



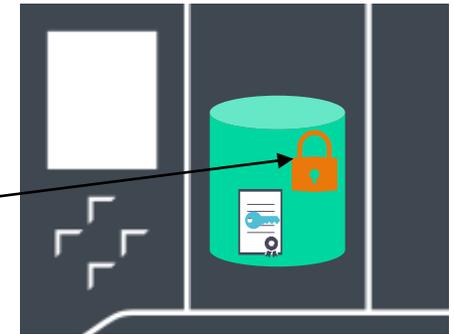
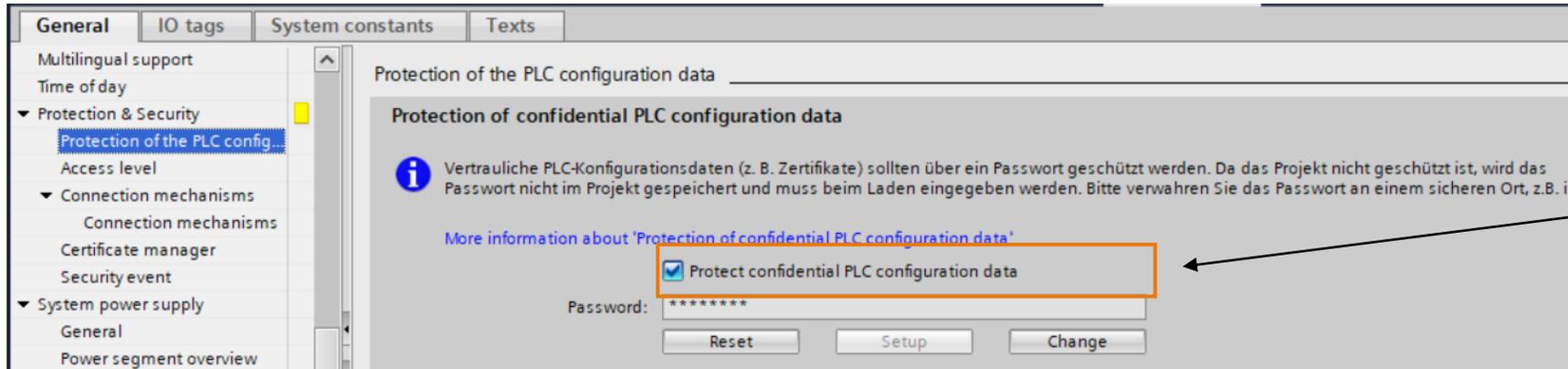
Enhancements with Firmware V2.9 und TIA Portal V17

- 1 Protection of configuration data
- 2 Secure communication between controller and TIA Portal V17
- 3 Secure communication between controller and HMI

Password protection of confidential configuration data

General concept

Protection of configuration data can be activated/deactivated in TIA Portal.

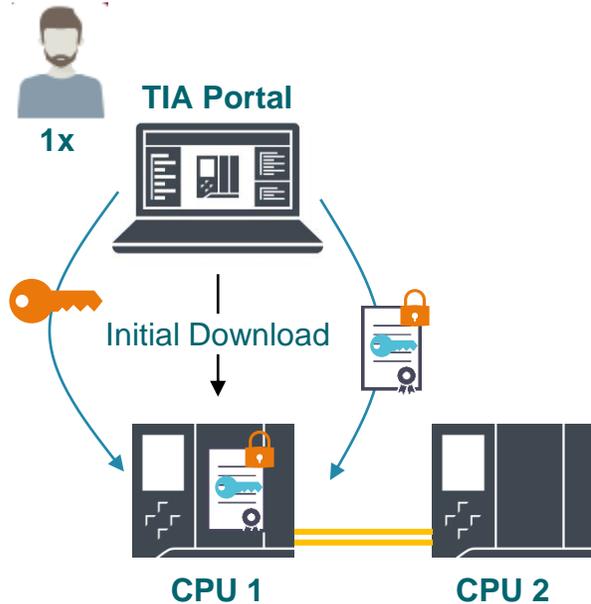


- The password for this protection is **not** stored in the TIA Portal project! It is only located inside the PLC but cannot be retrieved again. → Please save this password on a safe place (e.g. password manager)
- If the protection is activated, some things must be considered during initial commissioning and replacement of a controller → see next slides

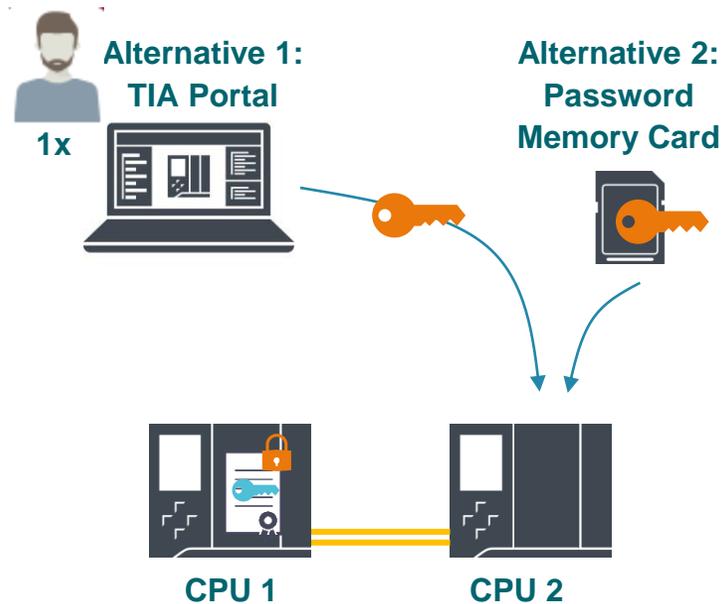
Password protection of confidential configuration data

Initial setup of a RH System

1) Download and set password in CPU 1

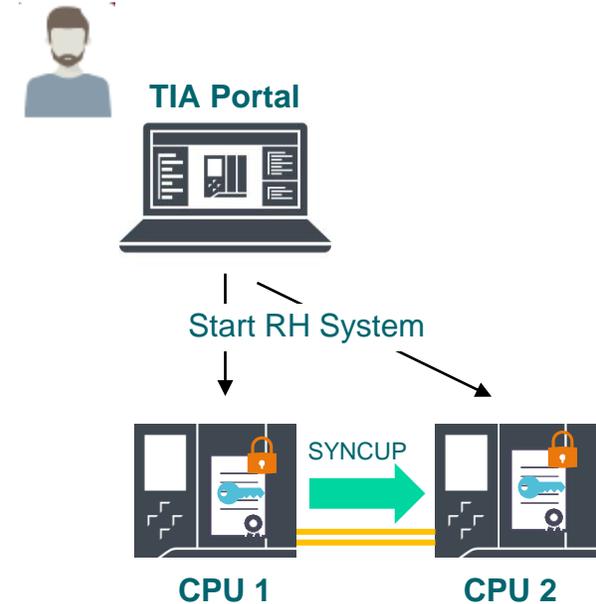


2) Set password in CPU 2



Without this step, SYNCUP will fail!

3) Start RH System – Program and Configuration are synchronized



Certificate with private key for PG/HMI communication



Password to protect confidential PLC configuration

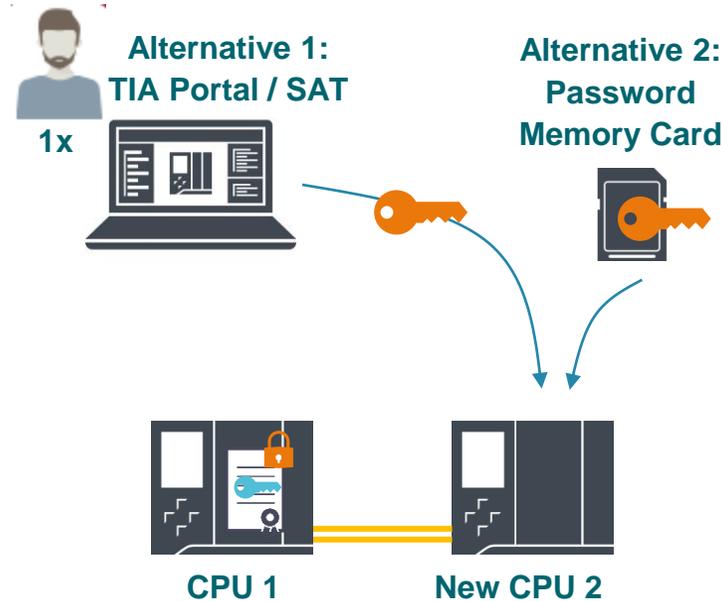
Password protection of confidential configuration data

Exchange of a defective RH CPU

1) One CPU fails and gets defective

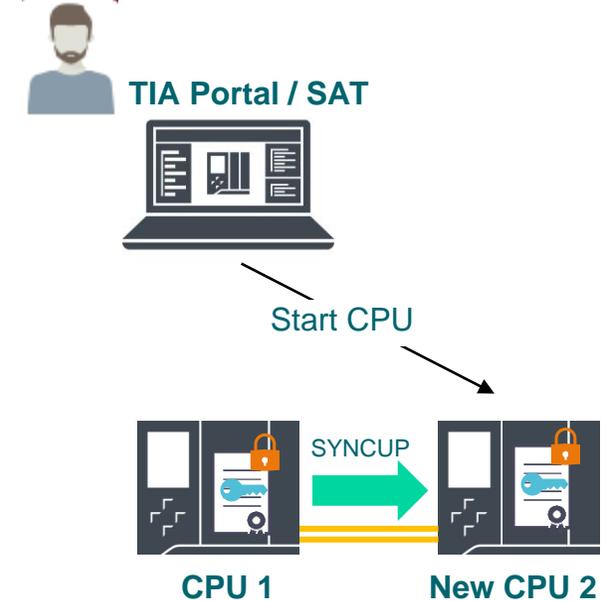


2) Exchange CPU and set password again



Without this step, SYNCUP will fail!

3) Start New CPU – Program and Configuration are synchronized



Certificate with private key for PG/HMI communication

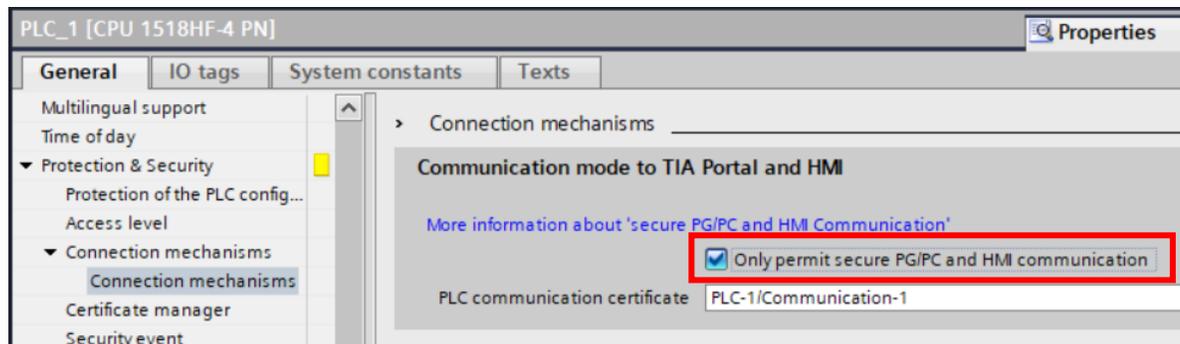
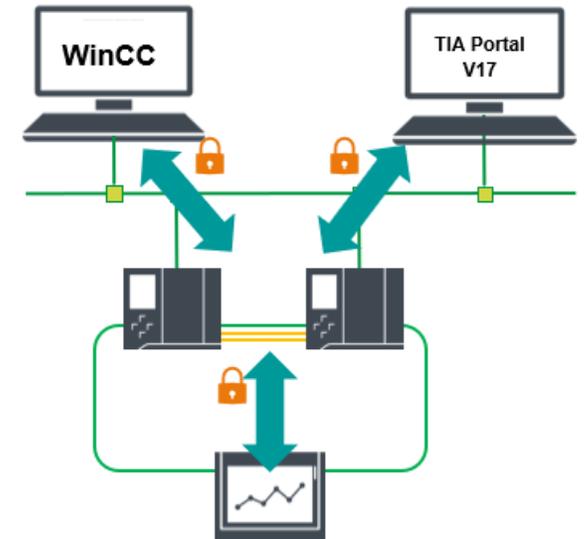


Password to protect confidential PLC configuration

Secure Communication to HMI and TIA Portal

PLCs with firmware version $\geq V2.9$ uses a secure communication to the following communication partners:

- TIA Portal V17
 - WinCC Runtime V17
 - Basic Panels 2nd Generation, Comfort Panel 1st Generation, Mobile Panels
 - WinCC Unified V17, Unified Comfort Panels
 - WinCC OA V3.18 + SP
 - WinCC V7.5 SP2 Update 1
- In order to communicate with other HMI devices, the option shown below must be deactivated.



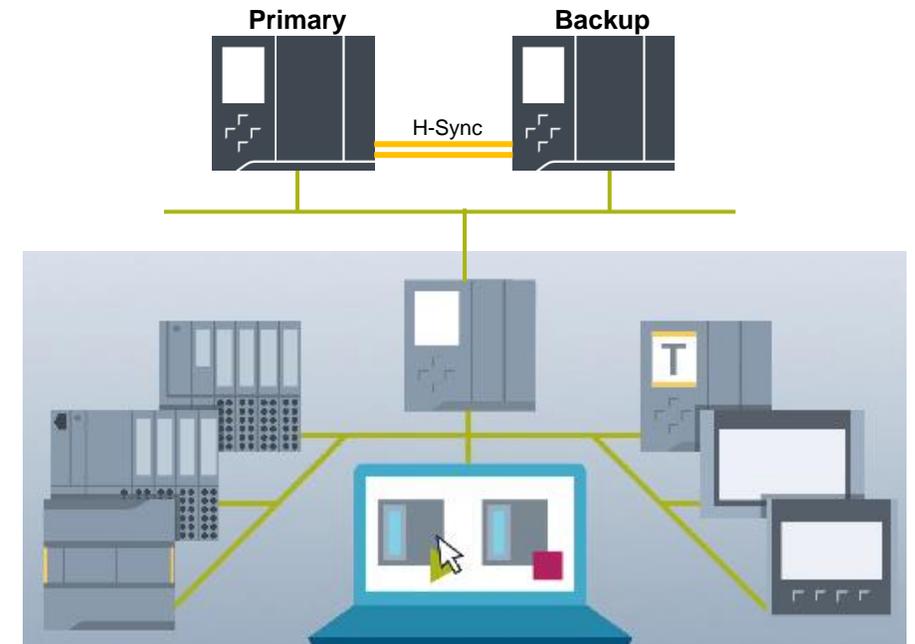
| Add-Ons

SIMATIC S7-1500 Redundant Systems

Support of S7-1500 R/H in SIMATIC Automation Tool (SAT)

- From version 4.0 SP3 of the SIMATIC Automation Tool, redundant controllers (S7-1500R und S7-1500H) are also supported.
- This allows e.g. an easy update of firmware or user program
- Information and download: See link below:

<https://support.industry.siemens.com/cs/ww/en/view/98161300>



SIMATIC Automation Tool

TIA Portal Add-In

Calculation of the watchdog time

For the connection of a PROFINET device to a redundant system S7-1500R/H it is necessary to set the correct watchdog time for each device. The provided TIA Portal Add-In determines the correct factor and updates it in the settings

Available via <https://support.industry.siemens.com/cs/ww/en/view/109769093>

Tool to Set/Reset the correct watchdog factor of PN IO-Devices connected to R/H systems

Select All

Set correct watchdog factor for selected PN IO-Devices

Reset watchdog factor of the selected PN IO-Devices to default

Selected	R/H System	Device number	Device name	Update time in ms	Watchdog factor	Watchdog time in ms
<input checked="" type="checkbox"/>	1517H System4 GroupLevel2	109 device(s)				
<input checked="" type="checkbox"/>	1517H System3 Group1Level1	109 device(s)				
<input checked="" type="checkbox"/>	1515R System6 Group2Level3	4 device(s)				
<input checked="" type="checkbox"/>	1515R System6 Group2Level3_1	4 device(s)				
<input type="checkbox"/>	1515R System6 G	1	io device_327	2	112	224
<input type="checkbox"/>	1515R System6 G	2	io device_326	2	3	6
<input type="checkbox"/>	1515R System6 G	3	io device_325	2	3	6
<input type="checkbox"/>	1515R System6 G	4	io device_324	2	112	224
<input checked="" type="checkbox"/>	1515R System5 Group2Level1	4 device(s)				
<input checked="" type="checkbox"/>	1517H System2 PNV Level	111 device(s)				
<input checked="" type="checkbox"/>	S7-1500R/H-System_1	5 device(s)				
<input checked="" type="checkbox"/>	S7-1500R/H-System_2	4 device(s)				
<input checked="" type="checkbox"/>	S7-1500R/H-System_3	6 device(s)				

Save & Close

Add-ins

Options

Add-ins

Name	Status
AddIns	
AddIns71500RH.addin	✓

Details

Name: AddIns71500RH.addin

Path: C:\Program Files\Siemens\Automation\Portal V1

Author: Siemens AG - adblan1 (DF FA S SUP SPH)

Modified on: 1/23/2020 1:57:00 PM

Product: TIA Add-In S7-1500R/H

Version: 1.1.0.0

Status: Activate Deactivate

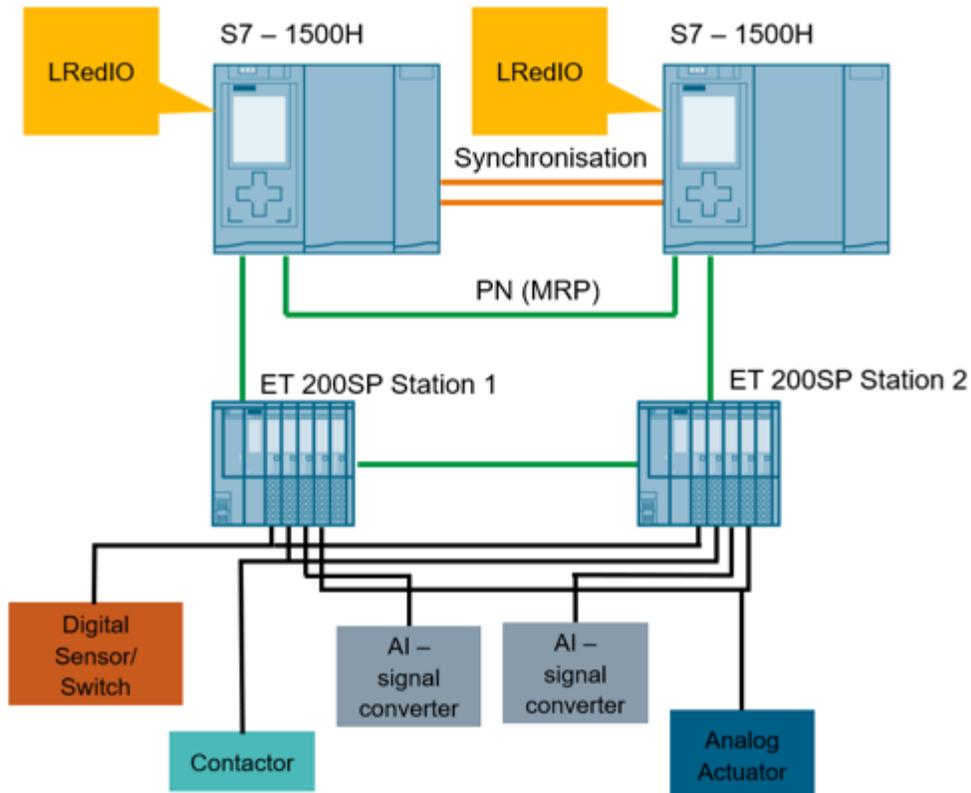
Description: Tool for watchdogfactor of PN IO-Devices connected to 1500R/H system(s)

Trust level: ⚠ Unsigned

Issuer: [View certificate](#)

Application Example

Connection of redundant I/Os



This application example shows how to connect redundant I/O signals to a S7-1500 controller. It works with the S7-1500R/H system but also can be used with non-redundant controllers

Function block	Function
LRedIO_RedDI	Redundancy function for two digital inputs
LRedIO_RedDQ	Redundancy function for two digital outputs
LRedIO_RedAI	Redundancy function for two analog inputs
LRedIO_RedAQ	Redundancy function for two analog outputs

Download: <https://support.industry.siemens.com/cs/ww/en/view/109767576>

Application Example

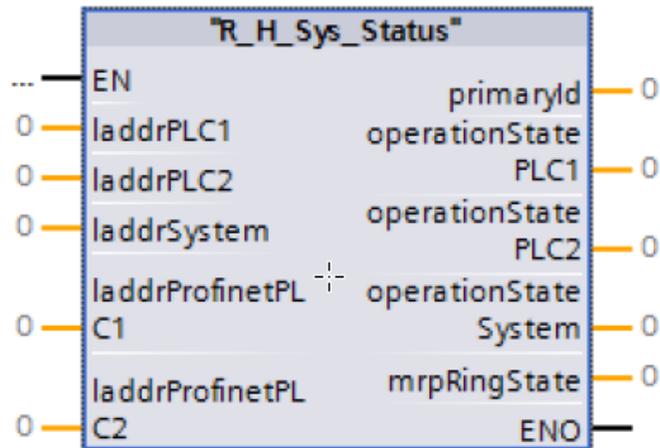
Diagnostics of the operating state of an S7-1500 R/H system using a function block

Various operating states of an S7-1500R/H system can be read out in the user program by a diagnostics block

Benefits

- Ready-made diagnostics block for S7-1500R/H systems
- Easy interconnection of various hardware addresses for extensive diagnostics
- Integrated self-diagnostics function (in addition to the standard diagnostics functions) of the S7-1500R/H system for early detection and signaling of errors before they affect the process

Download: <https://support.industry.siemens.com/cs/ww/en/view/109763768>



Parameter	Data type	Note
primaryID	INT	Returns the redundancy ID of the primary PLC
operationStatePLC1	UINT	Operating state of the first PLC of the S7-1500R/H system
operationStatePLC2	UINT	Operating state of the second PLC of the S7-1500R/H system
operationState-System	UINT	Operating state of the R/H system
mrpRingState	UINT	State of the MRP ring: Open: 0 Closed: 1 State undefined: 2

Communication Libraries

Telecontrol with SIMATIC S7-1500 R/H

Product	Version	Supported Protocols	SIOS
TIM 1531 IRC 	From V2.1	<ul style="list-style-type: none">• SINAUT ST7• DNP3• IEC 60870-5 101, 104	https://support.industry.siemens.com/cs/ww/en/view/109774204
SIPLUS RIC Library for SIMATIC S7-1500	From V1.7	<ul style="list-style-type: none">• IEC 60870-5 101,102,103, 104	https://support.industry.siemens.com/cs/ww/en/view/109422039
IEC 61850 Client Library	V16	<ul style="list-style-type: none">• IEC 61850 MMS	https://support.industry.siemens.com/cs/ww/en/view/109480624/

Communication Libraries

Redundant Communication

Product	Supported Protocols	SIOS
SIMATIC Modbus/TCP Red S7-1200/S7-1500	Modbus/TCP	https://support.industry.siemens.com/cs/bd/en/ps/6AV6676-6MB40-0AX0
Redundant Open User Communication	Multiple	https://support.industry.siemens.com/cs/w/en/view/109763719

Redundant Power Supply

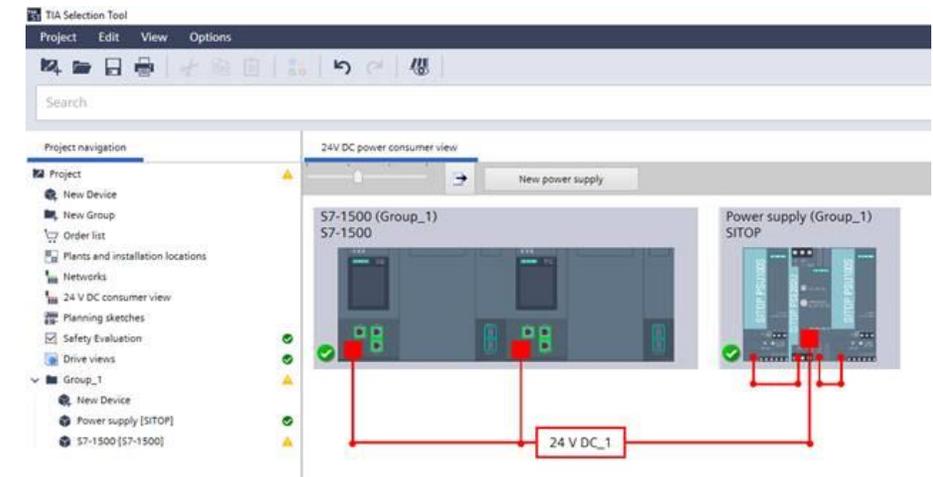
SITOP Redundancy Modules RED1200

EN

- Redundant design in the event of power failure
 - Stable DC voltage thanks to redundant switching of two identical power supplies
- Redundant design in the event of power failure
 - Power feed from different power supplies
- Decoupling diode when more than two power supplies are connected
- Protective diode for series connection of two power supplies for voltage increase
- Solution for different power ranges
 - SITOP RED1200 2 x 10 A: Operation with 2 x PSU 10 A
 - SITOP RED1200 2 x 20 A: Operation with 2 x PSU 20 A or 1 x PSU 40 A
- Fully integrated in TIA Selection Tool



[Details](#)
[Manual](#)



| Restrictions

SIMATIC S7-1500 Redundant Systems

Restrictions for S7-1500 R/H

Restrictions of the configuration

	S7-1500R/H	S7-1500	S7-400H
Central use of modules IO, CM/CP, System-Powersupply	no	yes	yes
PROFINET-Network structure	MRP Ring	any	any
Use of RH-Systems as shared device oder iDevice	no	yes	no
Use of PROFIBUS devices	Via Coupling PLC	yes	yes

Restrictions for S7-1500 R/H

Functional restrictions

	S7-1500R/H	S7-1500	S7-400H
S7-Communication (Client)	no ¹⁾	yes	yes
OPC UA / Webserver	no	yes	no
System-supported H-communication	no ²⁾	no	yes
System-supported redundant I/Os	no ³⁾	no	yes
Technology Objects	some ⁴⁾	yes	no
Support for MRPD, clock synchrony and IRT	no	yes	no
Hardware extensions in RUN	With IO-Link See Slides	With IO-Link	With switch over (H-CiR)
Firmware Update im RUN	no	no	yes
DHCP	no	yes	no

1) S7-Communication as Server is supported, Replacement: Open User Communication

2) Alternative: System IP-Address

3) Can be realized on application level, see [109767576](#)

4) TO Count, Measurement, PID, BasicPos are supported

| Ordering Information

SIMATIC S7-1500 Redundant Systems

Ordering Information

SIMATIC CPU S7-1500 R

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

SIMATIC CPU S7-1500 H

- CPU 1517H-3 PN 6ES7 517-3HP00-0AB0
 - CPU 1518HF-4 PN 6ES7 518-4JP00-0AB0
-

Distance up to 10m between SIMATIC S7-1500 H controllers: Use of synchronisation modules for FO cables up to 10 m

- FO Module: 6ES7 960-1CB00-0AA5
- FO cable 1m: 6ES7 960-1BB00-5AA5
- FO cable 2m: 6ES7 960-1BC00-5AA5
- FO cable 10m: 6ES7 960-1CB00-5AA5

Distance up to 10 km between SIMATIC S7-1500 H controllers

- FO Module: 6ES7 960-1FB00-0AA5
 - Monomode FO cable LC/LC Duplex crossed 9/125µ
-

SIMATIC S7-1500 H Bundle

(2 SIMATIC CPU 1517H-3 PN, 4 sync modules up to 10m and 2 sync cables 1m)

- 6ES7500-0HP00-0AB0

SIMATIC S7-1500 HF Bundle

(2 SIMATIC CPU 1518HF-4 PN, 4 sync modules up to 10m and 2 sync cables 1m)

- 6ES7 500-0JP00-0AB0

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