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

TIA Portal V17 Webinar Launch

SIEMENS

SIMATIC S7-1500 Redundant Systems
Index

SIEMENS

Motivation and Product Strategy

SIMATIC S7-1500 Redundant Systems

SIEMENS

SIMATIC S7-1500 Redundant Systems
Motivation

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

SIEMENS

SIMATIC S7-1500 Redundant Systems
Product Strategy SIMATIC S7-1500 R/H

Based on Standard S7-1500 CPUs and PROFINET

- Basis Hardware Standard-CPUs/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

SIEMENS

System Overview

SIMATIC S7-1500 Redundant Systems

SIEMENS

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

	Redundant – S7-1500 R	High available – S7-1500 H
CPU type	CPU 1513R / CPU 1515R	CPU 1517H / CPU 1518HF
Synchronization	via **PROFINET Ring (MRP)**	via **Sync-Modules / FO**
Hot-Standby	**Yes, fail-over time ca. 300ms**	**Yes, fail-over time ca. 50ms**
I/O systems	ET 200SP and ET 200MP	
Type of connection	Single connection (PN redundancy S2) and switched S1 [1]	

1) See slide Switched S1 Device

SIEMENS

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	-

new

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

SIEMENS

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 Plugable	6ES7960-1CB00-0AA5	6ES7960-1FB00-0AA5	4 pieces
	Plastic Fiber Optic Cable Pre-fabricated: • 6ES7 960-1BB00-5AA5 (1m) • 6ES7 960-1BC00-5AA5 (2m) • 6ES7 960-1CB00-5AA5 (10m)	Glass Fiber Optic Cable • 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

SIEMENS

System Redundancy and Network Configuration

SIMATIC S7-1500 Redundant Systems

SIEMENS

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.

PN Controller

PN Controller

PROFINET Network

2 or 4 connections

PN Device

PI
PROFIBUS • PROFINET

System Redundancy

Common profile
for PROFINET

Version 1.11   –   Date: February 2017
Order No.: 7.122

SIEMENS
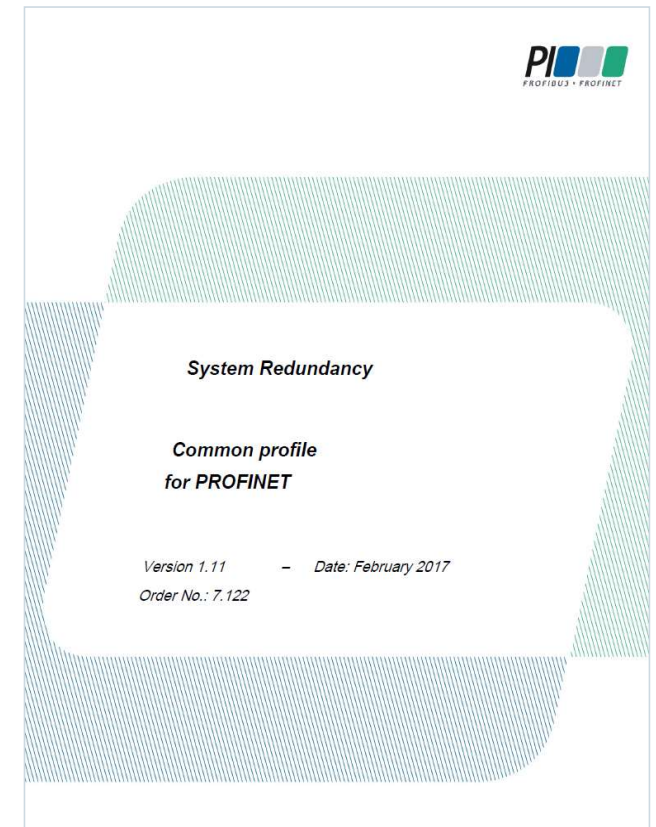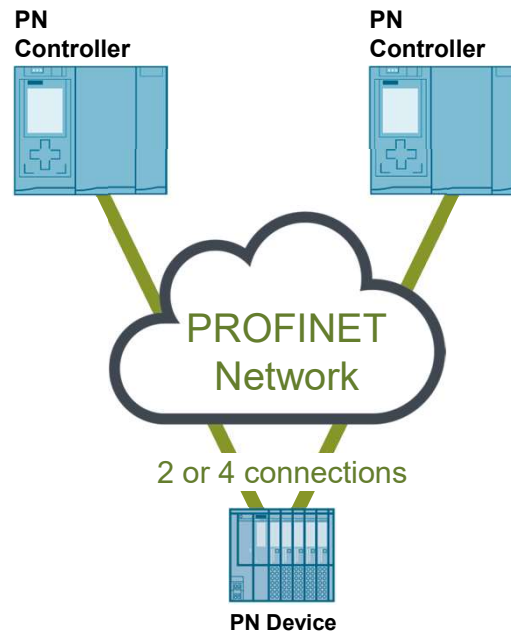
PROFINET System Redundancy
Redundancy Modes

S1 Mode

Primary PLC   Backup PLC

PROFINET IO Network

IM | IO
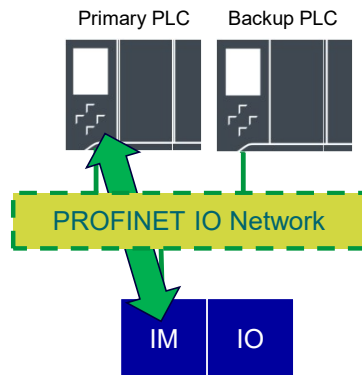
S1 Device

S → Single interface

1 → one connection to one PLC

Standard PLC + R/H

S2 Mode

Primary PLC   Backup PLC

PROFINET IO Network

IM | IO
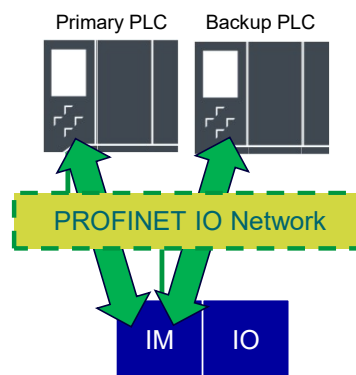
S2 Device

S → Single interface

2 → can switch between two connections

For R/H PLC

R1 Mode

Primary PLC   Backup PLC

PROFINET IO Network

IM | IM | IO
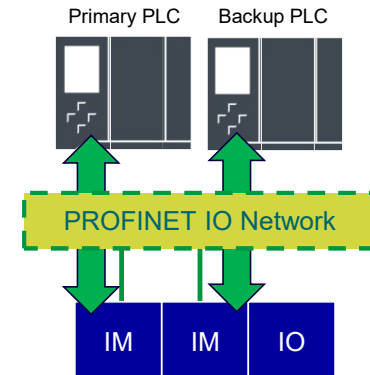
R1 Device

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

SIEMENS

PROFINET System Redundancy
Behavior of PN Devices with System Redundancy S2

Initial Situation

System state: RUN-Redundant

Primary   Backup

Primary AR   Backup AR

S2
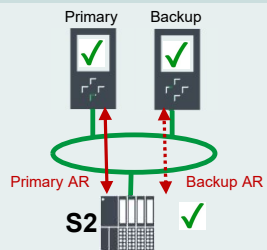
Both CPU have a relation to the PN device

- I/O data are exchanged

CPU fails

Failover R/H

System state: RUN-Solo

RUN Solo

Backup AR

S2
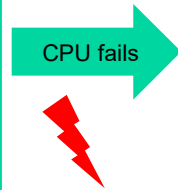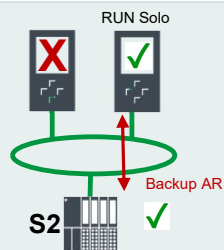
RUN-Solo CPU uses the already existing relation

- I/O data are exchanged
- Outputs keeps their last value during the hot-standby failover time (~50ms / 300ms)

AR = Application Relation

SIEMENS

PROFINET System Redundancy
Behavior of PN Devices without System Redundancy (S1)

Initial Situation

System state: RUN-Redundant

Primary   Backup

✓   ✓

Single AR

S1 ✓
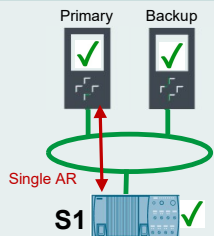
Only the primary PLC has a relation to the PN device

- I/O data are exchanged

CPU fails

Failover R/H

System state: RUN-Solo

RUN Solo

✗   ✓

S1 ✗
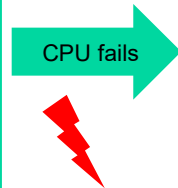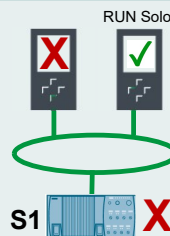
AR to the primary PLC gets lost
S1 device is now without communication

- Inputs in process image are "0"
- State of the outputs depends on the S1-device, e.g. by providing the function "Keep last value"

Re-Connection

System state: RUN-Solo

RUN Solo

✗   ✓

Single AR

S1 ✓
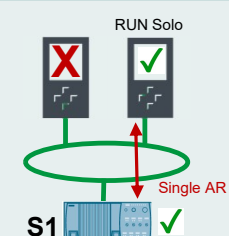
RUN-Solo PLC creates a new connection to the S1-Device.

I/O data are exchanged

Time is adjustable   **New**
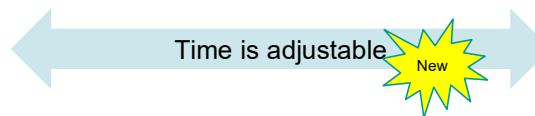
By changing the watchdog time, the reconnection time can be adjusted.
See detail slide

AR = Application Relation

SIEMENS

PROFINET System Redundancy
Visualization of redundancy modes in TIA Portal
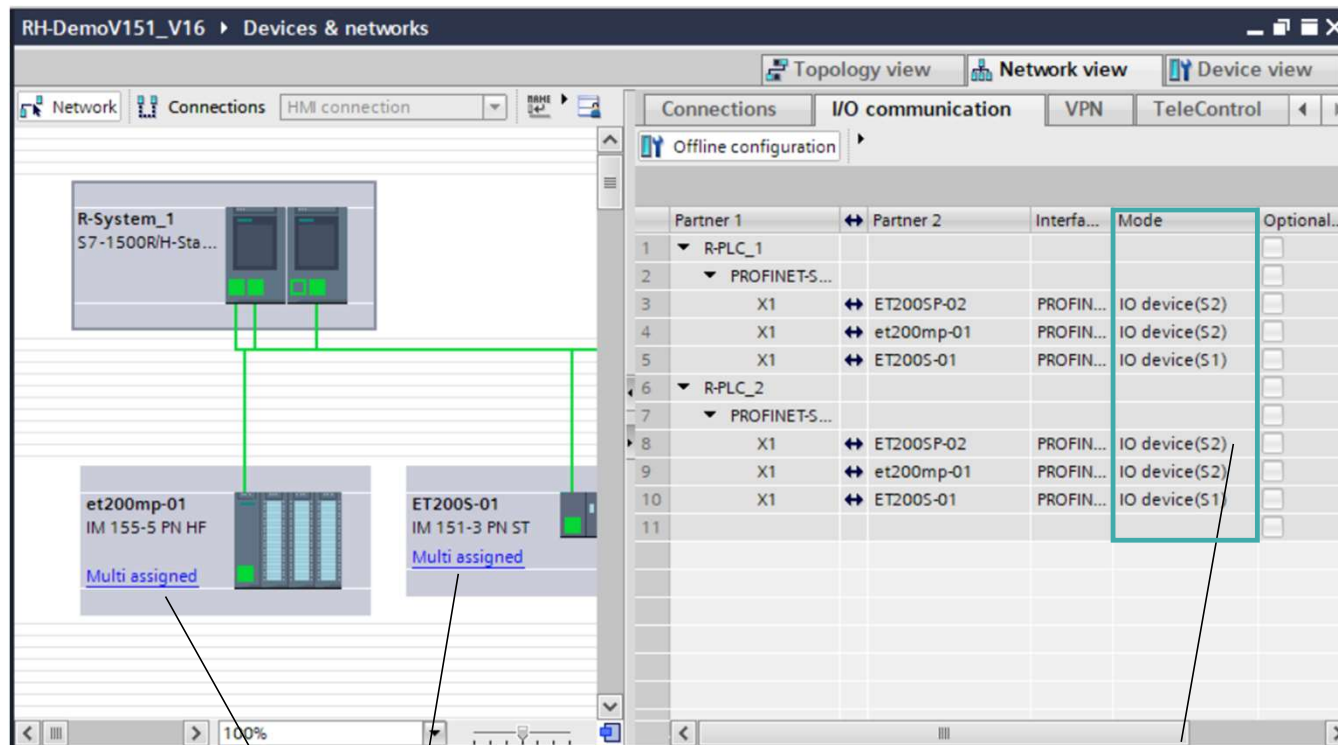
In the network view S1 and S2 devices are marked as „Multi-assigned"

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

SIEMENS

PROFINET System Redundancy
Siemens I/O Systems with PN S2 support

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

SIEMENS

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

SIEMENS

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

Primary   Backup

X1 P1   X1 P2   Sync   X1 P1   X1 P2

Single MRP Ring

ET 200SP   **ET 200MP**
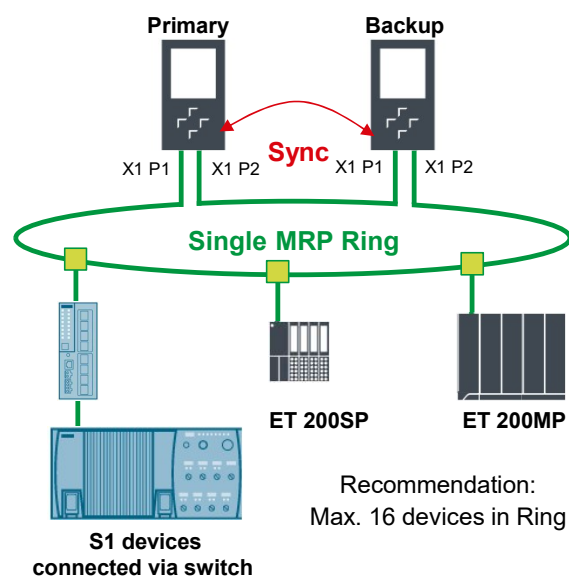
Recommendation:
Max. 16 devices in Ring

S1 devices connected via switch

High Available 1500 H

Primary   Backup

X1 P1   X1 P2   H-Sync   X1 P1   X1 P2

Single MRP Ring

S1 devices inside the ring   **ET 200SP**   **ET 200MP**
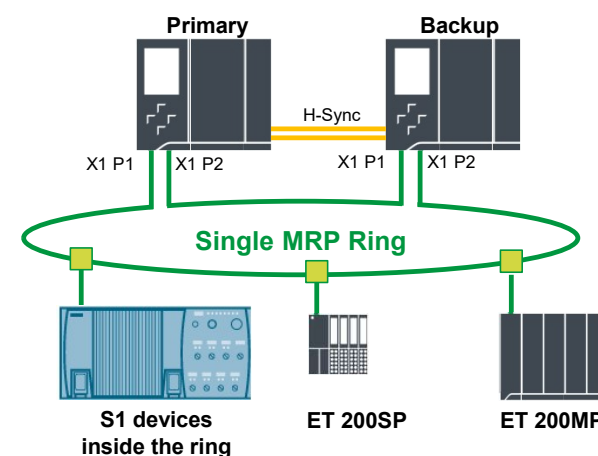
1) Reason: S1 devices do not forward H-Sync telegrams during a reconfiguration of the MRP ring. This can lead to a high cycle time in case of a interrupt in the ring.
See chapter „H-Sync Forwarding" in the system manual of S7-1500R/H for more details

SIEMENS

Network Configuration with S7-1500 R
Length of the synchronization connection

CPU 1513R
CPU 1515R

Direct Link
up to 100 m
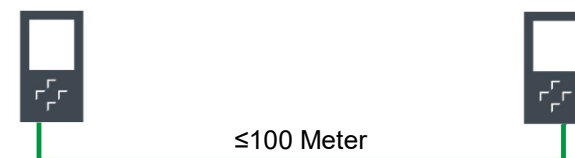
≤100 Meter

Fiber optic link
(media converter) up to 3 km

≤ 3 km
(Recommendation)

SIEMENS

Network Configuration with S7-1500 H
Length of the synchronization connection

CPU 1517H
CPU 1518HF

Short distance sync modules
→ up to 10 Meter

Primary   Backup

≤10 Meter
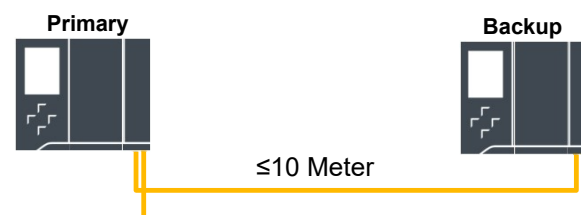
Long distance sync modules
→ up to 10 km

Primary   Backup

≤10 km

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

SIEMENS

Network Configuration with S7-1500 R/H
Connection of PROFINET Devices

S2 and S1 Devices can be connected

Primary   Backup

H-Sync

S2 Mode
→ Bump less Switchover

S2

S2

S1

Switched S1 Mode[1]
(New in V16)
→ Not bump less

S2

S1

S1

Connection of S1 Devices via PN/PC Coupler
with subordinated controller.
→ Bump less Switchover

Subordinated PLC

S1

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

SIEMENS
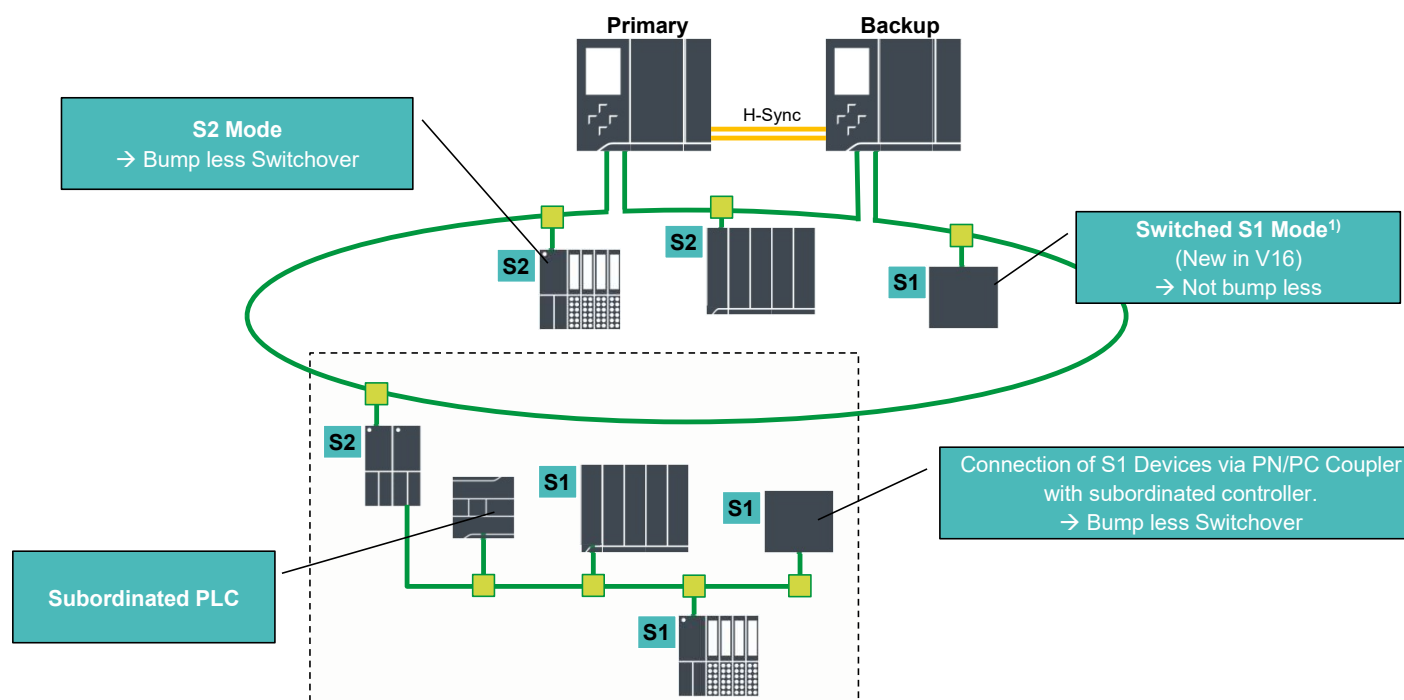
Network Configuration with S7-1500 R/H
Connection of Subordinated Controller

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 2:
Via PN/PN Coupler
→ Bump less switchover

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

Primary   Backup

H-Sync

S1

S2

Open User Communication

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

SIEMENS

Network Configuration with S7-1500 R/H
Connection of PROFIBUS DP Slaves

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.

Primary

Backup

H-Sync

S1

PROFIBUS

Open User Communication

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

S2

PROFIBUS

PROFIBUS

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

SIEMENS

Communication via System-IP and Device-IP Addresses

SIMATIC S7-1500 Redundant Systems

SIEMENS

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

X2-Interface
X2: System-IP1   X2: Device-IP11   X2: Device-IP12

Primary   Backup

X1-Interface
X1: System-IP2   X1: Device-IP21   X1: Device-IP22

SIEMENS
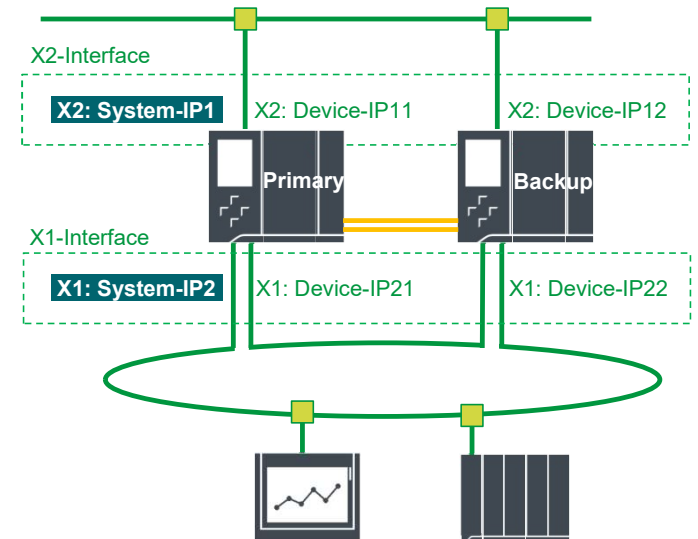
Communication via System-IP Addresses
Behavior

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.

X2: System-IP1

Primary

Backup

X1: System-IP2

SIEMENS
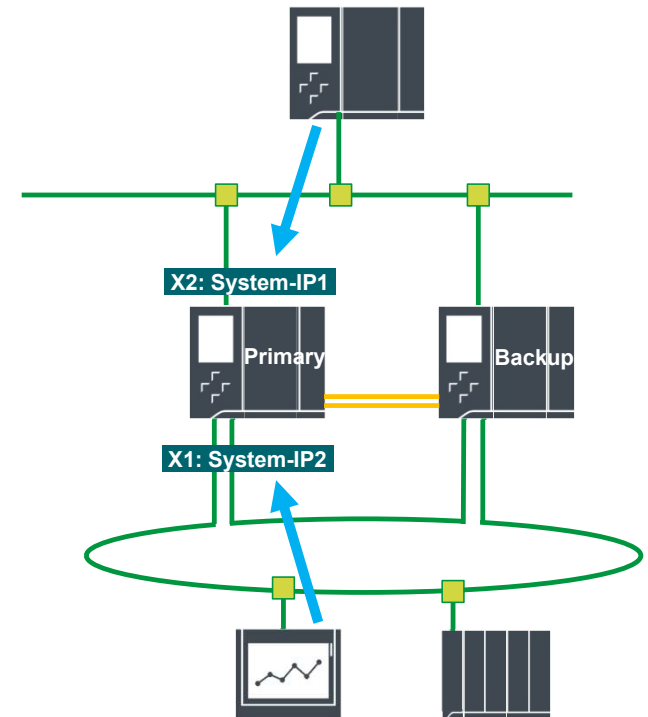
Communication via System-IP Addresses
Behavior at Primary-Backup Failover

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.

X2: System-IP1

Primary

X1: System-IP2

SIEMENS
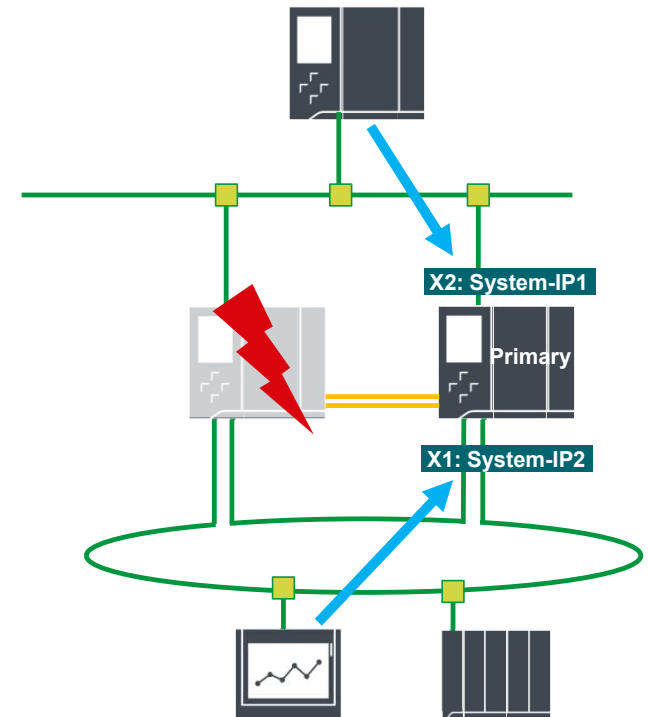
Communication via Device-IP Addresses
Behavior

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

Data is received

Data is requested

X2: Device-IP 11 — X2: Device-IP 12

Primary — SYNC — **Backup**

Data is synchronized

Communication via the Backup PLC

Data is forwarded

Data is received

Data is requested

X2: Device-IP 11 — X2: Device-IP 12

Primary — SYNC — **Backup**

Job is synchronized

Data is synchronized

SIEMENS
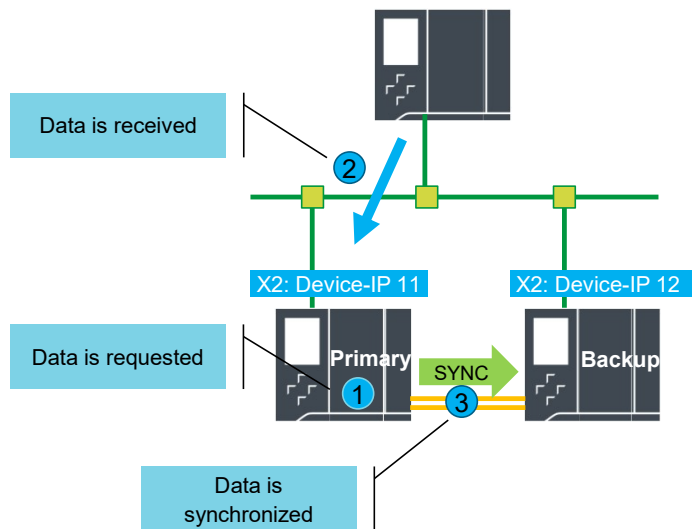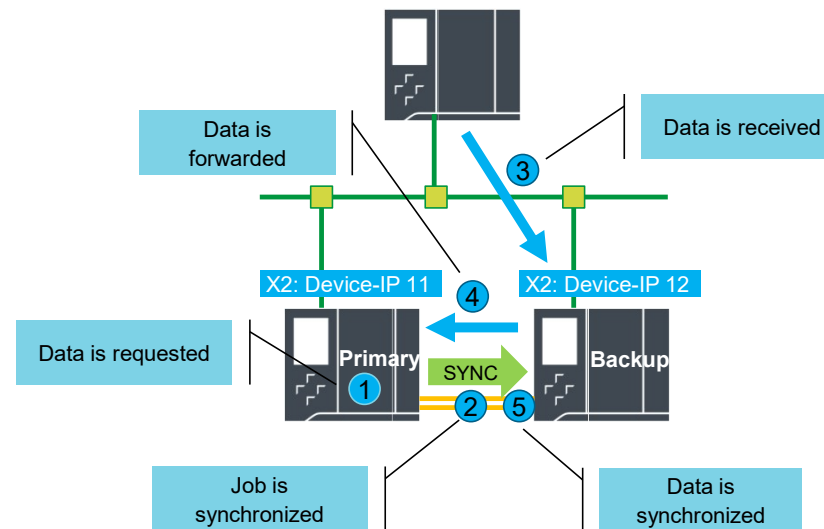
Safety for Redundant Systems

SIMATIC S7-1500 Redundant Systems

SIEMENS

Network configuration with S7-1500 HF
Safety Devices

Direct integration of safety devices with SIMATIC CPU 1518HF

New
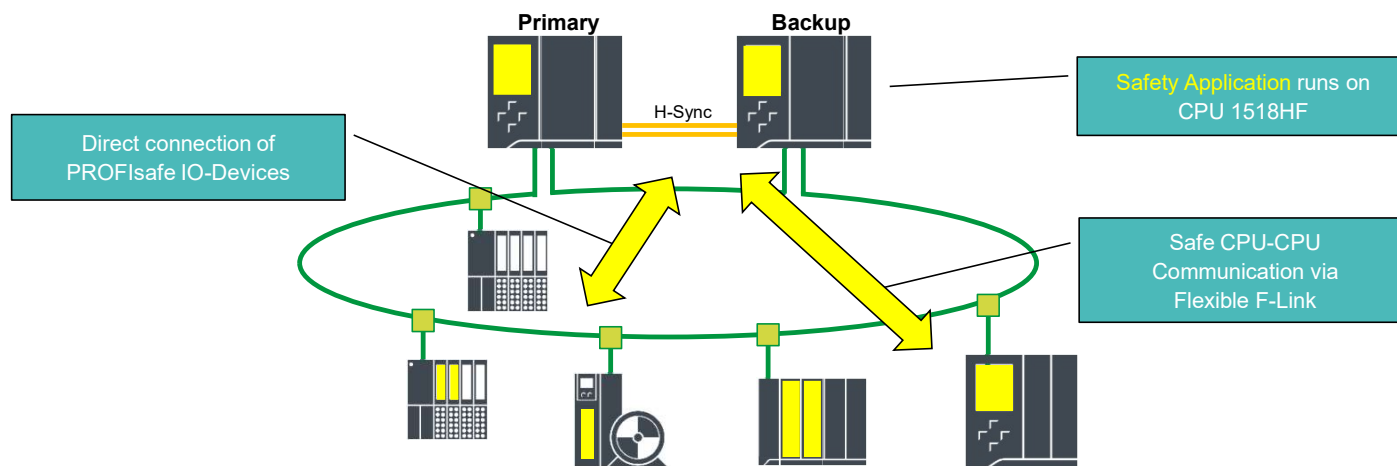
Primary   **Backup**

H-Sync

Safety Application runs on CPU 1518HF

Direct connection of PROFIsafe IO-Devices

Safe CPU-CPU Communication via Flexible F-Link

SIEMENS

Network configuration with S7-1500 R
Safety Devices

Safety Devices can be integrated via subordinated F-Controller

Primary

Backup

R/H-System (Non Safety) and connected I/O

Non safe) Communication between RH and F-Controller via iDevice or Open User Communication

Safety Application runs on a separated F-Controller

SIEMENS
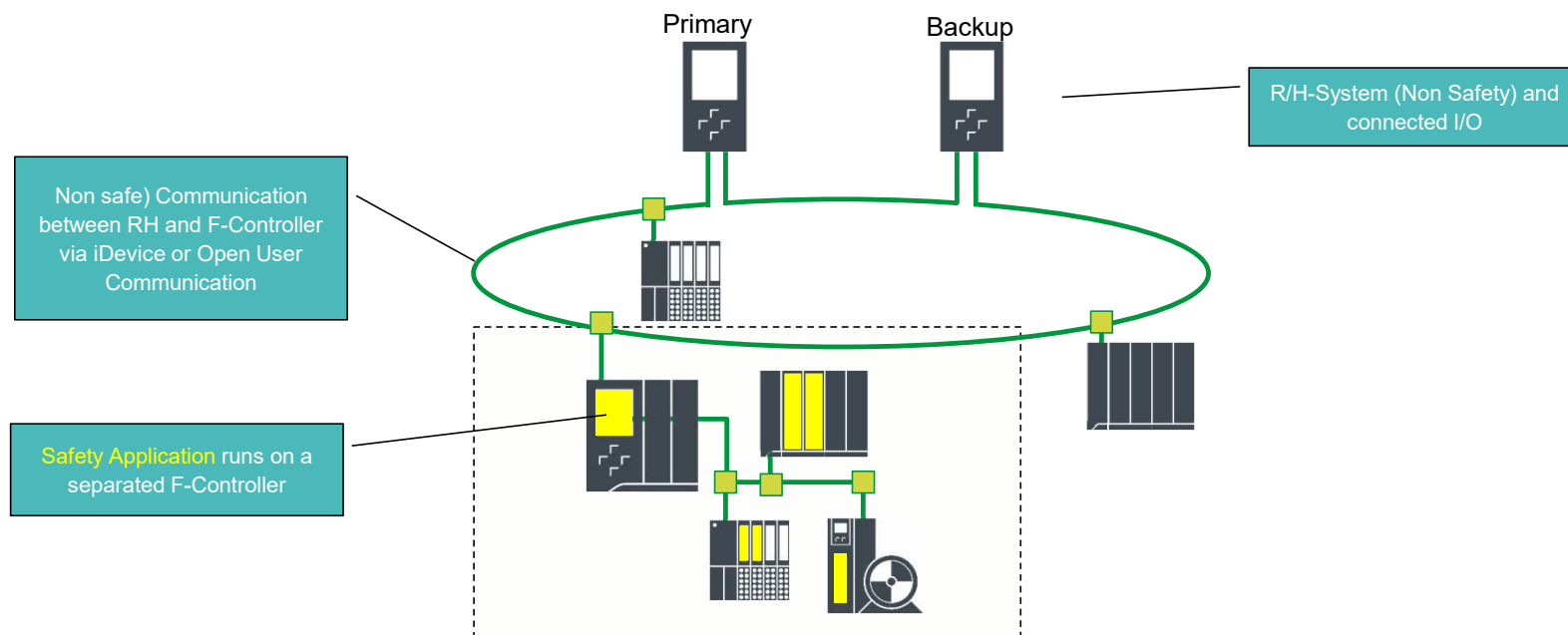
Network configuration with S7-1500 R
Safety Devices

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

Primary

Backup

R/H-System (Non Safety) and connected I/O

(Non safe) Communication between RH and F-Controller via iDevice or Open User Communication

Optional
Media Redundancy (MRP Ring) increases availability in case of network breakdown

Safety Application is located in a separated F-Controller

Optional
Usage of a second PN/PN Coupler to avoid a single point of failure

MRP Ring

SIEMENS

HMI Connection

SIMATIC S7-1500 Redundant Systems

SIEMENS

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
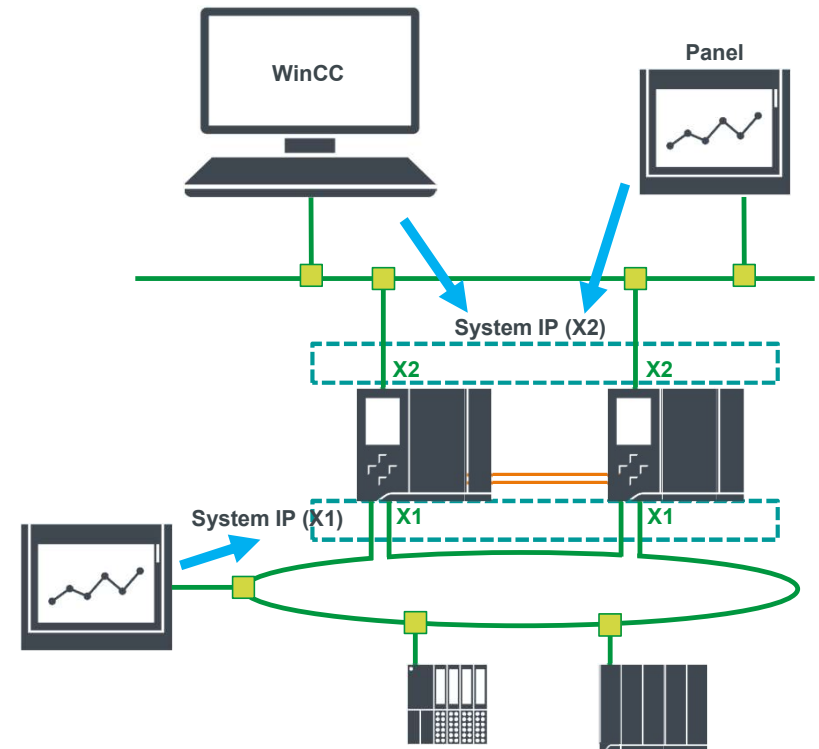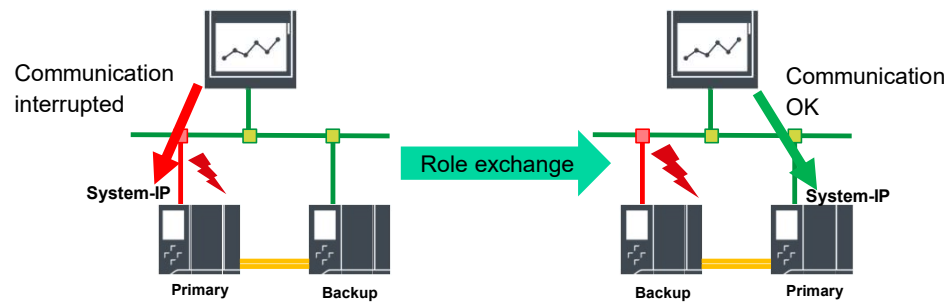
SIEMENS

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/109781587
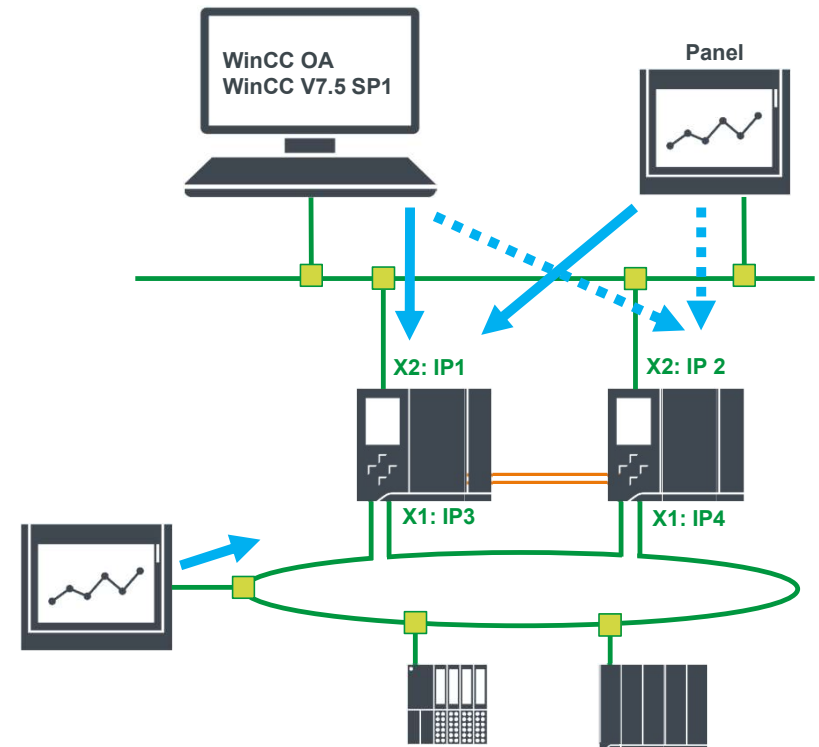
WinCC OA
WinCC V7.5 SP1

Panel

X2: IP1

X2: IP 2

X1: IP3

X1: IP4

SIEMENS

HMI Connection for R/H Systems
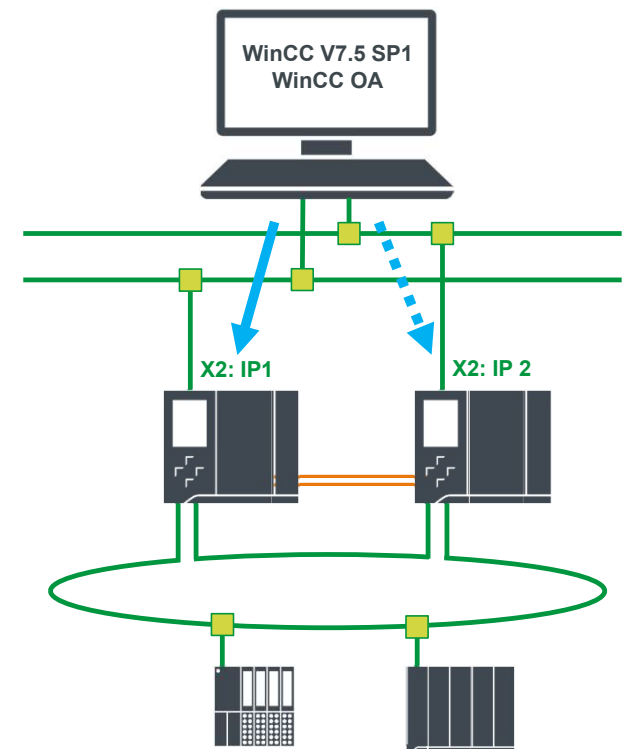## via a redundant network with device IP addresses

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

WinCC V7.5 SP1
WinCC OA

X2: IP1   X2: IP 2

SIEMENS

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

WinCC V7.5 SP1
WinCC OA

X2: System IP
X3: System IP
X2   X3   X2   X3

SIEMENS
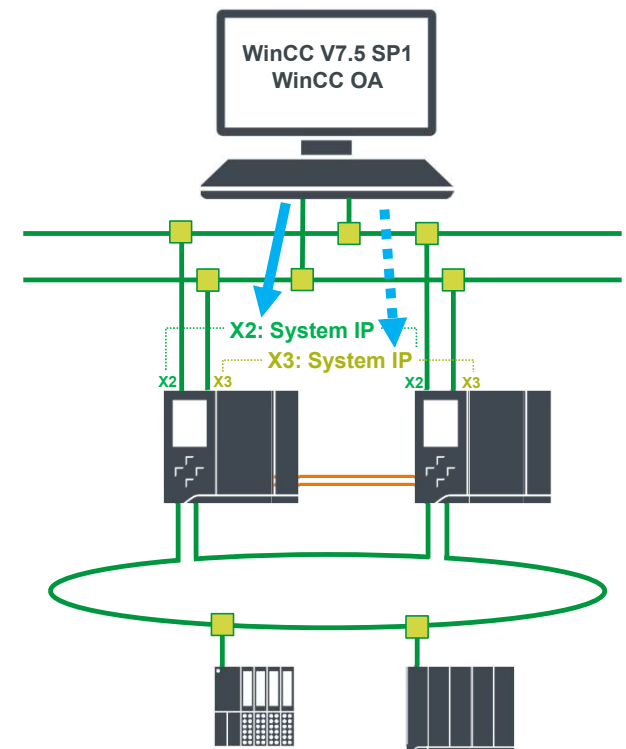
Installation Recommendations

SIMATIC S7-1500 Redundant Systems

SIEMENS

Installation Recommendations
for CPU 1513R-1 PN

Basic/Comfort Panel

OK
PN/PN Coupler

X1   100MBit/s   X1

PN/PN

OK
Up to14 Devices in
MRP Ring

Possible*

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

SIEMENS

Installation Recommendations
for CPU 1515R-2 PN

WinCC

OK
HMI Connection
via X2

Basic/Comfort Panel

Industrial Ethernet

Possible*

X2
X2

Standard PLC

OK
PN/PN Coupler

X1
100MBit/s
X1

Possible*

PN/PN

OK
Up to14 Devices in
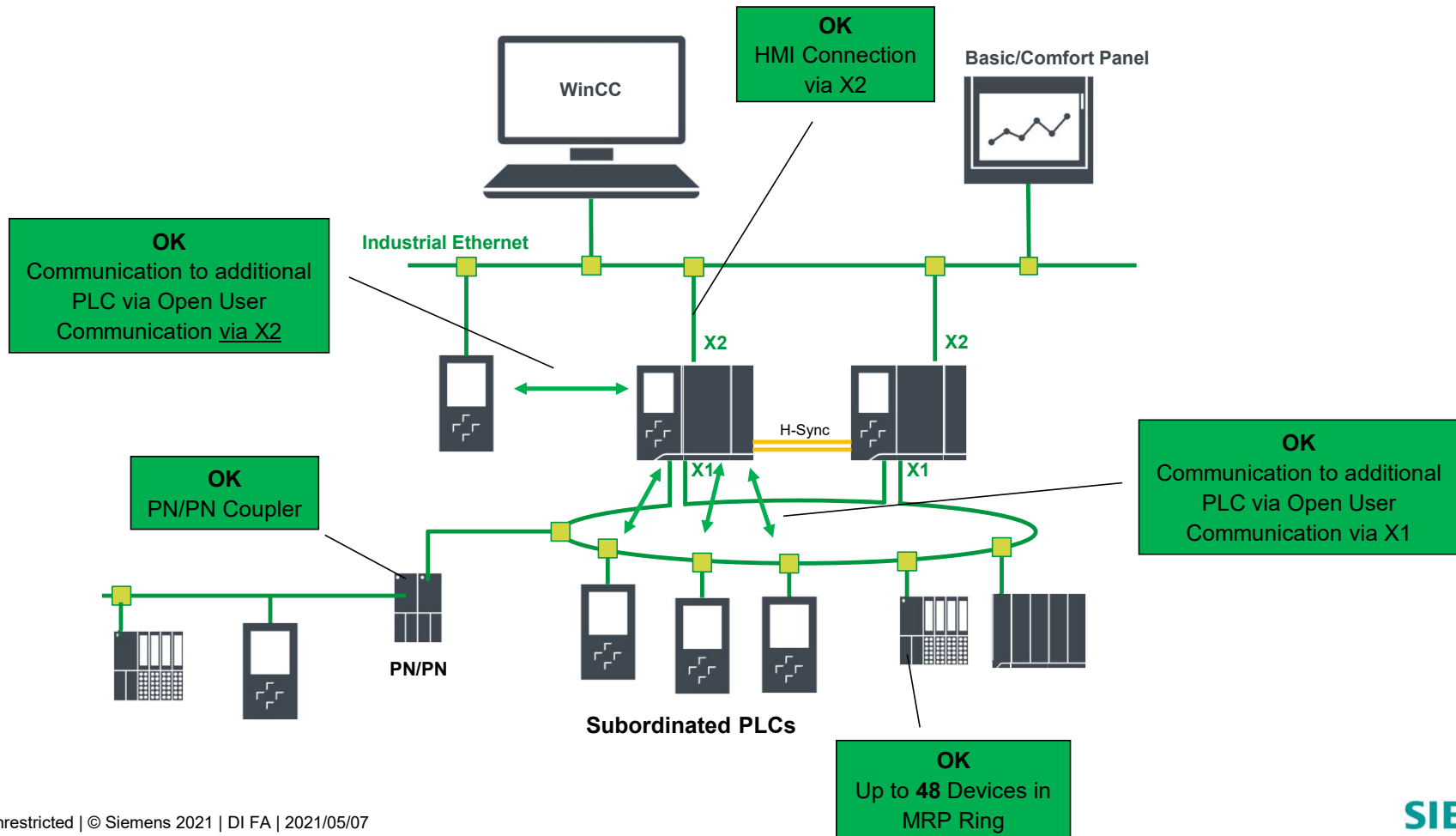MRP Ring

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

SIEMENS
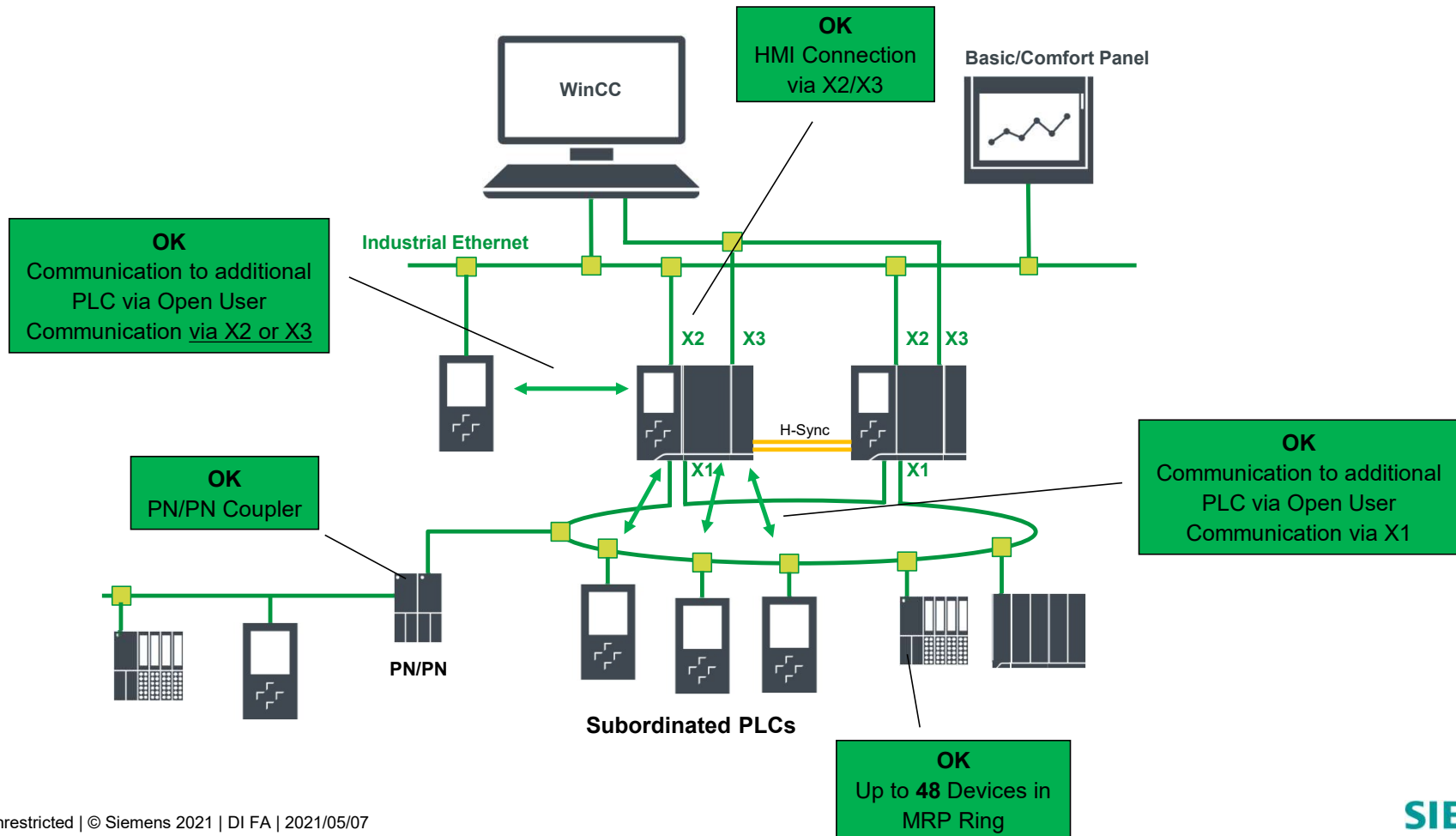
Installation Recommendations
for CPU 1517H-3 PN

WinCC

OK
HMI Connection
via X2

Basic/Comfort Panel

OK
Communication to additional
PLC via Open User
Communication via X2

Industrial Ethernet

X2

X2

OK
Communication to additional
PLC via Open User
Communication via X1

H-Sync

X1

X1

OK
PN/PN Coupler

PN/PN

Subordinated PLCs

OK
Up to **48** Devices in
MRP Ring

SIEMENS

Installation Recommendations
for CPU 1518HF-4 PN

WinCC

OK HMI Connection via X2/X3

Basic/Comfort Panel

OK Communication to additional PLC via Open User Communication *via X2 or X3*

Industrial Ethernet

X2 X3   X2 X3

H-Sync

X1   X1

OK Communication to additional PLC via Open User Communication via X1

OK PN/PN Coupler

PN/PN

Subordinated PLCs

OK Up to **48** Devices in MRP Ring

SIEMENS

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

SIMATIC S7-1500 Redundant Systems

SIEMENS

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]
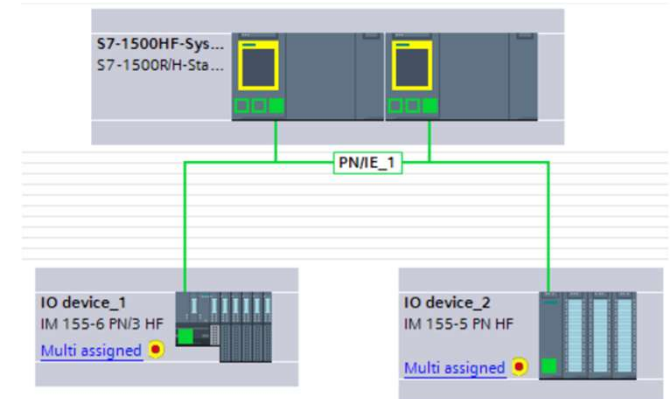
New support of S7-1500 standard features

Recipe Function (Instruction RecipeExport" and "RecipeImport, ….) [1]

1) Requires TIA Portal V17
2) Also older FW versions can be simulated

SIEMENS

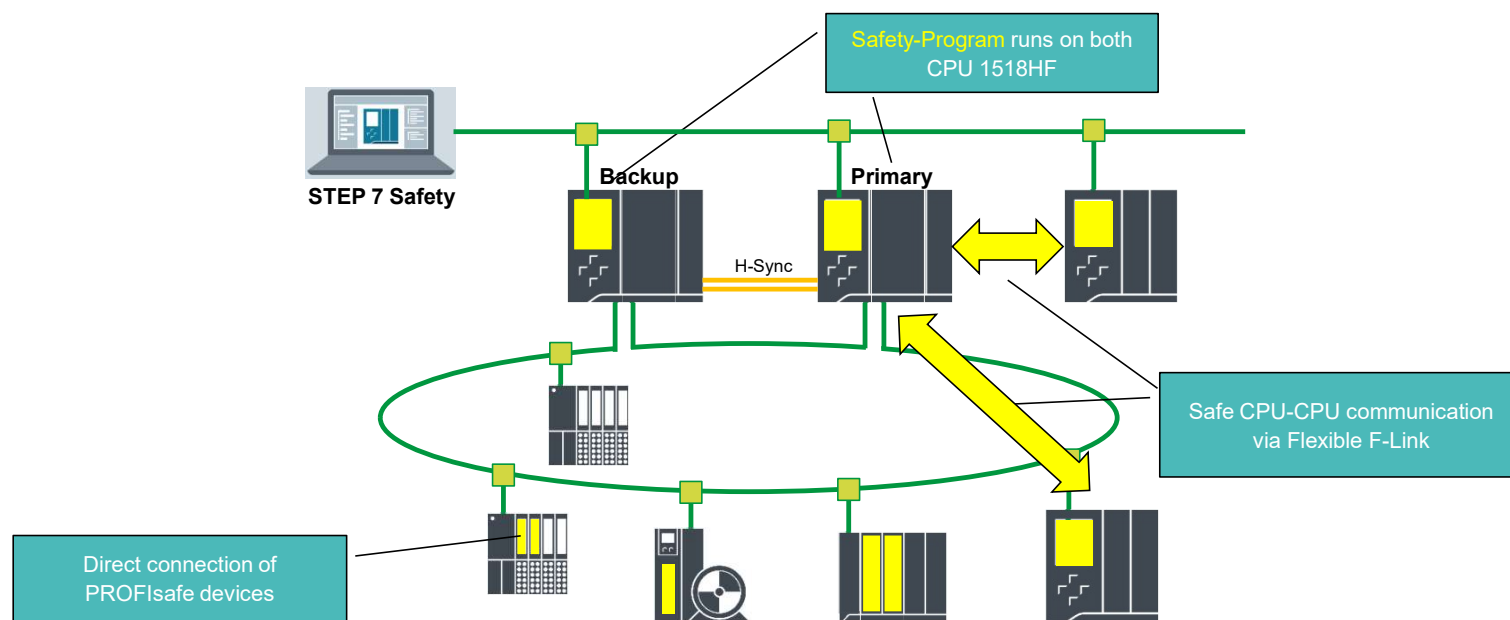# New in TIA Portal V17: Safety for redundant Systems
Realize Safety Applications with redundant Controller

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 PROFIsafe 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

SIEMENS

New in TIA Portal V17: Safety for redundant Systems
Configuration Example

Safety-Program runs on both CPU 1518HF

Backup

Primary

STEP 7 Safety

H-Sync

Safe CPU-CPU communication via Flexible F-Link

Direct connection of PROFIsafe devices

SIEMENS

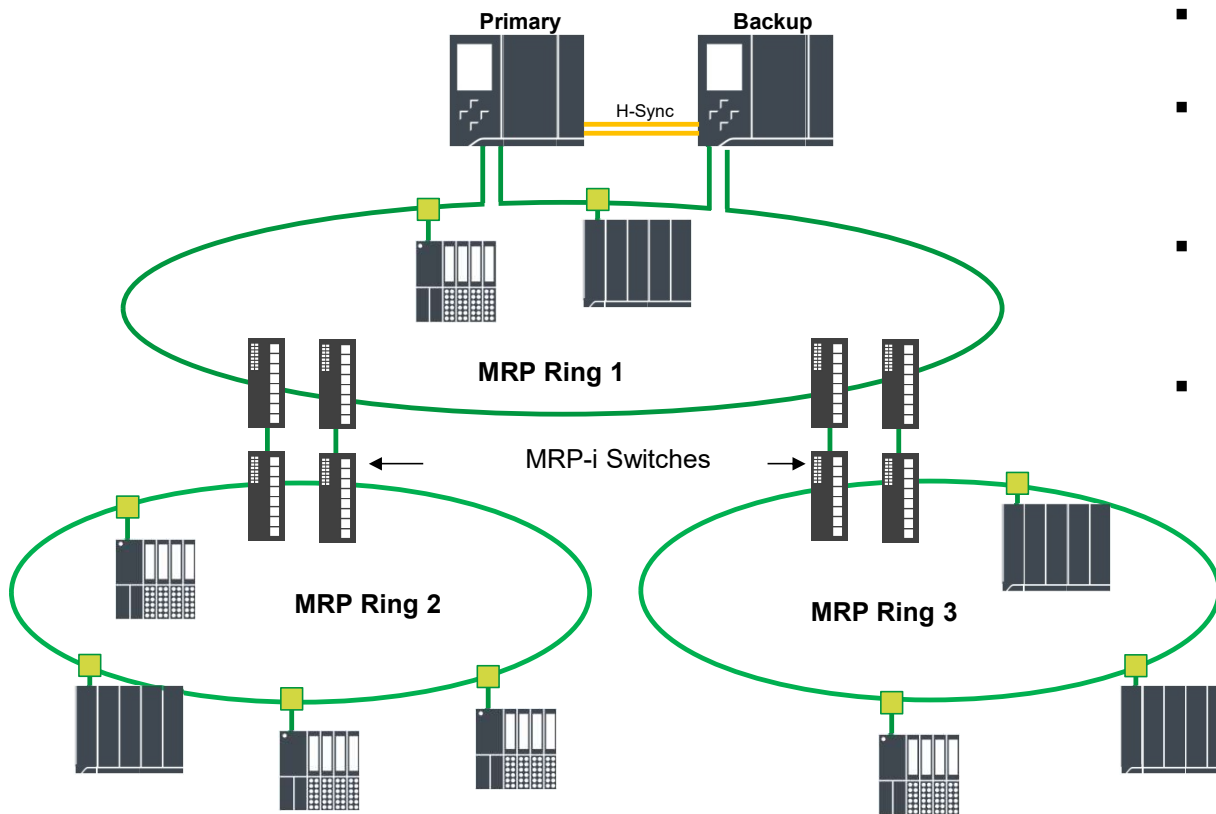# New in TIA Portal V17: CPU 1518HF-4 PN
Safety, More Memory, 3rd PN Interface

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 uses as Non-Safety H-Controller
- Same size as CPU 1517H
- Same accessories as for CPU 1517H

Activation / Deactivation of F-Function

SIEMENS
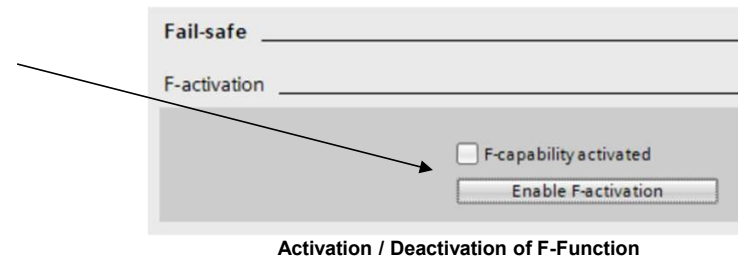
New with FW-Version V2.9: MRP Interconnect
Coupling of multiple MRP rings

Primary

Backup

H-Sync

MRP Ring 1

MRP-i Switches

MRP Ring 2

MRP Ring 3

- 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

SIEMENS

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.

SIEMENS
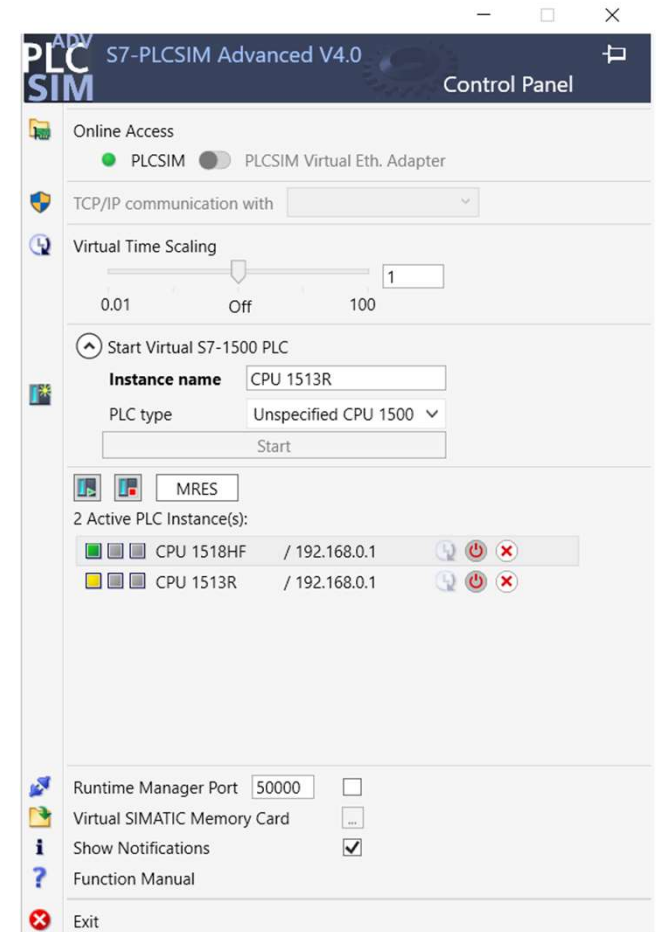
New in TIA Portal V17: Extension of RH_CTRL
Switch PLC roles in user program

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.
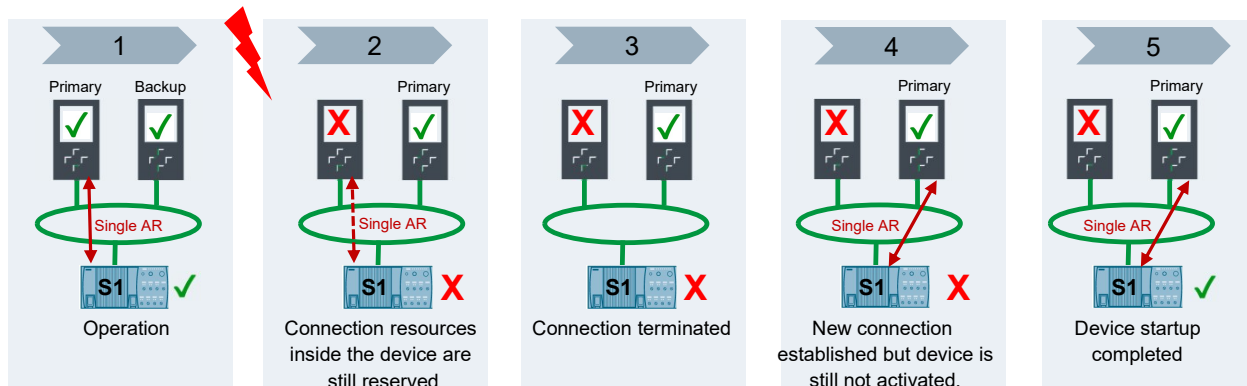- These functions can also be used with older TIA Portal versions! The only precondition is firmware version V2.9.
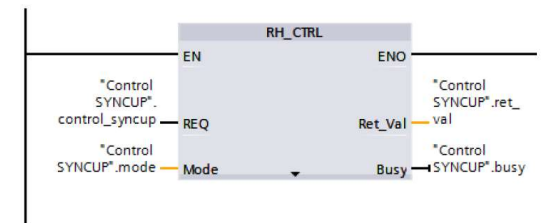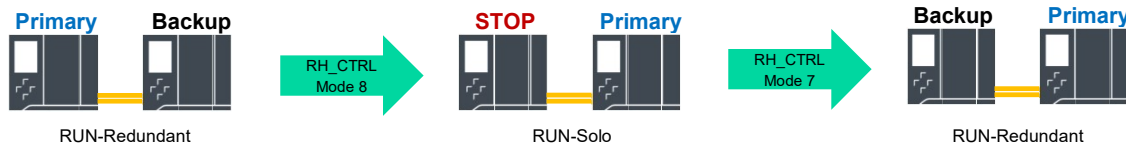
Mode	Function
3	Disable SYNCUP
4	Enable SYNCUP
7	Request SYNCUP
8	Stop Primary-PLC
9	Stop Backup-PLC

SIEMENS

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

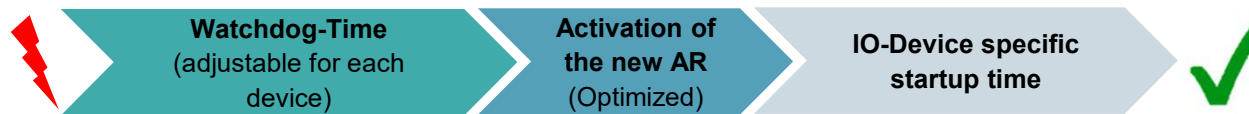AR = Application Relation (Connection between Controller and Device)

SIEMENS

New with Firmware V2.9: Faster S1 fail-over time
Adjustable fail-over with „Switched S1" function

Timing with FW-Version 2.8

| Waiting time before fail-over (not adjustable) | Activation of the new AR | IO-Device specific startup time | ✔ |

New timing with FW-Version 2.8

| Watchdog-Time (adjustable for each device) | Activation of the new AR (Optimized) | IO-Device specific startup time | ✔ |

Update time

- ● Calculate update time automatically
- ○ Set update time manually

Update time: 2.000   ms

☐ Adapt update time when send clock changes

Watchdog time

Accepted update cycles without IO data: 112

Watchdog time: 224.000   ms

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)

SIEMENS

# 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.

Redundancy Loss on H-Sync 2 !!

OB72

Primary   Backup

H-Sync 1
H-Sync 2

Process continues

SIEMENS
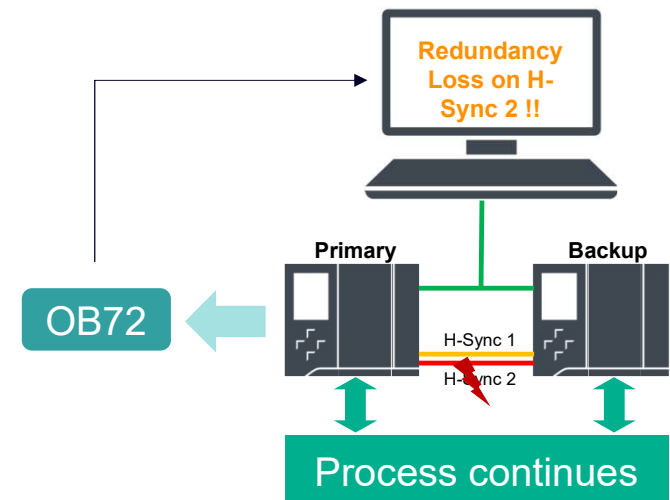
New in TIA Portal V17: Security Enhancements
Protection of configuration data / Secure communication to HMI and TIA Portal
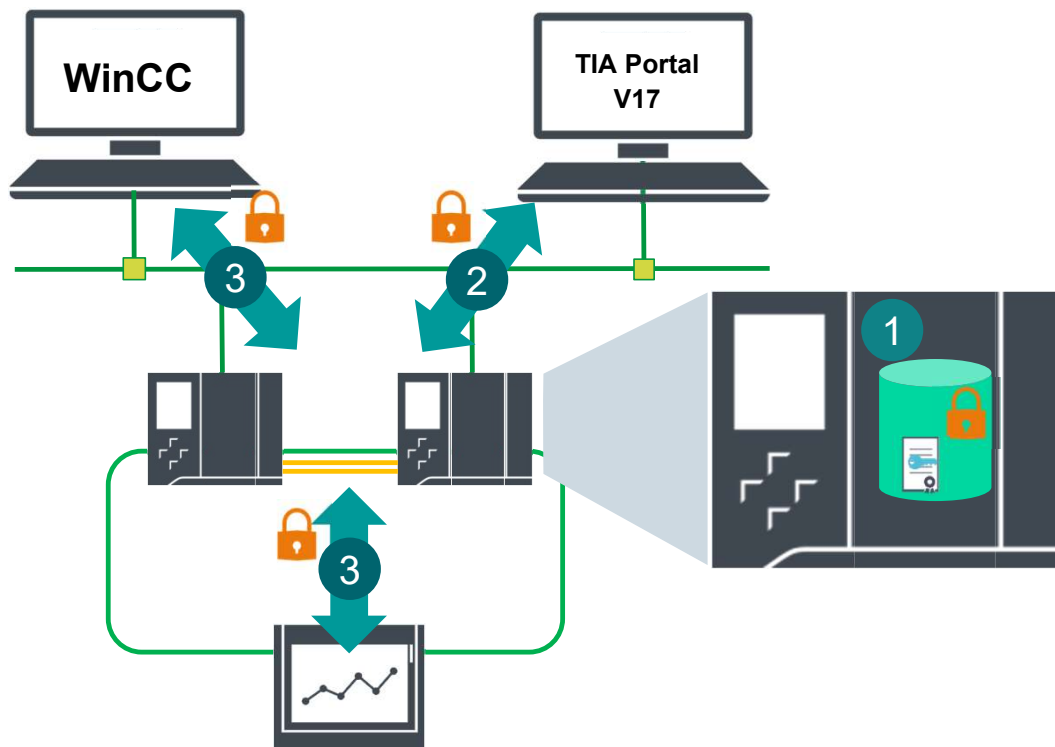
Enhancements with Firmware V2.9 und TIA Portal V17

1. Protection of configuration data

2. Secure communication between controller and TIA Portal V17

3. Secure communication between controller and HMI

SIEMENS

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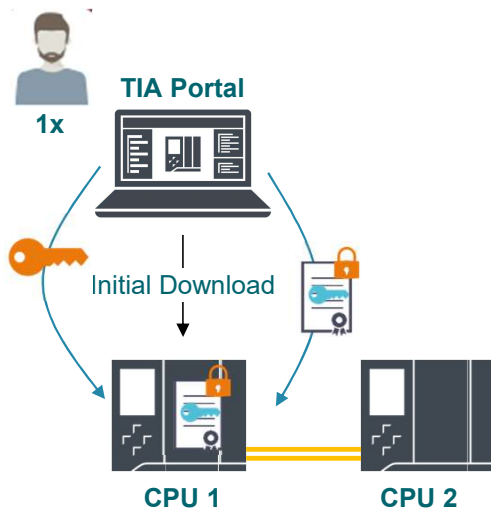
Protection of configuration data can be activated/deactivated in TIA Portal.
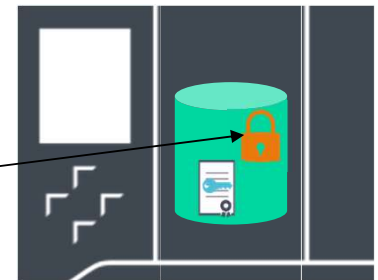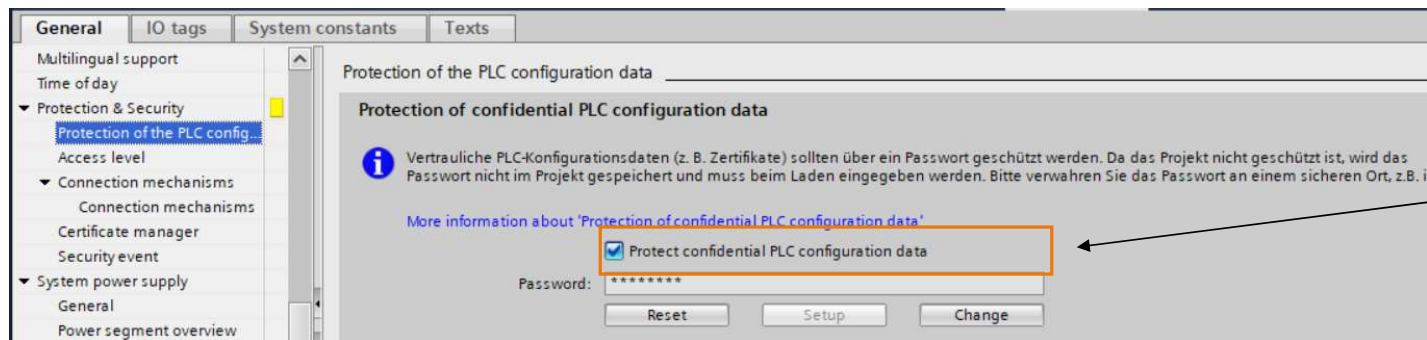
- The password for this protection is **<u>not</u>** stored in the TIA Portal project! It is only located inside the PLC but cannot be retrieved again. → Please save this password on a safe place (e.g. password manager)
- If the protection is activated, some things must be considered during initial commissioning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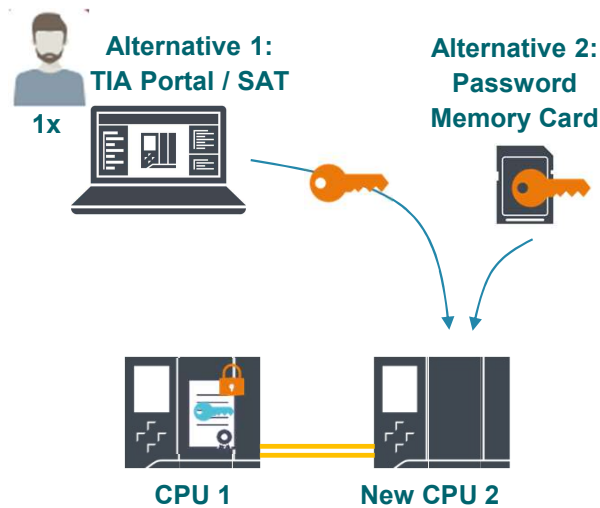
SIEMENS

Password protection of confidential configuration data
Exchange of a defective RH CPU

1) One CPU fails and gets defective

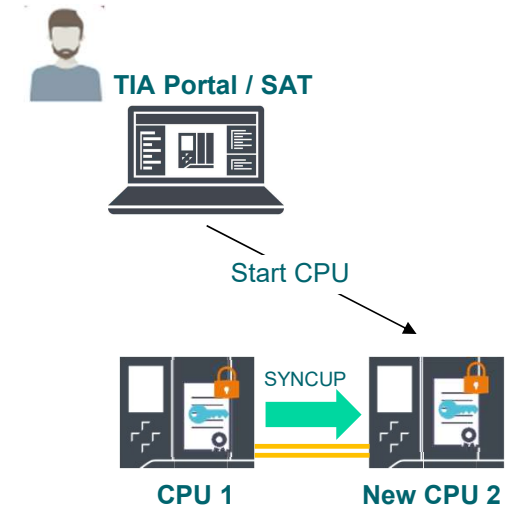CPU 1   Defective CPU 2

2) Exchange CPU and set password again

Alternative 1: TIA Portal / SAT

1x

Alternative 2: Password Memory Card

CPU 1   New CPU 2
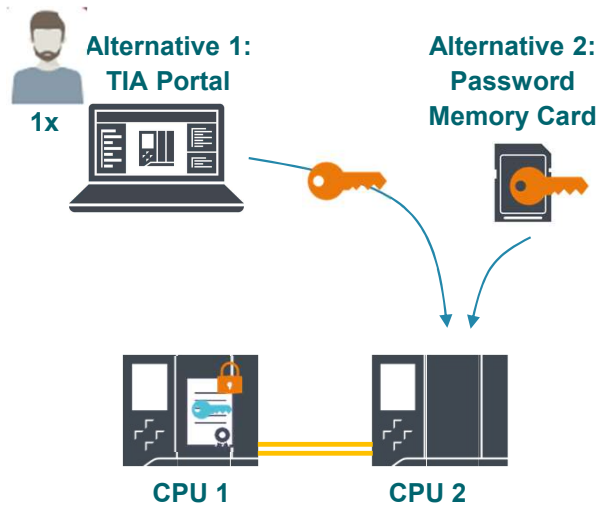
> Without this step, SYNCUP will fail!

3) Start New CPU – Program and Configuration are synchronized

TIA Portal / SAT

Start CPU

SYNCUP

CPU 1   New CPU 2

Certificate with private key for PG/HMI communication   Password to protect confidential PLC configuration

SIEMENS

Secure Communication to HMI and TIA Portal

PLCs with firmware version >=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.

SIEMENS
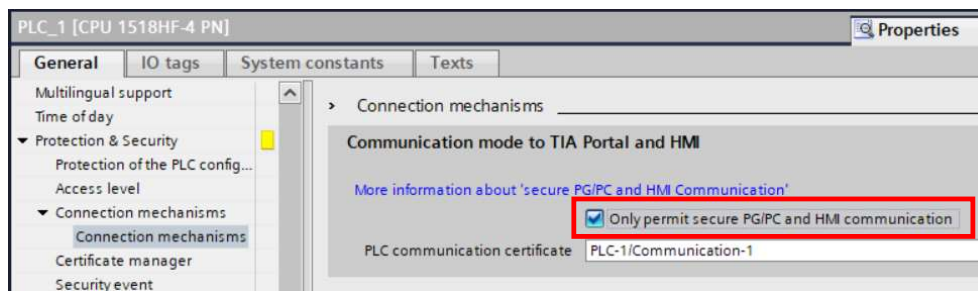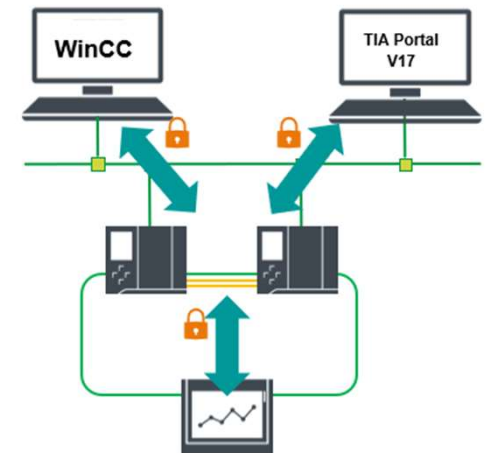
Add-Ons

SIMATIC S7-1500 Redundant Systems

SIEMENS

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

SIEMENS
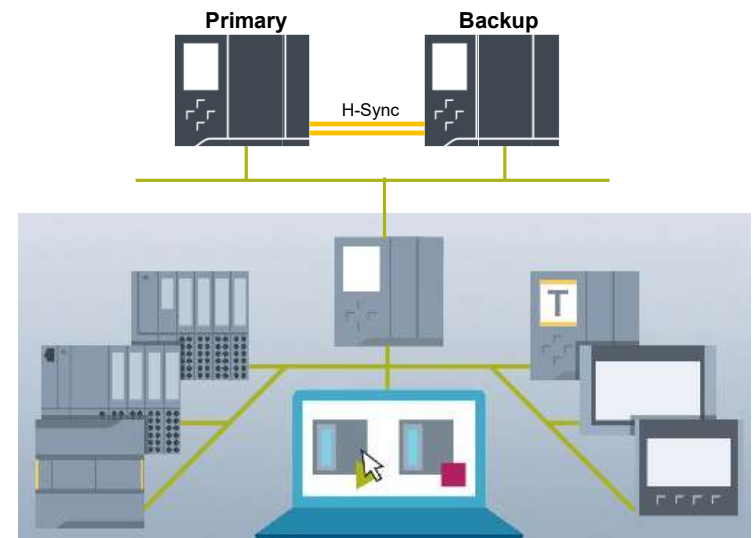
TIA Portal Add-In
Calculation of the watchdog time

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

SIEMENS

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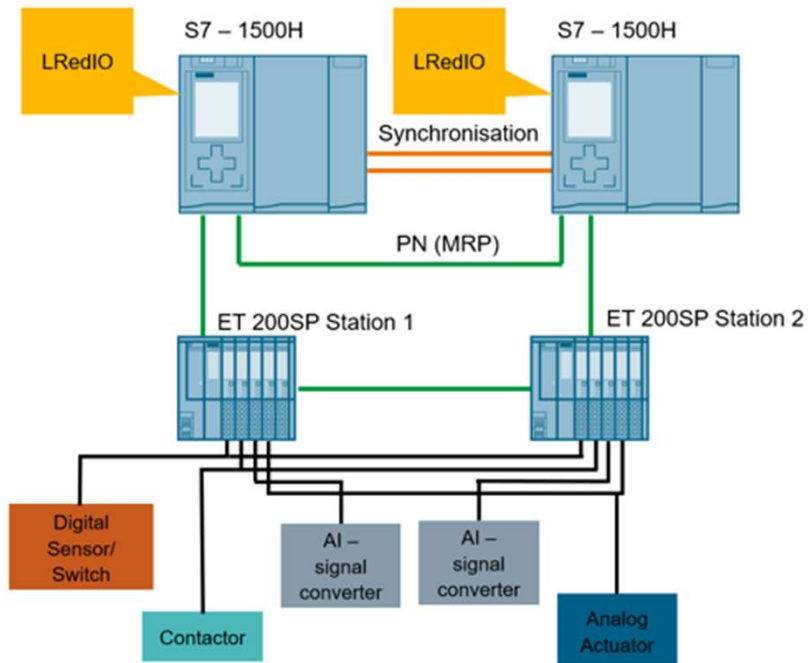
This application example shows how to connect redundant I/O signals to a S7-1500 controller.
It works with the S7-1500R/H system but also can be used with non-redundant controllers

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

SIEMENS

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
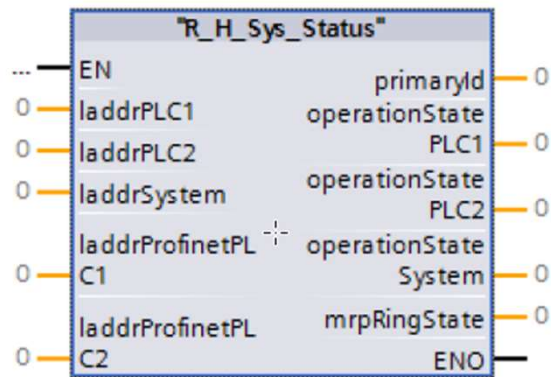 for early detection and signaling of errors before they affect the processDownload:
  https://support.industry.siemens.com/cs/ww/en/view/109763768

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

SIEMENS

Communication Libraries
Telecontrol with SIMATIC S7-1500 R/H

Product	Version	Supported Protocols	SIOS
TIM 1531 IRC	From V2.1	• 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	• IEC 60870-5 101,102,103, 104	https://support.industry.siemens.com/cs/ww/en/view/109422039
IEC 61850 Client Library	V16	• IEC 61850 MMS	https://support.industry.siemens.com/cs/ww/en/view/109480624/

SIEMENS

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/ww/en/view/109763719

SIEMENS

Redundant Power Supply
SITOP Redundancy Modules RED1200

- 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

Details

Manual

- 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

SIEMENS
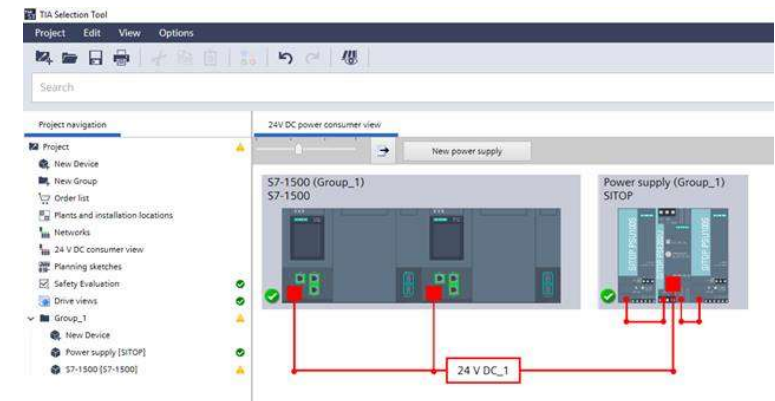
Restrictions

SIMATIC S7-1500 Redundant Systems

SIEMENS

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

SIEMENS

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	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

SIEMENS

Ordering Information

SIMATIC S7-1500 Redundant Systems

SIEMENS

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

SIEMENS

Heath Stranger
Siemens Ltd
Product manager – PLC (Australia & New Zealand)
Mobile: 0438 410 918
Email: heath.stranger@siemens.com

Publisher: Siemens 2021

SIEMENS

Disclaimer

© Siemens 2021

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

All product designations may be trademarks or other rights of Siemens AG, its affiliated companies or other companies whose use by third parties for their own purposes could violate the rights of the respective owner.

SIEMENS