SIEMENS

SIMATIC

PCS 7
High Availability Process Control Systems (V10.0)

Function Manual

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Cybersecurity information

1

Siemens provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/cert.

Industrial Security

2

This product is a part of SIMATIC PCS 7 and integrated into the overall plant security concept. Siemens strongly recommends setting up, operating, maintaining, and decommissioning the plant environment according to the SIMATIC PCS 7 Compendium Part F – Industrial Security: Technical documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/109815443).

Preface

3

Purpose of this documentation

This documentation informs you about the following aspects of configuring high availability systems with the SIMATIC PCS 7 Process Control System:

- The basic solution concepts
- The functional mechanisms
- The most important configurations

It presents the availability solutions on all automation levels (control, process, field).

You will find references to other product manuals containing specific information for working with individual components.

Options for accessing PCS 7 documentation

The documentation required for PCS 7 includes the following types:

- **PCS 7 Readme**
  The readme file is available in two versions:
  - PCS 7 Readme (Offline)
    This version is installed by PCS 7 Setup. The file only contains general information and links to documents on the Internet.
  - PCS 7 Readme (Online)
    This version contains all information on the installation and use of PCS 7 in the format which is already familiar to you. The file is only available on the Internet to keep it always up-to-date.

    Note

    The information provided in the *PCS 7 Readme* (online) on the Internet takes precedence over **all** other PCS 7 documentation. Refer PCS 7 Online Readme (https://support.industry.siemens.com/cs/us/en/view/109813959).

    Read this *PCS 7 Readme* carefully, because it contains important information and amendments on PCS 7.

- **PUD Manager**
  The "PUD Manager" an innovative tool to access documentation, comes with PCS 7 USB flash drive. Some of the highlights:
  - Create your own Manual Collection.
  - Customize the documentation set according to your needs.
  - Efficient search engine to access your information.

  To install the PUD manager and integrate the documents. refer to Siemens Industry Support (https://support.industry.siemens.com/cs/de/en/view/109748882).

- **PCS 7 System Documentation**
  System documentation contains information that covers several products, such as configuration manuals and Getting Started manuals. This documentation serves as a guideline for the overall system and explains the interaction between the individual hardware and software components.
  See information in the product overview *Process Control System PCS 7; PCS 7 - Documentation*; Section "Options for accessing the documentation".
- **PCS 7 Product Documentation**
  Product documentation contains information about special hardware and software components. The individual documents provide detailed information on the specific component.
- **PCS 7 Technical Information and Solutions**
  For important technical information and solutions, refer to SIMATIC PCS 7 Overview (https://support.industry.siemens.com/cs/ww/en/view/63481413).

Full versions of the documentation are available from the "Technical Documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/109801081)".

You can find additional information in the product overview *Process Control System PCS 7; PCS 7 - Documentation*; Section "Options for accessing the documentation".

Required basic knowledge

General knowledge in the area of automation engineering and basic knowledge of PCS 7 is required to understand this documentation. It is also assumed that the reader knows how to use computers or other equipment similar to PCs (such as programming devices) with the Windows operating system.

The configuration manuals and the Getting Started documentation for PCS 7 will provide you with basic information regarding the use of PCS 7.

Position in the information landscape

The following documentation provides more information about high availability process control systems and the handling of the individual components. This documentation is part of the PCS 7 software.

Manual	Contents
Getting Started *Process Control System PCS 7;* *Part 1 - Getting Started*	• Creating projects • Working with the CFC Editor • Working with the Import/Export Wizard • Working with the SFC Editor • Compiling, downloading and testing • Working with the operator station
Configuration manual *Process Control System PCS 7;* *Engineering System*	• Basics of PCS 7 • Creating projects • Configuring hardware • Configuring networks

Manual	Contents
Configuration manual *Process Control System PCS 7; Operator Station*	• Configuring SIMATIC connections • Interconnecting faceplates • Configuring operator stations • Compiling the OS • Installation guidelines
Process Control System PCS 7; Maintenance Station function manual	• Activation of the maintenance functions • Configuration of redundancy • Adding the OPC server
Configuration manual *WinCC*	• Getting Started • Operating principle of WinCC redundancy • User archives • Creating the "Project_Redundancy_Server" example project • Description of the WinCC projects • Server project
Manual *WinCC Hardware Options, Part 3 Redundancy*	• Structure of a redundant WinCC system • Operating principle of WinCC redundancy • Configuring the OS server pair • Guide for setting up a redundant system • Entering the servers in Windows
Manual *Process Control System PCS 7; SIMATIC BATCH*	• Structure of a redundant BATCH system • Configuring the BATCH server pair • Installation guidelines
Manual *Process Control System PCS 7; SIMATIC Route Control*	• Setting up a redundant Route Control system • Configuring the Route Control server pair • Installation guidelines
Manual Process Control System PCS 7; Software update ...	• Updating a PCS 7 Project with and without use of new functions • Upgrading a redundant system during online operation
Manual *Automation System S7-400H, High Availability Systems*	• Redundant SIMATIC automation systems • Increasing availability • System and operating modes of the S7-400H • Linking and updating
Manual *Modifying the System in Runtime via CiR*	• Modifying standard systems in runtime
Manual *Distributed I/O device ET 200M*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics

Manual	Contents
Manual *ET 200SP* *Distributed I/O system*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Manual *ET 200SP HA* *Distributed I/O system*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Manual *ET 200iSP* *Distributed I/O Device*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Operating instructions *SIMATIC NET;* *Industrial Ethernet Switches* *SCALANCE X-200*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Operating instructions *SIMATIC NET;* *Industrial Ethernet Switches* *SCALANCE X-300*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Operating instructions *SIMATIC NET;* *Industrial Ethernet Switches* *SCALANCE X-400*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Manual *SIMATIC NET* *Industrial Twisted Pair and Fiber-Optic Networks*	• Networks with Industrial Ethernet and Fast Ethernet • Network configuration • Passive components for electrical and optical networks • Active components and topologies
Manual *SIMATIC Diagnostic Repeater for PROFIBUS DP*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Operating instructions *DP/PA coupler, active field distributors, DP/PA Link and Y Link*	• Fundamentals of PROFIBUS PA • DP/PA Coupler • DP/PA Link • DP/PA Link in redundant operation with the S7-400H
Operating instructions *SIMATIC; Bus Link;* *Compact FF Link*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics

Manual	Contents
System manual *SIMATIC; PROFINET; System description*	• Overview • Configuration/Configuration examples • Data exchange and communication • IO engineering
Documentation *PCS 7 - Released Modules*	• Components released for redundancy in PCS 7
Manual *Compact Field Unit PA*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
SIMATIC NET;	• Industrial Ethernet • PROFIBUS IE/PB LINK

Guide

This manual is organized into the following topics:

- Basics of high availability in PCS 7
- Description of high availability solutions in PCS 7
- Description of configurations for various redundant components in PCS 7
- Failure scenarios and diagnostic options
- Options for quantitative analysis of high availability process control systems
- Glossary with important terms for understanding this documentation
- Index of important keywords

Conventions

In this documentation, the names of elements in the software interface are specified in the language of this documentation. If you have installed a multi-language package for the operating system, some of the designations will be displayed in the base language of the operating system after a language switch and will, therefore, differ from the designations used in the documentation.

You will find the Siemens SIMATIC programs in the Start menu under the menu command **All apps > Siemens Automation**.

Changes compared to the previous version

No changes in the documentation compared to the previous version.

Basics of high availability

4

4.1 Motivation for using high availability process control systems

Advantages of high availability components

Process control systems are responsible for controlling, monitoring and documenting production and manufacturing processes. Due to the increasing degree of automation and the demand for improved efficiency, the availability of these systems is playing an increasingly important role.

Failure of the control system or any of its components can lead to costly downtime in production and manufacturing. The expense involved in restarting a continuous process also has to be taken into consideration along with the actual production losses resulting from a failure. In addition, the loss of an entire batch may occur due to lost quality data. If the process is intended to operate without supervisory or service personnel, a process control system must be configured high availability for all of the components.

You can minimize the risk of a production failure and other detrimental effects by using high availability components in a process control system. A redundant design ensures increased availability of a control system. This means that all components involved in the process have a backup in continuous operation that simultaneously participates in the control tasks. When a fault occurs or one of the control system components fails, the correctly operating redundant component takes over the continuing control task. The ultimate goal is to increase the high availability and fail-safe performance in process control systems.

The following applies to you as the plant operator:

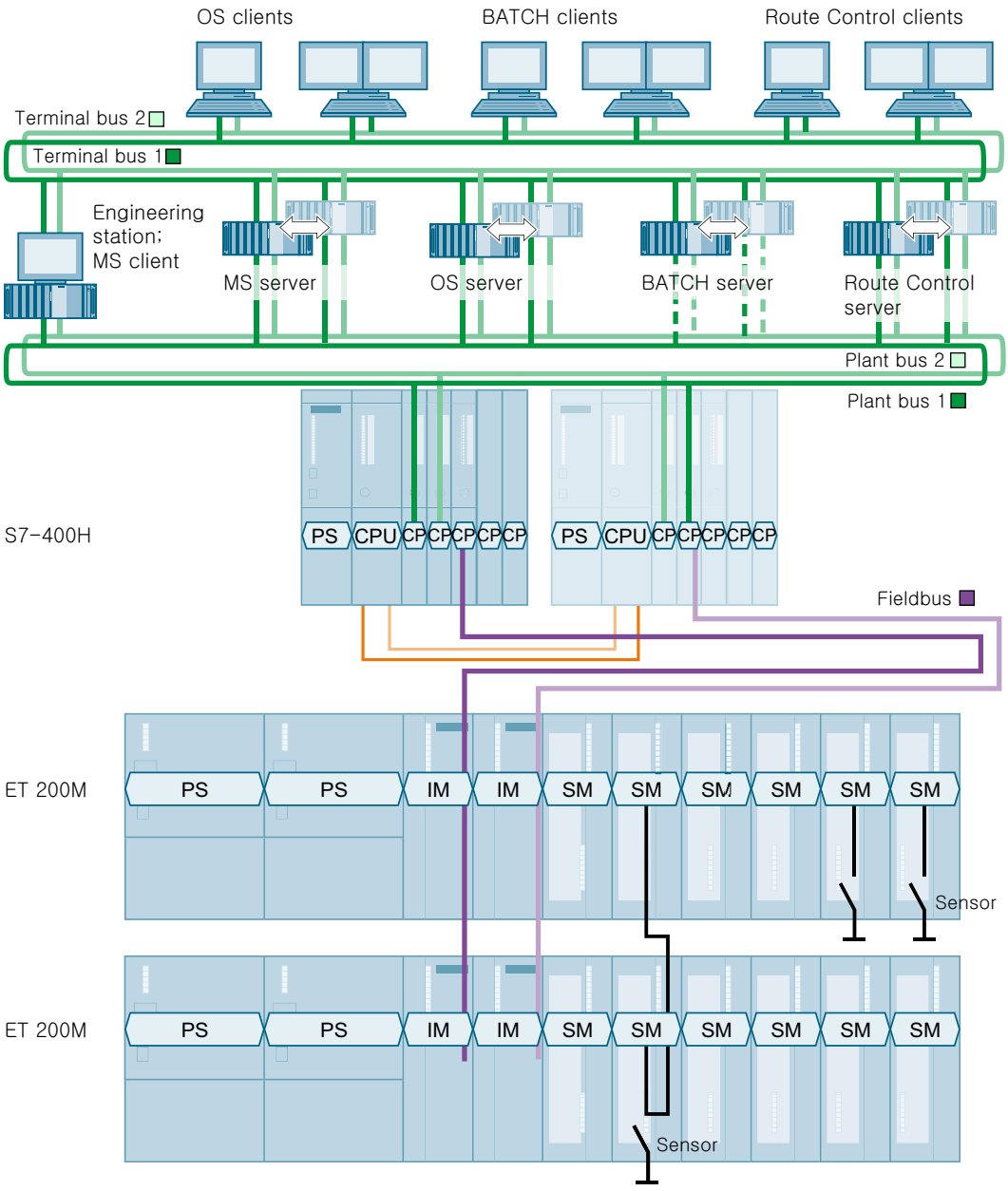
The higher the cost of a production stoppage, the more you need a high availability system. The higher initial investment usually associated with a high availability system is soon offset by the savings resulting from decreased production downtimes.

High availability PCS 7 process control system

The following components of the PCS 7 process control system allow you to implement high availability at all automation levels in the form and to the degree you require:

- Operator stations, maintenance station, central archive server, BATCH stations, Route Control stations (management level)
- Bus system
- Automation systems (process level)
- Distributed I/O (field level)

The following figure shows an example of a high availability process control system with PCS 7 components.



Legend for the above illustration:

Note

The following short designations are commonly used in this documentation.

Short designation	Meaning
Engineering station	Engineering station, PC
OS server	Operator station, PC project data station in the project form "WinCC Server"

Short designation	Meaning
OS client	Operator station, PC visualization station in the project form "WinCC Client"
BATCH server	BATCH station, PC recipe and batch data station
BATCH client	BATCH station, PC recipe creation and batch visualization station
Route Control server	Route Control station, PC Route Control data station
Route Control client	Route Control station, PC Route Control visualization station
Plant bus, terminal bus	Bus systems for communication over Industrial Ethernet (electrical or optical)
S7-400H	SIMATIC S7 high availability automation system, or H system for short
PS	Power supply
CPU	Central processing unit
CP	Communications processor
IM	Interface module
SM	Signal module / I/O module in analog or digital form
ET 200M	Distributed I/O device
Fieldbus	Fieldbus for distributed I/O
Sensor	Transmitters, sensors

4.2 Plant-wide availability considerations

Introduction

Availability must be analyzed globally for the system as a whole. Based on the degree of availability needed, each system level, each system and each component within a level should be evaluated. It is important to know the importance of each of these for the availability requirements as well as the ways and means that the required availability will be achieved.

Avoiding repair time

In many industrial processes, it is not enough to simply correct the failure of a component and then continue the process. The repair has to be made without interruption to the continuing production process. The repair time can be considerably reduced by keeping spare parts in stock on site. The use of high availability components in the process control system enables you to correct the cause of the system or component failure in runtime. The function of the component is retained if no fault occurs in the remaining active (redundant) components during the time a failed counterpart component is being repaired. That is, the plant continues operation without disruption.

Avoiding impermissible signal edge transitions

A reserve system with connected backup I/O may not cause a prohibited signal edge transition when a change occurs in the operating state (power on or off) or operating mode (master or slave).

4.3 PCS 7 redundancy concept

4.3.1 Advantages of the PCS 7 redundancy concept

Phases of a system lifecycle

High availability process control systems can be realized with SIMATIC PCS 7 at minimal cost in all phases of a system lifecycle:

- Configuration
- Commissioning/operation
- Servicing
- Expansion

Advantages

PCS 7 offers the following essential advantages:

- It provides you with system-wide scalable solutions based on the PCS 7 modular design.
  Advantage: The availability can be matched to your requirements. Your process control system can be upgraded with the SIMATIC PCS 7 components that are actually needed.
- Hardware upgrades for high availability do not depend on the software configuration.
  Advantage: If the user program has been configured with PCS 7, it does not have to be adapted following a hardware upgrade. You only need to download the new hardware configuration into the CPU.
- High availability automation system S7-400H with CPU (types: see documentation *Process Control System PCS 7; Released Modules*), whose module racks can be set up in separate locations.
  Advantage: Protection for the spatially separated CPUs resulting in increased availability in case of fire or explosion, for example.
- The use of redundant components in the process control system means isolated errors are tolerated.
  Advantage: The entire system does not fail when a single component in the process control system fails. The redundant component takes over its tasks therefore allowing the process to continue.
- Every failure of a redundant component is indicated on the OS clients in the form of a process control message.
  Advantage: You immediately receive crucial information about the status of your redundant component. Specific components that have failed can be quickly replaced to restore the redundancy.
- Software updates on redundant OS servers can be performed without loss of process operability or loss of data.

4.3.2 PCS 7 redundancy concept 1 (fieldbus based on PROFIBUS DP)

Overview of the PCS 7 redundancy concept

PCS 7 offers you a redundancy concept that reaches all levels of process automation.

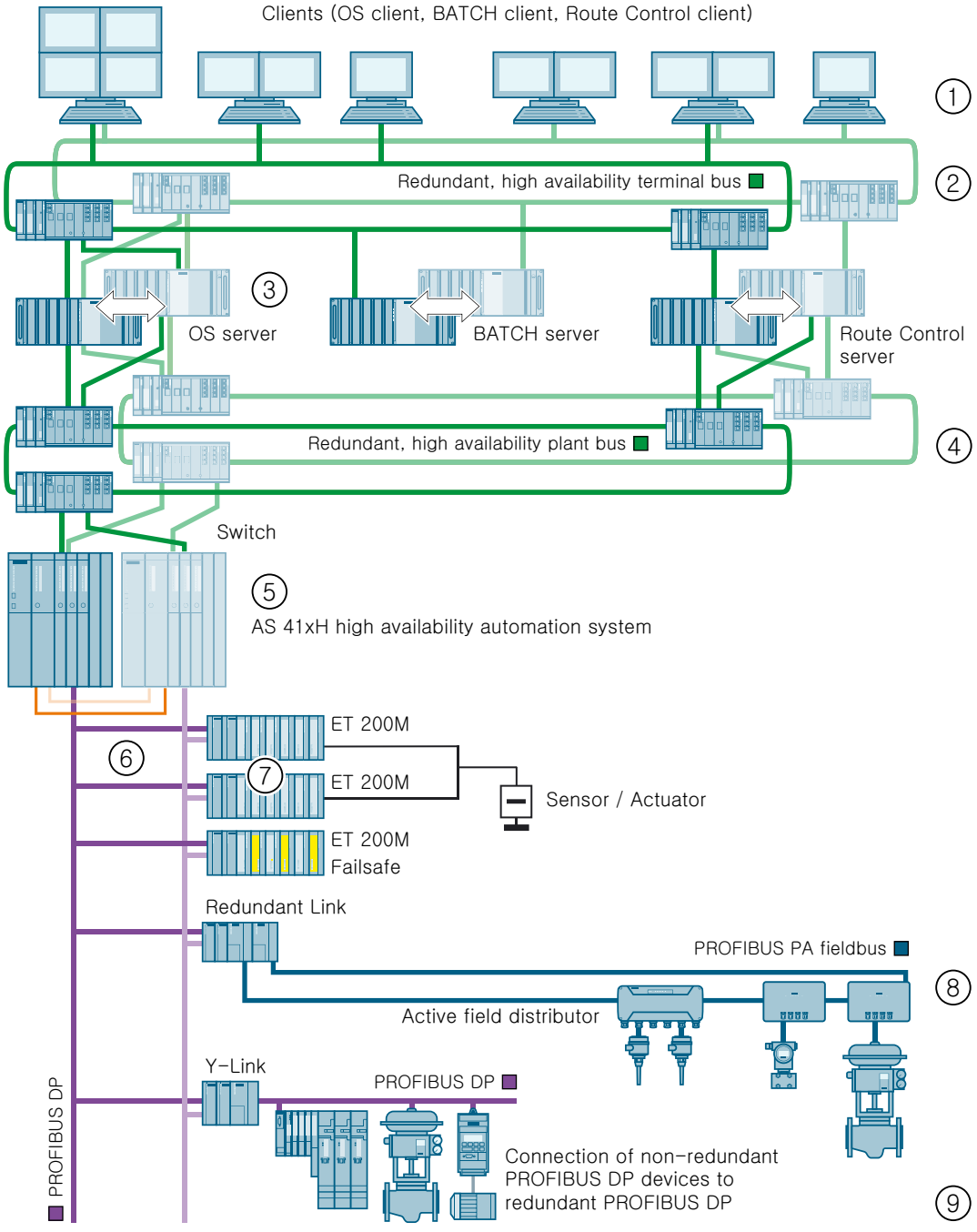


Figure 4-1 PCS 7 redundancy concept 1 (fieldbus based on PROFIBUS DP)

Note

The numbering of the components in the illustration relates to the descriptions provided below.

Number	Description
1	Several clients (OS clients, BATCH clients, Route Control clients) can access data on a server (OS server, BATCH server, Route Control server).
2	Communication between the operator stations (client and server) and communication with the engineering station is over a redundant, high availability terminal bus (Industrial Ethernet). The clients and server are connected to the terminal bus via switches.
3	The servers (OS server, BATCH server, Route Control server, maintenance server, central archive server) can, when necessary, be set up redundantly.
4	Automation systems communicate with the OS servers/Route Control servers and engineering stations and among themselves over the redundant, high availability plant bus (Industrial Ethernet). The automation system, server and engineering station are connected to the plant bus via switches.
5	Each part of the redundant, high availability S7-400H automation systems is connected to the plant bus with an Ethernet communications processor (CP). Each part of the AS is connected to several fieldbus chains (their PROFIBUS DP). The internal fieldbus interfaces or additional communications processors are used for the attachment.
6	The redundant connection to the fieldbus system is achieved by using two interface modules in each distributed I/O device (e.g. ET 200M on PROFIBUS DP).
7	Using redundant digital or analog input/output modules, you can evaluate signals from sensors/actuators. If one of the two redundant modules fails, the input/output signal of the functioning module are evaluated.
8	Single Fieldbus systems can be connected to the redundant PROFIBUS DP. The configuration of a redundant fieldbus can be realized with a redundant gateway (for example, PA link). The field devices are connected to the subsystem (for example, PROFIBUS PA) via AFD, active field distributors, (or AFS when ring/coupler redundancy is used).
9	The Y Link allows you to connect non-redundant PROFIBUS distributed I/O devices to a redundant PROFIBUS DP.

4.3.3 PCS 7 redundancy concept 2 (fieldbus based on PROFINET IO)

Overview of the PCS 7 redundancy concept for PROFINET IO

PCS 7 offers you a redundancy concept that reaches all levels of process automation.

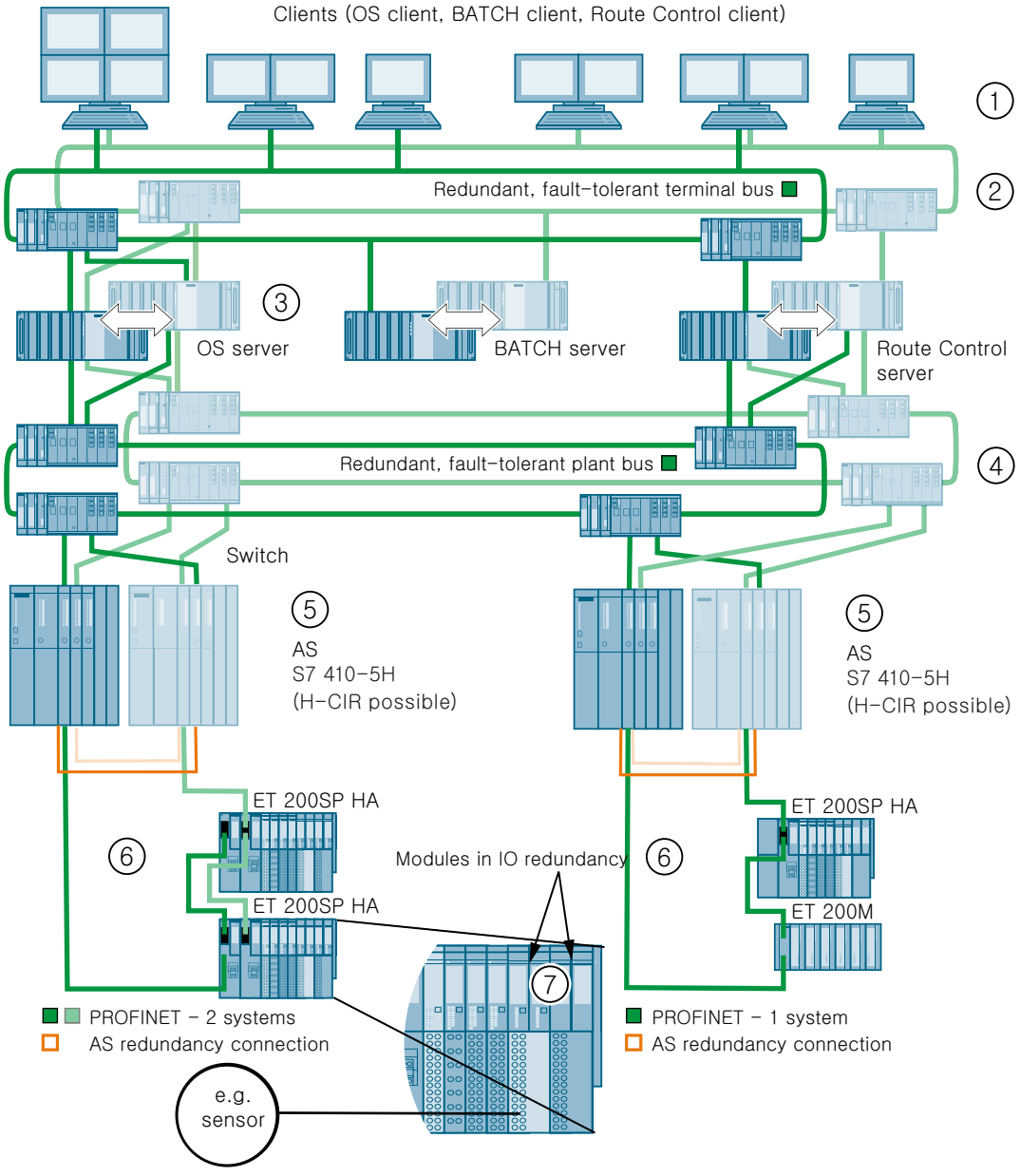


Figure 4-2 PCS 7 redundancy concept 2 (fieldbus based on PROFINET IO)

Note

The numbering of the components in the illustration relates to the descriptions provided below.

Number *	Description
1	Several clients (OS clients, BATCH clients, Route Control clients) can access data on a server (OS server, BATCH server, Route Control server).
2	Communication between the operator stations (client and server) and communication with the engineering station is over a redundant, high availability terminal bus (Industrial Ethernet). The clients and server are connected to the terminal bus via switches.
3	The servers (OS server, BATCH server, Route Control server, maintenance server, central archive server) can, when necessary, be set up redundantly.
4	Automation systems communicate with the OS servers/Route Control servers and engineering stations and among themselves over the redundant, high availability plant bus (Industrial Ethernet). The automation system, server and engineering station are connected to the plant bus via switches.
5	Each part of the redundant, high availability S7-400H automation systems is connected to the plant bus with an Ethernet communications processor (CP). Each part of the AS is connected to several fieldbus chains (their PROFINET IO). The internal fieldbus interfaces or additional communications processors are used for the attachment.
6	On PROFINET IO can be connected to the redundant distributed I/O devices based on ET 200SP HA or ET 200M.
7	The ET 200SP HA IO Redundancy is the possibility to reduce the wiring effort with regard to the connection of separate peripheral modules. The ET 200SP HA IO Redundancy is optimized for usage with one sensor/actor per redundant channel pair.

For more information on usage of SIMATIC PCS 7 with PROFINET, refer SIMATIC PCS 7 with PROFINET (https://support.industry.siemens.com/cs/ww/en/view/72887082).

4.4 Features of the PCS 7 redundancy concept at a glance

Introduction

The easiest way to increase availability is to keep replacement parts in stock on site and to have fast service at your disposal to replace defective components.

In this documentation, we provide you with PCS 7 software and hardware solutions that go well beyond fast service and replacement part warehousing. It focuses on "automated high availability process control systems".

System-wide, scalable solutions in PCS 7 available

Plants are divided into the following layers in PCS 7:

- Field layer
- Process layer
- Management level

The components of PCS 7 enable you to implement high availability solutions at all automation system levels in the form and to the degree you desire. In PCS 7, individual components (such as signal modules), complex systems (such as operator control and monitoring systems) and complete plants can be configured in such a way that one sub-component can automatically take on the function of another sub-component if it fails.

You decide which components in the plant require increased availability.

The following table lists the high availability components for the three layers.

Process layer	Components
Management level	OS clients, maintenance clients, BATCH clients, Route Control clients OS servers, maintenance servers, Process Historian, information servers, BATCH servers, Route Control servers Terminal bus (Industrial Ethernet)
Process layer	Plant bus (Industrial Ethernet) Automation system AS 41xH
Field layer	Fieldbus • PROFIBUS DP, PROFIBUS PA, FOUNDATION Fieldbus, PROFINET IO Distributed I/O device • ET 200SP HA, ET 200M, ET 200SP, ET 200iSP, ET 200S and ET 200pro Field devices • Compact Field Unit (CFU) • PROFIBUS DP, PROFIBUS PA, FOUNDATION Fieldbus and HART devices

Basics of increased availability

Increased availability in PCS 7 is based on the following principles:

- Duplication of a component
  Example:
  Use of duplicate signal modules
- Duplication of a component and a software component that performs an automatic fail-over from active and passive components in the case of malfunction.
  Example of redundant components:
  A signal is acquired with two signal modules and the redundancy software. The failure of one module remains non-critical for operation of the plant.
- Technical solutions for configuring components that prevent the failure of a sub-component.
  Example:
  Configuration of a network in a ring topology with redundancy manager component. If part of the ring is disrupted (by a defective cable, for example), the operation of the network is maintained.

4.5 Features for the configuration phase

Features for the configuration phase

In the configuration phase, PCS 7 provides you with support with the following features.

Feature	Meaning
Fault prevention through simplified configuration of the various components	You do not need additional training to configure the redundant components. Configuration can be performed in a similar way as for standard systems.
Simple integration of redundant I/O	No special knowledge is needed about redundant I/O modules.
The communication links between the system components are configured transparent to the application.	With the HW Config or NetPro graphical user interface, the configuration of the communication links is performed transparent to the application.

4.6 Features for the commissioning and operation phases

Features for the commissioning and operation phases

The following table lists the features PCS 7 offers for the commissioning and operation phases.

The redundant components allows the continuation of the process if a component fails. Operator control and monitoring of the process remains unaffected. In addition, the archiving of process data is not interrupted during the commissioning phase. Defective components can be replaced in runtime.

Note

If a component fails in a redundant control system, the high availability is lost. This means that another failure could potentially result in the failure of the entire system, although such occurrences are rare (for example, if both bus lines are disconnected in the case of a redundant bus system).
You can find additional information on this in the section "Redundancy nodes (Page 34)".

Feature	Meaning	Possible error / possible reason
Toleration of an isolated error	An isolated error is tolerated since the high availability redundant component continues the process.	Fault or failure of servers and clients Examples: • Hard disk failure • Operating system failure • Connection failure • Hard disk capacity for archiving exhausted Error or failure of the automation system Examples: • Failure of power supply • Failure of a CPU Error or failure of the communication Examples: • Line break • Electromagnetic compatibility (EMC) Error or failure of central or distributed I/O modules Example: • Component failure • Short circuit Fault in distributed I/O devices Examples: • Failure of the power supply (PS) • Failure of an interface (IM)
Ensure uninterrupted operation through redundant components.	The system can continue process control without operator intervention.	Failure of an individual component in a high availability process control system. Upgrade and expansion of the system.

Feature	Meaning	Possible error / possible reason
Ability of process to continue to be controlled and monitored even when a server switchover occurs.	If an OS server fails, the system switches over to the configured redundant partner server. All OS clients are automatically switched over to the now activate OS partner server. The process can continue to be controlled and monitored through the OS clients even during the switchover period.	Failure of the OS server Examples: • Operating system failure • Hard disk defect
Display of the master / standby identification of the OS server.	Information about the master / standby identification of the OS server can be requested and visualized using the OS clients.	The master / standby identification changes if the active OS server (master) fails.
No loss of data; gap-free data archiving.	The project data are saved according to the interval configured.	Failure of the OS server, for example, due to a hard disk defect.
Permanent operability of the control process by configuring a preferred server for each OS client.	The failure of some OS clients can be tolerated if the remaining clients continue to be connected to the process.	One or more client operator stations fail, for example, due to a hardware or software error. Duration of the switchover of the OS clients to the redundant OS server
Replacement of faulty components and reconnection to the system in runtime.	The failed components can be replaced without influencing the ongoing process and subsequently reconnected. A redundancy update is then performed.	OS client failure: e.g., operating system OS server failure: e.g., network adapter Plant bus failure: e.g., wire break Central rack failure: e.g., PS, CPU, synchronization line, CP, SM Fieldbus failure: e.g., defective PROFIBUS bus connector Failure of the distributed I/O device: e.g., PS, IM, SM
Update of faulty component with current system status after being reintegrated into the system.	Redundancy synchronization is performed for all high availability components, for example, a CPU or a server after return to operation.	Switching on a redundant component after a redundancy fault. Example: Startup of the module after a CPU is replaced with subsequent data synchronization on the CPU conducting the process.
System upgrades and expansions in runtime	Redundantly designed components can be upgraded, expanded or replaced in runtime.	Copying BIOS versions to redundant PC stations Software updates for redundant PC stations without utilization of new functions
Displays and documentation	Documentation of availability, for example, testing based on the mean time between failure (MTBF) residual time with optional printout.	Displays and documentation of a potential component failure in advance.

4.7 Features for servicing and system expansions

Features for servicing and system expansions

PCS 7 offers the following features for servicing and system expansions:

Feature	Meaning
Asset management with the maintenance station	The maintenance station provides comprehensive information for servicing and diagnostics of PCS 7 plants.
Integrated diagnostics of components (for example, LEDs) for fast, local error detection.	Diagnostics of components without an additional programming device (PG).
Faster service from SIEMENS Customer Support.	The service is on site within 2 to 48 hours to maintain the availability guarantee.
Repairs and component expansions (upgrades, conversions and updates) in runtime.	Repair and component expansions can be made in a high availability system. System components are installed redundantly so that repairs and expansions can be made in runtime.

4.8 Definition of availability

Definitions

Availability is usually defined as follows:

Quotient of MTBF and (MTBF + MTTR)
or in short form
actual operating condition / nominal operating condition.

Whereby:

- MTBF = mean time between failure; average amount of time between two successive error events, repair time excluded
- MTTR = mean time to repair; average amount of time between repair events

Increasing the basic availability

Based on this definition, the basic availability of a standard component or a standard system can be increased by the following:

- Reduction of error frequency
- Decreasing the period necessary for repairs
  A variety of measures can reduce the repair time:
  - Proximity to customer service
  - Spare parts warehousing
  - Repairs in runtime or repairs without downtime

With "repairs in runtime", no repair time is needed in the system to correct unscheduled operation disruptions.

4.9 Definition of the standby modes

Introduction

The availability of a system can be increased by additional components in the system (standby components). The operating mode of these components distinguishes them from the components that are active in process mode.

Standby operating mode

Operating mode	Definition
Hot standby	Hot standby means the parallel redundant processing of signals in redundant components. This allows a bumpless switchover of the entire system to the standby components.
Warm standby	Warm standby means the fast continuation of the aborted function by standby components at a program continuation point.
Cold standby	Cold standby means that there is a component of the system available that can be activated if a fault occurs. Following a restart, the newly activated component takes over the function of the previously failed component.

4.10 Redundancy nodes

Functionality

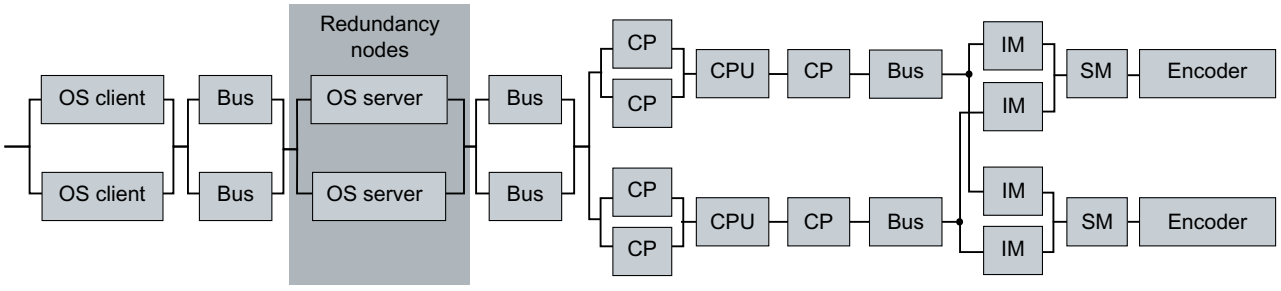
Redundancy nodes provided protection from failure of systems with redundant components. A redundancy node is independent when the failure of one component within the node does not affect the reliability in other nodes or in the entire system.

The availability of a complete system is illustrated in block diagrams. In a redundant system, a component in the redundancy node can fail without affecting the operation of the complete system. In the chain of redundancy nodes, the weakest link determines the availability of the entire system.

The block diagrams below present examples to illustrate this point.

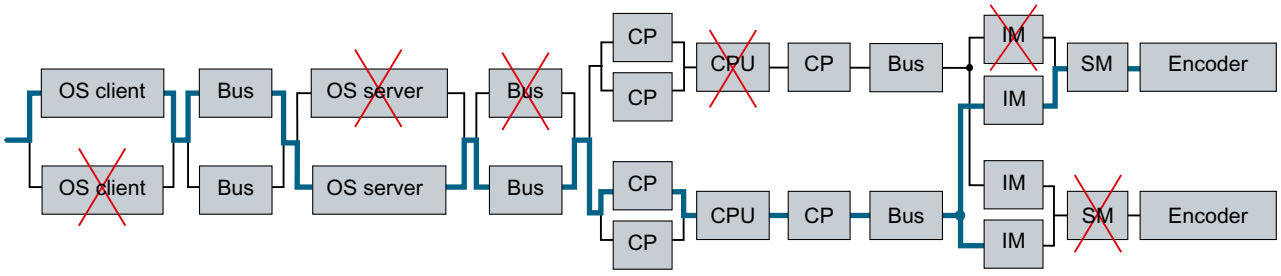
Redundancy nodes without fault

The following is a block diagram showing individual redundancy nodes operating without a fault.



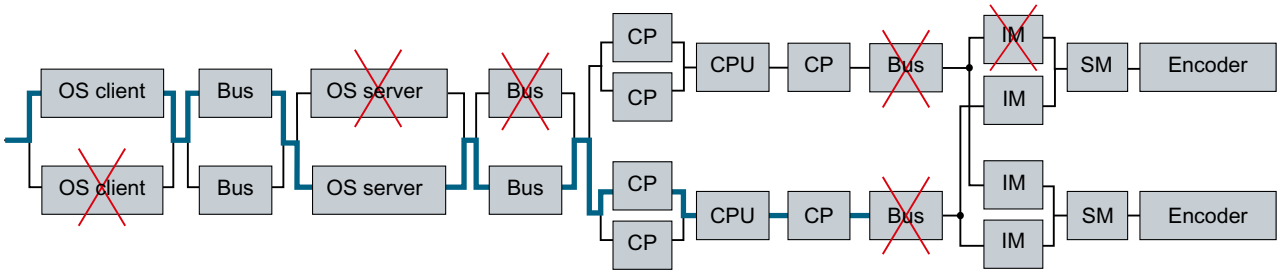
Availability of a redundancy node despite faults

If a component in a redundancy node fails, the overall system continues to operate.



Total failure of a redundancy node

The following figure shows a complete system that has ceased to operate due to a failure of the "Field bus" redundancy node.



High availability solutions in PCS 7

5

5.1 Solutions for the I/O

Introduction

In this section you will learn about the I/O systems and components that contribute to increasing the availability of your system. This means using the distributed I/O in PCS 7.

Distributed I/O

Distributed I/O refers to modules (input/output modules and function modules) that are used in a modular, distributed I/O device (such as the ET 200SP HA, ET 200M, ET 200SP or ET 200iSP).

Distributed I/O devices are often spatially separated from the central rack and located in direct proximity to the field devices themselves. This minimizes the requirements for wiring and ensuring the electromagnetic compatibility. Communication connections between the CPU of the automation system and the distributed I/O can be established with the following network types:

- PROFIBUS DP
- PROFINET IO

In addition to the I/O devices, distributed I/O includes field devices such as actuators, weighing systems, motor protection control equipment and all other field devices that can be integrated in the plant via the bus system.

HART devices are connected and addressed via the corresponding modules in the distributed I/O device. HART devices are actuators and sensors that can be configured per HART protocol (HART: Highway Addressable Remote Transducer).

Network components that are integrated at the fieldbus belong to the distributed I/O. These include, for example, the following network components:

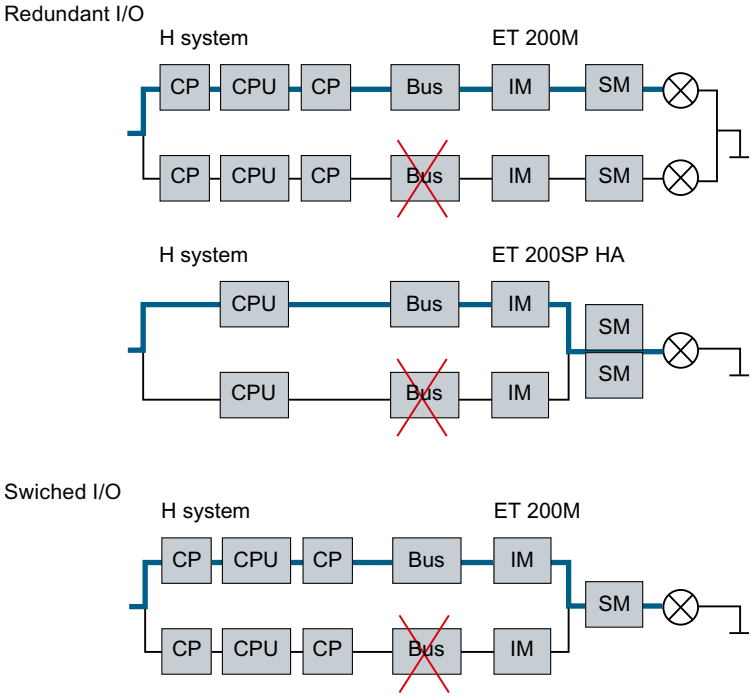
- Bus links
  - PA-Link
    The PA-Link enables the connection of a lower-level bus system such as PROFIBUS PA to a redundant PROFIBUS DP.
  - Y-Link
    With the Y-Link, you connect singular PROFIBUS components to a redundant system.
  - Compact FF Link
    This bus link enables the connection of a lower-level bus system such as FOUNDATION Fieldbus to a redundant PROFIBUS DP.
  - IE/PB Link HA
    The IE/PB Link HA enables the connection of a lower-level bus system such as PROFIBUS PA or PROFIBUS DP to a PROFINET.
- PROFINET switches
  With the PROFINET switches, you integrate PROFINET networks in the fieldbus of an AS.
- Compact Field Unit
  The Compact Field Unit, as a PROFINET IO device, combines the effort of distributed I/O for digital IO and bus link for field devices on PROFIBUS PA.

An AS interface can be connected using AS-Interface master modules (CPs) that are used in the distributed I/O device. This enables the connection of simple sensors and actuators to PCS 7 with AS-Interface. PCS 7 integrates other I/O levels in a project in this way.

Increasing availability

The availability of the I/O can be increased through the following configuration options:

- **Redundant I/O** (distributed I/O)
  The entire signal path up to the sensor/actuator is configured redundantly. Additional information on this topic is available in section "Redundant I/O (Page 40)".
- **Switched I/O** (distributed I/O)
  The communication path to the I/O (station) is redundant. There is only one input/output module (SM) for processing a process signal.
  Additional information on this topic is available in section "Switched I/O (Page 45)".



Modules for the distributed I/O

Note

Information on which modules are released for the distributed I/O in PCS 7 can be found in the documentation *PCS 7 - Released modules*. You can find this documentation on the Internet at: Technical documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/109801081).

5.1.1 Redundant I/O

Redundant I/O

Redundant I/O describes the situation when the I/O modules (SM) for processing a process signal are doubly available and can be addressed by both CPUs. The CPU signal or process signal will continue to be processed by a functioning module even when its partner fails. The entire signal path up to the sensor/actuator is configured redundantly.

Note

With PCS 7, you can determine if errors in redundantly acquired signals will have an effect of a module or channel. You can find additional information about this in the following sections:

- Section "Redundant input/output modules (Page 48)"
- Section "Failure of redundant input/output modules (Page 207)"

Configuration with PROFIBUS DP

On PROFIBUS DP you can configure redundant I/O with selected S7-300 I/O modules of the distributed I/O device (ET 200M).

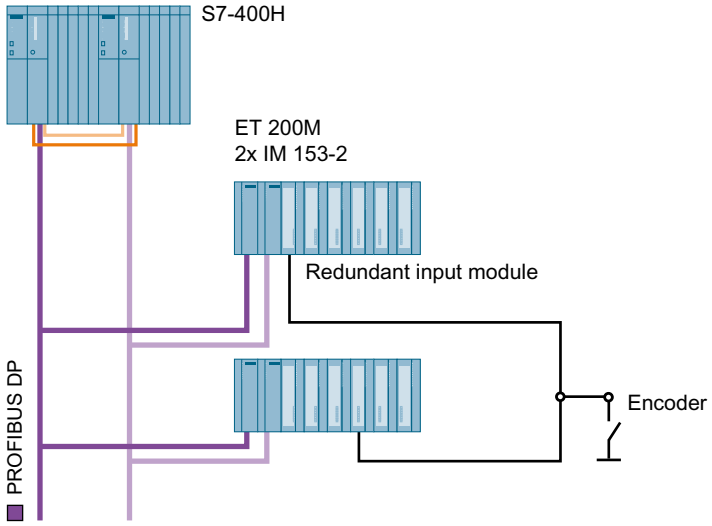
The distributed I/O device is connected as redundant DP slave to a high availability automation system operating as the DP master via PROFIBUS DP. A redundant configuration is achieved by installing an additional distributed I/O device and an additional PROFIBUS DP connection.

Note

ET 200M

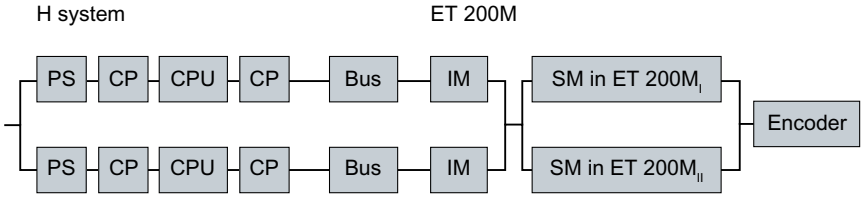
For the ET 200M, with PCS 7, use only active bus modules. Active bus modules enable you to plug and pull modules in runtime.

The following figure illustrates an example with ET 200M. Signals from redundant sensors can be registered.

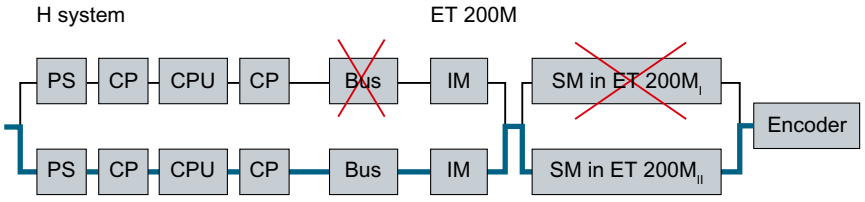


Availability

The block diagram shows an example configuration with ET 200M without a fault.



If a fault occurs in a maximum of one signal path per redundancy node (e.g. bus line (bus = PROFIBUS DP) in the first redundancy node and an input module (SM) in the second redundancy node), the overall system remains operable. The connected device continues to supply data to the central device, which remains available. If any other component in the redundancy chain fails, however, the complete system will fail.



Installation rules

The configuration always has to be symmetrical when using redundant I/O. Follow these installation rules:

- Using ET 200M as distributed I/O device: Both subsystems of the S7 400H must be configured identically. The same modules are located at the same slots.
  Example: CPU and CPs are located in both subsystems at the same slot.
- The communication paths and interfaces must be configured the same way in both subsystems.
  Example: The fieldbus cables in both subsystems are connected to the same bus interface of the CPU 41x-xH.
- Redundant modules are always identical (article number, hardware version, firmware version)

Configuration rules

- In a PROFIBUS System
  A DP slave must have the same PROFIBUS address in the mutually redundant DP master systems.
- In a PROFINET IO System
  The first module in Redundant I/O must be placed at an odd-numbered slot on a terminal block (TB45...).

Redundant I/O of ET 200SP HA

Redundant I/O of ET 200SP HA describes the situation when a pair of I/O modules (SM) use the same connectors for the sensor/actuator. The CPU signal or process signal will continue to be processed by a functioning module even when its partner fails. The entire signal path up to the sensor/actuator can configured redundantly.

Note

With PCS 7, you can determine if errors in redundantly acquired signals will have an effect on a module or channel. You can find additional information about this in the following sections:

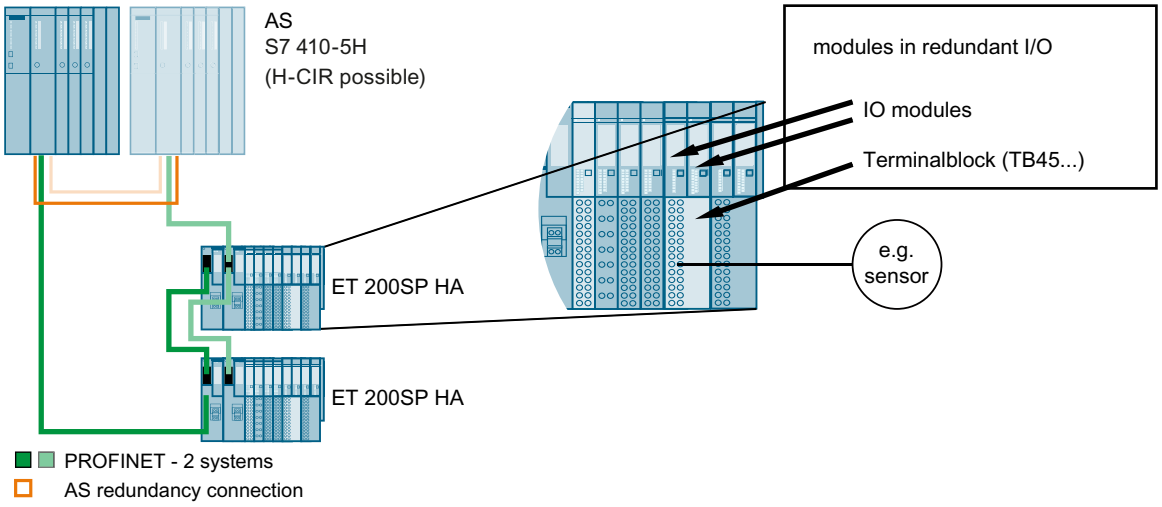
- Section "Redundant I/O modules (Page 48)"
- Section "Failure of redundant interface modules (Page 207)"

Configuration

In PCS 7, you can configure Redundant I/O with selected IO modules from ET 200SP HA.

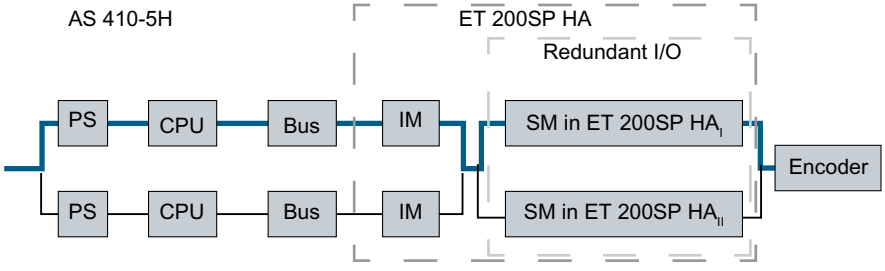
The ET 200SP HA distributed I/O is connected as a PROFINET IO-Device to a automation system operating as the IO Controller via PROFINET IO. A redundant configuration of IO modules is achieved by installing 2 identical IO modules on a terminal block for Redundant I/O (TB45...).

The following figure illustrates this configuration. Signals from redundant sensors can be registered and IO-modules can drive actors.

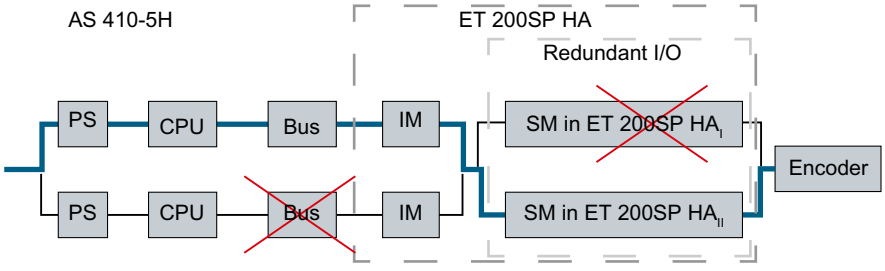


Availability

The block diagram shows an example configuration with Redundant I/O in ET 200SP HA without a fault.



If a fault occurs in an input module (SM) the system remains operable. The connected device continues to supply data to the central device, which remains available. If any other component in the redundancy chain fails, however, the complete system will fail.



Installation rules

The configuration always has to be symmetrical when using redundant I/O. Follow these installation rules:

- Using ET 200SP HA as distributed I/O device: By using IO redundancy the terminal block(TB45...) only needs to be connected to the field device (sensor or actor).
- The first module in Redundant I/O must be placed at an odd-numbered slot on a terminal block (TB45...).
- Redundant modules are always identical (article number, firmware version, release)

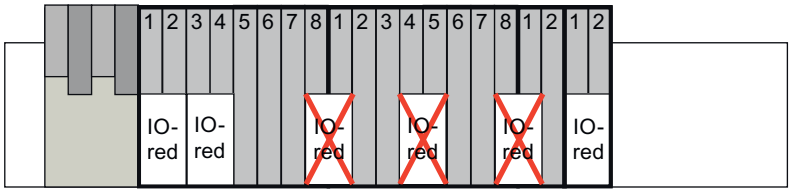


Figure 5-1 Slot configuration by Redundant I/O

Configuration rules

Note

This type of redundant operation is possible only with certain I/O modules of the ET 200SP HA. For additional information, please refer to the following documents:

- Documentation *PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

Additional information

- Section "Redundant interface modules in distributed I/O (Page 47)"
- Section "Redundant I/O modules (Page 48)"
- System manual *Distributed I/O System; ET 200SP HA*
- Manual *Automation System S7-400H; High Availability Systems*

5.1.2 Switched I/O

Switched I/O

Switched I/O describes the situation when there is only one I/O module (SM) for processing a process signal. The communication path to the I/O (station) is redundant. In the event that a communication path fails, the distributed I/O (station) switches to the functioning communication path. The non-redundant I/O modules of the distributed I/O can be addressed via the redundant interface module (DP slave) of both central modules (CPU) of a high availability system.

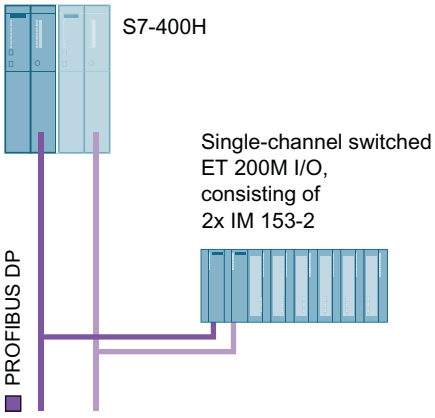
Configuration

A switched I/O can be set up in PCS 7 with the following distributed I/O devices:

- ET 200M
  For this setup, you require an ET 200M with active backplane bus modules and a redundant IM 153-2 interface module.
- ET 200iSP
  For this setup, you require an ET 200iSP and a redundant IM 152-1 interface module.

Each subsystem of the S7-400H is connected to one of the two PROFIBUS DP interfaces of the interface module via a DP master interface.

The following figure illustrates this configuration for the ET 200M.



Configuration with PROFINET IO

On PROFINET IO you can configure redundant connected I/O Devices with selected modules of distributed I/O devices of ET 200M or ET 200SP HA.

The distributed I/O device is connected as a redundant IO-Device to a high availability automation system operating as the IO master via PROFINET IO. A redundant configuration is achieved by installing the distributed I/O device with 2 interface modules or using MRP-connection.

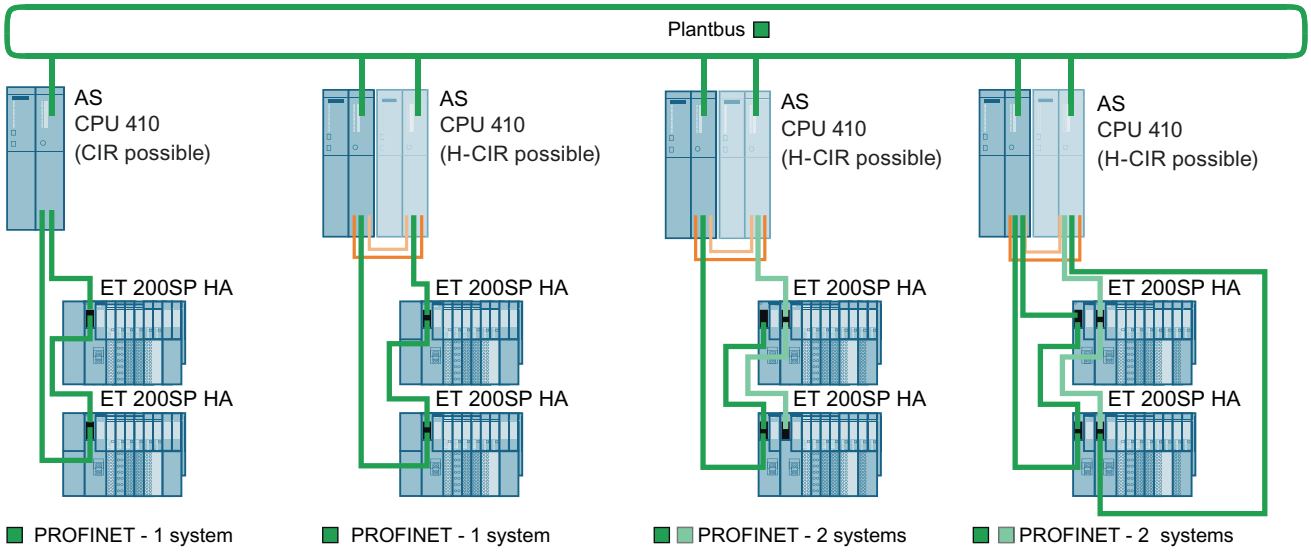
With ET 200SP HA, selected IO modules in IO redundancy can be connected to receive signals from redundant sensors and the operate redundant actors.

The following figure illustrates the possible configuration with ET 200SP HA. Sensors and actors can configure redundant I/O with selected modules.

Note

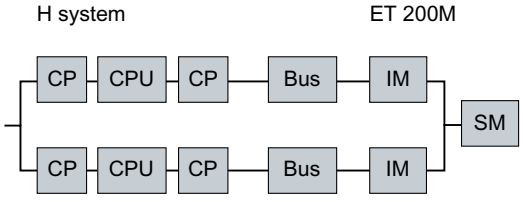
High availability PROFINET IO

When using rings with PROFINET IO, it is absolutely necessary to operate the fieldbus ring with MRP (media redundancy protocol).

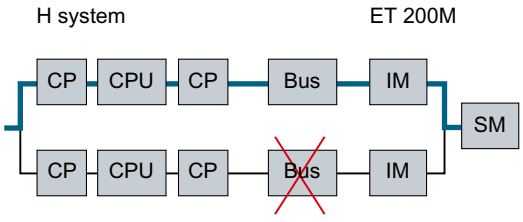


Availability

The block diagram shows the availability of the configuration illustrated above. When both systems are operating without fault, the block diagram appears as follows:



The following figure shows how one component may fail without this affecting the operation of the complete system.



The system remains available even when one component in part of a line of the redundancy node fails. There is only one I/O module and therefore no corresponding redundancy node. It is the weakest link in the complete system's chain.

Installation rules

The configuration always has to be symmetrical when using switched I/O. Follow these installation rules:

- CPU 41x-xH and additional DP masters must be located in the same slots in each subsystem (for example, in slot 4 of both subsystems).
- The PROFIBUS cables in both subsystems must be connected to the same interface (for example, to the PROFIBUS DP interfaces of the two CPU 41x-xH).

Configuration rules

- A DP slave must have the same PROFIBUS address in the mutually redundant DP master systems.

Additional information

- Section "Redundant interface modules (Page 47)"
- Manual *Automation System S7-400H; High Availability Systems*

5.1.3 Components in the distributed I/O

5.1.3.1 Redundant interface modules in distributed I/O

Redundant interface modules

By using two interface modules in one distributed I/O device, the following can be implemented:

- Setup of a switched distributed I/O
- Setup of a redundant distributed I/O

If the active interface module or the communication path fails via this interface module, the passive interface module takes over the relevant functions without interruption. The active interface is indicated by an illuminated "ACT" LED on the respective interface module.

Configuration:

The configuration is provided as an example in the section "Redundant I/O (Page 40)".

- ET 200M with redundant IM 153-2
  Two IM 153-2 interface modules are mounted on the active bus module in the distributed I/O device for redundant operation.
- ET 200SP HA with redundant IM 155-6
  Two IM 155-6 interface modules are mounted in the distributed I/O device for redundant operation.
- ET 200iSP with redundant IM 152-1
  Two IM 152-1 interface modules are mounted on the active TM-IM/IM terminal module in the distributed I/O device for redundant operation.

Note

The signal modules of the ET 200iSP cannot be used redundantly.

Additional information

- Section "How to configure the redundant interface module for the I/O device (Page 139)"
- Section "Failure of redundant interface modules (Page 207)"
- Manual *SIMATIC, Distributed I/O Device ET 200M*
- Manual *SIMATIC, Distributed I/O Device ET 200SP HA*
- Manual *SIMATIC, Distributed I/O Device ET 200iSP*
- Manual *Automation System S7-400H; High Availability Systems*

5.1.3.2 Redundant I/O modules

Configuring redundant input/output modules

Redundant I/O modules enable you to increase the availability in the I/O area.

The following configurations are possible with redundant I/O modules:

- Redundant input/output modules in redundant distributed I/O
  An example of this is the configuration shown in the section "Redundant I/O (Page 40)"
- Redundant input/output modules in single-channel switched distributed I/O
  An example of this is the configuration shown in the section "Switched I/O (Page 45)"

Note

Refer to the interconnection examples for redundant I/O (redundant input/output modules) in the manual *Automation System S7-400H; High Availability Systems*.

- Redundant input/output modules in IO Redundancy:
  An example of this is the configuration shown in the section "Redundant I/O (Page 40)".

Note

In case of using the I/O modules redundancy, the diagnostic feature or capability needs to be activated.

Redundant operation of I/O modules of ET 200SP HA

The following requirements must be met to operate redundant I/O modules of ET 200SP HA:

- PCS 7 as of V9.0
- CPU 410-5H as of firmware version V8.2
- Suitable I/O modules (documentation: *PCS 7 - Released Modules*)

Redundant operation of S7-300 I/O modules of ET200M (PROFIBUS DP)

The following requirements must be met to operate redundant S7-300 I/O modules of ET200M (PROFIBUS DP):

- PCS 7 as of V6.0
- H-CPU as of firmware version V3.1
- Suitable S7-300 I/O modules (documentation: *PCS 7 - Released Modules*)

Required software and configuration

You select and configure the redundant modules in HW Config.

- In order for both subsystems of the H system to be able to address redundant input/output modules, S7 driver blocks from the "Redundant I/O" library and PCS 7 driver blocks from the *PCS 7 Library* as of PCS 7 V9.0 are required in addition to the necessary hardware.
- Modules with the same article number and version number are configured redundantly to one another

You interconnect the signals in the CFC chart. You can find information on this in the section "Configuration of redundant signals (Page 157)".

When the user program is compiled, the required driver blocks are placed, interconnected and configured automatically.

Reaction to a channel fault

You can define the passivation characteristics, for example how redundant input/output modules react to a channel fault (such as broken wire, short-circuit on the signal line). The reaction to a channel fault depends on the following aspects:

- Module employed
- Configuration
- Version of the PCS 7 library
  - As of PCS 7 V7.1, the potential passivation reaction is automatically detected based on the configured modules. The passivation reaction is set channel-by-channel.
  - Only the module-based passivation reaction can be selected with the Redlib V3.x library.
  - You can set the channel-based passivation reaction with the Redlib library as of V4.

You will find information on the passivation reaction for individual modules in the documentation *PCS 7 - Released Modules*.

Additional information

- Section "How to configure redundant input/output modules (PROFIBUS DP) (Page 142)"
- Section "Failure of redundant I/O modules (Page 207)"
- Section "How to set the CPU for the reaction of the input/output modules to channel faults (Page 119)"
- Manual *Automation System S7-400H; High Availability Systems*
- Online help for *STEP 7*

5.1.3.3 Redundant actuators and sensors

Detecting failures

Actuators and sensors of I/O field level can be configured redundantly for PCS 7. A requirement therefore is that you can configure a pair of actuators/sensors to a pair of I/O-modules. The failure of an actuator or sensor can be detected and reported as an error in the process control system based on the used input/output module to which the redundant actuators or sensors are connected. If an actuator/sensor fails, the automation system continues working with the intact actuator/sensor. This means the current status of process values can be read or output at any time.

Note

Read the product description of the I/O module used to find out whether the module can detect and report a failure of the connected actuators and sensors.

Note

No redundant Actuators and sensors with ET 200SP HA

ET 200SP HA is optimized for Redundant I/O and uses a single sensor/actor connected to a pair of I/O-modules (redundant channel pair).
So you can't connect a pair of actuators/sensors.

Additional information

- Manual *Automation System S7-400H; High Availability Systems*

5.2 Solutions for automation systems

Introduction

This chapter presents solutions that can be used to increase the availability of an automation system.

S7-400H high availability programmable controller

Only a high availability automation system can ensure an extremely short process safety time, for example, a switchover time in the milliseconds range. PCS 7 enables you to configure your process control system with redundancy using the S7-400H high availability programmable controller.

Functionality

The S7-400H programmable controller and all the other components in the PCS 7 environment are tuned to one another.

With this solution, a second backup CPU, which is event-synchronized to the master CPU, performs the same processing tasks of the user program as the master. If the active master CPU fails, the standby CPU continues processing the user program without delay. This type of standby is referred to as "Hot standby".

There are always two CPUs and two power supplies in an S7-400H. The communications processors and I/O modules are expansion modules.

5.2.1 Hardware components of the S7-400H

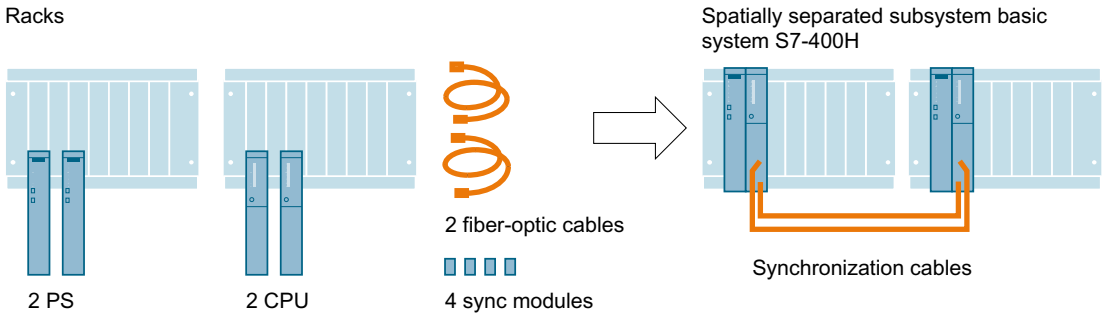
Hardware components

The following hardware components are available for the configuration of the high availability automation system.

Hardware components	
Racks	Rack UR2-H
	Rack UR2
	Rack UR1
	Rack CR3
Central processing units	Central processing unit CPU 410-5H
	Central processing unit CPU 412-3H ... 5H PN/DP
	Central processing unit CPU 414-4H ... 5H PN/DP
	Central processing unit CPU 416-5H PN/DP
	Central processing unit CPU 417-4H ... 5H PN/DP
Synchronization modules	Synchronization modules
Synchronization cable	Synchronization cable (up to 10 km)

Hardware components	
Communication processors	Communication processor CP 443-5 Extended
	Communication processor CP 443-1

Setup



Racks

The following racks are available for installing the S7-400H. Normally, the UR2-H rack is used.

Type	Slots	Special feature
Rack UR2-H	2 x 9	Installation of two separate subsystems each with nine modules. The two subsystems are electrically isolated (not mechanically). It is not possible to replace a rack in runtime.
Rack UR2	1x 9	Two racks are required for an S7-400H . You can replace a rack in runtime.
Rack UR1	1x 18	Two racks are required for an S7-400H . You can replace a rack in runtime.
Rack CR3	1x 4	Two racks are required for an S7-400H . You can replace a rack in runtime.

Central processing units

There are two CPUs in an H-system. The two CPUs are connected to one another using synchronization modules and fiber-optic cables.

Power supply

A separate power supply module from the standard S7-400 series is needed for each subsystem of the S7-400H. Two power supply modules can be used in each subsystem to increase the availability of the high availability system. In this case, use the following power supply modules that can be used for redundancy.

Power supply modules for 24 VDC as well as for 120/230 VAC nominal input voltages with output currents of 10 and 20 A.

Synchronization modules

Synchronization modules are used to link the two central processing units. They are installed in the central processing units and interconnected with fiber-optic cable. Two synchronization modules are installed in each CPU.

Set the rack number for the H CPU as of firmware version V4.X directly on the CPU. The synchronization modules can be replaced in runtime.

The same rack number must be set at all synchronization modules up to firmware V3.x.

Fiber-optic cables for synchronization

The fiber-optic cables are connected to the synchronization modules and form the physical connection (redundancy link) between the two automation stations. The synchronization cables must not be cross-connected.

In addition to the standard lengths of 1 m, 2 m, and 10 m, custom-made synchronization cables are available in lengths up to 10 km.

Transmission medium

The suitable physical transmission medium depends on the range, resistance to interference and the transmission rate.

- Industrial Ethernet using fiber-optic cables or triaxial or twisted-pair copper lines can be used for communication between the automation system and the OS servers.
- PROFIBUS DP or PROFINET IO with electrical or optical components is used for communication from the automation system to the distributed I/O device.

The transmission media and communications processors can be configured redundantly. If the active communication component (CP, bus) fails, the communication automatically continues through the redundant connection.

High availability communication for plant bus:

- The communication modules should be configured to use ISO protocol.
- Exception:
  High availability communication with CPU 41x PN/DP and SOFTNET-IE S7 REDCONNECT
  The communication modules need to be configured to use ISO-on-TCP.

Equipping the rack

The hardware setup in the automation system and the configuration in HW Config must match:

- Rack (4, 9 or 18 slots for redundant and, in some cases, remote configuration)
- Power supply modules (in some cases redundant configuration)
- H CPU with sync modules in slots "IF1" and "IF2"
- If necessary: Communications processors (CP 443-1, CP 443-5 Extended)

Configuration

A pre-existing network can be used for high availability communication between non-redundant SIMATIC stations and (redundant) SIMATIC H stations. You set the parameters of the high availability S7 connections in NetPro.

The required communication blocks for data transmission (measured values, binary values, interlocks) are available in the *PCS 7 Library*. The communication blocks differ in their transmission mechanism which, for example, may be secured or unsecured.

Additional information

- Section "How to add a SIMATIC H station to your project (Page 114)"
- Section "How to insert synchronization modules into the H CPU (Page 116)"
- Section "How to configure redundant communication processors (Page 117)"
- Section "Time synchronization (Page 111)"
- Manual *Automation System S7-400H; High Availability Systems*

5.2.2 How the SIMATIC S7-400H AS operates

Active redundancy

The automation system consists of two redundantly configured subsystems, which are synchronized through fiber-optic cables.

The two subsystems form a high availability automation system that operates with a dual-channel design according to the principle of active redundancy. Active redundancy, often referred to as functional redundancy, means that all redundant components are in continual operation and simultaneously involved in the acquisition of process data. The control task is the responsibility of the redundancy partner that is active at any given time. The user programs loaded in both CPUs are fully identical and are run synchronously by both CPUs.

If the active CPU fails, the automation system automatically switches to the redundant CPU (see section "Hardware components of the S7-400H (Page 52)" and documentation *Process Control System, SIMATIC PCS 7, Released Modules*). The switchover has no effect on the ongoing process because it is bumpless.

Additional information

- Section "Failure of the master CPU (Page 210)"
- Section "Failure of a fiber-optic cable (Page 210)"
- Manual *Automation System S7-400H; High Availability Systems*

5.3 Solutions for communication

Introduction

In this section, you will learn about the redundancy concepts for the various levels of the process control system.

Requirements for communication systems

The availability of a process control system is not only determined by the automation system, the environment also plays a considerable role. This includes not only the operator control and monitoring components but also a high-performance communication system that connects the management level to the process level and the process level to the field level.

Distributed control systems are also needed in the manufacturing and processing automation. Complex control tasks are broken down into smaller, simpler steps with distributed form. The demand for communication between distributed systems increases.

High-performance, comprehensive communication system is needed to fulfill this demand. The communication connections between the systems involved should be **redundant**.

Local networks (LAN) form the basis of the communication system. The following are options that can be implemented based on the specific system requirements:

- Electrical
- Optical
- Electrical/optical combination

The communication connections are grouped in three areas:

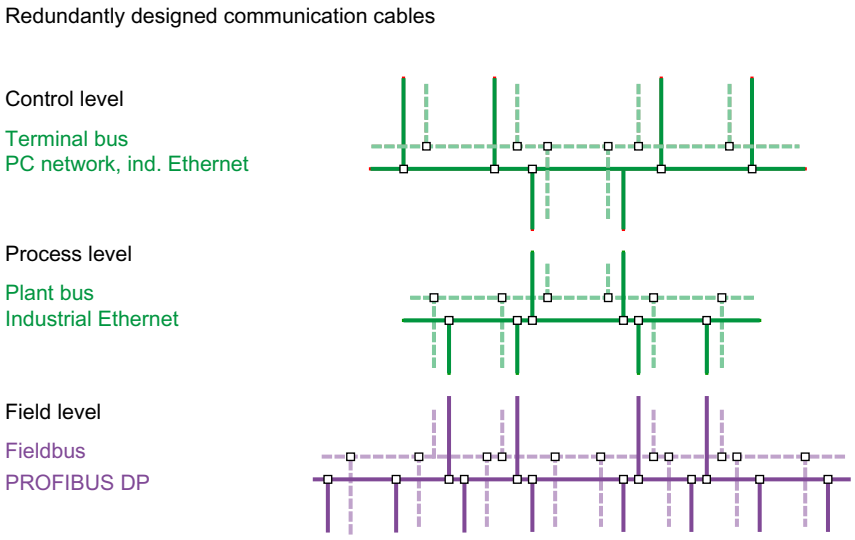
- Terminal bus
- Plant bus
- Fieldbus

In PCS 7, we recommend that the bus systems are set up in a ring structure. The ring structure makes the bus "high availability", since it can compensate for the failure of a bus line.

Redundant communication connections

Redundant communication connections can be formed on all levels of the process control system.

When a communication error occurs, communication automatically switches over from the active connection to the backup connection. Both connections use the same media and protocols. The switchover has no effect on the user program running in the CPU.



Overview of the redundant and high availability bus systems

In PCS 7 systems, you can configure **fully redundant bus systems** with redundant components for the following bus systems:

- Redundant, high availability terminal bus (Page 68)
- Redundant, high availability plant bus (Page 76)
- Redundant PROFIBUS DP (Page 81)

Bus systems set up as a ring are **high availability**. In ring structures, the signal path remains intact even if there is a disconnection on the transmission cable at any point in the ring (for example due to a wire break). The availability is ensured by ring redundancy.

This high availability is used in the following bus systems:

- High availability terminal bus (Page 66)
- High availability plant bus (Page 74)
- High availability PROFIBUS PA (Page 89)
- High availability FOUNDATION Fieldbus (Page 95)
- High availability fieldbus based on PROFINET (Page 83)

The following sections describe the basics of these communications solutions.

5.3.1 Network components

Introduction

Local networks (LAN) form the basis of the communication system. The following are options that can be implemented based on the specific system requirements:

- Electrical
- Optical
- Optical/electrical (mixed operation)

Overview of the network components

You can set up bus systems with the following link and switch modules of SIMATIC NET.

Network component	Bus system	Application
Switch (SCALANCE series)	Terminal bus Plant bus	Type-specific use in network setup Selected SCALANCE X components enable the following: • Transmission rates up to 10 Gbps • Media converter (electrical/optical bidirectional) • Function as redundancy manager (configuration of ring redundancy) • Function as standby manager or MRP-I Manager (redundant linking of networks) Depending on the type, either optical or electrical connections are used.
SCALANCE X204 RNA (communication on the basis of the Parallel Redundancy Protocol - PRP)	Terminal bus	Connecting a singular infrastructure component to the redundant terminal bus. For example: • A master clock for a system, e.g. SICLOCK TC400 • domain controller • File server Ports: • 2 ports for the infrastructure components • 2 ports for the connection to the redundant terminal bus (LAN A and LAN B)
RNA Box	Terminal bus	Connecting a singular infrastructure component to the redundant terminal bus. For example: • A master clock for a system, e.g. SICLOCK TC400 • domain controller • File server Ports: • 2 ports for the infrastructure components • 6 ports for the connection to the redundant terminal bus (LAN A and LAN B)

Network component	Bus system	Application
Switch (SCALANCE series)	Fieldbus • PROFINET	• Fieldbus as high availability PROFINET ring
OLM (Optical Link Module)	Fieldbus • PROFIBUS DP	Setup of optical transmission paths Configuration variants: • DP master (electrical) > OLM > FO > OLM > interface module (**electrical** connection) • DP master (electrical) > OLM > FO > interface module (**optical** connection)
AFD (Automatic Field Distributor) **AFDiSD**	Fieldbus • PROFIBUS PA • FOUNDATION Fieldbus	Connection of field devices via ring redundancy • Maximum of 31 fieldbus components on one bus • Maximum of 8 AFD/ADFiSD on a redundant bus link • Maximum of 4 field devices per AFD • Maximum of 6 field devices per AFDiSD
AFS (Automatic Field Splitter)	Fieldbus • PROFIBUS PA • FOUNDATION Fieldbus	Connection of field devices via coupler redundancy • 1 AFS on a redundant bus link • Up to 31 fieldbus components on the AFS

Redundancy manager

Certain network components in the SIMATIC NET product range support the redundancy manager function.

This function enables the configuration of ring redundancy. Network components operating as the redundancy manager can ensure that the bus connections remain undisturbed if there is a fault on a bus line (such as a cable break).

Example of a ring structure with SCALANCE X400 and X200

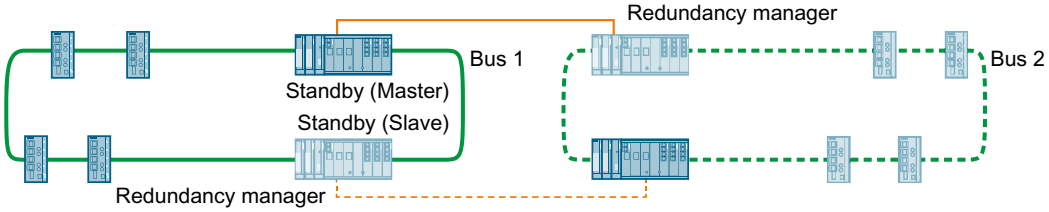
The SCALANCE X414-3E as the redundancy manager has a gray background in the figure.



Standby

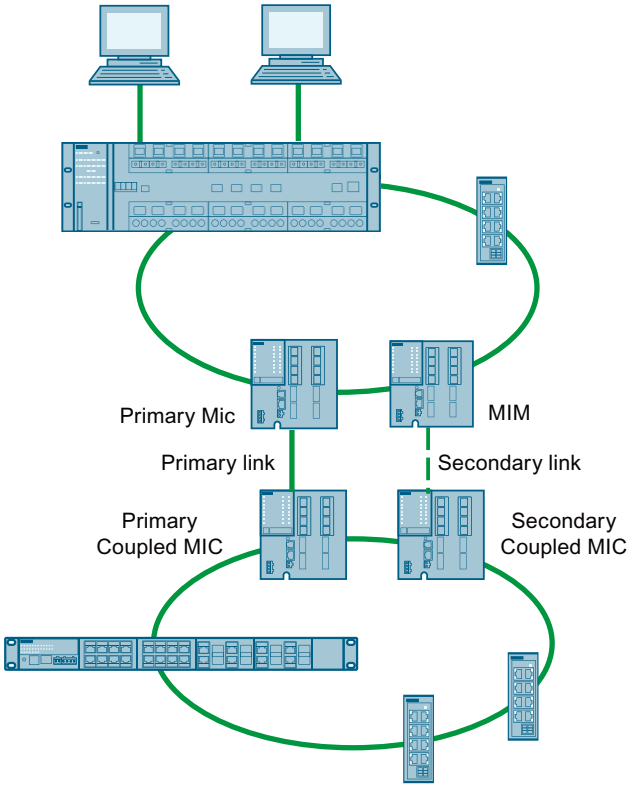
Switches and data links (network cable) connect the redundant networks. Redundant coupling of networks is only possible if two devices (switches) within a network segment support the standby function. Certain network components from the SIMATIC NET product range support this function.
Within a network segment, both devices are configured for the standby function. The two devices exchange data frames via the bus line and thereby synchronize their operating status. One network component becomes the standby (master) and the other standby (slave).
When operation is error-free, the data link running between the redundant networks is active for the standby (master). If this data link fails (e.g., due to a defective device or cable break), the standby (slave) activates its data link while the fault remains pending.

Example of a ring structure with SCALANCE switches



MRP Interconnection

The MRP Interconnection mode is an extension of MRP and enables redundant linking of two or more MRP rings in networks without real-time capability. MRP Interconnection similar to MRP is specified in the standard IEC 62439-2. MRP Interconnection allows for very fast reconfiguration; the reconfiguration time is typically less than 200 milliseconds.



The requirement for MRP Interconnection is that MRP is used in all rings involved. Four devices are required for the two MRP Interconnection connections:

- One Media Redundancy Interconnection Manager (MIM, shown with a yellow outline in the diagram)
- Three Media Redundancy Interconnection Clients (Primary MIC, Primary Coupled MIC and Secondary Coupled MIC)

All the devices shown in the above diagram are part of an MRP ring and each device takes one of the roles defined for MRP, for example: MRP-Client or MRP-Manager.

Depending on the connection status of the interconnection ports, Primary MIC and Primary Coupled MIC send status messages (Link up or Link down) to the MIM. Interconnection ports are ports that are connected over the primary or secondary link. This means, the MIM is always informed about the connection status between the Primary MIC and the Primary Coupled MIC ("primary link") as well as its own connection to the Secondary Coupled MIC ("secondary link"). In regular operation, the data exchange between the two rings is via primary link and the MIM blocks its interconnection port. If a Link down of the primary link is signaled to MIM, it switches its interconnection port to the "Forwarding" status, and the data exchange between the two rings is via secondary link between MIM and Secondary Coupled MIC.

SCALANCE X switches for setting up redundant networks

You can find additional information on SCALANCE X switches approved for PCS 7 in the *Process Control System PCS 7; Released Modules* documentation. The switches must have the necessary functions available to set up the relevant redundant network:

- Redundancy manager
- Standby manager
- Parallel Redundancy Protocol

PC stations on networks

The PC stations are connected to the networks via network adapters and network cables.

The network adapters occupy a slot in the PC or programming device (PG). The following different network adapters are used depending on requirements. You can find information about this in the following sections:

- Section "Connecting PC stations to the terminal bus (Page 65)"
- Section "Connecting PC stations to the plant bus (Page 73)"

Additional information

- Documentation *Process Control System PCS 7; PCS 7 Readme*
- Documentation *Process Control System PCS 7; Released modules*
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC Net PROFIBUS Networks*
- Manual *SIMATIC; Communication with SIMATIC*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-200*
- Operating instructions SIMATIC NET; *Industrial Ethernet; RNA Box, SCALANCE X204RNA EEC*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-300*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Configuration Manual *SIMATIC NET; Industrial Ethernet Switches; SCALANCE X-300; SCALANCE X-400*

5.3.2 Media Redundancy Protocols

Use of media redundancy protocols

Note

The X200 IRT switches cannot serve as redundancy manager and standby manager at the same time.

The standby manager can only be operated with the High Speed Redundancy Protocol. Standby redundancy and media redundancy protocol do not work together.

	HRP	Standby	MRP	MRP-I
Separate terminal and plant bus	X	X	X	X
Common terminal and plant bus	X	X	X	X
PROFINET fieldbus	-	-	X	-

Note

PROFINET fieldbus

If you configure a fieldbus ring with PROFINET, you must use the Media Redundancy Protocol (MRP). The High Speed Redundancy Protocol (HRP) and MRP cannot be used simultaneously in a ring. The PROFINET fieldbus ring may only consist of devices that support MRP functionality.

High Speed Redundancy Protocol (HRP)

HRP is used for redundant coupling in a terminal and plant bus ring.

Ring redundancy and redundant connection of rings are possible by means of configuration of the following functions:

- Redundancy manager
- Standby

High Speed Redundancy (HSR - obsolete)

Obsolete term: This term can be found in older firmware versions of Industrial Ethernet switches. The functionality corresponds to that of HRP. You can find additional information about High Speed Redundancy and High Speed Redundancy Protocol in the documentation of the Industrial Ethernet switches.

Media Redundancy Protocol (MRP)

MRP is a redundancy mechanism for network rings based on ethernet. All devices must support MRP.

Note

Industrial Ethernet switches that support MRP

The following Industrial Ethernet switches support the MRP function:

- SCALANCE XB-200 as of firmware V1.2
- SCALANCE X-200 as of firmware V4.0
- SCALANCE XC-200 as of firmware V2.1
- SCALANCE XP-200 as of firmware V2.0
- SCALANCE X-300 as of firmware V3.0
- SCALANCE X-400 as of firmware V3.0
- SCALANCE XM-400
- SCALANCE XR-500

Media Redundancy Protocol-Interconnect (MRP-I)

MRP-I supports the coupling of MRP Rings in Terminal and Plant bus

Note

Industrial Ethernet switches that support MRP-I

The following Industrial Ethernet switches support the MRP-I function:

- SCALANCE XC-200 as of firmware V4.2
- SCALANCE XP-200 as of firmware V4.2
- SCALANCE XF-200BA as of firmware V4.2
- SCALANCE XM-400 as of firmware V6.3
- SCALANCE XR-500 as of firmware V6.3

Configuration of the watchdog time (only for the PROFINET fieldbus)

When a transmission path fails, it may take up to 200 ms to reconfigure the network (switching to the redundant transmission path).

Increase the watchdog time for each station by adjusting the following values:

- Select the "fixed update time" setting.
- Increase the update time to a value that is less than the fastest update of the process image partition (PIP) for this station.
- Increase the number of accepted update cycles with missing I/O data, so that the watchdog time is > 200 ms.

Additional information

- You can find information about configuration of PROFINET in the *PROFINET System manual; System Description*. You can find more information on internet (https://support.industry.siemens.com/cs/us/en/view/55422236).
- You can find information about HRP, Standby, MRP and MRP-I in the documentation of the Industrial Ethernet switches.
- You can find information about High-availability Seamless Redundancy (HSR) in the section "Redundant, high availability terminal bus based on the Parallel Redundancy Protocol (PRP)".

5.3.3 Solutions for the terminal bus

5.3.3.1 Connecting PC stations to the terminal bus

You connect the following PC stations to industrial Ethernet via network adapters (communication modules or communication processors):

- Operator stations
- BATCH stations
- Route Control stations
- Engineering stations

The network adapters occupy a slot in the PC or programming device (PG). Depending on the requirement.

Network adapters for connection to the terminal bus

The following network adapters are released in PCS 7 (standard communication modules):

- PCIe network adapters
- Integrated network adapter
  - INTEL ... (LM-Adapter)
  - INTEL ... (L-Adapter)

Variants for the redundant connection of the PC station to a terminal bus

- High availability terminal bus (Page 66)
- Redundant, high availability terminal bus (Page 68)

Using the product documentation, check whether the network adapters are suitable for realizing the respective concept for the terminal bus.

Additional information

- Documentation *Process Control System PCS 7; Released modules*
- Documentation *Process Control System PCS 7; PCS 7 Readme*

5.3.3.2 High availability terminal bus

The terminal bus connects the servers (OS servers, BATCH servers, Route Control servers) with the clients of the process control system (OS clients, BATCH clients, Route Control clients).

high availability terminal bus can be set up in a ring structure with network components of SIMATIC NET. The network components enable unrestricted operation of the terminal bus. For example, a broken cable in the connection between the modules is tolerated and communication remains uninterrupted.

If the terminal bus experiences problems, no process data are sent from the servers to the clients.

High availability communication solutions

The following solutions are available to guard against failure of the terminal bus:

- Ring structure in an electrical network. The connection to the switches is electrical.
- Ring structure in an optical network with switches and FO cables. The connection to the switches is electrical or optical.
- Ring structure in a combined network with optical and electrical switches and FO cables. The connection to the switches is electrical.
- Ring structures as optical, electrical and combined networks with transfer rates up to 1 Gbps based on the modular switches

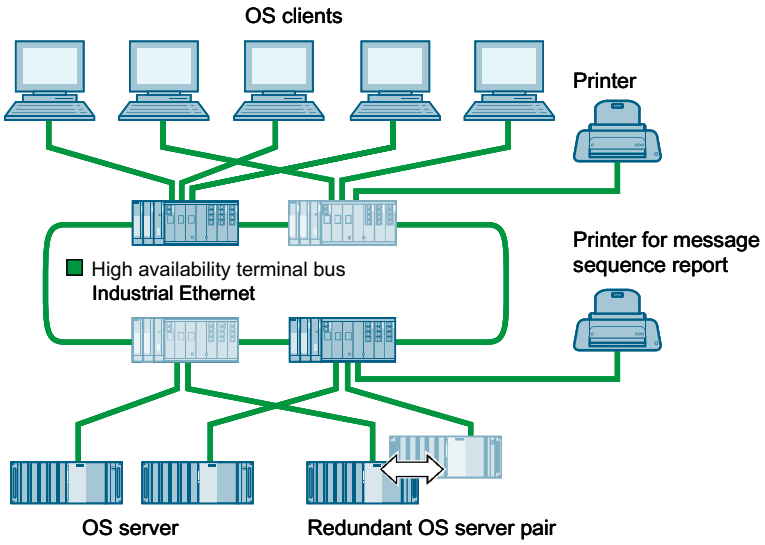
Configuration

In the following figure, the terminal bus is shown as a ring with switches as an example. The OS servers are connected to the switches in a distributed pattern in order to take optimal advantage of the switch functionality. The probability of OS server failure due to the failure of a switch and the bus load are thereby reduced.

The log data of the control process is secured and continuously available if you use two OS clients each equipped with a line printer for printing the message sequence reports.

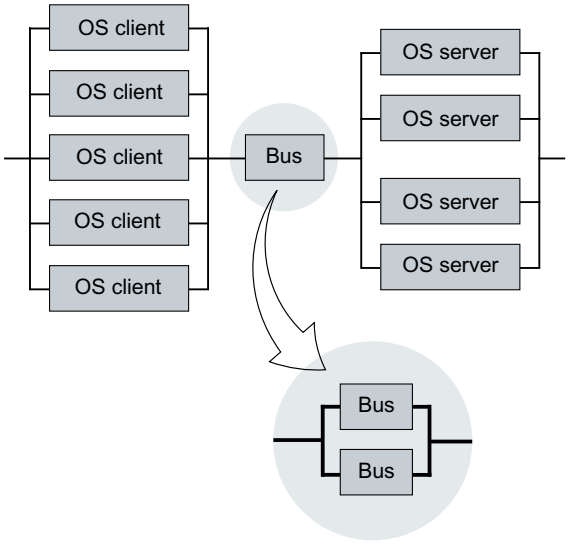
Note

If a switch fails, the connection to the associated nodes will also fail. Therefore, redundant servers must not be connected to the same switch.



Availability

If there is a fault in a ring line, the communication between clients and servers via the switches remains unaffected. However, if one of the switches fails, the link between the connected OS servers and the OS clients is interrupted. To increase the high availability even more, however, the redundant ring described in the following section can be used.



Additional information

- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-300*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-200*

5.3.3.3 Redundant, high availability terminal bus

Functionality

The terminal bus connects the servers (OS servers, BATCH servers, Route Control servers) etc. with the clients of the process control system (OS clients, BATCH clients, Route Control clients).

The following solutions for a redundant, high availability terminal bus is offered:

- Redundant, high availability terminal bus based on the Parallel Redundancy Protocol (PRP) Separate double ring with PRP; solution in accordance with IEC 62439-3)

Redundant components

The following components are configured redundantly:

- Electrical or optical network with Ethernet switches
- Switches, fiber optic cables and electrical connections
- Ring structures based on switches from the SCALANCE and Ruggedcom series.

You can find additional information on the switches used with PCS 7 in the section "Network components (Page 58)".

Additional information

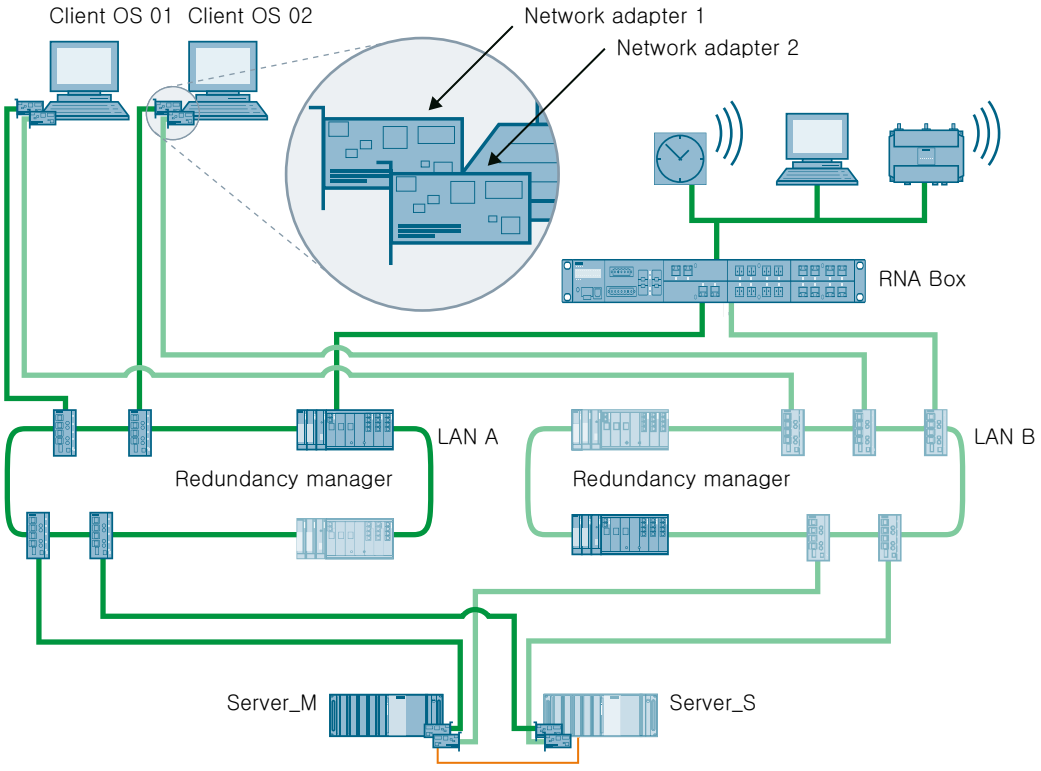
- Section "How to configure the redundant terminal bus on the basis of the Parallel Redundancy Protocol (Page 122)"
- Documentation *PCS 7 Released Modules*
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Configuration manual *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-200*
- Operating instructions *SIMATIC NET; Industrial Ethernet; "RNA Box, SCALANCE X204RNA EEC"*
- Operating instructions *SIMATIC NET; PG/PC - Industrial Ethernet; SOFTNET-IE RNA*
- Online help for SOFTNET IE RNA
- As of SIMATIC PCS 7 V10.0, RUGGEDCOM RMM2972M-4SFP and RMM2973M-4RJ45 MACsec Media Modules is supported. For more information, refer Ruggedcom Switches (https://support.industry.siemens.com/cs/ww/en/view/109820644).

5.3.3.4 Redundant, high availability terminal bus based on the Parallel Redundancy Protocol (PRP)

The section below describes the basic structure of a redundant high availability terminal bus using the SIMATIC NET SOFTNET-IE RNA software. This software is based on the Parallel Redundancy Protocol (PRP) as specified in IEC 62439-3.
Each PC station is connected to 2 separate redundant networks with two network adapters each. The communications processes on the redundantly connected PC stations are organized by the SIMATIC NET SOFTNET-IE RNA software.

The SIMATIC NET SOFTNET-IE RNA software package is required on each redundantly connected PC station.
You can find additional information on this in the section in the *Process Control System PCS 7; PCS 7 Released modules V10.0* manual.

The following diagram illustrates a sample configuration based on the SIMATIC NET SOFTNET-IE RNA software:



Configuration limits for the operator station

You can find information about this in the documentation *Process Control System PCS 7;* Licenses and Configuration Limits.

Redundant, high availability terminal bus with SIMATIC NET SOFTNET-IE RNA

All protocols among the redundantly connected components are automatically duplicated, sent and distributed in the mutually redundant networks. The respective receiver uses the first incoming frame with the same information from the redundant networks.
Advantages:

- Easy administration
- A fault on one bus has no effect on the redundant bus

Components

SCALANCE series switches are used to connect the components. Recommended switches that support the Parallel Redundancy Protocol may be found in the *Process Control System PCS 7; Released modules* documentation.

Encrypted communication

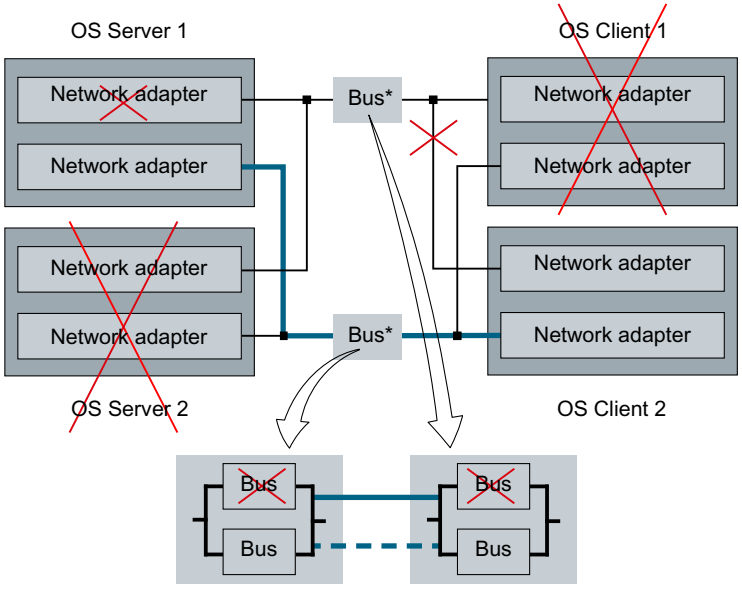
"Encrypted communication" is not approved for stations with SIMATIC NET SOFTNET-IE RNA.

Note

It does not apply for WinCC/SCS secure communication.

Availability - redundant high availability terminal bus

The entire transmission route can be configured redundantly. A transmission route remains operational for communication on the terminal bus if any of the network components fails.



Connecting non-redundant networks and components

An integrated solution of network components and protection devices can be implemented for a substation or process application using PRP-compatible SCALANCE X products. Connect components having only one network connection to the redundant, high availability terminal bus using the RNA Box. Select this connection for infrastructure components, for example:

- Central plant clock (e.g. Burk DTS4138S)
- Domain controllers (DCs), DNS, WINS, DHCP, WSUS
- WLAN access point
- File server

Requirements

- A maximum of 2 non-redundant networks and components with only one network connection for each RNA Box
- Two separate, redundant terminal bus networks
- Maximum distance to network node (component/switch):
  - Standard Ethernet cable up to 10m
  - IE FastConnect cable up to 100m

Recommendation for use

The PRP protocol requires the transmission of additional protocol information. The transmission rate of 1000 Mbps is not fully reached when PRP is used.

Recommendation:

Stations that transport a high volume of data over the network should always be connected directly to the redundant rings using two network adapters and the "SIMATIC NET SOFTNET-IE RNA" software. This recommendation applies to the following PC stations in PCS 7:

- Process Historian
- BATCH server
- OpenPCS 7 station

Note

Highly recommended

For PC's used for infrastructure purposes, for example, DC's, DNS, WINS, DHCP, WSUS and virus scanner, it is highly recommended that the PC should be connected via the RNA Box switch.

MTU size is very important for communication between RNA and non RNA devices. For more information, refer to the section "Workgroup and domain" in the *PCS 7 PC-Configuration* manual.

Common bus system for terminal bus and plant bus

As of PCS 7 V8.0 SP1, you can operate redundant, separate bus systems as a common terminal bus and plant bus. Configure each redundant bus system as described in the following sections:

- Section "How to configure the redundant terminal bus on the basis of the Parallel Redundancy Protocol (Page 122)"
- Section "How to configure a high availability plant bus (Page 123)"

Note

Using VLAN

You can use a Virtual Local Area Network (VLAN) to divide a physical bus system into logical subnets (e.g. terminal bus and plant bus).

For more information, refer FAQ (https://support.industry.siemens.com/cs/document/66807297).

Additional information

- Online help for "SIMATIC NET SOFTNET-IE RNA" software
- Section "How to configure the redundant terminal bus on the basis of the Parallel Redundancy Protocol (Page 122)"
- You can find information on the available operating systems in the *PCS 7 Readme* file

You can find additional information on this on the Internet Technical documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/document/109801081):

- Operating Instructions *SIMATIC NET; Industrial Ethernet; "RNA Box", SCALANCE X204RNA EEC*
- Operating instructions *SIMATIC NET; PG/PC - Industrial Ethernet; SOFTNET-IE RNA* V8.2
- For more information on Ruggedcom refer *Process Control System PCS 7; PCS 7 Released modules V10.0* manual.

5.3.4 Solutions for the plant bus

5.3.4.1 Connecting PC stations to the plant bus

Network adapters for connection to the high availability plant bus (1 ring)

Suitable network adapters are required in the PC station to establish the connection to the communication partners in the plant.

Network adapter	Number of connections	Connection type	Redundancy type
1x Standard Ethernet network adapter	8	S7 connection	-
	4	S7 connection, fault-tolerant (prerequisite: CPU as of firmware version V6.0)	2-way redundancy
1x Communications processor (CP 1623/CP 1628)	64	S7 connection	-
	32	S7 connection, fault-tolerant	2-way redundancy
2x Communications processor (CP 1623/CP 1628)	32	S7 connection, fault-tolerant	2-way redundancy
	16	S7 connection, fault-tolerant	4-way redundancy

Network adapters for connection to the redundant, high availability plant bus (2 rings)

You need network adapters with an integrated processor for connection to the redundant, high availability plant bus.

Network adapter	Number of connections	Connection type	Redundancy type
2x Communications processor (CP 1623/CP 1628)	32	S7 connection, fault-tolerant	2-way redundancy
	16	S7 connection, fault-tolerant	4-way redundancy

License key for AS communication

Depending on the network adapters used, you need a license key for PC stations with communication to the AS.

When using high availability S7 connections, you require a license for the software S7-REDCONNECT .

Network adapter	License key for product
Standard Ethernet network adapter	BCE
Standard Ethernet network adapter with high availability connections	SOFTNET-IE S7 REDCONNECT
When using SIMATIC NET CP (e.g. CP 1623)	Industrial Ethernet (IE)
When using SIMATIC NET CP (e.g. CP 1623) with high availability connections.	HARDNET-IE S7 REDCONNECT

Additional information

- You can find approved network adapters in the Catalog Overview *Process Control System PCS 7; Released Modules*
- Documentation *Process Control System PCS 7; PCS 7 Readme*
- *PCS 7 Virtualization - Project Engineering and Configuration*

5.3.4.2 High availability plant bus

The plant bus connects automation systems to servers (OS server, Route Control server). The connection to a high availability plant bus is implemented with Ethernet communications processors (CPs) that are installed in each subsystem of the automation system and in the servers.

High availability plant bus can be set up in a ring structure with network components of SIMATIC NET. The network components ensure unrestricted operation of the plant bus. For example, a broken cable in the connection between the modules is tolerated and communication remains uninterrupted.

If the plant bus is disrupted, no process data are transferred between the servers and the automation systems or between the automation systems themselves.

High availability communication solutions

The following communication solutions are offered to prevent a possible failure:

- Ring structure in an electrical network.
  The connection to the switches is electrical.
- Ring structure in an optical network with switches and FO cable.
  The connection to the switches is electrical or optical.
- Ring structure in a combined network with optical and electrical switches and a FO cable.
  The connection to the switches is electrical.
- Ring structures as optical, electrical and combined networks with transmission rates up to 1 Gbps based on modular SCALANCE X switches

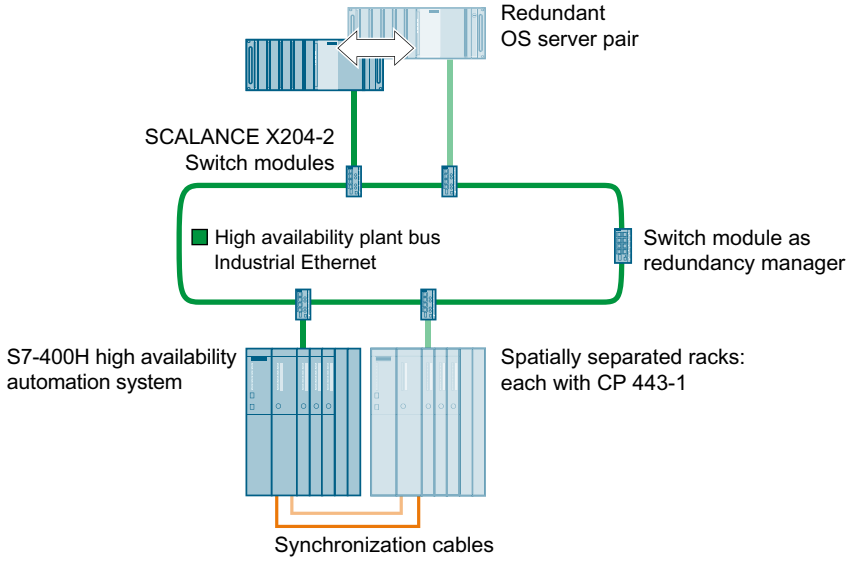
The use of switches from the SCALANCE series is recommended. Modules for optical and electrical connection are available for these switches.

Configuration - ring structure

The following figure represents a high availability plant bus in a ring structure with switches.

The following automation systems can be used:

- AS 41xH

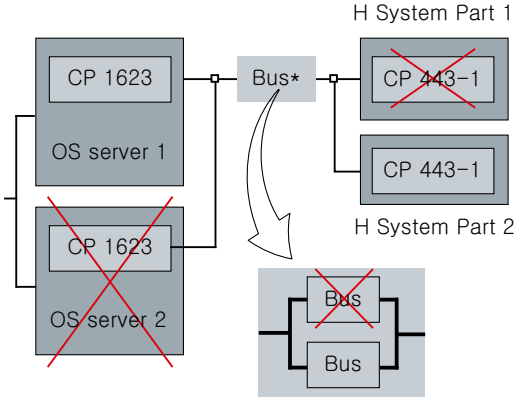


Availability - ring structure

In this system, one CP 443-1 may fail in each subsystem of the AS without this affecting the complete system.

The plant bus (identified by an * in the following figure) is equipped with switches for high availability operation. Each OS server is wired to two switches. The bus can be separated at any location. The overall system remains functional even if a switch fails. The redundant OS partner server then communicates via the functional switch. The same scenario applies to the switches that each have a CP of a subsystem of the H system connected.

To guard against the failure of all switches, however, the redundant double ring described in the following section can be used.



Additional information

- Section "How to configure a high availability plant bus (Page 123)"
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC; Communication with SIMATIC*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*

5.3.4.3 Redundant, high availability plant bus

Functionality

The plant bus connects automation systems to servers (OS server, Route Control server). The connection to a redundant, high availability plant bus is implemented with Ethernet communication processors (CPs) that are installed in each subsystem of the automation system and in the servers.

A redundant, high availability plant bus is set up using two identical, separate plant bus rings (double ring). The network components ensure unrestricted operation of the plant bus. If one of the plant buses fails, communication is maintained over the second plant bus.

Redundant communication solutions

The following communication solutions are offered to prevent a possible failure:

- Redundant electrical or optical network with switches set up as Industrial Ethernet
- Combined redundant network with switches, FO cables and electrical connection
- Ring structures can be set up based on modular switches from the SCALANCE series. (Can be implemented as optical, electrical and combined networks)

The use of switches from the SCALANCE series is recommended. Modules for optical and electrical connection are available for these switches. You can find additional information on the switches used with PCS 7 in the "Network components (Page 58)" section.

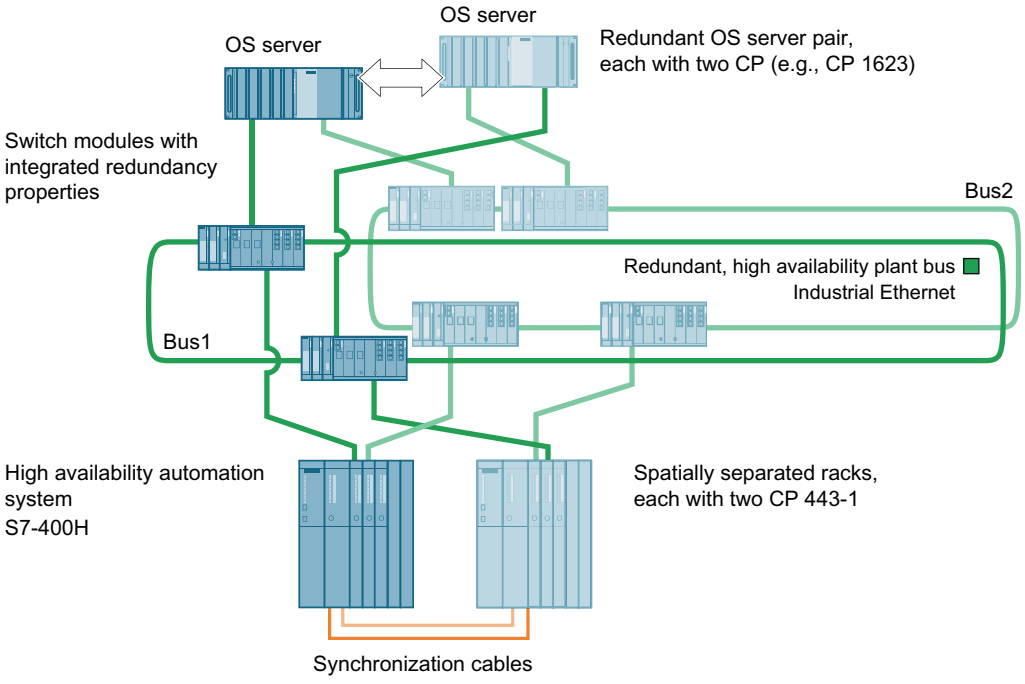
Configuration - redundant, high availability plant bus

The figure below shows the basic configuration of the redundant, high availability plant bus.

- Bus1 shows the functionally correct configuration (shared switches for AS and OS).
- Bus2 shows the typical configuration in PCS 7 plants (separate switches for AS and OS).

Note

Check the redundancy behavior of the individual components during commissioning.



Note

Address areas and IP addresses of the components on the plant bus

Always assign IP addresses in different IP address ranges to the network adapters (separate address range for Bus1 and separate address range for Bus2).

Example:

- Ring 1:
  - IP address area: 192.168.1.0 - 192.168.1.255
  - Subnet mask: 255.255.255.0
- Ring 2:
  - IP address area: 192.168.2.0 - 192.168.2.255
  - Subnet mask: 255.255.255.0

AS 41xH on redundant, high availability plant bus

A redundant AS can be connected to each CPU without redundant communication modules.

Connection possibilities:

- Single connection of every AS 41xH sub-system with a CP per CPU.
- Single connection of every AS 41xH sub-system via the CPU's internal Ethernet-interface.

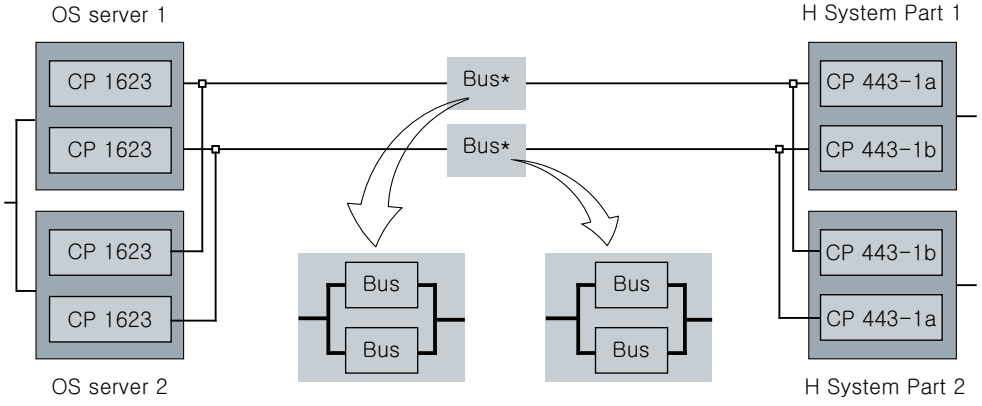
AS 410 on redundant, high availability plant bus

An AS 410 can be connected without communication modules to a redundant, high availability plant bus. You can find additional information on this in section "AS 410H on redundant, high availability plant bus (Page 79)".

Availability - redundant, high availability plant bus

The block diagram for a redundant, high availability plant bus with two CPs each in both OS servers and additional switches appears as follows:

In this system, one CP 1623 can fail in each OS server or one CP 443-1 in each subsystem of the AS without this affecting the complete system. The plant bus (bus) is configured redundantly and with redundant switches in each case. As a result, a failure of the bus component and all components involved (switches) is covered.



Additional information

- Section "Connecting PC stations to the plant bus (Page 73)"
- Section "Media Redundancy Protocols (Page 63)"
- Section "How to configure a high availability plant bus (Page 123)"
- Documentation *PCS 7 Released Modules*
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Manual *SIMATIC Communication with SIMATIC*

5.3.4.4 AS 410H on redundant, high availability plant bus

Functionality

The plant bus connects automation systems to servers (OS server, Route Control server).

An automation system with a SIMATIC S7 410H-type CPU can be connected to a redundant, high availability plant bus.

In the event of a plant bus failure, the CPU's second Ethernet connection enables communication via the second plant bus.

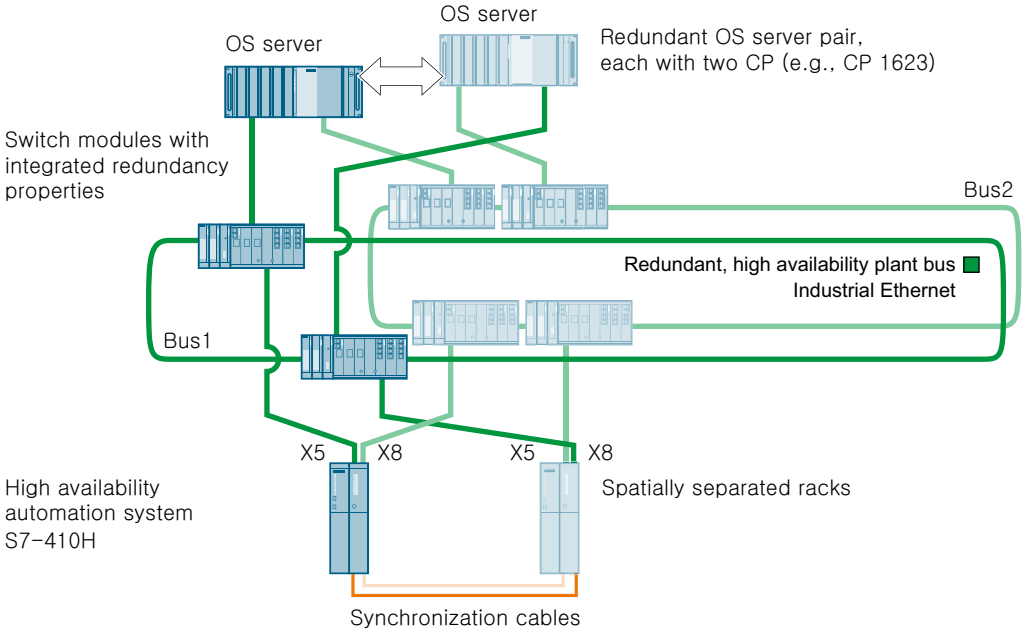
Configuration - AS 410H on redundant, high availability plant bus

The figure below shows the basic structure of the redundant, high availability plant bus with an AS 410H. The AS 410H also has 2 Ethernet connections and can be connected to the redundant, high availability plant bus.

- Bus1 shows the functionally correct configuration (shared switches for AS and OS).
- Bus2 shows the typical configuration in PCS 7 plants (separate switches for AS and OS).

Note

Check the redundancy behavior of the individual components during commissioning.



Note

Address areas and IP addresses of the components on the plant bus

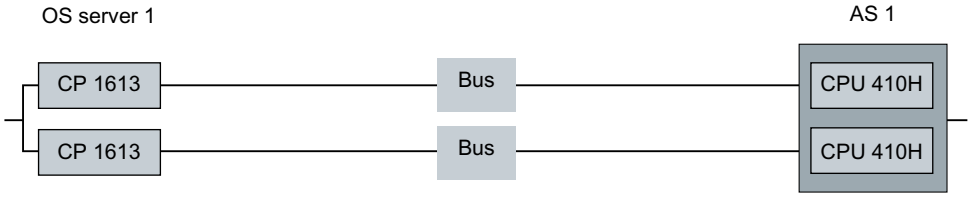
Always assign IP addresses in different IP address ranges to the network adapters (separate address range for Bus1 and separate address range for Bus2).

Example:

- Ring 1:
  - IP address area: 192.168.1.0 - 192.168.1.255
  - Subnet mask: 255.255.255.0
- Ring 2:
  - IP address area: 192.168.2.0 - 192.168.2.255
  - Subnet mask: 255.255.255.0

Availability - high availability available plant bus

The block diagram for a redundant, high availability plant bus with a CPU 410H and two CPs in the OS server is shown below:



In this system, one CP 1623 or one subsystem of the AS can fail in the OS server without affecting the overall system. The plant bus (bus) is configured redundantly and with redundant switches in each case. As a result, a failure of the bus component and all components involved (switches) is covered.

Additional information

- Manual *SIMATIC; PCS 7 Process Control System; CPU 410-5H Process Automation*
- Section "How to add a SIMATIC H station to your project (Page 114)"
- Manual *SIMATIC; Automation System S7-400H; High Availability Systems*

5.3.5 Solutions for the fieldbus

5.3.5.1 Redundant PROFIBUS DP

Functionality

The field bus is used for data exchange between the automation system (AS) and the distributed I/O. PROFIBUS DP (distributed peripheral) the field bus standard for manufacturing and process automation is used. PROFIBUS DP includes the specifications for the following elements:

- Physical bus characteristics
- Access method
- User protocol
- User interface

PROFIBUS DP is suitable for fast, cyclic data exchange with field devices. It is used to connect distributed I/O, for example, ET 200M, with very fast response times.

It is often advantageous to connect several DP master systems to an automation system in order to increase the number of I/O components that can be connected. This also enables segments to be formed, allowing individual production areas to operate independent of one another.

High availability communication solutions

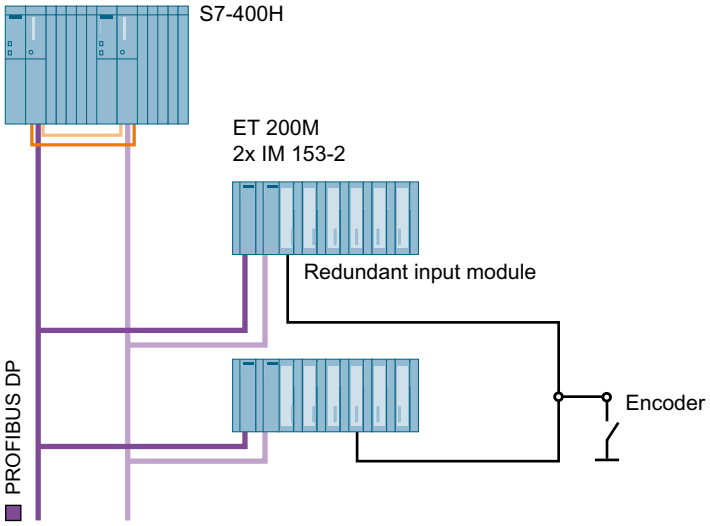
The following high availability communication solutions are offered for PROFIBUS DP:

- Redundant PROFIBUS DP as an electrical network
- Redundant PROFIBUS DP with OLMs (optical network)

Configuration

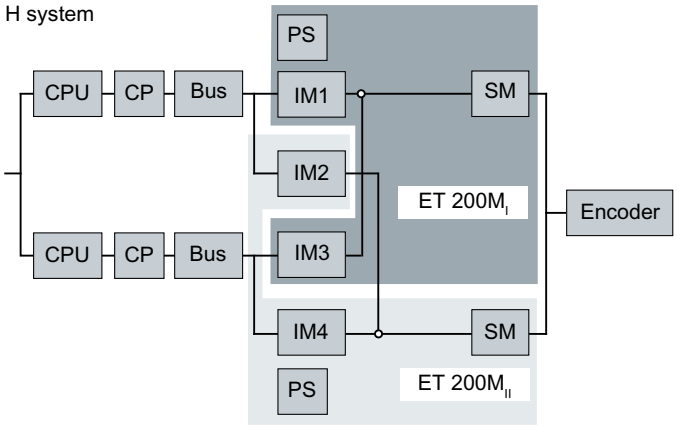
The S7-400H high availability automation system features a DP master interface on each CPU for connecting to PROFIBUS DP. The redundant PROFIBUS DP connects the redundant DP master to the redundant interface modules of the distributed I/O.

The following figure shows an example for connecting redundant distributed I/O based on ET 200M to a redundant PROFIBUS DP.



Availability

If the active PROFIBUS DP fails, sensors and H system can communicate with each other over the redundant bus connection. The configuration shown in the following figure provides increased availability due to the redundant interfacing of the distributed I/O.



Additional information

- Section "How to configure redundant PROFIBUS DP (Page 125)"
- Manual *SIMATIC Net PROFIBUS Networks*
- Manual *SIMATIC; Communication with SIMATIC*

5.3.5.2 High availability fieldbus based on PROFINET

Functionality

The fieldbus is used for data communication between the automation system (AS) and the distributed I/O. PROFINET is a standard for manufacturing and process automation. The PROFINET-based fieldbus comprises the specifications for the following elements:

- Physical bus characteristics
- Access method
- User protocol
- User interface

PROFINET is suitable for fast, cyclic data communication with field devices.

High availability communication solutions

The following high availability communication solutions are offered for the PROFINET-based fieldbus:

- Electrically designed network
- Optically designed network

Configurations

The S7-400H high availability automation system features a PROFINET interface on each CPU 4xx-5H PN/DP for connecting to PROFINET. The high availability PROFINET connects the CPU with the distributed I/O.

Note

High availability PROFINET

When using rings with PROFINET IO, it is absolutely necessary to operate the fieldbus ring with MRP (media redundancy protocol) .

The following figure shows the connection of I/O based on PROFINET.

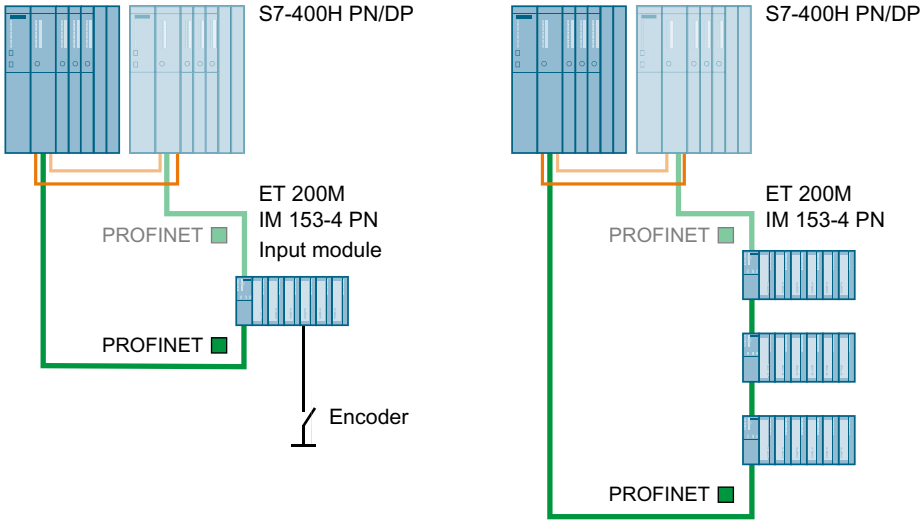


Figure 5-2 Sample for high availability PROFINET with ET 200M

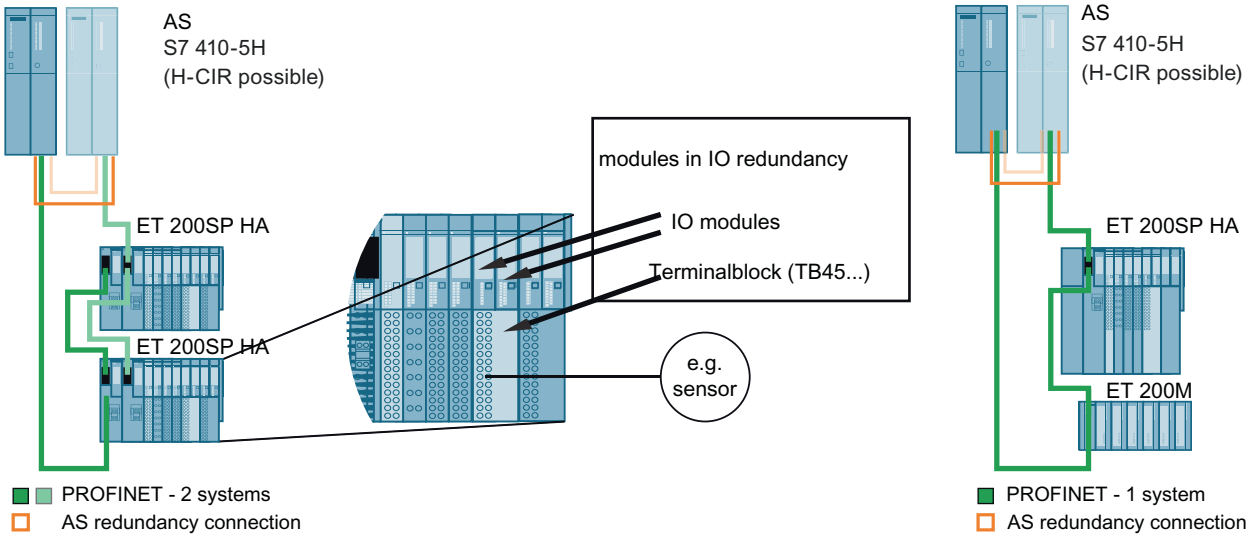


Figure 5-3 Sample for high availability PROFINET with ET 200SP HA

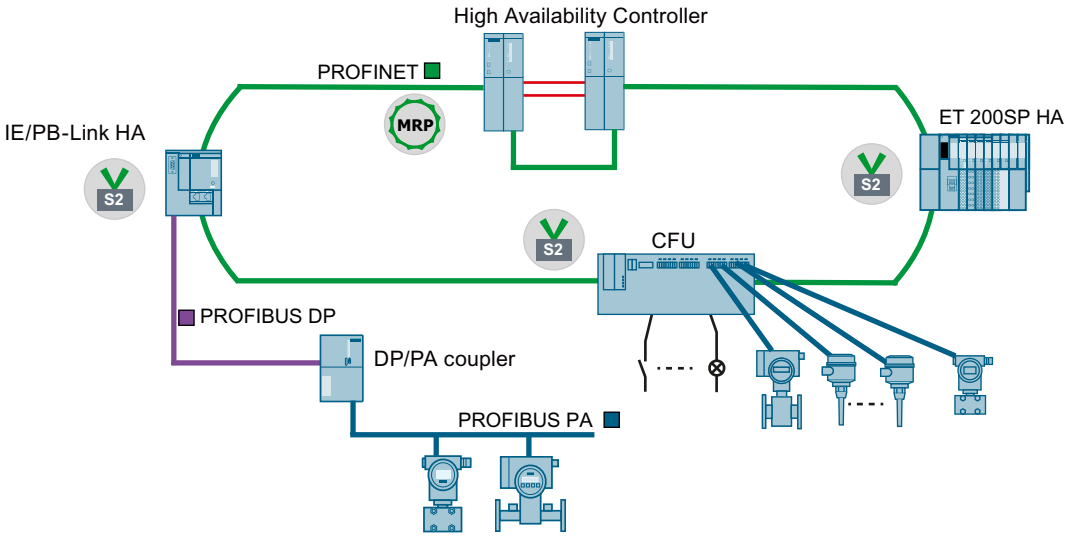


Figure 5-4 IEPB Link HA and CFU

Availability

If the communication connection via a CPU fails, the stations of the distributed I/O can communicate with the H system over the high availability bus line. The configuration shown in the following figure provides increased availability due to the interfacing of the distributed I/O.

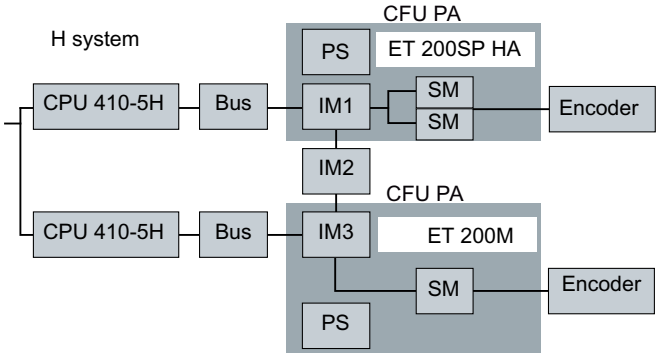


Figure 5-5 Sample for high availability PROFINET with ET 200SP HA and ET 200M

Note

Changes to PROFINET modules only take effect when you load your hardware configuration with the updated STEP 7 version to the CPU, which is in "STOP" mode.

Additional information

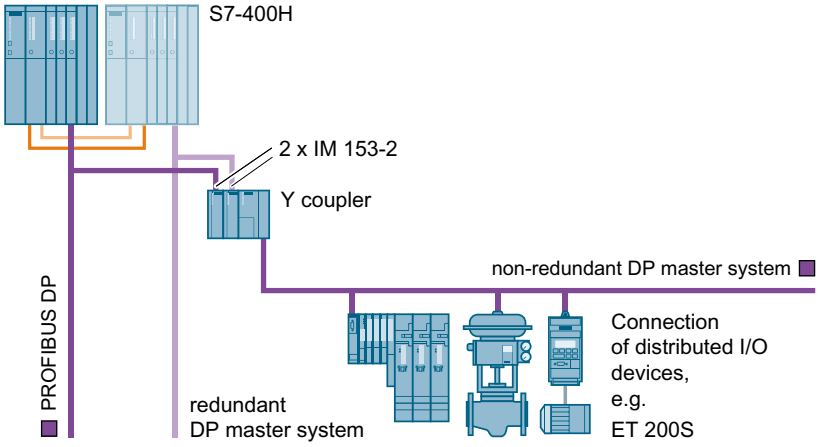
- Section "How to configure a high availability fieldbus on the basis of PROFINET (Page 127)"
- Section "How to configure a media-redundant fieldbus on the basis of PROFINET (Page 131)"
- System manual *SIMATIC; PROFINET; System description*
- Manual *SIMATIC; Communication with SIMATIC*
- Manual *SIMATIC STEP 7; Modifying the System during Operation via CiR*
- Application example Configuration examples for the S7-400H with PROFINET SIMATIC S7-400H as of V6.0 (https://support.industry.siemens.com/cs/ww/en/view/90885106)

5.3.5.3 Gateway between redundant and non-redundant PROFIBUS DP

Y Link

The Y-Link consists of two IM 153-2 interface modules and a Y coupler that are interconnected through the corresponding bus modules (BM IM/IM and BM Y coupler).

Configuration



Functionality

The Y-Link creates a gateway from the redundant DP master system of an S7-400H to a non-redundant DP master system. This enables devices with only one PROFIBUS DP interface to be connected to a redundant DP master system as switched I/O.

DPV1 slaves can be connected downstream from the Y-Link in addition to the standard PROFIBUS DP slaves.

Y-Link with integrated repeater can forward diagnostic requests from the corresponding function modules or input/output modules to the CPU.

Additional information

- Section "How to configure the Y Link (Page 151)"
- Operating Instructions *DP/PA coupler, Active Field Distributor, DP/PA Link and Y Link*
- Product overview *Process Control System PCS 7; Released Modules*

5.3.5.4 Connecting PROFIBUS PA to PROFIBUS DP

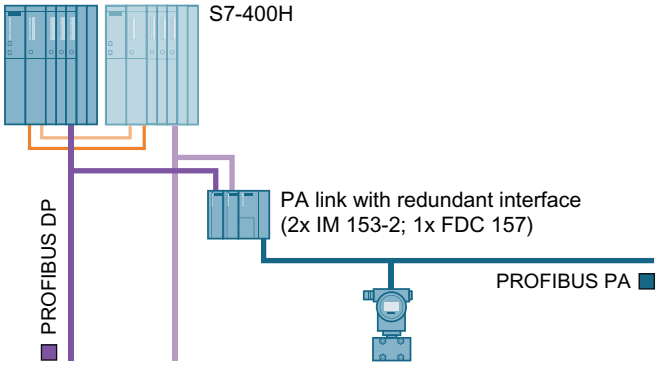
Bus links are gateways between bus systems and enable the communication connection of the bus systems.

PA Link

The PA Link allows a connection between PROFIBUS DP and PROFIBUS PA. PA Link includes the following modules, which are interconnected via the backplane bus:

- Interface module IM 153-2
- one or more FDC 157 DP/PA couplers

Configuration



Functionality

The DP/PA coupler connects PROFIBUS DP and PROFIBUS PA and decouples the various transmission rates. It is a slave on the PROFIBUS DP and a master on the PROFIBUS PA. Seen from the automation system, the PA Link is a modular slave. The individual modules of this slave are the field devices that are connected to the lower-level PROFIBUS PA lines.

The PA devices connected to the PROFIBUS PA are assembled at a PROFIBUS address by PA Link.

The PA Link can be connected directly to the PROFIBUS DP interface of programmable controllers (S7 400) for the coupling between PROFIBUS DP and PROFIBUS PA.

Versions

You can connect a PROFIBUS PA to the PROFIBUS DP. The following variants can be realized:

- Connection to a singular PROFIBUS DP
  - Connection via PA Link (1 x interface module, 1 x DP/PA coupler)
  - Connection via DP/PA coupler (45.45 Kbps on PROFIBUS DP)
  - Connecting a redundant PROFIBUS PA:
    You can find additional information on this in section "High availability PROFIBUS PA (Page 89)".
- Connection to a redundant PROFIBUS DP
  - Connection of a singular PROFIBUS PA via PA Link with redundant interconnection (2 x interface module and 1 x DP/PA coupler)
  - Connecting a redundant PROFIBUS PA:
    You can find additional information on this in section "High availability PROFIBUS PA (Page 89)".

Physical bus characteristics

- The application protocols for PROFIBUS DP and PROFIBUS PA are defined according to IEC 61158-2 and are identical for these two fieldbus variants.
  - You can set the transmission speed on the PROFIBUS DP. The maximum transmission speed with the Y-link is 12 Mbps.
  - The transmission speed on the PROFIBUS PA is 31.25 Kbps.
- If the DP/PA coupler is connected directly on PROFIBUS DP, the transfer rate is set to 45.45 Kbps. The DP/PA coupler can be operated with SIMATIC S7 automation systems and all DP masters that support the transmission rate of 45.45 Kbps.
- Depending on the power consumption of the PA devices, up to 31 PA devices can be connected to the PROFIBUS PA.

Use in hazardous areas

- The intrinsically safe PROFIBUS DP is specified for the type of protection EEx(ib).
- The following components can be used in operating environments of the Ex zone:
  - PA Link in Ex version, up to Ex Zone 2
  - PA Link or FDC 157-0 DP/PA coupler in a housing that meets at least degree of protection IP54; up to Ex Zone 2
  - DP/PA coupler Ex [i] cannot be used for redundant configuration (coupler redundancy, ring); up to Ex Zone 1
- If you use a SIMATIC AFDiS as a field barrier between the PA Link or DP/PA coupler and the field devices, you can connect the field devices in hazardous areas of Zone 0 or Zone 1. The outputs of the SIMATIC AFDiS fulfill the requirements for types of protection EEx(ia) and EEx(ib).
- The number of devices is limited by the current.

Additional information

- Section "Configuring a bus link for PROFIBUS PA (Page 153)"
- Section "High availability PROFIBUS PA (Page 89)"
- Section "How to configure the redundant PROFIBUS PA (Page 134)"
- Operating Instructions *DP/PA coupler, Active Field Distributor, PA Link and Y Link*

5.3.5.5 High availability PROFIBUS PA

Functionality

PROFIBUS PA allows the connection of PA devices. A redundant PROFIBUS PA is connected to FDC 157-0 redundant DP/PA couplers. If the communication path of the PROFIBUS PA fails, the communication path is preserved as far as the spur line to the field devices.

High availability communication solutions

The following communication solutions are offered to prevent a possible failure:

- Ring redundancy with the AFD (Active Field Distributor)
- Coupler redundancy with the AFS (Active Field Splitter)

The DP/PA coupler can be used stand-alone or in the PA-Link .

Note

Mixed configurations

You can connect only one redundant DP/PA coupler pair per PA-Link . In mixed configurations, you can operate up to 3 additional non-redundant DP/PA couplers. The coupler pair (FDC 157-0 DP/PA coupler) should be installed for redundant operation in the last two slots of the ET 200 station.

Connecting the high availability PROFIBUS PA to PROFIBUS DP

You can connect a high availability PROFIBUS PA to the PROFIBUS DP. The following variants can be realized:

- Redundant connection to the redundant PROFIBUS DP
  - The redundant PA-Link is the transition to the high availability PROFIBUS PA.
    (2 x interface module and 2 x DP/PA coupler)
- Connection to a single PROFIBUS DP PROFIBUS DP
  - A DP/PA-Link with redundant coupler pair is the transition to the high availability PROFIBUS PA.
    (1 x interface module and 2 x DP/PA coupler)
  - A coupler pair FDC 157 is the transition to the high availability PROFIBUS PA.
    (2 x DP/PA coupler directly to PROFIBUS DP)

We recommend the following configuration limits in PCS 7 when connecting PA devices using AFD or AFS :

- In the case of ring redundancy (high availability connection):
  - In the interest of increased availability, connect a maximum of 4 field devices (one field device per branch line) to an active field distributor AFD (maximum of 8 AFD to a redundant DP/PA coupler).
  - You can connect a total of 31 field devices.
- In the case of coupler redundancy:
  - 1 AFS connected to a redundant DP/PA coupler
  - Connect field devices via AFD (max. 8 AFD).
  - In the interest of increased availability, connect a maximum of 4 field devices (one field device per branch line) to an active field distributor AFD (maximum of 8 AFD to an AFS).
- You can connect a maximum of 31 field devices per PROFIBUS PA.
- The maximum power consumption of 1 A must not be exceeded. This figure includes all components connected to the PROFIBUS PA.

Configuration

Examples for connections of field devices via AFD and AFS are shown in the following figures.

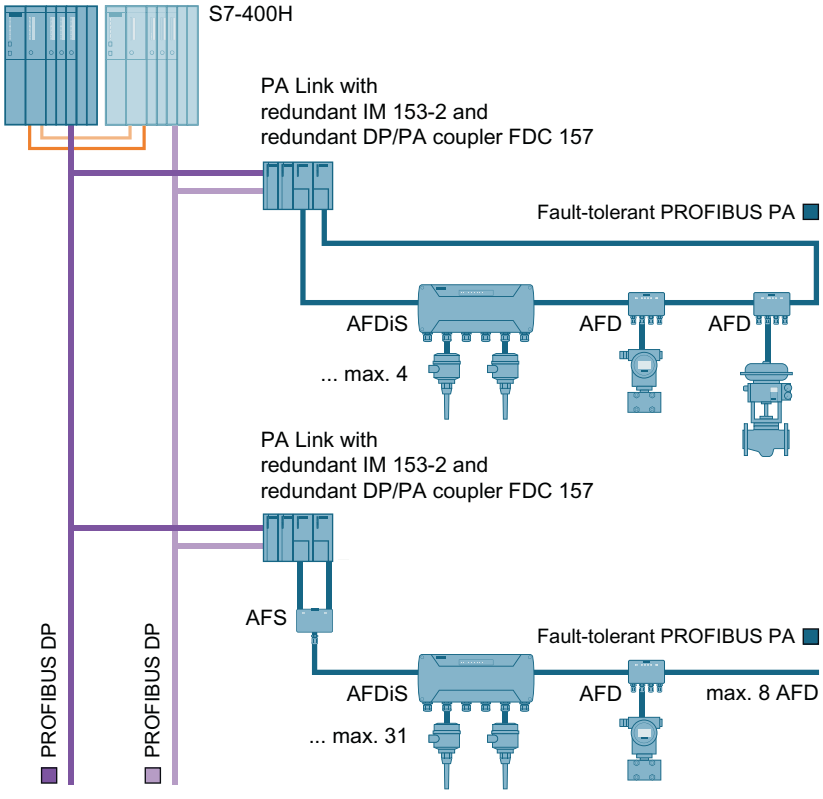


Figure 5-6 Redundant connection to the redundant PROFIBUS DP

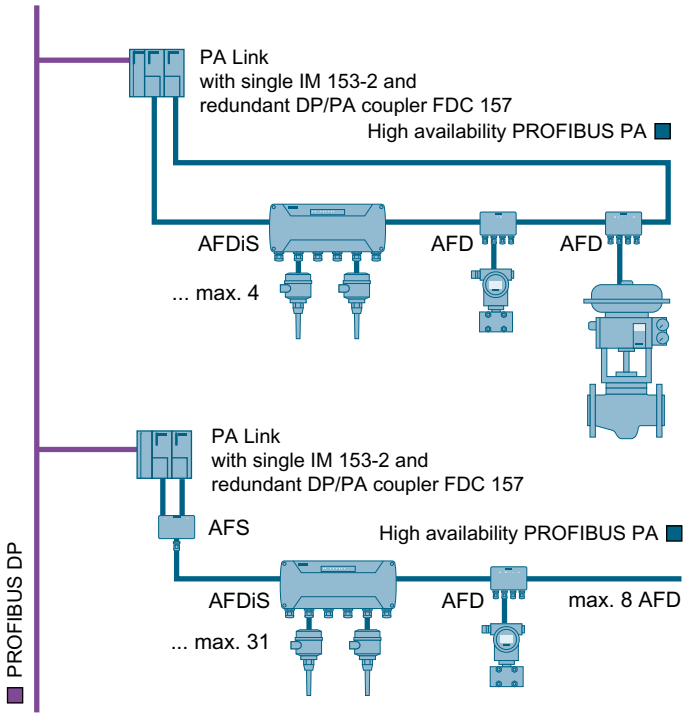


Figure 5-7 Connection to a single PROFIBUS DP

Transmission rate

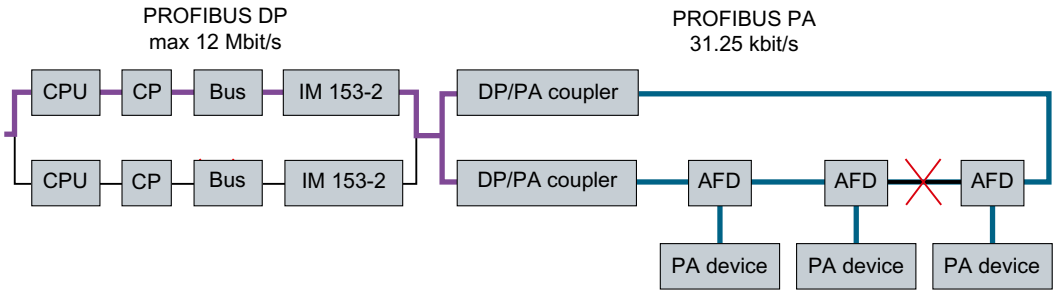
You have two interfacing options for the gateway between PROFIBUS DP and PROFIBUS PA. These result in different transmission rates on PROFIBUS DP.

- If you connect the DP/PA couplers via a PA-Link , a transmission rate of up to 12 Mbps is possible on the PROFIBUS DP.
- If you connect the DP/PA couplers directly, the transmission rate on PROFIBUS DP is 45.45 Kbps.
- The transmission speed on the PROFIBUS PA is 31.25 Kbps.

Availability - redundant interfacing

In a redundant system, we recommend that you implement the connection to the PROFIBUS DP redundantly (redundant IM 153-2).

If a PA bus cable, an IM 153-2 or a DP/PA coupler fails, the communication connection to the field devices is retained. The AFD or AFS automatically switches the connection to the available signal path.



Additional information

- Section " Connection of PROFIBUS PA to PROFIBUS DP (Page 87)"
- Section "How to configure redundant PROFIBUS PA (Page 134)"
- Operating Instructions *DP/PA coupler, Active Field Distributor, PA Link and Y Link*

5.3.5.6 Connecting the FOUNDATION Fieldbus to PROFIBUS DP

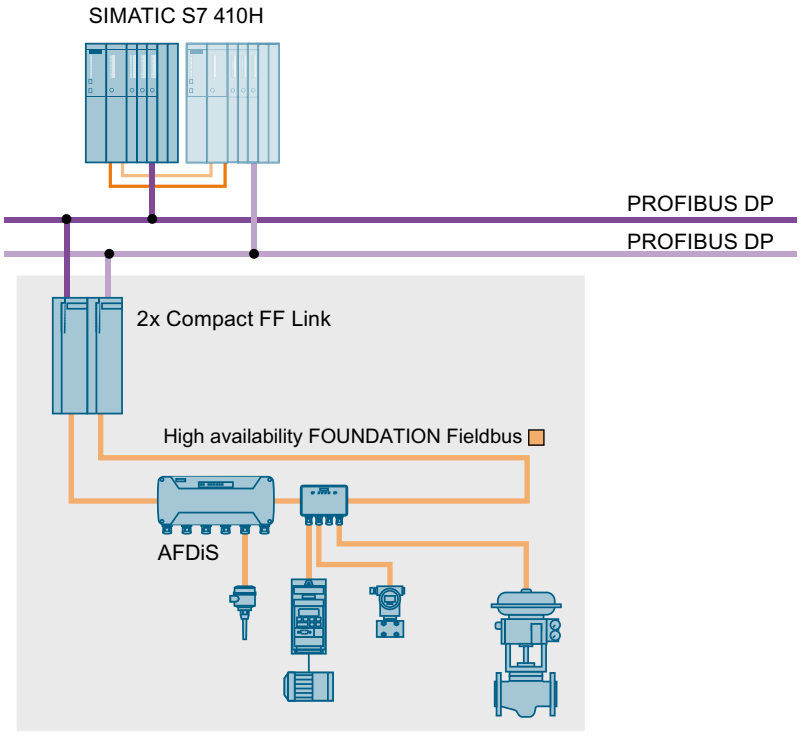
Bus link for FOUNDATION Fieldbus

The following bus links are available for communications between PROFIBUS DP and FOUNDATION Fieldbus H1:

- **Compact FF Link**
  This bus link consists of modules of the type Compact FF Link**.**

Configuration

The following figure is an example of the configuration of a bus link based on the Compact FF Link.



Functionality

The bus link connects PROFIBUS DP and FOUNDATION Fieldbus with one another and decouples various transmission rates. It is a slave on the PROFIBUS DP and master on the FOUNDATION Fieldbus. From the point of view of the automation system, the bus link is a modular slave. The individual modules of this slave are the field devices that are connected to the lower-level FF segment.

The FF devices connected to the FF segment are combined at one PROFIBUS address by the bus link.

The bus link can be connected directly to the PROFIBUS DP interface of data record gateway-capable automation devices for the coupling between PROFIBUS DP and FOUNDATION Fieldbus.

Versions

You can connect one FF segment to the PROFIBUS DP for each bus link. The following variants can be realized:

- Connection to a singular PROFIBUS DP
  - Connection via Compact FF Link (1 x Compact FF Link)
- Connection to a redundant PROFIBUS DP
  - Connection of a singular FOUNDATION Fieldbus via redundant Compact FF Link to a redundant interface.
- Connection of a redundant FF segment:
  - You can find additional information on this in section "High availability FOUNDATION Fieldbus (Page 95)".

Physical bus characteristics

- The application protocols for PROFIBUS DP and FOUNDATION Fieldbus are determined according to IEC 61158-2.
  - You can set the transmission speed on the PROFIBUS DP. The maximum transmission rate is 12 Mbps.
  - The transmission speed on the FOUNDATION Fieldbus is 31.25 Kbps. The transmission method is determined by IEC 61158-2.
- Depending on the power consumption of the FF devices, up to 31 FF devices can be connected to the FOUNDATION Fieldbus.

Use in hazardous areas

- The intrinsically safe PROFIBUS DP is specified for the type of protection EEx(ib).
- When the bus link is built into an enclosure conforming to at least an IP 54 degree of protection, the bus link can be installed in operating environments up to Ex Zone 2.
- If you use a SIMATIC AFDiS as a field barrier between the bus link and the field devices, you can connect the field devices in hazardous areas of zones 0 or 1. The outputs of the SIMATIC AFDiS fulfill the requirements for types of protection EEx(ia) and EEx(ib).
- The number of devices is limited by the current.

Additional information

- Documentation *SIMATIC; Process Control System PCS 7; PCS 7 Readme*
- Documentation *SIMATIC; PCS 7 process control system; PCS 7 - FOUNDATION Fieldbus*
- Operating Instructions *SIMATIC; Bus Link; Compact FF Link*

5.3.5.7 High availability FOUNDATION Fieldbus

Functionality

PCS 7 enables the connection of field devices to the FOUNDATION Fieldbus H1 (referred to only as FOUNDATION Fieldbus or FF from this point). A high availability FOUNDATION Fieldbus is connected to the redundantly configured Compact FF Link. If the transmission path fails, the communication path of the FOUNDATION Fieldbus is preserved as far as the spur line to the field devices.

High availability communication solutions

The following communication solutions are offered to prevent a possible failure:

- Ring redundancy with the AFD (Active Field Distributor)
- Coupler redundancy with the AFS (Active Field Splitter)

Connection of the high availability FOUNDATION Fieldbus to PROFIBUS DP

You can connect a high availability FOUNDATION Fieldbus to the PROFIBUS DP. The following variants can be realized:

- Connecting a high availability FOUNDATION Fieldbus to a redundant PROFIBUS DP Installation with Compact FF Link (2x Compact FF Link)

We recommend the following configuration limits in PCS 7 when connecting FF devices using AFD or AFS :

- You can connect an FF segment to a redundantly installed Compact FF Link.
- For the purpose of increasing availability when using ring redundancy (high availability connection), connect a maximum of 4 field devices (one field device per spur line) to an active field distributor AFD (maximum of 8 AFD to a redundant Compact FF Link).
- Connect an active field splitter (AFS) to a redundant coupler in the case of coupler redundancy. Connect the field devices via AFD (max. 8 AFD). For the purpose of increasing availability, connect a maximum of 4 field devices per AFD.
- You can connect a maximum of 31 field devices per FF segment.
- The maximum power consumption of the bus link must not be exceeded. This figure includes all components connected to the FF segment.

Configuration

Examples using the Compact FF Link for connections to field devices via AFD and AFS are shown in the following figures.

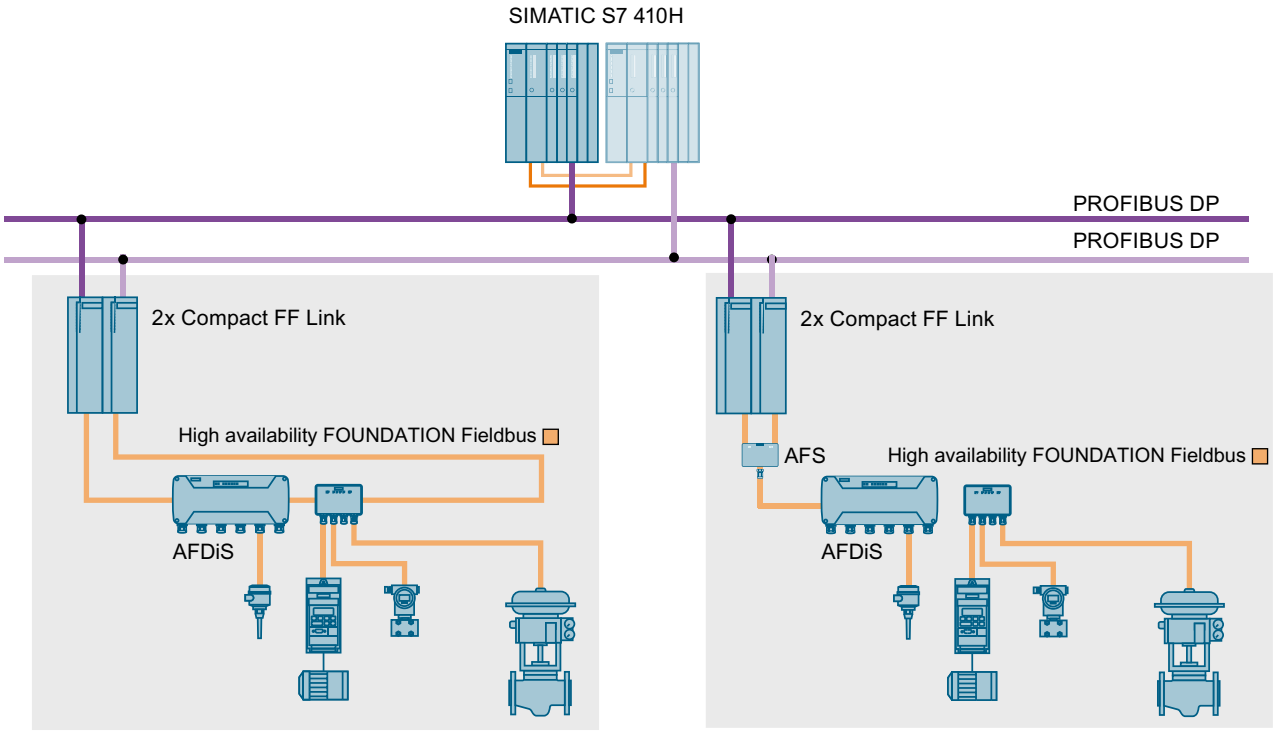


Figure 5-8 Connection to a redundant PROFIBUS DP

Transmission rate

You have two interconnection options for the gateway between PROFIBUS DP and FOUNDATION Fieldbus . These result in different transmission rates on PROFIBUS DP.

- If you connect via a bus link, a transmission rate of up to 12 Mbps is possible on PROFIBUS DP.
- The transmission speed on the FOUNDATION Fieldbus is 31.25 Kbps.

Availability - high availability interfacing

In a redundant system, we recommend that you implement the interface to PROFIBUS DP redundantly (redundant bus link).

The communications connection to the field devices remains established, even when an FF cable or a module fails. The AFD or AFS automatically switches the connection to the available signal path.

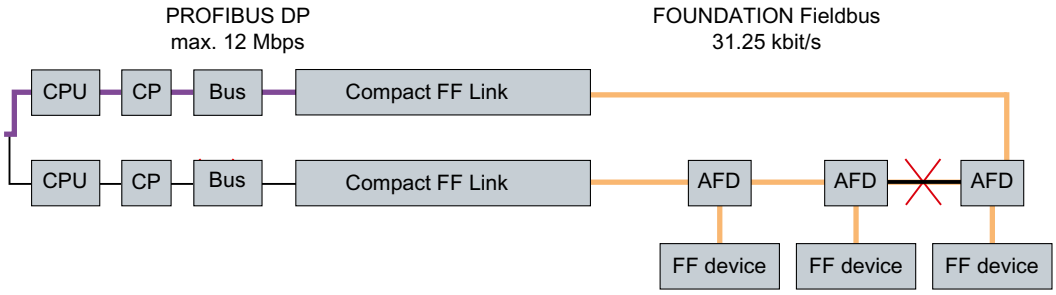


Figure 5-9 Schematic view for the installation with Compact FF Link

Additional information

- Section "Connecting the FOUNDATION Fieldbus to PROFIBUS DP (Page 92)"
- Section "Configuring a bus link for Compact FF segment (Page 154)"
- Documentation *SIMATIC; Process Control System PCS 7; PCS 7 Readme*
- Operating Instructions *SIMATIC; Bus Link; Compact FF Link*
- Documentation *SIMATIC; PCS 7 process control system; PCS 7 - FOUNDATION Fieldbus*

5.4 Solutions for integrating a PCS 7 system in a domain

For additional information, please refer to the following documents:

- Function manual *Process Control System PCS 7; Time Synchronization*
- On the Internet pages of Customer Support in Whitepaper SIMATIC; Safety Concept PCS 7 and WinCC; Basic document (https://support.industry.siemens.com/cs/ww/en/view/60119725)

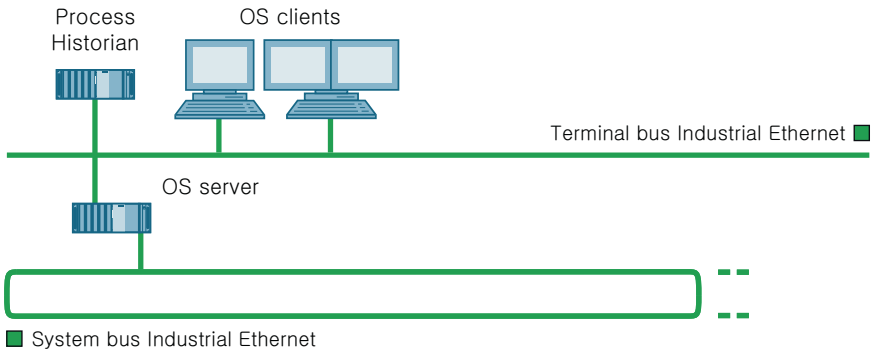
5.5 Solutions for OS servers

Redundant OS servers

PCS 7 enables you to configure two OS servers redundantly for high availability operation. This ensures that you can monitor and control your process at all times. The solution represents the entry level into high availability process control systems.

Configuration

The figure below shows an example of a configuration with redundant OS server and Process Historian.



Functionality

Redundant OS servers monitor each other in runtime. If one OS partner server fails, the event is detected in time.

If one of the two OS server fails, the OS partner server takes over the process. The interface between OS clients and the automation system remains available.

The OS clients are automatically switched to the redundant OS partner server. This means that the OS clients always remain available for the control and monitoring of the process. During the failure period, the redundant OS partner server continues to archive all messages and process data in the WinCC project. Once the failed OS server comes back online, the contents of all the message, process value and user archives are automatically copied to the returning OS server. This copy process is referred to as redundancy synchronization. Redundancy synchronization fills the gaps in the various archives that result from failures.

During the failure period, the internal master/standby identification changes from the failed OS server to its OS partner server. The master identification remains with the OS partner server even when the failed OS server comes back online.

Configuring the archives

Tag logging and alarm logging have to be configured functionally identical for redundant OS servers. Functionally identical configuration means the same archives, whereby extensions in the form of additional measuring points and archives are permitted.

OS partner servers (OS_Stby) are configured in the SIMATIC Manager. Using the menu command **PLC > Download** synchronizes the functionality.

Redundant external archive server

You use the Process Historian for central acquisition of archive information of the process control system. You can set up two Process Historians with redundancy functionality for high availability operation. The associated Information Server can be configured in such a way that it connects to the active Process Historian to execute tasks.

The Process Historian redundancy is based on the "High safety with automatic failover (synchronous)" Microsoft SQL Server database mirroring mode. In this mode, an additional "Witness" system is required in addition to the "Principal" and "Mirror" system.

The Witness component is typically installed on the Information Server system. As the Witness system initiates an possible automatic failover process, the witness component should be installed on a system with typically high availability.

Note

The Witness component can also be installed on an OS Server system.

The data is continuously synchronized between principal and mirror system. If a Process Historian of a server pair fails, the data is automatically synchronized on the return of the failed server.

This server does not require a connection to the plant bus. A high bandwidth network connection between the two redundant Process Historian server systems is highly recommended.

Redundant maintenance station

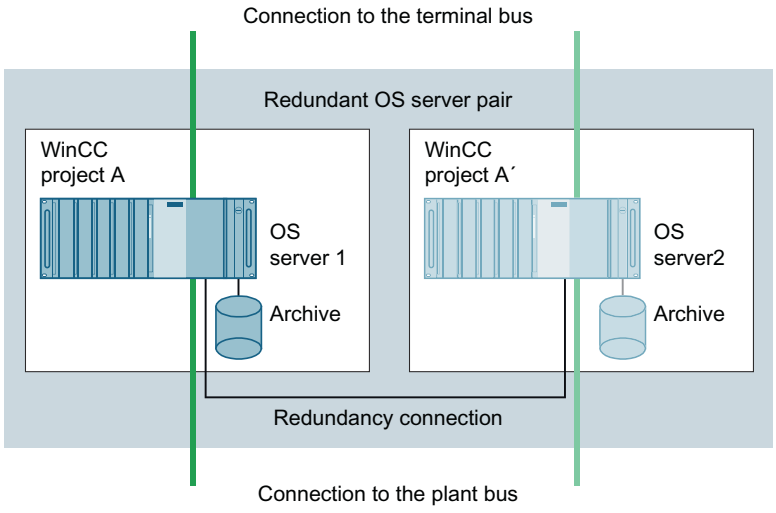
PCS 7 allows you to configure two maintenance servers with redundancy functionality for high availability operation.

Setting up a redundant OS server

The following configuration shows the basic operating principle of redundant OS servers.

Note

You need to connect the redundant PC stations through a redundancy connection. This connection offers security against problematic behavior during communication between the OS servers.



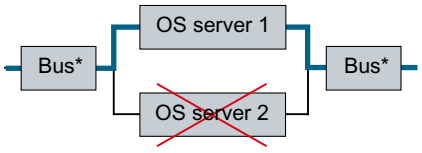
Redundancy connection

You need the following components to make the redundancy connection, depending on the distance to be bridged:

Maximum distance	Required components	Connection
10 m	Null modem cable	Serial connection
100 m	• Crossover network cable • Per server: A free network connection (see section "Network components (Page 58)")	Ethernet connection
1000 m	Fiber-optic cable Per server: • A free network connection (see section "Network components (Page 58)") • 1 Ethernet cable • 1 media converter (e.g., SCALANCE X101-1)	Ethernet connection

Availability

The availability of the complete system is ensured even if one of the two OS servers fails because the two OS servers form an independent redundancy node.



Note

The buses marked with * (terminal bus and plant bus) can be configured redundantly with optical or electronic switch modules.

Additional information

- Section "Network components (Page 58)"
- Section "How to configure an OS server and its redundant OS partner server (Page 160)"
- Online help for *WinCC*; *WinCC Redundancy*
- Documentation on the Process Historian

5.6 Solutions for OS clients

5.6.1 Additional OS clients

Additional OS clients

OS clients are PC stations that are used for control and monitoring of an automation process. They are connected to the OS servers through the terminal bus. The OS servers form the process connection to the automation system.

An OS client has its own WinCC project and visualizes the process data generated on an OS server.

If an OS client fails, this does not disrupt the overall process because the automation program in the CPU continues to control the process and the OS servers continue to process and archive the process data. However, the visualization of the process is lost and you can only influence the process through the OS servers. You should therefore protect against such failure by integrating additional OS clients.

By specifying a preferred server, you can distribute multiple OS clients between the redundant OS servers. The automation process can therefore be operated continuously, even during a switchover from the active OS to its OS partner server.

Additional information

- Section " How to configure an OS client (Page 171) "
- Online help for *WinCC*

5.6.2 Permanent operability

Permanent operability

"Permanent operability" in a redundant environment is the unrestricted ability to influence the system at any time even when confronted with the failure of one of the redundant OS servers. It is the most important safety characteristic for plants with critical operations.

This function is important in all systems in which the ability to handle failure of an OS server in a redundant configuration is not enough and in which continuous control of a process must be maintained. In the event of an OS server failure, all OS clients connected to the failed server temporarily lose their connection to the process while they switch over. In order to ensure that the OS clients can control and monitor the automation process continuously, the OS clients are distributed between the redundant OS servers with specification of a preferred OS server. The failure of some OS clients can therefore be tolerated because the other clients remain connected to the process.

Preferred server

A "preferred server" is an OS server in the redundant OS server pair that is preferred by the OS client for a connection. A preferred server can be defined separately for each OS client in order to ensure permanent operability. The distribution of the OS clients between the OS servers distributes the loads and increases the performance of the system as a whole.

Operating principle

If the active OS server fails, the process values on all of the connected OS clients are no longer updated and there is no operator control on these OS clients during the switchover. Other OS clients that are connected in parallel to the redundant OS partner server are not affected by this. The plant operator can therefore change to these OS clients if needed.

Generally, the following applies: The OS clients always connect to the specified preferred server if it is available. If it is not available, the OS clients automatically connect to its redundant OS partner server. If you do not specify a preferred server for an OS client, it connects to the OS server that has the master identification.

When the failed OS server comes online again, the OS client automatically reconnects to its preferred server. The master identification of the OS server does not change even when the failed OS server comes back online.

Additional information

- Section "How to configure an OS client for permanent operability (Page 173)"
- Online help for *WinCC*

5.7 Solutions for SIMATIC BATCH

Redundant BATCH servers

SIMATIC BATCH enables you to configure two BATCH servers redundantly for high availability operation. This ensures that you can monitor and control your batch process at all times.

Functionality

Redundant BATCH servers monitor each other in runtime to detect the failure of a BATCH server as early as possible.

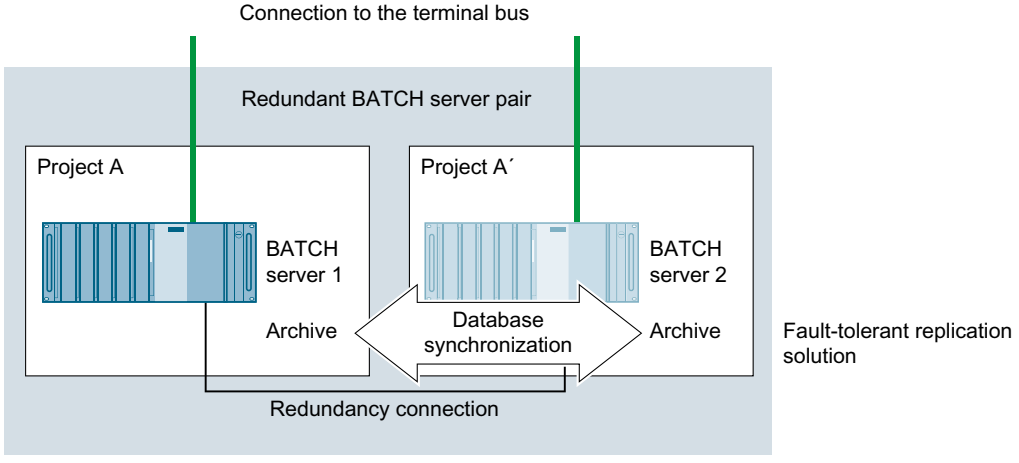
If one of the two BATCH servers fails, the process can be controlled over the second BATCH server after the switchover.

- The interface for message processing between the active BATCH server and the OS server remains available.
- The BATCH clients automatically fail over to the functioning (active) BATCH server. After the switchover, it is possible to control and monitor the process from all BATCH clients.

In SIMATIC BATCH, the consistency of the databases is achieved by data replication. In this solution, each of the BATCH servers of a server pair has its own database in which the batch data stored. The two databases are continuously synchronized.

Setting up a redundant BATCH server

The following configuration shows the basic operating principle of redundant BATCH servers. The BATCH servers are also connected to the plant bus if SIMATIC BATCH is operated "AS-based".



Redundancy connection

You need the following components to make the redundancy connection, depending on the distance to be bridged:

Maximum distance	Required components	Connection
100 m	• Crossover network cable • Per server: A free network connection (see section "Network components (Page 58)")	Ethernet connection
1000 m	Fiber-optic cable Per server: • A free network connection (see section "Network components (Page 58)") • 1 Ethernet cable • 1 media converter (e.g., SCALANCE X101-1)	Ethernet connection

Note

When a redundant server pair is used as an OS server and BATCH server, the redundancy connection must be configured via the Ethernet connection.

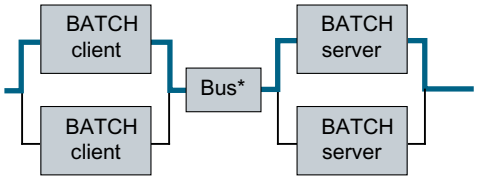
Serial linking of the BATCH server pair is not possible in PCS 7.

Availability

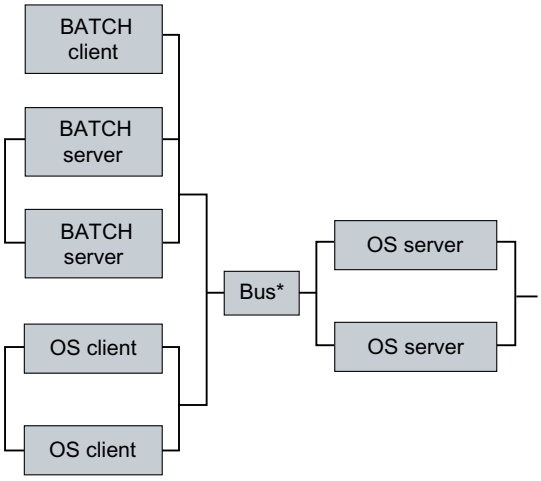
The following two block diagrams of fully operational systems illustrates the availability of the BATCH clients and BATCH servers. All BATCH components form an independent redundancy node since they are redundant. This ensures the independence of the subsystem.

Note

Only the BATCH components and the terminal bus are shown in the block diagrams. The terminal bus marked with * can be configured redundantly with switch modules.



The communication between BATCH clients and BATCH servers is performed over the terminal bus.



The BATCH servers also communicate with OS servers over the terminal bus. The OS servers are connected to the automation system over the plant bus.

Note

SIMATIC BATCH in "AS-based" operating mode

The BATCH servers are also connected to the plant bus if SIMATIC BATCH is operated "AS-based". The redundant interface is implemented as on OS servers. You can find additional information on this in section "Solutions for OS servers (Page 99)".

Additional information

- PC station identified as faulty; see section "Solutions for OS servers (Page 99)"
- Section "How to configure a BATCH server and its redundant BATCH partner server (Page 178)"
- Section "How to configure a BATCH client (Page 180)"
- Manual and online help for *SIMATIC BATCH*

5.8 Solutions for the Route Control server

Redundant Route Control servers

SIMATIC Route Control allows you to implement two Route Control servers with redundancy functionality for high availability operation. This ensures that you can monitor and control your route control at all times.

Functionality

The Route Control software automatically takes over the monitoring of the redundancy. The redundant Route Control servers monitor each other in runtime.

If one of the two Route Control server fails, the process can be controlled via the second Route Control server following switchover.

The Route Control clients automatically fail over to the functioning (active) Route Control server.

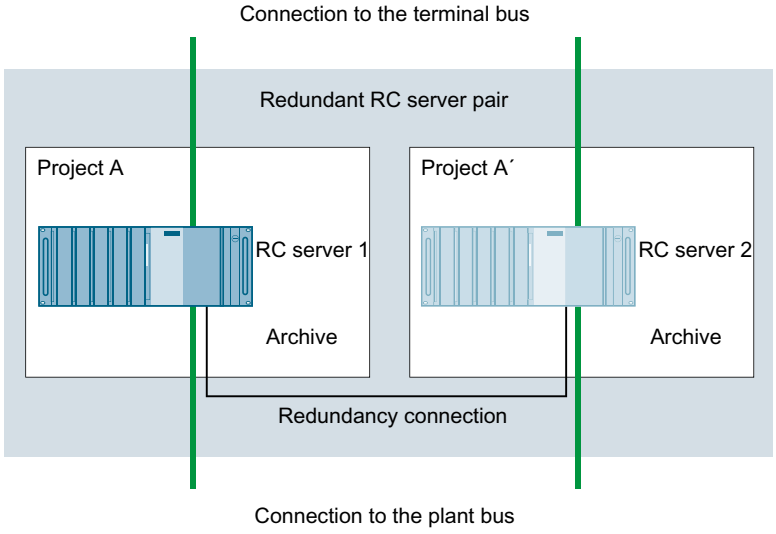
When the failed Route Control server resumes normal service, it retrieves the current process image from the automation system.

During the failure, the functioning Route Control server automatically receives the internal Master ID. If the active master server failed, the master ID is passed from the failed Route Control server to its Route Control partner server.

When the failed Route Control server becomes available again, it is given the standby ID. The master ID remains with the Route Control partner server.

Configuration of a redundant Route Control server

The following configuration shows the basic operating principle of redundant Route Control servers.



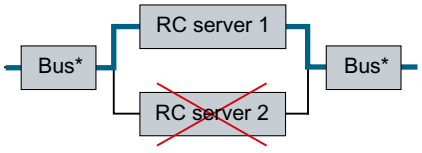
Redundancy connection

You need the following components to make the redundancy connection, depending on the distance to be bridged:

Maximum distance	Required components	Connection
10 m	Null modem cable	Serial connection
100 m	• Crossover network cable • Per server: A free network connection (see section "Network components (Page 58)")	Ethernet connection
1000 m	Fiber-optic cable Per server: • A free network connection (see section "Network components (Page 58)") • 1 Ethernet cable • 1 media converter (e.g., SCALANCE X101-1)	Ethernet connection

Availability

The availability of the complete system is also ensured even if one of the two Route Control servers fails because the two Route Control servers form an independent redundancy node.



Note

The buses marked with * (terminal bus and plant bus) can be configured redundantly with optical or electronic switch modules.

Additional information

- PC station identified as faulty; see section "Solutions for OS servers (Page 99)"
- Section "How to configure a Route Control server and its redundant Route Control partner server (Page 186)"
- Manual *Process Control System PCS 7; SIMATIC Route Control*

5.9 Solutions for the engineering station

Engineering station

The engineering station (ES) serves as a central configuration station.

There are no redundant engineering stations in PCS 7.

The ES is generally used to make changes to the configuration data of project components such as AS, OS and BATCH and then download the changes to the target systems. This makes PCS 7 configuration centralized and transparent.

Configuration

In order to use an ES as an OS client, you need to configure a PC station in the PCS 7 project for the ES. This PC station is configured and downloaded the same way as an operator station with regard to hardware (Station Configuration Editor), networks and connections (NetPro). The ES is displayed in NetPro.

If you specify permanently configured connections under "Named Connections", the following rules apply:

- When configuring the connections for the ES, you must configure a connection for every AS. This will ensure that a connection can be established to every AS regardless of which WinCC project is loaded.
- For connections from the individual PC stations (OS servers and ES) to the automation systems, the following rules apply:
  - All connections within an AS must have the same name.
  - Two connections must be configured for each OS server and the ES, one in AS 1 and one in AS 2.
  - The connections to AS 1 and the connections to AS 2 must always have the same name.

Backing up configuration data

The configuration data should always be backed up following a change in the configuration.

5.10 Time synchronization

Introduction

Time synchronization in a PCS 7 plant is of utmost importance for synchronizing, tracing, documenting and archiving all time-critical processes. Time synchronization is particularly important for the redundancy functions in PCS 7 such as the redundancy synchronization between OS servers or BATCH servers.

Time synchronization is active after one component has assumed the time master function in a PCS 7 system. All other time-dependent components receive the time from this time master.

Planning and setting up time synchronization in PCS 7

The information necessary for planning and setting up time synchronization within a Windows network is available in the following documentation:

Function manual *Process Control System PCS 7; PCS 7 Time Synchronization*

Setting the time synchronization of SIMATIC H stations

When a SIMATIC H station is connected to the redundant high availability plant bus each with two CP443-1 per CPU, the settings for time synchronization should be made according to the table below.

Set the time synchronization of CP 443-1 by selecting the "Time synchronization" tab in the object properties dialog of the CP.

Bus	**CPU 1/rack 1**		**CPU 2/rack 2**	
Plant bus1	CP 1/1	Time synchronization **enabled**	CP 2/1	Time synchronization **enabled**
Plant bus2	CP 1/2	Time synchronization **disabled**	CP 2/2	Time synchronization **disabled**

Advantages of high availability components 6

6.1 Creating and expanding a project with pre-configured stations

PCS 7 wizards "New Project" and "Extend Project"

You can create high availability stations for the AS and PC stations using the PCS 7 "New Project" and "Expand Project" wizards in the SIMATIC Manager. For redundant PC stations, you configure a redundant multiple station system using the PCS 7 wizard.

- **PCS 7 "New Project" Wizard**
  Use the PCS 7 "New Project" wizard to create a new PCS 7 project as a multiproject.
  You are guided through the individual configuration steps of the PCS 7 wizard. While working through the wizard, you specify the CPU, select the number of levels in the plant hierarchy and the AS objects to be created (CFC/SFC charts) and OS objects (PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control). Technological names such as plant, unit and function are specified and you can adapt these later to the requirements of your plant.
- **PCS 7 "Expand Project" wizard (pre-configured stations)**
  Using this wizard, you can expand a project with pre-configured stations, such as an AS or a PC station for OS, BATCH or Route Control.
  The AS is set up using the configuration bundles which you can find in the PCS 7 catalog and know from the PCS 7 "New Project" wizard. If you use such bundles in your plant, all required objects are created when you insert pre-configured stations.

Additional information

- Configuration manual *Process Control System PCS 7; Engineering System*

6.2 SIMATIC H station

6.2.1 Overview of configuration steps

Overview of configuration steps

You configure the redundancy functionality of the SIMATIC H station by performing the following steps:

Step	What?
1	Inserting a SIMATIC H station in a project (Page 114)
2	Plugging synchronization modules into the H_CPU (Page 116)
3	Configuring redundant communications processors (Page 117)
4	Setting the CPU for the error response of input/output modules (Page 119)

6.2.2 How to add a SIMATIC H station to your project

Introduction

The SIMATIC H station is contained in the hardware catalog of HW Config as a stand-alone station type. This station type is required if you want to configure two central devices each with a H CPU, thereby configuring the entire process control system with redundancy.

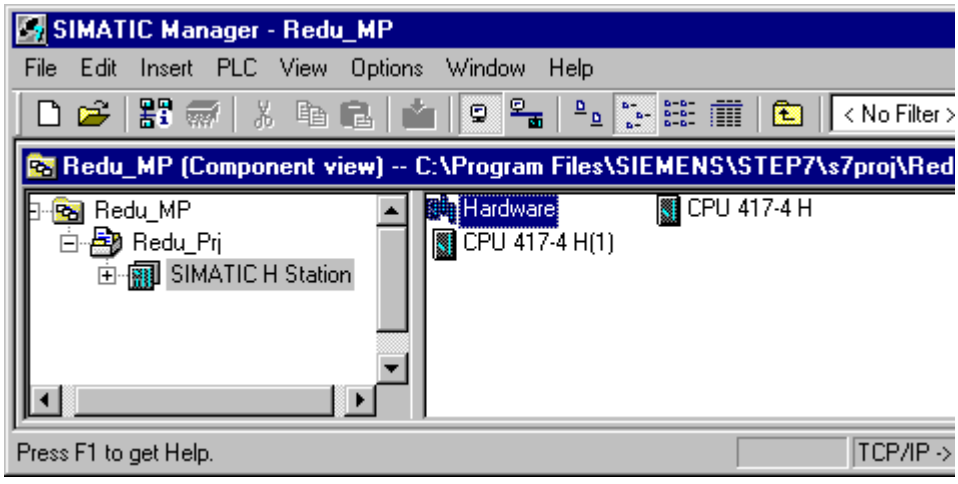
The direct connection of a singular CPU to the redundant, high availability plant bus is possible with a CPU 410H.

Procedure

1. Open your PCS 7 project in the component view of SIMATIC Manager.
2. Select the menu command **View > Component View**.
3. Select the project.
4. Select the following menu command: **Insert > Station > SIMATIC H Station**.
5. Click the inserted SIMATIC H station.

Result

The configuration in the SIMATIC Manager appears as follows:



Configuring the AS in HW Config

1. Double-click the **Hardware** object in the detail view.
   The HW Config dialog box opens.
2. Open the catalog and select the profile of the current PCS 7 version.
3. Insert the following objects of the SIMATIC 400 (**Insert > Object** menu command):
   You can find information about the objects in the information section of the catalog.
   - **Rack 400**
   - **PS 400**
   - CPU 400 > **CPU 400 H**
     Communication connections can be configured later. You can find information about this in the following sections:
     - Section "How to configure redundant PROFIBUS DP (Page 125)"
     - Section "How to configure a high availability fieldbus on the basis of PROFINET (Page 127)"
     - Section "How to configure a media-redundant fieldbus on the basis of PROFINET (Page 131)"
   - **CP-400** (optional)
     Communication connections can be configured later. You can find information on this in the section "How to configure redundant communication processors (Page 117)".

Additional information

- Manual *Automation System S7-400H; High Availability Systems*

6.2.3 How to insert synchronization modules into the H CPU

Requirements

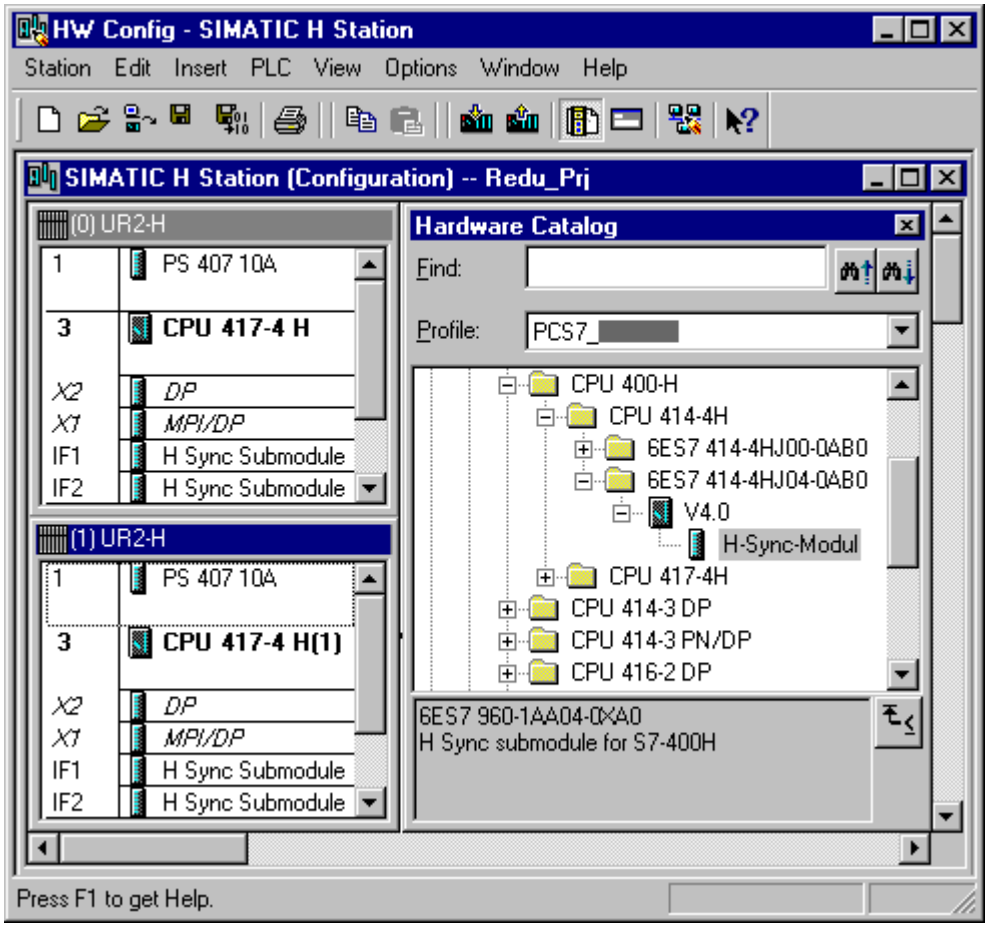
- The PCS 7 project is open in SIMATIC Manager.
- HW Config is open.
- The rack has been inserted according to the configuration in HW Config.
- Each rack has been fitted with an H CPU in HW Config.

Procedure

1. In HW Config, select the menu command **View > Catalog.**
2. In the hardware catalog, double-click the H CPU you are using. Within the active tree view, double-click on the version of the H CPU you have selected.
   The H sync module is located below the version folder, e.g V4.0.
3. Select the H Sync Module and drag it onto slots "IF1" and "IF2" of each H CPU.

Result

The following figure shows an example of the configured subsystems of the high availability station in HW Config:



Additional information

- Documentation *Process Control System PCS 7; PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

6.2.4 How to configure redundant communication processors

Introduction

If you use communications processors for communication in the SIMATIC H station, configure at least one CP 443-1 for each H CPU on a plant bus. A redundant connection is possible.

The AS 410H has 2 integrated Ethernet connections and can be connected to the redundant, high availability plant bus.

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- HW Config is open.
- The racks for the SIMATIC H station are inserted in HW Config, for example, 2 UR2-H racks.
- In HW Config, each rack has been fitted with an H CPU and the required synchronization modules.

Procedure

1. In the hardware catalog, double-click the "SIMATIC 400" folder. Then double-click the "CP-400" folder and finally the "Industrial Ethernet" folder.
2. Select the CP you are using and drag it to a free slot on the rack.

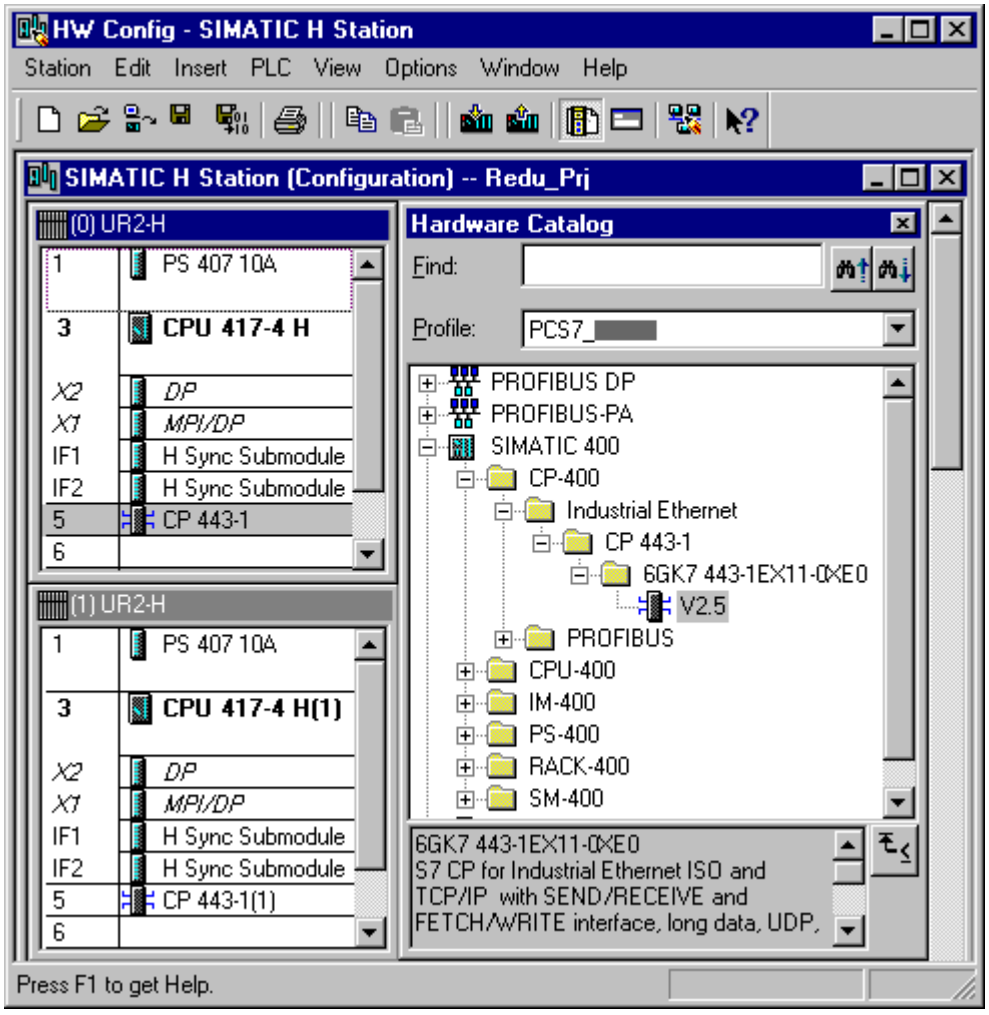
Note

Using a communication processor that supports multiple communication protocols

Configure the ISO interface for the "Fault-tolerant S7 connection" in the "Parameters" tab of the "Properties - Ethernet Interface CP 443-1" dialog box.

Result

The following figure shows an example of a configuration in HW Config: Connection to a high availability plant bus is possible.



Additional information

- Manual *Automation System S7-400H; High Availability Systems*

6.2.5 How to set the CPU for the reaction of the input/output modules to channel faults

Introduction

Only perform the following procedure when the libraries "Redundant IO (V3.0)" or "Redundant IO (V4.0)" are used.

As of PCS 7 V7.1, the characteristics of the redundant input/output modules are set for channel-based reaction to channel faults. The function in the AS depends on the employed PCS 7 library and the modules.

Depending on the configured module, the code is automatically generated for the automation system based on the optimal capabilities of the module.

Passivation reaction of the modules

You will find information on which modules are released for which passivation reaction in the documentation *PCS 7 - Released Modules*.

Passivation reaction	Reaction of the module
Module-based	The module is passivated if a fault occurs.
Group-based	If a fault occurs in a channel, the group of channels is passivated in a module in which a least one fault has occurred.
Channel-based	Only the channels on which the fault occurred are passivated.

Requirements

- The PCS 7 project is open in SIMATIC Manager.
- An H-CPU is configured in HW Config.
- S7 driver blocks from the "Redundant IO (V3.0)" or "Redundant IO (V4.0)" library

Procedure

1. In the component view, select the SIMATIC H station.
2. Double-click the "Hardware" object in the detail window.
   HW Config opens.
3. Select the CPU you are using on slot 3.
4. Select the menu command **Edit > Object Properties**.
   The "Properties - CPU ..." dialog box opens.
5. Select the "H Parameters" tab.
6. Please make a note of which data blocks in the "Data block no." input box are defined as standard transmitters so that you do not use them in your configuration.
7. Select the required setting for the passivation behavior from the "Passivation behavior" list in the "Redundant I/O" area.
   - **Module-based** when the "Redundant IO (V3.0)" library is used
   - **Channel-based** when the "Redundant IO (V4.0)" library is used

Additional information

- Function manual *Process Control System PCS 7; software update without utilization of new functions*
- Documentation *Process Control System PCS 7; PCS 7 - Released Modules*

6.3 Communications connections

6.3.1 Overview of configuration steps

Introduction

After you have inserted all of the components (AS, OS and ES) in your project, you can use NetPro to configure the network connections between the SIMATIC components. When the configuration of the connections and network is complete, the configuration needs to be compiled, saved and downloaded to the CPU of the automation system.

Downloading connection configurations

Connection configurations can be downloaded to the CPU in RUN mode. To do this, select the connection to be downloaded in NetPro and transfer it to the CPU by selecting the menu command **PLC > Download to Current Project > Selected Connections**. Process interfacing for operation stations is not possible until the connections are made known to the AS.

You need to change the MAC addresses after failure of network adapters. You adapt the addresses in the properties dialog box of the individual operator stations in NetPro. The configuration has to be compiled and downloaded in NetPro each time it is changed.

Note

The configuration data of the partner station must also be downloaded.

Overview

This section describes the configuration steps for the following topics:

- Configuring a redundant, high availability terminal bus (Page 122)
- Configuring a high availability plant bus (Page 123)
- Configuring a redundant PROFIBUS DP (Page 125)
- Configuring a high availability fieldbus based on PROFINET (Page 127)
- Configuring a media-redundant fieldbus based on PROFINET (Page 131)
- Configuring a redundant PROFIBUS PA (Page 134)

6.3.2 Configuring the connection to the terminal bus

6.3.2.1 How to configure the redundant terminal bus on the basis of the Parallel Redundancy Protocol

Introduction

The NetPro and HW Config programs do not support configuration of the terminal bus. The "SIMATIC NET SOFTNET-IE RNA" software is used in PCS 7 for the connection of a PC station to separate redundant networks.

Conditions and rights required

You require the following to be able to install and operate SOFTNET-IE RNA on your PC:

- 2 free Ethernet network adapters
- 2 separate Ethernet network adapters
- Administrator rights for installation
- Exactly one software license for SOFTNET-IE RNA per PC.

Installation and configuration

You can install the "SIMATIC NET SOFTNET-IE RNA" software with the PCS 7 system setup.

Select the "User-defined Installation" installation mode and select the "SOFTNET-IE RNA ..." program in "Options".

You can find information about the configuration in the *SIMATIC NET; PG/PC - Industrial Ethernet Operating Instructions; SOFTNET-IE RNA*.

Additional information

- Online help for "SIMATIC NET SOFTNET-IE RNA" software
- You can find additional information on this on the Internet Technical documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/109801081):
  - Operating instructions *SIMATIC NET; RNA Box, SCALANCE X204RNA EEC*
  - Operating instructions *SIMATIC NET PG/PC; Industrial Ethernet SOFTNET-IE RNA V8.2*
- You can find information on the individual SIMATIC NET products and their configuration on the Internet (https://support.industry.siemens.com).

6.3.2.2 How to connect singular components to the redundant terminal bus on the basis of the Parallel Redundancy Protocol

Introduction

You can connect the following non-redundant objects to a redundant network with the RNA Box.

- Non-redundant networks
- Components that have just one network connection, for example

You will find additional information on this topic in section "Redundant, high availability terminal bus based on the Parallel Redundancy Protocol (PRP) (Page 69)".

Procedure

1. Connect the networks for the redundant terminal bus (referred to as LAN A and LAN B below) to the following ports of the RNA Box:
   - PRP A (LAN A)
   - PRP B (LAN B)
2. Connect the non-redundant objects to the following ports:
   - P1
   - P2
3. Configure the RNA Box.

Messages

- RNA Box has signaling contacts.

Additional information about configuration

You can find additional information on this on the Internet Technical documentation SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/109801081):

- Operating instructions *SIMATIC NET;* RNA Box , *SCALANCE X204RNA EEC*
- Operating instructions *SIMATIC NET PG/PC; Industrial Ethernet SOFTNET-IE RNA V8.2*
- For more information on Ruggedcom refer; *Process Control System PCS 7; PCS 7 Released Modules V10.0* manual

6.3.3 How to configure a high availability plant bus

Introduction

You configure the communication connections for the plant bus with NetPro. Industrial Ethernet is used for the plant bus.

High availability plant bus

You can set up a high availability plant bus with a ring structure.

The components of the process control system are connected to the plant bus using switch modules.

The degree of availability you require determines whether or not you should use additional network adapters in the OS servers and in each subsystem of the automation system.

This section describes the procedure for a high availability plant bus (ring) with switch modules without additional CPs.

Additional information is available in the section "High availability plant bus (Page 74)".

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- The hardware configuration of the subsystems of the H system is the same.
- One of the following network adapters is configured in HW Config for the connection to the plant bus:
  - a PN IO interface of a CPU 410-5H in every subsystem of the H system.
  - a CP 443-1 CP has in every subsystem of the H system.
- Two SIMATIC PC have been configured in HW Config:
  - High availability plant bus:
    CP 1623; CP 1628 or standard network adaptor (as of V6.0 CPU)
  - Redundant, high availability plant bus:
    CP 1623 or CP 1628

Procedure

1. Open NetPro in SIMATIC Manager with the menu command **Options > Configure Network**.
2. Select the menu command **Insert > Network Objects** to open the hardware catalog.
3. In the hardware catalog, click the plus sign to open the submenu containing the subnets.
4. Double-click the "Industrial Ethernet" subnet to insert it into the network view.

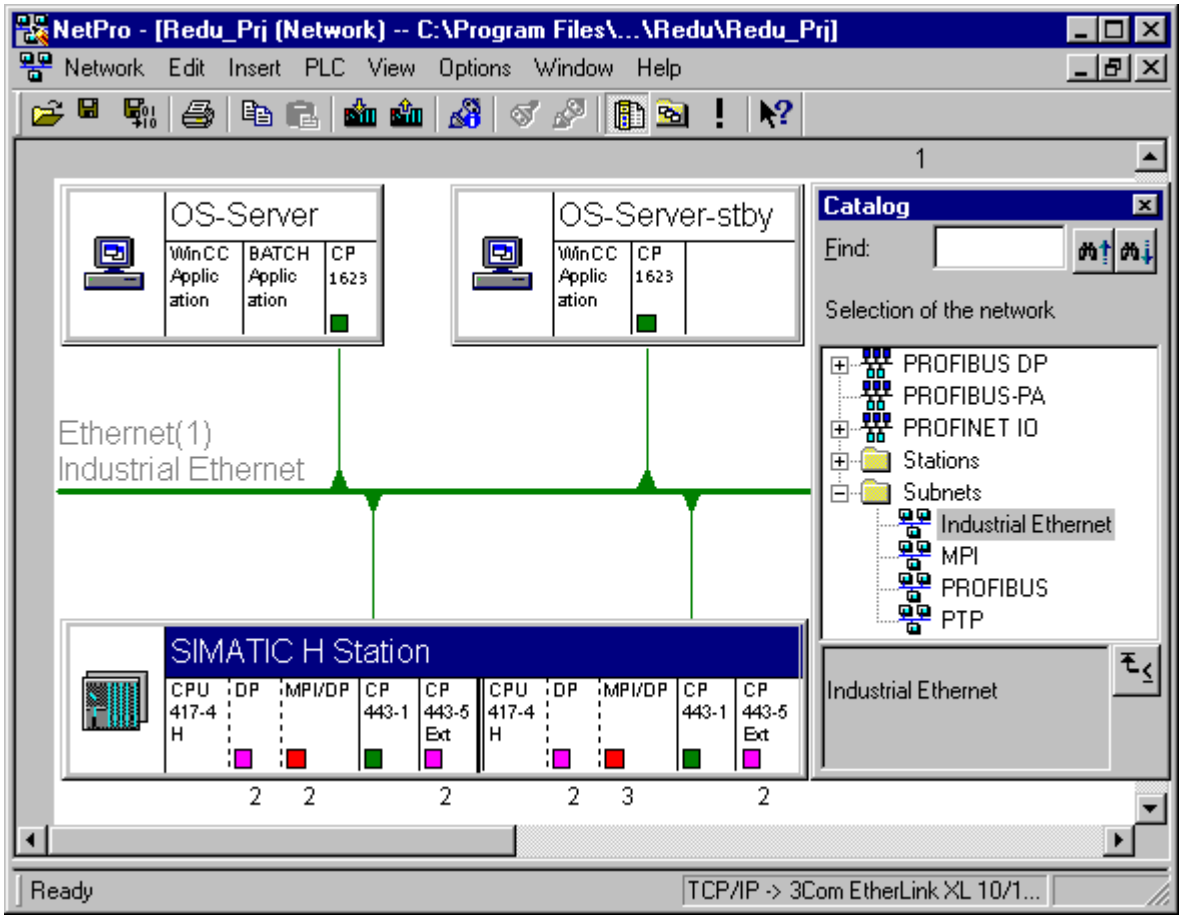
   Note

   To drag subnets into the NetPro project window, click the network, hold down the left mouse button and drag it to the desired location. If you cannot place the object where you want it, you may need to move other objects to make the necessary space.

5. In the left subsystem of the SIMATIC H station, select the PNIO interface of the CPU 410-5H or the interface icon for the CP 443-1 and drag a connection to the Industrial Ethernet subnet. Repeat the procedure for the network adapter of the right subsystem.
6. Follow the same procedure for the network adapters (CPs) in both OS servers.
7. Save your configuration.

Result

The following figure shows the resulting configuration:



Additional information

- Online help for *STEP 7*

6.3.4 How to configure redundant PROFIBUS DP

Introduction

The following section describes how to create and connect a redundant PROFIBUS DP.

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- HW Config is open.

- The UR2-H rack has been inserted twice in HW Config.
- In HW Config, each mounting rack has been fitted with an H CPU in slot 3 and the required synchronization modules.

Procedure

Note

Steps 1 through 4 are necessary only when a CP 443-5 Extended is used for the connection to the redundant PROFIBUS.

1. In HW Config, select the menu command **Insert > Hardware Components**.
2. In the hardware catalog, double-click the "SIMATIC 400" folder. Then double-click the "CP-400" folder and finally the "PROFIBUS" folder.
3. Select the version of the CP 443-5 Extended you are using and drag it to a free slot on the module rack.
   The "Properties - PROFIBUS Interface CP 443-5 Ext ..." dialog box opens.
4. Click "OK".
5. Select the slot on the rack for which you want to specify a redundant PROFIBUS DP interface:
   – Slot X2 to use the PROFIBUS DP interfaces of the CPU
   – Slot of the CP 443-5 Extended to use the PROFIBUS DP interfaces of the CP 443-5 Extended
6. Select the menu command **Edit > Master System > Insert**.
   The "Properties - PROFIBUS Interface CP 443-5 Ext..." dialog box opens.

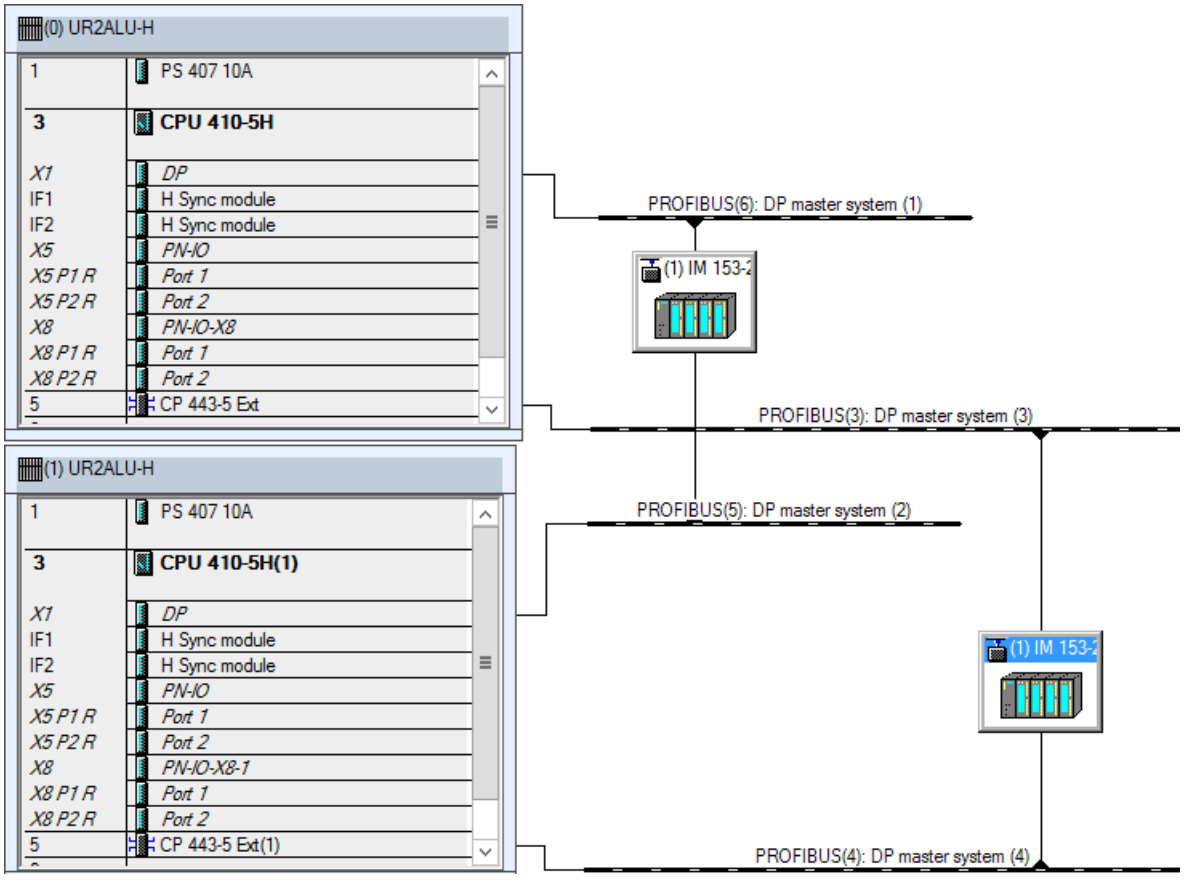
   Note

   When inserting the DP master system for the redundant PROFIBUS DP interface, the entry "Redundant subnet ..." is displayed below the "Subnet" list.

7. Click "New".
   The "New Subnet" dialog box opens.
8. Make any necessary system-specific settings in the "New Subnet ..." dialog box (for example, bus name, transmission rates, etc.).
9. Click "OK".
   The new DP master system is entered in the "Subnet" list.
10. Click "OK".
11. Repeat steps 1 to 10 for the redundant rack.

Result

The figure below shows the result of the configuration process in HW Config. Here, a distributed I/O has already been assigned to the DP master systems for the purpose of illustrating the redundancy principle:



Additional information

- Online help for *STEP 7*

6.3.5 How to configure a high availability fieldbus on the basis of PROFINET

Introduction

The following section describes how to create and connect a high availability fieldbus on the basis of PROFINET.

- Configure the components in HW Config.
- In the Topology Editor, configure the connections between the components in accordance with the cable sequence in the system.

Requirements

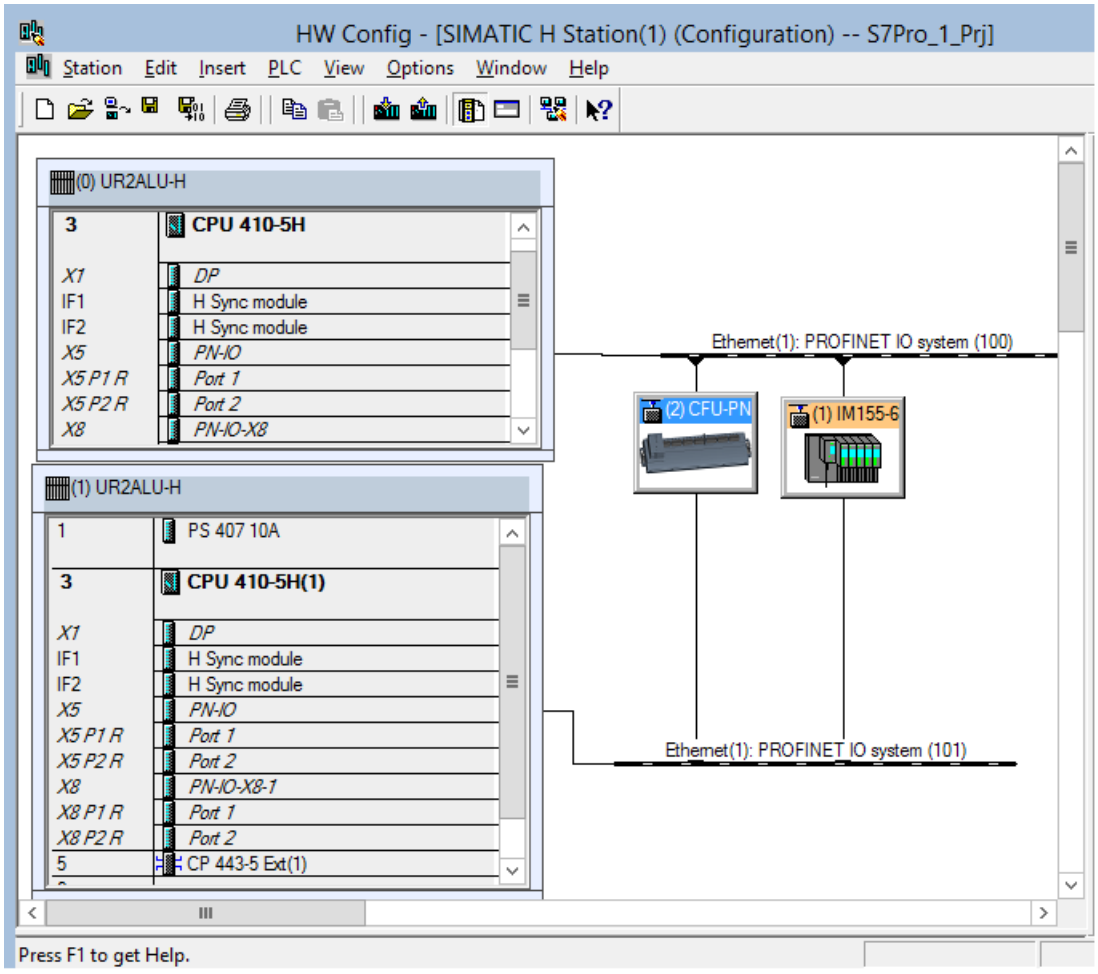
- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- HW Config is open.
- The redundant backplane is inserted in HW Config.
- In HW Config, each rack has been fitted with an 4xx-xH PN/DP H CPU and the required synchronization modules.
- The PROFINET IO systems are added to the H-CPU. This can be done using Insert on the H-CPU.

Configuring in HW Config

1. In the hardware catalog, open the **PROFINET IO > I/O >** folder of the IO device type:
   - **Compact Field Unit (CFU)**
   - **ET 200SP HA**
   - **ET 200M**
   - **ET 200SP**
2. Select the version of the interface module (ET 200M: IM 153-4 ...; ET 200SP HA: IM 155-6-PN/HA) you are using and move it onto the PROFINET IO system using drag-and-drop.

Result

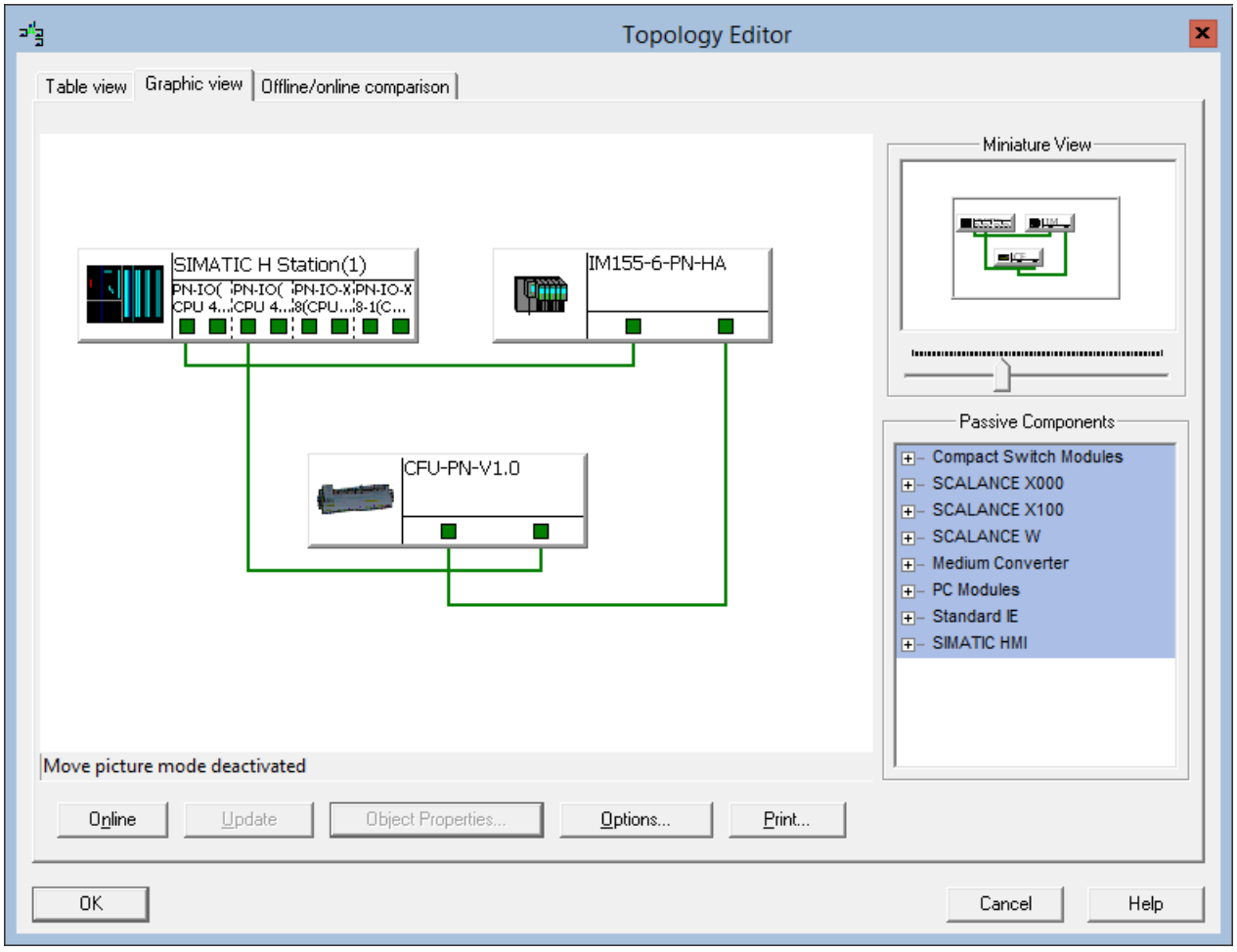
The figure below shows the result of the configuration process in HW Config. The distributed I/O is connected to the PROFINET IO system. The physical setup is configured below with the Topology Editor.



Connecting the components with the Topology Editor

1. Select the **PROFINET IO System** of the first CPU of this automation system.
2. Select the **Edit > PROFINET IO > Topology** menu command.
   The "Topology Editor" dialog box opens.

3. Select the "Graphic View" tab.
   Note:
   You can move the displayed objects. You can select the section displayed via the thumbnail view. Position the objects in accordance with the cable sequence in the system.
4. Using drag-and-drop, connect the I/Os of the CPU and the interface modules (green squares) in accordance with the cable sequence in the system.
   You can make additional system-specific settings on the "Table View" tab. For additional information, refer to the online help of the dialog box.



Additional information

- Online help for *STEP 7*

6.3.6 How to configure a media-redundant fieldbus on the basis of PROFINET

Introduction

The following section describes how to create and connect a media-redundant ring on the basis of PROFINET.

- Configure the components in HW Config.
- In the Topology Editor, configure the connections between the components in accordance with the cable sequence in the system.
- Configure the media redundancy for the following modules:
  - CPU
  - IM

Requirements

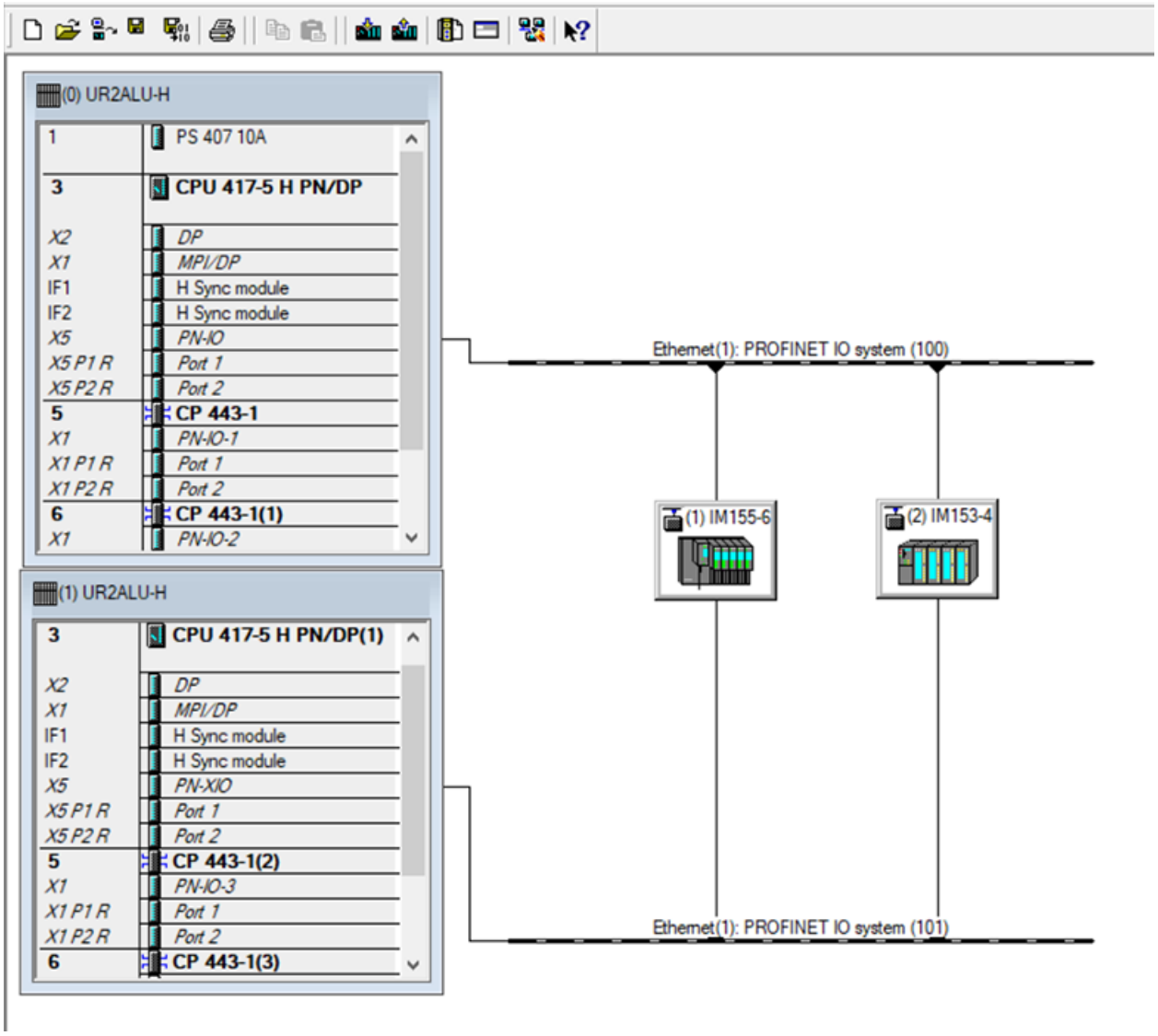
- The PCS 7 project with a SIMATIC station is open in SIMATIC Manager.
- HW Config is open.
- A rack with a PROFINET-capable module (CPU or CP) has been inserted in HW Config.
- The PROFINET IO systems have been inserted at the PROFINET-capable modules (CPU or CP). This can be done by inserting the PROFINET-capable module.

Configuring in HW Config

1. In the hardware catalog, open the **PROFINET IO > I/O >** folder of the IO device type:
   - **Compact Field Unit (CFU)**
   - **ET 200M**
   - **ET 200SP**
   - **ET 200SP HA**
2. Select the version of the interface module (ET 200M: IM 153-4 ...; ET 200SP HA: IM 155-6-PN/HA) you are using and move it onto the PROFINET IO system using drag-and-drop.

Result

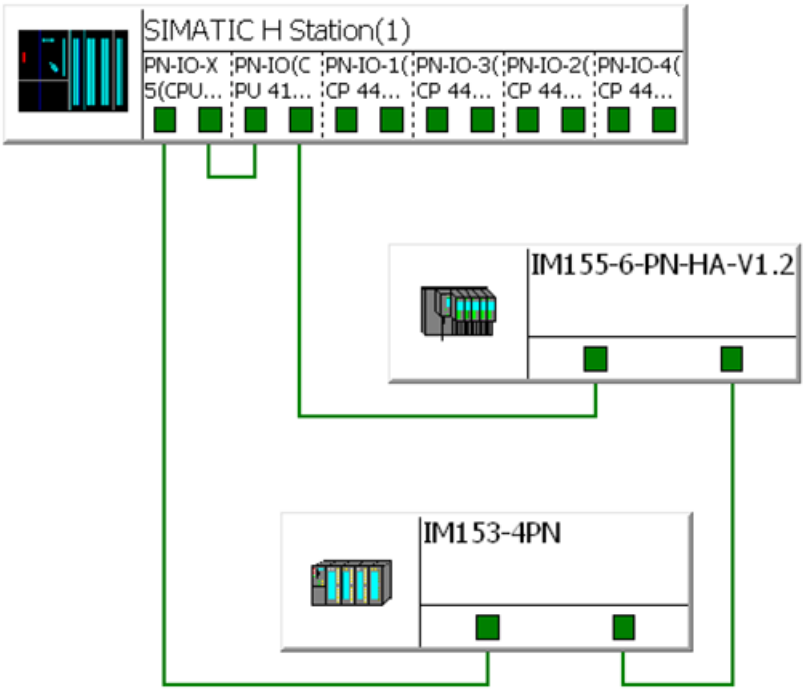
The figure below shows the resulting configuration in HW Config for the X5 interface of the CPU. The distributed I/O is connected to the PROFINET IO system. The physical setup is configured below with the Topology Editor.



Connecting the components with the Topology Editor

1. Select the **PROFINET IO system** of the PROFINET-capable modules (CPU or CP) of this automation system.
2. Select the **Edit > PROFINET IO > Topology** menu command.
   The "Topology Editor" dialog box opens.

3. Select the "Graphic View" tab.
   Note:
   You can move the displayed objects. You can select the section displayed via the thumbnail view. Position the objects in accordance with the cable sequence in the system.
4. Using drag-and-drop, connect the I/Os of the PROFINET-capable modules (CPU) and the interface modules (green squares) in accordance with the cable sequence in the system.
   Connection path for an interface of the PROFINET-capable module:
   From Port1 > via the interface modules of the distributed I/O > to Port 2
   You can make additional system-specific settings on the "Table View" tab. For additional information, refer to the online help of the dialog box.



Configuring domain management in HW Config

Note

Media redundancy

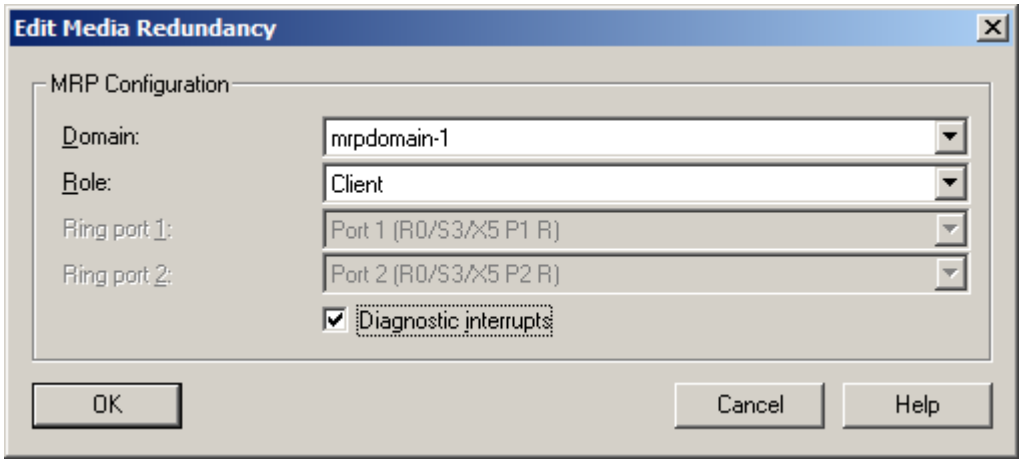
Only one MRP ring can be operated on a PROFINET interface.

If you are operating multiple MRP rings on a CPU with multiple PROFINET interfaces, you must not connect the MRP rings to one another.

If you are operating multiple MRP rings, the MRP manager must be configured. In most cases the CPU is configured as MRP manager.

1. Select any one member on PROFINET IO.
2. In HW Config, select the menu **Edit > PROFINET IO > Domain Management...** .
3. Select the tab "MRP-Domain".

4. In the Area "MRP Domain" choose the MRP Domain (mark the used domain in the tab "MRP Domain", if more than one are available).
5. On PROFINET IO select the member which should be configured as MRP-Manager.
   - Click "Edit".
     The dialog box "Edit Media Redundancy" opens.
   - In the "Role" drop box select the entry "Manager".
     Check the settings and click "OK".
6. Select the members on PROFINET IO which should be configured as MRP client. (You can select more than one).
   - Click "Edit".
     The dialog box "Edit Media Redundancy" opens.
   - In the "Role" drop box select the entry "Client".
     Check the settings and click "OK".



Additional information

- Online help for *STEP 7*

6.3.7 How to configure the redundant PROFIBUS PA

Introduction

The following is a description of how to configure a redundant PROFIBUS PA that is connected to a redundant PROFIBUS DP.

You can find configuration variants in the section "High availability PROFIBUS PA (Page 89)".

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- Two DP master systems are configured for the SIMATIC H station in HW Config and these are used as connection paths for the redundant interface.
- For commissioning: The PROFIBUS addresses are set with the DIL switches on the FDC 157-0 DP/PA couplers.
- You can install a maximum of 5 FDC 157-0 DP/PA couplers, one coupler pair of which is used at the end of the configuration in redundant mode.

Hardware setting on the DP/PA coupler

Note

The redundancy mode set on the DP/PA coupler (DIL switch bit 7) must match the configured redundancy mode:

- OFF: coupler redundancy (default setting)
- ON: ring redundancy (line redundancy)

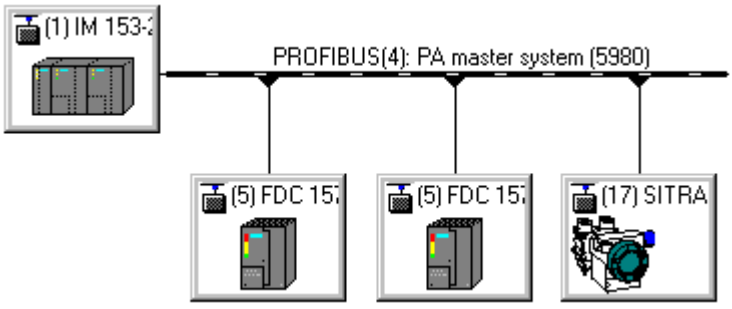
If there is a discrepancy between the set redundancy mode and the configured redundancy mode, a diagnostic message is generated.

Procedure

1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. In the current PCS 7 profile, double-click "PROFIBUS DP" and then "DP/PA Link".
4. Select the FDC 157-0 DP/PA coupler and drag it onto one of the two PROFIBUS DP lines.
5. Select shortcut menu command **Object Properties**.
   The "Properties - DP Slave" dialog box opens.
6. Click "PROFIBUS".
7. Enter the PROFIBUS address (PROFIBUS DP) in the "Properties - PROFIBUS Interface FDC 157-0" dialog box and click "OK".
   The "Properties - PROFIBUS" dialog box opens.
8. Open the "Network Settings" tab.
9. Select the "User-defined" item in the "Profile" list.
10. Click "Bus parameters...".
11. Ensure the value **3** is set for the "Retry Limit" parameter.
12. Click "OK" in the dialog boxes that were opened for this procedure.
13. Repeat steps 1 to 13 for the second DP/PA coupler for coupler redundancy.

Result

The following figure shows the resulting configuration in HW Config:



Additional information

- Operating Instructions *DP/PA coupler, Active Field Distributor, DP/PA Link and Y Link*

6.3.8 How to configure the redundant FOUNDATION Fieldbus

Introduction

The following is a description of how to configure a redundant FOUNDATION Fieldbus that is connected to a redundant PROFIBUS DP .

You can find the configuration in the documentation on the bus link used:

- Operating Instructions *SIMATIC; Bus Link; Compact FF Link*

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- Two DP master systems are configured for the SIMATIC H station in HW Config and these are used as connection paths for the redundant interface.
- For commissioning: The FF addresses are set at the Compact FF Link: Dip switch

Setting redundant mode at the bus link

The redundant mode set at the bus link has to match the configured redundant mode.

Compact FF Link - Setting at Compact FF Link (DIP switch "RING"):

- OFF: Coupler redundancy or non-redundant configuration
- ON: Ring redundancy

Note

Configuration

If there is a discrepancy between the set redundancy mode and the configured redundancy mode, a diagnostic message is generated.

Bus link with FOUNDATION Fieldbus: Create FF subsystem

1. In the component view, select the SIMATIC station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. Open the **PROFIBUS DP > FF Link** folder in the current PCS 7 profile and select IM 655-FF for Compact FF Link.
4. Drag-and-drop the module to be used as a bus link on PROFIBUS DP onto the PROFIBUS DP master system:
5. Enter the node address for the PROFIBUS DP in the "Parameters" tab of the Properties dialog.
   A free address is suggested by the system.

   Note

   "Configuration via PDM" option

   You configure the bus link and the FF devices using SIMATIC PDM in PCS 7. If the "Configuration with PDM" option is selected, you can open SIMATIC PDM by double-clicking the bus link.

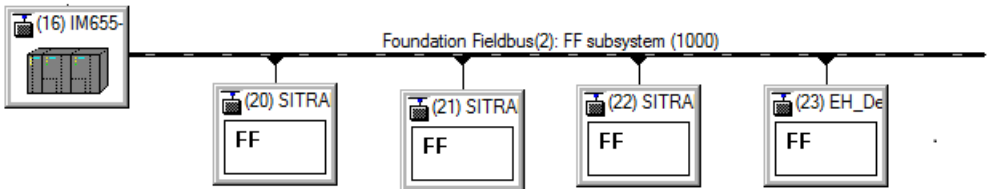
6. Optional steps for a redundant FOUNDATION Fieldbus:

These steps depend on the bus link that is used for the interconnection to the PROFIBUS DP:	
1.	Select the following module depending on the bus link used: • for Compact FF Link: "IM 655-5 FF"
2.	In the table, double click the slot of the first coupler depending on the bus link used. • for Compact FF Link: "Field Device Coupler" The "Properties - Coupler" dialog box opens.
3.	Select the "Parameters" tab.
4.	Select the redundancy mode in the "Value" column: • No redundant configuration (default) • Coupler redundancy • Ring redundancy

7. Click "OK".
   The bus link is created with a FF subsystem.

Result

The following figure shows the resulting configuration in HW Config:



Additional information

- Operating Instructions *SIMATIC; Bus Link; Compact FF Link*

6.4 Distributed I/O

6.4.1 Overview of configuration steps

Introduction

The following sections describe configuring redundancy of the individual components of the distributed I/O.

Overview

This section describes the configuration steps for the following topics:

- Configuring the redundant interface for the I/O device (Page 139)
- Configuring redundant input/output modules (Page 142)
- Configuring the input/output modules in IO Redundancy (Page 146)
- Configuring the Y Link (Page 151)
- Configuring a bus link for PROFIBUS PA (Page 153)
- Configuring a bus link for an FF segment (Page 154)
- Configuration of redundant signals (Page 157)
- Configuration of IE/PB Link HA (Page 157)

6.4.2 How to configure the redundant interface module for the I/O device

Introduction

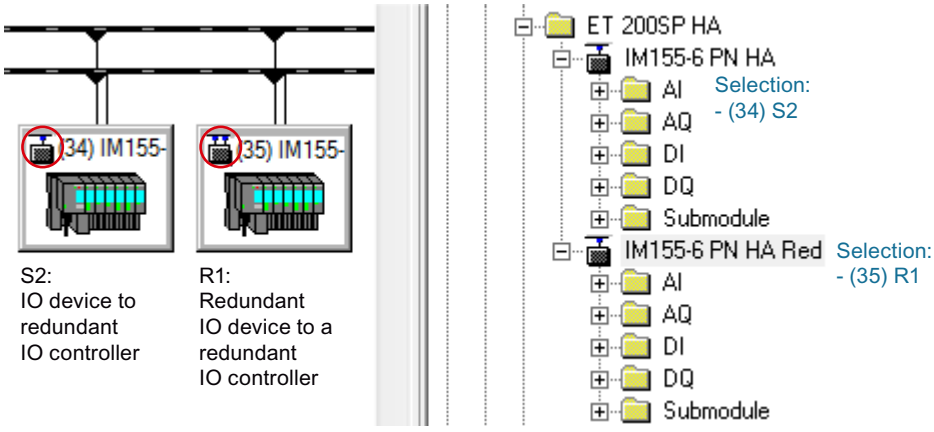
Once you have integrated the interface module (IM 153-2 for ET 200M, IM 152-1 for ET 200iSP; IM 155-6 for ET 200SP HA) as hardware in the distributed I/O device, the component is made known to the system in SIMATIC Manager with HW Config or NetPro.

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- If you want to use ET 200SP HA, a redundant CPU 410-5H with firmware version ≥ 8.2 is configured for the SIMATIC H station in HW Config.
- A redundant fieldbus system is configured for the SIMATIC H station in HW Config.

Procedure

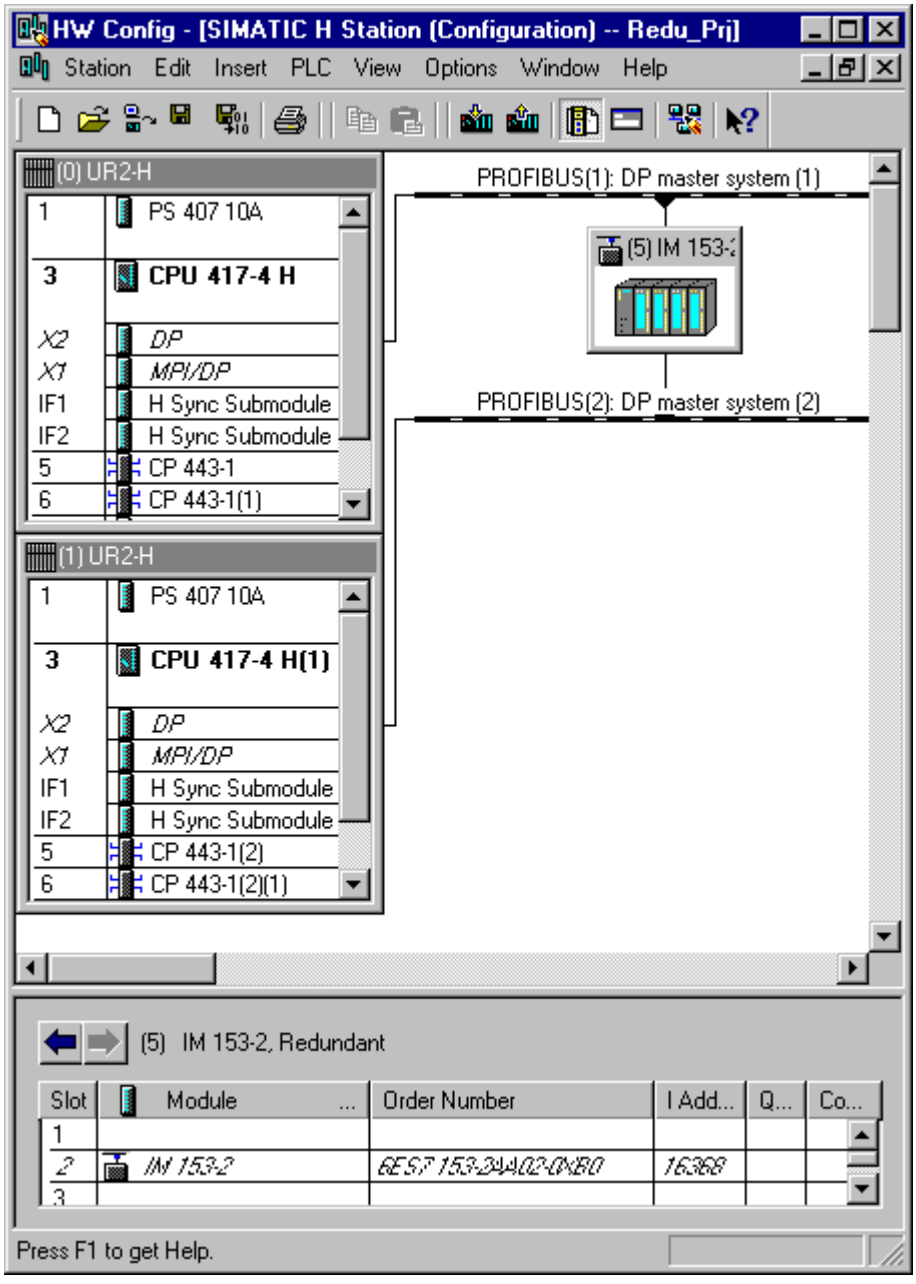
1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. Double-click on the fieldbus system in the current PCS 7 profile. It depends of required fieldbus system.
   - PROFIBUS DP
   - PROFINET IO
4. Double-click the I/O device you want to connect:
   - ET 200M
   - ET 200iSP
   - ET 200SP HA
5. Select the interface module:
   - For ET 200M: IM 153-2 in the hardware catalog.
   - For ET 200iSP: IM 152-1 whose hardware catalog description is "..., can be used redundantly in the H system".
   - For ET 200SP HA: IM 155-6 in the hardware catalog. Depending the type of redundancy you can select the I/O modules shown in the following figure:



6. Drag the interface module to one of the two fieldbus system lines.
   The connection to the redundant line is established automatically.
   - If you use PROFIBUS DP:
     Enter the PROFIBUS address in the "Properties - PROFIBUS Interface IM..." dialog box and click "OK".
   - If you use PROFINET IO:
     Enter the Ethernet address and Subnetmask in the "Properties - PROFINET IO Interface IM..." dialog box and click "OK".

Result

The following figure shows an example configuration in HW Config:



Additional information

- Function manual *Process Control System PCS 7; High-Precision Time Stamping*
- Manual *DP/PA Link and Y Link Bus Couplings*

6.4.3 How to configure redundant input/output modules (PROFIBUS DP)

Introduction

You configure the redundant I/O modules using HW Config.

Note

Redundant operation is possible only with certain S7-300 I/O modules of the ET 200M. For additional information, please refer to the following documents:

- Documentation *PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

Note

Only input/output modules with the same article number and the same product version in analog or digital version can be used.

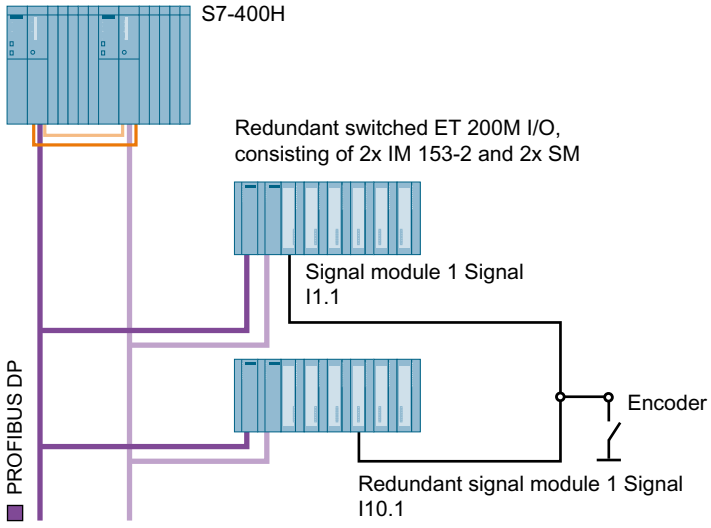
Assigning redundant modules

Redundant modules can be assigned to each other for the ET 200M as follows:

- The modules are located in two different ET 200M stations on the same redundant PROFIBUS DP (see sample configuration).
- The modules are located in two different ET 200M stations on different redundant PROFIBUS DPs.
- The modules are located in the same ET 200M station.

Example configuration

The figure below shows the setup for redundant input modules in a switched distributed configuration.



Method of operation in the example configuration

"Signal Module 1" is configured redundantly to "Redundant Signal Module 1". As a result, Signals E1.1 and E10.1 are redundant to one another.

If a fault is detected in "Signal module 1", the user program continues to work with the address I1.1, but the signal comes from the address I10.1. The user program does not detect an error since the signal status is still correct. The event generates a diagnostic message that provides information about the passivated signals.

As of PCS 7 V7.1, the passivation reaction of the redundant I/O modules are set for channel-based reaction to channel faults. Additional information about passivation reaction is available in the section "How to set the CPU for the reaction of the input/output modules to channel faults (Page 119)".

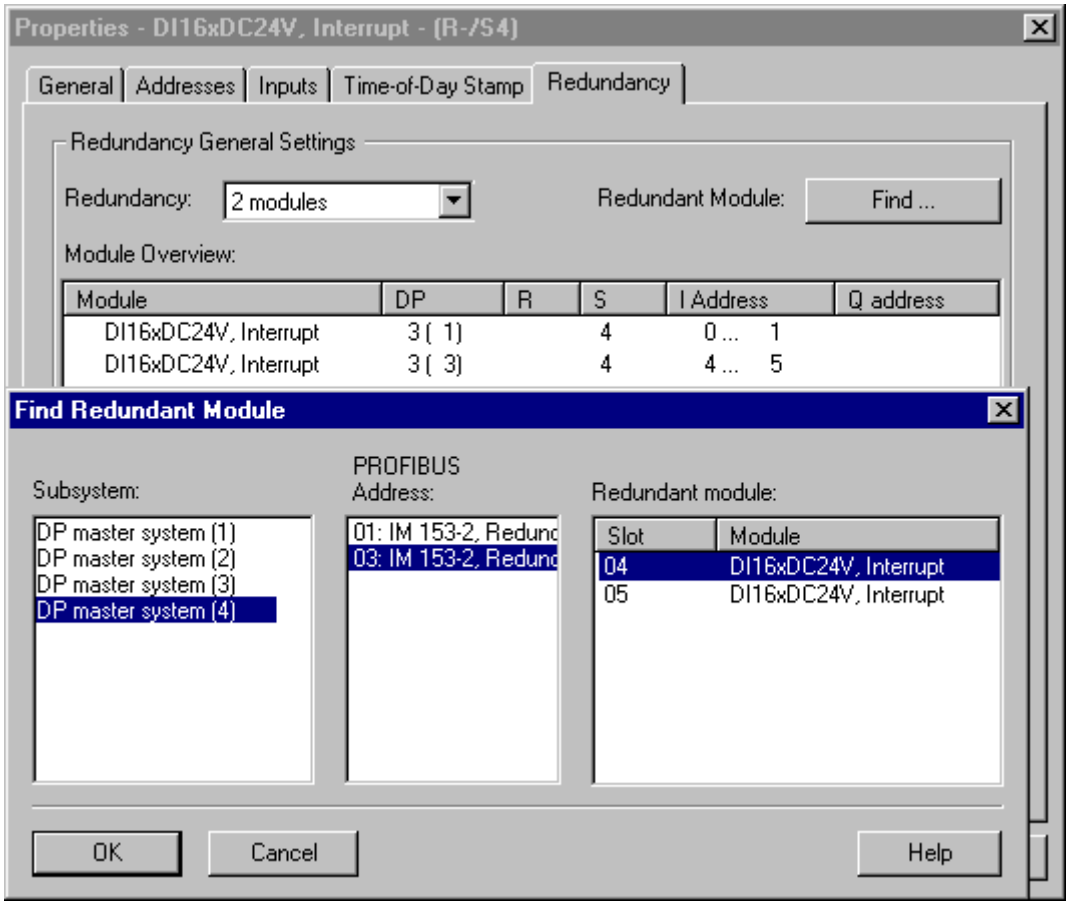
Requirements

- The PCS 7 project involving an H CPU must have been created and opened in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.
- The interface modules for ET 200M (IM 153-2) on the redundant PROFIBUS DP are configured in HW Config.

Procedure

1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. Select the IM 153-2 (ET 200M) in which you want to configure the redundant module.
   The module overview is displayed in the lower window pane.
4. In the hardware catalog, select a signal module that supports redundancy.
   Using drag-and-drop, move the signal module onto a free slot in the IM 153-2 (lower window pane).
5. Repeat steps 3 and 4 for the second signal module.
   The modules for which redundancy is to be configured are inserted.
6. Select the first IM 153-2 again.
7. Double-click the inserted signal module in the module overview.
   The "Properties ..." dialog box for this module opens.
8. Open the "Addresses" tab.
9. Select the process image partition in the "Process image" drop-down list.
10. Select the "Redundancy" tab.
11. Select the entry "2 modules" in the "Redundancy" drop-down list.

12. Click "Find".
    The "Find Redundant Module" dialog box opens.



13. In the "Subsystem" list, select the DP master system in which the redundant signal module is configured.
    All the available PROFIBUS addresses in this DP master system are displayed in the "PROFIBUS address" box.
14. In the "PROFIBUS address" box, select the IM 153-2 in which the redundant signal module is configured.
    The redundancy-capable signal modules available in this IM 153-2 for which no redundancy has yet been configured are displayed in the "Redundant module" list.
15. Select the signal module you want to use as a redundant signal module in the "Redundant module" list.
16. Click "OK" to close the dialog box.
17. In the "Additional parameters" area, make any additional settings required for input modules.
18. Click "OK".

Additional information

- Online help for *STEP 7*
- Documentation *Process Control System PCS 7; PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

6.4.4 How to configure redundant input/output modules (PROFINET IO)

Introduction

You configure the redundant I/O modules in Redundant I/O using HW Config.

Note

Redundant operation is possible only with certain I/O modules of the ET 200SP HA. For additional information, please refer to the following documents:

- Documentation *PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

Note

Only input/output modules with the same article number and the same product version in the analog or digital version can be used.

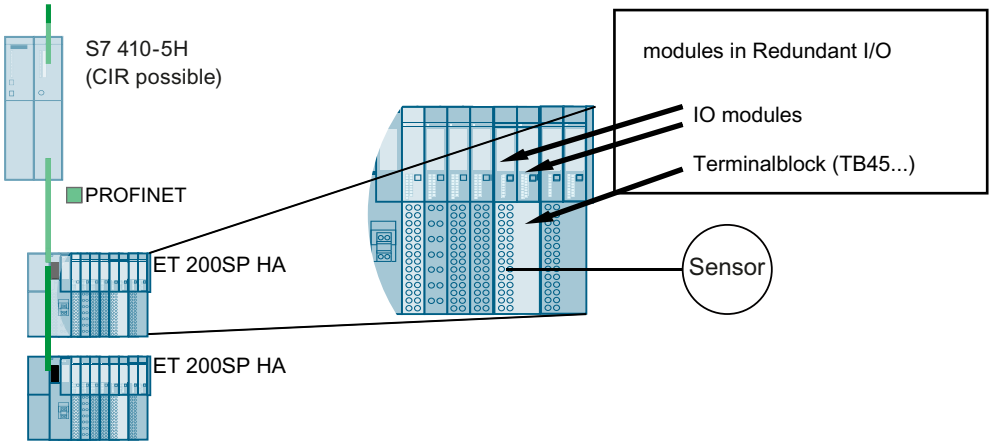
Assigning redundant modules

Redundant modules can be assigned to each other for the ET 200SP HA as follows:

- The peripheral modules are located in the same ET 200SP HA station.
- The peripheral modules are located on the same terminal block (TB 45...D)

Example configuration

The figure below shows the setup for peripheral modules in IO Redundancy in a ET 200SP HA configuration.



Method of operation in the example configuration

"Signal Module 1" is configured redundantly to "Redundant Signal Module 1". As a result, Signals I1.1 and I2.1 are redundant to one another.

If a fault is detected in "Signal module 1", the user program continues to work with the address I1.1, but the signal comes from the address I2.1. The user program does not detect an error since the signal status is still correct. The event generates a diagnostic message that provides information about the passivated signals.

As of PCS 7 V9.0, the passivation reaction of the redundant I/O modules are set for channel-based reaction to channel faults. Additional information about passivation reaction is available in the section "How to set the CPU for the reaction of the input/output modules to channel faults".

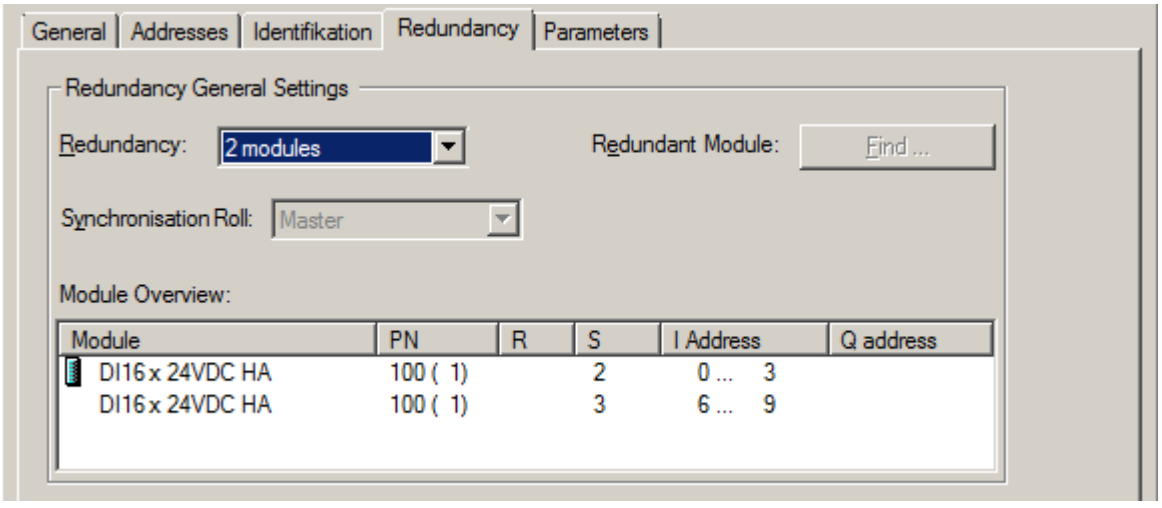
Requirements

- The PCS 7 project involving a CPU 410-5H must have been created and opened in SIMATIC Manager.

Procedure

1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. Select the IM 155-6 HA (ET 200SP HA) in which you want to configure the redundant module.
   The module overview is displayed in the lower window pane.

4. In the hardware catalog, select a signal module that supports redundancy.
   Using drag-and-drop, move the signal module onto a free slot in the IM 155-6 HA (lower window pane).
5. Repeat steps 3 and 4 for the second signal module.
   The modules for which redundancy is to be configured are inserted.
6. Select the first IM 155-6 HA again.
7. Double-click the inserted signal module in the module overview.
   The "Properties ..." dialog box for this module opens.
8. Open the "Addresses" tab.
9. Select the process image partition in the "Process image" drop-down list.
10. Select in the "Redundancy" tab the entry "2 modules".
    You see the 2nd module of the pair, if it is configured.



11. Click "OK" to close the dialog box.
12. In the "Additional parameters" area, make any additional settings required for input modules.
13. Click "OK".

Additional information

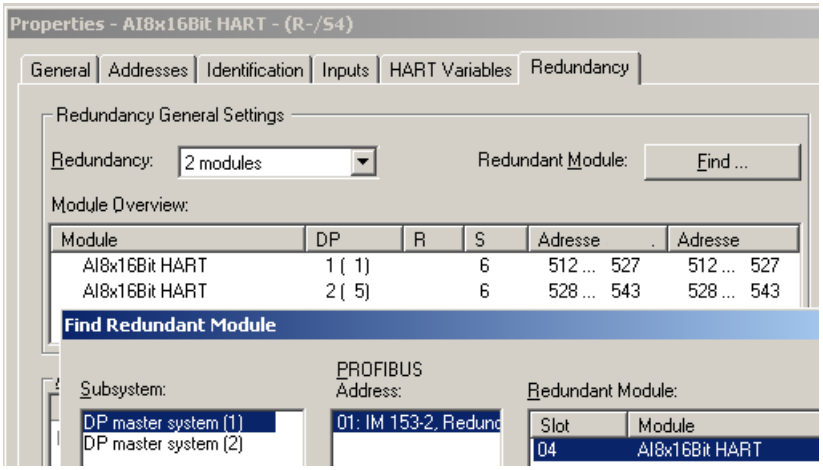
- Online help for *STEP 7*
- Documentation *Process Control System PCS 7; PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

6.4.5 How to configure the redundancy for HART field devices

HART field devices can be configured with redundant modules. HART field devices can only be redundant, if they are configured separately, for example, by a 1 of 2 selection.

Procedure

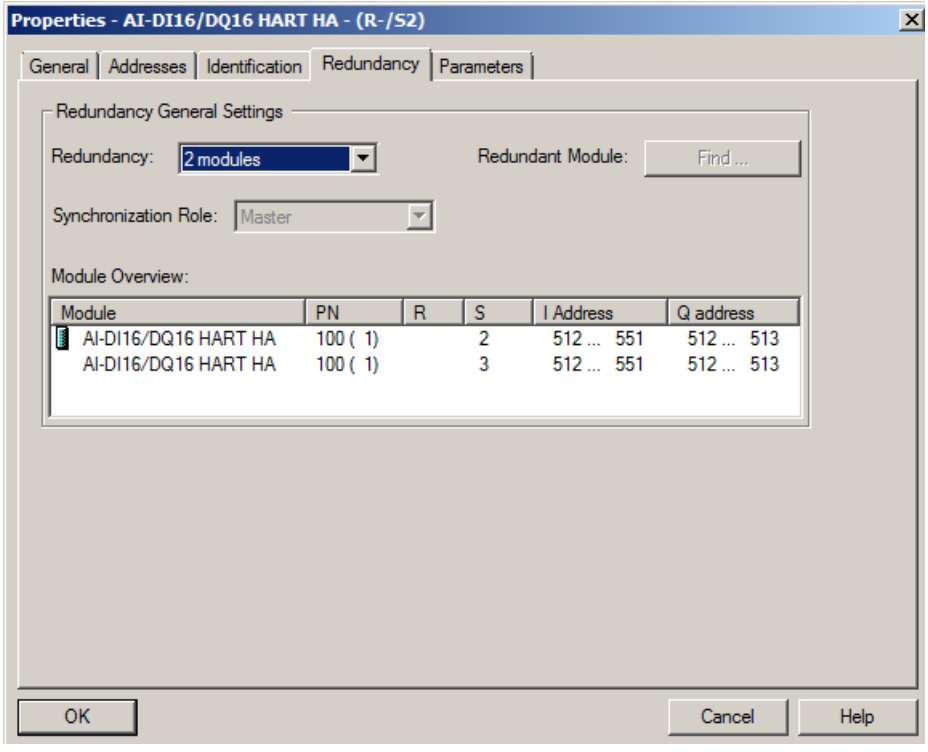
1. Configure redundant modules for HART field devices in HW Config as described in section "How to configure redundant input/output modules (PROFIBUS DP) (Page 142)".



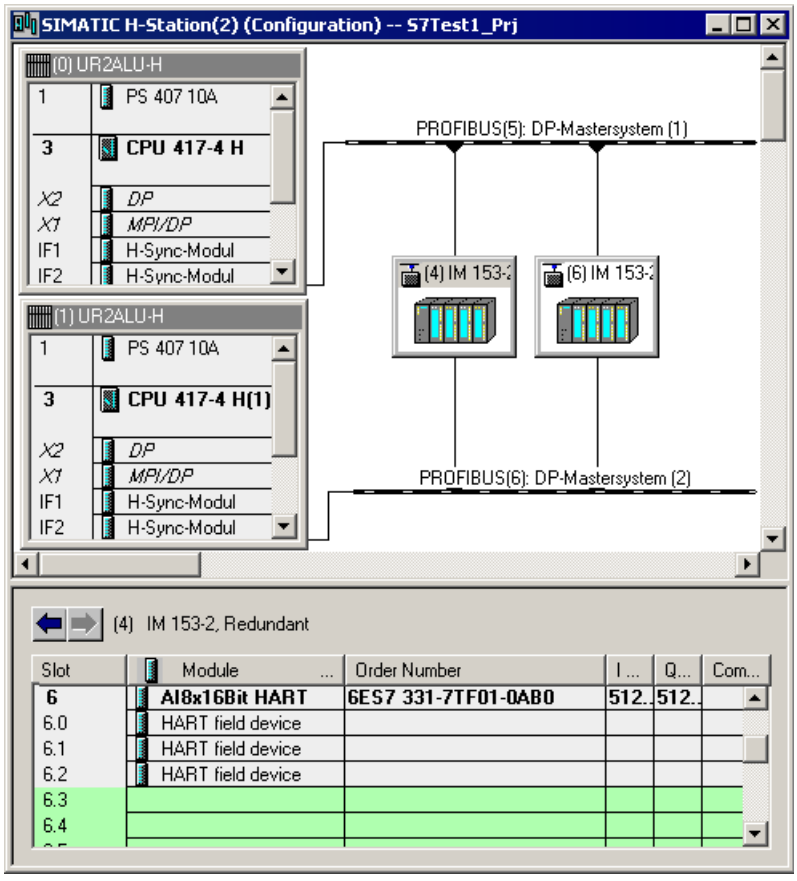
In the example, the module on slot 6 is configured in each case:

- ET 200M station with PROFIBUS address 4: Module 6
- ET 200M station with PROFIBUS address 6: Module 6

In the following example, the module on slot 2 and 3 is configured for ET 200SP HA:



2. Place the "HART field device" in the detail view of the redundant module.
   In the example, module 6 on ET 200M station with PROFIBUS address 4.



3. Place the "HART field device" in the detail view of the redundant module.
   In the example, module 6 on ET 200M station with PROFIBUS address 6.
4. Select the menu command **Station > Save**.
   The settings are saved.
5. Double-click the added HART field device in one of the ET 200M stations.
   SIMATIC PDM will open.
6. Make the necessary settings for the HART field device.

Retrospect implementation of the module redundancy for HART devices

There are no mechanisms set aside to implement a module redundancy for HART devices in PCS 7.

Additional information

Operating Manual *Process Control System PCS 7; SIMATIC PDM*

6.4.6 How to configure the Y Link

Introduction

The Y Link consists of two IM 153-2 interface modules and a Y coupler. The Y Link creates a gateway from a redundant DP master system to a non-redundant DP master system.

The following describes how to install and configure the Y Link.

You can find configuration examples in the section "Gateway between redundant and non-redundant PROFIBUS DP (Page 86)".

Requirements

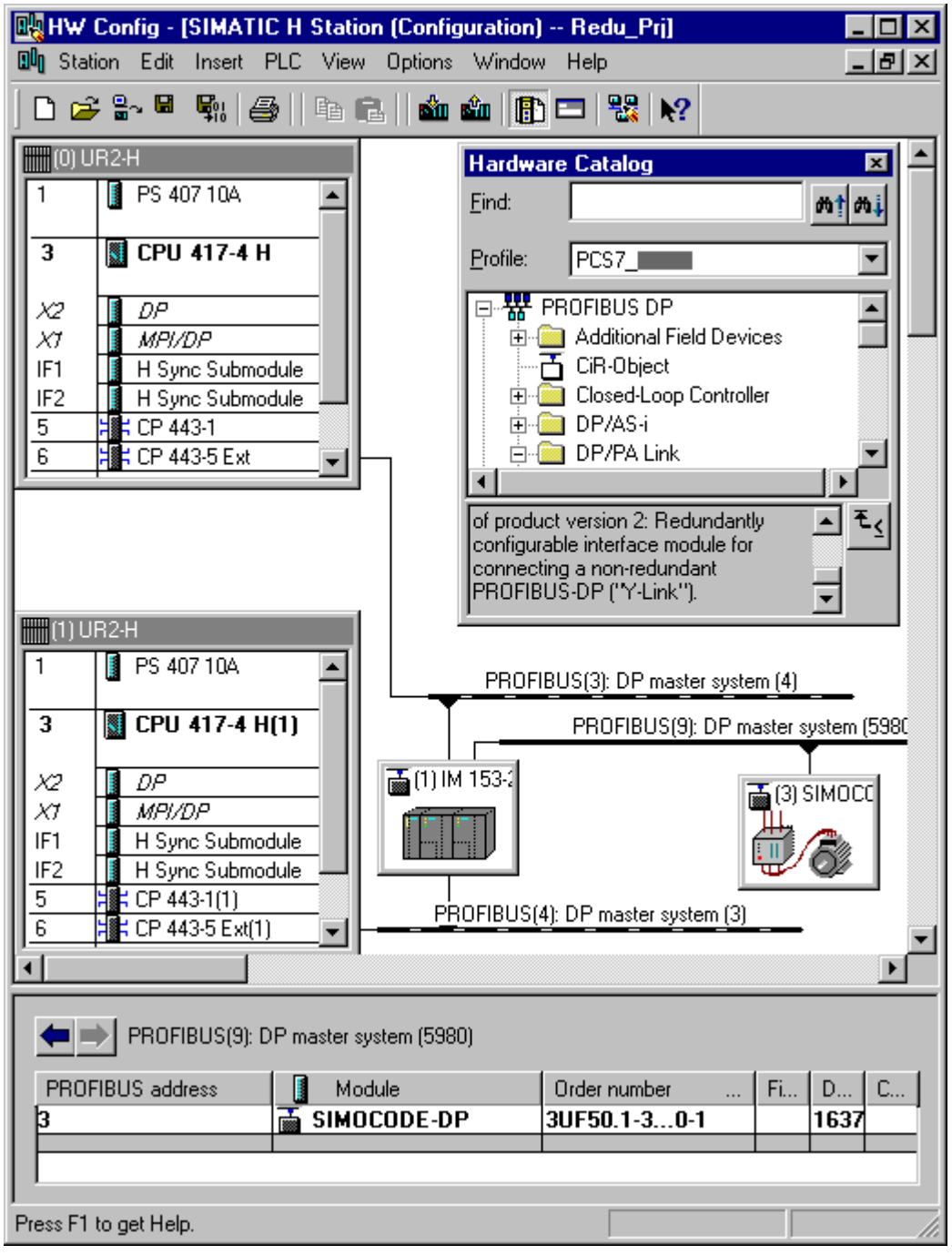
- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.

Procedure

1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. In the current PCS 7 profile, double-click "PROFIBUS DP" and then "DP/PA Link".
4. Select the IM 153-2 interface module whose hardware catalog description is "Y Link".
5. Drag the IM 153-2 interface module to one of the two PROFIBUS DP lines.
6. Enter the PROFIBUS address in the "Properties - PROFIBUS Interface IM 153-2" dialog box and click "OK".
7. Click on "Interface module for PROFIBUS DP" in the "Define Master System" dialog box and click "OK".

Result

The following figure shows an example configuration in HW Config:



Additional information

- Manual *DP/ PA Link and Y Link Bus Couplings*

6.4.7 Configuring a bus link for PROFIBUS PA

Bus links are gateways between bus systems and enable the communication connection of the bus systems.

The DP/PA Link is a bus link for communications between PROFIBUS DP and PROFIBUS PA.

Functionality

When connecting a redundant PROFIBUS DP, the DP/PA Link consists of two IM 153-2 interface modules and one or more DP/PA couplers. The DP/PA coupler is used to build a gateway between a redundant PROFIBUS DP subnet and a non-redundant PROFIBUS PA subnet. When configuring in HW Config in SIMATIC Manager, you can only select the IM 153-2 interface modules and not the DP/PA coupler.

The DP/PA coupler is transparent in regard to addressing and communication. It does not have its own bus address or diagnostic address; it simply forwards message frames. The field devices connected to the PROFIBUS PA are addressed directly from the automation device.

The DP/PA coupler can be reconfigured in runtime but it cannot be replaced.

Note

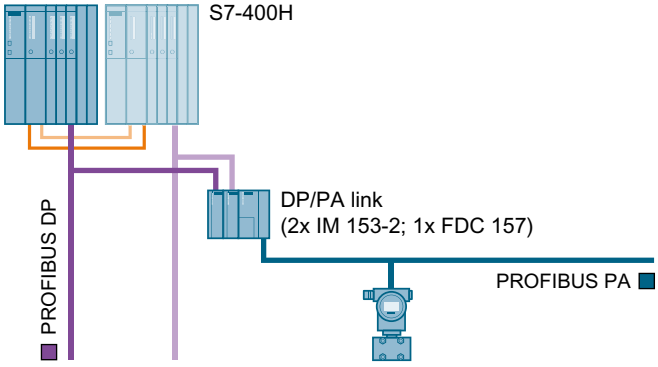
You can find a list of PA slaves that can be connected in the manual *SIMATIC Bus Couplers; DP/PA Link and Y Link*. Note that PCS 7 driver blocks are not available for all of the devices listed. Contact the PCS 7 Support Center to check if such a driver block is available for the device you have selected.

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.

Example configuration

The following figure shows how the DP/PA Link is used.



Procedure

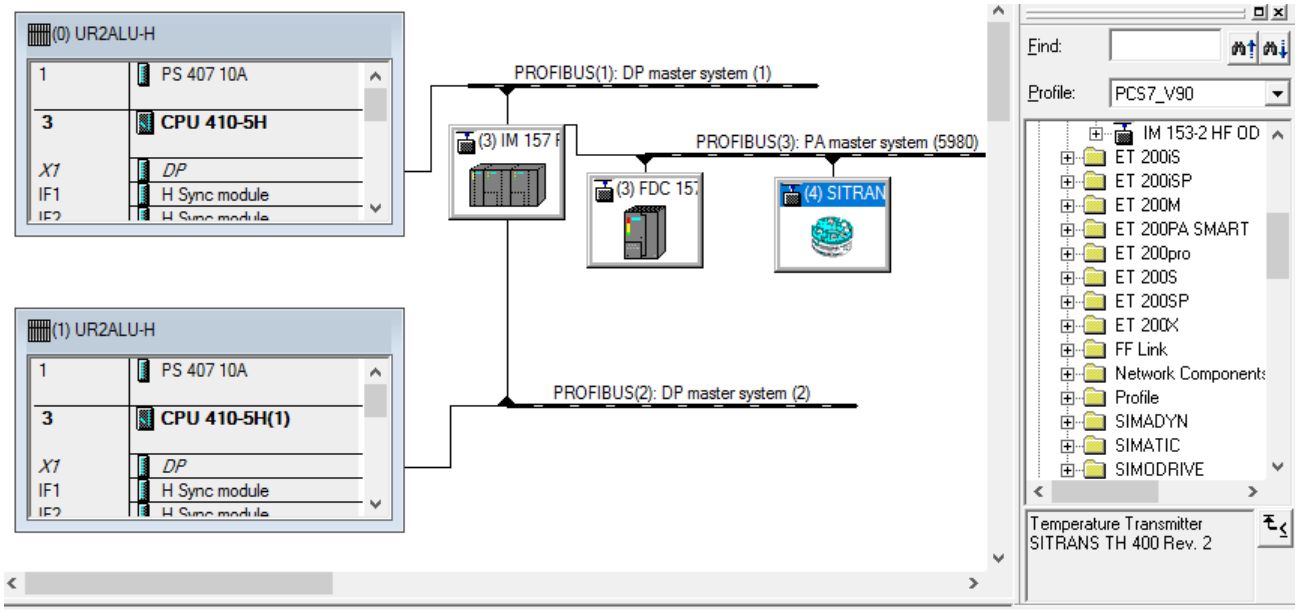
Configure the DP/PA Link as described in the section "How to configure the Y Link (Page 151)".

The DP/PA Coupler does not appear in the hardware catalog for the configuration of the bus system.

When configuring in HW Config, you only need to set the transmission speed for the selected PROFIBUS DP network in the "Network Settings" tab of the "Properties PROFIBUS dialog box.

Result

The following figure shows an example configuration in HW Config:



Additional information

- Manual *SIMATIC DP/PA Link and Y Link Bus Couplings*

6.4.8 Configuring a bus link for Compact FF segment

Bus links are gateways between bus systems and enable the communication connection of the bus systems.

The following bus links make the communication between PROFIBUS DP and FOUNDATION Fieldbus H1 (hereafter referred to simply as FF) possible.

- Bus link "Compact FF Link"
  The redundantly installed bus link consists of two Compact FF Link modules.

Functionality

The field devices connected to the FF segment are addressed directly from the PLC.

In PCS 7 there are the following possibilities for the installation of a bus link when connecting to a redundant PROFIBUS DP:

- **Compact FF Link**
  A coupler for the FF segment is integrated in the Compact FF Link (Field Device Coupler).

The redundant bus link can be re-configured and replaced during operation.

Note

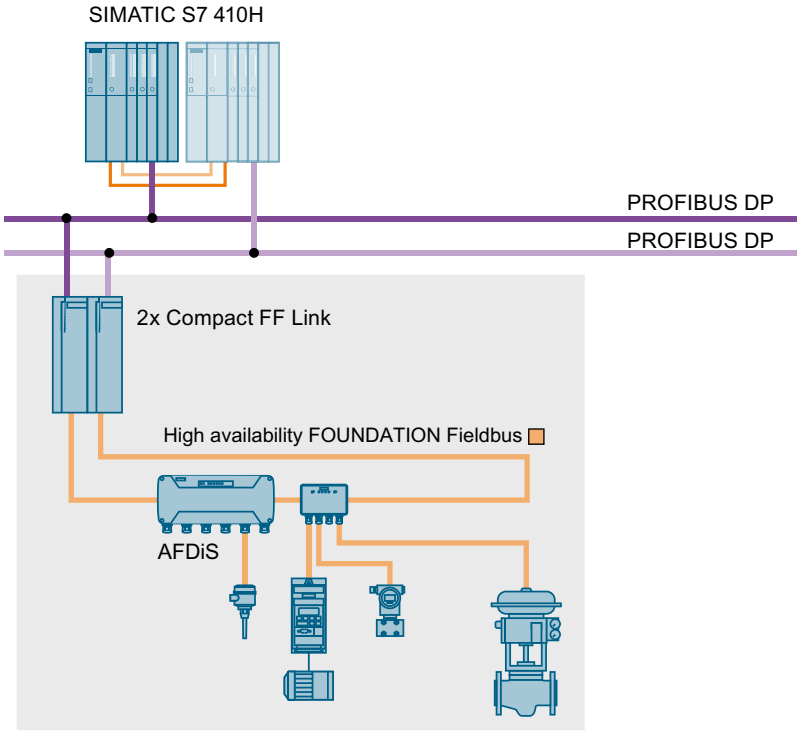
Please note that PCS 7 driver blocks are not available for all of the devices listed. Contact the PCS 7 Support Center to determine if a driver block is available for the device you have selected.

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.
- SIMATIC PDM V8.0 SP1 or higher

Example configuration

The following figure shows how the Compact FF Link is used:



Procedure

During configuration in HW Config, you can only select the Compact FF Link interface module in SIMATIC Manager:

- IM 655-5 FF (for Compact FF Link)

Configure the Compact FF link bus link in the same way as the PA link. You can find information on this in the section "Configuring a bus link for PROFIBUS PA (Page 153)".

More detailed information on configuring the message is available in the documentation Compact FF Link *Process Control System PCS 7, FOUNDATION Fieldbus*

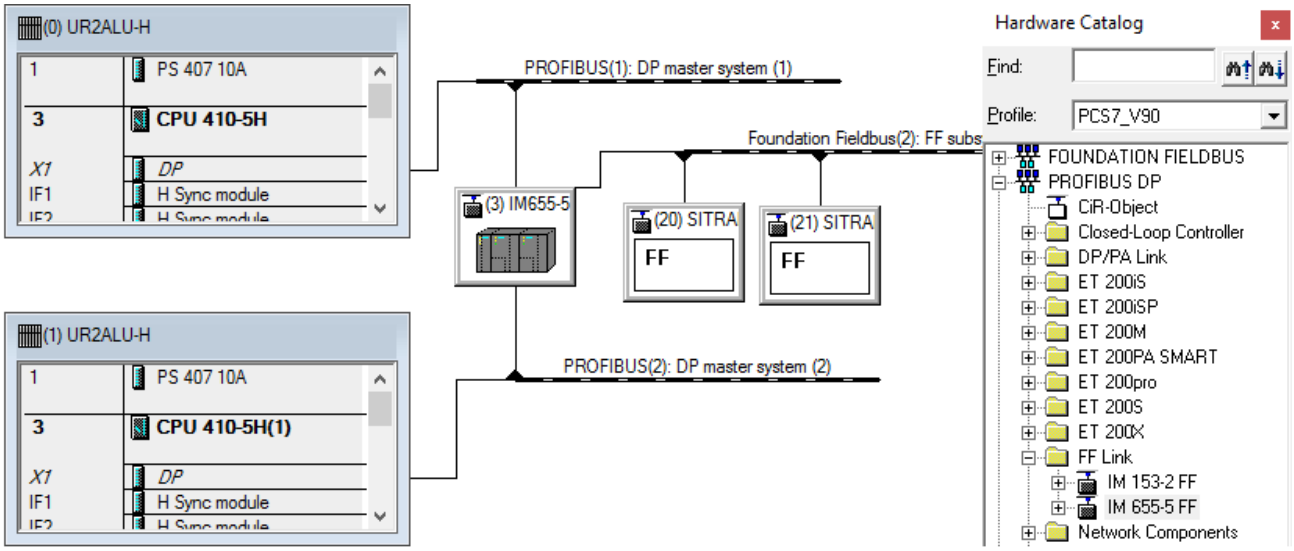
When configuring in HW Config, you only need to set the transmission rate for the affected PROFIBUS DP network in the "Network Settings" tab of the "FOUNDATION Fieldbus Properties" dialog box.

Note

The Field Device Coupler is a virtual bus link object in HW Config.

Result

The figure below shows the configuration of a Compact FF Link in HW Config with the "PCS7_V90" library as an example:



Additional information

- Operating Instructions *SIMATIC; Bus Link; Compact FF Link*
- Commissioning manual *SIMATIC; PCS 7 - FOUNDATION Fieldbus*
- Operating manual *SIMATIC; SIMATIC PDM*

6.4.9 Configuration of redundant signals

You configure only one signal in CFC for redundantly acquired signals.

Basic procedure

1. Place one channel block in the CFC for each redundantly acquired signal.
2. For redundantly detected signals (e.g. input 1.1 and input 10.1), interconnect only the symbol with the least significant address (e.g. input 1.1).
3. Compile the user program when the configuration is completed.
   The required driver blocks are automatically inserted, interconnected and configured during compilation of the user program.

6.4.10 Configuration of IE/PB Link HA

Bus links are gateways between bus systems and enable the communication connection of the bus systems.

The IE/PB Link HA is a bus link for communications between PROFINET and PROFIBUS.

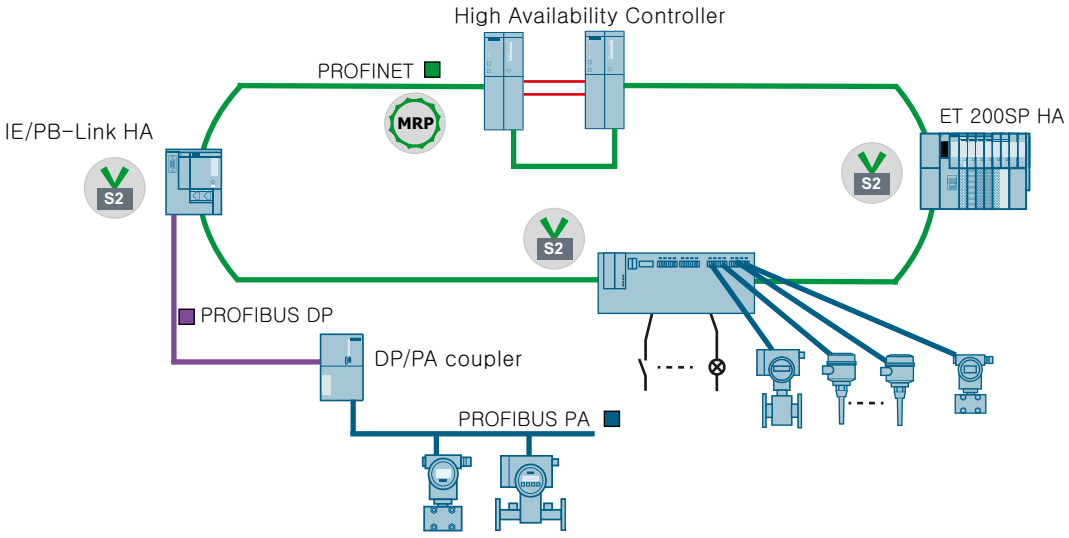
Functionality

- PROFINET IO proxy on the H-system
- Support of PROFINET system redundancy (S2 device mode): When the primary CPU fails, PROFINET communication is continued by the previous backup CPU without operation
- Support of configuration changes during redundant operation of the H-system (H-CiR)

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager
- Redundant CPU 410-5H with firmware version ≥ 8.2 is configured for the SIMATIC H station in HW Config
- A redundant PROFINET IO system is configured on the SIMATIC H station in HW Config

Example Configuration



Procedure

Configuring in mode as a PN IO proxy on the H-system

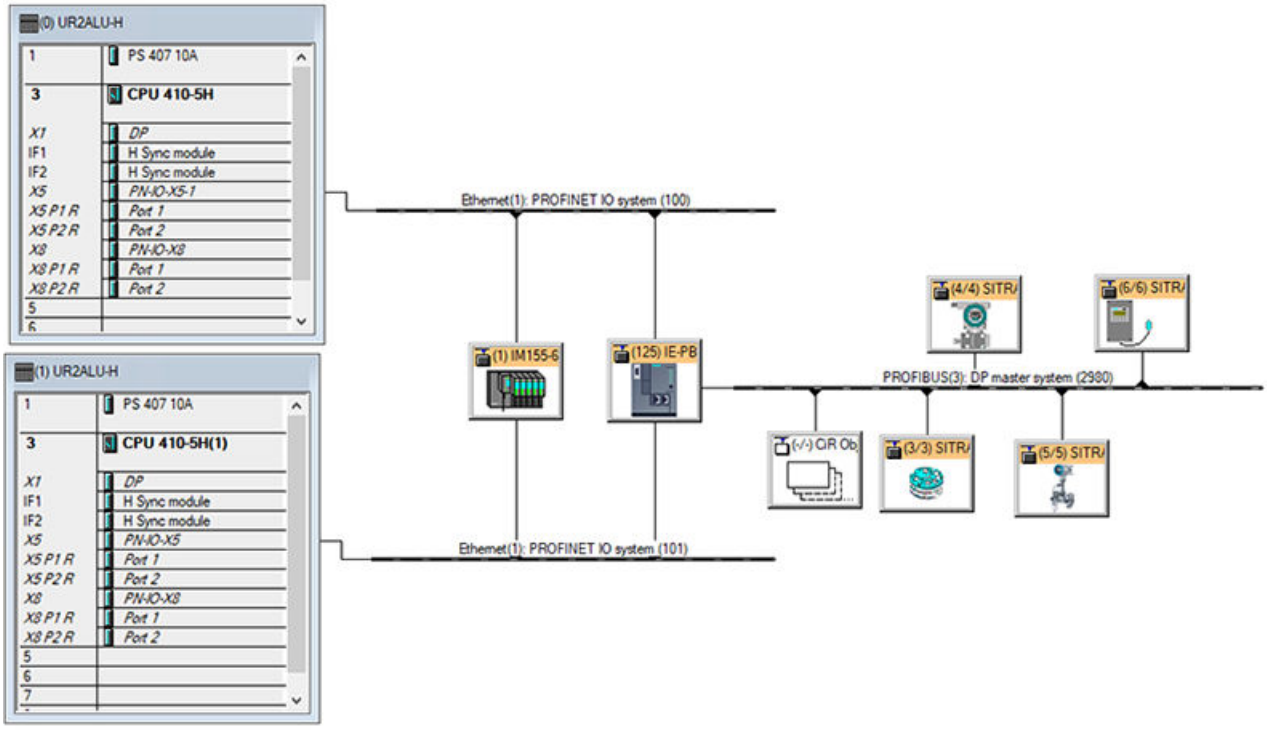
1. From the hardware catalog under PROFINET IO > Gateway > IE/PB Link HA, insert the LINK as an IO device on the corresponding PROFINET IO system.
   An IP address is assigned automatically for the interfaces in the PROFINET IO systems and the LINK is assigned a device number. The highest free device number in the current PROFINET IO system is selected.
   When you take the LINK from the hardware catalog, you will be requested to network the LINK on the PROFIBUS interface.
2. Network the LINK on the PROFIBUS interface.
   Result: The LINK is automatically connected to both PROFINET IO systems and is in S2 mode. In addition, the LINK is created with a connected DP master system with CiR object. The orange background shows that the device is CiR/H-CiR capable or was added using CiR/H-CiR.
3. As far as necessary, set further properties of the LINK.
4. Create the corresponding DP slaves on the DP master system.

Configuring the DP master system with its PROFIBUS nodes as CiR

CiR (Configuration in RUN) is a procedure with which you can make changes during operation of your plant.

1. Using drag-and-drop, place the desired slave from the hardware catalog onto the CiR object in the station window. Result: The name of the added slave is displayed on an orange background.
2. Click on the relevant CiR object and select the entry "Object properties" in the shortcut menu. If necessary, adjust default settings such as number of DP slaves or sum of address ranges. The CiR synchronization time cannot be changed.
3. Click the "Load to H-station" button. For the first load, the LINK must be in STOP mode. Enable the "Forward automatically" option to load in RUN mode.

Result



Additional information

- STEP 7 online help
- PCS 7 - Configuration Manual - Engineering System V10.0
- Manual: SIMATIC NET Industrial Ethernet / PROFIBUS IE/PB LINK

6.5 Operator stations

6.5.1 Overview of configuration steps

Introduction

The following sections describe how to configure redundancy for operator stations.

Overview of configuration steps

You configure the redundancy functionality of the operator stations by performing the following steps:

Step	What?
1	Configuring the PC stations for a redundant OS server pair (Page 160)
2	Setting the project path for the target OS and standby OS (Page 163)
3	Creating a redundant connection between an OS and AS (Page 164)
4	Configuring redundancy for OS servers on the engineering station (Page 166)
5	Setting the redundancy connection for OS servers (Page 168)
6	Assigning S7 programs to the OS (Page 170)
7	Configuring an OS client (Page 171)
8	Configuring an OS client for permanent operability (Page 173)
9	Downloading the SIMATIC PCS 7 project to the target systems (Page 176)

6.5.2 How to configure an OS server and its redundant OS partner server

Introduction

The following describes the individual steps involved in installing the OS server and its redundant OS partner server.

The example below shows the redundant connection of the two OS servers of the server pair to the plant bus (using CP 1623 communication processors, for example, per server).

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- The PCs have two communication processors each for connection to the plant bus.
- Each PC has a standard network adapter for connection to the terminal bus.

Procedure

Note

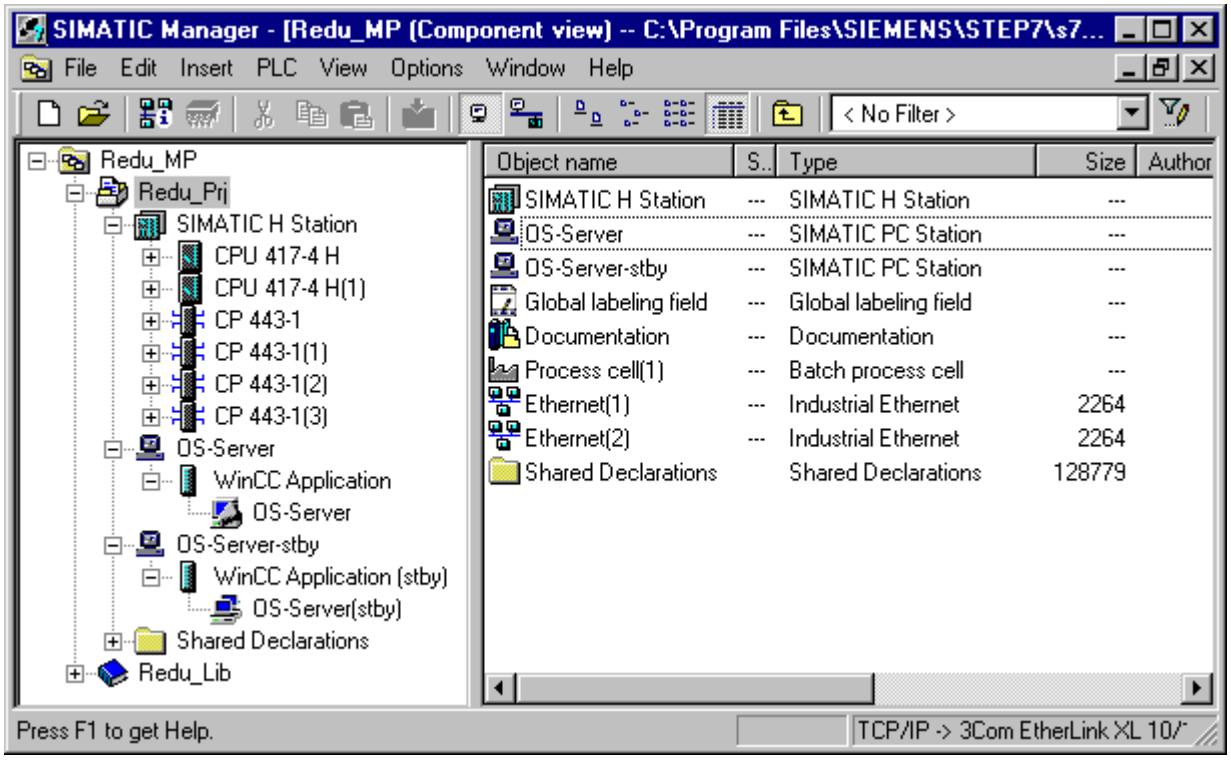
Steps 1 to 11 of this procedure have already been performed if an OS server was created in the project.

1. In the component view of SIMATIC Manager, select the project where you want to add the operator station.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, OS server).
4. Enter the Windows name of the computer to be used as the OS server in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
7. In the hardware catalog under "SIMATIC PC Station > HMI...", select the "WinCC application" and insert it in the configuration table by means of drag-and-drop.
8. Select the communication processor (CP 1623) from the "SIMATIC PC Station > CP Industrial Ethernet" folder of the hardware catalog and drag it to the PC station.
   The "Properties - Ethernet Interface" dialog box opens.
9. Set the required address on the bus for the CP.
   Select the "Set MAC address/Use ISO protocol" check box and click "OK".
10. Repeat steps 8 and 9 for the second communication processor.
11. Select the menu command **File > Save**, exit HW Config and change to SIMATIC Manager.
12. In the component view of SIMATIC Manager, select the project where you want to insert the redundant operator station.
13. Select the menu command **Insert > Station > SIMATIC PC Station**.
    A new SIMATIC PC station is inserted in the selected project.
14. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, OS partner server).
15. Enter the Windows name of the computer to be used as the OS partner server in the "Computer name" box.
16. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detail window.
    The hardware configuration of the SIMATIC PC station opens.
17. If the hardware catalog is not visible, select the **View > Catalog** menu command.
    The hardware catalog opens.

18. In the hardware catalog under "SIMATIC PC Station > HMI...", select the "WinCC application (stby)" and insert it in the configuration table by means of drag-and-drop.
19. In the hardware catalog under **SIMATIC PC Station > CP Industrial Ethernet**, select the communication processor and drag it to the PC station.
    The "Properties - Ethernet Interface" dialog box opens.
20. Set the required address on the bus for the CP.
    Select the "Set MAC address/Use ISO protocol" check box and click "OK".
21. Repeat steps 19 and 20 for the second communication processor.
22. Select the menu command **File > Save** and exit HW Config.

Result

Your project should now correspond to the project shown in the following figure. You can change the names of the components as you wish.



Additional information

- Configuration manual *Process Control System PCS 7; Engineering System*; section "How to Expand a Project with Pre-Configured Stations Using the PCS 7 Wizards"
- Online help for *STEP 7*
- You can find information about NDIS settings of a Maintenance Station in the manual *Process Control System PCS 7; PCS 7 - PC Configuration and Authorization*

6.5.3 How to set the project path of the target OS and standby OS

Introduction

Note

The procedure described in this section applies to the following servers:

- OS server
- Maintenance server

The description for the OS server is used here.

The OS servers of an OS server pair must be made known to each other. You do this by making the following settings for the SIMATIC PC stations:

- For both OS servers: "Target OS Computer"
- On the "master OS": OS name of the redundant OS server "Standby OS"

The destination OS computer is the Windows name of the PC in the Windows network to which the server data (configuration data) for an OS server of an OS server pair was downloaded.

Master OS and standby OS mean the OS servers that make up an OS server pair.

Requirements

- The PCS 7 project is open in SIMATIC Manager.
- Two SIMATIC PC stations have been configured in HW Config as an OS server and OS partner server.

Procedure

1. In the component view, select the OS that you want to specify as the master OS.
2. Select the menu command **Edit > Object Properties**.
   The "Properties - [name of the OS]" dialog box opens.
3. Select the "Target OS and Standby OS" tab.
4. Click the "Browse" button next to the "Path to destination OS computer" box and enter the path to the MCP file of the destination OS.
   The destination OS computer is the computer where the project is to run.
   The mcp file is generated automatically when you create the OS.

   Note

   Enter the network path for the destination OS using UNC (Universal Naming Convention) notation: \\Server name\Share name\Directory name

5. Select the OS that you want to use as the standby OS from the "Standby OS" list.
   All of the standby operator stations that you have created in SIMATIC Manager are displayed in this drop-down box.
6. Click "OK".
   You have completed all settings for the master OS.
7. In the component view, select the OS that you want to use as the standby OS.
8. Select the menu command **Edit > Object Properties**.
   The "Properties - [name of the OS]" dialog box opens.
9. Select the "Target OS and Master OS" tab.
10. Click the "Browse" button next to the "Path to destination OS computer" box and enter the path to the MCP file of the destination OS.
    The destination OS computer is the computer where the project is to run.
    The mcp file is generated automatically when you create the OS.
11. Click "OK".
    You have completed all settings for the standby OS.

Additional information

- Online help for *STEP 7*

6.5.4 How to set the redundancy connection for between an OS and AS

Introduction

To complete the configuration of the OS server and its redundant OS partner server, you need to create the high availability network connections to the AS in NetPro.

Requirements

- The PCS 7 project is open in SIMATIC Manager.
- The AS is connected to the plant bus in NetPro.
- The plant bus has been configured.
- Two SIMATIC PC stations with network adapters have been configured in HW Config as an OS server and OS partner server.

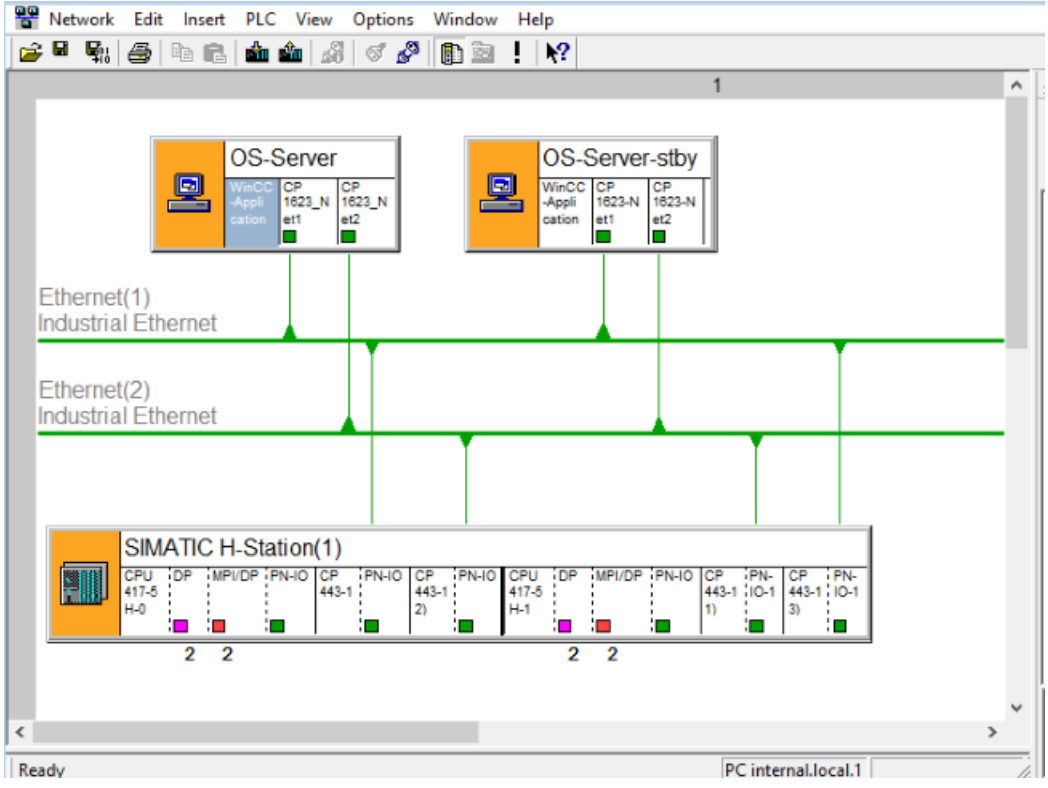
Procedure

1. Open NetPro in SIMATIC Manager with the menu command **Options > Configure Network**.
2. Select the interface symbol in the first network adapter (e.g. CP 1623) in the picture of the OS server and use the mouse to draw a connection to the plant bus.
   The network adapter is now connected to the plant bus.

3. If two network adapters are configured for the plant bus in the OS server, connect the second network adapter of the OS server to the (redundant) plant bus in the same way.
4. Connect the network adapters of the OS partner server to the plant bus in the same way.
5. Select the WinCC application of the OS server for which you want to configure a high availability network connection.
   The connection table is displayed in the lower window pane.
6. Select the first empty row in the connection table and select the menu command **Insert > New Connection**.
   The "New Connection" dialog box opens.
7. Select the desired connection partner in the tree.
8. Select the connection type "S7 connection fault-tolerant" in the "Connection" box.
9. Activate the "Show properties before inserting" check box.
   This allows you to make settings or changes to the connection.
10. If redundant CPs for the plant bus are configured in the SIMATIC H stations, activate the check box "Enable max. CP redundancy (with 4 connection paths)" in the "Redundancy" group.
11. Click "OK" to save your entries.

Result

The following figure shows the redundant network connection of the two OS servers to the SIMATIC H station in NetPro:



Additional information

- Section "Network components (Page 58)"
- Section "How to configure a high availability plant bus (Page 123)"
- Online help for *STEP 7*

6.5.5 How to configure redundancy for OS servers on the engineering station

Introduction

Carry out the following configuration tasks on the Engineering Station. The description for the OS server is used here.

Validity

The procedure described in this section applies to the following servers:

- OS server
- Maintenance server

Requirements

- The PCS 7 project is open in SIMATIC Manager.
- You configured two SIMATIC PC stations in HW Config for operation as master and standby OS servers.

Configuring WinCC Explorer "Redundancy"

Note

Settings in steps 5 and 6: The settings are adopted automatically from the configuration in SIMATIC Manager. It may be necessary to adapt settings if projects have been copied or if you configure in a different order from the one recommended for PCS 7.

1. In the component view of SIMATIC Manager, select the OS in the OS server and select the menu command **Edit > Open Object**.
   The WinCC Explorer opens.
2. Select the menu command **Editor > Redundancy > Open** in WinCC Explorer.
   The "Redundancy" application opens.
3. Select the "Activate redundancy" check box.

4. In the "General" tab, select the "Default Master" check box if you want to set the OS server as the default master.

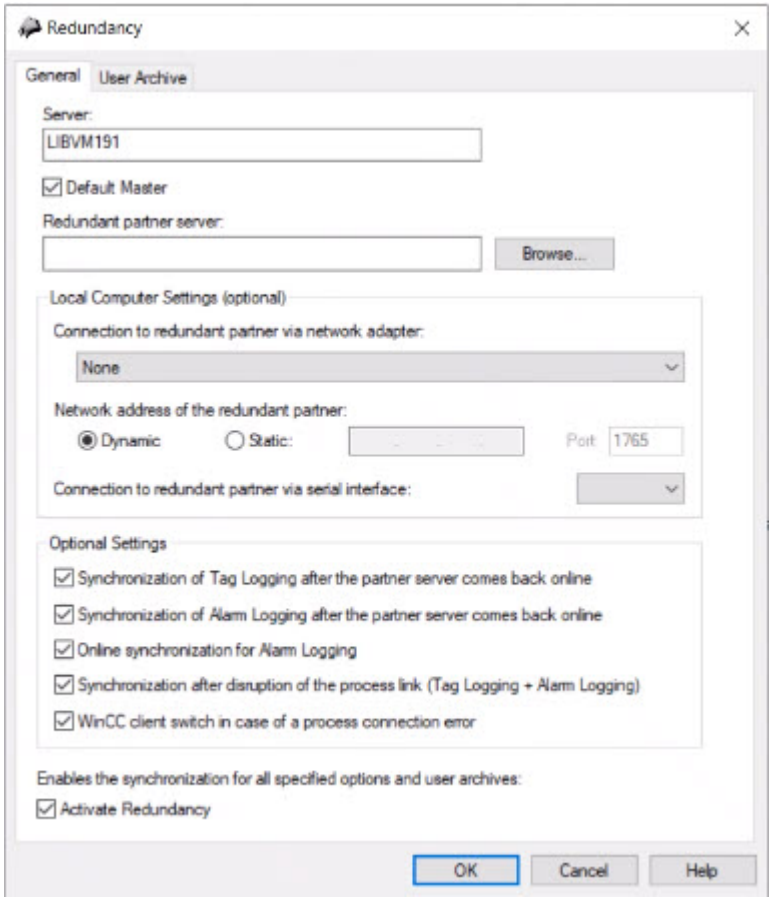
   Note

   Make sure that only one of the two OS servers is the "default master" and that this option is not selected for both of the OS servers in the "Redundancy" dialog box. Problems may otherwise occur during redundancy switchover of OS clients.

5. In the "Redundant Partner Server" field, enter the computer name of the redundant OS server. You can also use the “Browse” button to select an appropriate server from the network.
6. Select the following check boxes as required:
   - Synchronization of Tag Logging after the partner server comes back online
   - Synchronization of Alarm Logging after the partner server comes back online
   - Online synchronization for Alarm Logging
   - Synchronization after process connection error
   - WinCC client switchover if the process connection is disrupted
7. Click "OK".

Result

The "General" tab in the "Redundancy" dialog can be configured as follows:



Additional information

- Online help for *WinCC*

6.5.6 How to set the redundancy connection for OS servers

Introduction

You will now select the connection path for the redundancy connection between 2 OS servers.

You can make the following settings directly on each of the mutually redundant OS servers. The description for OS servers is used here.

Changing the connection path

Note

When the redundancy connection is established via a serial interface, you need to reboot the PC station after changing the connection path.

Validity

The procedure described in this section applies to the following servers:

- OS server
- Maintenance server

Requirements

- The OS server and OS partner server are connected by a redundancy cable.
  You can use the following as the redundancy cable:
  - Network cable to additional network adapter (free onboard network adapter possible as of PCS 7 V8.0)
  - Null modem cable on the COM port
- OS server and OS partner server are installed as redundant OS servers.
- The "OS Server Redundancy" license key is available on the OS server and OS partner server.

Procedure

1. Select the PC station (workplace) in the tree view of Windows Explorer.
2. Select the "Simatic Shell" folder
3. Select the shortcut menu command **Redundancy Settings...**.
   The "Redundancy Settings" dialog box opens.

4. Select the connection path through which the OS server pair is connected in the drop-down list.
   - For connection via RJ45 cable:
     In the "Network adapter" drop-down list, select the network adapter to which you want to attach the network cable for the redundant connection between the two PC stations of a server pair.
   - For a serial connection:
     In the "Serial port" dropdown list, select the port to which you want to attach the null-modem cable for the redundant connection between the two PC stations of a server pair: "COM1" or "COM2"

   Note

   One connection path is permitted between the two PC stations in a redundantly configured server.

5. Click "OK".

6.5.7 How to determine the S7 programs you want to assign to a given OS

Introduction

The AS-OS assignment of a hierarchy folder in the plant view of SIMATIC Manager results in the following in the component view:

- All CFCs and SFCs inserted in the plant view are stored in the chart folder of the assigned AS.
- All pictures and reports inserted in the plant view are stored in the folder of the assigned OS.

Requirements

- The PCS 7 project is open in SIMATIC Manager.
- The plant view is activated.

Procedure

1. Select the hierarchy folder for which you want to make the AS-OS assignment in the plant view.
2. Select the menu command **Edit > Object Properties** and change to the "AS-OS Assignment" tab.
3. From the "Assigned AS" list, select the S7 program that you want to assign to the selected hierarchy folder.

4. If the lower-level objects have another assignment but you prefer all lower-level objects to have the same assignment, select the "Pass on selected assignment to lower-level objects" check box.

   Note

   The "Pass on selected assignment to all lower-level objects" check box is active if the lower-level objects have another assignment or no assignment.

5. From the "Assigned OS" list, select the operator station you want to assign to the selected hierarchy folder.
6. If the lower-level objects have another assignment but you prefer all lower-level objects to have the same assignment, select the "Pass on selected assignment to lower-level objects" check box.

   Note

   If you select "Area oriented" as the compilation mode, the OS assignment can only be changed for PH folders of the OS area level.

7. Click "OK".

Result

The AS/OS assignment is selected, and the lower-level objects are passed on or not passed on according to your setting.

Note

If you have divided up the projects so that there is only one OS or one AS in a project, you cannot make an AS-OS assignment.

Additional information

- Online help for the "AS-OS Assignment" tab
- Online help for PH, IEA, and PO

6.5.8 How to configure an OS client

Introduction

The following section describes how to configure two OS clients, for example, that can be interconnected with a redundant pair of OS servers.

Requirements

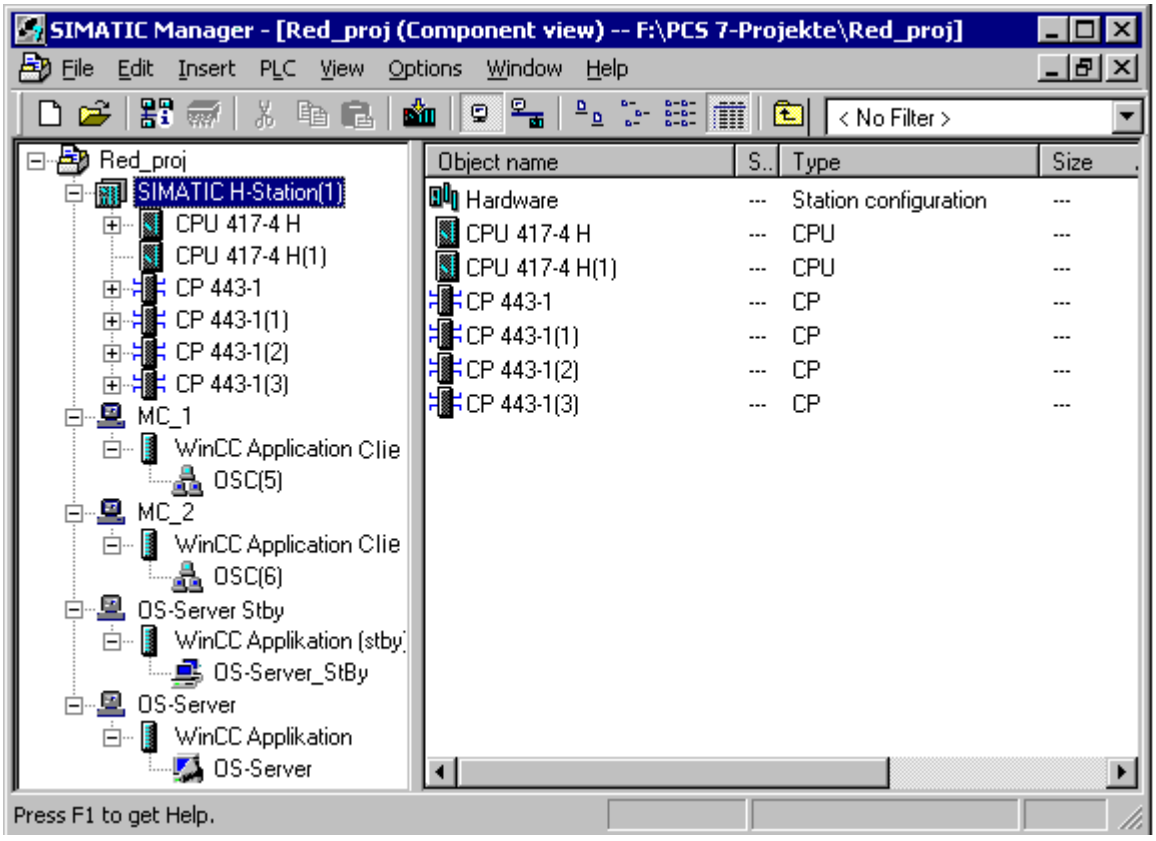
- The PCS 7 project is open in SIMATIC Manager.
- Each PC has a standard network adapter for connection to the terminal bus.

Procedure

1. In the component view of SIMATIC Manager, select the project in which you want to configure the OS clients.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name.
4. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detail window.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
6. In the hardware catalog under "SIMATIC PC Station > HMI...", select the "WinCC application client" and insert it in the configuration table by means of drag-and-drop.
7. Select the menu command **Station > Save**.
8. Close the hardware catalog.
9. Repeat steps 2 to 8 for the second OS client.

Result

Your project should now correspond to the project shown in the following figure. You can change the names of the components as you wish.



Using reference clients

You can set up additional monitoring stations using reference clients. They use configured OS clients as a basis.

Refer to the configuration manual *Process Control System PCS 7; Operator Station for more information*.

6.5.9 How to configure an OS client for permanent operability

Introduction

A minimum of two OS clients are required for permanent operability. A preferred server is specified separately for each client, thus distributing the OS clients to the redundant OS servers. This ensures that the process is continuously available even during a switchover from a faulty OS server to the redundant OS partner server.

Requirements

- The redundant OS server pair has been configured in SIMATIC Manager.
- WinCC redundancy is configured for the OS server (master).
- The OS server (master) has been compiled such that the server data have been generated.
- Two OS clients have been configured in SIMATIC Manager.
- The server data of the OS server (master) has been assigned to the client project.

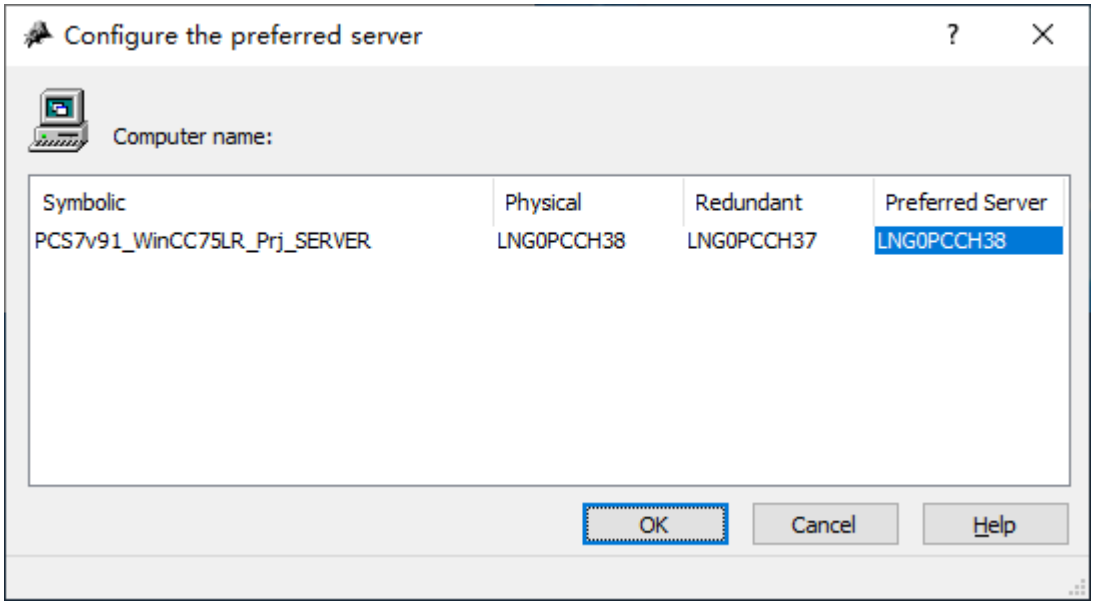
Procedure

1. Open the WinCC project of the first OS client in the component view in SIMATIC Manager.
2. Open the "Server Data" editor in WinCC Explorer.
3. Select the "Configure" command in the shortcut menu.
   The "Configure Server Data" dialog box opens.
4. Click the "No preferred server" cell in the "Preferred server" column.
   A drop-down list then appears. The preferred servers available for selection depend on the redundancy configuration of the OS servers and are transferred to the OS client with the server data.
5. Select the preferred OS server for the OS client from the drop-down list box.
6. Close the dialog box.
7. Repeat steps 1 to 6 for the second OS client. Note that you must set the redundant OS partner server as the preferred server for the second OS client.
8. Select the first OS client and select the menu command **Edit > Object Properties**.
   The "Properties [name of OS]" dialog box opens.
9. Select the "Target OS" tab.
10. Click the "Browse" button next to the "Path to target OS computer" box and enter the path to the MCP file of the OS client.
    The MCP file is generated automatically when you create the OS.
11. Repeat steps 8 to 10 for the second OS client.

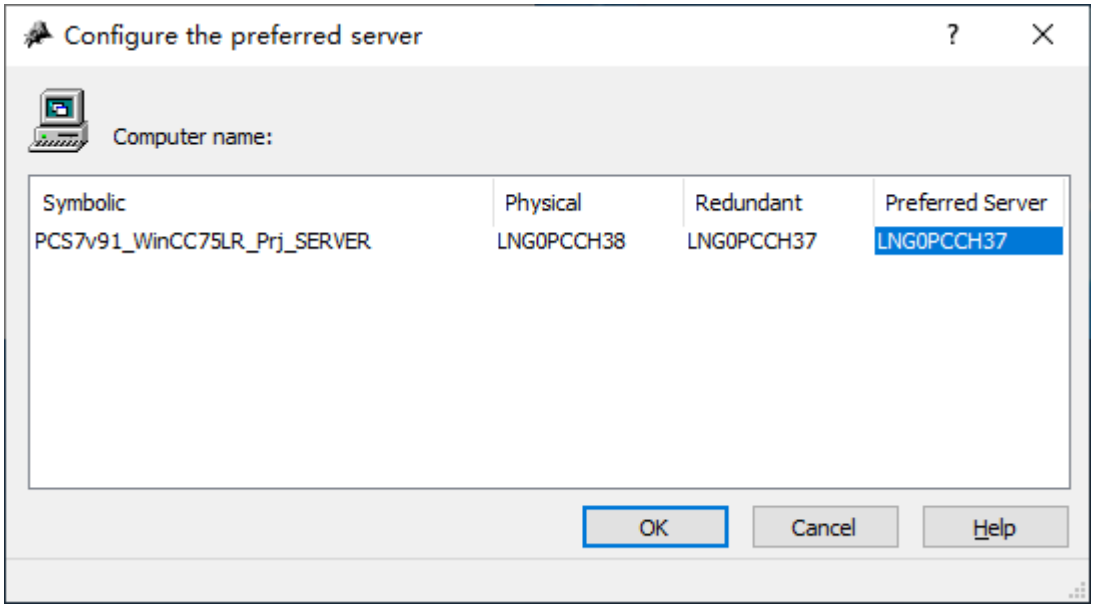
Result

The "Configure server data" dialog boxes on both OS clients appear as follows:

- Dialog box on OS client 1:



- Dialog box on OS Client 2:



Using reference clients

You can set up additional monitoring stations using reference clients. They use configured OS clients as a basis.

Additional information

- Online help for *WinCC*
- Configuration manual *Process Control System PCS 7; Operator Station*

6.5.10 How to download a SIMATIC PCS 7 project to the target system

Introduction

You can download a PCS 7 project that you created in SIMATIC Manager along with the components of the project (AS, OS, BATCH server/client) to the various target systems in a single step with the menu command **PLC > Compile/Download Programs**.

You can also download the various components individually to the PLCs using the menu command **PLC > Download**.

Requirements

- All of the required SIMATIC PC stations have been configured in SIMATIC Manager.
- The master OS/standby OS assignment has been made.
- The destination paths from the ES to the individual target systems have been configured.
- The AS and all of its components (synchronization modules, CPs, etc.) have been configured.
- All network connections have been configured, saved and compiled in NetPro.
- The destination computer is already equipped with an operating system, a network connection and WinCC.
- The PCS 7 project is open in SIMATIC Manager.

Procedure

1. Select the project in the component view of SIMATIC Manager.
2. Select the menu command **PLC > Compile and Download Objects**.
   The "Compile and Download Objects" dialog box opens.
3. Check whether all components in the project have been configured for complete compilation/ downloading.
4. Click "Start".
   The compile/download operation starts.

Sequence when loading redundant OS servers with "Changes-only download" function

The "Changes-only download" function of a redundant OS server is only available if both partner stations are in process mode (runtime).

For safety reasons, downloading is not performed to a redundant OS server pair at the same time:

- The OS server with the configured application "WinCC Appl. (stby)" is downloaded first.
- Once the downloading of the OS server with the configured application "WinCC Appl. (stby)" has been successfully completed, the partner station with the configured application "WinCC Appl." will be downloaded.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*
- Online help for *STEP 7*

6.5.11 Evaluating the redundancy tag "@RM_MASTER" with scripts

Recommendation

If you decide to evaluate the "@RM_MASTER" tag with scripts, you should program an operator button that can deactivate this part of the scripts. This way, you do not have to change and reload scripts each time the software is updated.

6.6 SIMATIC BATCH stations

6.6.1 Overview of configuration steps

Introduction

The following sections describe how to configure redundancy for SIMATIC BATCH stations.

Overview of configuration steps

You configure the redundancy functionality of the BATCH stations by performing the following steps:

Step	What?
1	Configuring the PC Stations for a redundant BATCH server pair (Page 178)
2	Configuring the PC station for a BATCH client (Page 180)
3	Setting the network adaptor for redundancy monitoring of BATCH servers (Page 182)
4	Setting redundancy of the BATCH servers (Page 183)
5	Downloading the target systems for SIMATIC BATCH (Page 184)

6.6.2 How to configure a BATCH server and its redundant BATCH partner server

Introduction

The following describes how to configure a redundant BATCH server.

In the following example, the BATCH server is connected to the high availability terminal bus.

Requirements

- The SIMATIC BATCH software package (BATCH Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

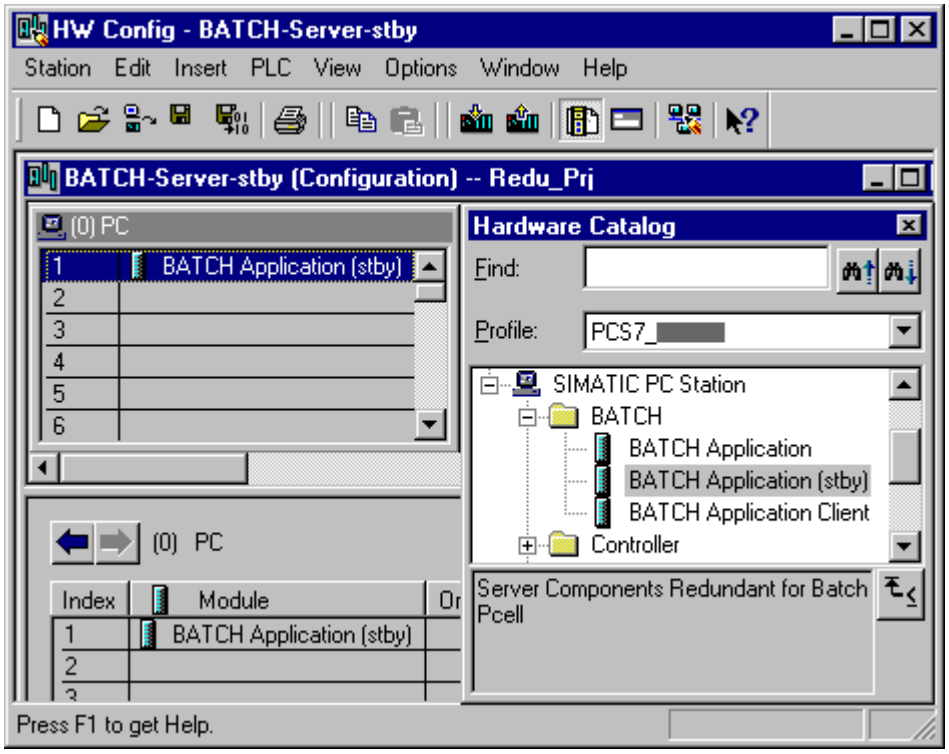
Procedure

1. In the component view of SIMATIC Manager, select the project into which you want to insert the BATCH server.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, BATCH server).

4. Enter the Windows name of the computer to be used as the BATCH server in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
7. In the hardware catalog under "SIMATIC PC Station > BATCH...", select the "BATCH application" and insert it in the configuration table by means of drag-and-drop.
8. Select the menu command **File > Save**, exit HW Config and change to SIMATIC Manager.
9. In the component view of SIMATIC Manager, select the project into which you want to insert the redundant BATCH server.
10. Select the menu command **Insert > Station > SIMATIC PC Station**.
    A new SIMATIC PC station is inserted in the selected project.
11. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, BATCH partner server).
12. Enter the Windows name of the computer to be used as the BATCH partner server in the "Computer name" box.
13. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detail window.
    The hardware configuration of the SIMATIC PC station opens.
14. If the hardware catalog is not visible, select the **View > Catalog** menu command.
    The hardware catalog opens.
15. In the hardware catalog under "SIMATIC PC Station > BATCH...", select the "BATCH application (stby)" and insert it in the configuration table by means of drag-and-drop.
16. Select the menu command **File > Save** and exit HW Config.

Result

The following figure shows an example configuration of a SIMATIC PC station with BATCH application (stby):



Additional information

- Configuration manual *Process Control System PCS 7; Engineering System*; section "How to Expand a Project with Pre-Configured Stations Using the PCS 7 Wizards"
- Manual *Process Control System PCS 7; SIMATIC BATCH*

6.6.3 How to configure a BATCH client

Introduction

A BATCH client and a OS client are often run together on one SIMATIC PC station. You configure both client applications in HW Config in a SIMATIC PC station.

Requirements

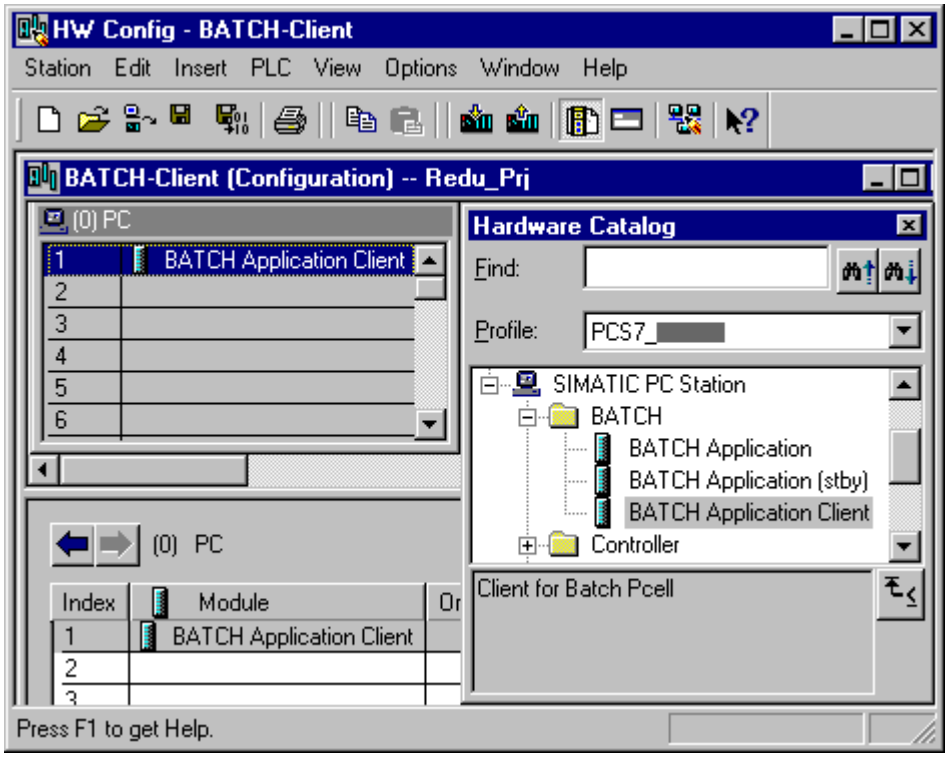
- The SIMATIC BATCH software package (BATCH Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

Procedure

1. In the component view of SIMATIC Manager, select the project into which you want to insert the BATCH client.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name.
4. Enter the name of the computer to be used as the BATCH client in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
7. Under "SIMATIC PC Station > BATCH..." in the hardware catalog, select the "BATCH application client" and insert it in the configuration table by means of drag-and-drop.
8. Save your current settings and close HW Config.

Result

The following figure shows the SIMATIC PC station with BATCH application client configured in HW Config:



Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

6.6.4 How to set the redundancy monitoring of BATCH servers

Introduction

A local Ethernet network needs to be built in PCS 7 for redundancy monitoring of redundant BATCH servers.

Requirements

- A network adapter for the local Ethernet network is available for redundancy monitoring on each BATCH server of a server pair (referred to below as the 3rd network adapter).
- All software components have been installed on the BATCH servers.

Procedure

1. Open the dialog window "Network connections" via the **Control Panel**.
2. Select the menu command **Advanced > Advanced Settings**.
3. The terminal bus must be at the top of the list for the connections. Set the 3rd network adapter in the list under the terminal bus.
4. Deactivate the options "Client for Microsoft Networks" and "File and Printer Sharing ..." in the "Network Adapters and Bindings" tab for the 3rd network adapter.
5. Click "OK".
6. In the "LAN or High-speed Internet" list of the "Network Connections" dialog box, select the 3rd network adapter and then select the menu command **File > Properties**.
7. Check the "Internet Protocol (TCP/IP)" box and deactivate all other elements.
8. Select "Internet Protocol (TCP/IP)".
9. Click "Properties".
   The "Properties of Internet Protocol (TCP/IP)" dialog box opens.
10. Set the "local" IP address in the "General" tab.

    Note

    Enter different IP addresses for the master server and standby server from a private subnet range (e.g., subnet 192.168.0.0) that cannot be routed to the WAN.

11. Click "OK".

6.6.5 How to configure the redundancy connection for BATCH servers on the engineering station

Introduction

Additional tasks must be performed in the engineering and for setting up the PC stations for redundant BATCH servers:

- On the engineering station:
  Check the default engineering settings in effect
- On each BATCH server:
  Set the network adapter for redundancy monitoring

Time needed for ending process mode of a BATCH server

The time needed for ending process mode of a BATCH server depends on the size of the SIMATIC BATCH configuration. The redundancy partner reports a fault on the BATCH server after the configured time. This time is set for redundant BATCH servers so that it is slightly longer than the time the BATCH server needs to normally end process mode in this plant.

Requirements

- The SIMATIC BATCH software package (BATCH Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.
- The configuration of the server pair for BATCH server in HW Config is completed.
- A network adapter is set up for redundancy monitoring via an Ethernet connection on each BATCH server.

Checking the configuration settings

1. Select the project in the component view of SIMATIC Manager.
2. Select the menu command **Options > SIMATIC BATCH** > **Open configuration dialog**.
   The "Configure Batch process cell ..." dialog box opens.
3. Select the project in the tree view and select "Settings".
4. Open the "Distribution" tab. Click "Update". Check the displayed settings.
5. Open the "OS Objects" tab. Click "Update". Check the selected message OS.
6. Open the "System characteristics" tab.
7. Check the displayed settings in the "Startup Characteristics" group.
   You can find additional information about this in the manual *Process Control System PCS 7; SIMATIC BATCH*.
8. In the "Times" group, enter the required time in the "End" input box.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

6.6.6 How to set the redundancy connection for BATCH servers

Introduction

You will now select the connection path for the redundancy connection between 2 BATCH servers.

You can make the following settings directly on each of the mutually redundant BATCH servers.

Note

Shared server for OS and SIMATIC BATCH

The configuration for redundancy connection has to be performed only once.

Requirements

- BATCH server and BATCH partner server are connected to an additional network adapter via a redundancy cable.
- BATCH server and BATCH partner server are installed as redundant BATCH servers.

Procedure

1. Select the PC station (workplace) in the tree view of Windows Explorer.
2. Select the "Simatic Shell" folder.
3. Select the shortcut menu command Redundancy Settings....
   The "Redundancy Settings" dialog box opens.
4. In the drop-down list under the "Network Adapter" group, select the network adapter through which the redundancy communication to the partner server should be established.
5. Perform steps 1 to 4 for each partner server.

6.6.7 How to download the target systems for SIMATIC BATCH

Introduction

You can download a PCS 7 project that you created in SIMATIC Manager along with the components of the project (AS, OS, BATCH server/client) to the various target systems in a single step with the menu command **PLC > Compile/Download Programs**.

Requirements

- The PCS 7 project is open in SIMATIC Manager in the component view.
- The SIMATIC BATCH configuration is completed.
- The batch plant is compiled.

Download via SIMATIC BATCH

1. Select the menu command **Options > SIMATIC BATCH > Open configuration dialog** .
   The "Configure Batch process cell ..." dialog box opens.
2. Select the plant object in the tree view.
3. Click "Download".
   All PC stations for BATCH servers (single, redundant), DB servers and BATCH clients are displayed with information about their download status in the "Downloading <plant>" dialog box.
4. Click "Start".
   The plant object is downloaded.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

6.7 SIMATIC Route Control stations

6.7.1 Overview of configuration steps

Introduction

The following sections describe how to configure redundancy for SIMATIC Route Control stations.

Overview of configuration steps

You configure the redundancy functionality of the SIMATIC Route Control stations by performing the following steps:

Step	What?
1	Configuring the PC stations for a redundant Route Control server pair (Page 186)
2	Configuring the PC station for a Route Control client (Page 188)
3	Creating a redundant connection between a Route Control server and AS (Page 191)
4	Creating a Route Control server (Page 194)
5	Downloading the target systems for Route Control (Page 194)

6.7.2 How to configure a Route Control server and its redundant Route Control partner server

Introduction

The following describes how to configure a redundant Route Control server.

In the following example, the Route Control server is connected redundantly to the plant bus via communication processors (CP 1623).

Requirements

- The SIMATIC Route Control software package (Route Control Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

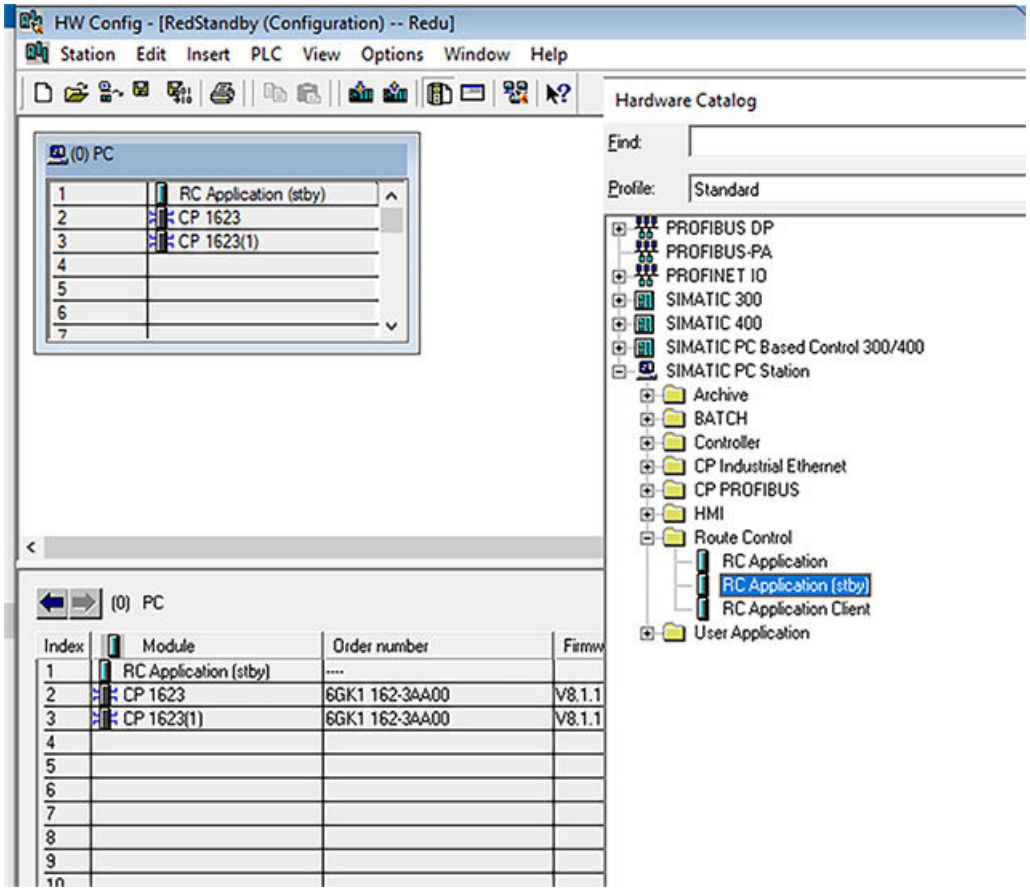
Procedure

1. In the component view of SIMATIC Manager, select the project into which you want to insert the Route Control server.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.

3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, Route Control server).
4. Enter the Windows name of the computer to be used as the Route Control server in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
7. In the "SIMATIC PC Station > Route Control ..." folder of the hardware catalog, select "RC application" and insert it in the configuration table by means of drag-and-drop.
8. In the "SIMATIC PC Station > CP Industrial Ethernet" folder of the hardware catalog, select the communication processor and drag it to the PC station.
   The "Properties - Ethernet Interface" dialog box opens.
9. Set the required address on the bus for the CP.
   Select the "Set MAC address/Use ISO protocol" check box and click "OK".
10. Repeat steps 8 and 9 for the second communication processor.
11. Select the menu command **File > Save**, exit HW Config and change to SIMATIC Manager.
12. In the component view of SIMATIC Manager, select the project into which you want to insert the redundant Route Control server.
13. Select the menu command **Insert > Station > SIMATIC PC Station**.
    A new SIMATIC PC station is inserted in the selected project.
14. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, Route Control partner server).
15. Enter the Windows name of the computer to be used as the Route Control partner server in the "Computer name" box.
16. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detail window.
    The hardware configuration of the SIMATIC PC station opens.
17. If the hardware catalog is not visible, select the **View > Catalog** menu command.
    The hardware catalog opens.
18. Under "SIMATIC PC Station > Route Control ..." in the hardware catalog, select "RC application (stby)" and insert it in the configuration table by means of drag-and-drop.
19. If redundant communication processors are installed for each PC station, repeat steps 8 and 9 for the second communication processor.
20. Select the menu command **File > Save** and exit HW Config.

Result

The following figure shows an example configuration of a SIMATIC PC station with Route Control application (stby):



Additional information

- Configuration manual *Process Control System PCS 7; Engineering System*; section "How to Expand a Project with Pre-Configured Stations Using the PCS 7 Wizards"
- Manual *Process Control System PCS 7; SIMATIC Route Control*

6.7.3 How to configure a Route Control client

Introduction

Below you find out how to configure a redundant Route Control client in HW Config.

Requirements

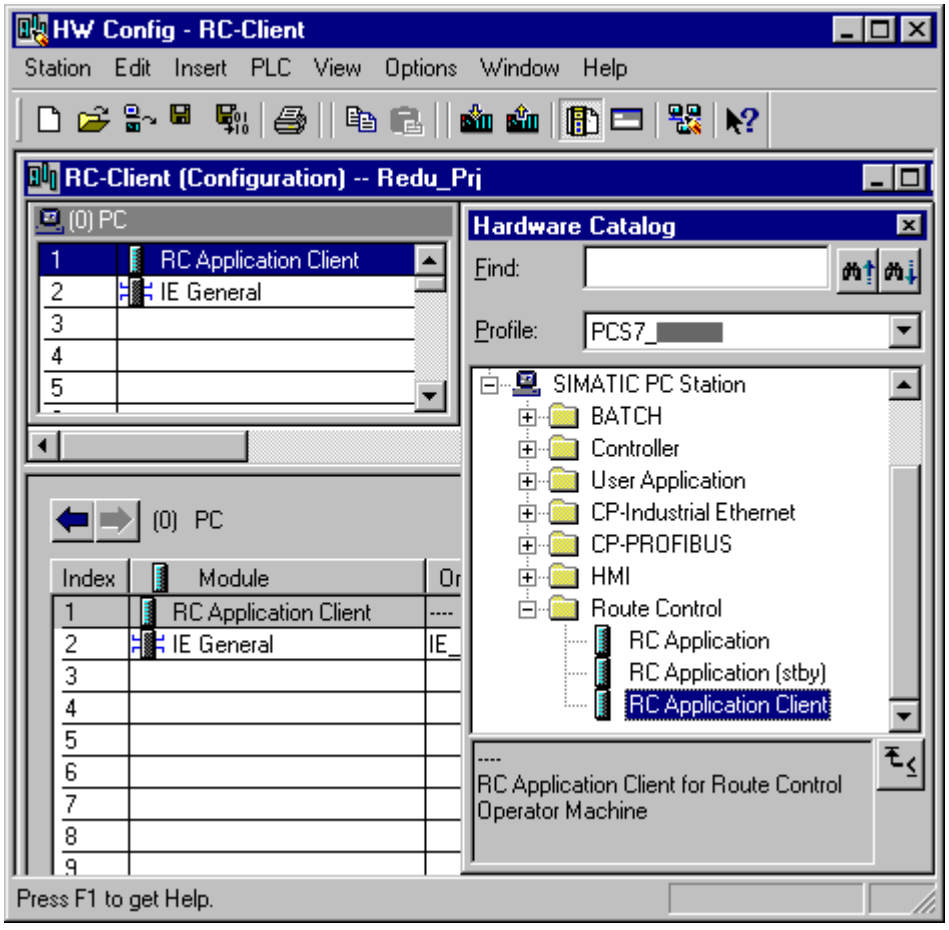
- The SIMATIC Route Control software package (Route Control Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

Procedure

1. In the component view of SIMATIC Manager, select the project into which you want to insert the Route Control client.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name.
4. Enter the name of the computer to be used as the Route Control client in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
7. Under "SIMATIC PC Station > Route Control ..." in the hardware catalog, select "RC application client" and insert it in the configuration table by means of drag-and-drop.
8. Save your current settings and close HW Config.

Result

The following figure shows the SIMATIC PC station with Route Control application client (RC application client) configured in HW Config:



Shared client for OS and Route Control

If a Route Control client and OS client are operated together on a SIMATIC PC station, configure both client applications in HW Config in one SIMATIC PC station.

Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

6.7.4 How to configure a redundant connection between a Route Control server and AS

Introduction

The redundant connections between the Route Control server and the AS are created in NetPro using SIMATIC Route Control wizards.

Requirements

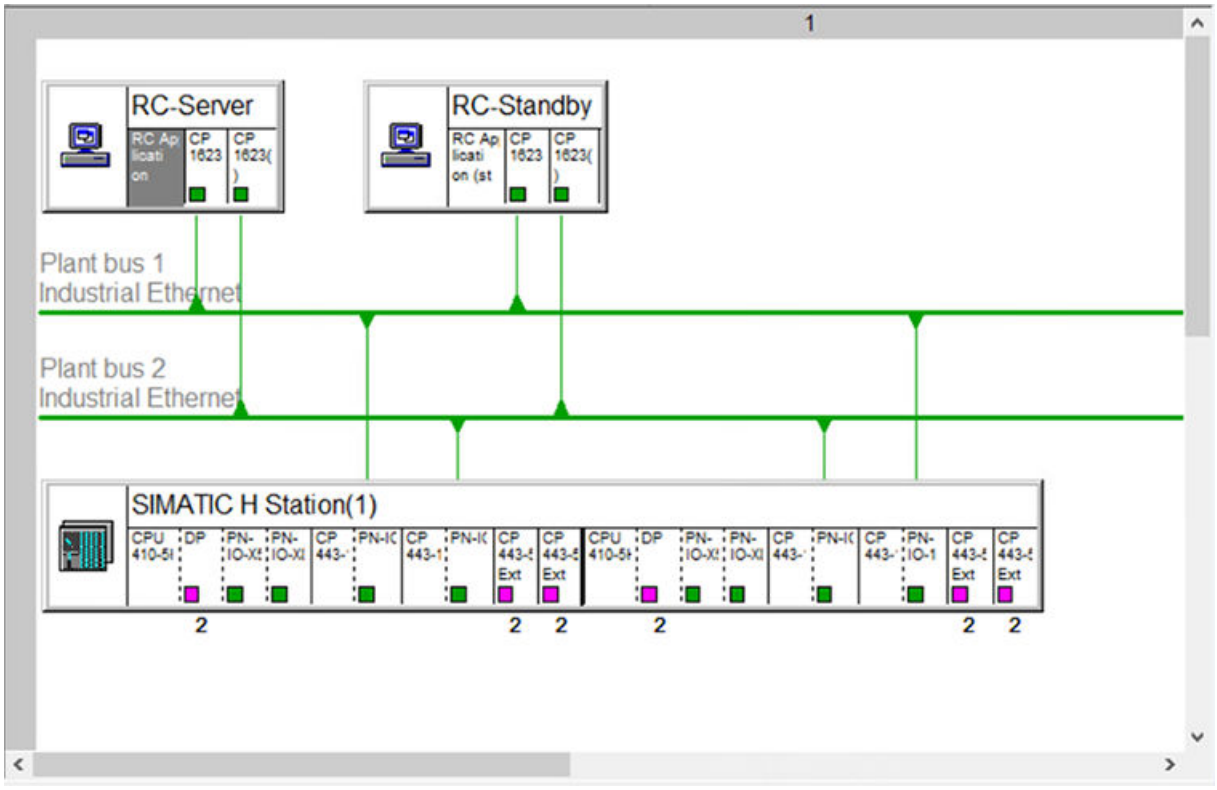
- The PCS 7 project is open in SIMATIC Manager.
- The AS is connected to the plant bus in NetPro.
- The plant bus has been configured.
- Two SIMATIC PC stations have been configured in HW Config as a Route Control server and Route Control partner server with network adapters.

Procedure

1. In the SIMATIC Manager, select the menu command **Options > SIMATIC Route Control > Wizard**.
2. In the "Introduction" dialog box of the wizard, click "Next".
   The "What do you want to do?" dialog box opens.
3. In the "Generate S7 connections" group, activate the check box "AS-Server connection information". Click "Next".
4. Make the settings according to the plant configuration.
   The Route Control wizard automatically creates a high availability connection when a high availability system is the connection partner.
5. When the Route Control server and SIMATIC H station are each connected to the plant bus with 2 network adapters, the following additional steps need to be performed:
   - Open NetPro in SIMATIC Manager with the menu command **Options > Configure Network**.
   - Select the Route Control application of the Route Control server for which you want to configure a high availability network connection.
     The connection table is displayed in the lower window pane.
   - Select the connection to the SIMATIC H station in the connection table.
   - Select the menu command **Edit > Object Properties**.
     The "Properties... S7 Connection" dialog box opens.
   - Select the "General" tab.
   - To use 4-way configuration, activate the check box "Enable max. CP redundancy (with 4 connection paths)".
   - Click "OK".

Result

The following figure shows the redundant network connection to the automation system for both Route Control servers in NetPro. The example plant is configured with a redundant high availability plant bus. Each PC station and each CPU is connected to the plant bus with 2 network adapters:



Additional information

- Section "How to configure a high availability plant bus (Page 123)"
- You can find information about the Route Control wizards in the manual *Process Control System PCS 7; SIMATIC Route Control*.
- Online help for *STEP 7*

6.7.5 How to set the redundancy connection for Route Control servers

Introduction

You will now select the connection path for the redundancy connection between two Route Control servers.

You can make the following settings directly on each of the mutually redundant Route Control servers.

Changing the connection path

Note

When the redundancy connection is established via a serial interface, you need to reboot the PC station after changing the connection path.

Validity

The procedure described in this section applies to Route Control servers.

Requirements

- The Route Control server and Route Control partner server are connected by a redundancy cable.
  You can use the following as the redundancy cable:
  - Null modem cable on the COM port
  - Network cable on an additional network adapter
- Route Control server and Route Control partner server are installed as redundant Route Control servers.

Procedure

1. Select the PC station (workplace) in the tree view of Windows Explorer.
2. Select the "Simatic Shell" folder.
3. Select the shortcut menu command Redundancy Settings....
   The "Redundancy Settings" dialog box opens.
4. Select the connection path through which the Route Control server pair is connected in the drop-down list.
   - For connection via RJ45 cable:
     In the "Network adapter" drop-down list, select the network adapter to which you want to attach the network cable for the redundant connection between the two PC stations of a server pair.
   - For a serial connection:
     In the "Serial port" drop-down list, select the port to which you want to attach the null-modem cable for the redundant connection between the two PC stations of a server pair: "COM1" or "COM2"
5. Click "OK".

6.7.6 How to set the redundancy of the Route Control servers

Introduction

Only the PC stations have to be configured in the SIMATIC Manager for a redundant Route Control server.
The computer name must be configured and the "Computer name identical with PC station name" option must be enabled in the object properties of the PC station.

Additional information

- Section "How to configure a Route Control server and its redundant Route Control partner server (Page 186)"

6.7.7 How to download the target systems for SIMATIC Route Control

Introduction

For Route Control plants with redundant Route Control servers, you should always download the Route Control configuration to the Route Control server and Route Control clients.

Additional information

- You can find information on downloading the Route Control server in the manual *Process Control System PCS 7; SIMATIC Route Control*.
- You can find information on downloading the configuration to a Route Control client in the manual *Process Control System PCS 7; SIMATIC Route Control*.

6.8 Archive servers (Process Historian and Information Server)

6.8.1 How to configure a Process Historian and its redundant partner server

Introduction

The configuration steps in this section is required specifically for the PCS 7 OS systems, as this configuration is used during the OS download.

The actual set-up of a redundant Process Historian system is specified in the Process Historian documentation:

In the following example, the two Process Historians of the server pair are connected redundantly to the terminal bus.

Requirements

- The PCS 7 project is open in SIMATIC Manager.

Procedure

Note

Steps 1 to 8 of this procedure have already been performed if a Process Historian was created in the project.

1. In the component view of the SIMATIC Manager, select the project into which you want to insert the Process Historian.
2. Select the menu command **Insert > Station > SIMATIC PC Station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, Archive 1).
4. Enter the Windows name of the computer to be used as Process Historian in the "Computer name" box.
5. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detailed view.
   The hardware configuration of the SIMATIC PC station opens.
6. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
7. In the hardware catalog under "SIMATIC PC Station > Archive", select the "Process Historian Appl." and insert it in the configuration table by means of drag-and-drop.
8. Select the menu command **Station > Save and compile**, exit HW Config and change to SIMATIC Manager.
9. In the component view of SIMATIC Manager, select the project where you want to insert the redundant operator station.

10. Select the menu command **Insert > Station > SIMATIC PC Station**.
    A new SIMATIC PC station is inserted in the selected project.
11. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the desired name (in the example, Archive 2).
12. Enter the Windows name of the computer to be used as the Process Historian partner server in the "Computer name" box.
13. In the component view, select the SIMATIC PC station and double-click the "Configuration" object in the detail window.
    The hardware configuration of the SIMATIC PC station opens.
14. If the hardware catalog is not visible, select the **View > Catalog** menu command.
    The hardware catalog opens.
15. In the hardware catalog under "SIMATIC PC Station > Archive", select the "Process Historian Appl. (stby)" and insert it in the configuration table by means of drag-and-drop.
16. Select the menu command **Station > Save and compile** and exit HW Config.

Additional information

- Configuration manual *Process Control System PCS 7; Engineering System*; section "How to Expand a Project with Pre-Configured Stations Using the PCS 7 Wizards"
- Online help for *STEP 7*
- Refer to Redundant system in the System Manual; *SIMATIC*; *Process Historian Administration*

Replacing components and plant changes 7

7.1 Failure and replacement of components

7.1.1 Replacement of SIMATIC components in runtime

Continuous operation

A crucial factor for continuous operation of high availability process control systems is the replacement of faulty or failed components in runtime. Replacement of defective components is only possible if high availability components are used. The redundant components continue to operate and supply the function until the replacement is made. The system is no longer high availability in this condition.

Which components can be replaced in central controllers?

The following components in a **redundantly configured automation system** can be replaced in runtime:

- Central processing units (e.g., CPU 410-5H)
- Power supply modules (e.g., PS 405, PS 407)
- Communication modules
- Synchronization modules and fiber-optic cables

Which components of the distributed I/O can be replaced?

The following components in a **redundantly configured distributed I/O system** can be replaced in runtime:

- DP master (CPU or CP in the AS)
- DP slaves (for example, ET 200M, ET 200iSP)
- IO controller (for example, CPU in AS)
- IO devices (for example, ET 200M, ET 200SP HA)
- Redundant interface modules (for example, IM 153-2; IM 152-1; IM 155-6 HA)
- Bus links (for example PA Link; Compact FF Link).
- Input/output modules
- Fieldbus cables (PROFIBUS DP, PROFIBUS PA, PROFINET IO, FOUNDATION Fieldbus)

Additional information

The following table shows where you can find the step-by-step instructions for replacing components:

You can find the procedure used to replace components ...	**.... in the manual *Automaton System S7-400H; High Availability Systems* in the section ...**
Central racks	Failure and replacement of a CPU (redundant CPU)
	Failure and replacement of a power supply module
	Failure and replacement of a communication processor
	Failure and replacement of a synchronization module or FO cable
Distributed I/O (on PROFIBUS DP)	Failure and replacement of distributed I/O components
	Failure and replacement of an input/output or function module
	Failure and replacement of a PROFIBUS DP master
	Failure and replacement of a redundant PROFIBUS DP interface module
	Failure and replacement of a PROFIBUS DP slave
	Failure and replacement of PROFIBUS DP cables
Distributed I/O (on PROFINET IO)	Failure and replacement of distributed I/O components
	Failure and replacement of an input/output or function module
	Failure and replacement of an IO controller
	Failure and replacement of a redundant PROFINET IO interface module
	Failure and replacement of an IO device
	Failure and replacement of PROFINET IO cables (Ethernet cable)

Note

After every component replacement

Make sure that all systems are free from faults and that the H-system is operating redundantly and without errors.

7.1.2 Replacement of bus components in runtime

Introduction

The information in this section relates to the following bus components

- Bus cable
- Bus links
- Switches, bridges

Failure and replacement of bus components

Components of a bus system (plant bus, terminal bus, fieldbus) can be replaced when there is no risk of accidentally affecting other components as a result of the replacement.

Before making a replacement, the following aspects must be taken into consideration:

- Bus topology (for example ring structure, spur lines, redundancy connections, disrupted bus cable)
- Connection of the bus system to "master systems":
  - The assignment of clients to servers
  - The connection to time master systems
  - The connection to domain controllers
  - For PCS 7 OS: The setting of preferred servers
- Other disrupted components

Recommended procedure

If a bus component is partially functional, we recommend the following procedure:

- If repairs are necessary, first replace the defective bus cable.
- Insert a new bus component into the existing system before you remove the old bus component completely.
- Avoid the occurrence of double faults.
- Replace the connection to the connected components in series (not at the same time).

Additional information

The following table shows where you can find the step-by-step instructions for replacing components:

You can find the procedure used to replace components ...	**.... in the following documentation**
Compact FF Link	Operating Instructions *SIMATIC; Compact Bus Link; Compact FF Link* • Replacing a bus link • Restoring the Compact FF Link factory settings

Note

After every component replacement

Make sure that all systems are free from faults and that the H-system is operating redundantly and without errors.

7.1.3 Replacement of operator stations in runtime

Replacement of operator stations

When replacing operator stations, a distinction must made between:

- Replacing an OS server
- Replacing an OS client

Note

Information on updating operator stations with redundant OS servers in runtime can be found in "guidelines on updating a redundant OS in runtime (Page 225)".

Requirements

- The new PC contains the same hardware components.
- An image of the PCs to be replaced is used for the installation.
- The name of the replaced PC is used for the new PC.
- The same IP address is used for the new PC.
- The MAC address is adapted in the project.

Replacing an OS server

Follow the steps below to replace an OS server:

Step	What?
1	Switch OS clients over to the server that will be remaining in operation.
2	Deactivate and replace the OS server,
3	Check the network addresses and download the configuration data.
4	On the engineering station: Download OS server data (and automatic redundancy update).
5	Start WinCC.
6	Activate process mode.
7	Activate or switch over assigned OS clients.

NOTICE
OS process data archive If OS process data archive to the Process Historian is projected, then "merge" OS on Process Historian after replacing an OS server is necessary.

Replacing an OS client

Follow the steps below to replace an OS client:

Step	What?
1	Deactivate process mode.
2	Deactivate and replace the OS client.
3	Check the network addresses and download the configuration data.
4	On the engineering station: Download target system (OS client).
5	Activate process mode.

Changing to a new PCS 7 version

You can find information on how to convert all operator stations of a redundant system to a new PCS 7 version in the section Guide to updating a redundant OS in runtime (Page 225).

You can also refer the *Process Control System PCS 7; Software Update without Utilization of New Functions* manual.

7.1.4 Replacement of BATCH stations in runtime

Replacement of BATCH stations

When replacing BATCH stations, a distinction must made between:

- Replacing a BATCH server
- Replacing a BATCH client

Requirements

- The new PC contains the same hardware components.
- An image of the PCs to be replaced is used for the installation.
- The name of the replaced PC is used for the new PC.
- The same IP address is used for the new PC.
- The MAC address is adapted in the project.

Replacing the BATCH server

Follow the steps below to replace a BATCH server:

Step	What?
1	Replace the BATCH server.
2	On the engineering station: Open the BATCH configuration dialog, select PCell, download BATCH server.
3	Start the BATCH server (BATCH server starts up as standby server).

Replacing the BATCH client

Follow the steps below to replace a BATCH client:

Step	What?
1	Close the BATCH Control Center.
2	Replace the BATCH client.
3	On the engineering station: Open the BATCH configuration dialog, select PCell, download BATCH client.
4	Open the BATCH Control Center.

7.1.5 Replacement of Route Control stations in runtime

Replacement of Route Control stations

When replacing Route Control stations, a distinction must made between:

- Replacing a Route Control server
- Replacing a Route Control client

Requirements

- The new PC contains the same hardware components.
- An image of the PCs to be replaced is used for the installation.
- The name of the replaced PC is used for the new PC.
- The same IP address is used for the new PC.
- The MAC address is adapted in the project.

Replacing the Route Control server.

Follow the steps below to replace a Route Control server:

Step	What?
1	Replacing the Route Control server.
2	On the engineering station: Open Route Control Engineering and download the Route Control server
3	Start Route Control (Route Control starts as standby server).
4	Update the Route Control servers using the Route Control Center, so that both Route Control servers operate with the same database.

Replacing the Route Control client.

Follow the steps below to replace a Route Control client:

Step	What?
1	Close the Route Control Center.
2	Replacing the Route Control client.
3	On the engineering station: Download Route Control client from the SIMATIC Manager or Route Control Engineering.
4	Open the Route Control Center.

7.2 Plant changes in runtime

Plant changes in runtime

In addition to the options for replacing failed components in runtime as described in the section titled "Failure and replacement of components during operation", the CPU (41x-xH) also supports a **system modification without interrupting the running program**.

Requirements

- The relevant hardware components are suitable for insertion and removal under voltage.
- The H system with CPU is available.

Use cases for plant changes

A plant change in which the hardware of the plant is changes occurs in the following cases:

- Hardware components of a high availability system are removed.
- Hardware components of a high availability system are added.
- Hardware components of a high availability system are replaced by non-identical components.

Plant modification always requires a software modification. Configuration changes are made in HW Config and downloaded to the CPU. The modified hardware is physically replaced, removed or added.

Similar to the events that occur when components are replaced, when the system is modified in runtime, the functions of the modified components are taken over by the corresponding redundant components. The running program is not interrupted.

Which components can be changed?

changes	Possible modifications
Changes in the CPU	• Editing CPU Parameters • Changes to the memory components of the CPU
Adding for removing modules in central racks	• Communication modules

changes	Possible modifications
Adding or removing modules components in distributed I/O modules	• DP slaves with redundant interface modules (for example, ET 200M, DP/PA Link, Y Link) • IO devices with redundant interface modules (for example: ET 200SP HA) • Non-redundant DP slaves in any DP master system • Non-redundant IO devices in any PROFINET IO system (CPU410 with firmware >= V8.2 is necessary) • Modules in modular DP slaves • Modules in modular IO devices (ET200SP HA only) • DP/PA Coupler • PA devices (process automation) • FF devices • Use of a free channel or reassignment of a utilized channel on an existing module
Changing the parameters settings for a module	• Editing parameters

Additional information

You can find detailed, step-by-step instructions on the procedure for plant changes in runtime in the manual *Automation System S7-400H; High Availability Systems*.

Note

Note the following information:

- The procedures described for PCS 7 can be found in the *Automation System S7-400H; High Availability Systems* manual, "Modifying the System During Operation" section.
- Make sure that all systems are free from faults and that the H-system is operating redundantly and without errors after any modification to the plant.
- If you violate one or more rules in this procedure, the high availability system may respond in ways that restrict its availability, up to and including failure of the entire process control system.

The following table is an overview of the descriptions. The procedures described for making changes in runtime assume that the system is designed redundantly and that your aim is to achieve this again.

You can find the procedure used to replace components ...	....in the manual ***Automation System S7-400H; High Availability Systems*** in section ...
Components	Adding Components in PCS 7
	Removing Components in PCS 7
	Changes to the memory components of the CPU
Parameter	Editing CPU Parameters
	Changing the parameters settings for a module

Failure, switchover and reintegration of high availability components

8

8.1 I/O

8.1.1 Failure of redundant interface modules

Functionality

Interface modules can be configured redundantly in the distributed I/O device (ET 200M, ET 200iSP, ET 200SP HA). The interface modules provide the interface to the automation system through the fieldbus system at the CPU. When there are two interface modules, in other words, the system has been configured with "Redundancy", if one of the two modules fails, the other interface module takes over the automation process without interruption.

Failure

If the active interface module fails, a bumpless switchover to the redundant interface module is performed. In the switchover, the master identification changes from the failed interface module to the interface module that is now active.

If the redundant interface module fails, the master identification does not change.

Hot restart

When the failed interface module restarts, the redundant interface module keeps the master identification. The master identification changes back to the now replaced or repaired module only if the redundant interface module fails.

8.1.2 Failure of redundant I/O modules

Functionality

As soon as an error occurs in one of the redundantly configured modules, there is a bumpless switchover to the second module, which then takes over the signal processing.

Failure scenarios

The following faults may occur in a module:

- Hardware or power failure in the module
- Detected signal interference (e.g. wire break, discrepancy)
- Fault on the assigned bus line to an interface module

The driver blocks detect a disturbance:

- At the input signals:
  The disturbed input module or, when channel selectivity is configured, the disturbed channel is passivated and only the signal of the redundant modules is evaluated. A module or channel is passivated when the function blocks can no longer access the respective module or channel.
- At analog output modules:
  Only analog output modules with power outputs can be operated redundantly (0 to 20 mA, 4 to 20 mA). The value to be output is halved and each module outputs one half of the value. If one module fails, the redundant module outputs the entire value.

Discrepancy with input modules

A discrepancy error at the input value occurs when there is a non-tolerated difference between the input values after the configured discrepancy time has expired. The following parameters should be set to configure the discrepancy:

- For digital input modules:
  - Discrepancy time (maximum allowed time that the redundant input signals can differ)
- For analog input modules:
  - Tolerance window (configured by the percent of the end value of the measuring range)
    Two analog values are the same if they are within the tolerance window.
  - Discrepancy time (maximum allowed time that the redundant input signals are outside the tolerance windows)
  - Value applied
    The value applied is one of the two analog input values that is transferred in the user program.

With discrepancy, information is entered in the diagnostics buffer and a corresponding message is generated.

Depassivation

Passivated modules or, when channel selectivity is configured, passivated channels are depassivated with the following events:

- When the H system starts up
- When operating state of the H system changes to "Redundant"
- Following a system modification in runtime
- Following depassivation via the maintenance station

- Following a prompt from the user program via an acknowledgement signal, for example, on an OS with a "Depassivation" button at the block
- After pulling/plugging a module
- Following a diagnostic interrupt (e.g. wire break, measured value)

Additional information

- Online Help for *STEP 7*
- Manual *Automation System S7-400H; High Availability Systems*
- Manual *Process Control System PCS 7; PCS 7 OS Process Control*

8.2 Automation system

8.2.1 Failure of the master CPU

Functionality

The initial situation is that the S7-400H is in "Redundant" system mode. The execution of the user program is synchronized on both CPUs of the H system and, for example, CPU0 is the master CPU and CPU1 is the backup CPU. Event-driven synchronization ensures that the backup CPU always continues processing without interruption if the master CPU fails.

Example: Failure of the master CPU

If CPU0 fails, for example, the following LEDs light up on CPU1:

- REDF = Redundancy loss
- IFM1F = Interface fault Interface Module 1
  This indicates the first fiber-optic cable of the synchronization line.
- IFM2F = Interface fault Interface Module 2
  This indicates the second fiber-optic cable of the synchronization line.

The H system switches to "Solo" system mode. CPU1 ensures uninterrupted execution of the user program. CPU1 is now the master CPU. The H system is no longer in "Redundant" system mode.

Example: Reintegration of the failed master CPU

When the failed CPU0 is reintegrated, it does not become the master CPU. The master CPU automatically performs the link-up and update of the reintegrated CPU0. Both processes are necessary in order to check and synchronize the data in the memory of the master CPU and the backup CPU. CPU0 then goes to RUN mode. Now the system is once again in "Redundant" mode.

8.2.2 Failure of a fiber-optic cable

Requirements for the example

- The S7-400H is in "Redundant" system mode in the starting scenario.
- The CPU in Rack 0 is the master CPU and the CPU in Rack 1 is the backup CPU.
- The mode selectors of both CPUs are set to RUN.

Example: Failure of a fiber-optic cable

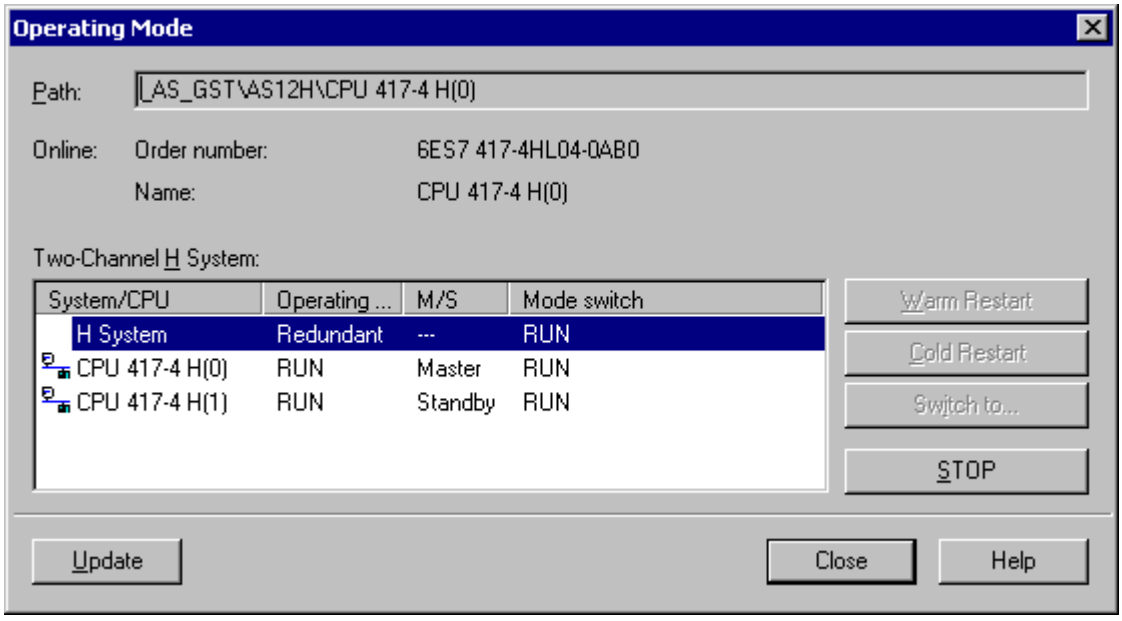
If a fiber-optic cable fails, the REDF LED and the IFM1F or IFM2F LED light up on the two CPUs depending on the location of the fiber-optic cable failure. The H system goes to "Solo" system mode and the user program continues to be processed by the master CPU used up to this point (CPU0).

Example: Reintegration of the CPU in rack 1

Once the defective fiber-optic cable has been replaced and connected to both CPUs, you must restart the backup CPU that is in STOP mode, i.e. CPU in Rack 1.

There are several options available to you:

- You have access to the automation system:
  Turn the key switch on the failed CPU from its current position to STOP back to the setting (RUN).
- You have an Ethernet connection to the H system:
  In the "Operating Mode" dialog box, restart the CPU in Rack 1, which is in STOP mode.
  - Open the PCS 7 project on an ES, click the "Online" icon in the task bar of SIMATIC Manager and select a CPU in the right window pane.
  - Open the shortcut menu with a right click and open the "Operating Mode" dialog box with the menu command **PLC > Operating Mode**.
  - Select the CPU in Rack 1 and click "Warm restart".
    The CPU in Rack 1 links up again and performs an update. The system is then in "Redundant" mode again.



Result

When the CPU in Rack 1 is back online, the "Operating mode" dialog box appears as follows:

8.3 Communication

8.3.1 Failure of redundant bus components

Functionality

As soon as a fault occurs on a transmission path, the second transmission path takes over and forwards the signals.

Failure scenarios

The following problems can occur on a bus component:

- Defective bus component (e.g., CP, coupler, AFD, AFS, cable)
- Problem on a bus line (e.g., overload, wire break)

Additional information

- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC Net PROFIBUS Networks*
- Manual *SIMATIC; Communication with SIMATIC*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-200*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-300*
- Operating instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*

8.4 OS server

8.4.1 Failure, switchover and restarting redundant OS servers

Introduction

This section describes the criteria by which the master/standby identification of an OS server changes. Examples are given to illustrate how the system reacts to failures.

Note

Information on updating operator stations with redundant OS servers in runtime can be found in "guidelines on updating a redundant OS in runtime (Page 225)".

Fault scenarios

- The project is not activated on the redundant OS partner server.
- The network connection from the OS server to the redundant OS partner is disrupted.
- The network connection to the OS clients is disrupted.
- The process connection to the AS is disrupted.
- The PC station is not operating correctly.

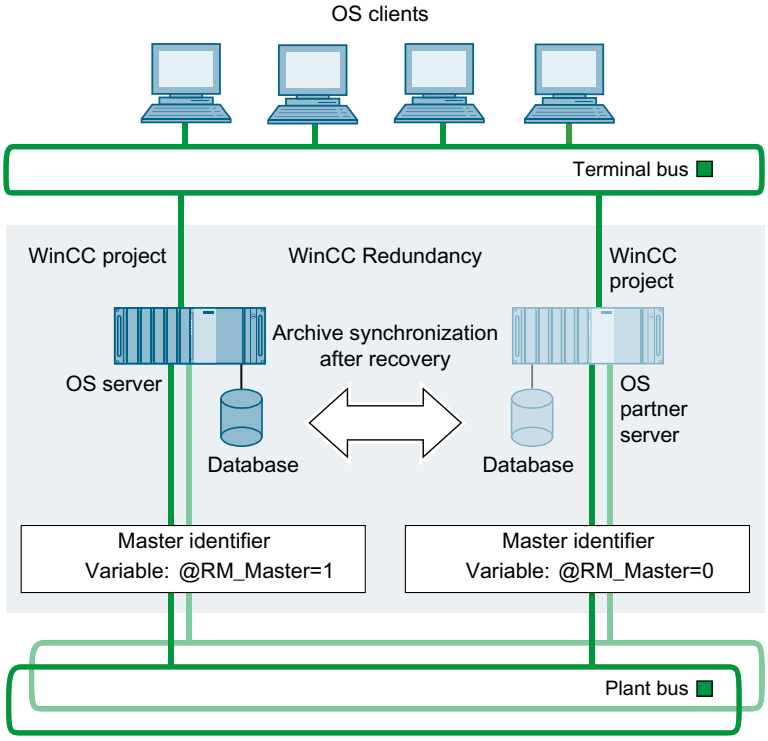
Reaction of WinCC redundancy to possible faults

WinCC redundancy can react to faults, errors or error messages in the following ways:

- By saving events and the time they occurred
- By synchronizing the archives of the process data (Tag Logging) and message data (Alarm Logging) with the archive data of the active OS server when a failed OS server is recovered.
- By changing the system tags "@RM_MASTER" and "@RM_MASTER_NAME" according to the situation.
- By automatically interconnecting the OS clients with the preferred server or with the available OS server with master identification. The "@RM_SERVER_NAME" tag indicates for an OS client the OS server to which this OS client is currently connected.
- By generating process control messages in the message list.

The fault scenarios listed above and the resulting reactions by WinCC Redundancy are described in the following.

Example configuration



Startup of an OS server pair

The following applies, in general: An OS server pair consists of the OS server and its OS partner server. The two PCs are configured with WinCC Redundancy in a redundant grouping.

When the OS server pair starts up, WinCC Redundancy first checks which of the two OS servers is to be assigned the master identification. This depends on which OS server starts up first.

- If one OS partner server is active already when the other comes online, the second OS server receives the standby identification.
- If no other OS server is active when an OS server starts up, it is assigned the master identification.

The internal WinCC tag @RM_MASTER is set to identify the master OS server. The internal WinCC tag @RM_MASTER is reset to identify the standby OS server.

The "@RM_MASTER_NAME" tag contains the name of the OS server, for example, "Server 1". You can display this tag, for example, in an I/O field of a Graphics Designer picture. Other applications or scripts can also evaluate these tags. The "@RM_MASTER" tag can also be changed.

WinCC project is deactivated

A functionally equivalent WinCC project is activated on both OS servers. If the WinCC project is deactivated on OS Server 1 (master identification), WinCC Redundancy triggers the following reactions:

- OS Server 2 (standby identification) saves the time of the failure (date and time of day) of OS Server 1 (master identification).
- OS Server 2 reports the failure of OS Server 1 with a process control message in the process control list.
- OS Server 2 now takes over the role of the master by setting the @RM_MASTER tag. The @RM_MASTER_NAME tag is changed accordingly.
- If the WinCC project is activated again on OS Server 1, OS Server 1 is set as the standby and the @RM_MASTER tag is reset. The @RM_MASTER_NAME tags are changed accordingly.

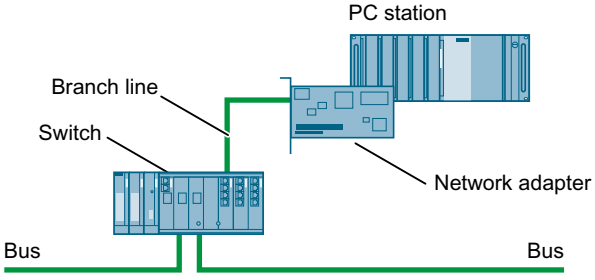
Gaps in the archive data occur on OS Server 1 during the time it is inactive. As soon as OS Server 1 returns, the gaps in the data are remedied by the following measures:

- OS Server 2 saves the date and the time of day, marking the return of OS Server 1.
- OS Server 2 reports the return of OS Server 1 with a process control message in the message list.
- The data gaps in the message, process data and user archives of OS Server 1 are filled by the data from the OS Server 2 memory. Conditions: The options "Synchronization of Tag Logging after the partner server comes back online" and "Synchronization of Alarm Logging after the partner server comes back online" must be enabled in the "Redundancy" dialog box for this.
- The @RM_MASTER tags remain unchanged in both servers:
  - OS Server 2 keeps the master identification.
  - The @RM_MASTER tag remains set.
  - The @RM_MASTER tag for OS Server 1 is reset.

Disrupted network connection to the OS partner server

A disrupted network connection is only detected in the redundancy scheme when:

- There is a fault in the spur line.
- There is a defective connector or network adapter.
- A PC station is identified as faulty.



The terminal bus as a whole and the communication between the AS and OS servers remains unaffected.

Both OS servers are started and begin processing an activated WinCC project. If a disruption in the network connection to the OS partner server occurs in this situation, WinCC Redundancy reacts as follows:

- Both OS servers save the date and time of day of the failure.
- Both OS servers report the failure with a process control message in the message list.
- If the disrupted OS server is a master, the master/standby identification changes.

During the connection failure no online synchronization for alarm logging, operation messages and user archives can be performed between the two OS servers. As soon as the connection is restored, this is remedied by following actions:

- Both OS servers save the date and time of day of the restored connection.
- Both OS servers report the return with a process control message in the message list.
- Data from the alarm logging, tag logging and the user archives accumulated during the connection failure are transmitted to the returning OS server.
- The @RM_MASTER and @RM_MASTER_NAME tags remain unchanged in both servers.

Disrupted network connection between the OS client the OS server

An OS server and the OS client connected to it are processing an activated WinCC project. A redundant OS partner server has been configured for the OS server in WinCC Redundancy. The OS server is defined as the preferred server for the OS client. A disrupted network connection to the OS server may result from a cable break in the spur line from the network to the OS server. The terminal bus as a whole remains unaffected.

If a connection failure occurs between the OS client and the OS servers, WinCC Redundancy triggers the following reactions:

- The OS client is not switched over from the failed OS server to its redundant OS partner server because the redundant OS partner server is also not available.
- When the connection is available again, the OS client automatically switches back to its preferred server.

Disrupted network connection to the AS

If a fault occurs on the plant bus connection between the OS server and the AS, WinCC Redundancy reacts as follows:

- The disruption of the plant bus connection is reported to the OS partner server.
- The OS partner server receives the message that the OS server has failed.
- The OS partner server saves the date and the time of day of the OS server failure.
- An OS client is automatically switched over from the failed OS server to its redundant OS partner server. Condition: The "WinCC client switch in case of a process connection error" option must be selected in the "Redundancy" dialog box for this.

When the process connection to the OS server is restored, the missing data in the archive of the OS server is updated by the procedure described below. Condition: The "Synchronization

after process connection error" option must be selected in the "General" tab of the "Redundancy" dialog box for this.

- The OS partner server saves the date and the time of day marking the return of the OS server.
- The data gaps in the archives of the failed OS server are updated by the data from the memory of the OS partner server. The process data of all automation systems (even those that have not failed) are synchronized.
- When the process connection is restored, this is announced by a process control message in the message list.

PC station identified as faulty

In PCS 7, the PC stations are preset in such a way that the network adapters are automatically deactivated when a PC station is identified as faulty. Depending on the Autostart settings, a manual reboot is required or an automatic reboot of the server is triggered.

Note

Terminate process mode on redundant systems

If the process mode of the PC station is to be terminated manually or the redundancy partner of the PC station is not available, a corresponding message points out this situation.

Additional information

- Online help for *WinCC*

8.5 BATCH server

8.5.1 Failure of BATCH servers

Functionality

BATCH applications and any configured WinCC applications are active on BATCH servers. A BATCH client visualizes the batch data of the BATCH server to which it is connected.

Failure of the master BATCH server

If the master BATCH server fails, for example, due to an operating system failure or an application error, the standby BATCH server detects that the master is no longer available based on redundancy mechanisms and takes over the master role. The BATCH clients are then automatically switched over from the master BATCH server to the standby BATCH server.

The running BATCH program is automatically resumed after the switchover to the redundant BATCH server. The BATCH program status is synchronized between the active BATCH server and the AS. You have to manually trigger the BATCH program to continue if communication errors have occurred.

In a replication solution, the databases on the master BATCH server and the standby BATCH server are continually synchronized. If the BATCH servers switch over, the new active BATCH server always has access to the latest BATCH data.

Note

Data reliability

During the switchover from the failed BATCH server to its redundant BATCH server, no automation process data are visualized on a BATCH client. Operator inputs are also lost during this brief period.

PC station identified as faulty

You can find information on this in the section "Failure, switchover and restarting redundant OS servers (Page 213)".

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

8.6 Route Control server

8.6.1 Reaction of Route Control servers to failures

Functionality

Route Control applications and any configured WinCC applications are active on Route Control servers. A Route Control client visualizes the route list of the Route Control server to which it is interconnected.

Failure of the master Route Control server

If the master Route Control server fails, for example, due to failure of the operating system or failure in an application, the standby Route Control server recognizes that the master is no longer available based on redundancy mechanisms and takes over the role of master. The new master automatically assumes all control functions of the running route control program, even of routes already requested. The visualization continues, since the Route Control clients automatically switch to the new master.

The status is synchronized between the active Route Control server and the AS. If communication errors occurred, the Route Control program can only be continued manually.

Note

Data security

During the switchover from the failed Route Control server to its redundant Route Control server, no data from the automation process is visualized on a Route Control client. Operator inputs during this switchover time are neither accepted nor executed.

Operation of a route via a Route Control faceplate from a PCS 7 OS is possible during redundancy switchover of a Route Control server, if there is a communications connection between PCS 7 OS and the automation system.

Activating process mode of Route Control servers

Note

Please note that you need to activate process mode for redundant Route control servers one after the other. One of the two Route Control servers will take on the property of Master server, depending on the configuration.

PC station identified as faulty

You can find information on this in the section "Failure, switchover and restarting redundant OS servers (Page 213)".

Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

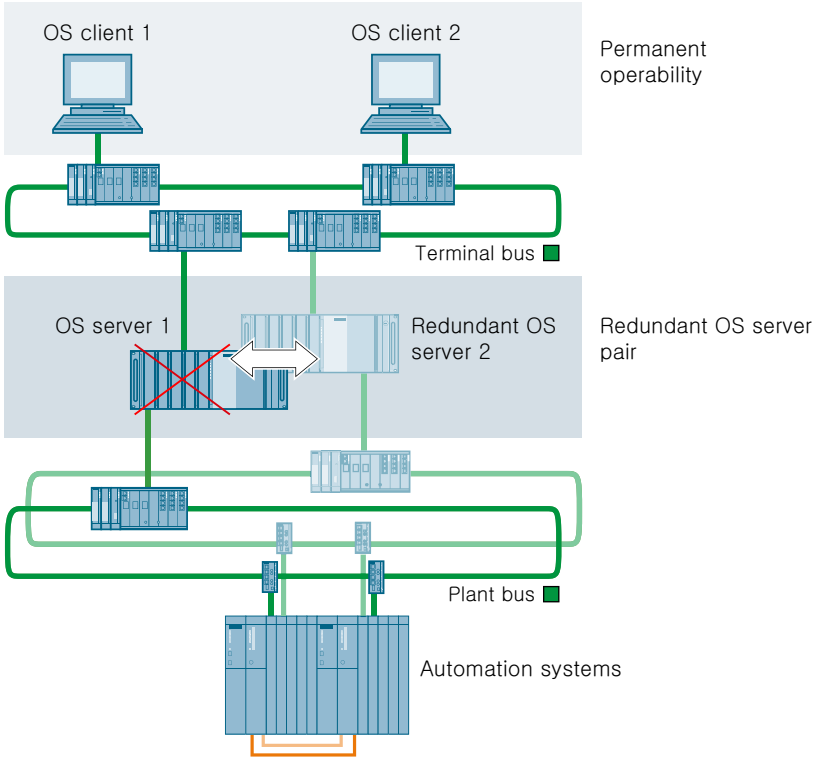
8.7 OS clients

8.7.1 Switchover characteristics OS clients with permanent operability

Functionality

If the connection to the configured OS server is interrupted, the process values on the OS clients are no longer updated. After successful switchover to the partner server, the process can be operated again on all OS clients. Other OS clients interconnected with the redundant OS partner server are not affected by this.

Example configuration



Permanent operability

If OS Server 1 fails, OS Client 1 is connected to redundant OS Server 2. The identity of the redundant partner server of OS Server 1 comes from the downloaded server data on the OS client. OS Client 1 is not available during the switchover to redundant OS Server 2 for a short time. However, if redundant OS Server 2 is specified as the preferred server for OS Client 2, you can operate the plant during the switchover from the failed OS Server 1 to redundant OS Server 2.

Once OS Server 1 becomes available again, OS Client 1 is switched over to the returning OS Server 1 because it is the configured preferred server.

Permanent operability is restored after the switchover is complete. OS Client 1 is not available for the duration of the switchover to OS Server 1. OS Client 2 remains operable without any interruption.

The status of the "@RM_Master" redundancy tag does not apply to the OS client with preferred server configuration. The @RM_SERVER_NAME tag indicates the OS server to which this OS client is currently connected.

Note

Information on updating operator stations with redundant OS servers in runtime can be found in "guidelines on updating a redundant OS in runtime (Page 225)".

Reaction of an OS client without a preferred server

If no "preferred server" is configured for the OS client in the "Configure Server Data" dialog box, the OS client connects to the OS server of a redundancy configuration for which the "@RM_Master" redundancy tag is set.

If the active OS server fails, its redundant OS partner server becomes the master server. You can recognize which of the two redundant OS servers is currently acting as the master server by the status of "@RM_Master" redundancy tag. You can trigger a manual switchover by setting or resetting this tag. All OS clients without a preferred server set connects to the "new" master server.

Switchover criteria of the OS client

The following faults trigger an OS client switchover. It is not relevant here whether or not a preferred server has been configured.

- The network connection to the redundant OS server is disrupted.
- The redundant OS server fails, e.g., due to power loss.
- The WinCC project of the redundant OS server is deactivated.
- A disruption of the network connection between OS server and AS, when the option "WinCC client switch in case of a process connection error" is selected in the "Redundancy" dialog box.

Additional information

- Online help for *WinCC*

8.8 BATCH clients

8.8.1 Switchover characteristics of BATCH clients

Functionality

If the master BATCH server fails, the BATCH clients automatically switch to the redundant BATCH server.

Reactions during switchover

During a switchover, a message window is displayed on the screen of the BATCH client indicating the switchover. The BATCH client cannot be operated during this time. The message window closes and the BATCH client can be operated only when the switchover from the failed BATCH server to the redundant BATCH server is complete.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

8.9 Route Control clients

8.9.1 Switchover characteristics of Route Control clients

Functionality

If the master Route Control server fails, the Route Control clients are automatically switched over to the redundant Route Control server.

Reactions during switchover

During a switchover, a message window is displayed on the screen of the Route Control client indicating a switchover. The Route Control client cannot be operated during this time. The message window closes and the Route Control client can be operated again only when the switchover from the failed Route Control server to the redundant Route Control server is complete.

Note

The route can be controlled from a Route Control faceplate during the switchover of a Route Control server.

Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

8.10 Guide to updating a redundant OS in runtime

8.10.1 Introduction

Introduction

You can find a guide to updating a redundant OS in runtime below. This means that the operation of the PCS 7 system is not disrupted, the AS does not switch to STOP mode and the automation process can continue to be operated and monitored.

Requirements

- The redundant OS is made up of the following components:
  - Redundant OS server
  - OS clients
- The PCS 7 version is at least PCS 7 V9.1.x.
- SIMATIC PCS 7 software of versions older than V9.1 cannot be directly updated to V10.0. The user has to reset and upgrade the computer to any one of the following operating systems and install SIMATIC PCS 7 V10.0 as a completely new installation:
  - Microsoft Windows 10 Enterprise LTSC 2019 and LTSC 2021 OS support
  - Microsoft Windows Server 2019
  - Microsoft Windows Server 2022

Information on updating the PC stations and project data

You can find information on updating the PC stations and project data in the *Process Control System PCS 7; Software Update without Utilization of the New Functions* documentation.

Rules

⚠ CAUTION

Make sure that you keep to the described order to avoid disrupting operation of the PCS 7 system.

Note

Perform the steps described from Phase 1 to Phase 5 without extended interruptions because the redundancy is not available during the update.

Note

Updating the maintenance station

Process mode on the maintenance client must be deactivated prior to updating the project on the ES.

The maintenance server must be the last server to be updated.

Checking time synchronization

To avoid any jumps in time (UTC/local standard time) when "updating redundant systems in runtime", check the time synchronization of the OS in the updated PCS 7 project on the ES:

1. Open SIMATIC Manager.
2. Select the OS in the component view.
3. Select the menu command **Edit > Open Object**.
   WinCC Explorer opens.
4. Click the "Computer" object in the tree view.
5. Select the menu command **Edit > Properties**.
   The "Computer Properties" dialog box opens.
6. Select the "Parameters" tab.
7. In the "PLC Clock Setting" group, activate the "PLC is set to coordinated universal time (UTC)" check box.

Objectives of the update

- The automation system remains uninterrupted in RUN mode.
- The process remains controllable at all times.

Sequence of the Update

Updating involves five phases:

Phase	Action
Phase 1	Updating Server_2 (Page 230)
Phase 2	Updating the OS clients interconnected with Server_2 (Page 233)
Phase 3	Downloading the connections, gateways and changes to the AS (Page 235)
Phase 4	Updating the OS clients interconnected with Server_1 (Page 237)
Phase 5	Updating Server_1 (Page 239)

The procedure described below must be repeated for all client-server relationships in the system, as appropriate.

- If you have several redundant servers, first update only the clients interconnected with the standby server that has already been updated or that has been defined as the preferred server for these clients.
- Then update the clients that are interconnected with the master server or that have defined it as their preferred server.

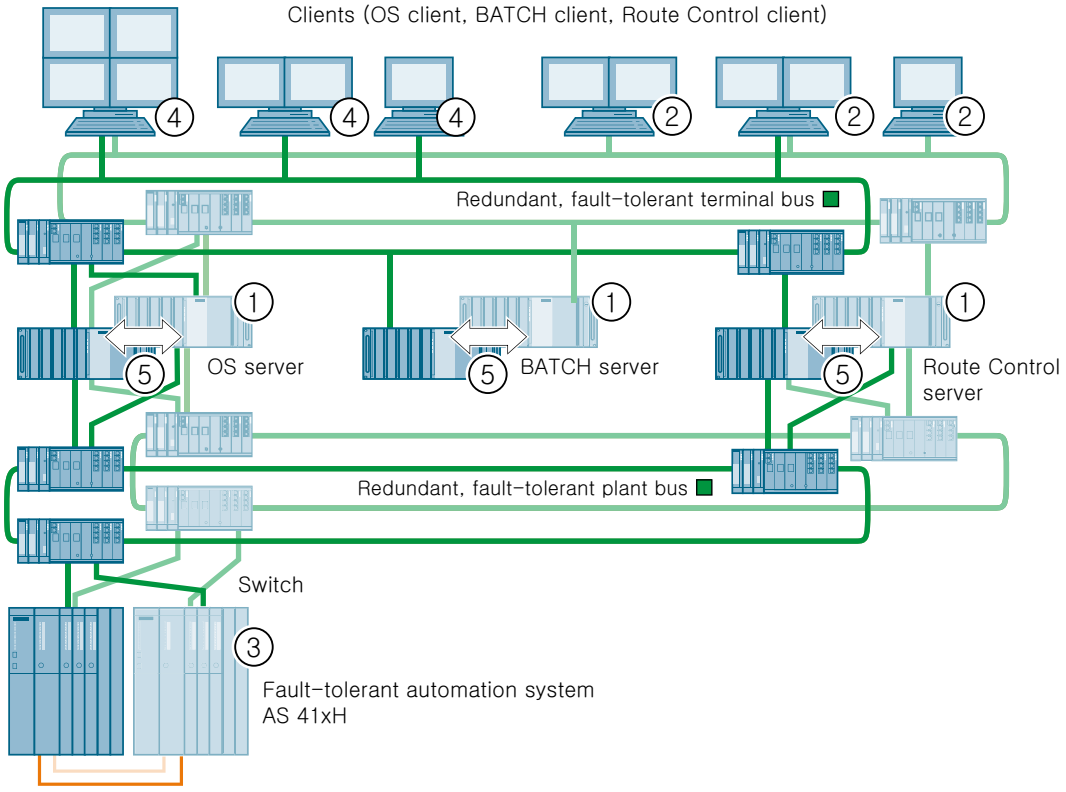


Figure 8-1 The numbering shows the sequence for the update.

8.10.2 Overview of the required tasks

Introduction

You update the redundant OS in runtime in five phases. Each phase is broken down into individual steps.

The section shows you an overview of the steps required in the five phases. You will find more detailed instructions for each phase in the following sections.

Initial situation

- Server_1 is master server.
- Server_2 is standby server.

- Client_1 is connected to Server_1 because this server is configured as its preferred server. Client_1 represents all OS clients connected to Server_1.
- Client_2 is connected to Server_2 because this server is configured as its preferred server. Client_2 represents all OS clients connected to Server_2.

Requirements

- Process Mode of the Maintenance Client was ended before the ES was updated.
- The update of the PCS 7 project for the ES is complete.
- If the Maintenance Station is used, SIMATIC PDM is installed on the ES.
- All the settings for the configured mode have been made. The configuration data has been loaded onto the ES from NetPro.
- If you want to switch to encrypted communication during the software update: Please find information in the documentation *Process Control System PCS 7; PCS 7 PC Configuration*.
- All OS servers and all OS clients are running with PCS 7 V9.1.x or higher.

Note

If a Process Historian is used in the Plant, it has to be updated, be in the state "Active" and all recoveries have to be finished first, before any OS Server is stopped. Otherwise some data gaps might not get closed after the migration is done.

Process Historian update will be available in next SP.

Overview of the required tasks

NOTICE

Interrupted redundancy

Perform the steps described from Phase 1 to Phase 5 without extended interruptions because the redundancy is not available during the update.

Upgrading Process Historian before the OS servers in runtime

You must first upgrade the Process Historian server before you:

- Upgrade a PCS 7 plant to the current version of PCS 7 in runtime
- Simultaneously upgrade the operating systems of the OS servers
- Replace the hardware of the OS servers

You can only start upgrading the OS servers in runtime when the Process Historian is in the "Active" operating state and all pending restorations have been executed.

Start the restoration multiple times, if necessary, if you still detect data gaps. You can start the restoration manually in the management console.

Phase	Step
Phase 1: Updating Server_2	1. Server_2: Deactivate and exit WinCC 2. Server_2: Back up the PCS 7 project Back up the operating system and the PCS 7 software installation 3. Server_2: Install or update the operating system, PCS 7 Installation "OS server" 4. ES: Download OS connection data and target system 5. Server_2: Start WinCC 6. Server_2: Check and save the "Redundancy" dialog box 7. Server_2: Check and save the "Time Synchronization" dialog box 8. Client_2: Deactivate process mode and exit WinCC 9. Server_2: Activate WinCC Runtime 10. Other redundant OS server pairs: Perform Phase 1: Steps 1 to 9
Phase 2: Update the OS clients that are interconnected on Server_2	1. Client _2: Back up the PCS 7 project Back up the operating system and of the PCS 7 software installation 2. Client _2: Install or update the operating system, PCS 7 Installation "OS client" 3. ES: Download to OS target system 4. Client _2: Activate
Phase 3: Downloading the connections, gateways, and changes to the AS	1. ES: Download connections and gateways from NetPro to the AS 2. ES: Download CFC charts to the AS

Phase	Step
Phase 4: Update the OS clients that are interconnected on Server_1	1. Client_1: Deactivate and exit WinCC 2. Client_1: Back up the PCS 7 project Back up the operating system and the PCS 7 software installation 3. Client_1: Install or update the operating system, PCS 7 Installation "OS client" 4. ES: Download of OS target system 5. Client_1: Select the operability of the clients
Phase 5: Updating Server_1	1. Server_1: Deactivate and exit WinCC 2. Client_1: Activate 3. Server_1: Back up the PCS 7 project Back up the operating system and the PCS 7 software installation 4. Server_1: Install or update the operating system, PCS 7 Installation "OS server" 5. ES: Download OS connection data and OS target system 6. Server_1: Start WinCC 7. Server_1: Check and save the "Redundancy" dialog box 8. Server_1: Check and save the "Time Synchronization" dialog box 9. Server_1: Activate WinCC process mode 10. Other redundant OS server pairs: Perform Phase 5: Steps 1 to 9 11. ES: Start SIMATIC PDM

Result

When you have completed all the steps, your system has the following status:

- Updated Server_1 is standby server.
- Updated Server_2 is master server.
- Updated Client_1 is connected to its preferred server Server_1.
- Updated Client_2 is connected to its preferred server Server_2.

The updating of your redundant operator stations is complete.

8.10.3 Phase 1: Updating Server_2

Introduction

In the first phase, you update redundant Server_2. In this way, you avoid an unnecessary switchover for OS clients that have no preferred server configured.

You can find additional information about redundancy synchronization in *WinCC Information System > Configurations > Redundant Systems*.

During the steps involved in Phase 1, your system continues to work with only one server. The system remains controllable from the OS clients that have not yet been updated. If this server fails, the automation system can no longer be controlled.

NOTICE
Interrupted redundancy Perform the steps without extended interruptions because the redundancy is not available during the update.

Initial situation before phase 1

- Server_1 is master server.
- Server_2 is standby server.
- Client_1 is connected to Server_1.
- Client_2 is connected to Server_2 because this server is configured as its preferred server.

Requirements

- The PCS 7 project you are updating has already been updated on the ES.
- When using an archive server:
  - Synchronization of the archive must be complete to ensure that the process data (RT data) is consistent.

Procedure - Phase 1

Note that you will need to work alternately on Server_1 and Server_2.

Phase 1 / 1. Server_2: Deactivate and exit WinCC

- Deactivate WinCC Runtime and exit WinCC on the standby Server_2.
  The system reacts as follows:
  - Client_1 remains interconnected with Server_1.
  - Client_2, which has Server_2 configured as the preferred server, changes over to Server_1.
  - Server_1 detects a failure caused by deactivation of Server_2. If you have configured system alarms, Server_1 generates a process control message to this effect.

Phase 1 / 2. Server_2: Backup of the PCS 7 project; backup of the operating system and of the PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation and your current PCS 7 project as a fallback strategy.

Phase 1 / 3. Server_2: Installation or update of the operating system, PCS 7 Installation "OS server"

- Install or update the operating system (you can find information about this in the manual *Process Control System PCS 7; PCS 7 PC Configuration*).
  An OS server can only run on a server operating system which has been released for PCS 7. You can find additional information on this in the *Process control system PCS 7; PCS 7 Readme* documentation.
- Install the necessary PCS 7 components.
  In the "Program Packages" dialog of the PCS 7 Setup, select the "OS Server" check box or, if the OS is to swap out data to the Process Historian, the "OS-Server for Process Historian" check box.
- Make the necessary settings.

Note that Windows administration of PCs should be performed by a Windows administrator. You can find a detailed description of the PCS 7 installation and the required PCS 7-specific settings for PC stations in the manual *Process Control System PCS 7; PCS 7 PC Configuration*.

Phase 1 / 4. ES: Download OS connection data and OS target system

- Open *NetPro* and download the connection data from the ES to Server_2.
- Right-click on the OS to be transferred in the open PCS 7 project below the WinCC application. Select the menu command **PLC > Download to Current Project > Selected Station** in the shortcut menu.
  This starts the transfer from the ES to Server_2.

Phase 1 / 5. Server_2: Start WinCC

- Start WinCC on Server_2.

Phase 1 / 6. Server_2: Check and save the "Redundancy" dialog box

- Open the "Redundancy" editor and check the settings in the dialog box. Click "OK" to exit the dialog box even if you have made no changes.

Phase 1 / 7. Server_2: Check and save the "Time Synchronization" dialog box

- Open the "Time Synchronization" editor and check the settings in the dialog box. Click "OK" to exit the dialog box even if you have made no changes.

Phase 1 / 8. Client_2: Deactivate process mode and exit WinCC

- Deactivate the process mode on all clients where Server_2 is set up as preferred server.

Note

In WinCC Explorer (Server data), you can activate Server_1 for operation as preferred server for Client_2 within the phases 1 and 2. This setting retains operability of the clients.

Phase 1 / 9. Server_2: Activate WinCC Runtime

- Activate WinCC Runtime on Server_2.
  The system reacts as follows:
  - There is no server switchover. Depending on the configuration, the activated Server_2 becomes the standby or master server.
  - All OS clients still receive their visualization data from OS server Server_1, which has not yet been updated.

Note

If a Process Historian is used in the project ensure the following:

- The Process Historian was updated before
- The Process Historian is in the "Active" state.

Phase 1 / 10. Other redundant OS server pairs: Repeat steps 1 to 10

- If you are using more than one redundant OS server pair, you must first update standby server Server_2 for each.
- Carry out the Phase 1 steps 1 through 10 for each Server_2.

Note

Migration of the central archive server (CAS) on the Process Historian

You can find more information about this in the "WinCC Classic Information System".

Result after Phase 1

- Server_2 is updated and not connected to any OS clients.
- Server_1 is the master server in the PCS 7 project being updated.
- Server_2 can be either master or standby, depending on the configuration.
- The archives will be synchronized between Server_1 and Server_2.
- Client_1 is connected to Server_1.
- Client_2 is either deactivated or interconnected with Server_1 after you have changed the preferred server setting. Client_2 cannot access the upgraded Server_2 as the preferred server.

8.10.4 Phase 2: Updating OS clients interconnected to Server_2

Introduction

In Phase 2, you update the OS clients that were interconnected with Server_2.

The system can be controlled at all times using Client_1, which is interconnected with the not-yet-updated Server_1.

The same PCS 7 version is running on the active OS server Server_1 and on Client_1. Mixed operation between OS clients and OS servers of different PCS 7 versions is not possible.

Archive data and messages that have accrued on OS server Server_1 during the update process are available on both OS servers. Synchronization of the archives is complete with the following message: "REDRT: <name of the OS server> finished". If Process Historian is

used, check the recoveries at the Process Historian Server and wait until they are finished, if there are any queuing.

CAUTION
Interrupted redundancy Perform the steps without extended interruptions because the redundancy is not available during the update.

Initial situation before phase 2

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is connected to Server_1.
- Client_2 is either deactivated or interconnected with Server_1 after you have changed the preferred server setting. Client_2 cannot access the upgraded Server_2 as the preferred server.

Requirement

The PCS 7 project you are updating has already been updated on the ES.

Procedure - Phase 2

Phase 2 / Step 1. Client_2: Backup of the PCS 7 project, operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation and your current PCS 7 project as a fallback strategy.

Phase 2 / 2. Client_2: Installation of the operating system, PCS 7 Installation "OS client"

- Install or update the operating system (you can find information about this in the manual *Process Control System PCS 7; PCS 7 PC Configuration*).
  An OS client runs only on an operating system that has been released for PCS 7. You can find additional information on this in the *Process Control System PCS 7; PCS 7 Readme* documentation.
- Install the necessary PCS 7 components.
  In the PCS 7 Setup, select the "OS Client" check box in the "Program Packages" dialog box.
- Make the necessary settings.

Note that Windows administration of PC stations should be performed by a Windows administrator. You can find a detailed description of the PCS 7 installation and the required PCS 7-specific settings for PC stations in the manual *Process Control System PCS 7; PCS 7 PC Configuration*.

Phase 2 / 3. ES: Download to OS target system

- Right-click on the OS to be transferred in the open PCS 7 project below the WinCC application. Select the menu command **PLC > Download** in the shortcut menu. This downloads the project for Client_2 from the ES to the relevant OS.

Phase 2 / 4: Client_2: Activate

- Start WinCC on Client_2.
- Activate WinCC Runtime.

The system reacts as follows:

- Client_2 connects with the upgraded Server_2.

Result after Phase 2

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is connected to Server_1.
- Updated Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.

Note

Maintenance client

If Server_2 is the maintenance server (last OS server pair to be updated in the project), then the maintenance client (Client_2) can be started.

Maintenance client accesses to intelligent field devices are only possible after completion of the software update.

8.10.5 Phase 3: Download of connections, gateways and changes to the AS

Introduction

In Phase 3, connections, gateways and CFCs are downloaded to the AS from NetPro by downloading changes only.

Initial situation before phase 3

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is connected to Server_1.

- Updated Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.

Requirements

- The PCS 7 project you are updating has already been updated on the ES.
- Configuration of the automation systems ready for download. All AS are compiled.

Procedure - Phase 3

Phase 3 / 1. ES: Transfer NetPro connection data and gateways to the AS

- Open NetPro and select your AS. Select the menu command **PLC > Download to Current Project > Connections and Gateways**.
- Select the CPU you want to download to in the "Select Target Module" dialog box and exit the dialog box by clicking "OK".

Phase 3 / 2. ES: Download CFCs to the AS

If there was no download to the AS during the project update, you now need to download to the AS.

- Select an AS in SIMATIC Manager.
- Select the menu command **PLC > Download**.
- Select the "Changes only" check box.

  Note

  If you select the "Include user data blocks" check box, the user data blocks on the AS are overwritten. You can find additional information in the online help for the "S7 Download" dialog box.

- Close the dialog box by clicking "OK".

Repeat the steps for downloading to the AS for each AS in the project.

The system reacts as follows:

- The system can be controlled and monitored from all clients.

Result after Phase 3

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is connected to Server_1.
- Updated Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.

8.10.6 Phase 4: Updating OS clients interconnected to Server_1

Introduction

In Phase 4, you update the OS clients that are interconnected with Server_1.

The system can be controlled at all times using Client_2, which is interconnected with Server_2.

⚠ CAUTION
Interrupted redundancy Perform the steps without extended interruptions because the redundancy is not available during the update.

Initial situation before phase 4

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is connected to Server_1.
- Updated Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.

Requirement

The PCS 7 project you are updating has already been updated on the ES.

Procedure - Phase 4

Phase 4 / 1. Client_1: Deactivate and exit WinCC

- Deactivate WinCC Runtime and exit WinCC on OS Client_1.

Phase 4 / 2. Client_1: Backup of the PCS 7 project, operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation and your current PCS 7 project as a fallback strategy.

Phase 4 / 3. Client_1: Installation or update of the operating system, PCS 7 Installation "OS client"

- Install or update the operating system (you can find information about this in the manual *Process Control System PCS 7; PCS 7 PC Configuration*).
  An OS client runs only on an operating system that has been released for PCS 7. You can find additional information on this in the *Process Control System PCS 7; PCS 7 Readme* documentation.
- Install the necessary PCS 7 components.
  In the PCS 7 Setup, select the "OS Client" check box in the "Program Packages" dialog box.
- Make the necessary settings.

Note that Windows administration of PCs should be performed by a Windows administrator. You can find a detailed description of the PCS 7 installation and the required PCS 7-specific settings for PC stations in the manual *Process Control System PCS 7; PCS 7 PC Configuration*.

Phase 4 / 4. ES: Download to OS target system

- Right-click on the OS to be transferred in the open PCS 7 project below the WinCC application.
- Select the menu command **PLC > Download** in the shortcut menu. This downloads the project for OS Client_1 from the ES to the relevant OS.

Phase 4 / 5. Client_1: Select the operability of the clients

Options:

- If all clients should remain operable, set the preferred server for Client_1 to Server_2. Client_1 is operable after you have completed Phase 4. After having updated Server_1 in Phase 5, change the server setting for Client_1 to preferred server = Server_1.
- If you do not need Client _1 to be operable during the software update, the preferred server for Client _1 does not have to be changed.

The system reacts as follows:

- Client_1 is connected to Server_2 or deactivated.

Result after Phase 4

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is updated (deactivated or connected to Server_2).
- OS Client_2 is interconnected with its preferred Server_2.

8.10.7 Phase 5: Updating Server_1

Introduction

While you perform the steps in phase 5, your system runs only with Server_2. The system remains controlled from the OS clients that were updated in phases 2 and 4.

CAUTION
Interrupted redundancy Perform the steps without extended interruptions because the redundancy is not available during the update.

Initial situation before phase 5

- Server_1 is master server in the PCS 7 project.
- The updated Server_2 is standby server in the updated PCS 7 project.
- Client_1 is updated (deactivated or connected to Server_2).
- OS Client_2 is interconnected with its preferred Server_2.

Requirements

- The PCS 7 project you are updating has already been updated on the ES.
- Archive synchronization is complete.
  - Message: "REDRT: <name of the OS server> finished".
  - Using a Process Historian:
    The data from the circular log of OS Server 1 is transferred or migrated to Process Historian.
    You can find additional information on this in the documentation *SIMATIC; Process Historian Installation Notes*.
- Make sure that at least one updated OS client is interconnected with Server_2.
  If no OS client is interconnected with Server_2, your system cannot be operated while you are updating Server_1.

Procedure - Phase 5

Phase 5 / 1. Server_1: Deactivate and exit WinCC

- Deactivate WinCC Runtime on Server_1.
- Exit WinCC on Server_1.
- Updated Server_2 is master server.

Phase 5 / 2. Client_1: Setting the preferred server

- If the preferred server for Client_1 is set to Server_2, carry out the following steps:
  - Close WinCC Runtime on Client_1.
  - Set the preferred server for Client_1 to Server_1.
  - Start WinCC on OS Client_1.
- Activate WinCC Runtime.

Phase 5 / 3. Server_1: Backup of the PCS 7 project, operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation and your current PCS 7 project as a fallback strategy.

Phase 5 / 4. Server_1: Installation or update of the operating system, PCS 7 Installation "OS server"

- Install or update the operating system (you can find information about this in the manual *Process Control System PCS 7; PCS 7 PC Configuration*).
  An OS server can only run on a server operating system which has been released for PCS 7. You can find additional information on this in the *Process control system PCS 7; PCS 7 Readme* documentation.
- Install the necessary PCS 7 components.
  In the "Program Packages" dialog of the PCS 7 Setup, select the "OS Server" check box or, if the OS is to swap out data to the Process Historian, the "OS-Server for Process Historian" check box.
- Make the necessary settings.

Note that Windows administration of PCs should be performed by a Windows administrator. You can find a detailed description of the PCS 7 installation and the required PCS 7-specific settings for PC stations in the manual *Process Control System PCS 7; PCS 7 PC Configuration*.

Phase 5 / 5. ES: Download OS connection data and OS target system

- Open NetPro and download the connection data from the ES to Server_1.
- Right-click on the OS to be transferred in the open PCS 7 project below the WinCC application. Select the menu command **PLC > Download** in the shortcut menu. This starts the transfer from the ES to Server_1.

Phase 5 / 6. Server_1: Start WinCC

- Start WinCC on Server_1.

Phase 5 / 7. Server_1: Check and save the "Redundancy" dialog box

- Open the "Redundancy" editor and check the settings in the dialog box. Click "OK" to exit the dialog box even if you have made no changes.

Phase 5 / 8. Server_1: Check and save the "Time Synchronization" dialog box

- Open the "Time Synchronization" editor and check the settings in the dialog box. Click "OK" to exit the dialog box even if you have made no changes.

Phase 5 / 9. Server_1: Activate WinCC Runtime

- Activate WinCC Runtime on Server_1.

Note

If a Process Historian is used in the project make sure:

- The Process Historian was updated before
- The Process Historian is in the "Active" state.

Phase 5 / 10. Perform Phase 5: Steps 1 to 10

If you are using more than one redundant OS server pair, repeat steps of Phase 5 / step 1 through 10 for each Server_1.

Phase 5 / 11. ES: Starting SIMATIC PDM

Start the SIMATIC PDM on the ES, if installed.

The system reacts as follows:

- Server_1 becomes standby server.

Result after Phase 5

- Updated Server_1 is standby server.
- Updated Server_2 is master server.
- Updated Client_1 is connected to its preferred server Server_1.
- Updated Client_2 is connected to its preferred server Server_2.

The updating of your redundant operator stations is complete.

Maintenance client accesses to intelligent field devices are possible when the PDM server has been started on the engineering station.

Note

If interface changes are done in PLC, WinCC is not able to get the changes from PLC or the redundant partner. Therefore, the customer must not do major block updates to ensure consistent archiving.

8.11 Guide to updating a redundant BATCH server in runtime

8.11.1 Software update

Information is available in the SIMATIC BATCH product documentation:

- Operating manual *SIMATIC Process Control System PCS 7; SIMATIC BATCH;* section "Software Update".

8.12 Guide to updating a redundant Route Control server in runtime

8.12.1 Updating a redundant Route Control server in runtime

For servers and single-station systems which are used for OS and Route Control, please observe the following information.

Requirement

- The Route Control project on the engineering station has been updated.
- Note the phases described in section "Guide to updating a redundant OS in runtime (Page 225)".

  Note

  Backing up the log files

  Back up the log files before replacing or reinstalling a computer, at the latest. You can find the configured storage path via the Route Control Engineering (list for route log in the path: Project Settings > Runtime Parameters > Routes Log > Values for Server and Standby).

- The PCS 7 version is at least PCS 7 V9.1.x.
- SIMATIC PCS 7 software of versions older than V9.1 cannot be directly updated to V10.0. The user has to reset and upgrade the computer to any one of the following operating systems and install SIMATIC PCS 7 V10.0 as a completely new installation:
  - Microsoft Windows 10 Enterprise LTSC 2019 and LTSC 2021 OS support
  - Microsoft Windows Server 2019
  - Microsoft Windows Server 2022

Procedure

Execute the following steps on the servers, note the sequence and the states on each PC station.

	Default Master (1)	**Default Standby** (1)
1.	V9.1.x (2) – Runtime	V9.1.x (2) – Runtime
2.	V9.1.x (2) – Runtime	Exit Runtime Execute an update installation on the "Default Standby Server" and the Engineering Station.
3.	V9.1.x (2) – Runtime	Update the database to the new version and download it (you may have to update and download the WinCC project)
4.	V9.1.x (2) – Runtime Do not update the current server (default master)!	Start the RC server (and also WinCC Runtime, if needed) and perform the update (the default standby server must be selected on a client with a new version in the RC Center using the menu command **Program > Server Selection**)

	Default Master [1]	**Default Standby** [1]
5.	The default master continues to operate as standby server	Activate the default standby This RC server becomes the master (new version – Runtime) • RC clients with V9.1 SPx [2] report errors because connection to an RC server of another version is not possible. • RC clients with the new version connect to the RC server • All running routes will be processed with the new RC server.
6	Exit RC server	New version – Runtime
7.	Execute an update installation on the default master.	New version – Runtime
The next step involves changing the master role.		
8.	Start RC server (or WinCC Runtime) – starts as standby (you may have to update the project)	New version – Runtime The database is read.
9.	New version – Runtime (standby)	New version – Runtime

[1] : Default master or standby refers to the current state of the server pair before the software update in runtime. Any redundancy switching is not necessary.

[2] : V9.1.x means Route Control V9.1.x ucx.

Additional information

- Programming and Operating Manual *SIMATIC Process Control System PCS 7; SIMATIC Route Control;* section "Software update."

8.13 Redundancy behavior of the PCS 7 OS, SIMATIC BATCH and SIMATIC Route Control servers

Error-free System

A redundant server pair is considered to be fault-free when the following conditions are met:

- Both servers are in process mode (master or standby).
- All process mode data are synchronized between the servers.

Failure of a server computer (computer of a server pair)

Order of the reactions	**Reactions**	
	Failure at the master server (Server_a power off)	**Failure at the standby server (Server_b power off)**
For computers with a server function or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	Standby server (Server_b) becomes master	
		No redundancy switchover master remains master

Failure of the terminal bus

Order of the reactions	**Reactions**	
	Failure at the master server (Server_a)	**Failure at the standby server (Server_b)**
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server	The dialog "Restart request" appears at the server affected by the failure.	
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server	Network adapter for terminal bus and redundant link are deactivated.	
For computers with a server function or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	Standby server (Server_b) becomes master	
		No redundancy switchover master remains master

Order of the reactions	Reactions	
	Failure at the master server (Server_a)	**Failure at the standby server (Server_b)**
For **OS** server or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	Process control message is output on the PCS 7 OS	
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server	If automatic restart is activated, it is executed on the server affected by the failure. The server is in "Standby" mode following restart.	

Plant bus failure

- **PCS 7 OS server**:
  So that the failure of the plant bus is recognized, the option "WinCC client switch in case of a process connection error" has to be selected.
  (Default setting: the option is selected)
- **SIMATIC BATCH**:
  Failure of the plant bus is only relevant for SIMATIC BATCH if the batches are executed in the automation system.

Order of the reactions	Reactions	
	Failure at the master server (Server_a)	**Failure at the standby server (Server_b)**
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server	Standby server (Server_b) becomes master; Computer (server a) becomes standby	
		No redundancy switchover master remains master
only for **Route Control** server	Standby server (Server_b) becomes master	No redundancy switchover master remains master
	Computer switches to initialization or error status. The computer becomes standby following reconnection to the plant bus.	
For **OS** server or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	Process control message is output on the PCS 7 OS. No isolation of the network adapter.	

Failure of the redundant connection

Order of the reactions	Reactions	
	Master server	**Standby server**
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server		The dialog "Restart request" appears on the standby server.
For **OS** server or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	Process control message is output on the PCS 7 OS	
only for **Route Control** server	No reaction to the error.	
Only for **BATCH** server or for **BATCH** server in combination with **Route Control** server	No reaction	• Network adapter for terminal bus and redundant link are deactivated. • If automatic restart is activated, it is executed on the server affected by the failure. The server is in "Standby" mode following restart.

Failure of software components (Health check)

Order of the reactions	Reactions	
	Master server	**Standby server**
OS server or **BATCH** server or for **BATCH** server in combination with **Route Control** server	The dialog "Restart request" appears on the standby server. A redundancy switchover then takes place.	The dialog "Restart request" appears on the standby server.
For **OS** server or computers with a combination of server functions • **BATCH** server • **OS** server • **Route Control** server	• Process control message is output on the PCS 7 OS • Network adapter for terminal bus and redundant link are deactivated. • If automatic restart is activated, it is executed on the server affected by the failure. The server is in "Standby" mode following restart.	

Automatic restart

The following is required for the automatic restart:

- Automatic restart has to be activated for all applications that are take part in process mode.
- All process mode data are synchronized between the servers.

If a redundancy error occurs on one server following the automatic restart, note the following:
If a new redundancy error occurs within the first hour that this computer again takes part in process mode, no automatic restart is executed.

Note

Restart

The automatic restart is also limited to 3 restarts. The counter is reset after 3 hours. At least 3 hours have to pass before the counter is reset following the third restart. If a restart is triggered hourly due to an error, an auto reboot is no longer executed following the 3rd error (because it has not been 3 hours without auto reboot)

Delayed reaction to errors

A double error can result in a delayed reaction by the server.

Example:

- Error 1: The partner server is not available or cannot be reached.
- Error 2: An additional error occurs during process mode (e.g. terminal bus cable pulled).
- Reaction:
  - The computer first remains MASTER.
  - An error is reported.
  - The reaction to the error is delayed.
  - Only when the partner server is recognized and all data are synchronized does the dialog "Restart request" appear.
    Note:
    As long as the process mode data from WinCC or SIMATIC BATCH are not synchronized, the server remains in the status MASTER.

Diagnostics

9

Information is available in the manual *Process Control System PCS 7; Service Support and Diagnostics*.

9.1 Advanced self-diagnostics of communication connections

PCS 7 features advanced self-diagnostics for redundant software systems (servers). If this diagnostics routine detects an internal fault, and in the event that the redundant partner server is fully functioning, all communication connections on the server affected by the fault are disconnected (terminal and plant bus).

The affected server is then restarted automatically.

Requirements

- Use of a PCS 7 OS (multi-station) redundant system, SIMATIC BATCH and SIMATIC Route Control.
- The following settings have been made on the server systems:
  - Automatic Windows logon (not relevant for servers in WinCC service mode)
  - Automatic start of the PCS 7 server applications
  - "Display Shutdown Event Tracker" is deactivated

Procedure

1. Use the search box in the start menu to open the file "gpedit.msc".
   The "Local Group Policy Editor" dialog box opens.
2. In the tree view, select the folder **Local Computer Policy > Computer Configuration > Administrative Templates > System**.
3. Double-click the "Display Shutdown Event Tracker" object in the detail view.
   The "Display Shutdown Event Tracker" dialog box opens.
4. Select the "Deactivated" option button.
5. Click "OK".

Note

Before a PCS 7 server application is exited, an availability check is carried out on the relevant redundant partner server. If the partner server is not fully functional, the user is informed of this status and can proceed accordingly.

Additional information

You can find more information in the corresponding documentation and readme files on:

- PCS 7 OS
- SIMATIC BATCH
- SIMATIC Route Control
- SIMATIC NET

9.2 State of redundant operator stations in diagnostic pictures

When using a Maintenance Station, the block icons show the redundancy state of the redundant OS servers in the diagnostic area. You can find information on the block icons displayed for redundant components in the documentation *Process Control System PCS 7; Maintenance Station*.

For OS Clients on Windows, the state of connected servers shows the redundancy state of redundant OS, Batch and PH servers.

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