SIEMENS

SIMATIC

Process Control System PCS 7 V7.0 Fault-tolerant Process Control System

Manual

11/2006
A5E00783458-01

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring to property damage only have no safety alert symbol. The notices shown below are graded according to the degree of danger.

Danger
indicates that death or severe personal injury **will** result if proper precautions are not taken.

Warning
indicates that death or severe personal injury **may** result if proper precautions are not taken.

Caution
with a safety alert symbol indicates that minor personal injury can result if proper precautions are not taken.

Caution
without a safety alert symbol indicates that property damage can result if proper precautions are not taken.

Notice
indicates that an unintended result or situation can occur if the corresponding notice is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel.** Within the context of the safety notices in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

Warning
This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.
Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Preface

Purpose of this documentation

This documentation informs you about the following aspects of configuring fault-tolerant 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 (management, process, field).

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

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 assumed that the reader knows how to use computers or other equipment similar to PCs (such as programming devices) operating under the Windows operating system.

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

Scope of this documentation

This documentation is valid for the software package *Process Control System; PCS 7 Toolset* as of V7.0.

Other related documentation

The following documentation provides more information about fault-tolerant process control systems and the handling of the individual components. This documentation is part of the software package *Process Control System; PCS 7 Toolset* as of V7.0.

Manual	Content
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
Configuration manual *Process Control System PCS 7; Operator Station*	• Configuring SIMATIC connections • Interconnecting faceplates • Configuring operator stations • Compiling the OS • Installation guidelines
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
Manuals for PCS 7 Software Update	• Updating a PCS 7 Project with and without use of new functions • Upgrading a redundant system during online operation
Manual *Programmable Controller S7-400H, Fault-Tolerant Systems*	• Redundant SIMATIC automation systems • Increasing availability • System and operating modes of the S7-400H • Linking-up and updating

Manual	**Content**
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 *Distributed I/O Device ET 200iSP*	• 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-400*	• Configuration options • Mounting • Wiring • Commissioning and diagnostics
Manual *SIMATIC NET* Manual *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
Manual *SIMATIC DP/ PA Link and Y Link Bus Couplings*	• Fundamentals of PROFIBUS PA • DP/PA Coupler • DP/PA Link • DP/PA Link in redundant operation with the S7-400H
Documentation *PCS 7 - Released Modules*	• Components released for redundancy in PCS 7

Finding topics

This manual is organized into the following topics:

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

What's new?

Below, you will find an overview of the most important changes in the documentation compared with the previous version:

- Use of the redundant, fault-tolerant terminal bus
  You can find information about this in the section "Redundant Fault-Tolerant Terminal Bus"
- Use of redundant PROFIBUS PA
  You can find information about this in the section "Redundant PROFIBUS PA"
- Redundancy concept of SIMATIC Route Control
  You can find information about this in the section "Redundant Route Control Server"

PCS 7 Glossary

You can find a PCS 7 glossary containing the definitions of important technical terms used in the documentation on the *SIMATIC PCS 7; Manual Collection* DVD or in the PCS 7 software via the help menu of the SIMATIC Manager (menu command **Help > Topics >** "Glossary" button).

Further Support

If you have any technical questions, please get in touch with your Siemens representative or responsible agent.

You will find your contact person at:

http://www.siemens.com/automation/partner

You will find a guide to the technical documentation offered for the individual SIMATIC Products and Systems at:

http://www.siemens.com/simatic-tech-doku-portal

The online catalog and order system is found under:

http://mall.automation.siemens.com/

Training Centers

Siemens offers a number of training courses to familiarize you with the Process Control System SIMATIC PSC 7. Please contact your regional training center or our central training center in D 90327 Nuremberg, Germany for details:

Telephone: +49 (911) 895-3200.

Internet: http://www.sitrain.com

Technical Support

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  http://www.siemens.com/automation/support-request
- Phone: + 49 180 5050 222
- Fax: + 49 180 5050 223

Additional information about our Technical Support can be found on the Internet pages http://www.siemens.com/automation/service

Service & Support on the Internet

In addition to our documentation, we offer our Know-how online on the internet at:

http://www.siemens.com/automation/service&support

where you will find the following:

- The newsletter, which constantly provides you with up-to-date information on your products.
- The right documents via our Search function in Service & Support.
- A forum, where users and experts from all over the world exchange their experiences.
- Your local representative for Automation & Drives.
- Information on field service, repairs, spare parts and more under "Services".

Contents

1 Basics of Fault Tolerance

1.1 Rationale for Using Fault-tolerant Process Control Systems

Advantages of fault-tolerant 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 fault-tolerant for all of the components.

You can minimize the risk of a production shutdown by using fault-tolerant 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 fault tolerance and fail-safe performance in process control systems.

The following applies to you as the plant operator:

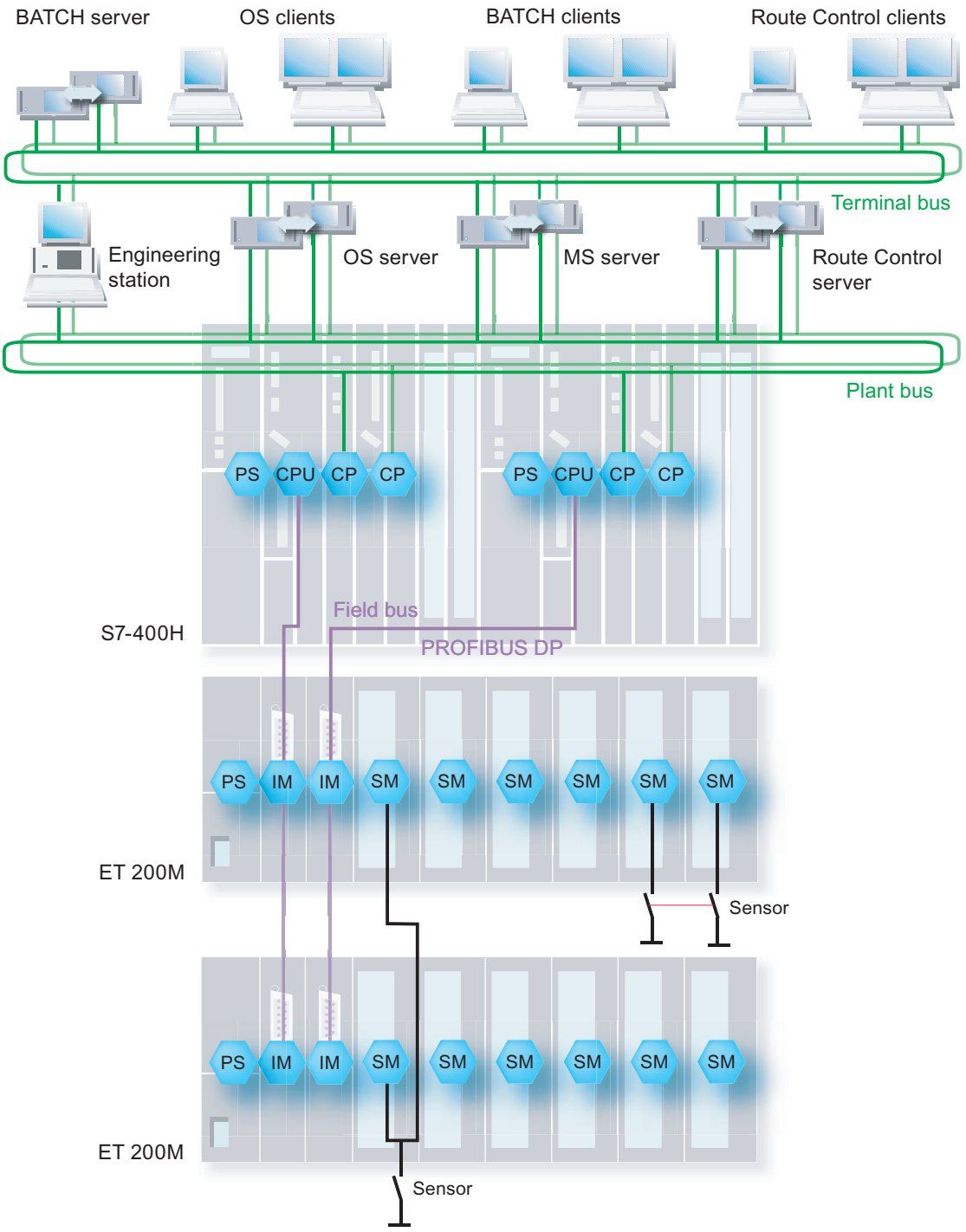
The higher the cost of a production stoppage, the more you need a fault-tolerant system. The higher initial investment usually associated with a fault-tolerant system is soon offset by the savings resulting from decreased production downtimes.

Fault-tolerant PCS 7 Process Control System

The following components of the PCS 7 process control system allow you to implement fault-tolerance 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 fault-tolerant 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"
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 fault-tolerant 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
PROFIBUS DP	PROFIBUS distributed I/O
Sensor	Transmitters, sensors

1.2 System-Wide Availability Analyses

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 replacement parts in stock on site. The use of fault-tolerant components in the process control system enables you to correct the cause of the system or component failure in runtime. This eliminates repair time altogether.

Avoiding Unallowed Signal Edge Changes

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

1.3 PCS 7 Redundancy Concept

Advantages of the PCS 7 redundancy concept

Fault-tolerant 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

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 fault tolerance 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.

- The fault-tolerant S7-400 H automation system with the CPUs 414-4H and 417-4H, whose mounting racks can be spatially separated.

  Benefit: 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.

  Benefit: 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.

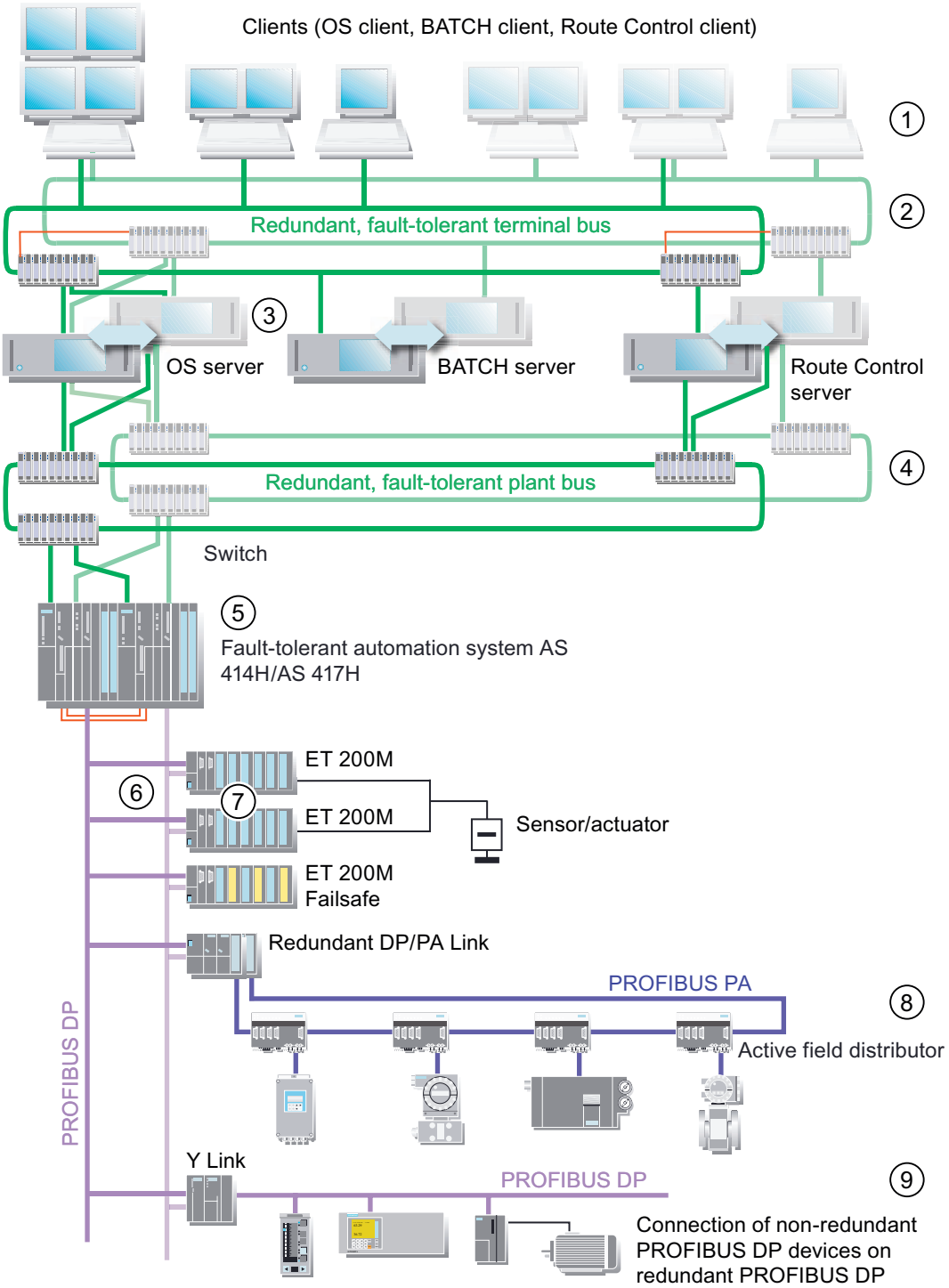
- Every failure of a redundant component is indicated on the OS clients in the form of a process control message.

  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.

Overview of the PCS 7 redundancy concept

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



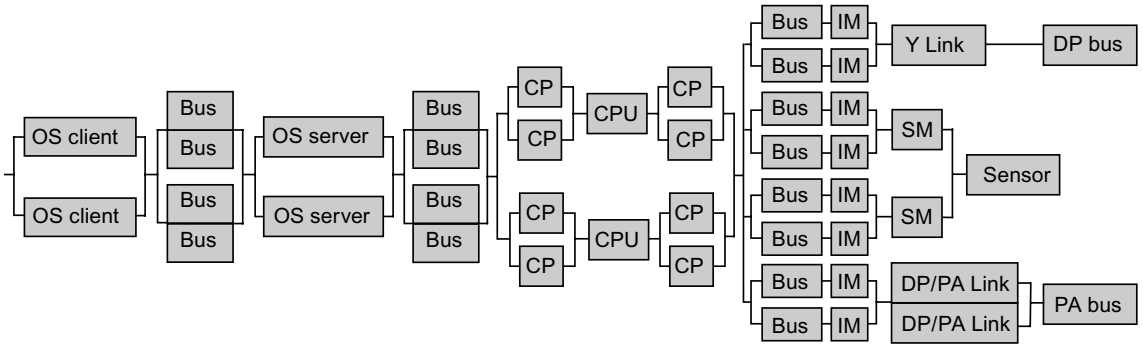
Note

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, fault-tolerant 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, fault-tolerant plant bus (Industrial Ethernet). The automation systems, server and engineering station are connected to the plant bus via switches.
5	Each part of the redundant, fault-tolerant S7-400H automation systems (AS 414H or AS 417H) is connected to the plant bus with an Ethernet communications processor (CP). Each part of the AS be connected to several PROFIBUS DP chains. The internal PROFIBUS DP interfaces or additional communications processors are used for the attachment.
6	The redundant connection to the DP master system is achieved using two 153-2 IM modules in each ET 200M.
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	The PROFIBUS PA I/O is connected to the redundant PROFIBUS DP using FDC 157-0 DP/PA couplers and two IM 153-2 modules. A redundant PROFIBUS PA is configured with a redundant DP/PA Link. The field devices are connected to the PROFIBUS PA via active field distributors (AFD 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.

Illustration of fault tolerance using redundancy nodes

Redundancy nodes can be used to provide an overview of the fault tolerance of a process control system. As an introductory example, the following illustration presents the process control system shown above as a block diagram with the individual redundancy nodes.



1.4 Overview of the PCS 7 Redundancy Features

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 local stock. It focuses on "automated fault-tolerant process control systems".

The PCS 7 process control system fulfills the described requirements for the availability of process control systems. The components of PCS 7 enable you to implement fault-tolerant solutions at all automation system levels in the form and to the degree you desire.

System-wide integration of PCS 7

The PCS 7 process control system is a uniform system whose components are tuned to one another. The complete uniformity of the system, from HMI devices to sensors and actuators, is self-evident and ensures maximum system performance.

Stepped, scalable availability through redundant components

Availability is increased by using redundancy for all critical PCS 7 components supported by appropriate software mechanisms. The components of PCS 7 can be divided into the following:

- Field level
- Process level
- Management level

PCS 7 offers a solution for every component on these levels. The following table lists the three levels and the corresponding fault-tolerant hardware components.

You can decide where to use redundant components depending on your availability requirements. In this way, PCS 7 offers you a scalable, uniform, and comprehensive availability concept.

Process level	Components
Management level	• OS clients, maintenance clients, BATCH clients, Route Control clients • OS servers, maintenance servers, central archive servers, BATCH servers, Route Control servers • Terminal bus (Industrial Ethernet)
Process level	• Plant bus (Industrial Ethernet) • Automation system AS 414H, AS 417H
Field level	• PROFIBUS DP, PROFIBUS PA field bus • Distributed I/O device ET 200M, ET 200iSP • S7-300 distributed I/O modules • PROFIBUS DP, PROFIBUS PA and HART devices

1.5 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 similar to 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.

1.6 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 of a component fails. The operation 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.

Notice

If a component fails in a redundant control system, the fault tolerance is lost. A further failure means the failure of the entire system.

Feature	Meaning	Potential source/reason for error
Toleration of an isolated error	An isolated error is tolerated since the fault-tolerant 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 fault-tolerant process control system. Upgrade and expansion of the system.

Feature	Meaning	Potential source/reason for error
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 failover period.	Failure of the OS server Examples: • Operating system failure • Hard disk defect
Display of the master / standby identification of the OS servers.	The information about the master / standby identification of the OS server can be queried and displayed through 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 through the configuration of 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 failover 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.	Failure of an OS client: e.g., operating system Failure of an OS server: e.g., network card Failure of a plant bus: e.g., broken cable Failure of central device: e.g., PS, CPU, synchronization line, CP, SM Failure of PROFIBUS DP: 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 fault-tolerant 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
Reliability documentation	Documentation of availability, for example, testing based on MTBF residual time with optional printout	Display and documentation of a potential component failure in advance.

1.7 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 fault-tolerant system. System components are installed redundantly so that repairs and expansions can be made in runtime.

1.8 Definition of Availability

Definitions

Availability is usually defined as follows:

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

Whereby:

- MTBF = mean time between failure
- MTTR = mean time to repair

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:

- Further increasing the mean time between failure (MTBF)
- Decreasing the period necessary for repairs (MTTR)

  A variety of measures can reduce the repair time:

  - Proximity to customer service
  - Replacement parts warehousing
  - Repairs in runtime or repairs without downtime

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

1.9 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

Mode	Definition
Hot standby	Hot standby means the parallel redundant processing of signals in redundant components. This allows a bumpless failover 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.

1.10 Redundancy Nodes

Functionality

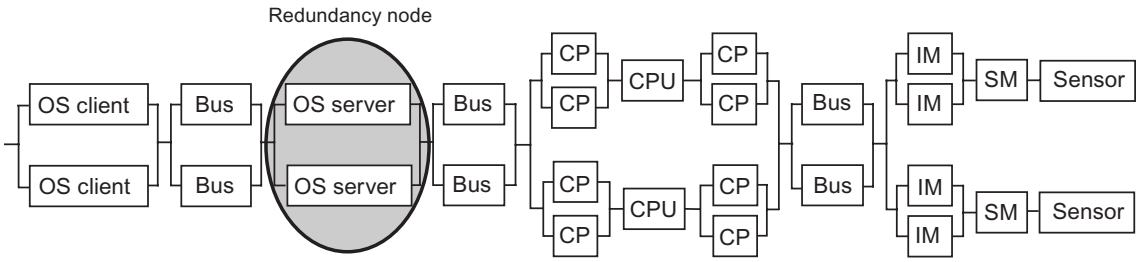
Redundancy nodes provided protection from failure of systems with redundant components. A redundancy node is independent when the failure of one component within the node does not affect the reliability in other nodes or in the entire system.

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 illustrated this point.

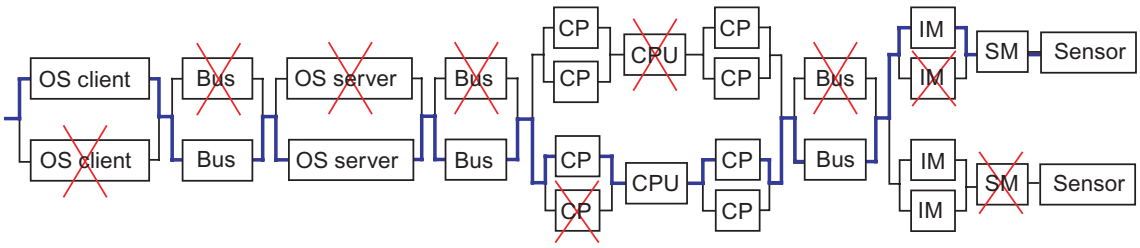
Redundancy nodes without fault

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



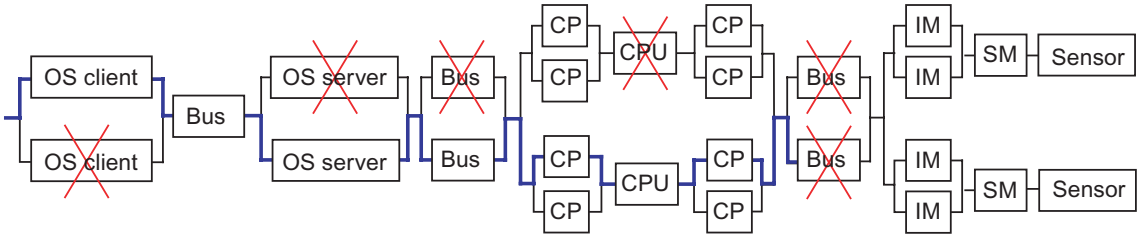
Availability of a redundancy node despite faults

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 (PROFIBUS DP)" redundancy node.



2 Fault-Tolerant Solutions in PCS 7

2.1 Solutions for I/O

2.1.1 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 (I/O modules and function modules) that are used in a modular, distributed I/O device such as the ET 200M 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 efforts needed for wiring and ensuring the electromagnetic compatibility. The high-performance PROFIBUS DP is used as the communication link between the distributed I/O device and the central rack. An interface module (IM) in the distributed I/O device serves as the PROFIBUS DP interface.

In addition to I/O devices, distributed I/O also includes field devices such as actuators, weighing systems, motor protection control devices and all other PROFIBUS-capable field devices.

HART devices can be directly connected and accessed through appropriate modules in an ET 200M. HART devices are actuators and sensors that can be configured per HART (Highway Addressable Remote Transducer) protocol.

Distributed I/O also includes bus converters such as DP/PA Links and Y Links. The DP/PA Link enables the connection of a lower-level bus system such as PROFIBUS PA to a redundant PROFIBUS DP.

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:

- **Single-channel switched I/O** (distributed I/O)
  Single-channel switched I/O describes the situation when the input/output module (SM) used to process a process signal exists only once. The communication path to the single-channel I/O is redundant and fails over to the functioning communication path if one of the paths goes down.
- **Redundant I/O** (distributed I/O)
  Redundant I/O describes the situation when the input/output modules (SM) for processing a process signal are doubly available and can be addressed by both CPUs. This ensures that the CPU signal or process signal will continue to be processed by a functioning module even when its partner fails.

Modules for the distributed I/O

Note

You can find which modules are released for the distributed I/O in PCS 7 in the documentation *PCS 7 - Released Modules*, which can be accessed with the menu command **Start > SIMATIC > Documentation > English**.

2.1.2 Single-Channel Switched Distributed I/O

Single-channel switched configuration

A single-channel switched configuration features an I/O module that can be addressed by both central processing units (CPUs) of a fault-tolerant system. In a single-channel switched configuration, there is only one I/O module (single-channel) but it can be accessed over a redundant PROFIBUS DP slave interface module.

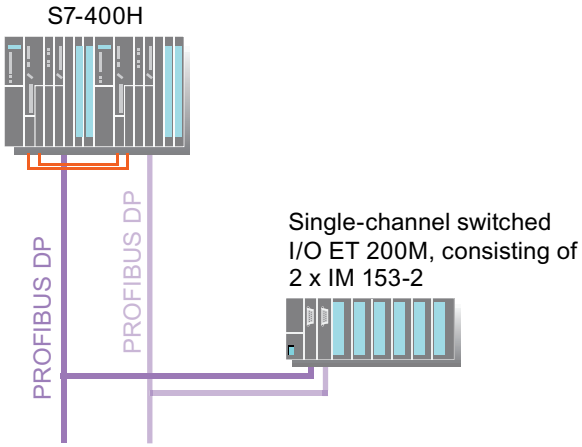
Configuration

A single-channel 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 PROFIBUS DP slave IM 153-2 interface module.
- ET 200iSP
  For this setup, you require an ET 200iSP and a redundant PROFIBUS DP slave IM 152-1 interface module.

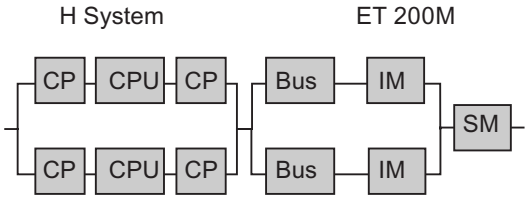
Each subsystem of the S7-400H is connected to one of the two DP slave interfaces of the interface module via a DP master interface.

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

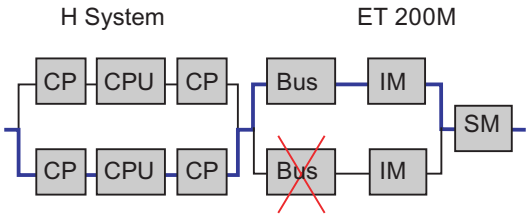


Availability

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 single-channel switched I/O. Follow these installation rules:

- CPU 41x-4 H and additional DP masters must be located in the same slots of both redundancy sections (for example, in slot 4 of both redundancy sections)
- The PROFIBUS cable in both redundancy sections must be connected to the same interface (for example, to the PROFIBUS DP interfaces of the two CPU 41x-4 H)

Configuration rules

- A DP slave in the redundant DP master system pairs must have the same DP address.

Additional information

- Section "Redundant Interface Modules of the Distributed I/O"
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.1.3 Redundant I/O

Redundant I/O

Redundant I/O describes the situation when the I/O modules is doubly available for a process signal and can be addressed by both CPUs.

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 information about this in the following sections:

- Section "Redundant I/O Modules"
- Section "Failure of Redundant Input/Output Modules"

Configuration

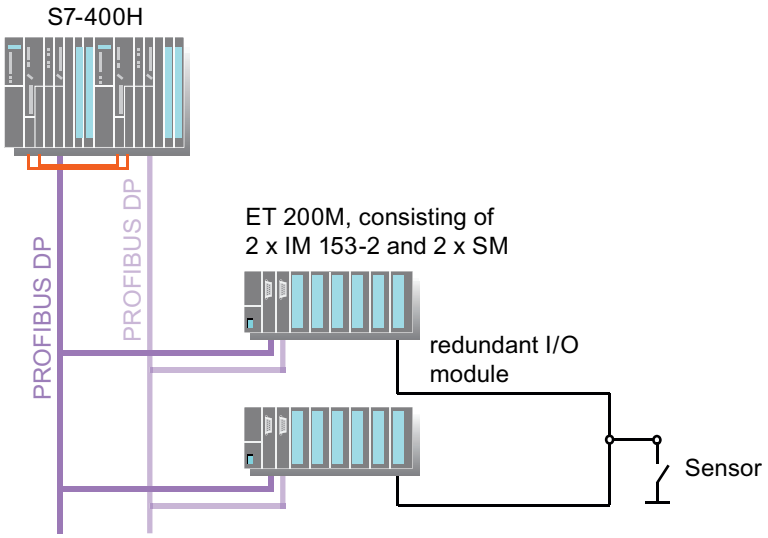
In PCS 7, you can configure redundant I/O with selected S7-300 I/O modules of ET 200M.

The ET 200M distributed I/O device is connected as a DP slave to a fault-tolerant automation system operating as the DP master via PROFIBUS DP. A redundant configuration is achieved by installing an additional ET 200M and an additional PROFIBUS DP connection.

Note

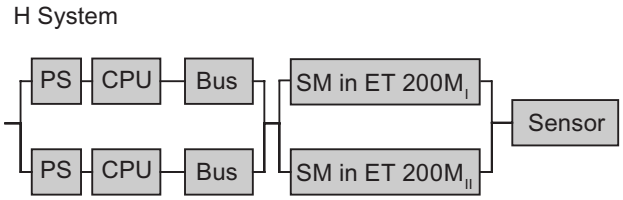
Use only active bus modules for the ET 200M in a fault-tolerant system with PCS 7. Active bus modules enable you to plug and pull modules in runtime.

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

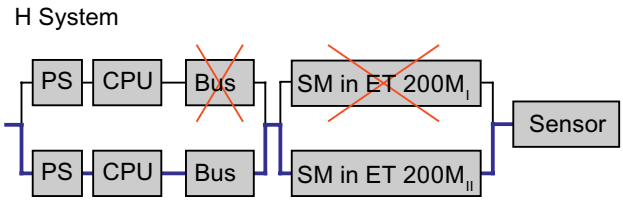


Availability

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.



Additional information

- Section "Redundant Interface Modules of the Distributed I/O"
- Section "Redundant Input/Output Modules"
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.1.4 Redundant Interface Modules of the 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 single-channel switched distributed I/O
- Setup of a redundant distributed I/O

If the active interface module fails, 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"

- 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 200iSP with redundant IM 152-1
  Two IM 152-1 interface modules are mounted on the 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"
- Section "Failure of Redundant Interface Modules"
- Manual *SIMATIC, Distributed I/O Device ET 200M*
- Manual *SIMATIC, Distributed I/O Device ET 200iSP*
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.1.5 Redundant I/O Modules

Redundant I/O modules

Redundant I/O modules enable you to considerably increase the availability in the I/O area. When redundant I/O modules are used, an application is not disturbed when a signal fails. The user program continues to work with the redundant signal.

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

- Redundant input/output modules in single-channel switched I/O.
  The configuration is provided as an example in the section "Single-Channel Switched Distributed I/O"
- Redundant I/O modules in redundant distributed I/O.
  The configuration is provided as an example in the section "Redundant I/O"

Note

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

Usable modules

As of PCS 7 V6.0, standard modules can be operated redundantly using the H CPUs (414-H, 417-H) in both redundant and single mode with the CPU firmware version V3.1 or later.

Redundant mode is only possible with specific S7-300 I/O modules of the ET 200M (e.g. digital/analog modules).

Note

Only modules with the same order number can be paired together in redundant configurations.

Required software and configuration

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 (V1)" library and PCS 7 driver blocks from the *PCS 7 Library* V6.0 and higher are required in addition to the necessary hardware.

You select and configure the redundant modules in HW Config.

Configuration in HW Config and CFC

Two identical I/O modules are configured for redundant operation in HW Config. You place a channel block in the CFC for each signal acquired redundantly. For redundantly registered signals (e.g. input 1.1 and input 2.1), connect the symbol only with the lowest value address (e.g. input 1.1). When the AS is compiled, the required driver blocks will be placed, interconnected and assigned parameters automatically.

Response of input/output modules to a disrupted channel

As of PCS 7 V7.0, you can specify how redundant input/output modules react to a channel fault (for example, broken wire, short-circuit on the signal line). If a channel fault occurs, the following reactions can be expected depending on the module used and the configuration:

- The entire module is passivated if a fault occurs (module-oriented passivation reaction).
- Only the channels on which the fault occurred are passivated (channel-oriented passivation reaction).

You can find which modules are approved for the channel-oriented passivation reaction in the documentation *PCS 7 - Released Modules*, which can be accessed with the menu command **Start > SIMATIC > Documentation > English**.

Additional information

- Section "How to Configure Redundant Input/Output Modules"
- Section "Failure of Redundant Input/Output Modules"
- Section "How to Set the Failure Reaction of the Input/output Modules on the CPU"
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*
- Online Help for *STEP 7*

2.1.6 Redundant Actuators and Sensors

Failure detection

Actuators and sensors on the field level can be configured redundantly for PCS 7. Depending on the I/O module to which the redundant actuators or sensors are connected, failure of an actuator or sensor can be detected and reported to the process control system as an error. If an actuator/sensor fails, the automation system continues to operate with the intact actuator/sensor. This ensures that the current status of the process values can be read in or output at any time.

Note

Refer to the product description of the I/O module you are using to see whether it can detect and report failures of connected actuators and sensors.

Additional information

- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.2 Solutions for Automation Systems

Introduction

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

S7-400H fault-tolerant programmable controller

Only a fault-tolerant 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 fault-tolerant 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 central processing units and power supplies in an S7-400H. The communications processors and I/O modules are expansion modules.

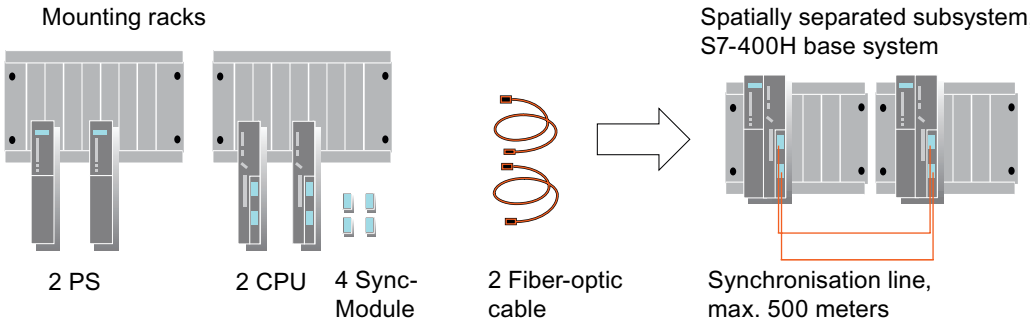
2.2.1 S7-400H Hardware Components

Hardware components

The following hardware components are available for the configuration of the fault-tolerant automation system.

Hardware components
UR2-H rack
UR2 rack
UR1 rack
CPU 414-4H
CPU 417-4H
Synchronization modules
Synchronization cable (up to 500 m)
CP 443-5 Extended
CP 443-1

Configuration



Mounting racks

The following three racks are available for installing the S7-400H. The racks are suitable for installation in 19" cabinets. Normally, the UR2-H rack is used.

Module type	Size	Special features
UR2-H	2 x 9 slots	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.
UR1	1 x 18 slots	Two racks are required for an S7-400H. You can replace a rack in runtime.
UR2	1 x 9 slots	Two racks are required for an S7-400H. You can replace a rack in runtime.

Central processing units

The CPU (CPU 414-4H or CPU 417-4H) exists twice 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. There are power supply modules for 24 V DC as well as for 120/230 V AC nominal input voltages with output currents of 4, 10 and 20 A. Two power supply modules can be used in each subsystem to increase the availability of the fault-tolerant system. In this type of configuration, you should use the power supply module PS 407 10 A R for 120/230 V AC rated voltages with 10 A output current.

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.

You set the rack number for the H CPU on the synchronization modules or directly on the CPU with the H CPU AK1+. The same rack number must be set on each synchronization module in the CPU.

The front panel of the synchronization modules serves the following purposes:

- It accepts threaded bolts which facilitate exchanging synchronization modules.
- It is used for switching in the supply voltage of the synchronization modules.

This feature is needed to enable replacement of synchronization modules even when the CPU is supplied with power.

The synchronization modules will not operate without the front panels fastened.

Fiber-optic cables for synchronization

The fiber-optic cables are connected to the synchronization modules and form the physical connection (redundancy coupling) 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 500 m.

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 with electrical or optical components is used for communication from the automation system to the distributed I/O devices.

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

Only Industrial Ethernet can be used as the plant bus for a fault-tolerant system. The fault-tolerant system also only supports the ISO protocol, not TCP/IP. The choice of the Ethernet CP is therefore limited. Only ISO or multi-protocol CPs can be used.

Configuration

An existing fault-tolerant Industrial Ethernet can be used for fault-tolerant communication between two standard CPUs and between two fault-tolerant CPUs. The parameters of the fault-tolerant S7 connections are set in NetPro.

A variety of communication blocks are available in the *PCS 7 Library* for data transmission (measured values, binary values, interlocks). 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"
- Section "How to Insert Synchronization Modules into the H CPU"
- Section "How to Configure Redundant Communications Processors"
- Section "How to Synchronize the Time of Day in Automation Systems"
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.2.2 How the S7-400H Operates

Active redundancy

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

The two subsystems form a fault-tolerant 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 participating in the processing control tasks. 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 (414-4H, 417-4H). The failover has no effect on the ongoing process because it is bumpless.

Additional information

- Section "Failure of the Master CPU"
- Section "Failure of a Fiber-optic Cable"
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

2.3 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
- Field bus

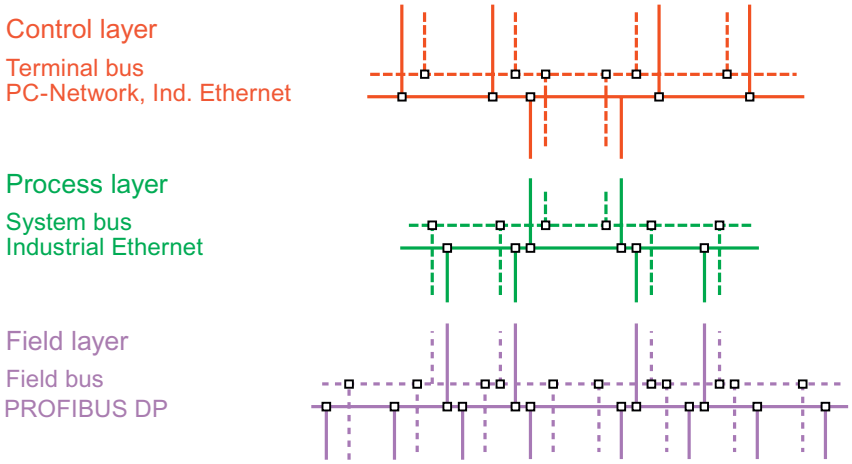
In PCS 7, we recommend that the bus systems are set up in a ring structure. The ring structure makes the bus "fault-tolerant", since it can compensate for the failure of a bus line.

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 failover has no effect on the user program running in the CPU.

Double communication lines



Overview of the redundant and fault-tolerant bus systems

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

- Redundant, fault-tolerant terminal bus
- Redundant, fault-tolerant plant bus
- Redundant PROFIBUS DP

Bus systems set up as a ring are **fault-tolerant** because there is cable redundancy. 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 broken cable). The availability is ensured by ring redundancy.

This fault-tolerance is used in the following bus systems:

- Fault-tolerant terminal bus
- Fault-tolerant plant bus
- Redundant PROFIBUS PA

The following sections describe the basics of these communications solutions.

2.3.1 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 (from the SCALANCE series)	Terminal bus Plant bus	Type-specific use in network setup Selected SCALANCE X components enable the following: • Transmission rates up to 1 Gbps • Media converter (electrical/optical bidirectional) • Function as redundancy manager
ESM (Electrical Switch Module)	Terminal bus Plant bus	Setup of electrical bus systems (suitable for redundancy manager)
OSM (Optical Switch Module)	Terminal bus Plant bus	Setup of optical bus systems An optical ring must be configured with at least two optical switch modules. (suitable for redundancy manager)
EMC (Electrical Media Converter)	Terminal bus Plant bus	**Mixed operation** of optical/electrical bus systems*:* Converter for converting signals between optical and electrical components (OSM and ESM): Conversion from optical transmission medium to electrical transmission medium
OMC (Optical Media Converter)	Terminal bus Plant bus	**Mixed operation** of optical/electrical bus systems*:* Converter for converting signals between optical and electrical components (OSM and ESM): Conversion of electrical transmission medium to optical transmission medium
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)

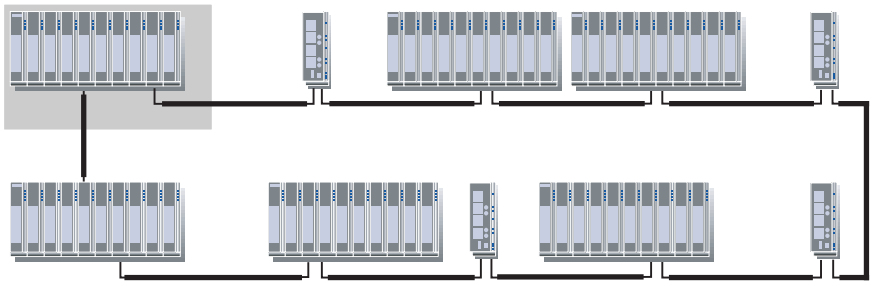
Network component	Bus system	Application
AFD (Automatic Field Distributor)	Fieldbus (PROFIBUS PA)	Connection of PA devices with line redundancy • Maximum of 8 AFDs for one redundant DP/PA coupler • Maximum of 4 field devices per AFD
AFS (Automatic Field Splitter)	Fieldbus (PROFIBUS PA)	Connection of PA devices with line redundancy • 1 AFD for one redundant DP/PA coupler • Maximum of 31 field devices for the AFS

Note

OSMs and OLMs cannot be operated together.

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.



Redundancy manager

Some bus components can operate as a redundancy manager.

This function enables the configuration of ring redundancy. Components operating as the redundancy manager ensure that the bus connections remain undisturbed if there is a fault in a bus line (such as a wire break).

Additional information

- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC NET; Industrial Ethernet OSM/ESM*
- 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-400*

2.3.2 Fault-Tolerant Terminal Bus

Functionality

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).

fault-tolerant terminal bus can be set up in a ring structure with network components of SIMATIC NET. The network components enables 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.

Fault-tolerant 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 transmission rates up to 1 Gbps based on modular SCALANCE X switches

The following switches can be used:

- Switches of the SCALANCE series
  Modules optical or electrical connection are used for the connection
- OSM (optical signal lines)
  The connection to the OSMs is electrical or optical.
- ESM (electrical signal lines)
  The connection to the ESM is electrical.

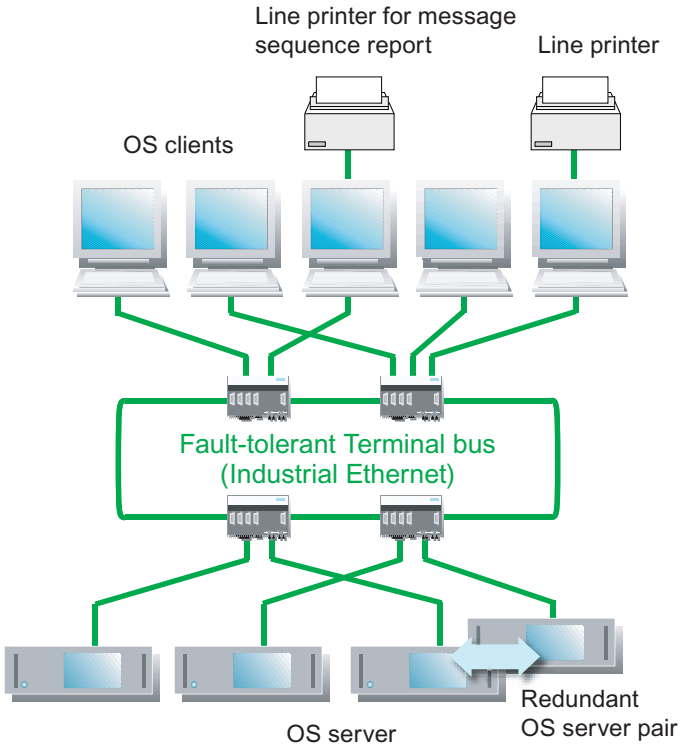
Configuration

In the following figure, the terminal bus is shown as a ring with switches (OSMs). 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.

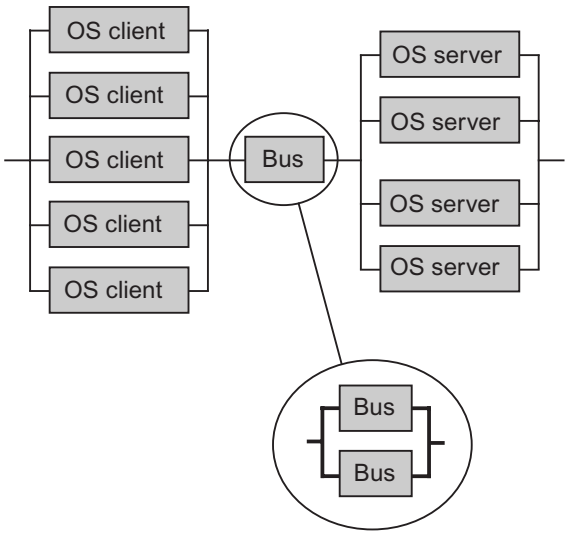
Note

If one of the switches fails, nodes connected to it fail as well. Redundant servers, therefore, must not be connected to the same switches.



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 connection between the connected OS servers and the OS clients is interrupted. To increase the fault-tolerance even more, however, the redundant double 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-200*
- Manual *SIMATIC NET; Industrial Ethernet OSM/ESM*

2.3.3 Redundant Fault-Tolerant Terminal Bus

Functionality

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).

A redundant fault-tolerant terminal bus is set up using two identical, linked terminal bus rings (double ring). The network components ensure unrestricted operation of the terminal bus. If a terminal bus fails, communication remains possible over the second terminal bus.

Redundant communication solution

The following solution is available to guard against failure of the terminal bus:

- Two identical networks (in PCS 7 usually terminal bus rings) with optical and electrical SCALANCE switches.

The redundant communication solution is set up with switches of the SCALANCE series. Optical, electrical and combined networks can be configured.

Switches

Bus components	Description
SCALANCE X414-3E	Modular switch with standby function, transmission rates up to 1 Gbps possible (suitable media module required for 1 Gbps) SCALANCE X414-3E can be used as a redundancy manager.
SCALANCE X204-2	Transmission rates up to 100 Mbps possible

Configuration - redundant terminal bus (double ring)

The following two network cards are used in each **server** that is to be connected to the terminal bus (for example, OS server, BATCH server, domain controller):

- Intel Pro/1000MT server adapter
- Intel Pro/1000GT desktop adapter

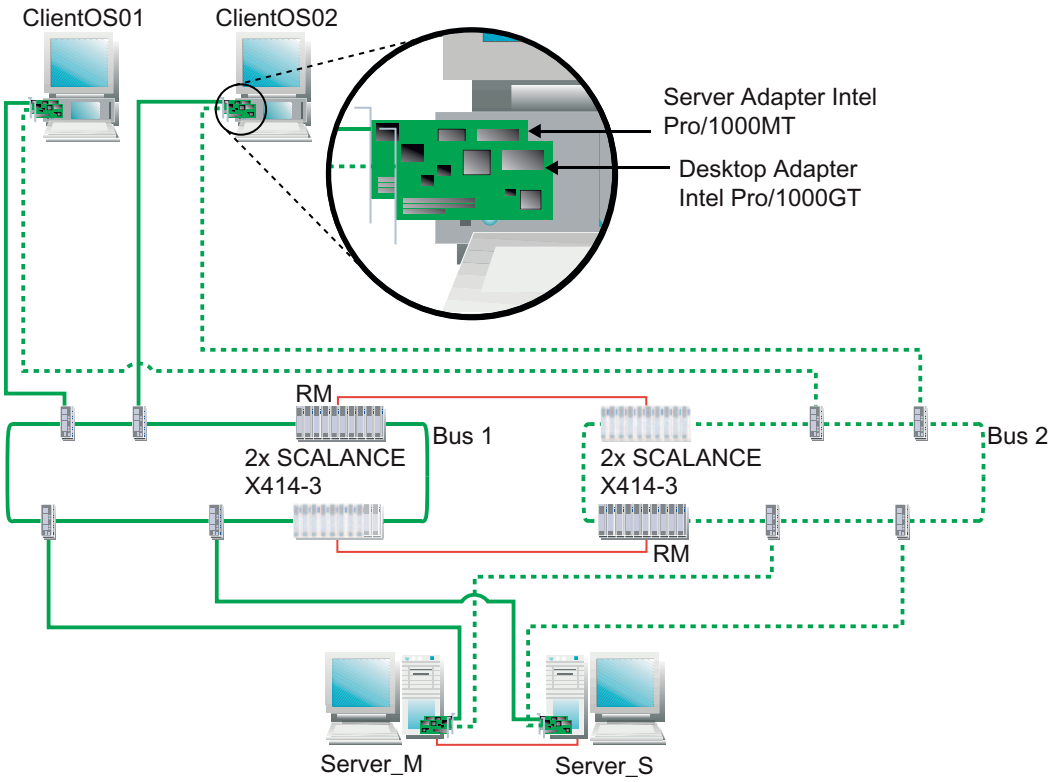
These network cards work in a "team mode" with only one logical network address. Each network card is connected to one of the redundant terminal bus rings. All network components are redundant.

Clients can also be set up with two network cards.

In a network segment (ring), a redundancy manager (RM) is configured to enable ring redundancy.

The **link** between the redundant network segments (rings) is implemented using two switches (100 Mbps) in each network.

The following figure shows this configuration.



Linking Redundant Network Segments (Rings)

Switches and data links (network cable) connect the redundant networks. For a redundant link between the redundant network segments (standby link), you need to configure two switches within a network segment for synchronization of the network segments. You can find additional information about this in the operating instructions *Industrial Ethernet Switches SCALANCE X-400*.

The two switches connected in the configuration exchange data frames and thereby synchronize their operating status (one device becomes the master and the other the slave).

When operating without fault, the data link to the other network segment is active only for the master. If this link section fails (for example, due to a defective device), the slave activates its data link as long as the fault exists.

Configuration of the switches

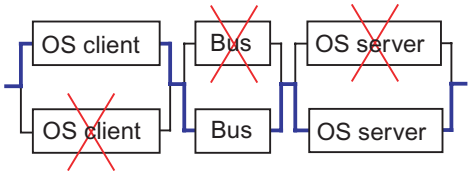
You can find detailed information about configuring switches in the configuration manual *Industrial Ethernet Switches SCALANCE X-400* :

- Configuration using Web-Based Management and Command Line Interface
- Configuration and Diagnostics over SNMP

Availability - redundant terminal bus (double ring)

The entire transmission path can be set up redundantly. If any network component fails, a transmission path remains operational over one terminal bus.

During operation, one switch automatically takes over the master role for linking the networks. In error-free status, the data link to the other network is active only for the master. If this link section fails (for example, due to a defective cable), the slave activates its data link.



Additional information

- Section "How to Configure a Redundant, Fault-tolerant Terminal Bus"
- 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*

2.3.4 Fault-Tolerant Plant Bus

Functionality

The plant bus connects automation systems with servers (OS server, Route Control server). The connection to a fault-tolerant plant bus is made using Ethernet communications processors (CPs), which are installed in each subsystem of the automation system and in the servers.

fault-tolerant 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.

Fault-tolerant communication solutions

The following communication solutions are offered to increase the system availability:

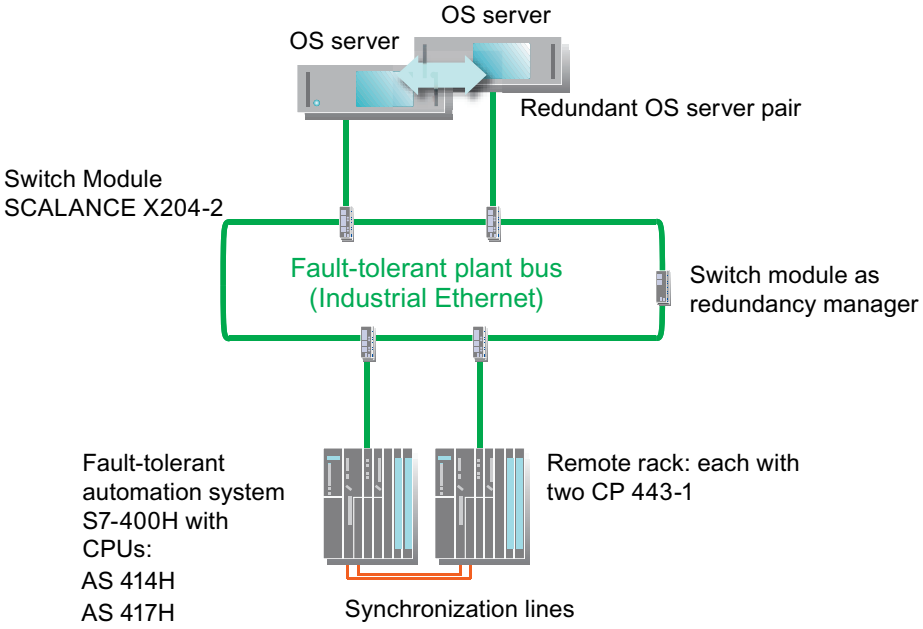
- Ring structure in an electrical network. The connection to the switches is electrical.
- Ring structure in an optical network with switches and FO cable. The connection to the switches is electrical or optical.
- Ring structure in a combined network with optical and electrical switches and FO cables. 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 following switches can be used:

- Switches of the SCALANCE series
  Modules optical or electrical connection are used for the connection
- OSM (optical signal lines)
  The connection to the OSMs is electrical or optical.
- ESM (electrical signal lines)
  The connection to the ESM is electrical.

Configuration - ring structure

The following figure represents a fault-tolerant plant bus in a ring structure with switches (OSMs).

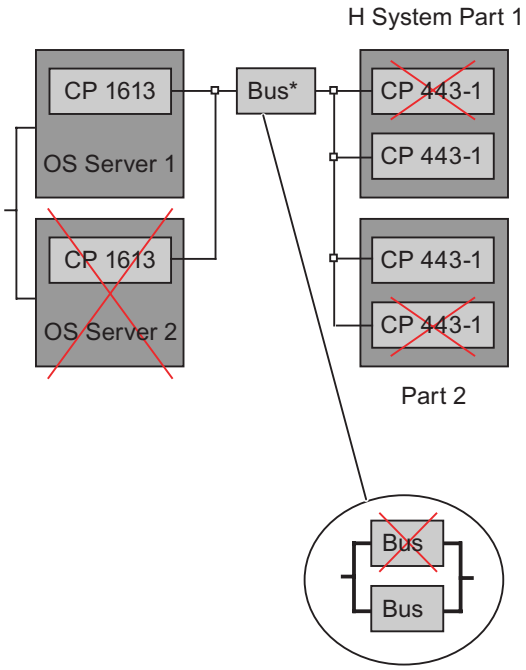


Availability - ring structure

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

The plant bus indicated by the asterisk (*) is set up with switches (OSMs) so that it is fault tolerant and will tolerate a break on the bus cable at any point. One of the two switches to which the OS servers are connected may fail without this affecting the complete system. If one switch fails, the redundant OS partner server can continue to communicate using the operational 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 Fault-Tolerant Plant Bus"
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC NET Industrial Ethernet OSM/ESM Network Management*
- Manual *SIMATIC; Communication with SIMATIC*
- Operating Instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*

2.3.5 Redundant Fault-Tolerant Plant Bus

Functionality

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

A redundant fault-tolerant plant bus is set up using two identical, linked plant bus rings (double ring). The network components ensure unrestricted operation of the plant bus. If a plant bus fails, communication remains possible over the second plant bus.

Redundant communication solutions

The following communication solutions are offered to increase the system availability:

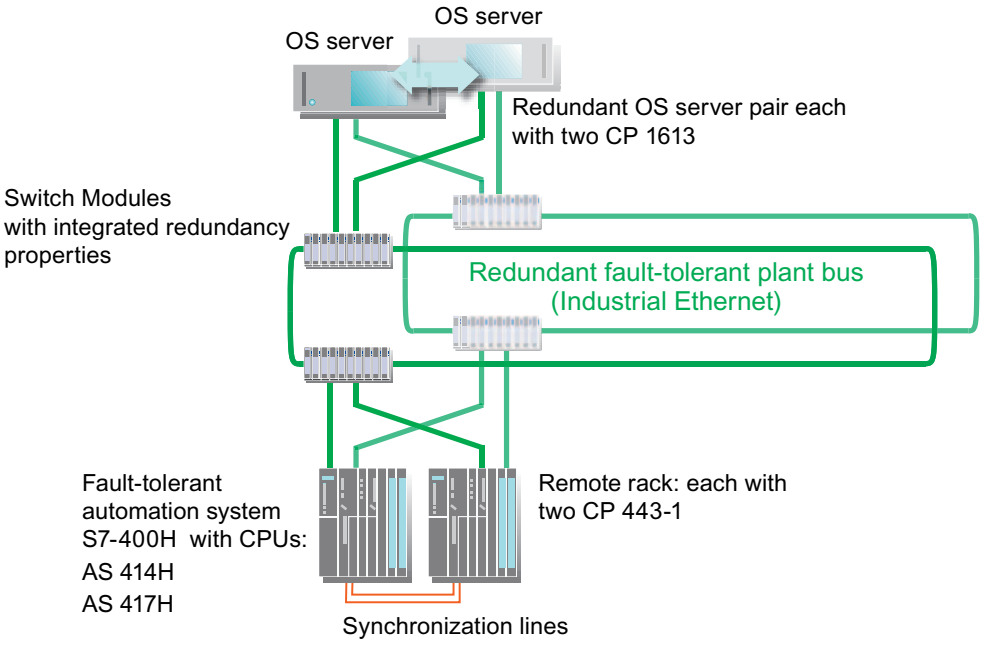
- Redundant electrical or optical network with switches set up as Industrial Ethernet
- Combined redundant network with switches, FO cables and electrical connection
- Redundant connection of network segments with two switches. One switch has the role of stand-by-slave and the other switch functions as stand-by-master. When OSMs/ESMs are used, the standby sync ports of both switches are connected together over an ITP XP standard cable 9/9.
- Ring structures with transmission rates up to 1 Gbps can be set up based on modular switches of the SCALANCE series. (Can be implemented as optical, electrical and combined networks)

The following switches can be used:

- Switches of the SCALANCE series
  Modules optical or electrical connection are used for the connection
- OSM (optical signal lines)
  The connection to the OSMs is electrical or optical.
- ESM (electrical signal lines)
  The connection to the ESM is electrical.

Configuration - redundant plant bus (double ring)

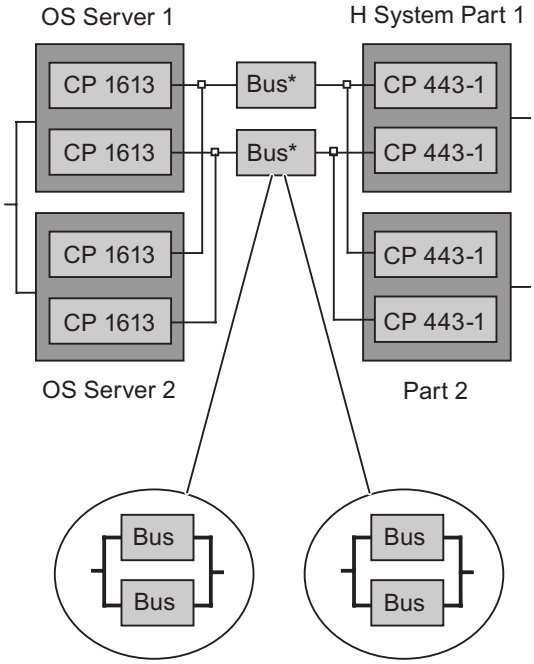
In contrast to the fault-tolerant plant bus with a ring structure, the redundant fault-tolerant plant bus (double ring) is as follows.



Availability - redundant plant bus (double ring)

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

In this system, a CP 1613 can fail in each OS server or a CP 443-1 can fail in each subsystem of the AS without this affecting the complete system. There are two plant buses (busses), each set up with redundant switches. This guards against the failure of the bus and all components involved (switches).



Additional information

- Section "How to Configure a Fault-Tolerant Plant Bus"
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Operating Instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Manual *SIMATIC NET Industrial Ethernet OSM/ESM Network Management*
- Manual *SIMATIC Communication with SIMATIC*

2.3.6 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.

Fault-tolerant communication solutions

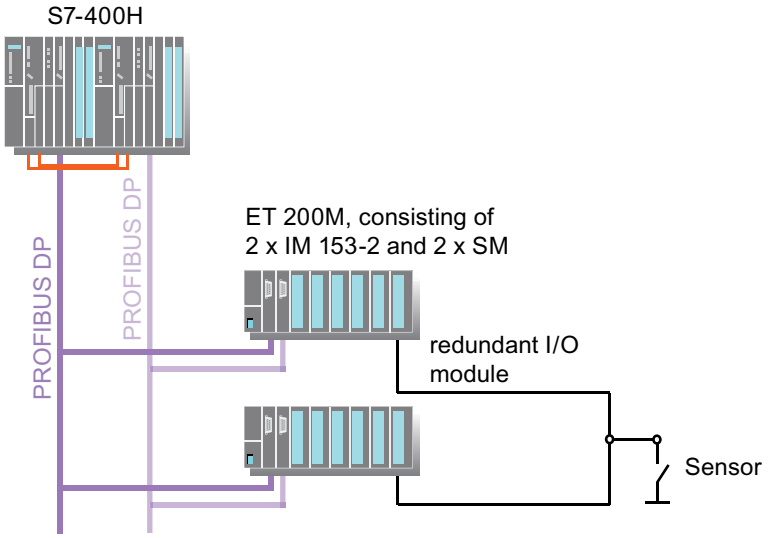
The following fault-tolerant communication solutions are offered for PROFIBUS DP:

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

Configuration

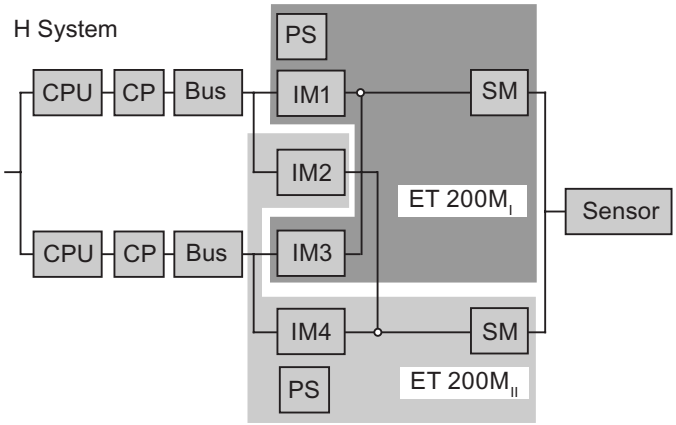
The S7-400H fault-tolerant automation system features a DP master interface on each CPU for connecting to PROFIBUS DP. The redundant PROFIBUS DP connects the redundant DP master to the redundant interface modules of the distributed I/O.

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

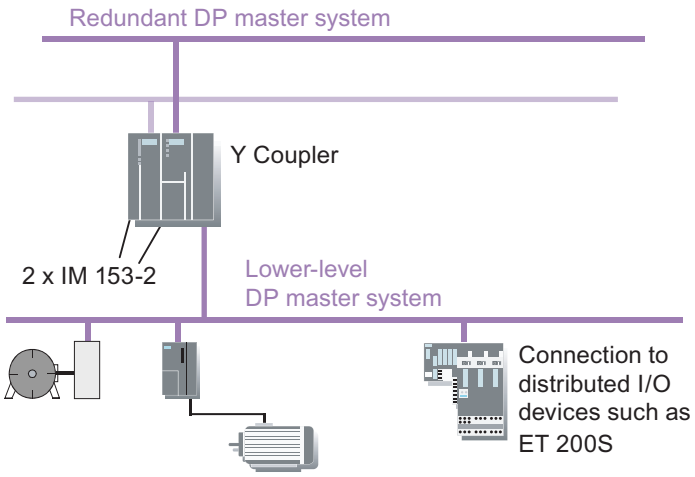
- Section "How to Configure a Redundant PROFIBUS DP"
- Manual *SIMATIC Net PROFIBUS Networks*
- Manual *SIMATIC; Communication with SIMATIC*

2.3.7 Gateway between Redundant and Single-Channel 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 single-sided 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.

The new generation of the Y Link no longer requires a repeater and is capable of forwarding diagnostics requests from the corresponding function modules or I/O modules to the CPU.

As of PCS 7 Version 6.0, DPV1 slaves can be connected downstream from the Y Link in addition to the standard PROFIBUS DP slaves.

Additional information

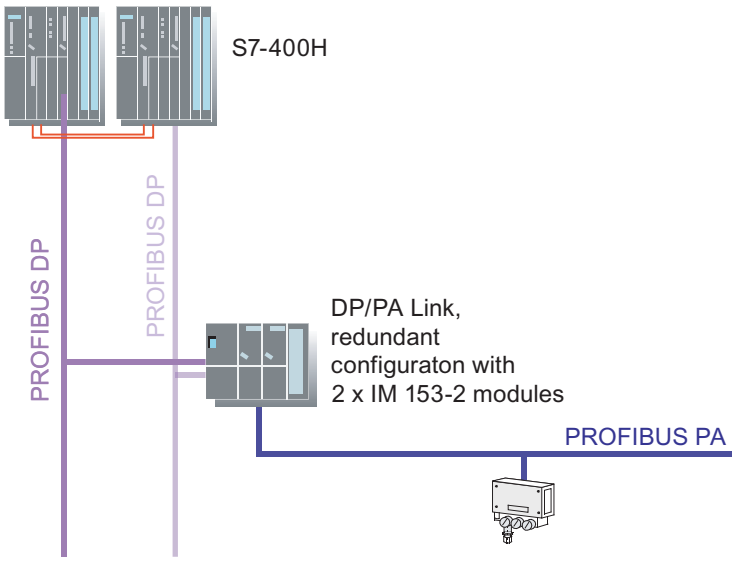
- Section "How to Configure the Y Link"
- Manual *DP/ PA Link and Y Link Bus Couplings*

2.3.8 Connection of PROFIBUS PA to PROFIBUS DP

DP/PA Link

The DP/PA Link allows a connection between PROFIBUS DP and PROFIBUS PA. The DP/PA Link consists of the IM 153-2 interface module and one or more DP/PA couplers FDC 157 that are interconnected through the backplane bus.

Configuration



Functionality

The DP/PA Coupler is a transceiver that interconnects 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 DP/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.

In the automation system, data are transmitted via PROFIBUS DP at a maximum speed of 12 Mbps with negligible delay. This is currently the fastest connection between PROFIBUS DP and PROFIBUS PA and can be used by all automation devices with a PROFIBUS DP interface.

The DP/PA Link decouples the various transmission rates of the bus systems and brings the lower-level PA devices together at one PROFIBUS DP address. All DP masters can take advantage of this feature.

You can connect a PROFIBUS PA to the PROFIBUS DP. The following versions can be implemented:

- Connection to a single PROFIBUS DP
  - Connection via DP/PA link (1 x interface module, 1 x DP/PA coupler)
  - Connection via DP/PA coupler
  - Connection of a redundant PROFIBUS PA:
    Further information can be found in section "Redundant PROFIBUS PA".
- Connection to a redundant PROFIBUS DP
  - Connection of a single PROFIBUS PA via DP/PA link with redundant interface module
    (2 x interface modules and 1 x DP/PA coupler)
  - Connection of a redundant PROFIBUS PA:
    Further information can be found in section "Redundant PROFIBUS PA".

Physical bus characteristics

As a PROFIBUS variant for the process industries, PROFIBUS PA uses a transmission technology based on IEC 1158-2, in which the transmission rate is specified as 31.25 Kbps. The application protocols for PROFIBUS DP and PROFIBUS PA are identical. The transmission rate for PROFIBUS DP is limited to 45.45 Kbps due to the transmission rate specified for PROFIBUS PA.

If you require faster transmission, the DP/PA coupler can be used for the connection. The DP/PA coupler can be operated with SIMATIC S5/S7 automation systems and all DP masters that support the transmission rate of 45.45 Kbps.
A maximum of 10 PA devices can be connected to the single DP/PA Coupler. The actual number depends on the power consumption of the connected PA devices.

The DP/PA coupler must be installed in a safe area outside the hazardous zone. The connected PA cable can be laid in the hazardous zone and satisfies type of protection EEx ia IIC.

Additional information

- Section "How to Configure the DP/PA Link"
- Section "Redundant PROFIBUS PA"
- Section "How to Configure Redundant PROFIBUS PA"
- Manual *DP/ PA Link and Y Link Bus Couplings*

2.3.9 Redundant PROFIBUS PA

Functionality

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

Redundant communication solutions

The following communication solutions are offered to increase the system availability:

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

The DP/PA coupler can be employed in stand-alone or in the DP/PA link.

A maximum of one redundant DP/PA coupler pair can be connected to DP/PA link. In mixed configurations you can operate up to 3 more non-redundant DP/PA couplers.

Interfacing redundant PROFIBUS PA to PROFIBUS DP

Redundant PROFIBUS PA can be interfaced with PROFIBUS DP as follows:

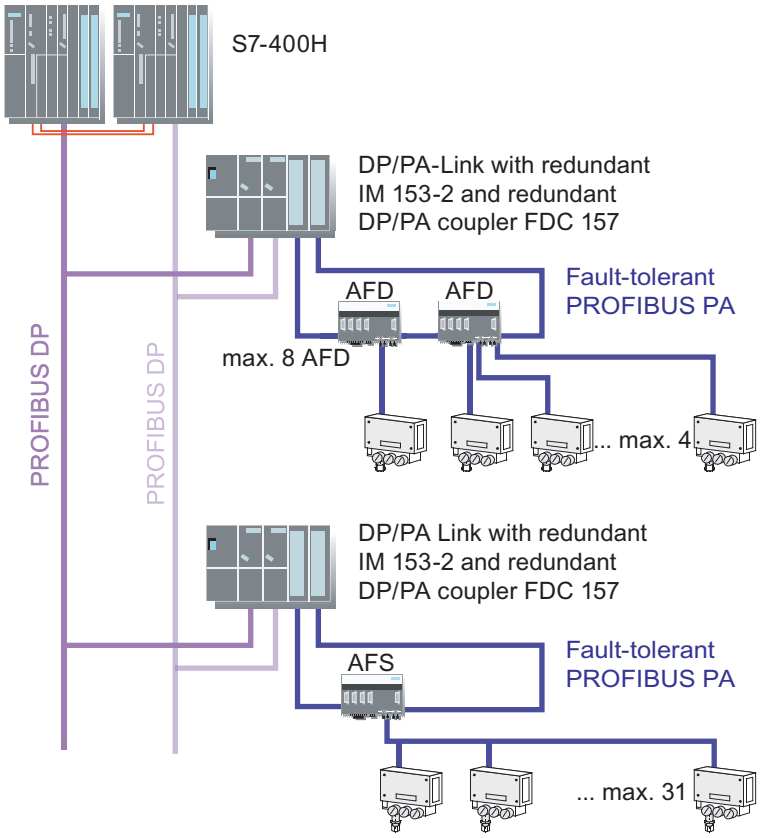
- Connection to a single PROFIBUS DP
  - Connection of a redundant PROFIBUS PA via DP/PA link with redundant coupler pair
    (1 x interface module, 2 x DP/PA coupler)
  - Connection of a redundant PROFIBUS PA with redundant coupler pair FDC 157
    (2 x DP/PA coupler directly in PROFIBUS DP)
- Connection of a redundant PROFIBUS DP
  - Connection of a redundant PROFIBUS PA via redundant DP/PA link
    (2 x interface module and 2 x DP/PA coupler)

For the connection of PA devices via AFD or AFS we recommend the following quantity structures in PCS 7:

- With ring redundancy close with increased availability maximum 4 field devices (one field device per spur line) on an active field distributor AFD (maximum of 8 AFD to one redundant DP/PA coupler). Altogether you can connect 31 field devices.
- With coupler redundancy close maximum 31 field devices to an active field distributor (AFS) on a redundant DP/PA coupler.

Configuration

The following figure illustrates the interlinking of field devices using AFD and AFS. The connection to PROFIBUS DP is shown as a redundant link.



Transmission rate

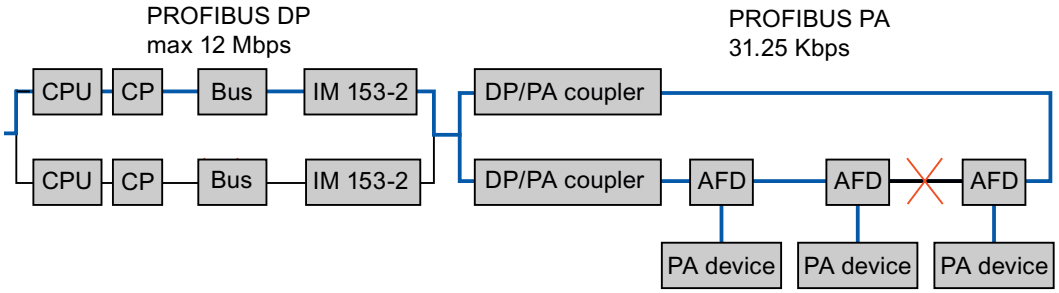
You have two interfacing options for the gateway between PROFIBUS DP and PROFIBUS PA. These result in different transmission rates on PROFIBUS DP.

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

Availability - redundant interfacing

In a redundant system, we recommend that you implement the interface to 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"
- Section "How to Configure Redundant PROFIBUS PA"
- Operating Instructions *SIMATIC; DP/PA Coupler, DP/PA Link and Y Link Bus Couplings*

2.4 Solutions for Integrating a PCS 7 Plant in a Domain

2.4.1 Integrating a PCS 7 Plant in a Domain

Recommendation

If redundant PC stations of a PCS 7 plant integrated in a domain, we recommend you use redundant domain controllers.

2.5 Solutions for OS Servers

2.5.1 Redundant OS Servers

Redundant OS servers

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

Functionality

Redundant OS servers monitor each other in runtime in order to detect the failure of an OS partner server as early as possible.

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.

Functionally identical configuration is ensured by configuring the OS partner servers (OS_Stby) in the SIMATIC Manager and then selecting the menu command **PLC > Download**.

Redundant central archive server

PCS 7 allows you to configure two central archive servers with redundancy functionality for fault-tolerant operation. This allows you to record and evaluate all the archive information from your controlled process.

Redundant maintenance station

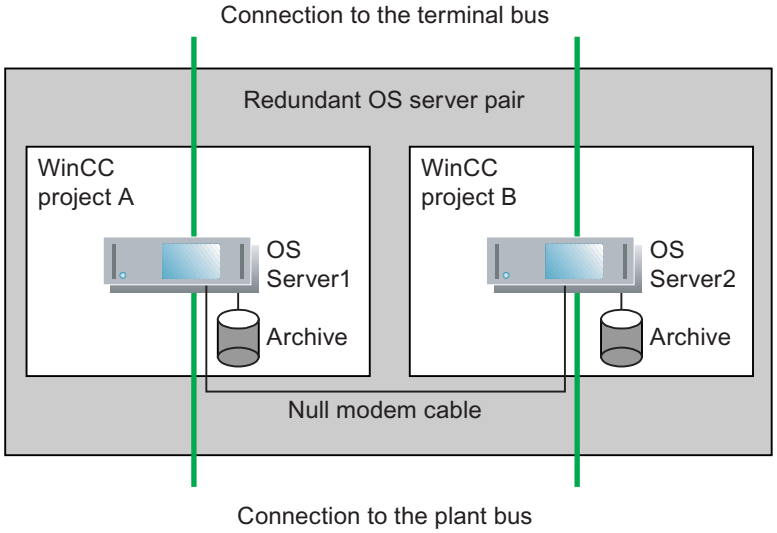
PCS 7 allows you to configure two maintenance servers with redundancy functionality for fault-tolerant operation. In terms of configuration, the maintenance station can be considered as a redundant OS.

Configuration

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
100 m	Crossover network cable	Ethernet connections
3000 m	FOC cable Per server: • A free network connection (desktop adapter Intel Pro/1000GT or on-board network connection) • 1 Ethernet cable • 1 media converter (e.g. SCALANCE X101-1)	Ethernet connections
10 m	Null modem cable	Serial connection

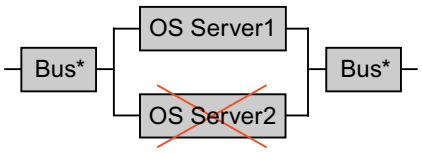
Note

If a redundant server pair is uses OS and SIMATIC BATCH at the same time, redundancy only has to be set up for SIMATIC BATCH.

The serial link of the server pair is not possible in PCS 7.

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 "How to Configure an OS Server and Its Redundant OS Partner Server"
- Online Help for *WinCC*; *WinCC Redundancy*
- Section "How to Configure an Archive Server and Its Redundant Archive Partner Server"

2.6 Solutions for OS Clients

2.6.1 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 failover from the active OS to its OS partner server

Additional information

- Section "How to Configure an OS Client"
- Online Help for *WinCC*

2.6.2 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 will 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 the OS client connects to preferentially. 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.

Method of operation

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 failover. 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.

In general, 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 will connect to the OS server that has the master identification.

When the failed OS server comes online again, the OS client 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"
- Online Help for *WinCC*

2.7 Solutions for SIMATIC BATCH

2.7.1 Redundant BATCH Servers

Redundant BATCH servers

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

Functionality

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

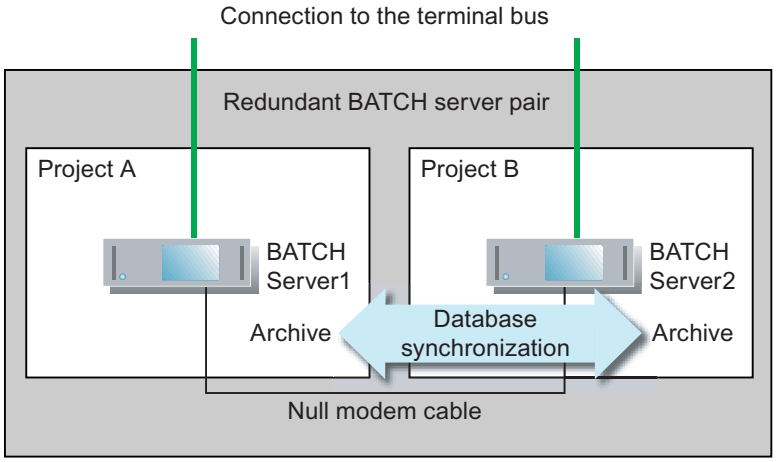
If one of the two BATCH servers fails, the process can be controlled over the second BATCH server after the failover.

- 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 failover, 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.

Configuration

The following configuration shows the basic operating principle of redundant BATCH servers. BATCH servers are only connected to the terminal bus.



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	Ethernet connections
3000 m	FOC cable Per server: • A free network connection (desktop adapter Intel Pro/1000GT or on-board network connection) • 1 Ethernet cable • 1 media converter (e.g. SCALANCE X101-1)	Ethernet connections

Note

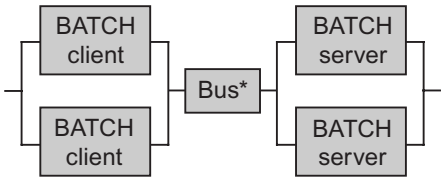
If a redundant server pair is uses OS and SIMATIC BATCH at the same time, redundancy only has to be set up for SIMATIC BATCH.

Availability

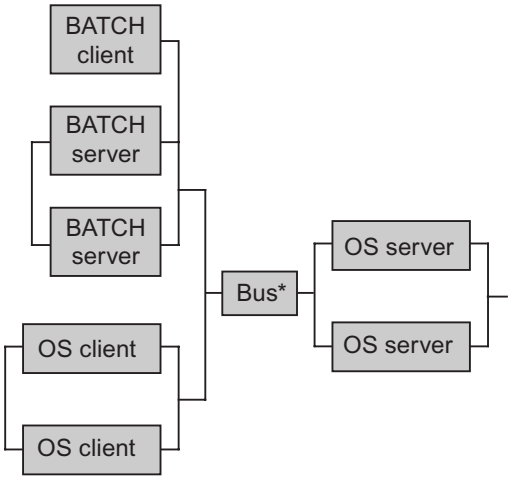
The following two block diagrams of fully operational systems illustrates the availability of the BATCH clients and BATCH servers. All BATCH components form an independent redundancy node since they are redundant. This ensures the independence of the subsystem.

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.

Additional information

- Section "How to Configure a BATCH Server and Its Redundant BATCH Partner Server"
- Section "How to Configure a BATCH Client"
- Manual and Online Help for *SIMATIC BATCH*

2.8 Solutions for Route Control Server

2.8.1 Redundant Route Control Servers

Redundant Route Control servers

SIMATIC Route Control allows you to implement two Route Control servers with redundancy functionality for fault-tolerant 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 servers fails, the process can be controlled over the second Route Control server after the failover.

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

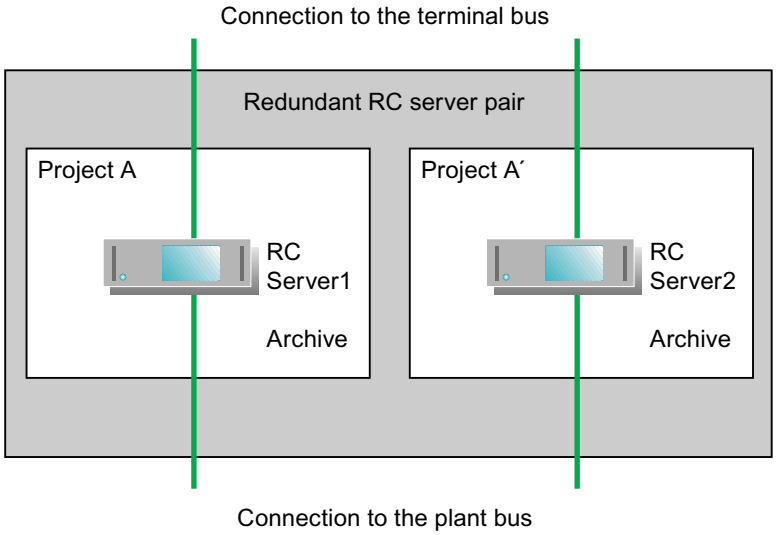
When the failed Route Control server becomes available again, the database and the material data are synchronized automatically with the active Route Control server.

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.

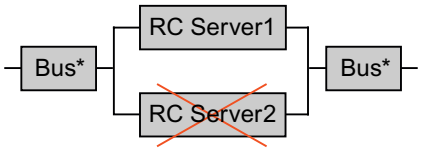
Configuration

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



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

- Section "How to Configure a Route Control Server and its Redundant Route Control Partner Server"
- Manual *Process Control System PCS 7; SIMATIC Route Control*

2.9 Solutions for Engineering Station

2.9.1 Engineering Station

Engineering station

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

The ES is not configured redundantly, since it is not needed for process mode.

The ES is generally used to make changes in the configuration data of project components such as AS, OS and BATCH and to 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 the WinCC project loaded.
- For connections from the individual PC stations (OS servers and ES) to the automation systems, the following rules apply:
  - All connections in an AS must have the same name.
  - Two connections must be configured for each OS server and the ES, one to AS 1 and on to 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.

2.10 Time-of-Day Synchronization

Introduction

Time-of-day synchronization within a PCS 7 system is essential for synchronization, traceability, documentation and archiving of all time-critical processes. Time-of-day synchronization is particularly important for the redundancy functions in PCS 7 such as the redundancy synchronization between OS servers or BATCH servers.

Time-of-day synchronization exists when all time-dependent individual components of the PCS 7 system have the identical date and identical time of day.

To allow this, one component in the PCS 7 system must take over the role of time master so that all other time-dependent components receive the time of day from this time master.

Time-of-day synchronization within a Windows network

In PCS 7, the frames for time-of-day synchronization are sent over Industrial Ethernet.

You can choose between the following time masters:

- Separate time server ((S)NTP server) with connected clock and time signal receiver module
- Separate clock and time signal receiver modules at the points to be synchronized (OS server/domain controller)
- Combination of these two options

The information necessary for planning and setting up time-of-day synchronization within a Windows network can be found in the following documentation:

- Manual *Process Control System PCS 7; PCS 7 Security Concept; Recommendations and Notes*
- Configuration manual *Process Control System PCS 7; Operator Station*
- Configuration manual *Process Control System PCS 7, Engineering System*
- Operating instructions *GPS Converter GPSDEC/GPSCOM*
- Operating instructions *SICLOCK Time Transmitter*

Additional information

- Section "How to Synchronize the Time of Day in Automation Systems"
- Section "How to Synchronize the Time of Day of OS Servers with an External Time Transmitter"
- Section "How to Synchronize the Time of Day of OS Clients with OS Servers"

3 Configuration of Fault-Tolerant Components

3.1 SIMATIC H Station

3.1.1 Overview of Configuration Steps

Overview of configuration steps

You configure the redundancy functionality of the SIMATIC fault-tolerant station (H station) by performing the following steps:

Step	What?
1	Inserting a SIMATIC H Station in a Project
2	Inserting Synchronization Modules in the H_CPU
3	Configuring Redundant Communications Processors
4	Setting Time-of-day Synchronization
5	Setting the CPU for the Error Response of Input/Output Modules

3.1.2 How to Add a SIMATIC H Station to Your Project

Introduction

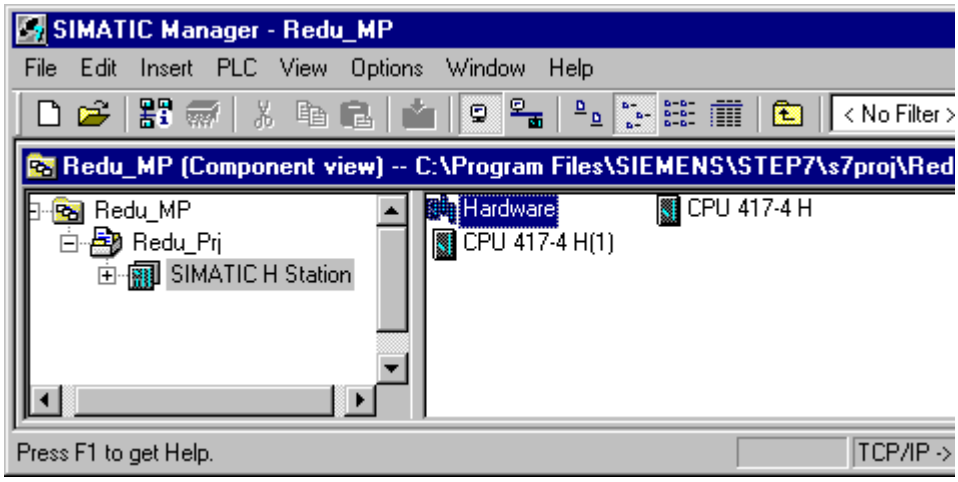
The SIMATIC H station is contained in the hardware catalog of HW Config as a stand-alone station type. This station type is required if you want to configure two central racks each with an H CPU, thereby configuring your process control system with redundancy.

Procedure

1. Open your PCS 7 project in SIMATIC Manager.
2. Open the component view with the menu command **View > Component View.**
3. In the component view, select the project and select the menu command **Insert > Station > SIMATIC H Station**.

Result

The configuration in the SIMATIC Manager appears as follows:



Additional information

- Manual *Automation System S7-400H; Fault-Tolerant Systems*

3.1.3 How to Insert Synchronization Modules into the H CPU

Arranging components on the rack

The AS is arranged the same way as in the configuration:

- Rack (9 or 18 slots for redundant and, in some cases, remote configuration)
- Power supply modules (in some cases redundant configuration)
- H CPU (414-4H or 417-4H) with sync modules in slots "IF1" and "IF2"
- Communication processors (CP 443-1, CP 443-5 Extended)

Requirements

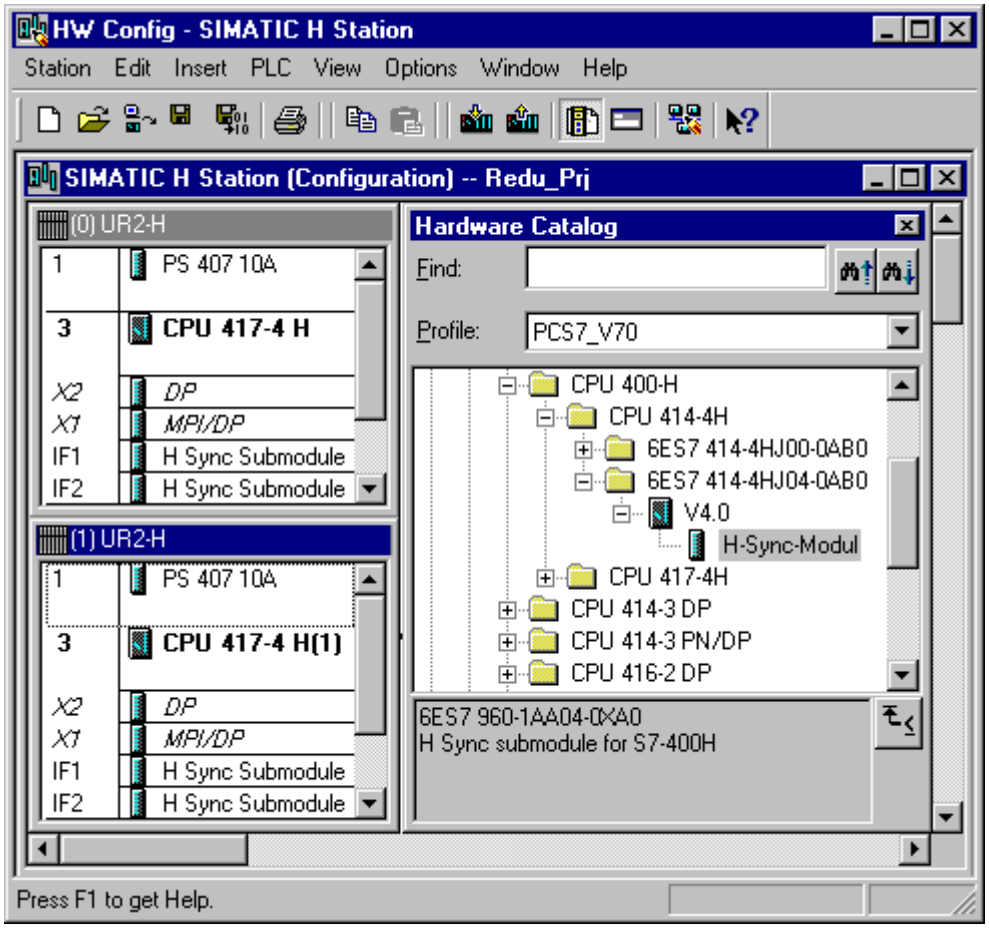
- The PCS 7 project is open in SIMATIC Manager.
- HW Config is open.
- The rack has been inserted according to the configuration in HW Config.
- Each rack has been fitted with an H CPU in HW Config.

Procedure

1. In HW Config, select the menu command **View > Catalog.**
2. In the hardware catalog, double-click the H CPU you are using. Double-click the version of your selected H CPU in the displayed tree.
   The H Sync Module (H synchronization module) is located under the version folder, e.g., V3.0.
3. Select the H Sync Module and drag it onto slots "IF1" and "IF2" of each H CPU.

Result

The following figure shows the configured subsystems of the fault-tolerant station in HW Config:



Additional information

- Manual *Automation System S7-400H; Fault-Tolerant Systems*

3.1.4 How to Configure Redundant Communications Processors

Introduction

Two CPs are needed for each H subsystem in a redundant plant bus design.

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 rack has been fitted with an H CPU and the required synchronization modules.

Procedure

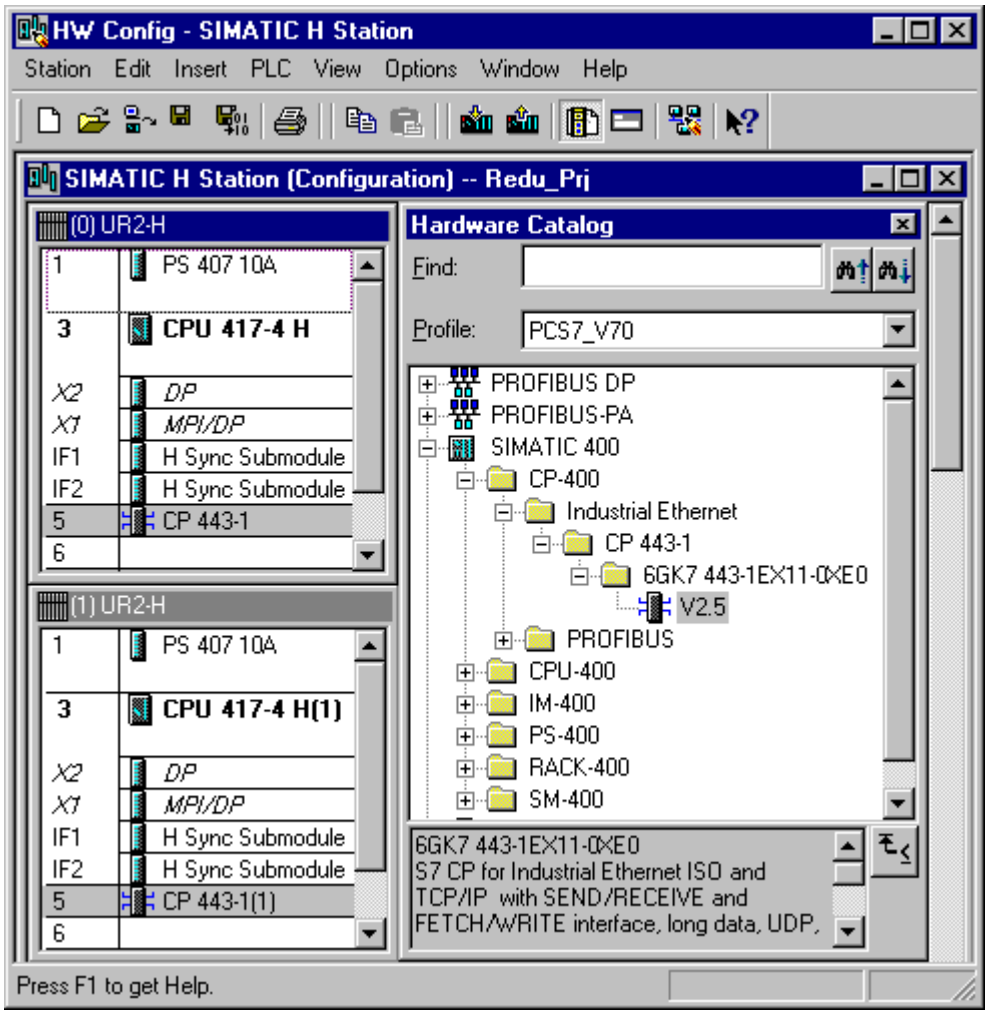
1. In HW Config, select the menu command **Insert > Hardware Components**.
2. In the hardware catalog, double-click the "SIMATIC 400" folder. Then double-click the "CP-400" folder and finally the "Industrial Ethernet" folder.
3. Select the CP you are using and drag it to a free slot on the rack.

Note

When using a multi-protocol communications processor, make sure that the ISO interface is configured 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 the configuration in HW Config:



Additional information

- Manual *Automation System S7-400H; Fault-Tolerant Systems*

3.1.5 How to Synchronize the Time of Day in Automation Systems

Introduction

During the configuration phase, settings must be made in two dialog boxes in order to synchronize the time in automation systems.

Requirements

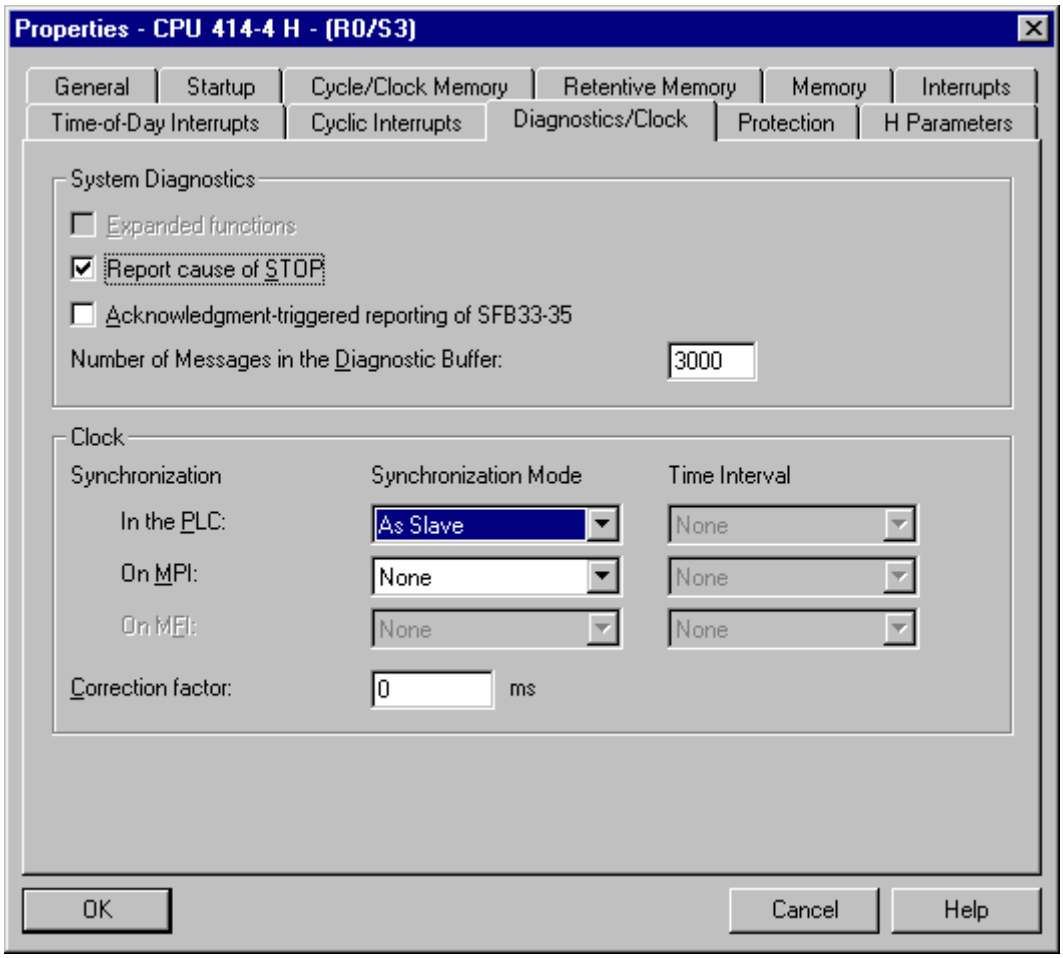
- The PCS 7 project is open in SIMATIC Manager.
- Two communications processors, for example, CP 443-1 Industrial Ethernet, have been configured in HW Config.
- An external time transmitter, such as SICLOCK TM, has been integrated in the Ethernet.

Configuring in the "Properties - CPU ..." dialog box

1. In the component view, select the SIMATIC H station.
2. Double-click the "Hardware" object in the detail window.
   HW Config opens.
3. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
4. Select the CPU you are using.
5. Select the menu command **Edit > Object Properties**.
   The "Properties - CPU ..." dialog box opens.
6. Open the "Diagnostics/Clock" tab.
7. In the "Clock" area, select the type of synchronization "As slave" for synchronization in the automation system.
   The automation system will then get its time of day from an external master clock.
8. Click "OK".

Result

The following figure shows "Diagnostics/Clock" tab:



Configuring in the "Properties - CP ..." dialog box

1. In the component view, select the SIMATIC H station.
   Double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
3. Select the first CP you are using on a slot of the interface module rack.
4. Select the menu command **Edit > Object Properties**.
   The "Properties - CP ..." dialog box opens.
5. Select the "Time-of-day synchronization" tab.

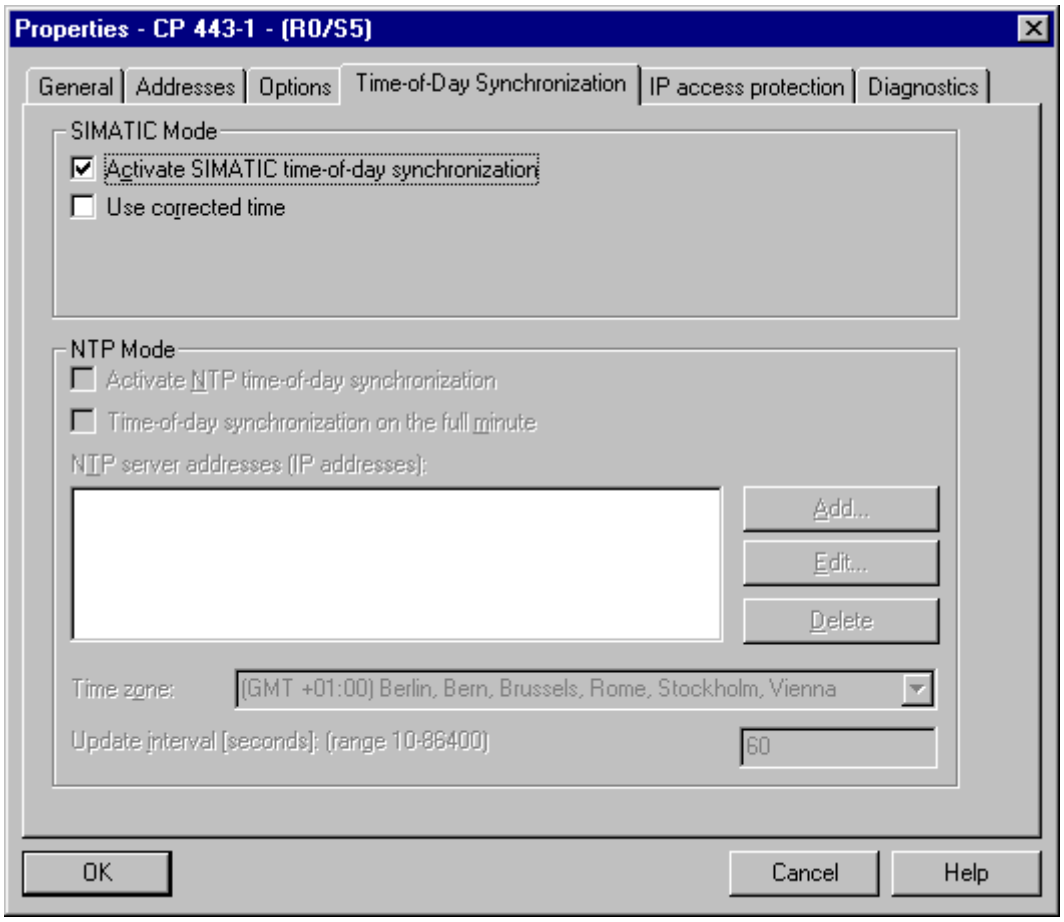
6. In the "SIMATIC Mode" area, select the "Activate SIMATIC time-of-day synchronization" box.
   If a SIMATIC H station contains multiple CPs that are connected to the same network, time-of-day synchronization may only be activated for one of these CPs (see table below).

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

7. Click "OK".
8. Repeat this setting for all CP 443-1.

Result

The following figure shows "Time Synchronization" dialog box:



Additional information

- Online Help for *STEP 7*

3.1.6 How to Set the Failure Reaction of the Input/output Modules on the CPU

Introduction

In the properties of the CPU (H parameters), you can specify how the redundant input/output modules react to channel faults. The setting affects the entire redundant I/O connected to a CPU.

Setting the Passivation Response

You set the reaction of the input/output modules to faults using the "passivation response" parameter:

- Module-oriented
  The module is passivated if a fault occurs.
- Channel-oriented
  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.
- If channel-selective passivation is needed, the following requirements must be fulfilled:
  - Suitable modules are used.
- The following driver blocks are in the AS-specific library:
  - S7 driver blocks from the "Redundant I/O (V1)" library
  - PCS 7 driver blocks from the *PCS 7 library* as of V6.0

Note

You can see which modules are approved for the channel-oriented passivation reaction in the documentation *PCS 7 - Released Modules*, which can be accessed with the menu command **Start > SIMATIC > Documentation > English**.

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. If the hardware catalog is not visible, select the menu command **View > Catalog**.
   The hardware catalog opens.
4. Select the CPU you are using on slot 3.
5. Select the menu command **Edit > Object Properties**.
   The "Properties - CPU ..." dialog box opens.
6. Select the "H Parameters" tab.
7. Enter an unused data block in the "Data block no." box.
8. Select the required setting for the passivation behavior from the "Passivation behavior" list in the "Redundant I/O" area.
9. Click "OK".

3.2 Communication Connections

3.2.1 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 even when the CPU of an AS is not in STOP mode. To do this, select the connection to be downloaded in NetPro and transfer it to the CPU with the menu command **PLC > Download > Selected Connections**. Process interfacing for operation stations is not possible until the connections are made known to the AS.

You edit and adapt the MAC addresses in the properties dialog box for the individual operator stations in NetPro. The configuration has to be compiled and downloaded in NetPro each time it is changed.

Overview

This section describes the configuration steps for the following topics:

- Configuring a Redundant, Fault-Tolerant Terminal Bus
- Configuring a Fault-Tolerant Plant Bus
- Configuring a Redundant PROFIBUS DP
- Configuring a Redundant PROFIBUS PA

3.2.2 How to Configure a Redundant, Fault-tolerant Terminal Bus

Introduction

The NetPro and HW Config programs do not support configuration of the terminal bus. SIMATIC NET offers several solutions for a redundant terminal bus. The PC stations are connected to the redundant terminal bus over network cards capable of redundancy.

The section below describes how you install and configure the drivers for network cards of these PC stations.

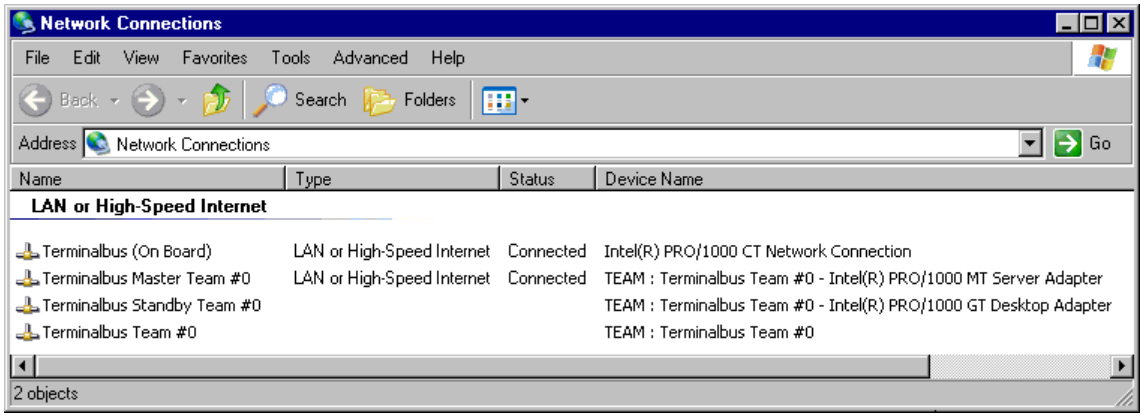
Requirements

- The following two network cards should be installed in each PC that is to be connected to the terminal bus (for example, OS server, OS client, domain controller):
  - Intel Pro/1000MT server adapter
  - Intel Pro/1000GT desktop adapter
- The "ProSet" configuration tool from Intel is installed.
  You can find the drivers for the redundant network cards used with PCS 7 on the PCS 7 Toolset DVD as of Version 6.1 SP1 in the following folder:
  Additional_Products > Drivers > NETWORK > Intel > ProSet.

Procedure – Installing and Configuring Drivers

1. Install the driver for the network card:
   Double-click on the "Autorun.exe" file (in the root directory of the storage medium, for example D:\Autorun.exe).
   The drivers for network cards are installed.
2. Select the menu command **Start > Settings > Control Panel > Administrative Tools > Computer Management > Device Manager > Network Adapters**.
3. Select the internal network card of the PC station and disable it in the shortcut menu.
4. Select the server adapter "Inter® PRO/1000 MT Server Adapter" and then select the menu command **Properties** in the shortcut menu.
5. Select the "Team with other adapters" check box in the "Teaming" tab and click the "New Team" button.
   The "New Team Wizard" dialog box opens.
6. Click "Finish".
   The "Welcome to the Inter® PRO Adapter New Team Wizard" dialog box opens.
7. Enter a name for the team (for example "terminal bus Team #0") and click "Next".
8. Select the "Switch Fault Tolerance" entry in the "Select a team mode" list and click "Next".

9. In the "Select the adapters to include in this Team:" list, select the check boxes for the network cards you wish to use to connect a server to the redundant terminal buses.
10. Click "Next".
    The wizard closes. The team (such as "Terminal Bus Team #0") is entered in the "Properties" dialog box of the network card.
11. Click "Properties".
    The "Team: <Team Name> Properties" dialog box opens (in this example, "Team: Terminal Bus Team #0 Properties").
12. Select the "Advanced" tab.
13. Select "Test" in the "Settings" list.
14. Select "enabled" in the "Value" list.
15. Go to the "Settings" tab and click the "Modify Team" button.
16. In the "Adapters" tab, select the network card (Server Adapter Intel Pro/1000MT) on the preferred terminal bus. Click the "Set Primary" button.
17. Select the network card (Intel Pro/1000GT desktop adapter) on the redundant terminal bus and click the "Set Secondary" button.
18. Click "OK".
    The "Team: <Team Name>" dialog box closes.
    The two network cards and their team affiliation are now entered in the device manager.

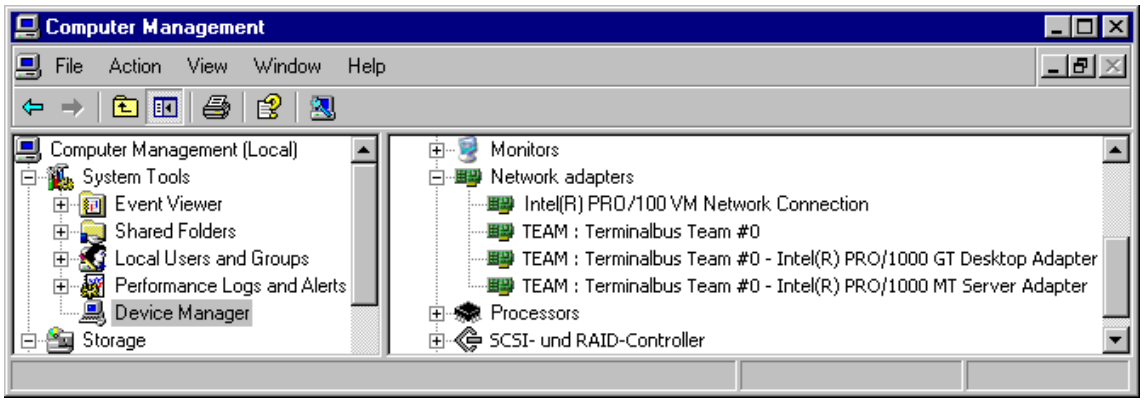


19. Open the "Properties" dialog box of the network card.
20. Select the "General" tab.
    In the "Connect using:" area, the entry is: "TEAM: <Teamname> (for example TEAM : terminal bus Team #0).
21. Select the "Show icon in information area when connection is made" check box.
22. Click "OK" to close the dialog box.

Result

In the device manager, you will find three entries with the name "TEAM".

- Two entries each with information on one network card
- One entry with information on the virtual network card



Additional information about configuration

- 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
- Manual SIMATIC Net PROFIBUS Networks

Refer to the following Internet address to obtain more information about specific SIMATIC NET products and their configuration:

"http://www.siemens.com/automation/service&support"

3.2.3 How to Configure a Fault-Tolerant Plant Bus

Introduction

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

Fault-tolerant plant bus

You can set up a fault-tolerant 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 CPs in the OS servers and in each subsystem of the automation system.

This section describes the procedure for a fault-tolerant plant bus (ring) with switch modules without additional CPs.

Redundant, fault-tolerant plant bus

To configure a redundant, fault-tolerant plant bus, two CPs each have to be physically present in the OS servers that will be connected redundantly and in each H subsystem and they must be configured in NetPro. Two networks must also be configured in NetPro.

The procedure is identical to the procedure for the fault-tolerant plant bus. This procedure must be performed for one CP per bus and subsystem (H system or PC station on the plant bus).

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- In HW Config, one 443-1 type CP has been configured in each H subsystem.
- Two SIMATIC PC stations each with one CP 1613 have been configured in HW Config.

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.

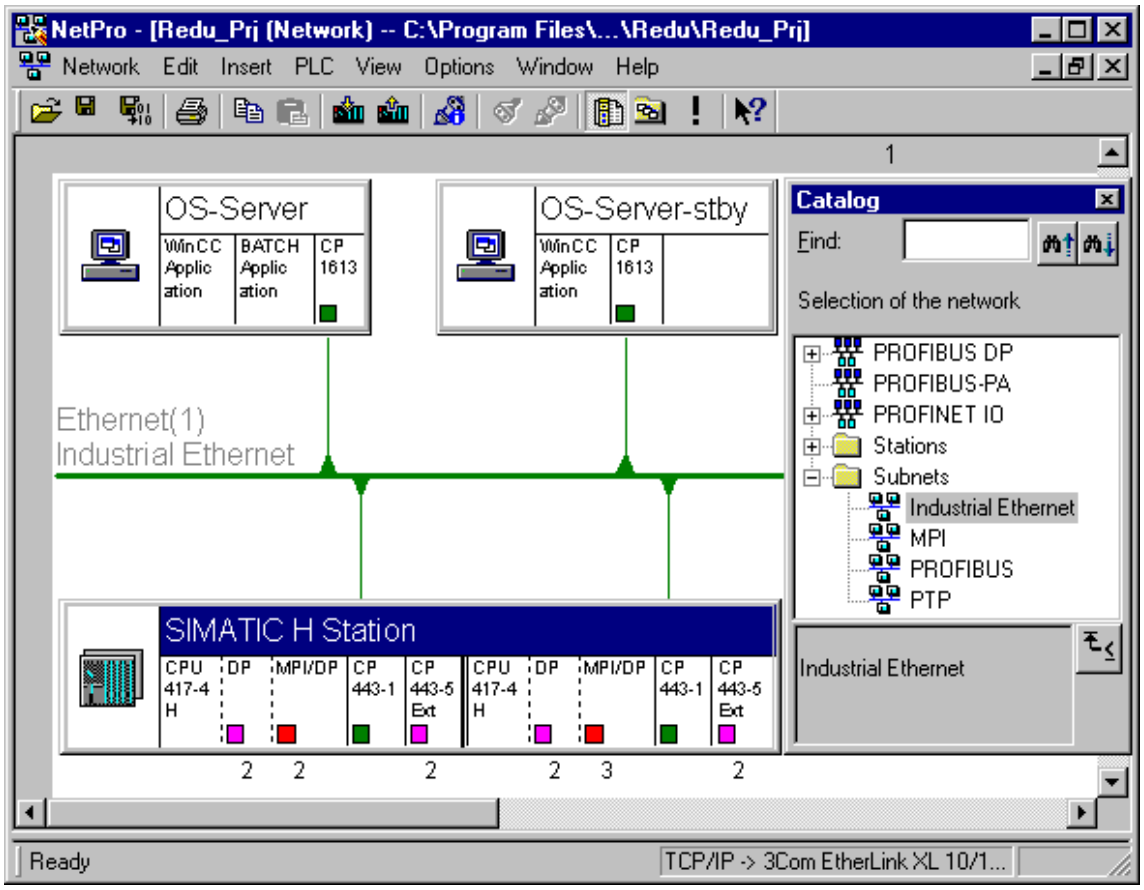
Note

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 interface icon for the CP 443-1 and drag a connection to the Industrial Ethernet subnets.
   Repeat the procedure for the CP of the right subsystem.
6. Follow the same procedure for the CPs in both OS servers.
7. Save your configuration.

Result

The following figure shows the resulting configuration:



Additional information

- Online Help for *STEP 7*

3.2.4 How to Configure a 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 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 interface:
   - Slot X2 to use the CPU's own PROFIBUS interfaces
   - Slot of the CP 443-5 Extended to use the CP PROFIBUS interfaces
6. Select the menu command **Edit > Master System > Insert**.
   The "Properties - PROFIBUS Interface CP 443-5 Ext ..." dialog box opens.

Note

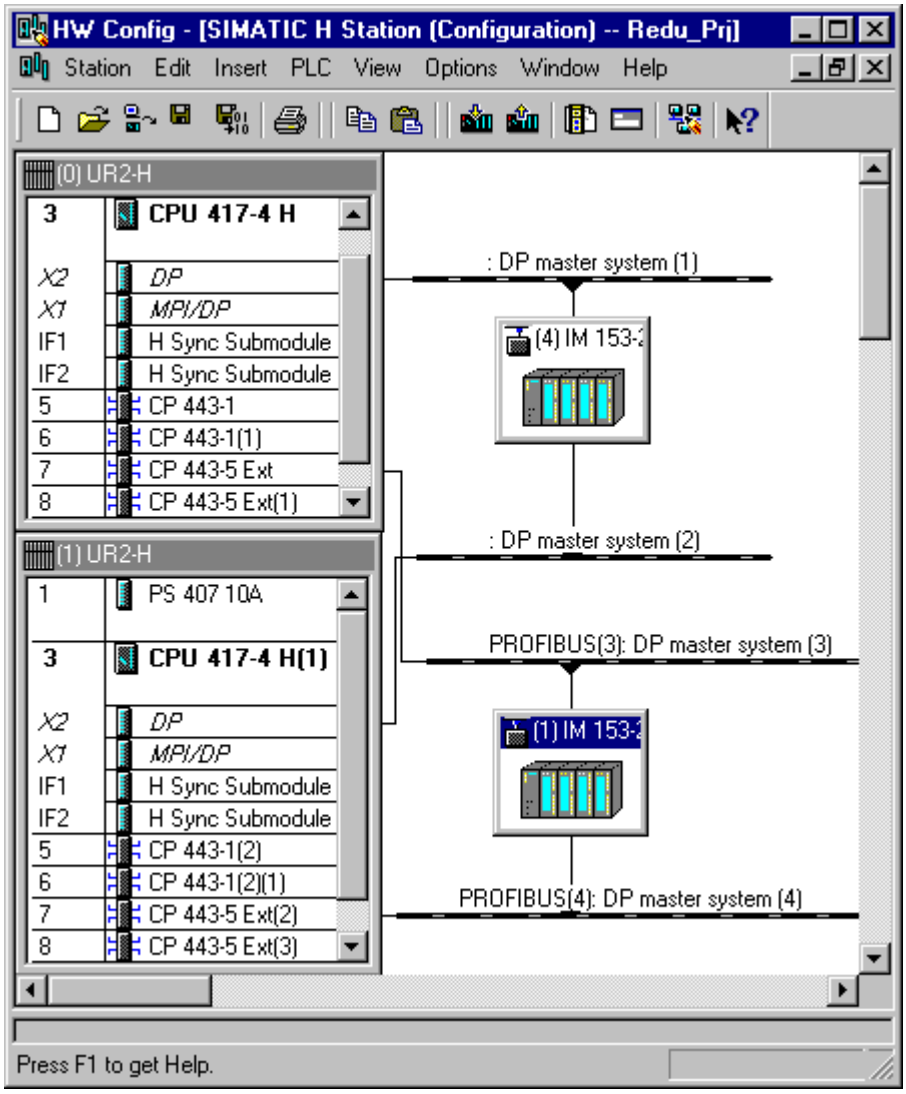
When inserting the DP master system for the redundant PROFIBUS interfaces, the entry "Redundant subnet ..." is displayed below the "Subnet" list.

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 following figure shows the resulting configuration in HW Config. In the figure, distributed I/O is already assigned to the DP master systems for visualizing the redundancy:



Additional information

- Online Help for *STEP 7*

3.2.5 How to Configure the Redundant PROFIBUS PA

Introduction

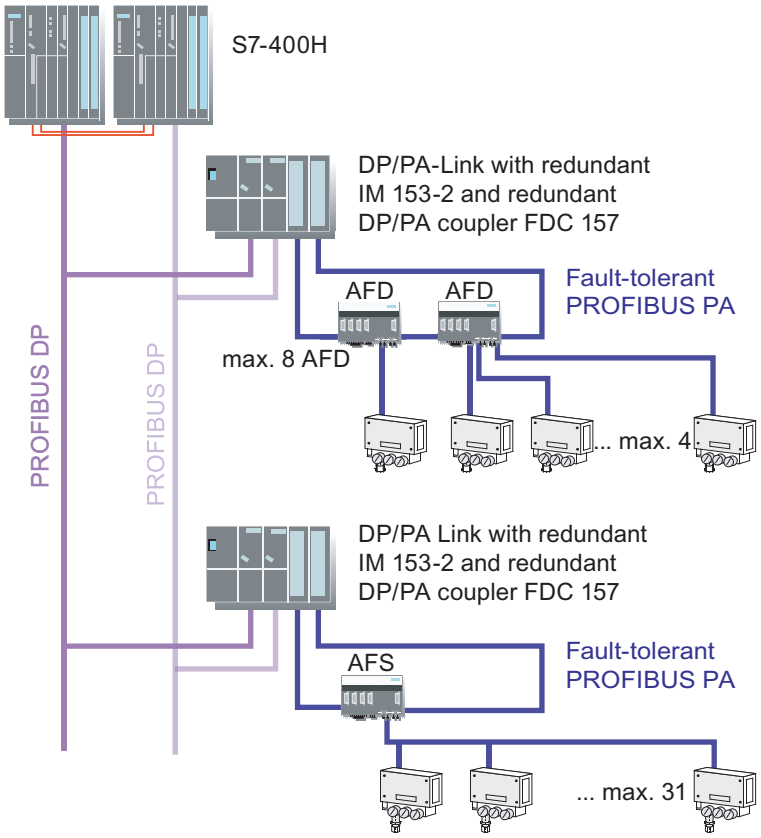
Below, you will find a description of how to configure a redundant PROFIBUS PA that is connected to a redundant PROFIBUS DP.

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.

Example configuration

The following figure shows the configuration of the redundant PROFIBUS PA using the DP/PA Link.



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.

Configuring PA field devices

Note

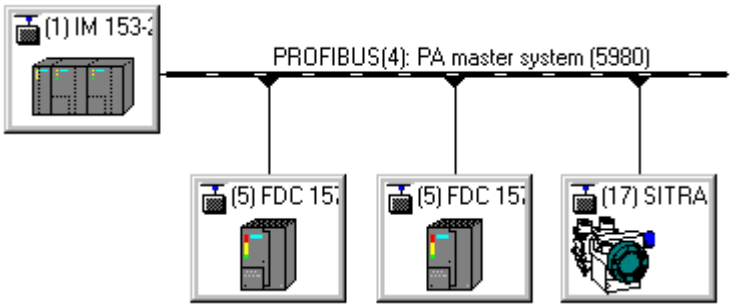
If you use several FDC 157-0 DP/PA couplers in a link, a topological assignment in HW Config is not possible. You can, however, check the assignment in the local lifelist online.

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 menu command **View > Catalog**.
   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. Enter the PROFIBUS DP address in the "Properties - PROFIBUS Interface FDC 157-0" dialog box.
6. Set the redundancy mode of the FDC 157-0 DP/PA coupler and click "OK".
7. Repeat steps 1 through 6 for the second DP/PA coupler.

Result

The following figure shows the resulting configuration in HW Config:



Additional information

- Section "Redundant PROFIBUS PA"
- Manual *SIMATIC DP/PA Link and Y Link Bus Couplings*

3.3 Distributed I/O

3.3.1 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
- Configuring Redundant Input/Output Modules
- Configuring the DP/PA Link
- Configuring the Y Link

3.3.2 How to Configure the Redundant Interface 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) as hardware in the distributed I/O device, the component is made known to the system in SIMATIC Manager with HW Config or NetPro.

Requirement

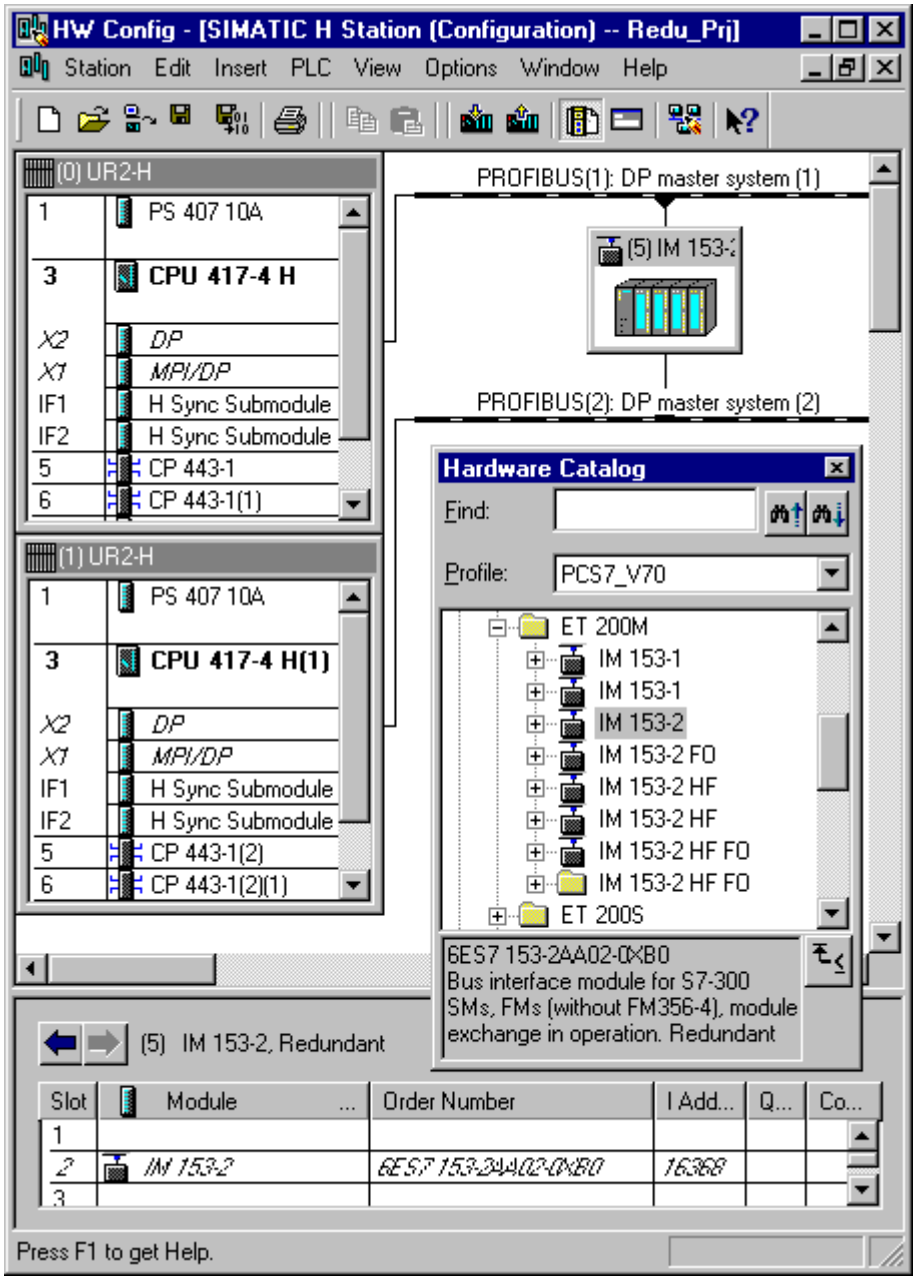
- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.

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 menu command **View > Catalog**.
   The hardware catalog opens.
3. Double-click on "PROFIBUS DP" in the current PCS 7 profile.
4. Double-click the I/O device you want to connect:
   - ET 200M
   - ET 200iSP
5. Select the interface module:
   - For ET 200M: IM 153-2 in the hardware catalog.
   - For the ET 200iSP: IM 152-1 whose hardware catalog description is "..., can be used redundantly in the H system".
6. Drag the interface module to one of the two PROFIBUS DP lines.
   The connection to the redundant line is established automatically.
7. Enter the PROFIBUS address in the "Properties - PROFIBUS Interface IM..." dialog box and click "OK".

Result

The following figure shows the resulting configuration in HW Config:



Additional information

- Function manual *Process Control System PCS 7; Highly Accurate Time Stamps*
- Manual *DP/PA Link and Y Link Bus Couplings*

3.3.3 How to Configure Redundant I/O Modules

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. You can find additional information about this in the following documentation:

- Documentation *PCS 7 - Released Modules*
  (via menu command **Start > SIMATIC > Documentation > English**)
- Manual *Automation System S7-400H; Fault-Tolerant Systems*

Note

Only identical I/O modules having the same order number in analog or digital form can be used. During configuration, the redundant module pairs are selected and, once selected, are always configured redundantly as a unit (not channel-by-channel).

Assignment of 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.

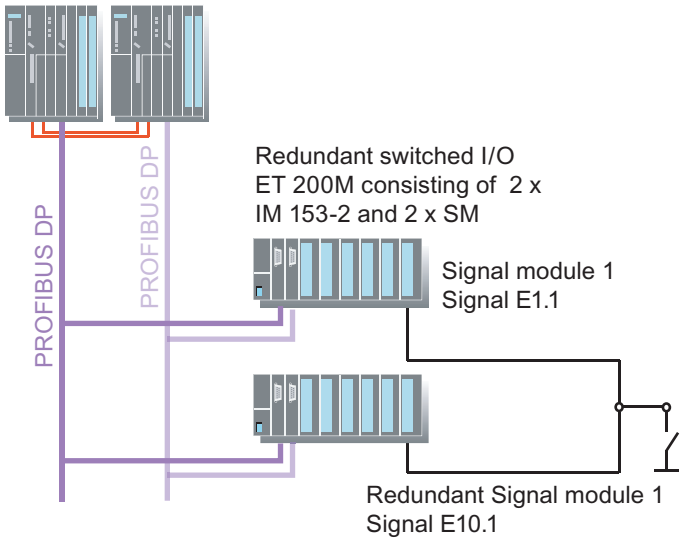
Setting the Passivation Response

Note that you must also set the passivation behavior of the redundant I/O in the properties of the CPU (H parameters) in addition to the following procedure.

You can find additional information about this in the section "How to Set the Failure Reaction of the Input/output Modules on the CPU".

Example configuration

The following figure shows the setup of 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 an error is detected in "Signal Module 1", "Signal Module 1" is passivated and only the signals from "Redundant Signal Module 1" are processed. The user program, therefore, still operates with the address E1.1, but the signal is coming from E10.1.

The user program does not see an error since the signal status is still correct. The passivated module generates a diagnostic message.

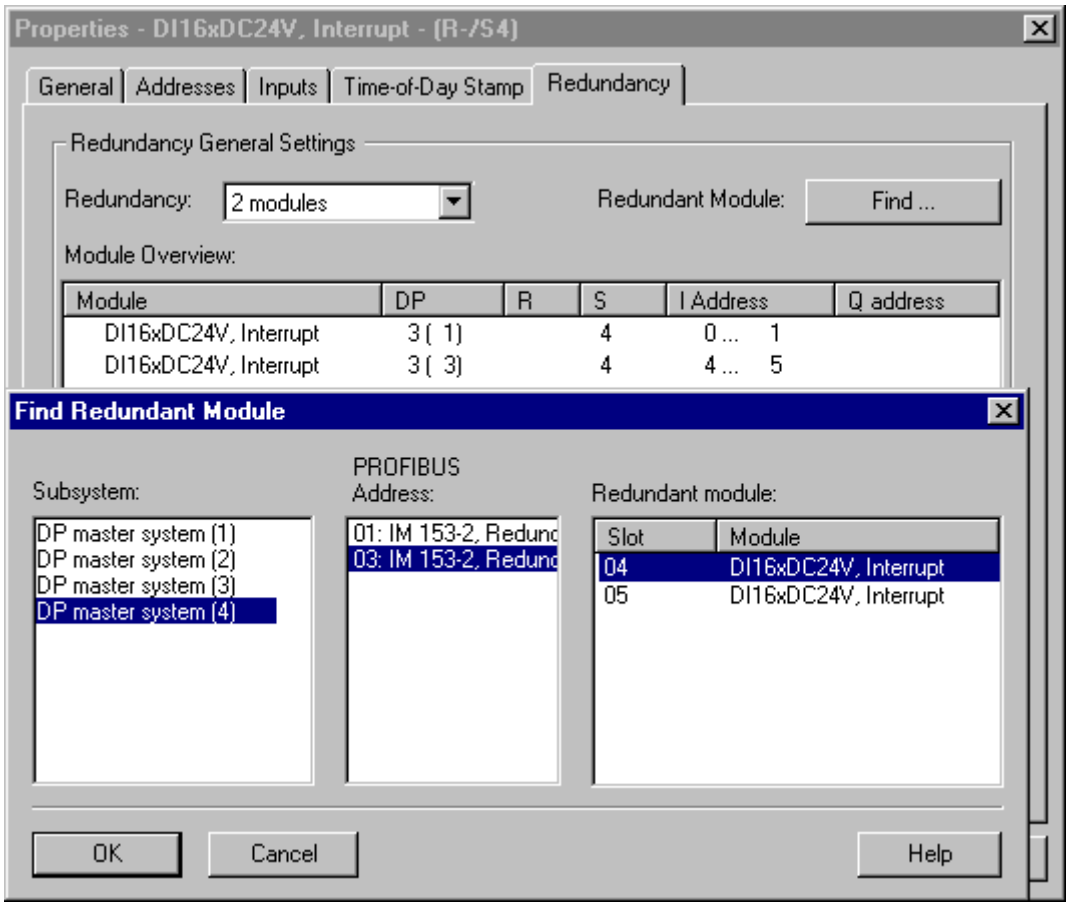
Requirements

- The PCS 7 project with an H CPU (414-4 H/417-4 H, firmware 3.1) is created and open 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 menu command **View > Catalog**.
   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. Select a signal module that supports redundancy in the hardware catalog. Drag the signal module to 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 on 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 from the "Process image" drop-down list.
10. Select the "Redundancy" tab.
11. Select the entry "2 modules" in the "Redundancy" list.

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



13. Select the DP master system in which the redundant signal module is configured in the "Subsystem" list.
    All the available PROFIBUS addresses in this DP master system are displayed in the "PROFIBUS address" box.
14. From the "PROFIBUS address" box, select the IM 153-2 in which the redundant signal module is configured.
    The signal modules in this IM 153-2 capable of redundancy and 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" to apply the settings.

Additional information

- Online Help for *STEP 7*
- Manual *Automation System S7-400H; Fault-Tolerant Systems*

3.3.4 How to Configure the DP/PA Link

Functionality

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 and 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

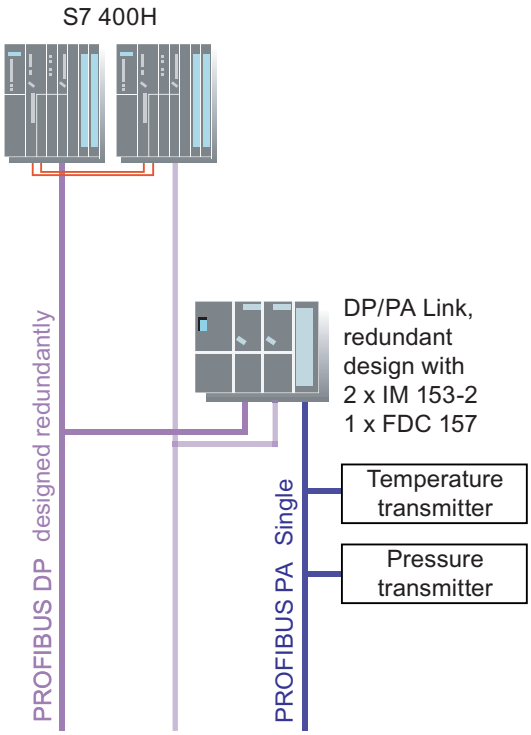
A list of PA slaves that can be connected is available in the Y Link manual. Please note that PCS 7 driver blocks are not available for all of the devices listed. Contact the PCS 7 Support Center to check if such a driver block is available for the device you have selected.

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

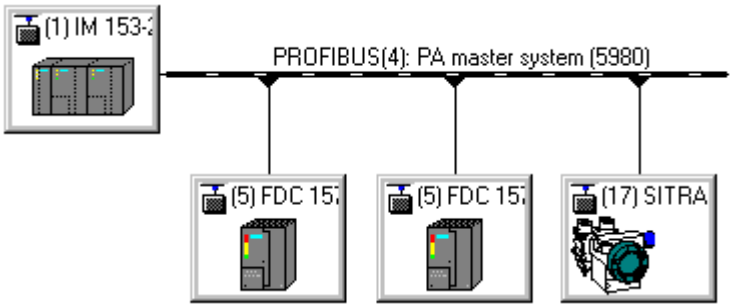
Configure the DP/PA Link in same way as described in the section "How to Configure the Y Link".

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 the resulting configuration in HW Config:



Additional information

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

3.3.5 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 single-sided DP master system.

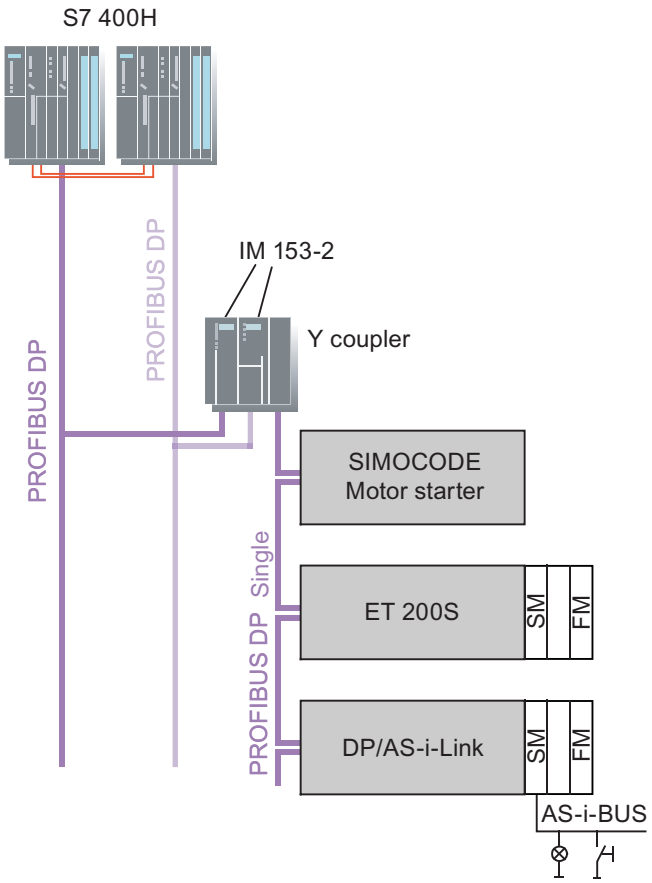
The following describes how to install and configure the Y Link.

Requirements

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

Example configuration

The following figure shows how the Y Link is used.

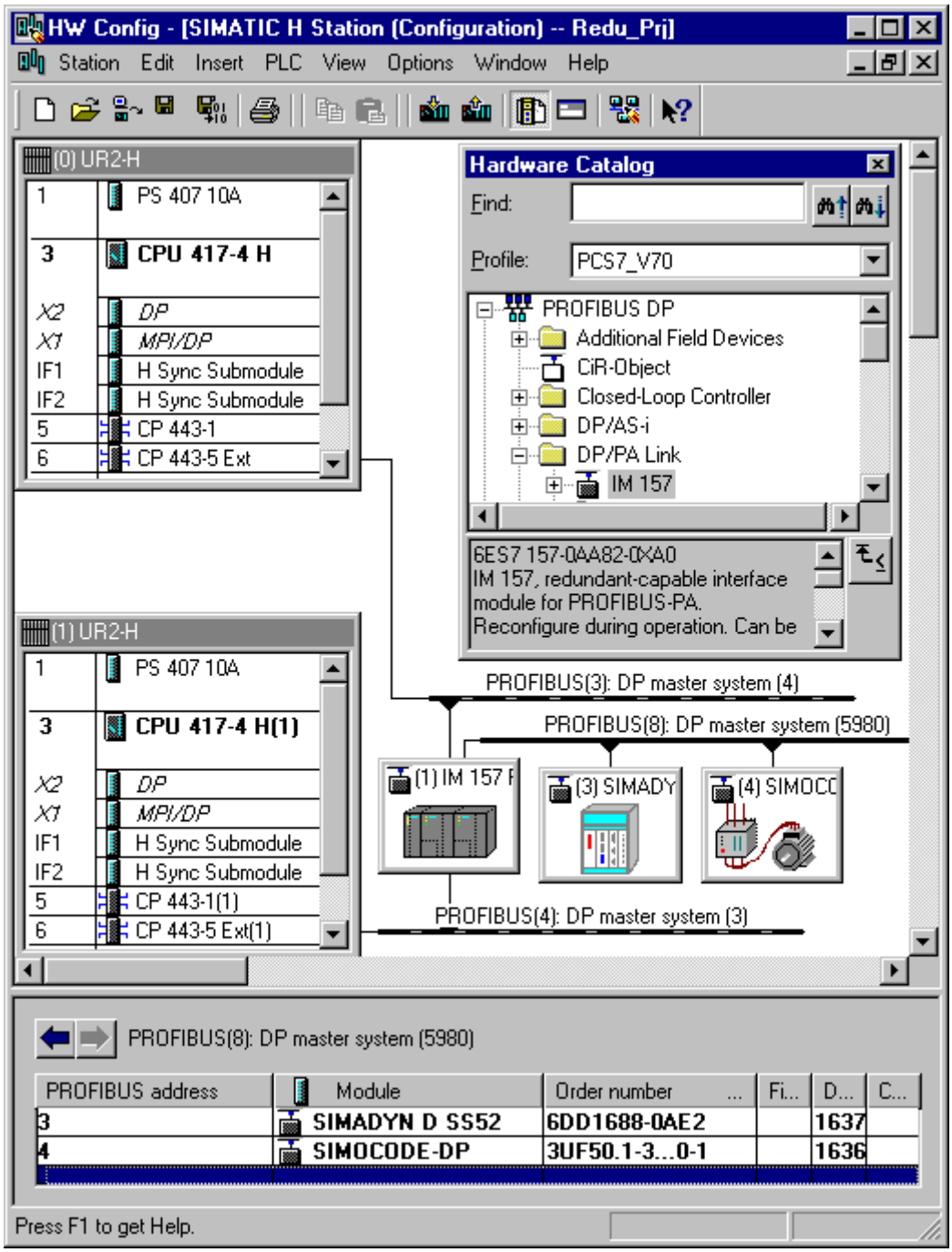


Procedure

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 menu command **View > Catalog**.
   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" and click "OK".
7. Click on "Interface module for PROFIBUS DP" in the "Define Master System" dialog box and click "OK".

Result

The resulting configuration in HW Config appears as follows:



Additional information

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

3.4 Operator Stations

3.4.1 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
2	Setting the Project Path for Destination OS and Standby OS
3	Creating a Redundant Connection between OS and AS
4	Specifying which S7 Programs you want to Assign to which OS
5	Configuring WinCC Redundancy
6	Downloading the SIMATIC PCS 7 Project to the Target Systems
7	Configuring an OS Client
8	Configuring an OS Client for Permanent Operability
9	Synchronizing the Time of Day of OS Clients with OS Servers
10	Synchronizing the Time of Day of OS Servers with an external Time Transmitter

3.4.2 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.

In the following example, both OS servers of the server pair are connected redundantly to the plant bus (two CP 1613s per server).

Requirements

- The PCS 7 project with a SIMATIC H station is open in SIMATIC Manager.
- Each PC has two CP 1613s for connection to the plant bus.
- The ISO protocol is set as the communication protocol on the plant bus.
- Each PC has a standard network card for connection to the terminal bus.

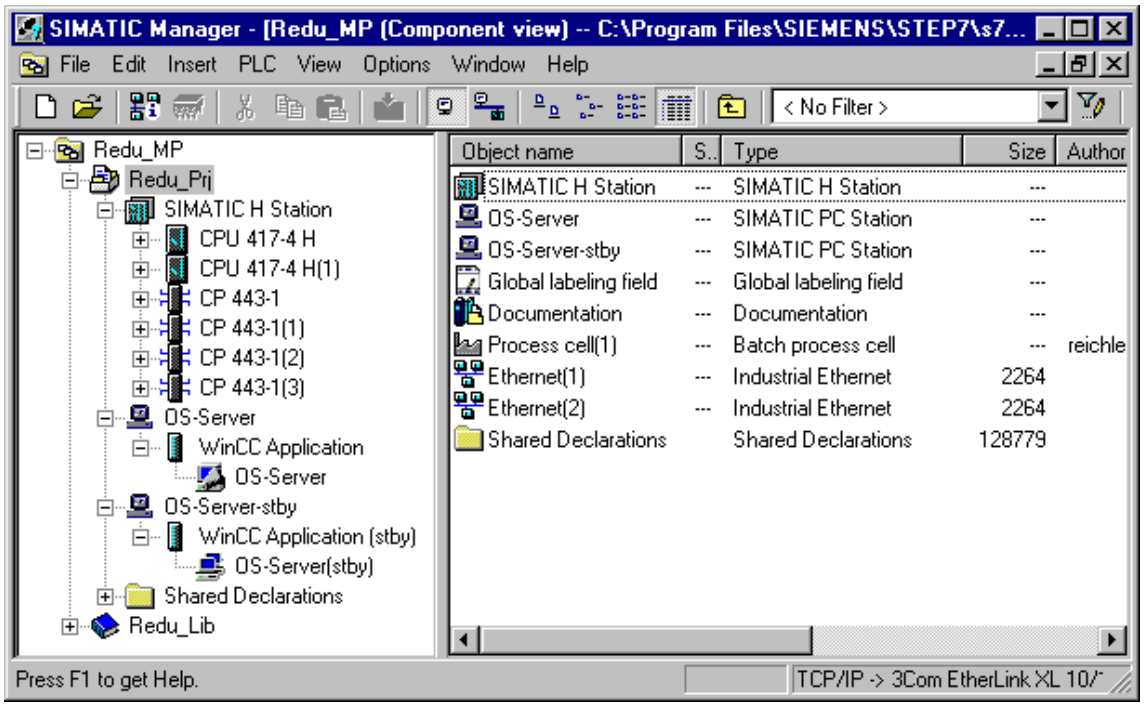
Procedure

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 menu command **View > Catalog**.
   The hardware catalog opens.
7. Under "SIMATIC PC Station > HMI ..." in the hardware catalog, select the WinCC application and drag it to the configuration table.
8. In the hardware catalog under **SIMATIC PC Station > CP Industrial Ethernet**, select the CP 1613 communications 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 CP 1613.
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 menu command **View > Catalog**.
    The hardware catalog opens.
18. In the hardware catalog under "SIMATIC PC Station > HMI...", select "WinCC application (stby)" and drag it to the configuration table.
19. In the hardware catalog under **SIMATIC PC Station > CP Industrial Ethernet**, select the CP 1613 communications 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 CP 1613.
22. Select the menu command **File > Save** and exit HW Config.

Result

Your project now looks like the one in the following figure. You can rename the components any way you please.



Additional information

- Online Help for *STEP 7*

3.4.3 How to Set the Project Paths of the Destination OS and Standby OS

Introduction

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 target 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 OS]" dialog box opens.
3. Select the "Destination 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.

Notice

Enter the path to the destination OS **without** a prefixed drive letter:

\\[Name of Server]\[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 list box.
6. Click "OK" to save your inputs.
   You have now completed all the 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 OS]" dialog box opens.
9. Select the "Destination 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" to save your inputs.
    You have now completed all the settings for the standby OS.

Additional information

- Online Help for *STEP 7*

3.4.4 How to Configure a Redundant Connection 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 fault-tolerant network connections to the AS in NetPro.

Requirements

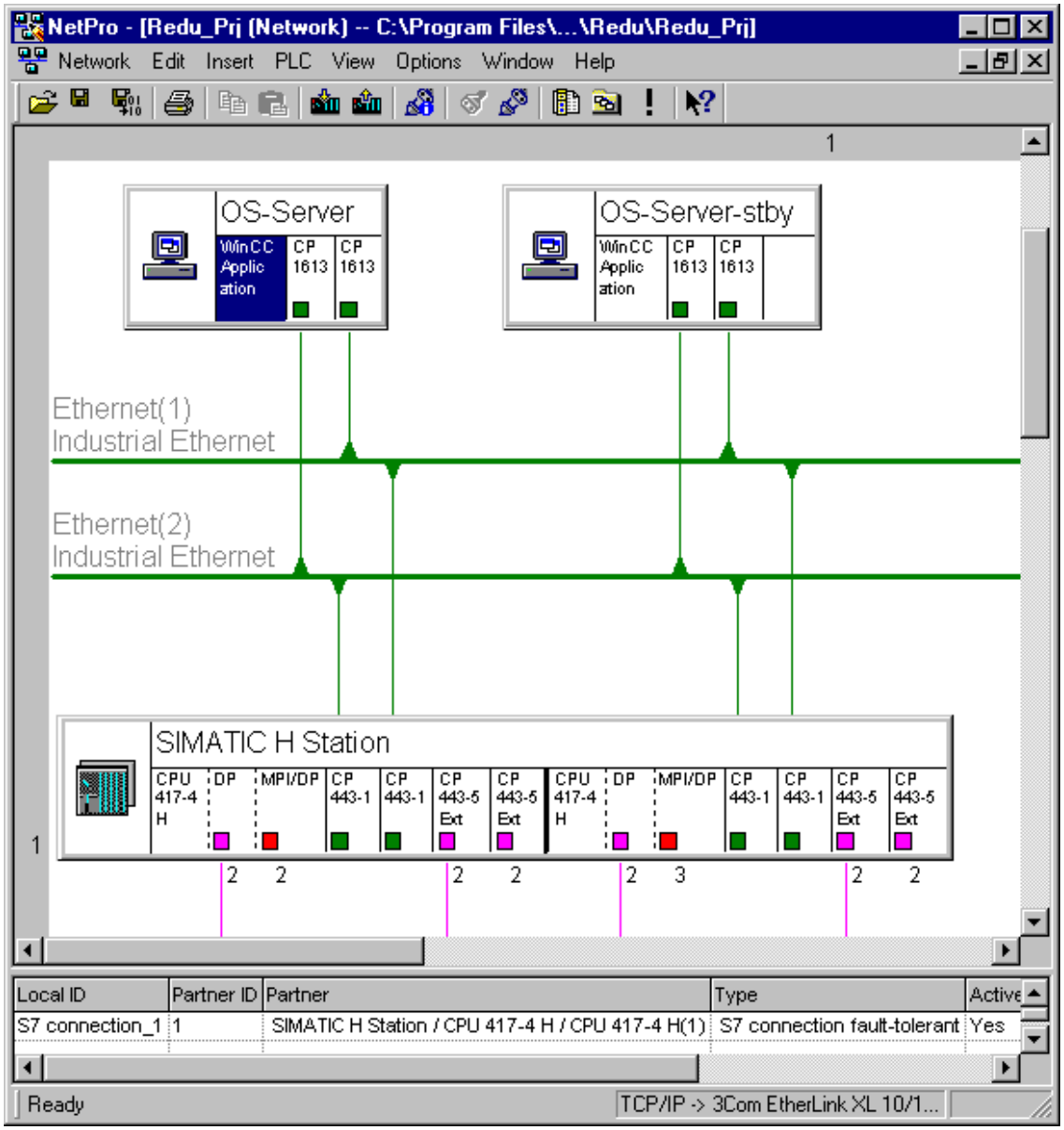
- The PCS 7 project is open in SIMATIC Manager.
- Two SIMATIC PC stations have been configured in HW Config as an OS server and OS partner server each with two CP 1613.
- The redundant plant bus has been configured.

Procedure

1. Open NetPro in SIMATIC Manager with the menu command **Options > Configure Network**.
2. Select the interface icon in the first CP 1613 of the OS server and drag a connection to Ethernet(2).
   The CP 1613 is now connected to the Ethernet(2).
3. Connect the second CP of the OS server to Ethernet(1) in the same way.
4. Connect both CPs of the OS partner server with the two Ethernet networks in the same way.
5. Select the WinCC application of the OS server for which you want to configure a fault-tolerant 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. Open the properties before inserting.
   This allows you to make settings or changes to the connection.
10. If redundant CPs for the plant bus are configured in the SIMATIC S7 stations, activate the check box "Enable max. CP redundancy (with 4 connection paths)" in the "Redundancy" group.
11. Click "OK" to apply 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 "How to Configure a Fault-tolerant Plant Bus"
- Online Help for *STEP 7*

3.4.5 How to Assign an S7 Program to an 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 CFC and SFC charts 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. Select the "Pass on selected assignment to all lower-level objects" check box if you want all lower-level objects to have the same assignment.

Note

The "Pass on selected assignment to all lower-level objects" check box is only 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" to save your entries.
   The AS-OS assignment is accepted 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 do not need to make an AS-OS assignment.

Additional information

- Online Help for *STEP 7*

3.4.6 How to Configure WinCC Redundancy

Introduction

WinCC Redundancy is used to implement redundancy between an OS server and its OS partner server. WinCC Redundancy must first be configured in WinCC Explorer on the OS server for this purpose.

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 failover of OS clients.

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, each with two CP 1613 communications processors.
- The OS server and OS 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

Procedure

Notice

Setting in step 3: Note the following if the redundancy connection to redundant OS server is configured as a serial connection:

If the redundancy connection to the redundant OS server is not established over "COM1" port, you will need to make the "Activate redundancy" setting locally on the relevant OS server.

Note

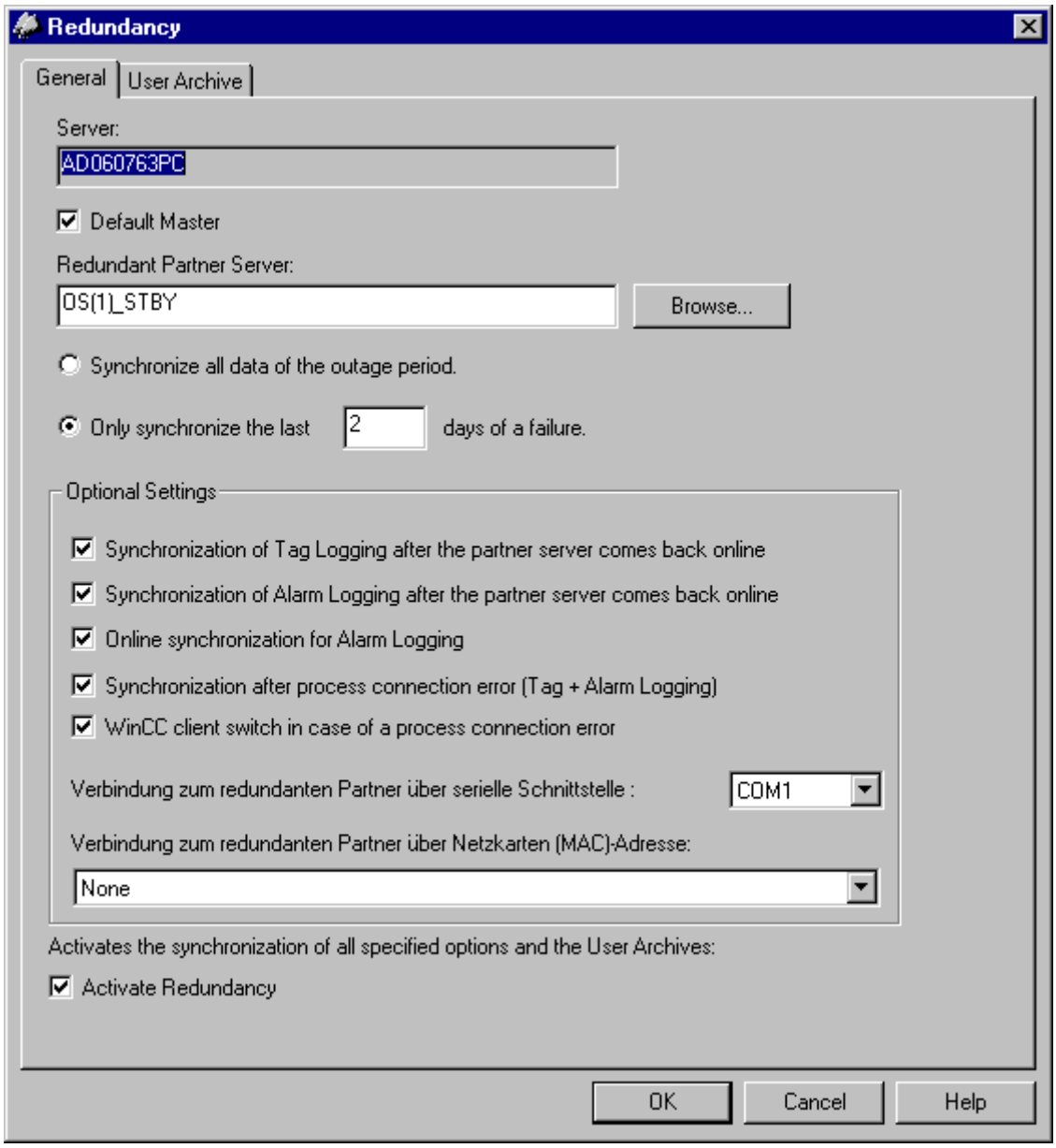
Settings in steps 5 and 6: The settings are adopted automatically from the configuration in SIMATIC Manager. It may be necessary to adapt settings if projects have been copied or if you configure in a different order from the one recommended for PCS 7.

1. In the component view of SIMATIC Manager, select the OS in the OS server and select the menu command **Edit > Open Object**.
   WinCC Explorer opens.
2. In WinCC Explorer, select the menu command **Editor > Redundancy > Open**.
   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.
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 failover if the process connection is disrupted

   For more information about the "General" and "User Archive" tabs refer to the Online Help for WinCC.
7. In the "Serial connection to redundant partner" drop-down list, select the COM port over which the OS server pair will be linked using the redundancy cable (null modem cable).
8. Click "OK".

Result

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



Additional information

- Online Help for *WinCC*

3.4.7 How to Configure an OS Client

Introduction

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

Requirements

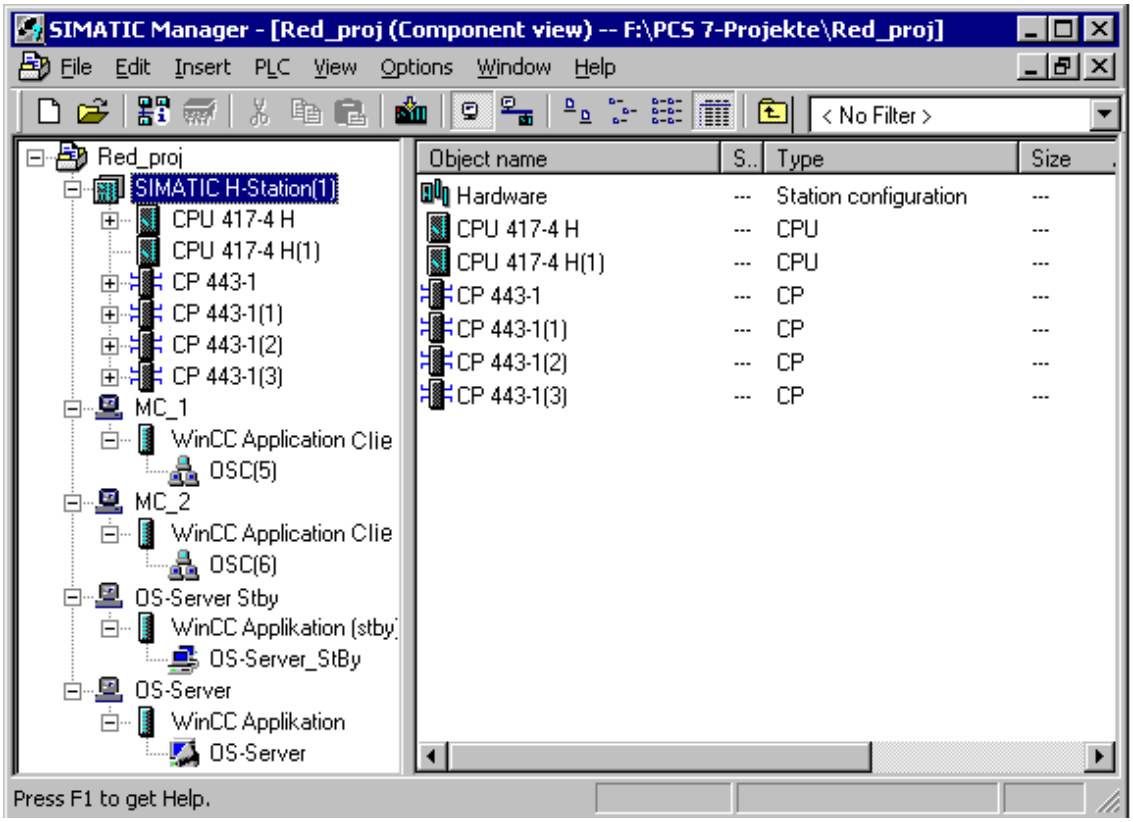
- The PCS 7 project is open in SIMATIC Manager.
- Each PC has a standard network card for connection to the terminal bus.

Procedure

1. In the component view of SIMATIC Manager, select the project in which you want to add 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 menu command **View > Catalog**.
   The hardware catalog opens.
6. In the hardware catalog under "SIMATIC PC Station > HMI...", select the "WinCC application client" and drag it to the configuration table.
7. Save your current settings. Close the hardware catalog.
8. Repeat steps 2 to 7 for the second OS client.

Result

Your project now looks like the one in the following figure. You can rename the components any way you please.



Using Reference Clients

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

You can find additional information about this in the configuration manual *Process Control System PCS 7; Operator Station*.

3.4.8 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 failover from one OS server to the redundant OS partner server.

Requirements

- The redundant OS server pair is 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.

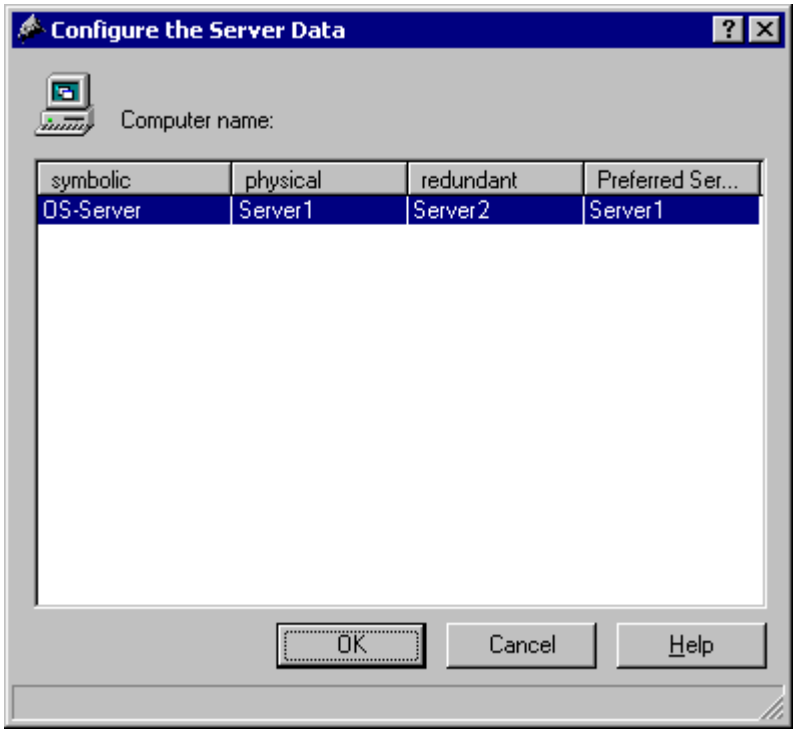
Procedure

1. Open the WinCC project of the first OS client in the component view in SIMATIC Manager.
2. In project navigation window in WinCC Explorer, right-click the "Server Data" editor and then "Configure".
3. In the "Configure Server Data " dialog box, click the cell "No preferred server in the "Preferred server" " column.
   A drop-down list box 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 dat.
4. In the drop-down list box, click on the OS server you want to designate as the preferred server for the OS client.
5. Close the dialog box.
6. Repeat steps 1 and 4 for the second OS client. Note that you must set the redundant OS partner server as the preferred server for the second OS client.
7. Select the first OS client and select the menu command **Edit > Object Properties**.
   The "Properties [Name of OS]" dialog box opens.
8. Select the "Destination OS" tab.
9. Click the "Browse" button next to the "Path to destination 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.
10. Repeat steps 7 and 9 for the second OS client.

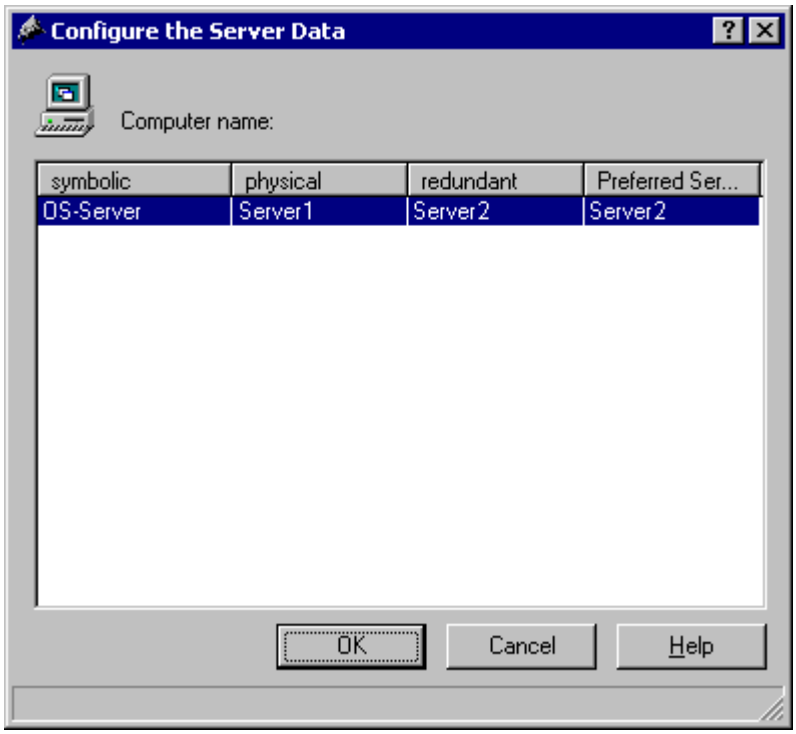
Result

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*.

3.4.9 How to Synchronize the Time of Day of OS Servers with an External Time Transmitter

Introduction

The procedure described here relates to OS servers in a domain that are connected to a redundant plant bus (Industrial Ethernet). This means that both of the redundant OS servers must have two CP 1613 communications processors. "SICLOCK TM" is used as the external time transmitter.

Note

All the OS servers used (including both OS servers of a server pair) must be set as described below.

Requirements

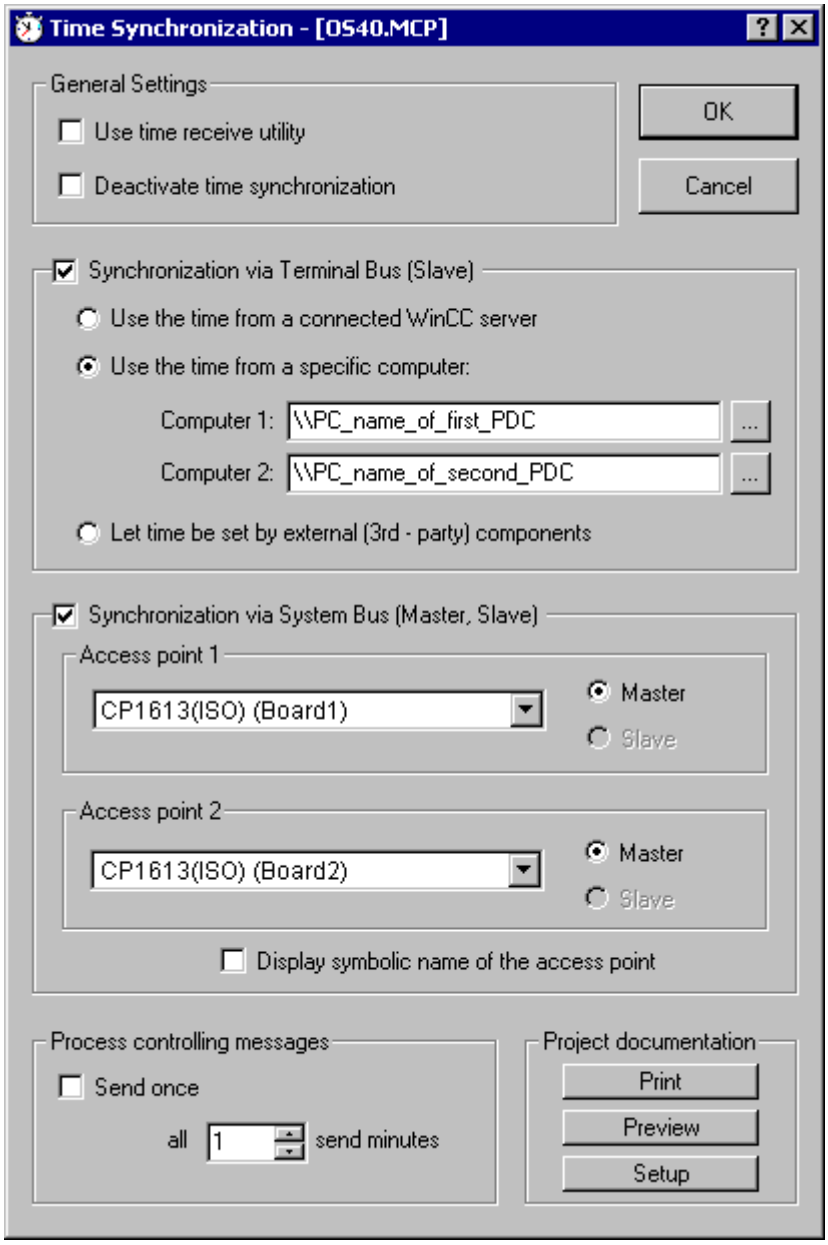
- Two CP 1613s are configured for each OS server of a server pair in HW Config.
- An external time transmitter, such as SICLOCK TM, has been integrated in the Industrial Ethernet.
- The WinCC project is open on an OS server.

Procedure

1. In WinCC Explorer, select the menu command **Editor > Time Synchronization > Open**.
   The "Time Synchronization" dialog box opens.
2. Select the "Synchronization via system bus (master, slave)" check box.
3. In the "Access point 1" list, select the required CP.
   This drop-down list box displays all CPs that are available in the OS server. You must select the CP for which you have activated time-of-day synchronization in the configuration console.
4. Click "Master".
   The OS server is now specified as the time master.
5. Select the required redundant CP for "Access point 2" and click "Master".
   This specifies a redundant CP for the time-of-day synchronization, which will provide the connection to the plant bus in case the first CP fails.
6. Click "OK" to apply your entries.

Result

The "Time Synchronization" dialog box can be configured as follows:



Additional information

- Online Help for *WinCC*
- Online Help for *STEP 7*
- Operating instructions *GPS Converter GPSDEC/GPSCOM*
- Operating instructions *SICLOCK Time Transmitter*

3.4.10 How to Synchronize the Time of Day of OS Clients with OS Servers

Introduction

The WinCC "Time Synchronization" editor is used for time-of-day synchronization.

Note

The settings described below must be made on all the OS servers in use.

Requirements

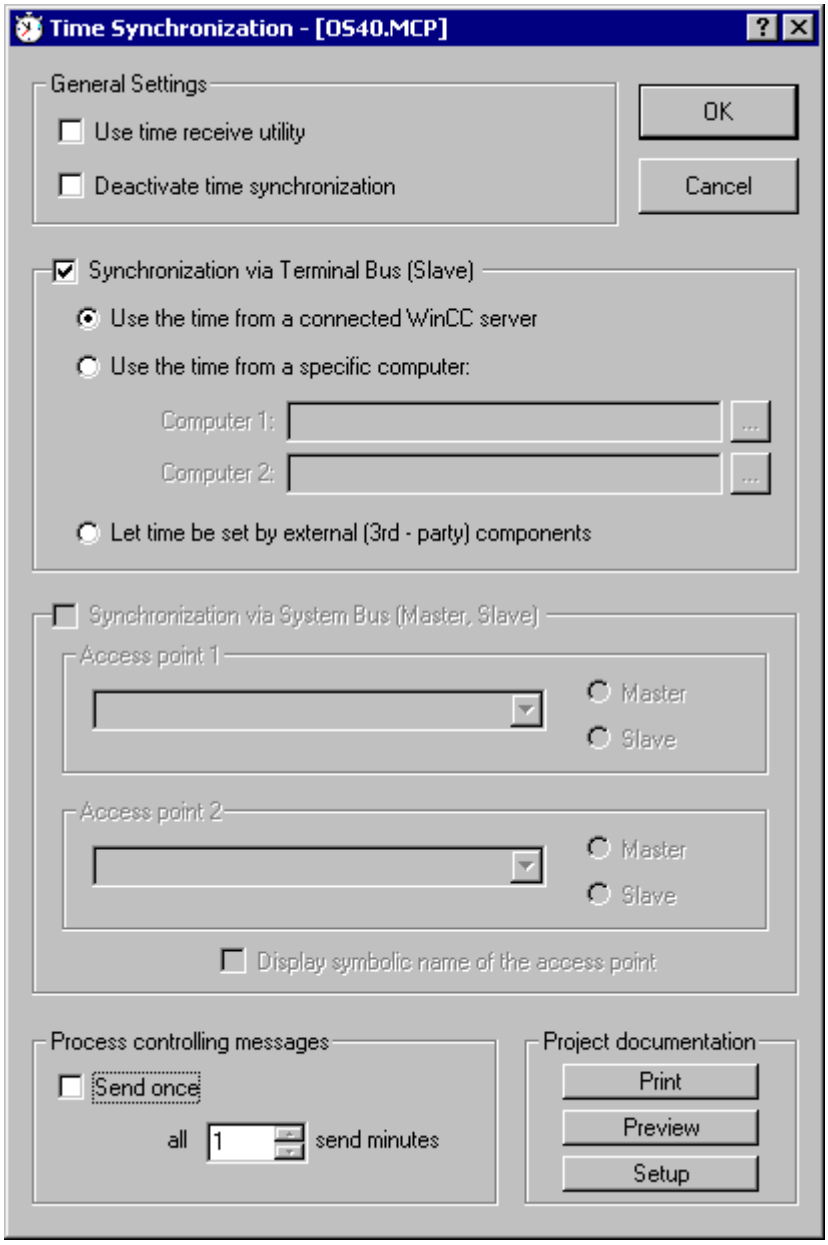
- The WinCC project is open on an OS client.
- OS clients communicate with the OS servers over the terminal bus.

Procedure

1. In WinCC Explorer, select the menu command **Editor > Time Synchronization > Open**.
   The "Time Synchronization" dialog box opens.
2. Select the "Synchronization via terminal bus (slave)" check box. There are two ways to synchronize the OS clients with OS servers over the terminal bus.
   - If you select the "Use the time from a connected WinCC server" check box, , the time of day on the OS client is synchronized with that of an OS server from which the OS client has downloaded the server data. This option provides failure security when the server data of at least two OS servers must be loaded.
   - If you select the "Use the time from a specific computer" check box, you need to specify the computer name under "Computer 1". You can also specify a second computer under "Computer 2". In this case there is an automatic failover to Computer 2 if Computer 1 fails.
3. Click "OK".

Result

The "Time Synchronization" dialog box may be configured as follows:



Note

Failure security is only provided for time synchronization of clients over the connected server if the client only has the server data from one server.

Additional information

- Online Help for *WinCC*

3.4.11 How to Configure an Archive Server and Its Redundant Archive Partner Server

Introduction

The following describes the individual steps involved in creating the archive server and its redundant archive partner server.

Requirements

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

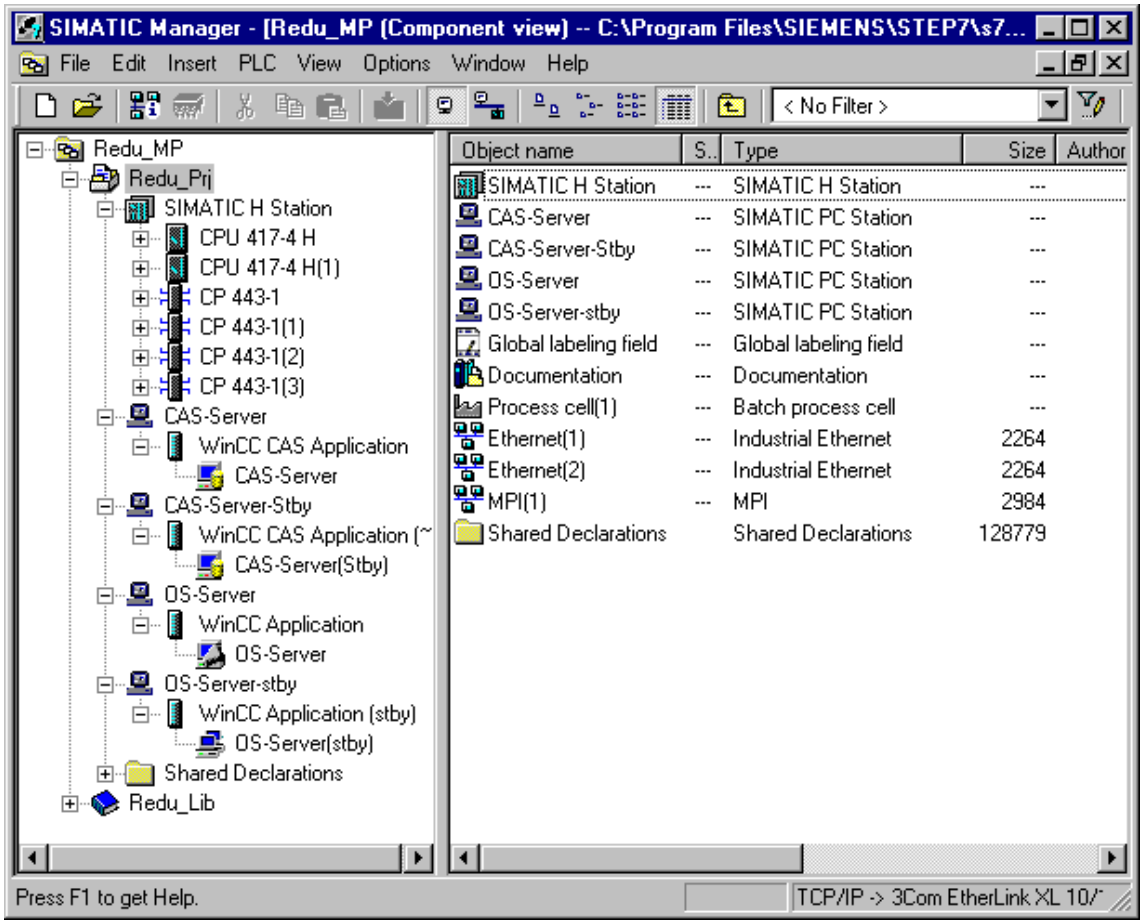
Procedure

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, CAS server).
4. Enter the Windows name of the computer to be used as the CAS 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. Under "SIMATIC PC Station > HMI ..." in the hardware catalog, select "WinCC CAS application" and drag it to the configuration table.
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 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, CAS partner server).
12. Enter the Windows name of the computer to be used as the archive 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 menu command **View > Catalog**.
    The hardware catalog opens.
15. In the hardware catalog under SIMATIC PC Station > HMI..., select the "WinCC CAS application (stby)" and drag it to the configuration table.
16. Select the menu command **File > Save** and exit HW Config.

Result

Your project now looks like the one in the following figure. You can rename the components any way you please.



Additional information

- Online Help for *STEP 7*

3.4.12 How to Download a SIMATIC PCS 7 Project to the Target Systems

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 if all components in the project are enabled for compiling and downloading.
4. Click "Start".
   This starts the compile and download operation.

Additional information

- Online Help for *STEP 7*

3.5 SIMATIC BATCH Stations

3.5.1 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
2	Configuring the PC Station for a BATCH Client
3	Setting the Network Adaptor for Redundancy Monitoring of BATCH Servers
4	Setting Redundancy of the BATCH Servers
5	Downloading the Target Systems for SIMATIC BATCH

3.5.2 How to Configure a BATCH Server and Its Redundant BATCH Partner Server

Introduction

The following describes how to configure a redundant BATCH server.

Note

A redundant PC cannot be used simultaneously as a shared server for PCS 7 OS and SIMATIC BATCH.

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.

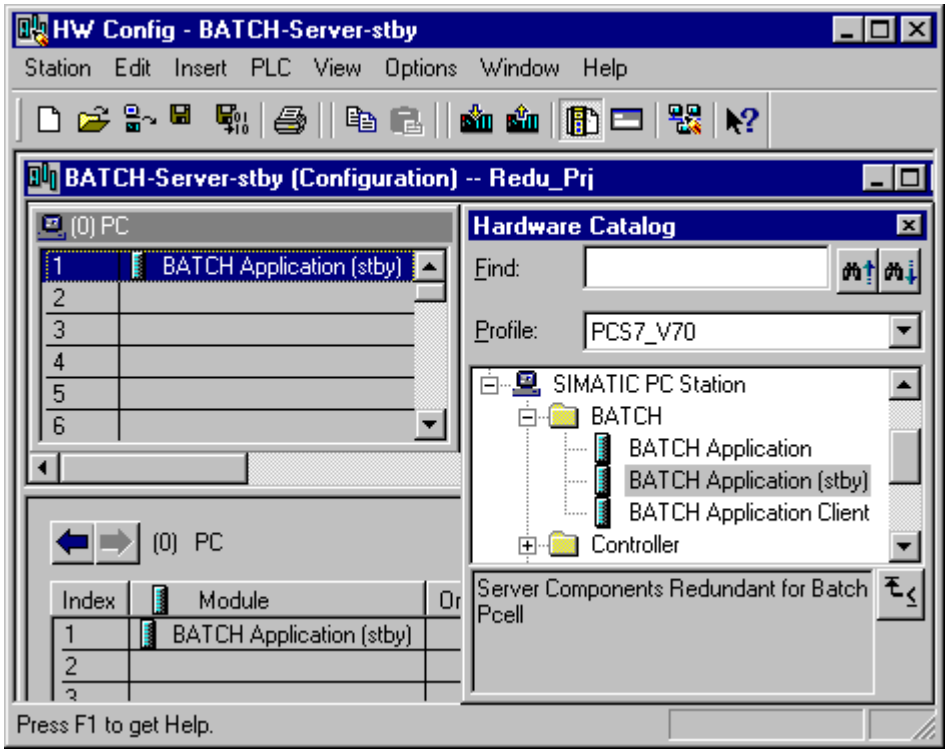
Procedure

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. Under "SIMATIC PC Station > BATCH ..." in the hardware catalog, select the BATCH application and drag it to the configuration table.
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 menu command **View > Catalog**.
    The hardware catalog opens.
15. In the hardware catalog under "SIMATIC PC Station > BATCH...", select the "BATCH application (stby)" and drag it into the configuration table.
16. Select the menu command **File > Save** and exit HW Config.

Result

The following figure shows the SIMATIC PC station with BATCH application (stby) configured in HW Config:



Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

3.5.3 How to Configure a BATCH Client

Introduction

A BATCH client and an 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

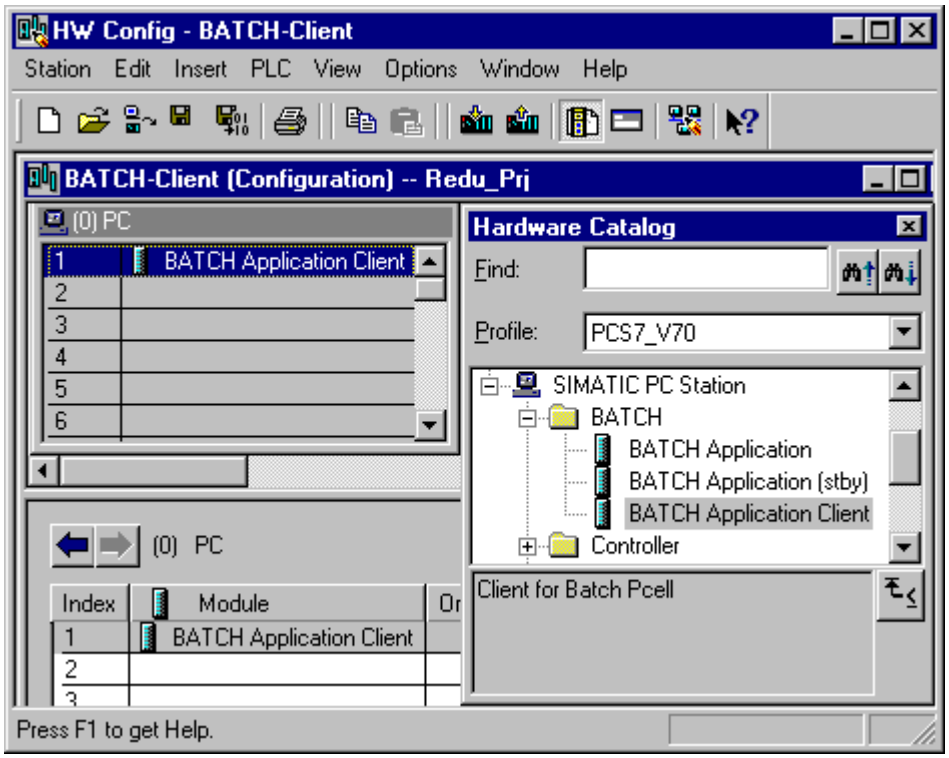
- The SIMATIC BATCH software package (BATCH Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

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. In the hardware catalog under "SIMATIC PC Station > BATCH...", select the "BATCH application client" and drag it into the configuration table.
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*

3.5.4 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 in each BATCH server of a server pair (referred to in the following as the 3rd network adapter).
- All software components have been installed on the BATCH servers.

Procedure

1. Open the network connections with the menu command **Start > Settings > Control Panel > Network Connections**.
   The "Network and Dial-up Connections" dialog box opens.
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 Bindungs" 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. Activate the check box "Internet Protocol (TCP/IP)" and deactivate all other elements:
8. Select "Internet Protocol (TCP/IP)". Click "Properties".
   The "Properties of Internet Protocol (TCP/IP)" dialog box opens.
9. Set the "local" IP address in the "General" tab.

Note

Enter different IP addresses for the master server and standby server from a subnet that is not routing-capable (for example, subnet 192.168.0.0).

10. Click "OK".

3.5.5 How to Set the Redundancy of the BATCH Servers

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
- 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.
- A network adapter is set up for redundancy monitoring via an Ethernet connection on each BATCH server.

Checking the configuration settings

1. S Select the project in the component view of SIMATIC Manager.
2. Select the menu command **Options > SIMATIC BATCH**.
   The "Plant Data" dialog box opens.
3. Select the project in the tree view.
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 Response" tab. Click "Update".
7. Check the displayed settings in the "Startup response" 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.

Setting Redundancy Monitoring

1. Open the Windows Explorer on the BATCH server.
2. Select the folder **Workstation > Simatic Shell** in the tree view.
3. Select the shortcut menu command **Redundancy Settings**.
   The "Redundancy Settings" dialog box opens.
4. In the drop-down list of 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.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

3.5.6 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 the Component view in the SIMATIC Manager.
- The SIMATIC BATCH configuration is completed.
- The BATCH plant is compiled.

Downloading via SIMATIC BATCH

1. Select the menu command **Options > SIMATIC BATCH**.
   The "Plant Data" dialog box opens.
2. Select the plant object in the tree.
3. Click "Download".
   In the "Download from <plant>" dialog box, all PC stations for BATCH servers (single, redundant), DB servers and BATCH clients are displayed with information about their download status.
4. Click "Start".
   The plant object is downloaded.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

3.6 SIMATIC Route Control Stations

3.6.1 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
2	Configuring the PC Station for a Route Control Client
3	Creating a Redundant Connection between Route Control Server and AS
4	Setting the Redundancy of the Route Control Servers
5	Downloading the Target Systems for Route Control

3.6.2 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 (two CP 1613s per server).

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.

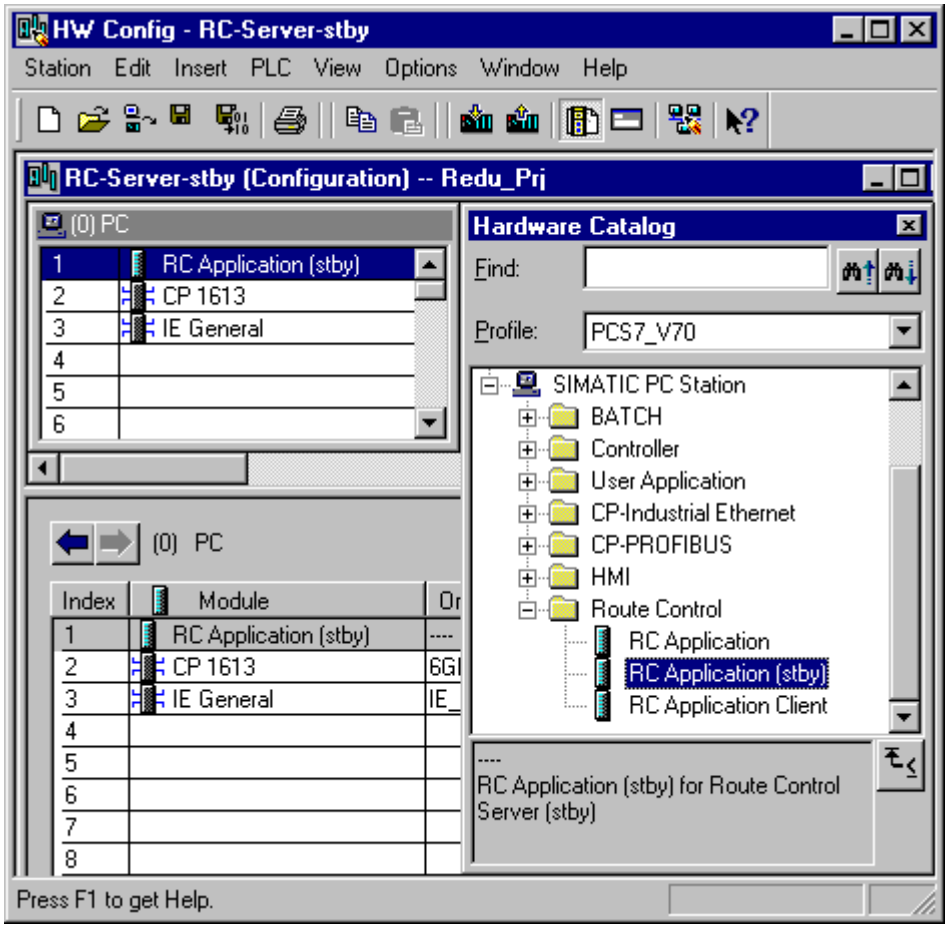
Procedure

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. Under "SIMATIC PC Station > Route Control ..." in the hardware catalog, select "RC application" and drag it to the configuration table.
8. In the hardware catalog under **SIMATIC PC Station > CP Industrial Ethernet**, select the CP 1613 communications 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 CP 1613.
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 menu command **View > Catalog**.
    The hardware catalog opens.
18. Under "SIMATIC PC Station > Route Control ..." in the hardware catalog, select "RC application (stby)" and drag it to the configuration table.
19. Select the menu command **File > Save** and exit HW Config.

Result

The following figure shows the SIMATIC PC station with Route Control application (stby) configured in HW Config:



Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

3.6.3 How to Configure a Route Control Client

Introduction

A Route Control client and an OS client are often run together on one SIMATIC PC station. Both client applications must be configured in HW Config on a SIMATIC PC station.

Requirements

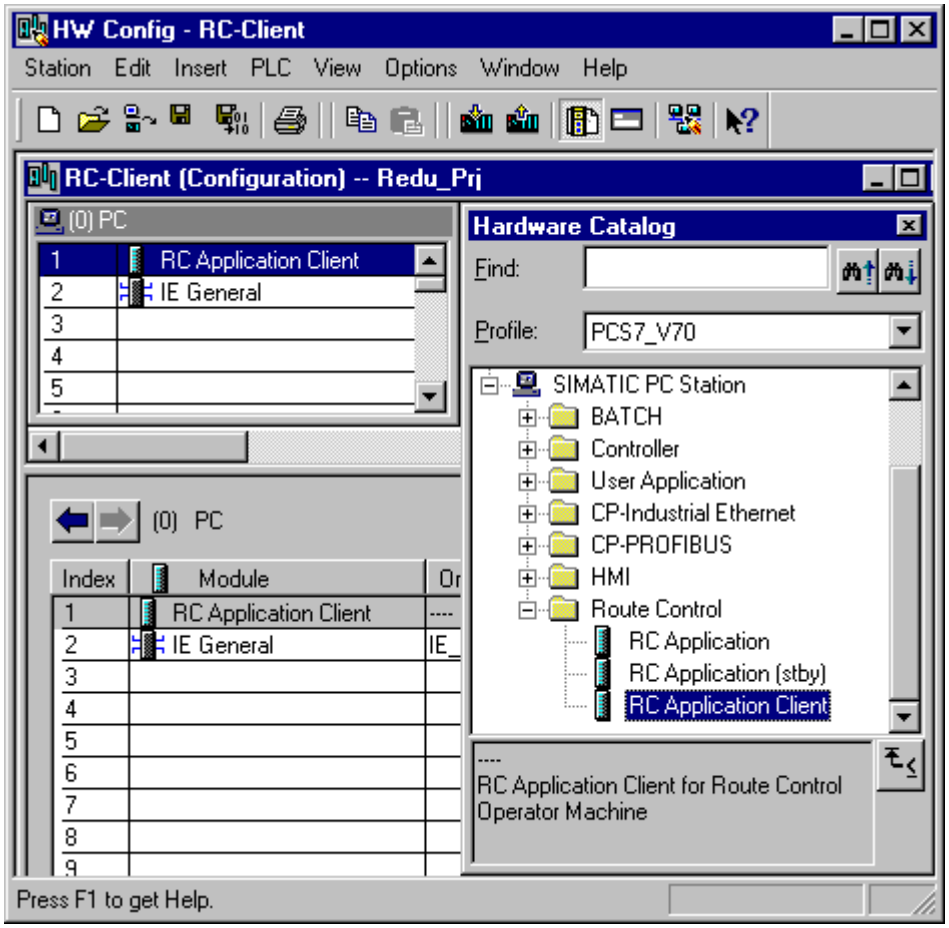
- The SIMATIC Route Control software package (Route Control Engineering) has been installed in addition to the PCS 7 software.
- The PCS 7 project is open in SIMATIC Manager.

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. In the hardware catalog under "SIMATIC PC Station > Route Control ...", select "RC application client" and drag it into the configuration table.
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:



Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

3.6.4 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 is created in NetPro using SIMATIC Route Control wizards.

Requirements

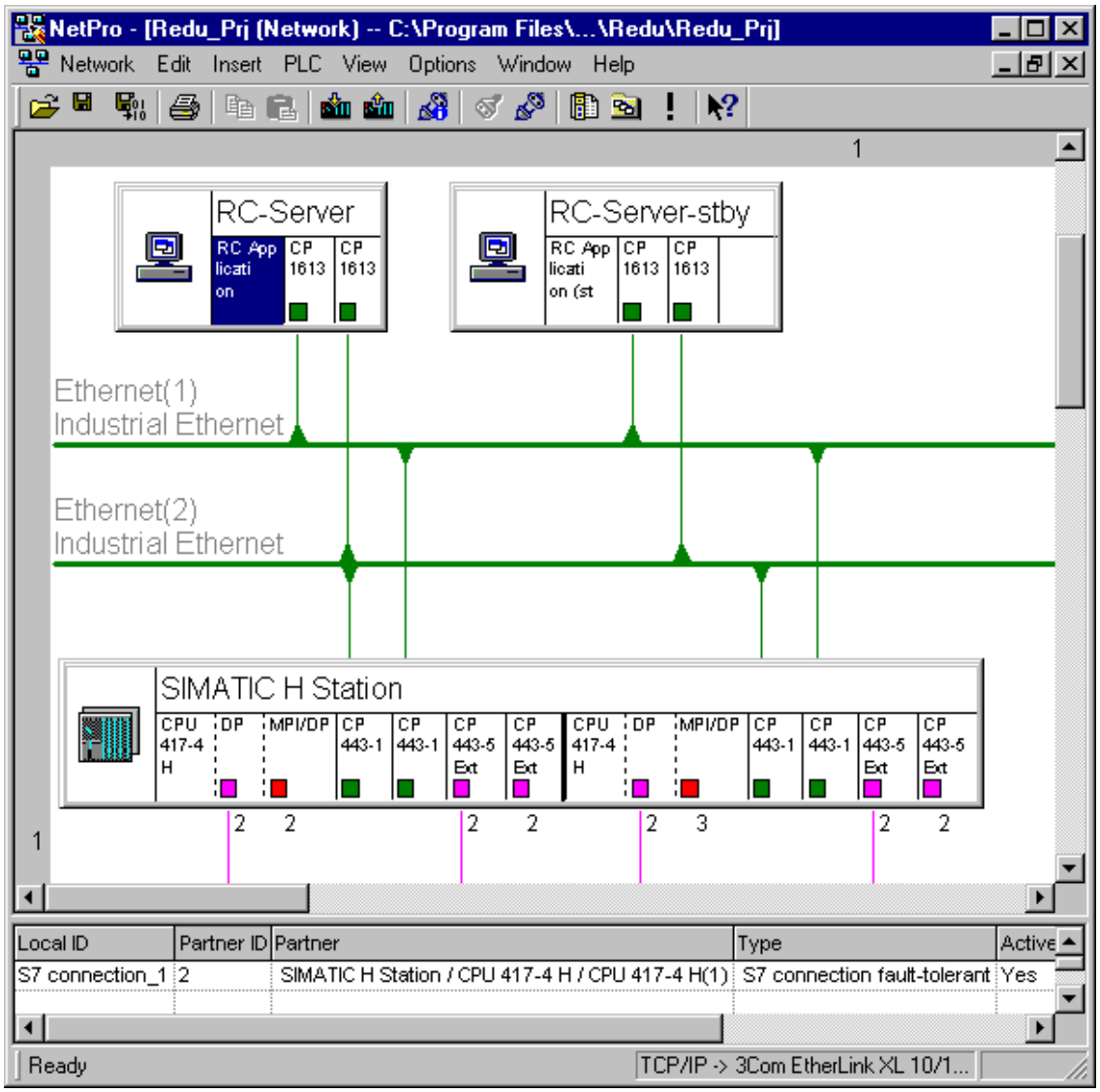
- The PCS 7 project is open in SIMATIC Manager.
- Two SIMATIC PC stations have been configured in HW Config as an Route Control server and Route Control partner server each with two CP 1613 (or IE General).
- The AS is connected to the plant bus in NetPro.
- The plant bus has been configured.

Procedure

1. In the SIMATIC Manager, select the menu command **Options > SIMATIC Route Control > Wizard**.
2. Make the settings according to the plant configuration.
   The RC wizard automatically creates a fault-tolerant connection when a fault-tolerant system is the connection partner.
3. When the Route Control server and SIMATIC H station are each connected to the plant bus with two CPs, the following additional tasks 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 fault-tolerant network connection.
     The connection table is displayed in the lower window pane.
   - Select the connection to the SIMATIC S7 station (SIMATIC S7 H Station) in the connection table.
   - Select the menu command **Edit > Object Properties**.
     The "Properties ..." dialog box for this S7 connection opens.
   - Select the "General" tab.
   - To use 4-way redundancy, 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 SIMATIC H station for both Route Control servers in NetPro:



Additional information

- You can find information about the Route Control wizards in the manual *Process Control System PCS 7; SIMATIC Route Control*.
- Section "How to Configure a Fault-tolerant Plant Bus"
- Online Help for *STEP 7*

3.6.5 How to Set the Redundancy of the Route Control Servers

Introduction

You only have to configure the PC stations in the SIMATIC Manager for redundant Route Control servers.
In the object properties of the PC station, the computer name must be configured or "Computer name identical to PC station name" the check box must be activated.

Additional information

- Section "How to Configure a Route Control Server and its Redundant Route Control Partner Server"

3.6.6 How to Download the Target Systems for 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 the Route Control clients.

Additional information

- You can find information about downloading the Route Control server in the manual *Process Control System PCS 7; SIMATIC Route Control*
- You can find information about configuring the Route Control client in the manual *Process Control System PCS 7; SIMATIC Route Control*

4 Component Replacement and Plant Changes

4.1 Failure and Replacement of Components

4.1.1 Replacement of SIMATIC Components in Runtime

Continuous operation

A crucial factor for continuous operation of fault-tolerant process control systems is the replacement of faulty or failed components in runtime. Replacement of defective components is only possible if fault-tolerant components are used. The redundant components continue to operate and supply the function until the replacement is made. The system is no longer fault-tolerant 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 417-4H)
- Power supply modules (e.g., PS 405, PS 407)
- Communication modules
- Synchronization modules and fiber-optic cables
- Interface modules (e.g., IM 460, IM 461)

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)
- Redundant interface modules (for example, IM 153-2 and IM 152-1)
- Input/output modules
- PROFIBUS DP cables

Additional information

You can find detailed, step-by-step instructions on the procedure for replacing components in runtime in the manual *Automation System S7-400H; Fault-Tolerant Systems.*

The following table is an overview of the descriptions:

Procedure for replacing components of ...	**.... refer to the manual *Automation System S7-400H; Fault-Tolerant Systems* in 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 Fiber-Optic Cable
	Failure and Replacement of an IM 460 and IM 461 Interface Module
Distributed I/O	Failure and Replacement of Components of the Distributed I/O
	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

4.1.2 Replacement of Bus Components in Runtime

Introduction

The information in this section relates to the following bus components

- Bus cable
- Switches, hubs, bridges

Failure and replacement of bus components

Components of a bus system (plant bus, terminal bus, PROFIBUS) 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 a PCS 7 OS: The preferred server settings
- 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 component completely.
- Avoid the occurrence of double faults.
- Replace the connection to the connected components in series (not at the same time).

4.1.3 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".

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 synchronization)
5	Start WinCC
6	Activate process mode
7	Activate or switch over assigned OS clients

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 the 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 manual *Process Control System PCS 7; Software Update without Utilization of New Functions*

4.1.4 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 BATCH Servers

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 a 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

4.1.5 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 a Route Control server

Follow the steps below to replace a Route Control server:

Step	What?
1	Replace 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 a Route Control client

Follow the steps below to replace a Route Control client:

Step	What?
1	Close the Route Control Center
2	Replace the Route Control client
3	On the engineering station: Download the Route Control client from SIMATIC Manager
4	Open the Route Control Center

4.2 Plant Changes in Runtime

4.2.1 Plant Changes in Runtime in Redundant Process Control Systems

Plant changes in runtime

In addition to the options for replacing failed components in runtime described in the section "Failure and Replacement of Components in Runtime", with the CPU 417-4H and CPU 414-4H, it is also possible to make a **plant change without interrupting the running of the program**.

Requirements

- The relevant hardware components are suitable for insertion and removal under voltage.
- Fault-tolerant system with CPU 414-4H or CPU 417-4H with firmware version V2.0.0 or later is available.

Use cases for plant changes

The following are considered plant changes in which the hardware of the plant is modified:

- Hardware components of a fault-tolerant system are removed.
- Hardware components of a fault-tolerant system are added.
- Hardware components of a fault-tolerant system are replaced by non-identical components.

A plant change always signifies a software change since the modified hardware is first configured in HW Config and then downloaded to the CPU. The modified hardware is then 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 • Interface modules (for example, IM 460, IM 461), only in no-voltage condition
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) • Single-sided DP slaves in any DP master system • Modules in modular DP slaves • DP/PA Coupler • PA devices (process automation) • Use of a free channel or reassignment of a utilized channel on an existing module
Changing the parameters settings for a module	• Changing 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; Fault-Tolerant Systems.*

Note

Refer to the procedure described for PCS 7 in the manual *Automation System S7-400H; Fault-Tolerant Systems*, section "Modifications to the System During Operation".

If you violate one or more rules in this procedure, the fault-tolerant system may respond in ways that restrict its availability, up to and including failure of the entire process control system.

The following table provides you with 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.

For the procedure used to replace components ...	.... refer to the manual ***Automation System S7400H; Fault-Tolerant Systems*** in section ...
Components	Adding Components in PCS 7
	Removing Components in PCS 7
	Changes to the memory components of the CPU
Parameters	Editing CPU Parameters
	Changing the parameters settings for a module

5 Failure, Switchover and Return of Fault-Tolerant Components

5.1 I/O

5.1.1 Failure of Redundant Interface Modules

Functionality

Interface modules can be configured redundantly in the distributed I/O device (ET 200M, ET 200iSP). The interface modules provide the interface to the automation system through the PROFIBUS DP. When there are two interface modules, in other words, the system is in "Redundant" mode, 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, there is a bumpless failover to the redundant interface module. In the failover, 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.

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.

5.1.2 Failure of Redundant I/O Modules

Functionality

As soon as an error occurs in one of the redundantly configured modules, there is a bumpless failover 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 the redundant input signals differ longer that the configured discrepancy time. 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. The driver blocks evaluate the status of the redundant modules.

Depassivation

Modules can be replaced during runtime and integrated with the functionally configured redundant modules.

Depassivation is requested from the user program using an acknowledgment signal, for example, on an OS.

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
- With the FC 451 "RED DEPA" function of at least one redundant module or channel is passivated.
  You can find additional information about the features and use of the FC 451 function in the corresponding online help.

Note

If automatic depassivation is not triggered, for example, after a faulty encoder is replaced, you can also trigger an overall depassivation by removing and inserting any module.

Additional information

- Online Help for *STEP 7*
- Manual *Programmable Controller S7-400H; Fault-Tolerant Systems*

5.2 Automation System

5.2.1 Failure of the Master CPU

Functionality

The initial situation is that the S7-400H is in "Redundant" system mode. The processing 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 will always continue 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 error interface module 1
  This indicates the first fiber-optic cable of the synchronization line.
- IFM2F = Interface error 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 processing of the user program. CPU1 is now the master CPU. The H system is no longer in "Redundant" system mode. If CPU1, now operating in solo mode, fails, the entire system goes down.

Example: Reintegration of the failed master CPU

When the failed CPU0 is reintegrated, it does not become the master CPU. The master CPU always 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.

5.2.2 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 or RUN- P.

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).

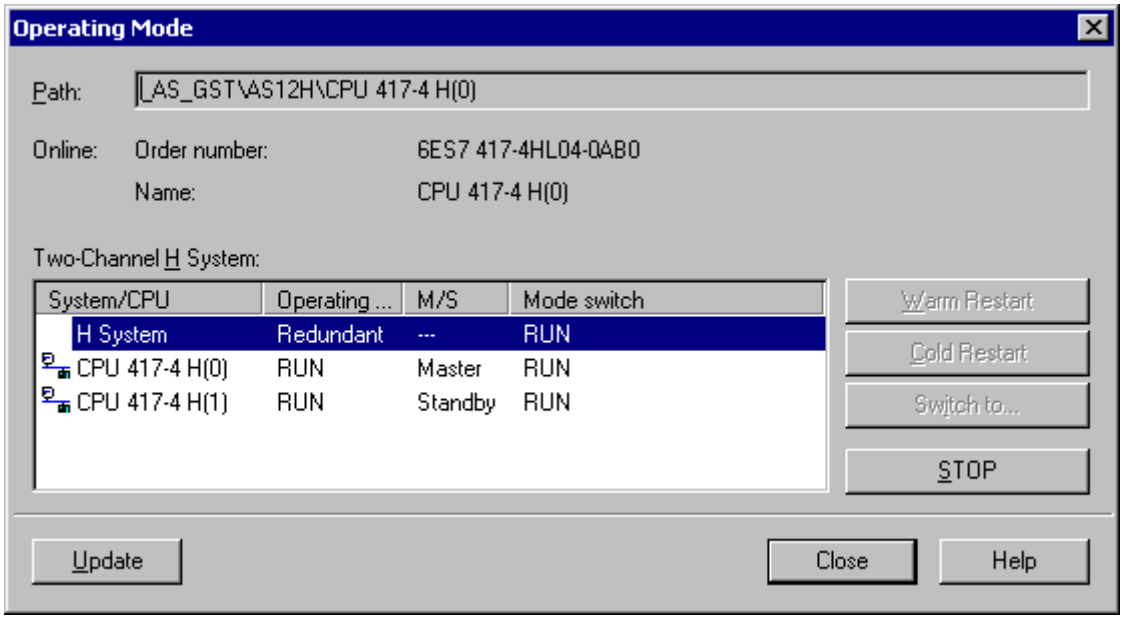
Example: Return of the CPU in rack 1

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 (STOP) to the most recent setting (RUN, RUN-P).
- You have an MPI 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 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**.

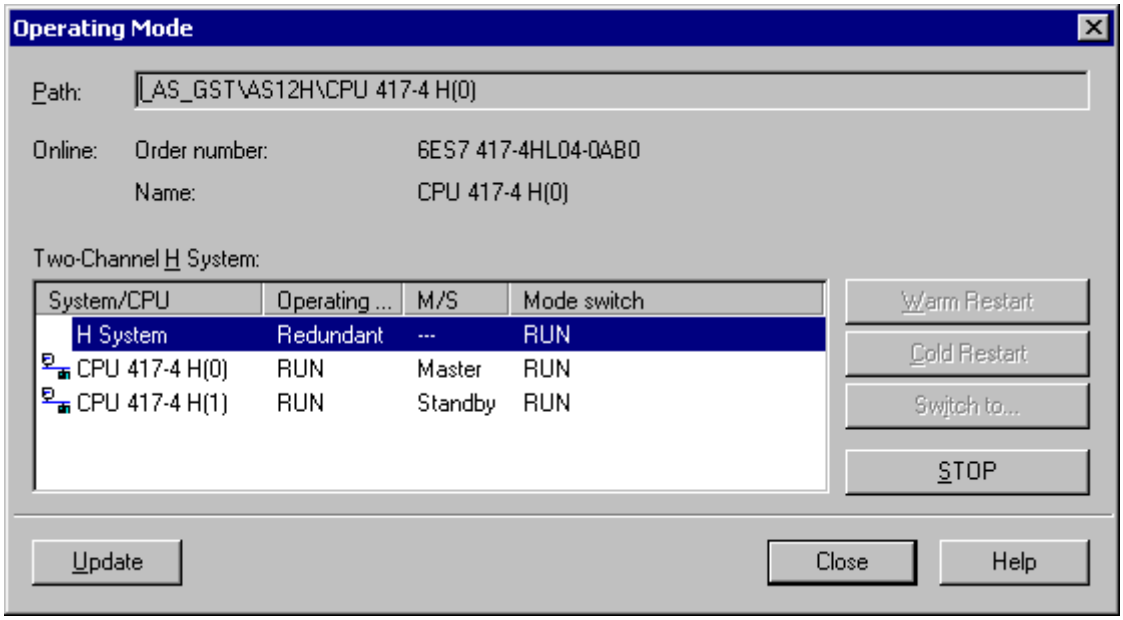
- You have an Industrial Ethernet connection to the H system:
  In the "Operating Mode" dialog box, restart the CPU in Rack 1, which is in STOP mode.
  - Open the PCS 7 project on an ES, click the "Online" icon in the task bar of SIMATIC Manager and select a CPU in the right window pane.
  - Open the 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:



5.3 Communication

5.3.1 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 (CP, coupler, AFD, AFS, cable)
- Problem on a bus line (overload, broken wire)

Additional information

- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Manual *SIMATIC NET; Industrial Ethernet OSM/ESM*
- 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-400*

5.4 OS Server

5.4.1 Failure, Failover and Restarting of 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".

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.

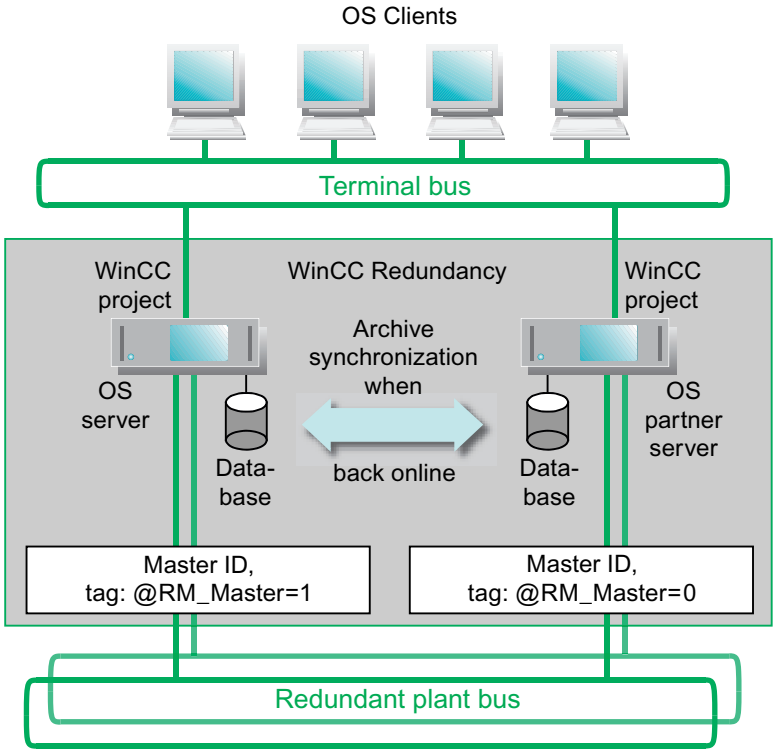
Reaction of WinCC Redundancy to possible faults

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), the message data (Alarm Logging) and the user data (User Archives) with the archive data of the active OS server when the failed server comes back online.
- By changing the system tags "@RM_MASTER" and "@RM_MASTER_NAME" according to the situation.
- By automatically interconnecting the OS clients to the preferred server or to the available OS server with master identification. The "@RM_SERVER_NAME" tag on an OS client indicates 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

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.

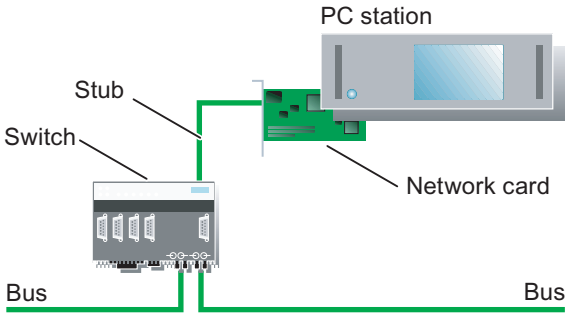
Gaps in the archive data occur on OS Server 1 during the time it is inactive. As soon as OS Server 1 returns, the gaps in the data are remedied by the following measures:

- 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. 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 card.



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 broken cable in the spur line from the network to the OS client. The terminal bus as a whole remains unaffected.

If a connection failure occurs between the OS client and the OS server, WinCC Redundancy triggers the following reactions:

- The OS client is automatically switched over from the failed OS server to its redundant OS partner server because the preferred server specified for the OS client is not available.
- When the failed OS server is available once again to the OS client, 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. 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. 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.

Additional information

- Online Help for *WinCC*

5.5 BATCH Server

5.5.1 Reaction of BATCH Servers to Failures

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 failover to the redundant BATCH server. The 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.

Notice

Data reliability

During the failover from the failed BATCH server to its redundant BATCH server, no automation process data are visualized on a BATCH client. A Operator inputs are also lost during this brief period..

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

5.6 Route Control Server

5.6.1 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 Route Control clients then fail over automatically from the master Route Control server to the standby Route Control server.

The running Route Control program is automatically resumed after the failover to the redundant Route Control server. The current route requests are then taken over by the redundant Route Control server and the visualization of the Route Control functions is continued on the clients.

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.

Notice

Data reliability

During the failover 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 failover time are neither accepted nor executed.

The route can be controlled from a Route Control faceplate during the switchover of a Route Control server.

Activating process mode of Route Control servers

Note

Note that you activate process mode of redundant Route control servers one after the other.

Additional information

- Manual *Process Control System PCS 7; SIMATIC Route Control*

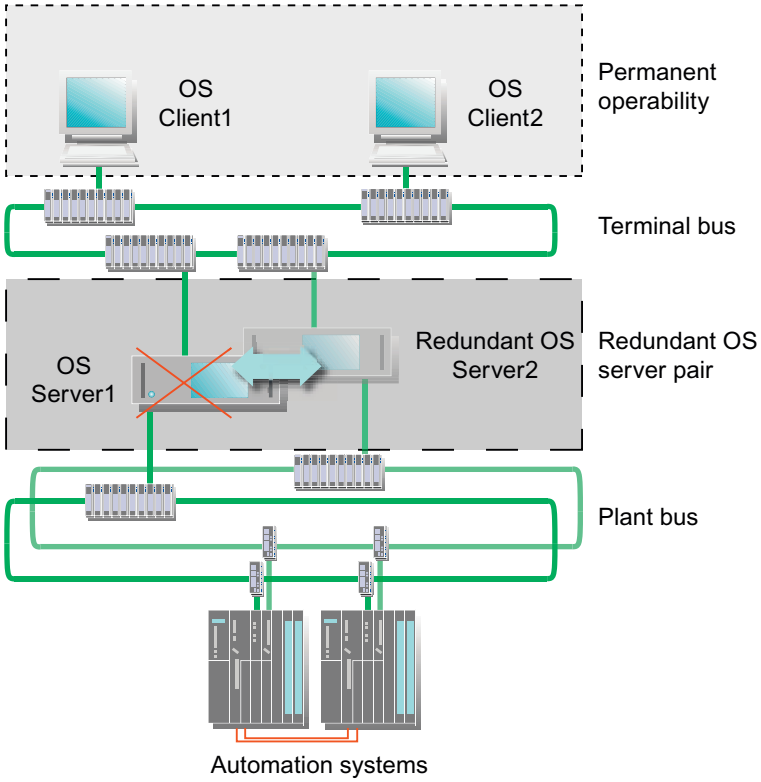
5.7 OS Clients

5.7.1 Failover Reactions of OS Clients with Permanent Operability

Functionality

If the network for the configured OS server is interrupted, the process values on the OS clients are no longer updated and process control is no longer possible. Other OS clients connected to the redundant OS partner server are not affected by this. The plant operator can therefore switch to these OS clients, if needed.

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 failover to redundant OS Server 2. However, if redundant OS Server 2 is specified as the preferred server for OS Client 2, you can continue to operate the plant during the failover from the failed OS Server 1 to redundant OS Server 2.

Once OS Server 1 becomes available again, OS Client 1 is connected to the returning OS Server 1 because it is the configured preferred server.

Permanent operability is restored after the failover is complete. OS Client 1 is not available for the duration of the failover to OS Server 1. OS Client 2 remains operable.

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 ".

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 then connect to the "new" master server.

Failover criteria of the OS client

The following faults trigger an OS client failover. 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*

5.8 BATCH Clients

5.8.1 Failover Reactions of BATCH Clients

Functionality

If the master BATCH server fails, the BATCH clients automatically switch to the redundant BATCH server.

Reactions during failover

During a failover, a message window is displayed on the screen of the BATCH client indicating the failover. The BATCH client cannot be operated during this time. The message window closes and the BATCH client can be operated only when the failover from the failed BATCH server to the redundant BATCH server is complete.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*

5.9 Route Control Clients

5.9.1 Failover Reaction 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 failover

During a failover, a message window is displayed on the screen of the Route Control client indicating the failover. 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 failover 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*

5.10 Guidelines for Updating a Redundant OS in Runtime

5.10.1 Introduction

Introduction

Below, you will find guidelines for updating a redundant OS in runtime. This means that the operation of the PCS 7 system is not disrupted, the AS does not change to STOP mode and the automation process can continue to be operated and monitored.

The redundant OS is made up of the following components:

- Redundant OS server
- OS clients

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.

Checking time-of-day synchronization

To avoid any jumps in time (UTC/local standard time) when "updating redundant systems in runtime", check the time-of-day 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. Select "The PLC is set to coordinated world time (UTC)" check box in the "PLC clock setting" area.

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
Phase 2	Updating the OS clients interconnected with Server_2
Phase 3	Downloading the connections, gateways and changes to the AS
Phase 4	Updating the OS clients interconnected with Server_1
Phase 5	Updating Server_1

The procedure described below must be repeated for all client-server relationships in the system, as appropriate.

- If you have several redundant OS servers, first update only the OS clients interconnected with the standby server that has already been updated or that have defined it as their preferred server.
- Then update the OS clients that are interconnected with the master server or that have defined it as their preferred server.

5.10.2 Overview of the Required Steps

Introduction

You update the redundant operator stations 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.
- OS Client_1 is connected to Server_1. OS Client_1 represents all OS clients connected to Server_1.
- OS Client_2 is connected to Server_2 because this is configured as its preferred server. OS Client_2 represents all OS clients connected to Server_2.

Requirements

- The updating of the PCS 7 project for the ES has been completed and all settings for the configured mode have been made. The configuration data have been loaded on the ES from NetPro.
- All OS servers and all OS clients are running PCS 7 V6.x or higher.

Overview of the required steps

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.

Phase	Steps
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 PCS 7 software installation (if you are updating the PCS 7 software) 3. Server_2: Install server operating system, PCS 7 installation "OS Server" (if you are updating PCS 7 software) 4. Server_1 and Server_2: Deactivate applications, evaluate @RM_MASTER 5. ES: Download OS connection data and target system 6. Server_2: Start WinCC 7. Server_2: Check and save the "Redundancy" dialog box 8. Server_2: Check and save the "Time Synchronization" dialog box 9. Server_2: Activate WinCC Runtime 10. Other redundant OS server pairs: Perform steps 1 through 9
Phase 2: Updating OS clients connected to Server_2	11. OS Client_2: Deactivate and exit WinCC 12. OS Client _2: Back up the PCS 7 project Back up the operating system and PCS 7 software installation (if you are updating the PCS 7 software) 13. OS Client _2: Install operating system and PCS 7 installation "OS Client" (if you are updating PCS 7 software) 14. ES: Download to OS target system 15. OS Client _2: Activate
Phase 3: Downloading the connections, gateways and changes to the AS	16. ES: Download NetPro connections and gateways to the AS 17. ES: Download CFC charts to the AS

Phase	Steps
Phase 4: Updating OS clients connected to Server_1	18. OS Client_1: Deactivate and exit WinCC 19. OS Client _1: Back up the PCS 7 project Back up the operating system and PCS 7 software installation (if you are updating the PCS 7 software) 20. OS Client _1: Install operating system and PCS 7 installation "OS Client" (if you are updating PCS 7 software) 21. ES: Download of OS target system
Phase 5: Updating Server_1	22. Server_1: Deactivate and exit WinCC 23. OS Client _1: Activate 24. Server_2: Reactivate applications, evaluate @RM_MASTER 25. Server_1: Back up the PCS 7 project Back up the operating system and PCS 7 software installation (if you are updating the PCS 7 software) 26. Server_1: Server operating system, PCS 7 installation "OS Server" (if you are updating PCS 7 software) 27. ES: Download OS connection data and OS target system 28. Server_1: Start WinCC 29. Server_1: Check and save the Redundancy dialog box 30. Server_1: Check and save the Time Synchronization dialog box 31. Server_1: Activate WinCC process mode 32. Server_1: Reactivate applications, evaluate @RM_MASTER 33. Other redundant OS server pairs: Perform steps 22 through 32

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 previous OS Client_1 is connected to its preferred server Server_1.
- Updated previous OS Client_2 is connected to its preferred server Server_2.

The updating of your redundant operator stations is complete.

5.10.3 Phase 1: Updating Server_2

Introduction

In the first phase, you update redundant Server_2. In this way, you avoid an unnecessary failover 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.

Caution

Make sure that you keep to the described order to avoid disrupting operation of the system.

Note

Perform the steps described from Phase 1 to Phase 5 without extended interruptions.

Initial situation before phase 1

- Server_1 is master server.
- Server_2 is standby server.
- OS Client_1 is connected to Server_1.
- OS Client_2 is connected to Server_2 because this 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:
  - If you are using "StoragePlus", make sure that it is not swapped out and finished.
    We recommend that you change over to a central archive server.
  - Synchronization of the archive must be complete to ensure that the process data (RT data) are consistent.

Procedure - Phase 1

Note that you will need to work alternately on Server_1 and Server_2.

1. Server_2: Deactivate and exit WinCC

- Deactivate WinCC Runtime and exit WinCC on the standby Server_2.

  The system reacts as follows:

  - OS Client_1 remains interconnected with Server_1.
  - OS Client_2, which has Server_2 configured as the preferred server, changes over to Server_1.
  - Server_1 detects a failure due to Server_2 being deactivated. If you have configured system messages, Server_1 generates a process control message to this effect.

2. Server_2: Back up the PCS 7 project, back up the operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation (if you are updating PCS 7 software) and your current PCS 7 project as a fallback strategy.

3. Server_2: Install server operating system, PCS 7 installation "OS Server" (if you are updating PCS 7 software)

- Install the server operating system (you can find information about this in the manual *Process Control System PCS 7; PC Configuration and Authorization*). An OS server operates only with the following server operating system:
  - Windows Server 2003
- Install the necessary PCS 7 components.
  In the PCS 7 Setup, select the "OS Server" 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; PC Configuration and Authorization*.

4. Server_1 and Server_2: Deactivate applications, evaluate @RM_MASTER

If you evaluate the status of the redundant OS servers in the updated PCS 7 project using the @RM_MASTER system variable, you will need to deactivate the corresponding applications on both redundant OS servers.

If the previous standby server Server_2 is activated, it becomes the master server in the updated PCS 7 project. This would result in two master servers in the system, so that the @RM_MASTER system variable cannot be evaluated unequivocally.

5. 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.

6. Server_2: Start WinCC

- Start WinCC on Server_2.

7. Server_2: Check and save the "Redundancy" dialog box

- Open the "Redundancy" editor and check the settings in the dialog box. Click the "OK" button to exit the dialog box even if you have made no changes.

8. Server_2: Check and save the "Time Synchronization" dialog box

- Open the "Time Synchronization" editor and check the settings in the dialog box. Click the "OK" button to exit the dialog box even if you have made no changes.

9. Server_2: Activate WinCC Runtime

- Activate WinCC Runtime on Server_2.

  The system reacts as follows:

  - There is no server failover. 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.

10. Other redundant OS server pairs: Repeat step 1 through 9

- If you are using more than one redundant OS server pair, you must first update standby server Server_2 for each.
- Perform steps 1 through 9 for each Server_2.

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.
- OS Client_1 is connected to Server_1.
- OS Client_2 is connected to Server_1. OS Client_2 cannot access the upgraded Server_2 as the preferred server.

5.10.4 Phase 2: Updating OS Clients Interconnected with 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 OS 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 OS 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 updating are available on OS server Server_2 only after the archives of the two servers have been synchronized. The archives can only be synchronized after both OS servers have been updated and have the same PCS 7 version.

Caution

Make sure that you keep to the described order to avoid disrupting operation of the system.

Note

Perform the steps described from Phase 1 to Phase 5 without extended interruptions.

Initial situation before phase 2

- Server_1 is master server in the PCS 7 project.
- Depending on the configuration, updated Server_2 is master or standby in the updated PCS 7 project.
- OS Client_1 is connected to Serve_1.
- OS Client_2 is connected to Server_1. An OS 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

11. OS Client_2: Deactivate and exit WinCC

- Deactivate WinCC Runtime and exit WinCC on OS Client_2.

12. OS Client_2: Back up the PCS 7 project, back up the operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation (if you are updating PCS 7 software) and your current PCS 7 project as a fallback strategy.

13. OS Client_2: Install server operating system, PCS 7 installation "OS client"
(if you are updating PCS 7 software)

- Install the server operating system (you can find information about this in the manual *Process Control System PCS 7; PC Configuration and Authorization*). An OS client can only run with the following operating systems:
  - Windows XP Professional
  - Windows Server 2003
- 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; PC Configuration and Authorization*.

14. 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_2 from the ES to the relevant OS.

15: OS Client _2: Activate

- Start WinCC on OS Client_2.
- Activate WinCC Runtime.

The system reacts as follows:

- OS Client_2 connects with the upgraded Server_2.
- As soon as Server_2 is standby, it becomes the master.

The system reacts as follows:

- As soon as Server_2 is standby, it becomes the master.

Result after Phase 2

- OS Client_1 remains connected to Server_1.
- Updated OS Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.
- Server_2 is master.

5.10.5 Phase 3: Downloading Connections, Gateways and Changes to the AS

Introduction

In Phase 3, connections, gateways and CFC charts are downloaded to the AS from NetPro by downloading changes only.

Initial situation before Phase 3

- Server_2 is updated and WinCC Runtime has been started.
- The updated OS Client_2 is connected to updated Server_2 and WinCC Runtime is activated.
- The system can be controlled from all clients.

Requirement

The PCS 7 project you are updating has already been updated on the ES.

Procedure - Phase 3

16. 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".

17. ES: Download CFC charts to the AS

If there was no download to the AS during the project update, you will 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

- OS Client_1 remains connected to Server_1.
- Updated OS Client_2 is connected to its preferred server Server_2.
- The system can be controlled from all OS clients.

5.10.6 Phase 4: Updating OS Clients Interconnected with Server_1

Introduction

In Phase 4, you update the OS clients that are interconnected with master server Server_1.

The system can be controlled at all times using OS Client_2, which is interconnected with the updated previous standby server Server_2. The same PCS 7 version is running on the active OS server Server_2 and on OS Client_2.

Caution

Make sure that you keep to the described order to avoid disrupting operation of the system.

Note

Perform the steps described from Phase 1 to Phase 5 without extended interruptions.

Initial situation before Phase 4

- OS Client_1 is connected to Server_1.
- Updated OS Client_2 is connected to its preferred server Server_2.

Requirement

The PCS 7 project you are updating has already been updated on the ES.

Procedure - Phase 4

Note

The procedure in phase 4 is essentially the same as in phase 2. In phase 4, however, OS Client_1 is updated.

18. OS Client_1: Deactivate and exit WinCC

- Deactivate WinCC Runtime and exit WinCC on OS Client_1.

19. OS Client_1: Back up the PCS 7 project, back up the operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation (if you are updating PCS 7 software) and your current PCS 7 project as a fallback strategy.

20. OS Client_1: Install server operating system, PCS 7 installation "OS Client"
(if you are updating PCS 7 software)

- Install the server operating system (you can find information about this in the manual *Process Control System PCS 7; PC Configuration and Authorization*). An OS client can only run with the following operating systems:
  - Windows XP Professional
  - Windows Server 2003
- 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; PC Configuration and Authorization*.

21. 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.

The system reacts as follows:

- Single Client_1 is connected to Server_2 or deactivated.

Result after Phase 4

- Server_1 is master server.
- Updated Server_2 is master server.
- Updated OS Client_2 is connected to its preferred server Server_2.
- Updated OS Client_1 is deactivated.

5.10.7 Phase 5: Updating Server_1

Introduction

In Phase 5, you update Server_1. Server_2 becomes the new master server because redundancy is activated in the "Redundancy" dialog box but no partner server is available.

While you perform the steps in phase 5, your system runs only with Server_2. The system remains controllable from the OS clients that were updated in phases 2 and 4.

Caution

Make sure that you keep to the described order to avoid disrupting operation of the system.

Note

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 is not controllable while you are updating Server_1.

Perform the steps from Phase 1 to Phase 5 without extended interruptions.

Initial situation before phase 5

- Server_1 is master server.
- Updated Server_2 is master server.
- Updated OS Client_1 is deactivated.
- Updated OS Client_2 is connected to its preferred server Server_2.

Requirements

- The PCS 7 project you are updating has already been updated on the ES.
- If you are using storage (StoragePlus), make sure that storage is not swapped out and finished.

Procedure - Phase 5

22. Server_1: Deactivate and exit WinCC

- Deactivate WinCC Runtime on the master server Server_1.
- Exit WinCC on Server_1.

23: OS Client _1: Activate

- Start WinCC on OS Client_1.
- Activate WinCC Runtime.

24. Server_2: Reactivate applications, evaluate @RM_MASTER

If you evaluate the status of the redundant OS servers in the updated PCS 7 project using the @RM_MASTER system variable, you can reactivate the relevant applications on the updated Server_2.

Within the system, the Server_2 is still the only master server.

25. Server_1: Back up the PCS 7 project, back up the operating system and PCS 7 software installation

- Back up your previous operating system, the previous PCS 7 software installation (if you are updating PCS 7 software) and your current PCS 7 project as a fallback strategy.

26. Server_1: Install server operating system, PCS 7 installation "OS Server" (if you are updating PCS 7 software)

- Install the server operating system (you can find information about this in the manual *Process Control System PCS 7; PC Configuration and Authorization*). An OS server operates only with the following server operating system:
  - Windows Server 2003
- Install the necessary PCS 7 components.
  In the PCS 7 Setup, select the "OS Server" 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; PC Configuration and Authorization*.

27. 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.

28. Server_1: Start WinCC

- Start WinCC on Server_1.

29. Server_1: Check and save the Redundancy dialog box

- Open the "Redundancy" editor and check the settings in the dialog box. Click the "OK" button to exit the dialog box even if you have made no changes.

30. Server_1: Check and save the Time Synchronization dialog box

- Open the "Time Synchronization" editor and check the settings in the dialog box. KClick the "OK" button to exit the dialog box even if you have made no changes.

31. Server_1: Activate WinCC Runtime

- Activate WinCC Runtime on Server_1.

32. Server_1: Reactivate applications, evaluate @RM_MASTER

If you evaluate the status of the redundant OS servers in the updated PCS 7 project using the @RM_MASTER system variable, you can reactivate the relevant applications on the updated Server_1.

Within the system, the Server_2 is still the only master server.

33. Other redundant OS server pairs: Repeat steps 22 through 32

If you are using more than one redundant OS server pair, repeat steps 22 through 32 for each Server_1.

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 OS Client_1 is connected to its preferred server Server_1.
- Updated OS Client_2 is connected to its preferred server Server_2.

The updating of your redundant operator stations is complete.

6 Diagnostics

6.1 Diagnostics for Redundant Components and Systems

Introduction

This chapter describes the testing and diagnostics features. You can use these features to perform diagnostics for individual redundant components.

Diagnostics using software programs

PCS 7 offers the following diagnostic features:

Program/Application	Component/Diagnostic Feature
Maintenance station (asset management)	The maintenance station of PCS 7 enables optimized asset management. Central monitoring of all PCS 7 components with diagnostics capability: • Operator control and monitoring stations (server and clients) • Automation systems (CPU, CPs, input/output modules, etc.) • Distributed I/O (ET 200M, ET 200iSP, etc.) • Bus components (switches, repeaters, CPs) • Diagnostics of redundant channels • Master-standby configurations • Communication connections
Hardware diagnostics	• Reading out of the diagnostic buffer of the CPU and modules capable of diagnostics • Communication properties, for example, CPs • Displays of incoming process control messages in plain text
WinCC diagnostics	• Status of logical connections • Status of tags • WinCC channel diagnostics
Lifebeat monitoring	Monitoring of all • OS servers • OS clients • Automation systems
Task bar on the BATCH server	• Status of redundant BATCH servers • Status of the data replication on the standby server
Task bar on the Route Control server	• Status of the redundant Route Control servers

Diagnostics using LEDs

The LED displays on the various redundant components enable you to determine the status of the components on the spot.

Redundant Hardware	Diagnostic Feature
PS (power supply)	LEDs
CPU (central processing unit)	LEDs
CP (communication processor)	LEDs
IM, interface module (DP interface module)	LEDs
SM, signal module (digital/analog I/O module)	LEDs

Additional information

- Manual *Process Control System PCS 7; Service Support and Diagnostics*

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