

SIEMENS

WinCC Options

Redundancy

Manual

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(We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.)

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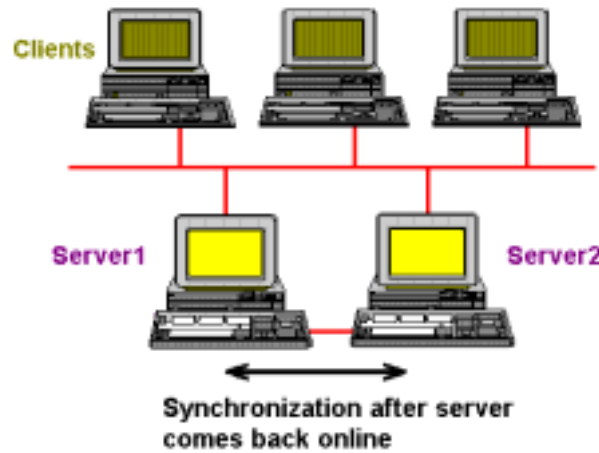
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Table of Contents

1	WinCC Redundancy	1-1
1.1	Structure of a redundant WinCC System.....	1-2
1.1.1	Structure of a WinCC System without Redundancy	1-2
1.1.2	Structure of a WinCC System with Redundancy	1-3
1.2	Functionality of Redundancy.....	1-4
2	Configuration of the Redundancy Servers	2-1
2.1	Functionally Identical Configuration.....	2-1
2.2	Prerequisites	2-1
2.3	Server-Local Messages	2-2
3	Working with Redundancy	3-1
3.1	Introduction: Creation of a Redundant System.....	3-1
3.2	Entering the Servers in Windows NT	3-2
3.3	Configuration.....	3-3
3.4	WinCC Redundancy Project Duplicator.....	3-6
3.5	WinCC Redundancy Project Switcher	3-8
3.6	Failure Scenarios	3-11
3.6.1	Scenario 1: Server not in Runtime.....	3-12
3.6.2	Scenario 2: Connection Error to the Partner Server.....	3-13
3.6.3	Scenario 3: Network Connection Error to the Client.....	3-13
3.6.4	Scenario 4: Process Connection Error	3-14
4	Appendix.....	4-1
4.1	System Messages of WinCC Redundancy.....	4-1
4.2	System Tags of WinCC Redundancy	4-2
4.3	Abbreviations	4-2

1 WinCC Redundancy

WinCC Redundancy provides a significantly higher availability of WinCC and the plant in total by running two connected server PCs in parallel.



The servers monitor each other during runtime operation, which allows them to detect a failing partner early.

If one of the two server PCs fails, the clients will automatically be switched from the failed server to the active server. As a result, all clients will always be available for monitoring and operating the process.

During the failure, the active server will continue to archive all messages and process data of the WinCC project. After the failed server comes back online, the contents of all messages and process value archives will automatically be copied to the returned server. Data gaps in the archives of the failed server are filled this way.

The WinCC Redundancy option provides you with:

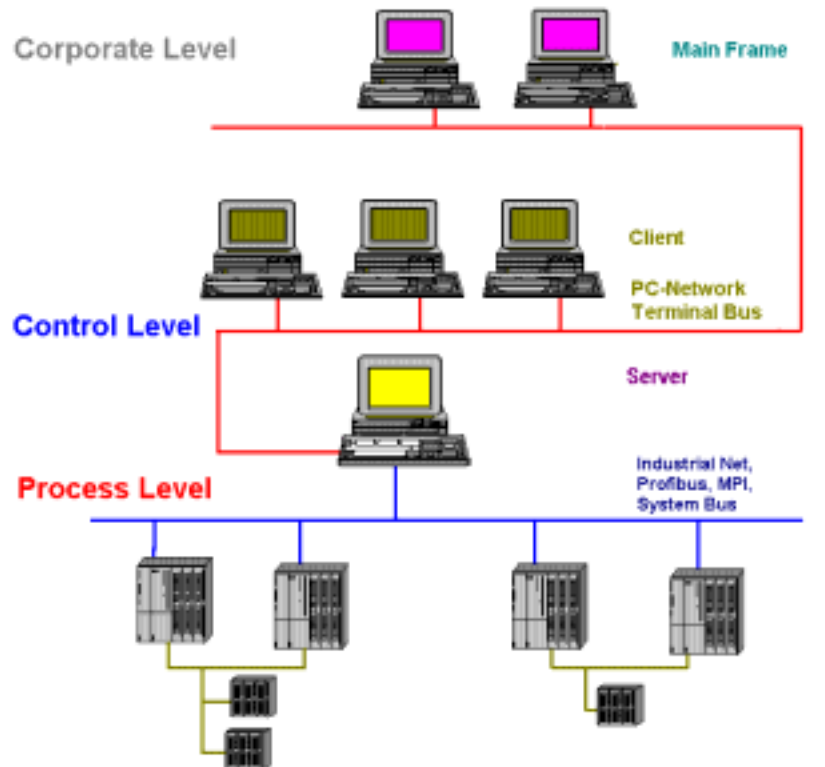
- Automatic synchronization of message and process value archives after a failed server comes back online.
- Online synchronization of message archives.
- A "Project Switcher" to automatically or manually switch the clients between the redundant servers.
- A "Project Duplicator" for copying a project to the redundant server.

Note

The redundant server PCs must run Windows NT. The clients can run either Windows NT or Windows 95. If the Project Switcher is being used, the client must run Windows NT.

1.1 Structure of a redundant WinCC System

1.1.1 Structure of a WinCC System without Redundancy



The chart above illustrates the structure of the WinCC Control Level with the Corporate Level above and the Process Level below.

As you can see, the tasks of the control level are distributed among multiple PCs. The tasks are distributed following to a client server structure.

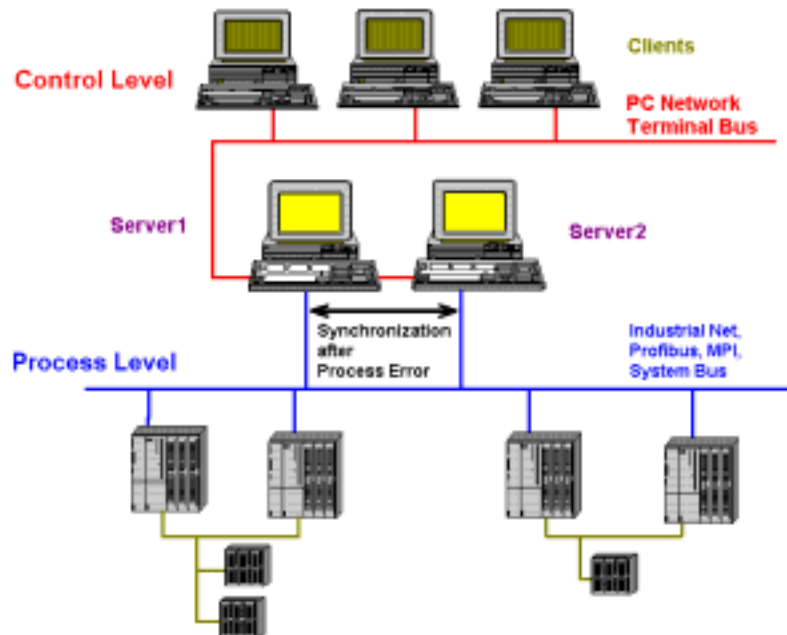
Tasks of the Servers:

- The servers acquire the process images and messages of the PLCs.
- To acquire data, the servers are connected to the PLCs via industrial networks.
- The servers provide the process data to the clients and control the processing states.

Tasks of the Clients:

- The client stations operate and monitor the entire plant.
- Clients retrieve the currently needed states from the corresponding server via PC networks.
- In general, all clients are equal and have the same rights.

1.1.2 Structure of a WinCC System with Redundancy



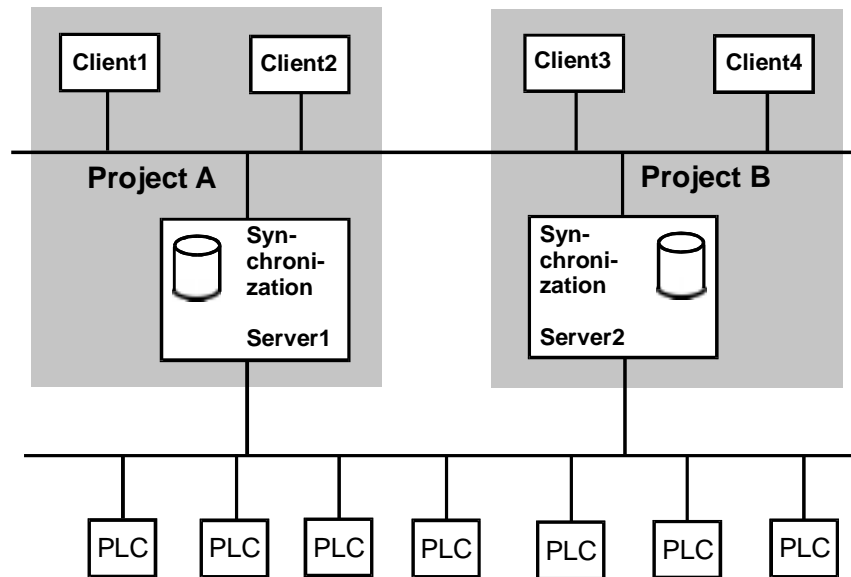
WinCC Project

Assign a group of PLCs, a server and one or multiple clients to a WinCC Project. The Project also includes all data (e.g. programs), configuration data, and miscellaneous settings.

Redundant WinCC Project

A redundantly structured Project is implemented by running an additional, functionally identical server in parallel. The two servers are connected to each other, the PLCs and the clients. See also Functionally Identical Configuration.

1.2 Functionality of Redundancy



Archiving and Archive Synchronization of the Redundant Parallel-Running Servers

WinCC Archiving during Normal Operation

During normal operation, the process data servers are running completely in parallel in runtime. Each server has its own process connection and available data archives. The process data and messages are sent by the PLCs to both redundant servers, which process them accordingly.

The servers monitor each other during runtime operation to allow for an early recognition of a failing partner server, which is then indicated by a process control message. Operator messages can continuously be synchronized online.

Both servers have equal rights and work independently of each other. They are both available to the user. Should one of the servers fail, an equal redundant server is always available.

The communication between the redundant servers, for lifebeat monitoring and archive synchronization purposes, is carried out via the terminal bus. As network, a PC LAN using the TCP/IP or NetBEUI protocols is utilized.

Failure of a Server

If one server fails, the remaining one will continue to receive and archive process values and messages from the PLCs. This guarantees complete data integrity.

The clients will automatically be switched from the failed server to the redundant partner server. After a brief switchover period, all operator stations will be available again.

Factors that trigger the Client Switchover

The switchover of the clients from the default (master) server to the partner server during a server failure, is performed automatically by the system. The following factors cause a switch of servers:

- Interrupted network connection to the server
- Server Error (WinCC Error)
- Server Failure

Factors that trigger the Archive Synchronization

The synchronization of the archives between the servers will be initiated after the following errors have been resolved:

- Process connection error. The process connection monitoring can be turned off, see "Configuration" chapter.
- Interrupted network connection to the partner server
- Project is not active
- Project has not been opened

Failed Server comes back Online

After the failed server comes back online, the Redundancy will perform an archive synchronization for the down time. The archive gap caused by the failure will be filled by transferring the missing data to the failed server. This action equalizes and makes both servers available again.

The archive synchronization is realized as a background function and runs parallel to the WinCC process and archiving. This ensures operation and monitoring of the plant at any time.

Synchronization after the Failed Server comes back Online

After the failed server comes back online, the synchronization of the message and process data archive will be performed. The failed server receives its data after a slight time delay caused by the failure.

Synchronization after a Process Error

If a network error occurs between a server and one or multiple PLCs during an operation, a synchronization will automatically be started - if this has been configured - after the error has been resolved.

Online Synchronization (Optional)

A direct server-to-server synchronization (online synchronization) is performed following Alarm Logging operator messages.

2 Configuration of the Redundancy Servers

2.1 Functionally Identical Configuration

Process Data and Message Archives

Tag Logging and Alarm Logging must be configured functionally identical for both redundant servers. Functionally identical means:

- Identical archives, where additions can be made in the form of additional measurement points or archives. These additions will not be synchronized and must therefore be updated on the partner server manually.

The following archives are synchronized by WinCC:

- Archives that are located on hard drives, i.e. process value archives, compressed archives and message archives (short-term and sequence archives).
- On the other hand, no synchronization of main memory archives is performed.

2.2 Prerequisites

The following prerequisites are expected for the WinCC Redundancy:

- The redundant server PCs must run Windows NT. The clients can run either Windows NT or Windows 95. If the Project Switcher is being used, the client(s) must run Windows NT.
- Synchronized servers are a prerequisite of the WinCC Redundancy. A time synchronization of the plant (WinCC computer, PLCs, etc.) is recommended. This can be realized using the Lifebeat Monitoring from the options package or the DCF77.exe from the SmartTools.
- Messages and acknowledgments of the PLCs and clients must always contain a time stamp (in the message) to avoid double entries (sequential reporting).
- Process values and messages from the subordinate PLCs are parallelly sent to both servers.
- The Redundancy option must be installed on both servers.
- The Redundancy servers must be configured functionally identical.
- The PMC (Process Monitoring Control) packages should be used.

Note

To safely end WinCC in the case of a power failure, the use of an uninterrupted power supply (UPS) is recommended.

If STORAGE is used in connection with REDUNDANCY and the archives are exported to a shared, third computer, the archiving drive for the redundant servers must not be the same.

2.3 Server-Local Messages

Server-local messages are also being synchronized. This includes the system operator messages of Alarm Logging and the messages of Batch-Flexible.

Additionally, a free range of message numbers (number range) is preset, in which customer specific server-local and to be synchronized messages can be directly stored. Comments for messages in this number range will also be synchronized. The numbers range from 1015000 to 1015999.

Locally generated process control messages are not being synchronized, since they are not unique, i.e. they are not specific to one computer and can not be traced to the server on which they were generated.

3 Working with Redundancy

3.1 Introduction: Creation of a Redundant System

The following introduction illustrates the creation of a redundant WinCC system consisting of Server 1 and its Partner Server 2.

Setting up the Servers and Clients on the Network

Install the network on each computer and give each computer a unique name by which it can be easily identified in the network.

Setting up the Users

After installing the network, user accounts must be set up on each computer.

Installation of the Authorization

If you did not install the Redundancy authorization while installing WinCC, you can do so by running the "authorsw.exe" program of the authorization disk. Install an authorization on each server.

Configuration of the Project

During the configuration of the WinCC Redundancy, the partner server is defined.

Configuration of the Clients

The "*Project Switcher*" allows you to configure clients so that they automatically switch to the still available server in the case of a server failure. This ensures the availability of your plant.

Note

If you configure your clients before the duplication, it is recommended to check the path statements of the project switcher (CCProjectSwitcherRt.exe) in the startup tab of the clients.

Be sure that all clients that are to be switched are known to both servers.

Duplicating the Project

To avoid having to configure the partner server for a second time, the "*Project Duplicator*" gives you the ability to duplicate the project from one server to the other.

Note

Before carrying out the duplication process, ensure that the recipient (server) has enough space and has not been recorded a client.

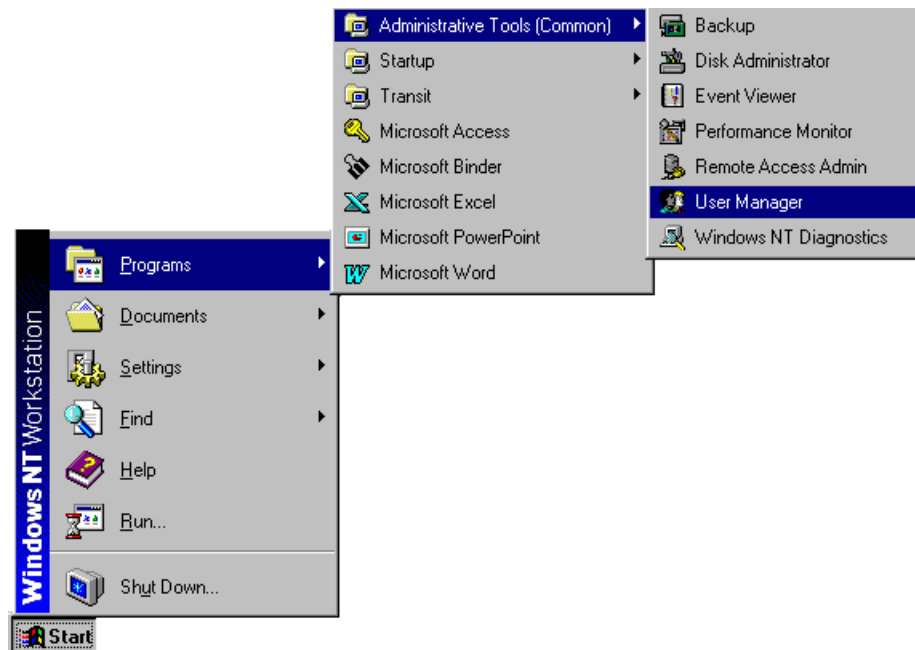
Activating Redundancy

After completing the configuration, the WinCC Redundancy is ready for use. Activate the WinCC Redundancy as follows:

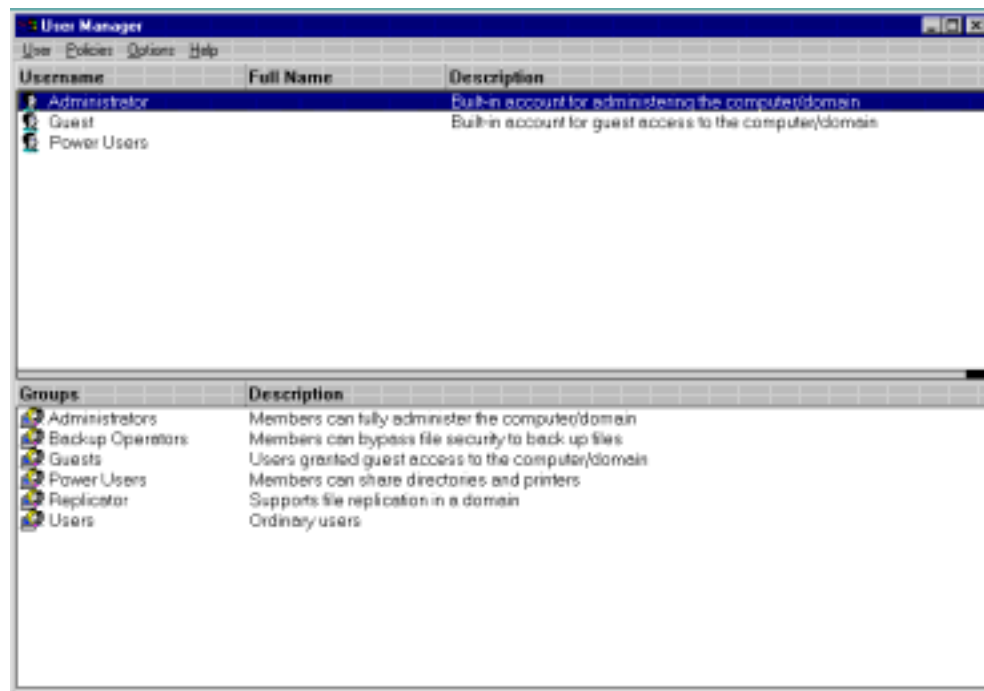
Activate the first server. Next, start its existing clients. Once they are active, activate the second server and its existing clients. The first synchronization will then be performed. The down time synchronized is the interval between starting the first and second server.

3.2 Entering the Servers in Windows NT

To enter the users in Windows NT, run the User Manager. The User Manager is called from the Windows Start menu:



In the following "User Manager" dialog box, the users are to be set up as "Power Users":



Both redundant servers must know each other on the network. To do so, enter the same user names in the Windows NT User Manager of both servers.

Note

The user must have administrator rights or be a power user.

The redundant server PCs must run Windows NT. The clients can run either Windows NT or Windows 95. If the Project Switcher is being used, the client must run Windows NT.

If more than four clients are used, the server must run Windows NT "Server".

3.3 Configuration

The WinCC "Project Duplicator" allows the duplication of an entire configuration from one server to the other. Existing plants can therefore be upgraded to the WinCC Redundancy functionality fast and easily. Additional configurations only have to be made on one server, since the redundant server can be supplied with the functionally identical project by the "Project Duplicator".

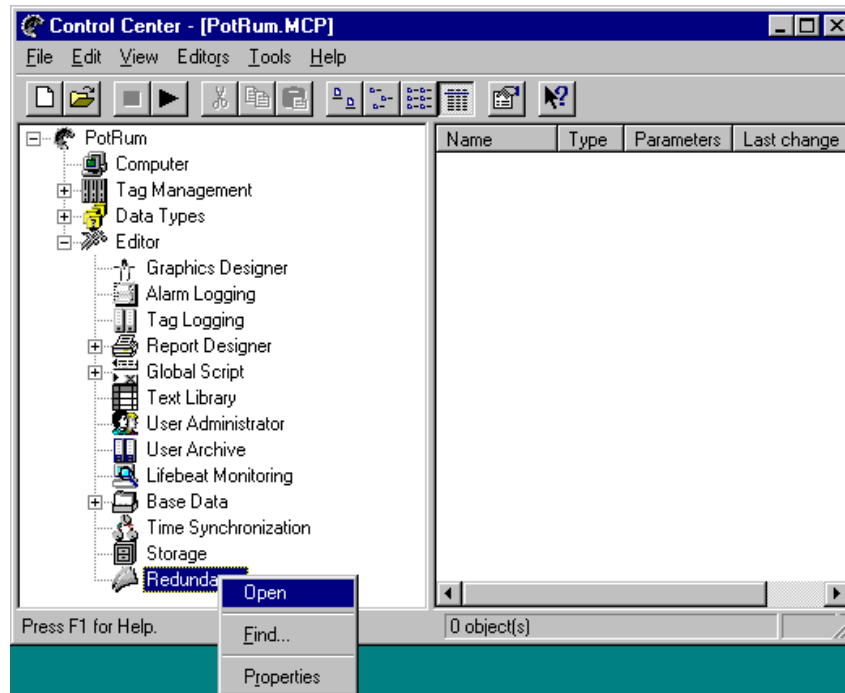
Note

The WinCC Redundancy system always consists of 2 servers. No additional Redundancy PCs should be configured as Redundancy computers.

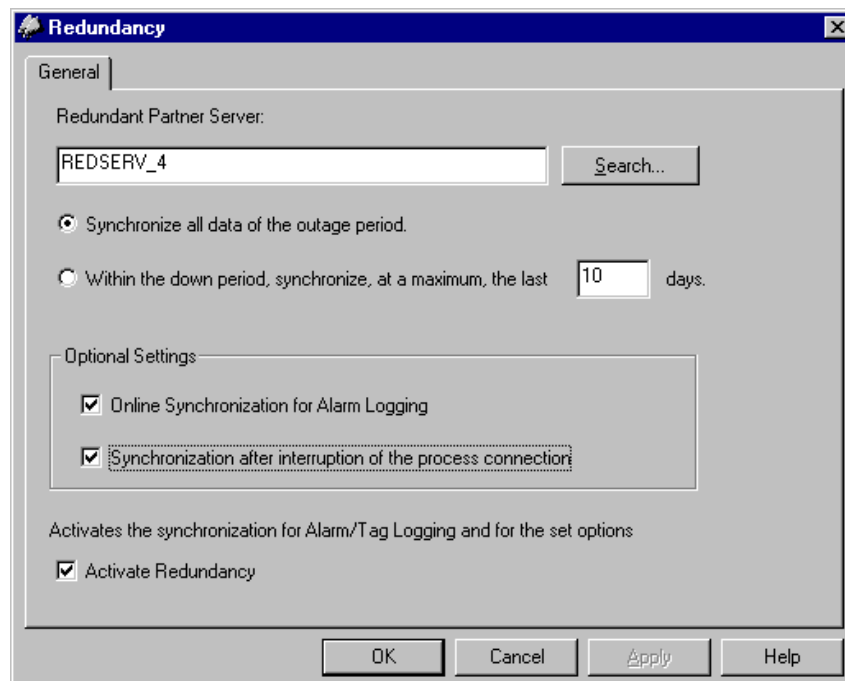
For the online alarm synchronization, the short-term archive must be configured in the message system. Afterward, computer-specific settings must be changed manually.

Procedure

To call the Redundancy system, display all editors and then right mouse click on the "Redundancy" editor. In the following pop-up menu, click on "Open".



"General" Tab



The "General" Tab	
Redundant Partner Server	In the "Redundant Partner Server" field, enter the computer name of the partner server, in our example this is "RedServ_2". The "Search" button supports you with the selection of the partner server.
Synchronize all data of the down time	The "Synchronize all data of the down time" radio button defines that all data of the entire down time are to be synchronized.
Within the down time, synchronize at a maximum the last ... days	The "Within the down time, synchronize at a maximum the last ... days" radio button defines that, for example, only the last 10 days of the down time are to be synchronized.
Online Synchronization for Alarm Logging	The "Online Synchronization for Alarm Logging" check-box defines, if a synchronization of the Alarm Logging operator messages and the messages of the reserved number range is to be performed in runtime.
Synchronization after interruption of the process connection	The "Synchronization after interruption of the process connection" check-box defines, if the network connection between servers and the PLCs of a project should be monitored. If the process connection monitoring is active, the corresponding server will perform a "Lifebeat Monitoring" to all connected PLCs. The server determines that a process connection to a PLC is faulty, if the addressed PLC does not reply. If a network error to one or multiple PLCs is detected in this way, a synchronization of all message and process data archives will be performed for all PLCs belonging to the project. This means that the archives of PLCs that have not failed will also be synchronized. If this option is deactivated, the runtime loads on the servers are reduced. Note that since an error occurring in the network of the PLCs can not be recognized if the monitoring of the network connections is turned off, <u>no</u> archive synchronization will take place.
Activate Redundancy	The "Activate Redundancy" check-box indicates if the Redundancy System is active. The Redundancy can be activated/deactivated by clicking on this field. This check-box is mainly used to temporarily deactivate the Redundancy system while configuring. If you click on the "Activate Redundancy" check-box while the Redundancy is running (indicated by the check mark), a dialog box asking you "Do you really want to deactivate the Redundancy?" will be displayed as a safety measure. This gives you the option to stop the deactivation of the Redundancy.

Note

During the configuration process, WinCC Runtime is often activated and deactivated on the server PCs. This causes archive synchronizations to be performed if the Redundancy option has been activated, which can cause noticeable degradation of WinCC's runtime performance. To avoid this, it is recommended to deactivate Redundancy while configuring.

The Redundancy can also be configured and activated while in runtime.

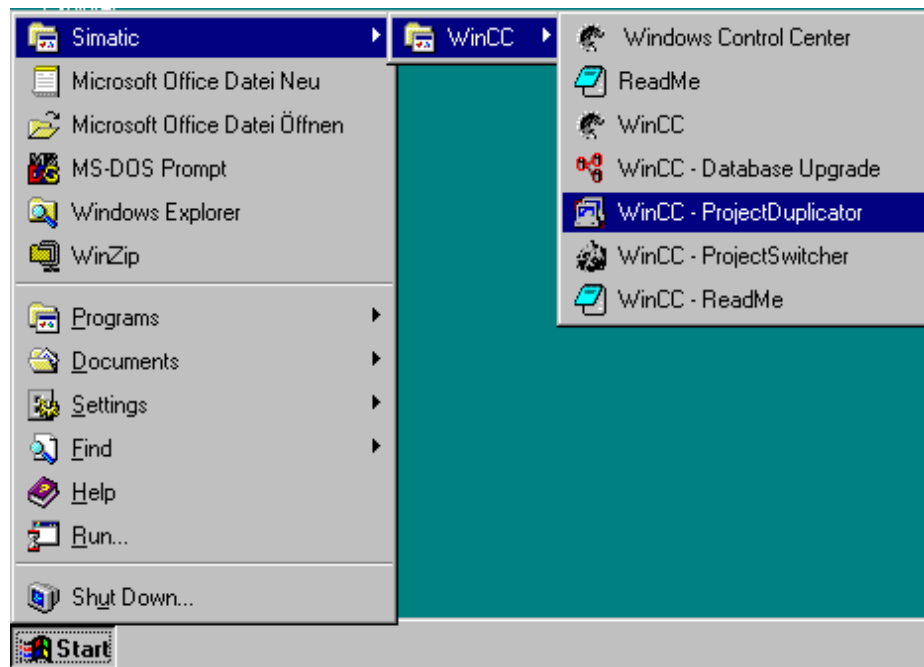
3.4 WinCC Redundancy Project Duplicator

Both servers must contain functionally identical projects. Once the configuration has been completed, the project duplicator enables you to copy all data pertaining to the Project to the redundant partner server.

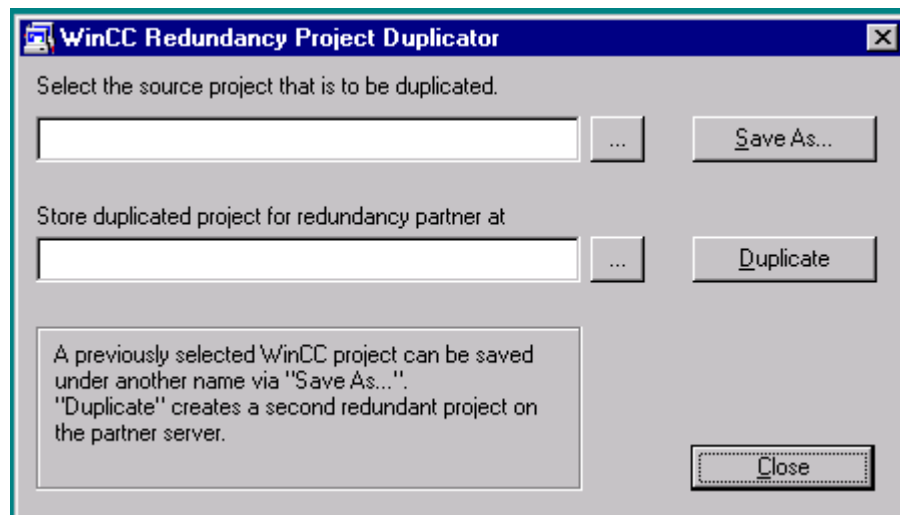
The WinCC project duplicator automatically generates and copies the redundant partner project. The project duplicator not only copies all the project data (pictures, scripts, archives, etc.), but also makes all the necessary settings on the target computer, which is then ready for the Redundancy.

Procedure

Open the WinCC Project Duplicator from the Windows "Start" menu as follows:



The "WinCC Redundancy Project Duplicator" dialog box will then be displayed:



The "WinCC Redundancy Project Duplicator" Dialog Box	
Select the Source Project	In the "Select the source project that is to be duplicated" field, the source project is selected. The "..." button helps you in finding the path name of the source project.
Duplicated Project	In the "Store duplicated project for Redundancy partner at" field, the target computer including the folder of the target project is selected. The "..." button helps you in finding the folder of the target project.
Save As	The "Save As" button allows you to create a back-up copy of the source project or you can save a project under a new name. "Save As" only saves the configuration data. The current runtime database will not be saved. But, a new, blank runtime database will be generated to ensure that a project is not started erroneously without a runtime database.
Duplicate	After selecting the source project and the target computer, click on the "Duplicate" button to start the duplication process. A completely configured partner project will then be created on the target computer.

Note

Computer-specific settings must be changed manually afterward.

3.5 WinCC Redundancy Project Switcher

The Project Switcher enables the switchover of one or multiple clients from a down server to a running server.

The switchover of the clients is performed either manually or automatically.

Note

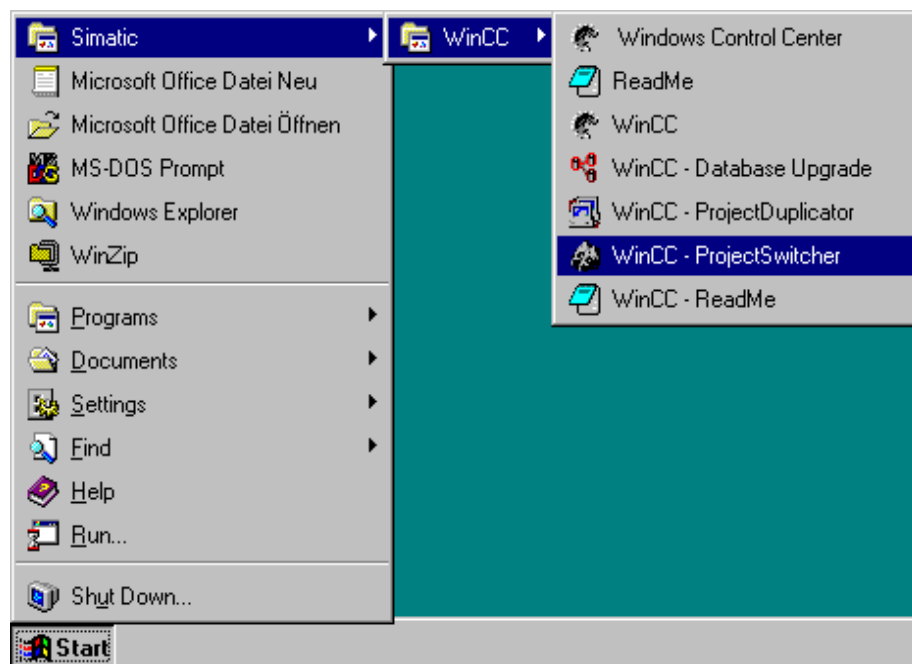
The automatic switchover of the clients is triggered by a server failure or by network errors between the clients and the current server.

The switchover process of the clients can take several minutes if the project is especially large. Because no project is active while the clients are switched over, the projects are inoperational for the duration of the switchover.

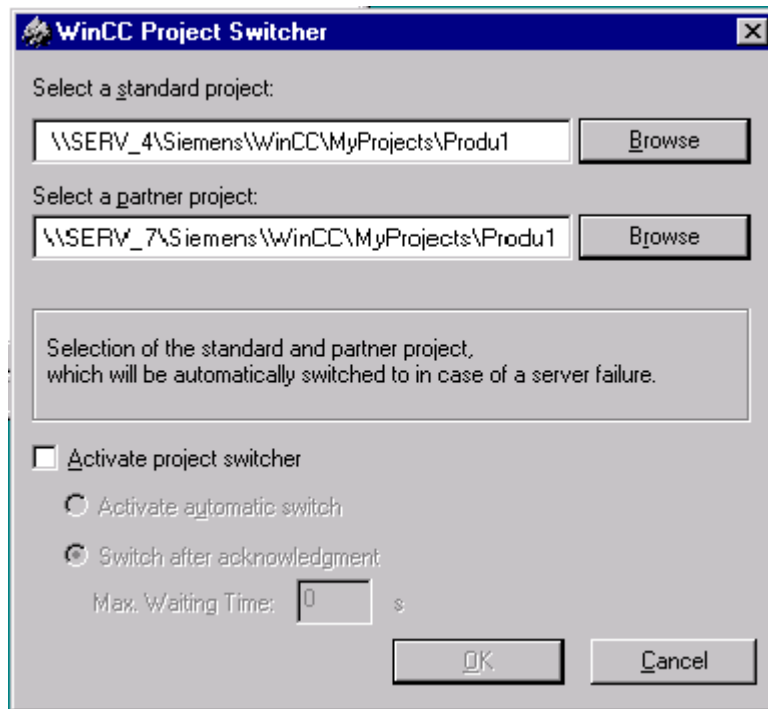
If runtime is ended or WinCC exited, the Project Switcher task at the clients is also ended. Clients can then only be switched over manually to the other server from the Control Center.

Setting the Project Switcher Parameters

To set the parameters of the Project Switcher, start WinCC on the client and open your standard project. The project must not be in runtime. To switch projects, start the "WinCC Project Switcher" from the Windows "Start" menu:



The "WinCC Project Switcher" dialog box will then be displayed:



In this dialog box, the server switchover during runtime operation is configured. Enter the following:

The "WinCC Project Switcher" Dialog Box	
Select Standard Project	In the "Select a standard project" field, enter the standard Project of the (master) server to which the client is connected by default.
Select Partner Project	In the "Select a partner project" field, enter the Project of the partner server to which the client will switch in the case of a failure.
Search	The "Search" buttons help you to find the desired project.
Activate Project Switcher	The "Activate Project Switcher" check-box enables or locks the Project Switcher.
Switch Automatically	To enable an automatic switchover of the clients in case of a server failure, the "Switch Automatically" radio button must be activated.
Switch after Acknowledgment	Instead of the automatic project switchover, a project switch can also be performed "after acknowledgment". To do so, the "Switch after Acknowledgment" radio button must be activated.
Max. Delay	If you activated the "Switch after Acknowledgment" radio button, you can define a delay time in the "Max. Delay" field. Within this delay time, the switchover can be confirmed or aborted. If the delay = 0, no action will be taken until you either confirm or abort the switchover.

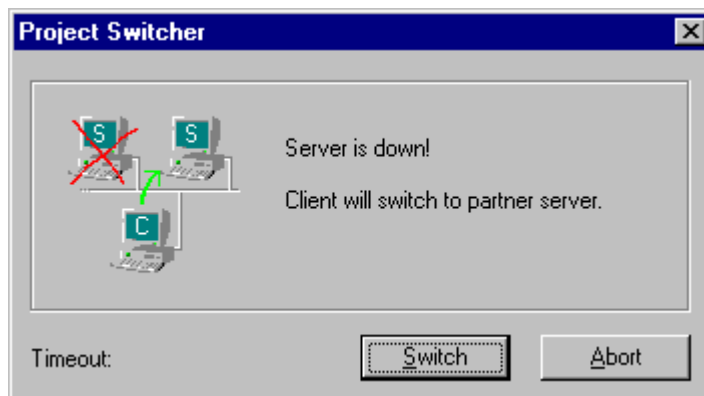
Switch Clients Automatically

To inform you about a server failure if the automatic switchover is used, the following dialog box is displayed:



Switch after Acknowledgment

If you configured the manual switchover, the following dialog box will be displayed:



Switch with a Delay

If a delay > 0 has been configured, the time remaining will be counted down in the "Timeout:" field. While the delay time is counted down, you can initiate the switchover immediately by clicking on the "Switch" button or abort the switchover by clicking on the "Abort" button. After the delay time has elapsed, the switchover will be triggered without any further input.

Switch without a Delay

If you configured no delay time (delay = zero), the dialog box above will remain on screen until you click on either the switch or abort button.

Once the switchover is complete, the Project Switcher dialog box will display the text "Switchover Complete".

Switchover via a WinCC Tag

To switch one or multiple clients to the other server during runtime, the internal WinCC tag "@RM_SWITCH" can be used. To do so, the tag must contain the name of the client to be switched.

For example, if you want to switch the client with the name "CLIENT_1" to the redundant partner project, write its name into the internal WinCC tag "@RM_SWITCH". If multiple clients are to be switched, their names must be written into this tag one after the other.

3.6 Failure Scenarios

By means of commonly occurring failures, the functionality of the WinCC Redundancy will be illustrated. The following failures will be discussed:

- Server Failure
- Server-Client Network Connection Error
- Process Connection Error

WinCC Redundancy recognizes the current error itself or reacts to error messages by:

- Saving times and events
- Synchronizing archives
- Changing master/slave identifications
- Switching over clients
- Displaying messages

Startup of the Server PCs

During startup of the server PCs, Redundancy determines if the partner server is already active. If this is the case, the server computer (1) will be set as the slave. If the partner server (2) has not been activated, the server computer (1) will be set as the master during startup. If there is a network connection error between the servers or the partner server is turned off, the master identification is reset. To identify the server computer (1) as the master, the WinCC internal tag "@RM_MASTER" will be set. To identify the server computer (1) as the slave, the tag "@RM_MASTER" will be reset. The tag "@RM_MASTER_NAME" contains the name of the server computer, for example "SERV_1". These tags can be evaluated and changed by other applications or scripts.

Redundancy only sets the above tags. Both servers are always completely equal.

Normal and Error-Free Operation

The servers independently store the process images and messages of the PLCs in their respective archives.

The servers perform a mutual Lifebeat Monitoring in short intervals to recognize a server failure as early as possible. By default, the interval is 10 seconds.

If configured, an online synchronization will be performed by Alarm Logging.

3.6.1 Scenario 1: Server not in Runtime

This scenario discusses the behavior of Redundancy, if the project has been deactivated on server 2.

The following actions are triggered:

- Server 1 stores the failure time (date and time) of server 2.
- Server 1 will report the failure of server 2 through a system message.
- If server 1 was the "slave", it will become the "master" by setting the tag "@RM_MASTER".
- If server 2 was the "master", it will become the "slave" by resetting the tag "@RM_MASTER". However, this is only possible if no essential parts of server 2 have failed.
- Correspondingly, the tags "@RM_MASTER_NAME" are changed.

Server 2 comes back Online

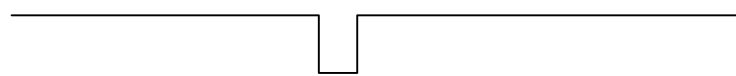
During the down time, a gap formed in the Archives of server 2. This gap will be filled by the following measures:

- Server 1 stores the return time (date and time) of server 2.
- Server 1 will report the return of server 2 through a system message.
- The gap in the message and process data archives of server 2 will be filled with the data of server 1's archives.
- In both servers, the tags "@RM_MASTER" remain unchanged, i.e. the tag "@RM_MASTER" in server 1 remains set and the tag "@RM_MASTER" in server 2 remains reset.

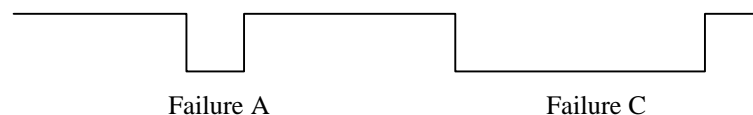
Compared to the online synchronization, the archive synchronization after a server failure can take noticeably longer depending on the number of data records to be synchronized and the computer/network loads.

If failures alternate between the two servers (see diagram), they will be synchronized one after the other. After the synchronization, all data is available in both archives.

Server1:



Server2:



In the scenario above, server 1 provides all values to server 2 for failure A – following that, server 1 will be synchronized by server 2 for failure B.

All these processes run automatically and in the background, independent of the parallelly running process value and message archiving from the subordinate PLCs.

3.6.2 Scenario 2: Connection Error to the Partner Server

This scenario discusses the behavior of Redundancy, if there is a connection error to partner server 2. In this case, both servers run without errors in runtime.

The following actions are triggered:

- Server 1 stores the failure time (date and time) of server 2.
- Server 1 will report the failure of server 2 through a system message.

Server 2 comes back Online

During the down time, a gap formed in the Archives of server 2. This gap will be filled by the following measures:

- Server 1 stores the return time (date and time) of server 2.
- Server 1 will report the return of server 2 through a system message.
- The gap in the message archive of server 2 will be filled with the data of server 1's archive.

In both servers, the tags "@RM_MASTER" and "@RM_MASTER_NAME" remain unchanged.

3.6.3 Scenario 3: Network Connection Error to the Client

In this scenario, a network connection error occurs between server 2 and its client "CL5".

The following actions are triggered:

- If configured, client "CL5" will automatically be switched from the down server 2 to the running server 1.

Elimination of the Network Error to the Client

The following actions are triggered after the network error has been eliminated:

- Client "CL5" will not be automatically switched back to server 2 by Redundancy. If the user wants to switch client "CL5" back to server 2, it can be initiated by writing "CL5" into the system tag "@RM_SWITCH".
- In both servers, the tags "@RM_MASTER" and "@RM_MASTER_NAME" remain unchanged.

3.6.4 Scenario 4: Process Connection Error

In scenario 3, a process connection error occurs at server 2, caused, for example, by a PLC failure or an interrupted PLC network connection.

A PLC connection error is recognized by Redundancy as a failure, if this error only occurs to one server. If there is a connection error from one PLC is to both servers (e.g. caused by a PLC failure), this is not recognized as failure by Redundancy.

If WinCC Redundancy recognizes a failure, the following actions are triggered:

- The process connection error is reported to server 2.
- Server 1 receives a message that partner server 2 has failed.
- Server 1 stores the failure time (date and time) of server 2.

Note

In both servers, the tags "@RM_MASTER" and "@RM_MASTER_NAME" remain unchanged. No automatic client switchover is performed.

Elimination of the Process Connection Error at Server 2

Provided that the process connection monitoring has been activated, the gap in the archive of server 2 will be filled by the following measures:

- Server 1 stores the return time (date and time) of server 2.
- The gap in the archive of server 2 will be filled with the data of server 1's archive. The data of all PLCs will be synchronized. This means that the data of PLCs that have not failed will also be synchronized.
- In both servers, the tags "@RM_MASTER" and "@RM_MASTER_NAME" remain unchanged.
- No automatic client switchover is performed.
- The elimination of the process connection error at server 2 will be reported by a system message.

4 Appendix

4.1 System Messages of WinCC Redundancy

The following system messages can be output by the WinCC Redundancy:

Message No.	WinCC Message Text
1012200	REDRT:Partner Server has failed WinCC has been ended on the Partner Server.
1012201	REDRT:Partner Server has come back online WinCC has been started again on the Partner Server.
1012202	REDRT:Projects are not functionally identical
1012203	REDRT:Archive Synchronization Error
1012204	REDRT:Internal Redundancy Error
1012205	REDRT:Connection Error to the Partner Server There is a connection error to the Partner Server.
1012206	REDRT:Connection to the Partner Server has been reestablished The connection to the partner server has been reestablished.
1012207	REDRT:Partner Server - WinCC has not been started During startup it has been detected that WinCC has not been started.
1012208	REDRT:Archive Synchronization started This message is displayed at the beginning of the archive synchronization.
1012209	REDRT:Archive Synchronization ended This message is displayed at the end of the archive synchronization.
1012210	REDRT:Tag Logging Synchronization started Start of the process data archive synchronization.
1012211	REDRT:Tag Logging Synchronization ended End of the process data archive synchronization.
1012212	REDRT:Alarm Logging Synchronization started Start of the message archive synchronization.
1012213	REDRT:Alarm Logging Synchronization ended End of the message archive synchronization.
1012216	REDRT:Synchronization has been interrupted Synchronization has been interrupted by another failure
1012217	REDRT:Partner Server Project is not active During startup it has been detected that WinCC has not been started or is not in runtime on the Partner Server.
1012218	SWITCH:Client has been switched over automatically Client has been automatically switched over to the Partner Server.
1012219	SWITCH:Client has been switched over manually Client has been manually switched over to the Partner Server.

4.2 System Tags of WinCC Redundancy

The system tags "@RM_MASTER", "@RM_MASTER_NAME" and "@RM_SWITCH" are used by the WinCC Redundancy for the master/slave control of both redundant servers and for the switchover process of the clients. These system tags can also be read and changed using other applications and scripts.

System Tags of WinCC Redundancy	
@RM_MASTER	To identify the server computer as the master, the internal WinCC tag "@RM_MASTER" is set. If the server computer is the slave, the "@RM_MASTER" tag is reset.
@RM_MASTER_NAME	The tag "@RM_MASTER_NAME" contains the name of the master server, for example "SERV_1".
@RM_SWITCH	To switch one or more clients to the partner server during runtime, the names of the clients to be switched are written into the internal WinCC tag "@RM_SWITCH" of the connected server. Redundancy will then perform the switchover.

4.3 Abbreviations

Abbreviation	Explanation
PLC	Programmable Logic Controller
CS	Configuration System, WinCC Configuration
CS	Control System
CSM	Control System Message, message pertaining to the control level
OS	Operator Station
TLG	Tag Logging
RT	WinCC Runtime
RTO	Runtime Object

Index

A

Archive Storage 3-12, 3-13

C

Clients 1-2
Configuration 1-3, 2-1, 3-3
Control Level 1-2
Corporate Level 1-2
Creation 3-1

D

Duplicating Projects 3-6

L

Lifebeat Monitoring 3-12

P

Prerequisites 2-1
Process Level 1-2
Project 1-3

R

Redundancy 1-1, 1-3
Redundancy System Messages 4-1

S

Scenario 3-12
Servers 1-2
Switching Projects 3-8

U

Uninterrupted Power Supply 2-1

W

WinCC Tag "@RM_MASTER" 3-12
WinCC Tag "@RM_MASTER_NAME" 3-12
Windows NT 3-3

