SIMATIC PCS 7 V6.1 + SP1

Redundancy and fault tolerance with PCS 7

SIEMENS
Process control systems are responsible for controlling, monitoring and documenting production and manufacturing processes.

The increasing degree of automation and the demand that these systems be cost-effective mean that the availability of the systems implemented is playing an increasingly significant role.
Failure of the control system or individual components of the control system can lead to costly production standstills.

In the case of processes in process engineering you must consider not only the loss of production caused by the standstill, but also the costly restarting of a continuous process.

Furthermore, there is the risk of losing a whole batch due to lack of quality assurance data.

In addition, if process operation without supervision or maintenance personnel is required, then the process system must be configured to be redundant across the board including all the associated components.
The availability is heightened by doubling-up all the key components of PCS 7 and ensuring support through relevant software mechanisms.

The components of SIMATIC PCS 7 can be classified as Field level, Process level and Control level components.

SIMATIC PCS 7 provides a solution for each component of a specific level.
A system is designated as being available when it is able to fulfill the tasks for which it is intended. Availability is designated as the probability that a system is functional (available) within a specified period of time.

A system is considered to be fault tolerance when an application even in the case of failure continues to be available and can continue to be used without immediate human intervention. Fault tolerance therefore designates the ability of a system to ensure unrestricted operation if one of its components fails.
In technology, the term "redundancy" generally designates the additional presence of functionally identical or comparable resources of a technical system when they are not required in a normal case of trouble-free operation.

The functional redundancy described here has the purpose of having multiple configurations of safety systems in so that if a component fails, the others ensure continued service. In addition, it is attempted to separate the redundant systems physically from each other. This minimizes the risk of the systems being subject to the same failure at the same time.
Redundancy and fault tolerance with PCS 7
Basic configuration

Operator stations

Engineering Station ES
SIMATIC PDM

PC with integrated RAID 1

OS Server
Batch-Server
RC-Server

Central Archive Server (CAS)

Industrial Ethernet / Fast Ethernet

ET 200iSP
MCC

ET 200M

ET 200iSP

Zone 1

Zone 2

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Redundancy and fault tolerance with PCS 7

Terminal and process bus ring

Operator stations

OS LAN Ethernet

OS Server
Batch-Server
RC-Server

Central Archive Server (CAS)

Industrial Ethernet / Fast Ethernet

Engineering Station ES
SIMATIC PDM

Terminal bus ring

Process bus ring

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Redundancy and fault tolerance with PCS 7
Redundant OS servers
Redundancy and fault tolerance with PCS 7

Redundant connection of sensors

Operator stations

Engineering Station ES
SIMATIC PDM

OS LAN Ethernet

OS Server
Batch-Server
RC-Server

Central Archive Server (CAS)

Industrial Ethernet / Fast Ethernet

Redundant connected sensor

ET 200M
MCC
Sensor

ET 200M
Sensoren
MCC

ET 200iSP

Zone 1

ET 200iSP

Zone 2

ET 200iSP

ET 200iSP

ET 200iSP

ET 200M

ET 200M

ET 200M

ET 200M

PROFIBUS PA
Redundancy and fault tolerance with PCS 7

PROFIBUS ring

Operator stations

OS LAN Ethernet

Engineering Station ES
SIMATIC PDM

OS Server
Batch-Server
RC-Server
Central Archive Server (CAS)

Industrial Ethernet / Fast Ethernet

PROFIBUS ring

ET 200M
MCC
ET 200iSP

Zone 1
Zone 2

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Redundancy and fault tolerance with PCS 7
Implementation of fault tolerance S7-400Hs

Operator stations

OS LAN Ethernet

Engineering Station ES
SIMATIC PDM

OS Server
Batch-Server
RC-Server
Central Archive Server (CAS)

Industrial Ethernet / Fast Ethernet

Redundant controllers
PROFIBUS

ET 200M
MCC
ET 200iSP

Zone 1
Zone 2

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Redundancy and fault tolerance with PCS 7
Double PROFIBUS ring
Redundancy and fault tolerance with PCS 7
Process bus configured as double ring
Redundancy and fault tolerance with PCS 7
4-way redundancy on the process bus

2 redundant interfaces per controller

Operator stations

OS LAN Ethernet

Industrial Ethernet / Fast Ethernet

ET 200iSP
MCC
ET 200iSP

ET 200M
MCC
ET 200M

ET 200M
MCC
ET 200M

ET 200M
MCC
ET 200M

ET 200iSP
MCC
ET 200iSP

ET 200iSP
MCC
ET 200iSP

ET 200iSP
MCC
ET 200iSP

Zone 1

Zone 2
Redundancy and fault tolerance with PCS 7
Double ring on the terminal bus

Operator stations

Redundant network cards

OS-LAN Ethernet

Industrial Ethernet / Fast Ethernet

ET 200iSP

MCC

ET 200M

ET 200iSP

Y Link

PROFIBUS PA

Zone 2

Zone 1

SIMATIC PCS 7 V6.1 + SP1

Siemens AG
The server and single stations from the PCS 7 catalog are delivered by default with RAID 1 (mirror disks).

Optionally, high-performance servers are also available as add-ons for PCS 7. They will be delivered with RAID-systems. Furthermore a lot of components can be selected as redundant:
- Power supply unit
- hotplug hard disks
- ...
Building rings is the simplest form increasing the availability. Using a ring structure the communication will not be affected by a fault.

Precondition is the usage of SIMATIC NET switches, where the functionality “Redundancy manager“ is implemented.

The bus is automatically reconfigured within a maximum of 0.3s.
Redundancy and fault tolerance with PCS 7
Implementation of redundant servers

- Implementation of redundant servers greatly increases system availability.
- It is possible to completely load the servers without loss of operability.
- The process values are captured continuously by both servers (hot stand-by).
- If one of the two servers fails, the archives are matched automatically.
- For increasing of performance the clients are divided between the two servers.
2 I/O modules for capturing process values.

Module change without loss of process values.

Partial external switching with diodes required.

Not all modules are approved for redundant implementation.

The breakdown of a module does not affect the plant. The signal is still available from the single implemented sensor.

Using 2 redundant sensors will increase the availability.
Building rings is the simplest form of increasing the availability. Using a ring structure the communication will not be affected by a single fault on the bus.

Configuration possible only with OLM → optical PROFIBUS ring
- Two S7-400s in the hot stand-by system.
- Continuous matching of the process values and the program.
- Rapid switchover in case of failure.
- Hardware changes can be loaded without CPU stop.
- Redundant connection of the ET 200 family.
- Via Y Link it is possible to connect PROFIBUS devices with just one PROFIBUS connection.
By using two IM 153-2 interface modules in a distributed I/O device you can configure switched distributed I/Os.

For redundant operation two interface modules are mounted on the bus module in the distributed I/O device.

If the active interface module fails, the passive interface module takes over the relevant functions in a bumpless transfer.

Page 2/2
Building rings is the simplest form of increasing the availability. Using a ring structure the communication will not be affected by a single fault on the bus.

Configuration possible only with OLM → optical PROFIBUS ring
In this system, one CP 1613 can fail per OS server or per AS one CPU or one CP 443-1 per automation system without affecting the functionality of the plant.

The system bus is twofold and configured as redundant with OSM in each case. This then also covers failure of the BUS component including all the components involved (OSM/ESM).

The configuration is only possible with H systems.
In this system, one CP 1613 can fail per OS server or per AS one CPU or one CP 443-1 per subsystem of the automation system without affecting the functionality of the plant.

The configuration is only possible with H systems.
Redundancy and fault tolerance with PCS 7
Double ring on terminal bus

- It is released from Version PCS 7 V6.1 + SP1
- The usage of special network cards, supporting „Teaming“ of network cards, is necessary.
- Following the concept, both rings have to be connected to each other.
- Furthermore the same advantages are valid like with the redundant ring on the process bus.