SIEMENS

# Flexible insurance against downtimes

**SIMATIC S7-400H: high availability and safety in one system – based on PROFIBUS and PROFINET**

**High-available controllers**

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# Success factor: Availability

**In response to the continually increasing pressures of cost, manufacturing companies must wherever possible rule out the possibility of plant failures or unscheduled downtimes – in all industries. In other words: the goal must be maximum productivity. This means that the economic efficiency of a plant depends directly on its availability – and therefore on the availability of the automation components used in it.**

## SIMATIC S7-400H:
## high availability for maximum productivity

All automation components – whether mechanical, electromechanical or electronic – are statistically subject to failure. This makes the necessity for maintenance and modernization work a reality. This factor alone means that the ideal availability of 100% cannot be achieved in practice.

With SIMATIC® S7-400H, however, Siemens offers a system that minimizes the probability of a production failure – and thereby makes a crucial contribution toward maximum productivity.

For this, SIMATIC S7-400H offers:

- Bumpless switchover in the event of a fault
- Integrated detection of faults before they have an effect on the process
- Online repair, i.e. replacement of defective components during plant operation
- Configuration changes, i.e. plant expansions, during operation
- Automatic synchronization of events
- High-available communication
- Redundant connection of I/O devices

### Advantages and main applications at a glance

- **Avoidance of downtimes** that a controller failure would cause – specifically in production, energy and water supply, airfield navigation lighting, marshalling yard systems etc.
- **Avoidance of high restart costs** as a consequence of data loss following plant failure – specifically in baggage handling, high-bay storage, tracking & tracing etc.
- **Protection of plant, workpieces and materials** in the event of a plant or machine standstill – especially in furnaces, the semiconductor industry, ships' rudders etc.
- **Safeguarding of operations** without supervisory or maintenance personnel – specially in wastewater treatment plants, tunnels, waterway locks, building systems etc.

# SIMATIC S7-400H: The flexible way to avoid downtimes

SIMATIC S7-400H enables you to implement solutions that are tailored perfectly to your specific task. The reasons are as follows: scalable performance, flexibly configurable degree of redundancy and easily integrated safety functionality. The integrated PROFINET interface can be used to provide system-redundant connection of the I/O devices or for plant communication when the I/O devices are connected via PROFIBUS. In every case, SIMATIC S7-400H offers you easy and extremely efficient programming and configuration in the familiar STEP 7 engineering environment.

### Tailored redundancy

- Redundant controllers for uninterrupted operation
- Redundant I/O for loss-free signal transfer from the field devices to the control system
- High-available field buses – for reliable communication from the field devices to the controller via distributed I/O

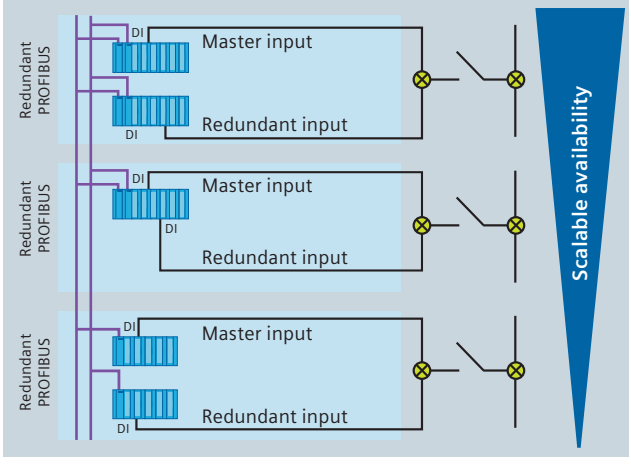
### Advantages in operation

- Trouble-free replacement of all components during operation
- Changes to the configuration possible during operation
- Early detection of faults and integrated diagnostics options
- No loss of data in the event of a fault

### Flexible modular redundancy (FMR)

SIMATIC S7-400H sets completely new standards in terms of flexibility, modularity and redundancy. The level of fault tolerance can be perfectly tailored to the requirements by mixing single and double redundancies in the same system and coordinating them with each other. Thanks to this flexibility, redundancy only has to be provided where it is actually needed. This permits less complex and more cost-effective solutions than conventional architectures with a standardized design.

Flexible Modular Redundancy on the basis of PROFIBUS



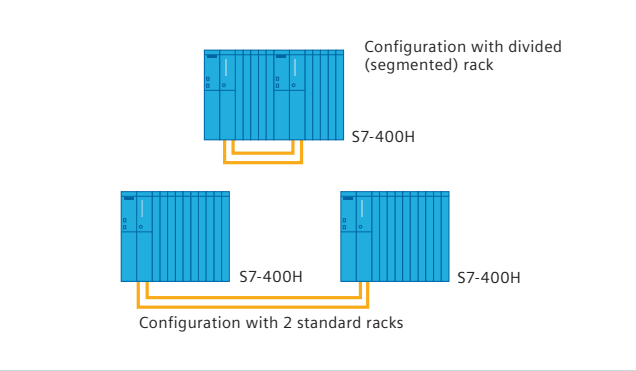



Fig. 1: Configuration of the central units

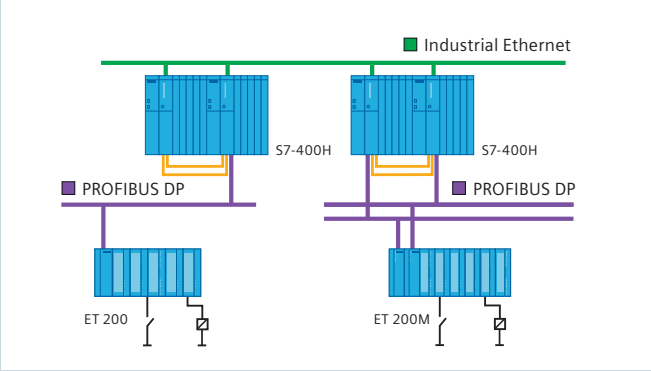



Fig. 2: One-sided (left) or switched (right) I/O interface via PROFIBUS

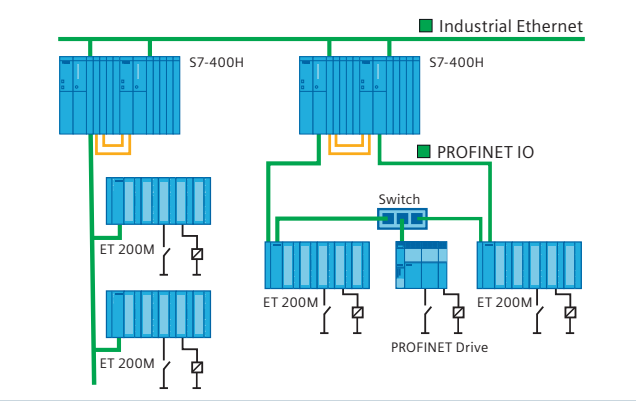



Fig. 3: One-sided (left) or system-redundant (right) I/O interface via PROFINET

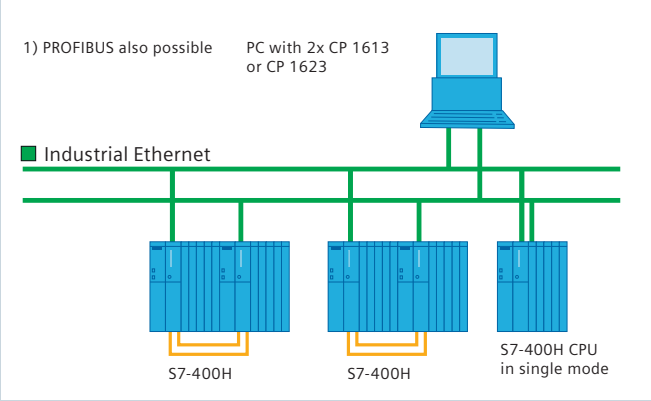



Fig. 4: High-available communication

## Tailor-made configuration and installation

### CPU

All CPUs have 5 interfaces:

- 1 PROFIBUS DP interface
- 1 MPI-/PROFIBUS DP interface
- 2 interfaces for accommodating the sync modules
- 1 PROFINET interface with 2-port switch

### Central units

Configuration options (Fig. 1):

- Configuration with segmented rack
- Configuration with 2 separate racks if the systems have to be completely separated for availability reasons. In this case the distance between the systems may be up to 10 km.
- If a particularly high level of availability is required, 2 redundant power supplies are used.

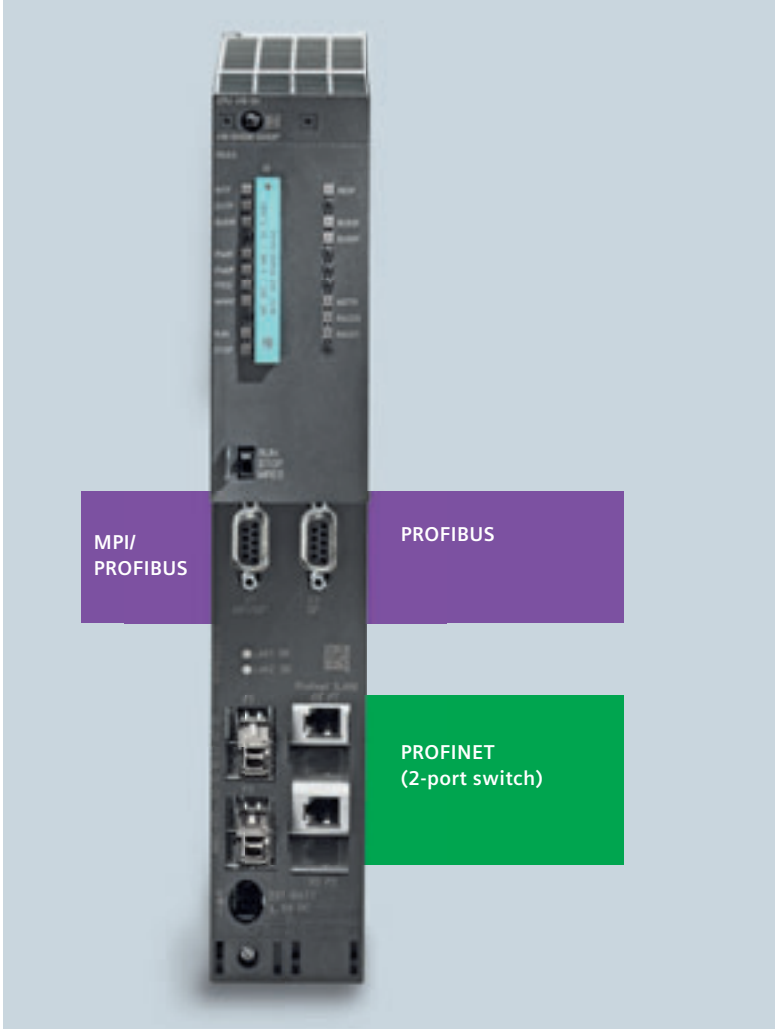
### Connection of the I/O

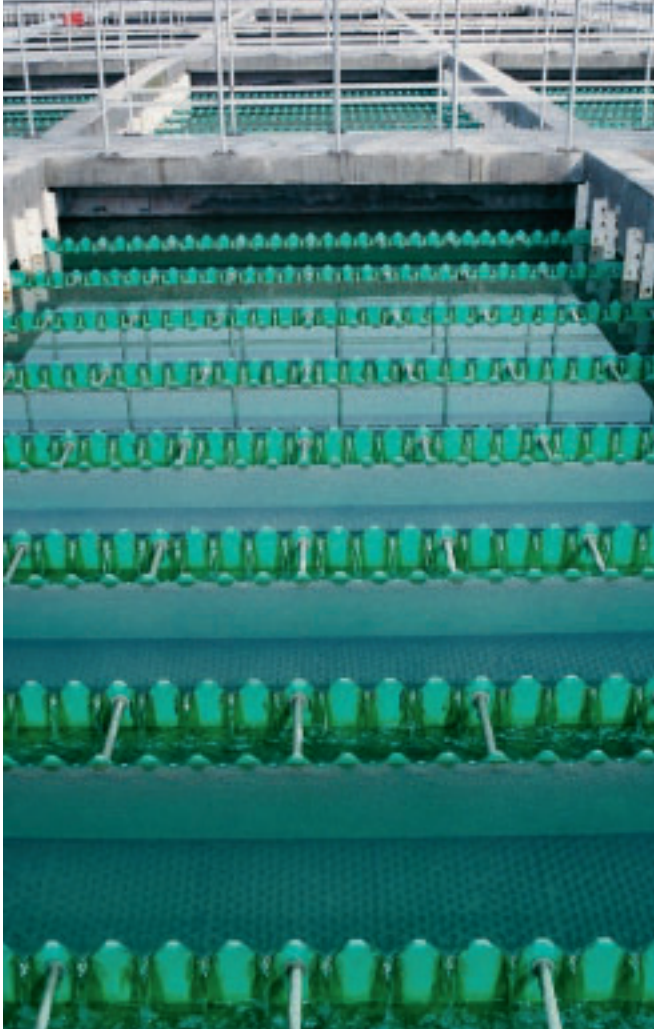
Flexible connection options via PROFIBUS and PROFINET

- PROFIBUS makes the unilateral interface (normal availability) or the switched interface (increased availability) available (Fig. 2).
- PROFINET makes the unilateral interface (normal availability) or the system-redundant connection via open ring available. The availability in the open ring is increased if devices are connected that support the PROFINET system redundancy, such as the SIMATIC ET 200M distributed I/O (Fig. 3).
- PROFIBUS and PROFINET configurations can be combined with one another.

### Communications

High-available communication (Fig. 4) for redundant connections is already integrated into the SIMATIC S7-400H. In the event of a fault, the high-available communication link takes over automatically and invisibly as far as the user is concerned.



## User-friendly and efficient engineering

The SIMATIC S7-400H is programmed as in a standard system in all STEP 7 programming languages. The programs can easily be ported from a standard system to a redundant system and vice versa. When the program is loaded, it is automatically transferred onto the two redundant CPUs. The redundancy-specific functions and configurations are parameterized with STEP 7.

## Clear advantages in diagnostics and module replacement

- With the integrated self-diagnostics functions, the system detects and signals errors before they can affect the process. This enables targeted replacement of faulty components and speeds up repairs.
- All components can be hot swapped while the system is running. When a CPU is replaced, it is automatically reloaded with all the current programs and data.
- Even program modifications (e.g. modification and reloading of blocks), configuration changes (e.g. adding or removing DP-slaves or modules) and changing the memory assignment of the CPU are all possible while the system is running.

## High availability and safety in one system

SIMATIC S7-400FH combines high availability and safety technology in a single automation system. The fail-safe and high-available controller is based on the S7-400H CPUs, the engineering tool F-Systems, the fail-safe I/O modules of the ET 200 and fail-safe communication via PROFIsafe.

On the occurrence of a safety-related fault, only the affected safety circuit affected enters a safe state thereby guaranteeing maximum safety for people, machinery, environment and process – the rest continue running.

The system is TÜV certified and complies with all relevant standards. Its architecture tolerates faults while retaining safety.

## Infrastructure example:

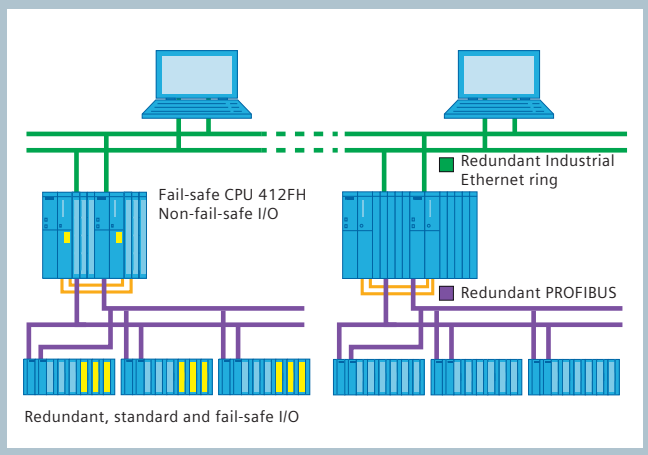
# Maximum availability – around the clock


### Requirements

Whether it is a matter of supplying water or electricity, or keeping traffic moving on streets, rails or water: in the field of infrastructure, 24/7 availability is absolutely essential. Without it, life as we know it would be unimaginable. For both rail and road transport, tunnels are particularly critical spots. For this reason, programmable logic controllers play a key role here. They are used in order to monitor and control all plant sections around the clock and with maximum reliability. These include: traffic control systems, medium-voltage and emergency power supplies, low-voltage energy distribution, air-measuring devices and video monitoring – as well as lighting, ventilation, fire alarm, loudspeaker, emergency call and radio systems.

### Solution

The high demands placed on availability and safety in tunnel systems can be met easily and efficiently using a redundant configuration of the SIMATIC S7-400H in connection with Safety Integrated. For this purpose, the entire I/O system and all sensor systems are connected to an Ethernet by means of a redundant PROFIBUS and the likewise redundant SCADA system – via the internal interfaces of the S7-400H CPUs. Safe operation is even ensured when SCADA systems or cable connections fail. The fire program, for example, operates extremely reliably even after the outbreak of a fire. In addition, the maintenance or service personnel can intervene in the event of a fault, which in turn helps to optimize the availability of the plant.




System-redundant and fail-safe I/O interface via PROFINET

## Warehouse example:

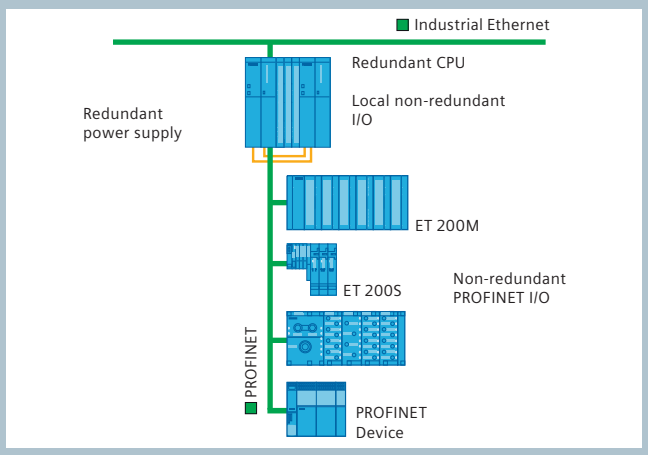
# Avoidance of data loss – and the associated high restart costs

### Requirements

In a typical warehouse, several thousand movements must be performed every day in three shifts. The corresponding orders come from the higher-level central controller. As long as this continues to function perfectly, everything runs to plan. The total failure of a single-design central controller would cause a partial loss of data with far-reaching consequences. After the restart, the stackers must be repositioned and the content of the transport containers rerecorded – and production would be at a standstill for all this time.

### Solution

The SIMATIC S7-400H high-available controller is available in redundant form. The automatic comparison between controllers ensures a consistent program and consistent data. On failure of one controller, at least one CPU is always at the latest (warehouse) status. After replacing the defective CPU, a synchronization of data is performed automatically.
If changes are required during operation, the same procedure is executed. In this case, CPU 1 is stopped, the modified program transferred and the CPU then restarted. The automatic synchronization ensures a consistent program.




Redundant controllers with one-sided I/O interface via PROFINET

## Memory and performance innovations of the S7-400H

| | CPU 412-5H | CPU 414-5H | CPU 416-5H | CPU 417-5H |
|---|---|---|---|---|
| **Memory (code/data)** | 1 MB<br>512 kB/512 KB | 4 MB<br>2 MB/2 MB | 16 MB<br>6 MB/10 MB | 32 MB<br>16 MB/16 MB |
| **MPI/PROFIBUS** | 1 | 1 | 1 | 1 |
| **PROFIBUS** | 1 | 1 | 1 | 1 |
| **PROFINET** | 1 with 2-port switch | | | |
| **Safety (optional)** | ✔ | ✔ | ✔ | ✔ |
| **Max. distance between 2 CPUs** | 10 km | 10 km | 10 km | 10 km |

Innovations

**Further information:**

siemens.com/s7-400h

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