The SIMATIC PCS 7 Process Control System
Totally Integrated Automation: Start efficiently. Increase productivity.

In the light of the growing complexity of machines and plants along with rising engineering costs, efficient engineering is a key factor for success in the manufacturing industry.

Totally Integrated Automation, industrial automation from Siemens, makes engineering efficient. The open system architecture that covers the entire production process ensures the efficient interaction of all automation components. This is guaranteed with consistent data management, global standards and uniform hardware and software interfaces. These common features minimize the engineering overheads. This reduces costs, shortens the time to market and increases flexibility.

The holistic approach of Totally Integrated Automation paves the way for better production: faster, more flexible and more intelligent. This, in turn, is the basis for real added value in all automation tasks, particularly:

- Integrated engineering
- Industrial data management
- Industrial communication
- Industrial Security
- Safety Integrated

Totally Integrated Automation creates the perfect framework for strategically harnessing optimization potential – throughout the entire production process:

- Time and cost savings thanks to efficient engineering
- Non-productive times minimized thanks to integrated diagnostic functions
- Greater flexibility in production thanks to integrated communication
- Plant and network security thanks to integrated security functions
- Protection of personnel, machinery and the environment with seamlessly integrated safety technology
- Improved quality thanks to data consistency
- Simplified implementation of automation solutions with global standards
- Better performance with the interaction of system-tested components
As one of the leading international process control systems, SIMATIC PCS 7 with the functional variety, flexibility and performance of the current version 8.1, has the potential for implementing innovative solutions that meet the special challenges of the process industry. Since function spectrum and application area extend far beyond the limits of a typical process control system, SIMATIC PCS 7 opens undreamed of possibilities and many new perspectives.

SIMATIC PCS 7 benefits from its seamless integration in Siemens Totally Integrated Automation, a complete range of matched products, systems and solutions for all hierarchy levels of industrial automation – from the enterprise management level, to the control level, all the way down to the field level. This enables uniform, customer-specific automation in all sectors of manufacturing, process and hybrid industry.
Progress you trust

We at Siemens are oriented according to the requirements of our customers and their markets. We continuously optimize our products and services to secure the competitive edge of customers through systematic further development.

In doing so, we always keep our attention on the requirements and trends in process automation: Our products, systems and solutions ensure more sustainability and help to save time and costs and our control system know-how makes a crucial contribution to boosting plant performance.

We have years of experience in all process industries. Our experts know the processes and support you with their knowledge on a daily basis when optimizing your plants. Intelligent automation and service concepts contribute decisively to the value added. They increase plant availability, profitability and process and plant safety and they are designed to protect investments and sharpen your competitive edge.

We place high demands on process management and implementation. As a partner in plant projects of all kinds and sizes, we are at your side with our specialist knowledge – based on globally standardized quality and with the help of specially trained experts for fast and efficient implementation.

Thanks to extensive research and development work, an innovative corporate culture, our understanding as a trendsetter in automation and representation on international committees, we want to do justice to our role as a motor of innovation and we consider ourselves capable, together with customers and partners, of leading the way with further developments in the process industry.

With consistent customer orientation, years of experience, high innovation and a comprehensive product and service portfolio, we create a foundation for trustworthy business relationships and satisfied customers.

SIMATIC PCS 7 is one of the world’s leading process control systems. An essential requirement for this leading position is the success of our customers who achieve maximum performance levels in their day-to-day work using ideas, products and solutions from Siemens. See for yourself:

Put your trust in performance – back SIMATIC PCS 7.
Performance you trust

In process plants, the process control system is the starting point for optimal value added: All procedures and processes can be operated, monitored and influenced with the process control system.

The process control system is the interface to the process and it enables safe process and plant control and at the same time serves as the central database from which further optimization potential can be tapped into. The more powerful the process control system, the more effectively this potential can be used. For this reason, performance is in the foreground with SIMATIC PCS 7, alongside scalability, flexibility and integration. Starting with planning and engineering, the process control system offers powerful tools, functions and features for cost-effective and efficient plant operation through all phases of the plant life cycle.

Performance through integration

Integration is one of the special strengths of SIMATIC PCS 7 and is evident in many aspects:

Horizontal integration into TIA
A system for integrated automation of the entire process chain, from incoming raw materials to outgoing goods – this is one of the decisive advantages resulting from the seamless integration of SIMATIC PCS 7 into Totally Integrated Automation.

The process control system is mainly responsible for automating the primary processes here, but it can do very much more: All ancillary facilities such as the electrical infrastructure in the form of low-voltage or medium-voltage switchgear or the building management system, can also be integrated into the system.

Vertical integration into hierarchical communication
The hierarchal communication of a company encompasses the field level, the control level and the process level, up to management and enterprise resource planning (ERP). Thanks to standardized interfaces, based on international industry standards as well as internal interfaces, SIMATIC PCS 7 is able to provide process data for analysis, planning, coordination and optimization of plant sequences or production and business processes – in real time and at any location in the company!

System-integrated tools for engineering tasks
SIMATIC PCS 7 convinces with graded functional diversity, consistent operator control philosophy and uniformly structured engineering and management tools. A central engineering system with a coordinated range of tools for integrated system engineering and configuring of batch automation, safety functions, material transport or telecontrol systems creates value added over the entire life cycle. Reduction in project configuration and training costs result in minimization of total cost of ownership (TCO).
**Integrated functions**
Depending on the typical process automation or customized requirements, SIMATIC PCS 7 can be functionally expanded for the following, for example:

- Batch process automation (SIMATIC BATCH)
- Functional safety and protection functions (Safety Integrated for Process Automation)
- Route control for material transport (SIMATIC Route Control)
- Telecontrol of remote units (SIMATIC PCS 7 TeleControl)
- Automation of electrical switchgears (SIMATIC PCS 7 PowerControl)

Further additional functions that are also integrated or can be integrated, seamlessly into the control system make optimization of processes and reductions in operating costs possible. SIMATIC PCS 7 has, for example, tools for energy and asset management and it offers higher quality closed-loop control functions, as well as industry-specific automation solutions and libraries.

**Customized performance**
Thanks to a unique scalable system architecture, SIMATIC PCS 7 creates the ideal basis for cost-effective implementation of individual automation solutions and economic operation of process plants.

SIMATIC PCS 7 users derive sustained profit from a modular system platform based on standard SIMATIC components. Its uniformity enables flexible scaling of hardware and software, as well as perfect interaction within the system – but also perfect interaction beyond system limits. The architecture of the SIMATIC PCS 7 process control system is designed in such a manner that instrumentation and control can be configured in accordance with customer requirements and optimally matched to the dimensions of the plant. The control system can be subsequently expanded or reconfigured at any time if there is an increase in capacity or a technological modification. When the plant grows, SIMATIC PCS 7 simply grows along with it – without the provision of expensive reserve capacities!

The scalability applies for all levels of the system. At the control level alone there are several functionally-compatible automation systems with graduated price/performance ratios that are available to the user. The automation performance can be optimally matched to the requirements of the plant/unit.
Scalability of the SIMATIC PCS 7 process control system

Performance in engineering

With regard to planning and engineering, performance can be equated with minimizing time and costs. SIMATIC PCS 7 offers a unique approach here in conjunction with COMOS: Integrated planning workflow from the description of the process to the automation program.

A standardized system interface, strictly object-oriented working and centralized data management mean data consistency across all planning steps including automatically updated system documentation.

With the Advanced Engineering (AdvES) option package, SIMATIC PCS 7 also handles engineering with other planning tools with maximum efficiency since plant data can be imported without problems from CAD/CAE tools.

In addition, it also allows automatic generation of the AS configuration thanks to simple multiplication of process tag types and model solutions, as well as parameter processing.

Performance in operation

Process control also becomes more complex as the multi-layer nature of automation engineering increases and it merges more and more with information technology. At the same time, rising pressure of costs makes intuitive and error-free operator input increasingly important to enable efficiency in operating personnel and to minimize downtimes and service work. SIMATIC PCS 7 supports operators optimally in their tasks and enables safe and user-friendly process control. Versatile tools are available here for reliable process optimization.

Process control and maintenance

As well as transparent process control, SIMATIC PCS 7 also offers monitoring of product quality and key performance figures for the efficient operation of your process plants and it ensures more flexible processes, higher plant availability and investment security.

The operator station of SIMATIC PCS 7 is the window to the process and the basis for safe and intuitive control of plants: Its architecture is flexibly scalable – from single-user systems to multi-user systems with redundant client-server architecture. The user interface takes into account requirements and recommendations of NAMUR (international user association of automation technology in process industries) and PI (PROFIBUS & PROFINET International).

Ergonomic symbols, task-oriented faceplates, uniform representation of status information and optimized alarm functions provide a high level of user convenience and enable safe operation of the process.
The integrated alarm management system of SIMATIC PCS 7 is a further performance feature for guaranteeing safe and cost-effective plant operation. It focuses on essentials alarms, allows selective operator prompting in exceptional situations and consistently contributes towards reducing the work load of plant personnel.

Preventive and predictive maintenance strategies reduce total cost of ownership. With the plant asset management system of SIMATIC PCS 7, you always have a watchful eye on critical production equipment such as pumps, valves, distillation columns or motors and you can carry out the relevant maintenance measures in good time before service is required – without an established maintenance plan and without the risk of an unplanned plant standstill.

**Process optimization**

As well as these functions for improving plant and process control, SIMATIC PCS 7 offers a wealth of tools and features that support optimization of the processes. These include:

- Control Performance Monitoring
- Advanced Process Control and
- Process Historian

Monitoring the control quality of the control loop ensures the maintenance of efficient plant operation. Control Performance Monitoring allows timely and above all selective, maintenance or controller optimization when performance capability wanes.

With Advanced Process Control (APC), including multivariable control, predictive control or override controls, SIMATIC PCS 7 offers decisive levers for improving plant efficiency, cost effectiveness, product quality, safety or environmental protection. These APC solutions are already stored in the standard block library and can thus be implemented at very low cost.

Current and historic process data form the basis of all optimization. Secure and user-friendly real-time data storage and analysis is handled using Process Historian. The long-term archive for information such as process tags, process alarms or batch data allows fast access to this historic plant data. The information server makes the information available to you again from the Process Historian – prepared in a clear and user-specific way with the standard reporting system of Microsoft Reporting Services.
Process automation with Siemens –
more than just reliable technology

Mature technologies, powerful hardware and software and industry-specific automation solutions create the optimal ba-
sis for your success. In addition, you will find Siemens to be a
globally positioned vendor of automation technology - one
you can trust.

► Innovation you trust

Siemens backs continuous technological innovation for your economic success today and in the future. Siemens is
currently carrying out worldwide research with approximately
29 800 employees at 188 locations and is cooperating with
research institutions of leading universities. In the 2013 fiscal
year, investments for research and development amounted to
approximately 4.3 billion Euros. As a result, approximately
8 400 inventions were registered – 38 per working day. This
high innovative strength is channeled into the products and thus has a positive effect on your results. As a trendsetter,
Siemens builds on sustainable development strategies, in-
creased application of renewable energy forms, efficient use
of raw materials and minimization of environmental pollu-
tion.

► Expertise you trust

Each sector makes special demands on automation technology, follows individual trends and must meet special
challenges. Siemens has responded to this by focusing on
industries: Our experts concentrate on individual branches
of industry. This guarantees that your contact person will be
familiar with your processes and your markets. Profit from this
experience and know-how in process control and optimiza-
tion, especially for your sector! Our comprehensive, industry-
specific range of engineering and consulting services covers
the entire life cycle of your plant, from planning to moderniza-
tion and it accompanies you in each phase with optimizing
service.

► Expertise you trust

When you choose SIMATIC PCS 7 from Siemens, you have opted for a strong, experienced partner who is at your side
with sound know-how in process automation and project
management. For efficient and fast project execution, we
have set up tried and tested guidelines and processes with
which our teams worldwide ensure a uniformly high quality
standard. To provide support, we have established a close-knit
network of experts. This includes Siemens system specialists
as well as highly qualified and authorized external partners
who provide first-class service and support in more than
190 countries of the world – from the initial consulting discus-
sion, right up to support for individual products or compre-
hensive life cycle services.

We regard our close cooperation with partners and system
integrators as a key to success in process automation. In order
to expand and intensify this collaboration, we have created
the Siemens Solution Partner program with a bandwidth that
is currently unique on the market. It combines outstanding
technology and application expertise with experience and
comprehensive product and system know-how to form a
tailor-made overall package for each individual plant project.

► Service you trust

Based on many years of experience in the field of automation
engineering, Siemens offers a comprehensive portfolio of
services, which can be modularly tailored to any requirement
and optimally adapted to the various requirements in the life
cycle of your plant. Service requirements are just as specific
as the uniqueness of each process engineering plant. The
demands for the range of services are equally different.

In addition, we offer a comprehensive consulting. For you
this means:
• Identifying potential – together with the plant operator
• Creating a custom action plan and making recommenda-
tions for its implementation

We are where you need us – on location worldwide.
SIMATIC PCS 7
performance you trust

Operator System (OS)
Single Station

Mobile Client

OS Client 427D

OS/Batch/Route Control/Maintenance clients

Mobile

Standard

automation systems

Embedded

automation systems

Compact systems

PCS 7 BOX

PCS 7 AS mEC RTX
with S7-300 I/Os

ET 200pro

ET 200M

ET 200M

SCALANCE X
switch

Integrated drives

OS server,
Batch server,
Route Control server,
Maintenance server,
Process Historian

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System administration with the Management Console

A process control system includes numerous heterogeneous components, each with specific parameters and settings. These are subject to this dynamic modification process through upgrades, upgrades, modernizations and expansions. As the plant gets older, it becomes increasingly difficult to keep track of the current state of hardware and software. Without system support, achievement and retention of the required transparency is furthermore extremely difficult.

The PCS 7 Management Console can be used to minimize the administrative requirements for a single SIMATIC PCS 7 plant or a plant network. The current status of the installed hardware and software components can be called at any time.

The PCS 7 Management Console permits:

- Central, standardized administration of SIMATIC PCS 7 software
- Creation of inventory for all installed hardware and software components of the SIMATIC PCS 7 system

With small plants, the PCS 7 Management Console can be installed and operated on the PCS 7 Engineering Station. However, a stand-alone PCS 7 Management Console on a PCS 7 Industrial Workstation is typical for medium-sized and large plants.

Central software administration

New SIMATIC PCS 7 installations, upgrades and service packs are administration components. The installation on the target station does not require active participation of the user. Security mechanisms prevent impairment of runtime operation.

- Provision of installation files on dedicated file server / PCS 7 Management Console
- Addition/removal of PCS 7 setups in the central setup management
- Creation of plant-specific or user-specific preconfigured setup packages
- Rollout of pre-configured setup packages to target stations
- Checking of target stations for installation readiness
- Implicit, remote disabling of a station for starting an update installation
- Status monitoring of the complete installation and continuation following restart or network disruption
- Implicit, remote enabling of a station after completion of an update installation

Creation of system inventory

The central creation of an inventory of installed hardware and software components simplifies the production of a detailed inventory report and permits rapid determination of candidates for updating/replacement:

- Central recording of inventory data by reading out of the engineering system or the component
- Inventory report in Microsoft Excel format
- Proof of license with installed and actually used components

For additional information, see: www.siemens.com/simatic-pcs7/managementconsole
The use of a central engineering system with a uniform and matched range of tools minimizes the configuration overhead. The engineering tools for the application software, the hardware components and the communications functions are called from a central project manager, the SIMATIC Manager. This is also the basic application for the creation, management, saving and documentation of a project.

The architecture of the Engineering System depends on how the SIMATIC PCS 7 project is processed:

- Locally, on a central engineering station
- In the engineering network (concurrent engineering, multiproject engineering)

The powerful SIMATIC PCS 7 Industrial Workstations with pre-installed Windows 7 operating system offer an optimum starting point for this. These can be used in the office sector as well as in industrial environments and can control up to four process monitors in multi-monitor operation.

Licensing of the standard engineering software depends on use of the engineering station as:

- Classic, exclusively engineering station
- Combined engineering/operator station for small applications

Engineering toolset

The complete functionality for the system-wide and project-oriented engineering – which is also the basis for asset management of the I&C equipment – is available to the planning engineer as an optimally coordinated engineering toolset.

This engineering toolset encompasses tools for effective engineering of the following components and functions:

- Mass data engineering and cooperation with CAD/CAE planning tools (Advanced Engineering System)
- Control system hardware including I/O and field devices
- Communication networks
- Automation functionality for continuous and batch processes (AS engineering)
- HMI functionality (OS engineering)
- Diagnostics and asset management functionality
- Batch processes, automated with SIMATIC BATCH
- Material transport, controlled by SIMATIC Route Control
- Safety applications (Safety Integrated for Process Automation)
SIMATIC Manager

The SIMATIC Manager is the integration platform for the engineering toolset as well as the configuration basis for all engineering tasks of the SIMATIC PCS 7 process control system. All aspects of the SIMATIC PCS 7 project are managed, archived and documented here.

Technologists as well as process and production engineers can plan and configure in their familiar environment as well by utilizing the engineering toolset designed for technological needs and the predefined blocks and charts. The uniform database of the engineering system guarantees that data which have been entered once are available system-wide.

Plant Hierarchy
Creating hierarchy folders implements a project structure, the plant hierarchy. By storing CFC and SFC charts for automation systems and pictures and reports for operator stations in a hierarchy folder along with additional documentation, the configuring engineer implicitly determines the hierarchical assignment.

Hardware configuration
The hardware required for use in a SIMATIC project – such as automation systems, communication components and process I/Os – is stored in an electronic catalog and is configured and parameterized using the HW Config application.

Encryption function for blocks
Function blocks and functions can be encrypted and decrypted with the S7 Block Privacy application to protect know-how. Following encryption, the blocks and their attributes can no longer be modified. Only the interfaces of the blocks are then visible.

Graphic configuration tool
In order to implement the automation logic, predefined function blocks are linked to other blocks in the graphic configuration tool CFC. An SFC editor is available for graphical configuring and commissioning of sequential controls.

Engineering of the operator systems
The project data for engineering of the operator systems is also organized with the SIMATIC Manager. All the data relevant to operation and monitoring of a process tag are generated automatically during definition of the automation function.

Graphics Designer
A powerful Graphics Designer supports generation of the process displays. The basis for generating process displays is provided by static symbols and dynamic block icons and faceplates that are managed in libraries and linked to the parameters of the function blocks.

Advanced Engineering System
With the optional Advanced Engineering System, configuring and commissioning can be effectively rationalized, e.g. by means of automatic generation of the hardware configuration or multiple use of standardized software modules. The Advanced Engineering System can also exchange data with higher-level planning systems for this purpose.

Complete SIMATIC PCS 7 projects or all applications of a project can be compiled and loaded into the target systems in one operation. The engineering system automatically ensures the correct sequence. A central dialog displays and controls the operation.

Selective compile and download
A more effective method for less comprehensive changes to the standard automation, e.g. addition or modification of single process tags, is selective compilation and downloading at chart level. This can be started from the plant hierarchy, from the CFC or from the chart folder.

The project engineer can recognize all changes since the last download by their color and the current chart states by means of the corresponding symbols. The project engineer can make a specific choice in a dialog form for selective downloading. In association with the Version Trail, each download is automatically followed by archiving.

In the case of blocks being executed on the AS 410 automation system, it is even possible to change types during runtime by means of seamless copying (TCIR). The new configuration data must be loaded in order to update the operator system.
The SIMATIC Manager supports the various tasks when creating a plant project by providing the following project views:

- **Component view (HW Config)**
  Configuration of hardware, such as automation systems, bus components or process IO
- **Process object view**
  Central development environment for all aspects of process tags/process objects

**Process object view**

The process object view of the SIMATIC Manager supports the work carried out by a process engineer by providing a universal view of the process tag. It shows the plant hierarchy (represented in tree form) in combination with a tabular view of all aspects of the process tag/object (general, charts, blocks, parameters, signals, messages, picture objects, archive variables, hierarchy folders, equipment properties and global declarations). This provides the technologist with fast orientation.

All objects in the marked branch of the hierarchy are displayed in the table so that they can be directly processed with user-friendly edit, filter, replace, import and export functions. A special test mode offers the facility for testing process tags and CFCs online and for starting them up.

The OS areas and the picture hierarchy for process control, as well as the SIMATIC PCS 7 asset management, can be derived from the plant hierarchy. This is also the basis for plant-oriented identification of process objects.

Group displays can be positioned in pictures by means of the picture hierarchy and automatically linked to subordinate pictures. The configuration engineer only has to ensure the correct positioning. Since the number of group display fields and their semantics can be configured, it is also possible to implement customized alarm configurations.

I&C messages and process messages are already pre-configured in the function blocks and operator input messages in the faceplates and they are generated automatically when the trigger event occurs. If required, message texts can be modified or message priorities defined.

Using the process object view, “Smart Alarm Hiding” can also be configured. This refers to the dynamic hiding of alarms that are of secondary importance to the safe and interference-free operation of the plant under certain plant conditions. Depending on the operating status of a plant unit (startup, service etc.), messages of the technological blocks grouped in this plant unit are shown or hidden in accordance with the previously set configuration. By selecting option boxes in the alarm matrix of the process object view, you can define the show/hide status of the alarms individually for as many as 32 operating states. Although hidden alarms are not signaled visually and audibly, they are still logged and archived as before.
Continuous Function Chart (CFC)

The CFC editor is used for configuration of the continuous automation functions. In addition to convenient editing functions, its scope of functions also includes powerful test and commissioning functions as well as individually configurable documentation functions.

Instances of function block types can be positioned, assigned parameters and interconnected on CFCs. Access privileges can already be assigned at the block level per block attribute, thus enabling finely graded privileges.

When creating a new CFC, a runtime group with the same name is created and automatically assigned to all blocks of this chart. Each block is therefore immediately assigned runtime properties which the configuration engineer can change or optimize using algorithms.

Special configuration techniques such as chart-in-chart for implementing hierarchical charts or the multiple uses of chart block types (individual control units/process tag types) and SFC types (standardized sequential controls) in the form of instances, offer additional rationalization potential.

The CFC editor supports the following types of standardized software modules:

- **Function block type**
  Function block types supplied with I&C libraries are used for I&C modeling of engineering equipment such as valves or motors. The smallest standardized software modules for multiple usage have connections for actuating and control signals and for parameter assignment and monitoring functions. Some also contain interlocking functions for automatic transition to defined safety settings.

- **Process tag type**
  Process tag types implemented with function blocks each represent a standardized CFC for the basic automation of specific I&C functions, e.g. for a level controller. Their instances can be modified centrally by the type-instance concept and also manually adapted and linked.

- **Individual control module type**
  The individual control module type (CMT) marks a new type of standardized software module. In conjunction with the Advanced Engineering System, this offers even more efficient engineering than classic process tag types. A CMT can contain blocks, charts, control variables (block I/Os such as signals and parameters) and messages.
Sequential Function Chart (SFC)

The SFC editor is used for the graphical configuration and commissioning of sequential controls for batch production operations. It possesses convenient editing functions as well as powerful test and commissioning functions. Using a sequential control, basic automation functions usually created using CFC are controlled and selectively processed by means of changes in operating mode and status. Sequential controls can be created either as an SFC or SFC type.

SFC

The SFC is used to implement sequential controls which can be applied once and which access several partial areas of the production plant. Each SFC has standardized inputs and outputs for status information and for control by the user program or the user. The SFC can be positioned and interconnected as a block in the CFC. The required CFC block I/Os are selected by simple operations and connected to the steps and transitions of the step sequences.

A status manager conforming to ISA-88 enables the configuration of up to 8 separate sequencers within a single SFC, e.g. for states such as RUNNING, HOLDING or ABORTING or for different operating modes.

SFC type

SFC types are standardized sequential controls which can be applied repeatedly and which access one partial area of the production plant. They can be organized in libraries and handled like normal function blocks, i.e. they can be selected from a catalog and positioned, interconnected and parameterized as an instance in a CFC chart. Changes to the original automatically result in corresponding changes in all instances. An SFC type may contain up to 32 sequences. Using the function "Create/update block icons", a block icon is automatically positioned and interconnected in the associated process display for all SFC instances with HMI features.

Process Control Libraries

The use of library elements plays a major role in minimizing the amount of engineering required and thus also the project costs. In the engineering standard software of SIMATIC PCS 7, two I&C libraries are integrated, the pre-installed Advanced Process Library as well as the post-installed SIMATIC PCS 7 Standard Library.

Preconfigured and tested blocks, faceplates and symbols are organized in these libraries and form the basic elements for the graphic configuration of automation solutions. The comprehensive range of blocks can be categorized as follows:

- Blocks for mathematical operations, analog and digital logic
- Interlocking blocks
- Technological function blocks with integral display, operation and signaling functions, e.g.:
  - Standard control blocks
  - Advanced Process Control blocks
  - Motor and valve blocks
  - Counter blocks
  - Dosing blocks
- Blocks for integration of field devices
- Operator control and monitoring blocks
- Signaling and diagnostics blocks

Pre-configured process tag types for process control equipment such as pumps, valves, dosers and controllers (cascade, split-range) etc. extend the spectrum.

In SIMATIC PCS 7, several versions of a library can coexist next to each other. This simplifies the adaptation of the user software for a system upgrade.
Advanced Process Library

The Advanced Process Library (APL) is based on many years of experience of project engineers and plant operators and takes into consideration current NAMUR recommendations and PNO specifications.

Proven functions as well as visually attractive GUIs for a high level of operator convenience facilitate and also force interaction of operators with the plant. Alternative, small versions of function blocks reduced to core functions, whose block icons and faceplates occupy less space in the process display, improve clarity in complex process displays.

Other notable features:

- Special operating modes
  - "Local" for integration of local control options
  - "Out of service" for deactivating a measuring point for maintenance
- Several faceplate views
  - "Preview" with information on the I/O signal status, automatic control and possible/permissible operator inputs; display of real value for simulation
  - "Memo view" for temporary operator information
- Convenient interlocking blocks with initial signal information, can be directly called from technological blocks
- Flexible scaling of functions in the library blocks
- Commissioning support through direct simulation on the operator station
- Protection against operator errors as the result of detailed grading of user privileges
- Explicit enabling/disabling of operations for a process tag for individual operator stations of the plant
- Integration of any compact drives and switch/starter objects via standard PROFIBUS profiles
- Coordination of multiple access operations, e.g. of SFC/SIMATIC BATCH, to the equipment such as valves, pumps etc.
- Tacking of operator input windows facilitates repeated, successive operations

Industry library and Condition Monitoring library

Industry library and Condition Monitoring library extend the standard functionality of APL. All display icons, function blocks and faceplates of these libraries are designed in the style of the APL.

The Industry Library contains blocks for:

- Building automation (heating, ventilation, air conditioning)
- Operator control and monitoring using Comfort Panels
- Integration of SIMATIC S7 package units (optimized for S7-300)
- Interfacing of external Advanced Process Control systems
- Multiple control room concepts
- Other technological functions, e.g. for expanding measured value monitoring or specifying a setpoint trend

The Condition Monitoring Library contains blocks for:

- Monitoring of centrifugal pumps (PumpMon)
- Monitoring of control valves (VlvMon)
- Detection of stationary states in a dynamic process (steady state)
- Online valve test during operation (PST)
- Monitoring for pressure loss and early detection of blockages (PressDropMon)
Shared configuration tasks

Concurrent engineering
With concurrent engineering, multiple project engineers can work concurrently on one project in CFC and SFC, without having to split the project up into sub-projects beforehand. During commissioning, for example, charts can be used in the online (debug) mode and at the same time changes can be made to the project. The Graphics Designer supports parallel work on a project even when creating plant pictures.

The project is localized on one of the participating Engineering Stations, the project server. The Engineering Stations working as “Project Clients” can access the project data via LAN/WAN. A specific chart can be found very quickly using a cross-project search function.

CFC and SFC charts can be opened and viewed by several project engineers concurrently. However, the system rejects concurrent write accesses to the database. If the project engineer attempts to access a chart which is already being used, a corresponding warning is output in a dialog window.

Every Engineering Station in the network (project server/client) is able to download configuration data to a SIMATIC PCS 7 subsystem provided it has the required communication connections.

Multiproject engineering
Multiproject engineering permits division of a complex project into several subprojects in accordance with technological criteria in order to allow several teams to work on the project in parallel. To achieve this, a host “Multiproject” is defined in the SIMATIC Manager. The individual projects can be added or removed from a multiproject at any time.

The subprojects in a multiproject are stored on a central server and moved to the local engineering stations for editing. The engineering performance is thus unaffected by network access.

The technological division and combination of projects is supported by the Branch & Merge functions. For the charts or units copied into another project for editing, cross-project interconnections, typically e.g. for interlocks, become textual interconnections. When merging, textual interconnections can be closed at the press of a button. Charts with the same name in the original object are overwritten.

Central configuration functions for multiprojects help to reduce the configuration overhead. For example, a hierarchy folder can be created automatically in all projects. Then, although only the original can be modified in the original project, objects can be inserted in all folders. All block types used in a multiproject can be updated centrally.
Access check and change verification

SIMATIC Logon, the user administration and access control function integrated into the engineering system, offers the plant operator excellent system support when verifying changes in combination with the detailed recordings in the change logbook.

With SIMATIC Logon, the administrator can divide users into groups with different access rights, thus controlling the access to data. Access rights for stations of the process control system and operator privileges for blocks can both be set up. Configurable modification protocols can record all access operations to the engineering system as well as all online changes concerning the automation systems, operator systems, SIMATIC BATCH or SIMATIC Route Control.

If you link the modification reports during the evaluation with the data of SIMATIC Logon, it is possible to verify clearly who has made a particular change and when. Such verifications are often the object of special sector-specific requirements, formulated, for example, in FDA 21 CFR Part 11 or GAMP.

Version Cross Manager

The Version Cross Manager is a user-friendly tool for determining the differences between various versions of individual projects or multiprojects by:

- Tracing missing, additional or differing objects by comparing hardware configuration, communication, plant hierarchy, CFCs/SFCs, SFC details, block types, alarms, global variables, signals and run sequences
- Graphic display of comparison results in a combination of tree and tabular formats
- Clear hierarchical structuring according to the plant hierarchy of the plant
- Color-coded identification of the differences

Version Trail

When used together with SIMATIC Logon, SIMATIC Version Trail permits version-specific archiving of libraries, projects and multiprojects. SIMATIC Version Trail tags the data with a version ID when archiving and enters the following information in the version history:

- Version
- Version name
- Date and time
- Users
- Comment

Individual versions can be retrieved from the archive and used further. SIMATIC Logon organizes the access protection.

Archiving and retrieval procedures can be automated on a time-driven basis. Retrieval of block parameters from the automation system can be coupled with the archiving procedure, but can also be performed independent of this on a time-driven basis and with version assignment.

The version history managed by Version Trail can be displayed and printed. An already completed version cannot be modified at a later date. In conjunction with the Version Cross Manager, an archived version can be compared with an existing project or a second archived version.

Project documentation

The reporting system integrated into the engineering system can be used to document the engineering project in accordance with standards. The project report records:

- Mimic diagrams and picture objects with properties, events, actions and direct links
- Variables, properties and communication links
- Message classes, message blocks and messages
- Archive tags and configuration data for archives
- User groups and users
- Source text of actions/functions
- Texts of text library
- Basic Process Control configuration data

The project data can be freely-structured, edited in the form of standardized circuit manuals and printed in a uniform layout. You can incorporate your own cover sheets, layouts, graphics, logos or title block data. A convenient output control function allows you to select a complete project or individual parts of a project for printing.
SIMATIC PCS 7 Advanced Engineering System (AdvES)

Using the AdvES, consulting engineers and planning offices as well as end customers can significantly reduce their configuration and commissioning costs while simultaneously improving the engineering quality.

The AdvES which can be called in the SIMATIC Manager from a SIMATIC PCS 7 project expands the functionality for plant configuration in cooperation with higher-level CAD/CAE planning tools. It acts as a link between standard engineering tools from the SIMATIC PCS 7 Engineering Toolset (CFC, HW Config, plant hierarchy) and tools for basic and detailed planning, e.g. EPlan, ELCAD or SmartPlant.

AdvES uses various data import options in order to collect existing engineering data from the SIMATIC PCS 7 process control system and from process tag and signal lists in Microsoft Excel format and to prepare these for utilization in the SIMATIC PCS 7 engineering system.

Data from process tag and signal lists can be automatically imported into AdvES. Integrated change management supports the repeated importing of modified data from Microsoft Excel.

AdvES recognizes process tags in Excel lists after the first assignment, automatically assigns them to process tag types of any PCS 7 project library and then generates the following data:

- PCS 7 process tag instances with signal and parameter settings
- Plant hierarchy (PH)
- Hardware configuration

Inconsistencies can be detected quickly by means of plausibility and data consistency checks, displayed in a log and then eliminated in a targeted manner.

Manual processing functions for editing plant hierarchies and process tags as well as for interconnection of signals between process tags allow completion of the imported data. Special editors for mass data processing offload the project engineer from time-consuming routine work.

With the support of integrated design templates, the different table views of the AdvES data can also be displayed as reports and printed.

The user is supported in carrying out tasks by integrated workflow management. The sequence and progress of execution are displayed in a header.

Mass data engineering

The AdvES rationalizes mass data engineering by means of multiplying standardized software modules. Both the individual control module types (CMTs) and the classic process tag types are supported. AdvES is optimized for working with the control module types.

A CMT library of the PCS 7 Basic Control Modules (BCMs) is integrated into AdvES. With system support, any user libraries with process tag types can be converted into control module types.

Blocks, links, connections or messages can be added later to a CMT or removed from it, even if instances (individual control modules (CMs)) already exist. In this way, versions of process tag types can be defined very easily for multiple uses. The instances can be checked for deviations from CMT and adapted if necessary.
Engineering System

Engineering system highlights

- Central hardware and software configuration which is uniform throughout the system through use of one engineering system
  - Low-effort parameterization of communication
  - Same configuration for redundant plants
  - Integrated configuration for field devices and safety-related applications
- Technology-oriented configuration
  - Functional hierarchy organized according to plants, units and technical equipment
  - Hardware-independent engineering: AS assignment and I/O modules can be subsequently selected
  - Expandable on industry-specific basis using standard data exchange interfaces
- Integral user administration with access control
- Libraries with sophisticated control functions:
  - Advanced Process Library (APL)
  - Industry Library
  - Condition Monitoring Library
- Central dialog for compilation and loading of AS, OS and SIMATIC BATCH modifications
  - Optimization of sequence and control by dialog with sequence control
  - Compilation and loading in one operation: minimum turnaround times
- Selective compiling and downloading on the chart level
- Process object view for display and processing of all aspects of process tags/objects
  - Convenient editing in tables
  - Process library with import/export functions
  - Online mode for testing and commissioning
- Block type changes during ongoing operation with AS 410 (TCIR)
- Shared configuration tasks: Concurrent Engineering or Multiproject Engineering with Branch & Merge
- Configuration-dependent hiding of alarms for specific operating states
- Special SFC functionalities:
  - SFC type: sequential control for multiple use, instances as block in the CFC
  - SFC: sequential control for single use, also with chart I/Os
  - Separate sequences for states such as HOLD, ABORT or SAFE STATE, conforming to ISA-88
- Lower engineering/validation overhead:
  - libraries with functions, faceplates, icons and process tag types
  - Type-instance concept with central modification option for all instances
  - Central updating of all block types of a multiproject
  - Many automatic configuration steps (auto engineering)
  - Simple duplication of units by copying, renaming and compilation
- High-performance version management with version comparison and version history
- Automatic generation of diagnostics displays for the maintenance station on the basis of the project data
Integrated engineering

COMOS – A database for everything

The basis for the Integrated Engineering is a data model in which there in exactly one instance of all engineering information of a project. In addition, all data on the engineering objects of the facilities is available directly, with consistent content and at all times, for example for the plants, pipelines, EI&C systems, instrumentation and automation engineering. It is irrelevant whether facility workers are located close together or are part of a global project team from different countries: The database is always the same – without exception.

We are the only provider worldwide to offer the process industry a software solution for holistic management of plant projects – from planning through operation and modernization up to decommissioning. COMOS ensures that planners and operators can access all project-relevant data at any time, across all levels of corporate organization and all project phases. This has become possible through the consistent object orientation of our pioneering software solution. In addition, COMOS also manages the complete plant documentation.

A bridge between two worlds: Integrated engineering with COMOS and SIMATIC PCS 7

Integrated engineering with COMOS and SIMATIC PCS 7 bridges the gap between plant planning and I&C and thus to the operating phase: It permits totally integrated engineering throughout all planning phases of an industrial plant with a reduced number of interfaces. The complete plant structure is generated from the engineering data in the control system simply at the flick of a switch. This simplifies automation engineering and enormously reduces the time overheads.

In the reverse direction, changes to the automation functions during operation (such as the replacement of field devices) are returned from SIMATIC PCS 7 to COMOS. The database in the engineering tool is thus updated immediately, together with the complete plant documentation.

In this way, integrated engineering provides the requirements for more confident decision making and for more efficient processes – thus making a contribution to sustained improvements in competitiveness.
Operator system

Safe and user-friendly process control with the SIMATIC PCS 7 Operator System

The operator system of the SIMATIC PCS 7 process control system permits user-friendly and secure execution of the process by the operating personnel. Operators can monitor the process sequence using various views and intervene as necessary. The operator system architecture is extremely variable and can be flexibly adapted to different plant architectures and customer requirements.

The basis is formed by perfectly coordinated operator stations for single-user systems (OS Single Stations) and for multiple station systems with client/server architecture.

Operator stations

All operator stations are based on modern Siemens PCS 7 Industrial Workstations optimized for use as OS single station, OS client or OS server.

The SIMATIC PCS 7 Industrial Workstations are optimized for use in harsh industrial environments and combine high-performance industrial PC technology with the Microsoft Windows 7 Ultimate 64-bit or Server 2008 R2 Standard 64-bit operating system. Standard components and interfaces from the PC world offer generous scope for system-, customer- or sector-specific options and expansions.

The connection of as many as 4 process monitors via a multi-monitor graphics adapter permits the user-friendly control of multiple plant areas from a single operator station.

The system software of the operator stations can be expanded flexibly using cumulative SIMATIC PCS 7 OS Runtime licenses for 100, 1,000 and 5,000 process objects (POs) up to following configuration limits:

- 5,000 POs per OS Single Station
- 12,000 POs per OS server (with client/server architecture)

Single-user system (OS single station)

In a single-user system architecture, all operator control and monitoring functions for a complete project (plant/unit) are concentrated in one station. A flat system configuration with up to 8 OS single stations can be implemented. In this case, two stations form a redundant pair of OS single stations that can be further expanded. With such a configuration, the engineering can be rationalized by duplication of a basic project. The Process Historian provides long-term archiving.

The OS single station can be connected to the Industrial Ethernet plant bus in two ways:

- CP 1613 A2/CP 1623/CP 1628 communication module for communication with a maximum of 64 automation systems of any type
- Simple 10/100/1000 Mbps Ethernet network card and Basic Communication Ethernet for communication with up to 8 automation systems (single stations)
Multiple station system with client/server architecture

With a multi-user system, one or more OS Servers supply up to 40 operator stations (OS clients) with data (project data, process values, archives and messages) via a terminal bus. The terminal bus can share the transmission medium with the plant bus or it can be designed as a separate bus (Ethernet with TCP/IP).

In this architecture, redundant OS servers may be set up to meet higher availability requirements. Critical applications are monitored by health check for software faults. If a fault is detected, switchover to the redundant system is triggered. Synchronization of the redundant OS servers takes place automatically and at high speed.

OS clients can access the data of not only one OS server/server pair, but of several at the same time (multi-client mode). This makes it possible to divide a plant into technological units and to distribute the data accordingly to various OS servers/pairs of servers.

In addition to scalability, the advantage of distributed systems is the ability to decouple plant areas from each other, which results in higher availability.

SIMATIC PCS 7 supports multiple station systems with up to 18 servers or 18 redundant pairs of servers. In multi-client mode, OS clients can access data from one or more of the 18 servers/pairs of servers in parallel (up to 40 OS clients simultaneously can access all).

The OS servers are designed in addition with client functions which permit them to access the data (archives, messages, tags, variables) from the other OS servers of the multiple station system. This means that process graphics on one OS server can also be linked with variables on other OS servers (area-independent displays).

Performance

The SIMATIC PCS 7 Operator System is optimized for processing large quantities of data. It impresses by means of its simple and intuitive operation and its high performance – even with large quantity frameworks. Many individual measures reduce the system load and improve the picture selection and updating times, e.g.:

- Combination of status and analog values with alarm information into expanded status displays
- Suppression of nuisance alarms and triggering of renewed transmission via acknowledgment
- Data transmission from the automation system only for changes instead of cyclically
- Blocking/Enabling of messages for individual process tags or all tags of an area
- Hiding messages, depending on the operating state of the unit

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**Operator system, configuration limits**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. number of OS single stations</td>
<td>8</td>
</tr>
<tr>
<td>Max. number of OS servers/pairs of servers</td>
<td>18</td>
</tr>
<tr>
<td>Max. number of automation systems per OS server/pair of servers</td>
<td>64</td>
</tr>
<tr>
<td>Max. number of OS clients in multi-client mode</td>
<td>40</td>
</tr>
<tr>
<td>Max. number of monitors per operator station with multi-channel operation</td>
<td>4</td>
</tr>
<tr>
<td>Max. number of monitors per system</td>
<td>60</td>
</tr>
<tr>
<td>Max. number of OS areas</td>
<td>64</td>
</tr>
<tr>
<td>Max. number of windows per monitor</td>
<td>1 to 16 (adjustable)</td>
</tr>
<tr>
<td>Number of trends per trend window</td>
<td>10</td>
</tr>
<tr>
<td>Selection time for OS area display (100 process symbols)</td>
<td>&lt; 2 s</td>
</tr>
<tr>
<td>Max. number of process objects</td>
<td></td>
</tr>
<tr>
<td>- Per OS single station</td>
<td>5 000 POs</td>
</tr>
<tr>
<td>- Per OS server</td>
<td>12 000 POs</td>
</tr>
<tr>
<td>Max. number of configurable messages per server</td>
<td>200 000</td>
</tr>
<tr>
<td>Number of process tags</td>
<td></td>
</tr>
<tr>
<td>- Per OS single station</td>
<td>approx. 3 000</td>
</tr>
<tr>
<td>- Per OS server</td>
<td>approx. 7 000</td>
</tr>
<tr>
<td>- Per multiple station system</td>
<td>approx. 126 000</td>
</tr>
<tr>
<td>Integral high-performance archive system (circular buffer), based on Microsoft SQL server, for:</td>
<td></td>
</tr>
<tr>
<td>- Process value archiving (per OS server/single station)</td>
<td>approx. 1 500/s</td>
</tr>
<tr>
<td>- Message archiving (per OS server/single station)</td>
<td>Continuous load approx. 10/s Message burst approx. 3 000/4 s</td>
</tr>
</tbody>
</table>

1) If every OS client has access to all OS servers/pairs of servers

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OS software

A standard view and a server view are available for the technological representation of a process cell, each with variously designed area overviews. Features provided in both views include:

- Message line for the last received message, configurable for priority-based display of message with highest message class or priority
- Date, time and name of the operator
- Area overview; number of displayed areas depends on resolution: up to 36 (lowest/XGA), up to 144 (highest/WQXGA)
- Working area for plant displays and movable windows for faceplates, trends, messages etc.
- System function keys

Based on this, the operator can combine and save individual picture compositions and recall them later.

The operator system software supports the representative functional display of the plant with a high-quality and modern design; depending on the versions of the graphics controller and process monitor, display is possible in:

- 4:3/5:4 screen formats with resolutions of 1024 × 768 to 1600 × 1200
- 16:9/16:10 panorama formats with resolutions of 1680 × 1050 to 2560 × 1600

The global appearance can be set using predefined or user-specific designs (color palette, colors, styles, optical effects, etc.). These central design settings can be changed locally for each picture object. In addition, the design can be fundamentally influenced using a wide range of attractive elements provided in the Engineering System for OS configuration:

- Object palettes with styles, controls, standard objects and smart objects
- Global symbol library with standardized display objects
- Symbols and faceplates of the PCS 7 Advanced Process Library (APL)

Graphics objects of the PCS 7 Advanced Process Graphics (APG) adapted to the APL enable task-specific optimization of process visualization with overview pictures (level 1/2). Compact, simplified representations draw attention to the essentials. The operator can very quickly grasp the current plant situation, identify trends early on and react immediately.

Graphical User Interface (GUI)

The predefined GUI of the operator system has all the features typical of a control system. It is clearly structured, ergonomic, easy to understand and multilingual. Operators can survey the process extremely easily and rapidly navigate between different views of the plant. The system supports them in this process with hierarchical display structures that can be configured as required. These facilitate the direct selection of lower-level areas during process control. The current position within the hierarchy can always be seen in a window of the Picture Tree Manager.

Mimic diagrams and process tags can also be called directly by their name or by a “Loop-in-alarm” starting from a selected message. An online language selector permits the user to change the display language during runtime.
TrendControls for table displays and trend displays

Using Trend Controls, operators can show archived values of archive tags from the process value archive as well as online values of process tags from the tag management in relation to time (table/trend window) or in relation to another value (function window). The time can be defined statically or dynamically (in relation to the actual system time) as:

- Start and end times
- Start time and period
- Start time and number of measuring points

All TrendControls have scrolling functions and a function for directly selecting the start or end.

During runtime, operators can individually adapt the TrendControls functions which have already been predefined during plant configuration and save the settings globally or user-specific. They are able to change the data link during runtime and to access other data. It is also possible to integrate exported archive databases online.

The displayed data can be processed further by:

- Exporting per CSV file
- Output in a predefined print job

Table window

- Display of one or more process value columns in relation to a time column
- Each line displays the process values recorded at a particular time
- Several separate time/value relations can be combined in a table

Trend window

- One or more time axes correlate with one or more value axes (linear, logarithmic, percentage or freely- configurable scales)
- Freely-selectable number of displayed trends
- Individual configuration of styles and colors, possibly with value-dependent change in color
- Grid lines and rulers for improvement of readability
- Trends can be grouped in one window with common time and value axes
- Multiple trend windows can be linked for comparison purposes (common time axis, zoom, scroll bar and ruler)

Function window

- Display of process values in relation to other process values, e.g. pressure depending on temperature
- Fixed or dynamic value range with linear or logarithmic scaling for X and Y axes
- Displayed time range can be defined separately for each trend
- Optional consideration of setpoint trends from user archives
- Properties, functions and configuration options largely identical to trend window

The ruler window shows additional information for the trend/table window with a ruler selected by the time or time domain, for example, statistical information such as minimum, maximum, average, standard deviation, integral.

AlarmControl function for message display and processing

Up to 200 000 messages can be configured per OS single station / OS server:

- Predefined system messages, triggered by a system event
- Individual or group messages, initiated by a change in process states
- Operator input messages, resulting from the manual operation of objects
The message system integrated in the operator system records these process messages and local events, saves them in message archives and displays them in various standardized lists by means of the freely-configurable AlarmControl function (message window):

- Entered state list: currently present, unacknowledged messages
- Acknowledged list: currently present, acknowledged messages
- Exited state list: unacknowledged messages, but already exited
- Operator list: current and archived operator input messages
- Process control list: current and archived I&C messages
- Chronicle: all currently present and archived messages arranged in chronological order
- List of manually or automatically suppressed messages
- List of messages to be suppressed when they occur

The lists are provided with a scrolling function and can be selected by the operator in the toolbar.

Parallel to the display, all messages recorded during runtime and their changes in state can be documented in chronological order in a message sequence log.

Flexible setting options for audible output and priorities which can be defined with signal tags support the signaling of messages through a sound card or by controlling external horns via a signal module.

By filtering, selecting or sorting the display according to the contents of individual message blocks, e.g. chronologically according to message priority or fault location, the operator can individually adapt the AlarmControl function during runtime. It is also possible to integrate archive databases online. The settings can be saved globally or user-specific.

The data can be processed further by:

- Exporting per CSV file
- Output in a predefined print job

After a power failure, the last messages can be reloaded from the message archive to the message window. Thus, when the system is restarted, the last message map prior to the power failure can be reconstructed.

In the case of large quantity structures with a high volume of messages, the following measures can improve transparency and perceptibly offload the operating personnel:

- Situation-based hiding of visual and audible operating messages which are insignificant e.g. for safe and fault-free operation of the plant (complete logging and archiving):
  - Dynamically, depending on preconfigured definition for up to 32 operating states (Smart Alarm Hiding)
  - Manually, for a limited period
- Assignment of priorities using up to 16 message priorities as additional attribute to the known message classes
- Intentional blocking/enabling of messages from an individual process tag or all process tags of the display/area, e.g. in the event of faults on a sensor/actuator or during commissioning (recorded in operator activity log)

For fast identification of faults and their resolution, the operator can go directly from the selected message to the process picture with the problematic object (loop-in-alarm). There, the operator can use the color-coded process tag to open the associated faceplate (loop). The faceplate window can be anchored so that it remains visible even when the display is changed.

Group displays visually signal the messages currently present in the mimic diagram. They do not provide information on whether messages are disabled or not.

The last received message is displayed at the top of the standard view. Using the “Extended message line” button, the Alarm Control function can be displayed as a window with all received messages. A list of all messages currently present with maximum priority 16 can also be directly called using a button.

User-configurable message classes
In the case of new projects, the user can decide to apply six free-configurable alarm classes instead of the previous message concept. The connection between the event and an alarm class can be redefined specific to the instance.
Reporting and logging system

Whereas the reporting system is provided to document the project during configuration, the logging system is used to print out the data recorded during operation in a clear manner. Different types of predefined logs are available:

- Message sequence log
- Message and archive log
- Measured value log
- Operator activity log
- System message log
- User log

However, a page layout editor can be used to create completely new page layouts or to individually adapt predefined ones. Log objects to be printed are simply selected from the editor’s object palette, positioned and configured.

The current log data is output in the assigned page layout on the printer by means of a predefined or self-generated print job. Prior to output on the printer, the logs can be saved and displayed as a preview on the screen. The operator can start jobs manually or triggered by time or event and query the status of print jobs online.

Archiving

The OS single stations and OS servers have an integral high-performance archiving system which can be configured during runtime and which is based on Microsoft SQL server technology. With this, process values and messages/events (alarms) can be temporarily recorded in circular archives. Data can be be transferred from this historical alarm list to the Process Historian for long-term archiving on a time-driven or event-driven basis.

Central user management, access protection and electronic signatures

With the integrated SIMATIC Logon, the operator system has central user administration with access control that complies with the validation requirements of 21 CFR Part 11. The administrator can divide the users into groups and assign differently defined access rights (roles) to these groups. The operator obtains the specific rights when logging on. Apart from the keyboard, an optional chip card reader, for example, can be used as the logon device.

SFC visualization

SFC visualization of the operator system allows sequential control systems configured with the SFC editor to be represented and operated in the same way as on the engineering system. This does not involve any extra configuration effort.

In an overview display it is possible, for example, to open step and transition displays and to present step comments or dynamically supplied step enabling conditions.

Sign-of-life monitoring

With the “Sign-of-life monitoring function”, the operator system is able to monitor the correct operation of all subordinate systems connected to the plant bus. A graphical plant configuration display shows the status of each monitored component. Additional functionality in this respect is offered by the SIMATIC PCS 7 Maintenance Station.

Clock synchronization

Together with a SICLOCK time generator, the operator system of the SIMATIC PCS 7 process control system can implement system-wide synchronization on the basis of UTC (Universal Time Coordinated). This feature is especially beneficial for widely distributed plants present in different time zones, e.g. pipelines.
Operator system highlights

- Flexible, modular architecture with scalable hardware and software components for single-user and multiple station systems
- Client-server multiple station systems, suitable for large plants with up to 18 OS servers / server pairs and up to 40 OS clients
- High-performance, stress-resistant operator stations based on rugged industrial standard PC technology
- OS single stations and OS servers that can be configured as redundant pairs
- Optimized AS/OS communication
- Copying of modifications without interfering with ongoing operations
- Online test of changes by selective loading of redundant servers
- Ergonomic graphical user interface for convenient process control and high reliability
- Versatile, practical controls for alarms and trends
- Variable, customer-oriented logging system
- Highly effective alarm management provides support for operating personnel
  - Assignment of priorities with up to 16 message priorities as additional attribute to the message classes
  - Visual and audible hiding of messages which are irrelevant depending on the operating state (dynamic or manual)
  - Suppression of alarms from a sensor/actuator during commissioning or in event of malfunction
- High-performance archiving system with circular archives and integral archive backup, which can be combined with the Process Historian for long-term archiving
- Central user management, access control, electronic signature
- Sign-of-life monitoring for subordinate systems connected to the plant bus
- Time synchronization based on Universal Time Coordinated (UTC)
Operating and monitoring via Internet/intranet

The SIMATIC PCS 7 process control system also supports global operator control and monitoring of a plant via Internet/intranet. Here the operator has access via the PCS 7 Web client to the project data provided by the PCS 7 Web server. The PCS 7 Web client uses Internet Explorer and plug-ins which can be installed via Internet/intranet.

The PCS 7 Web server uses the Web View Publisher to convert process displays and scripts into a form suitable for display with the Internet Explorer. It accesses project-specific process data in the lower-level OS servers using the mechanisms of a multi-client. The integrated OS user management guarantees a high degree of security here.

Using the PCS 7 Web client, the plant can be operated as with a PCS 7 OS client. The operator must log on in the same way here and the rules for assigning rights are also identical. The input operations made on the PCS 7 web client are recorded in the OS operating log.

Licensing

With regard to licensing, a distinction is made between the following constellations:

- **Standard**: Up to 50 PCS 7 web clients access the data of a PCS 7 web server over intranet/Internet. The number of PCS 7 Web clients that have simultaneous access to the PCS 7 Web server is scalable with cumulative PCS 7 Web server licenses.
- **Diagnostics**: One or only a few PCS 7 Web clients have access to several PCS 7 web servers for remote operation, diagnostics or monitoring. Each system involved requires a PCS 7 Web diagnostics license (server/client).

Load balancing

If the project requires simultaneous operation of a large number of Web operator stations, several PCS 7 Web servers can also be configured and networked together. With the load balancing function, the load caused by the PCS 7 Web clients can be distributed evenly over the configured PCS 7 Web servers. This results at the same time in high availability of the PCS 7 Web clients.

If a PCS 7 Web server fails, the PCS 7 Web clients assigned to it are automatically routed to one of the other participating PCS 7 Web servers. Load balancing can be used on up to 32 networked PCS 7 Web servers.
Process data archiving and reporting

Process Historian and Information Server

Process Historian

The Process Historian provides high-performance long-term archiving functionality for perfect integration into the control system: Process data, tags, alarms, as well as batch data from SIMATIC BATCH can be archived centrally in real time – without additional engineering overhead.

The Process Historian is suitable for all plant sizes. The number of archivable single stations, servers or server pairs is unrestricted.

The process values and alarms managed in the database of the Process Historian on the OS clients and OS single stations can be visualized in a user-friendly and clear manner. Data selection is supported by integrated filter functions. Alarms and process values can be shown in table form and process values also in graphic form. Tables of process values can be exported in CSV format for processing in other Windows applications, e.g. Microsoft Excel.

The data managed by the Process Historian can be transferred to commercially available storage media. You can back up and restore the complete database – both manually and automatically.

Methods of accessing the Process Historian data stock

View in the Web browser

Add-ins for Microsoft Word and Excel
Visualization of the data from the Process Historian database is supported by an additive reporting system, the Information Server. It provides the archived data in a Web browser in the form of shift, daily, weekly or monthly logs. Based on the Microsoft Reporting Services, the Information Server enables Web-based thin-clients to access to historical data. Add-ins for Microsoft Word und Excel offer additional methods of accessing the Process Historian database. The number of clients that have access to the Information Server can be regulated with cumulative client access licenses.

The Information Server is able to access one data source or multiple data sources in parallel. In addition to the Process Historian, this might also include archive data from operator stations. It can therefore also be used for plant reporting independent of the Process Historian.

If the Process Historian OPC UA Server is installed on the Process Historian, other applications can act as OPC UA clients and read the process values and messages archived in the Process Historian.

Depending on how important the availability of archive data is for the plant operator, the Process Historian can be configured either as a single server or a redundant pair of servers. For this purpose, the server version of the high-performance SIMATIC PCS 7 Industrial Workstation or Premium Server (add-on product for SIMATIC PCS 7) is recommended for the Process Historian.

The Information Server can be operated on the Process Historian hardware or on separate hardware. Any OS client version of the SIMATIC PCS 7 Industrial Workstation is suitable for separate operation.

Archiving and visualization functions

- Real-time archiving of the process values and messages of OS single stations und OS servers
- Archiving the batch data of SIMATIC BATCH
- Support of multiple SIMATIC PCS 7 projects
- Scaling of the performance and configuration limits of the basic hardware employed
- Data export to external storage media
- Data import from external storage media
- Data visualization on the OS clients / OS single stations:
  - Configuration of views (picture windows and masks) including the selection criteria for displaying the data
  - Visualizing of messages in table form dependent on filter functions
  - Display of process values in table or graphic form depending on filter functions
  - Batch overview (with a detailed log of a batch)

For additional information, see:
www.siemens.com/simatic pcs7/processhistorian
Plant device management

Engineering intelligent field devices with SIMATIC PDM

SIMATIC PDM (Process Device Manager) is a universal, multi-vendor tool for configuration, parameterization, commissioning, diagnostics and servicing of intelligent field devices (sensors and actuators) and field components (remote I/Os, multiplexers, control room devices, compact controllers). It enables the handling of more than 2 500 devices from Siemens and over 200 vendors worldwide on one homogeneous GUI. Parameters and functions for all devices are displayed in a consistent and uniform fashion independent of their communications interface.

From the viewpoint of device integration, SIMATIC PDM is the most powerful open device manager available in the world. Devices which previously were not supported can be integrated in SIMATIC PDM by importing their device descriptions (Electronic Device Description, EDD).

Essential for operational management

- Uniform presentation and operation of devices
- Uniform representation of diagnostic information
- Indicators for preventive maintenance and servicing
- Detection of changes in the project and device
- Increasing the operational reliability
- Reducing the investment, operating and maintenance costs
- Forwarding of device information to higher-level Maintenance Stations

Possible applications

- Integrated in the SIMATIC PCS 7 Engineering System
- Stand-alone as a service tool on a mobile computer with a local bus connection or with direct connection to the device

When integrated in SIMATIC PCS 7 system, SIMATIC PDM sends parameter data and diagnostic information to all devices defined by the Electronic Device Description (EDD) for display and further processing on the maintenance station, for example,

- Device type information (electronic rating plate)
- Detailed diagnostics information
- Results of internal condition monitoring functions
- Status information (local configuration changes)
- Information on changes (audit trail report)
- Parameter information

For the purpose of device configuration and diagnostics, SIMATIC PDM can be started directly on each SIMATIC PCS 7 maintenance station client (MS client).
Device Integration

SIMATIC PDM supports all devices defined by the Electronic Device Description (EDD). Based on EN 50391 and IEC 61804, EDD is the most widely used standardized technology for device integration.

At the same time, it is the guideline of the established organizations, such as:

- PROFIBUS & PROFINET International (PI)
- HART Communication Foundation (HCF)
- Fieldbus Foundation (FF)

The devices are integrated directly in SIMATIC PDM through a company-specific EDD or the current HCF or Fieldbus Foundation libraries. To achieve improved transparency, they can be managed in project-specific device libraries.

PROFIBUS devices are described in the EDD in terms of functionality and construction using the Electronic Device Description Language (EDDL). Using this description, SIMATIC PDM automatically creates its user interface with the specific device data. The range of devices can be updated and expanded by importing the manufacturer’s device-specific EDD.

Fieldbus Foundation provides pre-defined device descriptions for the basic functions of specific field device types. The basic functions are implemented using various standard function and transmission blocks.

Core functions

- Creation of project-specific device libraries
- Adjustment and modification of device parameters
- Comparing, e.g. project and device data
- Validation of data input
- Device identification and testing
- Device status indication (operating modes, alarms, states)
- Simulation
- Diagnostics (standard, detail)
- Management, e.g. networks and computers
- Export/import (parameter data, logs, documents)
- Commissioning functions, e.g. measuring circuit tests of device data
- Lifecycle management functions, e.g. for device replacement
- Global and device-specific change log for user operations (audit trail)
- Device-specific calibration reports
- Graphic presentations of echo envelope trends, trend displays, valve diagnostics results etc.
- Display of incorporated manuals
- Document manager for integration of up to 10 multimedia files

Communications and routing

SIMATIC PDM supports several communication protocols and components for communicating with devices that have the following interfaces (others on request):

- PROFIBUS DP/PA interface
- FOUNDATION Fieldbus (FF) interface
- PROFINET interface
- HART interface (modem, wireless)
- Modbus interface
- HART over PROFIBUS/PROFINET

From the central engineering system of the SIMATIC PCS 7 process control system, one can use SIMATIC PDM to navigate to the connected devices via the various bus systems and remote I/Os. As a result of this plant-wide routing, each device which can be parameterized per EDD can be processed from a central position as follows:

- Read device diagnostics information
- Modify device settings
- Adjust and calibrate devices
- Monitor process values
- Generate simulation values
- Reassign device parameters

For additional information on SIMATIC PDM, see: www.siemens.com/simatic-pcs7/pdm
Plant Asset Management with the SIMATIC PCS 7 maintenance station

The SIMATIC PCS 7 maintenance station is used to manage a company’s assets that are used for production. It is dedicated to the “Plant Asset Management” within the maintenance of a company, i.e. the efficient administration and management of the equipment of a technological plant, especially instrumentation and control systems, with the goal of value preservation and appreciation. It thus makes a valuable contribution to minimizing the cumulative total cost (Total Cost of Ownership) of a plant over its entire life cycle.

While the plant operator obtains all relevant information that is necessary for focused intervention in a process via the operator system, maintenance and service personnel can check the hardware components of the automation system (assets) and process their diagnostic messages and maintenance requests using the Maintenance Station. For this the Maintenance Station offers access to:

- Components of the process control system: intelligent field devices and I/O modules, fieldbus, controller, network components and plant bus, as well as servers and clients of the operator systems.
- Assets that do not directly belong to the process control system, such as pumps, motors, centrifuges, heat exchangers (mechanical assets) or control loops. They are represented by proxy objects in which the diagnostics rules are stored.

All activities are documented on the maintenance station without gaps – automatically and without additional configuration overhead.

Maintenance strategies

- Corrective maintenance:
  - Response to pending errors and diagnostics messages
  - Failures are risked or minimized by redundant configurations
  - Maintenance in the form of a repair or replacement
- Preventive maintenance
  - Preventive diagnostics and maintenance
  - Appropriate maintenance measures are initiated before a fault even occurs
  - Maintenance in the form of time-dependent or status-dependent maintenance (depending on degree of wear)
- Predictive maintenance:
  - Predictive diagnostics for timely detection of potential problems and determination of the remaining service life

Typical maintenance cycle

- Monitoring the status of components/devices:
  - Recording of diagnostics information via network components and PC basic devices per OPC coupling
  - Intelligent sensors detect and signal impending failures long before the actual failure
- Signaling the “maintenance required” in a group display, in symbol displays of the affected components/devices and in an alarm log
- Navigation to component/device requiring maintenance and information on specific data such as measuring-point number, mounting location and device type
- Display of detailed diagnostic information (depending on device type and vendor), e.g.
  - Error description
  - Cause of error
  - Trend statement
  - Operating instruction
- Evaluation, commenting and, if applicable, changing the priority of the maintenance requirement
- Initiation of a maintenance measure per maintenance request and tracking of execution; symbolic visualization of current status of maintenance measure
- Conclusion of maintenance measure; all status displays are reset to their normal state
Architecture

The SIMATIC PCS 7 maintenance station (MS) uses hardware and software components of the engineering system (ES) and operator system (OS) for asset management. As a result of the close interlacing, ES, OS and asset management functions run on common hardware. Such a multi-functional station cannot only be used for asset management, but also for system engineering or HMI.

Depending on the project-specific SIMATIC PCS 7 architecture, the SIMATIC PCS 7 maintenance station can be implemented on the basis of a SIMATIC PCS 7 BOX, a SIMATIC PCS 7 single station or a SIMATIC PCS 7 client-server combination. In client-server combinations, the MS server can also have a redundant design.

Message system, GUI, picture hierarchy and operator prompting are oriented according to the HMI philosophy of the operator system. The diagnostics data of all assets are displayed on uniform faceplates whose functions and information depend on the components. This makes working with the SIMATIC PCS 7 maintenance station simple and intuitive, a time-consuming training period is not required.

Integrated SIMATIC PDM provides the SIMATIC PCS 7 maintenance station the parameter data and the diagnostic information of the devices described by the Electronic Device Description (EDD) for the display and further processing. To assign parameters and diagnose these components, SIMATIC PDM can also be opened directly from the faceplate views of MS clients.

The access to the devices/components is controlled by function rights that correspond to the role of the user.

The diagnostic screens structured according to the plant hierarchy with the operating states of the SIMATIC PCS 7 components and the diagnostic information determined by SIMATIC PDM can be displayed both pure MS clients and on combined MS/OS clients. Extended online diagnostics in conjunction with HW Config are available on stations with combined “MS client” and “SIMATIC PCS 7 engineering” functionality.

User management and access control for the SIMATIC PCS 7 Maintenance Station is handled by SIMATIC Logon integrated in SIMATIC PCS 7.

Configuration

Supported by the system, the data relevant for asset management are derived from the hardware and software project of the application created with the default configuration and diagnostic screens are generated. The procedure is simple and no additional overhead is required for configuration of the asset management:

- Generation of the hardware and software project of the application
- Configuring/parameter assignment of specific maintenance station functions and connections (optional)
- System-supported generation of the diagnostic screens with all components present in the project, including the display hierarchy according to the project’s hardware structure
- Compilation of the configuration data and downloading to the operator station and maintenance station with subsequent test and commissioning phase

The names of imported pictures, icons, etc. can be permanently changed for further use in the maintenance project.

Conformity to international standards, specifications and recommendations

The SIMATIC PCS 7 maintenance station conforms to international standards, specifications and recommendations. It is based on the NAMUR requirements (process control standards committee in the chemical and pharmaceutical industries) defined for systems for plant-floor asset management and status messages from field devices:

In addition, it supports IEC 61804-2 for describing devices by means of the Electronic Device Description Language (EDDL) as well as specifications made by the PROFIBUS & PROFINET International (PI) organization, e.g.:

- PROFIBUS Profile Guidelines Identification & Maintenance Functions
- PROFIBUS PA Profile for Process Control Devices
Asset Management function characteristics

Standard diagnostics functions
Starting from the overview display, maintenance engineers can navigate to the diagnostics displays of the subordinate hardware levels to obtain information on the diagnostics status of individual plant areas or components.

If a fault is signaled in the overview display, the "Loop in alarm" function permits rapid switching to the diagnostics faceplate of the associated component. The information available is filtered according to the role of the user, for example:

- Diagnostics status determined by the system
- Information on the component, such as process tag name, manufacturer or serial number
- Diagnostics messages of a component
- Detailed diagnostic information of a component
- Enabling of maintenance measure by the process operator
- Type and current status of initiated maintenance measure

Information on mechanical assets
A function block acting as a proxy for mechanical assets without self-diagnostics (pumps, motors, etc.) can determine impermissible operating states from different measured values and their deviations from a defined normal status. These are then trigger a maintenance alarm. This function block is also suitable for implementing individual diagnostics structures, project-specific diagnostics rules and condition monitoring functions.

In addition, individual asset management blocks are available with which maintenance engineers can monitor plant components such as pumps, heat exchangers or control valves.

Extended information for assets according to IEC 61804-2
Additional information can be called for assets described by the electronic device description (EDD) according to IEC 61804-2. This information is automatically read out of the components and made available by SIMATIC PDM in the background, for example:

- Device type information (electronic rating plate)
- Detailed diagnostics information
  - Device-specific information from the vendor
  - Information on fault diagnostics and troubleshooting
  - Additional documentation
- Results of internal condition monitoring functions
- Status information (local operation, local configuration changes, etc.)
- Change information (Audit Trail)
- Parameter information

As the system interface to the maintenance engineer, the SIMATIC PCS 7 maintenance station provides integrated maintenance functions and information.
Visualization of the maintenance information

The hierarchical structuring of information and the uniform symbols support the overview, facilitate orientation and permit the maintenance engineer to rapidly access detailed information starting from the plant overview. The symbol set defined for the SIMATIC PCS 7 maintenance station contains symbols which identify the diagnostics status of the devices/components, the relevance of the maintenance request and the status of the maintenance measure. Group displays in the plant overview visualize the diagnostics status of the subordinate structures/components according to a type of traffic light with red, yellow or green.

Appropriate to their significance, the devices/components described per EDD can be marked as follows and also directly filtered using these features:

- Normal
- Important
- Safety Instrumented Function (SIF)

Diagnostics screens represent the status of components and subordinate devices/components through standardized symbols. These contain the following elements:

- Bitmap of component
- Tag identification of component
- Maintenance state display
- Group display for diagnostics status of components

Clicking an element in the symbol display either opens the subordinate hierarchy level or a component faceplate. The component faceplate offers various views of the associated component with additional device-specific information, e.g. an identification, message or maintenance view.

Information management

The maintenance engineer can use the following functions to forward classified information quickly and simply, access project-specific information databases or request maintenance measures:

- Export of identity data (electronic rating plate) and associated diagnostics status for filtered devices/components (complete export)
- Export all relevant information of a component to defined destinations, for example, the mail system, printer or pager (single export)
- Calling up to three applications (Web pages, programs or databases) defined in the project, e.g. shift logs

For additional information, see:
www.siemens.com/simatic-pcs7/plant-asset-management
Automation systems

Scalable performance for every requirement

SIMATIC PCS 7 automation systems, S7-400 model

Automation systems in the models shown above are available for the SIMATIC PCS 7 process control system. The automation performance can therefore be finely scaled within wide limits.

SIMATIC S7-400 modular automation systems with hardware controller

The selected components of the SIMATIC S7-400 are combined in bundles based on the task with consideration of the price/performance ratio. These automation systems are extremely rugged and feature a high processing and communication performance. Other outstanding features include:

- Modular, fan-free design
- Extremely rugged and expandable
- Single and redundant versions
- Comprehensive communication facilities
- Integrated system functions
- Integratable safety functions (Safety Integrated)
- Simple linking of central or distributed I/O
- PROFINET IO support

They can be classified according to their functionality as:

- Standard automation systems
- Fault-tolerant automation systems
- Safety-related automation systems

SIMATIC PCS 7 automation systems, Modular Embedded model

Depending on the scale of performance and perspective orientation, they can be differentiated across classes as:

- **Automation system AS 410**
  A universally applicable CPU type scaled by the number of process objects
- **Complementary SIMATIC S7-400 systems**
  Hardware scaling with CPU types of various performance levels

The rugged AS 410 is a modern, future-oriented, all-round system for the process industry. Due to its versatility, it can be used in every domain – as a standard AS 410S system, as a fault-tolerant AS 410H or as safety-related AS 410F/FH. More and more new functions are being exclusively combined with this automation system, for example, the possibility changing of block type during ongoing operation (TCIR).

The CPU for all automation systems of the S7-400 series is already equipped as standard with the PROFIBUS DP fieldbus connection.

Depending on the type of CPU, one or two additional PROFIBUS DP interfaces can be employed using additive IF 964 DP interface modules. If needed, up to 10 PROFIBUS communication modules can be additionally operated on a CPU.

A PROFINET IO connection can be made via the CPU interface or a CP 443–1 communication module, depending on the type.
Standard automation systems

The modular standard automation systems of the S7-400 are available for universal use. These are always your first choice when fault tolerance or safety-related engineering functions are of secondary importance.

Fault-tolerant automation systems

Fault-tolerant automation systems are used to reduce the risk of production failures. The higher investment costs are frequently negligible compared to the costs resulting from production failures. The higher the costs of a production failure, the more worthwhile it is to use a fault-tolerant system.

The two redundant and electrically isolated subsystems of the Redundancy Station can be mounted on one compact rack with divided backplane bus or on two separate racks. The design with two racks allows physical separation of the redundant subsystems over distances up to 10 km, e.g. separated by a fireproof partition. As a result of the electrical isolation, the system is insensitive to electromagnetic interferences.

Fault-tolerant SIMATIC PCS 7 automation systems can be used on their own or together with standard and safety-related automation systems.

Safety-related automation systems

Safety-related automation systems are used for critical applications in which an incident can cause danger to personnel, plant damage or environmental pollution. These F/FH systems collaborate with safety-related F modules of the ET 200 distributed I/O systems or fail-safe transmitters connected directly via the fieldbus to detect not only faults in the process, but also their own, internal faults. They automatically bring the plant into a safe state in the event of a fault.

The safety-related automation systems are TÜV-certified and comply with the safety requirements up to SIL 3 in accordance with IEC 61508. They are based on the hardware of the fault-tolerant automation systems that has been expanded by safety functions by means of S7 F Systems.

Analogous to the basic systems, they are available in two versions:

- Single stations with one CPU, safety-related
- Redundancy stations with two redundant CPUs, safety-related and fault-tolerant

The redundancy of the FH systems is only used to increase the availability. It is not relevant to processing of the safety functions or the associated fault detection.
In the multitasking systems, several programs can run simultaneously in one CPU. Basic Process Control System (BPCS) applications as well as safety-related applications. The programs are reaction-free, this means that faults in BPCS applications have no effect on safety-related applications and vice versa. Special tasks with very short response times can also be implemented.

With parallel processing of BPCS and safety functions in one CPU, mutual interference is prevented by ensuring the BPCS programs and the safety-related programs are kept strictly separate and the data exchange is by means of special conversion function blocks.

The safety functions are processed twice in different processor sections of the CPU by means of redundant, diverse instruction processing. Potential errors are detected by the system during the subsequent comparison of results.

Safety programs executed on different F/FH systems of a plant are also able to carry out safety-related communication with one another over the Industrial Ethernet plant bus.

**Flexible and scalable availability**

A particular characteristic of the modular S7-400 systems is the flexible and scalable availability of various modules.

When planning a system, it is even possible with a Single Station to increase the availability at a specific point by means of redundant configuration of the power supply or for the Industrial Ethernet communication module and to combine these measures.

The Redundancy Station with its two redundant CPUs already offers a higher level of availability. It operates according to the 1oo2 principle, in which a switch is made from the active subsystem to the standby system in the event of a fault. Based on this, as with the Single Station the power supply or the Industrial Ethernet communication module can be doubled for each subsystem and these measures can be combined.

### Overview of the automation system types

<table>
<thead>
<tr>
<th>AS type</th>
<th>CPU</th>
<th>Interfaces</th>
<th>DP module as optional plug-in</th>
</tr>
</thead>
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<td><strong>Standard systems</strong></td>
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<tr>
<td>AS 410S</td>
<td>CPU 410-5H Process Automation</td>
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<td>CPU 417-5H (1 × or 2 ×)</td>
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</table>
AS 410 automation system

The AS 410 is a new automation system of the SIMATIC S7-400 series which is exclusively envisaged for use in the SIMATIC PCS 7 process control system. With its innovative "CPU 410-5H Process Automation" and the appropriately optimized firmware, the AS 410 is able to cover the complete performance range of the complementary S7-400 automation systems (from AS 412H, AS 414-3 and AS 416, up to the AS 417H). The achieved reduction in the number of types not only simplifies the stocking of spare parts, but also provides advantages for the complete lifecycle of the process control system.

The performance levels are based on process objects (PO) of differently dimensioned system expansion cards. If the performance limit defined by the purchased system expansion card is reached during configuration, commissioning or operation, a subsequent increase in performance is possible by using an appropriate number of CPU 410 Expansion Packs 100 POs/500 POs. Hardware need not be exchanged in this case.

In addition to the CPU, the SIMATIC PCS 7 AS 410 bundle includes an aluminum rack, communication modules and selected power supply modules with an additional enamel coating (conformal coating).

The CPU 410-5H Process Automation already differs optically from all other current CPUs of the S7-400 series. It is equipped with one PROFINET and two PROFIBUS DP IO interfaces with a 2-port switch. Two integrated slots allow the synchronization of two redundant subsystems via sync modules and sync cables.

Since 48 MB of load memory and 16 MB of work memory is integrated for program and data, no memory cards are required. A recessed reset button replaces the usual RUN/STOP switch.

CPU 410-5H Process Automation supports NTP as well as S7 time synchronization. Their time stamping works with high precision.

### Automation system with APL

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</table>

Typical mixed configuration limits for SIMATIC PCS 7 automation systems, based on the SIMATIC PCS 7 Advanced Process Library (APL)
Modular Embedded automation system
SIMATIC PCS 7 AS mEC RTX with software controller

The SIMATIC PCS 7 AS mEC RTX that is fully integrated in SIMATIC PCS 7 is a robust automation system in S7-300 format, designed for the lower and medium performance range.

It is designed for maintenance-free 24-hour continuous operation at ambient temperatures between 0 and 50 °C. Since it works without fans or rotating storage media, it is relatively insensitive to vibration and shock.

Its special feature is centralized expandability by means of adding up to 8 I/O modules from the S7-300 I/O range on the same mounting rail. This merges the controller and I/Os into a low-cost compact unit that can be used preferably on the plant floor and as an OEM product, e. g. in package units.

Sensors/actuators integrated via distributed ET 200SP/ET 200M remote I/O stations can be connected via PROFINET IO.

An Ethernet interface with 10/100 Mbps is available for connection to the SIMATIC PCS 7 plant bus.

The Windows Embedded Standard 2009 operating system and the WinAC RTX 4 controller software are pre-installed in 4 GB of flash memory.

The system is configured using the SIMATIC PCS 7 Engineering System. The supplied AS Runtime license for 100 POs can be expanded up to 2 000 POs.

Highlights of the automation systems

Modular systems of the SIMATIC S7-400 series
- Individually configurable AS bundles, available as:
  - Individual components, bundled in stations
  - Pre-assembled and tested stations
- Flexible and scalable availability:
  - Standard systems as Single Station, optionally with redundant power supply
  - Fault-tolerant and safety-related systems as single/redundancy station; redundant power supply and/or Industrial Ethernet interface as options
- Redundancy Station with two electrically isolated subsystems
  - One or two racks (distances up to 10 km)
  - Synchronous processing of identical user programs
  - Bumpless switchover
- Changes to the configuration during operation

Modular embedded SIMATIC PCS 7 AS mEC RTX system
- Compact and rugged system in S7-300 format for small applications and package units
- Resistant to vibration and shock since there are no fans or rotating storage media
- Maintenance-free 24/7 operation at ambient temperatures up to 50 °C
- Centrally expandable thanks to the direct addition of up to 8 S7-300 I/O modules
- Connection of distributed ET200SP/ET 200M remote I/O stations via PROFINET IO
Compact systems

SIMATIC PCS 7 BOX – complete control system in compact design

SIMATIC PCS 7 BOX enhances the SIMATIC PCS 7 range with low-price, rugged and space-saving industrial PC systems with versatile application options, e.g. as:

- Client in an operator system or in SIMATIC BATCH
- Compact process control system with system functionality for engineering (ES), automation (AS), HMI (OS)
- Runtime system with system functionality as above, but without engineering

SIMATIC PCS 7 BOX systems are compact systems and are focused to the last two applications listed above.

With the SIMATIC PCS 7 OS Runtime software limited to 2,000 process objects (POs), excellent physical properties and small dimensions, they are designed for automation at plant level for:

- Small applications/units in production processes
- Package units (enclosed subprocesses)
- Laboratories or institutes

They are also highly suitable as training systems for operators and service engineers.

The application of standard SIMATIC PCS 7 components ensures scalability and unlimited expansion without a change in compatibility. With increasing requirements, e.g. if a test system is subsequently to be operated as a productive system of larger scale, expansion with SIMATIC PCS 7 system components is possible without problem, as is integration into the production plant.

The product range is differentiated primarily via the automation functionality, that is, via the controller type:

- **SIMATIC PCS 7 BOX RTX**
  - with integrated WinAC RTX software controller
- **SIMATIC PCS 7 BOX**
  - in combination with a separate external controller:
    - PCS 7 mEC RTX automation system
    - Modular automation system of the S7-400 series as single or redundancy station

The selection depends on the price/performance ratio and on the supported hardware and software functionalities.

The two basic types can be differentiated further depending on whether the engineering is concentrated in a central engineering system or integrated in the compact system:

- **SIMATIC PCS 7 BOX RTX**
  - ES/OS system with ES + OS + AS functionality
  - OS Runtime system with OS + AS functionality
- **SIMATIC PCS 7 BOX**
  - ES/OS system with ES + OS functionality
  - OS Runtime system with OS functionality

A complete process control system for small applications can be implemented by expanding with distributed process I/Os. Depending on the type of automation system, the distributed process I/O can be connected via PROFINET, FOUNDATION Fieldbus H1 or PROFINET I/O. Depending on the type of field communication, the ET 200M, ET 200SP, ET 200iSP, ET 200S and ET 200pro remote I/O stations are supported by a comprehensive range of low-cost signal/function modules, but also by field/process devices connected directly over the fieldbus. S7-300 I/O modules can also be directly attached to the mounting rail of the PCS 7 AS mEC RTX.

The compact systems can be incorporated into the PCS 7 asset management using the integrated SIMATIC IPC DiagMonitor diagnostic software. Equipped as an ES/OS system with additional software licenses for SIMATIC PDM and SIMATIC PCS 7 Maintenance Station, a compact system can also be operated as a maintenance station.

SIMATIC PCS 7 BOX systems with an external controller are also suitable for SIMATIC BATCH (up to 10 units) or as a Web server for up to two Web clients.
## System configuration

<table>
<thead>
<tr>
<th>System configuration</th>
<th>PCS 7 BOX RTX</th>
<th>PCS 7 BOX</th>
<th>PCS 7 AS RTX (Microbox) as separate controller</th>
<th>PCS 7 AS mEC RTX as separate controller</th>
<th>Modular AS 41x (AS Single Station) as separate controller</th>
<th>Modular AS 41xF or AS 41xH (AS Redundancy Station) as separate controller</th>
</tr>
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<tbody>
<tr>
<td>Integrated WinAC RTX Controller</td>
<td></td>
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</tbody>
</table>

### Software

<table>
<thead>
<tr>
<th>Supported functions and limits</th>
<th>Software</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AS/OS Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OS Runtime Single Station up to 2 000 OS runtime POs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PCS 7 APL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIMATIC PDM PCS 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIMATIC PCS 7 Maintenance Station</td>
<td></td>
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<tr>
<td></td>
<td>SIMATIC BATCH up to 10 units</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Web server, for up to 2 Web Clients</td>
<td></td>
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<tr>
<td></td>
<td>OS Single Station Redundancy</td>
<td></td>
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<tr>
<td></td>
<td>S7 F Systems</td>
<td></td>
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<tr>
<td></td>
<td>SIMATIC Safety Matrix</td>
<td></td>
</tr>
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</table>

### Hardware

<table>
<thead>
<tr>
<th>Supported functions and limits</th>
<th>Hardware</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controller (AS) independent of BOX PC system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AS-AS Communication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROFIBUS Communication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOUNDATION Fieldbus (FF)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROFINET IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Configuration in Run (CiR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High-Precision Time Stamping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S7 Block Privacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Block type change in run (TCiR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retentive AS Data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AS Configuration Limits2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WinAC RTX 2010 up to 1 200 AS runtime POs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WinAC RTX 2010 up to 1 200 AS runtime POs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WinAC RTX 2010 up to 1 200 AS runtime POs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depending on the AS 41x type, up to 2 000 AS runtime POs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depending on the AS 41xH or AS 41xF type, up to 2 000 AS runtime POs</td>
<td></td>
</tr>
</tbody>
</table>

1) The PROFIBUS routing functionality of WinAC RTX 2010 can only be used with the onboard CP of the SIMATIC PCS 7 BOX RTX and PCS 7 AS RTX.

2) Typical mixed configuration limits, based on the SIMATIC PCS 7 Advanced Process Library (APL).

### Design versions

The compact systems are operated and monitored as standard using separate control units (mouse, keyboard, process monitor).

An alternative design version with front panel (photo on right) also permits operation and monitoring using a 22” TFT panel with touch screen, resolution of 1920 × 1080 pixels.

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**SIMATIC PCS 7 BOX with Panel Front, side and front views**
Communication

Fast and reliable communication with Industrial Ethernet for plant bus and terminal bus

Through application of SIMATIC NET network components based on globally established standards, SIMATIC PCS 7 is provided with a powerful and rugged range of products for implementing integrated communications networks for reliable data exchange between the system components in different levels of a plant.

The SIMATIC NET products specially developed for industrial applications provide optimum suitability for plants in all sectors. They are matched to one another and meet the highest standards, especially in areas where they are subject to extreme influences, such as:

- Electromagnetic interference fields
- Corrosive liquids and atmospheres
- Explosion hazards
- High mechanical loads

The SIMATIC NET products ensure expandability and the protection of investments due to compatible further developments, as well as integration from inbound logistics to outbound logistics and from field devices up to the management information system.

Industrial Ethernet

The plant bus and the terminal bus for multiple station systems with client/server architecture are implemented with Industrial Ethernet, a powerful area and cell network for industrial applications in line with the international IEEE 802.3 standard (Ethernet).

In the various SIMATIC PCS 7 subsystems (ES, OS, AS, etc.), onboard interface modules, simple network adapters or special communications processors are used as communication interfaces. For small systems, the "Basic Communication Ethernet" integrated in the PCS 7 Industrial Workstations permits economical operation of single stations and servers on the plant bus with simple network cards.

In medium and large plants characterized by high requirements, SIMATIC PCS 7 relies on powerful CP 1613 A2/CP 1623/CP 1628 communication modules as well as modern Gigabit and Fast Ethernet technology which combines the high security provided by optical rings with the scalable performance provided by switching technology and high transmission rates up to 1 Gbps.

### Technical specifications for Industrial Ethernet

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant bus/terminal bus</td>
<td>Industrial Ethernet</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>1,023 per network segment (IEEE 802.3 standard)</td>
</tr>
<tr>
<td>Number of switches</td>
<td>up to 50</td>
</tr>
<tr>
<td>Length of the network</td>
<td></td>
</tr>
<tr>
<td>- Local network</td>
<td>Electrical up to approx. 5 km</td>
</tr>
<tr>
<td></td>
<td>Optical up to approx. 150 km</td>
</tr>
<tr>
<td>- WAN</td>
<td>Worldwide with TCP/IP</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree, ring, star</td>
</tr>
</tbody>
</table>
Industrial Ethernet switches

Industrial Ethernet switches are used for integration of communication participants in the plant bus. The switches from the SCALANCE X product series are particularly suitable for this and offer scalable performance at an attractive price while supporting versatile configuration possibilities.

The products from the SCALANCE X product series authorized for SIMATIC PCS 7 are multi-faceted. The number of ports and levels of modularity, flexibility and functionality increase with ascending type number. While the switches of the SCALANCE X-000, X-100, X-200 and X-200 IRT product series are only equipped with Fast Ethernet ports for data rates up to 100 Mbps, switches from the SCALANCE X-300, X-400/XM-400 and X-500 product series are usually equipped with Gigabit Ethernet ports. SCALANCE X-500 also features optical 10 Gigabit Ethernet ports. The design of the switches varies between compact, flat and rack models in the SCALANCE X-200/X-200 IRT and X-300 even within the product series.

Ring topologies are predestined for the plant bus and terminal bus due to their high availability. An additional advantage of optical rings is their EMC immunity.

Redundant ring topology

If availability requirements are particularly high, it is possible to distribute the communication on two physically separated redundant rings. One switch in each case takes over the function of the redundancy manager for each ring.

- **Terminal bus**
  The PCS 7 stations are connected to each of the two rings via an Industrial Ethernet interface. On the PCS 7 stations, the SIMATIC NET SOFTNET IE RNA communication software organizes the communication processes by means of the Parallel Redundancy Protocol (PRP) in accordance with IEC 62439-3. Terminal equipment with only one Industrial Ethernet connection, e.g. the SICLOCK TC 400 central plant clock, can be integrated via SCALANCE X204RNA.

- **Plant bus**
  The coupling partners connected to the two rings by means of two Industrial Ethernet interface per AS CPU and OS server are linked together logically when configuring with NetPro by using a fault-tolerant S7 connection (4-way redundancy).

Industrial Wireless LAN (IWLAN)

SIMATIC PCS 7 provides the option for integrating mobile or stationary remote clients via an IWLAN access point of the SCALANCE W760, W770 or W780 product series on the terminal bus.

Mobile remote clients (e.g. notebooks) can communicate with the IWLAN access point using a WLAN interface module and stationary remote clients in a desktop/tower housing (PCS 7 Industrial Workstations) can communicate using an IWLAN client module of the SCALANCE W720, W730 or W740 product series.

The following applications can then be implemented:

- Configuration of additional remote OS clients (up to 2 on IWLAN)
- Linking of Web clients to a SIMATIC PCS 7 Web server (up to 2 Web clients on IWLAN)
- Remote access to an engineering station, for example for commissioning.

All components used are very rugged, apply state-of-the-art authentication and encryption procedures and guarantee high reliability of the radio channel. You can achieve gross data transfer rates of up to 450 Mbps by means of link aggregation and parallel use of several antennas (MIMO technology) in accordance with the international standard IEEE 802.11n.
PROFINET –
The Industrial Ethernet standard for automation

PROFINET is based on the international standards IEC 61158 and IEC 61784 and combines the advantages of the open network standard, Ethernet and the PROFIBUS fieldbus system. PROFINET stands for maximum transparency, open IT communication, network security and real-time communication down to the field level. This makes it the ideal basis for a uniform automation network in the plant, into which existing field buses implemented with PROFIBUS can be easily integrated.

In the context of the SIMATIC PCS 7 process control system, the application of PROFINET mainly focuses on PROFINET IO, the field communication between the automation systems (controllers) and the process I/O. Together with the PROFIsafe profile, it also supports safety-related communication between automation system (controller) and process I/O. The integrated HART communication allows configuration of HART field devices with SIMATIC PDM from a central engineering station.

The S7-400 automation systems can be integrated into PROFINET IO via the PROFINET interface in the CPU or via a CP 443-1 communication module, the SIMATIC PCS 7 AS mEC RTX via the PROFINET interface in the EC31 embedded controller. Specific interface modules are available for the integration of the remote I/O stations:

• IM153-4PN High Feature for ET 200M
• IM 155-6PN High Feature for ET 200SP

Special PROFINET products as well as Industrial Ethernet products such as SCALANCE X switches and media converters, FastConnect connection elements and electrical and optical transmission media can be used as network components.

Add-on products for SIMATIC PCS 7 support integration of other PROFINET IO devices, for example:

• SIMOCODE pro V PN motor management system
• Adjustable speed SINAMICS drives
• AS-i slaves (sensors/actuators) on the IE/AS-i LINK PN IO (single or double master)

The PROFIBUS fieldbus or the FOUNDATION Fieldbus H1 can be integrated via a CP 443-5 communication module or a PROFIBUS DP interface in the CPU of the automation system and the PROFIBUS in addition via IE/PB Link PN IO.

A wide variety of network configurations can be implemented in the field based on line, star, tree and ring topologies. PROFINET IO configurations with ring topology guarantee higher availability of I/O devices than other topologies.
Example of PROFINET communication in the SIMATIC PCS 7 process control system

With PROFINET IO ring topologies and AS single stations, the media redundancy of the ring prevents failure of the complete segment. If there is an interruption in the ring or if one of the stations fails, the redundancy manager immediately activates the alternative communication path. It does not matter here whether networking is performed via SCALANCE X switches or direct via the PROFINET interfaces of the automation system and remote I/O station.

The maximum availability with minimum error handling times is achieved by AS Redundancy Stations in conjunction with the system redundancy of the I/O devices. System redundancy refers to a type of PROFINET IO communication where each I/O device establishes a communication connection to the two CPUs of an AS Redundancy Station over the topological network. In contrast to the single-sided I/O device connection to only one CPU, failure of a CPU in this case does not automatically lead to failure of the I/O devices.
**Fast and rugged fieldbus communication**

Distributed peripherals such as remote I/O stations with their I/O modules, transmitters, drives, valves or operator terminals communicate with the automation systems at field level through a powerful real-time bus system. This field communication is characterized by:

- **Cyclic transmission of process data**
- **Acyclic transfer of alarms, parameters and diagnostics data**

The universal PROFIBUS has proven itself as a rugged and reliable communication medium at field level. Based on the IEC 61158 and IEC 61784 standards, it can cover all requirements of the production and process industries, with:

- **Complementary transmission technologies**
- **Uniform communication profile**
- **Additive application profiles for typical device functions, e.g. PA Devices, PROFIdrive, PROFIsafe or PROFIenergy.**

**PROFIBUS DP**

PROFIBUS DP is designed to provide high data transmission rates and short response times (up to 1 ms) and is at the same time:

- **Communication medium for data transmission between automation systems and distributed I/O devices of the ET 200 series, as well as field/process devices, drives, analyzers, CPUs/CPs, operator panels etc. that have a PROFIBUS DP interface.**
- **Integrator for the PROFIBUS PA fieldbus and FOUNDATION Fieldbus H1 which are typical in the process industry.**

HART field devices can also be integrated in the PROFIBUS DP communication using the support of the HART protocol.

The PROFIBUS DP is available for electrical or optical transmission:

- **RS 485:** simple and low-cost electrical transmission system with a shielded two-wire cable.
- **Fiber-optic:** optical transmission system with glass or plastic fiber-optic cables, for fast transmission of large quantities of data in environments with high interferences or for covering long distances.

With the fieldbus isolating transformer and RS 485-iS electrical transmission technology, PROFIBUS DP can also be run as an intrinsically-safe fieldbus in all environments up to hazardous zone 1 or 21.
PROFIBUS PA and FOUNDATION Fieldbus H1

The direct connection of transmitters and actuators including power supply via the communication medium, as well as detailed diagnostics, are particularly relevant to the automation of industrial processes that frequently take place in corrosive, harmful and hazardous environments.

Both the PROFIBUS PA fieldbus and the FOUNDATION Fieldbus H1 (FF H1) meet these requirements. Both fieldbuses are optimally suitable for directing integrating actuators and sensors in operating environments up to hazardous zone 1/21 or 0 into the process system. The intrinsically-safe transmission technology MBP (Manchester Coded; Bus Powered) provides the power supply to the field devices as well as digital data transmission with a constant transfer rate of 31.25 Kbps over a two-wire cable.

The physical bus systems of PROFIBUS PA and FF H1 are largely identical in accordance with IEC 61158. Both can be integrated seamlessly in the SIMATIC PCS 7 process control system using PROFIBUS DP as link. PROFIBUS PA and FOUNDATION Fieldbus H1 thus profit equally from the higher-level PROFIBUS DP architecture. SIMATIC PCS 7 customers are therefore not limited to a specific fieldbus but can select this freely matching the optimum field instrumentation.

### Technical data

<table>
<thead>
<tr>
<th></th>
<th>PROFIBUS PA</th>
<th>FOUNDATION Fieldbus H1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission</td>
<td>MBP</td>
<td>MBP</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>31.25 Kbps</td>
<td>31.25 Kbps</td>
</tr>
<tr>
<td>Cable</td>
<td>Two-wire shielded</td>
<td>Two-wire shielded</td>
</tr>
<tr>
<td>Type of protection</td>
<td>EEx (ia/ib)</td>
<td>EEx (ia/ib)</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree, ring</td>
<td>Linear, tree, ring</td>
</tr>
<tr>
<td>Safety Integrated</td>
<td>•</td>
<td>–</td>
</tr>
<tr>
<td>Control in the field</td>
<td>–</td>
<td>•</td>
</tr>
<tr>
<td>Interoperability</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Field devices per segment/coupler</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Field devices per link</td>
<td>64</td>
<td>31</td>
</tr>
<tr>
<td>Active field distributor per segment/coupler</td>
<td>8 AFD4/AFD8</td>
<td>8 AFD4/AFD8</td>
</tr>
<tr>
<td>- AFD4/AFD8 or combination of AFD8 with AFD4/AFD8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Max. total current consumption of all field devices</td>
<td>1 A</td>
<td>1 A</td>
</tr>
<tr>
<td>Cable length per segment depending on transfer rate</td>
<td>1 900 m: standard</td>
<td>1 900 m: EEx (ib)</td>
</tr>
<tr>
<td></td>
<td>1 900 m: EEx (ia)</td>
<td>1 900 m</td>
</tr>
</tbody>
</table>

1) Conforming to PROFIBUS installation guideline 2.262
Fieldbus architectures

With the fieldbus architectures shown, the gateway from PROFIBUS PA or FF H1 to PROFIBUS DP is a link (PA link/FF link), which is equipped with 1 or 2 couplers.

A maximum of 5 bus segments can be operated via individual couplers on a PA link which can be equipped with up to 5 couplers (max. 3 for mixed configurations with ring or with coupler redundancy). Only 1 segment can be operated on the FF link which can be equipped with 2 couplers, independent of the configuration.

Due to the identical physical bus systems, the following active field distributors can be used for PROFIBUS PA and FF H1: AFS (active field splitter), AFD (active field distributor) for Ex-Zone 2/22 and AFDiS (active field distributor intrinsically safe) for Ex-Zone 1/21 and 2/22.

Linear architectures with single couplers
Active field distributors (up to 8 without AFDiS, up to 5 with) integrate the field devices in a line segment. Connection to these field distributors is made via short-circuit-proof spur lines. In contrast to AFD, the spur line lengths with AFDiS are independent of the total number of spur lines in the segment and need not be taken into account for the total length of the segment. The line segment can be connected to a single or redundant PROFIBUS DP via a link. The last AFD4/AFD8/AFDiS at the end of the line leading away from the link automatically activates its bus terminating resistor.

Linear architectures with redundant couplers
The active field splitter AFS is connected with a redundant coupler pair (2 × FDC 157) in the link. It interconnects a line segment with the respective active coupler. A coupler can be replaced during operation. The field devices are integrated in the line segment as described in the section “Line architecture with single coupler”.

Ring architecture with coupler and media redundancy
Maximum availability can be achieved with a ring segment that is created by means of a redundant coupler pair (2 × FDC 157) in the link. Active field distributors AFD4/AFD8/AFDiS (up to 8 without AFDiS, up to 5 with) integrate the field devices in this ring segment via short-circuit-proof spur lines. The bus is terminated automatically and is immediately adapted in the event of changes or faults on the bus. An extension on the fieldbus or replacement of a coupler during operation is possible.

Advantages of the ring architecture

- Maximum availability avoids unplanned plant downtimes
- Simple and safe installation
- Automatic termination
- Automatic, bumpless isolation of faulty subsegments
- Topology can be repaired or expanded during ongoing operation

Enhanced fieldbus diagnostics for PROFIBUS PA with AFDiSD

While the AFDiS diagnostics is limited to short-circuits, redundancy loss, chatter detection and failure of field devices, the advanced fieldbus diagnostics with active AFDiSD field distributors provides comprehensive diagnostics of the entire PROFIBUS PA segment. This includes detection, recording and monitoring of:

- Topology (DP/PA coupler, AFDiSD)
- Voltage and currents on the main and spur lines
- Signal and noise levels
- Capacitive unbalance to shield of main line

A prerequisite for the use of enhanced fieldbus diagnostics is that all field distributors of the segment as well as the components of the PA link support this functionality.

The functionality of AFDiSD and AFDiS complies in the factory state. The extended fieldbus diagnostics can be activated using the mode selector on the AFDiSD.
Process I/O

The right solution for every requirement

SIMATIC PCS 7 offers a variety of options for detecting and outputting process signals via sensors and actuators as well as for connecting process I/O to the automation systems:

- Signal and function modules in remote I/O stations on the PROFINET DP or PROFINET IO fieldbus
- Intelligent, distributed field / process devices and operator terminals directly on the PROFIBUS DP, PROFIBUS PA or FOUNDATION Fieldbus H1
- Analog and digital I/O modules of the SIMATIC S7-400 operated centrally in the automation system

In practice, field automation is characterized by distributed process I/Os, which, depending on the type, also support redundant configurations or operation in hazardous gas/dust atmospheres:

- SIMATIC ET 200 remote I/Os in conjunction with classic field/process devices and HART field devices
- Intelligent field/process devices for direct fieldbus connection

In addition to the wide technical bandwidth, the following properties characterize the distributed process I/Os:

- Modularity and uniformity
- Flexible adaptability to the plant structure
- Minimum cabling and engineering requirements
- Low commissioning, servicing and lifecycle costs

S7-400 signal modules that can be operated centrally in the automation system are an alternative to distributed I/Os for small applications or plants with limited distributed expansion.

Modifications possible online

| ET 200M/ ET 200SP | ■ Adding of ET 200M/ET 200SP stations
| ■ Adding of I/O modules to the station
| ■ Changing the parameter settings of I/O modules
| ■ Parameterization of connected HART field devices with SIMATIC PDM
| ET 2005 | ■ Adding of ET 2005 stations
| ET 200pro | ■ Adding of ET 200pro stations
| PROFIBUS DP, PROFIBUS PA, FOUNDATION Fieldbus H1 | ■ Adding of PROFIBUS DP stations
| ■ Adding of PA links and PA field devices
| ■ Parameter assignment of PA or FF field devices with SIMATIC PDM

Standard process I/Os for SIMATIC PCS 7

The following distributed standard process I/Os can be used for field automation with SIMATIC PCS 7:

- Via PROFINET
  - Distributed I/O system SIMATIC ET 200M
  - Distributed I/O system SIMATIC ET 200SP
- Via PROFIBUS
  - Distributed I/O system SIMATIC ET 200iSP
  - Distributed I/O system SIMATIC ET 200S
  - Distributed I/O system SIMATIC ET 200pro
  - PROFIBUS PA devices with PA profile 3.0 or later
  - Drives based on standard message frame types 1/20 of the PI specification "Profile Drive Technology PROFIdrive"
  - Switchgear according to profile type 1 specification "Profiles for Low Voltages Switchgear Devices"

This process I/O can be integrated with standard function blocks from the Advanced Process Library in SIMATIC PCS 7.

More features specifically tailored to the process I/Os are offered as add-on products for SIMATIC PCS 7, for example, for drive and weighing systems such as:

- SIMOCODE pro motor management system
- SINAMICS G120 frequency inverter
- SIWAREX U/FTA/FTC weighing systems
- Measuring devices 7KM PAC3200/4200
Process I/O in hazardous atmospheres

The figure shows the possible applications for the SIMATIC PCS 7 process I/O with consideration of different environmental conditions.

MTA terminal modules

Field devices, sensors and actuators can be connected simply, rapidly and reliably to I/O modules of the ET 200M remote I/O stations using MTA terminal modules (Marshalled Termination Assemblies). MTA versions are available for standard I/O modules as well as for redundant and safety-related I/O modules. The use of the MTA achieves a significant reduction in costs for cabling and commissioning and avoids wiring errors.
## Distributed I/O systems

Recommended devices for field automation

<table>
<thead>
<tr>
<th>I/O system</th>
<th>ET 200M</th>
<th>ET 200iSP</th>
<th>ET 200SP</th>
<th>ET 200S</th>
<th>ET 200pro</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20</td>
<td>IP30</td>
<td>IP20</td>
<td>IP20</td>
<td>IP65/IP66/IP67</td>
</tr>
<tr>
<td>Model</td>
<td>Modular</td>
<td>Modular</td>
<td>Discretely scalable</td>
<td>Bit modular, expandable block</td>
<td>Modular</td>
</tr>
<tr>
<td>Mounting</td>
<td>Mounting rail</td>
<td>Mounting rail</td>
<td>Standard sectional rail</td>
<td>Standard sectional rail</td>
<td>Mounting rail</td>
</tr>
<tr>
<td><strong>Special applications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td></td>
<td></td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For use in hazardous areas</td>
<td>Zones 2, 22</td>
<td>Zones 1, 21</td>
<td>Zones 2, 22</td>
<td>Zones 2, 22</td>
<td>–</td>
</tr>
<tr>
<td>Increased availability</td>
<td>Switched, redundant</td>
<td>Switched, redundant</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Temperature range</td>
<td>0 ... +60 °C (^1)</td>
<td>-20 ... +70 °C</td>
<td>0 ... +60 °C (^1) (horizontal)</td>
<td>0 ... +60 °C (^1)</td>
<td>-25 ... +55 °C</td>
</tr>
<tr>
<td>Vibration resistance (continuous)</td>
<td>1 g</td>
<td>1 g</td>
<td>Up to 5 g</td>
<td>2 g</td>
<td>5 g (module-dependent)</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROFBUS (Cu/FO)</td>
<td>(\bigcirc) / (-) (12 Mbps)</td>
<td>(\bigcirc) / (-) (1.5 Mbps)</td>
<td>(-) / (-)</td>
<td>(\bigcirc) / (\bigcirc) (12 Mbps)</td>
<td>(\bigcirc) / (\bigcirc) (12 Mbps)</td>
</tr>
<tr>
<td>PROFINET (Cu/FO)</td>
<td>(\bigcirc) / (-)</td>
<td>(-) / (-)</td>
<td>(\bigcirc) / (-)</td>
<td>(-) / (-)</td>
<td>(-) / (-)</td>
</tr>
<tr>
<td><strong>System functions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent wiring</td>
<td>(\bigcirc) (pulling and plugging)</td>
<td>(-)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>–</td>
</tr>
<tr>
<td>Hot swapping</td>
<td>(\bigcirc) (with active backplane bus)</td>
<td>(-)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
</tr>
<tr>
<td>Expansion/ configuration during ongoing operation</td>
<td>(\bigcirc) / (-)</td>
<td>(\bigcirc) / (-)</td>
<td>(-) / (-)</td>
<td>(\bigcirc) / (-)</td>
<td>(-) / (-)</td>
</tr>
<tr>
<td>Diagnostics (module-dependent)</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
<td>Channel-discrete</td>
</tr>
<tr>
<td><strong>Functions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital channels</td>
<td>(-)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
</tr>
<tr>
<td>Analog channels</td>
<td>(-)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
</tr>
<tr>
<td>incl. HART</td>
<td>(-)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
<td>(\bigcirc)</td>
</tr>
<tr>
<td>Motor starter</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Pneumatic interface</td>
<td>–</td>
<td>(\bigcirc)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Technological functions</td>
<td>Counting/measuring, controlling, weighing</td>
<td>Counting, frequency measuring</td>
<td>–</td>
<td>–</td>
<td>Counting/measuring</td>
</tr>
</tbody>
</table>

\(^1\) Also available as SIPLUS component for expanded temperature range -25/-40 ... +60/+70 °C and corrosive atmosphere/condensation (exact details at www.siemens.com/siplus)
Drives
Recommended devices

<table>
<thead>
<tr>
<th>Drives</th>
<th>SIMOCODE pro</th>
<th>SINAMICS G120</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Motor management system for constant-speed motors in the low-voltage range</td>
<td>Frequency converter for three-phase asynchronous and synchronous motors</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP20 (module-dependent)</td>
<td>IP20</td>
</tr>
<tr>
<td>Model</td>
<td>Modular</td>
<td>Modular (control unit, power unit)</td>
</tr>
<tr>
<td>Performance range</td>
<td>0.1 ... 700 kW</td>
<td>0.37 ... 250 kW</td>
</tr>
<tr>
<td>Voltages</td>
<td>Up to 690 V AC</td>
<td>380 ... 480 V or 660 ... 690 V ± 10 %</td>
</tr>
<tr>
<td>Rated motor currents</td>
<td>Up to 820 A</td>
<td>–</td>
</tr>
<tr>
<td>PROFIBUS communications</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Block library for integration in SIMATIC PCS 7</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Application</td>
<td>Protection and control of motors</td>
<td>For universal use in all industrial and trade sectors</td>
</tr>
<tr>
<td></td>
<td>- In hazardous areas for types of protection EEx e/d corresponding to ATEX directive 94/9/EC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- With heavy-duty starting (paper, cement, metal and water industries)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- In high-availability plants (chemical, oil, raw material processing industry, power plants)</td>
<td></td>
</tr>
</tbody>
</table>

Sensors/actuators, analyzers, weighing and dosing systems

Siemens Sensors and Communication offers a comprehensive range of devices for operation with the SIMATIC PCS 7 process control system, for example

- Devices for measurement of pressure, flow, temperature or level
- Positioners
- Gas analyzers
- SIWAREX weighing systems

This includes versions with PROFIBUS DP/PA interface and for HART communication. The majority of devices is already included in the device library of the SIMATIC PDM process device manager.

Overview of the current range of devices with additional information, technical specifications and ordering data: [www.siemens.com/processinstrumentation](http://www.siemens.com/processinstrumentation)
Batch automation with SIMATIC BATCH

Modular, flexible, scalable and fully integrated in SIMATIC PCS 7

SIMATIC BATCH’s recipe-driven control strategies enable efficient and flexible execution of simple and complex batch processes with changing control sequences. SIMATIC BATCH meets all the associated high requirements without exception:

- Optimum capacity utilization of production plants
- Uniform product quality
- Traceability
- Compliance with statutory standards and directives
- Fast response to changing market conditions

Modular architecture

SIMATIC BATCH is configured as a single station system or as a client/server system and can be used in plants of any size due to its modular architecture and scalability in cumulative SIMATIC BATCH UNITS (sets of 1, 10 and 50 plant unit instances).

For small batch applications, a SIMATIC PCS 7 BOX can be combined with a separate controller, for example, a SIMATIC PCS 7 AS mEC RTX.

However, characteristic for the automation of batch processes using SIMATIC BATCH are client/server architectures with which one batch server and several Batch Clients process a plant project together. The batch server can also be configured with redundancy in order to increase availability.

In addition to the SIMATIC PCS 7 Industrial Workstations, the more compact SIMATIC PCS 7 OS clients 627 and 427 are also suitable for use as batch clients.

Integration in SIMATIC PCS 7

SIMATIC BATCH is completely integrated in SIMATIC PCS 7. Connection to the production control level is supported by direct communication with SIMATIC IT or by an open interface to any manufacturing execution system (MES).

The plant data can be configured entirely using the Engineering System. This passes on all data required for recipe creation to the batch server, making recipe processing possible separate from the Engineering System. Changes to the configuration which are made on the Engineering System are available to the batch server using an update function.

The SIMATIC BATCH server software usually runs on autonomous server hardware (batch server), separate from the OS servers. Depending on the capacity utilization of the operator system, OS and batch server software can also be operated on shared server hardware. SIMATIC BATCH clients and OS clients can run on separate or common basic hardware.

SIMATIC BATCH uses SIMATIC Logon integrated in the process control system for central user administration and authentication, as well as for the “electronic signature” to release master recipes, formulas and library objects through enabled Windows users/user groups. Individual configuration settings of the Batch Control Center and recipe editor are saved as a user-specific profile when logging off. This means that you can work in a familiar environment as soon as you log on again at any client in the plant.
Communication with the automation systems

Depending on the operating mode, SIMATIC BATCH communicates with the automation systems via the SIMATIC PCS 7 operator system or direct via S7 DOS.

SIMATIC BATCH provides special faceplates and OS controls for controlling and monitoring units and equipment phases. As a rule, instances of an SFC type are used as the interface to the lower automation level.

Operating modes for recipe processing

- **PC mode**: execution of complete recipe logic in the batch server
- **AS mode**: execution of unit recipe logic in the automation system:
  - Very fast step changing times
  - Improved determinism during batch processing
  - Enhanced availability
- **Mixed mode**: parallel application of PC and AS modes in one batch

SIMATIC BATCH highlights

- Modular architecture with flexible scalability (hardware and software)
  - Optimum scaling to plant size and individual requirements
  - Grows with the plant configuration; no expensive spare capacities
- High availability thanks to redundant batch servers
  - No loss of batch data
  - Automatic synchronization of batch data
- PC and AS modes
- Homogenous integration of SIMATIC BATCH into the HMI strategy and the engineering of SIMATIC PCS 7 via system interface
  - No customized interfaces
  - No double configuring for batch-specific engineering data
  - OS Controls for integration in process displays
- Recipes independent of unit
  - Considerable simplification in recipe management and validation
  - Flexible control strategy and optimum plant utilization through allocation strategies and assignment of units during batch runtime
- Recipes according to ISA-88.01
  - Creation of recipes oriented according to process engineering
  - Quick, easy and fault-minimizing creation
- Importing and exporting of master recipes, formulas and library objects
- Saving and archiving in the Process Historian and in XML format as well as comprehensive reporting of batch data
  - Production becomes transparent and comprehensible
  - Reliable operator prompting, safe response to process faults
  - Viewer for archived batches
- Reduction in engineering and validation overhead through:
  - Type/instance concept of SFC
  - Separation of procedure and formula
  - ROP library and configuration independent of unit
  - Multiple uses, central modification
- Validation support according to 21 CFR Part 11 through:
  - Audit Trail (change log)
  - Free and system-aided versioning
  - Libraries with recipe operations and formulas
  - User administration with access protection and electronic signature
- Interfacing SIMATIC IT or any other MES systems
Batch client functionality

**Batch Control Center**

The Batch Control Center (BatchCC) is the "command center" for monitoring and controlling batch processes. The data relevant to SIMATIC BATCH are managed using a GUI. BatchCC offers powerful functions for the following tasks:

- Reading in and updating the process cell data of the basic automation
- Definition of user privileges for all functions, for clients or for units of SIMATIC BATCH
- Definition of material names and codes
- Management of master recipes
- Management of libraries with recipe elements (library operations)
- Editing of formula categories and management of associated formulas (parameter sets)
- Creation of master recipe from control recipe
- Exporting and importing of master recipes, formulas and library objects
- Creation of batches with master recipes
- Starting of batch processing and controlling of batches
- Monitoring and diagnostics of batch processing
- Occupation strategy during creation of the recipe and assignment of units during batch runtime
- Modification/deletion/insertion of objects and structure elements (loops, transitions etc.) of the recipe online
- Recording and archiving of recipes and batch data
- Calling of SFC visualization directly from the control recipe

**Batch Planning**

BatchCC can be used to create production orders and batches individually. However, Batch Planning offers significantly more planning functions. Batches for a large number of production orders can then be planned in advance. In addition to planning, the scope of functions include the modification, cancellation, deletion and release of batches.

**Batch OS Control**

Batch OS Controls output in the process display permit operation and monitoring of batch processes.
Recipe system, archiving and logging

Recipe Editor

The Recipe Editor is used for easy, intuitive creation and modification of master recipes and library operations. It possesses a GUI, processing functions for individual and grouped objects and a structural syntax check. The basis for recipe creation are the batch objects created from the plant configuration using the SIMATIC PCS 7 Engineering System, e.g. units and equipment phases. The Recipe Editor can be called from BatchCC or it can be started individually.

The following tasks can be performed with the Recipe Editor:

• Creation of new master recipes and library operations
• Modification of existing master recipes and library operations (changes to structures or parameters)
• Querying of states of the recipe objects and of process values in transition conditions
• Assignment of route control locations to the transport phases as transfer parameters (source, target, via), in order to direct products of one batch into other units (local or external plants)
• Configuring arithmetic expressions for calculating setpoints for transitions and recipe parameters from recipe variables and constants
• Documentation of master recipes and library operations
• Validation under inclusion of user-specific plausibility checks
• Selection of appropriate units using static equipment properties and dynamic attributes
• Releasing master recipes and library operations for test or production

Recipe elements for handling of exceptions

Monitoring of process states is possible during runtime by marking freely selectable recipe sections. It is possible to react to evaluated events or faults using a command block or jump function in a special container.

Batch reports

Batch reports comprise all data required for the reproduction of batch process, for proof of the quality and for compliance with statutory directives, including

• Identification data
• Control recipe data
• Effective production data
• Time sequence of steps
• Status messages, fault messages and alarms
• Operator interventions
• Process values

Recipe reports

The recipe reports contain the production data, e.g.

• Recipe header data
• Recipe topology
• Input material, output material and parameter lists

Viewer for archived batches

The batch data which is only accessible to authorized persons or systems can be saved in XML format – locally, on a network drive or on a central archive server. It is insignificant whether the connected batches originate from a single SIMATIC BATCH plant or from several plants. The batches archived in this manner can be displayed again as a control recipe in the Batch Control Center using a Viewer.
Hierarchical and recipes not specific to the unit

Hierarchical recipes according to ISA-88.01

SIMATIC BATCH and SIMATIC PCS 7 form a functional unit that fully covers the models described in the ISA-88.01 standard. The hierarchical recipe structure is mapped on the plant model as follows:

- Recipe procedure for controlling the process or production in a process cell
- Recipe unit procedure for controlling a process step in a unit
- Recipe operation/recipe phase to implement the process engineering task/function in an equipment module facility

Non-specificity and assignment of units

Creation of recipes that are not bound to a specific unit minimizes the engineering overhead and provides significant advantages for validation. During creation of the recipe, the recipe unit procedures are only assigned selection criteria. The final assignment of the units following evaluation of the static and dynamic properties (e.g. vessel size and cleaning status) is then carried out during runtime. In the cases of batches which run for a longer period and where the units are not to be already determined and occupied at the start of a batch, the assignment is only carried out at the time of use. Conflicts in the unit allocation are detected by the system and displayed.

The following allocation strategies for unit assignments permit optimum orientation according to the specific plant situation:

- "Manual selection of unit" when the units are occupied
- "Preferred unit" for preselection at time of recipe creation
- Determination of "Unit unused for longest time" to achieve uniform utilization
- Assignment of unit to be used by means of "Process parameters" from external module (e.g. scheduler)
Rationalization of recipe creation and supporting of validation

Library with recipe operations (ROP)

Recipe operations managed in a user library (ROP library) can be installed in the recipe procedures of hierarchical recipes as a reference and thus modified centrally.

This reduces the requirements for engineering and validation. If the reference link is broken, the recipe operation becomes a fixed component of the recipe procedure and is thus independent of further central modifications.

Separation of procedure and formula

The flexibility achieved by recipes which are independent of specific units can be increased even further if the procedure and parameter sets (formulas) are separated from one another. Various master recipes can be created by linking several formulas using a recipe procedure. This enables central modification of procedures. The formula structure is determined by the formula category defined by the user.

Application Programming Interface (API)

The SIMATIC BATCH API Application Programming Interface is an open interface for customer-specific extensions. To program special industry-specific or project-specific applications it offers the user access to data and the functions of SIMATIC BATCH.

Validation according to 21 CFR Part 11

As a manufacturer of process control systems, Siemens has specially trained personnel, as well as many years of experience in quality management and plant validation. SIMATIC BATCH particularly supports validation according to 21 CFR Part 11 through:

- Consistent standardization, e.g. with
  - Type/instance concept of SFC
  - Recipe creation independent of a specific unit
  - Separation of procedure and formula
  - Library recipe operations
- Audit Trail (change log):
  - Recording of changes in recipes and recipe operations (saved with modified object)
  - Recording of changes during production (in the batch report), including the operations of the individual control level belonging to the corresponding batch
- Free and system-aided versioning of recipes, formulas and library elements
- Central user administration with access control through SIMATIC Logon
- Electronic signature for release of master recipes, formulas and library objects based on SIMATIC Logon

For additional information on SIMATIC BATCH, see: www.siemens.com/simatic-batch
SIMATIC Route Control (RC) expands the SIMATIC PCS 7 process control system with a sector-independent tool for the configuration, control, monitoring and diagnostics of material transport in pipeline networks or on conveyor belts. Thus SIMATIC PCS 7 is capable of automating not only production processes and associated warehouses but also the material transport linking both areas.

SIMATIC Route Control is suitable for small plants with simple, static transport routes or also for plants in the medium and top performance ranges possessing comprehensive, complex routes and pipeline networks.

SIMATIC Route Control is particularly predestined for the following requirements:

- Frequent conversions and extensions of the transport network including actuators and sensors
- Transport routes with high flexibility, characterized by:
  - Regularly changing materials
  - Dynamic selection of the origin and destination of the material transport (including reversal of direction on bidirectional transport routes)
- Numerous simultaneous material transports
- Dynamic allocation of units using SIMATIC BATCH

This requirement profile particularly applies to plants with numerous branched pipelines or comprehensive tank farms typical for the chemical, petrochemical or food and beverage industries.

**Modular architecture**

Thanks to its modularity and discrete scalability with cumulative SIMATIC Route Control (10 and 50 quantity options for simultaneously active material transports), SIMATIC Route Control can be flexibly adapted to different plant sizes and architectures (single-station / multiple station systems) up to the project upper limit of 300 routes.

**Integration in SIMATIC PCS 7**

The Route Control engineering software consists of engineering tool, wizard and block library. Together with the other engineering tools, it is integrated in the central SIMATIC PCS 7 engineering system.

For small plants, SIMATIC Route Control can be installed either alone or together with the OS software on a single station system. However, distributed multiple station systems with client-server architecture are more typical for the automation of material transports with SIMATIC Route Control.
A Route Control server or server pair is configured in a SIMATIC PCS 7 multiple station system consisting of one or more sub-systems. In the case of multiple station systems with small quantity frameworks it is also possible to operate the Route Control Server, Batch Server and OS Server on shared basic hardware. However, availability will be higher and performance better if the subsystems are installed on separate servers or redundant pairs of servers.

In the mimic diagram of the SIMATIC PCS 7 operator system, each route block is represented by an RC block symbol and an RC faceplate. Locations are parameters for requesting a material transport (source, destination, intermediate points/via). (Synonymous terms are nodes, plant locations). They mark the start and end of each partial route and thus also the source and destination of a material transport. The selection for partial routes and routes is facilitated by drop-down lists.

For access control and for managing the graded user rights for engineering, operating and maintenance personnel, SIMATIC Route Control uses the SIMATIC Logon integrated in the process control system.

**Route Control Center (RCC)**

The Route Control Center (RCC) is a synonym for the Route Control client. It can be installed on an OS client, a batch client or separate client hardware. The RCC can be called from the RC faceplate of the route block or from the keyset on the operator station. It displays all route data and error information relevant to material transport in several coordinated views.

**Route Control Server**

After the transport network has been configured and the variants of a material transport tested, the Route Control project engineering data are transferred to the Route Control server where they can then be activated at a suitable time. The new data are then considered when searching for a route.

The Route Control server (RC server) supplies the Route Control clients (Route Control Center) with the necessary data and transfers their commands to the automation systems.

If a material transport is waiting, a route is requested either via the controller or by the operator at the Route Control Center (RCC). Apart from specifying the source, destination and up to 10 optional locations, this also includes creating a start signal on the route control block of the automation system.

If no saved route is available, the RC Server starts the route search and, if possible, combines the statically defined partial routes into one complete transport route. From there on, Route Control takes over the control and monitoring of all RC elements involved in the transport route. The process cell control only has to switch the individual technological functions. When errors occur, the operator receives detailed diagnostics information about the cause, e.g. why the search for a transport route failed.

For maintenance purposes, an automation system can be specifically set to “in maintenance” (out of service). The material transports operating via this automation system are then completed, but no more new ones are permitted.

When transporting solid materials on conveyor belts, the sequence for switching actuators on and off can be cascaded using WAIT elements. When transporting liquids in pipelines, the valves can be cleaned by means of pulses, with the sequence and time intervals being set using WAIT elements.
Route Control Engineering

The Route Control configuration supplements the basic configuration with blocks from the SIMATIC PCS 7 library. Even existing SIMATIC PCS 7 plants are therefore easy to expand with SIMATIC Route Control.

Technological elements of relevance to control of material transport (RC elements) are adapted in the CFC editor using uniform interface blocks from the Route Control library. The RC elements include:

- Control elements (actuators)
- Sensor elements (sensors)
- Parameter elements (setpoints)
- Connection elements (material information related to partial route)
- WAIT elements

Locations of partial or complete routes are configured in the SIMATIC Manager as "Equipment properties of units" and transferred to the RC project together with the other RC-relevant basic data of the SIMATIC PCS 7 project.

Route Control library
The Route Control library contains blocks for RC and transport route configuration and interface blocks for RC elements. It is provided in the catalog of the CFC editor.

Route Control wizard
The Route Control wizard constitutes the interface between the SIMATIC PCS 7 basic configuration supplemented with RC interface blocks and the actual RC configuration in the RC engineering tool. The wizard, which can be called up from the SIMATIC Manager menu, accepts the RC-specific configuration data of the SIMATIC PCS 7 project into the Route Control engineering. In doing so, it carries out a plausibility check, defines the AS-OS and AS-AS communication connections (NetPro and CFC) and configures the RC server signals.

Route Control Engineering tool
Once the RC-relevant basic data of the PCS 7 project has been transferred to the RC project, the next step is to configure the RC-specific objects with the Route Control engineering tool:

- Subdivision of the transport routes into flexible partial routes; parameters "bidirectional" and "priority"
- Interconnection of the RC elements by means of installing in a partial route and thus transfer of type-specific additional properties to these RC elements, e.g. in the base position "Close valve"
- Assignment of the partial routes to mode tables, e.g. "cleaning" or "product transport", that operate as a criterion in the route search to restrict the resulting quantity
- Assignment of technological sequence functions that determine the flow of the material transport via interconnected RC elements, for example:
  - Basic setting of the control elements
  - Open transport valves
  - Open source valve
  - Activate pump
Graphical offline route search to determine all possible route combinations

Configuration of the partial routes and assignment of the RC elements to the partial routes are performed in a matrix of the Route Control engineering tool. With the aid of generic elements, objects or blocks generated on a user-specific basis can be integrated into the RC project and handled like RC elements.

Similarly to a navigation system, the graphically visualized offline route search determines all possible route combinations. Errors in the route network or undesired routes can be detected in advance.

A preferred route can be selected from the results of the offline route search and saved as a static route. An active route can also be saved for re-use via the Route Control Center. A saved route takes priority in a route request.

Special configuration functions make it easier to perform repetitive routine work and extend the range of options for controlling material transport, e.g.:

- Exporting configuration data in the form of CSV files to Microsoft Excel, copying and editing the data there and then re-importing the files into Route Control
- Controlling the joint use of partial routes by configurable function IDs
- Checking of material compatibilities by evaluating the partial route material IDs and interlocking of partial routes in the case of incompatible material sequences
- Connecting setpoints arriving from the process (e.g. weighed quantity) to the route block in runtime

For additional information, see: www.siemens.com/simaticpcs7/routecontrol

**SIMATIC Route Control highlights**

- Flexible, modular and scalable architecture for single-user and multiple station systems
  - Optimum adaptability to plant size and individual requirements
  - No expensive reserve capacities
  - High availability thanks to redundant Route Control Servers
- Homogenous integration into the HMI strategy and the engineering of SIMATIC PCS 7
- Can be combined with SIMATIC BATCH – material transport from batch control recipe
- Mapping of route network of the plant through partial routes
- Fast response to plant modifications during configuration, commissioning or runtime
- Exclusive assignment of RC elements and partial routes involved in material transport

- Reduction in configuration overhead and commissioning times
  - Configuring partial routes by means of repeated application
  - Data export to Microsoft Excel and re-importing
  - Reduction in complex, repeated tasks through RC wizard
  - Graphical offline route search determines all route combinations in advance and finds undesired routes
- Consideration of material compatibilities to avoid undesired mixing
- Offline testing for completeness, inconsistencies and undesired combinations
- Detailed diagnostics of material transport requirement faults and current material transport
- Saved static routes are executed with priority when a route is requested
- Definition of on/off switching sequences using staggered control of actuators, e.g. for conveyor belts
The process industry frequently features complex production sequences where materials and mixtures which are explosive or dangerous to health are produced or processed. A fault or failure could have disastrous consequences.

Therefore the objective of Siemens safety technology is to minimize potential hazards for personnel, plant and environment by means of technical measures, without adversely affecting the production process. A reliable Safety Instrumented System (SIS) is therefore required which is able to automatically place the plant into a safe state should critical events occur, to continue operating it safely under defined conditions and to limit any negative effects in the event of a safety-related event.

Safety Integrated for Process Automation provides a comprehensive range of products and services for safe, fault-tolerant applications in the process industry – based on the Siemens safety-related system. It offers complete safety-related functionality – extending from safe instrumentation for signal recording and conversion, to safe and fault-tolerant control, up to the actuator (e.g. positioner, valve or pump).

The enormous potential of Safety Integrated for Process Automation can best be exploited in conjunction with SIMATIC PCS 7. Thanks to the modularity and the flexibility of the safety-related products this combination is extremely variable. It is not just the degree of integration of safety-related systems that can be individually defined in the process control system, it is also the degree of redundancy for controllers, fieldbus and process I/O (Flexible Modular Redundancy). Thanks to the reduced spatial requirements, the scope of hardware and wiring, as well as reduced mounting, installation and engineering overhead, complete (common) integration of the safety-relevant systems in SIMATIC PCS 7 offers the greatest cost advantages viewed over the entire life-cycle of a plant.

Both the safety technology and the safety applications implemented with it are characterized by great efficiency and comply with both national and international standards, such as:

- IEC 61508 – basic standard for specifications, as well as for the design and operation of safety-related systems
- IEC 61511 – application-specific standard for the process industry
### Product range

#### Safety Integrated for Process Automation – Product spectrum for SIMATIC PCS 7

<table>
<thead>
<tr>
<th><strong>Engineering</strong></th>
<th>Configuration of safety functions (up to SIL 3) using TÜV-certified function blocks and Continuous Function Chart (CFC) or SIMATIC Safety Matrix (Cause&amp;Effect matrix)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automation systems</strong></td>
<td>Fail-safe, fault-tolerant controllers with a redundant or non-redundant design (SIL 3) for the bottom, mid and top performance ranges</td>
</tr>
<tr>
<td><strong>PROFIsafe with PROFIBUS</strong></td>
<td>For standard and safety-related communication on just one bus cable, certified according to IEC 61508 (SIL 3)</td>
</tr>
<tr>
<td><strong>ET 200M</strong></td>
<td>ET 200M: Modular I/O for multi-channel applications with safety-related signal modules (F-DI, F-DO, F-AI), SIL 2/SIL 3; IP20 degree of protection</td>
</tr>
<tr>
<td><strong>ET 200ISP</strong></td>
<td>ET 200ISP: Modular, intrinsically-safe I/O with safety-related electronic modules (F-DI Ex, F-DO Ex, F-AI Ex), SIL 3, IP30 degree of protection</td>
</tr>
<tr>
<td><strong>ET 200S</strong></td>
<td>ET 200S: Bit-modular I/O with safety-related electronic modules (F-DI, F-DO) and safety-related motor starters, SIL 2/SIL 3; IP20 degree of protection</td>
</tr>
<tr>
<td><strong>ET 200pro</strong></td>
<td>ET 200pro: Modular, very compact I/O with safety-related electronic modules (F-DI, F-DI/F-DO), SIL 2/SIL 3; F-switch for switch-off of standard I/O and control of motor switches; IP65/66/67 degree of protection</td>
</tr>
<tr>
<td><strong>Process instruments/process devices</strong></td>
<td>Safe process instruments/devices on PROFIBUS: SITRANS P DS III PA pressure transmitters (SIL 2) with PROFIsafe, SIMOCODE pro with DM-F local/PROFIsafe (SIL 3), SIPART PS2 PA (SIL 2)</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>Partial Stroke Test</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>Predefined function blocks and faceplates for online valve test to enable preventive valve diagnostics without affecting production</td>
</tr>
</tbody>
</table>
Safety-related design versions

The PROFIsafe profile allows safety-related communication for between the controller and the process I/O via the open standard buses PROFIBUS and PROFINET. The decision between these two standard buses seriously influences the architecture of the safety-related system.

Safety-related design versions with PROFIBUS communication

In the case of a safety-related system with PROFIBUS communication integrated into SIMATIC PCS 7, a distinction is made across all architecture levels between two design versions:

- Single-channel, non-redundant design
- Redundant, high availability and fault-tolerant design

Both alternatives are extremely variable and offer generous scope for design. At the individual architectural levels (controller, fieldbus, distributed I/O), the configuration options shown in the diagram are available depending on the process I/O used.

Standard (basic process control) and safety-related functions can be combined flexibly, not only in the area of the distributed I/O. Even at the controller level, they can combined in one system or separate. In addition, there are numerous possibilities using flexible modular redundancy (FMR).
Flexible Modular Redundancy (FMR)

Depending on the automation task and the associated safety requirements, the degree of redundancy may be defined separately for the controller, fieldbus and distributed I/O level and coordinated with the field instrumentation. In this way, individual fault-tolerant architectures which are precisely tailored to the individual tasks can be implemented and tolerate several faults occurring at once. As FMR provides redundancy only where it is actually required, comparatively more attractive and cost-effective applications are possible than with conventional redundancy architectures.

As shown in the example of a process cell with ET 200M distributed I/O, the total of the tasks can produce a mix of different degrees of redundancy within one architecture level (1oo1, 1oo2, 2oo3).

Safety-related design versions with PROFINET

PROFINET supports safety-related systems on the basis of safety-related SIMATIC PCS 7 automation systems (F/FH) and ET 200M remote I/Os. With a safety-related system with PROFINET communication, the ring is the topology of choice from the point of view of availability. The media redundancy of the ring means that bus interruptions or failure of a node will not result in failure of the entire segment.

The maximum availability level is achieved with a PROFINET ring on a redundant controller (AS Redundancy Station). In such a configuration, the structure of PROFINET IO communication referred to as system redundancy enables the I/O devices to establish a communication connection to each CPU of the AS Redundancy Station over the topological network.
Engineering tools for safety functions

The F-block library in S7 F Systems and the SIMATIC Safety Matrix are available for configuring and programming safety-related controllers.

**S7 F Systems with F-block library**

The S7 F Systems engineering tool permits parameterization of safety-related controllers as well as safety-related F-modules of the ET 200 series. It supports configuration by means of functions for:

- Comparison of safety-related F-programs
- Recognition of changes in the F-program using the checksum
- Separation of safety-related and standard functions.

Access to the F-functions can be password-protected. The F block library integrated in S7 F Systems contains predefined function blocks for generation of safety-related applications with the CFC or the Safety Matrix based on it. The certified F-blocks are extremely rugged and intercept programming errors such as division by zero or out-of-range values. Diverse programming tasks for detecting and reacting to errors can thus be omitted.

**SIMATIC Safety Matrix**

The SIMATIC Safety Matrix which can be used in addition to S7 F Systems is an innovative safety lifecycle tool from Siemens, that can be used not only for the user-friendly configuration of safety applications, but also for their operation and service. The tool, which is based on the proven principle of a cause & effect matrix, is ideally suited to processes where defined states require specific safety reactions.

The Safety Matrix not only means that programming of the safety logic is significantly simpler and more convenient, but also much faster than in the conventional manner.

During the risk analysis of a plant, the configuration engineer can assign exactly defined reactions (effects) to events (causes) which may occur during a process. The possible process events (inputs) are initially entered in the horizontal lines of a matrix table comparable to a spreadsheet program and then their type and quantity, logic operations, any delays and interlocks as well as any tolerable faults are configured. The reactions (outputs) to a particular event are then defined in the vertical columns.

The events and reactions are linked by simply clicking the cell at the intersection point of line and column. Using this procedure, the Safety Matrix automatically generates complex, safety-related CFC programs. Special programming knowledge is not required and the configuration engineer can concentrate fully on the safety requirements of his plant.
Safety-related controllers and process I/O

Safety-related automation systems

The safety-related SIMATIC PCS 7 automation systems are available in two design versions:

- **AS Single Station** of type AS 410F, AS 412F, AS 414F, AS 416F and AS 417F, with only one CPU, safety-related
- **AS Redundancy Station** of type AS 410FH, AS 412FH, AS 414FH, AS 416FH and AS 417FH, with two redundant CPUs, safety-related and fault-tolerant

All these systems have multitasking capability, i.e. several programs can be executed simultaneously in one CPU, both basic process control applications and safety-related applications. Working together with the safety-related signal modules of the ET 200 distributed I/O systems or directly via fail-safe transmitters connected via the fieldbus, they detect faults both in the process and their own internal faults and automatically set the process cell to a safe state in the event of a fault. Safety programs executed on different automation systems of a plant are able to carry out safety-related communication with one another over the Industrial Ethernet plant bus.

The standard PROFIBUS or PROFINET is used together with the PROFIsafe profile for safety-related communication between the CPU of the automation system and the safety-related process I/O. In both cases, operation of standard and safety-related components on the same bus is possible. This makes a separate and expensive safety bus unnecessary.

The PROFIsafe profile is implemented as an additional software layer within the devices/systems without modifying the communication mechanisms of the standard PROFIBUS. PROFIsafe expands the frames by additional information with which the PROFIsafe communications partners can recognize and compensate transmission errors such as delays, incorrect sequences, repetitions, losses, addressing errors or data falsification.

Safety-related F-modules

The safety functions of the F/FH automation systems are perfectly matched to the following safety-related F-modules of the ET200 range:

<table>
<thead>
<tr>
<th>ET 200M</th>
<th>F-DI 12/24 × 24 V DC</th>
<th>F-DI 4/8 × NAMUR (Ex ib)</th>
<th>F-DO 10 × 24 V DC/2 A</th>
<th>F-DO 8 × 24 V DC/2 A</th>
<th>F-DO 3/6 × 20 mA or 4 ... 20 mA (HART)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200SP</td>
<td>F-DI Ex 4/8 × NAMUR</td>
<td>F-DO Ex 4 × 17.4 V DC/40 mA</td>
<td>F-Al Ex HART 4 × 0 ... 20 mA or 4 ... 20 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET 200S</td>
<td>F-DI 4/8 × 24 V DC</td>
<td>F-DO 4 × 24 V DC/2 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET 200pro</td>
<td>F-DI 8/16 × 24 V DC</td>
<td>F-DI/DO 4/8 × 24 V DC (DI) and 4 × 24 V DC/2 A (DO)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Safety-related F-motor starter for ET 200S

Safety-related motor starters up to 7.5 kW, can be expanded by brake control module:

- F-DS1e-x direct-on-line starter
- F-RS1e-x reversing starter

Initiated by a switch-off signal, safety-related ET 200S motor starters can be selectively switched off by the series-connected PM-D F PROFI safe power module. In addition to a circuit-breaker/contactor combination, the safety-related motor starters have a safe electronic evaluation circuit for fault detection.

If the contactor to be switched in the case of an emergency stop fails, the evaluation electronics detects a fault and deactivates the circuit-breaker in the motor starter in a safety-related manner.
PROFIBUS PA devices for safety shutdowns

The SITRANS P DSIII digital pressure transmitter which can be used on the PROFIBUS PA fieldbus is suitable for SIL 2 safety shutdowns conforming to IEC 61508/IEC 61511-1. For this reason, Siemens has extended its standard instrument for measuring pressure, absolute pressure and differential pressure to include a PROFIsafe driver.

In a safety application, the pressure transmitter can be interconnected via PROFIBUS PA with a safety-related automation system (F/FH). The digital input of the PROFIBUS PA SIPART PS2 electropneumatic positioner can be used for the safe shutdown. With a redundant, multi-channel design, measuring circuits can also be implemented up to safety integrity level SIL 3.

For additional information, see: www.siemens.com/simatic-pcs7/process-safety

Highlights of Safety Integrated for Process Automation

- Comprehensive range of products and services for safe, fault-tolerant and high-availability applications in the process industry
  - Easy implementation, operation and maintenance of safety applications
  - Reliable elimination of dangers and risks
  - Adaptable and high level of innovation security

- Homogenous integration of safety technology in the SIMATIC PCS 7 Process Control System
  - Processing of basic process control functions and safety functions in one controller
  - Safety integrity level SIL 3 possible with only one CPU
  - Standard and safety-related communication via PROFIBUS/PROFINET with PROFIsafe; no separate safety bus
  - Mixed operation of standard and safety-related F-modules in ET 200 stations
  - Uniform data management for basic process control and safety-related automation; no complex data management

- Integration of safety-related application into process visualization of PCS 7 operator station

- Automatic consideration of safety-related fault messages with their time stamp

- Configuration of safety functions is part of the integrated SIMATIC PCS 7 system configuration
  - S7 F systems, CFC and SIMATIC Safety Matrix are anchored in the engineering toolset
  - Uniform configuration of basic process control functions and safety functions with CFC
  - Safety Matrix for creation of safety functions even faster, simpler and more user-friendly, without programming know-how

- Uniform diagnostics and maintenance from sensor/actuator via automation system up to the operator system

- Integration of safety-related technology in diagnostics and maintenance with the PCS 7 Maintenance Station

- Minimization of total lifecycle costs
  - Costs for hardware, mounting, wiring, installation, engineering and commissioning decrease as the level of integration increases
  - Low acquaintance and training requirements as result of uniform system/tool landscape
  - Cost-effective stocking of spare parts through reduction of types and parts
Industrial security

Comprehensive protective measures for I&C plants

Progressive standardization, opening and networking of control systems has been accompanied by an enormous increase in security risks for a process control plant. The potential dangers arising from destructive programs and access by unauthorized personnel range from network overloads or failures, theft of passwords and data, to unauthorized access to process automation. Apart from material damage, specifically targeted sabotage can also have dangerous consequences for personnel and the environment.

SIMATIC PCS 7 security concept

SIMATIC PCS 7 offers comprehensive solutions for safeguarding a process engineering plant that is based on a hierarchical security architecture. What is special about this concept is its holistic approach. It is not restricted to use of individual security methods (e.g. encryption) or devices (e.g. firewalls). Rather its strengths are the interaction of a host of security measures in the plant network.

The SIMATIC PCS 7 security concept comprises advice and recommendations (best practices) on the following topics:

- Design of a network architecture with graded security levels (defense in depth), combined with segmenting of the plant into security cells
- Network management, network segmentation
- Operating plants in Windows domains
- Administration of Microsoft Windows and SIMATIC PCS 7 operator privileges; integration of SIMATIC PCS 7 operator privileges into the Windows administration
- Reliable control of time synchronization
- Management of security patches for Microsoft products
- Use of virus scanners and firewalls
- Support and remote access (VPN, IPSec)

The security aspects and the recommendations for safeguarding the automation plant are described in detail in the manual "PCS 7 & WinCC Security Concept basic document" and the further detailed documents.
System support for the security concept

On the system side, SIMATIC PCS 7 supports the implementation of guidelines and recommendations of the security concept:

- Compatibility with current versions of virus scanners
  - Trend Micro OfficeScan Client-Server Suite
  - McAfee VirusScan Enterprise
  - Symantec Endpoint Protection
- Use of the local Windows firewall
- Automatic setting of security-relevant parameters such as DCOM, registry and Windows firewall already during setup
- User administration and authentication using SIMATIC Logon
- CP 1628 Industrial Ethernet interface with integrated security functions (firewall, VPN)
- Integration of SCALANCE S industrial security modules
- Automation firewall
- Application whitelisting with McAfee Application Control

SCALANCE S industrial security modules

The rugged SCALANCE S602, S612, S623 and S627-2M industrial security modules can be used, for example, to safeguard the cross-cell data exchange between components of automation and process control systems. They possess security functions such as stateful inspection firewall, port filter, NAT and NAPT address conversion and DHCP server. In addition to this, S612, S623 and S627-2M provide authentication and data encryption with Virtual Private Network (VPN) via IPsec tunnel.

Automation firewall

The automation firewall is provided with stateful inspection packet filters, application layer firewall, VPN gateway functionality, URL filtering, Web proxy, virus scan and intrusion prevention. It thus protects the access point to the production environment, e.g. from the office or intranet/Internet networks. It can be used as follows, depending on plant size:

- Access point firewall for small plants and secure remote access
- Three-homed firewall for small to medium-sized plants with minimal perimeter network
- Front and back firewall for maximum protection in larger plants with extensive perimeter network

Integrated services such as hotline support, replacement service and Software Update Service enhance the automation firewall even more. Additive services permit customized firewall solutions or support integration of the firewall into customer systems.

For additional information, see:
www.siemens.com/industrial-security

Industrial security services

Application whitelisting

Application whitelisting protection mechanisms guarantee that only trustworthy applications and programs are executed on a station of the SIMATIC PCS 7 process control system. They prevent the execution of illegal software and the modification of installed applications and thus add to the existing protection against malware (malicious software).

Industrial security services

Siemens Industry Automation not only offers products and systems but also professional services and solutions for protection of industrial plants against the manifold threats to IT security. These industrial security services are not only oriented according to individual phases but are provided for the complete lifecycle of the plant.

Specific consulting concerning secure plant configurations and concepts support customers in the individual planning of their I&C plant.

Security certification

Since Siemens places great importance on the security of the SIMATIC PCS 7 process control system, it has it regularly tested by independent experts. The following certificates certify a high level of security for SIMATIC PCS 7 and its components:

- Achilles Level II Certification for communication stability of individual components
- Achilles Practices Certification in bronze for SIMATIC PCS 7 from December 2013

For additional information, see:
www.siemens.com/industrial-security
Virtualization is an innovative software technology for emulation of hardware, operating system, data memory and networks, which is also increasingly finding its way into industrial automation. The initially higher investments for hardware, visualization software, service contracts and infrastructure pay off as a result of long-term savings in operating costs in most cases during the plant's lifecycle. Important guarantees for the success of virtualization are capable IT departments with well-trained specialists as well as specific expertise in process automation.

Profitability essentially depends on the special project requirements which are characterized by aspects such as space requirements, remote access, energy saving, validation, plant layout, infrastructure or by virtual operation of other applications such as evaluation tools and information/reporting systems.

IT security is just as important in the virtual world as in the real environment. Therefore, comparable security mechanisms and methods are applied, e.g. security patches, virus scanners, user management or access protection.

Virtualization solutions based on SIMATIC PCS 7 have currently been approved for clients (OS, Batch, Route Control) and add-ons such as SFC Visualization, OpenPCS 7/OS Client, PCS 7 Web Server or PCS 7 terminal server. Servers (OS, Batch, Route Control), engineering system or OS single station can also be operated in the virtual environment specific to the project.

Low-cost thin clients or zero clients serve as the hardware for the virtual clients and add-ons. The operator stations configured in this manner are interfaced using remote protocols (VNC, VMware View). The operator control and monitoring functionalities known from the real plant are available to operators on these stations.

**SIMATIC Virtualization as a service**

“SIMATIC Virtualization as a Service” is a modular Siemens offering for creating the best possible virtualization solution for a specific project. The core is a comprehensive "service package" for implementing the virtualization solution with pre-built, configured and tested systems. This not only includes installation and configuration, but also system documentation and 2-hour technical support for each order. In addition, experienced service specialists within the "Technical Support Extended" framework provide support by creating scripts and customization, project configuration, implementation of individual special requests and commissioning. Based on the "SIMATIC Remote Services", a secure and high-performance connection for remote access can also be set up by service specialists.

The “Configured Host” system platform, consisting of the server hardware and a thin client, is delivered with pre-installed and pre-configured VMware software. The virtualization layer for resource sharing between the hardware and the virtual machine is installed in the "Pre-installed Hypervisor" module. Finally, the type-specific configuration of a turnkey virtual machine as a server OS, ES/OS client, OS client or Web server for SIMATIC PCS 7 is made in the “Virtual Machines” module.
Plants often extend over huge areas, especially in the water & wastewater and oil & gas industries. In such cases it is necessary to integrate outstations for monitoring and controlling highly remote units (usually with a small or medium degree of automation) into the control system of the complete plant. This is carried out by means of telecontrol protocols over a WAN (Wide Area Network).

The telecontrol center for the outstations (consisting usually of simpler remote terminal units (RTUs)) can be integrated directly into the process control system using SIMATIC PCS 7 TeleControl.

This results in significant advantages compared to conventional solutions in which central and remote plant areas are configured as separate units and then combined in a higher-level network control system. Benefits include:

- Uniform process control
- Simple and user-friendly data management
- Integrated engineering for central and remote plant units
- Lower service and training costs

The telecontrol center is integrated into the SIMATIC PCS 7 process control in the form of an operator station in single station or server design (also redundant as option). This PCS 7 TeleControl Operator Station is dedicated to telecontrol operation. However, with smaller configurations, it can also control SIMATIC PCS 7 automation systems in central plant areas in parallel with telecontrol systems (dual-channel operation).
There are no differences between central and remote automation with regard to operating philosophy and alarm response. Data from the RTUs of the telecontrol system can be displayed in one process picture together with data from SIMATIC PCS 7 automation systems.

To enable engineering of the TeleControl Operator Station (single station/server), the functions of the central Engineering Station of the SIMATIC PCS 7 process control system are expanded by DBA technology (DBA) and the object library “SIMATIC PCS 7 TeleControl”.

In addition to technological objects for processing and displaying process data, the library also contains diagnostics objects for communication diagnostics and control. These blocks support SIMATIC PCS 7 compliant operator control by means of symbols and faceplates, as well as the hierarchy of SIMATIC PCS 7 fault messages. If necessary, the DBA Type Editor can be used to expand the library project-specifically with new script-based object types.

For additional information, see: www.siemens.com/simatic-pcs7/telecontrol

<table>
<thead>
<tr>
<th>RTU type¹</th>
<th>RTU category</th>
<th>Possible telecontrol protocols</th>
</tr>
</thead>
</table>
| controller integrated in SIMATIC ET 200S | Small with 30 ... 200 I/Os² | • Modbus  
• IEC 60870-5-101, IEC 60870-5-104 |
| SIMATIC S7-300/S7-300F controller | Medium with 100 ... 2 000 I/Os² | • SINAUT ST7  
• DNP3  
• Modbus  
• IEC 60870-5-101, IEC 60870-5-104 |
| SIMATIC S7-400/S7-400F controller | Large with 500 ... 5 000 I/Os² | • SINAUT ST7  
• DNP3  
• Modbus  
• IEC 60870-5-101, IEC 60870-5-104 |
| SIMATIC S7-400H/S7-400FH controller | | • DNP3  
• IEC 60870-5-101, IEC 60870-5-104 |

¹ Also in SIPLUS extreme version, e.g. for environments with temperature from -25 °C to +70 °C, condensation or medial loading
² Dependent on CPU size, protocol type and application
Switchgear automation

Integration of switchgear/controlgear automation in the process industry with SIMATIC PCS 7 PowerControl

An electrical switchgear distributes or transforms electrical energy, bundling loads/consumers into load groups. With the help of switching devices, network nodes implemented as busbars connect incoming and outgoing cables known as feeders. The switchgear design takes into account the change to the network topology in the event of faults and the isolation and grounding of equipment for maintenance work.

In the past systems for process automation were strictly separate from plants for power utility automation of the process. SIMATIC PCS 7 PowerControl now enables you to combine process automation and the automation of electrical switchgear for medium voltages ranging from 4 to 30 kV in one control system. This results in numerous advantages with enormous cost savings over the entire life cycle of the plant, which is gaining in importance with increasing decentralization due to increased use of renewable energy sources, for example:

- Simpler plant structures with more transparency in the technological dependencies
- Further increase in the level of integration of the plant
- Uniform process control and further expansion of the operator’s task area
- Long-term investment security thanks to globally valid standard IEC 61850
- Rational, integrated engineering and fast commissioning
- Lower administration, service and training costs thanks to uniform holistic view
- Cost-effective modernization of plants using an existing PROFIBUS DP infrastructure

Integration of devices for switchgear automation

Intelligent electronic devices (IEDs) for protection, control, measurement and monitoring in the electric power transmission and distribution are integrated into the SIMATIC PCS 7 process control system as follows:

- Via Ethernet TCP/IP communication with IEC 61850 transmission protocol
  - Direct on the plant bus
  - Via a station controller on the plant bus
  - Via a station gateway (single or redundant) on the plant bus
- With driver blocks of the PCS 7 PowerControl PROFIBUS DP Driver Library
  - On PROFIBUS DP (SIPROTEC protection devices)
Integration options for automating medium voltage switchgears

The integration of IEDs on the PROFIBUS DP is primarily intended for:

- Re-use of existing PROFIBUS DP infrastructures
- Partial modernization of existing plants
- Hybrid configurations of IEC 61850 and PROFIBUS DP in plant expansions

**Functional and performance features of SIMATIC PCS 7 PowerControl**

**SIMATIC PCS 7 Engineering**
- Object library with function blocks, symbols and faceplates
- Object-oriented type-instance concept
- Automatic generation of the objects for the operator station
- Integration of new IEDs by importing their IEC 61850 Device Description (ICD)
- Additives library with technological blocks for electrical equipment such as feeders, machines, transformers, cables, busbars

**SIMATIC PCS 7 process control**
- Faceplates for SIPROTEC protective devices in the SIMATIC PCS 7 APL style (look&feel)
- Standardized behavior in the case of alarms, messages and operator control and monitoring
- Diagnostics functionality for every IED

For additional information, see: [www.siemens.com/simatic-pcs7/powercontrol](http://www.siemens.com/simatic-pcs7/powercontrol)
Energy management with SIMATIC PCS 7

Resources which are becoming scarcer, increasing energy prices, an increased sensitivity for environmental matters and tighter statutory constraints significantly emphasize the importance of efficient energy management. All aspects concerning the generation, procurement, distribution and consumption of energy must be considered.

Companies operating in the process industry must be able to plan, monitor and record their energy consumptions, to define and implement possible energy saving measures and to prove the efficiency through regular evaluation of indicators.

Identification and evaluation of energy data

Transparency is a basic prerequisite for improving the energy balance, i.e. the measurement and recording of consumption data and the presentation of the flows of energy and media within the company. It is only possible to define potential savings and the required efforts when the consumption of each type of energy is known.

This is supported in the context of the SIMATIC PCS 7 process control system by:

- Basic power monitoring with SIMATIC PCS 7 standard functionality:
  - Data of process-related energies measured using process instruments, such as steam, cooling media or gas
  - Data provided directly by electric components such as circuit-breakers (SENTRON), frequency converters (SINAMICS), motor starters (ET 200S) etc.
  - Data of other energy consumers measured using power monitoring devices of the SENTRON PAC range

- SIMATIC B.Data software for optimization of operational energy management with usage-based allocation and transfer to the accounting system
  - Company-wide transparency thanks to gap-free energy and material balancing of power generation and consumption plants
  - Generation of key performance indicators (KPIs) for reliable statements on raising the efficiency of energy generation, distribution and consumption systems
  - Distribution of energy costs and revenues based on causer and transfer of such to ERP systems (e.g. SAP R/3)
  - Production-based prediction of loads and requirements to improve planning security
  - Support of cost-effective purchasing of energy

Energy management with SIMATIC PCS 7
Optimization of energy utilization

SIMATIC PCS 7 can be used to optimize the energy utilization such that previously unused resources can be accessed and consumption peaks avoided. SIMATIC PCS 7 standard blocks use the current consumption to calculate a prediction for the running 15-minute average and compare this with defined limits. Consumers can be specifically switched off or on, for example, in order to smoothen larger peaks or to observe limits agreed by contract with the energy supplier. In the case of unstable power supplies, loads can also be rapidly disconnected in order to guarantee the operation of critical plant components using the remaining infeed capacity.

Furthermore, the optimization of processes using Advanced Process Control (APC) as well as plant-level asset management with the PCS 7 Maintenance Station provide a significant contribution to energy-efficient plant operation.

Energy saving with innovative technology

The application of low-energy motors or frequency converters is a further large potential for savings, especially with energy-intensive production processes, e.g. in the chemical or pharmaceutical industry.

Energy-saving motors

Energy-efficient motors have a power loss reduced by up to 42%. Since the share of energy costs in the total costs of a motor over its complete lifecycle is approximately 98%, enormous cost savings can be achieved for new plants or when modernizing existing plants.

Frequency converters with braking energy recovery

Frequency converters make it possible for the equipment in plants, such as pumps, fans or compressors, to always operate within the optimum working range. Energy savings of up to 50% can then be achieved compared to conventional control procedures.

For additional information, see: 
www.siemens.com/simatic-pcs7/energy-management
Optimization with Advanced Process Control

With complex processes, control concepts based on PID controllers often reach their limits quickly. Advanced Process Control (APC) functions are integrated in the SIMATIC PCS 7 process control system and provide significantly more options. The application of these advanced control functions permits the following:

- Drastic reduction of undesirable variations in critical process variables
- Noticeable reduction in use of raw materials and consumption of energy
- Increase in throughput and product quality
- Reduction in demands placed on operating personnel

Integrated Advanced Process Control functions

In addition to numerous basic control functions, e.g. PID control, cascade control, split range control and ratio control, the I&C libraries of SIMATIC PCS 7 provide function blocks and templates at no extra cost for the advanced control functions described below.

Using these model solutions already included in the standard, complex APC applications can be implemented simply and cost-effectively for small and medium-sized plants.

Override control

With override control, the outputs of two or more controllers are connected to a common final controlling element. The decision concerning which controller actually has access to the final controlling element is made depending on the evaluation of the current process state.

- Two or more controllers share a final controlling element
- Decision for the active controller based on:
  - Measurable output variables, e.g. one of the controlled variables
  - Manipulated variables of the controllers

Gain scheduling

Gain scheduling enables infinite adjustment of the controller settings in non-linear processes depending on three operating points.

Linear interpolation effects soft, bumpless transitions between the operating points so that the parameters can be infinitely modified dependent on the course of the measured variable X.

- Suitable for non-linear processes
- Three complete parameter sets for three operating points

Dynamic feedforward control

Feed-forward control can compensate a strong, measurable interference in advance so that the control is limited to model uncertainties and non-measurable interferences.

- Compensation of strong, measurable interferences
- Eliminating faults before the appearance of negative effects

Monitoring of the control performance

The ConPerMon block determines the control quality of the PID controller block. Depending on the deviation from the comparison value, e.g. the control quality during commissioning, it triggers warnings or alarms which can be combined clearly in OS displays for a plant or unit. In this way, problems can be detected, analyzed and specifically corrected at an early stage.

- Online monitoring of the control performance
- Identification of control loops according to the criteria:
  - Maximum urgency for optimization
  - Imminent fault
- Configurable alarm limits for standard deviation
- Graphic evaluation
**PID controller optimization**

A model of the process is initially generated using the PID Tuner integrated in the engineering system. Based on this, the most favorable controller settings can be determined, while differentiating between the optimum response to disturbance variable changes or setpoint changes.

- Optimization of PID control loops
- Can be used for standard PID controllers and blocks from user-specific libraries
- Simulation of closed control loops

**Smith Predictor**

The Smith predictor can significantly improve the control quality of processes with long and relatively constant dead times. The dead time component is eliminated using a process model running parallel to the actual process. The controller can then be designed for a process free of dead time and set more effectively.

- Can be used on processes with long, known and relatively constant dead times:
  - Process model runs parallel to the actual process
  - Feedback of virtual controlled variable free of dead time
  - Feedback of deviation between the measured actual value and the virtual value with dead time
- Draft PI(D) controller:
  - Based on component of process model that is free of dead time
  - Allows significantly more precise controller setting

**Model-based predictive multi-variable control**

Model-based predictive multi-variable controllers (MPC) separately analyze the behavior of several interdependent variables for complex processes over a longer period. The results are used for optimized control of these variables. They eliminate adverse interactions which occur with separate control of the interdependent variables. The integral static operating point optimization can calculate the economically optimal operating point in a tolerance range specified as a setpoint.

Using a mathematical model of the process dynamics, MPCs are able to predict the future process response over a defined period of time (prediction horizon) and optimize a quality criterion on this basis.

Scalable MPC applications:

- Internal (“lean”) MPC4x4 (ModPreCon): up to 4 coupled manipulated variables and controlled variables
- Internal MPC10x10: up to 10 coupled manipulated variables and controlled variables, up to 4 measurable disturbance variables
- External “full-blown” MPC (add-on product INCA MPC)
Simulation and training systems

Simulation and virtual commissioning with SIMIT Simulation Framework

Application and integration options of SIMIT Simulation Framework

In the process industry, automation projects are characterized by tight budgets, increasing complexity and a tightly organized implementation timeframe. The challenges are therefore the planning, installation and commissioning of I&C plants within the shortest possible time, but at the same time satisfying the increasing quality and cost demands.

Reduction of commissioning times resulting from testing the automation system using the simulation functionality of SIMIT Simulation Framework makes a significant contribution toward faster achievement of the planned efficiency and productivity of new plants, expansions and modernizations.

SIMIT Simulation Framework permits testing and commissioning of the project-specific user software on a partially virtual plant. To achieve this, the response of the field technology and of the technological plant/unit can be mapped and simulated in real-time or virtually. Either a real or virtual automation system is used for the control.

Many efficient tests for detection and elimination of potential faults can already be carried out before the real plant is even available, e.g. application of correct identifications, testing of interconnection or interlocking logic. In this manner it is possible to optimize the quality of the configuration process without a risk for the real plant.

In addition, SIMIT Simulation Framework can be used to train personnel to handle the real SIMATIC PCS 7 automation system. In this case, the plant behavior is simulated for testing and commissioning.

SIMIT Simulation Framework runs on the latest notebooks or desktop computers with Windows 7 Professional / Ultimate (32/64-bit) and also on virtual systems (VMware). It can be flexibly used and integrated in the SIMATIC PCS 7 process automation via open interfaces.
Abstraction levels of the simulation

Efficient simulation based on the abstraction of the three levels of signals, devices (e.g. sensors and actuators) and technological characteristics.

SIMIT Simulation Framework can be connected to the real SIMATIC PCS 7 automation systems via PROFINET IO. Simulation units simulate the devices on PROFIBUS DP/PROFINET IO in this case. An alternative to this, you can couple specific applications such as S7-PLCSIM (AS simulation) or PRODAVE (MPI/IE).

This results in two modes of virtual commissioning:

- Preliminary test without the real system (software in the loop)
  - User program running in the virtual AS (S7-PLCSIM)
  - SIMIT Simulation Framework provides simulated I/O signals via S7-PLCSIM coupling
- Factory Acceptance Test (hardware in the loop)
  - User program running in the real AS
  - SIMIT Simulation Framework simulates the I/O signals, instrumentation and field devices.
  - Transmission of the simulation values to the AS via message frame via the simulation unit
  - Extension to the system test by additional simulation of the technological characteristics

Cooperation with other simulation models support SIMIT Simulation Framework using:

- Data exchange via standardized interfaces such as OPC and shared memory
- Synchronization via the remote control interface (with SIMIT in the role as master or client)

Component-based, signal flow oriented modeling of the plant with extendable base libraries via the graphical user interface of SIMIT Simulation Framework. The project flow is controlled by an integrated workflow management. Special simulation skills are not required.

Arguments for the use of SIMIT Simulation Framework

- Testing of original automation project
- High quality thanks to early detection and elimination of faults in the I&C project
- Virtual commissioning shortens project commissioning times and reduces project costs
- No simulation-specific programming required in the automation project

Additional information available in the Internet: www.siemens.com/simit
Interfacing to IT systems

OpenPCS 7 server for data exchange via OPC

Evaluating and managing process data with OpenPCS 7

Systems for production planning, process data evaluation and management (OPC clients) that are at a higher level than the process control system can access SIMATIC PCS 7 process data by means of an OpenPCS 7 server. This server collects data distributed across different SIMATIC PCS 7 stations (OS server, Process Historian) depending on the system configuration. OpenPCS 7 utilizes both the DCOM technology and the advanced OPC Specification OPC UA (Unified Architecture).

Access to station | OPC interface | Data type/ access method |
---|---|---|
OS Server | DA or UA DA (Data Access) | Read/write access to process values |
| A&E (Alarm & Events) | Read and acknowledging access to alarms and messages |
OS Server/ Process Historian | HDA (Historical Data Access) | Read access to archived process values |
| H&A&E (Historical Alarms & Events) | Read access to archived alarms and messages |

Simple, standardized direct access to the archive data in the Microsoft SQL server database of the operator system is possible with the OLE-DB. Through this, all OS archive data are accessible with the accompanying process values, message texts and user texts.

Integration and synchronization of all business processes with SIMATIC IT

The competitiveness of a company depends on a quick response to market requirements and optimization of the supply chain. At the interface between production and management, Manufacturing Execution Systems (MES) ensure uniform optimization of corporate processes and therefore greater efficiency, integrated transparency and consistent quality.

With SIMATIC IT, Siemens has one of the most powerful and flexible MES systems on the market. SIMATIC IT works homogeneously with all major ERP and process control systems. Modeling of the entire product manufacturing know-how, precise definition of the operating processes and real-time data acquisition from the ERP and the production level enable SIMATIC IT to control operating processes more effectively, to minimize downtimes, production waste and follow-up work and to optimize stockholding.

You can find detailed information about SIMATIC IT suites, components and libraries in the Internet:

www.siemens.com/mes
The standard functionality for graphic configuration of automation solutions already defined in the SIMATIC PCS 7 Advanced Process Library (APL) can be expanded by specific technological functions using the SIMATIC PCS 7 Industry Library (IL). In addition to individual blocks, faceplates and symbols which are specifically designed for special I&C tasks in various industrial sectors, the IL also provides sector-specific package units, e.g. for the water/wastewater or building automation sectors. The uniformly styled blocks of IL and APL can be used to create harmonic HMIs which provide a uniform look and feel.

Operator control and monitoring per Comfort Panel

Operator control and monitoring of automation functions (APL/IL) on a touch panel is possible using IL interface blocks. Configuration takes place in the CFC by linking to the technological block, e.g. a motor. Taking operating rights and hierarchical operating concepts (multi-control room operation) into consideration, the technological function executed in a SIMATIC PCS 7 automation system or SIMATIC S7-300 controller can then be operated from an operator station and also from a Comfort Panel.

S7-300 package units

The IL not only supports the engineering of automation systems and operator stations of the SIMATIC PCS 7 process control system, but also the configuration of package units based on SIMATIC S7-300 controllers. The S7-300 package units can be seamlessly integrated into the process control system using IL blocks and homogeneously embedded in the HMI of the SIMATIC PCS 7 operator station. The function blocks are configured in CFC. The following are available for this:

- Panel interface blocks for IL functions
- Analog monitoring of 8 freely selectable limits
- Analog monitoring with additional binary limit monitoring
- Equipment monitoring for up to 8 units
- Analog measured value monitoring
- Digital measured value monitoring
- 3-point actuator (flaps, motors, valves, etc.)
- PID controller
- Operator control blocks
- Valve control
- Motor control (standard motor, with 2 directions of rotation, with variable speed)
- Functions for building automation
- AS-to-AS communication for reading/writing of data
Controller integration with PCS 7/OPEN OS

As a result of developments over many years, I&C plants frequently have heterogeneous structures in which system components from different manufacturers are combined. During plant modernizations, owners endeavor to increase the efficiency of process control by simplifying the HMI level. In the case of plant expansions where control desks are merged or existing plants are migrated step-by-step, the challenge is to integrate different types of controller in one HMI system.

The SIMATIC PCS 7 operator system can be expanded by PCS 7/OPEN OS for such purposes. It can be used to integrate the following controllers into the process management:

- Third-party controllers of control systems
- Programmable logic controllers from Siemens and other manufacturers
- Package units

Depending on the technical situation of the controller to be integrated, connection to the PCS 7/OPEN OS operator station (single station / server / redundant pair of servers) is possible via OPC (OPC DA and OPC A&E) or the existing WinCC channels (e.g. S7 channel or Modbus TCP channel). In the case of OPC communication, the OPC server can be executed on separate hardware or together with the OPC client on the PCS 7/OPEN OS operator station.

The existing engineering system of the controller can be used further to configure the automation functions.

The basis for OS engineering with the PCS 7 engineering system is the Toolset Database Automation (DBA) of PCS 7/OPEN OS. It is then possible to rapidly and simply create OS objects in SIMATIC PCS 7 design for the controller to be integrated. Manual inputs are limited to organization of the project, the creation of static display elements, archive definition, user management and customized adaptations.

**DBA functions**

- Generating the display hierarchy
- Automatic creation of displays with icons and faceplates in the hierarchy tree
- Automatic creation of the variables function in the operator station
- Automatic creation of messages
- Assignment of message priorities
- Definition of the process variables to be archived
- Creation of trends
- Export/import for mass data processing
- Type editor for creation of function block images of the existing controller
  - Creation of data structures (structure types)
  - Import/export and documentation of types
  - Creation of type from instance
  - Integration of type into another type

**Further relevant PCS 7/OPEN OS functions**

- PH synchronization: alignment of plant hierarchy with existing PCS 7 project
- Multi-project engineering: division into several DBA projects, e.g. system-granular
- Online scripting: creation of scripts for supplementary functions, for execution during runtime

**Handling of package units**

Package units can be created once in PCS 7/OPEN OS and supplied as an OS typical on CD or per download. On site, the configuration engineer imports this typical and generates instances from it according to the number of units. The package units can subsequently be visualized in the SIMATIC PCS 7 process displays.
Migration of own and third-party systems
An investment for the future

Migration strategy

Globalization and the intensified competition that accompanies it are forcing companies to continuously increase productivity and shorten product launch times. Existing systems and plants have to be repeatedly expanded and modernized to ensure they can also satisfy tomorrow’s market requirements. However, since the installed basis of hardware, application software and know-how of the operating and maintenance engineers represents an enormous value, the safeguarding of investments for companies operating the plants is always assigned a high priority during all modernization plans.

Experience has shown that the success of a migration process greatly depends on a technical solution optimally matched to customer requirements and the respective plant. The following fundamental aspects apply:

- Minimization of the financial and technical risks
- Long-term safeguarding of investments already made
- The different lifecycles of the system components must also be considered, e.g.:
  - 5 years for PC-based workstations
  - 15 years for controllers
  - 25 years for input/output components and wiring

Added value due to migration

The reasons for modernization of the process control technology are just as diverse as the objectives to be achieved by using a modern process control system such as SIMATIC PCS 7:

- Guaranteeing automation functionality in aging components
- Optimization of stocking of spare parts
- More flexible production with higher capacities
- Increased system performance and process transparency
- Increase in product quality and saving of resources by using modern control strategies
- Reduced engineering requirements
- Simpler process control with reduced demands on operators
- Improved system reliability thanks to more comprehensive diagnostics and plant asset management
- Powerful interfaces and plant networks with high potential for protection against IT security threats

Siemens sees its task in the case of migration to be not simply the complete replacement of an existing system, but also, in close collaboration with customers and their system integrators, the production of an individual, future-oriented solution based on the state-of-the-art SIMATIC PCS 7 process control system – always under the directives:

- Step-by-step system innovation
- Adaptable to the special conditions of the plant
- Flexible according to production demands

The first and most important task of an optimal migration concept for a plant is to analyze the starting point and from this to derive the goals of the modernization.

With very old systems, complete replacement by the new process control system is usually the preferred method. However, it is often possible to continue using components such as controllers or I/O modules if they are still supported by the supplier and if sufficient spare parts are still available. By integrating components that are worth keeping into the migration concept, significant investment savings can be achieved and conversion times shortened.
Even if the hardware is largely obsolete, the available controller engineering can still represent significant value. The entire process automation know-how, often optimized over a period of years, is concentrated here. Intelligent tools help to analyze this data and in certain circumstances, they can significantly reduce costs for re-engineering the new system thanks to functional implementation (typicals).

**Experts with experience of migration**

In view of the complexity of many migration projects, decisive prerequisites for migration success include the analysis and design of the correct procedure, including a realistic assessment of the opportunities and risks. The migration experts at Siemens have already acquired relevant experience in migrating the most diverse systems.

If desired, Siemens works closely with the customer’s system integrators when implementing migration projects, for they have the know-how gained over many years, coupled with precise knowledge of the plant and the customer’s requirements.

For additional information, see:  
www.siemens.com/simatic-pcs7/migration

**Migration spectrum**

Siemens recognized the significance of migration for process automation at an early stage and has for many years offered a wide range of innovative migration products and solutions for its globally proven systems, such as APACS+ or TELEPERM M.

Migration of old systems from other manufacturers such as ABB, Honeywell, Emerson or Invensys has since become firmly established. Here too, various products and solutions support the step-by-step transition to SIMATIC PCS 7. Increasingly, the universal, OPC-linked SIMATIC PCS 7/Open OS is used here. Additional solutions supplement the portfolio, including those for communication between old and new systems or for fast switchover of field wiring in migration projects, e.g. specific gateways, connectors, cables and field termination assemblies (FTA).

With the future-oriented SIMATIC PCS 7 process control system, innovative migration solutions and services, many years of expertise in process automation and migration, as well as continuous worldwide servicing, Siemens demonstrates its expertise and offers the security of a reliable partner.
Services
Global service & support

Whether in the production or processing industry, the services provided for the industry have become a decisive factor toward successful competitiveness when considering the high cost pressures, increasing energy costs and increasingly strict environmental regulations. Siemens supports its customers worldwide with appropriate product, system and application services for the complete lifecycle of a plant. Whether planning and development, operation or modernization are concerned, customers profit from the services thanks to the comprehensive technological and product know-how and the sector competence of the Siemens experts.

This leads to a reduction in downtimes and to optimized usage of resources. The result: increased productivity, flexibility and efficiency along with lower total costs.

Online support

Quickly available information with illustrative examples makes contact with an expert in most cases unnecessary. The Siemens Industry Online Support additionally offers comprehensive information and a platform for exchanging information with other users.

Technical support

Technical questions concerning products and systems can arise at any time – ranging from optimum usage up to troubleshooting. The specialists at Technical Support provide 24/7 support and answer any questions concerning the functionality and operation of products and systems.

Spare parts

Drive systems and automation systems must be continually available – in any industry, anywhere in the world. The lack of spare parts may result in the shutdown of the entire system, causing significant financial damage to the operators. The worldwide available spare parts service from Siemens provide a solution to this through rapid delivery of original spare parts. Original spare parts from Siemens guarantee the smooth interaction with other system components. Individual spare parts packages for various products and solutions provide a preventive replacement parts inventory on site.
Repair services

In every industry, machinery and plants must run at the highest level of productivity throughout their life cycle. The experts of the Repair Service will develop a service concept precisely for you. The combination of expert repair and inspection with a variety of additional services significantly contributes to maximum efficiency and productivity.

Field services

Maximum availability of machinery and equipment is essential in all industries. Siemens provides field services and professional maintenance support, such as inspection and maintenance as well as fast fault clearance for industrial plants worldwide - even by emergency services if needed. The services include the full spectrum from commissioning, preventive maintenance and troubleshooting, all the way to a full service contract.

Training

Participation in professional training oriented according to target groups in more than 60 countries worldwide enables the acquisition of profound SIMATIC PCS 7 system knowledge as well as the expansion of existing know-how. In practice-oriented courses, participants receive excellent training directly from the manufacturer and this enables them to efficiently use the process control system within the shortest possible time. The range of courses also includes special hands-on training directly on site at the customer’s plant.

Discover all the advantages of our service portfolio:
www.siemens.com/industry-services

For additional information on SIMATIC PCS 7 training, see:
www.siemens.com/sitrain
Service programs

As well as global service and support, the range of services also includes special service programs for the process industry that can be used independently of each other and flexibly adapted.

SIMATIC PCS 7 Life Cycle Services

When making decisions concerning investments in new or innovative control technology, the associated costs must always be evaluated in relation to the total cost of ownership (TCO) of the plant. Support, maintenance, servicing and modernization make a significant contribution to these costs. The short innovation cycles associated with the introduction of PC technology to process automation must also be taken into consideration. It is all the more important to keep servicing costs transparent and plannable. Indispensable in this regard is a cost-optimized life cycle service which guarantees the functionality of the control technology for a defined time period. By using active obsolescence management, Siemens takes into account the aging process of the I&C plants and supports its control system customers during the elaboration of specific substitute solutions as well as appropriate maintenance and spare parts strategies.

Based on many years of experience, the service specialists from Siemens have identified four fundamental requirement profiles and developed appropriate service modules which build upon each other: Standard Service, Maintenance Service, Basis Life Cycle Service and Extended Life Cycle Service (see graphic).

The scope of services agreed individually on the basis of service modules and additive supplementary services is stipulated in a contract. The contracts are flexible enough to allow adaptation in the event of plant modifications. The service contract management includes documentation, planning of measures and performance controlling.

Safety Life Cycle Services

The safety life cycle is divided into analysis, implementation and operation and it follows the life cycle of the I&C systems. Operators of safety-related I&C systems, e.g. chemical plants, refineries and distilleries, who use safety-related systems and equipment to reduce the risk and effects of a safety event are obliged in accordance with IEC 61511 to verify the effectiveness of their protection measures in the safety life cycle.

In addition to the correct hardware and software, applied planning, operating and modification processes are decisive in ensuring that the safety engineering effectively maintains its intended function throughout the complete life cycle of the plant. With Safety Life Cycle Services, Siemens provides not only the necessary expert know-how for safety verification, but also progressive tools and methods that exclude systemic errors in all project phases. This is all the more important since errors in an early project phase are often costly and time-consuming to correct at a later date. In addition, plant operators do not have to acquire the expert know-how themselves and permanently adapt to the latest guidelines and technologies.

SIMATIC Remote Support Services

Using modern IT structures and secure Internet connections, SIMATIC Remote Support Services offer preventive, system-specific support, which is highly efficient, flexible and profitable. The SIMATIC Remote Support Services are based on the high-performance Siemens Remote Service (SRS) platform, which enables secure remote access to the automation system – both by Siemens experts as well as by your own system specialists or system integrators.
Get more information

Comprehensive information concerning the SIMATIC PCS 7 process control system:
www.siemens.com/simatic pcs7

Totally Integrated Automation:
www.siemens.com/tia

SIMATIC Manual Overview:
www.siemens.com/simatic-docu

Information material to download:
www.siemens.com/simatic/printmaterial

Service & Support:
www.siemens.com/automation/support

SIMATIC contacts:
www.siemens.com/automation/partner

Industry Mall for electronic ordering:
www.siemens.com/industry mall

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. For more information about industrial security, visit www.siemens.com/industrialsecurity.

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit http://support.automation.siemens.com.