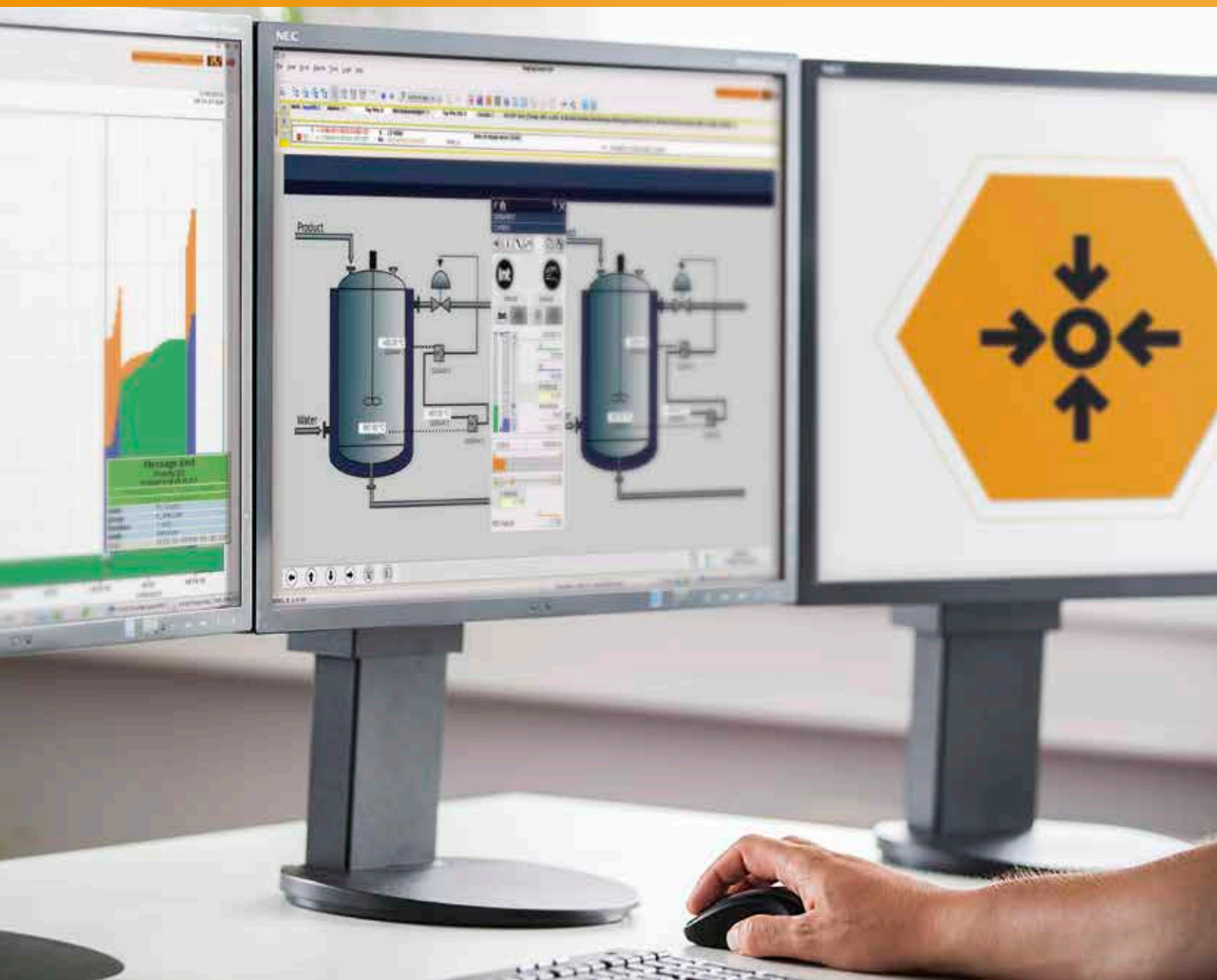
APROL
Process automation
Scalable. Flexible. Modular.

PERFECTION IN AUTOMATION
www.br-automation.com



One system for many disciplines.

Contents

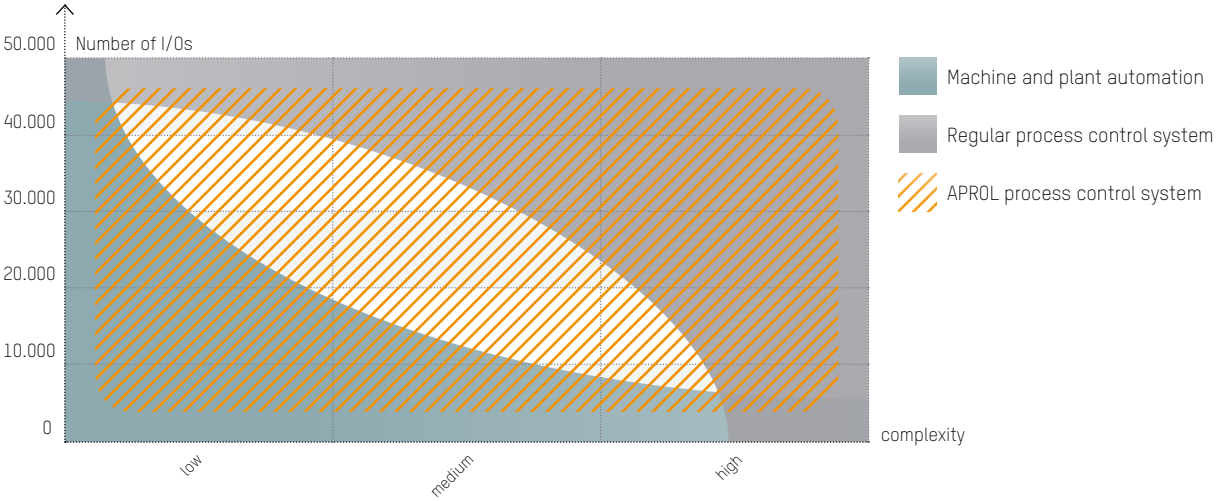
Flexible system design

APROL system software and X20 system automation components are constantly stepping up to new challenges in manufacturing, process and building automation, with countless successful applications all across the world:

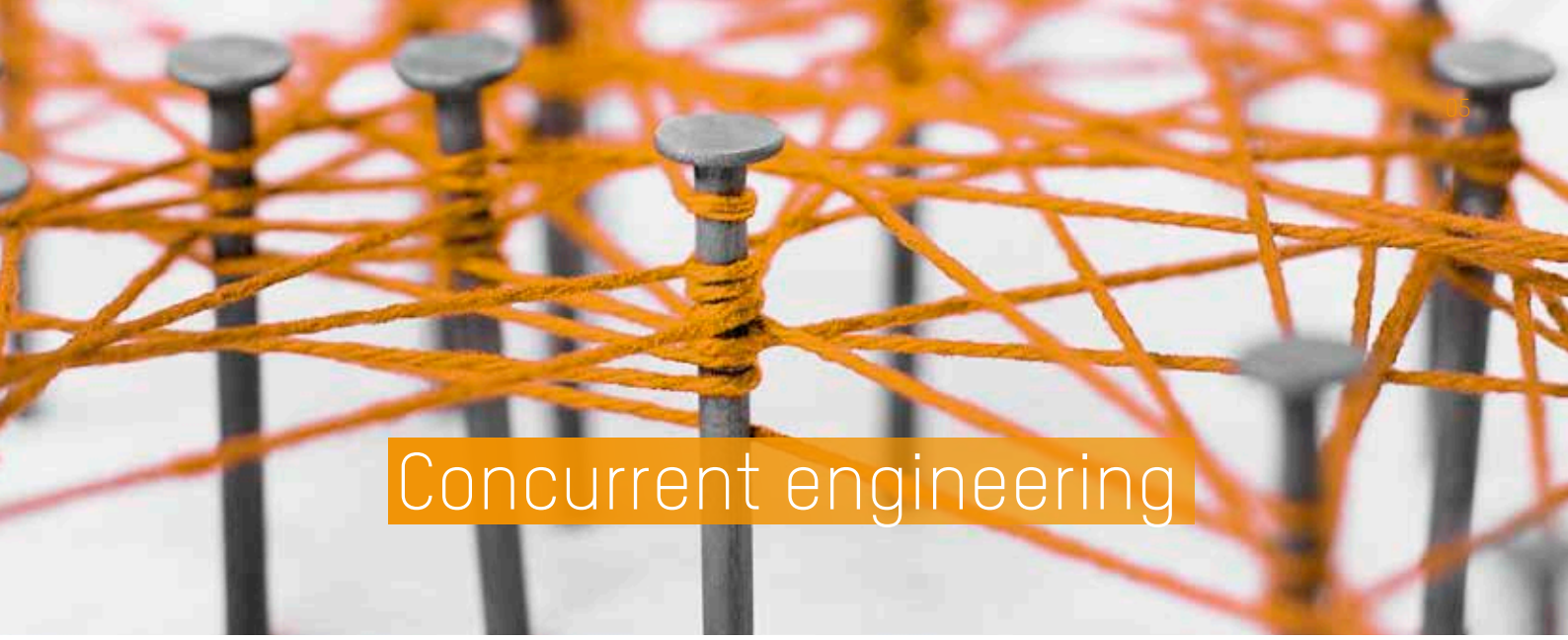
- Installations in a wide range of industries
- High performance, high reliability and high availability
- Optimal and efficient operation of throughout a system's entire life cycle
- All of a system's upstream, downstream and auxiliary processes also automated by APROL
- All current process values managed by centralized losys real-time database
- Continuous development of innovative new solutions compatible with stock installed technology

Limitless scalability
Complete scalability ensured: from single-node to large-scale systems, APROL can adapt to any requirement. Whether it's a lab system with a small number of I/O channels, a demanding technical system or even a extensive production facility, this process control system can grow right along with the system.

Functionality independent of system size
Regardless of the size of a system, the user has access to all APROL features without modification in any way. This ensures that users can always count on a familiar environment.



APROL covers every requirement, regardless of the size or complexity of a project.



Concurrent engineering

Several project engineers can work in a team on the same project without having to worry about access conflicts. Configuration data is stored centrally on the engineering server.

→ **Coordinated access to project elements**
The database server coordinates access to the engineering data and individual configuration elements. If a configuration element is being worked on, then all other project engineers only have read access to the configuration element.

→ **Complete configuration history**
All control computers maintain a complete history of all configuration changes.

→ **Change control logging with seamless documentation of all changes**
The ability to trace all engineering changes is a critical factor in adhering to legal regulations. The version management system in APROL seamlessly traces all changes and documents them using the integrated Change Control logging feature (21 CFR Part 11, GAMP5).

→ **Selective rollback using labels**
The system offers a mechanism for reverting back to previous versions of individual project elements.

→ **Differences between libraries by comparing two labels**
Information is displayed about which user created or changed an individual block.

→ **Filtering functions for Change Control report queries**
Filters make it possible to generate a targeted display of change control data.

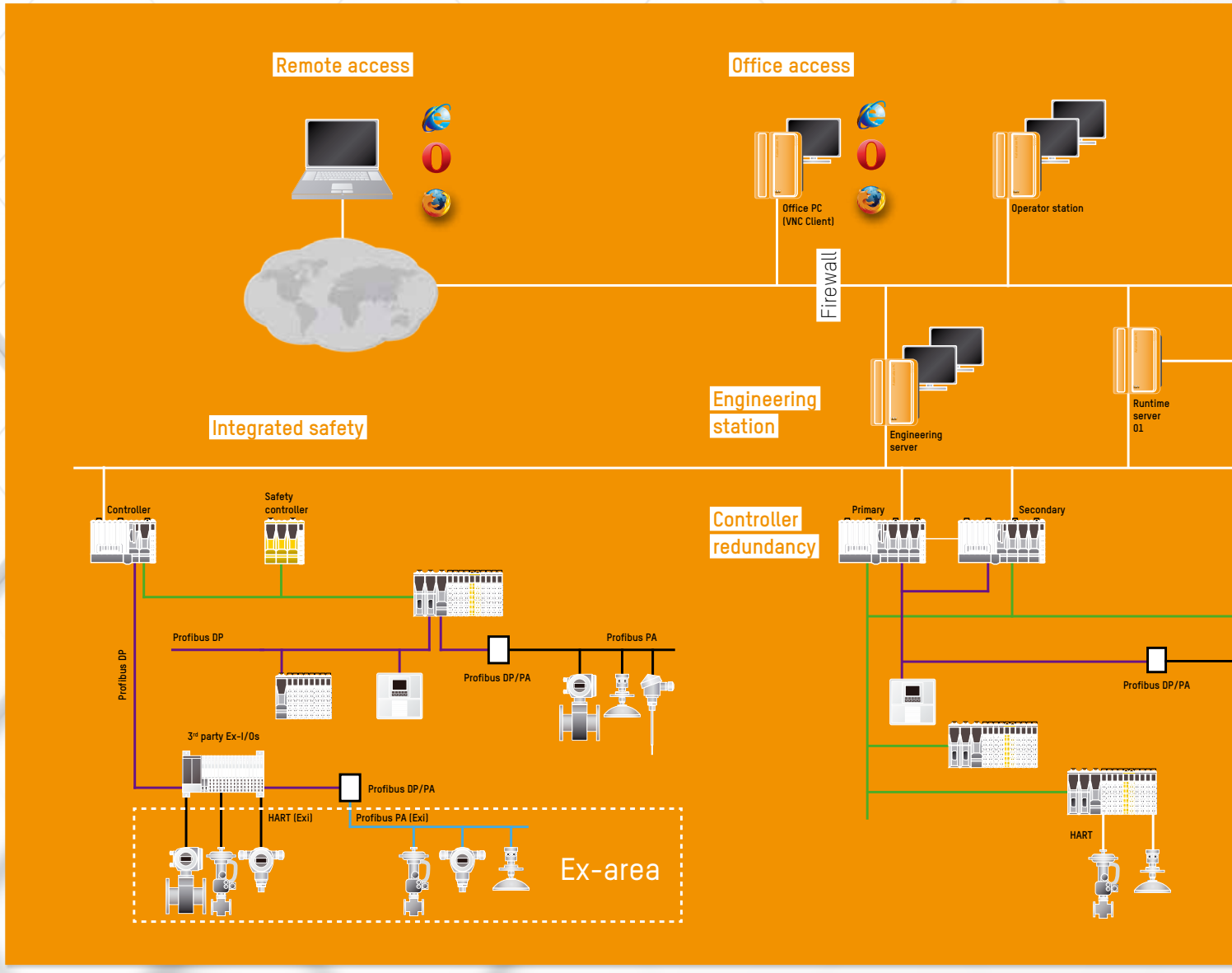
→ **Version as unique ID for a project element**
All project elements have a unique version number.

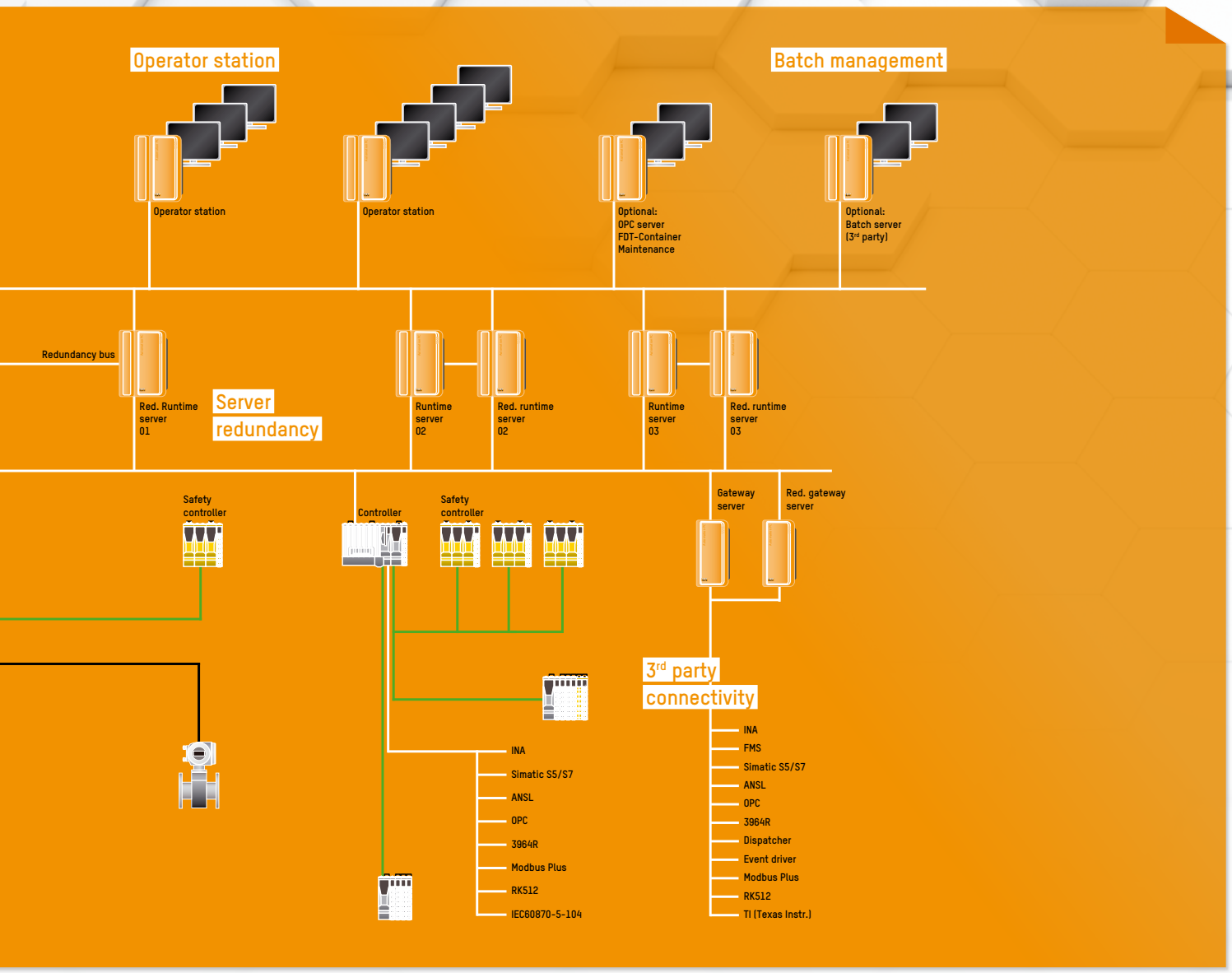
→ **Offline engineering**
Offline engineering makes the storage and offline engineering of configuration elements possible on a remote engineering server. It is then possible to continue working externally, with "stored" configuration elements write-protected in the central engineering database until they are reverted back to online engineering.

→ **Labeling of libraries**
Labeling is a way to "stamp" an entire library while providing protection for all activated blocks from being deleted.

→ **Confirming versions of configuration elements**
This feature clearly indicates that an element version is functional, tested and accepted.

System architecture




Operator station
Batch management
Operator station
Operator station
Optional:
OPC server
FDT-Container
Maintenance
Optional:
Batch server
(3rd party)
Redundancy bus
Red. Runtime
server
01
Server
redundancy
Runtime
server
02
Red. runtime
server
02
Runtime
server
03
Red. runtime
server
03
Safety
controller
Controller
Safety
controller
Gateway
server
Red. gateway
server
3rd party
connectivity
INA
Simatic S5/S7
ANSL
OPC
3964R
Modbus Plus
RK512
IEC60870-5-104
INA
FMS
Simatic S5/S7
ANSL
OPC
3964R
Dispatcher
Event driver
Modbus Plus
RK512
TI (Texas Instr.)

Controller Redundancy

Implementing high-availability systems with real CPU redundancy has often been considered to expensive to implement. Now, however, B&R is making high-availability systems much more attractive by reducing costs to previously unheard of levels. The CPU is the heart that makes redundant automation possible; if this essential yet complex component fails, it can have extremely dramatic consequences.

Reducing the cost of redundancy

CPU redundancy for B&R's X20 systems makes high availability an attractive and economical option for small applications as well.

Fiber optic interface prevents delays

With B&R's solution, one processor provides active control, while the second one runs in the background in standby mode. All necessary functions are monitored continuously so that when the time comes, the backup processor can take over all of the active processor's functions. While in standby mode, the backup processor is anything but inactive. On the one hand, the cross-communication capability of POWERLINK allows it to monitor all data traffic as well as the synchronization signal from the main processor in order to respond to a failure within one network cycle. On the other, the two processors are constantly exchanging data via the redundancy link in order to remain synchronized. This high-speed fiber optic interface operates independently of the fieldbus and is connected via redundancy interface modules. This makes it possible to set up a high-availability system using standard CPUs from the X20 portfolio. There is no need for specialized redundancy CPUs, which are generally very expensive.

Switchover in a matter of milliseconds

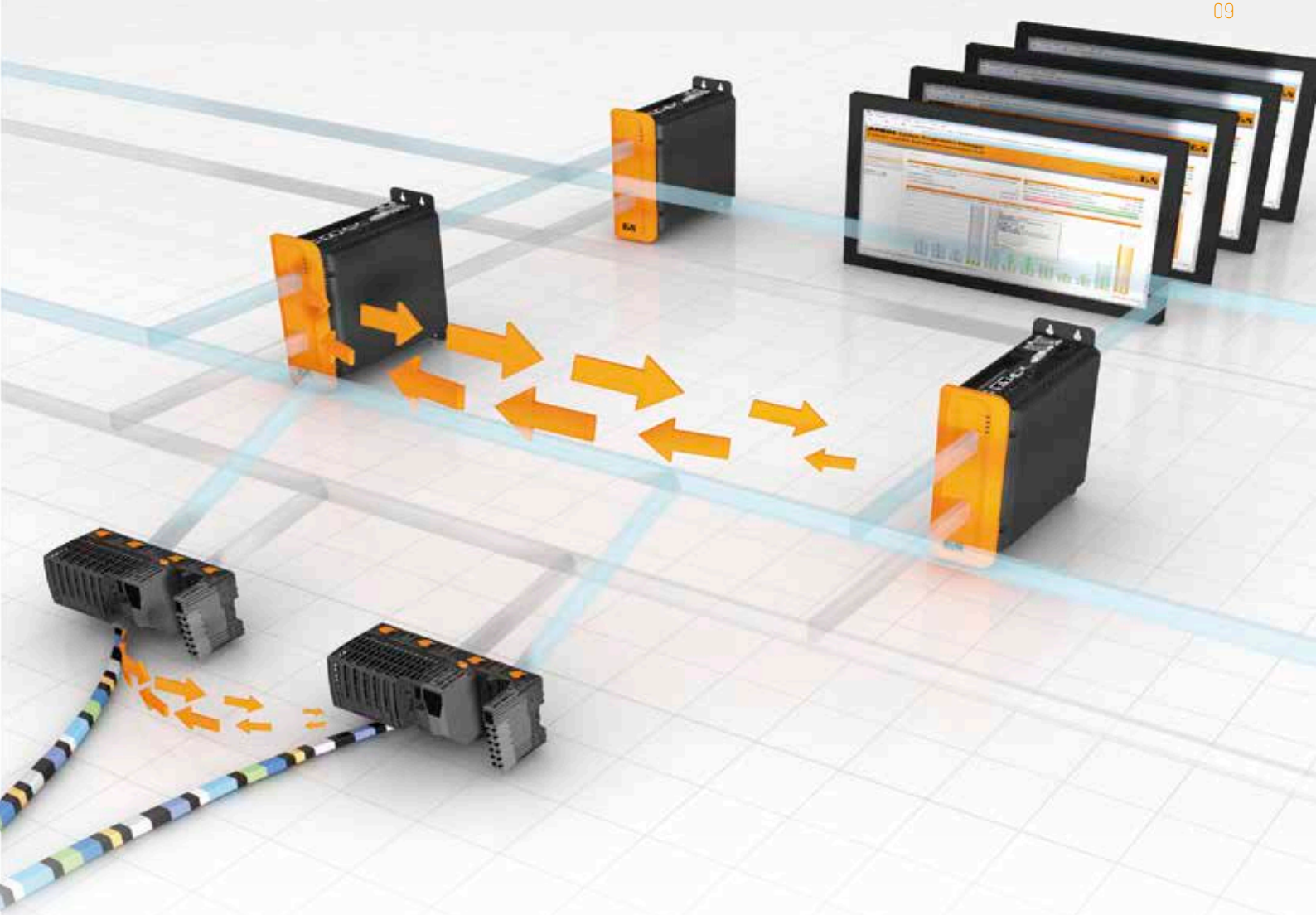
One of the most critical characteristic of a redundant system is its switchover time. This time determines how long a system "flies blind" when switching to the backup processor – and whether this transition is acceptable given the nature of the process and system. With B&R's solution, however, this is no longer an issue. The reason? The X20 system from B&R provides a switchover time of only 1 to 2 task class cycles on the I/O bus, which equates to just a few milliseconds. The result is a quick and smooth transition of the process control when an error occurs with no expensive downtime.

Fully automatic comparison and synchronization

Since new stations are automatically synchronized during operation, replacements can be

Highlights

- → Fiber optic redundancy link
- → Switchover in just a few milliseconds
- → Fully automatic synchronization of application and operating system
- → Nearly no configuration work necessary
- → Standard CPUs (no special hardware required)



Redundant fieldbuses and controllers as well as redundant servers and a client-server architecture guarantee maximum availability.

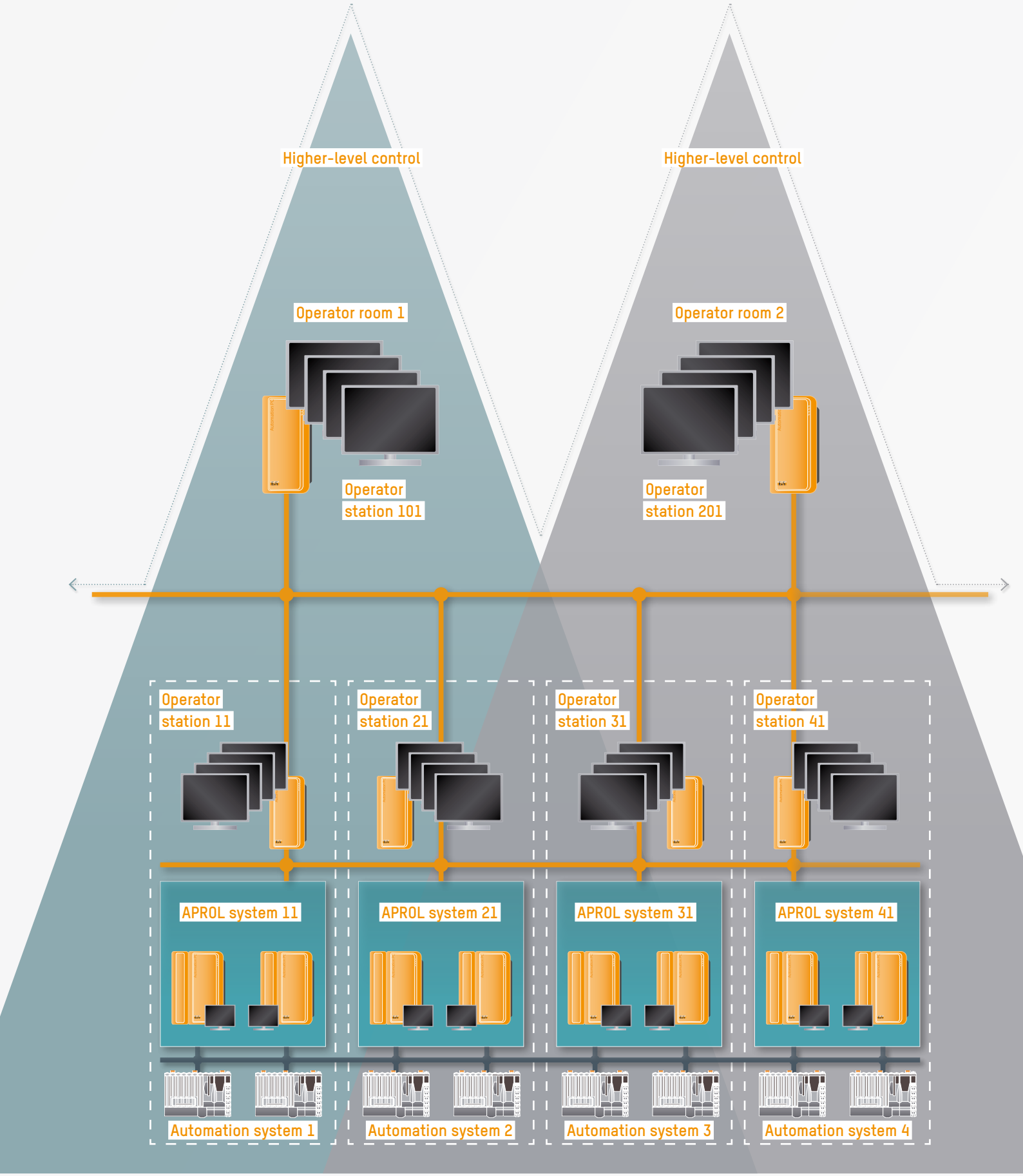
made by personnel with minimal training and without affecting productivity. Automatic synchronization applies not only to the application software, it also includes the operating system on the controller, therefore maximizing the speed of service tasks.

Minimal engineering

Configuration is only necessary for one piece of hardware. In order to set up processor redundancy, the user simply declares the CPU as a redundant unit – this can be done at any point for an existing project – by configuring the communication parameters or failure criteria. Individual process variables and libraries can be defined as redundant or non-redundant in a way that deviates from the default settings suggested by Automation Studio, further optimizing the resources being used.

CPU redundancy without special CPUs

B&R's system philosophy makes it possible to design high-availability systems with real processor redundancy without requiring specialized CPU modules.



A multi-runtime project also supports the higher-level process control level.

Multi-runtime projects

In addition to controllers, an APROL process control system consists of the following core components: the engineering system, runtime server and operator stations. The entire system configuration is created in the engineering system; from there it is loaded to the controllers, runtime servers and operator stations. This results in sections of programming logic for the controller and the runtime server that are based on the software design of control modules. In order to ensure maximum upward scalability, the number of controllers as well as the number of runtime servers must be scalable.

APROL's multiple runtime server capabilities currently make it possible to use up to 31 runtime servers in a single project. The user can distribute the sections of programming logic created during configuration to any of the controllers and runtime servers defined in the project as needed. This divides up the load for executing control computer tasks. The load caused by existing server processes is also distributed to multiple runtime servers.

Independent subprojects
The use of independent runtime systems allows completely independent subprojects and subsystems to be implemented in the project. Download requirements are thus also limited to just one subsystem.

One computer – multiple runtime systems
The operation of up to 16 runtime systems on one physical computer makes it possible for multi-runtime projects to be implemented even if there is no financial leeway in the project for additional hardware.

Higher-level control
In addition to the distribution of system load and server processes, the implementation of independent subprojects and the reduction of download requirements – all features that support task distribution – multiple runtime server capability also supports the integration of independent subprojects in a higher-level automation system.

The higher-level APROL process control system can display process graphics, alarms, trend curves and historical event data that include the real-time and historical process data from all lower-level runtime systems.

Central server for high-speed data access
A central server for historical data and a central server for documentation are available so the higher-level control system can quickly access lower-level runtime system data. It is possible to access either the data on the historical data server or the lower-level runtime systems.

In order to minimize administrative effort, a central LDAP server integrated in APROL supports operator authentication both on all lower-level runtime systems as well as the higher-level control system.

Simple fieldbus integration

→ **Fieldbus over POWERLINK**
This feature makes it possible to connect fieldbus systems directly to POWERLINK-based remote I/O devices, thereby minimizing cabling expense and effort.

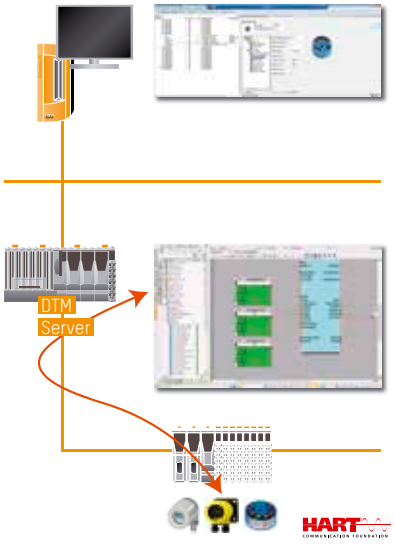
→ **Intelligent field devices**
Digital communication is possible with intelligent field devices based on HART or PROFIBUS PA, with full support for all troubleshooting options.

→ **FDT (Field Device Tool)**
FDT technology standardizes the communication interface between field devices and systems. DTMs contain all device-specific data, functions and operating rules, such as the device structure, available communication options, internal dependencies and human-machine communication capabilities. DTMs also have functions for reading device parameters, configuring and operating devices and detecting errors.

→ **Integration in the remote I/O system**
Fieldbus connectivity is not restricted solely to the controller; it can also be integrated directly into the remote I/O system.

→ **CaeManager / Automation Studio**
In the engineering environment, a fieldbus interface is added to a controller or bus connector like a standard module. Regardless of the fieldbus protocol, the user can use the same interface as for the I/O module by importing a device description file (GSD, EDS, etc.). The fieldbus modules and fieldbus devices are shown in the hardware tree like standard modules, as are the assignments of process variables to I/O channels. In addition, libraries for special access are shown (e.g. for reading acyclic data, diagnostic data, etc.).

→ **Motor controllers / Frequency inverters / Packages**
Digital communication to motor controllers and frequency inverters (PROFIBUS DP) or other complex packages via DeviceNet, EtherNet/IP, CANopen and PROFINET.



The DTM server supports read/write access to field device parameters for asset monitoring tasks with logic blocks.

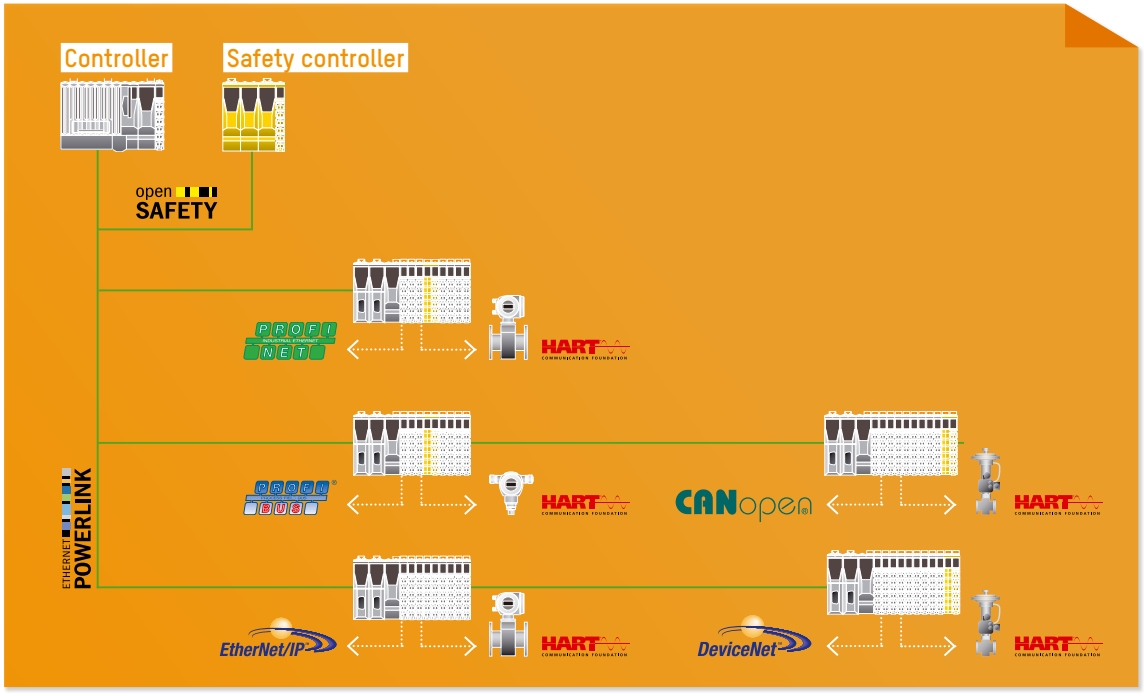
Safe communication

→ Guaranteed response/cutoff time
The deterministic processing of safety-related data via the open, fieldbus-independent openSAFETY protocol makes it possible to guarantee the response time over a given safety circuit (input > safe transfer > processing > safe transfer > output). TÜV certification, SIL 3, Cat. 4, PL e.

→ Reduced cost
Fieldbus systems reduce cabling costs for the system, save valuable space and reduce engineering expenses.

→ Use the existing system bus
Using the "Black Channel" principle, openSAFETY is the only safety protocol in the world that can transfer secure data via any fieldbus system. In addition to its high degree of interoperability, the way this protocol communicates ensures that messages are received and processed by all recipients at the same time.

→ Simple system expansion
The I/O layer can be expanded simply by extending the fieldbus cabling without interrupting system operation.



Web-based diagnostics

The APROL System Diagnostics Manager provides a graphic representation of all relevant information.

An APROL process control system is always made up of three core components:

- **Engineering server**
- **Runtime server**
- **Operator station**

A glance at the automation pyramid shows that the APROL process control system from B&R is a complete system – from the field level to the management information level.

The APROL web server makes it possible to operate and monitor a system via the intranet/Internet without limitations. Up to 25 web clients access the data of an APROL web server via the intranet or Internet.

Accessing diagnostics via the web
One or more web clients have access to multiple APROL web servers for remote operation, diagnostics and monitoring.

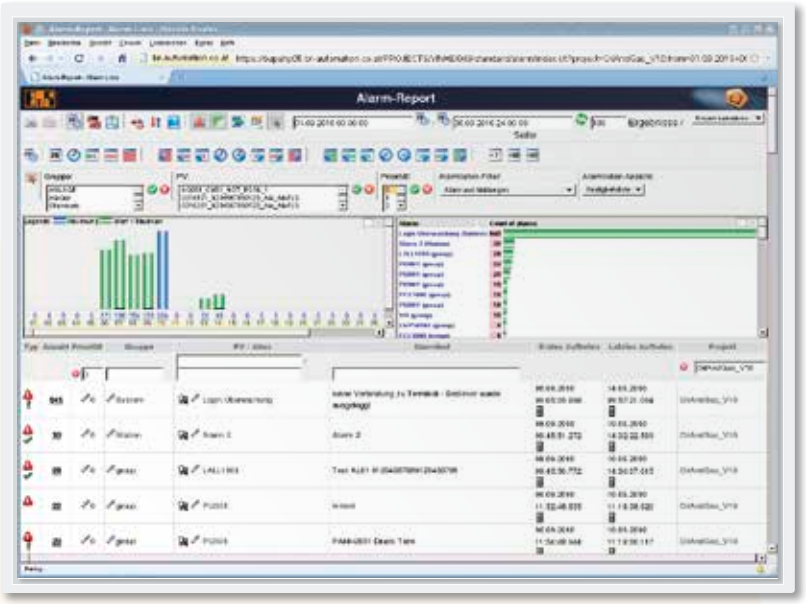
Detailed diagnostics of control computers
The System Diagnostics Manager (SDM) provides detailed diagnostics of control computers and controllers via a standard web browser over the intranet or Internet. This means that no additional diagnostics tools are needed for analysis. SDM is a standard feature in APROL and is available to all users.

Extensive diagnostics options
Diagnostics comprises many different aspects, from the software version and analysis of hardware all the way to the system configurations. Historical data is available in the same way. It is also possible to upload and display profiler recordings or an error logbook.

History via web

All historical data (trend data and events) can be queried from the web. This data is available in standard reports with extensive filtering options as well as in the trend viewer with a simple click of the mouse.

→ **AlarmReport**
The AlarmReport makes it possible to display and evaluate all current and historical alarm data.



The web-based AlarmReport provides a detailed overview of alarm statistics.

→ **ProcessDataReport**
The ProcessDataReport allows the current values of process variables to be queried.

→ **CompressorReport**
The CompressorReport provides preprocessed values over a configurable time period.

→ **CustomerReport**
Generated PDF files are formatted according to rules defined by style sheets (CSS).

→ **ChangeControl Report**
The version management system keeps track of and seamlessly documents all changes.

→ **Build Report**
The Build Report shows all errors and messages that occur during a build process.

→ **TargetControlReport**
The TargetControlReport provides a detailed log and analysis of all downloads that have been carried out.

→ **AuditTrail Report**
All operator actions are logged automatically using the integrated AuditTrail feature.

Information management

The simultaneous display of continuous data and events in a consistent, intuitive way makes it easy to recognize trends and events that might have a negative effect on system operation. This makes it quick and easy to determine how an intervention by the operator or a changed parameter affects the process.

Integrated historical data collection (for trend curves and events) in the blocks is as simple as setting parameters.

- **State-of-the-art trend system**
  A high-speed database and sophisticated web-based query technology masters even the most demanding tasks.

- **Integrated analysis functions**
  Easy-to-use analysis functions in the Trend-Viewer results in the efficient evaluation of historical trend data.

- **Use time offsets to display the curves**
  Any time value can be configured to offset the display of a trend curve.

- **Multivariate analysis for determining the "golden batch"**
  Analyze good and bad batches based on product quality and reference curves.

- **AutoFit**
  The AutoFit function automatically adjusts the y-scale of the trend curve to make the entire curve fit inside the display.

- **AutoMove**
  The AutoMove function automatically shifts the y-scale of the trend curve to make the entire curve fit inside the display.

- **AutoProcess**
  The AutoProcess function defines the y-scale (start/end) of each trend curve using current process values (e.g. recipe parameters, currently calculated value).

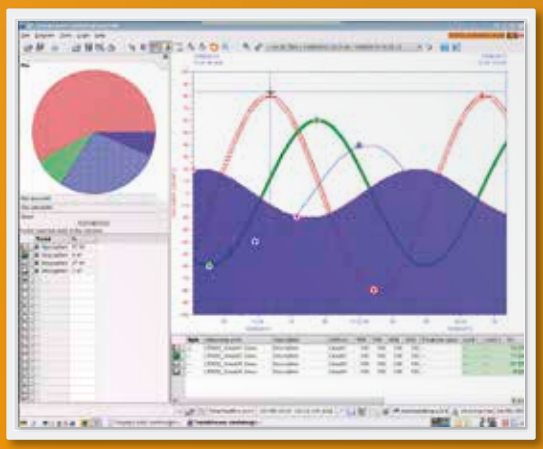
- **2 limits per trend curve**
  Up to 2 limits can be set for each trend curve to display limit violations. No configuration is necessary to record exceeded limit values.

A graphic representation of chronological events that also includes limit values makes work much easier.

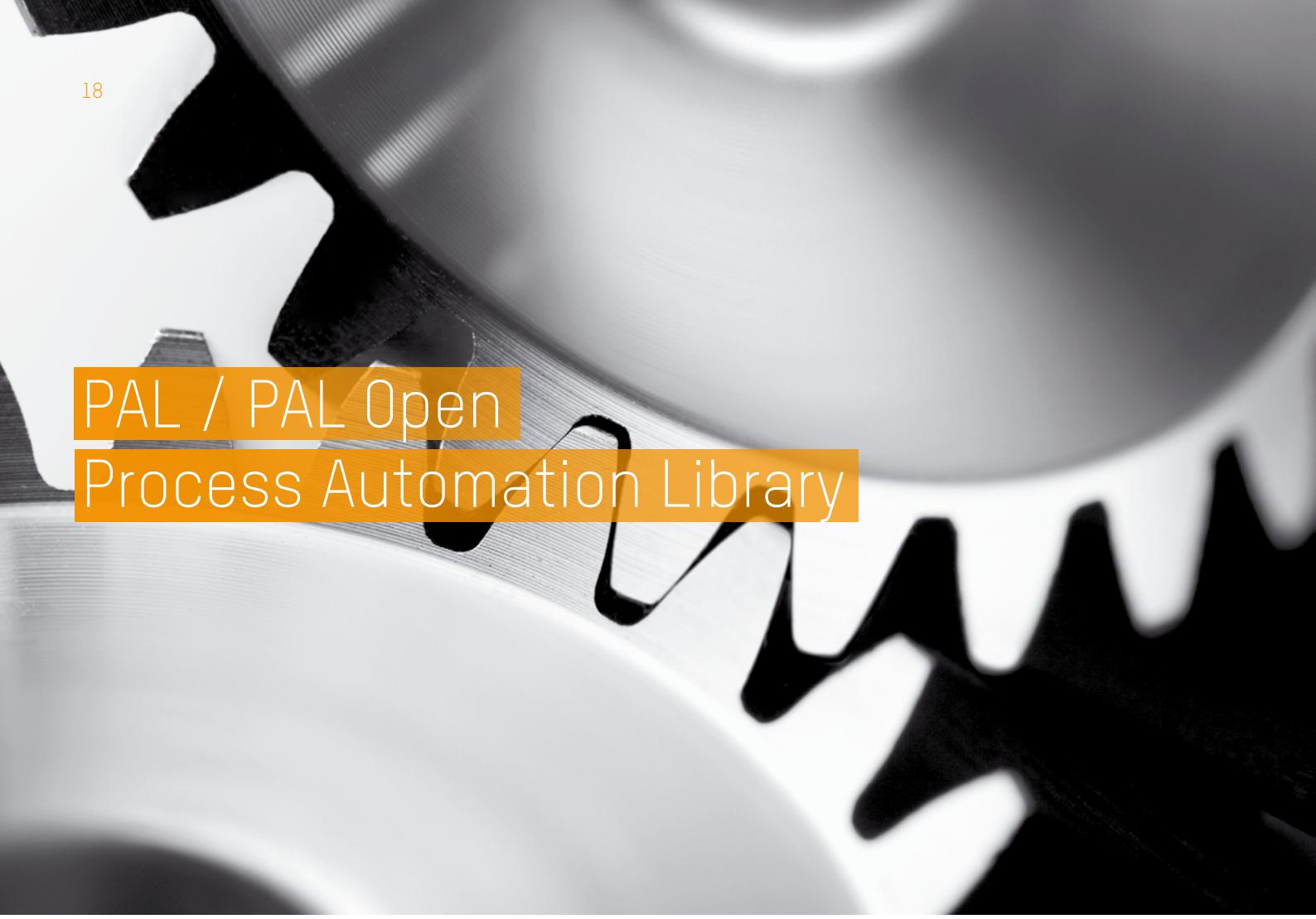
Historical data acquisition

Historical mode and online mode in a single display

- **Markers**
  In the form of a ruler or symbol
- **Rulers**
  Up to two rulers configurable as chronological measurement points.
- **Trend data export**
  For additional processing in Office environments.
- **Diagram views**
  Shared diagram, separate diagrams and X/Y view
- **Adding comments**
  Historical identification of relevant process events
- **Redundant historical trend database**
- **Complete configuration in the process control system**
- **100,000 trend curves configurable in up to 5,000 trend groups**
- **Context data browser**
  Table display of the data configured as markings.
- **Trend statistics display**
- **Open connectivity**
- **Combined zoom**
  Possible to display a selected range
- **Horizontal or vertical time axis** Displayed as continuous-line recorder or process-variable recorder



Trend curves can be easily merged using drag-and-drop.



PAL / PAL Open
Process Automation Library

- **Process Automation Library (PAL)**
  PAL is a universal library that is suited for any industry, anywhere in the world. It includes easy-to-use blocks for users who value standards.

- **Open Process Automation Library (PAL Open)**
  PAL Open is a universal library that is suitable for 3rd-party controllers and systems. It includes easy-to-use blocks for SCADA applications and migration projects.

- **Clear faceplates with icons**
  Clearly arranged faceplates ensure easy usability. Icons are based scalable vector graphics (SVG).

- **Integrated system functions**
  System functions such as the shift logbook for taking notes, the trend viewer, the alarm report, etc. can be opened directly from the shortcut menu of the measurement point (TAG).

- **Exclusive function for operator access**
  The operator can lock access to a measurement point (faceplate) selectively. This function can also be linked to a control computer.

- **Integrated maintenance functions**
  Service and maintenance functions (e.g. switching cycle counter) are integrated directly into the blocks. This makes additional configuration work unnecessary.

- **Configurable operating philosophy**
  The operating philosophy can be designed with or without a confirmation requirement using parameters and connections.

- **Signal status**
  Each PAL block monitors the signal status, including configuration, software, I/O module and open connection errors. This can influence logic connected further downstream.

The faceplate coordinates many different blocks.

→ **Priority commands and locking**
The "Priority Command Manual" and "Priority Command" commands allow tasks to be prioritized. With interlocking, operator and automatic commands are no longer necessary.

→ **Analog value monitoring**
The element offers additional scaling options in the faceplate. The average value filter can also be scaled to 30 s. Simulation is also possible by toggling between live/dummy values, and limit value monitoring can be performed for 3x high, 3x low and the rate of change. Rate of change

→ **Digital value monitoring**
This block can be used to display, bypass, normalize, delay, save, alarm and record trends for a digital input signal.

→ **Simulation from the faceplate**
Simulation of measured values is integrated in the faceplate to simplify the loop check.

→ **Possible to cascade interlock block**
This configurable block can be used to display, bypass and connect digital signals. The gate types it contains allow the flexible interconnection of input signals. Interlocking signals can be displayed flexibly with the incremental design option.

Highlights

- → Universal library for all industries
- → Design with replaceable SVG icons
- → Possible to launch important system functions from the faceplate
- → Simulation of signals in the faceplate

Batch production

The SFC faceplate allows fast interactions.

SFC is a visual language that provides a clear overview of individual steps as well as detailed information.

→ **ParameterCenter**
The ParameterCenter interface can be used to control discontinuous batch processes.

→ **Configuration via templates**
Parameter set templates and system components are defined in the engineering system.

→ **Parameter set defines a product**
Parameter sets are substituted for the products in the system.

→ **Download/Upload function for product handling**
Parameter sets can be switched by the operator.

→ **Flexible modifiable parameter set**
Parameter sets can be created and modified at runtime.

→ **Management with MySQL**
Parameter sets are stored in a MySQL database. An interface makes it possible to import and export data to a production planning system.

→ **ParameterManagement database**
The ParameterManagement database can be accessed via the Python API. The interface can be operated using display driver function blocks and UCB scripts.

→ **Download/Upload support**
The ParameterManagement tool can be used to download/upload a parameter set to/from the process database.

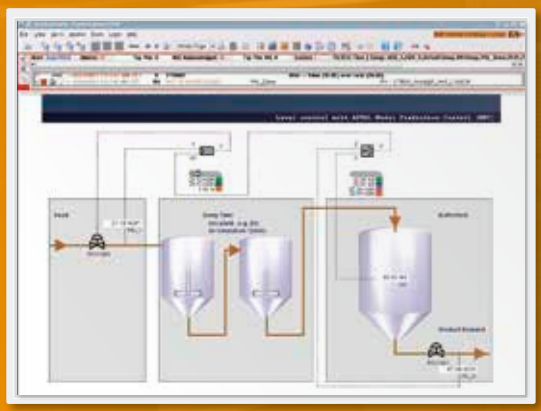
→ **Import/Export interfaces**
The ParameterManagement tool allows all data to be exported from or imported to the runtime server's parameter set database in XML format.

→ **Flexible solution for batch processes**
The ParameterCenter and ParameterManagement tools allow the operation of batch processes to be designed flexibly.

→ **All actions recorded by AuditTrail**
The integrated AuditTrail (21 CFR Part 11, GAMP5) records all actions in the ParameterCenter.

→ **Integrated batch systems**
Third-party batch systems can be integrated to meet any functional requirements that aren't covered by the ParameterCenter and ParameterManagement tools. The basis for this is a phase logic interface (PLI) using Sequential Function Chart (SFC). This allows for a high degree of continuity throughout the process control system.

Advanced process control



Model predictive control simplifies the processing of complex procedures with a PID controller.

Even multivariable MPC is relatively easy to set up in APROL through the configuration and selection of transfer functions.

Improving control engineering with effective tools

→ **Advanced process control**
APC refers to all control procedures that go beyond standard PID closed loop and sequential control.

→ **Optimizing process control**
Optimizing process control means optimizing throughput, efficiency, product quality and the costs for energy and raw materials while maintaining reproducibility of the process.

→ **APC methods**
PID optimization and PID expansions, rapid prototyping, fuzzy control, neuronal networks and model predictive multivariable controllers (MPC) are the classical methods for advanced process control.

→ **MATLAB®/Simulink®**
The optional "B&R Automation Studio Target for Simulink" toolkit integrated in Automation Studio is an extremely high-performance feature also available for use with APROL.

→ **MapleSim/Maplesoft**
Physical models developed in MapleSim can easily be used for hardware-in-the-loop simulations.

Language switching / Speech output (TTS)

- **Language switching**
  The APROL TranslationManager can be used to create translations beyond those included in the existing languages English, German and Chinese.

- **All alphabets and character sets**
  APROL's support for Unicode means that all international alphabets and character sets can be used.

- **Language-dependent texts in the visualization**
  APROL supports language switching to all target languages supported in the visualization application

- **Localization for alarm text**
  Alarm texts can be displayed on the operator station or in the alarm report during runtime.

- **Compendium contains all visualization texts**
  The texts used in the libraries for input pins, faceplates, etc. are grouped in a compendium.

- **TranslationManager for translation in a list**
  The TranslationManager allows convenient translation of the visualization texts in the form of a list. Translation work is reduced and simplified by being able to reference existing compendia.

- **Automatic download of translated texts**
  The translated text is automatically updated with the normal download mechanism.

- **Speech output for alarms**
  All alarms shown on the alarm page can be output automatically or selectively using the integrated TTS server. Texts are converted into natural spoken audio format.

- **Life-like voice thanks to TTS**
  Loquendo TTS text-to-speech technology delivers realistic voices for audio alarm output. English, German and Chinese are currently available in APROL.

Integrated automation
Global presence
Solid partnership

ETHERNET POWERLINK

open SAFETY

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