Between convenience and security
Balancing act in the energy market

IT security in data networks is arguably the most widely discussed problem behind the closed doors of energy providers. The "Blackout" book by Marc Elsberg clearly depicts the potential consequences resulting from nationwide power outages. It shows that the issue is very much in the public consciousness. Energy networks have entered the line of fire of hackers for all kinds of reasons, and have become more interesting as the target of attacks than was ever considered possible by many – escalated perhaps by public debates.

We started early with the development and implementation of appropriate security technologies in our systems, and are able to claim with pride that we have established a leading market role within this sector. The fociusses of our developments were the BDEW whitepaper and the individual structure of the ISMS (Information Security Management System). We are now in a position to offer comprehensive security concepts based upon standardised technology.

"Just how much security is required?"
This question must be answered by DSOs themselves on the basis of their risk analyses. We can only act in a supportive role here. If investments have already been made in the firewailing of networks, easy-to-use technologies such as USB and web servers can potentially continue to be used, and performance-hungry, secure protocols such as https and ftps can be dispensed with. More detailed checks of individual situations are required in any case.

In our most recent customer survey, IT security was deemed by far the most important issue for the industry in the future. The same focus was reflected during our "Expert days" event. We view coming challenges with excitement and do not tire of confronting tasks set with an innovational spirit and making our contribution towards future-oriented solution concepts.

I trust you enjoy reading this issue ...
**Certified security – is there actually such a thing?**

**Data security**

Lately, many customers have understandably been stipulating general conformity with new security standards in tenders for new systems. But does such “conformity” actually exist?

There is unfortunately no across-the-board answer to this question. Conformity always pertains to the individual security guidelines of a company and so cannot be generally applicable. Even when secure (i.e. correspondingly configured) SAE components are used, this level of conformity can only be attained when the other infrastructures and processes within a company also satisfy the necessary security requirements. But what are necessary security features?

Firstly, an internal ISMS (Information Security Management System) should be set up if not already in place. Its individual security requirements must be specified with the specialists and IT department at the company. At this point it is essentially about clarification of the following:

- Who takes part in the project, and with which responsibilities and access rights?
- Risk analysis: What relevance does failure of an object or component have?
- Definition, installation and safeguarding of the infrastructures involved
- Specification of communication plans and guidelines

The exact arrangement depends heavily on the infrastructures used and the application area planned. If the aim for example is to operate a large scale virtual power plant, and to offer balancing power to one or more transmission system operators, orientation must be towards their individual minimum specifications. TSOs are currently stipulating for example end-to-end VPN encryption of communication to the distribution management system. Up to recently, encryption with GPRS was considered completely adequate. The risk of granting access to the system control by means of a connection to the telecontrol interface having no explicit mechanism is not permitted however when a public network such as GPRS or DSL is used for data transmission.

Shown in the checklist below are a few considerations to be observed when implementing an SAE system conformant to the (potential) BDEW whitepaper:

- Enable https and ftps in the “Services” station dialogue
- Inhibit the USB Ethernet service when it must not be possible to establish access to the unit over the USB cable
- Disable Bluetooth® when no wireless access may be used
- Inhibit firmware updates when no teledownloads are permitted
- Lock the console on series5 systems (series5+ is locked)
- Inhibit the web server when no network access may be used from browsers
- Enable the firewall for series5+ systems and restrict the services in the connections to the required minimum
- Enable Ipsec on series5+ systems if VPN point-to-point mode encryption is to be established
- Create your own user certificates if your IT policy requires it

It is also interesting in this context that the IEC 60870-5-101 protocol is experiencing a renaissance. The reasons for this are its serial protocol structure and the serial hardware interface (generally RS-232, WT modem or RS-485/RS-422) that do not permit any manipulation (barring complete disruption of communication). Getting back to the example of balancing power – the network operators’ specification of the -101 protocol as the transfer interface for provision of capacity data is binding.

The application of new technologies and security strategies mean the administration of systems is becoming increasingly difficult. The assignment and management of necessary security certificates in particular are laying down challenges to the expertise and experience of users. For this, clear-cut structures must be created and agreements arrived at for well-regulated operations to be maintained both now and in the future. In particular, light can be shed on the darkness of new transmission structures with the newly integrated “Wireshark”-compatible recording by setIT™ for TCP communication, and use of the Racoon debug log. In online diagnostics, the network analysis enables establishing of the IPsec connection to be logged in the latest setIT™ version. The individual phases of the VPN being established are recorded and shown. The ability to “ping” other network nodes from the station is also very useful.

The start-up of secure systems is also becoming increasingly difficult. Expert knowledge is an absolute requirement here. We can of course

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**Features of secure infrastructures using large scale virtual power plants as an example**

- **Remote terminal unit (RTU)**
- **Central of installation (ICC), CHP plant, inverter**
- **Technical unit (TU)**
- **Optional with telecontrol master station**
- **Control centre TSO**
- **Control centre**
- **Router**
- **User management**
- **Security certificates, security protocols, VPN encryption**
That time arrived again this year: Our work over recent years was put to the test as part of a customer satisfaction analysis – again with very pleasing results.

98% of those participating again stated they would recommend SAE IT-systems on to others. We received particular praise for the functionality, quality and innovation levels of our products. series5 units received an even higher appraisal than the System-4 product family in the previous survey. The similarly positive appraisal of the series5+ confirms we are on the right track - in particular as regards the strongly growing significance of IT security models, web interfaces and IEC 61850.

The intention of many customers in the future to deploy our products in additional or new application areas fills us with pride - we will be glad to take up the challenges!

We would like to take this opportunity to thank once again for their commitment all those who took part, and to congratulate the winner of the draw, Mr. Kollbach from Gronau public utilities.

August 2014, Joachim Schuster

It could be worse –
Customer satisfaction 2014

SAE Internal

offer all-inclusive solution concepts and deliver everything from a single source, from telecontrol system to central router, including configuration. But in many cases this equipment is already installed at customers and we are coming across fully heterogeneous network structures with a broad diversity of IT components. Installation of these systems quickly becomes a time-consuming and hence costly adventure without the effective teamwork of customer experts and suppliers involved (of the central router in particular). Excellent coordination is absolutely fundamental here.

We addressed very early on the whole issue of IT security and subjected our products to a series of tests. Excellent feedback showed that early, intensive investment in this area has paid off. We are glad to be able to share this edge in expertise with you!

SAE star coupler
Now also with SMA connector

The mcFO media converter is available with SMA connectors. Distances up to 2.7 km are bridged with 50/62.5/125 μm multi-mode fibres having a wavelength of 820 nm. The mcFO-SMA and mcFO-ST components are powered by the mcPS-1 and can be deployed in mixed configurations.

By special request:
Profibus-DP slave for FW-5

The PDPS-1 makes possible direct linking of controllers to an FW-5 or FW-5-GATE over the Profibus-DP. The interface is integrated as an expansion module in the I/O range. As a slave, it detects the bus baud rate automatically, is connected as an isolated interface via terminals in the bus and has a termination resistor that can be activated from the front. The PDPS-1 is configured entirely from setIT (V5.1 and higher) and positions the required data directly as process data of the bay station controller, as specified in the protocol capacity. A PROFINET variant is in the preparation phase.
setIT V5
The big day has arrived – the version is released!

The version has been maturing for a long time and many functions are included in its development. One of the most important enhancements is the IEC 61850 station bus, facilitating initially as a client the connection of Intelligent Electronic Devices (IEDs) such as protective equipment. IEC 61850 is known as being a complicated protocol. But our integration again demonstrates the philosophy lived and breathed by SAE - of also making substantial processes as straightforward as possible.

With a simple import of ICD/SCD configuration data and selection of the datasets and reports required, they are as good as ready. The IEC 61400-25 profile specialised for wind power is also supported.

IT security naturally assumes great importance in this version too. Informed customers are confirming to us that choice of functions and depth of setting options are in a league of their own in the marketplace. In setIT V5, the selection of security functions has been completed in accordance with ISMS (Information Security Management System) specifications in place. The block checklist enables the necessary settings to be completed quickly and in accordance with ISMS (Information Security Management System) specifications in place. The block next to this provides a summary of the functions.

But what else is there?

SNMP network monitoring
The monitoring capability of network components with SNMP is also new. Many statuses (such as temperatures and communication parameters) can be read from switches, routers and modems with the client connection. This means that, for every station, up to 250 pieces of information can be polled, and problems in the communication network identified, before they have an effect on the remote process.

DSIG protocol
The new digital interface for gas monitors means flow control systems, quantity converters, gas-phase chromatographs, slide controllers and other DSIG-compatible components can be integrated conveniently and speedily into projects. Taking events from the archives of relevant units is also possible here.

SMART meter interface
Protocols for integrating Smart Meters are available in the SML protocol for SyMP meters and IEC 62056-21. In addition to the meter readings, separate measurement period sequences can be created and actual network states of currents, voltages, capacities and frequencies can be read.

Telealarms
Telealarms with text notifications via mobile services can be realised in different ways - as an SMS or direct call as a ring tone (and as a fax or email with conversion by the provider). Alarm profiles and recipients are of course freely definable.

Wireshark network trace and Racoon debug log
Advanced diagnostics of networks and VPN tunnels render possible deep insights into LAN cabling with standard tools.

New products supported

M2G-I
GPRS/EDGE modem for cost-effective integration of mobile telephony with advanced diagnostics

CPU-SC
A high-tech series5+ variant of the net-line FW-50 with encryption engine for speedy calculation of signatures and encryptions, more memory, up to 6 network segments and a temperature sensor

SWI-1-6/STI-1-7
New switch modules with single and multi-mode fibre optics on ST and SC connectors with range up to 32 km

SWI-2
Provision of further network segments by switch with internal USB connection, also with copper and single/multi-mode fibre optics in conjunction with CPU-SC of net-line FW-50 or CPU-DSC of FW-500

What would a new version be without far-reaching improvements in configuration?

- Individual command run-times are configurable
- System target values allow the dynamic setting of factors for computed values and set points
- System readings/information as computed values with logic functions and calculation
- Computed values provide logic functions without PLC application / codeIT
- Enabling of codeIT programming interface from system command
- Commands with selection and run are supported on IEC level
- Assignment of start values such as common addresses, station names, IP parameters and factors (system target values) from the station website
- Scaling of metered values and cumulative values with multiplicator/divisor
- Meter overflow can be set
- Remanent storing of metered values for use following system start
- Protection equipment coupling optimised on SG-50
- Coupling for short-circuit / earth fault indicator integrated (models CornPass and IKI-50)
- Virtual connection to lower-level station with the option of switching configuration via the panel interface
- Online language switchover between German, English and French
- Support for Windows 8

A comprehensive list of all enhancements is available in the ‘setIT V5.0 release notes’ (available on request).
The TBUS extension provides a low-cost method of binding/coupling distributed panels and remote measurement points to a telecontrol system. Instead of installing a separate FW-5 at every point, or needing elaborate cabling of signal and measurement lines to a central RTU, the expansion modules are installed in a decentralised manner and connected with a patch cable. The bus signal is read on an FW-5 or FW-5-GATE with sender TBUS-T as the last expansion module of the block, and routed to the TBUS-R receiver over a CAT6e cable. This again powers the local expansion modules and connects up the modules to the bus. The system works transparently and with all expansion module types without configuration intervention - in all setIT versions. From setIT V5.0, the current limitation on the TBUS can be lifted because the recipient again powers the block. Up to ten blocks with a maximum overall length of 100 m can be set up this way.

Manufacturers of switching equipment can now fully pre-wire switch panels, and fully install and test measurement point and switching elements; the installer need only fit the patch cables.

**Security functions as per BDEW whitepaper**
- User profiles with password-protected login and roles as per the BDEW whitepaper:
  - Administrator
  - Function with switch authorisation
  - Configuration
  - Diagnostics
  - Observer
  - and freely definable roles
- Login with role profiles for website and setIT database
- System passwords can be set individually
- Settable password attributes: length, special characters, uppercase
- VPN tunnel end-to-end via IPsec and diverse certificate attributes
- Secure transmission protocols selectable for series5+: FTP/FTPS, http/https
- Certificate management for https (on series5+)
- Firewall can be activated with port enabling on a per-socket / network connection basis
- Automatically generated port filter (on series5+): only the ports actually needed are enabled
- Services not required can be disabled: Bluetooth, web server, USB device, console, firmware update
- Session timeout configurable for web server; the session is automatically ended on expiry
- Backdoor prevention with update of php release in web server
- SSL encrypted transmission of service interface on series5+
- Access to lower-layer station via SSL encrypted transmission from master station (authentication and station control)
- DOS defence with bandwidth limitation with switch (from SWi=1-5, -6 / -7 and SWi=2-x)

**Remote I/O for FW-5**

New product · Communication

The M2G-1 2nd generation mobile radio unit is the successor to the GPRS-1 with far more advanced diagnostics in GSM, GPRS and EDGE modes. GSM mode provides a replacement for analogue dial-in lines and telealarms with SMS text-based fault alarms. In GPRS/EDGE mode, the module is used as a low-cost online connection. The module does not require a separate VPN tunnel because series5+ technology bay station controllers, as recommended in the BDEW whitepaper, are able to provide full end-to-end encryption. Connection to the bay station controller is fully compatible with the GPRS-1 using a patch cable with RS-232 signals in accordance with ETSI EN 300 392-5 DEE.

Display of the current field strength in online mode with status LEDs with a phase model, and advanced diagnostics capabilities directly from the wireless chip over the USB service port with setIT (from V5.1) are new. In addition to the general statuses, the names and field strengths of all other repeater stations in the reception range are also listed here.
The problems posed must also be solved for existing as well as new systems.

General

Which information is required and where is it analysed?
In control centres, information from substations and distribution stations is taken into account in the data model. In most cases however, energy transition was not a consideration when network control centres were procured. We are aware of control centres for which the connection of distributed energy resource suppliers for feed-in management has meant a doubling in the number of telecontrol stations in the control centres. The same applies for data points. Good planning is required if yet more stations from the local networks are added. This is due in particular to additional information accruing when a connection is broken when mobile radio network transmission is used.

For all types of station, the heart of local network automation is the compact net-line FW-5 system - in different basic forms and with expansion capabilities. We have supplied more than 12,000 FW-5 systems to date, most of them in compact wall cabinets for deployment in renewable energy installations. Experience we have been able to gain is channelled into the design of new switchgear cabinets. We attached great importance to sufficient processor performance and memory in the development of the FW-5 system. This was the correct decision considering the speedy change of requirements pertaining to processing, memory depth and above all security. The availability of separate transmission routes to local network stations is becoming increasingly rare, meaning transmission with DSL/UMTS/LTE/GPRS is becoming more common. And the requirements made of protection against unauthorised access when these communication paths are used are justifiably very strict.

Housings

Components are typically mounted in a wall enclosure. The telecontrol system, the transmission modem, the uninterrupted power supply and the transfer terminal are housed in the switchgear cabinet. To prevent heat building up in the summer, the dimensions of the housing should not be chosen too small. If no separate room is available in the local network station for the telecontrol equipment, one clever solution is to use magnets to attach the switchgear cabinet.

Data transmission paths

Communication to the control centre is generally with TCP/IP-based transmission routes using the IEC 870-5-104 protocol. Stay on the safe side and use the FW-5 system’s VPN encryption functionality. We have made every effort to facilitate all popular methods of IPsec encryption. Our own MQG-I modem is of interest for data transmission over GPRS. The modem is configured with setIT. The connection set-up phases can be analysed accurately with the diagnostics capabilities of the latest setIT generation. Now you do not have to stand helplessly in front of the system when communication cannot be established at the first attempt.

Stations with monitoring without remote control

In our view different systems are available to read currents, voltage, load flow direction, power factor and frequency. An intelligent short-circuit and earth fault indicator is already fitted into new network stations at the factory, such as the Compass B from Horstmann. Readings can be taken and values derived by the capacitive voltage tap and the split-core current transformers. In addition to the high-quality units from Horstmann, couplings to other systems available on the market have also been implemented, such as:

- Kries IKI 50
- A.Eberle EOR 3D, NRG 96, ESM NA 400, ESM ENA 7000
- Janitza UMG 103, 104, 604, 96

Templates for automatic adaptation of relevant capacities are created in our setIT configuration software for the most popular systems. Modbus RTU is used for coupling between the measurement systems and the telecontrol system.

In addition to the reading of values via external systems, a directly measuring module will soon be available as an expansion module for the net-line FW-5 and FW-5-GATE. The module has four current and three voltage inputs and calculates the derivable values (see New products DM-1).

In this regard, we are also attentively tracking the latest developments in the fields of voltage taps and converters for retrofit solutions.

Four quadrant meters are fitted in some stations. These also provide the meter reading and all required parameters over a serial interface. The SML protocol of the Sym² meter or IEC 62056-21 (formerly IEC 1107) is provided as the protocol. The values are sent in the OBIS data model
and are predefined in setIT.

**Measurement on the low voltage side**
The retrofitting of taps on the medium voltage level is complex on existing local network stations. Measurement on the low voltage level is much easier to implement. The telecontrol system calculates the medium voltage value from the values measured. Actuating variables such as primary and secondary transformer voltages can be entered as variables from the web server, setIT or the control centre.

For stations without remote control, an uninterruptible power supply can be implemented simply and cost-effectively with the 230 VAC variant of the FW-5 system. The battery is connected directly to the FW-5, and charging circuit and 24 VDC for modem and signal voltage are supplied by the FW-5.

**Stations with monitoring and remote control**
In local network stations with remote control, the DSO-1 command output module is also required as an addition for the FW-5 system. The module has three double commands with one out of n monitoring as well as measuring circuit test, command termination and return information.

The ComPass BS short-circuit and earth fault indicator is available as an alternative, and provides the control function in addition to the familiar features of the Compass B product family.

**Power supply must be rated such that another three switching operations over a time period of eight hours are possible following a power outage. An uninterruptible power supply is required for this. The battery should not be sized too small because temperatures in local network stations are high in part and negatively impact the service life of the battery. A power rating of 10A is certainly necessary given the high starting currents of the circuit breakers. In this regard, the normal (i.e. 24V) variant of the FW-5 can be used.**

**Stations with monitoring, remote control and DMT protection**
We can recommend our very own SG-50 combination protective device for DMT protection. The SG-50 is available in different variants. With four current inputs for very simple DMT protection, and with additional voltage inputs for more advanced functions. The system functions are configured from the well-structured software. The protective equipment naturally provides all the necessary measured values and can assume switching operations – all in one unit.
The Ulm/Neu-Ulm Netze GmbH public utility is a network operator in the region of Ulm/Neu-Ulm, the towns of Herbrechtingen and Niederstotzingen, and the borough of Hermaringen. With around 280 employees, it operates electrical and gas networks, as well as drinking water and district heating networks, on behalf of SWU Energie GmbH. It assumes the role of network operator in line with the regulations and directives laid down by the Energy Industry Act. Here the Ulm/Neu-Ulm Netze GmbH public utility bundles all activities required for successful network management.

Under the terms of German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) § 6, system operators commit to fitting renewable energy and CHP systems having an installed electrical capacity exceeding 100 kW with a technical installation for remote-controlled reduction of feed-in capacity in the event of network overload and for accessing the respective actual feed-in, and to which network operators have access.

PV, CHP and biogas installations whose installed capacity exceeds 100 kW must be fitted with a telecontrol system to satisfy the legal requirement. With it, the actual feed-in capacity can be accessed and the system capacity reduced temporarily (remotely) in the event of imminent overload.

Following a tender process, Ulm Netze GmbH placed an order with SAE in 2012 to supply 160 telecontrol systems for their renewable energy installations. It was the overall concept presented by SAE in particular that impressed, a concept which can be ideally adapted to the respective applications and can also be deployed in other areas, such as in local network stations and switching stations. The price/performance ratio of the telecontrol components as well as the ease and convenience of configuration were also convincing arguments in favour of SAE.

Radio ripple control receivers were never discussed at Ulm Netze GmbH because they cannot send the regulated capacity values or the actual feed-in capacity.

This project was realised with the powerful net-line FW-5 telecontrol systems, of which the integrated eight information inputs (for return information), four command outputs (for regulation) and two analogue inputs were just right for this application. The metered values for capacity measurement are read as S0 pulses. A GPRS modem with VPN encryption is used for data transmission, as per the recommendations in the BDEW whitepaper.

In addition to the usual telecontrol functions, corresponding faults were defined for system behaviour in renewable energy installations, and specified in the system as follows:

- Conversion of pulse to persistent commands
- Deactivation of pending stage for new specification; also overlapping if required
- Behaviour following activation
- Behaviour when link goes down
- Behaviour for voltage outages, etc.

All components are fitted in a compact wall enclosure and wired ready for connection.

SAE recommended using net-line FW-50 telecontrol interfaces with two separate Ethernet ports for decoupling of the networks. They enable up to 128 TCP/IP connections to be established simultaneously. The telecontrol interfaces assume communication to the lower-level substations and final data transfer to the PSI control system. The standard IEC 60870-5-104 protocol is used throughout.
Municipal power networks Inn-Salzach

In 2003, comprehensive modernisation of the telecontrol equipment, with a new distribution management system primarily for water and electricity, was put out to tender. Following the tender process with technical testing, the decision was made in favour of a complete SAE system. After the control centre, by means of a redundant ProCoS central control station, many net-line FW-40 substations were deployed in the water supply installations, distribution stations and Isen power plant; mostly over WT connections on separate Cu cable sections.

It was important from the very outset to the workers there that all configuration steps can be performed autonomously in the field as well as from the central control system. Over time, a respectable level of expertise was built up - that become known far across the region. Resulting from this were numerous queries from other suppliers for empirical data and reference visits. Since initial start of operations, the installations have been expanded continually, meaning subsequent work to date has also included protective couplings as per IEC 60870-5-103, external connections of generator controllers and network analysis systems, integration of ripple control unit, SHDSL section expansions using the IEC 60870-5-104 protocol, terminal server integration in the control centre, etc. It was always their intention to do all of this by themselves.

In 2012, Mühldorf was one of the first suppliers in Bavaria comprehensively realising a technical data connection of customer renewable energy feed-in with a capacity exceeding 100 kW, and having it completed on schedule by the statutory deadline of 30 June 2012. The task was then to create a demand-based solution for their own network region based upon a net-line FW-5 station with GPRS modem. In this job definition too, other network operators aligned themselves to the experience gained from Mühldorf, something that is shared unselfishly at all times.

About 60 substations, from net-line FW-40s and net-line FW-5s to FW-5-GATEs and net-line FW-50s, have entered service to date. An adjacent supply region is currently connected into the ProCoS central control station for monitoring.

Gronau public utility

Telemetry on the basis of Tetra radio

In 2009, we started to test the products from SAE for medium voltage stations and were/are very pleased with the setIT configuration tool. Service, the support hotline in particular, also fully meets our expectations. The good price/performance ratio means SAE has become our supplier of choice for telecontrol equipment.

We now operate about 110 telecontrol systems, including mainly the net-line FW-5 but also the net-line FW-50. About 40 of these units are installed for renewable energy feed-in management for installations with capacities exceeding 100 kW. Another 45 systems are installed in the medium voltage stations for monitoring and control of transformer stations and distribution stations. In the water works, we run about 20 telecontrol systems for monitoring water delivery in our discharging wells. The other systems are fitted in the GDRM high and medium pressure stations; everywhere SAE components perform their tasks to our utmost satisfaction. It is for this reason we will be using SAE telecontrol equipment in the future for the provision of control energy by means of our own CHPs and emergency power generators.

A particular feature in industry comparisons is deployment of a TETRA radio network as the basis for communication. Considering we have our own network available anyway, the decision was to use this network for connecting up the telecontrol equipment – this way we have control over the infrastructure.

The standard IEC 60870-5-101 and 104 protocols are used for communication between the control centre and the telecontrol systems, and between the systems themselves. Modbus (RTU and TCP) is used to connect lower-level components such as the Compass B short-circuit and earth fault indicator from Horstmann.
RheinEnergie, Cologne and the Rhineland - belonging together for 140 years now. As a regional power generating company with head offices in Cologne, the company is responsible for supplying power and water to around 2.5 million people and businesses. Furthermore, it provides comprehensive service, and as a partner to industry, public utilities and other institutions, it is in the reckoning nationwide with contracting and service provision offerings.

The business relationship with SAE has long-standing tradition. SAE was contracted to supply FW-10 systems back in 1980. Then, the telecontrol stations were deployed in the gas supply sector. These telecontrol systems are still in use today and are continuing to reliably serve their purpose. This says something about quality and prolonged longevity.

RheinEnergie is currently using SAE telemetry and substation automation equipment for electricity, gas and district heating. For supply to be guaranteed, about 20 telecontrol nodes (FW-4000 and FW-5000) and about 400 telecontrol stations are installed, distributed around the municipal region of Cologne. These nodes are used to connect all substations and send their data to the central control station. The majority of the stations use dedicated lines to send their data. The GPRS/UMTS network is used for some data transmission.

**Electricity**

In their own power generation, RheinEnergie has for decades employed simultaneous production of electricity and heat in one system – combined heat and power. The larger installations are in Niehl, Merkenich, Cologne Sudstadt and Merheim. Electricity being generated in the Cologne cogeneration plants is currently being fed into the Cologne network. The start-up of the latest gas and steam turbine plant in 2016 will see feeding into the German network too.

In terms of power supply, about 200 telecontrol stations in the System-4 (net-line FW-40) and series5/series5+ (net-line FW-50 and net-line FW-5) product families have been used so far in substations, local network and customer stations. Also, about 100 net-line FW-5 are installed at the transfer points to the renewable energy feed for feed-in management.

**Natural gas**

RheinEnergie supplies natural gas to Cologne and Rösrath. Within the municipal area of Cologne, gas represents around 66.7% of the heating requirement for households, small businesses and public buildings. The natural gas for Rhineland grids comes almost exclusively from the Netherlands and Germany. The transit lines of upstream suppliers ultimately flow into household connections having a diameter of 5 centimetres and a pressure of 0.022 bar.

In terms of gas supply, about 60 net-line FW-10, net-line FW-40 and net-line FW-50 telecontrol stations have been used to date to monitor and control natural gas transfer stations.

**District heating**

To also guarantee the supply of district heating, SAE net-line FW-10 and FW-40 telecontrol systems are being deployed in the cogeneration plants and power grid substations of RheinEnergie. Of particular interest was the provision of a district heating tunnel under the Rhine. A tunnel 461 metres in length is used to transport heat between the two sides of the Rhine. The tunnel starts on the same level as the exhibition grounds, near the Hohenzollernbrücke (bridge), and has a diameter of only three metres. SAE technology is used here to control the lighting and the fans for inlet/outlet air.

Over and above reliable and well-coordinated technology, the regional energy supplier also values the expertise of SAE IT-systems. And proximity of the company to the customer is certainly a benefit when competing for corresponding services.
The market is demanding more capacity – we are offering the CPU-5C

The high demands of an IEC 61850, such as when connecting large protective equipment, and the exploding computing intensity for encryption whilst satisfying high levels of IT security stipulations, are crying out for yet another increase in performance. We are facing up to the challenges of the market with the CPU-5C of the modular net-line FW-50.

Based on series5+ technology, the CPU-5C features more memory, more computing power and, with up to six LAN segments, more network connections. Two Ethernet connections are located on the front. The new SWI-2 modules mean four more network segments can be set up as copper networks, or single/multi-mode FO.

In addition to the 512 MB of memory for storing large SCD files (IEC 61850), the encryption engine has even faster signature calculation for VPN encryption. An on-board temperature sensor enables the cabinet temperature to be controlled in a measuring range from -20° to 100°C. Bluetooth\textsuperscript{®} can be retrofitted, as can a fifth RS-485 interface. The tailored earthing concept with floating USB device enables operation when “positive” is earthed in the supply. Fault indication contact and redundant supply are sacrificed intentionally.

The CPU-5C can be deployed in all FW-50 racks and is supported from setIT V5.0.

Single-mode FO and more network segments

more performance, extended range, increased security

Ten new switch modules provide additional security, convenience and diagnostic capabilities. The variants differ in their connection to the network (copper / FO) and internal system connection. With single-mode fibre optic couplings and SC/ST connectors for example, direct connection options are available on the net-line FW-50 and FW-5000 with ranges up to 32 km. The unmanaged switches enable eavesdropping of network traffic with “port mirroring” and feature reliable protection against DoS attacks (Denial of Service) with active bandwidth restriction to the telecontrol core.

Internally the SWI-2-x family uses a USB connection and also provides an additional socket with separate IP address space in a separate network segment. This function is available with CPU modules CPU-5C (FW-50) and CPU-D5C (FW-5000) in new racks from setIT V5.0.

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<th>Medium</th>
<th>Mode</th>
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Stadtwerke Emden GmbH has been supplying the town of Emden and its people with gas for 150 years now—and for 115 years with water and 88 years with electricity. 51,362 inhabitants need these supplies. Stadtwerke Emden operates extensive infrastructures to guarantee this— the gas network is just under 500 km in length, the majority in the high pressure range. With almost 600 km of distribution network, the water supply is guaranteed and power is distributed by means of about 240 medium voltage stations, almost 200 km of medium voltage network and a good 650 km of low voltage network.

This project is also to include a wind farm with twelve wind turbine generators of different power ratings and a total connection power rating of 31 MW with QÜ protection. All of this retrofitting stemmed from the fact that existing Siemens 7SJ protective equipment lacked a communication interface. Whilst a conversion would generally have been possible, it would have resulted in the field in longer stoppage of operations with removal, sending in, actioning time and subsequent re-installation. The decision was made to go with the guard-line SG-50 from SAE—for two reasons:

1. The modular design of the protection modules enables the protection functions (even QÜ protection) to be “adjusted” by specifying a few parameters, and do not need, as with many other manufacturers, complex programming from different fragments.
2. The protective functions of the SG-50 can be aligned to changed requirements by loading separate software modules (even retroactively).

New protective equipment at Stadtwerke Emden GmbH

Three SG-50s each with four current and four voltage inputs as QÜ protection, with fault locator, system automation and user interface, were fitted. A dual busbar system was implemented with a busbar isolator, circuit breaker, cable outlet isolator and earth switch. Switch error protection was realised in full by the system automation in the SG-50. Communication to the NLR is over an optical interface to a net-line FW-5-GATE, and from there over Ethernet to the control centre in accordance with IEC 60870-5-104.

Stadtwerke Emden GmbH was extremely happy with the conversion and is already looking forward to new projects with the guard-line products from SAE IT-systems.

Authors: Jens de Boer and Jörg Schroeder
Within its supply region, Belgian distribution network operator Infrax provides the infrastructure for electricity, gas and waste water, as well as cable television. With around 1,400 employees, Infrax ensures supply and disposal for 126 local authorities in the Flemish region of Belgium.

Infrax runs a Network Manager central control station from ABB which collects information from all media within the supply region. The company’s own copper cabling (on which ADSL is realised) as well as fibre optic cabling and GPRS services from Vodafone, are used as the communication infrastructure. ABB telecontrol interfaces are interconnected when fibre optic or ADSL is used for the connection; GPRS couplings on the other hand connect the substations to the control centre over the Vodafone network via routers and firewalls. Telecontrol protocol IEC 60870-5-104 is used throughout for telecontrol component communication. The new IEC 61850 protocol is used for connecting up the ABB protective equipment. In terms of the new challenges in the field of IT security, Infrax uses SAE series5+ components and safeguards its links with end-to-end VPN encryption.

**Electricity – Renewable energy**

Many decentralised energy producers as well as wind energy, biogas, PV and CHP plants are located within the Infrax region. Given there are about 50 renewable energy plants having a nominal capacity exceeding 2 MW, feed-in capacity is monitored and reduced as required. Unlike the regulation levels typical in Germany (0, 30, 60 and 100%), 0, 50 and 100% as well as 0, 33 and 100% are common in Belgium. Set points are used for reactive power regulation. SAE provides for feed-in management ready-to-connect telemetry boxes based on the net-line FW-5.

**Electricity – Local network stations**

SAE technology is also deployed by Infrax in the field of local network automation. Driescher switching stations with circuit-breakers and motor drive are used for the new construction of larger local network stations with multiple feeders. SAE telecontrol equipment is fitted directly into the switching station by Driescher.

SAE was requested to develop a “remote I/O” module so that a separate FW-5 need not be used for every switching station. We addressed this requirement with the flexible TBus TBUS-T and TBUS-R extensions. The modules enable distributed I/O expansion modules from the separate switching stations to be coupled to only one FW-5. Configuration is carried out autonomously on site by Infrax workers. There are also Driescher local network stations at Infrax that are fitted with circuit breakers; the associated protective relays are connected to the SAE telecontrol equipment in line with IEC 61850.

**Natural gas**

In the gas sector, the modular net-line FW-50 systems are used for monitoring pressure reduction systems (from 65 to 15 bar) and in odorising systems. The differential pressures and flow-through speeds of the gas are recorded by checking the input and output pressures at the pressure plates. These values can in turn be used to monitor for fault-free function of the Fiorentini flow computer connected over the Modbus.

**Waste water**

The rain and waste water of private households within the supply region of Infrax is routed to underground reservoirs via pipes. Two pumps in a redundant configuration are typically installed in these reservoirs, and relay water to the corresponding waste water plants provided the fill levels permit it. SAE technology is used to monitor the fill levels and to control the pumps. Infrax has in excess of 200 pumps, each with a power rating of 1 to 3 kW.

**Benefits of SAE technology**

The intention of Infrax for the broad deployment of SAE technology was to implement a standardised system for all application areas. Contributing towards this was in particular the extensive yet simple to use configuration options with the setIT software tool. As a result of setIT training in Cologne, workers from a specialist Infrax department are able to set up fully autonomously their projects for different application areas, and configure the telecontrol systems accordingly.

Overall, praise was given to the high degree of flexibility shown by SAE, the obvious willingness to participate in creative discussion and tackle new project definitions, and exemplary levels of support.

"Whenever I ask an accurate question in an email, I generally have a good solution for my problem within the hour*

Johan Vanzurpele from Infrax
Following the strong focus on technical communication equipment for renewable energy systems over recent years, we were very pleased about an order from our “traditional”, principle focus – technical telecontrol equipment for substations and distribution stations. This installation was to be carried out for Energie und Wasser Potsdam GmbH (EWP) in Substation South.

The starting point was the requirement to replace existing central terminal units and bay controllers because spare part procurement for the systems is now very complicated. The 110 kV double busbar and four 10 kV blocks were to be connected “anew” to the control centre using FO and IEC 60870-5-104 protocol during ongoing operation. Communication in the substation itself was also to be implemented over FO (multi-mode) on six separate sections.
An FW-50 as a central terminal unit with a 19" switch serves as a master instance.

The conversion of the bay controllers in the cells started on the 10 kV level. Isolation cell by cell was carried out for this. 20 outgoing feeds, two coupling feeders and four transformer cells needed to be connected up. For the former, a double command, 4 x double-point information, one current (1A) and 4 x single-point information were to be provided in each, and in the transformer cells, two double commands, 4 x double-point information, 3 x current (1A), 4 x voltage and 4 x single-point information each.

DSO cards with 1 out of n monitoring and measuring circuit test were used for command output. The electrical parameters required for operations are derived from the currents and voltages measured. FO links in accordance with IEC 60870-5-104 are used for data transmission to the control centre from the feeders. The FO are laid in four sections emanating out in a star shape.

The substations for the 110 kV feeders are housed in standalone external cabinets. Each has their own FO link. Read and sent in addition to six double commands with return information are 3 x current (1A), 3 x voltage, 32 x single-point information, as well as the derivable measured values for active/reactive power, conductor-conductor, conductor-earth, zero voltage, power factor and frequency.

Interlock and control functions are implemented in all 110 kV substations. The automatic switchover unit for the transformers is controlled from the central terminal unit using a PLC program based on codeIT. The new systems were installed, set up and tested in close collaboration with EWP technicians. We appreciated very much the professionally structured yet straightforward working methods of the EWP team, especially in regard to the conversion during live operations. We were therefore able to replace all of the secondary level technology in the substation in just four weeks.

Digression - automatic switchover for transformers

Automatic switchover is required for two scenarios:
1) It is used to enable the coupling in the event of a fault in dual transformer mode
2) Or in single transformer mode to switch to the intact transformer

Automatic switchover can be activated from the master display or on site from a button. Operational readiness is in this case reported to the control centre with IEC 60870-5-104 communication, and signalled on site by an illuminated button. A continual check is performed for whether the switch-on conditions are satisfied:
- Status of Local/Remote switch
- No circuit breaker or voltage regulator in fault or intermediate position
- Protection fault
- Arc protection and system protection – not actuated

Automatic switchover starts when one of the following signals is pending:
- Diff protection OFF
- Buchholz main vessel OFF
- BIH load switch OFF

Then a predefined program runs, thereby sending switching commands to the individual transformers and couplings to enable/disable switches. Every switching command remains pending until the corresponding return information is detected in the automatic switchover; only then is the next switching operation run. If switch return information is not detected within a defined time, an automatic switchover device fault occurs and it switches itself off. The relevant commands are reset and the fault is reported to the control system. Activating the Local/Remote switch during a running automatic switchover also results in this abort scenario. Following scheduled conclusion of all switching commands, the automatic switchover device switches off automatically and reports execution of the switching operations to the control system. In order not to burden the communication paths unnecessarily between the feeders, we use 32-bit switching signals over which a great deal of time-critical payload information can be sent with just one frame.

SAE expertise

New successes

GEW Wilhelmshaven GmbH

March 2014 saw us receive from GEW Wilhelmshaven GmbH an order to modernise the protection and telecontrol equipment at the Rüstersiel substation. 110 kV power is fed-in there by EWE. Transformation is in 12 outgoing feeders with 20 kV. The obsolete telecontrol equipment made possible the deployment of new Kombisave SG-50 combination protective devices and new net-line FW-50 telecontrol stations.

14 combination protective devices with four current and four voltage converters, and 14 binary inputs and 14 outputs, were used. 2 x DMT protection and 12 x distance protection in the outgoing feeders were used in the transformer feeders. Feeders not configured with protective equipment were connected in the classic way to telecontrol equipment. There DSO cards switch with 1/n control and measuring circuit test, and read isolator positions and measured values.

The stand-alone cabinet was assembled in Systems Engineering at SAE IT-systems in Cologne and supplied fully wired. FO cables via SAE star couplers are used to couple the cells to the telecontrol station with the IEC 870-5-103 protocol. The ‘104 protocol over SHDSL is used for the connection to the control centre. The modernisation means ten bays of classic cross-connect technology are replaced.

We thank those responsible at GEW Wilhelmshaven GmbH for their trust and await successful project conclusion.

Stadtwerke Baden-Baden

Baden-Baden public utility

We received an order to supply 50 remote terminal units for the transmission of 20 kV local network station data over Tetra digital radio. The ability to flexibly integrate protective equipment and short circuit indicators from different manufacturers was regarded as excellent. The readied control unit for feed-in management in renewable energy systems was also praised. This means the Baden-Baden public utility is set for continued, systematic deployment of SAE IT-systems technology.
Austro Control operates within Austria a nationwide system for the acquisition of switching statuses and alarms, and for the control of facilities necessary for maintaining air traffic control operations in general. This system is called the SMA (for control alarm system).

Different interfaces and protocol formats are used to make available the operational states and alarms of these air traffic control facilities to operating personnel at airports and centrally at the ATCCV in Vienna (Air Traffic Control Centre Vienna). The capability to control air traffic control systems emanates from these systems.

The technical air traffic control equipment is connected at the respective airport via a subsystem. All of the data volume is relayed to the system in the ATCCV over active redundant lines. The system in the ATCCV portrays all states of the systems in Austria. In the control direction, airports can only operate their own area, and from the ATCCV, air traffic control facilities across the whole of Austria can be controlled.

An expansion of the existing SMA system (of former VA TECH SAT GmbH) was necessary for monitoring of the new tower at Salzburg Airport in terms of infrastructure and power engineering.

The telecontrol system supplied comprises a redundant fire zone isolated data node (FW-5000/FW-50), and small FW-5 telecontrol systems in the building level distributors. These communicate with each other over the existing SMA LAN. System and payload data is sent directly by the redundant data node to the existing SAT250 SCALA visualisation system provided on site.

Three different redundancy types have been implemented on telecontrol level:

• The FW-5 stations connected over TCP-IP maintain a connection to both data nodes and send all data points in the monitor direction.

• The external IEC 60870-5-101 external couplings connected to the data nodes over V.24 interfaces work with interface redundancy. This means only one data node retains the connection to the respective external station. The second data node eavesdrops this coupling and assumes communication with no interruptions in the event of a fault with the active connection.

• The local FW-50 stations connected over TCP-IP maintain a connection to the respective data nodes and send the data read by the peripheral modules and Modbus interfaces in the monitor direction.

The data nodes were fully assembled and mounted at our factory in standalone cabinets measuring 2000 x 800 x 800 mm (H x W x D). Reichle & De-Massari rails were used for wiring within the standalone cabinets. Setup, installation and start-up were carried out on site by our partner Greylogix SAT.

Configuration of the required data points using setIT and codeIT, and implementation into the visualisation system, were carried out by the TCMS team (Technical Control and Monitoring Systems) of Austro Control.

“I regarded implementation of redundancy provided and modified for ACG in the SAE systems as the greatest challenge in this project. The development department and project management at SAE faced up to this task meticulously, vehemently and ultimately successfully. This enabled the project objectives of ACG for the start-up of the new tower in Salzburg to be met on schedule.”

Project manager Margit Lassl