Grasped from the future
New challenges are unavoidable

In recent years, scarcely any industry has had to face such a rapid and profound change requirements than the energy sector. Both the German Federal Government’s political environmental targets and the side effects of technological progress are manifesting themselves in strict legal requirements. Real implementation opportunities lead to massive costs (smart meter roll-out) or in many places are extremely vague (IT Security Act).

After most existing renewable energy plants were connected as per § 9 EEC and a large number of market firms already got out of direct energy marketing due to smaller margins, the focus – and intelligent local networks – has returned to traditional work, such automation of substations and distribution stations. In the form of the net-line BCU-50 SAE can offer a station and bay controller which meets the most exacting requirements for medium- and high-voltage switchgears as per IEC 61850-3.

With this in mind specially, the platform-independent visualisation tool visIT has also been further developed as the increasing complexity of our supply networks has also brought about greater challenges in its monitoring. In times of reduced staff numbers, it is important to get a good overview right away. Efficient plant visualisation makes the troubleshooting and resolution work of service staff on-site considerably easier; saving you time and money. We do not use any safety-critical elements such as Java. Contrary to our expectations, many customers are also considering using visIT in local network stations and customer systems. Thanks to power measurement terminals PM-1-R for connecting Rogowski coils and PM-1-S for the linking of small-signal sensors, new possibilities open up towards the intelligent distribution network. In telemetry, we have made the switch to LTE with the FW-5-GATE-4G.

Unexpectedly we have been forced to act in the market in a different area. Some telecom providers have terminated ISDN and analogue dial-up links in combination with DSL and have switched to IP-based connections – All-IP. This technology replacement can offer up benefits but can also be time-consuming. We can give you an overview of the courses for action.

The issue of IT security has become a significant aspect of telecontrol systems and is not likely to vanish from all of our agendas any time soon. At SAE, we invested a lot of money last year in order to adapt our products, processes and infrastructures to more stringent standards. In particular, driven by stimuli from foreign countries which are far ahead of Germany in this issue, we have been able to learn a great deal and integrate new features into our systems.

Joachim Schuster, Managing Partner
Cologne, November 2016
Next level IT-Security
A continuous process

Data security

IT security is a highly-prized asset. To attain it requires extensive effort in various different areas. Using secure components which meet strict requirements is only one of such areas. The programmed objectives can only be reached when all components work harmoniously with each other without impairing practical and the operability of a facility.

In the areas of commissioning, maintenance and diagnostics especially, some very popular functions must be dispensed with for reasons of security. The challenge when developing Version V5.003 was to maintain the usual high functionality of setIT. Metaphorically speaking, some ditches need to be jumped, new bridges built, some doors closed, but some doors also needed to be torn down. At the same time, new algorithms and the latest drivers needed to be integrated to provide lasting security based on BSI requirements.

IPsec IKEv2
A secure connection needs a means of encryption which switches keys when establishing a connection and checks these keys before the connection is deemed secure and can be released. The methods used include highly-sophisticated state of the art mathematical functions. These need to be updated from time to time. Automatic key management for IPsec is handled using the Internet Key Exchange Protocol. The previous version - IKEv1 - is now considered vulnerable to attack. For this reason, the IKEv2 procedure was defined in Guideline RFC4306, since integrated via the StrongSwan library. Simply choose the method in station services and configure the necessary parameters - it could not be any easier.

SYSLOG
Log messages are automatically-recorded information such as logins, updates, website access, building connections to setIT, compromise reports from the firewall, and much more. Syslog allows you to transmit log messages automatically from one station to a central server across the network.

The great aspect of this function is the centralised acquisition of operational events from many stations. It also evaluates this information. Depending on the type and the equipment of the Syslog server, alarms may be generated to report attacks, attempted attacks, e.g. a high number of incorrect password entries, an update outside of operating hours or other unusual events.

In addition, the last 40 messages can be displayed on the station’s web server and a log file can be loaded on-site containing up to 1MB of information. Of course, only to authorised users!

Sign firmware
When a station configuration is updated, a compressed archive is sent to the station. This archive contains a fully executable system in the form of firmware with configuration data and runtime systems. This system can also be signed via the system password. By selecting this option, the firmware archive created during the generation process is encrypted and is given a project-specific signature. This protects the firmware from unauthorised modifications and also prevent unauthorised access to the information contained therein. A station to which a signature has been applied will then only accept appropriately signed firmware; manipulation is thus excluded.

Encrypted database
Securing a station is only one of the measures we have talked about for secure implementation. A potential risk lies in having an unprotected setIT project database. As well as the user profiles with granular access control to setIT and the stations on-site, the database itself can also be protected against any form of attack. The new database format .sdbx allows the entire file to be encrypted using secure AES256 encryption. Protected by the system password, the encryption keeps information safe, only allowing genuine users access.

Control commands for the temporary activation of system functions
There is a certain tension in the air when safety experts and commissioning personnel implement a project together. The arguing begins when it comes to access for on-site diagnostics and maintenance. Commissioning personnel would have to do without some much loved functionality if it were not for system commands. Some functions which can potentially be classified as critical in the station can be activated externally using an adjusting command, they do not run permanently, exposing a potential for attack but are temporarily released via the system commands. This can be done e.g. via a key-operated switch on-site or via a command from the control centre.

Extended firewall rules
setIT V5.003 allows extended firewall rules to be defined. As well as defining which services are available at which interface, you can now configure granularly whether a service needs to be transmitted securely in a connection or whether a tunnel is permitted for operational reasons.
Reduce power with the 4DI4DO
An extension board has four particularly-powerful relay outputs and four information inputs. The latter are 2-pole isolated without a common root. They operate in both ± directions and provide a selection of operating thresholds in wide range operation. The command relays are available as monostable or bi-stable changeover contacts. The bistable variant 4DI4DO-2 keeps its switching status even in the case of a power failure.

For instance, power reduction and checkback indication on EEG facilities is only available with one assembly. A timer integrated in the 4DI4DO makes an additional PLC program in the FW-5 unnecessary. Alongside direct command processing, a 1/n monitor and the BBO (Break Before Operate) and BAO (Break After Operate) modes are available with the definition of a pause- and overlap time which enables adaptation to the different requirements of the generation plants.

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>4DI4DO-1-1</td>
<td>4 messages, value range ±18 to ±72 V DC</td>
</tr>
<tr>
<td></td>
<td>4 changeover contact</td>
</tr>
<tr>
<td>4DI4DO-1-2</td>
<td>4 messages 110/220 V AC/DC</td>
</tr>
<tr>
<td></td>
<td>4 changeover contact</td>
</tr>
<tr>
<td>4DI4DO-2-1</td>
<td>4 messages value range ±18 to ±72 V DC</td>
</tr>
<tr>
<td></td>
<td>4 bistable changeover contact</td>
</tr>
<tr>
<td>4DI4DO-2-2</td>
<td>4 messages 110/220 V AC/DC</td>
</tr>
<tr>
<td></td>
<td>4 bistable changeover contact</td>
</tr>
</tbody>
</table>

Care for a bit less?
The 2AO extension board is identical to the known 4AO in function and specification. However, in many applications in Feed-in Management or direct marketing, only two set points are needed for the P & Q requirement, two of the most cost-intensive outputs can be dispensed with. We can offer you a more favourable solution.

New connection variants with the PM-1
The PM-1 module allows cost-effective measurement of relevant network values in low and medium voltage networks. As an extension board to the FW-5 and FW-5-GATE, it also allows for measurement of characteristic values for voltage quality in accordance with DIN EN 50160 and provides basic data as per ISO 50001. The connection options are extended again with variants PM-1-R and PM-1-S.

- The PM-1-R measures currents up to 4000 A using Rogowski coils; the voltage measurement is as before done directly or via metering transformers. The coil can simply be attached to the bus bar and delivers an output signal of 100 mV/1 kA.
- The PM-1-S uses small signal sensors* to connect currents and voltages. In contrast to PM-1 and PM-1-R, the transformer ratios for the current and voltage are fixed.

Both variants make retrofitting in installations a breeze. In the best case scenario, the device does not need to be shut down.

*At present, the PM-1-S has only been tested with the small signal sensors made by Zelisko. Transformers can be used with other loads (19.1 kΩ voltage or 490 kΩ current) to reduce measuring precision.
Enexis is responsible for a large portion of the electricity and gas network in the Netherlands. Enexis’ Supply region includes the provinces of Groningen, Drenthe, Overijssel, as well as parts of Flevoland, Noord-Brabant and Limburg. Enexis uses approx. 142,000 km cable network and 40,000 km gas pipelines in these regions in order to supply its 2.5 million electricity and 1.8 million gas customers.

Enexis operates approx. 1,200 medium-voltage installations (MV-T) in its network. The sub-stations have simple busbars with 5 to 20 outputs and are located in the network between the HV/MV transformer stations and MV/LV stations.

Some of these stations have been monitored with the aid of fix-wired digital and analogue inputs for many years. Since 2011, Enexis has also been providing substations with the capability of using medium voltage circuits. Here, the protective equipment is used for interaction with the primary process and the data are transferred to the remote terminal unit via an unmanaged single star IEC 61850 network. The remote terminal unit is responsible for mapping the data from IEC 61850 to IEC 60870-5-104. Due to these different connection strategies, the remote terminal unit must function as both an IEC 61850 client to the protective equipment, as well as assuming basic I/O.

**FW-5-GATE as DO Box**

The basic DO Box MV-T version is designed for the implementation of telemonitoring and -control from new/modern MV-MV stations. Enexis will also use the DO box ordered by SAE IT-systems to break up the existing MV-MV stations which have reached the end of their service life. These older monitoring systems are based on conventional, fixed-wired I/O (voltage, current, feed-in capacity, switch position, initiation signal, etc.). As these upgrades are very work-intensive and also result in an increasingly higher depreciation cost due to the premature replacement of existing technology, Enexis plans to add the existing I/O to the next generation of automation systems; the FW-5-GATE with its separate extension boards is a perfect fit here.

“ENEXIS plans to provide comprehensive automation (monitor and control) of its MV network and touch up its old stations. ENEXIS is initiating a European write-down for selecting a remote control solution for the MV-MV stations. The core criteria for this remote control solution is a high level of IT security and communicability.

All of the bidding parties were assessed on an equal footing in terms of conformity with the technical specifications, progress made in their IT security measures, user-friendliness, and the ruggedness and performance of the demo systems they provided.

SAE IT-systems had the best score in this evaluation process and were awarded the contract.”

Ivan Theunissen, Enexis B.V.
Langenzenn public utility is using SAE telecontrol

The Langenzenn public utility has a very long history, founded as long ago as 1848. Back then during this eventful historical period, petrolum-lamp street-lighting was brought in. A few years later in 1862, the first water pipe was built in Langenzenn. The municipal water pipe network was extended until 1905. This provided the inhabitants with a good supply of high-quality drinking water. In 1911, the connection to the Middle Franconia power plant was begun, which enabled electrical street-lighting to be introduced. More and more households were connected up to the electrical system. The number of consumers increased rapidly. The first unit-type district heating power station was established in 1993. Based on its many years’ experience, the Langenzenn public utility provides a reliable supply of drinking water and electrical power to its inhabitants, running a 20kV medium voltage and low voltage network. The sub-supplier for the power supply is MDN Main-Donau Netzgesellschaft mbH from Nuremberg.

Approx. in 2008, it became clear that the current telemetry system with process control system was in need a major revamp in the coming years. The technical staff at the public utilities made an extensive survey of the market. At a SAE telecontrol user day in 2009, held in Firth, good contacts were made with local suppliers were and one got up to speed with the latest technical information. A number of visits were made to get an extended overview of the practical use of SAE IT systems. In 2014, it became real. Detailed plans for a new network control system with telecontrol were drawn up for electricity and water supply areas. In on-site discussions, technical sales at SAE IT-systems lent their support for structuring and design planning. The focus was on the planning of a new control centre and telemetric connection to substations and other central network stations. The head of the e-plant, master electrician Carle Eberlein was at the fore of the planning, putting a great emphasis on independent working independently across the board. The aim was to achieve autonomous connection planning and assembly of all components. Special attention was also paid to ensuring the parametric tools were easy to use. After the framework conditions were established, suitable offers were gathered. SAE IT-systems was able to convince in functionality and price. In the detailed planning discussion which took place in mid-2015, more concrete agreements were made concerning the new ProCoS network control system made by KISTERS, as well as the network control system and SAE-IT telecontrol. As part of the first project planning phase, only the power supply area is being taken into account. Later, the drinking water supply will be added. A net-line FW-50 in a large rack is being used in the central zone. The very remote substations, including Teichenbach, Ziegebruck, which can also be reached via their own Cu cables or transfers were also equipped with the modular net-line FW-50 units. The good news that the entire communication structure could be built using Langenzenn’s own cables enables connection to other stations coupled with the IEC 60870-5-101 protocol by WT modem. These are usually equipped with appropriate extension boards with the smaller net-line FW-S type compact units. The switches in the stations are triggered from suitable DOS units, 1,5 pole via double command. Various external couplings such as Janitza directional earth fault relay and network analysis systems are implemented via Modbus. After being assembled independently, the configuration was carried out in cooperation with SAE IT-systems design. After the basic installation of the control centre, it was possible to continue configuration work here via remote access.

Work with the project manager is structured and partner-like. Mr Eberlein emphasised the handling of the tele-control systems during assembly and configuration using setIT so that a good foundation was established for much of the independent work for later system extensions in local network automation and drinking water supply. The existing protective equipment was first to be adapted to the central positions as per IEC 60870-5-103. The project is scheduled to be completed in 2016.

The idea of a simulation is nothing new, although realisation of it is not trivial – especially because its operation should fit into setIT’s intuitive input philosophy. The idea of a simulation is nothing new, although realisation of it is not trivial – especially because its operation should fit into setIT’s intuitive input philosophy.

Simulation of process data

Only one simulation mode can be launched during the active connection from setIT to the station, via the context menu. The context menu allows you to set single-point information, double-point information, system information, system double-point information, measured values, system measured values, bitstring information or computed values to a predefined state for test purposes, so they can also be simulated for the control system.

As well as this value, the statuses of the process data can also be simulated individually or together according to IEC 870-5 IV/NT/SB/BL/OV. The simulation remains active until the connection from setIT to the station is disconnected. If the operator then refrains from ending the simulation mode, a one-minute timeout stops the mode and overwrites the process data with its real values.

This allows you to check planned process data ahead of a modification.
visIT
Web-based plant visualisation

The concept

visIT is a platform-independent visualisation tool for creating modern user interfaces. By importing all process variables from the parametrisation tool setIT*, the Designer can be used to conveniently integrate all relevant elements and can quickly be compiled into a tailor-made visualisation; the provided symbol library can be accessed but also drawn and dynamised fully autonomously.

The visualisation is then loaded into the telecontrol unit as an element of the firmware and can be called from its IP address in the same way as the web server. Almost all devices with HTML5-enabled browsers can serve as terminals; compatible smartphones and tablets, as well as fixed-installed touch displays.

By combining with connectIT and installing on a separate server, visIT technology can also provide information for calls via decentralised close operating stations and can thus be used as a rudimentary control system.

Monitoring & intervention

visIT runs in the station in runtime mode and has direct access to current process data and logged values of the station. In this way, all relevant information can be shown for operation and service:

- Online values
- Operations diary
- Alarm list
- Curve diagrams**

As well as the pure monitoring of system components and communication paths, active interventions such as switching operations and target requirements are also possible with visIT.

Exporting and importing process variables

Calling the Designer from within setIT*, the created process variables are automatically sent to the Designer. Big process data can be imported quickly and are ready for process visualisation. Separate designators in setIT set up a self-sufficient reference. Some process variables can be created and edited in the Designer.

The Designer

Visualisation images are created by the VisIT Designer, a variant of the professional visualisation tool PROCON-WEB V6. The process variables for the telecontrol station are modelled in the Designer as numerical, logical or text variables and can be displayed using simple assignment in the interface. The user has a number of pre-made controls, such as number fields, buttons and sliders. These can be adjusted individually both visually and functionally. Even self-drawn graphics can be imported and used in the visualisation. Through dynamisation of graphics, their representation can vary depending on the process variables, in the form of:

- Flashing
- Colour change
- Movement (e.g. Rotation)

Efficient plant visualisation makes the work of service staff much easier. Allows for quick troubleshooting and saves time and money. The display can be installed on-site from mobile devices or remotely over network connections as with the Web server; all meeting stringent IT safety standards as you would expect.

* starting with setIT V5.003.05  
** starting with setIT V5.004
High IT security
Sending switching commands or predefining set points via visIT requires a user management in setIT to be created and activated with password protection. This ensures that only employees can perform switching operations who have appropriate permissions. Unlike many other concepts on plant visualisation in the market, HTML5 and JavaScript used for VisIT offer a high level of IT security.

Example
The position of switchgears is recorded via digital inputs on the remote terminal unit. In the visualisation interface, this is represented by the rotation of a switch symbol. To implement the requirement, information about the process point states is needed for various display angles:

**Single-point information**
This process data type from SetIT corresponds to a logical variable in VisIT.
- logical process variable = 0 corresponds to switch OFF (inactive)
- logical process variable = 1 corresponds to switch ON (active)

**Double-point information**
This process data type from SetIT corresponds to a numerical variable in VisIT.
- numerical process variable = 0 corresponds to switch moving
- numerical process variable = 1 corresponds to switch OFF (inactive)
- numerical process variable = 2 corresponds to switch ON (active)
- numerical process variable = 3 corresponds to switch malfunction

### Application capabilities and terminals

- **Control centre**
- **Installed touch panel**
- **Service staff with smartphone or tablet PC**
- **On separate server for workstations**
- **Mobile radio: GPRS/UMTS/HSPA/LTE**

### Example of an Operations Diary

<table>
<thead>
<tr>
<th>Datum, Uhrzeit</th>
<th>Meldung</th>
<th>Zustand</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.07.2016 16:19:19</td>
<td>F02_Q1 geschlossen</td>
<td>Aktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:19</td>
<td>F01_Q1 offen</td>
<td>Inaktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:19</td>
<td>F01_Q1 geschlossen</td>
<td>Aktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:16</td>
<td>LV_Q0 geschlossen</td>
<td>Inaktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:16</td>
<td>LV_Q0 offen</td>
<td>Aktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:16</td>
<td>F03_Q1 offen</td>
<td>Aktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:16</td>
<td>F03_Q1 geschlossen</td>
<td>Inaktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:15</td>
<td>F02_Q1 offen</td>
<td>Aktiv</td>
</tr>
<tr>
<td>11.07.2016 16:19:14</td>
<td>F01_Q1 geschlossen</td>
<td>Aktiv</td>
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<tr>
<td>11.07.2016 16:19:14</td>
<td>F01_Q1 geschlossen</td>
<td>Inaktiv</td>
</tr>
</tbody>
</table>
Across Europe, some telecom providers have terminated ISDN and analogue dial-up links in combination with DSL and have switched to IP-based connections (All-IP). The aim is to reduce complexity in the network infrastructures by phasing out local exchanges. The switch in technology can offer advantages but can also be complex to carry out.

Is there any change to purely analogue switched telephone lines?

No. Telekom – the largest offering of last miles connections – is aware of its responsibility and is not keen to undertake the expense of making changes to millions of terminals. Although a network-side adjustment is made, this should not something customers notice. Special adapters were set up on the new connection nodes. These continue to support the old standard. All old services are to continue to be available until the rotary selectors are supplied remotely with pulse dialling. A longer routing or transfer time was not fixed.

For the simple existing telephone connection, the conversion will likely take place in the background without notice. Best if the customer does not notice anything.

So who will actually be affected?

All ISDN subscribers (Deutsche Telekom) and all DSL connections with old telephone connections (analogue or ISDN) are affected for whom data transmission with DSL and telephone using the old technology is operated. At Deutsche Telekom, the first step consists of altering the VDSL connections with more than 16 MBit/s Downstream. The entire migration shall be completed before 2018. Swisscom for example aims to have done the conversion to All-IP by the end of 2017. At Vodafone, ISDN should remain available until 2022 at least. Pure ISDN connections without DSL are also to be modified. Deutsche Telekom has already stopped selling new connections. Telekom is offering an ISDN-All-IP converter which however does not meet industrial requirements.

Can the dial-up link to DSL continue to be used?

An earlier analogue switched telephone line used a telephone connection as a cable harness to the next switching centre. In the classic case, the line was only active when the handset was picked up and a telephone call was initiated by dialling up. If the Internet was connected at the same time via the cable, a higher frequency range was then modulated enabling a permanent connection to the Internet. In other words, there were two worlds in a single cable. These days, VoIP technology is standard. It is used to package voice signals into IP packets - the basic means of communication over the Internet. The old regional switching office is obsolete. A central control point over the Internet is used - the SIP technology. By the way, the call was initiated by dialling up. If the Internet was connected at the same time via the cable, a higher frequency range was then modulated enabling a permanent connection to the Internet. In other words, there were two worlds in a single cable. These days, VoIP technology is standard. It is used to package voice signals into IP packets - the basic means of communication over the Internet. The old regional switching office is obsolete. A central control point over the Internet is used - the SIP technology. By the way, the radio link is protected from unauthorised access by cryptography.

Is VoIP - the transmission of voice over IP - a solution?

Yes, it is a different story when it comes to data transmission; here this now needs to be IP-based.

Is VoIP - the transmission of voice over IP - a solution?

Compromises are used with VoIP telephone systems which reduce considerably the data volume to be transmitted. Data packets must be transmitted transparently, i.e. no changes to the data are allowed. A dial-up model connection via VoIP could work however there is no guarantee of function.

Can a switch be made to mobile via GSM?

In some cases, switching the medium from terrestrial telephone services to mobile via GSM is possible. In this case, the telecontrol system can continue to be used though it will need to be set up with a different model and new numbers.

How much longer to wait?

Telekom and Vodafone switched the CSD service to IP back in 2011. At present in Germany, there are no plans to terminate the 2G network GSM/GPRS/EDGE. Swisscom is switching off the 2G network in 2020.

Can a radio link be used?

Depending on the conversion effort and the position of the building, the switch to radio link may be a good alternative. Modern radio systems such as the Aprisa series 4RF offer good penetration in the exclusive 470-MHz band, as well as a respectable range and a transparent bandwidth of up to 120 kBit/s with IT technology. The radio link is protected from unauthorised access by means of AES256 encryption. A service provider should assist you with the planning in order to confirm radio broadcasting and channel registration with the German Federal Network Agency.

Can GPRS/EDGE/UMTS/HSPA/LTE mobile technology be used?

If the mobile network is available, a switch to GPRS/UMTS or LTE has been the favoured solution up to now for replacing terminated dedicated lines. This option is also available here. A system replacement is compulsory.

Telecommunication
Why do we recommend an industrial-suitet ADSL router?

With the DSL connections, the Telekom providers provide a router adapted to its routers which can be purchased or rented. Usually relatively cheap electronics are involved—these are designed for sporadic use in the home of office. Speedport & Co. are not suitable for long periods of round-the-clock services.

Important features for industrial use, such as e.g. top-hat rail assembly; supply from the same voltage source as the telecontrol station in the cabinet; or simple buffering capability via battery/UPS are important reasons for using professional-standard equipment. On top of this, it is worth mentioning their considerably longer service life and much greater immunity to overvoltage and voltage peaks/flashes. Industrial routers are designed for reliable long-term operation and can also be supplied with the latest firmware. If additional VPN encryption is needed (KRITIS), traditional routers are usually out of the picture. The LANCOM routers designed for business use are equipped with a stateful inspection firewall, offer built-in VDSL/ADSL2+ modems, All-IP option and optionally also VPN encryption of additional network components. The higher quality of router is also associated with a better stability and professional service in the event of failures. The Lancom B31A with All-IP option is an inexpensive entry-level model.

Annex B or Annex J, what is correct?

Annex B is a requirement on how to integrate old DSL connections with stop-band for analogue and ISDN telephony. The range below 338 kHz is not available for DSL.

Annex J is the newer standard which can provide the lower frequency band for a quicker upstream connection; both are the same in the downstream. Annex J has been in use longer and is usually installed on the network node for All-IP connections. Deutsche Telekom intends to convert all connections to Annex J on the network side before 2018. A router must support Annex J in order to be able to synchronise an Annex-J connection.

Many new routers already support both variants meaning no new investment is required. Annex-J compatibility is also important.

IT-Security: How can the installation be supported?

Every access to the Internet via ADSL, GPRS or other means conceals the risk of an unintended access through compromised access attempts or sabotaging communication. To prevent affecting the systems behind it and to ensure continued safe operation, cabinets and fuses must be activated in the upstream devices or - even better - in the telecontrol system. With basic routers, these are not available or are only insufficiently available.

The new seriesS+ technology offers extensive fusing in order to ensure operation based on the BDEW white-paper. By selecting the functions, all of the required safety functions such as firewall or end-to-end encryption of data paths can be configured directly from the substation. An “IT security for SAE IT systems” checklist helps you with the set-up. Both the station itself and the entire installation must be taken into account with the accesses to it.

Conclusion

If you are using a remote terminal unit on a public dial-up connection (analogue/ISDN), the conversion planned before 2018 is relevant for you. In the best case scenario, everything will continue as before yet it is not known whether the conversion is functionally-compatible or not.

The conversion of telecontrol stations to TCP/IP-enabled connections (All-IP) is a complex process. However, the conversion is worth it as the new communication paths allow for the use of additional services and system jobs can be performed better and in a more reliable way. In any case, it pays to get advice.

Christopher Budschun

As former employee of the Krefeld public utility, Dominik Mäkelburg is not only perfectly familiar with our products he also knows the needs and requirements of our customers. He is on hand with advice and support as an expert for substation automation and distribution network automation.

Dominik Mäkelburg

In the East Germany region, we have added another specialist. Dipl.-Ing. Heiko Kühn has joined our local external sales team with a fixed position in Kleinmachnow. He is not only perfectly familiar with our products he also knows the needs and requirements of our customers. He is on hand with advice and support as an expert for substation automation and distribution network automation.
Bay station controllers in the electrical power supply must withstand special environmental requirements, especially when the station automation is used in high-voltage equipment, strongly vibrating or shock generating system components as well as environments with a seismic risk. The BCU-50 based on the established net-line FW-50-14. In terms of mechanics, isolation, stability and function, it has also been adapted to the more stringent requirements of IEC 61850-3.

Common strengths supplemented as needed
As with all series 5 products, a special strength with the BCU-50 is the extensive communication capabilities and redundancy concepts, the wide range of functions, stringent IT security based on the BDEW whitepaper and last but not least in the convenient configuration and quick diagnostics capability provided by setIT.

The BCU-50 offers high flexibility through a wide selection of communication interfaces and highly resilient input/output modules. The capacity can be adapted to custom requirements thanks to its modular structure. Large capacities can also be realised easily with up to 16 BCU-50s cascadable to a logical station.

The various assembly variants, e.g. in the 19''-rack frame with optional cable tray or direct wall-installation allow for uncomplicated integration into existing structures.

To meet stringent availability requirements, the intelligent SV-6 power supply with 24/48/60/110/220 V DC for the BCU-50 and FW-50 can also be made redundant. Different supply voltages can be used in parallel. Additional features of the SV-6 include voltage-, power- and temperature monitoring, as well as a potential lockout after an under-voltage. This is used to prevent switching errors for empty battery blocks.

The IZRA system card for controlling circuit breakers directly is new.

A connection of the BCU-50 to the IED (Intelligent Electronic Device) as protective equipment in the IEC 61850 network is of course possible. Starting with the new setIT version, the BCU-50 also supports the IEC 61850 server and can itself be used as an IED, e.g. as a remote IO controller.

On the test bench
The BCU-50 has been consistently developed towards the product standard DIN EN 61850-3 (communication system for automation in the electric power supply) for the highest class of high voltage switchgears “H” and connections “h” which also cover the other areas. Therefore, the dielectric strength of 2.5 kV AC/3.5 kV DC and 5-kV surge voltage also conforms to the VW3 class according to IEC 60870-2-1.

With a vibration resistance of 10 m/s as per DIN EN 60068-2-6 and a shock resistance of 15 g (150 m/s²) as well as a continuous shock load of 10g given a stress immunity of 6000 shocks in accordance with IEC 60068-2-27, the system is able to withstand a good deal. In order to withstand the mechanical stresses in areas exposed to the risk of earthquake as well, the system can also tolerate seismic vibrations up to 3.5 mm in accordance with EN 60255-21-3 (measuring relays and protection equipment) in each axis.

Free space for raw application areas
The BCU-50 offers a perfect system for realisation as a
• Station and bay controller in medium- and high-voltage switchgears
• Gateway and communication router between station buses, fieldbus and control systems
• Monitoring and control device for utilities, waste disposal and industrial sectors

It's tough!
Bay controller BCU-50 for the most exacting of requirements

<table>
<thead>
<tr>
<th>Types of sites for casings, power supply and function earth links</th>
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<tbody>
<tr>
<td>1. Common application in HV substations</td>
</tr>
<tr>
<td>2. Common application in Generation plant and MV stations</td>
</tr>
<tr>
<td>3. Protected area, if existing</td>
</tr>
<tr>
<td>Types of signal links</td>
</tr>
<tr>
<td>1. High voltage equipment</td>
</tr>
<tr>
<td>2. Field connection</td>
</tr>
<tr>
<td>3. Telecommunication</td>
</tr>
<tr>
<td>4. Links to protected area, if existing</td>
</tr>
</tbody>
</table>

Recommended areas of application net-line BCU-50 (Source: based on IEC/TS 61000-6-5:2001, Fig. 3)
All in one
The net-line FW-5-GATE-4G

Product innovation

What do your customers expect from an intelligent component for the automation of distribution networks? It should take up as little space as possible in the switchgear cabinet, be easy to parameterise, offer high flexibility, ensure the necessary IT security and where possible, not cost a great deal.

The net-line FW-5-GATE-4G is a concrete answer to these wishes. The system is a telecontrol station, router, gateway and modem in one. An internal LTE mobile telephone modem is added to high FW-5-GATE performance range. All earlier forms of use as a router, gateway or protocol converter with media disruption from serial to LAN as well as the chance to increase capacity using extension boards continue to be available of course.

Rapid commissioning and simple diagnostics

Thanks to full configuration of all components of the device in setIT, there is no need to integrate or adapt an external modem, which can be time-consuming at times. VPN tunnels and end-to-end encryption must be established from the station, according to the BDEW Whitepaper. In addition, all available information from the mobile radio module must be used in the diagnostics functions of setIT.

Installation in the switchgear cabinet becomes far easier: Only 65 mm are used on the top-hat rail; an additional power supply is not needed for an external model and there is no need for the connection cable between station and modem; a typical point of vulnerability in risk assessments. Afterwards, only the power supply and the aerials need to be mounted, insert SIM card, load firmware - and you are done.

New LEDs for system information have been added to the front panel for basic checking. The general system state can be indicated via the sys-LED. The VPN-LED indicate the status of the tunnel. Both signals can be freely configurable in order to offer flexible signalling for any application and network topology.

State-of-the-Art technology with high IT security

The FW-5-GATE-4G was converted to a new, future-proof platform. The series 5e generation has at least 3x the performance of the series 5+ generation with 1200 MIPS. The improved performance in particular has a positive impact on the network communication via IEC 61850 and process point treatment according to IEC 60870-5-10x standards. The overall system was based on a modern linux kernel which allows for greater flexibility and easier maintenance of firmware especially in terms of IT security.

Prepared for M2M and IoT applications

The M2M (machine to machine) core of the FW-5-GATE-4G is a modern 4G chipset with high recipient technology through MIMO technology with two antennas. Download rates up to 150 MBit/s are attainable; upload to the station of up to 50 MBit/s is possible. The ability to fall back to 3G (UMTS/HSPA) or 2G (GPRS/EDGE) allows the FW-5-GATE-4G to operate even in areas with poor reception/reduced mobile phone coverage.

The modem has approval for Europe and covers the typical frequency bands there. Support for DUAL SIMs for an online provider change is in preparation.

More is possible!
The intelligent protocol converter

Product innovation · Communication

Many IT security concepts require a media disruption from Ethernet network/LAN to serial interfaces in order to prevent potential attacks resulting from a physical decoupling. Other applications need a transformation from IEC 60870-5-101 to a -104-series protocol because the devices to be coupled simply do not provide this.

For such scenarios, a FW-5-GATE offers a tailor-made solution in the “Protocol converter” mode since - unlike a telecontrol station - no process data let alone specific information about the signals being transmitted need to be configured. The converter is happy with the declaration of the connected stations and the addressing of them. It converts the protocols in both directions thereby providing the stringent IT security standard of series 5 technology. In spite of a serial linking on the one hand, for example, an end-to-end VPN tunnel can be set up for one or more control centres via IEC 60870-5-104.

Converting an unprotected IEC 60870-5-104 protocol into an as VPN-protected tunnel is also possible - using setIT in the customarily simple and intuitive way.

Communication can be controlled in so-called white lists in which the common addresses of the authorised stations and their type identifications can be released. Familiar diagnostics functions such as the interface monitor or Wireshark logs remain available as before.

Connection to multiple control centres possible
VPN-encryption for -104 (optional)
The Jozwin (Poland) wind farm comprises eleven 2.85-MW wind turbines which are connected to the 110-kV network using 110/15-kV transformer substations. The brand-new transformer substation connects two 110-kV lines via one linking field and the farm using a 110/15-kV transformer. There are nine 15kV fields on the medium voltage area. Additional wind turbines are being added to the wind farm this year which is why the station will be the recipient of 6 additional MV fields.

To meet the network connection conditions, the station was equipped with telecontrol which is designed to send the online values to the distribution and Transmission System Operator. A system based on the SAW net-line FW-5000 was chosen to do so. Based on the requirements, the FW-5000 offers five RS232 interface cards with DNP3 communication. Three of them exchange the information and commands with the Distribution System Operator (two redundant DNP3 channels to the regional SCADA system, one third to the main control centre). The remaining two DNP3 channels secure a redundant connection with the dispatching centre of the Transmission System Operator. In addition, there are two IEC 60870-5-104 channels to the BTC PRINS® SCADA system of the park operator and a further one for local HMI applications (also based on BTC PRINS®).

The FW-5000 integrates a large number of different components in the field direction. The 13 high-voltage protection devices are connected with the aid of the mcFO-ST star coupler as per optical multimode based on the IEC 60870-5-103 protocol; nine medium-voltage protection devices per RS485 bus (IEC-103 here too). Further auxiliary power supplies, switch automatic devices and additional devices (e.g. pressure sensors) are connected via the standard Modbus-RTU or Modbus-TCP however.

The customer wants to read out some intelligent electricity meters directly. 28 ZMD/ZMQ meters from Landis+Gyr were integrated successfully thanks to the support of IEC 62056-21 protocol based on the RS485 interface of the net-line telecontrol unit. An additional FW-5 collects some general I/O from the

BTC Business Technology Consulting Sp. z o.o. is a wholly-owned subsidiary company of BTC AG Germany. In Poland, BTC offers both SCADA solutions for public utilities and automation systems for Smart Grid and renewable energies. Thanks to the many years’ experience in the IT and energy market, BTC Poland - together with SAE IT-systems - was able to present a convincing case to its customers when it comes to the full monitoring and control of its wind farms. The highly-developed BTC PRINS® SCADA system with fully-redundant backup is now also providing special functions for wind turbines. In the project, SAE IT systems with DNP3-Online came into use.

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controlled station.

Communication with the wind farm control was given particular importance. The telecontrol station uses the modbus TCP interface with an optical Ethernet connection in single mode. This is a very important data source for the overall system. For this reason, the connection and all switches in the path are monitored continuously by the telecontrol system using SNMP diagnosticks. This was made possible by releasing the SNMP service in the FW-5000.

After completing start-up work, the wind farm and all substations enter productive operation. The wind park is controlled by the BTC PRINS® SCADA system of the operator whereby all daily actions such as P/Q/U/output factor presetting remain the responsibility of the Distribution System Operator. For this reason, the substation is provided with all set points and commands for the 110-kV side per DNP3 channel. Thanks to the support of the DNP3 Unsolicited mode in the telecontrol unit, Distribution- and Transmission System Operators are given quick and reliable feedback from the field.

VHPready with SAE

VHPready Version 4.0 was published in September 2015. Now, connecting virtual power stations can be based on a single industrial standard. This promises to generate enormous simplifications when joining generation plants from different manufacturers. Important communication cornerstones of this standard are: the use of a self-contained user group; the OpenVPN encryption method; and the use of the telecontrol protocol IEC 60870-5-104. Its flexible connection capabilities and extensive security features make SAW telecontrol systems perfect for connecting generation plants according to VHPready 4.0.

“The FW-5000 is presented as a powerful, efficient platform for processing various SCADA protocols (DNP3/IEC101/IEC104). It can also be integrated into heterogeneous infrastructures thanks to its high compatibility and communicability.”

Marcin Wycinka, BTC Business Technology Consulting Sp. z o.o.
Over 240 employees provide optimum energy supplies to approximately 91,600 inhabitants in the supply region 88.7 km² in size. Around 1,290 km of modern electrical power lines and its own command centre staffed 24/7 generate energy sales of around 510 million kWh (2015). The energy feed into the electrical distribution networks is based on three substations and three key stations from the 110kV network belonging to the Transmission System Operator, Westnetz GmbH. The public utility converts the electrical energy on the secondary coil of the power transformers. Distribution to a extended 10-kV-medium voltage network is done by means of highly-modern transformers. Distribution to a extended 10-kV-medium voltage network is done by means of highly-modern transformers. Distribution to a extended 10-kV-medium voltage network is done by means of highly-modern transformers.

All data points must be connected via terminals in the substations. In the largest substation - UA Ratingen - three net-line FW-50 are installed in the BGT-L, with a total of 370 digital inputs, 56 measured value inputs and 64 command outputs with corresponding return information, inclusive of 1/n monitoring and measuring circuit tests. In the smallest key station, a large rack (also net-line FW-50-14) was adequate for a total of 48 digital inputs, 16 measured value inputs and 16 command outputs with their corresponding return information; also with 1/n monitoring and measuring circuit tests here too. With the energetic support of the Stadtwerke Ratingen GmbH project leader, Mr Jan Maurmann, commissioning and all of the work associated with it could be implemented briskly and to the fullest satisfaction of Stadtwerke Ratingen GmbH.

Based on the system relevance for telecontrol, to ensure a secure telecontrol system regeneration of relevant operating equipment it was important for us to hire an established market player", according to Dipl.-Ing. Rainer Schermuly, Head of power supply at the Ratingen public utility. "This meant choosing the potential firms was not an easy undertaking for us". The basic requirement was that a single provider would be able to take care of all service aspects such as drawing up concepts, building, configuration, commissioning up to complete documentation of the installed system parts.

We also considered the customer focus of the partner company very relevant. What matters is that once the risk transfer had taken place, competent contact persons were available to use in the event of a fault or if we had some specialised questions."

In November 2015, Stadtwerke Ratingen GmbH awarded the contract to SAE IT-systems GmbH & Co. KG to alter the telecontrol system in three substations and three key stations after comparing several offers. The order comprised:

- Disposing of old switchgear cabinets and cables
- Producing new switchgear cabinets
- Configuration of the stations
- Support for commissioning
- On-site assembly, including cabling
- Documentation of the "process point–terminal" assignment directly in setIT

Stadtwerke Ratingen is a multi-utility company that offers electricity, natural gas, heat and drinking water in one go. The public utility is also responsible for running public street lighting and public baths. The KomMITT Ratingen GmbH subsidiary is also focusing through the expansion of fibre-glass communication networks and professional measuring services.

The preparations for extending an information security management system based on DIN ISO/IEC 27001:2015-03 have been addressed with appropriate certificates. Due to the size of the company, Stadtwerke Ratingen GmbH is not required to obtain certification before the 2018 financial year, but despite that it has already begun preparations for reaching its information security targets in order to extend appropriate security organisation and develop the necessary processes. An IT security officer has been appointed which will from now on be involved in all projects with a relevance to IT security as a means of taking into account safety-relevant aspects in the planning phase.

In the context of the pending certification, all security-relevant IT components are subject to a stringent selection process. This includes, in particular, telecontrol system components. Stadtwerke Ratingen GmbH are on the safe side with SAE products as the company has already integrated an extensive range of security technology into its telecontrol systems and has taken on far-reaching optimisations to its own infrastructures and processes. SAE is also aiming for certification based on DIN ISO/IEC 27001 and has begun a project to this end.
In 2008 the Marburg public utility launched the SAE net-line FW-5 telecontrol system for the first time, which was used to monitor a rain spillway basin (RSB). Continuous monitoring at weekends was to be ensured. The GPRS network was chosen as the communication network in order to transmit data securely and encrypted to the BTC control system via a VPN router. The IEC 60870-5-104 protocol was used throughout. In the meantime, almost 40 FW-5 telecontrol stations have been built over the entire urban area. GPRS and VFT systems are preferred for the data communication.

The waste water/water areas are currently equipped with ten stations which are predominately used for monitoring RSBs and pump stations. Another 30 stations have stood the test in the monitoring of 20-kV local network stations; 15 of them are joined with LINK dries via the Modbus-RTU, thus enabling remote switching of the installations.

Complete fuel package
Stadtwerke Marburg has a compact, powerful telecontrol system in the form of the FW-5, which meets all of the requirements on monitoring, control, logging and transmission. Complex tasks such as command termination with measuring circuit testing or modbus couplings are done securely and reliably by the FW-5. If the application changes, the system can be equipped with up to twelve expansion modules. To enable the user to respond quickly and flexibly to current developments and to implement the requirements in a cost-effective manner.

Easy configuration
The configuration tool setIT is a winner versus the products of other manufacturers due to the quick and easy configuration which leads to considerably shorter implementation times. The personnel at Stadtwerke Marburg were quick to realise the importance of quick project implementation. In 2009, it sent two employees to a training seminar in Cologne.

Migration step-by-step
In 2015, Stadtwerke Marburg paved the way for the future investing in a new ring concept based on a network with SHDSL modems and six new net-line FW-5000 gateways. The prerequisite was a step-by-step migration while the old systems continued to run in parallel.

The advantage of this gateway ring architecture was the noticeably quicker data communication to the higher-level BTC control system. The underlying integration of additional BTC work stations via LAN gave staff at the public utility quick access to existing remote terminal units. Thanks to net-line FW-5000 gateways, modular master stations with TCP/IP networks and individually-equipped interfaces were used, allowing gradual conversion of systems without fuss. In addition, existing copper lines were used to join the master stations in a network which lead to massive cost savings. Using the MiniFlex SHDSL modem, an Ethernet network was built as a ring. Depending on the characteristic curve, it was possible to bypass distances of up to 15 km and attain a throughput of up to 15 Mbit/s. The protocols IEC 60870-5-101/IEC 60870-5-104 were used here by default.

Stadtwerke Marburg GmbH is a 100 % municipal, customer-focussed service provider active in the electricity, gas, heat, water, waste water local transportation and communication services sector in county of Marburg.
ZVO Energie GmbH operates 20 master stations and 121 telecontrol substations, including six waterworks, six storage tanks, one gas transfer station and a wide range of measuring and control stations. For ZVO drainage, ZVO Energie GmbH operates 188 remote terminal units in their sewage treatment and pumping stations in the service relationship. SAE telecontrol systems are responsible for monitoring- and remote control tasks in a total of 309 stations.

The vast majority of them are wired. ZVO Energie GmbH operates its own cable network with a length of approx. 900 km and 740 terminal boards. Communication is done via VFT channels. SHDSL routes are also being planned or in the testing phase. All other communication paths are switched telephone lines, directional radio communication and GRPS solutions. In larger works with PLCs, these are coupled with the substation via IEC 60870-5-104 or Profinbus-DP. All process data from the remote substations are sent to the central command centre at Neustadt i. Holstein. A total of around 20,000 process data items are sent and processed by the control system.

ZVO Energie uses Siemens S7-300 and its successor the S7-1500 as the PLC. SAW telecontrol substations have been in use at ZVO Energie since 2011. Every year, old telecontrol stations are being replaced with the new net-line FW-5 and FW-50s. Currently, SAIA Burgess PCD 4 are being used as master stations. These are equipped by Proton as a master station and have their WT-and RS232-COMIOs developed in-house. SAE master stations are also used; e.g. in the last project which was implemented in 2015 with the aid of SAE.

To replace an old GSM master station, an FW-50 was coupled to the control system via GRPS with the IEC 60870-5-104 protocol, taking into account all the necessary security aspects of course, e.g.:

• User administration
• secure protocols HTTPS, FTPS
• IPsec-secured connection between substation and master

“...”

Oliver Kirpal, ZVO Energie GmbH

In SAE IT-systems, we have managed to find a competent and reliable partner with whom we can also address new projects in the future.”

ZVO Energie GmbH
Gas and water supply with SAE Technik

ZVO Energie GmbH is a subsidiary of the Ostholstein municipal union and a part of the ZVO Group. The primary areas of business of ZVO Energie GmbH are gas and water supply to the County of Ostholstein. The ZVO Group is headquartered in Neustadt in Holstein. The surface area of the supply area is 1,392.65 km². In the supply area there are 29,763 domestic water and 24,038 domestic gas connections. As well as supplying the inhabitants of Ostholstein, ZVO Energie GmbH also supplies a large number of tourists who come to Ostholstein and especially the Baltic Sea on holiday each year.