

IEC 61850: Thematic Introduction and Testing Solutions



Introduction to IEC 61850

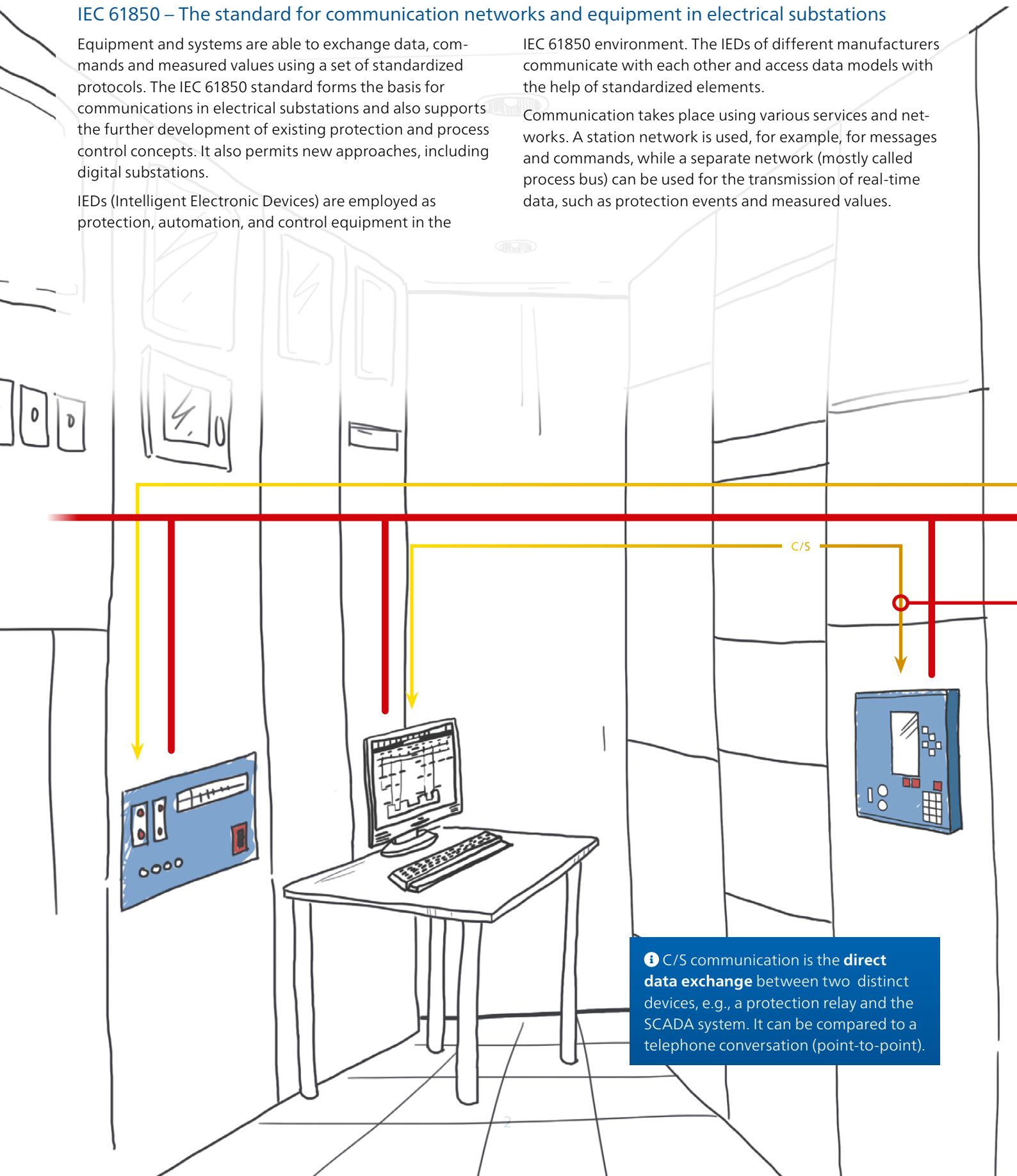
IEC 61850 – The standard for communication networks and equipment in electrical substations

Equipment and systems are able to exchange data, commands and measured values using a set of standardized protocols. The IEC 61850 standard forms the basis for communications in electrical substations and also supports the further development of existing protection and process control concepts. It also permits new approaches, including digital substations.

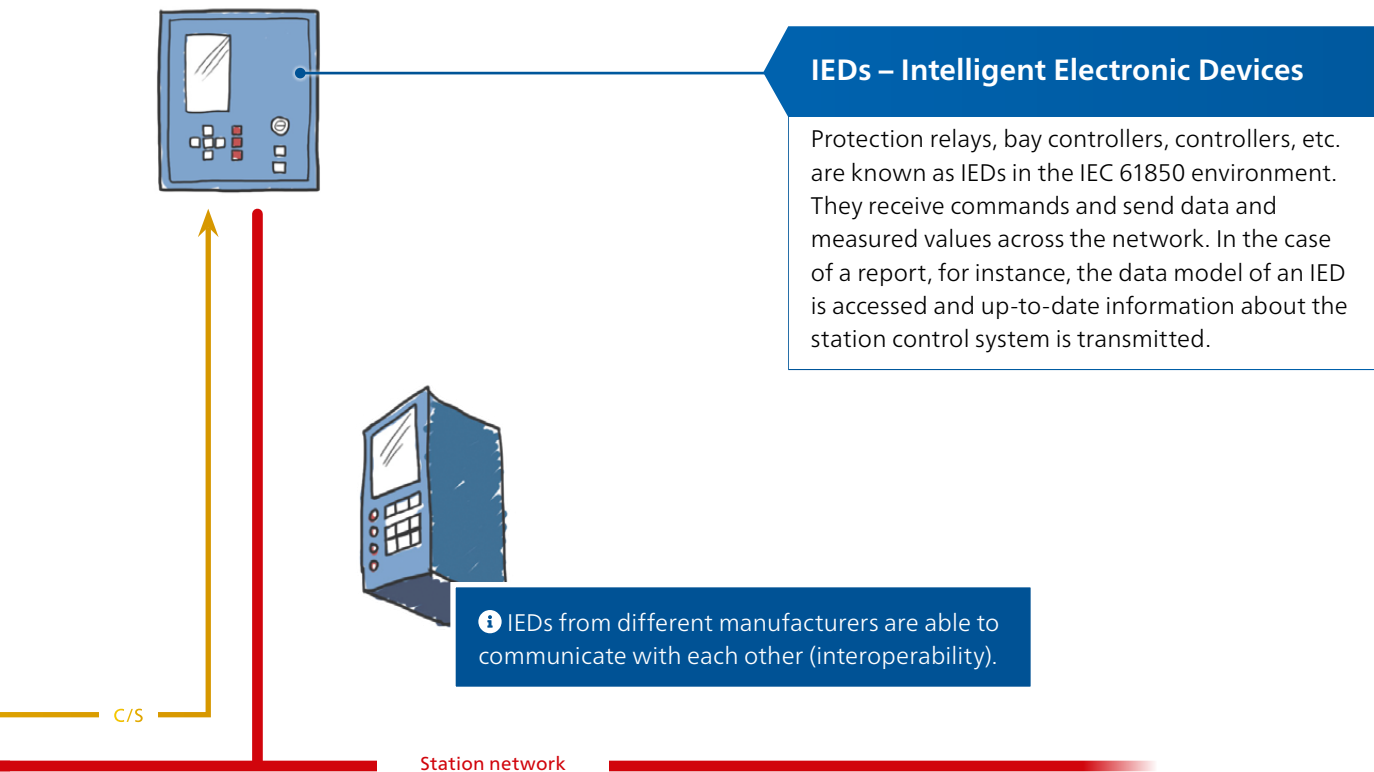
IEDs (Intelligent Electronic Devices) are employed as protection, automation, and control equipment in the

IEC 61850 environment. The IEDs of different manufacturers communicate with each other and access data models with the help of standardized elements.

Communication takes place using various services and networks. A station network is used, for example, for messages and commands, while a separate network (mostly called process bus) can be used for the transmission of real-time data, such as protection events and measured values.



i C/S communication is the **direct data exchange** between two distinct devices, e.g., a protection relay and the SCADA system. It can be compared to a telephone conversation (point-to-point).



C/S – Client/Server

Process control communication

Communication between a client and a server takes place over a unicast connection that supports the *acknowledged* exchange of commands and messages.

Example: An IED transmits data and in this sense acts as a server – the local station control system is then the connected client. The information contained in the dataset of the IED (e.g., values for excitations, triggers and position feedbacks)

is transferred in a report to the SCADA system whenever a trigger condition (e.g., change in data) is met.

Communication with the SCADA system is based on TCP/IP. The services are mapped to the manufacturing messaging specification (MMS) protocol. This mapping is defined in IEC 61850-8-1. Mappings to other transport protocols, such as XMPP, are foreseen as defined in IEC 61850-8-2.

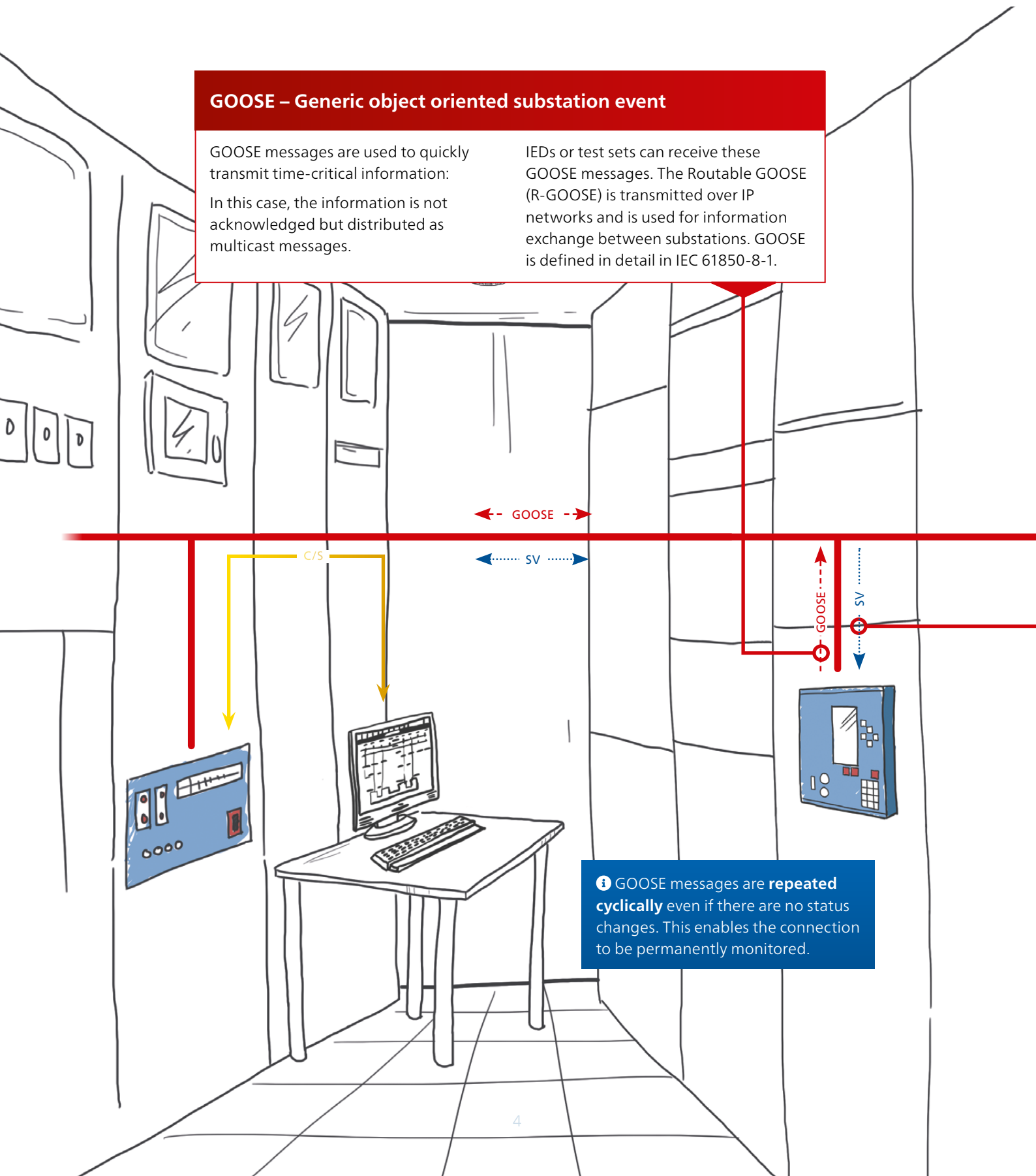
Real-time communication with GOOSE and Sampled Values

GOOSE – Generic object oriented substation event

GOOSE messages are used to quickly transmit time-critical information:

In this case, the information is not acknowledged but distributed as multicast messages.

IEDs or test sets can receive these GOOSE messages. The Routable GOOSE (R-GOOSE) is transmitted over IP networks and is used for information exchange between substations. GOOSE is defined in detail in IEC 61850-8-1.



i GOOSE messages are **repeated cyclically** even if there are no status changes. This enables the connection to be permanently monitored.

SV – Sampled Values

Sampled Values are used to transmit measured values from conventional or nonconventional current and voltage transformers. Merging units (MUs) publish the Sampled Values into the communication network. As with GOOSE messages, multicasting is again used here (defined in IEC 61850-9-2).

IEC 61869-9 adds additional definitions on top of IEC 61850 such as new preferred variants. It also proposes using configurable data sets already implemented in recent products supporting Sampled Values.

←-- GOOSE -->

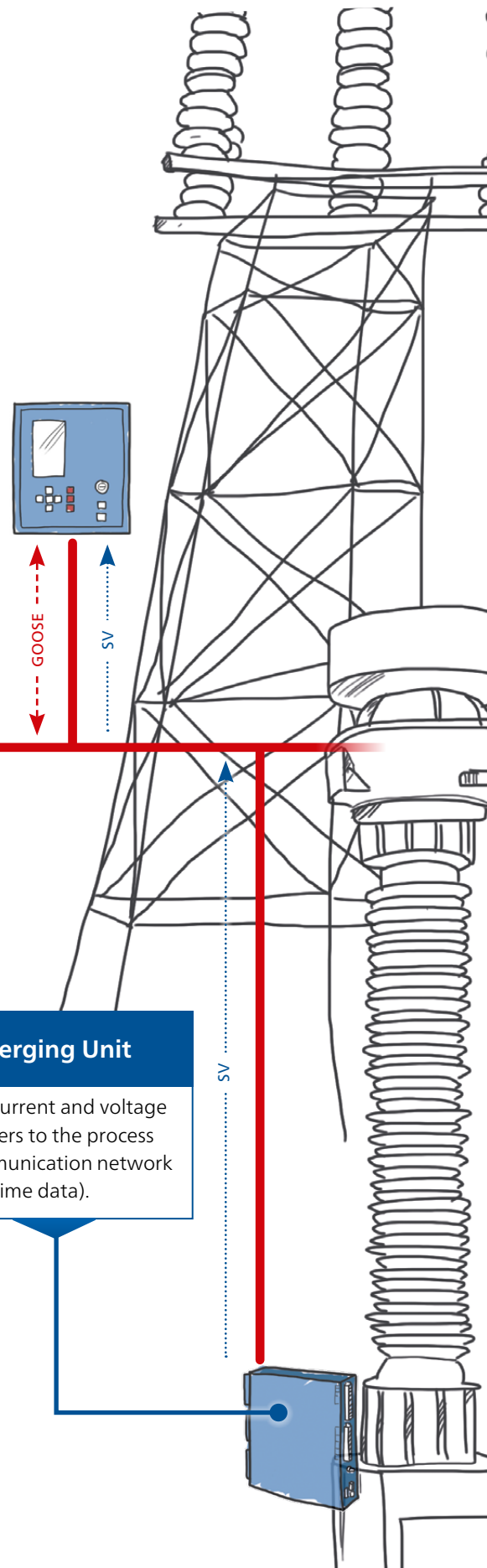
←..... SV

Station network or process bus

i SV and GOOSE messages are sent as **multicast messages** (one-to-many). In other words, the signals, measured values, etc. are distributed across the network. No addressees are specified and no acknowledgments are expected. In much the same way as with radio broadcasting, any device that is "ready-to-receive" may obtain them - this is referred to as subscribing.

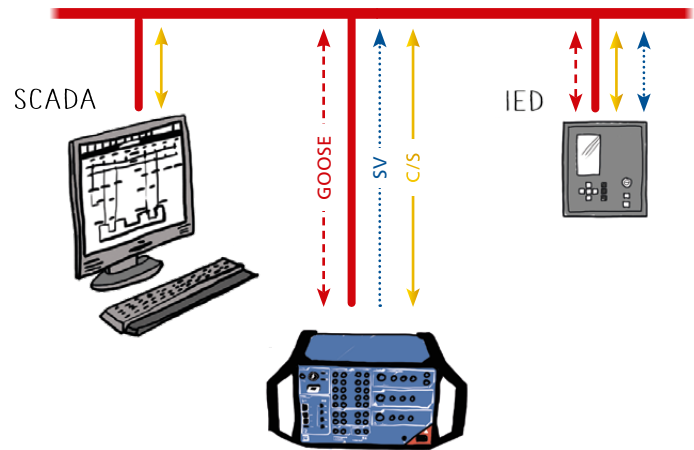
MU – Merging Unit

MUs link current and voltage transformers to the process bus (communication network with real time data).



Test sets

The network technology employed opens up new opportunities, although it does demand innovative testing technology. Ever since the publication of IEC 61850, OMICRON has kept in step with the standard by constantly upgrading its testing solutions.



CMC family

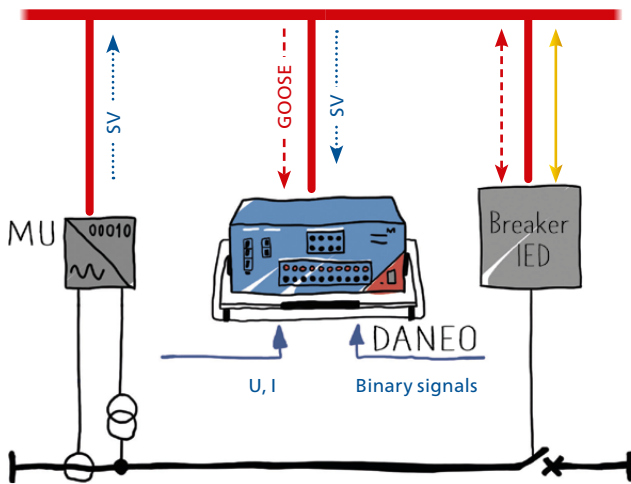
Versatile protection testing devices with powerful software

The CMC family meets the professional needs of test engineers in the field of protection technology. A range of reliable and flexible solutions are available – from compact protection test sets for simple applications, through ultra-precise calibration tools, to versatile commissioning tools. In addition to digital signals, the CMC 500, CMC 430, and CMC 353 protection test sets can also output high-power analog signals.

The easy to use **configuration modules** of the Test Universe testing software permit CMC test sets to be controlled and facilitate testing with **GOOSE** and **Sampled Values**. The CMC sends and receives GOOSE messages and enables protection testing to be carried out in the same way as with binary signals. Sampled Values, which the CMC 500 and CMC 430 are able to measure, can also be output. With the Test Universe Module **IEC 61850 Client/Server**, values from the data model can be read and SCADA reports can also be tested. Switching to test mode is possible.

RelaySimTest comprehensively supports the use of Sampled Values, GOOSE and R-GOOSE.



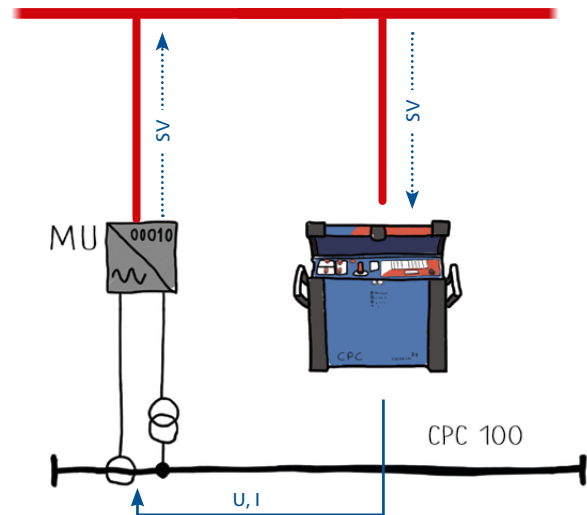


DANE0 400

Hybrid signal analyzer

The hybrid measuring system simultaneously analyses analog signals and messages across the communication network. This combination enables in-depth and flexible tests to be carried out.

Distributed measurements using several devices are precisely synchronized, allowing signal propagation delays to be measured very accurately. The analysis software carries out comprehensive evaluations of processes in the installation; the analyzer also features monitoring and observation functions.



CMC 850

Specifically for IEC 61850 tests

The CMC 850 was developed specifically for carrying out testing in digital transformer stations. No analog amplifiers are required, which means the test set is small and light. All values and data are transferred via GOOSE messages and Sampled Values.



CPC 100

Primary test set

Our universal test set for primary equipment also evaluates IEC 61850 Sampled Values ("9-2LE"). This tests the entire signal chain from the sensor to the IED.



Test software & accessories

StationScout

Testing IEC 61850 Substation Automation Systems (SAS)

StationScout simplifies the process of testing the automation, control, and SCADA communication in SAS utilizing IEC 61850.

StationScout visualizes and analyzes the communication relationships and depicts the system topology in an intuitive manner. The powerful MBX2 test set ensures a cybersecure separation of the test system from the SAS.

The extensive simulation and test functions support designers and testing engineers during the entire lifecycle of an IEC 61850 SAS.



IEDScout

Versatile tool when using IEDs

IEDScout provides a detailed inside view of IEC 61850 IEDs of all manufacturers for in-depth analysis. GOOSE and C/S traffic is presented in a clear manner.

The software is particularly suitable for testing, troubleshooting and commissioning. IEDScout also simulates IEDs.



EMCON 200

PTP Ethernet media converter

EMCON 200 connects fiber glass- and copper-based networks (100 MBit/s and 1 GBit/s). SFP modules make the configuration as flexible as possible.

Time synchronization in networks with Precision Time Protocol (PTP) is maintained. The network cable supplies the power using Power over Ethernet (PoE).

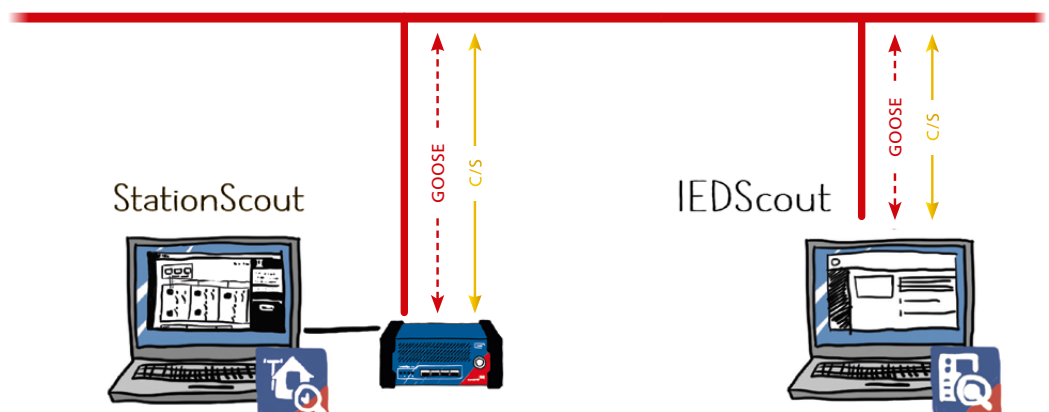


Time synchronization

Precision Time Protocol (PTP) equipment

Precise synchronization is essential for modern station automation systems.

The OTMC 100p and the CMGPS 588 Grandmaster Clocks deliver the IEEE 1588 PTP to the network (IEEE C37.238-2017 Power Profile v2, IEC 61850-9-3 Power Utility Profile).



Cybersecurity Solutions

StationGuard

Cybersecurity and Functional Monitoring for the Power Grid

The Intrusion Detection System (IDS) StationGuard monitors Ethernet networks in the power grid and identifies cyber threats, prohibited activity, and malfunctions.

Discover our innovative allow list (whitelist) approach for maximum security and convenience for IT security officers and SCADA & protection engineers alike. Cyber threats and communication problems are detected and can be analyzed, guaranteeing security to the most minute detail.

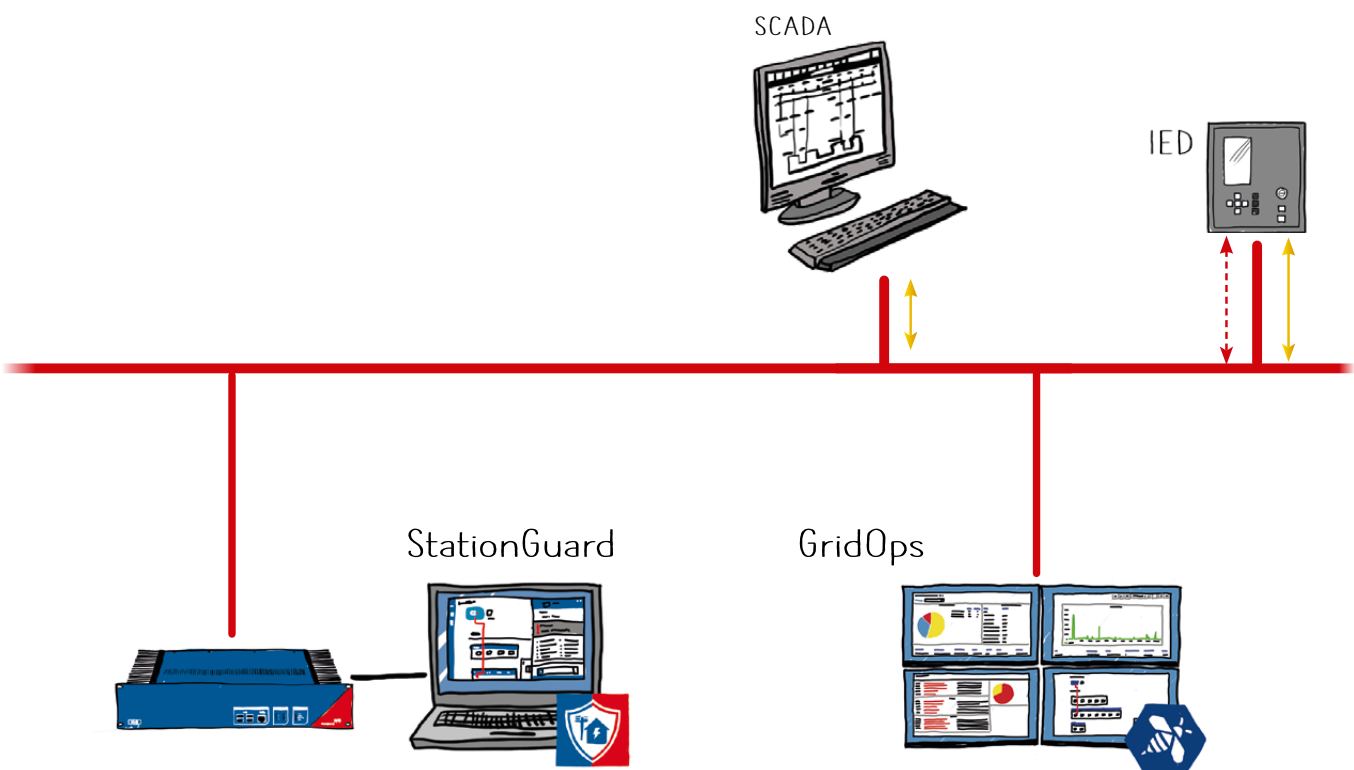
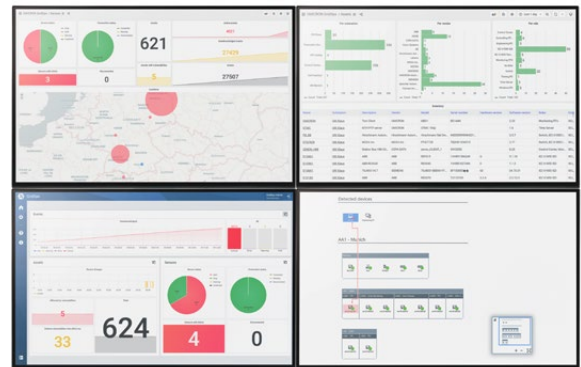


GridOps

Central Management System for StationGuard

GridOps – as part of our StationGuard solution – helps you bridge the IT and OT team gap.

The powerful central management system delivers a comprehensive alert analysis and threat investigation. Combined with its detailed asset inventory you can improve your vulnerability management and achieve full network visibility to keep yourself firmly in control.



Support in the IEC 61850 World

Training courses and seminars

The OMICRON Academy offers a range of IEC 61850 training courses. The courses are built around real testing situations, and are ideal for technical staff from electrical utilities, industrial plants, equipment manufacturers and service companies.

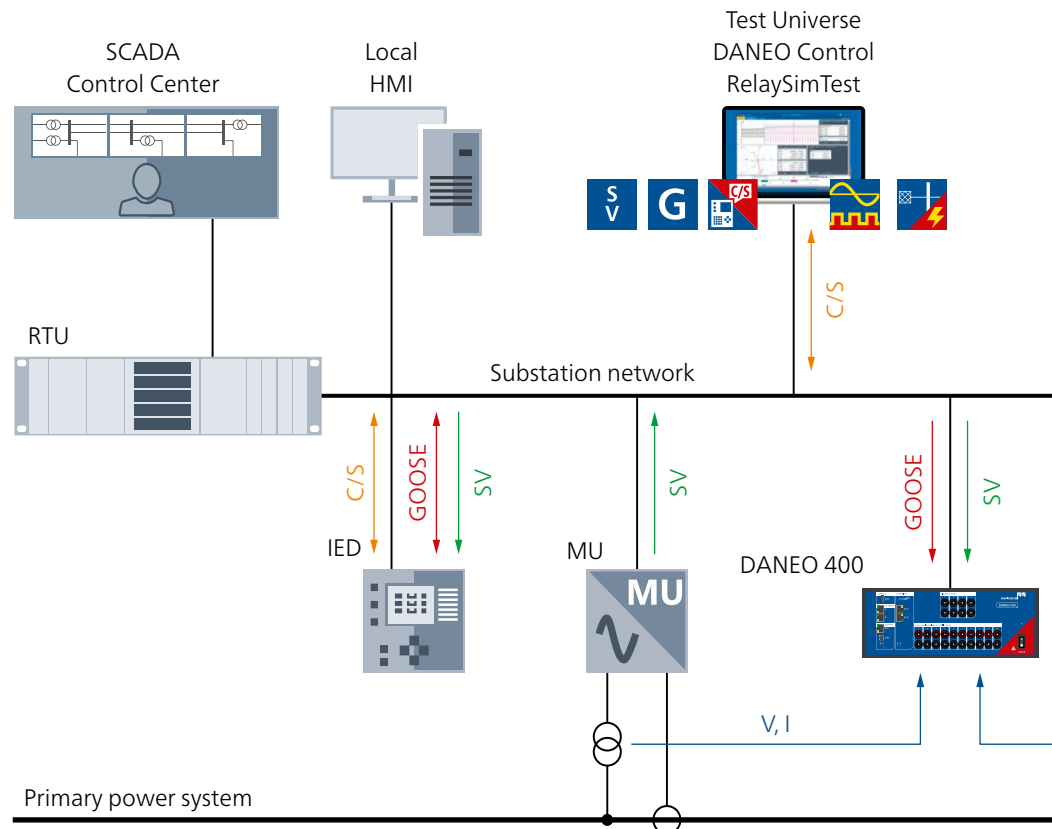
Contents range from basic knowledge of IEC 61850 concepts and protocols to commissioning and trouble-shooting of Digital Substations. The trainees learn to fully utilize the test equipment, perform efficient tests and how to interpret the test and measurement results.

For additional information, visit:
omicronenergy.com/academy

Webinars

Complementing the real-life events and Academy trainings, OMICRON offers online seminars.

These webinars are free of charge and, moreover, they are recorded. They are available on our website 24/7 and can be watched at any point in time, wherever and whenever it is preferred.



Engineering services and consulting

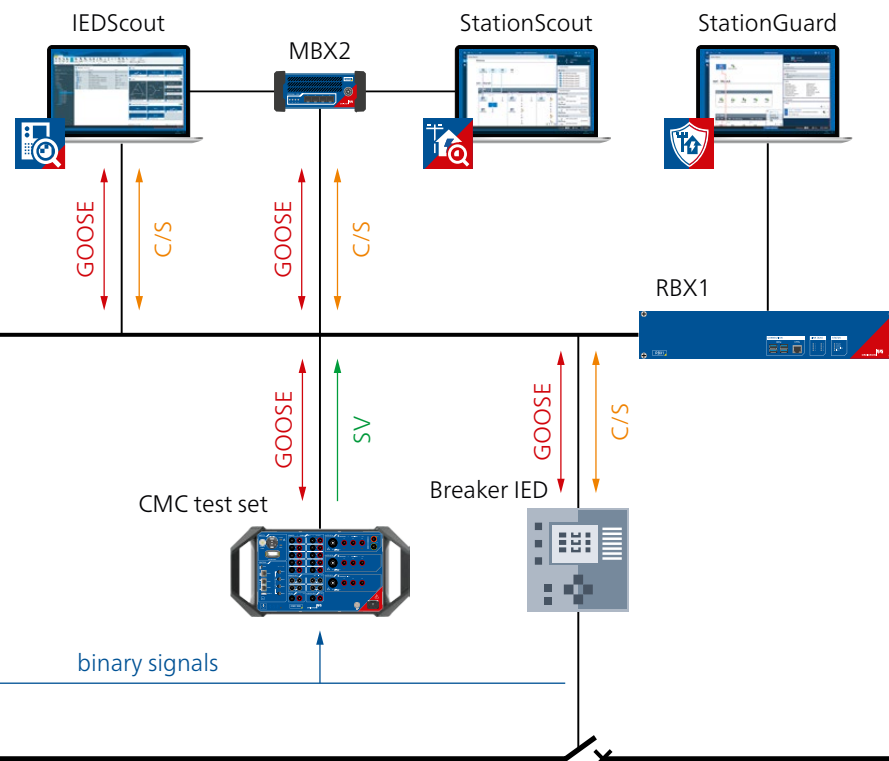
In our effort to support the transition to Digital Substations, we want to support utilities and service provider throughout the entire lifecycle of their projects.

We are continuously developing innovative solutions and built up vast global expertise to help you ...

- ... design your system to meet your requirements.
- ... create customized procedures for testing, commissioning, and maintenance.
- ... define monitoring and cybersecurity strategies for operational phase.
- ... share knowledge and best practices from the industry.
- ... provide tailor-made training courses for your staff.

24/7 technical support

Should you require rapid assistance, you will receive excellent support from our highly trained and dedicated technicians, 24 hours a day, seven days a week. We pride ourselves on exceptional customer service and premium quality.



We create customer value through ...

Quality

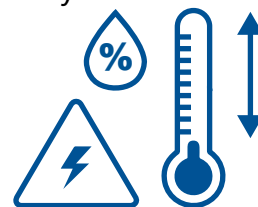
We always want you to be able to rely on our testing solutions. This is why our products have been developed with experience, passion, and care, and are continually setting groundbreaking standards in our industry sector.



Highest safety and security standards

Superior reliability with up to

72



hours burn-in tests before delivery

100%

routine testing for all test set components



ISO 9001
ISO 27001
TÜV & EMAS
ISO 14001
OHSAS 18001



Compliance with international standards

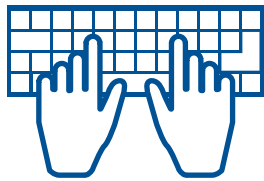
Innovation

Thinking and acting innovatively is something that's deeply rooted in our genes. Our comprehensive product care concept also guarantees that your investment will pay off in the long run – for example, through regular software updates.

More than

200

developers keep
our solutions up-to-date



I need...

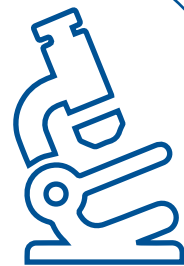


... a product portfolio
tailored to my needs

More than

15%

of our annual sales is
reinvested in research and
development



Save up to

80%

testing time through
templates and automation



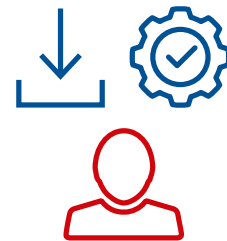
We create customer value through ...

Support

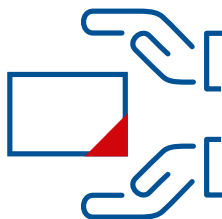
When urgent assistance is required, our highly qualified technicians are always available to provide a rapid response. In addition, our calibration and repair services are designed to extend the life of your devices and ensure uninterrupted operation.



Professional technical support
at any time



Easy access to software downloads,
services, and certificates via the
Customer Portal



Comprehensive repair and
calibration services for reliable
measurements



offices worldwide for local
contact and support

Knowledge

We maintain an ongoing dialogue with users and experts. Customers benefit from our expertise through free access to application notes and professional articles. Additionally, the OMICRON Academy offers a wide range of training courses and webinars.



Frequent OMICRON-hosted user meetings, seminars, and conferences

More than

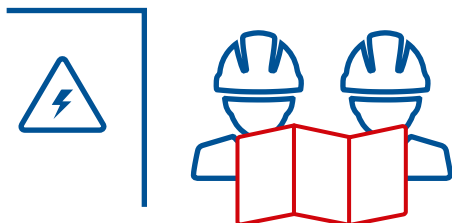
300



Academy courses and hands-on trainings per year



to thousands of technical papers and application notes



Extensive expertise in consulting, testing and diagnostics

OMICRON is an international company that works passionately on ideas for making electric power systems safe, secure, and reliable. Our pioneering solutions are designed to meet our industry's current and future challenges. We always go the extra mile to empower our customers: we react to their needs, provide extraordinary local support, and share our expertise.

Within the OMICRON group, we research and develop innovative technologies for all fields in electric power systems. Customers worldwide rely on the accuracy, speed, and quality of our reliable, user-friendly solutions for electrical testing of medium- and high-voltage equipment, protection systems, digital substations, and cybersecurity.

Founded in 1984, OMICRON draws on their decades of profound expertise in the field of electric power engineering. A dedicated team of more than 1,300 employees provides solutions with 24/7 support at 23 locations worldwide and serves customers in more than 170 countries.



Emotions are energy. Our energy moves.

Move with us! Scan the QR code to explore our events, training courses, and products. Stay connected by following us on social media.