# Clearing the way for green energy

## State-of-the-art

**software architecture developed with Azure IoT and Azure Kubernetes for cable monitoring system HiMON®.**

## 100 TB of data

**collected per month by up to 2,000 sensors and analysed in real time. Use of AI planned.**

## High reliability

**for critical infrastructure using Azure Monitoring, Azure Sentiel, Azure Entra ID and other cloud-native services.**

**Client**
**HIGHVOLT Prüftechnik Dresden**

**Industry**
**Manufacturing, Energy**

**Platform**
**Azure Cloud**

**Services**
**Application Services, Data and AI Services**

**Country**
**Germany**

Germany plans to be climate-neutral by 2045. In order to supply southern Germany with green electricity from large wind farms in the north of the country in the future, underground extra-high voltage cables are being laid over hundreds of kilometres across the country.

HIGHVOLT, one of the leading suppliers of measuring, testing and monitoring systems for power grids worldwide, has developed an innovative system to continuously monitor the underground power transmission. It uses Azure cloud services to process large amounts of data in real time, enabling faster and more accurate localisation of cable faults. In collaboration with SoftwareOne, a solution architecture has been designed that also allows for the future integration of AI algorithms for predictive maintenance. The monitoring system will bring significant benefits to transmission system operators. By minimising faults and maintenance work, it will increase the availability of power lines and drastically reduce downtime costs.

software one

HIGH VOLT

## The challenge

> We chose SoftwareOne after intensive research and comparing three different providers. Why? Because we were very impressed by the professional approach, the willingness to cooperate with other service providers and the great commitment of the employees.

Thomas Steiner,
Executive Director
Technology, HIGHVOLT
Prüftechnik Dresden

# Advancing solutions in the energy sector

In Germany, environmentally friendly electricity is mainly produced by large wind turbines on land and at sea in the north of the country. However, conurbations, especially in the south, have a high demand for energy, even as large conventional power plants are gradually being phased out. To ensure a sustainable and secure energy supply in all regions for the long term, the successful remote transmission of renewable energies is essential for the success of the energy transition in Germany and worldwide.

HIGHVOLT is a partner of many transmission system operators in Germany and abroad. It supports the expansion of the high-performance extra-high voltage lines “SüdLink” and “SüdOstLink” in Germany, which will be completely underground and up to 700 kilometres long.

HIGHVOLT recognised early on that the maintenance of underground cables over such a length is a challenge because it is difficult to locate faults with any precision. With a capacity of 2 gigawatts per cable, faults and long maintenance work generate enormous losses in power transmission. HIGHVOLT’s HiMON® cable monitoring system, developed and patented in cooperation with the Technical University of Dresden, is the first modular measurement and condition assessment system for the rapid localisation of cable faults. It is also used to assess partial discharges and to provide trend analysis of cable ageing in order to analyse cable failures. The future use of predictive maintenance will mitigate the risk of future cable failures.

The monitoring system is based on up to 2,000 sensors, which are installed within the underground cable that permanently measure and calculate the transmission quality of the cable. HIGHVOLT has developed mathematical models and the necessary physical devices for this purpose.

However, for the digitisation, storage, and processing of data in the range of up to 100 terabytes per month, HiMON® needed a solid software architecture that also considered the high requirements and regulations for critical infrastructure with regard to security and availability. For cost reasons alone, an on-premises solution was out of the question. For its expertise in cloud technologies, especially Microsoft Azure cloud services, HIGHVOLT brought SoftwareOne on board as a partner.

## The solution

# Innovation meets cloud technology

In collaboration with HIGHVOLT engineers and developers, SoftwareOne analysed the exact circumstances and requirements for the solution in several workshops. Using Azure cloud services, SoftwareOne then developed a software architecture for the HiMON® monitoring system. The architecture meets the high requirements for fail-safety and safeguarding, as well as the need to reliably store and process large amounts of data in real time. This allows transmission system operators to receive timely evaluations of the data for possible cable faults. For reasons of cost-effectiveness and to be able to scale up to 2,000 sensors according to requirements, HIGHVOLT decided to use Microsoft cloud technology.

The following Azure services are used in the software architecture:

- Azure IoT: Via the Azure IoT Hub, the measured data from the sensors is received and stored by so-called data collectors. Azure IoT Edge enables the containerisation of own applications such as data reception. The service also covers IoT management for software provisioning and device configuration.
- Azure Kubernetes Service enables the processing and preparation of data on a container basis. Various processes are automated. They enable more flexibility and scalability in case of changes in the architecture and minimise own operating expenses.
- Azure Blob Storage is used to store large amounts of unstructured data. The data lake serves as a source for various evaluation scenarios that HIGHVOLT can develop according to the future needs of transmission system operators or other clients. The data will also be used for future AI trainings.
- Azure SQL Database is used to store processed data that is eventually connected to a portal for HIGHVOLT, and a client portal hosted in Azure Static Web App.
- Data evaluation for the rapid localisation of cable faults, evaluation of partial discharges and signs of ageing in the cable is carried out using machine learning (ML) and is to be controlled by AI in the future.
- Azure Key Vault enables the storage of sensitive data such as API keys, connection strings, passwords and the establishment of a corresponding rights management.
- Application Gateway with WAF provides protection against cyber-attacks and bots. DDoS Protection protects against overload attacks on the cloud solution. Azure Monitoring ensures ongoing operation.
- Azure Entra ID covers identity management.
- Security-relevant data of all architecture components are additionally analysed by Azure Sentinel, allowing security incidents to be registered and responded to more quickly.

> Together with SoftwareOne, we built HiMON® on cloud technology to get a highly scalable and flexible, but also secure solution. With Azure services such as Azure IoT, we have much more scope to test new ideas and respond to our clients' needs and requirements. In addition, services like Azure Kubernetes enable a high level of automation, so our teams benefit from less administration.

Thomas Steiner,
Executive Director
Technology, HIGHVOLT
Prüftechnik Dresden

## The solution

# Proof of Concepts, MVP and GA Releases

In order to be able to check subsystems of the software architecture, SoftwareOne carried out two proofs of concepts and considered:

- Sensor data acquisition and processing via data collectors and transfer to the IoT Hub.
- Device and sensor management (data configuration, on-remote control, and administration).

SoftwareOne developed an initial Minimum Viable Product (MVP) of the HiMON® monitoring system, covering the entire process from data transmission to output of the evaluated data via the portals. The MVP provided HIGHVOLT with an initial demo version, allowing the company to test the system with early adopters and gain valuable feedback.

In the next project phase, the HIGHVOLT and SoftwareOne development teams completed the first General Availability (GA) release of the system. This release incorporated the experience gained during the MVP phase and included updates, support, and management processes for ongoing operations.

Work is already underway on GA Release 2 to ensure the continued success of the project and the ongoing development of HiMON®. Future releases are planned to include the use of AI to predict cable faults, and the system architecture is already prepared for this.

## The outcome

> We are very pleased with our collaboration with SoftwareOne. We quickly realised that SoftwareOne has outstanding expertise in developing applications based on Azure cloud technology and brings experience from other projects to our partnership. This helped us a lot. I am proud of what we have already achieved and look forward to a further inspiring collaboration with SoftwareOne.

Thomas Steiner,
Executive Director
Technology, HIGHVOLT
Prüftechnik Dresden

## The future is green(er)

Green energy is the future for combating climate change. When the power lines for “SüdLink” and “SüdostLink” finally go into operation in 2028, they will be able to transmit a total of 8 gigawatts of power, supplying around one million households with green energy. The HiMON® monitoring solution, which is based entirely on state-of-the-art Azure technology, is being continuously developed, tested and optimised by HIGHVOLT and SoftwareOne.

The interaction of the various Azure services offers a high degree of scalability, flexibility and security in order to collect large amounts of data and to process and evaluate it in real time, with the result that faults in the cables can not only be localised much faster, but also more precisely.

With the help of AI-supported calculation models, it will also be possible in the future to predict failures and thus detect impending cable damage before it occurs. This could be followed by AI-generated suggestions for predictive maintenance measures. Ultimately, this could make a significant contribution to drastically reducing failure and maintenance costs and increasing the availability of the underground extra-high voltage lines. In this way, the transport of green electricity becomes more reliable and efficient.

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