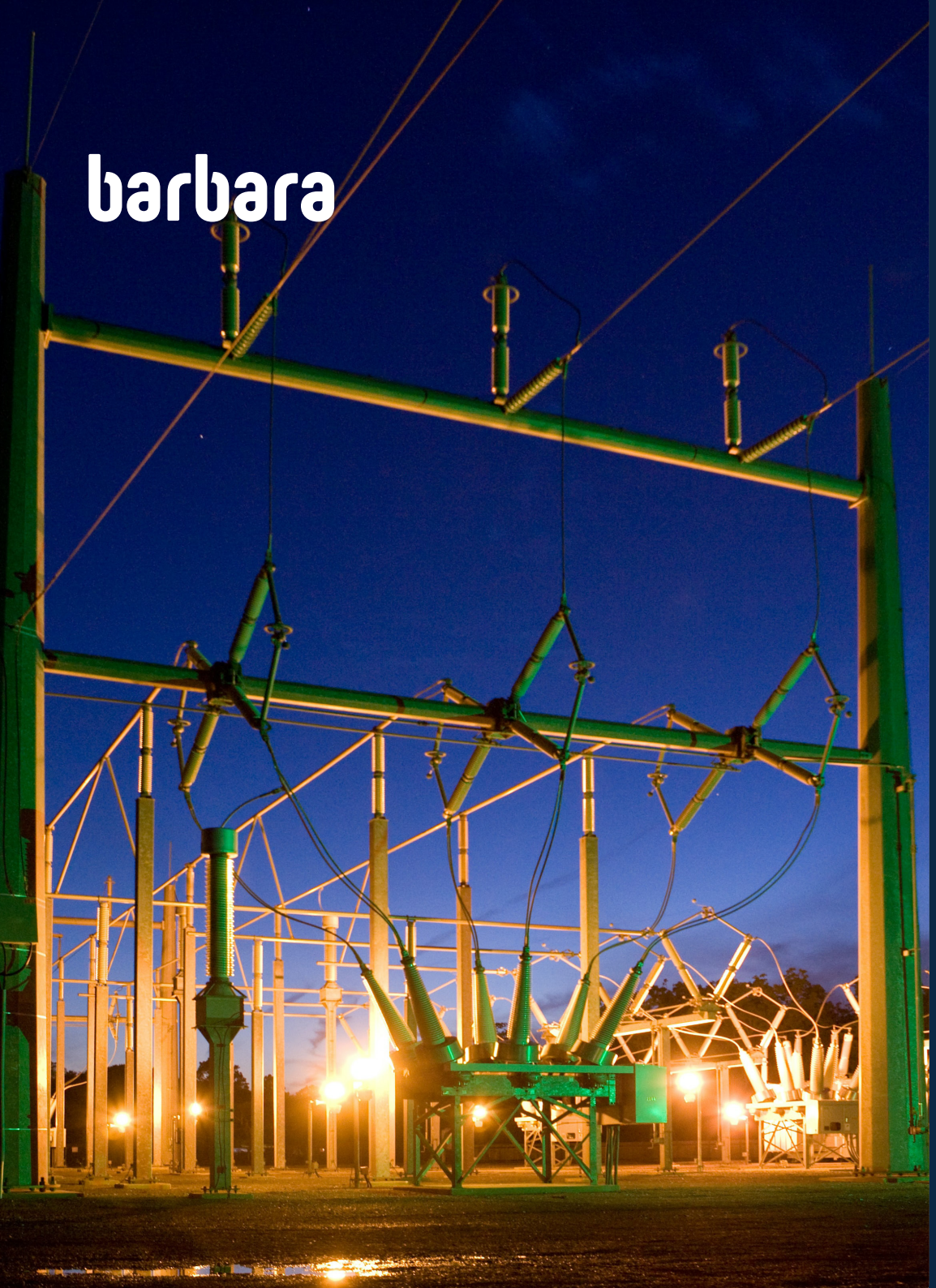


barbara

USE CASE

Transformer Substation Digital Twin

2022, Barbara IoT

www.barbaraiot.com

INTRODUCTION

The hardware and software for the equipment at an electricity substation is traditionally installed in a fully integrated way.

However, as it has been proven in other industries, **the separation of hardware and software can accelerate innovation and equipment update cycles, extending usage to new functionalities or improving the performance of current ones.**

This division of hardware and software is usually known as “virtualisation”. Normally limited in its processes and communications, with virtualisation existing transformation equipment can have more advanced capabilities. The result is what is known as a Digital Twin for the transformer substation - a digital replica of the equipment - which is then used to understand and predict the performance characteristics of its physical equivalent.

Furthermore, **with the integration of the Digital Twin into an Edge Computing structure, it is also possible to take action safely on the physical component, such as dynamic adjustments in real time. In this way substations become the new “Smart Transformers”, capable of maintaining the optimum voltage during periods of large fluctuations in supply and demand.**

SCOPE OF THE PROJECT

The purpose of the project was the **design and development of the Edge Nodes to be fitted in the Transformer Substation, with a view to generating and managing their digital twin.**

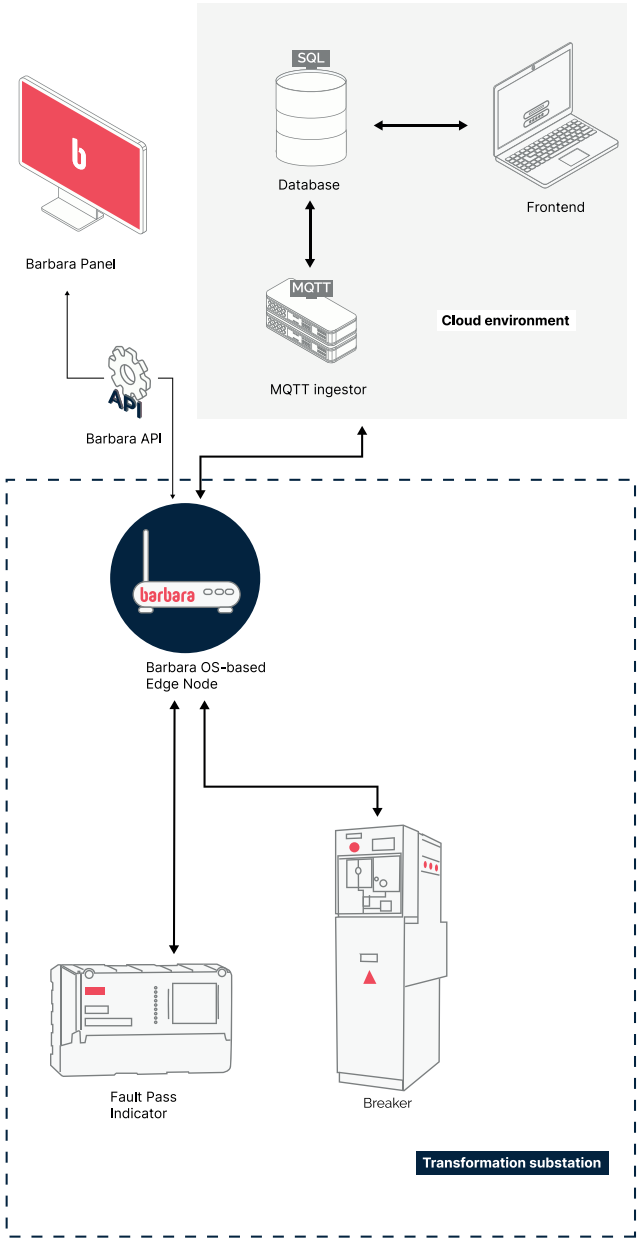
In order to do this, the Nodes have to:

- **Integrate multiple communication protocols** with devices of the Transformation Center, primarily Modbus RTU and IEC- 104, but also IEC-61850 for the future.
- **Allow the running of the necessary software to create the digital twin,** with functionalities to ensure the continuity and integrity of data, among others.
- **Be managed remotely** to minimise the need for on-site staff at these highly geographically dispersed substations.

GENERATION OF A DIGITAL TWIN OF A TRANSFORMER SUBSTATION USING BARBARA´S TECHNOLOGY

The joint installation of Edge Nodes for monitoring and processing data from the substation equipment, and the Barbara Control Room software, which provides the centralised remote management of all the Edge Nodes, allows the full virtualisation of the Transformer Substation and the creation of its digital twin.

In addition, in the future it will facilitate concurrent computing in the Nodes with **advanced IT and OT algorithms and flexibility in the substation, as the Edge Node will have cyber-secure “sandboxes” for storing virtualised applications by different authors.**



SOLUTION ARCHITECTURE

The Digital Twin created consists of actions on 2 different layers:

1. In the Edge (local layer): A communications and functionality Edge Node must be fitted at the Substation to monitor and manage the equipment

2. In the Cloud (remote layer): a tool is needed to monitor and update the Edge Nodes, as well as the data storage and visualisation applications for the digital twin itself.

The Edge

The Edge Node is responsible for virtualising the Transformer Substation and enabling the Digital Twin. It is connected to the different substation equipment and compiles and processes the data locally.
These Nodes are industrial computers running the Barbara software stack and other opensource components to generate the model, including:

- Hardware communications ports
- Data logger (Influx)
- Digital Twin of the Transformer Substation
- Data Search engine (ElasticSearch)
- Time Series Display (Grafana)
- Synoptic Display of Digital Twin

Cloud

Barbara´s technology provides all the capabilities needed to be able to manage both the Edge Nodes installed at each substation and the intelligence (applications) that will be installed at a later stage.

Barbara Control Room cloud tool will manage and modify the firmware and software remotely and securely.

WHAT WE ACHIEVE

Edge Computing provides faster and more efficient processing, improving stability and response times while minimising data traffic.

In the specific case of Medium Voltage to Low Voltage electrical transformer substations, this is essential due to their heterogeneity, geographical distribution and near-real time requirements.

By implementing Edge Computing, the substations can process local data from different sources and make independent decisions quickly, without having to go through centralised systems like SCADA or Cloud, although they are compatible.

This **means a paradigm shift in the architecture of the power grid, which may have an unprecedented impact on improving costs, response times, scalability, reliability and data security.**

WHY BARBARA?

Barbara IoT has developed the Cybersecure-by-design Edge platform to enable and manage distributed intelligence.

It is a technological solution that:

- Is robust and tested in the energy sector
- Allows scalability to hundreds or thousands of installations of facilities
- Has a short time to market period
- Provides cybersecurity by design that meets standard IEC 62443

Barbara is the Cybersecure Industrial Edge Platform designed to implement automated decision-making into critical industrial processes.

Its architecture, distributed over thousands of computation nodes, allows the communication and virtualisation of any smart electricity network element for subsequent use via Artificial Intelligence applications in real time.

Developed with cybersecurity by design and compatible with Edge applications that optimise the generation, transmission, distribution, and consumption of electricity, it is the perfect tool for responding to the major challenges of the energy sector.

If you are interested in finding out about our Thin Edge technology, you can contact us by email, on our website, or via social media.

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