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Summit
Energy Automation

2024

¡Eficiencia energética!

Conocimiento & Conexiones

Anton Krupskii

Vice President Digital Substation at Welotec

a.krupskii@welotec.com

Welotec is a german manufacturing company, founded in 1969, that is focusing on industrial computing hardware.

For over 10 years now Welotec is manufacturing products for the Energy industry, including IEC61850-3 and IEEE1613 complient devices for power substations.

Welotec is a member of CIGRE, IEC, IEEE, vPAC Allianc and LF Energy.

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WELOTEC

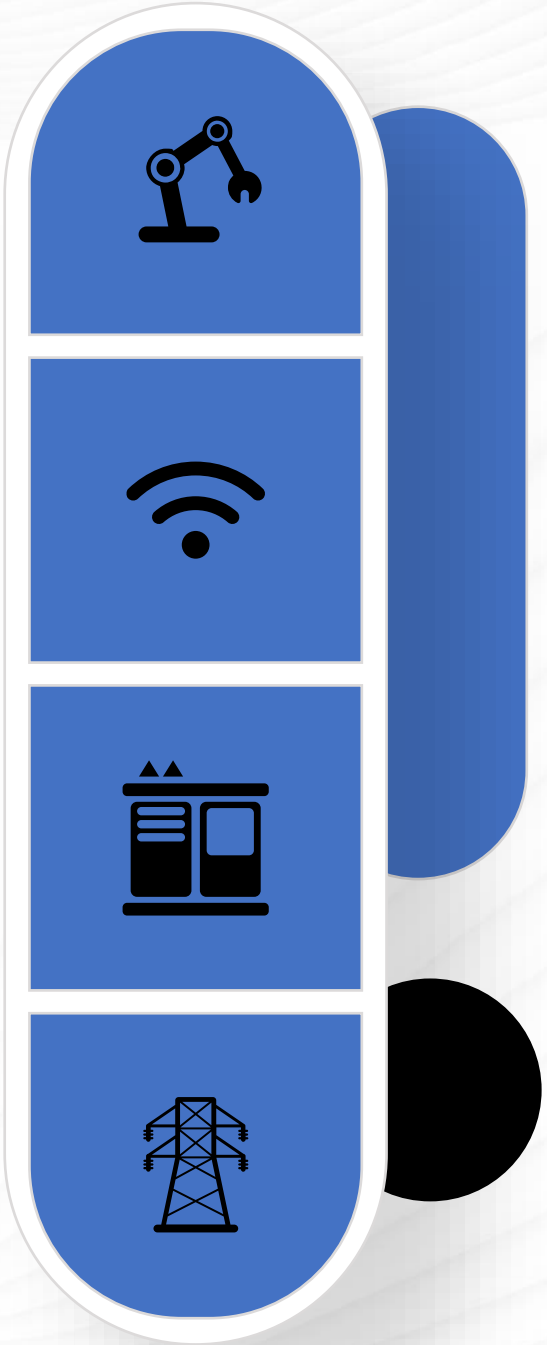
Welotec is a German manufacturer, focused on industrial hardware

50+ Years
Industrial Automation

20+ Years
Wireless Data-Communication

10+ Years
Secondary Substation Automation

5+ Years
Primary Substation Automation



Virtualization in substations for more efficiency of the power grids

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01

Computerization of substations

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Why are Substations beeing digitized

50+ years ago, Conventional Fully HW Systems

Substation automation relied entirely on electromechanical devices and hardwired circuits, with protection and control functions implemented using physical relays and analog instrumentation.

30 years ago, First Microprocessors in SAS

The introduction of microprocessor-based relays enabled digital processing in substations, allowing for more complex protection algorithms and programmable settings.

20 years ago, Introduction of IEC 61850

The adoption of the IEC 61850 standard and Ethernet technology brought standardized communication protocols and faster data exchange to substations, enhancing interoperability and integrated control.

Now, x86 CPU Computers, Software, and Virtualization

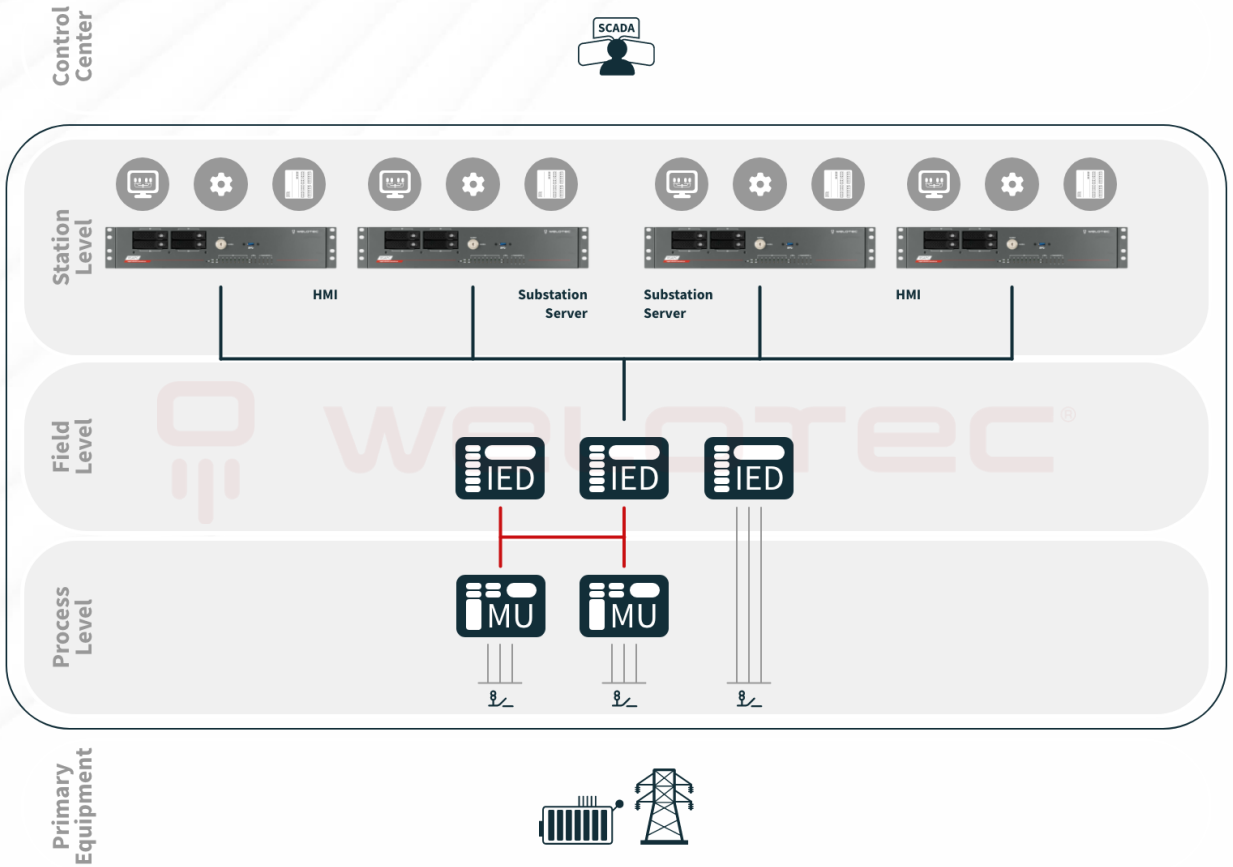
Modern substations utilize servers with software running on it – and virtualization to run multiple software-based protection, automation, and control functions on shared hardware platforms.

2030+, Fully Virtualized Substations

Future substations will be fully virtualized with vPAC systems, where all protection and control functions operate as virtual instances, offering maximum flexibility and integration with advanced grid technologies.

Conventional Substations are not suitable for handling the complexity of modern power grids

Benefits from computers in substations



Implementation of servers on the station level allows for:

- Real Time Control and Monitoring
- Integration and Interoperability:
- Screenshots and Back Ups
- Cost Efficiency in Maintanance
- Enhanced Cybersecurity
- Support of virtualized applications

What applications can run on computers

Servers in substations serve as a central platform for a wide range of applications that enhance automation, control, monitoring, and security.

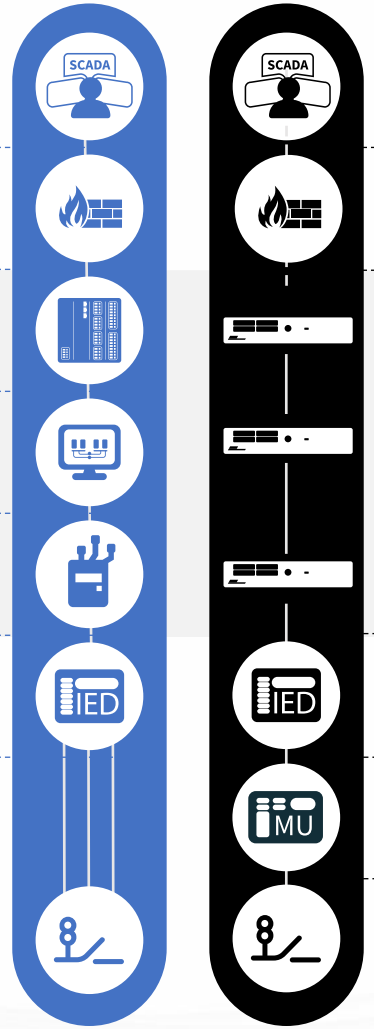
- SCADA
- HMI
- Video Survaillance
- RTU
- Gateways
- Backup Services
- Cybersecurity
- Simulation & Testing
- and many more

Basic Use Cases

Application	HMI	Engineering workstation	Substation Gateway
OS	Windows	Windows	Linux
Hardware Platform			

Conventional Substations vs. Computerized Substations

Conventional Substations	Computerized Substations
SCADA / EMS	SCADA / EMS
Firewall	Firewall
Gateway	Computerized Gateway
HMI	Computerized HMI
Substation Controller	Computerized Substation Controller
IED (Protection, Relays, BCU)	IED (Protection, Relays, BCU)
	Merging Unit
CTs/VTs	CTs/VTs



But if you already have powerful servers...

Why don’t you run additional applications on the same hardware?

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Basics of Virtualization

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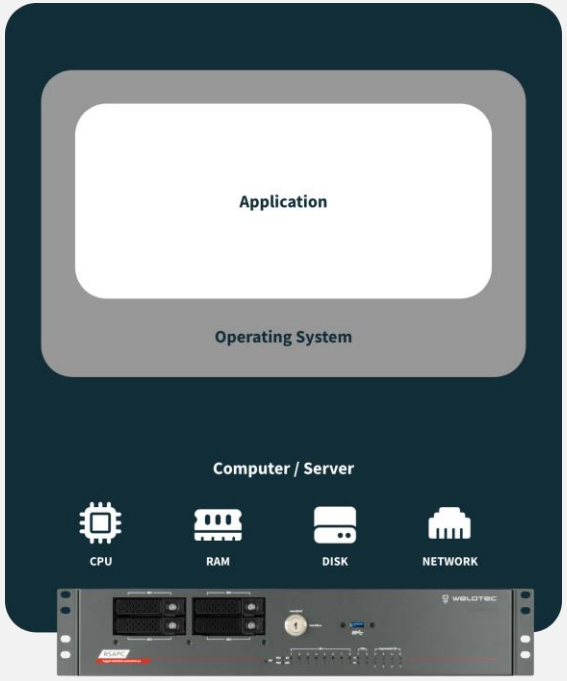
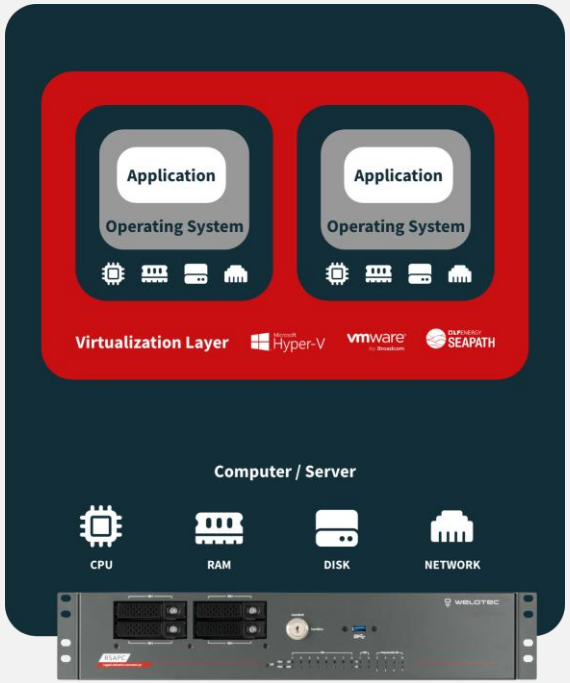
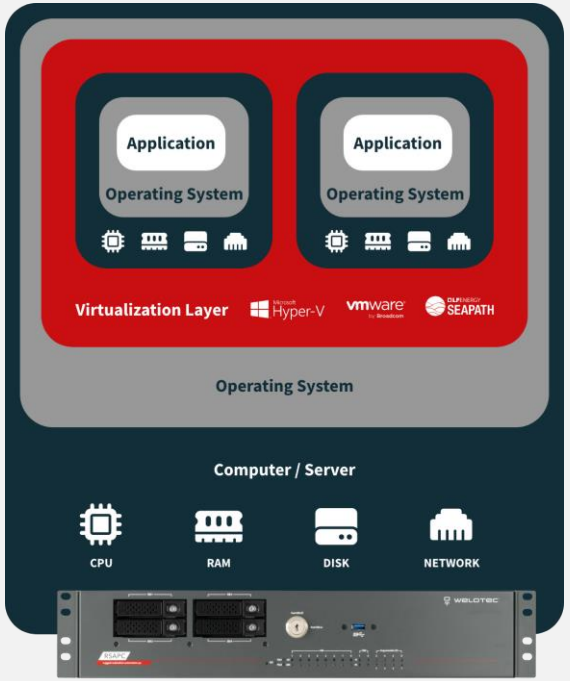
Virtualization is the process of running a virtual instance of a computer system in a layer abstracted from the actual hardware



Bare Metal installation



Type 1 Hypervisor



Type 2 Hypervisor

Bare Metal vs Virtualization

Microsoft Hyper-V

vmware by Broadcom

LF ENERGY SEAPATH

Red Hat

Microsoft Hyper V

Native Windows hypervisor that enables the creation and management of virtual machines on Windows platforms.

Pro: Seamless integration with Windows environments
Contra: no Real time support

VMware ESXi

Hypervisor that provides a robust, enterprise-grade virtualization platform for deploying virtual machines.

Pro: high performance, advanced features, and strong reliability suitable for large-scale
Contra: High licensing costs and complexity

Linux-based Hypervisors

Open-source virtualization solutions, with **LF Energy Seapath** offering a specialized hypervisor for energy sector applications.

Pro: customization, flexibility, and cost savings
Contra: require advanced technical expertise and support

Virtualization & Open source

Flexible, scalable, and cost-effective solutions

Open source enables utilities to modernize infrastructure, enhance interoperability, and avoid vendor lock-in.

Benefits:

- Flexibility and Scalability
- Cost Efficiency
- Interoperability
- Innovation through Collaboration:

LF Energy Projects:

SEAPATH (Software Enabled Automation Platform and Artifacts):

- Develops a standardized, real-time virtualization platform for substations.
- Enables deployment of virtual protection, automation, and control (vPAC) applications.

ComPAS (Configuration Modules for Power Industry Automation Systems):

- Simplifies and standardizes substation automation configurations.
- Enhances interoperability with common configuration modules.

FledgePower:

- Provides an edge computing platform for data acquisition in power systems.
- Supports integration of distributed energy resources and advanced analytics.

Red Hat Contributions:

- Offers enterprise-grade open-source virtualization platforms like **Red Hat Enterprise Linux (RHEL)**.
- Supports real-time hypervisors suitable for critical infrastructure.
- Collaborates with LF Energy, reinforcing the industry's move toward open-source solutions.

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Use Cases

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Virtualization of Applications

Current status of the market

Automation and control applications

- Station bus applications
- Cybersecurity applications
- Process bus applications

Benefits of virtualization

- Easy updates and rollback
- Backup and snapshots
- Easy Maintenance
- Easy Hardware replacement

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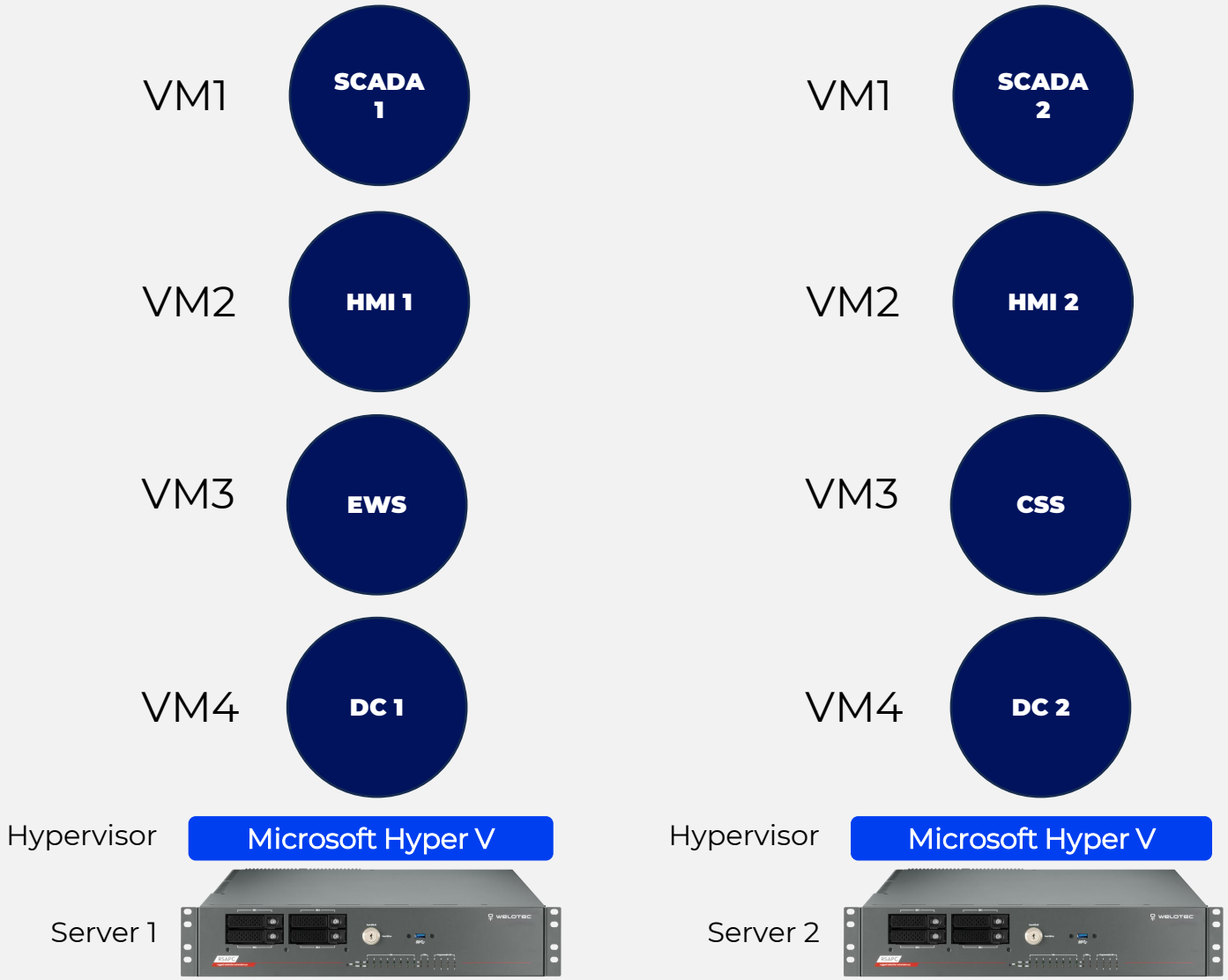
All these applications can run in virtualized environment



Virtualization Scenario with Redundant Systems

This Scenario increases the overall availability in case of planned (e.g. patching or updates) or unplanned outages.

Redundancy is realized on application level. Optionally a dedicated third server can be used to Access different VMs and to manage Hypervisor.

Legend:

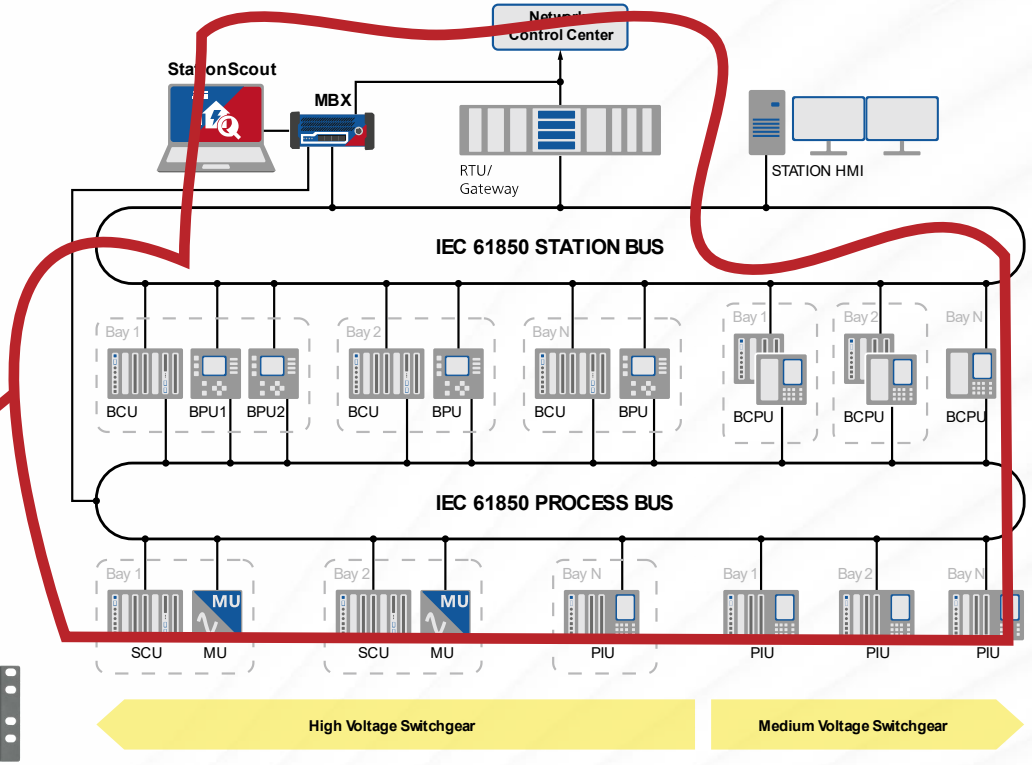
- SCADA - Supervisory Control and Data Acquisition
- HMI – Human-Machine Interface
- EWS – Engineering workstation
- CSS – Cybersecurity server
- DC – Domain controller

Virtualized testing*

Benefits of virtualized testing:

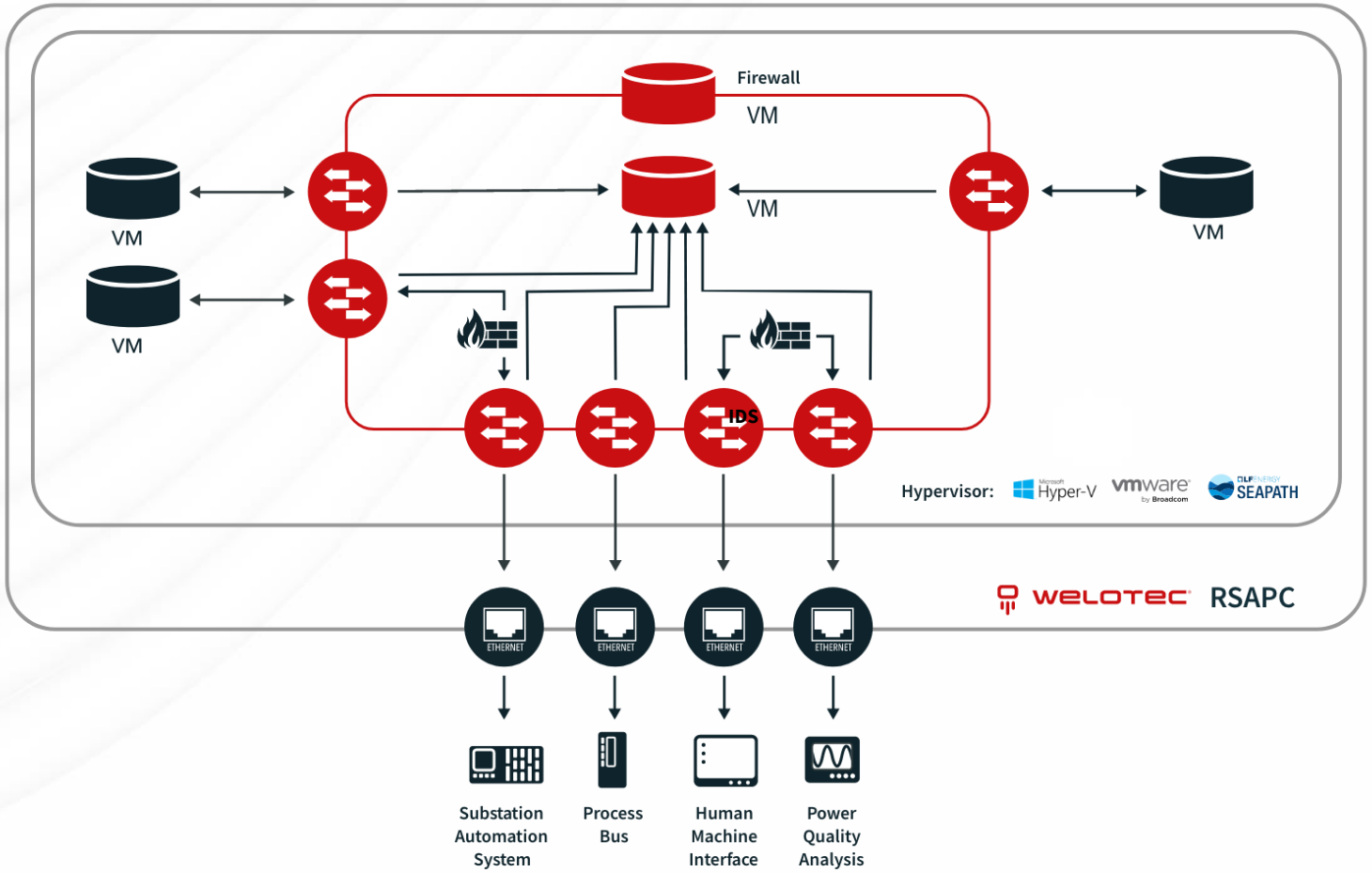
- Whole substation in a single device
- Low effort for the test setup
- Can be used in all testing phases
- Errors fixed in early engineering stage
- Can be easily configured and adapted
- Suitable for permanent and continuous testing/monitoring

Virtualized server



*Use Case of virtualized testing provided OMICRON Electronics

Virtualized Cybersecurity



Top-Benefits of virtualizing Cybersecurity applications

- Enhanced Isolation and Security
- Resource Optimization & Savings
- Scalibility & Flexibility
- Simplified Management & Maintanance
- Improved Recovery & Redundancy

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Future of Virtualization

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vPAC – virtual protection, automation and control

vPAC is an innovative approach where traditional protection, automation, and control functions—historically performed by dedicated physical devices—are implemented as software applications running on virtualized computing platforms within the substation.

Evolution of protection and control

300-500 Electromechanical relays (single functions)

100 Microprocessor-based, multifunction relays

5 centralized protection plattforms

1 high-compute server with virtual machines

Cloud with 5G or 6G

Conventional Substations vs. Fully Virtualized Substations

SCADA / EMS

Firewall

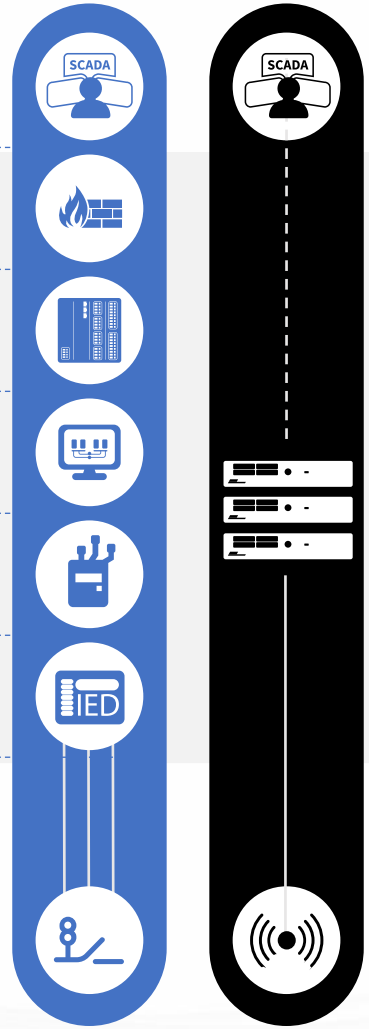
Gateway

HMI

Substation Controller

IED (Protection, Relays, BCU)

CTs/VTs



SCADA / EMS

Virtualized substation automation applications

Sensors

IEC TC57 WG10

Virtualization task force led by
Christophe Camelis from Enedis

CIGRE B5.84

vPAC WG group, led by
David McDonald, GE Vernova

vPAC Alliance

Collaborative initiative dedicated to define requirements for software defined substations

Experts working on vPAC

Expert groups play a crucial role in shaping the future of power systems by addressing technical challenges, developing international standards, and promoting best practices. Their collective efforts aim to enhance the reliability, efficiency, and adaptability of substation automation through the integration of virtualization technologies.

vPAC Alliance

vPAC Alliance is a collaborative initiative where industry professionals and organizations work together to promote the adoption of virtualization in substation environments.

Experts form different fields (vendors, manufacturers, solutions providers and utilities) focus on developing solutions, setting standards, and fostering innovation to advance virtualized protection and control systems.

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Utilities already pursuing vPAC solutions today

UK Powernetworks

Project Constalation

Caruna & ABB

The first vPAC solution in the field

RTE & LF Energy

SEAPATH Project, Open Source Hypervisor with vPAC applications running on top of it

Salt River Project

Centralized and Virtualized protection and control system4

Expected Benefits of software defined substations*

- Turnkey & flexibility
- Reliability
- Reduction of assets
- Interoperability
- Security Remote patching
- System savings OPEX/CAPEX
- Backups and asset management
- Lifecycle management

Reduced cabling costs
-90%

Reduction of engineering costs
-20%

Reduction in construction costs of the HV/MV substation up to
$ -1Mln

Reduced deployment time for substation automation systems
50% faster

Reduction of operational costs
-25%

Total Savings for the substation Automation System
-30%

Use of technologies Grid Edge & AI for Autonomous network

Simplification of standards and assets

Greater visibility of current and upcoming events

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*source: ABB study, shared while a joint event with Intel from August 19, 2024

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¡Muchas gracias!

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