SIPROTEC DigitalTwin

- Introduction
- Product details
- Customer feedbacks and benefits
Market – Major factors driving the revolution of energy systems ...

Decarbonization
“All electric world” – Fluctuating infeed – e-Mobility
- Power production from renewables
  Increases by over 300% between 2010 and 2030
  Share of renewables goes up to 40% in 2030

Decentralization
Distributed generation – Microgrids – Energy autonomy
- New installations distributed power generation
  Increases by over 150% between 2010 and 2030
  Share of distributed goes up to 67% in 2030

Digitalization
Connectivity – Edge computing – End-to-end
- Major industrial companies will using virtual avatars
  By 2021, half of the major industrial companies will be using virtual avatars, resulting in productivity gains of up to 10%
The “Digital Twin” – A virtual copy of a physical asset

- The digital twin integrates all data, models, and other information of a physical asset generated during engineering, commissioning, operation, or service.

- Role of the digital twin is to predict and optimize performance of a physical asset (whether for design, production or operation). To this purpose we use simulation methods and/or data-based methods.
Seven Elements of Digitalization –
The Digital Twin links the physical and virtual worlds

- **CYBER SECURITY**
  - Closing physical and digital security gaps ensures the safety of your Information Technology (IT) and Operational Technology (OT).

- **CONNECTIVITY**
  - Syncing assets to your data management system, or into the cloud, lets you access and leverage your equipment's performance data.

- **CLOUD & PLATFORM TECHNOLOGY**
  - Using cloud and platform technology allows you to run complex analytics seamlessly and access data remotely.

- **ANALYTICS**
  - Turning millions of data points into actionable insights allows you to discover new ways to optimize performance.

- **ARTIFICIAL INTELLIGENCE**
  - Scenario-based modeling helps you mitigate risk and validate key operational decisions before you make them.

- **SIMULATION TECHNOLOGY**
  - Bringing your facility to life with deep learning enables your systems to autonomously spot trends and make adjustments for you.

- **DIGITAL TWIN**
  - At its core, digitalization is about creating a digital clone of your assets so you can virtually predict what will physically happen.
SIPROTEC DigitalTwin – Digitalization meets Energy

More than 1.6 million devices installed base

2011
SIPROTEC 5 benchmark for protection, automation and monitoring

2015
SIPROTEC 5 process bus and digital substation

2018
Cloud based applications for SIPROTEC

2017
SIPROTEC 5 IoT connectivity to MindSphere

2019

More than 1.6 million devices installed base
Customer – Major challenges

Time and Costs

- Complexity of the protection system,
- Implementation is time consuming,
- Considerable efforts for testing & commissioning

Outage Management

- Faster energization (green field)
- Shorter outages (planned & unplanned)
- Substation extensions (brown field)

Agility and Flexibility

- Validation of new products,
- Implementation of new protection schemes,
- Fault analysis very complicated

Training and maintenance

- Training costs very high,
- Test lab assets (costly)
- Efficiency of maintenance
Our Solution – SIPROTEC DigitalTwin

A digital twin of your SIPROTEC 5 device

Individually simulate and test your SIPROTEC 5 project data in the cloud …

... in minutes
... without hardware
... without additional efforts
SIPROTEC DigitalTwin
A 3-minutes Video say more than thousand words…
Our Solution – SİPROTEC DigitalTwin

Virtual Testing of SİPROTEC 5 protection devices in the cloud

With the SİPROTEC DigitalTwin you can test your engineered energy automation system in the cloud, in parallel or before you set-up the real hardware.

It shortens your time-to-operation significantly.

All devices to be tested from a bay or from a full substation are set-up virtually in minutes!

The three steps to success

• Upload your engineering data and your automated test cases
• Simulate and test your energy automation system in the cloud
• Get test reports of your engineered system

Lower Total Cost of Ownership
Saves time, increases quality throughout the entire lifecycle of your system

Maintenance and Service
- Fault analysis
- COMTRADE replay
- Upgrade scenarios

Pre-sales and Design
- Information and Presentations
- Application concept and testing
- Design Specification
- Approvals

Training
- Device handling
- Operators
- Customer specific
- Flexible at any place

Implementation
- Planning
- Algorithm
- Settings
- Pre-testing

Operation
- Device handling
- COMTRADE replay

Commissioning
- FAT
- SAT, Field test
- Fault analysis

Saves time, increases quality throughout the entire lifecycle of your system
Benefits –
The customer value proposition

Testing of the energy automation system within minutes, without hardware and without additional effort

• Simulation and validation of product properties
• Faster energization of new systems thanks to shorter project lifetimes
  • Increase engineering quality
  • Virtual testing before start of commissioning
  • Shortest commissioning times
• Reduced OPEX with shorter outages for higher availability thanks to better pre-testing
• Efficient, scalable trainings on the job
• Fast and realistic fault analysis by easily reproducing the behavior of products and systems
SIPROTEC DigitalTwin within the entire energy automation system

Visualize and Interact with the simulated device
- Device operation
- Analog values
- Binary inputs and outputs

Documentation
- Test reports
- Logs

Fault analysis
- COMTRADE replay

DIGSI 5 Online Testing and Web Browser
- Online CFC Debugging
- Download Logs and Fault records
- Test sequence
- Plug & Play

Communication interfaces
- IEC 61850
- IEC 60870-5-104
- DNP3 TCP, Modbus TCP
- Protection Data Interface

Integration into substation automation system
- SICAM A8000
- SICAM PAS, SCC and PQS
- 3rd party systems
- Interlockings via GOOSE
Access your SIPROTEC DigitalTwin in 5 Steps

1. Open DIGSI 5 project
2. Export SIM file
3. Connection to the Cloud
4. Import SIM
5. SIPROTEC DigitalTwin
3 Login to the SIPROTEC DigitalTwin

https://www.siprotec-digitaltwin.siemens.com

Supported by all major Web browsers
4 Import of SIM configuration file from DIGSI 5

- Add several devices by importing the SIM file
- SIM files can be updated/overwritten
- SIM files include the TEAX-file for displaying texts of binary in-/output and LEDs
Simulate a single SIPROTEC 5 device

- Select the single device to be simulated
- Activate the simulation in manual mode

The device is recognized by:
- Device Name
- Product Code
- IP Address
- Date of Import
5 Visualize and interact with the simulated device –
Device operation

- Device view
- Operating via SIPROTEC 5 operation panel
- Testing all protection algorithms
- Testing of automation logic (CFC)
- Interaction of several devices
5 Visualize and interact with the simulated device – Analog values

- Injection of process data (I/V)
- Setting of equal amplitudes for 3 phases
- Settings of the symmetrical phases
- Automatically calculation of I4, V4
- Visualization of the vectors
- Definition of binary and analog profiles
Visualize and interact with the simulated device – Binary Inputs and Outputs

- Overview of available inputs and outputs
- Display status of in-/outputs and the life contact
- Setting of inputs
- Definition of binary and analog profiles
- Numbering according DIGSI 5 e.g. BO 3.2
- Displaying of texts
- Hide unused binary outputs
Virtual wiring between simulated devices

- Virtual wiring from Binary outputs to Binary inputs
- Mapping of 1 binary output to 1 or several binary inputs from same or multiple devices
- Closed loop for same simulated device (e.g. for very basic behavior of a primary equipment)
- Wiring between several devices
- Matrix overview of configured wirings between devices

Example of device operational log for the application of testing controls (via front display or via IEC 61850 MMS) based on closed loop virtual wiring on same device
COMTRADE replay

- Standard COMTRADE files (1999, 2013) can be:
  - Uploaded,
  - Mapped to binary, voltage or current inputs of one or several simulated devices
  - Replayed into the device(s)

- COMTRADE file from:
  - Real protection device (fault analysis)
  - Test tool (PSS SINCAL, RTDS, Omicron Test Universe, etc.)
SIPROTEC DigitalTwin within the entire energy automation system

Visualize and Interact with the simulated device
- Device operation
- Analog values
- Binary inputs and outputs

Documentation
- Test reports
- Logs

Fault analysis
- COMTRADE replay

DIGSI 5 Online Testing and Web Browser
- Online CFC Debugging
- Download Logs and Fault records
- Test sequence
- Plug & Play

Communication interfaces
- IEC 61850
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- DNP3 TCP, Modbus TCP
- Protection Data Interface

Integration into substation automation system
- SICAM A8000
- SICAM PAS, SCC and PQS
- 3rd party systems
- Interlockings via GOOSE
DIGSI 5 Online Testing

- Download logs and fault records
- Test and diagnostic functions
- Online CFC debugging
- Test sequence
- Plug & Play
Web Browser

Monitoring of
- Device information
- Settings
- Measurements
- Logs

Download of
- Logs as CSV or COMFEDE file

Secure
- https connection
- Access defined per port
- Role Based Access Control (RBAC)
Communication Interfaces

Communication interfaces...
- IEC 61850
- IEC 60870-5-104
- DNP3 TCP, Modbus TCP

Protection Interface PI
- Establishment of the communication
- Testing of Differential Protection
- Messages sent via protection interface

PMU

VPN
Integration into substation automation system

Integration into Substation Automation …
- SICAM A8000
- SICAM PAS
- SICAM PQS
- SICAM SCC

IEC 61850 Goose Simulation
- IEC 61850 communication
- Messages can be sent via Goose communication
Fault Analysis

Fault analysis
- COMTRADE replay
Customer Feedbacks and Benefits
Benefits
Save time & increase quality throughout the system lifecycle

Example scenario: Fault analysis, system optimization and upgrade

Without
- Replay fault
- Improve Settings
- Test new firmware
- SAT

With
- Replay fault
- Improve Settings
- Test new firmware
- SAT

Significantly reduced outage time / time-to-operation

... and all this with higher quality, flexibility and more customer confidence in our products and systems
Benefits
Investment cost reduction for test lab usage

• Reduce your test lab CAPEX investments by typically 80%
• Test your external dependencies and reduce external costs by 100%
Customer Feedbacks and Benefits – What customer say about the SIPROTEC DigitalTwin …

5. As a training participant, I can always work with exactly the right device that fits my application.

1. With the SIPROTEC DigitalTwin, I can demonstrate the devices to my customers in the exactly fitting version without having devices on site.

1. As an EPC I can plan, engineer and test my complete station automation system without having to order a single device in advance. As soon as everything is in place, I order the exactly fitting devices directly onto the system on schedule. This gives me security and saves money.

6. As a service engineer, I can read the exact data of the field via DIGSI 5 in the event of a network failure and then test and analyze it from my office with exactly the same hardware. That makes it pleasant and efficient.
Customer Feedbacks and Benefits – What customer say about the SIPROTEC DigitalTwin …

2. When creating automation functions (CFC), I can test them immediately with the exactly fitting device. Especially helpful is the simulation of process signals and the inclusion of GOOSE information.

1. As part of device approvals, I can perform the entire test with the SIPROTEC DigitalTwin without having devices on site and having to wire them. I then carry out a final, short test on a real device.

3. I can implement the commissioning of the system much faster, since the device parameterization and the integration into the station automation have already been tested. This saves us time and money and enables us to put the system back into operation quickly.

3. As a commissioning engineer I am on the road a lot and don’t always have the right hardware with me. With the SIPROTEC DigitalTwin I can easily test the complete engineering from anywhere with DIGIS 5 and Internet access.
Customer Feedbacks and Benefits –
What customer say about the SIPROTEC DigitalTwin …

3 Especially when testing and commissioning line differential applications, the devices and systems are often far away from each other. IBS requires a lot of time and staff. With the SIPROTEC DigitalTwin I can very easily test them completely in advance from the office. Testing the protection interface and the messages is also very simple.

2 As a switchgear manufacturer, we always order the SIPROTEC 5 devices on time for installation in the switchgear. To save costs, we integrate more and more automation functions into the devices. With the SIPROTEC 5 DigitalTwin we can check the parameterization and especially the automation in advance in the office without the hardware. A short final test in the system is then sufficient.

3 The integration and testing of the protective devices in the station automation with system interlock and interface has been very complex to date. With the SIPROTEC 5 DigitalTwin it is much easier and cheaper to do it in advance in the engineering department without devices.
Benefits –
The customer value proposition

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Conclusion

SIPROTEC DigitalTwin – Virtual Testing of SIPROTEC 5 Protection Devices in the Cloud

"The SIPROTEC DigitalTwin has the great benefit that you always have the protection device you need in your pocket"

Hans Kristian Muggerud, Technical Supervisor, Norway
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Thank you!

SIPROTEC DigitalTwin