

SIPROTEC DigitalTwin

Virtual Testing of SIPROTEC 5 Protection Devices in the Cloud

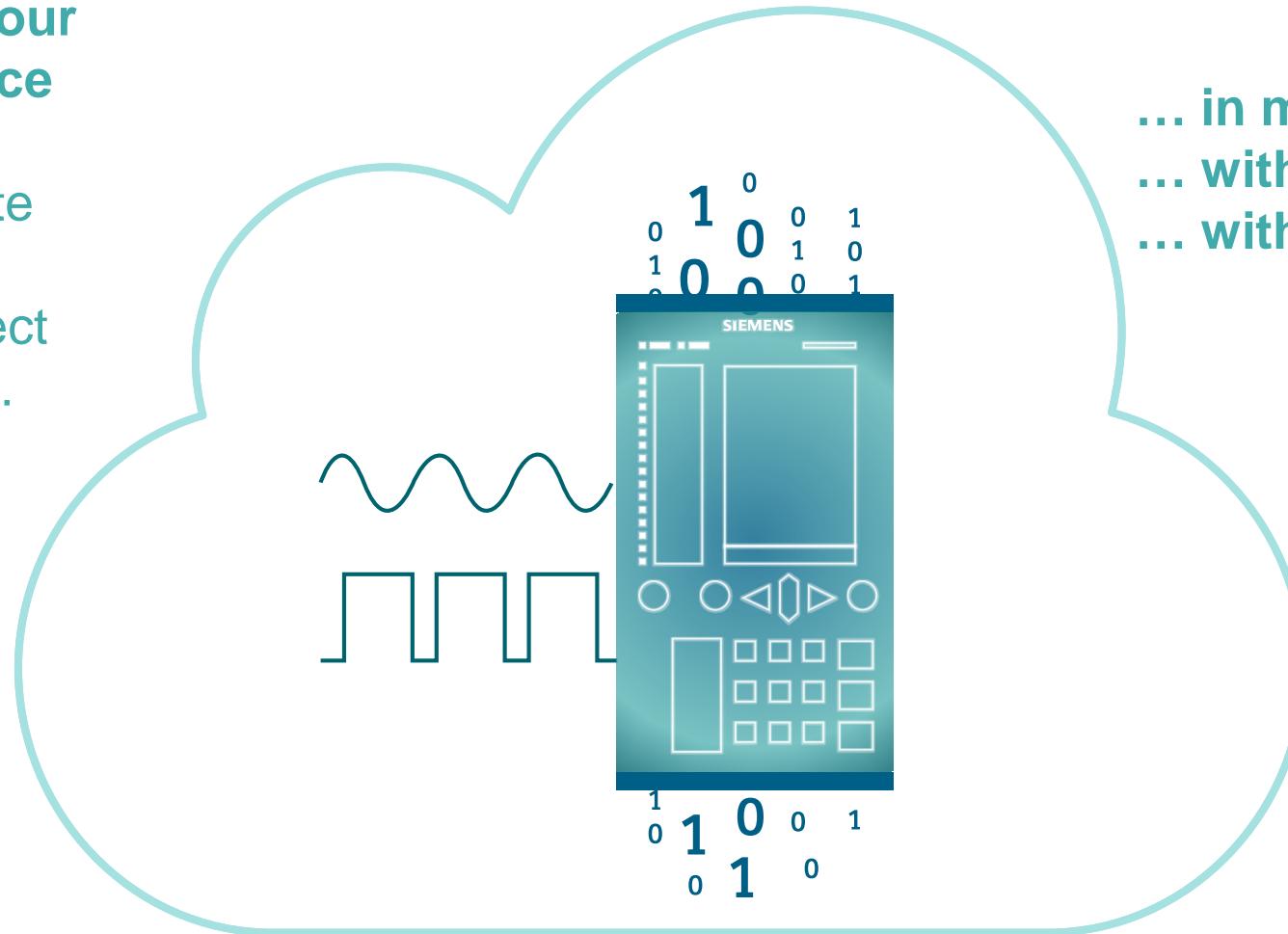
Simone Kachelriess, Sales Consulting, Energy Automation

September 12-13, 2019 | VAR Partner Day 2019 | Bled, Slovenia

Our Solution – SIPROTEC DigitalTwin

A digital twin of your SIPROTEC 5 device

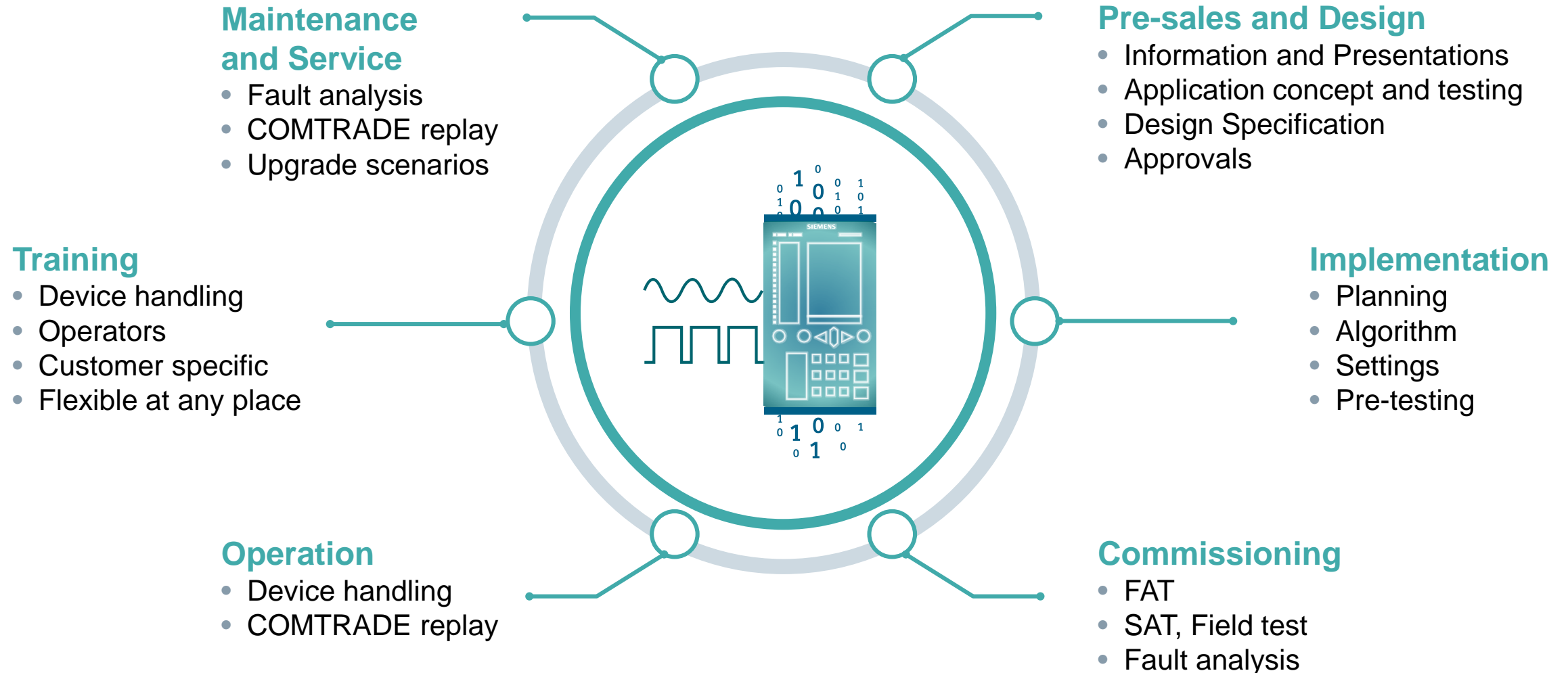
Individually simulate
and test your
SIPROTEC 5 project
data in the cloud ...



... in minutes
... without hardware
... without additional efforts

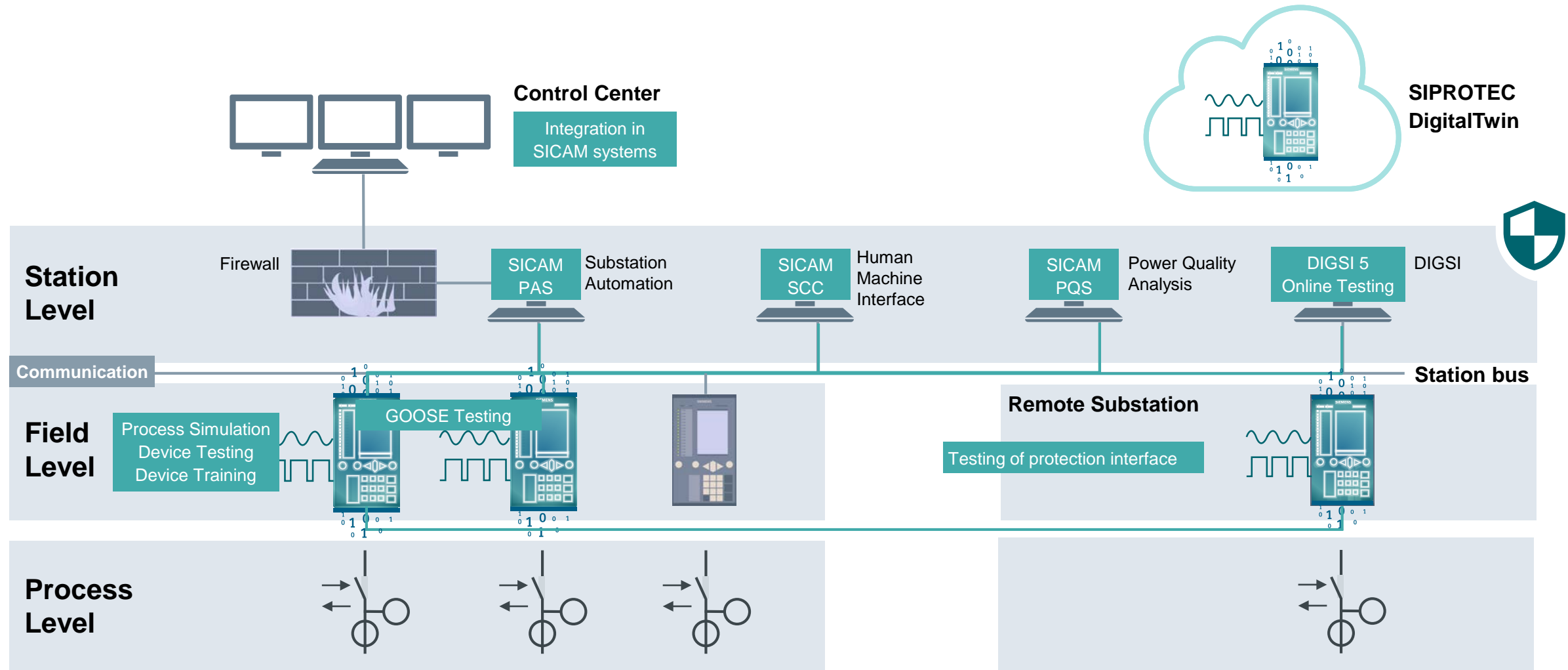


Saves time, increases quality throughout the entire lifecycle of your system



SIPROTEC DigitalTwin Application Scenarios

SIEMENS
Ingenuity for Life



SIPROTEC DigitalTwin within the entire energy automation system

Visualize and Interact with the simulated device

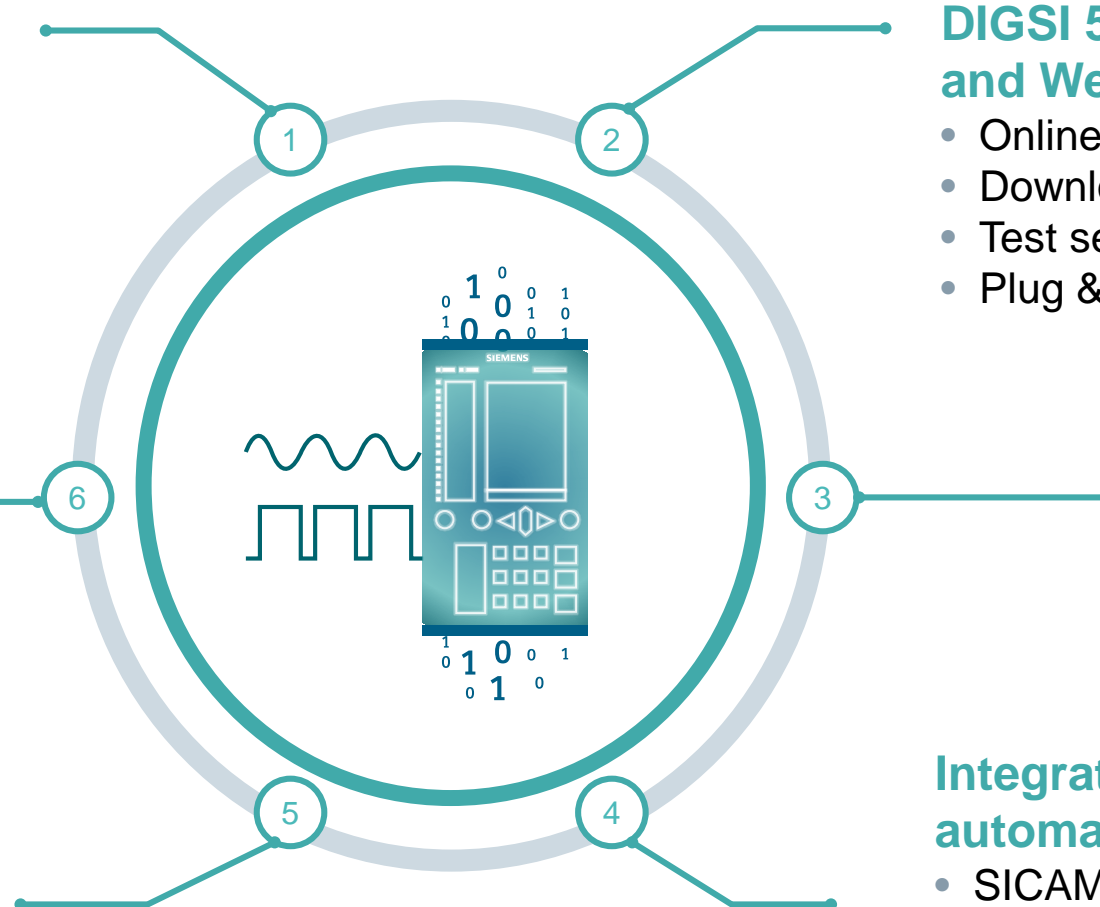
- Device operation
- Analog values
- Binary inputs and outputs

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

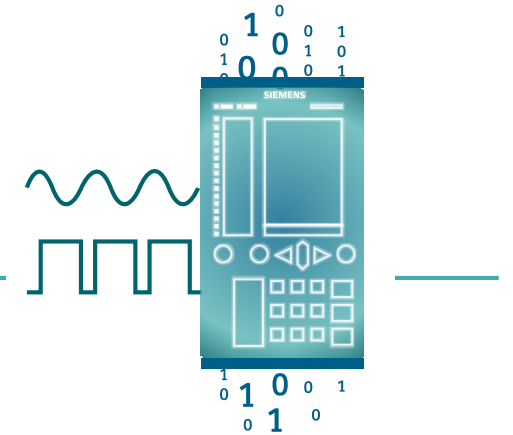
- IEC 61850
- IEC 60870-5-104
- DNP3 TCP, Modbus TCP
- Protection Data Interface

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

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1
Open DIGSI 5 project

A screenshot of the DIGSI 5 software interface. The left pane shows a hierarchical project tree with folders for 'Appareils', 'SIPROTEC', and 'SIPROTEC-DigitalTwin'. The right pane shows a detailed view of a device configuration.

2
Export SIM file

A screenshot of the 'Exportation' dialog box in DIGSI 5. The title is 'SE_DIGSI_V4_01'. It lists various export formats: 'MICS - Model Implementation Conformance Statement', 'DIGSI103 - SEI 60879-5-133 réglages de protocole pour SICAM PAS', 'DIGI2NP - DNP3 réglages de protocole pour SICAM PAS', 'DIGI104 - T104 réglages de protocole pour SICAM PAS', and 'Réglages de protocole SIPROTEC - Modbus TCP pour SICAM PAS'. The 'SIM - Format de données de simulation pour un ou plusieurs appareils' option is selected. The file path is 'C:\Users\FRO06983\Documents\AutomationSE_DIGSI_V4_01.sim'. There are 'Export' and 'Annuler' buttons at the bottom.

3
Connection to the Cloud

A screenshot of the SIPROTEC DigitalTwin cloud interface. It features a blue and purple background with a 3D visualization of a power substation. The text 'SIEMENS SIPROTEC DigitalTwin' is prominently displayed. At the bottom, it says 'Version 1.00 | ©2019 Siemens AG'.

4
Import SIM

A screenshot of the SIPROTEC DigitalTwin interface showing a table of device data. The table has columns for 'Device Name', 'Protocol Code', 'IP Address', and 'Discovery Date'.

Device Name	Protocol Code	IP Address	Discovery Date
SIP11_28		10.10.0.100	10.0.2016.18:02:47
SIP11_2		10.10.0.100	10.0.2016.18:02:47
SIP11_24		10.10.0.100	10.0.2016.18:02:47
SIP11_20		10.10.0.100	10.0.2016.18:02:47
SIP11_16		10.10.0.100	10.0.2016.18:02:47
SIP11_12		10.10.0.100	10.0.2016.18:02:47
SIP11_8		10.10.0.100	10.0.2016.18:02:47
SIP11_4		10.10.0.100	10.0.2016.18:02:47

5
SIPROTEC DigitalTwin

A screenshot of the SIPROTEC DigitalTwin control interface. It shows a complex dashboard with various gauges, graphs, and control elements. The interface is designed for monitoring and controlling a power system.

4 Import of SIM configuration file from DIGSI 5

No selected device

SIEMENS SIPROTEC DigitalTwin
cedric.harispuru@siemens.com

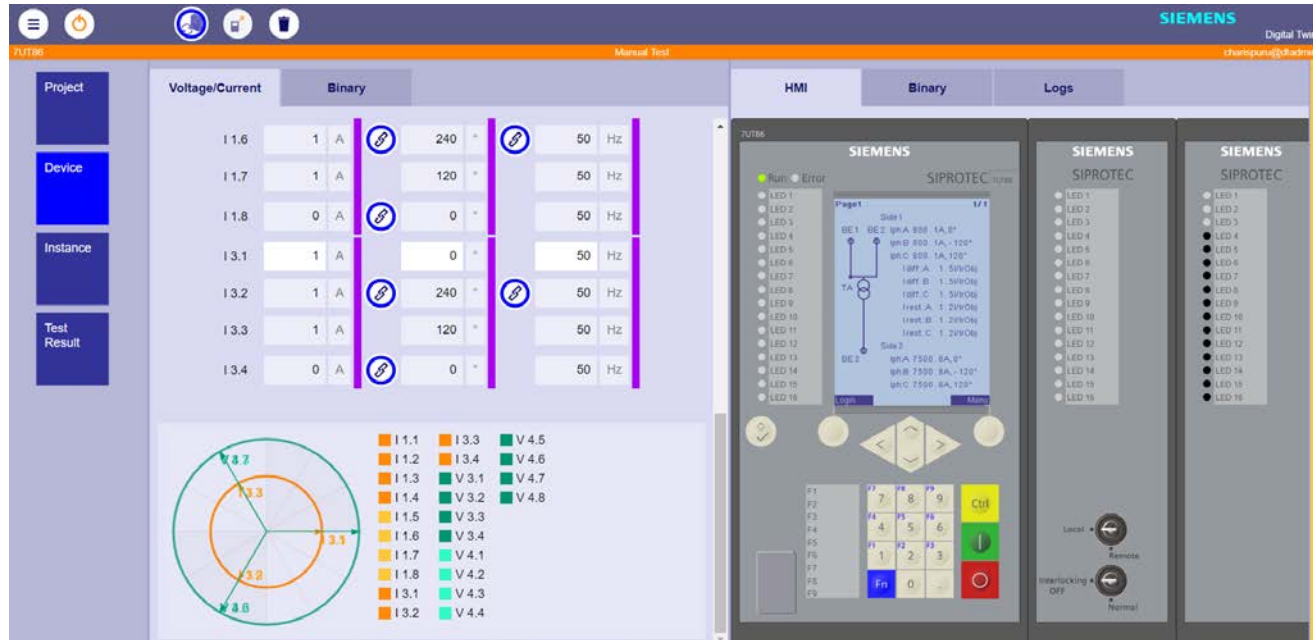
Project
Device
Instance
Test Result

Device List Routing Matrix Testfiles

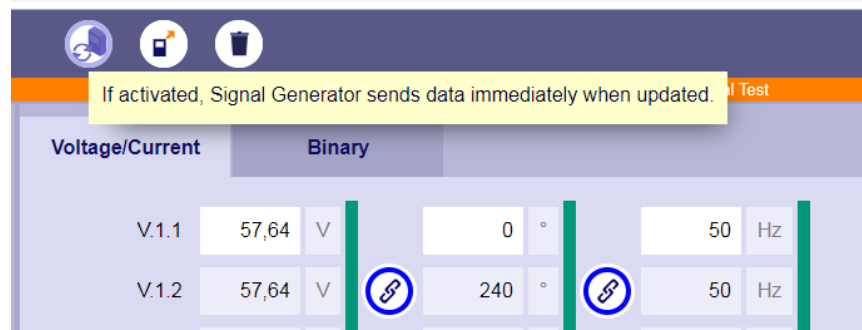
<input type="checkbox"/>	Device Name	Product Code	IP Address	Imported On	TEA-X	Upload TEA-X
<input type="checkbox"/>	7SJ82-Publisher	7SJ82-DAAA-AA0-0AAAA0-AH0411-13113B-AAA000-000AB0-HB1BD4-JZ0	172.16.60.86 (Port J) 10.16.60.86 (Port E)	29.7.2019, 14:01:18	<input type="checkbox"/>	
<input type="checkbox"/>	7SJ85-Subscriber	7SJ85-????-???-??????-?R01?2-23???3A-ABB000-000AC0-CB1BA1-CG0	10.16.60.78 (Port F) 172.16.60.78 (Port J)	29.7.2019, 14:01:18	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	PrimaryEquipmentSimulator	6MD85-????-???-??????-?M01?2-331?1A-AAA000-000AC0-CB3BA1-EB0EB0	172.16.60.60 (Port J)	29.7.2019, 14:01:18	<input checked="" type="checkbox"/>	

- Add several devices by importing the SIM file
- SIM files can be updated/overwritten
- Option: Upload additional TEAX-file for display texts of binary in-/output and LEDs

5 Visualize and interact with the simulated device – Device handling and injection of process data

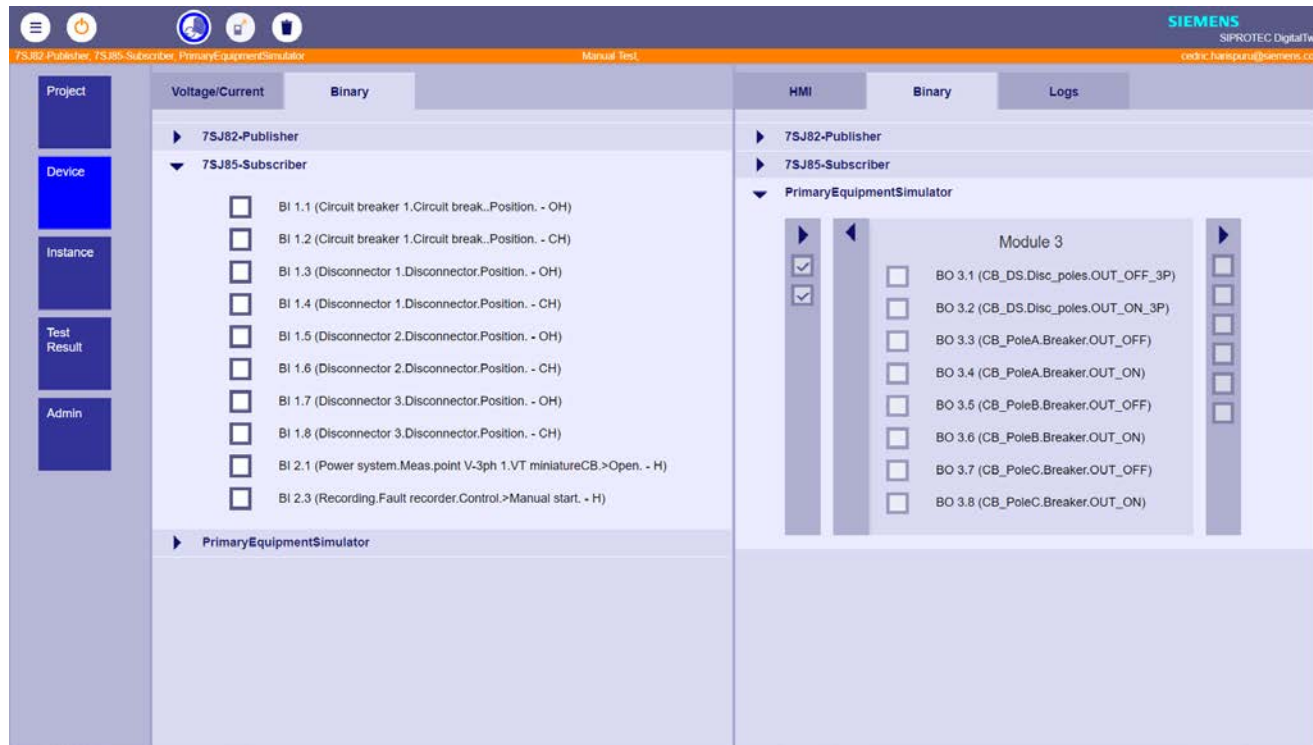


- Device view
- Operating via SIPROTEC 5 operation panel
- Testing all protection algorithms
- Testing of automation logic (CFC)
- Interaction of several devices



- 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

5 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

Using and importing TEAX-File

- Displaying of texts
- Hide unused binary outputs

DIGSI 5 Online Testing



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

Wiring Tests

Binary inputs/outputs and LEDs	Mapped to signal(s)	Terminal	Current value	New value
Binary inputs				
Binary outputs				
LEDs				
LED 1.1	Line 1:Group indicat.:Pickup		off	on
LED 1.2	Line 1:Group indicat.:Pickup		off	on
LED 1.3	Line 1:Group indicat.:Pickup		off	on
LED 1.4	Line 1:Group indicat.:Pickup		off	on
LED 1.5	VS:Circuit break.:Spring Charged		on	off
LED 1.6			off	on
LED 1.7			off	on
LED 1.8			off	on
LED 1.9	Line 1:87 Line diff. prot.:General:Inactive		on	off
LED 1.10	2 device prot. com.:Prot. interf.1:Pi synchro...		off	on
LED 1.11			off	on
LED 1.12			off	on
LED 1.13			off	on
LED 1.14			off	on
LED 1.15			off	on
LED 1.16			off	on

Protection Functions

Diagram shows of days secondary values

Time stamp	Relative time	Indication	Value	Quality	Additional information
(All)	(All)	(All)	(All)	(All)	(All)
31.01.2019 16:00:27.117	00:00:00:00...	Security:Security Logging:Sec. Ev. Logg.:User logged on	on	good (process)	Data change
31.01.2019 16:00:27.117	00:00:00:00...	Security:Security Logging:Sec. Ev. Logg.:User logged off	off	good (process)	Data change

Control Functions

Switching devices	Current value	New value	Select	Operate	Cancel	Interlocking condition	Quality
VS	intermediate	open	Select	Operate	Cancel	Fulfilled	good (process)
RS 1	intermediate	open	Select	Operate	Cancel	Not fulfilled	good (process)
RS 2	intermediate	open	Select	Operate	Cancel	Not fulfilled	good (process)
	intermediate	open	Select	Operate	Cancel	Fulfilled	good (process)

Time stamp	Indication	Value	Additional information	Quality
(All)	(All)	(All)	(All)	(All)

Web Browser



Operational log

50 of 162 logs loaded [download as file](#)

Date	Time	Functions structure	Name	Value
18.04.2018	16:39:59.891	Circuit breaker 1	74TC sup.1BI 1:Trip-circuit failure	on
18.04.2018	16:35:10.077	VI 1ph 1:Rotor gnd. fault -I 1	General:Failure RGF frated	on
18.04.2018	16:35:03.369	E:ETH-BA-2EL:Channel 1	Line Mode:Redund. Channel Live	on
18.04.2018	16:35:03.346	E:ETH-BA-2EL:Channel 1	Line Mode:Channel Live	on
18.04.2018	16:35:00.088	Generator stator:SGF 90% MP-1ph 1	General:Health	ok
18.04.2018	16:35:00.079	Generator stator:81 Underfreq.-A 1	General:Undervoltage blocking	on
18.04.2018	16:35:00.079	Generator stator:81 Overfreq.-A 1	General:Undervoltage blocking	on
18.04.2018	16:35:00.079	Generator stator:32R Revers.pow. 1	General:Undervoltage blocking	on
18.04.2018	16:35:00.079	Generator stator:SGF 90% MP-1ph 1	General:Health	alarm
18.04.2018	16:34:59.919	Recording	Grnd.-flt log:Fault number	0

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)

7UM85

Device information

Mode	Process mode
Firmware (FW)	V07.80.07
Configuration(CFG)	V07.80.07
System time	2018-04-19 14:16:45

IO modules

Mounting position 1	IO208
Mounting position 2	PS201
Mounting position 3	IO202

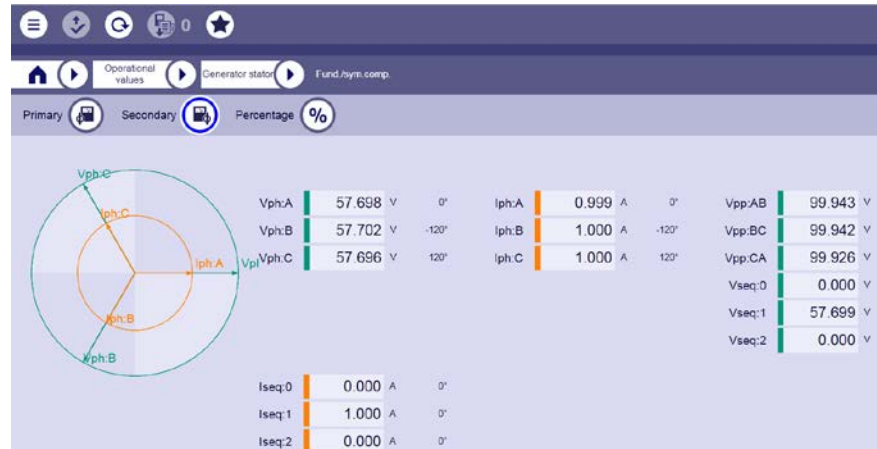
Communication

Port F	USART-AC-2EL
Port E	ETH-BA-2EL

Product code#1 7UM85-DAAA-AA0-0AAAA0-A90111-13112B-AAC000-000AC0-CH2BA1-CB2

Short product code P1L7845

Serial number BMTTTT123456



Communication Interfaces

The screenshot shows the SIEMENS IEC-Browser interface. The left pane displays a tree view of the communication interfaces, with 'SD05Application/LPHD0\$DC\$PhyNam' selected. The right pane shows a table of properties for this object.

Name	Type(Len[arr])	Value
Name		PhyNam
Type		Data Object
Path		SD05Application/LPHD0\$DC\$PhyNam
vendor	VisString (256[-2)	SIEMENS
hwRev	VisString (256[-2)	7SD86-DAAA-AA0-
swRev	VisString (256[-2)	V07.82
serNum	VisString (256[-2)	BM0123456789
model	VisString (256[-2)	7SD86
location	VisString (256[-2)	
owner	VisString (256[-2)	

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

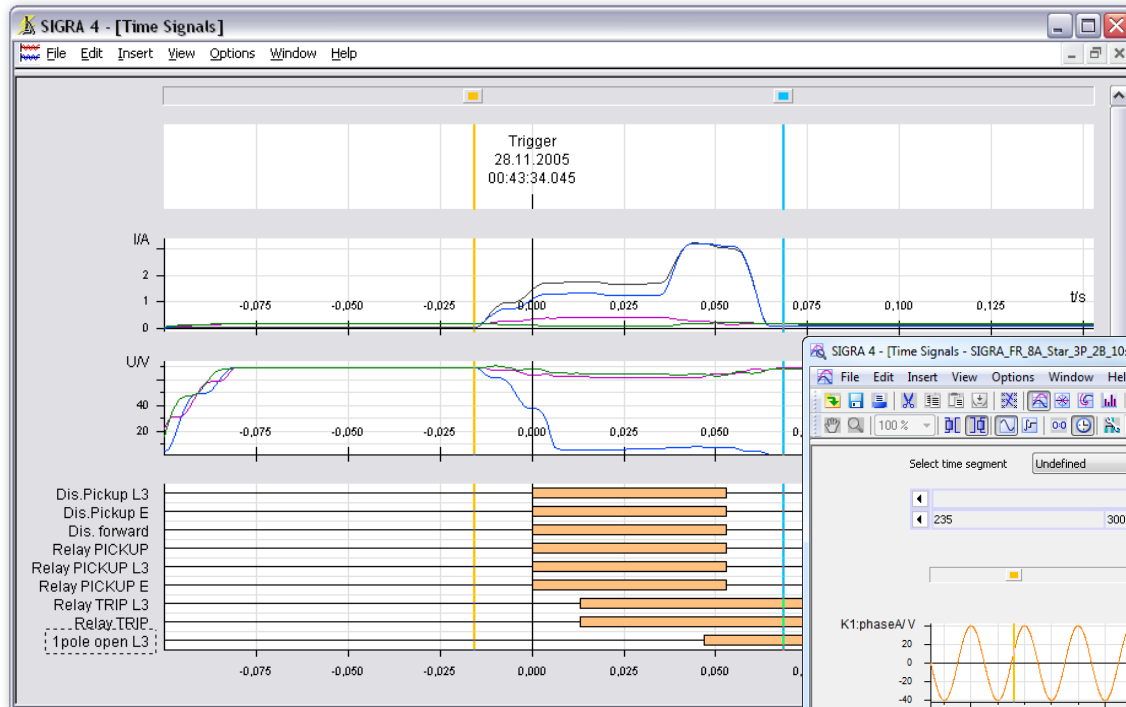
Integration into substation automation system

Integration into Substation Automation ...

- SICAM A8000
- SICAM PAS
- SICAM PQS
- SICAM SCC

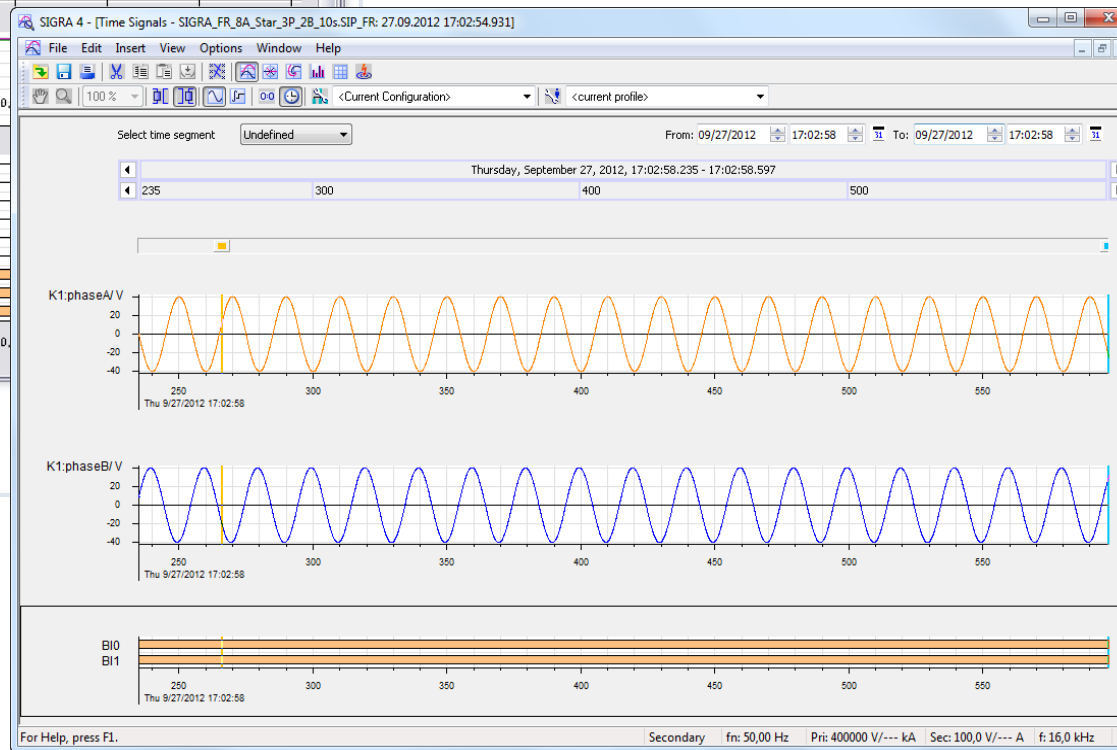
IEC 61850 Goose Simulation

- IEC 61850 communication
- Messages can be sent via Goose communication



Fault analysis

- COMTRADE replay



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

3 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.

2 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.

- 1** Pre-Sales and Design
- 2** Implementation
- 3** Commissioning
- 4** Operation
- 5** Training
- 6** Maintenance and Service

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



Time and Costs



Agility and Flexibility



Outage management



Training and maintenance

Conclusion

**SIPROTEC DigitalTwin –
Virtual Testing of SIPROTEC 5 Protection Devices in the Cloud**
Virtuelles Testen von SIPROTEC 5-Schutzgeräten in der Cloud

“

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

”

Hans Kristian Mugggerud,
Technical Supervisor, Norway

SIPROTEC DigitalTwin

Virtual Testing of SIPROTEC 5 Protection
Devices in the Cloud