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EXPERT WORKSHOP SERIES

What´s new – SIPROTEC 5 V9.90

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SIPROTEC 5 V9.90 - News
Summary

General Description:

Highlighted Topics:

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SIPROTEC 5 V9.90

General Description

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SIPROTEC 5 V9.90 - News
New device types and hardware components

New device types and hardware components

7SX82: Compatible with ETH-BD-2FO

→ The plug-in Ethernet communication module ETH-BD-2FO can be used in 7SX82 devices.
As with the ETH-BA-2EL Rev.2 and the ETH-BB-2FO Rev.2, the ETH-BD-2FO is compatible with:
- Several applications such as IEC 61850-8-1, IEC 60870-5-104, DNP3 TCP, Modbus TCP, Synchrophasor (IEEE C37.118 – PMU), DIGSI 5 protocol, PROFINET IO, S2 Redundancy and SOE for PROFINET IO, and SUP Ethernet (Slave Unit Protocol).
- Additional Ethernet protocols and services such as DHCP and DCP (automatic IP configuration), Line Mode, PRP (ethernet ring redundancy), HSR (ethernet ring redundancy), RSTP (ethernet ring redundancy), SNTP (time synchronization over Ethernet), SNMP V3 (network management protocol), IEEE 1588v2 (PTP via Ethernet – us accuracy), and IEEE 802.1Q (VLAN).

Additionally, the ETH-BD-2FO is compatible with IEC 61850-9-2 Merging Unit function, IEC 61850-9-2 Process Bus Client function, IEEE 1588v2/PTP Grandmaster Clock function and Protection Interface.

See Highlighted Topics for detailed information on Process Bus application using ETH-BD-2FO on 7SX82 devices.

ANAI-CE-2EL: Hardware revision 2

→ The plug-in measuring-transducer module ANAI-CE-2EL Revision 2 offers a second input channel with a potentiometer input.
Via this input the position of an Arc-Suppression Coil is detected. See Highlighted Topics for detailed information.

The UL certification for the ANAI-CE-2EL Rev. 2 is pending.
Therefore, it is currently not possible to order the ANAI-CE-2EL Rev. 2 equipped in the SIPROTEC 5 device. For a limited time (till UL certification is given), the ANAI-CE-2EL Rev. 2 must be ordered as spare part (without UL certification).
If you order an ANAI-CE-2EL as part of the SIPROTEC 5 device you will receive the ANAI-CE-2EL Rev. 1, which is not applicable as potentiometer input.
It is important to note that UL certification is only required for US-dominated markets and is not relevant for European markets.

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SIPROTEC 5 V9.90 - News
Version releases per device types

Version releases per device types (one DIGSI Device Driver per row)	V9.90
Compact Universal Protection 7SX800	X
Fault Recorder 7KE85	X
Generator Protection 7UM85	X
High-Speed Busbar Transfer 7VU85	X
High-Voltage Bay Controller 6MD85, 6MD86	X
IO-Box 6MD84	X
Line Protection 7SA82, 7SA86, 7SA87, 7SD82, 7SD86, 7SD87, 7SL82, 7SL86, 7SL87, 7VK87, 7SJ86	X
Low-Impedance Busbar Protection 7SS85	X
Merging Unit 6MU85	X
Motor Protection 7SK82, 7SK85	X
Overcurrent Protection 7SJ81, 7SJ82, 7SJ85	X
Paralleling Device 7VE85	X
Transformer Differential Protection 7UT82, 7UT85, 7UT86, 7UT87	X
Universal Protection 7SX82, 7SX85	X
Universal Protection LPIT 7SY82	X

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SIPROTEC 5 V9.90 - News
Essential new functionalities

Essential new functionalities	C*	Non-modular devices									Modular devices																						
	7SX800	7SA82	7SD82	7SJ81	7SJ82	7SK82	7SL82	7SX82	7SY82	7UT82	6MD84	6MD85	6MD86	6MU85	7KE85	7SA86	7SA87	7SD86	7SD87	7SJ85	7SJ86	7SK85	7SL86	7SL87	7SS85	7SX85	7UM85	7UT85	7UT86	7UT87	7VE85	7VK87	7VU85
Arc-suppression Coil (ASC) Control See Highlighted Topics for detailed information.	-	-	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	X	-	X	X	X	X	-	-
Line Differential Protection: Enhanced sensitivity for stages IN-DIFF and I2-DIFF Improved stabilization algorithm to allow a higher sensitivity for high resistive earth faults compared to the I-DIFF stage.	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	-	-	-	X	X	-	X	-	X	X	X	-	-		
Subsynchronous Resonance (SSR) Detection See Highlighted Topics for detailed information.	-	X	X	-	-	-	X	-	-	X	X	X	X		X	X	X	X	X		X	X		X	X	X	X						
7SS85 Distributed Busbar Prot.: Exchange of user defined SPS indications between 7SS85 CU and Bay Units User defined SPS indications from the Bay Units to the 7SS85 Central Unit and from the 7SS85 Central Unit to the Bay Units without IEC 61850 GOOSE. Only for 7SS85 CU (significant feature = F, G, H, J or K).	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7SS85 Distributed Busbar Prot.: Health indication of functions in the Bay Units available in the 7SS85 CU The health indication of the functions 50BF Inherent, 50BFAd.CBF, 50 EF 3pole and Ext. trip BZ in the Bay Units is shown as External Health in the 7SS85 Central Unit. Only for 7SS85 CU (significant feature = F, G, H, J or K).	-	-	-	-	-	-	-	-	-	-	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

* C: Compact devices

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SIPROTEC 5 V9.90 - News
Essential new functionalities

Essential new functionalities	C* 7SX800	7SA82	7SD82	7SJ81	7SJ82	7SK82	7SL82	7SX82	7SY82	7UT82	6MD84	6MD85	6MD86	6MU85	7KE85	7SA86	7SA87	7SD86	7SD87	7SJ85	7SJ86	7SK85	7SL86	7SL87	7SS85	7SX85	7UM85	7UT85	7UT86	7UT87	7VE85	7VK87	7VU85
7SS85 Distributed Busbar Prot. (IEC 61850 Compliant): Compatible with measurements without IN See Highlighted Topics for detailed information.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
7SY82: Release of further functions New additional functions can be configured: • ANSI 37 – Undercurrent protection [I<] • ANSI 46 – Negative-sequence overcurrent protection [I2>] • Directional intermittent ground-fault protection [Iie dir>] • ANSI 87N – Restricted ground-fault protection [ΔIN] • ANSI 90V – Automatic voltage controller for two-winding transformer • CEI 016 protection functions Motor protection functionality is now covered: • ANSI 48,14 – Starting-time supervision for motors, Locked rotor [I²start, I> + n<] • ANSI 49R – Thermal overload protection (motor) [θR] • ANSI 50L – Load-jam protection [I>L] • ANSI 66 – Restart inhibit for motors [I2t]	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* C: Compact devices

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SIPROTEC 5 V9.90 - News
Essential new functionalities

Essential new functionalities	C* 7SX800	7SA82	7SD82	7SJ81	7SJ82	7SK82	7SL82	7SX82	7SY82	7UT82	6MD84	6MD85	6MD86	6MU85	7KE85	7SA86	7SA87	7SD86	7SD87	7SJ85	7SJ86	7SK85	7SL86	7SL87	7SS85	7SX85	7UM85	7UT85	7UT86	7UT87	7VE85	7VK87	7VU85
IEEE C37.118 - PMU: Support of Time Quality Bit — Support the Time Quality Information as defined in IEEE C37.118.2 (2011) when the time source is IEEE 1588v2 PTP.	-	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IEEE C37.118 - PMU: Transmission of Measured Values — See Highlighted Topics for detailed information.	-	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Modbus RTU and Modbus TCP: Modbus Client functionality — See Highlighted Topics for detailed information.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Process Bus: Redundant Sampled Values by the Process Bus Client function — See Highlighted Topics for detailed information. X¹: Only 7SS85 (significant feature = 9, A, B, C, D or E)	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X¹	X	X	X	X	X	X	X	X
Process Bus: 7SX82 compatible with Process Bus applications — See Highlighted Topics for detailed information.	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Web-UI: Extension for binary outputs — Display also the physical status of the binary outputs based on the IEC 61850 Mod, for a better commissioning support.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Non-modular devices: 7SA82 ... 7UT82

Modular devices: 6MD84 ... 7VU85

* C: Compact devices

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SIPROTEC 5 V9.90 - News
Tools

DIGSI 5 V9.90

The engineering tool DIGSI 5 in the version V9.90 replaces the predecessor versions and is compatible with all SIPROTEC 5 devices.

Focus topics in V9.90 are:

Typical Based Engineering for IEC 61850 (step 2)

- See Highlighted Topics for detailed information

Engineering of Modbus Client functionality

Usability Improvements

- Allow archive saving without process data (reduces archive size significantly)
- Easier access to protocol settings: New Editor (especially useful for SIPROTEC 5 Compact devices)

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SIPROTEC 5 V9.90 - News
Tools

SIPROTEC Tools V2.20

SIPROTEC Tools in the version V2.20 replaces the predecessor versions.

Focus topics in V2.20 are:

Usability Improvements

- Possibility to test wirings of 7SY82 devices with SIBushing (Low Power Instrument Transformer – LPIT sensors in the bushing)
- Upgrade directly old firmware to newest version, for a better serviceability

SIPROTEC & SICAM Function Point Manager

No news.

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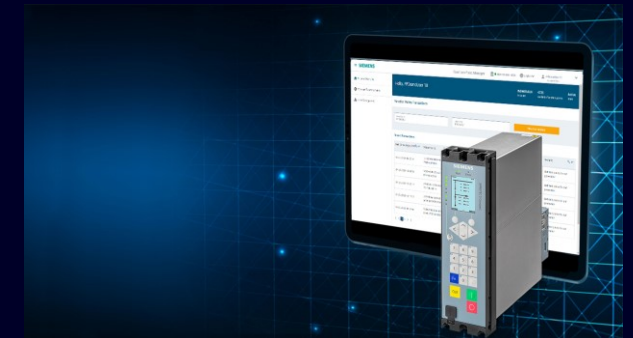
SIPROTEC 5 V9.90

Highlighted Topics

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SIPROTEC 5 V9.90 - News
Arc-suppression Coil (ASC) Control

The **Arc-Suppression Coil (ASC) Control** (also known as **Petersen Coil Control**) is now available and can be easily integrated into the **SIPROTEC 5** devices, **saving** a dedicated ASC Control physical device.

ASC is used to compensate the capacitive ground fault current at the fault position by a similarly large inductive current when a single phase-to-ground fault occurs.

In this way an arc at the fault position will be suppressed and the ground fault can even extinguish by itself.

To **enhance the reliability and stability** of medium and high-voltage networks by effectively managing the ASC, a control device is required to adjust the inductance of the ASC in real-time, significantly reducing fault currents and preventing potential damage to the system.
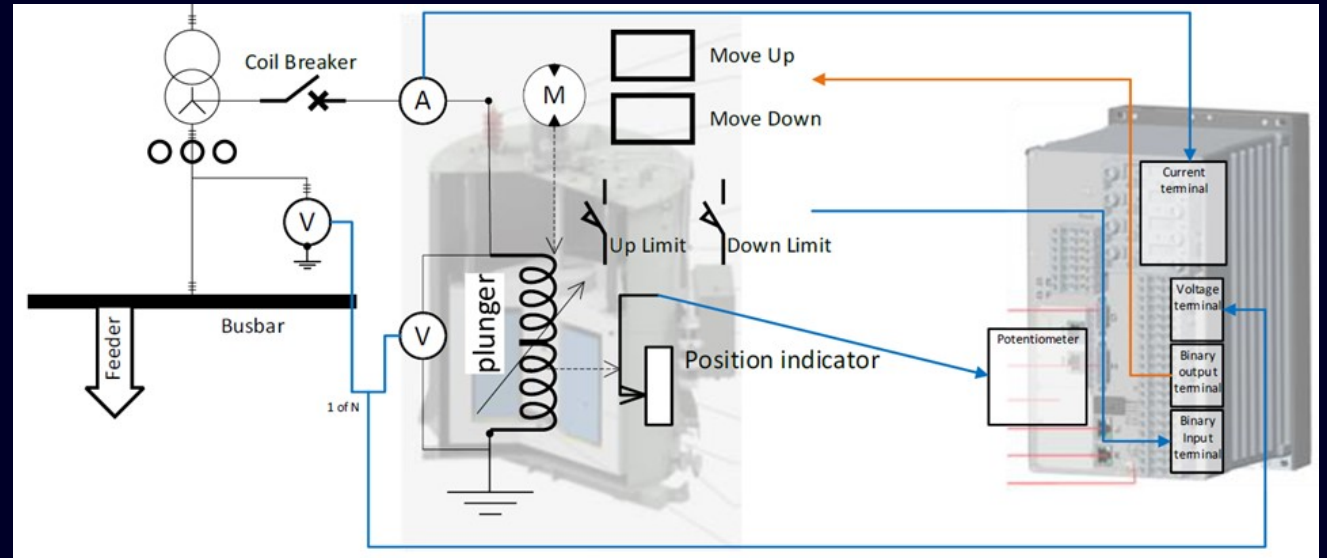
The Coil position is detected by a measuring-transducer input, e.g. the "**ANAI-CE-2EL Revision 2**" module with potentiometer input

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SIPROTEC 5 V9.90 - News
Subsynchronous Resonance (SSR) Detection

Prevent your installation from **being damaged** by **Subsynchronous Resonance (SSR)** using the SSR Detection available **on SIPROTEC 5 devices**.

SSR is a complex and dynamic phenomenon in power systems where electrical networks interact with power plants.

SSR refers to the condition where the electric network exchanges energy with a turbine-generator shaft at a frequency lower than the fundamental frequency of the system and **can cause serious mechanical and electrical problems**.

SSR leads to **oscillations at a frequency below the synchronous frequency of the system**, which is typically 50 Hz or 60 Hz.

Bild 3

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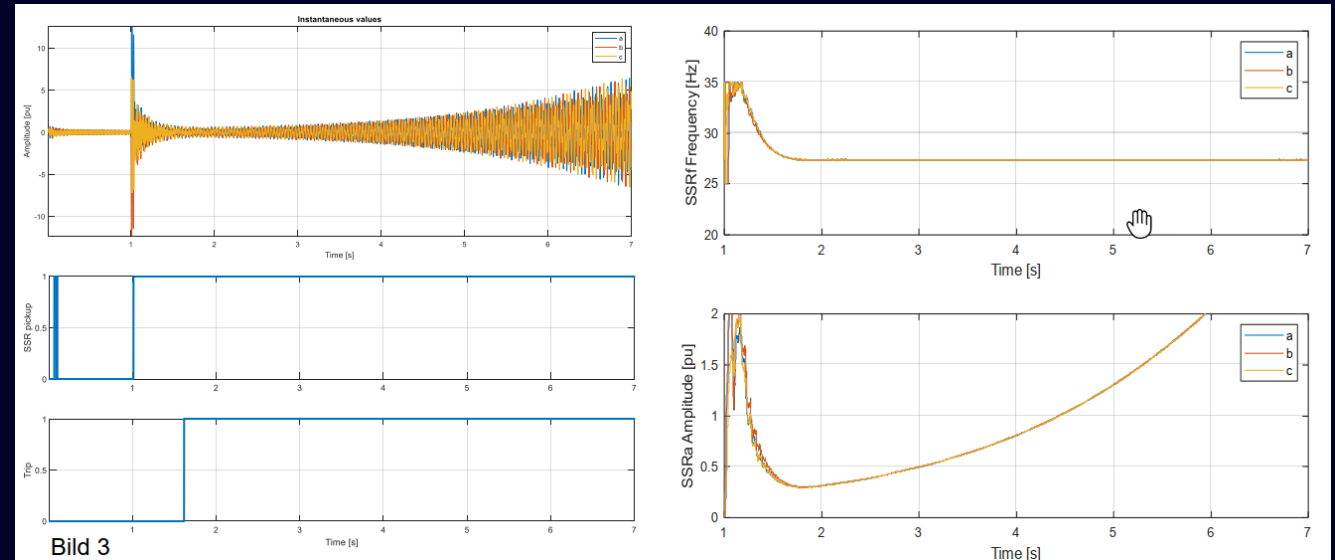
SIPROTEC 5 V9.90 - News
Subsynchronous Resonance (SSR) Detection

Power plants with long shafts are critical, such as steam, gas, and nuclear power plants.

Due to the increased installation of wind-power plants, incidents on **wind turbines** with doubly-fed induction generators (DFIGs) and **full converters** are also possible.

Power electronic components in the primary system can also generate subharmonic oscillations.

The function Subsynchronous Resonance (SSR) Detection provides the following functionalities:

• Detect the subsynchronous resonance in the power system

• Trip the generator or the power system to prevent its damage in a critical case
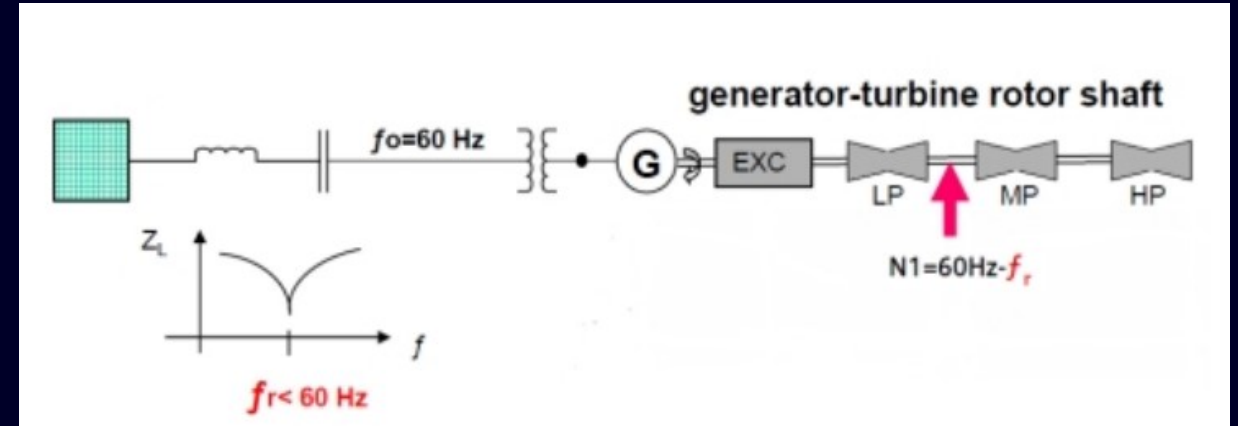
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SIPROTEC 5 V9.90 - News
7SS85 Distributed Busbar Prot. (IEC 61850 Compliant): Compatible with measurements without IN

The **7SS85 busbar protection device as distributed busbar protection (IEC 61850 Compliant)** system now also accepts current-measuring points without neutral current, bringing several benefits such as:

- **Increase of the compatibility with 3rd party Merging Units** as some vendors don't support the neutral current
- **Save costs in medium voltage applications** where the device's current terminal has phase current inputs with a protection class and neutral current input with a measurement/sensitive class

It is recommended that **high voltage applications** use current-measuring points "3-phase + IN" having 4 current inputs (Ia, Ib, Ic, In) with protection class to allow the additional security of the ADC supervision against wrong tripping.
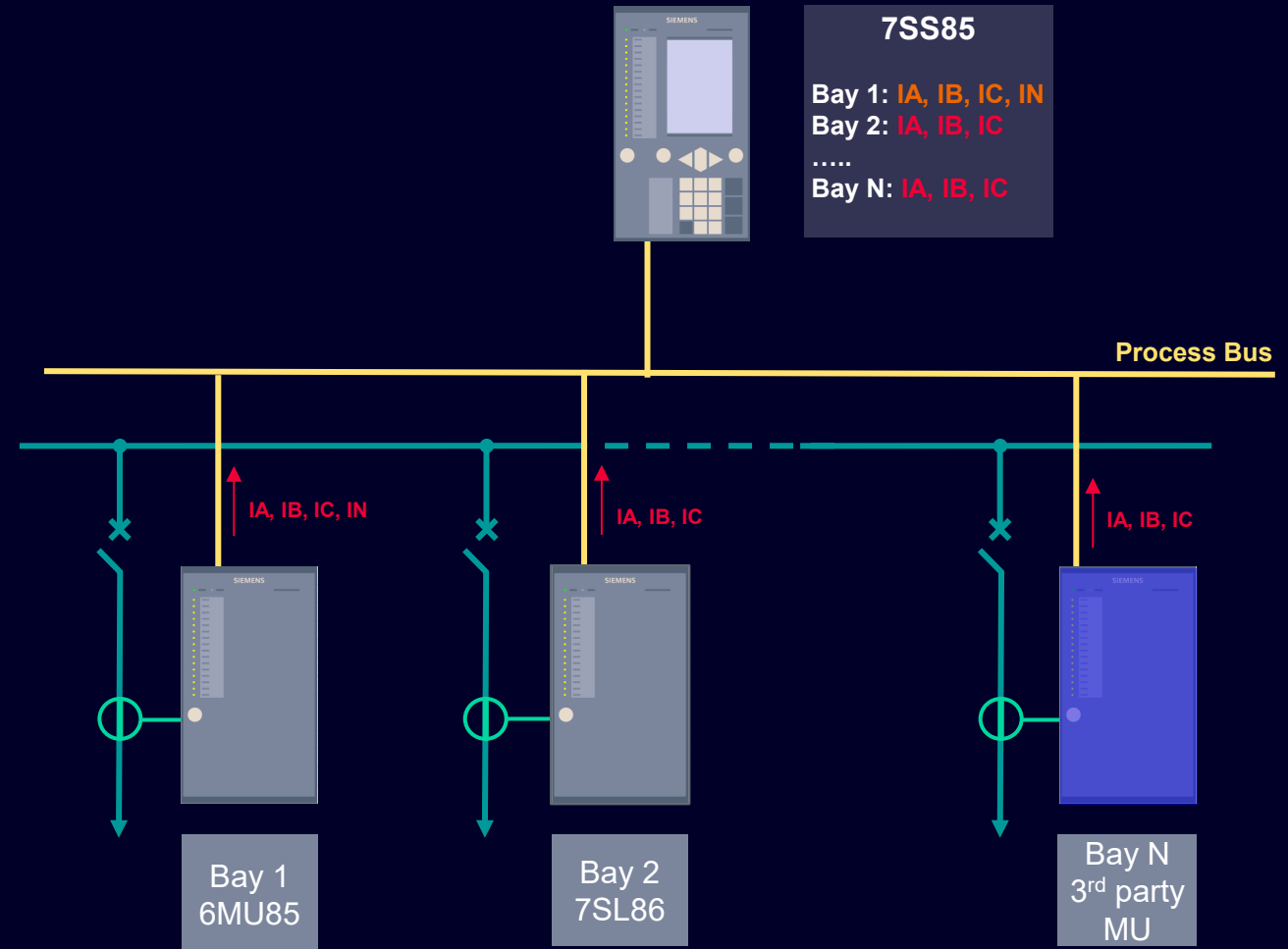
7SS85

Bay 1: IA, IB, IC, IN
Bay 2: IA, IB, IC
.....
Bay N: IA, IB, IC

Process Bus

IA, IB, IC, IN

IA, IB, IC

IA, IB, IC

Bay 1
6MU85

Bay 2
7SL86

Bay N
3rd party
MU

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SIPROTEC 5 V9.90 - News
7SS85 Distributed Busbar Prot. (IEC 61850 Compliant): Compatible with measurements without IN
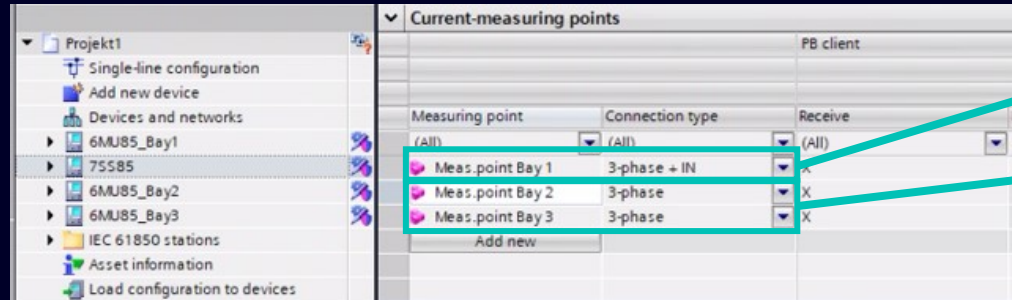
DIGSI 5: Example of Measuring-points routing configuration

Current-measuring point "3-phase + IN"

Current-measuring point "3-phase"

Current-measuring point "3-phase + IN"

Current-measuring point "3-phase"
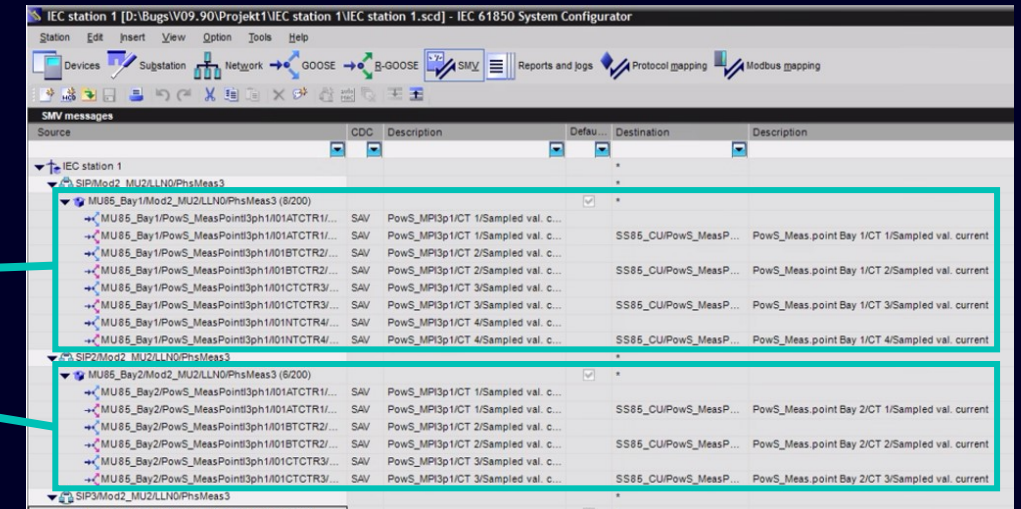
IEC 61850 System Configurator: Example of SMV messages configuration

The 7SS85 busbar protection device as Distributed Busbar Protection system with the 7SS85 as the Central Unit (CU) and other SIPROTEC 5 devices, the Merging Units (MU) as Bay Units, still supports only the current-measuring points "3-phase + IN".

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SIPROTEC 5 V9.90 - News
IEEE C37.118 - PMU: Transmission of Measured Values

Phasor Measurement Units (PMU) measure complex voltage and current phasors.

Together with the values of power frequency and power frequency change rate, all values get a high precision time stamp and are **transmitted via Ethernet to a Phasor Data Concentrator (PDC)** that stores and evaluates the phasors of different PMUs.

The standardized transmission protocol **IEEE C37.118** is used to do this.

Additionally, it has already been possible to transmit optional binary data (up to 80 per PMU function group) since the release of the PMU protocol on SIPROTEC 5 devices.

But now it brings even greater flexibility by allowing **any Measured Value (MV)** (up to 60 per PMU function group) available on the SIPROTEC 5 device to be **transmitted to the PDC**.

In this way, the PDC can monitor binary data and measured values in addition to bringing even **more power and flexibility** to mitigate the consequences of disturbances, for systemic network protection applications, among others.
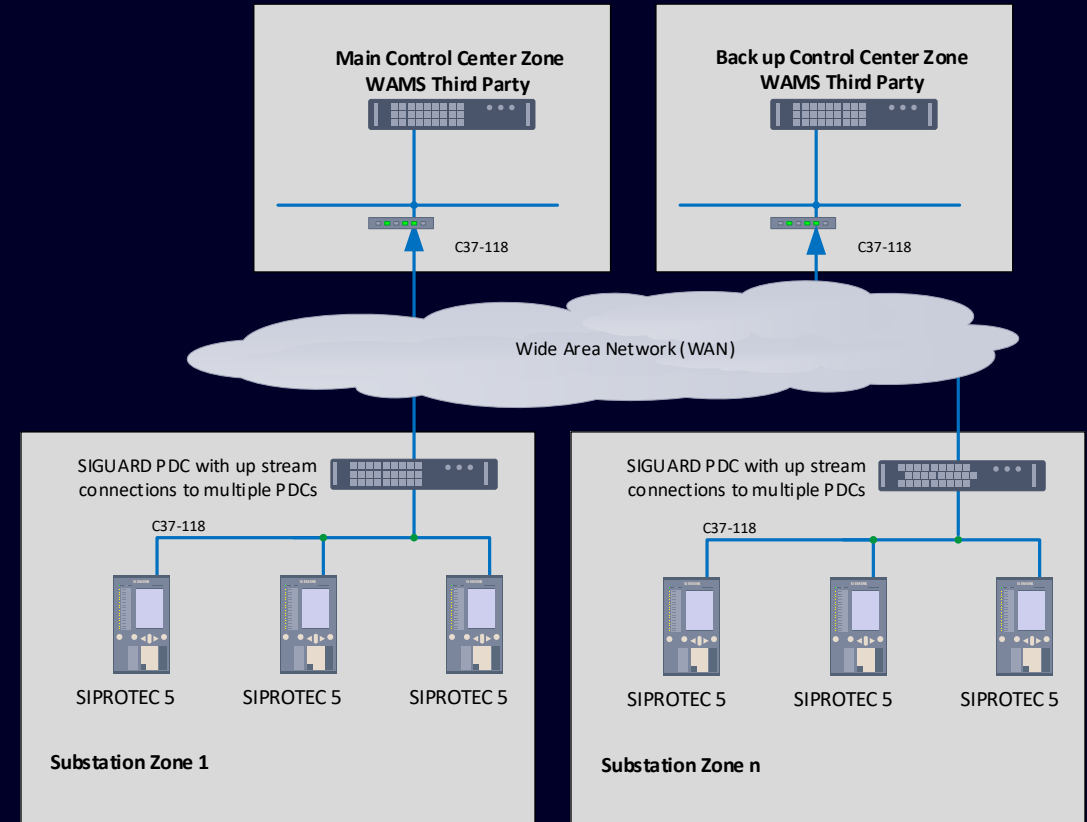
Example of PMU protocol use case with SIGUARD PDP in Station Level like PDC

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SIPROTEC 5 V9.90 - News
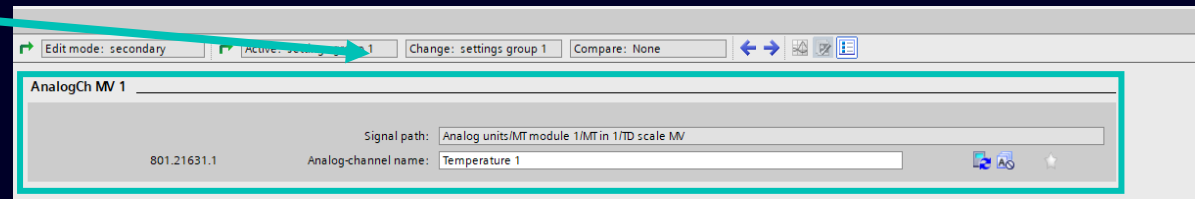## IEEE C37.118 - PMU: Transmission of Measured Values

The **configuration of Measured Values to be transmitted** by SIPROTEC 5 devices via the PMU protocol can be done very simply and easily in just **3 steps**:

1. New Column "PMU" appears in Information Routing matrix when Function Group PMU is activated

2. You can route each measurement of type "MV" to PMU protocol

3. Name the measurements in the PMU settings

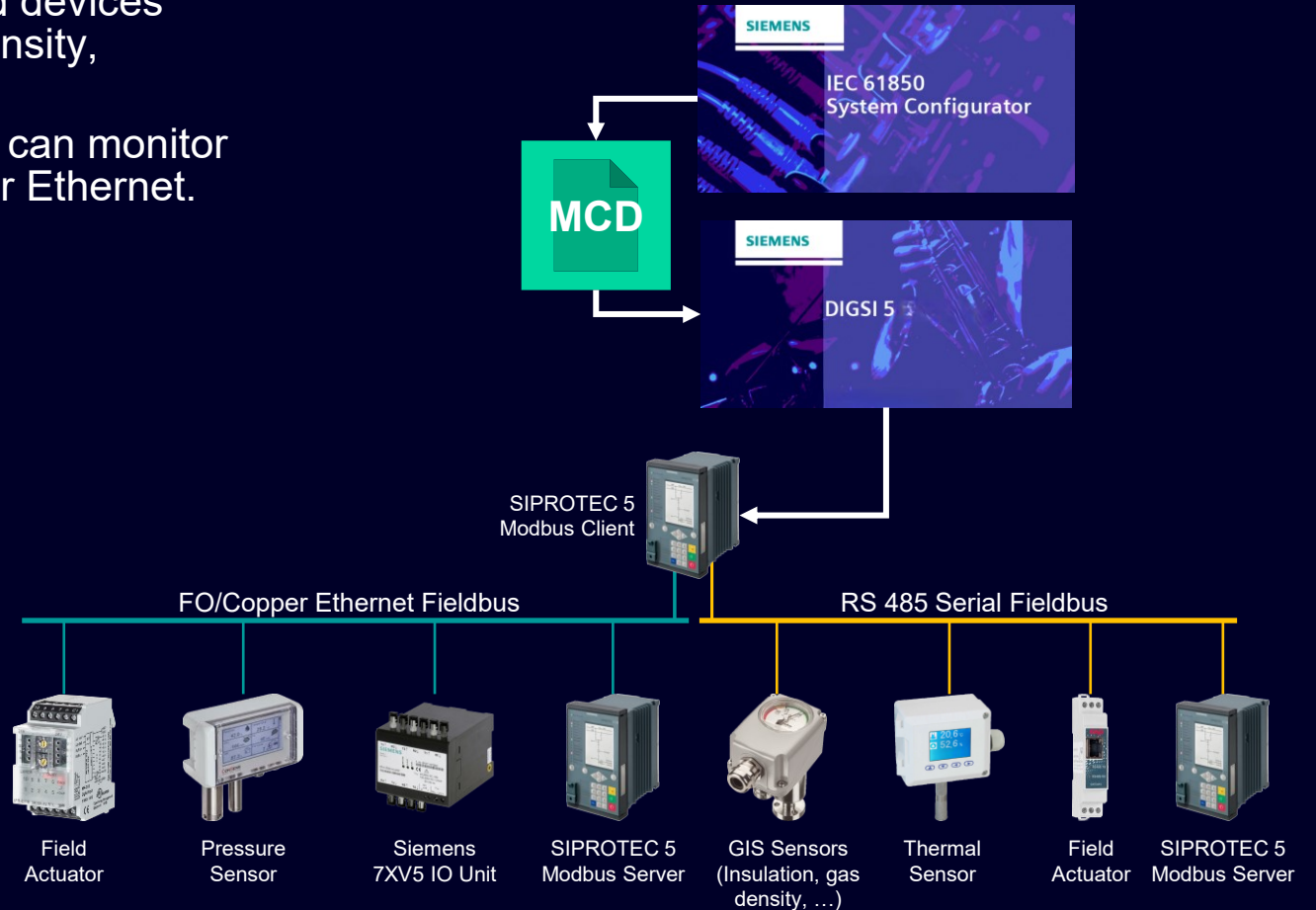**SIEMENS**

SIPROTEC 5 V9.90 - News
Modbus RTU and Modbus TCP: Modbus Client functionality

Modbus is historically widely applied for field sensors and devices that measure: voltage, current, temperature, pressure, density, viscosity, position, speed, among others.

With **Modbus Client functionality** SIPROTEC 5 devices can monitor and control such field sensors and devices, either serial or Ethernet.

Possible benefits and applications are as follows:

- **Expansion of SIPROTEC 5 devices** with additional binary inputs, binary outputs, analog inputs, temperature inputs, …

- Motor, Generator, turbine Control schemes for **industrial and generation applications**

- **Station level custom control applications** like load shedding or fast automatic transfer switching based on data from SIPROTEC 5 or other devices

- **Controlling and monitoring legacy devices** with Modbus RTU or Modbus TCP when SIPROTEC 5 device is used as bay controller

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IEC 61850
System Configurator

MCD

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DIGSI 5

SIPROTEC 5
Modbus Client

FO/Copper Ethernet Fieldbus   RS 485 Serial Fieldbus

Field Actuator | Pressure Sensor | Siemens 7XV5 IO Unit | SIPROTEC 5 Modbus Server | GIS Sensors (Insulation, gas density, …) | Thermal Sensor | Field Actuator | SIPROTEC 5 Modbus Server

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SIPROTEC 5 V9.90 - News
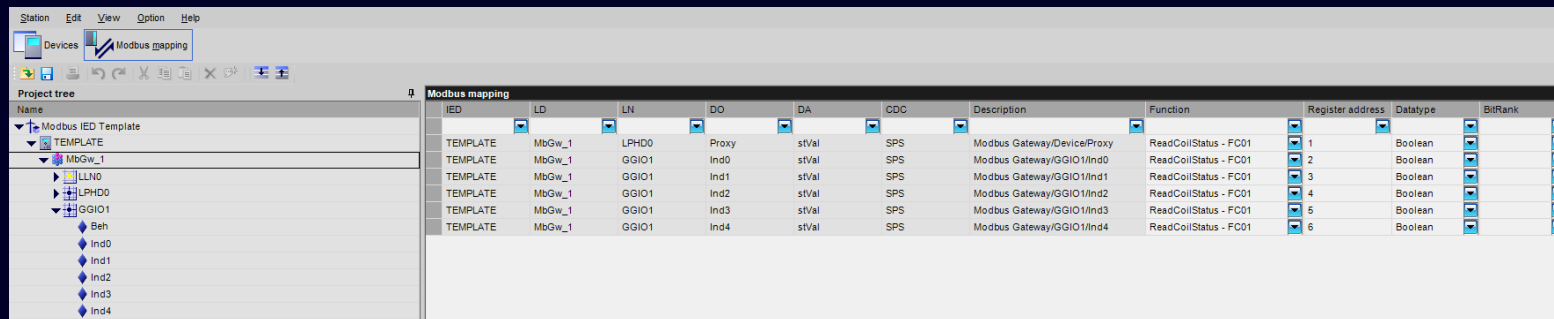## Modbus RTU and Modbus TCP: Modbus Client functionality

In the present use of **Modbus**, there is no standardized method for the exchange of data point coding types and their addressing.

The exchange of such technical information has generally been through the exchange of documents (e.g. Excel or PDF files) that define the addresses of a Modbus server in a human-readable form.

The concept of the **Modbus Configuration Description - MCD** was introduced with **IEC 61850-80-5** to solve this problem and additionally map the Modbus server address space to the IEC 61850 gateway data model.

If MCD files are available or generated for each device type, the engineering process can be faster and less error prone.

The Siemens **IEC 61850 System Configurator** is the **first vendor agnostic IEC 61850-80-5 compliant tool** for **creating MCD files** for any Modbus server device:

IEC 61850 System Configurator: Example of Modbus mapping configuration
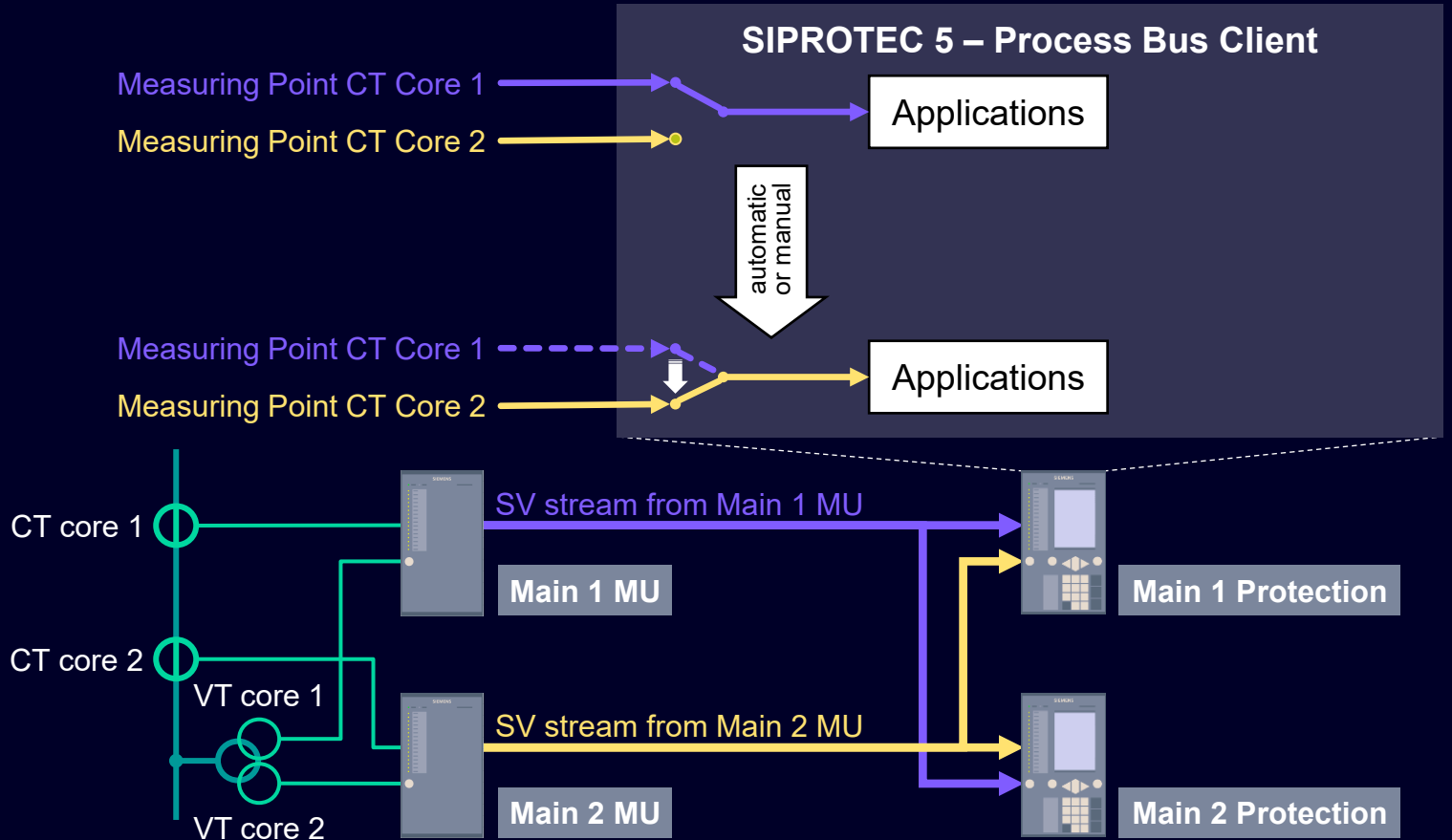
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SIPROTEC 5 V9.90 - News
Process Bus: Redundant Sampled Values by the Process Bus Client function

The **redundant Sampled Values subscription** available* now on SIPROTEC 5 devices bringing several benefits such as:
- **Increased availability**
- **Operational flexibility**
- **Easy upgrade** of existing configuration

Some examples of **applications**:
- **Switching of individual measuring points** rather than complete SV stream
- **Automatic switching modes** for automated change to the healthy measuring point due bad quality, missing stream, …, to prevent blocking protection functions
- **Manual switching** for maintenance or operational purpose

SIPROTEC 5 – Process Bus Client

Measuring Point CT Core 1 → Applications
Measuring Point CT Core 2

automatic or manual

Measuring Point CT Core 1 → Applications
Measuring Point CT Core 2

CT core 1 — Main 1 MU — SV stream from Main 1 MU → Main 1 Protection
CT core 2
VT core 1
VT core 2 — Main 2 MU — SV stream from Main 2 MU → Main 2 Protection

* All modular SIPROTEC 5 devices support redundant subscription of sampled values streams except 6MD84, 7KE85 and 7SS85 CU (significant feature = F, G, H, J or K).
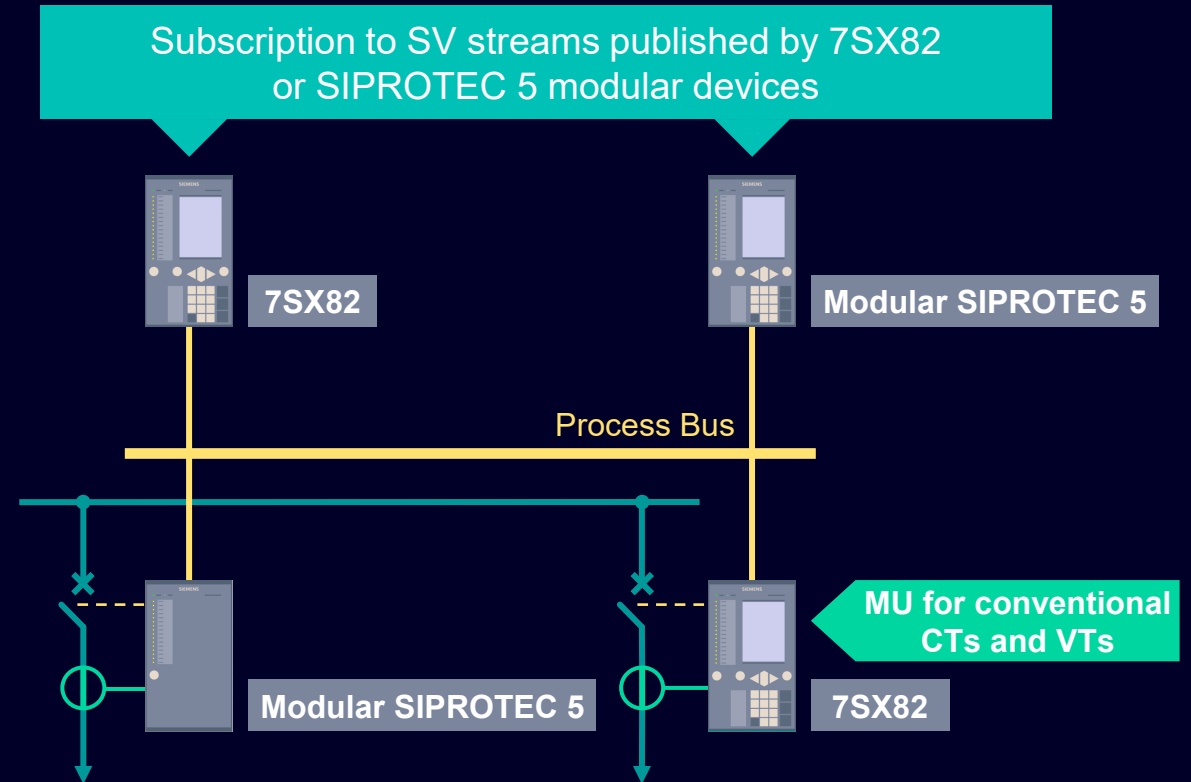
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SIPROTEC 5 V9.90 - News
Process Bus: 7SX82 compatible with Process Bus applications

With this **new SIPROTEC 5 option** for Process Bus applications, it is possible to bring the flexibility of the universal devices with **cost savings**.

The **Non-modular Universal Protection device 7SX82** can be used* with the same features already available in the modular SIPROTEC 5 devices:

- **IEC 61850 Edition 2.1 compliant**
- ETH-BD-2FO as access point required
- Publishing of Sampled Values streams (**IEC 61850-9-2 Merging Unit function**)
- Subscription of Sampled Values streams (**IEC 61850-9-2 Process Bus Client function**)
- Two **supported stream types** (IEC 61850-9-2 LE and IEC 61869-9 flexible streams)
- **Sample synchronization** can be via IEEE 1588v2/PTP, IRIG-B, Optical or electrical PPS

Subscription to SV streams published by 7SX82 or SIPROTEC 5 modular devices

7SX82

Modular SIPROTEC 5

Process Bus

Modular SIPROTEC 5

MU for conventional CTs and VTs

7SX82

* Only the 7SX82 devices with the universal power supply are compatible with the ETH-BD-2FO.

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SIPROTEC 5 V9.90 - News
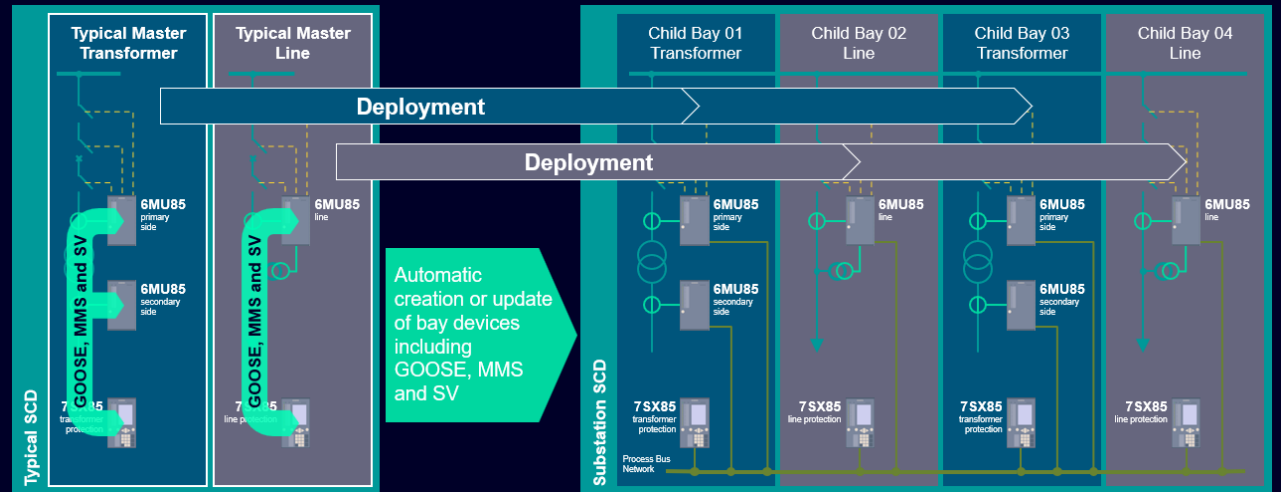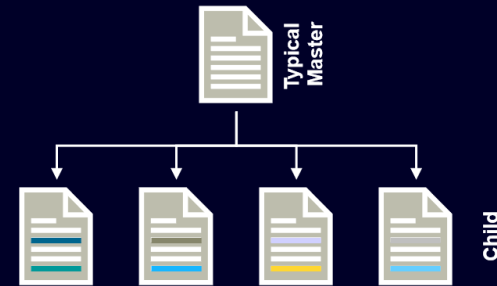## DIGSI 5: Typical Based Engineering for IEC 61850 (step 2)

The **Typical Based Engineering** step 1 was released in V9.80 allowing typical and child devices contain the sender IEC61850 datasets for GOOSE, SMV and reports.

With V9.90 this functionality **is now complete**, accelerating the engineering process of a Digital Substation using the full concept of **Typical Based Engineering**:

1. Develop and configure the "Typical Master" devices
2. Derive the "Child" devices based on the "Typical Master" device
3. Configure the "Child" specific settings, if they are not identical

By applying this concept, it is possible to bring **several benefits** such as:

• Reduce error rate

• Faster adaptation to changes, which apply to all devices of a typical

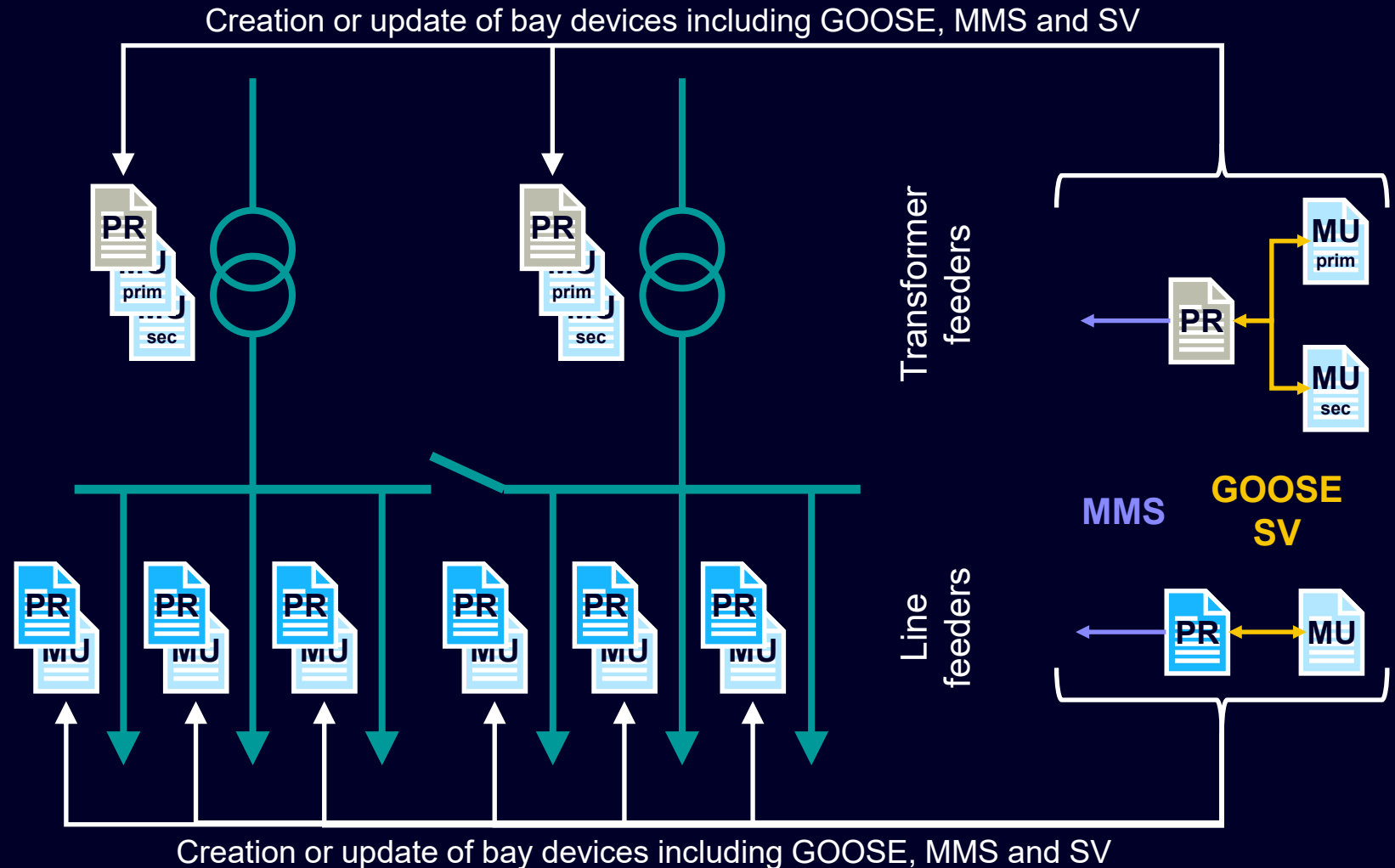• Version management allows to return to previous configurations

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SIPROTEC 5 V9.90 - News
DIGSI 5: Typical Based Engineering for IEC 61850 (step 2)

The concept of **Typical Based Engineering** can be easily applied through just **5 steps**:

1. Develop and configure the "typical master" device
2. Generate GOOSE messages, Sampled Values (SV) and reports (MMS) within a "Typical System Configuration Description (SCD)"
3. Derive the "child" devices based on the "typical master" devices
4. Transfer the GOOSE messages, SV and reports from the "Typical SCD" into the Substation SCD for the "child" devices
5. Create GOOSE and SV required across the typicals

Creation or update of bay devices including GOOSE, MMS and SV

Transformer feeders

Line feeders

MMS

GOOSE SV

Creation or update of bay devices including GOOSE, MMS and SV

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