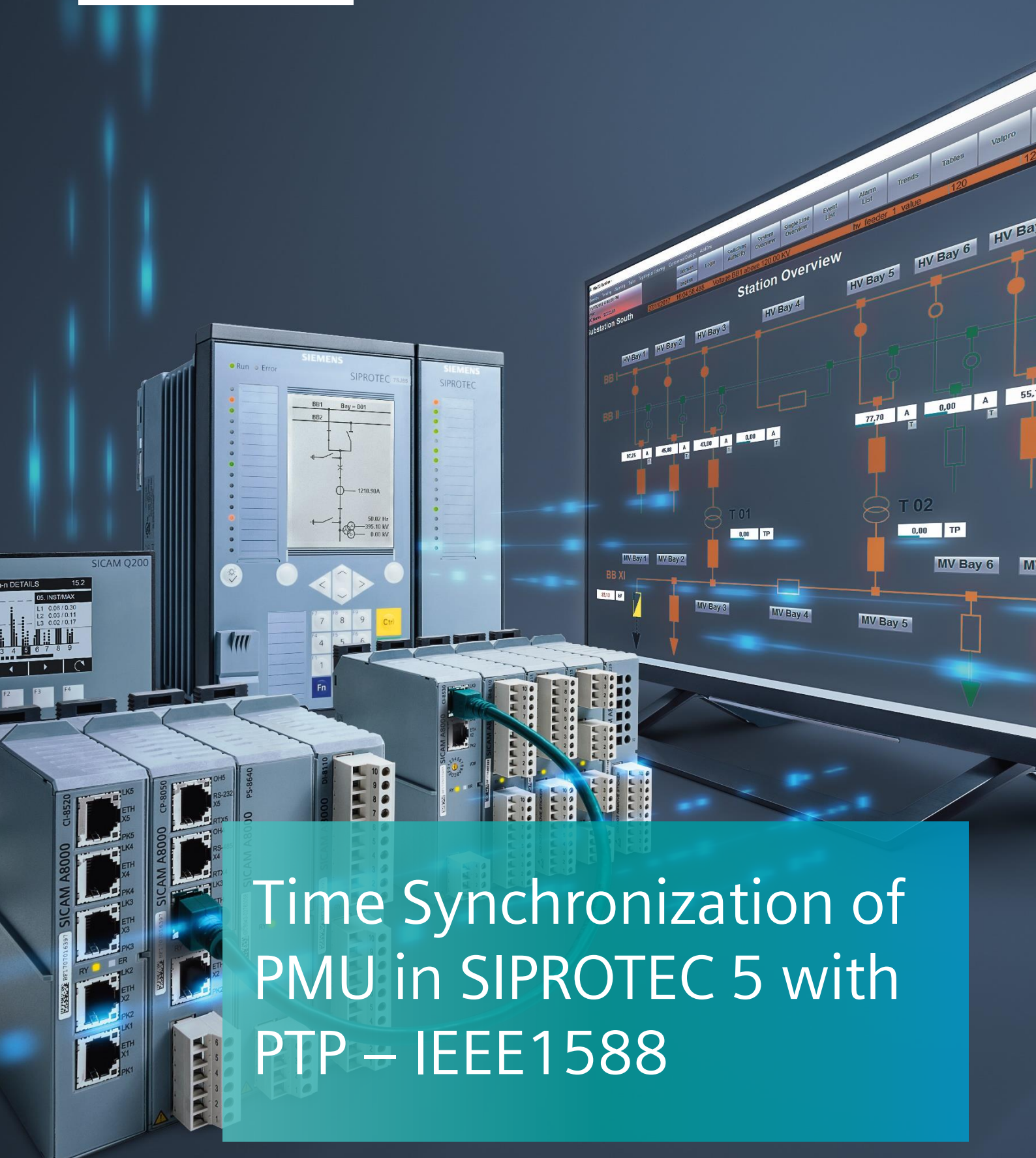


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Time Synchronization of PMU in SIPROTEC 5 with PTP – IEEE1588

SIPROTEC 5 Application

Time Synchronization of Phasor Measurement Unit (PMU) with PTP – IEEE1588

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APN-064, Edition 1

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1 Time Synchronization of Phasor Measurement Unit (PMU) in SIPROTEC 5 with PTP – IEEE1588

1.1 Introduction

This document describes how to build up a SIPROTEC 5 PMU with IEEE1588 PTP time synchronization for SIPROTEC 5 V7.90.

The selection of the PMU function in SIPROTEC 5 itself is described in the SIP-APN-037 and the basics of time synchronization via IEEE 1588 in the SIP5-APN-028 which are also published in the Internet.

1.2 Definition IEEE1588 and PMU

IEEE1588 is standardized and contains the precision time protocol (PTP). It is a network protocol which secure the synchronism of the time settings of all devices within a network with the focus on high accuracy in a local defined network. The precise time synchronization is necessary to permit the accurate reconstruction of an event from operational logs of different devices or for high-precision applications like Phasor Measurement Unit (PMU) and IEC 61850 process bus.

A **Phasor Measurement Unit (PMU)** measures the phasor values of current and voltage, as well as the values of power frequency and rate of change of frequency (ROCOF). This data will be combined with high precision time stamp.

The measured data are transmitted to a central analysis station (Phasor Data Concentrator, PDC) in accordance to the standardized transmission protocol IEEE C37.118.

A PMU can be a stand-alone physical unit or a functional unit within another physical unit.

The Total Vector Error (TVE) describes the error between the actual and the measured values of the input signal of the PMU device.

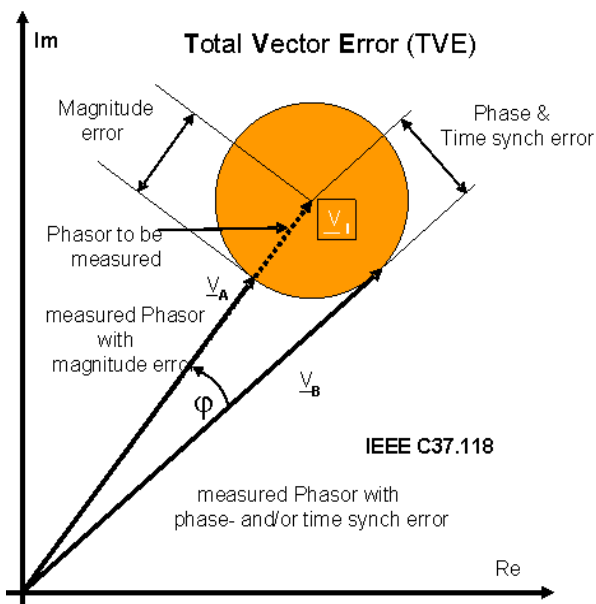


Figure 1: Total Vector Error (TVE)

Both amplitude and phase angle error must be considered for synchrophasor accuracy.

In the Standard IEEE C37.118 the allowed TVE is limited to 1 %.

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Time Synchronization of Phasor Measurement Unit (PMU) with PTP – IEEE1588

1.3 New with SIPROTEC 5 V7.90

A new Ethernet fiber optic module ETH-BD-2FO has been released with SIPROTEC 5 V7.90 which supports the high precision time synchronization according IEEE1588. This module does not support the IEEE C37.118 protocol for synchro phasor communication, therefore a second communication module (e.g. ETH-BA-2EL) is necessary for the Function Group PMU. See Fig. 1.

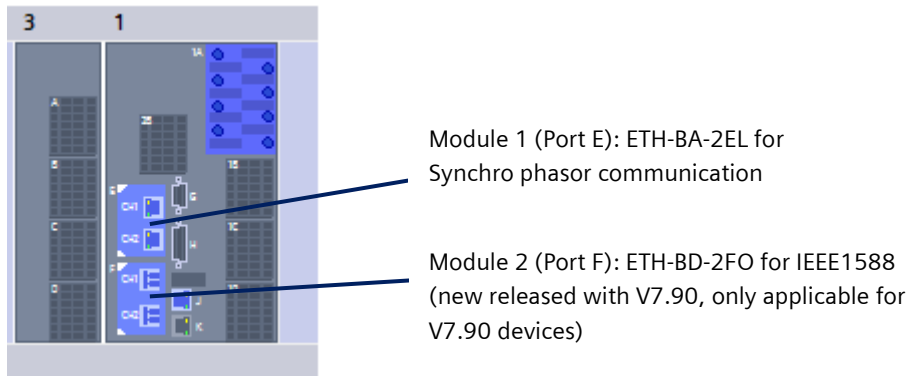


Fig. 1: SIPROTEC 5 device requirements: ETH-BD-2FO and ETH-BA-2EL for Synchro phasor application with IEEE1588 Settings in DIGSI 5: No specific issues.

Configuration of the PMU on Module 1 and selection of IEEE1588 time sync for module 2. See Fig. 2.

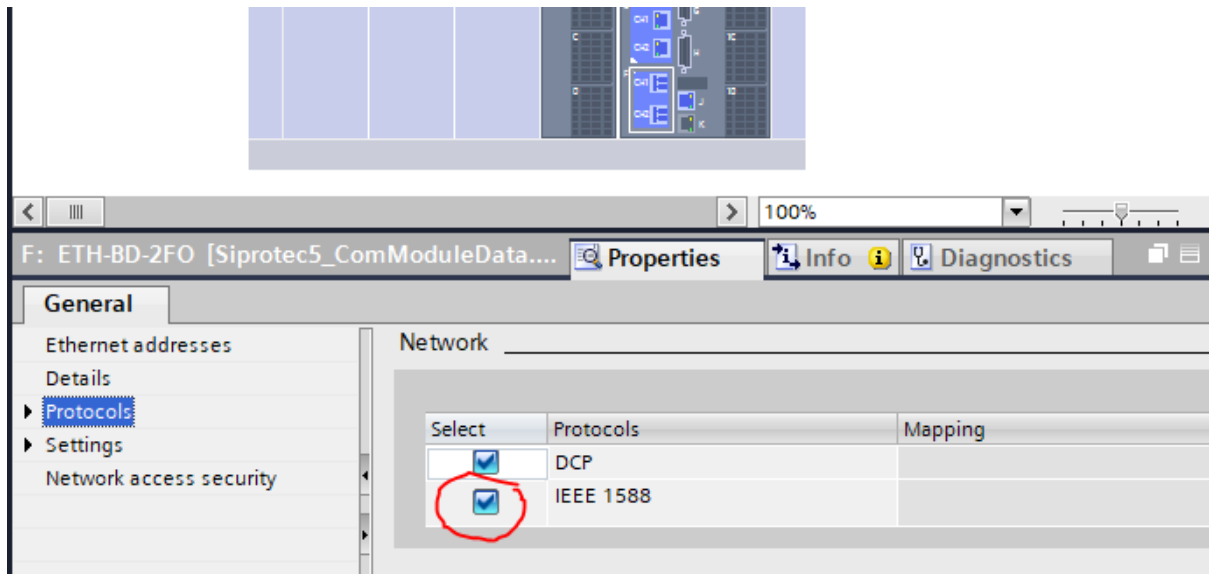


Fig. 2: Configuring IEEE1588 on Module 2.

Next step is to select Port F / IEEE1588 for the device's time sync (via settings-time settings dialogue, see Fig. 3).

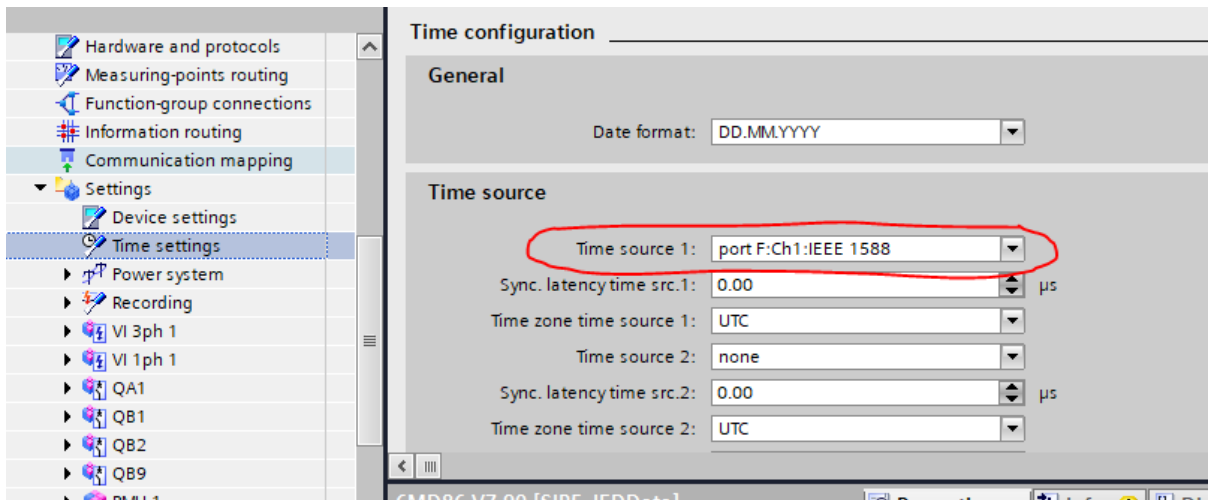


Fig. 3: Configuration of IEEE1588 time sync

Note: In current version, IEEE1588 can only be selected for Time source 1 (not as Time source 2).

As a last step, make sure that “domain number” in IEEE1588 settings is the same as set in the switch (Fig. 4). You can find the domain number in the IEEE1588 settings of the communication module (accessible in the DIGSI 5 “Hardware and protocols” Editor).

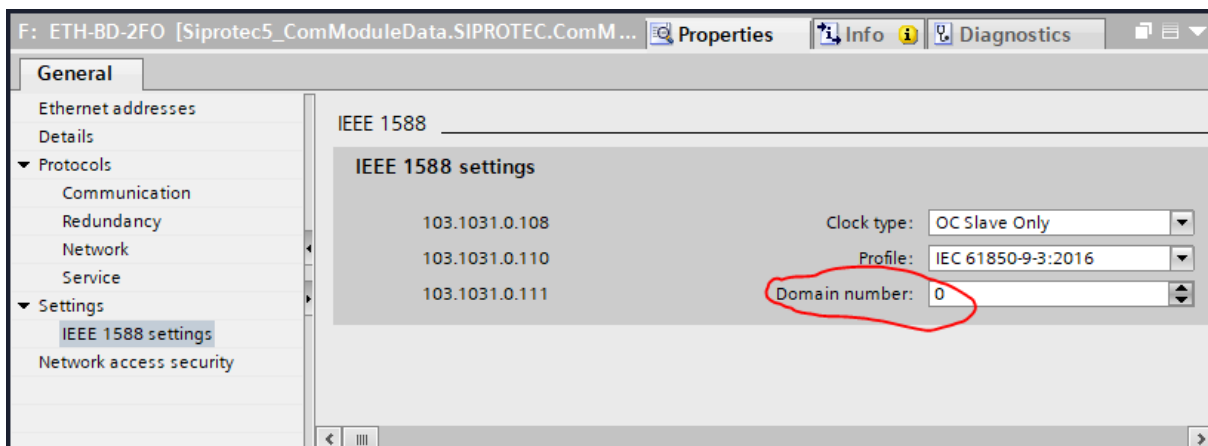


Fig.4: Setting of domain number

It is necessary to use switches which supports the Precision Time Protocol (PTP), so that the PMU can fulfill the 1% Total Vector Error (TVE) Requirement, e.g. [Ruggedcom RSG2488](http://www.ruggedcom.com/products/rsg2488)

Note: PTP currently is only possible for star structure (PRP and Dual Homing).

1.4 Conclusion

All SIPROTEC 5 devices can have integrated measuring of synchro phasors (Function Group PMU) and can transmit those synchro phasors via IEEE C37.118 communication to a Phasor Data Processor like SIGUARD PDP in order to automatically detect power swings and trigger alarms.

By selecting the new Ethernet fiber optic module ETH-BD-2FO released with SIPROTEC 5 V7.90 the high precision time synchronization according IEEE1588 is configurable, replacing the IRIG-B telegram from GPS clock.

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