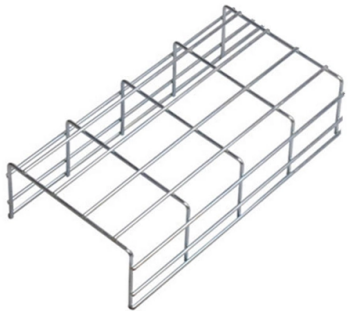
Time synchronization algorithm for relay protection devices



Overview

TIME SYNCHRONISATION USING ABB RELAYSABB has used the strengths of the protocol and the IED design to allow the maximum flexibility in selection of a time.

Key Takeaways

Accurate time synchronization is critical for relay protection systems to ensure coordinated operation, precise fault analysis, and reliable power system monitoring.

Importance of Time Synchronization

Relay protection equipment and other Intelligent Electronic Devices (IEDs) rely on a common time reference to accurately record events, measure phase angles, and coordinate protection actions. Without synchronized clocks, event logs from different devices cannot be correlated, leading to misinterpretation of faults, delayed responses, or misoperation of protection functions. In digital substations, especially those using IEC 61850 process bus, precise timing ensures that voltage and current measurements from multiple merging units are correctly aligned.

Methods and Protocols1. Precision Time Protocol (PTP)PTP, defined in IEC 61588 and used in IEC 61850-9-3, is the preferred method for high-accuracy synchronization. It allows devices to synchronize over Ethernet networks with nanosecond-level precision.

PT



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P supports multiple clock types: Grandmaster Clock (GM): Provides the primary time reference. Boundary Clock (BC): Acts as a slave to one domain and master to another. Transparent Clock (TC): Measures and corrects packet delays to improve accuracy.

PT

P can seamlessly switch between multiple master clocks and is compatible with GNSS clocks for global time traceability. 2. Global Navigation Satellite System (GNSS) ClocksGNSS clocks provide a global time reference for protection relays and merging units.

They are essential for applications like phasor measurement units (PMUs), line-differential protection, and traveling-wave fault location, where absolute time accuracy is critical. 3. One Pulse Per Second (1PPS)1PPS signals can be used for synchronization, often in combination with GNSS clocks.

While simpler than PTP, 1PPS is less flexible for networked systems and does not inherently support multiple master clocks. 4.

Protocol-

Based Synchronization

Some IEDs use communication protocols like DNP 3. 0, Modbus, or SNTP to synchronize internal clocks. Accuracy depends on the protocol and network conditions: Protocol-based synchronization can achieve millisecond-level accuracy.

Dedicated channels like IRIG-B or GPS signals provide higher precision than general network-based methods.

Implementation Considerations

Accuracy Requirements: Protection and control applications may require microsecond-level synchronization to avoid phase-angle errors and misoperation. Redundancy: Multiple master clocks or GNSS sources improve reliability in case of failure. Retrofitting Existing Relays: Time synchronization can be applied to already installed devices using external timing sources, ensuring all devices share a common time base.

Network Traffic and Processing Delays: When using protocol-based synchronization, variations in network latency and IED processing times can affect accuracy, making dedicated timing channels preferable for critical applications.

Practical Example

At the Chemistry Park Knapsack in Germany, a large-scale retrofit project synchronized protection relays and power quality recorders across a medium-voltage grid using a reliable time source. This allowed accurate fault analysis and ensured uninterrupted operation of chemical production processes.

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Summary

Time synchronization in relay protection systems is essential for: Coordinated protection operationAccurate fault analysisReliable monitoring and control Preferred methods include PTP with GNSS clocks for high-precision applications, while protocol-based synchronization or 1PPS can be used for less critical systems. Proper implementation ensures that all devices in a power network operate on a common, traceable time reference, enhancing system reliability and safety.

Article Content

TIME SYNCHRONISATION USING ABB RELAYS

ABB has used the strengths of the protocol and the IED design to allow the maximum flexibility in selection of a time clock synchronization method regardless of the protocol selected in the IED. This

IMPROVED PROTECTION RELIABILITY WITH PTP MASTER

IEC 61869-9 recommends using either Precision Time Protocol (PTP) or one pulse per second (1PPS) inputs to achieve the required accuracy. PTP has emerged as the preferred synchronization method

Relay device, relay method, relay program, and time synchronization

A relay device (10A, 10D) receives a time synchronization message on each of a plurality of time synchronization networks (101A, 101B) using different time synchronization profiles. On the

Time Synchronization of Power Protection Devices at the Chemistry

This pilot project shows a simple and cost effective way to retrofit already installed protection relays independently of the time synchronization method required by these devices.

Advancements in Industry Sync or Sink: The Crucial Role of PTP in ...

In power system protection, time has always been critical—from coordinating relay trip times to selecting algorithms and schemes that minimize fault clearing time.

Time Synchronization of protection relays to IEEE 1588/PTP

The following chapter covers a typical time synchronization setup with the TICRO 100 and the RET670 using the RET670''s optical time sync input. It shows how to connect the relay to the TICRO 100, the

Methods of Time Synchronization

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Many different time-synchronization methods currently in use provide time using different physical dissemination methods and deliver varying levels of accuracy. In many cases, these time

Multi-ended line differential protection communication and time ...

The scheme utilizes High-Availability Seamless Redundancy (HSR) to ensure communication redundancy and employs the Precision Time Protocol (PTP) to achieve precise time

Full digital substation with Process Bus

In full digital substation applications with process bus implementing IEC 61850, accurate, and error free time synchronization is highly important for syntonization of current and voltage measurements

Understanding the Impacts of Time Synchronization and Network

DSS, an Ethernet network is used to exchange time synchronization and Sampled Values (SV) data between devices. For prote yzes the impacts of time synchronization and network issues on

Time Synchronization in Electrical Systems

Time synchronization for substations with integrated protection- and system control functions, as well as data collection require a target architecture that distributes synchronized time in several ways.

Solved: Time Synchronization and Protection & Control

Protection & Control Schneider Electric support forum about Protection Relays, Substation Controllers & RTUs, Arc Flash Devices & Systems in Medium Voltage and Low Voltage.

Time coordination method for power system protection by evolutionary ...

Its purpose is to search for an optimal protection setting to minimize the system disturbance time as well as the time of interruption of the power supply. An evolutionary algorithm is applied as a constraint

Time Synchronization of Power Protection Devices at the Chemistry

An easy and accurate evaluation is only possible when all involved devices refer to the same time scale. Otherwise, the dependencies of specific reactions cannot be reproduced. To have the correct time at

Synchronism Check in Line Protection vs. Synchronizing Function:

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This article compares the synchronism check function in line protection devices and the synchronizing function in dedicated synchronizing equipment. The synchronism check function

IMPROVED PROTECTION RELIABILITY WITH PTP MASTER

Failure/loss of these GNSS devices has adverse effects on related power-system applications. This paper discusses implementing PTP master-clock functionality in protection relays and how it

(PDF) Understanding the Impacts of Time Synchronization and

This paper analyzes the impacts of time synchronization and network issues on protection functions for an IEC 61850-based DSS. Test cases that demonstrate disabling of protection functions due to loss

Power-Utility Time Synchronization (IEC 61850)

Time Synchronization of protection relays with IEEE 1588 A lot of IEDs (Intelligent Electronic Devices) installed around the world are not supporting modern time synchronization with IEEE 1588.

Related Video Reference

This video was associated with the source search result. Verify technical details against current product documentation and project requirements.

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

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