

End-to-end delay of relay protection channel



AI Overview

The end-to-end delay of a relay protection channel is the total time taken for a protection signal to travel from the local relay to the remote relay, typically ranging from 3 to 12 milliseconds depending on the communication technology and network design.

Definition and Measurement End-to-end delay, also called teleprotection latency, is the time from when a local protection device generates a signal to when the remote protection device receives and acts on it. It is measured from the interface of the relay to the communication network at the sending end to the interface where the signal exits the network at the receiving end (). This delay is critical because it directly affects fault-clearing times, which in turn influence system stability, equipment protection, and power quality ().

Typical Values Analog or early digital circuits: 8–12 ms Modern TDM circuits: 3–5 ms Ethernet-based or packet-switched networks: Latency can vary depending on network load, jitter, and asymmetry, but careful design can achieve comparable performance to TDM ().

Factors Affecting Delay Communication Technology: Fiber optics, PLC, microwave, and Ethernet have different inherent latencies. Dedicated TDM circuits are typically faster and more deterministic than packet-switched Ethernet networks (). Network Topology: Redundant paths, relays, and switches can introduce additional delay but improve reliability. Channel Asymmetry and Jitter: Unequal delays in forward and return paths and variations in packet arrival times can affect the effective end-to-end delay (). Relay Processing Time: The internal processing time of the relay, including signal encoding and decoding, contributes to the total delay ().

Importance in Protection Systems Fast end-to-end communication is essential for line current differential protection, transfer trip schemes, and other pilot protection applications...

Article Content

LINE CURRENT DIFFERENTIAL PROTECTION OVER MPLS

The speed at which the protection scheme operates is dependent on the combination of internal relay data latencies, algorithm processing time, and communications channel delay.

A Guide for Calculating Step Distance Relay Settings

The relay setting development process should include a series of steps that guides the settings engineer to achieve reliable and properly coordinated relay settings. First, each utility must develop a solid

Achieving Relay Coordination and Selective Short Circuit Protection In ...

Relay Coordination & Selective Protection The selected protection principle affects the operating speed of the protection, which has a significant impact on the harm caused by short

Relay Protection Basics: Types of Transmission Line Faults and ...

Learn the basics of relay protection for transmission lines: common fault types (phase-to-phase, ground faults), protection schemes, and how they ensure grid reliability.

When Can a Relay Reduce End-to-End Communication Delay?

Abstract—The impact of relaying on the latency of communication in a relay channel is studied. Both decode-forward (DF) and amplify-forward (AF) are considered, and are compared with the point-to

Speed and Security Considerations for Protection Channels

This paper describes the communications requirements for various protection and control applications, including channel time, channel asymmetry requirements, and jitter.

Speed and Security Considerations for Protection Channels

The communications devices that provide the relay interface are referred to as teleprotection devices. II. SPEED AND SECURITY The total operation time of a pilot protection communications scheme as

C37.113-2015

Information on the concepts of protection of ac transmission lines is presented in this guide. Applications of the concepts to accepted transmission line-protection schemes are also

How to calculate relay settings for IEC 61850-9-2 Sampled ...

Network latency is a measurement of delay in a system. Latency accounts for processing delays, network queuing delays, and propagation delays in the channel. A simple Ethernet-based...

State-of-the-art in the industrial implementation of protective relay ...

The paper summarizes the operating principles of relay applications, the available measurements used by relays and the protection schemes for various faults that occur frequently in

The Use of Instantaneous Overcurrent Relay in ...

This paper focuses on using the threshold current and voltage to reduce the time of delay and trip time of the instantaneous overcurrent relay protection for a 330 kV transmission line.

When can a relay reduce end-to-end communication delay?

When can a relay reduce end-to-end communication delay? Abstract: The impact of relaying on the latency of communication in a relay channel is studied. Both decode-forward (DF)

Channel Asymmetry Compensation for Line Current Differential Relays ...

Abstract—Line current differential relays exchange line current data samples to perform differential protection. The data received from the remote end are time-aligned with the locally sampled data to

Buffer-aided relaying improves both throughput and end-to-end delay

Moreover, using intuitive generalizations, we conclude that the use of buffers at relays improves not only throughput but ironically the average end-to-end packet delay. Through extensive

Channel Performance Considerations for Ethernet Circuits Applied to ...

2. Scope This report discusses the use of Ethernet transport for teleprotection services (directional comparison pilot protection, transfer trip and line current differential protection); plus, the circuit

Evaluating Line Relaying Schemes in Terms of Speed, Security, and ...

Critical clearing times for a transmission line are often used to determine the required operating speed for the transmission line protection. These critical clearing times are usually based on close-in three

Utility Experience of System-Based End-to-End Testing of EHV

Abstract System-based end-to-end testing focuses on the validation of protection schemes independently of protection relay type and settings. Fault values for tests are based on actual system

The Relay Testing Handbook: Principles and Practice

This online protective relay testing seminar follows Chris Werstiuk (author of The Relay Testing Handbook) as he tests a relay from start to finish. You'll learn the basic skills needed to test any

Solving the Inherent Problem of Transporting Serial Teleprotection ...

To evaluate the long-term performance of the channel and the feasibility of the scheme, Consumers Energy installed a pair of protective relays and ran a live current differential protection

End-to-End Performance Analysis of Delay-Sensitive Multi-Relay Networks

We study the end-to-end (E2E) performance of multi-relay networks in delay-constrained applications. The results are presented for both decode-and-forward (DF) and AF (A: amplify)

Principles and Characteristics of Distance Protection

Distance protection, in its basic form, is a non-unit system of protection offering considerable economic and technical advantages. Unlike

How to calculate relay settings for IEC 61850-9-2 Sampled ...

This remote data acquisition scheme introduces delays and directly impacts the performance of the protection relay. The SV Network Delay (SVND) is the sum of the MU processing

Communications Systems Performance Guide for Electric Protection

Some modern microprocessor relays use a channel-based messaging system to determine the end-to-end delay while transmitting the data between the relays or a time-based

IEEE Guide for Protective Relay Applications to Transmission Lines

Many important issues, such as coordination of settings, operating times, characteristics of relays, mutual coupling of lines, automatic reclosing, and use of communication channels, are examined.

Assessment of Communication Channel Effects on Time-Domain

the effects of communication channel latency (CCHL) on time-domain line protection functions. The Alternative Transients Program (ATP) was used to simulate the monitored pow

Distribution Automation Handbook

The principle of inverse time protection is especially suited for radial networks where the variations of short-circuit power due to changes in network configuration are small or where the short-circuit

The Use of Instantaneous Overcurrent Relay in Determining the

When a fault occurs on the transmission line, the relay should send the faulty signal to the circuit breaker to trip or isolate the line. Timely detection is integral to fault protection and the

Power System Relaying Committee

This report assists protection engineers and communications engineers who are working on implementing protection channels over Ethernet networks by outlining specific performance

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