Selection of Relay Protection Communication Channel



Overview

Many Relay Engineers are responsible for specifying and/or designing Protection Schemes that include Pilot Communication channels.

Key Takeaways

Relay protection communication channels must be selected based on reliability, low latency, bandwidth, and compatibility with protection schemes to ensure rapid and secure fault isolation.

Key Considerations for Channel Selection

Reliability and Redundancy: Communication channels are integral to protection systems, especially for pilot relaying and remedial action schemes (RAS). Channels must maintain high reliability under substation environmental conditions and during system disturbances. Redundant paths, such as dual fiber or ring topologies, are often used to prevent single-point failures.

Latency and Delay: Protective relays require minimal end-to-end delay to operate correctly. Typical relay applications demand delays well below 50 ms. Differential delays between channels can cause misoperation, so careful evaluation of propagation times and switching delays is essential.

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Bandwidth and Data Rate: The channel must support the required data rate for the protection scheme, including analog signals, digital status, and control commands. High-bandwidth channels like fiber optics are preferred for multi-channel or high-speed applications. Channel Types and Media: Common communication media include: Fiber Optic: High bandwidth, low latency, immune to electromagnetic interference, suitable for long distances and multi-channel applications.

Microwave/

Radio: Useful for remote or inaccessible areas but subject to interference and line-of-sight limitations. Power Line Carrier (PLC): Cost-effective for short distances along transmission lines but limited in bandwidth and susceptible to noise. Digital Networks (Ethernet, TDM, SONET/SDH): Increasingly used for integrated substation automation, offering flexibility and multiple services but requiring careful management to avoid differential delays.

Network Topologies: The choice of topology affects reliability and maintainability: Point-to-Point: Simple, low-latency, but single failure can disrupt communication. Star: Centralized monitoring, easy to manage, but hub failure affects all nodes. Bus: Flexible, allows multiple nodes, but may introduce delays and complex troubleshooting.

Ring (UPSR/BLSR): Provides redundancy and automatic switching in case of fiber failure, but differential delay must be managed. Integration with Existing Systems: Channels must be compatible with existing relay schemes and SCADA/DNP links. Protective relay engineers should coordinate with communications engineers to ensure proper specification and performance.

Environmental and Security Factors: Channels must withstand substation conditions (temperature, humidity, electromagnetic interference) and provide secure transmission to prevent unauthorized access or tampering.

Practical Selection Approach

Define Protection Requirements: Identify the type of protection (pilot relaying, UFLS, UVLS, RAS) and required response times. Evaluate Available Media: Consider fiber, microwave, PLC, or digital networks based on distance, bandwidth, and environmental constraints. Assess Reliability and Redundancy Needs: Determine if ring or dual-path topologies are necessary.

Analyze Latency and Delay: Ensure end-to-end delay meets protection scheme requirements. Coordinate with Communications Engineers: Align technical specifications with utility communication infrastructure and standards. Test and Validate: Perform end-to-end testing under normal and fault conditions to verify performance and reliability.

By carefully considering these factors, utilities can select communication channels that ensure fast, reliable, and secure operation of relay protection systems, minimizing the risk of misoperation and equipment damage.

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Article Content

Communications Systems Performance Guide for Electric Protection

This guide was prepared by the WECC Telecommunications and Relay work groups. It gives recommendations to communications system designers for communication circuits that support

Microsoft Word

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C37.113-2025

Abstract: Concepts and applications of ac transmission line protection are presented in this guide. Many important issues, such as coordination of settings, operating times, characteristics of relays, mutual

Communications in power system protection (medias, protocols and

Type of medias and network topologies in communications provide different opportunities to advance the speed, security, dependability, and sensitivity of protection relays.

Relay-to-Relay Digital Logic Communication for Line Protection ...

The new, patented relay-to-relay logic communication technique repeatedly sends the status of eight programmable internal relay elements, encoded in a digital message, from one relay to the other

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.

DIGITAL COMMUNICATIONS FOR RELAY PROTECTION

This is of particular concern when communications facilities are used for multiple applications of which relaying is only a part. In these cases, extra assurance of adequate relay channel management,

SPECIAL CONSIDERATIONS IN APPLYING POWER LINE

The intent of this paper is to document important issues that should be considered when applying a PLC channel to a protective relay system.

Pilot Communication Channels in Power System Protection

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Pilot protection schemes use communication channels to send information from the local relay terminal to the remote relay terminal, thereby allowing high-speed tripping for faults occurring within the

SELECTION GUIDE

SELECTION GUIDE TE Connectivity (TE) is your components provider for relays that help increase reliability and enhance productivity in your applications. We ofer the broadest range of relays and

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

IEEE Guide for Protective Relay Applications to Transmission Lines

The impact of different electrical parameters and system performance considerations on the selection of relays and protection schemes is discussed. The purpose of this guide is to provide a reference for

Power System Protective Relays: Principles & Practices

Abstract: Protective relays and devices have been developed over 100 years ago to provide “last line” of defense for the electrical systems. They are intended to quickly identify a fault and isolate it so the

Communications and Data Synchronization for Line Current

Third, the paper elaborates on typical channel monitoring and alarming features built into line current differential relays and multiplexers to maximize the security and availability of the 87L

Basic protection relay knowledge

Selectivity Selectivity is a mandatory requirement for all protection, but the importance of it depends on the application. For example, unselective protection operation during a medium voltage network fault

PC37.113/D3.5, Sept 2024

Scope: Concepts and applications of AC transmission line protection are presented in this guide. Many important issues, such as coordination of settings, operating times, characteristics of relays, mutual

Design, implementation, and evaluation of secure communication for

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In this work we propose a secure communication concept for the protection of critical power supply and distribution infrastructure. Especially, we consider the line current differential

Relay Selection Guide Overview | PDF | Relay | Electrical Impedance

This document provides an introduction to power distribution system protection and relay selection. It discusses basic concepts like zones of protection, types of equipment distress, protection

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