



## Designing Copper Wiring Out of High Voltage Substations: A Practical Solution and Actual Installation

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Substantial cost is associated with copper wiring (designing, documentation, construction, commissioning, troubleshooting of tens of thousands of individual termination in a substation). The next generation Protection and Control (P&C) solution is often viewed as eliminating “copper” and replacing it with “fiber”. A single optical fiber can replace hundreds of copper wires.

A successful fiber-based P&C solution needs to address the issue of copper holistically considering most, if not all, copper signaling between the switchyard and the control house. It should not be limited to just supporting optical instrument transformers, or tripping via dedicated breaker relays over the station-level communication.

This paper presents a practical architecture that uses an open-standard protocol (IEC 61850) for fiber-based P&C systems that fits the task of protection and control by drawing from the universal topology rules of substations. The term “architecture” refers to the definition and structure of the interface points in a switchyard, partitioning and allocation of P&C functions to the devices, the underlying structure of time synchronization, settings and firmware management, failure-tolerant communication framework, required data throughputs and latency considerations, data traffic patterns, and other related aspects.

Using a plain P&C language, the paper describes a practical and simple solution in detail that meets accepted practices and rules of protection and control systems, and built on proven hardware and technologies. The paper also explains the many advantages of this architecture, such as simplicity, scalability, rapid deployment, and reliability.

The paper reports on a field installation of the system, and to-date operational experience with it.

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