MICROPROCESSOR-BASED RELAYS AN ENABLER TO SCADA INTEGRATION

By Gustavo Brunello

SCADA integration has historically been a costly and complex venture for many utilities. The need for simplified amalgamation has become increasingly pressing as the industry moves to the establishment of open, worldwide accepted standards to share data seamlessly throughout the organization. While the establishment of these protocols is an important catalyst in the successful evolution of today's SCADA environments, there is the ongoing challenge of ensuring that substation equipment is optimized in order to leverage all the technology and economic benefits that these standards bring to the equation.

Now more than ever, utilities need flexible, microprocessor-based hardware and software tools to truly realize these benefits. Without them, SCADA systems will continue to be restricted by the complexities of working with proprietary equipment, software and communications protocols. Among other challenges, equipment having different proprietary protocols cannot be integrated without the installation of Remote Terminal Units (RTUs) to perform the translation work, which is both expensive and labour-intensive.

The move to international standards has been evolving over many years, and led to the widespread acceptance of the UCA/MMS Version 2.0 protocol. This was established by Electric Power Research Institute (EPRI) under the sponsorship of utilities around the world and has been steadily gaining in popularity. More recently, the International Electrotechnical Commission (IEC) has been moving towards the establishment of the IEC 61850 Communication Networks and Systems in Substations standard communication protocol. This new standard, which is scheduled for final approval later this year, represents an enhanced version of EPRI's UCA/MMS.

The new IEC standard incorporates the following features:

- Complete communication profile based on existing IEC/IEEE/ISO/OSI communication standards
- Uses existing standards and commonly accepted communication principles, open protocols and self-descriptive devices that allow one to add new functionality.
- Self-descriptive data objects related to the needs of the electric power industry.

THE NEED FOR GLOBAL COMMUNICATIONS PROTOCOLS

Industry experience has demonstrated the need and the opportunity for developing standard communication protocols, which would support interoperability of IEDs from different manufacturers. Interoperability in this case is the ability to operate on the same network or communication path sharing information and commands. There is also a desire to have IED interchangeability — i.e. the ability to replace a device supplied by one manufacturer with a device supplied by another manufacturer — without making changes to the other elements in the system. Interoperability is a common goal for electric utilities, equipment vendors and standardization bodies.

With open, standard protocols, it is understood that utilities can more easily — and affordably — benefit from advanced high-speed, peer-to-peer communications as well as device interoperability for substation automation without the need of high cost for integration. Standards-compliant hardware and software from different vendors can be linked and progressively integrated over time, thereby providing a means to cost-effectively upgrade as needs and technology develops.

The flexibility provided by the IEC850/UCA-MMS protocols has the potential for saving millions of dollars in development costs for utilities and manufacturers, since it eliminates the need for protocol converters and lengthy, complex database mapping when integrating devices from different manufacturers. In addition, the possibility of exchanging protection/control signals in real time over a high-speed LAN in a peer-to-peer relationship means that a great deal of inter-device control wiring can be eliminated by performing inter-device control signaling over the LAN. New protocols also provide an easy, clear path for expansions and future upgrading to SCADA systems.

This communications flexibility of substation devices represents significant advantages to SCADA environments on a number of fronts. With microprocessor-based hardware based on an open platform, utilities can perform upgrades more cost-effectively, preserve their initial technology investment, and substantially reduce long-term implementation costs. Gateways may still be required at the substation as data concentrators and/or protocol translation for legacy devices.

The new standards offer the connectivity that older SCADA systems have difficulty providing. Any authorized user within the utility enterprise can easily access information from devices on the network from their desktop, without the usual complexity and expense of building SCADA "extensions" to engineering, accounting, planning and other departments that need the information.

THE CONCEPT OF THE UNIVERSAL RELAY

GE Multilin recognized the industry needs for a modular, Intelligent Electronic Device (IED) platform using open communication protocols at the beginning of the development of the Universal Relay (UR) several years ago. The UR platform provides modularity and flexibility to adapt and support several communication protocols — includ-

ing those that have yet to be established. In order to achieve this end, it relied on the same concepts and technologies that have driven the desktop PC to becoming a general-purpose tool and engine of the information age.

Whereas traditionally, manufacturers of protective relay devices produced different products specific to the protection of generation, transmission, distribution and industrial equipment, the UR provides utilities with a common, microprocessor-based tool for protection, metering, monitoring and control, across the entire power system. In essence, its purpose is to serve as a universal platform for substation automation.

As a microprocessor-based relay, the UR comprises a core set of software and hardware building blocks that can encompass a number of functions, including: algorithmic and control logic processing; power system current and voltage acquisition; digital inputs and outputs for control interfaces; analog inputs and outputs for interfacing to transducer and SCADA systems; communications to station computers and/or SCADA systems; local Human Machine Interface (HMI) and power supply circuitry for control power.

The architecture accommodates these functional blocks in a modular manner to allow for cost-effective scalability, flexibility and upgradeability. Much of the cost savings is achieved through the use of common components such as CTs and VTs modules, single identical CPU cards, power supplies and network/communication cards. Modularity is achieved through a plug-in card system similar to that found in programmable logic controllers (PLCs) as well as PCs. A high-speed parallel bus provides the modules with a common power connection and high-speed data interface to the master processor as well as to each other.

SCALABILITY, UPGRADEABILITY

Scalability is found in the ability to configure the relay from minimum to maximum I/O capability according to particular requirements. Users can add modules configured with the desired I/O for maximum flexibility.

Upgradeability requires the simple replacement or addition of modules. For example, users can upgrade from a twisted pair copper wire communications interface to high-speed fibre-optics communications — or enhance a transformer protection application by adding an Analog I/O module for RTDs — among other enhancements.

Modular, field programmable software can be configured to support a number of functions. These can include protection elements, programmable logic and I/O control, metering, data and event capture/storage, digital signal processing, HMI control and communications.

One advancement in engineering that is an integral part of UR development is Object Oriented Programming and Design. By using this concept, users can create a protection class and objects of the class. These software modules can be completely self-contained or encapsulated.

While not all utilities have made the move to new standards, gaining international acceptance, this advanced level of communications promises to play a critical role in the evolution of the SCADA environment. As the industry continues to seek out ways to migrate to more efficient operations, it stands to reason that the more flexible and upgradeable the elements are on the system, the easier and less costly the integration requirements.

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