

Wide-Area Transient Stability

For the BiTRONICS M871 Multifunction Recording Transducer.

- Helps prevent cascading faults from collapsing power systems.
- High-speed network architecture allows previously impossible applications.

Introduction

The following is a very forward-thinking application that uses the high-speed measurement engine and Ethernet communications of the M871 to vastly improve wide-area stability and protection schemes.

On July 2 & 3 and August 10 of 1996, two major events caused the Western Systems Coordinating Council (WSCC) to rethink their wide-area fault protection strategies. Due to the interdependence and tight tolerances of the power grid, these events spread from a single location to affect the entire western power grid, dropping power to an estimated 15 million customers within a matter of seconds and garnering concern from Bill Clinton, who was then president of the United States.

Since 1996, the utilities in the WSCC have expanded and increasingly relied on Remedial Actions Scheme (RAS) Systems to prevent such events from occurring again. These schemes are developed using modeling software and incorporated into substation control to allow efficient, reliable power management at a fraction of the cost of new power lines. One of the WSCC utilities envisions an expansion of RAS Systems from a preventative modeling role to that of a high-speed measurement and control network capable of detecting and correcting transient faults in real-time.

How It Works

The application uses fiber-optic Ethernet and the high-speed

measurements of the M871 to change the nature of RAS Systems from an event-based (reactive) to a response-based (proactive) system. When completed, this high-speed measurement network will create a synergy between wide-area control and substation automation. The network will respond to measured changes in system voltages, frequencies, and power, and initiate corrective action within a second. Such a scheme is referred to as feed-forward (disturbance-rejecting) design.

Currently, RAS Systems are designed by feeding theoretical faults into a software simulation and tracking their results. Engineers then analyze these results and develop control actions to be implemented with the control hardware at each substation. The approach suffers from imperfect foresight about which faults can occur, and local control that has little or no knowledge of wide-area conditions. A fiber-optic Ethernet network connecting several M871s can provide the control center software with real-time (within a cycle) measurements. This would effectively eliminate the analysis and programming steps of the current RAS methodology, allowing the control center computers to make control decisions to control system disturbances as they happen, not just in simulations.

The overall effect of the application can be likened to the difference between a) running, tripping, falling to the ground, and picking yourself back up, and b) running, tripping, starting to fall, but regaining your balance and footing in time to avoid a fall. In such a scheme, speed is the crucial factor.

Application

This network will be able to provide power values to a logic center within a few milliseconds, where advanced software systems will be able to perceive the entire system, find the ideal course of preventative or remedial action, and execute those actions within a few hundred milliseconds. Such a scheme has never before been attempted, or even considered possible, but could produce a considerable leap in system reliability and flexibility.

Additional Benefits

- In addition to trend data, the M871 captures fault and event waveforms and satisfies the recording needs of multiple utility departments (protection, planning, power quality, and revenue (0.2% Revenue-class accuracy)) in a single platform.
- Multiple communications ports and protocol processing allows easy integration into different networks.
- ¼ cycle measurement speed is fast enough for backup protection applications.
- Flexible modular design allows for future expansion of features and easily upgradeable functionality.