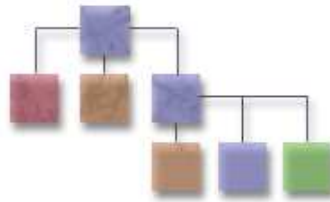




Intelligent Substation Management Solutions

KALKI
COMMUNICATION
TECHNOLOGIES



Copyright 2004
Kalki Communication Technologies Pvt Ltd



Kalki Communication Technologies Pvt Ltd
#147, 5th Main Road
H.S.R. Layout Sector 7
Bangalore 560034
India

Web: <http://www.kalkitech.com>
Phone: +91-80-25721263

1. Introduction

Increased competition, deregulation and customer demands for power quality and reliability are forcing power utilities to improve their operating efficiencies at all levels. Companies are increasingly exploring automation of substations as a way to enhance quality of service to customers, while minimizing losses and increasing operating profits.

The advent of intelligent electronic devices has revolutionized how substations are designed and operated. Digital technology has made available a huge amount of system data available to the operator that was previously unavailable. This data includes real-time measured values, alarms and events, disturbance records, fault location, etc., which enable the operator manage the substation optimally. Manufacturers are incorporating emerging communication standards into substation equipment, which offer a host of new capabilities to operators, including unmanned substations and remote management.

Kalki SMARTSTATION is a software platform designed for the next generation of automated substations that enable operators collect, view, analyze, store, manage and optimize vast amounts of data generated by IEDs. It is an open platform designed for integration with most popular IEDs today.

The following sections describe some of the features of SMARTSTATION.

2. Overview

Briefly SMARTSTATION provides the following functions:

- Monitoring of substation feeders
- Indicating status of substation equipment
- Logging of events
- Display Sequence of Events
- Recording of disturbance and fault conditions
- Viewing of disturbance data
- Circuit Breaker Control
- Bus bar coloring

SMARTSTATION collects data from numerical protection relays, measurement centers and other intelligent electronic devices in the field. It facilitates viewing of information on fault and disturbance conditions collected from relays.

2.1 Human Machine Interface

SMARTSTATION has a PC based HMI for operator interactions.

- Process data displays on graphic screens
- Single line Diagrams
- Trend displays
- Reports

- Alarms and events

Special features:

- Collecting fault and disturbance data from protection relays, converting and saving in standard formats.
- Invoking software tool for viewing of disturbance data

2.2 Communication Network

IEDs are connected to the serial communication ports or over Ethernet LAN to the SMARTSTATION server. The number of channels is expandable as per specific project requirements.

A number of communication protocols are supported including industry standard open protocols and vendor specific proprietary protocols. Custom protocols can be implemented for specific projects on request.

Popular protocols include Modbus, IEC 60870-5 family, DNP3, IEC 61850, SPA, Courier, LON, etc. for integration of a wide variety of IEDs, including digital protection relays, measurement centers, fault and event recorders, and others. Third party applications such as power quality analysis, power system modeling, etc. can be integrated using the application programming interface.

Process data is collected from incomer, outgoing feeder and bus coupler related equipment. This includes status of circuit breakers, events, fault and disturbance conditions and analog parameters in the electrical system.

3. System functions

Various functions of the System are the following:

- Acquisition of analog data
- Acquisition of discrete data
- Control of circuit breaker
- Bus bar coloring
- Acquisition of event records
- Acquisition of fault records
- Acquisition of disturbance records

3.1 Data Presentation

The acquired data is displayed on the HMI at Substation control room. The following displays shall be made available in the HMI:

- Overview
- Bus section Views
- Bay Level View
- Alarm display
- Event Display
- SOE View

- Real time Trend display
- Historical trend display
- Relay View
- Measurement center View
- System configuration display

3.2 Sequence of Events

Sequence of events (event description, time stamp) will be displayed in SOE View as shown in the figure below. By default all events for the current day will be displayed in the grid. Once user sets the filter condition and clicks the **Filter** button, only filtered events will be displayed. User can filter for System events (iFIX events) or Relay events. Within Relay events, user can select to see events for just one relay (each relay will correspond to a feeder) or for all relays. User can also select the desired date range between which the sequence of events will be displayed.

Timestamp	Event Description
5/27/2004 12:03:56.0	[FIXLAP] SAC - Cold Start
5/27/2004 12:03:56.0	[FIXLAP] SAC - Initialization Complete
5/27/2004 12:03:57.3	[FIXLAP] TESTTAG
5/27/2004 12:03:57.3	[FIXLAP] TESTTAG
5/27/2004 12:03:57.3	[FIXLAP] P01R_DISTNO
5/27/2004 12:03:57.3	[FIXLAP] P01R_DISTNO
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIE
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIE
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIE
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIE
5/27/2004 12:03:57.3	[FIXLAP] P01M_ENERGY4
5/27/2004 12:03:57.3	[FIXLAP] P01M_ENERGY4
5/27/2004 12:03:57.3	[FIXLAP] P01M_EXPEGY2
5/27/2004 12:03:57.3	[FIXLAP] P01M_EXPEGY2
5/27/2004 12:03:57.3	[FIXLAP] P01M_EXPEGY3
5/27/2004 12:03:57.3	[FIXLAP] P01M_EXPEGY3
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIII
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TIII
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TII
5/27/2004 12:03:57.3	[FIXLAP] P01R_SET_TII

The screenshot also shows a 'Filter' panel on the right with the following settings:

- System events
- Relay events
- Select device: ALL
- From: 5/27/2004
- To: 5/27/2004
- Buttons: Filter, Print, Save As, Close

4. Database Management

SMARTSTATION server reads process information from protection relays and measurement centers and saves it in process database in the system. The primary source of data for any further processing is the process database. Following parameters will be logged into the historical database in the SCADA server. These data can be accessed using historical trending and analysis tools.

Phase to Phase Voltage	for each bus section
Single phase Current	for each Incomer, feeder and bus coupler
Frequency	for each bus section
MW	for each Incomer, feeder and bus coupler
MVar	for each Incomer, feeder and bus coupler

Data will be sampled and logged to the Historical database at predefined intervals and can be used for analysis.