

# 230/400 KV Swtchyard Operation by Scada System

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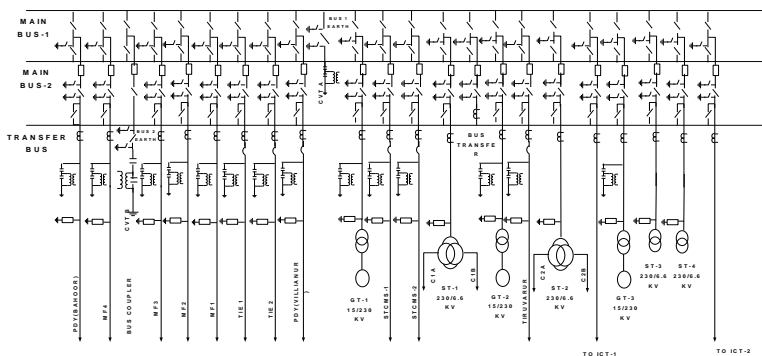
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## I. INTRODUCTION

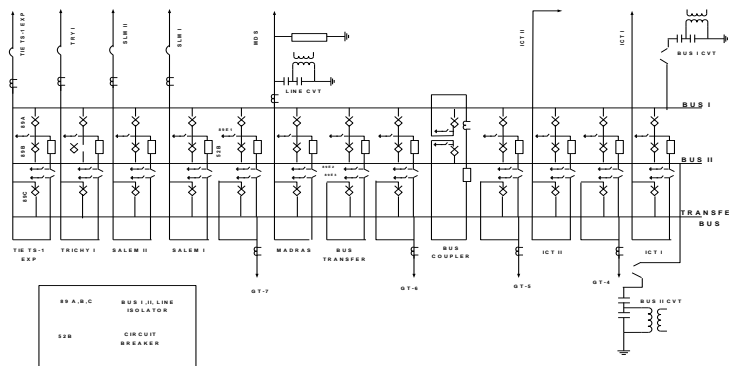
Switchyard is the interconnection of generating station and grid. The generated power from the generating station is transmitted to the grid through switchyard. Switchyard is used to give a secured power to the grid. In our project SCADA is used to operate and control of the switchyard operations. SCADA is an emerging trend in WSN technology. It is a transceiver used to transmit and receive data in full duplex mode. The switchyard is controlled and monitored from the UCB room through the underground cables. But in our project it is done by SCADA MODULE. These modules are fixed in switchyard and another in UCB room. In the switchyard side it is controlled by microcontroller and in UCB room side is by operator. If any operation such as opening/closing the isolator, generator breaker can be done by operator by giving command to SCADA module in UCB side. The SCADA module receives the command signal and transfer it to microcontroller. It will do the operation through relay module. In this project we are replacing cables by wireless sensor network SCADA.

## II. CIRCUIT DIAGRAM

230KV SWITCHYARD LAYOUT



400KV SWITCHYARD LAYOUT



## III. OPERATION

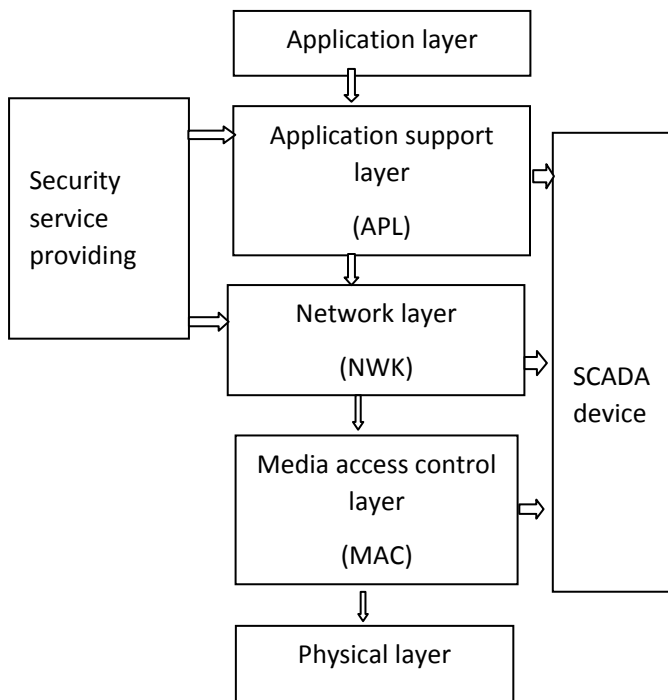
Switch yard as said earlier, it acts as a interface between the generating power station and the distributing grid. The generated powers are distributed to the various areas through grids. In switch yard two buses are present. Bus 1 supplies certain set of areas and bus 2 for some other areas. For this process of transmission and distribution the generated powers of the isolator, generator breakers play a vital role. If bus 1 has to be chosen for distributing the generated power then isolator 89A (bus 1 isolator) has to be in close condition. Similarly for all other elements. In our project two Scada modules are placed for the operation and monitoring of switchyard. One module is placed at the control room which serves as the transmitter and another at the switch yard field which acts as a receiver. Commands for opening and closing of the isolator, breakers are given in the mimic panel. Mimic panel is nothing but a VB based set up at the PC present in the control room. Thus the commands are given just by clicking the respective icon on the mimic panel. An Event manager which is a LCD display is used to display the status of the operation. SCADA module at

the control room receives the signal and transmits it to the SCADA module at the switchyard. Status of real power, reactive power from the field serves as the input to the microcontroller. After receiving the signal the processor checks for the interlock conditions. If the interlock conditions are satisfied then respective port pin will be activated. This in turn triggers the respective relay coil. Once the relay is activated to the specified command then the isolator arm starts moving from its position towards the limiting switch. Isolator which is a motor operated device consists of two limiting switches, one for opening and another for closing. For example the isolator 89A has to be closed then the relay contact is moved. Then the isolator arm<sup>1</sup> starts moving from limiting switch 1 (open) to limiting switch 2. The same process is followed for all other equipment. Suppose if the interlock conditions are not satisfied then a command “ACCESS IS DENIED” will be displayed in the event manager. This ensures the safety operation of the switch yard. The position of the earth switches is also monitored.

**SCADA Standard Overview**

In this section you will learn about Scada wireless Networking standards.

**SCADA Protocol Stack:**



**IV. STRUCTURE OF SCADA PROTOCOL STACK**

In order to adopt WSN technology for use in real-life applications an association of industry companies. Scada alliance has specified a full protocol suit that provides efficient high level communication in wireless sensor networks. Scada low stack layers (PHY and MAC) are equal to those in IEEE 802.15.4 while high stack layers are designed to support extended networking functionality and to provide simple interface between network and end user applications.

Main Scada extensions compared to IEEE 802.15.4

Full support of complex network topologies: tree and mesh

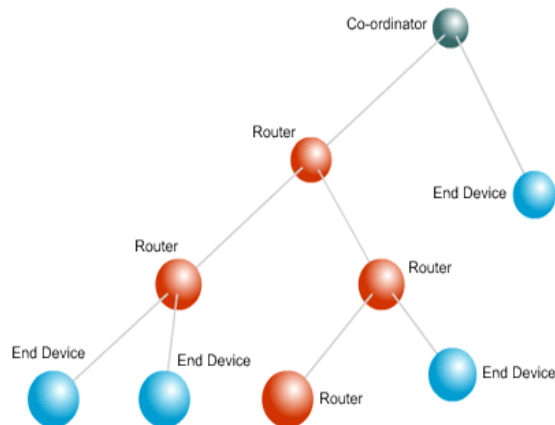
Reliable communication within entire network (beyond transmission range of a single node).

3. Unified networking interface for end user applications.

4. Public application profiles for interoperability between devices from different vendors

**A. Network topologies**

In order to enable efficient data exchange in large-scale networks Scada standard utilizes topologies enabled by data IEEE 802.15.4 transfer models and extends them by specifying tree and mesh network topologies. Often in order to deliver data from one end of the network to another, a packet shall be forwarded several times by intermediate routers. Such routing procedure requires intelligent route discovery mechanism that depends on the network topology. However for all topologies routing is built in NWK layer and does not require any additional effort on user application level.



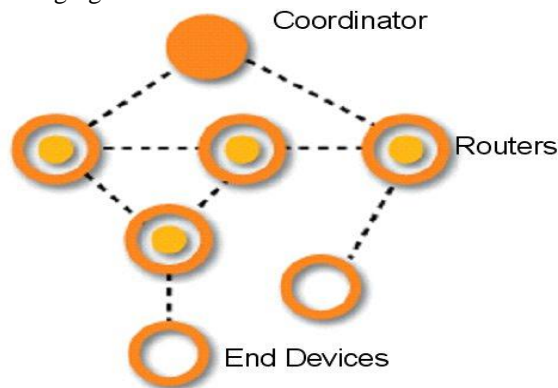
### B. Tree Topology

Parent-child relationship is directly used in tree topology to build a Scada network.

Such tree topology is based on top of IEEE 802.15.4 peer-to-peer data transfer model and has following properties:

1. Routers are able to have child nodes.
2. Direct communication is possible only in terms of Parent child relation.
3. Hierarchical routing without alternative paths

In tree topology if a link fails, i.e., data cannot be transmitted along certain branch anymore; there is no alternative link available without Changing the network structure.



### V. SCADA MESH NETWORK TOPOLOGY

#### A. Mesh Topology

One of the key features introduced in Scada is full mesh networking.

It completely utilizes functionality of IEEE 802.15.4 peer-to-peer data transfer model and provides following features:

1. Routers are able to have child nodes.
  2. Direct communication is possible between any FFD devices (coordinator and router) within transmission range of each other.
  3. An end devices can exchange data with its parent node only
  4. Optimum and dynamic routing with alternative paths
- Because in mesh topology routers can have alternative links for direct data transmission a packet is transferred over the most suitable path in terms of reliability and transmission time.

PORT PIN	ALTERNATE FUNCTION
P3.0	RXD (Serial Input Port).
P3.1	TXD (Serial input port).
P3.2	INT0(External input 0)
P3.3	INT1(External input 1)
P3.4	T0 (Timer 0 external input )
P3.5	T1(Timer 1 external input )
P3.6	WR(External data memory write strobe)
P3.7	RD(External data memory Read strobe)

AT89C51 Port3-Description

### VI. MATLAB

This research hwork makes use of MATLABSIMULINK modelling tools for modelling the substation section in a distribution system by making use standard power block set elements in SIM POWER in the SIMULINK environment. It is in the MATLAB Simulink environment that the control signals for optimization of substation operation are generated.

### VII. SUBSTATION MODELLING

The simulation of the data acquisition and processing section of a substation in distribution system would be effectively achieved using Proteus Isis 7.8 to produce characterization of real time operations of the system. MATLAB Simulink would be used in this research to give a detailed block by block representation of the substation model with the standard key block-set elements and functions. The substation model is designed to constantly generate raw data that simulate information obtained from the physical substation in reality. This data is communicated in predetermined intervals for further processing by other software components. Several major blocks are implemented in order to model important elements and functions in the substation. The distribution (location) of analogue and digital measurements in the substation model is determined considering following rules:

1. Each circuit breaker has two current measurements (one at each Side).
2. Each transmission line has one current measurement, one voltage Measurement and calculated active and reactive power measurements.
3. All switch elements have contact status measurement. All measurements are single-phase measurements. Four main

Simulink blocks are developed for the substation model to describe different elements:

- (i) equivalent source block,
- (ii) switching element block,
- (iii) measuring unit block

## VIII. SYSTEM ARCHITECTURE

The architecture of the complete SCADA system can be divided into two parts.

- a. Hardware
- b. Software

### A. Hardware Architecture

The hardware consists of the Circuit Breaker Monitor (CBM), Global Positioning System (GPS) clock receiver, the concentrator personal computer (PC).

The circuit breaker and isolator then transfer bus monitor; this consists also of an intelligent electronic device which is housed in the cabinet of the circuit breaker in the switchyard. The global positioning system clock receiver and the concentrator personal computer (PC) are also housed in the control room and are both connected together through a wireless point-to-multipoint network. The above configuration is been design to work as a master slave arrangement.

The slave circuit breaker monitoring units are arranged at each breaker in the switchyard and are wired together to achieve the desired signal for a smooth and appropriate circuit breaker control. The concentrator personal computer (PC) which is the master unit is housed in the control house in order for it to gather all collected data by all the slave unit in the switchyard, store and process it.

### B. Software Architecture:

Circuit breaker and isolator then transfer bus monitor software performs data analysis and output information for different uses. It represents software architecture. The application enables customized views for various types of users since they may have different interests regarding breaker performance, sequence of breaker operations and network topology status. For some users it is important to know the precise topology of the systems and the status of CBs in every moment and for group of CBs after fault was recognized and cleared.

## IX. APPLICATIONS AND BENEFITS

The advantages of maintaining power system equipment, specifically the transmission,

distribution, circuit breaker and medium voltage equipment has increased due to the aging assets problem these include:

1. The Circuit breaker monitor system will improve CB condition monitoring performing online monitoring of all available signals in the breaker control circuit.
2. This system should provide data for condition assessment.
3. Identification of problems and in some cases.
4. Prediction of failures and operating problems before they become critical.
5. Without making changes on existing data acquisition units, implementation can be done using from multiple circuit breaker monitors.
6. Circuit breaker can provide only information about the states of the individual breaker and its operations.
7. Data from multiple breakers can enable implementation of substation and system wide monitoring and control applications
8. Decrease in the down time and increase in reliability and availability of the circuit breaker.

Based on data availability three level of analysis applications are possible.

1. Applications are using data from multiple circuit breakers across the system.
2. Operation of single breaker and condition analysis can be performed, based on present and historical data available.
3. Analysis of a switching sequence that involves multiple breakers uses time correlated data from multiple circuit breakers from single substation.

## X. CONCLUSION

Using Scada We are glad to complete this project work successfully and satisfactorily. The 230KV/400KV SWITCHYARD OPERATION BY SCADA METHOD. Has the following advantages: Simple in design, Low cost, High in reliability, Easy fault identification. This project has developed our knowledge in the areas of electronic circuits, microcontroller and software, hardware design. We had a very good opportunity to work at Neyveli Lignite Corporation, which had given us an exposure to industrial atmosphere.

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