ABSTRACT

SCADA stands for Supervisory Control and Data Acquisition: As the name indicates it is not a full control system, but rather focuses on the supervisory level. Several parameters like temperature, proximity, pressure, flow, level, etc are required to be monitored continuously at the process plants in industries. These measurements are facilitated by the various analog to digital converters. Technically it is not always feasible to have the controlling station in the vicinity of the process plant. This digital data is acquired by data acquisition techniques by the controlling station either by wired or wireless transmission. Wireless SCADA technology could be implemented by using GPRS-enabled GSM mobile phones. Thus the primary purpose of SCADA is to monitor, control and alarm plant or regional operating systems from a central location.

KEYWORDS: Data Acquisition, RTUs, HMI, GPRS

INTRODUCTION

SCADA stands for supervisory control and data acquisition. It generally refers to industrial control systems: computer systems that monitor and control industrial, infrastructure, or facility-based processes. It is a computer system for gathering and analyzing “real time data”. SCADA systems are used to monitor and control a plant or equipment in industries. SCADA systems have made sustainable progress over the recent years in terms of functionality & performance. Wireless technologies have enhanced the range of communication in a SCADA system. SCADA is purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules. SCADA is normally a software package designed to display information, log data and show alarms. The software would normally be installed on a computer on the customer’s site and all the various signals would be wired back to the central point. Contemporary SCADA systems exhibit predominantly open-loop control characteristics and utilize long distance communications by wireless technologies. It is used in manufacturing to acquire measurements of process variables and machine states, and for performing regulatory or machine control. SCADA is used by the energy industry, telecommunication industry, transport industry, and water and waste control industry. Wireless SCADA systems are the ones in which the communication between the Remote Terminal Unit (RTUs) and Human Machine Interface (HMI) is wireless in nature. General Packet Radio Service (GPRS) is the commonly used wireless technique used in wireless SCADA systems.

SUBSYSTEMS IN A SCADA SYSTEM

There are three main elements to a SCADA system: various RTU’s (Remote Telemetry Units), communications and an Human Machine Interface (HMI).

- Remote Terminal Units (RTUs) are connected to sensors in the process uses to measure various parameters. The RTUs convert sensor signals to digital data using analog to digital converters (ADCs), and send this digital data to the supervisory system. This supervisory system gathers data on the process and sends appropriate control commands to the process. Each RTU effectively collects information at a site, while communications bring that
information from the various plants or regional RTU sites to a central location, and occasionally returns instructions to the RTU. In recent times, Programmable Logic Controllers (PLC’s) are used as field devices because they are more economical, versatile, flexible, and configurable than special-purpose RTUs.

- Communication infrastructure connects the supervisory system to the Remote Terminal Units. Communication within a plant will be by data cable, wire or fiber-optic, while regional systems most commonly utilize radio for wireless transmission. Reliable communication between these two major subsystems of the SCADA system is the backbone of the SCADA system.

- A Human-Machine Interface or HMI is the apparatus which presents process data to a human operator, and through this, the human operator monitors and controls the process. The HMI system usually presents the information to the operating personnel graphically, in the form of a mimic diagram. This means that the operator can see a schematic representation of the plant being controlled. Mimic diagrams may consist of line graphics and schematic symbols to represent process elements, or may consist of digital photographs of the process equipment with animated symbols.

- Another important feature of the HMI is the alarm handling facility. Whenever an alarm event is detected by the RTUs, the operators are informed by the activation of sirens or alarms. These alarms are acknowledged by the operators and are deactivated by implementing suitable controlling actions.

OPERATION OF A SCADA SYSTEM

Supervisory control and data acquisition (SCADA) technology collects real-time data via RTUs from virtually any environment where there is a need to monitor machinery or processes, make adjustments based on measurable conditions, measure down time, or regulate processes to avoid costly problems. The computer-based technology is designed to do all the things with little human involvement. From a central reading location, a SCADA system can monitor a number of remote sites equipped with RTUs. The RTUs measure various conditions and parameters, including tank levels, temperature, voltage, current, volume, and flow. The unit reports the data back to the HMI, carrying out the necessary analysis and cost functions. Additionally, SCADA technology personal of current or potential alarm situations, allowing an operator to fine tune a process. Control can be automatic or initiated by operator commands, based on the sophistication of the individual system. This technology is widely accepted as a reliable and efficient control system within numerous industrial markets.

![Figure 1: A Basic SCADA Network](image)

WORKING OF A WIRELESS SCADA

Network
The figure shown above is the basic block diagram of the transmitter section used in wireless SCADA systems. It consists of the sections mentioned below:

**Sensor**

As we know that SCADA systems are used to monitor various parameters located at remote locations, sensor is the most essential and integral part of the system. There are various types of sensors which are used to monitor various parameters. For example, a thermometer is used to measure temperature, barometer for pressure, hygrometer for humidity etc.

**Signal Conditioner**

The readings taken by the measuring devices or transducers are weak in nature. So they cannot be transmitted as it would get heavily attenuated making it difficult to be detected at the receiving end. They need to be amplified for further data processing. This action is performed by the signal conditioner. Signal conditioners collect information from the sensor and amplify them to the suitable level.

**ADC**

The readings taken by the measurement devices are analog in nature. It is quite difficult to process and store the analog data. Also the analog signal is more affected by noise. So it is necessary to convert the data into digital form, generally in the form of 0’s and 1’s.

**Micro-Controller Interface**

The digital data is then passed through this unit. This section performs modulation, i.e., it transforms the data to a high frequency signal so that it can be transmitted without any effect of noise and loss of data. This unit is also connected to GSM MODEM for wireless data transmission. The microprocessor acts as a brain for all these functions and performs the task without human intervention.

**GSM Modem**

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network.

While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

**FLOWCHART**

The above flowchart explains the sequence of events taking place to acquire data from the RTUs. The mobile user sends synchronizing signals to the RTU via his GSM mobile phone. The micro-controller receives the synchronizing signals and accepts a request. Now the mobile phone sends a request for the specific data that it wants to access and monitor. The controller’s normal process gets interrupted and it fetches the required data.

The micro-controller starts the polling process to identify the source of the request. It checks with every member's mobile number of its database and asks for the details of the data to be transmitted. The GSM mobile sends the details which the user wants via SMS. The micro-controller decodes the received SMS and fetches the data and then dispatches the required data.
APPLICATIONS

Common applications of wireless SCADA systems typically include water and waste treatment, petroleum and hydrocarbon processing, power generation, food processing, steel manufacturing, remote telecommunications and plant machinery maintenance. Unlike in plant process control systems, SCADA systems typically include a remote telecommunication link by radio or GPRS. Real-time measurements and controls at remote stations are transferred to a CPU through the communication link. Large systems can monitor and control 10-2000 remote sites, with each site containing as many as 2000 I/O points.

ADVANTAGES

Advantages of Wireless SCADA system include:

- SCADA systems hardware is ruggedized to withstand temperature, vibration, and voltage extremes.
• Reliability is enhanced by having redundant hardware and communications channels.
• The calculated mean time to failure of such high reliability SCADA systems can be on the order of centuries.
• SCADA significantly reduce operating labor costs and improve plant system performance.
• SCADA based alarming is also very reliable since it is in-house and tied directly to process control.
• Graphically displayed and accumulated operating data often will indicate a developing problem, or an area for process improvement.
• Wireless SCADA technology using GPRS enabled GSM mobile phone requires no extra hardware to establish a connection between the RTUs and the mobile phone because the connection is already made by the GSM service provider. We only need to find the receiver onto which the data has to be transmitted.
• Another advantage of this technology is that the client can receive the information regarding the plant on his mobile phone wherever he is, in any part of the world.

DISADVANTAGES

Disadvantages of Wireless SCADA Technology include:
• Communication between different computers is not easy, resulting in configuration problems
• Data processing and databases have to be duplicated across all computers in the system resulting in low efficiencies.
• There is no systematic approach to acquiring data from the plant devices – if two operators require the same data, the RTU is interrogated twice.
• The disadvantage that can hamper this technology is when the client asking for data is outside the coverage area of the GPRS service provider. This would restrict the client from receiving data and to take any decisions based on the analysis.
• As it involves sending and receiving SMSs the cost of continuous monitoring of data will exceed beyond the company’s budget. Never though this technology has more benefits rather than disadvantages.

THREATS TO MODERN SCADA SYSTEM

There are two distinct threats to a modern SCADA system. First is the threat of unauthorized access to the control software, whether it be human access or changes induced intentionally or accidentally by virus infections and other software threats residing on the control host machine. Second is the threat of packet access to the network segments hosting the SCADA device. In many cases, there is no security on the actual packet control protocol, so anyone who can send packets to the SCADA device can control it. It’s a misconception that a SCADA network is secure because it is not connected to the Internet. In reality, the data could be tampered by bypassing the firewall of the system. Hence for a foolproof system, the network should be protected by appropriate anti-virus softwares and firewall settings.

CONCLUSIONS

In a wireless SCADA system, the objective is to work on the remote site safety & security application by using controller to produce an input data file for each of the RTUs, build a Control Area Network(CAN), collect & manage data
in the CAN and send SMS to a monitoringcentered. GSM communications perform almost flawless data transfer from sensor at remote area. Since all communication between RTU and HMI are wireless based, this translates into lowest cost compared to all others system. In this project all the database is stored in a central database in the RTU or data logger; user has global access to consolidate data from many system or locations. Subsequently newer and advanced wireless techniques are being worked upon by scientists to take wireless SCADA technology to entirely new level of sophistication.

REFERENCES


2. www.modular-scada.co.uk/what-is-scada.html