lamaPLC Communication: SCADA

SCADA (*supervisory control and data acquisition*) is a control system architecture comprising computers, networked data communications and graphical user interfaces for high-level supervision of machines and processes. It also covers sensors and other devices, such as programmable logic controllers, which interface with process plant or machinery.

The operator interfaces which enable monitoring and the issuing of process commands, such as controller setpoint changes, are handled through the SCADA computer system. The subordinated operations, e.g. the real-time control logic or controller calculations, are performed by networked modules connected to the field sensors and actuators.

The SCADA concept was developed to be a universal means of remote-access to a variety of local control modules, which could be from different manufacturers and allowing access through standard automation protocols. In practice, large SCADA systems have grown to become similar to distributed control systems in function, while using multiple means of interfacing with the plant. They can control large-scale processes that can span multiple sites, and work over large distances. It is one of the most commonly-used types of industrial control systems.

The key attribute of a SCADA system is its ability to perform a supervisory operation over a variety of other proprietary devices.

- Level 0 contains the field devices such as flow and temperature sensors, and final control elements, such as control valves.
- Level 1 contains the industrialized input/output (I/O) modules, and their associated distributed electronic processors.
- Level 2 contains the supervisory computers, which collate information from processor nodes on the system, and provide the operator control screens.
- Level 3 is the production control level, which does not directly control the process, but is concerned with monitoring production and targets.
- Level 4 is the production scheduling level.

Components

A SCADA system usually consists of the following main elements:

Supervisory computers
This is the core of the SCADA system, gathering data on the process and sending control commands to the field connected devices. It refers to the computer and software responsible for communicating with the field connection controllers, which are RTUs and PLCs, and includes the HMI software running on operator workstations. In smaller SCADA systems, the supervisory computer may be composed of a single PC, in which case the HMI is a part of this computer. In larger SCADA systems, the master station may include several HMIs hosted on client computers, multiple servers for data acquisition, distributed software applications, and disaster recovery sites. To increase the integrity of the system the multiple servers will often be configured in a dual-redundant or hot-standby formation providing continuous control and monitoring in the event of a server malfunction or breakdown.

Remote terminal units

RTUs connect to sensors and actuators in the process, and are networked to the supervisory computer system. RTUs have embedded control capabilities and often conform to the IEC 61131-3 standard for programming and support automation via ladder logic, a function block diagram or a variety of other languages. Remote locations often have little or no local infrastructure so it is not uncommon to find RTUs running off a small solar power system, using radio, GSM or satellite for communications, and being ruggedised to survive from -20C to +70C or even -40C to +85C without external heating or cooling equipment.

Programmable logic controllers
PLCs are connected to sensors and actuators in the process, and are networked to the supervisory system. In factory automation, PLCs typically have a high speed connection to the SCADA system. In remote applications, such as a large water treatment plant, PLCs may connect directly to SCADA over a wireless link, or more commonly, utilise an RTU for the communications management. PLCs are specifically designed for control and were the founding platform for the IEC 61131-3 programming languages. For economical reasons, PLCs are often used for remote sites where there is a large I/O count, rather than utilising an RTU alone.

Communication infrastructure
This connects the supervisory computer system to the RTUs and PLCs, and may use industry standard or manufacturer proprietary protocols. Both RTUs and PLCs operate autonomously on the near-real time control of the process, using the last command given from the supervisory system. Failure of the communications network does not necessarily stop the plant process controls, and on resumption of communications, the operator can continue with monitoring and control. Some critical systems will have dual redundant data highways, often cabled via diverse routes.

HMI - Human-machine interface
The HMI is the operator window of the supervisory system. It presents plant information to the operating personnel graphically in the form of mimic diagrams, which are a schematic representation of the plant being controlled, and alarm and event logging pages. The HMI is linked to the SCADA supervisory computer to provide live data to drive the mimic diagrams, alarm displays and trending graphs.

In many installations the HMI is the graphical user interface for the operator, collects all data from external devices, creates reports, performs alarming, sends notifications, etc. Mimic diagrams consist of line graphics and schematic symbols to represent process elements, or may consist of digital photographs of the process equipment overlain with animated symbols. Supervisory operation of the plant is by means of the HMI, with operators issuing commands using mouse pointers, keyboards and touch screens. For example, a symbol of a pump can show the operator that the pump is running, and a flow meter symbol can show how much fluid it is pumping through the pipe.

The operator can switch the pump off from the mimic by a mouse click or screen touch. The HMI will show the flow rate of the fluid in the pipe decrease in real time. The HMI package for a SCADA system typically includes a drawing program that the operators or system maintenance personnel use to change the way these points are represented in the interface. These representations can be as simple as an on-screen traffic light, which represents the state of an actual traffic light in the field, or as complex as a multi-projector display representing the position of all of the elevators in a skyscraper or all of the trains on a railway.

A historian is a software service within the HMI which accumulates time-stamped data, events, and alarms in a database which can be queried or used to populate graphic trends in the HMI. The historian is a client that requests data from a data acquisition server.

Sources

Wikipedia (here)

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