# Intelligent Network Monitoring System Based on Industrial Ethernet

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**Keywords:** Monitoring, Ethernet, Smart grid.

**Abstract.** Remote centralized monitoring system capable of remote operation allows the operator to take the man-machine interface, which not only eliminates a lot of unnecessary human consumption, and its high speed and efficiency of data acquisition and remote control, more convenient power management department of the grid electricity status monitoring and control. Meanwhile, it can be effective for data calculation, and constantly improve the efficient use of electricity. And remote centralized monitoring system can make the operation personnel adopt remote operation, and the administrative departments of electric power monitors the power grid more convenient.

## 1. Introduction

In all areas of daily life, modern industry and the national economy contact closely with human lives as a major energy power. With the growing social development and the demand for electricity in China's power production planning and scheduling and economic dispatch of the increasingly high demand, and electricity production is characterized, supply, electricity is completed at the same time, so as a non-storage of commodities used to accurately calculate the flow of electrical energy, monitoring and rational use becomes particularly important.

Due to the rapid development of electronic technology, intelligent products gradually replaced the cumbersome and complex manual labor, in the presence of meter hundred years, gradually to the electronic transition, so the smart grid centralized monitoring system is the development of basic smart meter future. With the progress of science and technology, booming electronic age and machines gradually replace the manual labor requirements, the use of intelligent electronic products to replace the original manual labor, eliminated in every household installed energy meter, and provides the user the power to check the person's regular field situation usage, the labor force freed from the original mechanical labor out remotely via Ethernet to the actual situation of users of electricity monitoring and accurate measurement and recording, and based on the detection data actually returned to the user's electricity consumption in real time control and reasonable adjustments, smart grid centralized monitoring network system came into being, which is the future of the national electricity centralized monitoring and analysis and trends on the rational utilization.

## 2. Industrial Ethernet Control Technology

EPA full name Ethernet for Plant Automation. It is a real-time Ethernet standard applies to industrial measurement and control systems. As a distributed system, EPA system can connect each subsystem field to make up a whole, together to complete control and measurement tasks. Industrial Ethernet is an Ethernet technology used in industrial control, it is technically compatible with commercial Ethernet, it must meet the needs of industrial control network communications, real-time response that is better, fault-tolerant, open and good characteristics. In order to apply to the field of traditional commercial Ethernet control, we used real-time Ethernet EPA, not only to maintain the traditional advantages of Ethernet, but also to solve the communication of uncertainty and real-time Ethernet.

EPA communication protocol model the physical layer and data link layers of Ethernet technology, using IEEE802 series specifications, increase the production site for industrial application specifications on the transmission medium and the physical interface. In order to ensure

real-time transmission of information to increase the EPA real-time communications management interface, which is located between the data link layer and the network layer, data packets between the network layer and the physical layer transmission, it uses time-delivery mechanism, for periodic packet transmission based on configuration time, it sends the message according to the priority order and the time for effective and other non-periodic packets.

## 3. Design of Smart Grid Centralized Monitoring Network System

Smart Grid centralized monitoring network system consists of five parts, namely loop control device, the information collection device, power monitoring module, PLC and HMI control module. Loop control device with the loop-off signal to implement on-off control of the power supply network; information collection device used to sense the voltage and current measurements into the household size for conversion to electric power monitoring module to facilitate measurement of the signal, preventing the direct measurement of the power supply network voltage and current directly affect the stability of the power supply; power monitoring module is the actual circuit do a DC signal AC signal further processing into PLC control module can be directly measured and directly analyzed digital signal; PLC control module will collect collection point further analysis of the data and calculations, the user can directly after analytical processing. Then use the data collation stored for a user calls and information exchange via an Ethernet connection with a PC to control the execution order issued by the control center, control center operators can be simple and fast operation of the PC monitor household electricity consumption by the master module control solid state sensor for excess electricity or illegal use of electricity users to cut the electrical treatment.

PC via Industrial Ethernet PLC directional analysis and sampling, and all the inner PLC access to the engine room to Industrial Ethernet switch, and then interact with the PC information. Signal communication between PC and control module, is through the EPA protocol model transfer.

## 4. Composed of Smart Grid Centralized Monitoring System

### 4.1．Loop Control Device

Loop control device is the use of solid state relays and digital output control module fitted to achieve on-off control loop. Solid state relay is an isolation of non-contact electronic switch, connected to the household power supply input terminal, when the user of excess electricity, power control center issued a directive, with its cut off the power supply. Through the analysis of the rated current and voltage, peak current and voltage, the line current phase number, etc., refer to the control module for solid state relay control voltage size, and select the appropriate solid state relay based on actual usage and site design costs, taking into account the actual use of solid state relays circuits require long-term in the conduction state, so choose normally closed solid state relay.

### 4.2 .Information Collection Device

Smart Grid centralized monitoring system, you need the information collection device to detect voltage and current size of the user used in this design is the use of voltage and current transformers to achieve voltage and current acquisition. Because the large current and voltage values to facilitate difficult to measure small current into a voltage signal is transmitted to the power control module measuring current loop stability directly prevent interference measuring circuit, so the measurement data to be scaled down by electromagnetic induction mode conversion for the second term security models can be directly captured.

Access to electricity voltage transformer primary circuit, namely the end of the voltage sensor primary access line of fire, one end of the zero line access, access to the power input terminal of the secondary monitoring module voltage measurement; current transformer installed in the line of fire into the household wires on the wires coming into the household after firing through the current transformer into each branch, provided for the use of electrical power, access to current input measuring the output terminals of the power monitoring module.

### 4.3 .Power Monitoring Module

Power monitoring module DLC1000, is the core module power monitoring centralized management system, which is an efficient and powerful three-phase integrated power monitoring and signal acquisition, processing and conversion, and has fully functional, economical and practical, high reliability, anti-jamming ability and many other advantages. DLC1000 is mainly used for power monitoring module grid phase voltage, phase current and power factor data acquisition can be realized on the entire grid voltage, current, power real-time monitoring. Voltage signal voltage signal and the voltage transformer measurement after sampling resistor, respectively amplification processing. Prior to the acquisition signal amplification required to filter out the measuring signal is superimposed high-frequency interference and prevent interference signals affect the measurement results, the method using a low pass filter to filter out this part of the high-frequency interference filter, and then use the instrument for a signal amplifier enlargement processing. Then were amplified after blocking voltage and current signal is processed and square wave converter, wherein the signal processing is a sinusoidal AC signal precision full-wave rectifier, a diode and an operational amplifier sinusoidal AC signal precision full wave rectifier circulation, after the adoption of energy storage capacitor voltage into a DC signal conditioning output.

### 4.4 .PLC Master Control Module

PLC master control module and power control module with the use of voltage and current signals together to complete the acquisition, the voltage and current phase acquisition through power control loop. Collected voltage and current signals are reactive voltage value of the actual magnitude of the voltage and current; voltage and current phase of the acquisition is the actual current and voltage phase response relationship square wave; on-off control circuit controls the power supply network is on-off state of each branch.

Voltage and current signal acquisition capabilities for analog control module collection function, when there is an analog signal access its analog input voltage value input via analog input AI port sampling resistor bridge, then zoom into the low-pass filter AD converter chip to convert analog to digital quantity calculation, the port collected analog acquisition, analog voltage value is converted into binary machine code CPU recognizes the data stored in the ram after conversion. When the main control center need to monitor site electrical conditions, it will be appropriate to collect data transmission to the control center via Ethernet distal end by the man-machine interface control module returned data is displayed, and then directly reflect size of the actual size of the voltage and current of electricity per household when.

### 4.5 .Interactive Interface

First, to set the power monitoring module DLC1000 in the master module before using the power monitoring system, the basic parameters: Channel selection control pin conditioning board analog acquisition index, a combination of digital acquisition, transient data storage area, historical data storage period, historical data store word offset the like; import power monitoring module of zero and span, zero and full scale is not linear error used to calibrate the analog signal acquisition itself exist. Set the calibration value engineering; according to the actual situation manually enter the required engineering calibration values, used to remove the actual use of linear error-site presence. When setting channel energy, turn-on voltage and current acquisition channels.

## 5. Summary

The design of the centralized monitoring system based on smart grid industrial Ethernet, including current and voltage acquisition, power control module for the current signal and voltage signal acquisition process, PLC control module data analysis, monitoring and intelligent man-machine interface based on industry the practical application of smart grid centralized monitoring system on Ethernet five parts. Mainly to solve the following problems: (1) the introduction of industrial Ethernet technology, making the master module can easily communicate with the man-machine interface to facilitate the transmission and grid work of the monitoring data, the realization of the system all monitoring point the remote control. (2) the use of non-standard AC

power monitoring module signal current and voltage transformers are converted into standard signals 0-5V PLC identified, and a high degree of accuracy. (3) the use of current and voltage transformers for the acquisition, without the need to install meters, reducing the cost of electricity monitoring equipment, and put an end to the phenomenon of illegal use of electricity, facilitate unified management.

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