

## Progress of Internet-Based Energy Management/Supervisory Control and Data Acquisition Systems

### Innovations in Power System Computer Control Technology Considering Paradigm Change in Energy Systems

TAKENAKA Shoji

#### Trends in Advanced Control Systems for Power Systems

WATANABE Hiroshi / MITAMURA Kenichi / KUDO Yoshimasa

Toshiba provides a broad range of systems for power systems, including energy management systems (EMS) for generation control and network analysis, supervisory control and data acquisition (SCADA) systems, and distribution automation systems (DAS). The requirements for these systems have been changing greatly in recent years, in line with the changing circumstances in the power system environment. We have therefore been making innovations to power system technologies in order to develop advanced control systems for power systems.

First, we have developed an advanced middleware applied to virtual technology as an innovation of the system configuration. Second, we have developed a new information system, a high-performance telecommunication unit, and a remote terminal unit to assist operators. Through these innovations in power system technologies, we are aiming at the development of optimized control systems supporting stable power supply.

#### Advanced Energy Management Systems for Electric Power Systems

FUJIMOTO Yuji / ICHIKAWA Tadashi / ASANO Toshiaki

In the field of energy management systems (EMS) for load dispatching centers of electric power utilities, a number of automatic load dispatching functions have been developed and introduced to ensure stable power supplies and optimally economic operation.

Toshiba has been engaged in the research and development of various technologies and the creation of new services for EMS. With the progress made in introducing network technologies to EMS in recent years, it has become possible to improve the system of wide-area dispatching operations, such as joint training and cooperative operation between load dispatching centers and backup of a central load dispatching center. Furthermore, to reduce the burden on operators and facilitate optimal operation, we have developed an automatic supply and demand control technology that can respond flexibly to various operational restrictions, uncertainties with regard to distributed generators, and operator skills.

#### New Distributed SCADA Systems on Wide-Area IP Network

OHSAKO Yoshiaki / SAITO Hideki / TSUJI Hisashi

Toshiba developed a middleware applying intranet technologies for supervisory control and data acquisition (SCADA) systems ahead of other companies, and supplied Japan's first wide-area-network distributed SCADA system incorporating this middleware in 2005.

For wide-area Internet Protocol (IP) -network distributed SCADA systems, we have applied our original technologies to realize the integration of servers by multisite management and highly reliable communications control, and to ensure security from unsecured networks. Based on the advantages of these technologies we have been leading the field of wide-area-network distributed systems, which has recently become the mainstream model for updating SCADA systems.

#### Distribution Automation System for Wide-Area Operation

NISHI Akinori / SAKURAI Mikiya / KONO Hiroki

Since Toshiba's introduction of Japan's first distribution automation system (DAS), we have been developing such systems applying state-of-the-art technologies to meet the functional, operational, and performance requirements of users. In recent years, there has been growing demand from users for wide-area operation via information and communication networks, which can improve both the efficiency and flexibility of operations, reduce costs, and allow rapid sharing of information.

We have therefore developed a new DAS for wide-area operation, and supplied this system to electric power utilities. The system is now in operation in large cities.

#### High-Performance Remote Terminal Unit for Next-Generation SCADA System

HASEGAWA Yoshiaki / SAIGO Nobuhiro / EBATA Yoshio

The introduction of high-performance microprocessors with low power consumption is making it possible to improve remote terminal units (RTUs), leading to changes in the architecture of supervisory control and data acquisition (SCADA) systems. High-performance RTUs incorporating some of the server functions of a SCADA system will realize a distribution system that can manage the information of each substation connected to the computer center via a wide-area network. This is expected to be one of the key technologies for the next-generation SCADA system.

#### Remote Terminal Unit with Advanced Functions for Distribution Automation Systems

TSUKADA Toru / TANAKA Toshio / KOSUGI Mitsugu

Remote terminal units (RTUs) are widely used in the distribution automation system (DAS) environment to supervise and control load break switches dividing distribution feeders from branch facilities of electric power companies. Recently, there has been increasing demand for RTUs offering higher performance and functionality to safeguard the public from breakdown faults and control power quality including in connections between distributed power sources.

Toshiba has developed an RTU for DAS to meet these requirements. The new RTU provides power system fault detection, fault tripping and quantitative measuring functions as well as a waveform collection function. In addition, it can also be used in an Internet Protocol (IP) network system.

#### Keyword Extraction for TV Program Information Retrieval without Interruption of PC Work

YAMASAKI Tomohiro / UZAWA Hideaki / HAYASHI Eiji

PCs are rapidly joining the ranks of audiovisual (AV) equipment, a trend that is true for both notebook and desktop models.

Toshiba has developed a function called KININARU Link to enhance the experience of TV watching by AV-PC. By means of this function, users can easily retrieve information on a scene of interest when watching TV, with a single click. The features of Kininaru Link include estimation of the user's retrieval purpose when the button is pushed, and automatic enumeration of keywords and search methods suitable for the meaning of each keyword.

We evaluated the accuracy of keywords extracted by our engine and confirmed the efficiency of Kininaru Link through the high precision and high recall rate of the results obtained.

#### Optimal Design Methodology and Tools for Efficient Supply Chain

KOTAKE Masahiro / KOGA Yasutaka

Toshiba has developed a methodology and simulation tools for enterprise supply chains, and applied them to the development of a new production scheduling system that reduces manufacturing lead time and work-in-process inventory while maintaining a high level of demand satisfaction.

The concept of the supply chain from parts procurement to shipment of finished goods is regarded as a water flow. Under this water flow model, plans for improved control of the supply chain are considered and key parameters are identified. Three types of tools are also provided: a point of production (POP) system, a set of optimal supply chain design tools, and a financial simulation tool.

#### Basic Simulation Tools for Automatic Design of Production Lines

OOUCHI Toshihiro

There is growing demand for the speeding up of production processes with the rapid changes taking place in market environments. The rapid development of new products and design of efficient production lines are indispensable in this situation.

Toshiba has been applying simulation technology to the design of production lines. However, one of the major problems encountered in this area is that the development of simulation models depends on the skills and experience of experts. In order to solve this problem, we have developed basic simulation models for tools allowing the automatic design of production lines. These basic simulation tools are expected to realize significant reductions in the design period for high-efficiency production lines.

#### Purulia Pumped Storage Power Station in Commercial Operation

IKEDA Chikamasa / TEZUKA Kotaro / SAKAMOTO Shigeru

The Purulia Pumped Storage Power Station has been constructed in Purulia district, located 300 km northwest of Kolkata in the state of West Bengal, India. All units had successfully entered commercial operation as of January 2008. This project was implemented to overcome shortages of peak power, so as to stabilize and achieve effective operation of the power grid.

Toshiba received an order for this project as a result of an international competitive bidding process called in 1998. We designed, manufactured, and delivered major equipment such as pump-turbines, generator-motors, the supervisory control and data acquisition (SCADA) system, static frequency converters, and electrical equipment for the power station. The Purulia Pumped Storage Power Station is expected to contribute to improved power grid stability in West Bengal.

#### Online Diagnosis of Insulation Condition of Generators

SAKAI Masahiro / SATO Fumio

Online partial discharge monitoring and diagnosis of the insulation condition of rotating machines can be expected to reduce their maintenance costs.

Toshiba has developed an online partial discharge sensor for such purposes. This sensor does not come into contact with a high-voltage conductor and is easily mounted on a generator. Online diagnosis of the insulation condition of generators shows promise as a component of generator maintenance.

#### Thickness Measuring Technology for Pipes of Thermal Power Plants

YAMAGA Nobuo / TAKAHASHI Masashi / AHIKO Norio

In thermal power plants, an ultrasonic thickness meter is generally used to measure the thickness of the main pipes and detect corrosion wastage. However, this conventional technique requires plant outage time and costs to dismantle and reassemble the heat-insulating coats of the pipes.

To solve these problems, Toshiba has developed a new measuring method combining electromagnetic acoustic transducer (EMAT) and fiber-optic Doppler (FOD) sensors. The pipe thickness is measured by analyzing the resonance phenomenon of ultrasonic waves multireflected from both the inner and outer surfaces of the pipe. Since they can be inserted between the pipe and the heat insulator, the sensors allow the thickness of the pipe to be measured and monitored online, thereby contributing to the enhancement of plant safety.

#### Movable Compact Type Substation System for Electric Railways

SATAKE Nobuhiko / UCHIDA Masato / FUKUDA Yasuyuki

There is increasing demand for temporary facilities for the replacement of electric railway substations, with reduction of both the workspace and the period of construction.

In response, Toshiba has developed a movable compact type substation for electric railways, incorporating a number of our advanced technologies including a silicone-fluid-immersed transformer, solid-insulated switchgear (SIS), high-speed vacuum circuit breaker (HSVCB), and miniature switchboard. The first movable compact type substation has been delivered to the Wabuka Substation of the West Japan Railway Company. This system realizes the satisfaction of customer needs for easy setup in a small area and in a short time.

#### Radio-Frequency Microelectromechanical Systems (RF-MEMS) for Built-in Antenna of Mobile Terminal