

Special Reports

Smart Grid for Realization of Low-Carbon Society

Prospect and Realization of Smart Grid

YOKOTA Takeshi

Trends in Smart Grid Technologies and Toshiba's Approach

WATANABE Hiroshi / SHOBATAKE Yasuro

Global warming due to increased emissions of greenhouse gases has become a serious issue in recent years. In order to achieve a low-carbon society, there is a strong need for the construction of smart grids to introduce renewable energy sources and improve the efficiency of energy usage in the power generation sector. However, as renewable energy sources such as solar, wind, and other natural energies are extremely dependent on natural factors, more efficient integration of solar and wind power into existing grid systems has been attracting considerable attention as a solution to these issues.

Toshiba has been participating in large-scale pilot projects to gain a deeper understanding of these issues, and developing related technologies to realize a smart grid based on the results of these efforts. We are also actively promoting the international standardization of such smart grid-related technologies for entry into the global market.

μEMS Next-Generation Energy Management System for Smart Grids

YOSHIMURA Yoshihiko / KOBAYASHI Takenori / YANO Ryo

The introduction of renewable energy sources such as solar power and wind power into existing power systems is being promoted on a global scale with the aim of realizing a low-carbon society. As power generation from renewable energy sources fluctuates greatly depending on the weather conditions, a smart grid integrating these renewable energy sources is required to perform both supply and demand control in the smart grid itself and coordinate operation with trunk power systems, in order to maintain the energy balance between supply and demand.

Toshiba has developed the μEMS (Micro Energy Management System) not only to improve power supply reliability for smart grids but also to enhance operation efficiency of whole power systems through optimum power control using storage batteries.

Output Power Fluctuation Suppression Technology for Photovoltaic Power Generation Systems

OKUDA Yasuo / KIMURA Misao

Photovoltaic (PV) power generation is expected to play a significant role in reducing carbon dioxide (CO₂) emissions. Japan

has set a target of increasing the introduction of PV power generation systems to 20 times the installed capacity by 2020

compared with the level in 2005. However, as renewable energy sources such as PV power are affected by weather conditions, their output tends to be unstable. The large-scale connection of PV power generation systems to the power grid will therefore make it difficult to maintain frequency control of power grid lines.

Toshiba has developed prototype suppression equipment to control output power fluctuations through the use of rechargeable batteries, and verified the performance of the system for practical application. We are continuing our efforts to further improve the performance of this system, and incorporate it into PV power generation systems.

50 kW Storage Battery System Applying SCiB_{TM} Batteries for Photovoltaic Power Generation Systems

SHIMADA Naoto / UMEHARA Tatsushi / OTSUKA Masahiro

As electricity generation systems using renewable energies such as photovoltaic (PV) power make a substantial contribution to the reduction of carbon dioxide (CO₂) emissions, such systems have been increasingly introduced in recent years. However,

when PV power generation systems, whose output tends to fluctuate in accordance with weather conditions, are incorporated into an electric power system, it is necessary to introduce an energy storage system with rechargeable batteries for the stabilization of output fluctuations.

Toshiba has developed a 50 kW storage battery system applying our SCiB_{TM} batteries with excellent life performance and high safety. This system can store 10 kWh of power and maintain more than 80% of capacity after 34,000 charge-discharge cycles through the optimization of output power capacity between the storage battery system and power conditioning system (PCS).

Advanced Metering Infrastructure for Smart Grid

NITTA Keiko / MIE Kunitoshi / GOTO Yoshihide

The United States is actively promoting the smart grid to solve power supply and demand problems existing between power utilities and consumers by means of information and communication technology (ICT).

Toshiba has developed major components for a prospective advanced metering infrastructure (AMI) system for the smart grid including a smart meter, an in-home display, and a meter data management system (MDMS). The smart meter measures the instantaneous values of active power, reactive power, voltage, current, and frequency based on the American National Standards Institute (ANSI) C12.20 0.5% accuracy class standard. It also transmits measurement data for power utilities via Ethernet, and communicates watt-hour values to the in-home display using the ZigBee short-range wireless communication protocols for home appliances. The in-home display shows real-time power, watt-hour, and demand trend graphs. The MDMS performs management and control of smart meters using interactive network communications and analyzes utility operations from the collected data.

AMSO_{TM} Unified Key Management Mechanism Integrating Authentication and Encryption for Smart Meters

An advanced metering infrastructure (AMI) system is one of the important elements of a smart grid system. In an AMI system, so-called smart meters with communication functionality are required instead of conventional electrical meters.

Toshiba has developed AMSO_{TM} (advanced meter sign-on), a unified key management mechanism for smart meters, which integrates the key management functions of authentication, encryption, and integrity for all communication applications on smart meters. It can be used for future communication applications for smart meters as well as for strengthening the security of smart meters.

Feature Articles

Block-Based Adaptive Loop Filter toward Next-Generation Video Coding Standardization

WATANABE Takashi / CHUJJOH Takeshi

The standardization of High Efficiency Video Coding (HEVC) toward the next-generation video coding standard has been started by the Joint Collaborative Team on Video Coding (JCT-VC), which has been set up by the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) Moving Picture Experts Group (MPEG) and the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Video Coding Experts Group (VCEG). The objective of HEVC is to provide double the compression performance of the current H.264/Advanced Video Coding (AVC) standard.

Toshiba has developed a block-based adaptive loop filter (BALF) as a new in-loop filtering technology for HEVC. BALF has already been adopted in the reference software for feasibility studies used by VCEG, and is expected to contribute to HEVC standardization.

Random Noise Removal Technology to Realize High-Quality Digital Cameras

KAWATA Satoshi / TAGUCHI Yasunori / MATSUMOTO Nobuyuki

With the reductions in size of image sensors installed in cameras in recent years, the intensity of the incoming light received by each sensor has also been decreasing. Random noise is an inevitable consequence of this decrease in light intensity.

Toshiba has developed a new technology to remove noise having no correlation with natural images and input images. This technology makes it possible to enhance the quality of various types of pictures taken by digital cameras, surveillance cameras, and so on.

Underwater Laser Beam Welding Technology for Reactor Vessel Nozzles of PWRs

YODA Masaki / TAMURA Masataka

Toshiba has developed an underwater laser beam welding technology for the maintenance of reactor vessel nozzles of pressurized water reactors (PWRs), which eliminates the need for the drainage of water from the reactor vessel. The new welding system makes it possible to both reduce the work period and minimize the radiation exposure of workers compared with conventional technologies for welding in ambient air.

We have confirmed the effectiveness of this technology through experiments in which stress corrosion cracking (SCC) was mitigated on the inner surfaces of nozzles. We are promoting its practical application in Japan and overseas in cooperation with Westinghouse Electric Company, a group company of Toshiba.

ON-AIR MAX_{TM} FLASH High-Reliability Flash Memory Server

KATO Nobuyuki

Toshiba developed the world's first flash memory video server, the ON-AIR MAX_{TM}, in the mid-1990s. Since then, we have been introducing flash memory video servers with higher reliability compared with previous hard disk drive server models into the broadcasting market.

With flash memories accepted today as the standard for data storage, we have developed a next-generation flash memory server, the ON-AIR MAX_{TM} FLASH, equipped with 10 Internet Protocol (IP) ports, each with approximately 700 Mbits/s of dedicated bandwidth for non-real-time file transfers, enabling the server to handle files such as Material Exchange Format (MXF) faster. It also offers simultaneous input/output operation with 40 channels of frame-accurate real-time baseband output ports, enabling flash memory storage to currently be scaled up to 60 Tbytes. The ON-AIR MAX_{TM} FLASH can be upgraded and serviced with hot-swappable components and can be easily adapted to the customer's ever-changing workflow due to its flexibility and scalability.

Transportation Revenue Examination Settlement Statistics System Supporting Internal Control

NARITA Masahiro / KOYANO Akio

A transportation revenue examination settlement statistics system deals with accounting data necessary to ensure the reliability of financial reports of railway companies as one of the objectives of internal control, based on passenger revenues.

Toshiba has developed a new transportation revenue examination settlement statistics system to replace conventional systems that makes it possible to not only improve reliability, but also to construct proper mechanisms for internal control by means of information technology (IT). We have supplied this system to Seibu Railway Co., Ltd.

Frontiers of Research & Development

Removal and Recovery of Phosphorus from Wastewater Using Absorbents