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Special Reports

Technologies for Railway Transportation Systems

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Special Reports

Technologies for Railway Transportation Systems

*Railway Systems for the New Century

TAKAHARA Eimei

*Trends in Railway System Technologies

OHYAMA Takio MIYASHITA Takehiko

Various social challenges facing the railway business in the 21st century are becoming increasingly important, such as responding to the information technology society, reduction of CO₂ emissions for environmental conservation, promotion of barrier-free transportation systems, and coping with the declining birthrate and growing proportion of elderly people. Railway systems are often considered to be energy-efficient and eco-friendly systems. At the same time, however, efforts to reduce pollution through the application of fuel cell technology and hybrid technology have been rapidly progressing in the automotive field. This paper describes Toshiba's latest technical trends and efforts to realize "human-friendly and eco-friendly transportation systems" for railway and automatic fare collection systems, taking into consideration both competition and cooperation with other transportation systems.

*Next-Generation Train Information Control System

KAMO Yushi ISHII Hideaki MIYOSHI Miyako

Toshiba has applied general-purpose digital communication technology to the field of train information control systems and developed a next-generation, Ethernet-based system aimed at enhancing train safety and reliability. We have evaluated the performance of this system with actual trains. We will systematize the advantages and tasks related to broadband communication lines for multifunctional use in trains, so as to realize a high-performance train information control system.

*Power Electronics Equipment for Rolling Stock

NAKAZAWA Yosuke HENMI Takuma AOYAMA Ikuya

In addition to the recent trends toward downsizing and weight reduction of power electronics equipment for the Shinkansen, commuter trains including subways, and electric locomotives, increasing importance is being placed on energy saving, consideration for the environment, and improved reliability. In these circumstances, the development of core technologies is indispensable for the commercialization of power electronics equipment that can meet the needs of the market.

Toshiba has introduced and commercialized drive technologies for trains including the latest low-loss power devices and techniques for their application, as well as vector control technology, ahead of other companies in this field. These technologies have received high evaluations for their contribution to eco-friendly railway systems by reducing noise and improving riding comfort.

*Traction Motors Aiming at High Efficiency and Low Maintenance

YAMADA Toshiaki SHIRAIISHI Shigetomo

Due to the demand for high-output motors in the limited space between the wheels in an electric train, self-ventilating traction motors have been used for many years. Periodical disassembly maintenance is necessary to remove the small quantities of dust that enter the motor from the open-air ventilation. Reducing this burden, as well as increasing efficiency and reducing noise, would benefit the next generation of motors.

To address these needs, Toshiba is developing a fully enclosed type traction motor, a fully enclosed type traction motor with outer fans, a high-efficiency permanent-magnet synchronous motor, and a direct-drive motor (DDM) as traction motors for the next generation of trains.

*Innovation of Transport Operations Using Information Technology

MUGIYA Yasuyoshi KAWAUCHI Masao

As computerization progresses, it is becoming increasingly important to communicate and share information among railway operation staff to improve passenger services, reduce losses, and increase profits. Moreover, communication and sharing of information is essential in an abnormal situation such as disorder of train operations, in order to guide passengers precisely and recover from confusion promptly. Communication with staff who deal with passengers has been difficult up to now as they move around on a platform or in a train. However, it has now become possible due to recent trends in the field of portable terminals and wireless access devices including standardization, cost reduction, and performance improvement.

Toshiba has developed a mobile communication system for staff handling railway operations.

*Transportation Information Systems to Control Confusion at Time of Schedule Disorder

FUJIIWARA Yuji

In recent years, incidents of disorder in the schedule of railroad operations have caused major social confusion. For this reason, demand has been increasing for the introduction of information systems to control confusion at the time of schedule disorder.

Toshiba has developed a train location detection system, a train operation schedule adjustment system, and a traffic information distribution system as information systems for this purpose.

*Locomotive and Freight-Traffic System Supporting Modal Shift

NAGASE Mitsunori NUMAZAKI Mitsuhiro

Freight trains in Japan are mainly powered by locomotives employing a concentrated traction system. By passing the freight cars to a variety of different locomotives, the train can travel through sections of direct and alternating current as well as through areas that have not been electrified. In recent years, the induction motor has become the main type of motor used. The control systems of such motors use high-capacity semiconductors capable of high-speed switching. These control systems are able to perform near-instantaneous control of the motor torque, leading to the development of high-power locomotives with large tractive force capability. Toshiba has developed these technologies and incorporated them into an inverter system for a locomotive that offers both high power and low maintenance. To meet the needs of different lines, diesel-electric locomotives, AC/DC electric locomotives, and DC electric locomotives can be used to cover almost all of the railway sections in Japan. In order to increase expediency, a new system to meet the freight transportation needs of the next generation is currently being tested where the powering of a fixed train set has been considered for both the current concentrated traction system and the distributed traction system.

*Railway Substation Systems Offering Environmental Harmony and High Reliability

IEIRI Ichiro ITO Takashi

In recent years, there has been growing demand for railway substation systems providing greater environmental preservation features, higher performance, space saving, higher reliability, and improved maintainability.

Toshiba has responded to this demand by employing the latest technologies in the fields of power electronics, microelectronics, and information technology to develop and commercialize a range of products for railway substation systems. These are a solid insulated switchgear and a solar electricity generation system offering environmental preservation benefits; various converters with enhanced functionality and higher performance; and a microelectronic type switchboard as well as a maintenance management system that realize expanded functions, higher performance, and improved maintainability.

*SCADA System for Railway Substations Offering High Efficiency and Reliability

OTSUJI Koji

The downsizing of supervisory control and data acquisition (SCADA) systems for railway substations has been progressing and distributed client-server systems have become the mainstream replacing the conventional centralized systems. The adoption of hardware suitable for each function, such as a data acquisition control (DAC) server, console clients, and PCs for record charts, makes it possible to build a flexible system. A SCADA system based on a versatile operating system can provide an easy-to-use graphical user interface, easy data transfer to and from other systems, and functional improvements.

*IC Card System Aiming at Improved User Convenience

HASHIMOTO Tetsuo

The railway industry has been actively investigating the introduction of IC card systems since the Suica IC card system of East Japan Railway Co. began operation. One of these systems is the PiTaPa (Post pay IC for Touch and Pay) system being advanced by the Surutto Kansai Council, which has a simple configuration using IC cards. The post-payment method has been adopted for this system for the first time in the railway industry, with the aim of making it easy to understand and improving convenience for users.

Toshiba has been participating in this project, which is scheduled to start operation in fiscal year 2003, since the planning stage. We have been developing automatic ticket gates and a station total machine for the system, making full use of our know-how of automatic fare collection systems and wireless system technologies.

*New Automatic Ticket Gate System Designed for Future Expandability

ISE Tomoaki NAKAO Kazuhiko SHOGASE Akira

New automatic ticket gates are to be set up at the Shinagawa Shinkansen Station in Tokyo. Toshiba developed the fare collection system (FCS) for the Shinkansen services of Central Japan Railway Co. seven years ago, becoming the first company to realize a Shinkansen FCS. Various new technologies have been introduced in the field of railway automatic ticket gate systems in recent years, including the barless type human detection system and the wireless IC card FCS.

Toshiba has now developed a new ticket gate machine based on the following concepts: (1) a user-friendly design for station staff and users, (2) shortened processing time, (3) a high-reliability printing mechanism, and (4) built-in wireless IC card technology taking future expandability into consideration.

*High-Definition LED Display System

SHINOHARA Koichi NOGUCHI Hiroyuki YOSHIZAWA Nobukazu

Light-emitting diode (LED) screen displays have become a focus of attention in the large screen display category over the past few years. Recently in particular, demand has been rising for higher resolution and larger screen sizes for use in live concerts and exhibitions, and this trend is expected to continue.

In order to meet these requirements, Toshiba Transport Engineering Inc. has developed the world's largest size high-definition full-color LED display system and supplied it to the Port of Nagoya Aquarium.

This display has 766,208 pixels, a brightness of 5,000 cd/m², and dimensions of 14 m (horizontal) x 7.9 m (vertical).

Feature Articles

*T618X High-Performance Cellular Phone with Video Mail Function

SHIKURA Akira SUZUKI Sadao HIRAI Masato

The People's Republic of China now has the largest number of mobile phone subscribers in the world, and growth is continuing at a fast pace. Toshiba has succeeded in developing the first CDMA cellular phone for the China market, the T618X model, which can record, receive, and send photos and videos. The T618X was launched on the market by the joint-venture company Nanjing Postel Wong Zhi Telecommunications Co., Ltd. in March 2003.

The T618X can take photos and videos with its built-in 310,000-pixel CCD camera and send them by e-mail, supporting new services offered by China Unicom. It is equipped with a large 2.1-inch polycrystalline silicon (poly-Si) TFT display with 260,000 colors, enabling high-resolution pictures to be displayed. This high-performance phone incorporating Toshiba's advanced MPEG-4 technology can support up to 15 seconds of video recording.

*Internet-Based Monitoring and Control System for Small Store Facilities

TAKATA Satoshi YUZURIHA Hiroyuki

Chain-store organizations including convenience store companies are currently focusing on energy saving and efficiency of facilities as major subjects in the management of heating, ventilation, and air conditioning (HVAC) as well as cold chain facilities.

Toshiba and Toshiba Carrier Corporation have developed a monitoring and control system for small store facilities that offers a comprehensive solution to these needs.

*Jet Fan for Small-Scale Tunnels

HAYASHI Kenichiro NIIZEKI Yoshiki ADACHI Toshiro

A jet fan is used for ventilation in a tunnel, and is installed by hanging it from the tunnel head lining. In recent years, plans have been made for increased tunnel construction along regional trunk roads in response to the growth in traffic and expansion of the road network. As a result, the demand for ventilation systems is increasing not only for large-scale tunnels such as those on main highways, but also for comparatively small-scale tunnels.

Toshiba has developed a high-performance, low-noise (single-row) jet fan for small-scale tunnels applying the latest aerodynamic technology. This jet fan has been installed in the Kuramoto Tunnel on the Kiso River right-bank road in Nagano Prefecture.

*DWS-70EY Compact Automatic Dishwasher with High-Temperature Sterilizing Function

TERANISHI Masahiro KOHNO Genichiro KUBOTA Tooru

The automatic dishwasher is highly ranked by homemakers in Japan, as shown by its appellation as one of the *3 new treasures* of household appliances[†] together with the induction heating (IH) cooking heater and the kitchen garbage processing machine. It is also attracting attention due to its environmental benefits compared to washing by hand, including (1) the global warming prevention effect of reducing hot water usage, (2) the environmental protection effect of conserving water, and (3) the water quality preservation effect of reducing sewage. The diffusion of automatic dishwashers had been lagging due to kitchen space constraints as well as doubts concerning their washing performance. With the reduction of required installation space and performance improvements in recent years, however, the household diffusion rate surpassed 10 % in 2002 and future growth is expected.

Toshiba has developed the DWS-70EY compact automatic dishwasher featuring a compact body with large inside volume, high washing performance, and a high-temperature sterilizing finish function.

Frontiers of Research & Development

*High-Performance Motor Drives for Home Appliances

*Development and Verification of Direct Analysis Method for Two-Phase Flows