

TOSHIBA REVIEW

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Special Reports

Technologies for Railway Transportation Systems

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Special Reports

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*Never Stop Efforts of Seeking for More Advanced Business Models in the IT Era

MINAMI Masana

*Technological Trends in Railway Transportation Systems

HIROSE Noriaki NAKAGAWA Ryuichi

In order to accommodate increasing numbers of railway passengers and promote the development of the railway business in the 21st century, while fulfilling the basic role demanded of public transportation to carry passengers rapidly, safely, and comfortably, it is necessary to realize systems that can offer passengers satisfactory convenience and comfort such as automatic fare collection (AFC) systems which can make transfers smooth at stations, new information-providing services corresponding to individual requirements, and so on. Moreover, with the railway business now in a situation of intensifying competition with other means of transportation, a management revolution is required so that railway operators can conform with the changes in social needs such as by realizing energy saving for various types of equipment, labor saving in maintenance work, and harmony with the environment.

To achieve these requirements, Toshiba offers a railway total system that integrates information, communication, and control system technologies at the highest level.

*System Integration of IT-Oriented Railway Systems and Related Consulting Services

YANAGIDA Keiichiro FUJIWARA Yuji

Railways in Japan have spread broadly as a social infrastructure and have greatly contributed to cultural and economic development, ranking at the top level in the world along with European railways. However, there are calls to review railway operations from the standpoint of management efficiency, in the same manner as other industries. At the same time, the rapid progress of information technology (IT) has enabled the high-speed and highly reliable transmission of massive amounts of information. This leads to easy integration at existing subdivided units and makes possible remarkable improvements in management efficiency based on knowledge databases.

With this as a background, Toshiba is offering integrated railway systems applying our high-quality software and hardware with excellent IT in the most management-efficient configuration. Toshiba also assists clients with speedy problem-solving by providing our know-how as a management consultant from the initial planning stage.

*Information and Control System Technologies to Realize Railway IT Solutions (e-RAIL service)

FUJIWARA Yuji TAKAO Kazuyoshi BAN Kimiyoshi

Railway information and control systems have been supported by characteristic technologies unique to those systems up to the present time. Now, however, railway management issues are expected to be solved with new ways of thinking by introducing general-purpose information technology (IT) represented by the Internet in recent years.

This paper presents a deployment design developed by Toshiba (e-RAIL service) to realize IT solutions for railway issues, and describes knowledge management, mobile, electronic commerce (EC), and application service provider (ASP) technologies as examples of its services.

*Train Operation Management System in Information Technology Era

OGAWA Shinichiro MORI Minoru YASUMOTO Takanori

Most railway companies are continuously improving the efficiency and reliability of their business processes in train operation management, in order to provide better passenger services. Toshiba has been developing solutions based on the synergy between human expertise and knowledge on the one hand, and supporting computer performance on the other. The recent rapid progress in information technology is leading to innovations not only in the field of communication and control systems but also safety systems.

*Technical Trends in Train Information Control Systems

KAMO Yushi TAKAHASHI Hideyuki

Train information processing covers a fairly broad spectrum, from equipment monitoring and control to diagnosis and service. These functions are continually expanding. The principal functions of train information processing have been realized and improvement of operating performance is now being promoted. Not only the enhancement of functions, but also communication between trains and ground systems and the realization of service functions for passengers will be among the keywords in the technical trends for future train information control systems.

This paper describes the technical trends for future train information control systems, taking systems developed by Toshiba as an example.

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*Rolling Stock Control Systems

OYAMA Takio HASEBE Toshio AOYAMA Ikuya

In the field of rolling stock control systems applied to the Shinkansen, which represents rapid-transit railways, as well as to existing railway lines that support urban transportation, subways, etc., efforts are being made to improve riding comfort and energy saving by adopting the latest power electronics technologies.

In recent years, three-level conversion equipment incorporating insulated gate bipolar transistors (IGBTs) and two-level conversion equipment incorporating high-voltage IGBTs have been commercialized as product series, achieving greater comfort and lighter weight compared with previous equipment. In line with this trend, Toshiba has developed conversion equipment for the Shinkansen applying the Injection Enhanced Gate Transistor (IEGT), which is a power semiconductor that operates at a higher voltage than the IGBT and has lower loss than the gate turn-off thyristor (GTO).

*Service Equipment for Rolling Stock

OONISHI Toshiyuki YAMAMOTO Joji MIYAZAWA Norihiro

A major technical subject in the railways field has been how to safely achieve high-speed performance of rolling stock. In recent years, however, attention has been focused not only on maintaining high safety but also on global environmental preservation and improvement of services.

Toshiba supplies rolling stock air conditioners and auxiliary power supply units as typical service equipment for railways. Such equipment has contributed to the environment of rolling stock, particularly the interior comfort of passenger cars.

*Systems and Equipment for Railway Substations

KUNII Hikoichi OOTAKE Shirou OOTSUJI Kouji

Railway power supply systems have recently been required to provide environmental preservation features as well as greater functionality, higher performance, space saving, higher reliability, and improved maintainability. New systems and equipment meeting these requirements have been developed using the latest technologies in fields such as power electronics, microelectronics, and information technology.

This paper introduces the following systems and equipment for railway substations: a heat-pipe-cooled rectifier using pure water, for environmental preservation; a self-commutated rectifier and active filter, which realize greater functionality and higher performance; a cubicle type gas-insulated switchgear (C-GIS), whose size is reduced for space saving; and a distribution panel applying microelectronics as well as a digital relay, which offer greater functionality, higher performance, and improved maintainability.

*Power Control System and Facility Management System

KITAMURA Tsuneaki KUSA Takashi UMEHARA Tatsushi

In addition to the power supply equipment that supplies electric power, signaling, communications, and mechanical equipment are installed in railways. Power control systems and facility management systems have been introduced in order to minimize operation and maintenance work for such equipment. With the dissemination of computer systems in society, these systems are required to have more advanced functions and higher performance.

Toshiba is developing power control systems and facility management systems that are more easy to operate and user-friendly while offering more advanced functions and higher performance in response to these requirements.

*Rolling Stock Maintenance Systems

MURATA Hitoshi

Rolling stock maintenance plays a major role in ensuring safety, on-schedule services, environmental harmony, and vehicle life in railway operation. Accordingly, maintenance work on rolling stock in train sheds or railway factories often requires many inspectors and considerable time. Improvements in the maintenance workshop environment and in work efficiency are therefore necessary.

To meet these needs, we have developed various rolling stock maintenance systems applying advanced sensor technology and image processing technology. These systems can acquire inspection data on rolling stock in motion using sensors or cameras installed on the ground, and perform quality judgments of the measurement results. Furthermore, they can also estimate replacement times for worn parts. These systems therefore bring about significant improvements in inspection work.

*Automatic Fare Collection Total Management System

TAKAHASHI Nobuo

The railway automatic fare collection (AFC) total management system uses the data aggregating machine currently installed in a railway station as a core, and is connected on-line with automatic ticket machines, coupon-ticket machines, automatic fare adjustment machines, automatic gate machines, commuter pass issuing machines, service window processing machines, etc., managing the sales income data of each station. The data aggregating machine not only collects sales information from the AFC equipment installed in the station, but also allows remote maintenance to be carried out via the Internet and intranets.

The sales income data collected by the data aggregating machine are again aggregated and analyzed by the headquarters income management system and statistics management system, and utilized as data for management strategies.

*Automatic Fare Collection System Technologies

HASHIMOTO Tetsuo FUJIMOTO Hiroaki KUSHIMA Hidekiyo

As a new demand arising from the need for greater efficiency of railway station sales counter operations and the effective use of station space, expectations are being placed on the realization of an automatic gate system with functions such as integration with ticket sales, which have been performed by special machines up to now, as well as the reception of plural inserted tickets, confirmation of ticket continuity, and automatic fare adjustment. Moreover, the utilization of contactless IC card tickets is expected to relieve congestion of ticket gates and complexity of fare adjustment, and to expand areas of common ticket use.

Feature Articles

*Hole Mobility Enhancement in Strained Si p-MOSFETs

TEZUKA Tsutomu SUGIYAMA Naoharu KUROBE Atsushi

It is known that hole and electron mobilities are enhanced in tensilely strained (001) Si. The enhancement of hole mobility is expected to improve the operation speed of CMOS circuits. The origin of mobility enhancement in hole inversion layers has been conjectured to be the deformation of the valence band structure. However, the valence band structure is not yet clearly understood.

We fabricated strained Si p-MOSFETs and then measured the ratio of the Hall mobility to the conductivity mobility of the hole inversion layers. We found mobility enhancement of up to 40 % and the reduction of anisotropy in the hole subbands due to the strain. These results are important for understanding the mechanism of mobility enhancement and developing CMOS circuits with strained Si MOSFETs.

*High-Efficiency and High-Performance Motor for Energy Saving in Systems

SAKAI Kazuto ARATA Masanori TAJIMA Toshinobu

Recently, increasing importance has been placed on energy saving in various systems. This has created a need for a motor with high efficiency that is capable of operation over a wide range of speeds.

We have developed a novel permanent magnet reluctance motor (PRM) that has permanent magnets embedded in the rotor to increase the power. This PRM has a wide variable-speed range (1:5) and high efficiency (92 to 97 %). With a power output of 8 to 250 kW, the motor is suitable for application to electric vehicles, railway systems, and elevator systems.

*Super-High-Resolution, 10.4-inch Type UXGA TFT-LCD for Sub-Notebook PCs

ISHIZAWA Shuichiro HANARI Jun

We have developed a super-high-resolution, 10.4-inch diagonal UXGA thin-film transistor liquid-crystal display (TFT-LCD) as the fourth product in the 200 pixels per inch (ppi) display series. This LCD can be easily applied to sub-notebook PCs because of its compatible outline dimensions with SVGA and XGA. It enables images to be displayed with resolution equal to that of printed matter and photographs and promotes the high performance of recent graphic chips, thus paving the way for the next generation of sub-notebook PCs.

*New TBA – 120FR Automated Clinical Analyzer Pursuing Faster Measurement and High Data Accuracy

IKEDA Kazuyoshi KUMADA Michio HASEGAWA Shinichi

Automated clinical analyzers are widely used in hospital laboratories to perform clinical chemistry analysis of patient samples such as serum and urine. Since its introduction in 1992, the TBA – 80FR analyzer has become highly popular among medium-sized laboratories. In recent years, however, changing markets have created the demand for even higher performance and throughput.

The TBA-120FR analyzer has been developed to meet this need in medium-sized to large hospitals. Designed with proven Toshiba technology, the TBA-120FR has further enhanced performance and throughput with a processing capacity of up to 1,200 tests/h.

Epoch-Making Toshiba Technologies

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