

TOSHIBA REVIEW

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Special Reports

Radio Wave Application Technologies and Systems

Special Reports Radio Wave Application Technologies and Systems	Feature Articles	Epoch-Making Toshiba Technologies
<ul style="list-style-type: none">*Radio Wave Application Technologies to Support Global Infrastructure*Radio Wave Application Technologies in Public Infrastructure*Newly Developed Secondary Surveillance Radar*Advanced Air Traffic Control Equipment*Global Navigation Satellite System*Aeronautical Satellite Communications System*Weather Radar Data Analysis and Data Distribution Systems*Doppler Weather Radar*Space Monitoring Facility*Software Radio*Prospects for Overseas Airport Projects*Technologies for Signal Processing	<ul style="list-style-type: none">*Development of High-Accuracy Clock for ETS-VIII*MPEG-4 Videophone LSI*GR-421FSK "USUGATA SENZO" 50 cm-Depth Refrigerator*"PLASMA DAISEIKAI"Series Room Air Conditioners with High Efficiency and Air-Cleaning Function	<ul style="list-style-type: none">4. NAND Flash Memories

Special Reports

Radio Wave Application Technologies and Systems

*Radio Wave Application Technologies to Support Global Infrastructure

MIYAUCHI Hiroshi

*Radio Wave Application Technologies in Public Infrastructure

OTANI Yukinori SHINONAGA Mitsuyoshi

Public infrastructure, which supports people's daily productive activities, consists of transportation, communications, power supply, and various other facilities. Among the technologies providing this public infrastructure are radio wave technologies. Radio wave technologies exploit the potential capabilities of radio waves, such as detection and communication, to the greatest possible extent for the construction of public infrastructure.

Toshiba has been making a major contribution to the construction of public infrastructure based on radio wave technologies, including air traffic navigation and control systems, weather radar systems, and other systems.

*Newly Developed Secondary Surveillance Radar

MURAMATSU Tetsuya KANO Tokuji HASHIDA Yoshio

Secondary surveillance radar (SSR) is one of the essential facilities in air traffic control, providing three-dimensional position information and identification signals (beacon codes) of aircraft. So far, aircraft position information has been provided by primary surveillance radar (PSR), and SSR has provided only supplemental information. Recently, however, SSR has been attracting considerable attention and there has been increasing demand for SSR-only stations, such as a movable type SSR system and the Aircraft Position Information Display (APID) system, according to the application.

Toshiba has been producing these SSR systems and has developed a Mode S-compliant SSR that will be deployed worldwide in the future.

*Advanced Air Traffic Control Equipment

KANO Haruhide SEINO Yoshinori KAKIZAKI Takuji

We have developed advanced air traffic control equipment comprising a radar display console and a communication control unit (CCU). The digital technologies employed in this equipment realize high performance, low cost, and high reliability. A digital signal processor is used to process the digital signals. Field programmable gate array (FPGA) and ball grid array (BGA) technologies are implemented in the digital circuit for high integration.

We are planning to apply this equipment to both domestic and overseas air traffic control systems.

*Global Navigation Satellite System

KAWANO Shuichi SUGA Shuichi

The safety of civil aviation relies on ground navigation aids. In areas where there are no ground aids and on oceanic air routes, aircraft must depend on their own navigation system. The predicted increase in civil aviation traffic in the near future will make it difficult for current navigation aids to support navigation in all phases of flights.

To avoid this problem, the International Civil Aviation Organization (ICAO) is directing the establishment of standards for the global navigation satellite system (GNSS). GNSS employs navigation satellites, such as those of the global positioning system (GPS), to provide navigation capability throughout the world. In Japan, the Electronic Navigation Research Institute, the Ministry of Transport, and the Japan Civil Aviation Promotion Foundation are carrying out research on this navigation system. Toshiba has been providing experimental equipment for this research.

*Aeronautical Satellite Communications System

SAKAGUCHI Yukiko SUZUKI Masahiro

The aeronautical satellite communications system has recently been used at the international level, superseding the current HF communications system. This system has the characteristics of good communication quality and the capability for both data and voice communications.

Toshiba has developed modems for satellite communications which demodulate the burst signal under the large Doppler shift and fading phenomena that are peculiar to high-speed mobile communications, in conditions of a low carrier-to-noise-density (C/No) ratio. Toshiba has also delivered aeronautical satellite communications systems incorporating these modems, both domestically and internationally.

In the field of aeronautical satellite communications systems, there are strong expectations for the development of application systems including a new-generation air traffic control system.

*Weather Radar Data Analysis and Data Distribution Systems

UCHIDA Yoichiro TAKAHEI Kazuaki UENISHI Norihisa

With computer post-processing, the observed data from weather radar are widely utilized for weather forecasts, road management, dam control, river control, countermeasures against lightning accidents and natural disasters, and various other fields. Recent advancements in network technology have enabled the transmission of much larger volumes of data and the provision of easy-to-use information to users.

As a weather radar system manufacturer, Toshiba has been supplying weather radar data analysis and data distribution systems as well as the radar equipment.

*Doppler Weather Radar

ADACHI Hideo SATO Yuko

Conventional weather radar transmits high-frequency pulses from the transmitter, and only observes the intensity of echoes reflected back from raindrops. Due to recent technological advancements in signal processing, data processing, and other fields, the capability to detect echo velocity, or Doppler velocity, based on this raindrop movement has been achieved. Processing of this Doppler velocity has enabled the system to provide more sophisticated weather information on downbursts, three-dimensional wind direction and velocity, and other weather phenomena.

*Space Monitoring Facility

ANDO Yasuhiro NOZAWA Tatsuya

With the growth in social / economic activities and the movement toward a highly information-oriented society, the demand for radio wave transmissions in the satellite communication and broadcasting fields is growing and the number of geostationary satellites is increasing. Under these circumstances, the Space Monitoring Facility has been installed in Japan in order to collect data and provide monitoring and evaluation of possible illegal emissions and interfering / disturbing radio waves from satellites which violate international agreements. The facility incorporates a wide-range radio frequency (RF) receiving system, a highly accurate tracking system, a measurement system automated by software, and other features, enabling satellites and their various emissions to be observed.

*Software Radio

YOKOI Tokihiko NAMIKI Shin-ichi YOSHIDA Hiroshi

Software radio, which is adaptable to several radio systems by changing the software, is being widely discussed nowadays. Communications Research Laboratory (CRL,MPT) have conducted a triple-mode (personal handy-phone system/electronic toll collection/global positioning system: PHS/ETC/GPS) software radio system development and we contracted for this. This software radio system is characterized by a parameter download for minimization of the download software capacity.

*Prospects for Overseas Airport Projects

NAKAMURA Masakazu KISHI Yoichiro

In overseas airport projects, extensive electronic systems are newly installed or modified around the airport and air routes to improve air safety for aircraft. These systems include the air traffic control system with radar systems as major components, air navigation aid systems, and incidental facilities such as power supply equipment.

Toshiba has supplied a wide range of systems and equipment to many countries for their overseas airport projects, and is continually requested to develop and install new technologies. This paper describes our record of supplying such systems and the status of new technology development, and forecasts the future trends in overseas airport projects.

*Technologies for Signal Processing

KIHARA Hiroki HIRAYAMA Fumio OKAMOTO Tetsuya SARUWATARI Nobufumi

In the field of radio wave application systems such as radar and radio communication equipment, sophisticated functions and high performance are required to meet the needs of the market. Moreover, downsizing and low cost are vital to ensure competitiveness. Real-time processing capability is required for most applications in this field, which formerly required dedicated hardware. Due to the remarkable progress of semiconductor technologies, processing with software and the use of field programmable gate array (FPGA) and digital signal processor (DSP) technologies have become possible.

These papers describe various recent signal processing technologies for radio wave application equipment, centering around actual cases of application.

Feature Articles

*Development of High-Accuracy Clock for ETS-VIII

HAMAMOTO Naokazu NODA Hiroyuki TAKAHASHI Tamaki SATO Tomoichi

The high-accuracy clock (HAC) is an item of equipment for navigation that will be carried on board the geostationary Engineering Test Satellite VIII (ETS-VIII). The purpose of installing the HAC is to establish the basic techniques for navigation. In the future, this technique and system will improve the performance of navigation by the existing global positioning system (GPS) in such areas as integrity, continuity, availability, and accuracy.

The HAC has two modes: an atomic clock mode and a bent-pipe mode. In the atomic clock mode, the navigation signal is generated from the onboard cesium atomic clock and transmitted to the user on the ground. In the bent-pipe mode, the navigation signal is generated in the ground station and relayed by the HAC to the user on the ground.

To date, development of an engineering model of the HAC has been completed and the desired performance has been confirmed.

*MPEG-4 Videophone LSI

NISHIKAWA Tsuyoshi

We have developed a low-power LSI for an MPEG-4 mobile videophone. This is the first single-chip, MPEG-4 videophone LSI in the world. In addition to conventional low-power techniques, we adopted new techniques comprising an optimized embedded DRAM, a variable threshold voltage scheme, and low-power motion estimation. The new LSI consumes 240mW, which is sufficiently low power for typical videophone operation.

*GR-421FSK "USUGATA SENZO" 50 cm-Depth Refrigerator

NANRI Satoshi UENOYAMA Yoshihiko SAEKI Tomoyasu

Large-capacity refrigerator models of 400 liters or more hold a ratio exceeding 25% of total refrigerator shipments, making these models the main market of overall demand. In addition, greater attention is being paid to the depth of refrigerators accompanying the increasing construction of facing type kitchen systems in new residences in recent years and the growing number of consumers desiring efficient kitchen room layout.

In response to these trends, we have developed the "USUGATA SENZO" ("thin depth and fresh refrigeration") refrigerator, model GR-421FSK. This is a large refrigerator of the 400 liter or more class but with a module having a depth of about 50 cm, so that it does not protrude when installed parallel with cupboards.

The GR-421FSK is one of Toshiba's 125th anniversary commemoration products.

*"PLASMA DAISEIKAI"Series Room Air Conditioners with High Efficiency and Air-Cleaning Function

NAKAMURA Yoshiro SANO Hirofumi KOMAZAKI Megumi

The "PLASMA DAISEIKAI" series of room air conditioners, with greatly enhanced energy-saving and environmental protection features and the ability to supply healthy air, has just been launched on the market. This series employs a new refrigerant called R410A, which does not deplete the ozone layer. It incorporates a compressor with a high-efficiency motor featuring the world's first concentrated winding system. As a result, it realizes an average energy consumption rate of 5.30 for cooling and heating, and a maximum heating capacity of 8.0 kW, which is at the top within the industry (2.8 kW-class cooling capacity).

The "PLASMA DAISEIKAI" series is equipped with a plasma air purifier, which resolves and eliminates not only dust particles but also odor-generating molecules. Moreover, its ion generator produces negative air ions, which promote a feeling of relaxation and recovery from fatigue.

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