

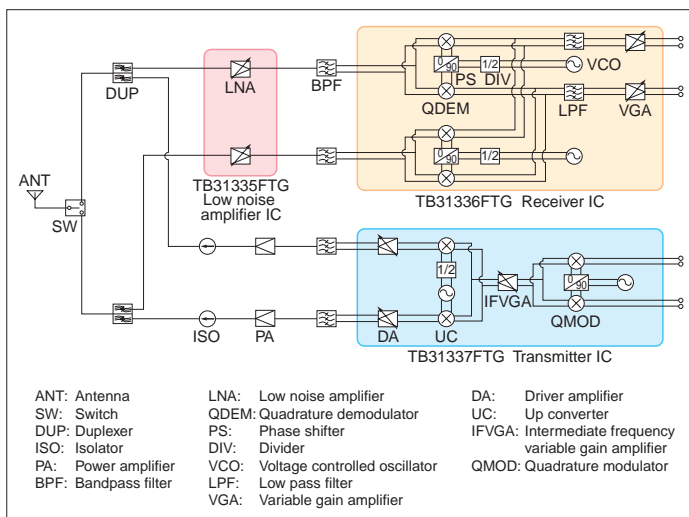
Toshiba is now in its 130th year of operation. The mottoes that guide the R&D section are those of our founders, "Insatiable inquisitive spirit" and "Passion for challenging the new". With this tradition in mind, we faithfully perform basic and applied research with the aim of creating new business opportunities through the introduction of innovative products.

## Analog ICs for Dual-Band W-CDMA Transceivers

Toshiba has developed a low-noise amplifier IC (TB31335FTG), receiver IC (TB31336FTG) and transmitter IC (TB31337FTG) for dual-band W-CDMA transceivers.

These analog ICs are fabricated using the SiGe-BiCMOS process. The low-noise amplifier IC is mounted in a TQON16 package, and the receiver and transmitter ICs are mounted in a VQON44 package.

To realize long battery life for W-CDMA transceivers, low power consumption is achieved in these analog ICs.



Analog ICs for dual-band W-CDMA transceiver



**Low-noise amplifier IC (TQON16)**  
External dimensions:  
2.4 mm×2.4 mm×0.5 mm

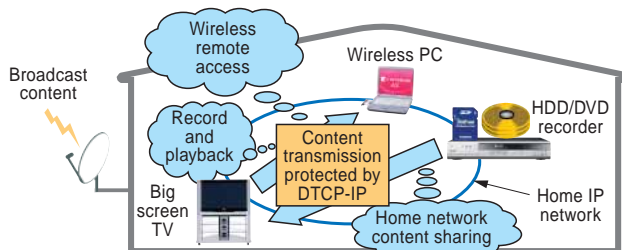


**Receiver and transmitter IC (VQON44)**  
External dimensions:  
5.3 mm×5.3 mm×0.6 mm

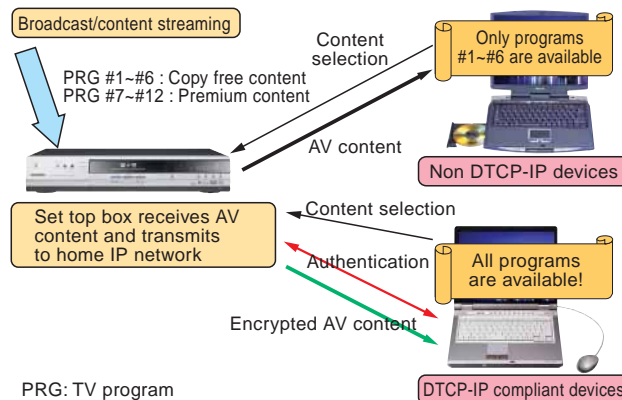
## Content Protection Technology for the Home IP Network

Content protection technology is a key component in digital AV products. DTCP (Digital Transmission Content Protection) is a de facto standard technology which provides robust and flexible protection for digital content transmission on IEEE1394 (Institute of Electrical and Electronic Engineers 1394) wired networks.

Toshiba believes that devices will be seamlessly connected by wireless and wired networks in the future digital home AV network. To achieve this goal, Toshiba is making an effort to establish a DTCP-IP (DTCP over IP) specification. Under this specification, content will be transmitted over the home IP (Internet Protocol) network securely between devices, such as wireless digital set-top boxes and wired DVD recorders. Consumers will be able to enjoy premium entertainment content from anywhere in their home.



Usage model of IP-based home AV network



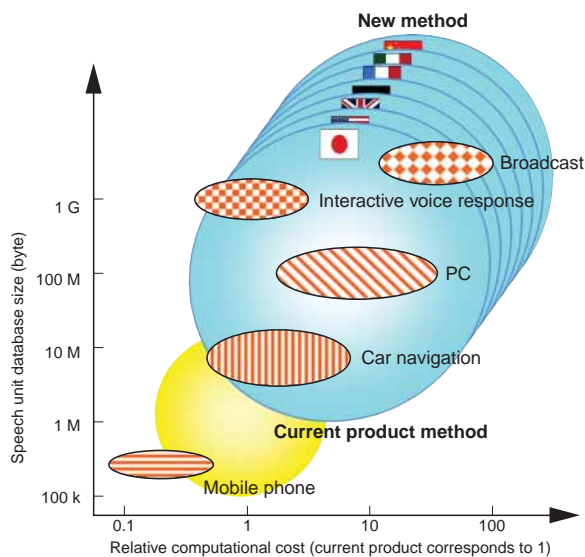
Future home AV network supporting DTCP-IP

## High Quality and Scalable Speech Synthesizer

Toshiba has developed a high quality speech synthesizer in order to expand the applications of our text-to-speech (TTS) middleware. The key technology in this synthesizer is the “plural unit selection and fusion method” that we have developed in order to realize high quality synthetic speech and scalable TTS middleware.

Conventional unit-selection-based synthesizers generate speech by concatenating speech units selected from a speech database. These synthesizers are subject to problems of unnatural speech quality caused by incorrectly selected units. On the other hand, the new method greatly improves the speech quality by integrating a unit fusion process with the unit-selection-based method. In the new method, plural speech units are selected for each segment, and fused into a unit. This process can compensate for the degradation caused by an incorrectly selected unit.

The TTS middleware adopting the new method can control the tradeoff between speech quality, computational cost and the database size. Therefore, it can be used for a wide range of applications working on various platforms. It is possible to optimize the middleware to exercise the best performance under the constraints of hardware resources on each platform. Moreover, a multi-lingual TTS middleware, which supports Japanese, English, Mandarin and so on, can be realized by this method because it is not dependent on a specific language.



Expansion of the application range of speech synthesizers by the newly developed method

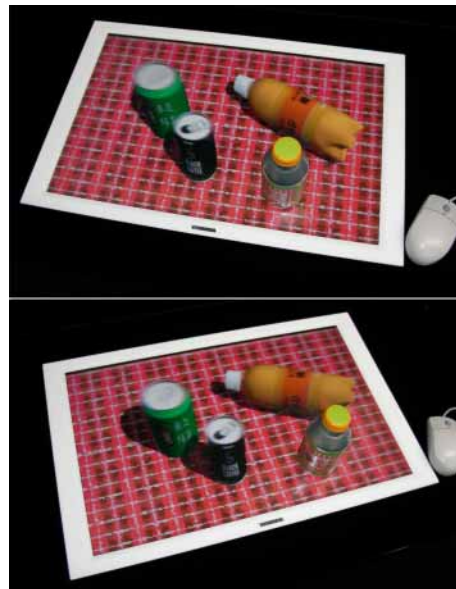
## Flatbed Autostereoscopic Display System

Toshiba has developed a new display technology that allows 3-D images to be viewed on a flatbed display without any need for special glasses. Viewing the display from an angle allows the viewer to experience 3-D images that appear to stand out several centimeters from the surface of the display.

The new technology opens up new areas of application for 3-D displays, including arcade games, e-learning, simulations of buildings and landscapes, and even 3-D menus in restaurants.

The new displays employ an integral imaging system that reproduces light beams similar to those produced by a real object. In seeking the reproduction of natural 3-D images on the flatbed display, Toshiba developed proprietary software that utilizes 10 or more views of an object. Toshiba also developed middleware and dedicated circuitry that supports fast playback of the images with only a normal graphics card.

Toshiba has applied the new technology to 24- and 15.4-inch displays. The resolutions are 480×300 pixels and 480×400 pixels, respectively. It allows viewers to see high quality autostereoscopic images.



Flatbed 3-D display

Display (top) viewed from the right and display (bottom) viewed from the left.

The can with the orange and yellow cap in the right foreground is real and the other objects are generated by the display.

## Novel Schottky-Source/Drain Transistor Technology for Future LSIs

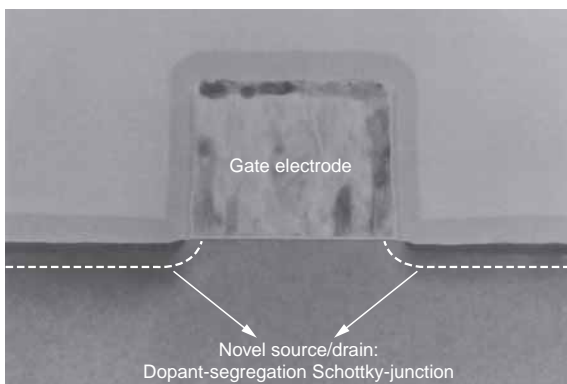
Toshiba has developed a novel Schottky-source/drain technology for advanced LSI transistors.

The Schottky-source/drain technology has attracted much attention as a candidate for high-performance devices in a deep sub-50-nm gate regime. However, it has been pointed out that large barrier heights at the source-Schottky junction significantly lower drive current for the transistors. The existing Schottky-source/drain technologies also require different metals for n- and p-type transistors, which significantly increases the process cost. These problems have prevented us from adopting the commercial use of Schottky transistors.

Toshiba proposed a novel source/drain technology for engineering the Schottky barrier height (SBH) using the dopant-segregation technique. Our technology makes use of the SBH modulation due to the dopant atoms present at the metal/semiconductor interface in the Schottky junction.

The experimentally obtained SBH lowering exceeded 0.4 eV for an arsenic-doped Schottky junction and 0.3 eV in the case of boron-doping, which results in competitive drive current and better short-channel effect immunity compared to conventional MOSFETs. The conventional single-metal and doping processes are fully applicable to our transistors without any additional cost.

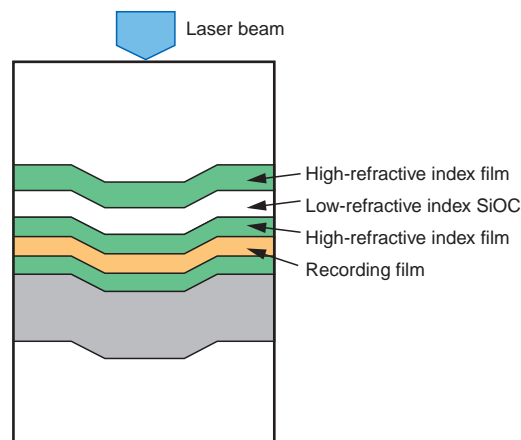
Furthermore, successful CMOS operation has been achieved for the first time in Schottky transistors fabricated with a single-metal process.



Cross-sectional image of novel Schottky-source/drain transistor

## New Technology for Mass Production of Rewritable HD DVDs

Toshiba has developed a new technology by which production speeds for rewritable HD DVDs are dramatically increased. The HD DVD is the next-generation DVD suitable for high-definition moving pictures utilizing a blue-violet diode laser. It also offers a number of benefits including compatibility with the conventional DVD and installation in notebook PCs. Rewritable HD DVDs use a low-refractive index film to increase the recording density. We have developed a new technology to produce transparent and low-refractive index "SiOC" out of opaque silicon carbide. The technology enables production throughput more than three times higher than that of the conventional technique.



Cross-sectional view of 20 Gbyte rewritable HD DVD with SiOC film



Rewritable HD DVD media manufactured by newly developed process

## Nano-Patterned Media for Future High Density Magnetic Recordings

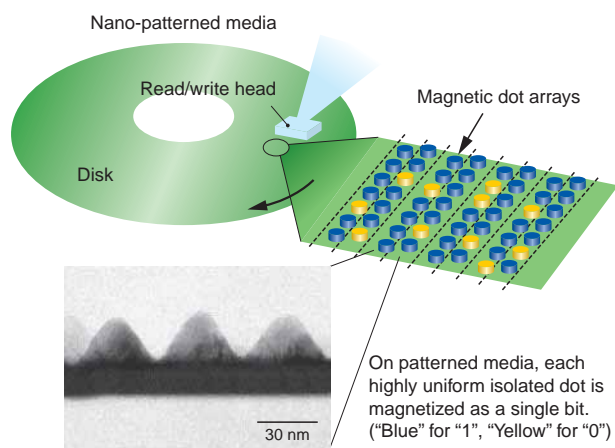
Toshiba has developed a novel fabrication method for nano-patterned magnetic media which can generate an ultra-high density magnetic recording system.

Patterned media have attracted much attention because of their potential to achieve a density of over 1Tbps with magnetic recordings. But because the difficulties of ultra-high resolution patterning had not been resolved, practical disk production had been thought to be impossible.

Toshiba has applied the self-assembling characteristics of polymer materials to form regularly aligned highly resolved dot patterns and achieved the fabrication of patterned magnetic media with cell spacing of about 30 nm on a HDD glass substrate. Alignment of self-assembling dot patterns on a circumferential track was achieved using guide grooves where the polymers show restricted self-assembly in a linear direction.

This fabrication method is cost effective and will serve as a high throughput disk production process, which will open the way for 1Tbit storage systems.

This achievement is in part a result of the "Terabyte optical storage technology" project which OITDA contracted with The Ministry of Economy, Trade and Industry of Japan (METI) in 2002 and contracted with The New Energy and Industrial Technology Development Organization (NEDO) since 2003 based on funds provided from METI.

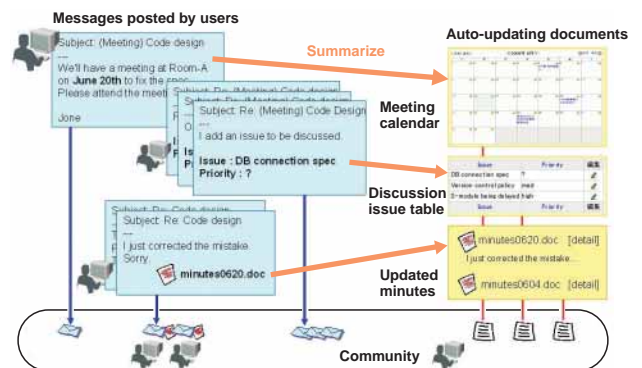


Microscopic image of aligned magnetic dots with about 30 nm spacing

## GroupScribe™ Message-Summarizing Communityware

Toshiba has developed a message-summarizing system, GroupScribe™, a communityware that provides mechanisms which facilitate efficient communication by e-mail and information sharing among users in a community. GroupScribe™ has the function of a bulletin board system allowing e-mail exchange and Web access. It also allows users to leave messages or create message-related documents. These documents can be automatically generated and updated according to the "summary rules", by which the system extracts relevant information from the messages and classifies them into a variety of types, e.g. event calendars, question-and-answer, spreadsheet with specified "key: value" patterns and digest of discussion, etc.

GroupScribe™ has been in experimental use since June 2003, and it is presently used by about 14,000 people in Toshiba as of April 2005. It has proven to be a great aid to efficient communication and knowledge management for real business purposes.



Schematic usage diagram of message summarization



Web screen display of GroupScribe™



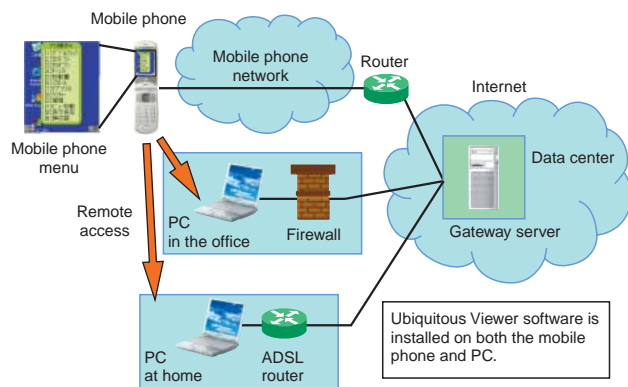
## Ubiquitous Viewer

Toshiba has developed a software package called “Ubiquitous Viewer”, which enables its users to operate a PC remotely via their cellular phone. This software allows users to have real-time direct access to almost all the applications running on a Microsoft® Windows®-based PC in their home and office at any time and place, even sitting on a park bench or commuting on the train.

In order to achieve the function of the Ubiquitous Viewer, Toshiba has developed three main technologies: a cellular phone menu for operating a PC more easily from a cellular phone, an advanced data compression technique for transferring massive amounts of data (e.g. a screenshot) from the PC to a cellular phone, and an authentication scheme with a password and subscriber ID for the cellular phone on a secure socket layer (SSL) for establishing a secure connection link between the PC and a cellular phone.

The communication link between a user’s cellular phone and the PC in their office is established with hypertext transfer protocol security (HTTPS) via a gateway server. Therefore, the current network configuration in the office does not have to be changed at all.

The Ubiquitous Viewer will debut on the CDMA 1X WIN cellular phone service called “au”, the cellular phone division of KDDI Corporation, which is one of the major Japanese telecommunication firms. Inexpensive access to a PC from a cellular phone will surely be achieved soon, under au’s flat-rate data communication service for Internet access.



System configuration of Ubiquitous Viewer

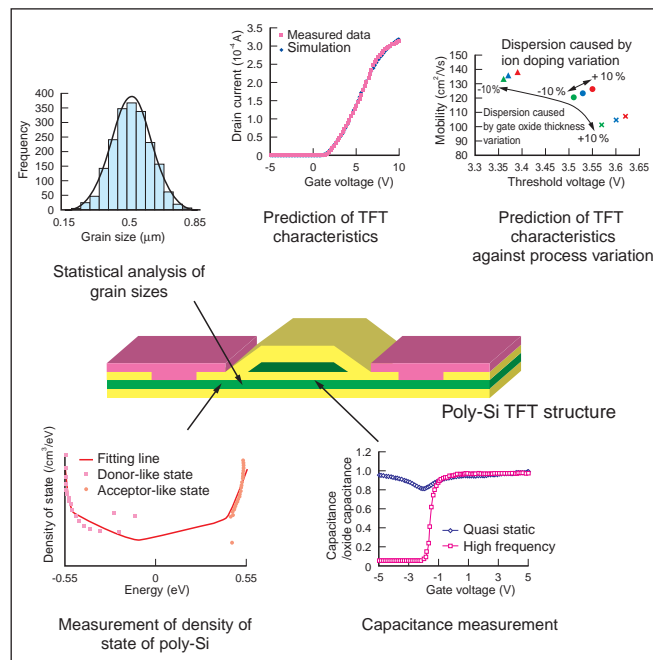
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## Technology CAD Simulation for Polycrystalline Silicon Thin Film Transistors

Toshiba has developed a high accuracy T-CAD (Technology Computer Aided Design) device simulation technology for polycrystalline silicon (hereinafter referred to as “poly-Si”) TFTs (Thin Film Transistors). Poly-Si TFTs are widely used in LCDs (Liquid Crystal Displays).

The essential features of a poly-Si film are the grain sizes and boundaries. The grain boundaries are described in the device simulation by a DOS (Density of State) function, which was based on measurements of the film. The distribution of the grain sizes is treated statistically using a Monte Carlo algorithm. In addition, the physical and electrical characteristics of the poly-Si film and its interface with the dielectric layer were measured, and used in the device simulation. These improvements have made the simulator highly accurate and enabled the correct prediction of TFT characteristics against eight parameters in the TFT structure, such as gate oxide thickness and gate length.

Using this T-CAD based device simulator, Toshiba will produce TFTs with constant device characteristics in our current and future manufacturing.



T-CAD simulation technology for poly-Si TFT