

# Vision Exhibition

## The Vision of Digital Terrestrial Broadcasting

### The World of Digital Terrestrial Television Broadcasting

Digital terrestrial broadcasting will realize a variety of new broadcasting services that would not have been feasible through conventional broadcasting. They include Hi-Vision (HDTV) with its high picture and sound quality, simultaneous viewing of more than one standard quality TV program on one screen, nationwide and localized data broadcasting, and video services for mobile terminals carried by pedestrians or mounted on cars, buses, and trains.



### Digital Terrestrial Television Broadcasting Schedule

In December 2003, digital terrestrial broadcasting will begin in the three large metropolitan areas of Tokyo, Osaka, and Nagoya. To deliver broadcast-waves nationwide, the current analog broadcasting system uses approximately 3,500 relay stations throughout Japan. Digital terrestrial broadcasting will require the digitization of these relay stations. The government's schedule is for digital terrestrial broadcasting to have started in all major cities in Japan by the end of 2006 and for it to have completely replaced analog broadcasting by 2011.

### Receivers for Digital Terrestrial Television Broadcasting

Digital terrestrial broadcasts can be watched on standard TV sets connected to a digital tuner and a UHF antenna. Owners of digital BS TV sets can enjoy HDTV and services unique to data broadcasting by attaching a digital BS tuner compliant to digital terrestrial broadcasting and a UHF antenna.

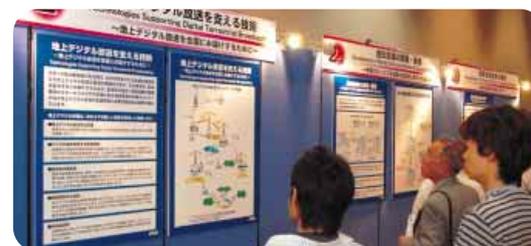
We also exhibited a panel explaining the analog broadcast channel changeover and digital radio broadcasting.



## Technologies Supporting Digital Terrestrial Broadcasting

### Master Control and Network Operation Facilities

Circuits to transmit signals from a broadcasting station to a transmitter (STL) or between transmitters (TTL) will employ microwave transmission. These microwave circuits will appropriately select between digital TS (Transport Stream) transmission and analog IF (Intermediate Frequency) transmission. NHK constructed systems for each transmission type.



### Central Digital Transmission Facilities

We developed facilities to transmit a variety of services, including data broadcasting and the electronic program guide (EPG), to broadcasting stations nationwide using a channel equivalent to one conventional TV circuit.



### Broadcast Wave Relay Technologies

While a broadcast-wave relay that receives and re-transmits master station broadcast-waves after signal amplification can efficiently use a frequency, it is also prone to signal distortion and noise. NHK has developed countermeasures to various disturbances in the master station's broadcast waves.



### Improvement of Reception Performance

Technologies to improve the reception characteristics within a service area are intended to maximize the attractiveness of digital terrestrial broadcasting. Developments in this area include a technology that equalizes multipath interference in excess of OFDM signal delay time tolerances and a technology for HDTV service reception via mobile terminals.

### Optical Wave Division Multiplex Transmission

With the aim of diffusing digital terrestrial broadcasting throughout the country, we are studying technologies that distribute digital terrestrial broadcasting to homes by using optical fiber cable as a supplement to radio-wave transmission.

## Ultrahigh-definition Wide-screen System with 4000 Scanning Lines

Improvements were made to the prototype fabricated in 2002. We also developed a 1 1/4-inch CMOS imaging device to reduce the camera's size. Other recently constructed systems includes a recording system that employs hard-disk HDTV recorders arranged in parallel and extends the recording/playback time to 18 minutes from the previous 34 seconds. This improvement has allowed us to produce videos to verify the effects of wide-view and large-display systems.



## New Broadcasting Services Based on Home Servers

Examinations are underway on broadcasting services based on home servers, through which a user will be able to utilize broadcasting contents stored at the receiving side or contents accessed on the broadband Internet. These services are expected to transform the television into an integrated services terminal that fuses broadcasting and communications.



## Program Request Service

While NHK receives a large number of requests for the rebroadcast of its programs, the limited number of broadcast time slots prevents it from fulfilling all of them. We constructed a prototype system that allows a viewer to watch TV programs via a network. The network adaptor that we developed connects to a commercially available digital BS tuner.



## Advanced Program Production & Control System Using High-speed Network

NHK is enthusiastically pursuing research on an advanced broadcasting station system that utilizes IT. The aim is to create broadcasting station systems that will be prompter and more efficient in their production and transmission of programming. This exhibit featured a program production system using an IP network. The system enables a program producer to freely combine video materials and production equipment to suit his or her purpose.



## Flexible Organic EL Display

Research progresses on lightweight flexible, organic EL displays that can be rolled up. Improvements to the structures of phosphorescent polymer materials and devices have led to a higher efficiency and have made possible construction of a prototype full-color flexible organic display.



## Flexible Color Film LCD

Our goal is to build an LCD TV system whose screen is flexible enough to be rolled up. The flexible color film LCD contains a liquid crystal and polymer composite film sandwiched between thin plastic substrates. A technology was developed for this display by which color filters for the three primary colors are placed inside the plastic substrates.



# General Exhibition

## The 50th Anniversary of TV Broadcasting in Japan

NHK's research on imaging, emission, reception, and display came to fruition on February 1, 1953, the date when TV broadcasting began in Japan. Since then, TV has evolved, from color TV broadcasting to satellite broadcasting, Hi-Vision (HDTV) and digital broadcasting. We compiled a brief history of broadcasting technology for visitors to the open house.



## Reception of Digital Broadcasting

The commencement of digital terrestrial broadcasting will complete the digitization of TV media. In addition to introducing the unique features of digital broadcasting, this exhibit included a service counter where visitors could get answers to their questions about broadcasting reception options.



## TV System Recognizing Viewers with Dialogue Interface

Receiver operations are becoming more complicated as the selection of TV broadcasting services expands with the proliferation of digital BS broadcasting and digital terrestrial broadcasting. It is also becoming more difficult to operate peripherals. We constructed a TV system in which the viewer operates the receiver and peripherals with a dialogue interface. This system can recognize the viewer from his or her facial features and voice and can give responses appropriate to him or her.



## The Mechanism of Television



Television has become an indispensable part of everyday life, like air or water to some. This exhibit presented the basic process by which a TV image leaves the broadcaster and reaches a viewer's home.

## Human-friendly Broadcasting Technologies

Information barrier-free broadcasting will make an enjoyable television experience possible for anybody, regardless of handicap. Studies in this area include ones that take superimposed characters in a program or data broadcasting screen and put them into an enlarged easy-to-see display, tactile presentation methods including Braille, and sound presentations. Research is also progressing on services for people with hearing impairments. It includes speech recognition technology that efficiently generates real-time closed-captioning, even during a live broadcast.



We are also pursuing sound broadcasting that makes listening easier for elderly viewers.

## Advanced Virtual Studio

The virtual studio system will be part of a program production system with enriched powers of expression. The exhibit presented a new method to detect a performer's position using facial features and a virtual studio system with an intelligent robot camera. We also presented an example of a composed scene of a program produced in the virtual studio.



### Ubiquitous Web Page Navigation

The exhibited system can quickly call up a homepage linked to a program currently being broadcast. This is accomplished by pressing a button on a PC screen in a manner similar to that of TV channel selection. NHK has provided this function, as the "ch@NET" service, on its official homepage. The web page navigation system is capable of, anytime, anywhere, access to not only program homepages, but also other homepages corresponding to the time, location, and type of the receiver in use.



### Sports TV4U

We created metadata for categorizing sports program scenes by play, score, and player data, etc. and built a database. A prototype TV4U system connected to this database automatically created sports programming at the receiver that matched the individual viewer's preferences.



### International Broadcasting Service and Its Translation Aid System

NHK provides the world with the latest news, cultural, and social trends in Japan and Asia via its international TV and radio broadcasting service "NHK World." This service is also available online. To enhance these services, a translation example browser system that supports efficient multilingual translation was developed. This system currently supports translations into nine languages.



### Ultrahigh-speed 3-CCD Color Camera



Work is progressing on a high-speed, high-sensitivity camera capable of shooting phenomena too fast to be perceived by the human eye under ordinary lighting conditions. As a first step in the research, we constructed a prototype ultrahigh-speed 3-CCD color camera that incorporated novel 8-million-pixel CCDs that can capture an event lasting only one millionth of a second.

\* Refer to NHK Tech on the last page.

### Silicon Microphone

Studies continue on the next generation of ultra-small, high-performance microphones. The research emphasis is on implementation of the microphone, and we succeeded in developing a technology to slice a silicon wafer with multiple microphone elements fabricated on it into small individual microchips, with a good yield.



### Re-transmission Technology Using 60-GHz Radio Waves

Apartment dwellers may sometimes have difficulty receiving satellite broadcasting if they can't find a suitable location to install the antenna pointing in the direction of a satellite or where a common reception facility already in use is not compliant with satellite broadcasting signals. To



deal with such situations, a technology was developed to re-transmit the received satellite signals to individual apartment units by using 60-GHz-band radio waves.

# Technical Exhibition

## Software-defined Receiver for Digital Terrestrial Broadcasting

Software-defined radio technology describes the reception functions of a radio terminal, such as a broadcasting receiver or a cellular phone, through software. Our latest software-defined receiver loads software for digital terrestrial broadcasting reception, and software updates are used to improve its robustness to ghost interference and its mobile reception characteristics. This system loads software to update functions within several seconds.



## 1024QAM Modem for Cable Television

Cable TV networks are becoming an information infrastructure for re-transmission of satellite and terrestrial broadcasting, independent broadcasting, and Internet access. However, cable TV transmission capacity may become insufficient as the number of channels continues to increase. As a countermeasure to this problem, we are developing a large-capacity transmission technology by increasing the number of bits per symbol in the QAM (Quadrature Amplitude Modulation) scheme.



## MPEG-2 HDTV High Compression Technology

If HDTV signals can be highly compressed, data services can be enhanced with program-related information, news, and weather forecasts broadcasts on the same channel. This would increase the attractiveness of digital terrestrial broadcasting. We are studying low-bit-rate digital HDTV broadcasting achieved by improving the MPEG-2 encoding scheme while maintaining compatibility with the current digital receivers.



## Advanced Data Broadcasting Services for Mobile Reception



Digital terrestrial broadcasting makes possible reception with a portable receiver while on the move, such as on foot or in a car. Studies are underway on attractive new services for portable receivers, including a broadcasting-communications linkage service that combines data broadcasting and cellular phone functions, a data broadcasting read-out service, and a data multiplexing scheme for quick reception/display.

## Content Rights Management and Protection

Digital content distribution over the Internet requires contents distribution from reliable providers and the protection of content copyrights. This exhibit presented a system that incorporated both authentication technology and watermarking technology to ensure that contents are not distributed by unauthorized providers and to discourage illegal use of distributed contents.



## Scalable JPEG2000 Hi-Vision Codec

The advanced JPEG2000 coding scheme features a high compression rate and a hierarchical structure to extract images at different resolutions and levels of picture quality from HDTV-coded data. It makes possible a single source multi-use application that can efficiently reuse a single piece of material for various program production purposes. We used Motion-JPEG2000, which applies JPEG2000 to moving pictures, to construct a prototype HDTV scalable codec.



## Ultrahigh-sensitivity Imaging Device

The charge multiplication factor of the device is now twice that of the previous HARP tube. Fluctuations in sensitivity can be reduced by controlling the impurity concentration distribution in the HARP film and by increasing the film thickness to 35  $\mu$ m. Our New Super-HARP camera tube using this film achieves a sensitivity approximately 200 times that of a CCD and a resolution limit of 900 TV lines or higher.



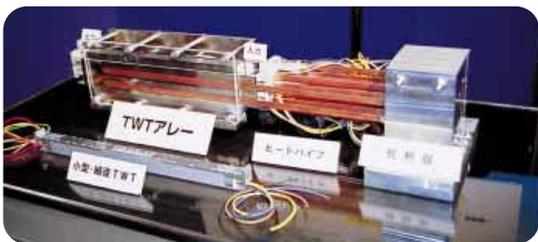
## Key Technologies of Field Emission Display

Research is progressing on a thin display system with the goal of creating a large-screen, high-definition television. It is desirable for large displays to have a high luminous efficiency and low power consumption. We exhibited a cold cathode and phosphor for the field emission display. Since the power consumption of a field emission display is greatly influenced by the characteristics of the cold cathode and phosphor, we employ a cold cathode made of graphite nanofiber, which is expected to provide efficient electron discharge, even in a large display. We are reducing the voltage of electron emission by devising a new cold cathode structure.



## Future Satellite Broadcasting System

NHK is examining a satellite broadcasting system that uses the 21-GHz band as a means to deliver multi-channel HDTV service and future broadcasting services that convey a stronger sensation of reality than is possible with today's technology. While satellite broadcasting in this band is capable of transmitting large amounts of data, it also suffers from significant radio-wave attenuation caused by rainfall. We are estimating the distribution of rain attenuation throughout Japan and developing a phased-array antenna technology to intensify only the radio waves radiated toward a rainfall area.



## Three-dimensional TV Systems

### 3-D HDTV

3-D HDTV allows viewers to enjoy high-quality stereoscopic images created with HDTV technology. We have determined the shooting conditions for capturing natural images, the location of viewing zones in front of a screen, and the characteristic differences between right and left images to make the three-dimensional images easier to see.



### Integral 3-D TV

"Integral 3-D TV" aims to reproduce natural stereoscopic images without the use of special glasses. We have improved the picture quality of the reconstructed images by developing a process to correct the distortion in the lens arrays and other optical systems.



## Basic Technologies for Utilization of Millimeter Waves

The employment of millimeter bands (30 GHz to 300 GHz) in a reliable newsgathering system for prompt reporting or in wireless program production systems will require clarification of the radio-wave propagation characteristics and a technology to manipulate radio waves. The delay characteristics measurement system exhibited at the open house can detect the power of the received signal and the delay for each radio-wave path from the transmitting antenna. We also exhibited a millimeter beam former that changes the propagation time of millimeter waves by exploiting the properties of liquid crystal.



## HDTV Recording Experiment on an Optical Disk for Broadcast Use

NHK is working to develop a high-speed, large-capacity optical disk system for broadcasting purposes, including HDTV newsgathering. Using a new high-speed, high-density optical disk, we can record HDTV video signals on the disk in the HDCAM VTR compression format currently used for newsgathering.



## Highly Realistic Active Control of Sound Field

A technology to control reverberation will enable an audience to enjoy musical performances in facilities such as multifunction auditoriums that are not intended solely for such a purpose. The target system of our studies is one that can provide good sound to any seat of a large hall through the use of loudspeaker "walls" that reproduce the sound field of a concert hall. It takes advantage of our speaker-wall-technology developed for a small room.



## High-density Magnetic Recording

Our goal is to construct a compact video recording system with a large recording capacity. Studies on perpendicular magnetic recording have shown that the output level can be increased by improving the magnetic characteristics of magnetic particles. The small magnetic particles can smooth out the reverse part of the magnetization, thereby reducing noise. As a result, a linear recording density of 25 nm/bit can be achieved.



## Patents and Technical Know-how of NHK

NHK is conducting a wide range of research and systems development related to broadcasting technology. The patents and technical know-how obtained through such work can be utilized in a variety of fields besides broadcasting.

