The Science & Technical Research Laboratories has been pioneering new broadcasting media for many decades, and its achievements range from satellite broadcasting and Hi-Vision (HDTV) to digital broadcasting. For the next generation of broadcasting, STRL is now developing the Super Hi-Vision (SHV) ultrahigh-definition television system.

Some of STRL’s research is aimed at inspiring new media through the construction of what may be the ultimate in video and audio reproduction: three-dimensional TV and sound.

STRL is developing an easy-to-operate, convenient television system that can be tailored to the individual viewer’s needs and preferences. The exhibit displayed element technologies and showed an image of what the service will be like.

This exhibit showed viewers an advanced content production environment for next-generation program production. Various component systems were exhibited, such as robot cameras that can perform collaborative shooting, a millimeter-wave TV camera that uses radio-waves to capture images of objects that are obscured by fog or smoke, and an ultrahigh-speed camera system.

Many of the technologies that were created by STRL researchers are being used in non-broadcasting fields. Some are even being used for space and deep-sea exploration. The exhibits in this zone featured these versatile technologies.

Visitors with expertise in many fields related to broadcasting could view in-depth explanations of our latest research results presented in poster form.
33M-pixel Image Technology

The Super Hi-Vision (SHV) system will require advances in equipment and signal processing and in-depth examinations from a human sciences perspective. For this study, the most essential is to obtain SHV video data of three elementary colors (red, blue and green) with a resolution of 7680 (horizontal) × 4320 (vertical) pixels. We fabricated a new prototype that can capture images with this level of resolution.

Image Sensor Using Organic Compounds

Research is progressing on an advanced imaging device that may eventually be incorporated in a compact SHV camera. A recent experiment on this organic image sensor demonstrated color video imaging for the first time from such a device. The open house showed images shot with this device.

Super Hi-Vision Codec System

Our studies continue on ultrahigh-compression coding for SHV broadcasting. We exhibited a codec system that can compress the 24-Gbps SHV signal to approximately 118 Mbps for video and approximately 2 Mbps for sound. The compression level is suitable for MPEG-2 TS output at 126 Mbps, which is part of the provisional advanced digital satellite broadcasting standard for Japan.

In Development

Satoshi Aihara, Materials Science & Advanced Devices

The current Super Hi-Vision camera separates incident light into the three primary colors (red, green, and blue) by using a prism. These colors are converted for color video reproduction into electrical signals by using three imaging devices. Although this three-chip color imaging device has good light-usage efficiency and enables high-quality color video reproduction, the prism and three imaging devices are bulky. To make a compact, lightweight SHV camera, we are developing a new single-chip color imaging device that uses organic films. This "organic" imaging device contains layers of organic photoconversion film that are each sensitive to one of the three primary colors. This device can separate light into the three primary colors and read out signals that correspond to red, green, and blue. We believe that a single-plate imaging scheme can yield imaging characteristics that are equivalent to those of a three-plate scheme.

In Development

Kazuhisa Iguchi, Human & Information Science

Super Hi-Vision’s heightened sensation of presence and immersion is made possible through its 7680 × 4320-pixel ultrahigh-definition video and 22.2 channel three-dimensional sound. Its video and audio signals have a bit rate approximately 24 Gbps, so video and audio data compression is required to provide SHV services over a limited broadcasting bandwidth. We constructed an SHV codec system that uses the AVC/H.264 scheme for video compression and the AAC scheme for sound compression. This system can reduce the overall video and audio signal bit rate to approximately 126 Mbps, which is within the feasible range specified by the provisional scheme for the advanced digital satellite broadcasting system. We are planning an experiment using a broadcasting satellite to transmit coded video and sound. The results of the experiment will determine the feasibility of such coding for SHV. After that, we will improve the picture quality offered by the coding system.
Advanced Digital Transmission System for Satellite Broadcasting

The advanced digital satellite broadcasting system is a proposal for a versatile, large-capacity transmission system that will utilize satellite broadcasting channels that will become available after 2011. This exhibit displayed some of the element technologies of this system and showed how it can be used to deliver SHV and download services.

Dirac: The New Coding Technology

Dirac is a video coding scheme that was developed at the BBC’s technology laboratory in the United Kingdom. NHK is working together with the BBC on using Dirac video coding for SHV. The exhibit presented SHV video coded with this software.

Super Hi-Vision Home Theater System

Visitors to this exhibit experienced what viewing SHV in the home may be like in the future. The home theatre had a large display composed of four 56-inch LC display panels and a compact 22.2 multi-channel loudspeaker sound system.

Channel Equalization for Echoes Outside the Guard Interval of OFDM Signals

Multi-path interference from delayed waves arriving after the guard interval length occur on the transmission path of digital terrestrial broadcasting. The exhibited channel equalization technology can correct this distortion.

Shoji Tanaka, Broadcasting Systems

Digital satellite broadcasting in Japan uses the ISDB-S standard to provide broadcasting services such as digital HDTV. Currently, the Telecommunications Council and the Association of Radio Industries and Businesses (ARIB) are examining the technological requirements for new broadcasting schemes on the four channels that will become available for use after 2011. (The parties to the World Radiocommunication Conference 2000 allocated these four channels to Japan.)

NHK submitted the following proposals in response to ARIB’s call: 1) a channel coding scheme to expand the transmission capacity beyond that of the current digital satellite broadcasting, 2) a high compression efficiency video coding scheme, 3) a high-definition video format exceeding the quality level and sense of presence offered by HDTV, 4) multichannel audio to reproduce a sound field that corresponds to the sensation of quality and presence conveyed by an ultrahigh-definition video presentation, 5) coding for more versatile data broadcasting, and 6) a variable length packet multiplexing scheme for a storage type broadcasting service. These proposals were reflected in ARIB’s draft of the provisional system that was submitted to the Telecommunications Council in January 2008, and they were the topic of deliberations involving broadcasters and manufacturers. The provisional scheme reflects a potential capability to increase the number of HDTV programs transmittable on a single transponder by combining a high-compression efficiency video coding and expanded capacity channel coding.

This year’s open house demonstrated the multiplexed transmission of four HDTV programs and the transmission of SHV using hardware based on the draft-compliant channel coding, video coding and audio coding.

ARIB is planning further experiments to verify the feasibility of the provisional scheme. NHK will take the initiative in this process.
Automatic Activation of One-Seg Receivers for Emergency Broadcasting

We developed a technology that automatically activates standby receivers in case of disasters and instantly delivers emergency information to the public. One technology automatically activates One-Seg receivers so that they can receive emergency warning system (EWS) messages, and the other one wakes up receivers in response to earthquake early warnings sent by Japan Meteorological Agency.

One-Seg Combined Retransmission System

We developed a retransmission system to deliver One-Seg services to areas where direct reception is impossible, such as in underground shopping arcades or in building shadows. The exhibit showed a retransmission system that combines the One-Seg signals from multiple broadcasters into a single channel for re-transmission.

High-speed Mobile Reception for HDTV Digital Terrestrial Broadcasting

Mobile reception of digital terrestrial broadcasting is difficult while in transit on a train or in an automobile traveling at high speed. This exhibition introduced a system that enables stable digital terrestrial broadcasting reception even when the receiver is traveling at 300 km/h.

Multi-level OFDM Technology

The next generation of terrestrial broadcasting will offer large-capacity services, including Super Hi-Vision (SHV). We started R&D on multi-level OFDM modulation/demodulation technology for new terrestrial digital broadcasting schemes.

Super Hi-Vision Theater

Super Hi-Vision (SHV) is a future television system consisting of ultrahigh-definition video with four times the vertical and horizontal resolution of HDTV and 22.2 multi-channel sound. We screened amazing video content that showed the unparalleled attraction of the SHV format.

International Collaboration

STRL’s international collaborative activities include its contributions to standardization, exchanges of researchers with overseas research institution, promotion of Japan’s ISDB-T standard, and cooperation in presenting exhibitions abroad.

The various international collaboration activities being carried out by STRL researchers and colleagues around the world.
"Enhanced Reality" Spatial Reproduction

Integral Three-dimensional Television

A three-dimensional TV that uses spatial image reproduction would be able to produce natural 3D images that could be viewed without special glasses. Our exhibit at this year’s open house displayed an integral 3D television that uses ultrahigh-definition Super Hi-Vision (SHV) video technology and a depth positioning control technique to make striking three-dimensional reproductions.

Audio Devices for the Ultimate in Sound Reproduction

We are researching an ultra-thin loudspeaker based on an elastomer material for Super Hi-Vision (SHV) home displays and a world first unidirectional ultrawide-range microphone system.

Psychological Evaluation of Sound Conveying a Heightened Sensation of Presence

We are interested in developing media conveying a sensation of presence beyond what people experience from today’s television. To make such an advance, we are developing new evaluation techniques that take into consideration psychological effects as well as the physical characteristics of sound.

Power Saving Technology for Super Hi-Vision Plasma Displays

This exhibit included an ultrahigh-definition PDP with a 0.3-mm pixel pitch, which is the finest pitch ever achieved. The unit is capable of presenting moving pictures. The exhibit also showed how power consumption could be reduced by increasing the panel’s luminous efficiency.

In Development

Satoko Oode, Human & Information Science

Besides assessments made using physical indices, such as frequency, sound media are assessed with psychological evaluations that ask listeners to describe impressions in words such as 'bright' or 'powerful.' While psychological evaluations using such terms are good for categorizing sounds with similar characteristics, they do not necessarily gauge the quality of the sound, because individual subjects can evaluate sounds with completely different characteristics as good. As a first step toward compiling an evaluation index for “good” sound, we used questionnaires and conducted a psychological experiment on keywords that people tend to use to express positive emotional impressions, or “kandou” in Japanese. We regard such words as being ones describing the various requirements for a sound to be perceived as “good.” We are progressing with research on advanced sound media that can meet the needs of a diverse group of listeners.

Satellite Broadcasting in the 21-GHz Band

We are progressing with R&D on how to deliver Super Hi-Vision broadcasting channels to homes. The 21-GHz band will allow wideband channel engineering for satellite broadcasting. To use this band, we are developing a phased array antenna that radiates intensified radio-waves to reception areas where signals suffer from significant rain attenuation.

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Wide Dynamic Range Projector with 33-million-pixel Panel

One of our research goals is to create a projector capable of displaying Super Hi-Vision video. This year, we succeeded in fabricating a projector that can display full-resolution SHV video (7680x4320 pixels) for the first time. This video projector has high resolution and an extremely wide dynamic range.
Useful and Universal Services

AdapTV: A Context-aware Broadcasting Service

AdapTV will be used in a broadcasting service that adapts to the preferences and viewing environment of individual users by converting broadcasting content at the receiver side into the desired form of display.

CurioView: A New Viewing Style Utilizing Information Retrieval

CurioView automatically retrieves information and scenes from a program in accordance with the viewer’s interests. The user retrieves video by using CurioView’s simple remote control instead of a more complicated PC operation.

Secure Broadcasting for Content Distribution via Communications

This exhibition featured security technology for convenient, yet secure video-on-demand service, in which a broadcaster delivers programs directly to viewers, and peer-to-peer service, in which programs are exchanged among receivers without the involvement of broadcasters.

TV4U (TV for You)

Research continues on the TV4U system that will allow anyone to produce and upload TV programs to the Web. This year’s open house explained TV4U features that enable multiple users to collaborate in producing and viewing programs, including ones for introducing other people’s programs and commenting on programs that others have produced.
**Advanced Receiver Platform for Interactive Services**

STRL is examining a new data broadcasting scheme and receiver platform that will enable devices connected to a home network to work together to display data broadcast programs. This system is intended for interactive data broadcasting of the advanced digital satellite broadcasting system.

**New Closed-captioning System Using Speech Recognition**

We improved the speech recognition accuracy of live closed captioning by incorporating measured variations between individual speakers and between different acoustic environments. We constructed a closed-caption production system for news programs that needs only one or two operators.

**Flexible Displays**

Research continues on lightweight flexible displays that can be rolled up for easy transport. Our latest active-driving display based on an organic TFT array can show color moving pictures.

**In Development**

Akitsugu Baba, Broadcasting Systems

Telecommunications technology is beginning to be used to link home information appliances into a home network. The addition of a data broadcasting receiver to such appliances will enable unconventional services and new forms of program presentation. We are studying a digital broadcasting platform that can work together with other home devices. We are also studying a data broadcasting scheme based on Java data broadcasts: Java that "executes" a data broadcast program on a receiver. Our goal is to use the advanced digital satellite broadcasting that is scheduled to begin sometime after 2011 to provide a wide range of data broadcasting applications through a home network system.

**Interactive Tactile Display**

The interactive tactile display incorporates a touch-panel to enable users with visual impairments to benefit from data broadcasting and operate an Internet graphical user interface (GUI). Users can get a "grasp" of visual data such as diagrams and charts.

**Flexible Displays**

Thin, lightweight flexible displays will enable viewers to watch video anytime, anywhere. Such displays will require a thin-film transistor (TFT) material that is flexible enough to be bent over a thin plastic substrate. The flexible structure and low-temperature manufacturability of organic TFT make this material compatible with flexible displays. High picture quality can be achieved by developing organic TFTs with larger pixel counts on a plastic substrate and driving technologies for them.

**In Development**

Yoshihide Fujisaki, Material Science & Advanced Devices

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Environment for Producing Advanced Content

Advanced Studio Production Technology
The exhibited systems included a collaborative robot shooting system, in which multiple robot cameras work together to follow the movements of studio cast members or CG, and a real-time video composition technology that can accurately compose actual shots and CGs without the need for a studio set of a particular color.

TV Camera Equipped with Millimeter-wave Signal Transmitter
A TV camera equipped with a millimeter-wave signal transmitter can be used in more diverse camerawork than would be possible with normal cameras whose movement is restricted by signal cables. The exhibit presented technologies for size reduction of the camera that improve its mobility and technologies to prevent signal interruptions.

Millimeter-wave TV Camera
Radio waves can pass through fog and smoke. We exploited this characteristic to make a TV camera that can capture images of subjects obscured by fog or smoke. The camera transmits millimeter waves toward the subject and receives the reflected waves that reach its antennas. The camera’s frame rate is four times higher than last year’s model.

New File System for Transferring Program Files
Hard disk storage is rapidly replacing tape, and we are working on a tapeless program production system that handles programs as video and audio files. The system will incorporate a means of high-speed file replacement that rewrites only the edited part of a file to enable production staff to edit "footage" immediately before broadcast.
Our goal is to develop advanced recording media for archiving that is suitable for next generation video system. Currently, we are studying a thin, flexible optical disk with high-speed rotation and recording capability. To speed up recording and lower the error rate, we increased the recording sensitivity and planar uniformity of the disk and improved the optical beam control algorithm.

Research is progressing on a "thin optical disk" to replace magnetic tape as a program storage medium at broadcasting stations. The risk of damaging conventional optical disks during high-speed rotation makes it difficult to achieve a high enough bit rate for recording. We developed a thin optical disk with a paper-thin substrate that can rotate at up to 15,000 rpm and an accurate optical head positioning mechanism. The new medium has a recording and reproduction capability equivalent to that of HDTV VCRs currently used in broadcasting stations. It will allow archiving of the NHK’s priceless store of program data, totaling over 600,000 rolls. This thin optical disk could also be developed as a Super Hi-Vision recording medium.

This high-sensitivity camera has a maximum speed of one million frames per second. It can capture images of fast-moving phenomena that cannot be perceived with the naked eye or ordinary cameras. This year, we doubled the recording time of our previous prototype.

The multi-view HDTV system generates impressive video effects for sports scenes and other applications by seamlessly switching between HDTV cameras placed at various viewing points.
Multi-joint Manipulator Equipped with Extremely Small HD Camera

Sometimes shots have to be made in narrow or confined spaces. We fabricated a multi-joint manipulator mounting an HDTV video camera that can maintain its position when pointed in any direction. The manipulator and camera can fit in places too small for an ordinary camera to fit.

New Camera Stabilizer

We exhibited a compact shoulder-held camera stabilizer. To reduce wobble, this device uses a sensor to detect camera vibration and activates an actuator in the opposite direction to the vibration.
Utilization and Deployment of Broadcasting Technology

Ultrahigh-sensitivity HARP Camera
The ultrahigh-sensitivity HARP camera can capture vivid images even in faint light. This ability makes the camera ideal for nighttime emergency reporting and shooting certain topics in science programs. The camera is also being used in various fields besides broadcasting, such as deep-sea exploration, biological research, and medicine.

Watermarking that Survives after Re-shooting a Screen
This digital watermarking technology allows electronically embedded information to be detected even from images taken by shooting a TV or movie screen with a video camera.

Patents and Technical Know-how of NHK
NHK Engineering Services, Inc. is working to return the results of NHK’s R&D to society by licensing NHK’s patented technology and devices.

Broadcasting Museum
Television research at NHK began in 1930, the year when STRL was founded. This section of the open house focused on STRL’s first decade. It featured equipment from the Broadcasting Museum and the history of TV research and development at STRL.

Digital Broadcasting Information Corner
This special section explained methods for receiving digital broadcasting in individual homes and apartment buildings. It also had a digital receiver operation guide and an explanation of data broadcasting/interactive services. We also outlined our efforts to enhance safety information broadcasting during a major disaster.
This was our second poster exhibit to be held at an open house. The exhibit gave researchers a chance to present in-depth information about their research and answer the question of visitors.

**Super Hi-Vision (SHV) and 3D video require high-speed recording devices with ultra-large capacities to store massive amounts of data. One potential technology is a holographic recording medium that can record data even in the depth direction. Its parallel data handling capability is also advantageous for high-speed recording. However, the realization of such technology will necessitate an input device, an ultrahigh-definition high-speed spatial optical modulator. We are developing an optical modulation device for a new driving scheme. This device controls the magnetization orientation by injecting an electric current with a uniform electron spin into a magnetic body (spin-injection magnetization reversal) and by exploiting a phenomenon in which the polarization surface changes when light hits the magnetic body (a magneto-optical effect). This new scheme has significantly better definition and speed compared with the conventional one. Our research on this technology is advancing toward the realization of an ultrahigh-definition, high-speed spatial optical modulator.**

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**New Director General**

On 16 June, NHK appointed Dr. Keiichi Kubota to Director General of Science and Technical Research Laboratories. Kubota joined NHK in 1976. Since 1980, he had been with the Science and Technical Research Laboratories, working in the areas of satellite and terrestrial transmission systems of HDTV, signal processing for HDTV, and subjective assessment of HDTV picture quality. After 1989, he was consecutively in charge of the posts such as Senior Scientist at NHK’s New York Office, Senior Research Scientist of STRL, Senior Associate Director of Planning Division of Engineering Administration Department, Director of Planning and Coordination Division of STRL, Deputy Director of STRL, Engineering Controller of Engineering Administration Department, Director-General of Corporate Planning Bureau of NHK. He has been a SMPTE fellow since 1993, and an IEEE fellow since 2008.