

International Overviews

An overview from NHK (Japan Broadcasting Corp.)

NHK, the only public broadcasting organization in Japan, provides services through various media including two terrestrial TV channels, two DBS (Direct Broadcasting Satellite) TV channels, two medium-wave radio networks, one FM-radio network, an international radio station, and two teletext services. In addition, NHK provides Hi-Vision (HDTV) service and international broadcasting to North and South America, Europe, Asia Pacific, and North Africa. The HDTV service via the broadcasting satellite BS-3, begun by NHK and seven commercial broadcasters in 1994, expanded its broadcasting time from 98 to 119 hours per week in October 1997. The service is now being aired from 7 a.m. to 12 p.m., a total of 17 hours a day, using the follow-on satellites BSAT-1a and 1b launched in April 1997 and 1998, respectively.

The Winter Olympic Games

The Winter Olympic Games were held in February 1998 in Nagano, Japan. At the Games NHK aired around 8 hours of terrestrial TV, 19 hours of DBS TV, 17 hours of HDTV, and 6 hours of medium-wave radio daily. NHK and commercial broadcasters introduced various newly developed equipment to cover the Games, including an HDTV one-piece camera, a high-speed HDTV camera with three times normal speed, and the Ice-Zone microphone system for picking up skating sounds. Thanks to developments by NHK and manufacturers, equipment for HDTV has been made as compact and advanced as in the conventional NTSC system.

Hi-vision Camcorder (HD-CAM) on the Space Shuttle Discovery

NHK developed the HD-CAM based on the conventional NTSC system for use in the space environment.

A contribution from Ichiro Yuyama, Director, NHK, Tokyo 157-8510, Japan.

Dr. Chiaki Mukai, one of the crew aboard the space shuttle *Discovery*, which also included Senator John Glenn and was launched on October 30, 1998, took along the HD-CAM and shot the inside of the shuttle and the landscape of the earth. NHK aired many programs related to the shuttle for terrestrial TV, DBS TV, and HDTV.

Satellite Digital Broadcasting

DBS broadcasting uses four of the eight channels assigned to Japan for current NTSC and HDTV services. In May 1997, the Radio Regulatory Council recommended that the Minister of Posts and Telecommunications introduce digital broadcasting to the BS service around the year 2000, using the remaining four channels, and that HDTV should be the main service of digital broadcasting. In February 1998, the Telecommunication Technology Council (TTC) recommended a digital BS broadcasting standard based on a report by the Association of Radio Industries and Businesses (ARIB), a voluntary standardization organization with close to 260 members from the broadcasting, telecommunication, and manufacturing industries. As a member of ARIB, NHK has contributed to the standardization of DBS broadcasting; some of the distinctive features of these standards are as follows:

- The information bit rate of about 52 Mbits/sec will make it possible to provide a variety of services, such as the simultaneous broadcasting of two digital HDTV programs, using a TC8PSK modulation scheme, on a single 12-GHz BS frequency.

- Digital satellite broadcasting will be flexible, allowing one modulation scheme to be changed for another, such as QPSK or BPSK. It will also be possible to use several schemes together, as in a hierarchical transmission system.

- Digital satellite broadcasting will also be able to handle several MPEG transport streams and thereby ensure the independence of services on the same frequency.

NHK and commercial broadcasters have been preparing for the implementation of DBS broadcasting.

Digital Terrestrial Television Broadcasting

TTC and ARIB have been studying the digital terrestrial television broadcasting (DTTB) system since 1994. As a result, in September 1998, a draft standard for DTTB, which is an OFDM-based system, was developed by TTC and ARIB, and TTC will adopt a final standard in the autumn of 1999, after field tests are completed. Along with standardization, the Advisory Committee on Digital Terrestrial Broadcasting of MPT has been studying ways to achieve a smooth introduction of DTTB since 1997, and the final report was submitted in October 1998. Since digitization of terrestrial television needs studies of various technical and business aspects and is expensive for broadcasters, NHK believes DTTB service should be introduced after satellite digital broadcasting is started.

Research Activities

The NHK Science and Technical Research Laboratories have consistently promoted research activities relating to broadcasting technologies, ranging from such basic fields as auditory and visual science, materials and devices, and language processing to broadcasting systems and broadcasting services. In the midst of many reforms taking place around us, the Laboratories have emphatically promoted overall research and development toward implementing digital broadcasting to fulfill its role as a laboratory for public broadcasting, further raising its significance and returning the results to communities. Meanwhile, efforts are being made to promote interchanges and collaboration with communities in the development of new research fields and toward an open laboratory. In 1998, at our research institute, studies continued on new broadcasting services to improve conventional ones and into basic technologies to support broad-

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casting in the future. Some of the results of research at the Laboratories are as follows.

A 42-in. color PDP was developed early this year with 1920 x 1035 cells, a horizontal pitch of 0.48 mm, and a vertical pitch of 0.50 mm; the fabrication technology has been transferred to a manufacturer for a production model. At the Laboratories we concentrated on the improvement of luminance, luminous efficiency, and reduction of total power consumption of the panel. To improve the luminous output our efforts were concentrated on the basic mechanism of gas-discharge, including the light output from the positive column or the negative glow.

NHK has developed segmented orthogonal frequency division multiplexing (OFDM) for the transmission scheme of ISDB-T (ISDB for terrestrial). The TTC has specified requirements for a future transmission system taking into account the advantages of terrestrial digital broadcasting. Based on these, the council has also specified the technical standard for the transmission of the terrestrial ISDB. These technologies will be implemented when we start the digital terrestrial ISDB broadcasting in Japan.

For the purpose of captioning news programs for the hearing impaired, research into speech recognition has been emphatically performed; we are aiming at a recognition rate of 95% in the year 2001.

New Products and Systems from NHK

A Large Scale Still Picture System with Video Servers

A large scale still picture system (Fig. NHK 1) with video servers was developed for the NHK News Center. Controlled by the News Editing and Information Service System, it consists of video servers and input/output units connected to a high-speed asynchronous transfer mode (ATM) network. It can simultaneously input and output still pictures to and from the video servers, thereby greatly facilitating real time news production and transmission. This system has 30 outputs, uses reliable RAID disks for recording, and stores 30,000 non-compressed still pictures.



Fig. NHK 1. A large scale still picture system with video servers.

Development of a Radio Broadcasting System Using a Digital Audio File

NHK has developed and made ready for service a digital audio file (DAF) system, using a UNIX server and flash silicon disk, as a new radio broadcasting system for two of its AM services and one FM service. This system consists of the following four parts: a cart device that can handle a maximum of 120 DATs; an interface that applies MPEG compression to the output signals of the cart device; DAF storage to store and control 1600 hours of broadcast programs; and a flash silicon disk (on-air DAF) to store three days worth of broadcast programs for later airing.

The DAF makes it possible to handle emergency broadcasts and conduct flexible programming simply, and also to construct a highly reliable, totally digital system.

Variable Rate Playback VTR System with Natural Sound

A new application system for professional VTRs has been developed using our high-quality speech rate conversion method. This system can maintain the pitch of audio signals when playback speed is changed between x0.3 and x3.0. A special feature of this system is to maintain the

intelligibility of output speech when the VTR is fast forwarded. This function effectively reduces the work of program editing, for example, when speed-watching a program. On the other hand, the VTR can be slow-forwarded with real sound as if it were produced with the slow-motion picture. This system is expected to be useful for language educational programs and sports programs.

Development of Animation Guideline Compliance Analyzer

In a technical collaboration with Advantest KK, NHK Science and Technical Research Laboratories has developed a production version of an analyzer system for use in monitoring compliance of program material with guidelines. (Following problems with animation at the end of 1997, NHK and NAB produced guidelines, in April 1998, on the use of special image effects in animation, etc.) This analyzer automatically detects and logs, in real time, any sections of video that may fail to comply with one or more of the various provisions in the guidelines. Principal features of the system include:

- Monitoring with respect to every item specified in the guidelines.
- Real-time display of measurements and alarms (possible violations).

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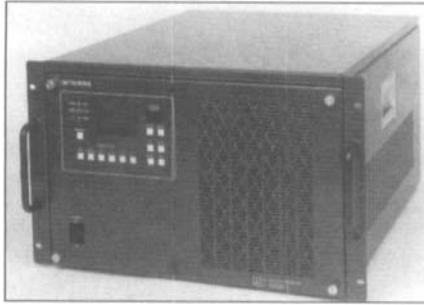


Fig. NHK 2. Real-time video quality assessment system

- Automatic location of alarm sections using VTR remote control function.
- Display and output of list of alarm sections to printer.
- Easy-to-use touch panel user interface in a compact unit.

Real-time Objective Video Quality Assessment System

NHK and Mitsubishi Electric Corp. have jointly developed a real-time objective video-quality assessment system (Fig. NHK 2). This system predicts subjective quality scores such as double stimulus continuous quality scale (DSCQS) scores for degraded pictures. This method uses a human visual sensitivity model to obtain numerical values representing picture quality. The real-time video-quality assessment system uses spatiotemporal filters, whose frequency responses and gain parameters are adaptively controlled according to the brightness of the reference or test signal. After the spatiotemporal operation, signals are processed linearly and nonlinearly and a final quality score is predicted. The system is useful for objectively predicting the subjective picture quality of sequences degraded through image processing and compression, because it is designed to emulate the sensitivity of the human visual system. It can evaluate the quality in real-time of "in-service" pictures.

HDTV New Super-HARP Handheld Camera

NHK recently developed an ultrahigh-sensitivity 2/3-in. HDTV image pickup tube with compact all-electrostatic focusing-deflection (SS) elec-

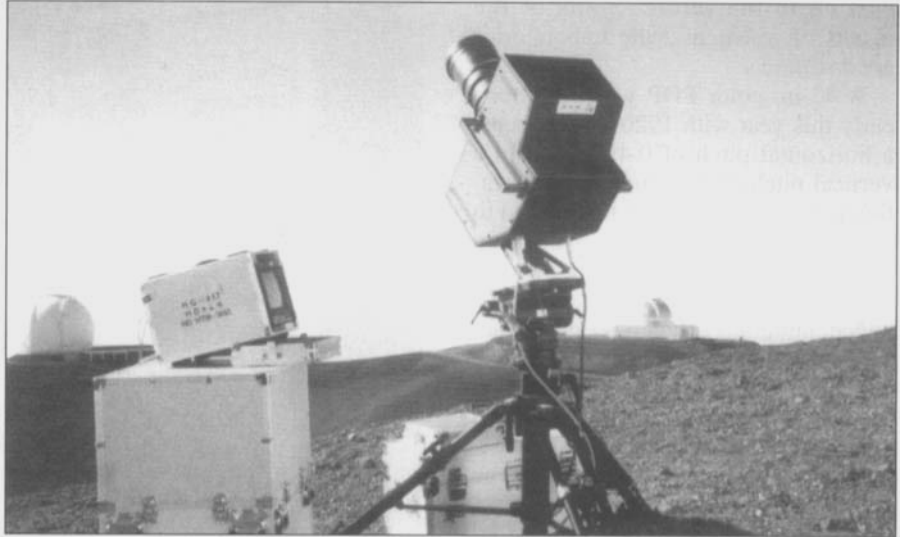


Fig. NHK 3. Ultrahigh-sensitivity color HDTV camera.

tron optics. Called the New Super-HARP tube, it is 640 times more sensitive than a conventional pickup tube. A handheld HDTV color camera, which uses the new Super-HARP pickup tube, has exhibited outstanding characteristics, including ultrahigh sensitivity greater than that of the human eye (0.8 lux, F2); almost negligible lag, just like a CCD camera; and high resolution (a limiting resolution of more than 1000 television lines). The HDTV New Super-HARP camera is capable of producing excellent picture quality over a wide-range of shooting conditions from daylight to moonlight. This camera is expected to become a powerful tool in the produc-

tion of science programs, nighttime news gathering, and other applications.

Ultrahigh-sensitivity Color HDTV Camera for Shooting Heavenly Bodies

NHK has developed an ultrahigh-sensitivity color HDTV camera, consisting of three proximity-focused image intensifier tubes of large image size (useful area: 40 mm diameter) and three FIT CCDs of 2/3-in. 2M pixels, relayed by high-quality lenses with reducing power of 1/3.6 (Fig. NHK 3). The sensitivity of the color camera is 3000 times as high as that of conventional HDTV CCD cameras.



Fig. NHK 4. A produced picture of Leonid.

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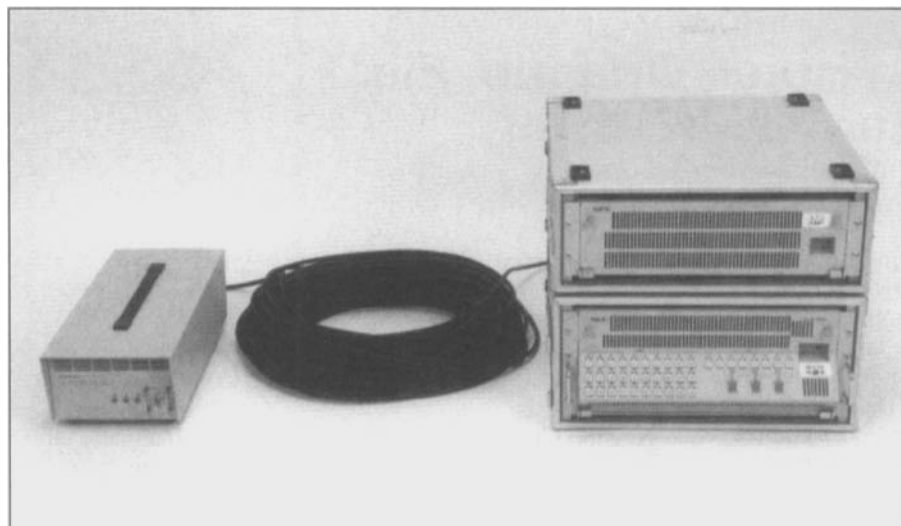


Fig. NHK 5. Multichannel HDTV transmission system using dense WDM.

Additionally, it has high resolution and high SNR due to its large image format. An F1.4/50-mm field lens and an image reducer lens of 0.23x magnification for telescopes have been developed simultaneously. The camera, using the field lens, was able to photograph stars of the 9th magnitude, and the those of the 17th magnitude, with the 2.2-m UH telescope at Mauna Kea Observatory. It makes it possible to shoot high-quality real-time images of heavenly bodies, such as the milky way, nebula, galaxies, and meteors (Fig. NHK 4).

Robot Camera for Virtual Racing

NHK has developed a robot camera that makes it possible to overlap the images of athletes who do not actually take to the field together, as if they were racing directly against each other, in a live sports program. The camera is capable of memorizing a cameraman's work and of repeating the camera operation by reproducing it accurately, enabling the TV audience to see the recorded time differences with their own eyes. The cameraman shoots by operating the camera's manipulator, which is equipped with sensors. The images taken by a connected robot camera are recorded in

real time on a videodisc recorder (VDR), and the camerawork data are input into a PC. This data is used to operate the robot camera with the same timing for later contestants. The images from the robot camera are then overlapped with those from the VDR for showing to the audience.

Advanced Lighting System with Free-positioning Function at a TV Studio

NHK introduced an advanced lighting system for the 500-m² drama studio. Because of the new system, the drama studio can now be used more than 290 days a year. The characteristics of the system:

- 33 lighting rails on which computerized grid telescopes are able to slide manually.
- The grids of the studio are divided into four areas and telescopes of each area can be operated at the same time.
- The telescope positions and the instrument types are automatically displayed on CRT.
- Fully computerized self-climbing winch units with 1-kW to 3-kW lighting instruments that can be operated remotely.
- Each lighting instrument can be placed at intervals of 75 cm minimum.

- Each barrel has a sensor to find electric leaks and irregular movements.

800-MHz-band OFDM UHF link

We have developed an 800-MHz-band OFDM UHF link. The carrier modulated by the OFDM method transmits an MPEG-2-compressed 525-line video signal using an 800-MHz-band wave. The specifications of the OFDM UHF link conform to the ARIB standard in Japan. The OFDM UHF link has been used in live outside broadcasts since June 1998, most effectively for marathon races. Until now, 800-MHz-band analog UHF links have been used, and a large-scale field production system with many UHF receiving points has been necessary. By introducing OFDM UHF links and utilizing the advantages of the OFDM, such as robustness in a multipath environment, the number of the receiving points can be considerably reduced, thereby establishing a much more compact system.

Multichannel HDTV Transmission System using Dense WDM for on-site HDTV Broadcasting

For live on-site HDTV program broadcasting of full-scale sporting events such as golf tournaments, a huge amount of metal cable must be laid between cameras, outside broadcasting vans (OB vans), and a switching center. To simplify the work of cable-laying, NHK has developed an HDTV transmission system capable of transmitting 30 HDTV serial-digital-interface (SDI) signals through a single-mode optical fiber. The system uses such advanced technologies as dense wavelength division multiplexing (DWDM) and optical signal amplification using an erbium-doped fiber amplifier (EDFA). It consists of four transmitter/receiver devices; optical fiber cables commonly used for HDTV cameras; and an optical coupler device. The input/output SDI signal format of the system is SMPTE 292M (BTA S-004B).