# The Applications of High Definition Television (HDTV) System for Still Imaging — Part 1

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At the end of the 1960s, the idea for a high definition television (HDTV) system was proposed by Japan Broadcasting Corporation (NHK) as a future TV system.[1] The picture configurations and signal specifications were established by results of psychological and engineering experiments. After decades, development of most equipment for trial broadcasting service was completed and it was named "Hi-Vision".[2] We, Sony supplies all equipment for Hi-Vision system.

The main purpose of Hi-Vision was to achieve a direct satellite broadcasting (DSB) service, although its high resolution picture characteristics had fascinating potential for applications to pictorial information media including various electronic imaging in the non-broadcasting fields. This paper introduces the applications of Hi-Vision system to electronic imaging. The discussion is primary with regards to application of it to still picture imaging.

## 1. Proposal of the HDTV system

In Japan, the development of color television system was attained and the color TV receivers spread rapidly to the consumer market at the 1964 Olympic Games in Tokyo. Immediately following that phase, NHK began to discuss the future TV system and established the target of developing a high definition TV system capable of showing more excellent and realistic images than the current NTSC TV system.

The basic investigations had started to clarify the conditions necessary to satisfy the human mind watching TV pictures.[3] The first item was the condition of viewing angle to feel the ambiance or reality on the TV screen. Psychological experiments on watching wide images projected on a semi-globular shape screen at different viewing angles revealed that the optimum viewing angle for the horizontal direction to generate the feel of reality could be estimated 30 degrees and that of the vertical direction was narrower than that angle. Thus the picture aspect ratio of the new TV, so-called Hi-Vision, screen was decided at 5(H) : 3(V), and the recommended viewing distance was three times that of the picture height. The aspect ratio of the current NTSC TV system are 4 : 3 and the viewing distance is send the viewing distance is seven times picture height. Later, the picture aspect ratio of Hi-Vision was modified to be 16 : 9 (5.33 : 3) at the request of cinematography people.

Another important factor for the TV system was the number of the scanning lines. In the above viewing conditions, the existence of the scanning lines should not be recognized in the viewing angle of less than 1 minute in steradian. This corresponds to more than 1000 scanning lines. For many reasons, the number of scanning lines for Hi-Vision was fixed at 1125.[4]

## 2. Specification of HDTV systems

After the two decades, in the mid of the 1980s, European broadcasting companies have developed their own HDTV system and later U.S. group proposed the advance TV system (ATV) following Hi-Vision. Their concepts were compatibility with the current PAL and NTSC broadcasting systems. Thus their system specifications were 1250 and 1050 scanning lines, twice that of the current standards, and the frame speed were 25 and 30 Hz, respectively. But the picture aspect ratios were 16 : 9 the same as that of Hi-vision.

Current consideration for HDTV systems is the development of the digital format allow merging with computer systems. The preliminary digital formats of Hi-Vision, European HDTV, ATV, NTSC and PAL TV systems are shown in Figure 1. These are temporary values and not to be concreted at present. In any case, the greatest advantages of the HDTV are the capturing and transmitting of 25 or 30 high definition full color pictures, each individual image data of 10 or 14.5 Megabytes per second. The new systems consist of newly developed various image capturing, recording and displaying equipment. Moreover, the establishing of those equipment is based on a huge number of newly developed electronic devices. Now most of these are digital components and useful for novel electronic imaging.

At the first stage of Hi-Vision proposal, it was suggested that its image quality was compatible with 35 mm movie film. Figure 2 shows the sharpness characteristics shown with the contrast transfer function (CTF) characteristics of various photography color prints prepared from the output of various cameras.[5] The CTF characteristics of photograph and electronic photograph prints prepared from the outputs of a half-size 35 mm still camera and an electronic camera having 1000 TV lines of resolution shows very close results. The visual difference between the two prints showing the same actual subjects were very few.

## 3. Applications of Hi-Vision

The applications of Hi-Vision to the electronic imaging fields have proceeded in three styles; the first application is the introduction of its program to the printing and the publication as an information media mixing — this is application A (Hi-Vision publishing), the second application is to merge the Hi-Vision pictures with the com-

puter graphic images — this is Application B (landscape simulation); and the third application is the global introduction of electronic devices and components to the novel electronic imaging — These are applications C (Hi-Vision museum) and D (Hi-Vision electronic photography).

Figure 3 shows the system configuration of Hi-Vision and signal flows for applications A to D. The basic TV system consists of image capturing, processing, recording and displaying. At present, most of these processes are analog operation. The above four applications utilize output signals from the capturing, the recording process.

### 3.1 Application of Hi-Vision Programs to Publications — Application A

Typical applications to the publications have been proceeding in the photography pages of some books, magazines and newspapers directly related to the Hi-Vision program.

In 1988, NHK Shuppan Kyokai, a subsidiary publisher of NHK published a pictorial book of "Mitsuko" related to the Hi-Vision broadcasting program. All sources of color photographs printed in the book, including the maximum size of near 8" × 10", were produced from Hi-Vision scenes (frames) read out from the video tape recorder (VTR). Related books were published later on. In 1990 a major Japanese printing company, Toppan Printing Co. experimented with distributing a daily photo-newspaper produced by Hi-Vision scenes at the Osaka Flower Exposition.

Now NHK broadcasts daily eight hours of Hi-Vision program by DSB and it is a good source for application to publishing. Recently, some sports newspapers have introduced pictures of decisive moments in sports events from the air-checked broadcasting of Hi-Vision programs. These are done by extracting one frame from the recorded or air-checked Hi-Vision program. Most signal treatments are analog phase, and in the final stage the signal processing was done in a digital format. Moreover, the outputs of these applications appear as hardcopy.

### 3.2 Application to the Computer Graphics — Merging with Hi-Vision frames and synthesized pictures, Application B

The second application of Hi-Vision system is the combination of Hi-Vision frames and computer generated fictitious image. It is a kind of "andscape simulation". To investigate the renovation of downtown, a new landscape simulation was proposed by the city planning designer. The wide angle Hi-Vision picture is suitable for the panoramic view. The computer generated image of the new building is exchanged with part of a picture of the actual scene taken by Hi-Vision camera. These synthesized pictures are very useful for estimating the future view and for evaluating the assessment by the executor and related people. The outputs of this application appear both as hardcopy and softcopy. This application will be more popular soon.

### 3.3 Application of Hi-Vision system for file picture — Museum application, Application C

Usually museums of fine art have many places in their art collections, however only a few of them are displayed in the gallery. At present, some museums display elec-tronic file pictures of the collection to visitors. They make files containing image data of the artworks in the memory devices. The selected image data of a piece is displayed on the Hi-Vision receiver or printed color hardcopy upon the visitor's request.

This is not the total application of the Hi-Vision system itself. The video or photo-production prepares the image file through a hybrid imaging system. The works of art are photographed by large format camera and the image from the developed film is captured by scanner. The digitized image data is memorized in the diskette memories. In the museum, the data is retrieved and displayed on the monitor upon the visitor's request. In this case, the Hi-Vision system consists of only signal and display monitor.

### 3.4 Direct application of captured Hi-Vision image to electronic photography — Application D

The electronic photography system is a suitable application of the Hi-vision system. The current Hi-Vision cameras for broadcasting have a lot of margin and very luxurious configurations of three solid state imagers for color signal generations, however it is very expensive.

The basic function of the present high grade electronic photography (EP) camera is very close to that of the Hi-Vision cameras, although with these it is simpler to realize reasonable price. Thus there is no EP camera generating pictures equivalent to the signal quality of Hi-Vision cameras.

Now several leading commercial customers have introduced Sony Electro-Photo Studio System: (SEPS) using a Hi-Vision camera and a digital color printer. It is useful in making portraits and originals for printing matter, and the captured image output as EP prints is compatible with color photographs.

## 4. Conclusion

The application of the Hi-Vision system has system has continued modestly during the past decade. We can now predict the rise of the Hi-Vision system because of the trial DBS and price reductions of the receiver. Moreover, proposals for new digitized HDTV systems compatible with computer systems are appearing gradually.

The possibilities for applications of both the HDTV system itself and its components will increase rapidly in the near future. The next system, excellent ultra high definition TV (UDTV), showing even higher definition electronic images is already beginning to come under consideration in the U.S. and Japan, respectively.

## References


1. K. Hiwatashi, *J. Inst. TV Eng. Jpn.*, **26**(11) 885 (1972).
2. K. Hayashi, *SMPTE, J.*, *90* (3) 178 (1981).
3. T. Hatada, et al., ibid, **89** (8) 560 (1980).
4. T. Fujio et al., ibid, **89**(8) 579 (1980).
5. S. Ohno, *Proc. Symp. Electronic Photography*, p. 8(1992) IS&T.

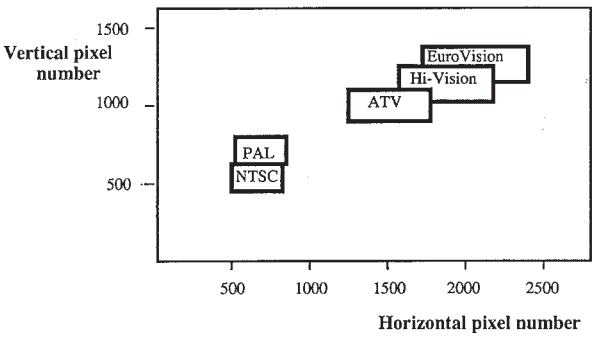
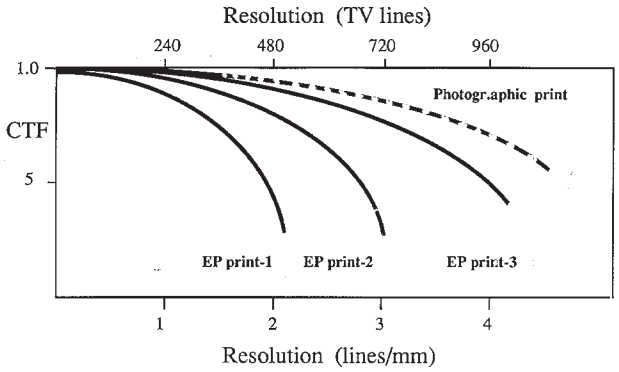



*Figure 1. Pixel configurations of TV systems. (tentative values)*




EP print-1: 500 TV lines camera & Dye sublimation print.
EP print-2: 800 TV lines camera & Dye sublimation print.
EP print-3: 1100 TV lines camera & Dye sublimation print.
Photgr. print: Half size 35 mm [ISO:100] color film & color print.

*Figure 2. Sharpness (CTF) characteristics of various color prints.*

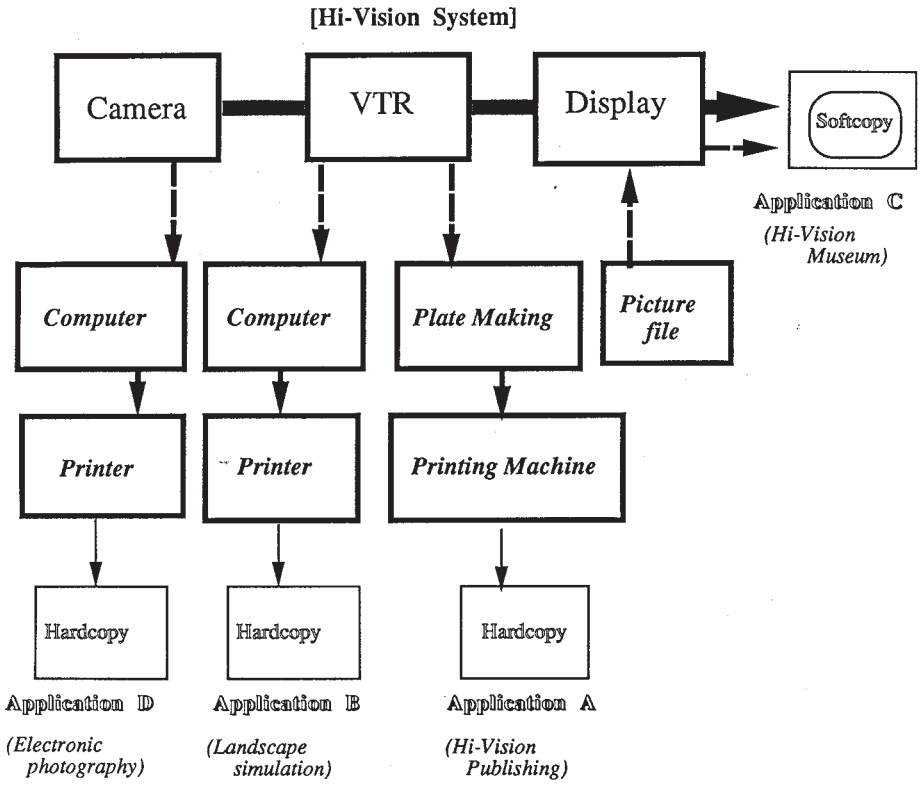



*Figure 3. Application scheme of Hi-Vision system.*