FUTURE BROADCASTING SERVICES AND MULTIMEDIA TECHNOLOGIES IN ISDB

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ABSTRACT: Although digitalization of broadcast waves is extending the multichannel programming capabilities of broadcasting, it does not fully exploit the potentiality of the digital evolution in broadcasting. ISDB has been put forth as second-generation digital broadcasting which offers a basis for a universal service in the future multimedia environment, and opens many new possibilities for services and their use. The paper is divided into three parts: A vision of the future of broadcasting, Evolution towards ISDB - Integrated Services Television, and Technology development.

PART 1: A Vision of the Future of Broadcasting

1. Enhancement of Broadcasting Services in Multimedia Context

It is predicted that information transmission and exchange techniques in the broadcast, communications, and computer areas, supported by digital technology, will dramatically develop within a couple of decades. The computer area, in particular, is seeing very rapid performance improvement and fusion with multimedia services, and it will continue to have a strong impact on the other areas. In the communications area, plans are under way to connect all households in a particular region to a high-speed digital network by optical fibers through which various services will be provided to the audience. The planned services include video program distribution, which has traditionally belonged to the broadcasting industry, and services currently provided by the video package business. The new media structure thus conceived cannot be confined within the conventional industrial framework. Work is already under way, therefore, to review and redefine boundaries between media services.

If the above-stated prediction is realized, all information media industries related to broadcasting will undergo radical changes. The proper role of broadcasting of offering accurate information to a large number of people simultaneously at reasonable cost, and the social and cultural needs for such a role will continue unchanged. The audience, meanwhile, will gradually grow accustomed to the everyday practice of taking the initiative in accessing personally necessary or preferred information by means of computers, communications services, and video packages, all having multimedia functions, or a mixture of these media. It should be noted that the audience will be more active than at present in selecting information. This implies the necessity of reviewing broadcasting services from the unbiased standpoint of active users along with that of traditional passive audiences, to renew the conception of broadcasting services.

As individual media are reformed and the fusion between different media develops, information flow from the supplier to the user will automatically take the most suitable channel or medium. Broadcasting has so far had its own attributes and advantages over other media in terms of content production capabilities including information gathering, analysis, processing and image representation. Under such circumstances, broadcasters will need to integrate advanced features into their services, such as interactive functions and reinforced user-oriented attributes. This can be easily implemented by broadcasters by remodeling their industry into new concepts of broadcasting that also accommodates wired networks besides the basal radio transmission media. The concepts will be producing new services suited to the new century while continuing to provide conventional services.

2. Concepts of Future Broadcasting Services

Described below are some of the major features and primary concepts of future broadcasting services. [2][3]

Accessible to anyone, anytime, anywhere. The services will offer information anytime users need it. This additional function of broadcasting

services represents an augmentation of the conventional two, i.e., information is available to anyone anywhere. This new function will facilitate the use of broadcasting media by users more easily from various receiving terminals. Broadcasting stations for their part will perform large-capacity digital transmission through a multi-network. The multi-network will integrate nationwide low-cost satellite and terrestrial radio networks of high durability able to resist disasters as well as fiber networks and CATV. Receiving terminals, which will be equipped with large-capacity memories, will store incoming information in the memories so that users can call it up whenever necessary.

Closer for users. The services will provide users with a variety of programs and information through a user-friendly interface that will make access easier. Broadcasting stations will offer program menus and summaries as the media's self-description. These programs and information items will be indexed or devised in many other ways so that receiving terminals can automatically select them or preset their reception. The terminals will be equipped with intelligent functions aided by high-performance CPU and software.

Dynamic representation. The services will be offered via multiple information representation methods, such as telefacsimile, personal computers, remote-controlled musical instruments, etc., in addition to images and sounds transmitted in two or more different formats. This will help enrich information representational modes. In the image representation area, producers will be able to make use of multiple production methods including three-dimensional images and computer graphics images generated in real time on receiving terminals, to say nothing of standard television images and high definition TV images. The services are aimed not only at many and unspecified persons but also small groups or even individuals. Such groups will be defined geographically, ranging from local communities to countries or global areas. They will also be specified by users' personal interests or concerns.

Real-time advantages. The services will reinforce such major advantages of broadcasting media as conveying the same information to large audiences immediately and simultaneously. This will make it possible for broadcasting media to maintain its advantages over communications media and package media.

Interactive with users. The services will have an interactive function so that users can directly join programs or access whatever programs they will need. Such a function will be implemented by the use of a two-way network, or it will be incorporated in the functions of the receiving terminals. Broadcasters have attempted to make up for the shortcomings of one-way program transmission by responding to audience opinions in order to improve production, or by calling on them to participate in programs by means of telephone, telefacsimile, video tapes and PC network communications. Such communication circuits between users and broadcasters will be reinforced by the interactive function of the services.

3. Layer Model for Broadcasting Services

Figure 1 (a) shows the composition of current broadcasting services presented in a layer structure. Each successive layer is supposed to function based on the layer below it. This figure indicates that at present one-way type programs are broadcast using the SDTV (NTSC, PAL or SECAM) or HDTV system as representation media by means of wireless analog transmission.

In contrast, the structure of future broadcasting services is illustrated in Figure 1 (b). Transmission will be digitized to facilitate the functions of upper layers, as well as to give flexibility and expandability to the broadcasting services. A new layer will be introduced that will function to support the selection of programs and information by users. The services will be reinforced with the dynamic representation functions included in the representation layer. Into the program layer, functions which offer interactivity will be introduced. Interactive programs will be available in two types: pseudo two-way programs using terminal functions and actual two-way programs using networks. Figure 2 illustrates the two types of interactivity in the broadcasting service. In the former type, users will interactively access a variety of information broadcast and stored in the receiver memories. In the latter case, users will be connected to a broadcasting station through a two-way network and will interactively access information or participate in programs prepared by the station.

4. Services and Programs

Considering the concepts and structure described above, it is envisaged that new services and programs will reach fruition some 20 years from now when the future broadcasting is supposed to be fully operational in the context of multimedia technology. Even after this time lapse, the way people generally watch broadcast programs may be unchanged, i.e., mostly the so-called 'couch potato' style. The primary goal of the future broadcasting is to make it easier and more comfortable for the 'couch potato' users to access

programs and information. Meanwhile, the future broadcasting will respond to the requests of users once they become active.

Broadcast information on the wall. Using multichannel and multimedia characteristics, various items of information will be broadcast by dedicated information channels in the future broadcasting. Users can display, on a flat screen display hanging on the wall for example, the specific information they need in their daily life from the information broadcast on a real-time, 24 hours a day basis. Users can access the information any time they want by just very simply looking at the display hanging on the wall as if it were a calendar.

Electronic program guides. Electronic program guides such as a program menu, and a summary or preview of programs will be broadcast. The guides will also include indexes for users accessing desired programs or information.

Storage type programs. Two types of programs are proposed for the future broadcasting. One is the type equivalent to conventional programs that can be watched in real time. The other is a storage type. The storage type programs may be temporally compressed so that they can be transmitted in a shorter time than they are viewed. This type of program will be temporally expanded when they are presented to users.

Hyper news and information. In the future broadcasting, pieces of news items and information spanned by hyper links will be broadcast along with news and information in a conventionally edited version. The high performance CPU and large capacity memories contained in the receiver will be organized as a hyper type data base that can write and read out the hyper news and information. Users can browse the news items and information at will on their receiving terminals.

Computer graphics model-casting. In an educational science program for example, three dimensional computer graphics data for an illustration model will be broadcast with conventional video images and sound. At the receiving terminal, with the modeling data received, images of the illustration model can be reproduced by a computer graphics function in the receiver. A user may manipulate the computer graphics images on a real time basis which will facilitate in-depth understanding of a phenomenon being explained. This concept will develop further to combine computer graphics data with real time data, and to include virtual realty in the future broadcasting representation method.

Networked party channel. For broadcasters, the use of two way networks will increase in importance when the networks become multimedia and communications using the networks become popular among the general public. Associated with audience participation programs, a multimedia 'blackboard' on a network may be set up at a future broadcasting station. A 'meeting' using this blackboard may be hosted and broadcast by the station. Users or participants can write their opinions or information on the blackboard with text, voice, video or using some other representational method.

PART 2: Evolution towards ISDB - Integrated Services Television

1. Evolution of Current Broadcasting Services and Development of ISDB

There are three major areas in evolution of broadcasting services: data broadcasting, digital multichannel broadcasting and HDTV services.

In data broadcasting, new styles of broadcasting which have not been offered with traditional radio and television services have appeared, bringing computer and communication technologies into the broadcasting industry. One example is broadcasting of computer software signals for reception of video games. Another example is employment of the public service telephone network (PSTN) as a feed-back connection to broadcasting stations for home viewers. These new styles in broadcasting have already been introduced in Japan.

In digital broadcasting services implemented recently in the United States, Europe and Japan, multichannel television is being offered with one hundred channels or more.

HDTV which is called Hi-Vision in Japan offers viewers the sharpest television images ever, more than doubling the number of scanning lines to 1125. The result is a nearly five-fold increase in the number of picture cells which is about two millions. This means HDTV images are in crisp detail even though the size of screen is larger. With its wider screen, an aspect ratio of 16 by 9, it gives viewers the experience of "being there".

In Japan, NHK and associated commercial broadcasters are broadcasting a total of 93

broadcast hours per week of HDTV programming, by sharing one broadcasting satellite channel.
At the occasion of the Atlanta Olympic Games, NHK offered a total of 273 hours of Hi-Vision programming through the domestic broadcasting satellite BS-3.
The number of HDTV receivers shipped from manufacturers totaled 285 thousand as of November 1996.
HDTV broadcasting is rapidly increasing in popularity in Japan.

These three evolutionary currents in broadcasting will be absorbed and integrated into ISDB (Integrated Services Digital Broadcasting), which is attracting attention as a second-generation digital broadcasting medium that responds to the diverse demands of the evolving multimedia society. Transmitting all video, audio, text and other types of data signals in a common format, ISDB integrates various services such as conventional standard-definition television, HDTV and enhanced teletext and audio services, as well as new types of interactive multimedia services (Figure 3). The concept calls for user-friendly, interactive use anywhere, anytime. ISDB will make the integrated implementation and use of all services easy. It has the potential for further expansion of services as multimedia technologies evolve.

ISDB will create many new possibilities for broadcasting services and help form universal services in the future multimedia environment.

2. Service conception of ISDB

Starting with multichannel programming, digital broadcasting services will evolve into ISDB in the years to come. Multichannel information presentation capability will not be limited to video and audio. It can be extended by text, still-picture and computer graphic signals and other representation media. For example, in addition to speciality TV broadcasts and information channels on selected subjects, "information anytime" channels that broadcast news and daily information of a variety of categories such as weather, traffic information and local shopping information, with text and pictures, will open a new dimension and result in a greater range of broadcasting services. An important point for this capability is that this information will be indexed to be automatically selected at a receiver terminal.

ISDB will broadcast programs with indexes so that viewers can select programs on the air or preset programs easily. The receiver terminal will be equipped with a personal filtering function to automatically receive and store necessary programs and information in accordance with the viewer's preference. Also, there is a possibility that each cut of a video image or each piece of information will be labeled so that viewers can browse programs and information at will on their receiver terminals. For example, when the viewer chooses a live sporting event in the middle of the game, he or she can quickly browse the highlights of the game up to that point and then follow the ongoing game. With these "nonlinear programs," ISDB will add new dimensions to its services.

ISDB will feature digital HDTV with the start of its services. Also, extra high-definition pictures and 3D-HDTV programs compatible with 2D-HDTV will be introduced when video compression for those signals becomes possible. Extra high-definition TV will allow viewers to select camera angles freely. Real-time computer graphics and other unique representation techniques will extend the video and image capabilities together with the interactivity of ISDB services, thanks to the high-performance computing functions of future receiver terminals.

3. Receiver terminal and viewer interface simulation

The ISDB receiver terminal should provide a sophisticated interface for viewers to help them navigate the many programs and information broadcasts, and to make the interactivity in the services practical. Since ISDB is intended to be a universal service that anyone can access, the viewer-interface must be a natural extension of the television viewing style.

To gain a clear image and idea of ISDB services and the viewer-interface, we have built a simulative ISDB receiver terminal called IS-TV (an Integrated Services TV), by which one can watch simulated programs and information broadcasts similar to future ISDB services interactively. IS-TV will integrate services not only from ISDB but also from other sources according to viewers needs and preferences. Figure 4 illustrates the relation between the services offered by ISDB and integration of services with the IS-TV set.

The viewer-interface of the future IS-TV will likely have the following features:

(1) Viewers will be able to operate it with only a remote control. It will be a home television set which can be operated by anyone.

(2) It will be an integrated service terminal. Viewers will be able to obtain information not only from ISDB and other broadcasting services but also from telecommunications services such

as e-mail and from a locally installed multimedia server (home database).

(3) The local server will contain an immediately accessible program memory which will have a capacity equivalent to 10 hours or more of video programs. This local server is a unique function of the IS-TV set. It is sometimes called a 'program refrigerator,' a concept for automatically and selectively storing programs and information that viewers need from among the large variety of programs and information on the air 24 hours a day. The management of the server will be taken care of by an 'agent' to ensure that the programs and information stored in it are the necessary ones and are always fresh. This will allow viewers to extract those programs they want whenever needed. To make this system work, we will need to send not only programs and information but auxiliary data on their attributes as well in order to activate the personal filter at the input port of the server.

(4) It will have a flat panel HDTV screen on which high-definition video as well as a variety of information will be attractively presented.

(5) It will have an initial turn-on menu screen (see Figure 5) by which a viewer, at a glance, will be able to understand major information items of his or her interest, such as news headlines and weather, or access channels and programs of personal interests with one click. The menu contains the following video windows and icons. The arrangement can be customized according to the viewer's preference. This initial menu screen will be taken over automatically by a **main channel** screen in several seconds, if the viewer does nothing. By clicking one of the window screens or icons, the content will appear immediately on the full screen.
- **Favorite channels**: the viewer's favorite channels including the main channel will appear on small video windows on the menu screen.
- **TV newspaper**: a kind of electronic newspaper delivered by ISDB, which will have the hypernews structure mentioned above. News items will be categorized into several areas such as 'general', 'international', 'social', 'economy', 'sports', 'local', and 'culture and entertainment'. News headlines of one of the categories will be shown on a part of the menu screen. The categories can be changed by just clicking an icon.

The arrangement and simulative operation of the viewer-interface will be designed based on studies on human behavior during television viewing and information acquisition from mass media [4].

PART 3: Technology Development

1. Required Technologies for realization of ISDB

The considerations described above will determine the required technologies for realization of ISDB. According to the layer model described in Part 1, those technologies are categorized as follows:

Transmission
(1) Reliable transmission through various types of transmission channels including satellite (21GHz, 12GHz and 2.5GHz, etc.), terrestrial and cable. In lower frequency satellite and terrestrial services, mobile reception should be taken into account. Figure 3 illustrates the relation between the transmission channels and possible services to be carried.
(2) Flexible integration of various types of services.
(3) Commonality in the transporting format for various types of services.

User/viewer access support
(4) Supporting schemes to improve human interface, e.g. 'agent'.
(5) Guides for viewers: menus, previews, summaries and indexing.
(6) Identification of services and information: Selection by categories, genres and attributes.
(7) Description or indexing schemes associated with program content.
(8) Technology for 'Program refrigerator' metaphor

Representation
(9) Various definition or quality levels and scalability introduced in video and audio representation.
(10) Various representation possibilities by data: text, still-pictures, graphics, facsimile print, PC software and real-time computer graphics etc.
(11) Synchronization among the combined program components, and those with an absolute time if necessary.
(12) Flat panel large screen high definition display

Programs
(13) Programs of different types: real-time, down-load and storage type; one-way, pseudo two-way and two-way type.
(14) Programs and information which can be presented either by a single medium or combination of representation media (program components).

(15) Efficient program production

Others
(16) Addressing of individuals or groups of viewers including conditional access.
(17) Interface with network and package services.
(18) Expandability for future extension of services.

2. ISDB Receiver

Figure 6 is a configuration of an ISDB receiver. The reception system will be important, enabling viewers to access programs and information freely without even knowing which transmission media or channel they are selecting; satellite, terrestrial or cable. The receiver will be equipped with an intelligent home server (data base) to select and store items from ISDB, so that viewers can retrieve programs and information instantly. ISDB will be enjoyed by a wide range of viewers, from children to the elderly. So viewer-friendly interface supported by 'agent' is an important challenge.

NHK Labs have already developed experimental 40-inch plasma display panels (PDPs) for wall-type HDTV receivers.[7] The panels have two million plasma cells and a peak luminance of 150 cd/m2. Researchers' major efforts are now concentrated on commercializing the panels before the 1998 Nagano Winter Olympic Games.

3. Content production in multimedia environment

ISDB services and their utilization look very attractive, but most will agree that whether they are successful or not depends on the contents of the services. Development of the tools to supply the contents easily and at a low cost to these services should be taking place with the development of the services and user interface. In particular, efforts should be directed toward the following issues:
- Efficient low-cost program production
- Multiple use of video, audio and other materials
- Association of index and attribute data with materials and contents produced
- Addition of related information to, and spanning links among content pieces

Taking into account the above considerations, researchers at the NHK Labs have been working on a way to provide a new content production environment called DTPP (desktop program production).
DTPP has been proposed as a total system supporting the entire program production procedures. Figure 8 illustrates the configuration of the DTPP system. The system consists of terminals (DTPP terminals) capable of handling multimedia, a media server to store multimedia data including video and audio materials and their attribute information, a computing server to process the multimedia data, and a network to connect this equipment.

Ideally, the network should be able to accommodate several non-compressed video signals including HDTV signals. With the script-driven process described below, currently available transmission means can be used to reasonably realize such a network. Under the script-driven process, the DTPP system handles compressed video data for monitoring via the network and uncompressed video data for broadcasting.

The production staff can operate the DTPP terminals like ordinary computers, retrieving information on the Internet at the planning stage or producing plans and scripts by utilizing the wordprocessing function. Further, they can perform many other different tasks, including: non-linear editing while randomly accessing and browsing video and audio materials stored in the multimedia server; visual communication with other terminals; sharing of production information; and controlling the computing server that processes selected multimedia materials and script.

In addition to video, audio and other kinds of materials, the media server stores attribute data and hyper-link information that describes relations among these multimedia data.

Physically, several media servers are distributed along the network, but they are synchronized; pictures within different media servers can be read and composited simultaneously. Further, they can be accessed by several operators at the same time.

As a first step toward realization of the DTPP system, a small-scale experimental system has been developed at the NHK Labs. NHK has also developed and started to use a multimedia server in which video materials of up to 4000 items and 500 hours are stored with the MPEG1 format. Currently, it contains historical video materials from the National Archives of the US.

The computing server processes multimedia data read from the multimedia server to create special effects and quality correction. The processing functions can be flexibly changed according to the script written by the producers. The server sends out the processed content data for transmission.

The video and audio materials can be edited on the DTPP terminal. This means that the results are not recorded or sent out directly, but that they are recorded as the procedures of processing and editing; the materials themselves are left intact.

The procedures are called 'script'. From the DTPP terminal, only this script is sent via the network to the media server and the computing server. With this script-driven processing, a system with a relatively low-speed network can be constructed. By altering the script, and simply using the same material, programs of several different editions can be produced immediately.

Since the DTPP system is organized by using a network, production staff members who are geographically separated can work together.

DTPP preserves edit information produced during off-line editing of video and audio materials, and control codes for special effects conducted along with the time code. They precisely indicate the video cut points in the program. Further, the ability to detect the camera work (panning, tilting, dollying) during material shooting provides an important clue as to video movement. These physical data are important attribute information for the DTPP editing process.

In DTPP, the descriptions currently available from the producer's documents such as a planning sheet, a script, a story board and memos are preserved electronically in a common space of the media server as attribute information. With the integrated working environment of the DTPP, producers will simply process a variety of information on the DTPP terminals, generating attribute information naturally linked to video and audio without any additional burden.

A useful method for indexing the attribute information on video materials with natural language is being studied. The aim is to develop a system that allows producers with little technical background to input attribute information without difficulty, and that converts script descriptions written in a natural language into codes that the computer understands [9].

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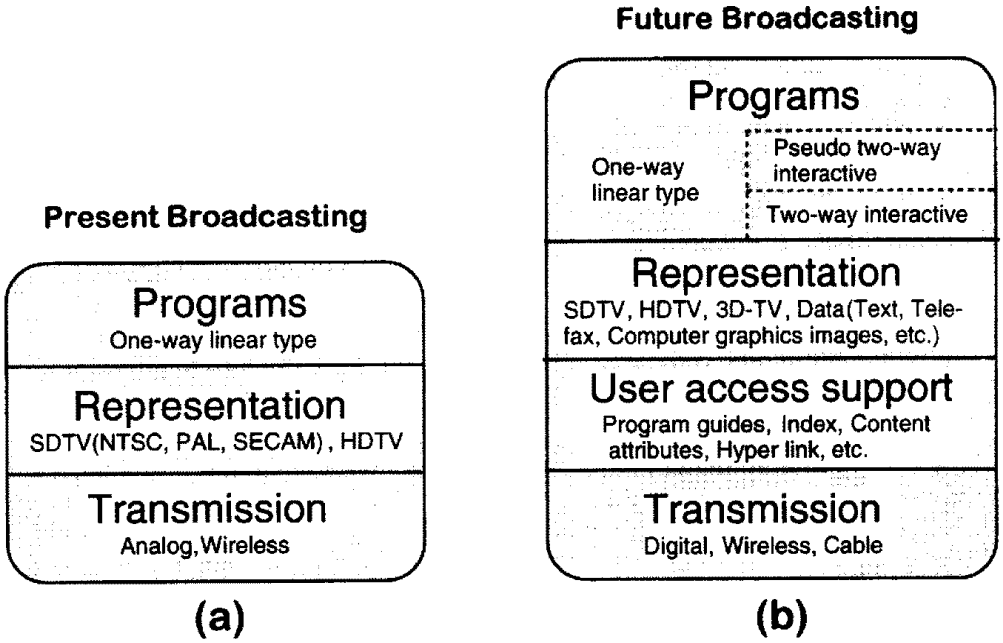

Figure 1 Layer Model for Broadcasting Services

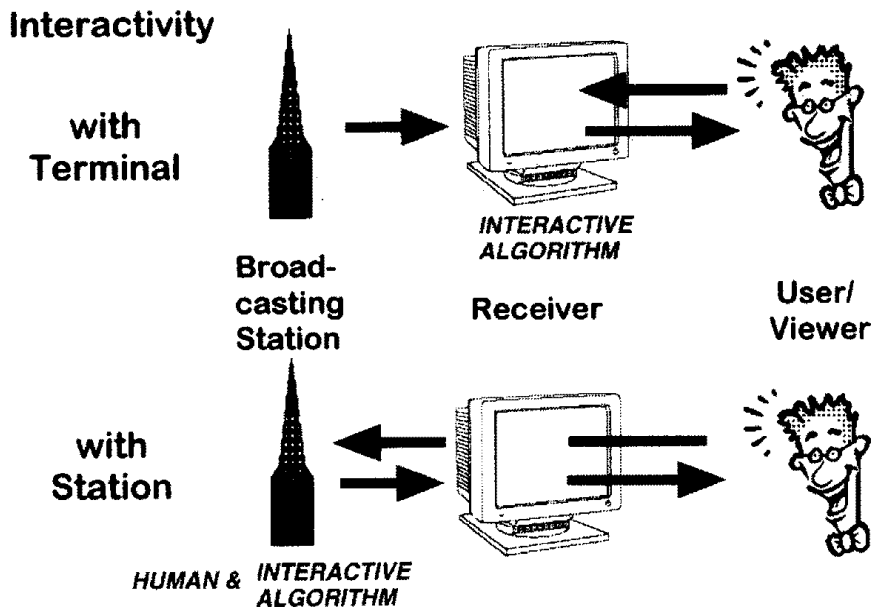

Figure 2 Interactivity in Broadcasting Services

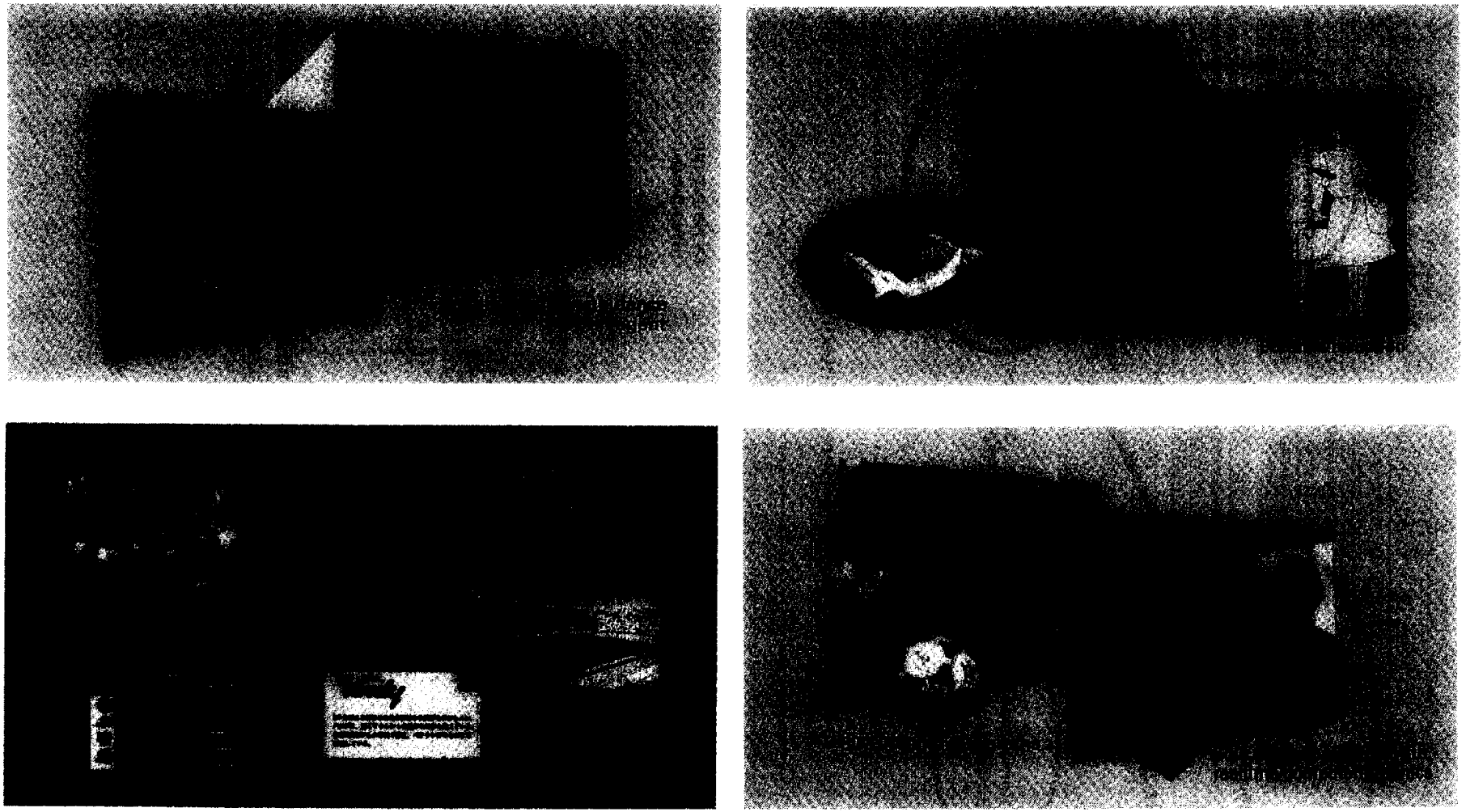

Figure 3 Concepts of ISDB Services

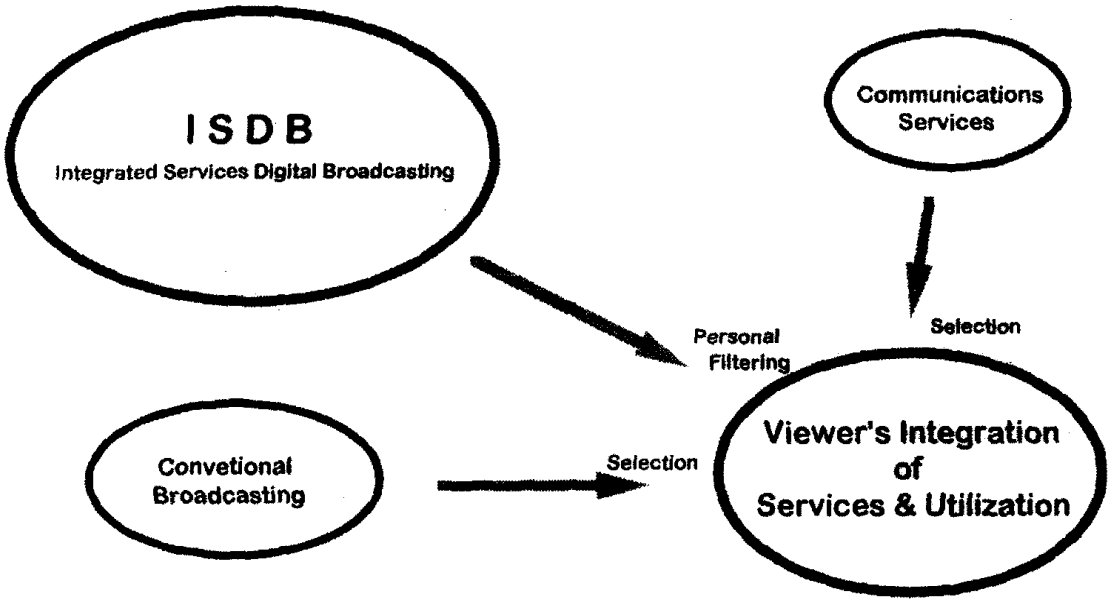

Figure 4 Viewer's Service Integration

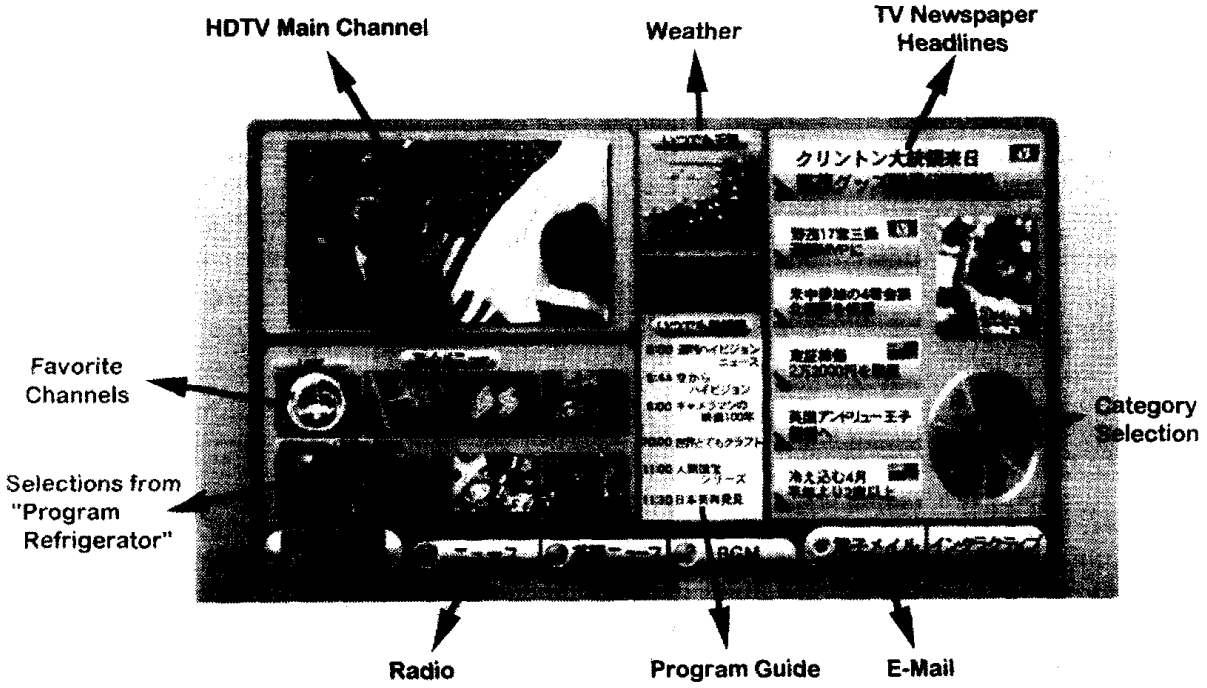

Figure 5 Viewer's Service Integration (Screen Display Example)

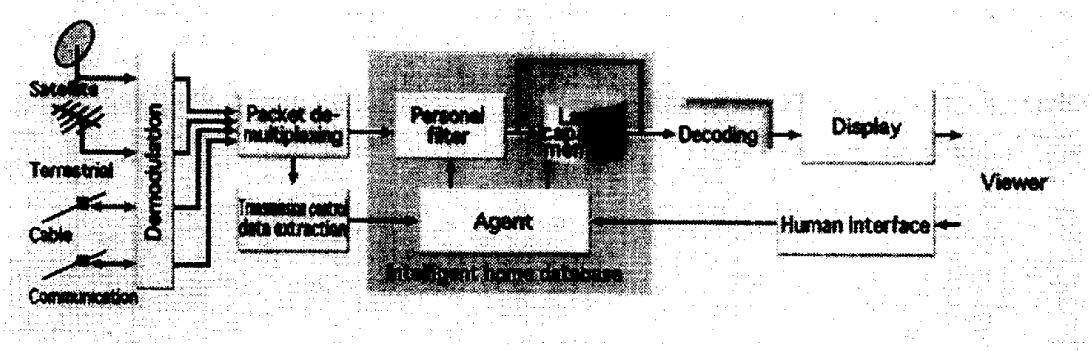

Figure 6 Configuration of ISDB receiver

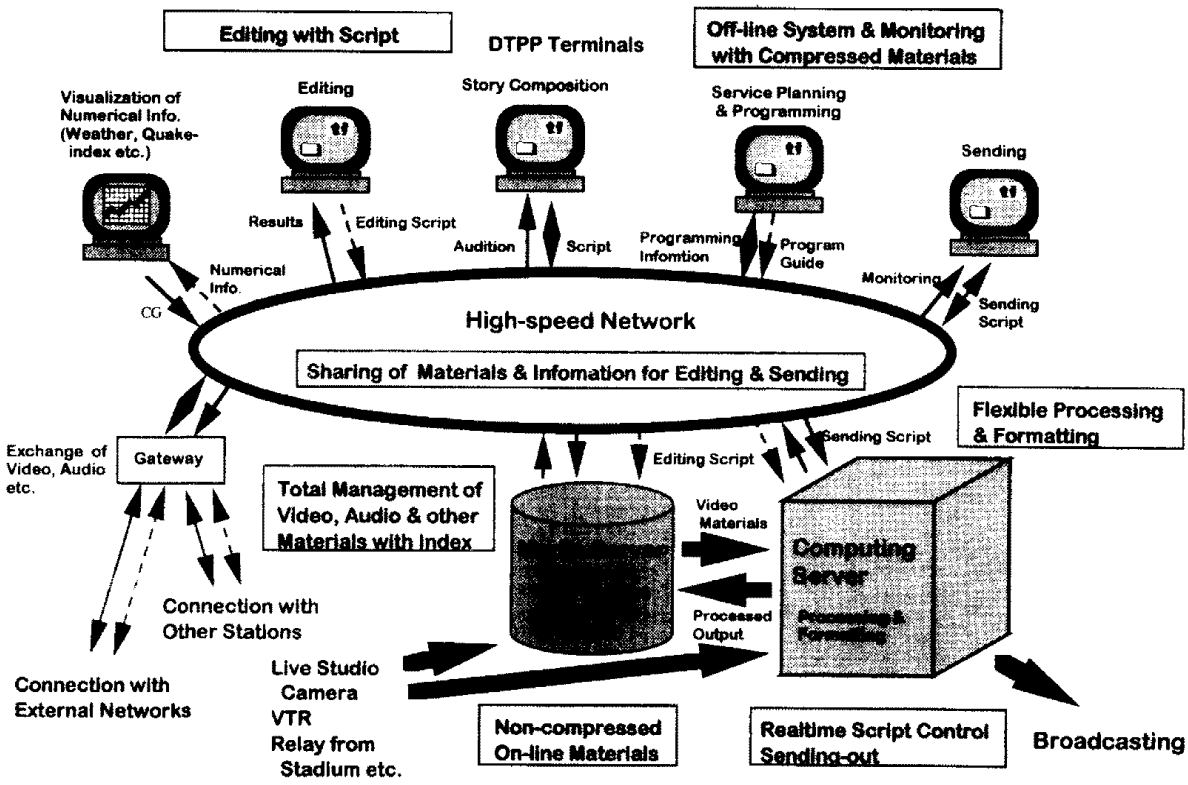

Figure 7 Conceptual Illustration of DTPP System