New Ancillary Services Using a Television Channel

By BERNARD MARTI

A data-broadcasting system implemented in France by the CCETT is discussed. Employing an ordinary television channel, the system provides at least three new ancillary services, and more are under development. The first service accomplishes the automatic recording of preselected programs for any user with a keypad, memory unit and VTR; the second provides scrambling and unscrambling of a television signal as for pay TV and theater projection; and the third uses the ANTIOPE teletext system to transmit "magazines" in page form to the home viewer. If the teletext system uses time-division multiplexing with an ordinary program, subtitling in any of several languages is possible along with transmission on request of special news-flash pages. Otherwise, when magazine pages only are transmitted on the channel, a page rate of about 20,000 per minute (24 lines of 40 characters each) is possible.

Introduction

The arrival of so-called "still-picture broadcasting" on the international scene of a (CCIR) meeting started a new era for the development of broadcasting services. Of course, eleven years ago, it was proposed to use time multiplex techniques for data transmission in a television channel,[1] but this was only for the use of broadcasters themselves and not for the public. Technological progress since then has raised the opportunity for new services, using data transmission and broadcasting, to be offered to the public at large or to certain categories of the public.[2]

The first studies gave rise to a fully new service, independent from the usual program, named the teletext service.[3]

French agencies in the CCETT laboratories started studying such services in late 1973. The conclusion based on the first experiments, held in Rennes, France, was that it was possible to implement on a normal television network a complementary data broadcasting network, on which the data related to a lot of different new services can be simultaneously transmitted for all the people in the coverage zone of the transmitters.

The DIDON Data Broadcasting System

Definition

The data broadcasting system (called in French, DIDON, for Diffusion de Donneés) applies packet switching techniques to broadcasting.[4] It allows several digital data sources, each related to a given service, to share the transmission resource — namely, the free lines of a television signal.

Every data source is connected to the multiplexing system, called network data handler, through a standardized digital junction. Thus, any kind of data system may be connected on the network.

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Within the coverage zone of television transmitters, anybody may use these broadcast services, subject only to the condition that they be able to access the particular data link.

The general properties of such a network are:

Transparency. Every user receives data as if he was directly connected to the data source through the digital junction.

Speed regulation. Three elements are to be taken under consideration: the data source, the service terminal device, and the network itself. The fact is that the data broadcasting system is, by its nature, unidirectional only and that the data source has no means to know the receiver's state. This is why an interface device, at the input of the network handler, works as a fictive receiver and avoids saturation of the terminal devices.

Transmission System

Data from a source are available at the digital junction as 8-bit bytes. This information stream is split into packets of no more than 32 bytes each.

An 8-byte "title" is added to every packet by the network handler. This title contains the following service information:

(1) a clock run for data receiver bit synchronization;

(2) framing code for byte synchronization;

(3) digital channel identification (i.e., source identification);

(4) packet sequence control code (the packets from a given source are numbered in sequence to detect a packet loss due to transmission errors); and

(5) fill-in code (number of effective bytes in a given packet).

The most important feature is the 3-byte channel identification allowing a large diversification of services; it permits open services with public access as well as closed services with scrambled or paid-access procedures.

The line structure of a television signal makes it possible to associate to each free line one packet to be broadcast. To do that, every bit is transmitted as a pulse, with a repetition rate of 397 times the line frequency in the European E, G, and L television standards. These pulses, in a nonreturn-to-zero (NRZ) modulation, are filtered to a raised cosine form so as to fit the television channel bandwith requirements.

With that rate, the packet occupies the active part of the television line. A packet can be time-multiplexed in the television signal by use of every black line. Thus, two situations can occur, depending on whether or not a program is being aired.

When the television signal carries a program, only the few lines of the field blanking interval are available. The bit-rate capability is, for European systems, 50 packets/s per used line, in other words 12.8 kb/s per used line. When no program is on the air, all lines may be used except those for vertical sync. A total bit rate of 4 Mb/s can be shared between all services. In June 1977 at the Montreux exhibition, a presentation was made in the U.S. M/NTSC standard, leading to a rate of 9 kb/s per used line in the 4.2-MH_2 bandwidth.

Implementation of New Services Using the DIDON Network

General

Three new services using the capabilities of the data broadcasting network have so far been experimented with at the CCETT; two are program-related, the other can be program-related or not.

The two program-related services are, respectively, a service for automatic recording of preselected programs, and a scrambled television service used, for instance, in a pay-TV structure. The third has become known as the teletext system and is intended for displaying alphanumeric or graphic pages on a television screen.

The EPEOS System

For various reasons, most European countries use their television transmitters under conditions different from those in the USA. It appears that in Europe the network is underemployed. Moreover, many programs are missed by a potential part of their audience because of time constraints. In another area the market of consumer videotape recorders is not developing because of a lack of available software and because of the constraints of delivery pro-

cedures. All these remarks lead to the idea that the recording techniques could be used more efficiently if delivery concerns only the software itself and not the associated recording tape.

An identification label is transmitted with every program in a particular channel of the DIDON network using the blanking interval free lines. With this label are associated codes for the remote control of a tape recorder. The user with keypad can record in a memory a list of up to fifteen labels. When one of these labels is broadcast, just before the associated program starts, the digital device used to receive this service sets the recorder on. Special codes are then transmitted for recording, for program interrupt if any, for end of interrupt, and for program end. Every preselected program is recorded with a footage, associated in the memory with the identification label. On playback, the user can call a given program: if it has been received, the footage recorded on a special track of the tape enables its automatic search to the desired playback. The French acronym "EPEOS" is used to signify this service for automatic recording of preselected programs.[5]

This service can be useful for the general public. It can also upgrade the efficiency of educational programs. It can be used for automatic mailing of special programs for particular segments of the public, such as businessmen and doctors.

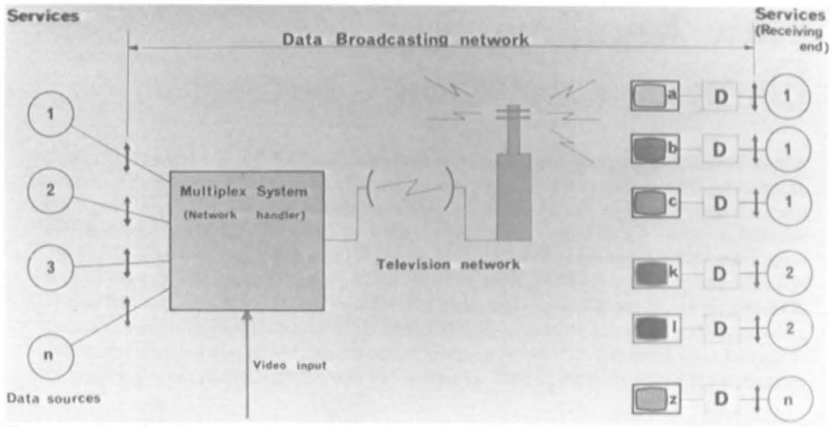

Fig. 1. Data broadcasting network.

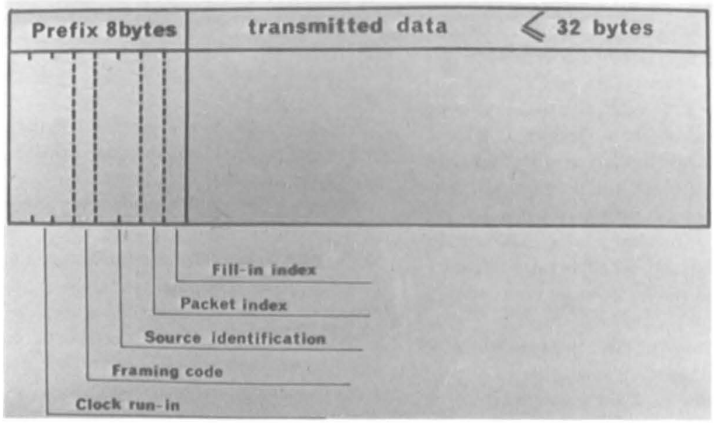

Fig. 2. Content of a data packet.

The Scrambled Television Service (Discrete System)

Alone or associated with the one previously outlined, the "Discret" system television service[6] makes it possible to select the part of the public that is interested in the reception of a given program. Various criteria for this selection are possible: payment of a subscription for pay TV or association, with one or another professional or economic or political group.

The television signal is scrambled by inverting and shifting some of the TV lines under the control of a pseudorandom generator. Reconstruction of the original picture is not possible for those who do not know the real structure of the generator and the value of a synchronizing "word" which sets up the generator at the beginning of every frame. These elements are the key for unscrambling.

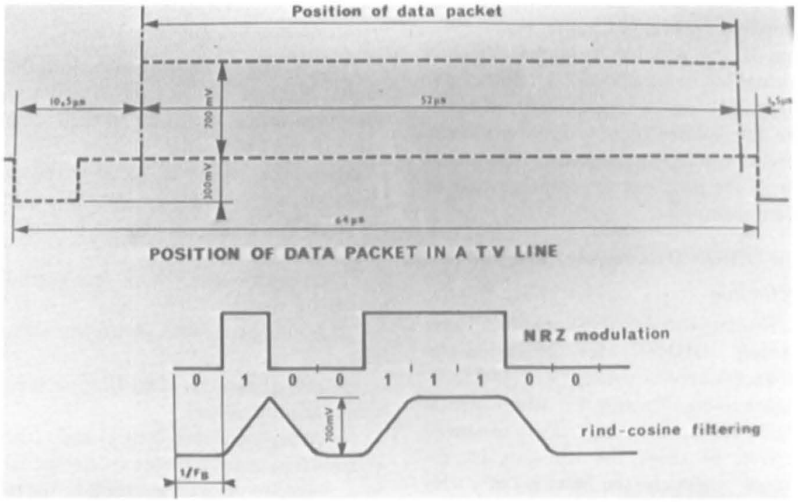

Fig. 3. Modulation standards.

Some of the key elements are to be found in the hardware—a small printed-circuit board that constitutes a read-only-memory (ROM). Others are transmitted as data packets. Comparison between the data from both these sources as well as with some built-in characteristics of the decoder make possible, first, the configuring of a programmable pseudorandom generator to be identical with that of the emitting side, and second, the phasing of these two generators to make them start in phase at the beginning of each frame. Line frequency shift keeps them in phase if, and only if, they have the same structure.

The problems that have not been completely solved are related to sound scrambling. However first-generation scrambling and unscrambling units were used for an experiment held in Clermont Ferrand early in 1977. Many cinemas and theaters equipped with large-screen projectors received and decoded scrambled television programs from one transmitter while pri-

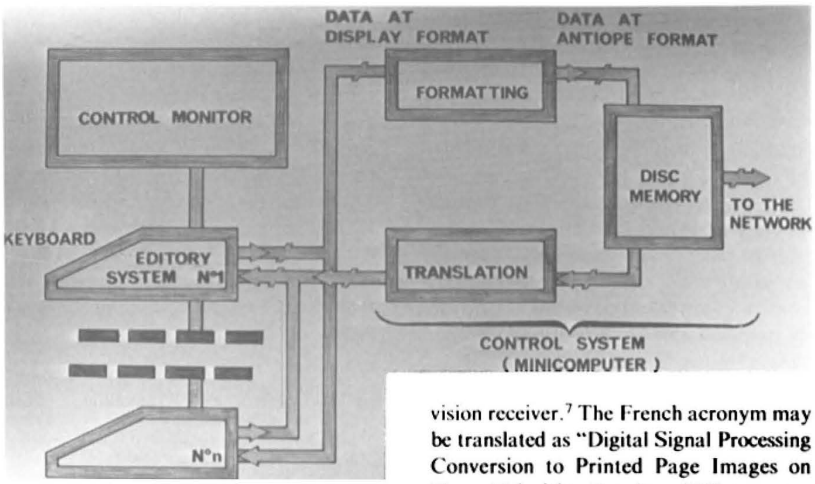

Fig. 4. Teletext editing system.

vate receivers could not unscramble the received signal. Thousands of spectators in various categories were invited to these showings and the experiment could be extended in the near future.

The Teletext Service (ANTIOPE)

ANTIOPE Teletext is the name of a new broadcasting service that involves broadcasting of text pages for them to be displayed on the screen of a domestic television receiver.[7] The French acronym may be translated as "Digital Signal Processing Conversion to Printed Page Images on Home Television Receivers." These pages are organized as "magazines" for education, entertainment or information purposes. This service can be fully independent from the usual television service. However, when the data supporting the teletext are broadcast while a normal program is on, some of the pages might be used to subtitle the program itself.

The display characteristics of the service depend on the properties of the television tube and their choice has been made according to the data obtained about those properties.[8]

We may sum up the main characteristics of the system as follows:

Every digital channel may transmit a magazine of up to 999 pages. Each page can contain 24 lines of 40 characters each, plus a one-line title, for service information. This title may be displayed or not. A character may be alphanumeric or graphic, colored on a black background or black on a colored background, with any one of seven possible colors (white, blue, green, red, cyan, yellow or magenta). The character in any one of four possible sizes, can be flashing or steady. The system has multialphabet capabilities which makes it possible to write some pages in French or English and others in Russian or Arabic.

Editing System. The pages of the magazine are written with a special keyboard and kept in a refresh memory to permit continuous display on the screen of the control monitor.

In the memory, every character is represented by a 16 bit word (7 bits for the character code in an extended ASCII set, and the remaining 9 bits for display functions such as color, graphics, and steady vs flashing display).

A computer translates these data into a byte stream, according to a programming language — ANTIOPE that is compatible with the international standards for data

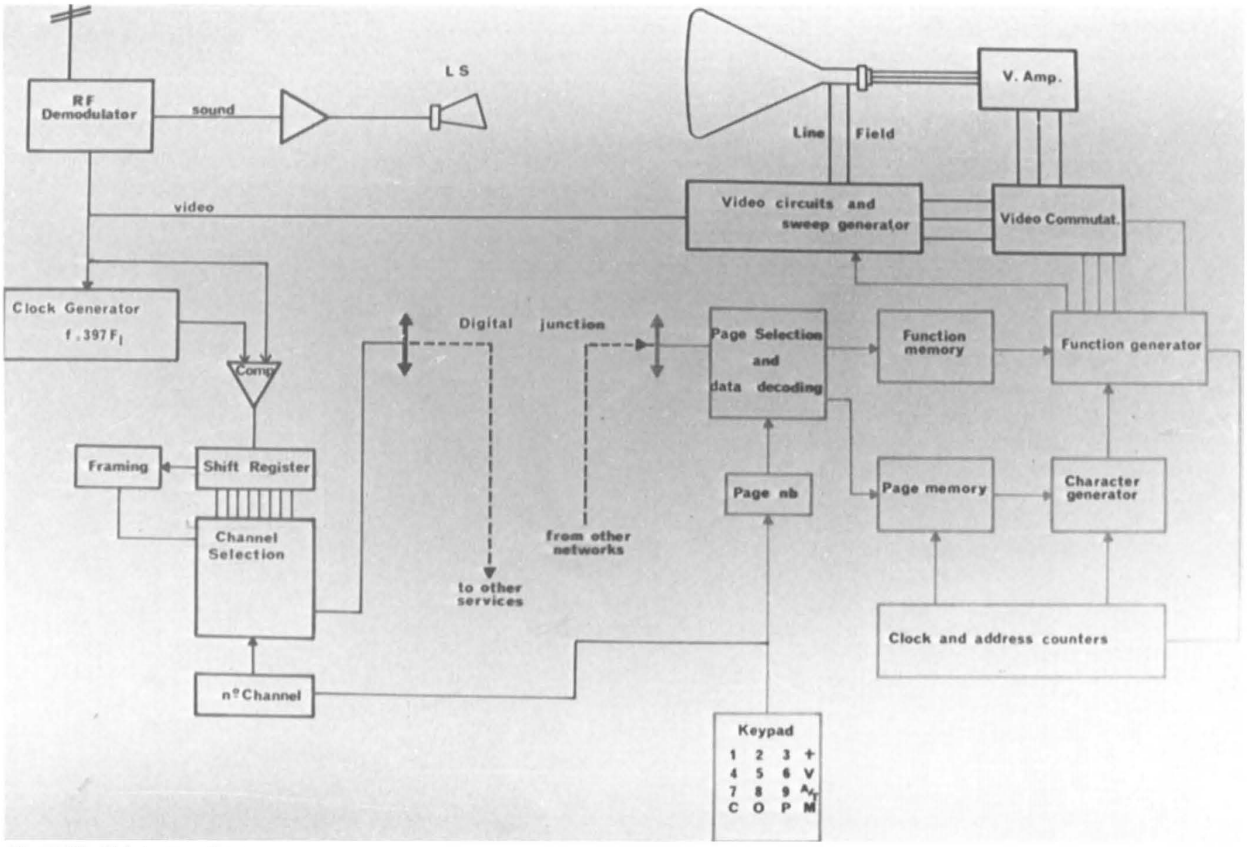

Fig. 5. The Teletext receiver.

communication between digital equipments. Color functions, graphics, etc. that are not implemented on usual line printers are transmitted by use of standardized sequences of two characters called "escape sequences." The translated page is then stored on a magnetic disc which contains the whole magazine. The computer reads out the disc file and sends its contents to the multiplexing device of DIDON (or any other network) via an appropriate modem). When necessary, the page can be called back in the editing system and corrected or updated before it is sent back to be broadcast.

The Receiving Set. The user has a modified television receiver that gets RGB signals from a teletext decoder

With the keypad that is associated with the decoder and employing the data receiver and the television receiver (for remote control) the user selects the number of the chosen data channel on which the desired magazine is transmitted. The data receiver excludes all the packets having addresses different from the one entered, and the title of every packet kept. The decoder receives only the data concerning the chosen magazine.

The user may then dial the pages he wants to receive. The decoder keeps the data having a page title corresponding to the page number dialed. It translates from ANTIOPE language to 16-bit words and fills in its refresh memory, which drives the character and special-effects generators for displaying the text on the screen.

When the teletext magazines are time-division multiplexed with an ordinary program, the available bit rate allows a page rate of roughly 50 per minute on each used line. Thus, it is possible to broadcast some magazines with only a few pages in each in order to limit access time. In addition to broadcasting the pages repeatedly at set intervals, it is possible to broadcast special pages to display news flashes superimposed on the television program. When the user requests a news-flash page, it appears only if something new has happened, and it disappears at the user's request. One or more subtitle pages, in any of several languages, related to the program being broadcast may also be added to the magazines.

Use of the whole channel for data broadcasting (without multiplexing) make subtitles and news flashes impossible, but the maximum page rate of roughly 20,000 pages per minute allows many more complete magazines to be broadcast.

Conclusion

Here we have described the implementation of new services on a television broadcasting network. It is clear, however, that they can be used very well (and perhaps sooner) on cable-television networks. The services which have been described are not the only ones that could be implemented on television networks by use of the data broadcasting system. Others are under investigation in the CCETT laboratories, and some are of great interest even at a very early stage in their development. Among these, we may mention the systems for analog still-picture broadcasting, the systems for graphical communication, the use of fast telefax for broadcasting newspapers. The next few years will see experimentation with these future services, while those we have described in this paper will be already in service.

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