Japanese VIDEOTEX System "CAPTAIN"—Experimental Service and User Reactions Outline

SUSUMU HARASHIMA, TAKAO KUMAMOTO, AND TADASHI KITAMURA

Abstract—**The CAPTAIN [1] system is a VIDEOTEX system in Japan. Existing telephone lines are used for transmission and home TV sets are used for the display units. The first experimental service (with 1000 user terminals, 199 information providers, and 100 000 display frames) was carried out from December 1979 to March 1981 by the Ministry of Posts and Telecommunications and the Nippon Telegraph and Telephone Public Corporation.**

Based on surveys carried out to obtain opinions on the system, the first experimental system was improved and the second experimental service (with 2000 user terminals, 200 000 display frames) was started in August 1981.

The system uses the pattern transmission method so as to display pictures precisely. This method transmits dot pattern information intact between a center and home terminals, allowing the system to display not only handwritten pictures but also complex shaped characters, such as Kanji (Chinese ideograph) characters, Arabic characters, Korean syllabary, etc.

According to a questionnaire sent to users, many want to utilize this system when the commercial service starts. Display attractiveness is evaluated highly by these users, verifying the effectiveness of the pattern transmission method.

This paper describes:

- **experimental service outline**
- **system functions and new techniques for this system (especially display characteristics and transmission method)**
- **user reactions to this system.**

I. INTRODUCTION

MASS communication media, such as television, radio, newspapers, and magazines, have developed remarkably. However, these media are not sufficient because people cannot always obtain the desired information when they want it. A new image information service, called VIDEOTEX, has been developing all over the world.

CAPTAIN, developed under the auspices of the Ministry of Posts and Telecommunications (MPT) and the Nippon Telegraph and Telephone Public Corporation (NTT), is a VIDEOTEX system now furnishing experimental service in Japan. This service is a social experiment to ascertain whether or not this new medium is acceptable to society. The experimental service is planned to continue until 1982.

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S. Harashima and T. Kitamura are with the Visual Communications Division, Engineering Bureau, Nippon Telegraph and Telephone Public Corporation, Tokyo, 100, Japan.

T. Kumamoto is with the Engineering Research Division, Tokyo Telecommunications Bureau, Nippon Telegraph and Telephone Public Corporation, Tokyo, 100, Japan.

[1] Character And Pattern Telephone Access Information Network system.

In a technical sense, many new methods, such as the pattern transmission method, are provided in order to increase graphic capability.

II. CAPTAIN SYSTEM AIM AND CHARACTERISTICS

A. Aim of This System

Recently, people have become eager for a new medium which is easy to use and which enables them to obtain desired information when they want it. The growth of the new medium using image information is highly expected, because a picture can provide more information immediately than several pages of written text and image information provided on a TV screen is very familiar to the public.

However, as installation investment for a completely new wide-band transmission network would be very expensive, it is difficult to provide an inexpensive image information service to the public by this means. Therefore, CAPTAIN uses the existing telephone network (with 50 million telephones) for the transmission lines and home TV sets (in more than 90 percent of Japanese homes) for the display units [1].

MPT is concerned with the overall policy making on this system and NTT is responsible for design and implementation of this system. The CAPTAIN System Research and Development Center, established in February 1979, operates the system and coordinates with information providers and monitors.

Image information for experimental service is supplied by 199 information providers (see Table I). The Association of CAPTAIN Experimental Information Providers is organized as a voluntary organization. Study on ways and means to provide information both smoothly and effectively, as well as discussion on problems peculiar to the provision of information, are also objectives of this association.

B. System Characteristics

Generally, character information is stored in coded format in the information center. It is necessary to convert from code format to pattern format using a character generator to display the character.

Consequently, there are two methods to transmit and display a character. They are:

a) code transmission method, which transmits character codes between the center and user terminals, and

b) pattern transmission method, which transmits dot pattern information intact between the center and user terminals.

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TABLE I
INFORMATION PROVIDER LIST

Category	Numbers
Newspaper	25
Publishers	37
Advertisers	26
Department Stores	22
Transportation & Traveling	23
Broadcasters	9
Others	57
TOTAL	199

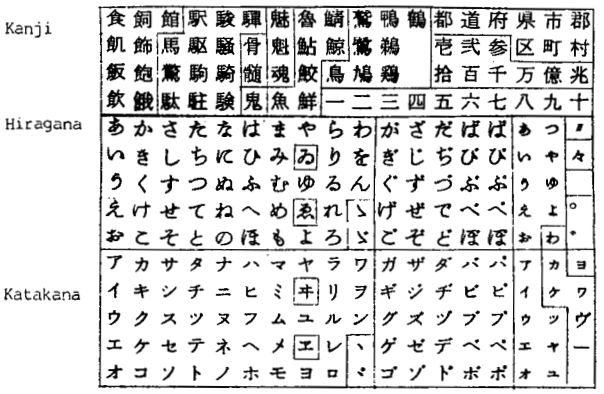


Fig. 1. Example of Kanji, Katakana, and Hiragana.

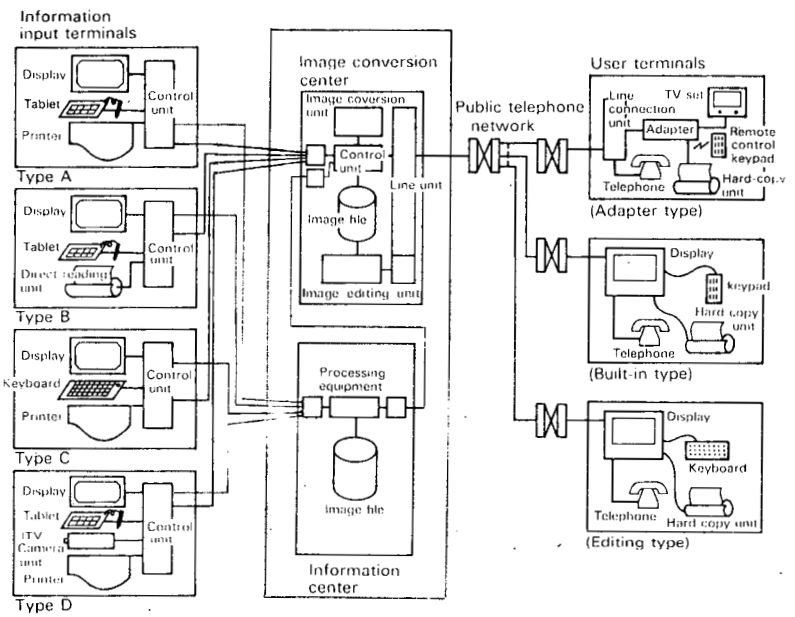


Fig. 2. Experimental system configuration.

The pattern transmission method can be used to transmit both character and graphic images. Graphic information can be transmitted using mosaic symbols with the code transmission method. However, graphic capability is limited by the precision of the mosaic symbol.

In the CAPTAIN system, it was intended to develop an enhanced display function in order to be able to display a picture precisely. Therefore, the pattern transmission method was adopted with the character generator placed in the center. Since in Japan, many different kinds of Kanji (Chinese ideograph) characters are in common use in the Japanese written language and each shape is complex (see Fig. 1), the character generator is too large and expensive to set up into each terminal. Therefore, the pattern transmission method is very useful for reducing terminal costs.

III. EXPERIMENTAL SYSTEM CONFIGURATION

The experimental system is composed of the center, information input terminals (IT), user terminals, and telephone lines as shown in Fig. 2.

The center is composed of the image conversion center and the information center. The function assignment of each center is shown below.

- Information center—Retrieval and update function of image information.
- Image conversion center—
  - User terminal control function
  - Code/pattern conversion function
  - Editing function
  - Retrieval and update function of image information.

An information input termianl (IT) is used in order to input and edit the image information. That information is sent to the center for storage using a 2400 bit/s transmission line.

Four kinds of IT (IT-*A*, IT-*B*, IT-*C*, and IT-*D*) were developed so as to input not only handwritten pictures but also Kanji (Chinese ideographs), Hiragana, and Katakana (vowel and consonant combination symbols). According to the characteristics of the input information, the most suitable terminal can be chosen. An IT is located in the center and used by all of the information providers.

IT-*A* and IT-*C* are suitable for input of character information. In the case of the IT-*A*, Kanji, Katakana, and Hiragana are input directly from a tablet. The tablet is a small board upon which Kanji, Katakana, Hiragana, and mosaic pattern pieces are arranged. In the case of the IT-*C*, Kanji is input indirectly by a Katakana keyboard. The Katakana character string is converted into a Kanji character string by what is generally called the "Kana-Kanji conversion method."

IT-*B* and IT-*D* have both an input function using the tablet and a direct input function for handwritten pictures. The IT-*B* input function is based on facsimile principles while the IT-*D* uses an ITV camera (with 384 dots vertically by 496 for a screen). IT-*D* can vary the size of the handwritten picture by the ITV camera.

The IT-*B* and IT-*D* directly read the handwritten picture with 8 scanning lines/mm (for IT-*B*) and 4 scanning lines/mm (for IT-*D*). The obtained source information is converted into the image information suitable for displaying on the screen and also compressed on run-length coding.

There are three types of user terminals—the adapter, the built-in, and the editing units. The adapter and the built-in units are used to retrieve information. The keypad with about 60 buttons (alphanumeric, Kana, and function buttons) is installed. The editing unit is used both to input and to retrieve information. A Kanji character input function, an editing function, and a coloring function are necessary for creating the display frame format images. The center provides all of these functions while the editing unit only transmits a Katakana character string and function codes necessary for editing. The Kana-Kanji conversion function is installed in the center for Kanji character input. This editing unit is inexpensive enough so that it can be put in each information provider's office.

IV. DISPLAY CHARACTERISTICS

A. Display Frame and Character Set

The number of scanning lines available for the display is about 400 from the displayable range with the television set using the NTSC standard. With this, 204 vertical dots by 240 horizontal dots of information are displayed on a TV display frame to make the intensity of the image element half that of the line [2].

The maximum number of Kanji characters readily readable is eight rows of 15 written characters on the screen of a home television set. This is because the shape of the Kanji character is more complex than Kana (Katakana and Hiragana) or alphanumerics. Kana and alphanumerics can be displayed in one half or one quarter the space otherwise required for a Kanji character. The standard size block consists of 24 vertical dots by 16 horizontal dots, and a reduced size subblock consists of 12 vertical by 8 horizontal dots. A frame consists of 31 by 17 subblocks as shown in Fig. 3. The uppermost row of the subblocks displays a page number or an information provider's name and is named the header section. The rightmost subblocks are for punctuation symbols only. Three character sizes, standard, medium, and small, are used in this system. A standard-sized character, mainly used for Kanji, is arranged so

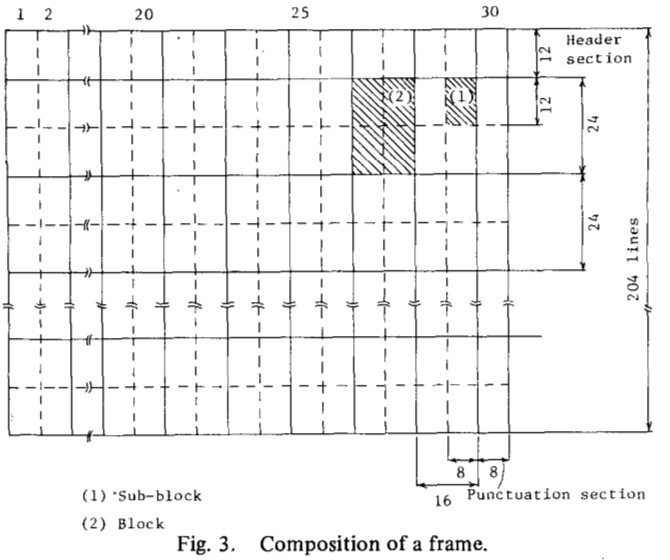


Fig. 3. Composition of a frame.

that it occupies one block. A medium-sized character occupies two subblocks and a small-sized character, mainly used for alphanumerics, occupies one subblock (See Table II). Therefore, a television display frame can contain a maximum of 120 standard-sized characters (8 rows of 15 characters) or 480 small-sized characters (16 rows of 30 characters). These characters can also be mixed, the average numbering 180.

A 186 mosaic symbol set, as defined in Fig. 4, is employed to achieve a graphic capability. The size of a mosaic symbol corresponds to the size of one subblock and is bigger than that of Prestel [3].

B. Coloring Function

Available colors are white, yellow, cyan, green, magenta, red, blue, and black. The smallest element in coloring is a subblock and an independent coloring capability for foreground and background in a subblock is available. The rasterground color can be chosen from eight available colors, and brightness of the rasterground color is lower than that of the foreground and the background so as to produce higher quality images and to give higher contrast.

The system is also provided with a flashing function in order to attract user attention. There are two flashing phases and two flashing colors, so four kinds of flashing can be selected for each subblock. Characters or patterns can be flashed anywhere in a designated section on a screen.

C. Display Methods

The display methods are broadly divided into frame and scroll categories (see Fig. 5). Images are stationary in the frame display, whereas they move upward at a constant rate in the scroll display. The frame display is subdivided into two categories:

- the line-by line display method—characters are shown successively from the top to the bottom line, and
- the character-by-character display method—characters are shown successively from left to right, one character after another in a row.

TABLE II
OUTLINE OF CHARACTER AND MOSAIC SYMBOLS

Size of Character	Number of Dots Allocated	Character Category	Available Number of Characters or Patterns
Standard-Size	18 dots vertically by 15	Chinese character	2,987
		Alphanumeric character, Kana character and mark	566
		Special symbols including weather symbols	4
Medium-Size	11 by 7	Alphanumeric character, Kana character and mark	356
Small-Size	9 by 7	Alphanumeric character, Kana character and mark	230
Mosaic Symbols	12 by 8	For graphs and patterns	186

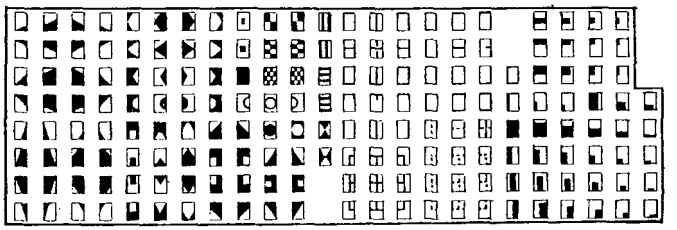


Fig. 4. Mosaic symbol set.

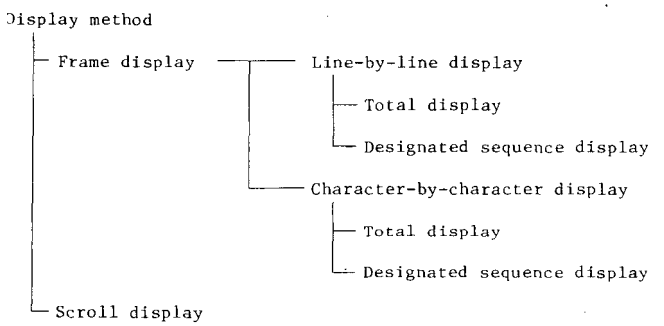


Fig. 5. Display methods available in this system.

In each of the above subdivided methods, images can be displayed either in an orderly manner from the top to the bottom (the total display) or from any row following a display sequence that can be freely designated (the designated sequence display). The display sequence can be optionally changed by providing each image with information of display position and by altering the transmission sequence accordingly.

Continuous display function is installed to improve user operation. When the entry frame is accessed, an arbitrary number of frames are automatically displayed according to the predefined sequence. There are no constraints for the entry frame.

The information providers can select the most suitable display method to convey the information.

V. TRANSMISSION METHOD

The data are transmitted between the center and user terminals and between the center and information input terminal. The basic transmission procedure is applied between the center and the IT. Between the center and user terminals, the packet transmission method is implemented in order to transmit the pattern data and obtain high transmission speed. Handwritten pictures can be transmitted easily using the packet transmission method.

In the code transmission system, such as Prestel, the time for composing a frame is shorter than the pattern transmission system, but handwritten pictures cannot be displayed. In the case of Telidon, the picture description instructions (PDI) are transmitted from the center to the terminal. The graphic capability is very high but the terminal cost with a PDI decoder is probably expensive compared with the Prestel's or the CAPTAIN's terminal cost.

A. Transmission Method from Center to User Terminals

1) *Transmission Format:* Images are transmitted from the center to user terminals in packets together with flags that indicate the start or end of a packet. Fig. 6 shows packet categories and formats.

An image control packet, sent at the head of any information packets, carries basic and overall information such as the display method and rasterground color for defining a display frame.

A color information packet carries coloring information of 31 subblocks in subblocks (specified color and the length of the color). The coloring information is compressed when the same color continues.

A cursor control packet carries the cursor address necessary for editing type user terminals.

A horizontally scanned pattern packet transmits the pattern information to be displayed in line-by-line and scroll methods, while a horizontally scanned compressed pattern packet transmits the pattern data that are coded in lines into one-dimensional runlength codes when they are displayed in the line-by-line method.

A character-by-character display pattern packet for medium-sized characters transmits pattern information made of one medium-sized character for character-by-character display. The number of dots transmitted is 18 vertically by 8 horizontally. A standard-sized character is sent in two packets.

A character-by-character display pattern packet for small-sized characters is concerned with pattern information consisting of small-sized characters and/or mosaic symbols for the

Packet Category	Byte Sequence / Size	1	2	3	4	5	6	
Image Control Packet	6 B	Identification code (*1)	Display mode	Raster ground color (*2)	Raster ground color (*3)	Flashing color	Spare	
Color Compressed Information Packet	34 B maximum	Identification code	Display position (*4)		Specified color 0	Length of the color		
Cursor Packet	8 B	Identification code	Mode	Display position			Spare	
Horizontally-Scanned Pattern Packet	34 B	Identification code	Display position		Pattern data (248 dots)			
Horizontally-Scanned Compressed Pattern Packet	34 B maximum	Identification code	Display position		Compressed pattern date			
Character-by-character Disply Pattern Packet (Medium-Sized Character)	21 B	Identification code	Display position		Pattern data (8 dots by 18)			
Character-by-character Display Pattern Packet (Small-Sized Character)	28 B	Identification code	Display position		Pattern data (16 dots by 12)			

(*1): shows packet category (*2): for display frame (*3): for header section (*4) shows display position

Fig. 6. Packet format.

TABLE III
PACKET SEQUENCE FOR CHARACTER-BY-CHARACTER DISPLAY METHOD

Display Category	Packet	Display Sequence	Remarks
(A)	MP_1 AD A_1 . . . A_{36} MP_2 AD B_1 . . . B_{36}	8: $A_1 \rightarrow A_{19} \rightarrow A_{36} \rightarrow$; 8: $B_1 \rightarrow B_{19} \rightarrow B_{36} \rightarrow$ standard sized char.	MP :Character-by-character display pattern packet (Medium-sized character) AD :Address A :Four bits string B : " C : " D : " → :Display direction Small numeric means the number of dots.
(B)	MP_1 AD C_1 . . . C_{36}	8: $C_1 \rightarrow C_{19} \rightarrow C_{36} \rightarrow$ medium sized char.	
(C)	SP_1 AD D_1 . . . D_{48}	4 4 4 4: $D_1 \rightarrow$ $D_2 \rightarrow$ $D_{48} \rightarrow$ small sized char.	SP :Character-by-character display pattern packet (Small sized character)

(A):Character-by-character display of standard-sized character
(B):Character-by-character display of medium-sized character
(C):Character-by-character display of small-sized character

character-by-character display. The number of dots is 12 vertically by 16 horizontally (sufficient for two subblocks).

An example of transmission by character-by-character display pattern packet is shown in Table III.

2) *Transmission Procedures:* Specific transmission procedures are not fixed. This is due to the relatively large allowance for transmission errors as one of the major characteristics of the pattern transmission system. A system free of any specific transmission procedure, however, cannot remedy errors in coded information, such as the packet identification code, image control information, color information, and information for display position, which are included in image information transmitted by the pattern transmission method. For this reason, Hamming check bits are provided to correct one-bit error and to detect two-bit errors in coded information.

In the pattern transmission, a bit configuration sharing common arrangement with that for a flag pattern appears in the pattern data and may be erroneously processed. So, a bit is processed by a procedure similar to that used in the HDLC procedure.

3) *Improvement in Transmission Speed:* Vestigial sideband, two-phase differential phase modulation (two-phase PM-VSB) is used as a modulation/demodulation method in order to secure stable and high-speed image transmission through the public telephone network. A phase modulation/demodulation method is desirable for services with widely varying amplitude characteristics. Image transmission has been carried out at 3200 bits/s. The error rate with pseudorandom codes is about 10^{-6} at 17 dB S/N ratio. This arrangement allows phase equalization equivalent to one transportation link at the demodulation side.

4) *Redundancy Reduction:* The time required to form a frame is shortened by the compression of redundancy involved in pattern data and also by coding the data into one-dimensional runlength codes. The amount of transmission data can be cut in half with the following method. As the result, the time required for forming a frame is less than 10 s on the average.

a) Pattern data are reduced into a one-dimensional runlength code, and judgment is made for each line as to whether a packet length can be shortened by compression or not.

b) The packet is not transmitted for a space between lines (in the case of a line-by-line display) and an empty space (in the case of a character-by-character display).

c) In compressed pattern transmission, the final run of the runs composing one line is not transmitted, and the run is produced when a terminal receives the end flag, in order to improve the compression effects.

Moreover, if new images can be recomposed by partially modifying those which are already displayed, modified parts only are transmitted. Identification codes are applied beforehand to parts that should not be converted.

B. Transmission Method from User Terminals to the Center

In order to transmit requests from users, a 75 bit/s reverse channel is provided using the FSK method, thus permitting full duplex transmission. A transmission error can be detected by the parity check bit. Error messages are sent from the center when the parity check detects error.

VI. IMAGE CONVERSION CENTER CONFIGURATION AND NETWORK ARCHITECTURE

A. Image Conversion Center Configuration

The image conversion center is composed of the main control unit, image conversion unit, line control unit, and image editing unit. The precise configuration of units for a user terminal input-output control function is shown in Fig. 7.

An input signal from a user terminal (retrieval request) is separated by the modem and transmitted into the main control unit (MCU) by way of the communication control unit (CCU). The necessary functions for output of the obtained

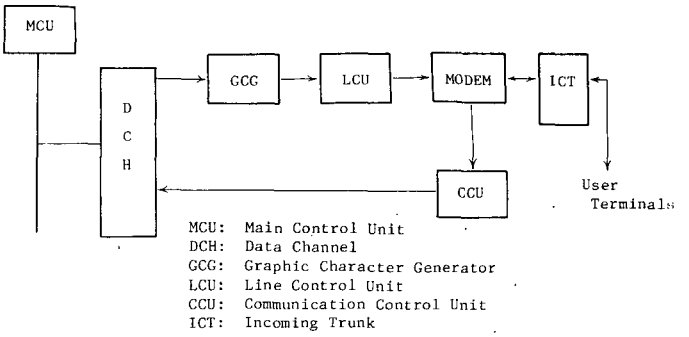


Fig. 7. Configuration of the units for user terminal input-output control function.

information based on retrieval requests are shown below:

1) code/pattern conversion
2) data compression, packet assembling of pattern information, and check bit padding.

As data compression, packet assembling, and check bit padding are especially simple and repeating processes, function 2) is suitable for a microprocessor, and can be obtained inexpensively. Thus, function distribution using the microprocessor is very effective both for reduction of MCU process power and total cost of the center. Therefore, a microprocessor is installed line by line for the line control unit (LCU) with function 2). The MCU transmits a string of coded information and the pattern information corresponding to handwritten pictures into the graphic character generator (GCG). First, the GCG converts the string into pattern information and then merges converted pattern data with the pattern data corresponding to handwritten pictures. The obtained pattern data and control data necessary for assembling the packet (character size, color, etc.) are transmitted into the LCU. The LCU converts the data into the packet. The main functions of the LCU are shown below:

- packet assembling
- data compression (one-dimensional runlength codes method)
- frame synchronizing signal transmission
- padding of Hamming check bits and parity check bits
- scrambling of pattern data.

B. Network Architecture

The function model (from a network standpoint) of ths experimental system is shown in Fig. 8. There are two retrieving and storing functions ($F1$ and $F2$ in Fig. 8). The image information controlled by $F1$ and $F2$ is independent. There is no redundancy in the information. All of the user's retrieval request is analyzed and the selection of F is done by the user terminal control and code/pattern conversion function (C in Fig. 8, C-center). This architecture is different from Prestel's [4]. The file cost is less expensive than Prestel because each retrieving and storing function controls different information and it is easy to connect the CAPTAIN network to another information center. The reduction of file cost has been furthered by the development of large capacity disks such as the

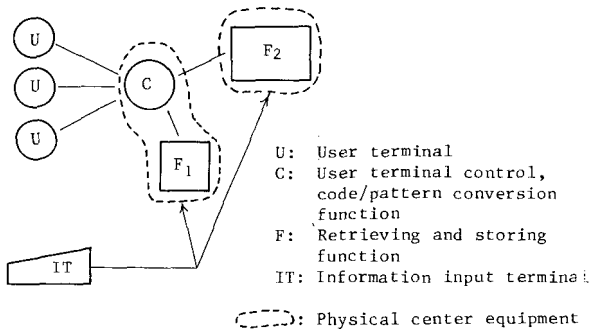


Fig. 8. Model of the experimental system.

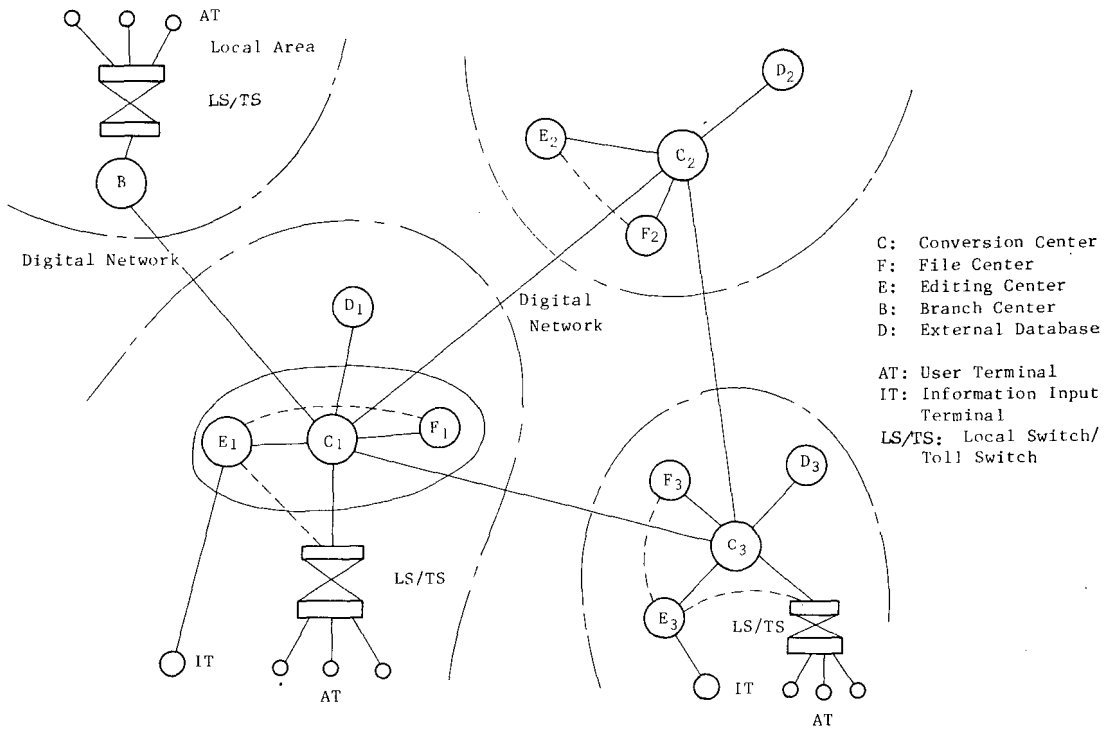


Fig. 9. One of the network architectures of the future.

400MB/800MB disk. On the other hand, construction of the digital transmission network is now in progress. So network architecture should be defined based on the transmission cost, file cost, updating times of data, and response time required.

In the future, the CAPTAIN network will be expanded to cover the country and many kinds of information will be provided by the way of the network. User terminals will be connected to the nearest C-center and will be able to have access to many kinds of information centers through the C-center. One of the CAPTAIN network architectures for the future is shown in Fig. 9.

VII. RESULT OF THE FIRST EXPERIMENTAL SERVICE AND USER REACTION

A. Service Time and System Reliability

The first experimental service started on Christmas Day, 1979. Service time originally was from 10 A.M. to 8 P.M., but was extended from 10 A.M. to 10 P.M. in February 1980. During the period from December 25, 1979 to March 15, 1981, total service time was 5258 h and service interruptions caused by system troubles occurred 34 times, totaling 472 min. The service availability ratio was 99.8 percent.

B. Stored Image Information

The first experimental system had the capacity to store 100 000 display frames. As of March 15, 1981, nearly 98 000 picture frames were stored in the center. Details of those frames are shown in Table IV. "Amusement and Hobbies" picture frames are referenced mostly often. The rate of handwritten picture frames out of all of the stored frames was increasing gradually from 7.9 percent (February 1980) to 15.2 percent (March 1981).

Fig. 10 shows the percentage of display method selected according the type of information accessed.

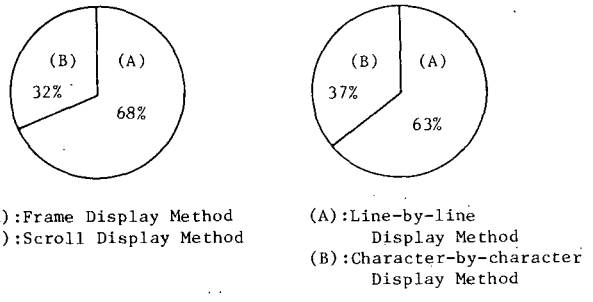
C. User's Behavior

1000 user terminals were planned for the Tokyo metropolitan area. They were classified into four categories: 700

TABLE IV
DETAILS OF STORED INFORMATION AND AVERAGE NUMBER OF UPDATING

Category	Number of information (frame) (1981.3)	Averave number of updating(*1) (1979.12-1981.3)
Index	1749	1.9
News & Weather Reports	5112	9.6
Public Information	6684	1.8
Health & Beauty	1692	1.7
Shopping Guides	4211	5.6
Cooking	5047	1.7
Housing & Real Estate	1740	5.1
Home Economics & Law	1850	1.3
General Knowledge for Living	8645	1.3
Education & Culture	14081	1.9
Sports	10488	4.0
Amusements & Hobbies	17600	3.4
Travel & Sight-seeing	7619	2.5
Business Information	8210	2.9
Information in English	436	5.8
Weekend Saloon	444	5.4
Town Guides	316	1.9
Sample	3020	1.1

(*1) The Number of Total Updating Frames / The Number of Stored Frames.



(A):Frame Display Method
(B):Scroll Display Method

(A):Line-by-line Display Method
(B):Character-by-character Display Method

Fig. 10. Display method used in the stored information.

terminals for residential use, 100 terminals for business, 150 terminals as information providers, and 50 terminals for system development and exhibition. Each subscriber only paid the telephone charge.

The average number of calls totals 0.72 per day for all user terminals. A residential subscriber makes 0.67 calls per week, on an average. Residential users can be clearly separated into two categories, based on the number of calls they make. 30 percent of the residential users make a call two or three times a week.

TABLE V
UTILIZATION MOTIVE OF THE SYSTEM

Utilization motive	Answer	
	the first	the second
Interest in a new media	59.8%	16.7%
To obtain the necessary information for daily life	24.0%	60.4%
Interest to use and to see	5.2%	17.1%
To be used to the operation of unit or selection of the information	5.5%	0.4%
Others	5.5%	5.3%

The total average call length is about 13.7 min. A residential user's average call length is about 12 min.

"Amusements and Hobbies," "Sports," and "News and Weather Reports" categories are accessed most frequently from residential user terminals.

D. User Reaction

Since the beginning of the trial service, several surveys were carried out in order to gather the opinions of monitors, information providers, and others. According to these surveys, the first experimental service was highly valued and 63 percent of the monitors thought that the commercial service would be possible within two or three years.

Two questionnaires for the trial users were filled out regarding technical and operating features. Various opinions were given by residential and business users. The main aim of business users appeared to be "to examine the applicability of this system," 59.7 percent of the users selecting this item on the questionnaire.

1) *Utilization Motive*—At the time of the first questionnaire, CAPTAIN use was motivated by interest in a new medium. However, when the second questionnaire was filled out, residential subscribers who utilized CAPTAIN for obtaining necessary information for daily life had increased. (See answers compiled in Table V.)

2) *Comments on Commercial Service*—Most of the trial users have shown interest in receiving commercial service. 52.6 percent of residential users and 55.1 percent of business users think that CAPTAIN will be applicable to their own requirements when the commercial service starts within two or three years.

Regarding the charges for the commercial service, 70.6 percent of the residential users want expenses to be less than 3000 yen a month (approximately U.S. $14). And 34.0 percent of the business users want expenses to be less than 5000 yen. 29.9 percent of the business users want expenses to be less than 10 000 yen. Business users can afford to pay higher charges than residential users, but they also want to use this system with cheaper charges compared with data communication terminal charges. 70 percent of the residential users

and 80 percent of the business users expect the price of the terminal equipment to be less than 50 000 yen (approximately U.S. $240).

VIII. CONCLUSION

The first experimental service has been operating successfully since December 1979. According to opinions of the users and information providers and the statistics on usage, the following factors are seen to be very important in starting commercial service.

1) *Connection to the External Computer System*—To increase the attractiveness of CAPTAIN service, it is very important to provide many kinds of services, such as seat reservation, banking, stock information, order entry, etc. The connection between the external computer system and the CAPTAIN system is an advantageous approach for the purpose. CAPTAIN will be able to connect with many external computer systems and grow from being merely an information retrieval service into a new image information medium.

2) *Information Enrichment*—There are more opinions about the information itself than opinions about the system function. Whether or not this new medium is acceptable to the society depends on the information quality provided. As a first step, it is necessary to research and collect a broad spectrum of information that users want to obtain. As a next step, an input method that is easy and inexpensive to use must be prepared. The input and editing methods for pictures are especially important.

3) *Improvement of the Information Input Terminal*—Two kinds of information input terminals are now used to input handwritten pictures. The average time necessary for the input of one handwritten picture is about 15 min.

It is necessary to develop a new information input terminal with higher input capability and better man-machine interface because many kinds of pictures must be input at a reasonable cost in commercial service. At the same time, reduction of equipment cost must be accomplished.

4) *Inexpensive Service Realization*—Charges for this new medium must be relatively cheap because the main aim in developing it is to provide a new interactive medium for both business users and the public. Reduction in terminal cost, center equipment cost, and information input cost must be accomplished.

The recent remarkable advances in LSI technology will contribute to reduction in terminal and center equipment cost. Reduction in operator cost for information input must be seriously considered to provide inexpensive information.

The second experimental service has enhanced many system functions and started in August 1981 and is scheduled to continue through 1982. Commercial service is scheduled to be launched in 1983. The design of the commercial system has already been started. Keeping abreast with this design, NTT will continue doing various surveys necessary for the commercial service and continue investigation and development on the following:

- hybrid (code and pattern) transmission
- connection to digital transmission line
- display of a more finely detailed picture
- simplified animation and telesoftware by command transmission.

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Susumu Harashima received the B.E.E. degree from Tohoku University, Sendai, Japan, in 1960.

Since his graduation, he has been working for Nippon Telegraph and Telephone Public Corporation (NTT), Tokyo, Japan. He was a Director of the Plant Engineering Divison in the Chugoku and Kyushu Telecommunications Bureaus and is now Director of the Visual Communications Division, Engineering Bureau. His recent interests are in VIDEOTEX, video communication systems, and facsimile communication systems.

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Takao Kumamoto graduated from Keio University, Tokyo, Japan, in 1964.

From 1971 to 1973 he was concerned with the planning of computer industry policy at the Ministry of International Trade and Industry. Up to 1978 he was engaged in developmental research on a data communication system at the Data Communication Bureau and the Yokosuka Electrical Communication Laboratory of Nippon Telegraph and Telephone Public Coporation (NTT), Tokyo. Up to February 1981, he was responsible for the planning and development of the CAPTAIN system at the Engineering Bureau of NTT. He is now a Director of the Engineering Research Bureau in the Tokyo Telecommunications Bureau of NTT.

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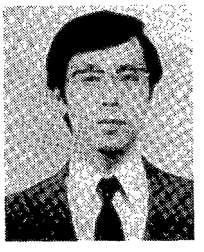

Tadashi Kitamura received the B.Eng. and M.Eng. degrees from Waseda University, Tokyo, Japan, in 1971 and 1973, respectively.

After receiving his degrees, he joined the Electrical Communication Laboratories of Nippon Telegraph and Telephone Public Corporation (NTT), Tokyo. He was concerned with the development of database management systems. Since 1980 he has been engaged in the development of the CAPTAIN system at the Engineering Bureau of NTT.