The real challenge of providing effective man-to-machine communications will culminate in man's home and his office. The future household will, in all probability, be a giant electric "appliance" that will be plugged into a nationwide communications network. The building blocks are available in the telephone and the television receiver. Today experimental information services for the home are in operation globally in test communities. They are based on two-way television. In the future, besides information retrieval, other more complex chores will be performed by specialized terminals that will combine microprocessors with conventional hardware. Laboratory systems being developed are based on a residential power center, the television receiver, and the telephone.

In the office, sophisticated tools need to be integrated into automated work stations. To meet that goal, both the manufacturer and the user of the equipment must chart the course. Methods of integration must be found in both hardware and software so there is easy access by man to machine in the "office of the future." Also, communication paths that facilitate access to equipment in other offices must be charted. As local nodes are built up and become self sufficient, they will become part of nationwide information networks. New equipment, in addition to changing the office environment, will cause upheavals in the organizational structure. As in the home, the availability of new services and novel systems will depend to a great extent on relaxed regulation by government agencies.

The wired household

Teletext services pave the way for a variety of useful monitoring and control features in the home

Information retrieval is not the only capability that advanced electronics can offer to households. Other, more complex chores can be performed by specialized terminals that combine microprocessors with relatively conventional hardware. Three experimental systems now in the laboratory would do the following in homes:

1. Control the use of electricity to avert overloading at utilities that can lead to blackouts.
2. Turn the television receiver into a programmable information/entertainment center.
3. Use the telephone at idle times for meter reading, alarm reporting, and the remote monitoring and control of lighting, heating, and air-conditioning.

Controlling power consumption automatically

When there is excess demand by consumers for power, utilities have no choice but to shed load to maintain system stability. For the householder, this generally means a period of intermittent or total blackout. Shaving these peak loads can reduce the frequency of such occurrences, conserve fuel, and reduce the need for expensive, inefficient peak-load generating equipment. Automatic load control can help achieve these goals.

In the experimental load-control and energy-management system in Fig. 1, the primary power circuit of the load center is divided into individual circuits connected to such loads as lights and appliances. These connections are controlled by commands either from the utility or the customer. Major loads like the water heater, a space heater, or air-conditioner can be turned off or on by the utility via a command carried by radio, telephone line, CATV cable or power line. These and other loads can also be controlled by customer use of a programmable device, manual controls or an adaptive control that prevents the total load from exceeding some limit.

E. Bryan Carne GTE Laboratories Inc.

The system may include a display. In its simplest form, this may be a signal lamp that lights on command from the utility to indicate that cycling of the major loads has begun, that all but essential loads should be shed or that a blackout is imminent. The display may also include a household demand meter that gives information on current load. More sophisticated units could give historical information and perform limited analysis of recent consumption. In areas where time-of-day pricing is employed, time would be an important input to the householder's programmer and display.

Wider use of TV receivers planned

In a television receiver, microprocessor and electronic actuation permit the random selection of channels. But new conveniences are in the offing:

The receiver can also be programmed to provide automatic reception of specific channels at specific times for viewing or recording. A sequence of instructions can be entered to insure that interesting programs are not missed throughout the week. Day, date, time, and channel number can be superimposed on the picture at will. What's more, simple messages can be composed, stored, retrieved, and displayed as a means of family communication. If a teletext service is available, signal decoding, page selection, and storage of additional information are possible. Graphics can be generated, and with the addition of joysticks, games can be played.

The degree of flexibility of such an information/entertainment center (Fig. 2) largely depends on the capability of the

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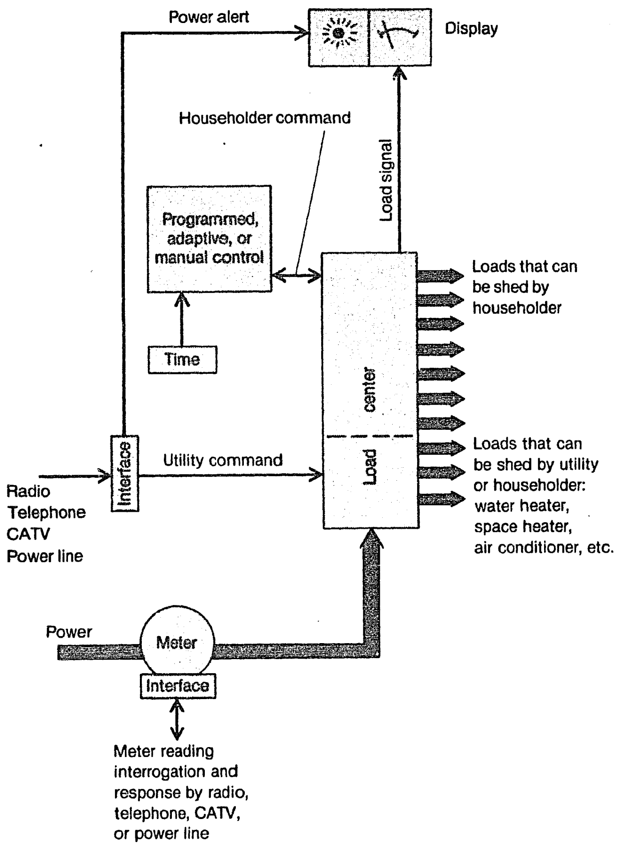
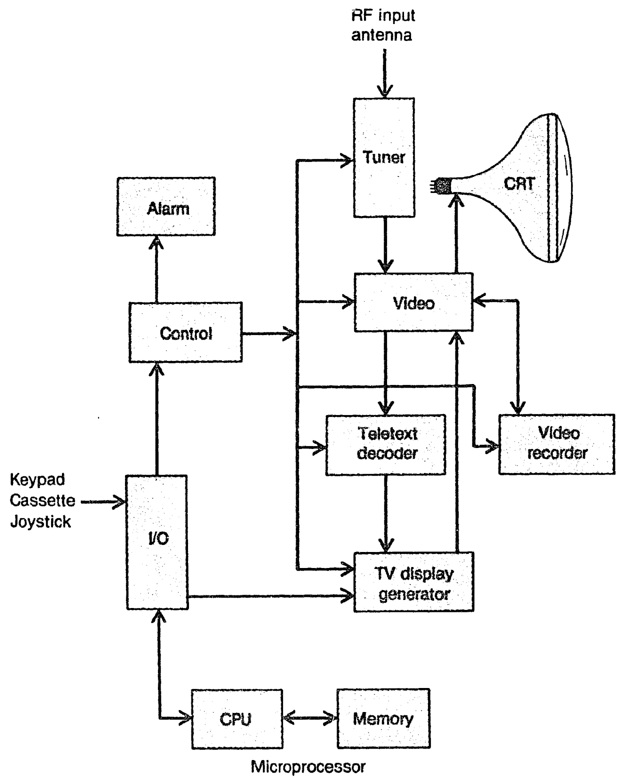




microprocessor. With the exception of teletext, which is already formatted, all other functions and displays can be constructed from information placed in memory.

For time-dependent control of the receiver functions, a programmable, nonvolatile memory stores the channel selections programmed by the viewer for automatic activation. An audible alarm indicates the receiver has been automatically turned on. In one experimental system, approximately 4000 bytes of memory are used to list preprogrammed channels, provide automatic activation, and display date, time, and channel number on demand.

More memory is needed for playing games. Sophisticated coding and presentations of limited complexity permit a color picture to be described in about 2000 bytes. Movement of the entire picture in a wrap-around mode can be achieved through scanning of a larger memory. Additional foreground memory or dedicated symbol hardware provide fast, smooth, complex motion. The detection of symbol-to-symbol and symbol-to-background collisions, required in many games, can be performed in hardware, which may also contain rules indicating which symbol shall dominate. New game programs can be loaded from a cassette or a different ROM module.

Using the phone to monitor the home

The average household uses the telephone circuit as a talking path only a small fraction of the day—perhaps 30 minutes. With additional electronics, the line can be used for new services.

With a system like the one in Fig. 3A, the customer could monitor the status of a household device by calling the home telephone. If no one was at home, the ringing would activate a message recorder. The customer would transmit a coded signal with the pushbuttons on the originating phone. Upon receipt of the correct coded signal, the recorder would generate a short acknowledgement tone. The recorder would then disconnect, and the equipment would be ready to receive codes from the customer to be turned on or off.

The input/output circuitry for such a system contains a ring detector, a tone detector, an A/D converter to digitize the signal tones for decoding in the microprocessor, and an answering tone generator. The microprocessor interprets the received signals, executes the appropriate functions, and sends the proper code to the answering tone generator.

Besides responding to a call, the system can also place calls in response to signals from alarms and can transmit data messages to answering points. Approximately 2000 bytes of memory are used in the experimental unit in Fig. 3B, which contains an information display and includes wired teletext.

Three fields hold key to progress

Developments like these will depend largely on continuing advances in three major areas: increased levels of integration

[1] In load control and energy management applications, a "smart" load center (top, left) receives a command from the utility or householder to manage the load. This may be done to contain peak demand or to minimize cost.

[2] With the addition of a microprocessor, input devices, control logic, and a display generator, a conventional television receiver (bottom, left) can be made to turn off and on at times determined by the householders. Or it can display information or be used to play games.

Teletext and viewdata—a primer

In the home of the future, teletext and viewdata information-retrieval systems are expected to be as common as TV entertainment is today. Teletext and viewdata are mediums for transmitting text and simple graphics to a television receiver. In both, the information is digitally encoded for transmission and is organized into pages.

In teletext, the digital code is included in a television signal and is cyclically repeated. The television receiver grabs the page of interest and stores it locally.

In viewdata, the digital code is modulated onto an audio-frequency carrier that is usually transmitted over a telephone channel. The terminal requests pages, which are sent individually and stored locally. Unlike teletext, viewdata is interactive.

Teletext signals are analog representations of digital bits inserted on two lines of the television receivers's vertical blanking signal. A threshold sensor device makes the transition from the analog television signal to the digital signal-handling circuits. The teletext data base is usually organized on a menu basis.

Teletext signals consist of a clock run-in burst, a framing code, a preamble, and an ASCII-like code. The viewdata signals are of an asynchronous nature, similar to teletype writer signals. They contain a start bit and a stop bit. Clock run-in and framing codes are unnecessary. The bits are modulated onto the audio-frequency carrier by use of frequency-shift-keying modulation techniques.

In teletext—because the data is coded onto normally unused lines of a television transmission—faults that would be tolerated for television may cause data-recovery problems. And because the number of unused lines is limited, the total data content is limited.

The viewdata decoder is connected to the user's telephone line and uses the public telephone network to transmit characters to and from the computerized data base. System capacity is limited only by physical restraints. Because individual connections are used, service can be personal.

Teletext evolved as an extension of British efforts to transmit captions to the deaf. Developed by the British Broadcasting Corp. in the early 70s, the system is in use on more than 50 000 sets in the United Kingdom. It is known as Ceefax on the two noncommercial BBC channels and as Oracle on the commercial channels. To view the service, a subscriber pushes 1-0-0 on a keypad, which produces an index of major headings, such as News, Weather, and Travel, Sports, Finance, and Entertainment. Sub-indexes give a specific number for particular subjects—for example, 1-2-6 calls up a stock-market report. Pushing another button restores the regular program to the screen.

Prestel is the trade name for the British Post Office's viewdata service—the first such public service. Last March the initial service was made available to London-based residential users. By the early 80s, the viewdata service will be offered to customers in Manchester and Birmingham, with over 60 percent of all telephone users having toll-free access to the service.

The Prestel data base is structured in free form. The user progresses down the tree by keying numbers alongside the information required from a handheld keypad. The same procedure—that of selecting one item from each frame—is repeated at each level until the required information is received. For example, the customer might select Travel and follow successive branches in the tree-structure search technique to obtain a listing of hotels in the city of his choice.

Any organization can become an information provider to Prestel for an initial charge of $500 plus $2 per page per year, with a minimum of 100 pages. Over 160 organizations have subscribed to the initial 185 000-frame capacity of Prestel. The index includes 1000 topics ranging from Accident Prevention to Yoga.

Ceefax, Oracle, and Prestel information is transmitted asynchronously in 8-bit ASCII code, decoded into 5 × 7 dot matrix elements, and displayed in color in 24 lines of 40 characters. In the broadcast systems, 6.9-Mb/s data is inserted on two lines per field. It may take up to 20 s after a request is made for a page to appear. In the wired system, data is sent to the subscriber at a rate of 1200 b/s. Requests from the subscriber are sent at a rate of 75 b/s. A page of information can be called up in a few seconds.

Countries conducting research and trials based on Prestel standards include; Sweden (Datavision), Finland (Telset), and Bell Canada (Vista). France is developing a similar viewdata system called Telitel (formerly Antiope), which uses somewhat different standards but has much in common with Prestel—data rate, for instance. The French teletext version, Didon, uses a nonsynchronous transmission scheme that is suited to all television formats. The British system uses a synchronous method in which character position on the screen is tied to a specific position in the television line used to broadcast the digital data.

Two developments differ markedly from Prestel. Japan's Captains system uses a central character generator to cope with the complexity of the Katakaha alphabet. In Canada, the Department of Communications has developed Telidon, an alphanumeric technique that provides high-resolution graphics displays. Characterized as a second-generation information retrieval system, Telidon incorporates a complex coding scheme that makes it possible to display photograph-like images as well as standard graphics and alphanumerics. Other improvements relate to economy of transmission and use with variable resolution terminals.

Several other countries—including West Germany, the Netherlands, Spain, and Switzerland, along with Hong Kong—are planning or testing national services based on one or another of these sytems.

In the United States, CBS is testing two teletext systems: the British Ceefax/Oracle and the French Antiope. Test transmissions are being conducted at KMOX-TV in St. Louis. The station is transmitting teletext on lines 15 and 16 of the television signal to produce a page comprising 20 lines, each of 32 characters.

In June 1978, KSL-TV in Salt Lake City became the first U.S. station to transmit teletext for test purposes. The system uses British standards (24 rows of 40 characters each) modified to the U.S. page of 20 lines of 32 characters each. The advertiser-sponsored service will permit the user to request a desired page by punching appropriate codes into a Touch-Tone phone. There will be no connection between telephone and receiver.

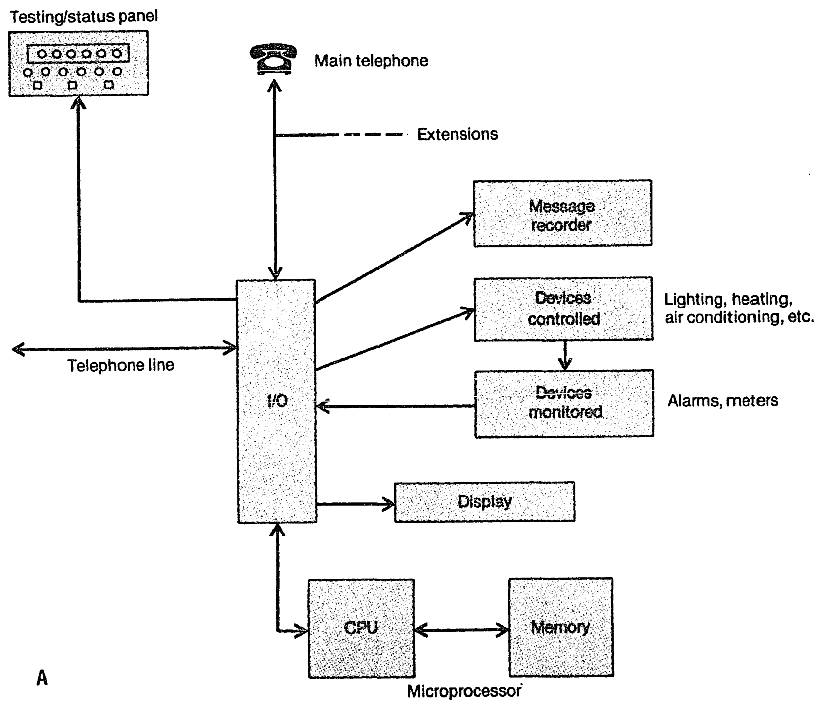
Oak Communications Inc., a CATV supplier in Crystal Lake, Ill., has developed a teletext system called Videotext that will allow cable operators to supply alphanumeric information to customers. And Micro-TV Inc. of Philadelphia is offering the Info-Text teletext system to send the news services of Reuters, United Press International, and the Associated Press to cable operators.

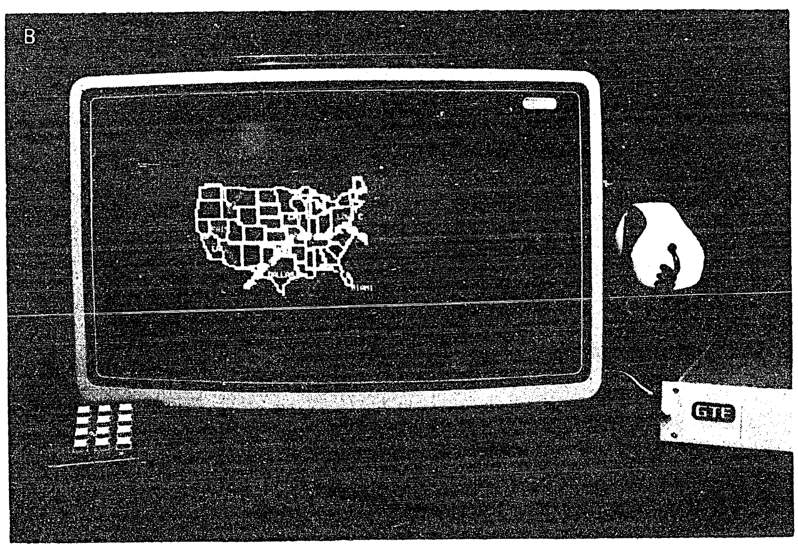
Some 200 farmers in Kentucky will soon begin receiving weather and crop information over a modified wired teletext system known as Green Thumb, supported by the U.S. Department of Agriculture.

The New York Times Corp. has announced a two-year pilot project to test interest in wired teletext. Plans call for weather, sports, news, and movie schedules to be made available to 150 to 200 homes.

The General Telephone & Electronics Corp. has recently been licensed to offer Prestel service in the U.S. A market trial is planned after modification of the software and identification of information providers.

Although the United States has more communications equipment per capita than any other country in the world, the development of advanced communications and information systems lags other countries. This can be attributed in part to an uncertain regulatory environment and the absence of a central standardization tradition. —*Ed.*





[3A] Adding a microprocessor and other devices to a conventional telephone allows household equipment to be monitored and controlled remotely. In addition emergency services can be summoned automatically, and information can be displayed.

[3B] This version of a remotely-controlled telephone uses a color display for retrieval of information from a wired teletext service.

in digital circuits, the operation of satellite circuits at higher frequencies, and improved optical communications products.

Today the most complex IC chip in a memory contains 64 000 bits. By 1985, advances in chip size, element density, and circuit design are expected to produce chips containing at least one million elements. These super chips will provide renewed impetus to the implementation of more features digitally, and they can be expected to produce a continuing demand for low-cost A/D and D/A conversion.

Higher frequencies for orbiting satellites provide the potential for distribution of information and entertainment signals of value to communications/information services. Although the orbital slots for satellites operating at 4/6 GHz are virtually filled, space is still available at 11/14 GHz, and the entire orbital arc is available at 18/30 GHz. At these very high frequencies, the radiation pattern from the satellite can be split into many spot beams, each illuminating a small area of the earth. This allows the same frequencies to be used in different geographical areas.

Optical fibers provide a wideband transmission path of extremely small physical cross section that is free from power and radio-frequency interference. Point-to-point communications applications have already been demonstrated—including the transmission of digital signals inside the telephone network and the transmission of video signals for video conferencing and cable TV. Effective local distribution of mixed signals—voice, data, and video—will be possible as soon as adequate networking components have been perfected and some form of optical switch has been developed. The latter could be an important component in the local distribution of personal video services.

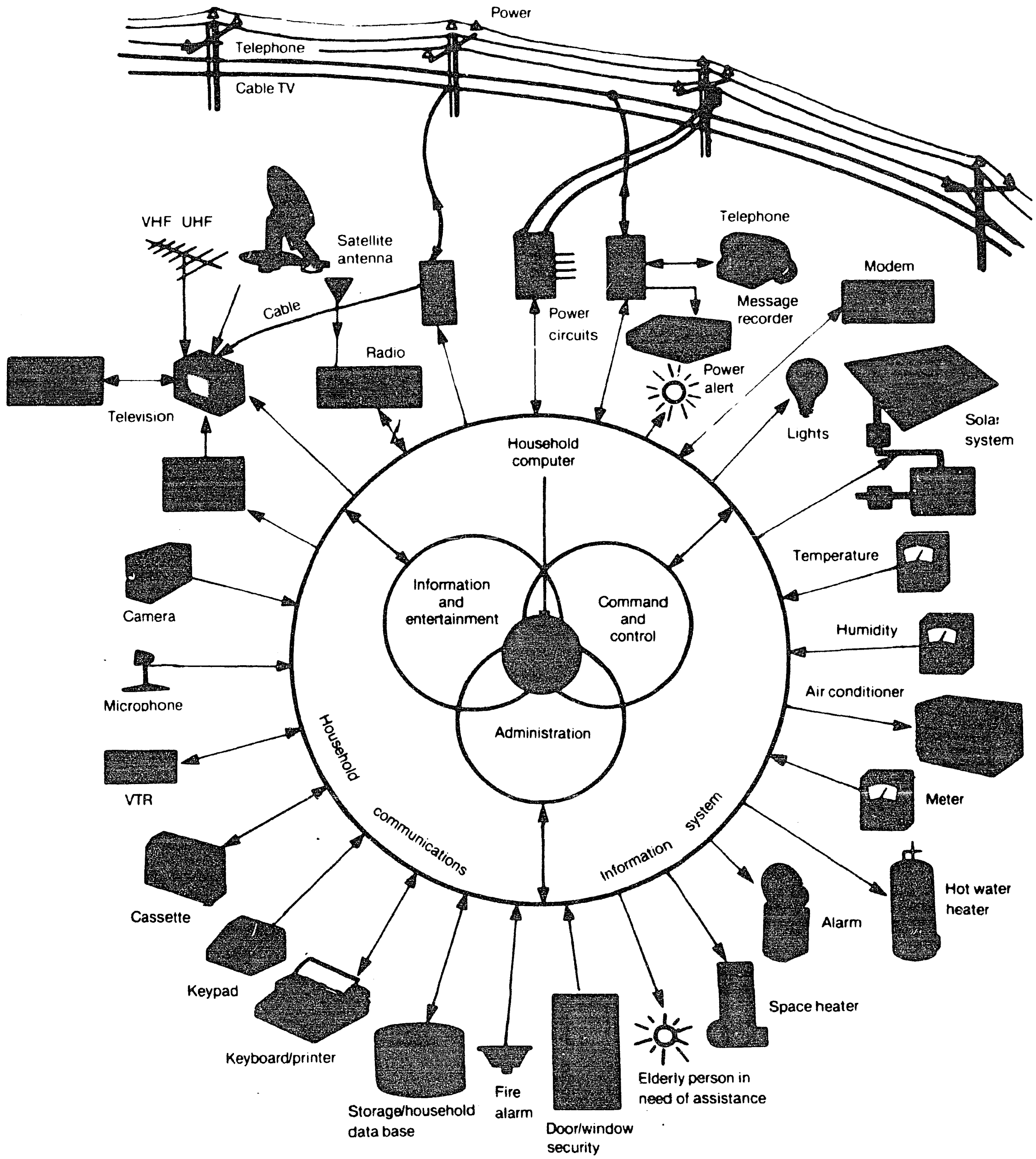
Putting the computer into the home

An all-encompassing household communications/information system (Fig. 4) centers on a home computer that supports three subsystems: information and entertainment, command and control, and administration. It receives radio signals transmitted over the air; television signals from terrestrial, cable, and satellite facilities; administrative signals from an electric utility, and signals from the telephone network. A myriad of household products and applicances can be controlled by the system. In principle, a single wideband connection like an optical fiber could link the system with the world.

The information and entertainment subsystem could provide the following:

• Retrieval, schedule, and library information, as well as news and reports. It would use the television receiver, a teletext decoder, telephone, modem, and keypad or keyboard/printer, supported by broadcast teletext services, wired teletext services, community services or other sources.

[4] A "total" household communications/information system, in which communications are provided by power line, telephone, cable television, and broadcast services. Household activities are supported by a computer.



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