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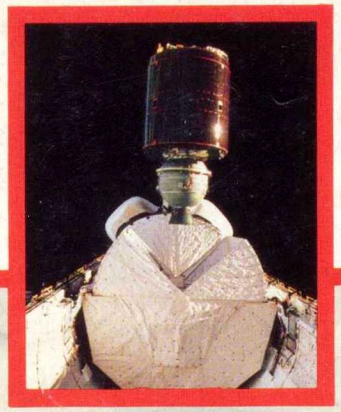
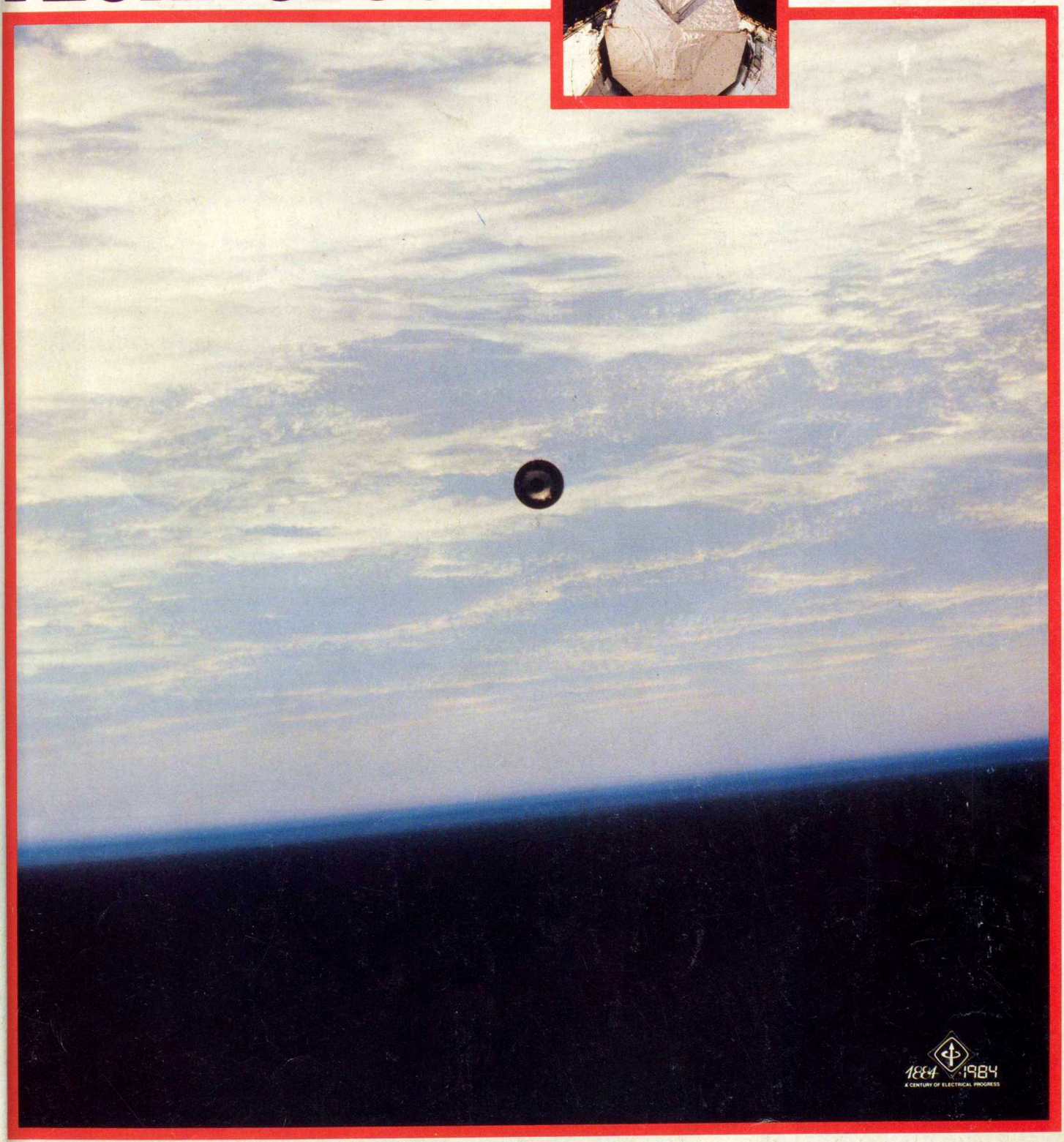
TECHNOLOGY '83





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STAFF

On board the most recent U.S. Space Shuttle flight, a preset 35-mm camera recorded this picture of the four NASA astronauts. Clockwise, beginning top left, are mission specialist William B. Lenoir (SM); pilot Robert F. Overmyer; mission specialist Joseph P. Allen IV; and, holding the sign celebrating the successful deployment of two commercial communication satellites during the flight, crew commander Vance D. Brand. The picture was taken in the mid-deck area of the U.S. Space Shuttle Columbia.

This second flight of the Columbia in 1982 was the first to have a crew of four. The two communications satellites put into orbit were the SBS-3 and Anik 1. Future Columbia flights have been cut to 312 from the 487 originally planned for a 12-year span. For more information on the space shuttle and other aerospace developments in 1982, see page 71.

This spectacular display of light is evident when dust or moisture in the air is lit by beams of light from hundreds of heliostats (mirrors) at Southern California Edison's Solar One project in Daggett, Calif. Each morning the heliostats are focused first on "standby" points, as shown here, and then later in the day are focused on the boiler atop a 75-meter water tower. Steam developed in the boiler is used to operate the turbine generator located below the tower. This installation, the world's largest (10 MW) solar-thermal electric generating station, delivered its first full electric power output in September 1982.

The Southern California Edison installation incorporates 1818 heliostats, all under computer control. For details, see page 59.

ARTICLES

DEPARTMENTS

THE COVER

Telesat, Canada's Anik C-3 spacecraft, is seen at frame's center, against the earth as background. It was the second of two commercial satellites deployed during the U.S. Space Shuttle Columbia's November 1982 flight. The first, the Satellite Business Systems spacecraft, is pictured in the inset just as it left the cargo bay of the Columbia.

The "spot" photograph appearing with the titles of each article in the issue is of Lockheed's CMOS-in-SOS gate array designed for digital signal processing.

The very high-tech home

Consumers move one step closer to the electronic household as video, audio, and computer-game technologies merge

Personal possessions used to be predictable. Watches told time, phones carried voices, stereos played records, and television sets displayed programs. Today, watches double as radios, phones carry data, stereos plug into the television, and TVs answer the phone and display everything from videotex magazines to Donkey Kong.

The year just ended saw a continuing merger of once-distinct categories in consumer electronics—with audio manufacturers tacking TV monitors onto their products and video manufacturers exploring new audio technology—and consumers were able to choose from a plethora of products to fill a particular need. Consumers who wanted commercial-free movies could buy prerecorded video cassettes, video disks, or a subscription to pay cable, and those who wanted to play PacMan could purchase a game-playing unit or home computer.

Color TV sets, cheaper and smarter than ever, continued to be the staple of the consumer electronics industry; one manufacturer predicted that more than 11 million were sold in the United States. Video-cassette recorders (VCRs) also sold well, with about 2 million purchased by year-end, thanks in part to the introduction of ever-lighter VCR–camera packages. The audio market, however, remained slow, despite the continued popularity of personal portable radios and cassette players, advances in noise reduction, as in CBS's CX, and the spread of Dolby C in a growing number of audio products. It was the high-end products that suffered the most, however, in the year's recession economy. Projection television sets, retailing for about $2000 to $4000, did not sell well. At the same time the Zenith Radio Corp. of Chicago introduced a new black and white television set with a microprocessor-based, keyboard-addressable tuner, which was, according to a company executive, "going over better than our wildest dreams."

Carol Truxal Associate Editor

Video games: still all the rage

The home-video-game industry continued to boom, while maintaining its decade-old tradition of breaking price barriers in electronics [see "Video games: the electronic big bang," *Spectrum*, December 1982, p. 20]. The General Consumer Electronics Corp. in Santa Monica, Calif., began marketing the Vectrex Arcade System, a home game-playing unit, complete with a vector generator and black and white monitor, selling for about $200. William von Meister, founder of The Source, announced that his new company, the Control Video Corp. in McLean, Va., would introduce in 1983 a high-speed phone modem for downloading game software. It will sell for less than $40.

Home game-playing units also became more versatile. Coleco Industries of Hartford, Conn., unveiled ColecoVision, a game console with an "expansion module interface." By tacking a conversion module onto the ColecoVision 1, consumers can play

Video and digital audio disks: finally rolling

Video disks, originally a grave disappointment in the market, finally seemed to be attracting consumer interest in 1982.

Several compatible disk-player technologies have been developed, including the capacitance electronic disk and the laser disk [see "Video disks: three choices," J. Clemens, *Spectrum*, March 1982, p. 38]. RCA Corp. reports that its grooved capacitance electronic disk (CED) system is the market leader. The company attributes the sudden public interest to the slashing of the price of its SelectaVision disk players (the original model dropped from $499 to $299), the introduction of new software, and the addition of two stereo models to its video-disk-player line.

The principal competition of the capacitance electronic disk is the grooveless laser disk system, originally developed by NV Philips and MCA Inc. and produced as well by Pioneer. Pioneer's top-of-the-line LaserDisc player, the stereo LD-1100, has an on-board microcomputer for random access. The viewer can jump to any frame or "chapter" of the program and control the program's progress. The applications of these so-called "interactive" video disks, particularly when linked to computers, video games, education, and the recording of "moving" journals, are only beginning to be explored. In 1982, a joint MCA-Pioneer-Magnavox venture called Optical Programming Associates produced a set of interactive programs on laser disks, among them a master cooking course and a disk called, "How to Watch a Pro-Football Game."

Digital audio disks, the great hope of the sleepy audio business, also got off the ground last year. Although a single international standard for digital audio recording has yet to be set, a host of manufacturers have opted to license a system known as the Compact Disk, developed by the Sony Corp. and Philips. Music is encoded digitally on a grooveless disk and read optically. The disk never wears down, has exceptional dynamic range, and is compact (an hour of music on a record only about 4¾ inches in diameter). Sony and other manufacturers began selling the players in Japan in the fall of 1982, and they are expected to hit the European and U.S. markets this year.

A second digital audio disk system—the audio high-density system—has been developed by JVC, using a grooveless capacitance player. Both digital audio disk systems will have to compete in the market with digital tape systems. Sony's new digital audio processor, the PCM-F1, for example, enables the consumer to record music digitally on any video cassette player. The digital audio disks will also find competition from new high-fidelity analog disks. CBS's new companding system for disk recording, called CX, gives analog records exceptional dynamic range. —*C.T.*

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games originally designed for Atari's video computer system (VCS). Next year Coleco plans to introduce another conversion module that will turn its machine into a personal computer.

Game software for both game consoles and personal computers proliferated. Some retailers predicted that more than 50 million cartridges for game units would be sold in the United States by year-end, while software for games constituted about half of all the software sold for home computers. The bottom floor of the summer Consumer Electronics Show in Chicago last June was crowded with new game companies like the Imagic Corp., as well as old giants trying to enter the games software market, such as CBS and Parker Brothers. As competition in game cartridges stiffened, graphics improved and a wider variety of games was offered; the standard shoot-'em-ups and gobble-'em-ups began sharing shelf space with cerebral and educational games. Games found their way into schools, Army training facilities, and casinos.

Component television gains proponents

The national passion for video games, the popularity of cable and VCRs, and the dawning interest in video disks and stereo TV led to a growing understanding among consumers that the modern television set is a versatile device. To capitalize on this flexibility, a host of manufacturers last year offered component sets. In component, or modular, television the TV monitor, tuner, amplifier, and speakers are all independent units; consumers can build video systems in much the same way they mix and match stereo components.

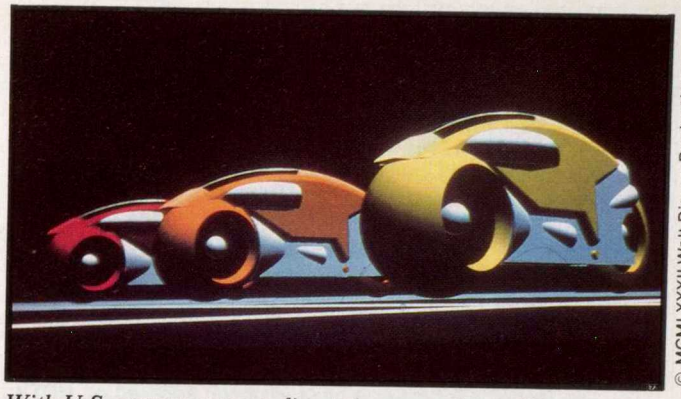
Component TVs can produce sharper pictures than standard TVs. Pioneer's component TV Monitor 250, for example, has 400 lines of horizontal resolution, in contrast with the traditional 280 lines. Pioneer uses comb filters to improve the separation of luminance signals from chrominance signals [see "TV broadcast technology highlights," p. 66].

Component TVs typically have jacks enabling viewers to switch from network TV, to VCRs, to games, and so on, without constantly plugging and unplugging systems. They can also be hooked up to stereo systems. At present U.S. consumers can get stereo sound with video only from VCRs, video disks, or cable (with, for example, the new Music TV). However, three candidate systems have been developed for the broadcast of multichannel sound for TV. Within a year or two, the Federal Communications Commission may set necessary standards [see "Stereophonic sound for television," R. Jurgen, *Spectrum*, September 1982, p. 30].

As more TV sets are equipped with high-quality sound systems, and companies traditionally involved with audio equipment (such as Marrantz, Fisher, and Emerson) begin to introduce TVs and VCRs, the distinction between audio and video equipment is fading. In keeping with this trend, Jensen introduced the first receiver with a combined AM/FM/TV tuner in 1982, and Kenwood Electronics unveiled a line of audio-video packages—cabinets complete with TV monitors, stereo amplifiers and speakers, audio and video tuners, and inputs for VCRs, games, and computers.

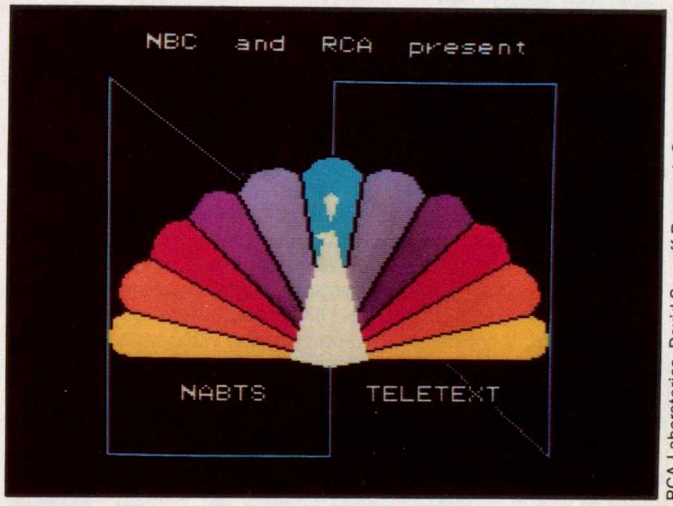
Information sources: a growing choice

TV owners today can receive programs and information from a wide array of sources, from VCRs and personal computers to cable and phone, to low-power and multipoint distribution broadcasts [see Fig.]. While some of the options may be short-lived—for example, consumers now using TV-received-only (TVRO) antennas to pick up broadcasts intended for cable operators, such as Home Box Office, will be thwarted by



© MCMLXXII Walt Disney Productions

With U.S. consumers spending twice as much on video games as movies last year, film companies decided to get in on the action. Paramount, Universal, and Twentieth-Century Fox were among the major studios that established games divisions. Walt Disney Productions, meanwhile, made a video-game designer the hero of its movie Tron *and arranged with Midway Manufacturing to design a game based on the movie. In this scene from* Tron, *the three motorcycles were computer-generated by the Mathematical Applications Group Inc. of Elmsford, N.Y.*



RCA Laboratories, David Sarnoff Research Center

The rise of teletext has been slowed in the U.S. by debates over technical standards. While one of the nation's first commercial teletext services—launched last fall—is using British technology, other potential teletext suppliers have thrown support behind technology based on the North American Broadcast Teletext Specification (NABTS). The screen reveals the graphics capability of NABTS-compatible equipment; it was created and shot at RCA Laboratories, Princeton, N.J.

scrambled signals in 1983, and subscription TV (broadcast-scrambled) has a dubious commercial future—the trend in general will be toward a growing number of choices for the consumer and greater use of the spectrum.

This trend has been encouraged in the United States by the Federal Communications Commission. The FCC, for instance, has issued relatively lax rules for the licensing of low-power stations, which operate on the same channels as regular broadcast television stations. The Commission's main requirement is that low-power stations not interfere with the regular stations—a requirement that can be met through clever location and/or design of the transmitting antenna [see "Low-power television," *Spectrum*, June 1982, p. 54].

The FCC also began approving construction of direct-broadcast-satellite (DBS) systems in 1982, approving an application

TV broadcast technology highlights

Headway was made last year in diverse areas of broadcast technology, including high-definition or enhanced TV, digital video and audio, teletext, and electronic graphics.

An accelerating interest developed in high-definition television (HDTV), as well as in other advanced systems that have come to be known as "enhanced" or "extended definition" television. Two factors were largely responsible for this interest: the development in Japan of a variety of advanced HDTV equipment; and the near-term prospect of satellite broadcasting directly to homes via the 12-gigahertz band, with the concomitant opportunity to consider new technical standards.

No technical standards have yet been adopted on HDTV, although proposals for such standards are the subject of intense study. It is generally agreed that HDTV should be characterized by the following attributes: (1) an improvement of approximately 2 to 1 in both vertical and horizontal resolution; (2) improved color rendition from wide chrominance bandwidths that are separate from the luminance bandwidth and not "interleaved" within it, as is the case with existing color television systems; (3) a wide aspect ratio of at least 5:3, as opposed to the current 4:3; and (4) full-fidelity stereophonic sound, which will be more impressive when offered with HDTV, since it combines "wide" sound with a "wide" picture.

These four features would make practical the use of large-screen displays, which suffer at present from the intrinsic limitations of the 525-line or 625-line scanning structure. In Japan, where most of the HDTV developments have occurred, a preliminary standard has been proposed. It involves 1125 scanning lines, a 5:3 aspect ratio, a frame rate of 30 per second, interlaced 2:1 scanning, and full-fidelity stereophonic sound. The theoretical video baseband required for such a signal is approximately 30 megahertz.

NHK, the Japanese national television authority, in cooperation with CBS Inc., conducted demonstrations of the NHK HDTV system in Los Angeles, Washington, and New York early last year. The reactions of viewers were extremely favorable. Near-prototype HDTV equipment consisted of cameras, monitors, projection sets, and video-tape recorders.

In contrast to HDTV, enhanced or extended-definition TV systems involve no change in the basic scanning structure, or in the current 4:3 aspect ratio. The most prominent of such systems are in development in England.

Digital video and audio coding standards adopted

In what has been called a milestone in the evolution of television, the International Radio Consultative Committee (CCIR), at its fifteenth plenary assembly in February 1982, adopted a worldwide uniform digital video encoding standard for television studio productions.

Digital technology, including its application to video-tape recorders, opens up new horizons in TV-program production. A shortcoming of present video-tape recording is that successive copying of the tapes means a reduction in quality. The new digital equipment will be virtually free of this restriction.

An important forthcoming study area for the CCIR is the precise format for the digital signal to be recorded on video tape. Such a standard will facilitate the international exchange of digitally recorded programs. The long-term benefits of the new standard are likely to include the potential for lower equipment costs because of the economies of scale and a greater international exchange of information on operational techniques.

Studies are under way throughout the world on the techniques and procedures to implement the proposed standard, known as Recommendation 601. Studies on digital audio, similar to those that led to Recommendation 601, are also being made. Digital audio standards are needed for the audio associated with TV, radio broadcasting, and recording.

Teletext—testing the waters

In 1981, the FCC issued a Notice of Proposed Rulemaking, proposing to authorize the broadcasting of teletext, but not specifying any technical standard. In other words the Commission proposed a "market place" approach, believing that industry and the public would determine what standard was appropriate. This position was supported by some broadcasters and manufacturers but opposed by many others. The opposition says that without a specified, single technical system, there will be little incentive for manufacturers to build teletext receivers, and therefore little possibility of achieving the large-volume production needed to lower the cost to consumers to an acceptable level. The FCC is expected to rule on the matter in the near future.

Meanwhile, extensive work has continued in the design, development, and production of the integrated circuit-chip sets that will be needed for teletext decoders—either as stand-alone set-top adapters or for building into new teletext-equipped TV receivers. When the FCC does act, a rapid acceleration of the introduction of teletext services, both national and local, may occur.

Meanwhile, the FCC has authorized 23 stations to conduct teletext experiments, both of a technical and marketing nature. Station KSL-TV in Salt Lake City, Utah, was the first to experiment, using the "fixed" or "defined" format system espoused by British teletext proponents. CBS was next with technical tests over KMOX-TV in St. Louis, Mo., using both the British and the "variable-format" system favored by the French teletext interests. The public broadcasting station in Washington, D.C., WETA-TV, has been experimenting with the Canadian teletext system, which is like the French variable-format system, though it employs more sophisticated graphics.

French and Canadian interests joined with CBS and American Telephone & Telegraph to propose a North American Broadcast Teletext Specification (NABTS). British interests countered with a revision date of its original system and said it could provide the same type of teletext services.

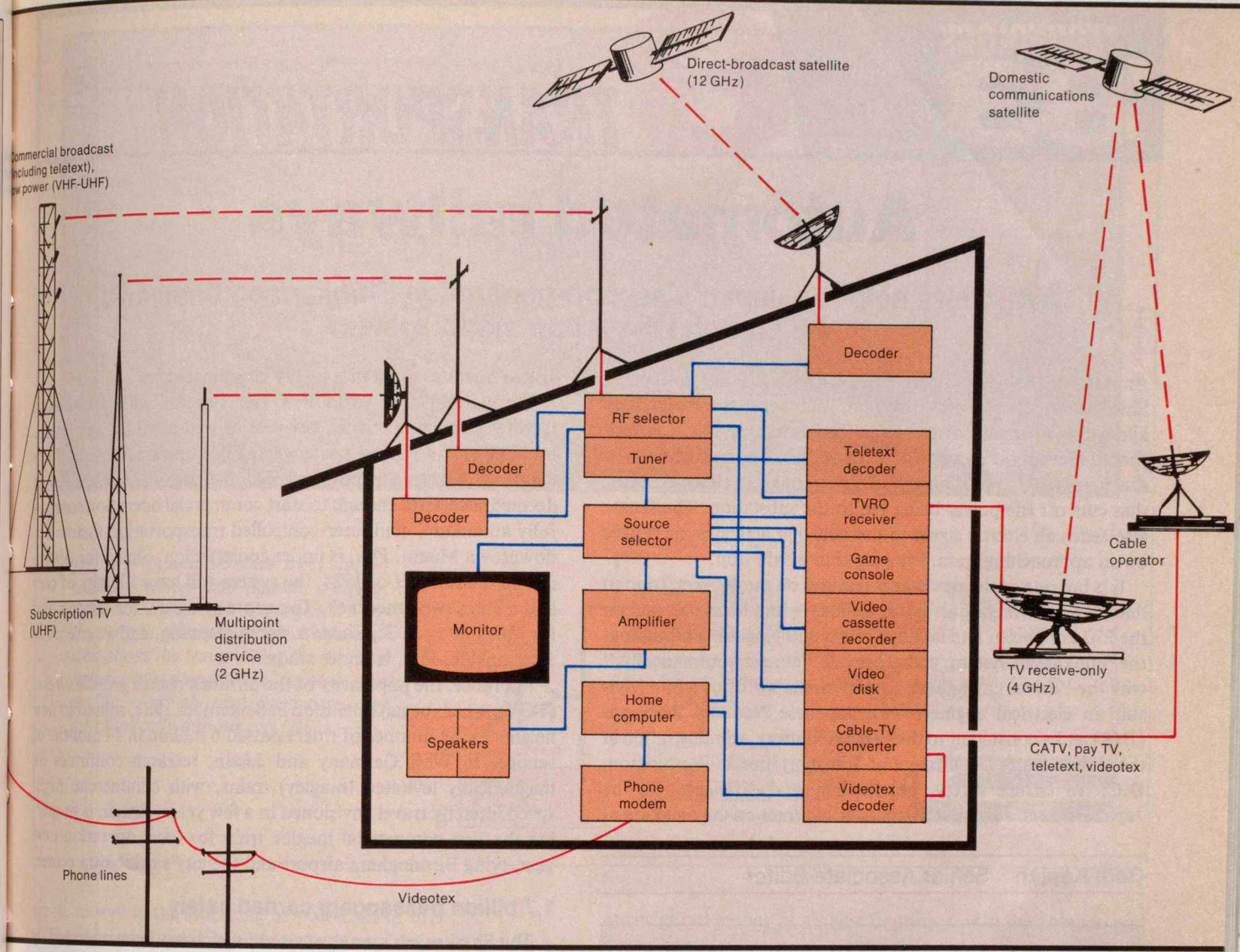
Electronic graphics dazzling the eye

The year 1982 also witnessed accelerating developments in computer-controlled electronic graphics in television broadcasting (comparable developments in the motion picture industry, with movies such as Walt Disney Productions' *Tron*, have been widely reported). Ten years ago electronic graphics in the form of character generators was considered a breakthrough. The character generators could produce electronically a wide variety of alphanumerics in various fonts and spacings, as well as simple block graphics. Today the television viewer is dazzled by images that twist, revolve, flip, zoom, flash, and more—all accomplished by computer-controlled electronic graphic systems.

The television graphic artist, seated in front of a television monitor with a light pen and electronic palette, can call upon thousands of colors of innumerable line widths and sizes, as well as virtually limitless special effects, to create artwork of astonishing complexity. Once a piece of art is completed, it can be stored in a computer for recall at any time.

The technological basis for the new digital art systems is the digital frame store and the microprocessor. A television frame store involves a memory of about 4 million bits of information. Every picture element (pixel) in the television raster is controlled by a separate memory location in the frame store matrix. When the artist moves a light pen or stylus over the "drawing board," he can address each memory location in the frame store that the stylus passes over. Pixel memories generally have 8-bit resolution, which allows a wide variety of color to be used for each pixel.

Special effects are created by a variety of programs, or algorithms, to which the artist has access. A "fill" program, for example, will color in an entire area for which the artist has drawn a line boundary. Other effects include zoom, twist, and revolve, each accomplished by a different program. The ever-increasing sophistication of such algorithms is resulting in more and more complex special effects, and there is every indication that this trend will continue. —*C.T.*



Consumers are facing a growing array of options for bringing programs and information to their TV monitors. The figure shows one possible arrangement of equipment for the well-equipped home of the future. Most signal sources shown here are available today; some, like direct-broadcast satellite (DBS), will not go on line until later in the decade.

The ability to mix and match equipment is one reason for the introduction of component TV. Ongoing work is devoted to developing control protocols to simplify switching among sources.

Many alternate configurations of equipment and hookups are possible. Teletext and videotex decoders may be in one box, for instance; video-cassette recorders (VCRs), video-disk games, and computers may feed into the RF selector rather than the source selector. The figure does not include all possible sources of information (omitted, for instance, is educational programming currently available on VHF-UHF), nor all possible equipment (headphones, for example, could be added).

from the Satellite Television Corp., a Washington, D.C., subsidiary of Comsat. In November, it approved seven more applications. Because signals from DBS satellites will be 40 times more powerful than those from domestic communication satellites, consumers will be able to receive programming directly from small rooftop antenna dishes [see "Getting set for direct-broadcast satellites," W. Pritchard and C. Kase, *Spectrum*, August 1981, p. 22]. And because DBS satellites will broadcast in the 12-gigahertz range, they will have sufficient bandwidth available to allow high-definition television transmission.

The FCC has yet to rule on another form of broadcast—teletext. A number of TV manufacturers and broadcasters are hoping that the commission will set a single standard for the transmission and display of teletext data, but this seems unlikely given the FCC's present deregulatory leanings (in April 1982, for instance, it declined to set a single standard for AM stereo). In spite of the remaining standards confusion, several companies intend to start teletext services when the FCC gives its approval, including CBS, NBC, and Keycom Electronic Publishing in Chicago. New teletext hardware as well is expected to emerge soon: RCA and Zenith are both on the verge of introducing decoders, and Texas Instruments Inc. of France has introduced the first custom chip set designed to handle Presentation Level Protocol—one of the leading competitive approaches for displaying teletext.

Videotex—two-way information services—also picked up momentum in the United States last year, with both Keycom and Viewtron, a joint Knight-Ridder and American Telephone & Telegraph venture, announcing plans to begin commercial services this year [see "Americanizing videotex," *Spectrum*, November 1982, p. 52]. ◆

Among the major sources of information for this article were the IEEE Consumer Electronics Society and the IEEE Broadcast Technology Society.