Teletext in the USA

By JOSEPH ROIZEN

This paper describes the current status of teletext in the USA, covering: (1) the standardization activities of the Teletext Subcommittee of the EIA/BTS Committee, (2) the CBS petition to the FCC, and (3) the local network on-air experiments being conducted to evaluate various systems.

Introduction

Teletext is a generic term describing a new form of television service, which delivers to home viewers visual information in the form of "pages" of alphanumerics or color graphics. This service usually includes "pages," or screenfuls, of general interest content such as news, weather, sports, stock quotations, and program logs.

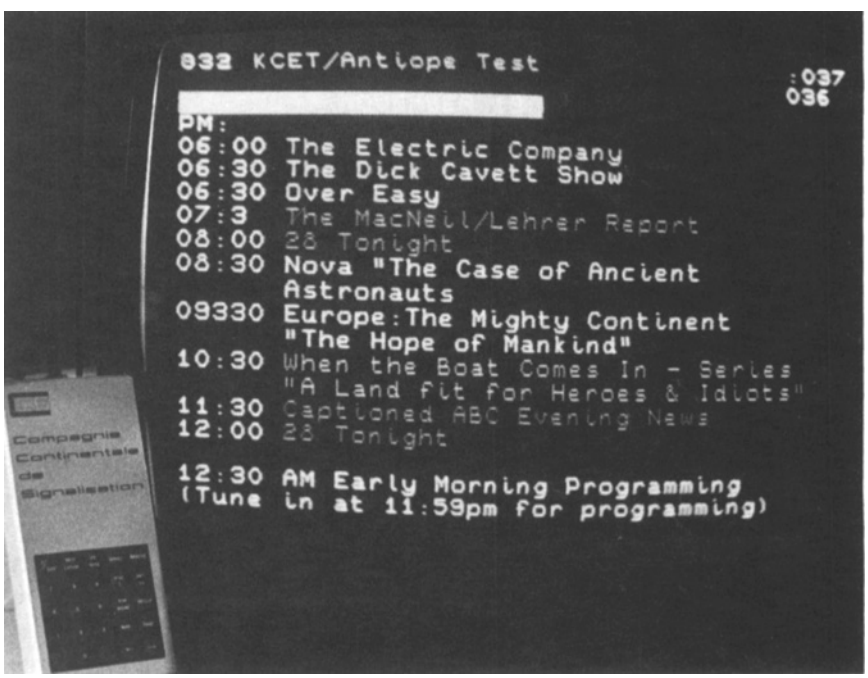
A teletext service can be provided without affecting the normal TV broadcast and is considered an ancillary service that can be either program-related or completely independent of the program. By using a small keypad, the viewer can choose to watch the television program, specific teletext pages, or a combination of the two where appropriate.

Teletext services are presently in public service in a number of countries on either a regular or experimental basis. In England, both the BBC and the IBA offer viewers over 100 teletext pages each, under services with the self-evident names of Ceefax and Oracle. In France, the national TV network, Télédiffusion de France, provides teletext transmissions as part of their regular operations. This system is known as Antiope.

In Japan, the NHK Research Laboratories have developed a teletext system which has been dubbed Captain. The Department of Communications of the Canadian Government in Ottawa has also fielded a teletext operation known as Telidon. Both Japan and Canada are conducting on-air tests of their national teletext system, and a number of other countries around the world are either experimenting with or implementing teletext services by adopting or modifying one of the above systems.

Australia, Belgium, Denmark, Sweden, West Germany, Switzerland, Austria, Venezuela, Hong Kong, and Holland are among the many countries whose public and private television networks are now involved in teletext.

Teletext should become a major television ancillary service in the next few years — at least in countries that have national TV networks supported by viewer licensing. This covers the majority of TV broadcasters outside of North America. How-



Teletext can be used to provide the viewer with a program log. A typical page of the teletext magazine from KCET-TV is shown, giving the available programs.

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Abbreviations and Acronyms

Antiope	Acquisition Numérique et Télévisualisation d'Images Organisées en Pages d'Ecriture (the French national teletext system; an approximate translation is "acquisition of televised written pages")
BBC	British Broadcasting Corp.
BTS	Broadcast Television Systems
Captain	Character and Pattern Telephone Access Information Network System (a Japanese teletext system)
CCETT	Centre Commun d'Etudes de Télédiffusion et Télécommunications
EIA	Electronic Industries Association
FCC	Federal Communications Commission
IBA	Independent Broadcasting Authority
MDS	Multipoint Distribution Service
NAB	National Association of Broadcasters
NCTA	National Cable Television Association
NHK	Nippon Hoso Kyokai (Japan Broadcasting Corp.)
NTSC	National Television System Committee
PBS	Public Broadcasting Service
SMPTE	Society of Motion Picture and Television Engineers
STA	Special Temporary Authorization
STV	Subscription Television

ever, not even the private (commercial) networks can avoid the impact of teletext; they will have to offer their viewers similar access to teletext data in order to stay abreast of the national services. The major difference is that the commercial networks will make teletext a revenue-generating service by selling advertising pages to sponsors.

Teletext also has some important sociological implications, providing essential services such as *closed captioning** for the deaf or hearing-impaired viewer, multilanguage subtitling for ethnic minorities, detailed political information on local or national issues, and a host of other educational services.

Teletext in the USA

Unlike Britain, France, Japan, and Canada, the U.S. has not developed a "national" teletext system for domestic use. The primary reason for this is economic. Television in the U.S. is overwhelmingly commercial, and teletext could distract a viewer from watching the sponsor's message. There was, therefore, little incentive for the major U.S. networks to develop teletext systems. The Public Broadcasting Service (PBS), which had no such antipathy toward teletext, did not have the financial resources to take on such a major development, although it did embark on a more limited program to develop closed captioning, which has resulted in FCC authorization for this service. Nevertheless, the impact of teletext abroad could not be ignored indefinitely, and as more information about the English and French systems became available, the need for some concerted action by the U.S. television industry became apparent. By early 1978, several private experimental teletext systems were being tested; Micro TV of Philadelphia and KSL-TV in Salt Lake City both tested modified Ceefax systems adapted to U.S. television standards.

Starting in May 1978, Antiope was shown in an NTSC format at the NCTA conference in New Orleans and at a National Science Foundation seminar in Washington, D.C. These and other teletext activities attracted the attention not only of the broadcasters, cable companies, and MDS operators, but also of the members of the FCC. As a result, the developers of the various teletext systems were invited to make technical presentations to the full Commission and to the regulatory agencies involved with establishing a U.S. teletext standard.

At an open hearing on November 8, 1978, after a series of side-by-side demonstrations of various teletext systems, Chairman Charles D. Ferris declared that the Commission was convinced that teletext was a useful potential television service and that the FCC would look with favor on any applications for experimental licenses to broadcast teletext for field trial and evaluation purposes. He also stipulated that a U.S. teletext service should meet three goals.

1. It should make efficient use of the limited and very valuable spectrum space in the vertical interval.
2. It should adopt the best available technology, in order to develop a reliable, flexible teletext service for the largest segment of the U.S. viewing public.
3. It should be reasonably affordable to the widest range of television receiver buyers.

In addition to these three points, the FCC also encouraged the formation of an EIA committee to initiate field tests of teletext and to evaluate the results. These evaluations could then be used to develop a set of recommendations to the FCC for the

Captain is a Japanese teletext system developed by NHK. As shown, there is a separate decoder (on top of the receiver), but in the future the decoder will be integrated into the circuitry of the receiver.

*See the glossary at the end of this article for an explanation of this term and other italicized terms.

This teletext/viewdata receiver has a keypad to call up teletext pages, an alphanumeric keyboard for telephone access to a data bank, and a five-page memory to store pages of data. Such receivers are currently available in Europe, allowing the viewers to receive teletext transmissions.

ratification of a U.S. teletext standard — a necessary step before the public service of teletext could be implemented.

EIA/BTS Teletext Subcommittee

The role of the EIA in broadcast standards was reviewed by E.M. (Eb) Tingley, Deputy Manager of Engineering for the EIA. The Association is an industry-supported group whose major work deals with industrial product-oriented standards. The BTS Committee of the EIA concentrates on the development of broadcast television system standards. Starting with the EIA's sponsorship of the well-known NTSC work which resulted in the current TV signal standards, the Association has continued to take an active role in this area. The BTS Committee contributions include the development of the VIR (vertical interval reference) signal. Sponsorship by the EIA provides support of administrative costs and document distribution. Field test costs are usually shared with other participating organizations that have a stake in a project.

The EIA and its BTS Committee considered teletext to be within its charter, and so, with the interests of their own organizations and those of an NAB ad hoc group known as the All Industry Committee on Implementing Ancillary Broadcast Signals, they undertook the task of directing standards work in two fields: (1) multichannel TV sound and (2) teletext. The EIA then informed the FCC of the formation of this subcommittee and apprised them of the basic objectives, namely, to furnish a good technical record and to recommend a suitable set of standards. The FCC was invited to participate and has provided a number of people who have regularly attended meetings. The initial meeting was in January 1979. There have been meetings almost monthly for the various task forces and working groups charged with selected objectives.

The Teletext Subcommittee of the EIA/BTS Committee was formed under the chairmanship of Robert O'Connor of CBS in February 1979. Originally, the target for completing its task was set as the end of 1979, but it soon became apparent that this target could not be met; in fact, the date for completion was still indefinite at the end of 1980.

A number of task forces and working groups were needed to carry out the actual work of testing and evaluating teletext systems for the potential recommendation to the FCC for a single standard. The Teletext Subcommittee was organized into five task forces (designated as A through

The FCC hearing of November 8, 1978, held at their Washington, D.C. headquarters, involved the full Commission. It was indicated that teletext was considered to be a useful service.

Demonstrations held during the FCC hearings on teletext. Proponents of various teletext systems set up operating systems so that the Commission members could see teletext in operation.

E). The subcommittee and the subgroups were made up of about 40 experts representing the full gamut of specialties within the TV industry: broadcasters, cable TV, corporate TV, receiver manufacturers, computer companies, telecommunications groups, and component manufacturers.

Mr. Tingley felt that the subcommittee had passed the halfway mark in its assigned task, and that the development of the systems analysis chart represented a major accomplishment of this group. Future work will concentrate on definitive cost information and the essential needs of the broadcasters in order for them to provide a viable service.

The Steering Committee

For the first 18 months (Feb. 1979–Aug. 1980), Robert O'Connor of CBS served as an excellent chairman for the Teletext Subcommittee and reported frequently on its work at SMPTE and NAB technical conferences. His fine leadership and dedicated activity were greatly appreciated, and the membership expressed a strong vote of thanks to him at the meeting of September 4, 1980. However, when CBS petitioned the FCC to consider the adoption of the Antiope teletext system, it was understood that it would no longer be appropriate for an employee of CBS to continue as chairman. The new chairman appointed to the BTS Committee is Bernard Lechner, of RCA, who is a long-time member of the group and a technical expert well versed in the subject matter. Mr. Lechner indicates that the scope of this subcommittee remains substantially the same, with a few minor clarifications. Also, there has been some updating to accommodate recent developments. The Teletext Subcommittee is directed to provide a recommendation for a standard that could be adopted as the U.S. standard for a teletext service. Lechner is confident that this widely representative industry group has the necessary technical expertise to eventually reach a consensus. He also pointed out that some elements of this teletext problem are already resolvable. He gave the example of system-independent factors such as page format, data rate, and clock run-in. All of these are applicable to the modified U.K. system, the Antiope system, and the Telidon system. Because all the systems can operate with the same parameters, these factors need no further resolution by the subcommittee.

The noncontroversial items lend themselves to consensus agreement, and Lechner feels that the subcommittee will work most diligently to secure such consensus. The unanimity should be reflected in an interim report and should also help to expedite further field work.

An early problem faced by the subcommittee was the receipt of three system proposals that were not necessarily in similar formats. It was, therefore, necessary to develop a systems analysis chart to translate those documents into a tabular arrangement; with the help of the system proponents this has been done. The selection of the best features of the various systems on the chart could lead to a hybrid system that may be the optimum choice for the U.S.

Two milestones now face the subcommittee. The short range goal is to generate this interim report, which will show the world and make available to the FCC and the manufacturers all of the results that have been achieved by the subcommittee under Robert O'Connor's chairmanship. The longer term goal is to continue working on those issues that are more complex, where more data and work are needed to complete the task. New hardware and new field tests may be needed to do this, so it is not yet possible to set a timetable. Mr. Lechner expressed his gratitude at having such a large, competent, and dedicated group of people working in his subcommittee.

Task Forces of Teletext Subcommittee

Task Force	Chairman
A. Systems	*Carl Eilers (Zenith Corp.)*
B. Laboratory and Field Tests	*David Sillman (PBS)*
C. Analysis of Data	*Shri Goyal (GTE Labs.)*
D. Time Domain Adaptive Equalizer	*Walter Ciciora (Zenith Radio Corp.)*
E. International Liaison	*Gregory Harper (PBS)* and *Harold Kassens (A. D. Ring Assoc.)*

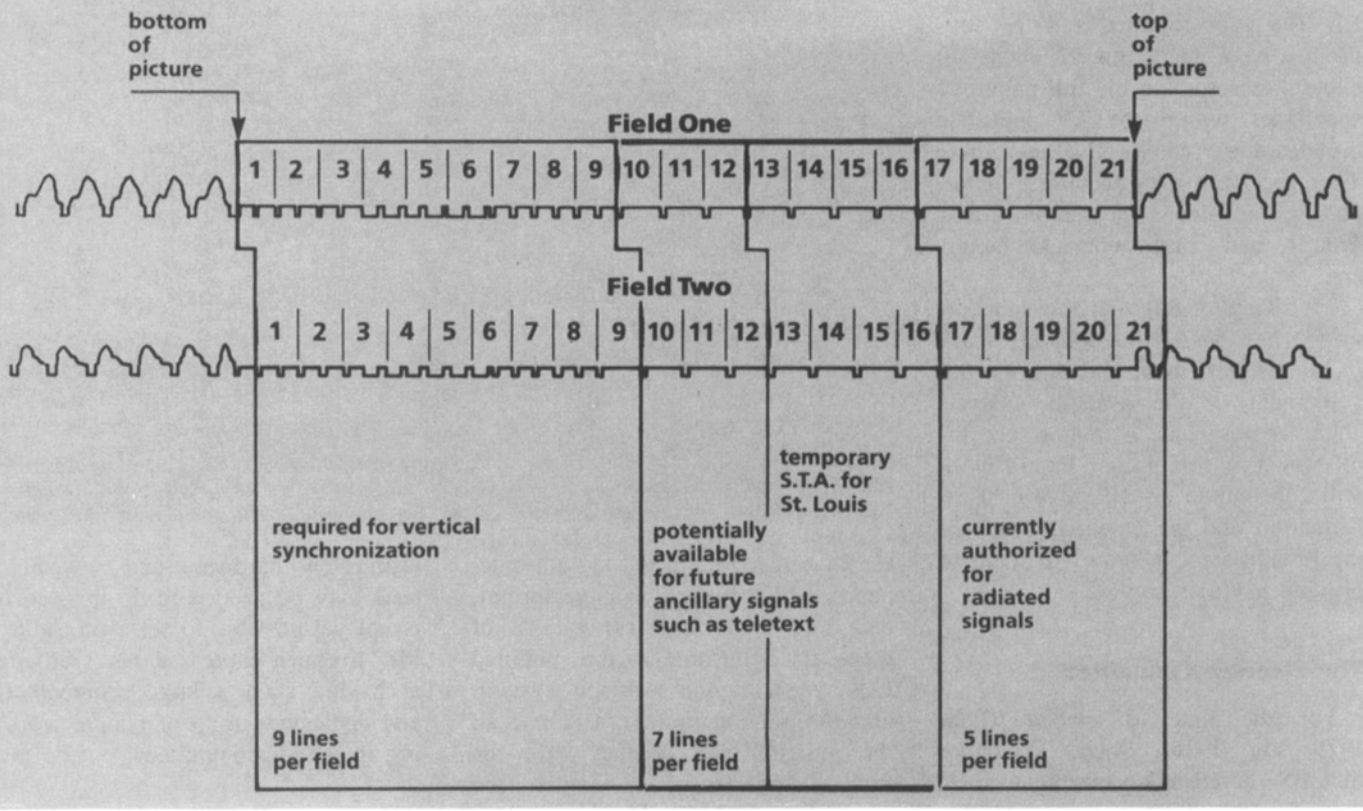
Task Forces

Much of the actual work done in setting up and evaluating teletext systems has been done by the various task forces that have been established. The author has had an opportunity to discuss current activities with the Chairmen of Task Forces A–D.

Task Force A (Systems) is concerned with the analysis of the various teletext systems proposed. It will then recommend one of the systems or come up with a hybrid that best suits a U.S. application. In addition, it may have to identify special required parameters that are peculiar to the 525-line, 60-field System M in use in the U.S.

The task force has 12–15 people from all branches of industry attending a typical meeting. Mr. Eilers estimates that the task force has accomplished 50% of its assigned task. A basic item-by-item identification of the three systems in parallel columns is a good portion of the work. The remaining task is to resolve differences between the systems, especially if there is to be a hybrid that picks and chooses between the systems for a final selection.

Mr. Eilers also was emphatic



The vertical blanking interval is shown, with an indication of the currently authorized area for test signals and closed captioning, the area left for teletext or other ancillary services, and the area that was temporarily authorized by the FCC for teletext experiments by KMOX-TV in St. Louis and other stations. Although four lines (13–16) were authorized for the St. Louis tests, only lines 15 and 16 were actually used extensively because older receivers showed some visible retrace effects on lines 13 and 14.

about setting the record straight on the erroneous impression in the trade press that the subcommittee was at a standstill. Even though CBS has chosen to go directly to the FCC with a petition for a teletext system, the subcommittee still has a role to play, with CBS participation, in continuing to evaluate systems. Other system proponents may also petition the Commission, and if this action occurs, the recommendations of Task Force A will be even more useful to the FCC.

Task Force B (Laboratory and Field Tests). The main thrust of its work is the planning and performance of laboratory and over-the-air testing of teletext systems. The data transmission capacity of a system can be characterized by analyzing two major elements — instantaneous data rate and the number of *vertical interval blank lines* adopted for teletext use. In addition, each element in the chain has to be evaluated, including the TV plant generating the digital data, the transmitter and its radiator, the propagation path, the receiving antenna, and the receiver characteristics as they relate to the teletext transmission.

Task Force B has 10–12 regular members who are mostly from the receiver and broadcast industry. The group meets on an average of every six weeks and, according to Mr. Sillman, it has completed about 70–75% of its assigned task. Currently, an interim report is being put together to present findings and to recommend further action. Any further work would be dependent upon steering committee directives.

Task Force C (Analysis of Data). The data collected by Task Force B is intended for critical analysis by Task Force C. This analysis, which is aided by computer techniques, will allow Mr. Goyal's Task Force to provide recommendations and results as to what would be appropriate for a teletext system.

Task Force C has about 10 members, who are mainly receiver manufacturers and broadcasters. In addition to the field data collected, there is also some raw data—collected from direct transmissions, stored on a digital scope, and fed into a computer for further analysis. So far, the data has come from KMOX-TV in St. Louis, CBS in New York, and Tektronix in Portland. Data analysis is done on the GTE Laboratory computer by using data recorded on an Arthur D. Little digital scope with a data storage facility.

The available data is used to plot *eye diagrams*, which are used for analysis of data. This method determines the transmission channel performance in relation to data rate and other factors.

Mr. Goyal described his task force's accomplishment as having developed all the tools for the analytical job that faces them. He also felt that they were from 50% to 70% completed, but wanted one more set of data to round off the project.

Task Force D (Time Domain Adaptive Equalizer) is primarily concerned with the question of whether a *time*

domain equalizer is required for reliable teletext reception. If it is required, there is also another kind of broadcast signal, specifically a *training signal*, that might be included. This could help to make time domain equalizers more effective, more cost effective, or more rapidly available. There is also an ancillary issue to be settled; namely, is it impossible that the same time-domain-equalizer training signal could be of use in ordinary video equalization.

Mr. Ciciora emphasized that ghost rejection, which is advantageous for teletext, is a matter of high interest to receiver manufacturers in its own right. It is, however, an extremely difficult problem because the nature of the filter is very complex, and so technology in this area has moved rather slowly.

Task Force D has about the same membership and representation range as the other task forces, with a somewhat stronger attendance from receiver manufacturers and broadcasters — the averge meeting has about a dozen members in attendance. Meetings are often coordinated with other task force meetings in order to exchange pertinent data. In terms of the creative work, Mr. Ciciora feels that they are about 66% done; in terms of the actual collection of data, however, they are still at the beginning stage. Without the resources to run a parallel effort with other task forces, this group must wait for input from the others before proceeding with their own work. As a consequence, it is difficult to predict when their task will be completed.

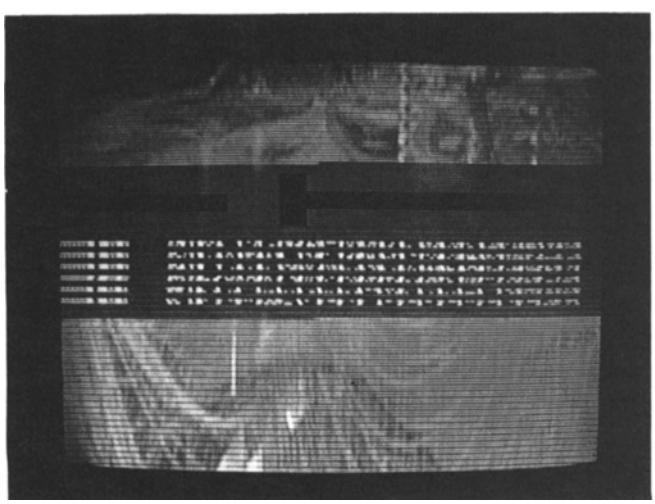
Need for a Teletext Standard

It is difficult to conceive of a situation where a color television set working in one part of the country would not function just as well in another. We are indeed fortunate in North America that the same color TV standard in use in the USA is also in use in Canada and Mexico.

If a teletext service is to be implemented on the public air waves, it would be advantageous from both an economic and social standpoint if the teletext signals were standardized so that decoders would function in exactly the same way throughout the country. It would also be desirable that the teletext standard extend beyond the U.S. borders to encompass neighboring countries. The economic advantage is that the decoder design would be compatible, leading to volume production and inherently lower cost. The social benefits are that everyone with a decoder would have access to a broad range of information via teletext transmissions available from the TV broadcasters.

To achieve such a national consensus standard requires that agreement be reached on a variety of technical questions confronting the EIA/BTS Teletext Subcommittee. The FCC shall then consider adopting such a standard. As a rule, such questions as page format (the number of characters per row, and rows per page), transmission bit rate, synchronous or asynchronous systems, hardware or software orientation, and reliability in fringe areas are items on which it is not easy to achieve a consensus. There are honest differences of opinion as to the technical and economic tradeoffs that confront the proponents of a national teletext service. The simplest approach influenced by economic constraints could limit future flexibility for additional features or services yet to be conceived. The most sophisticated technical system, with all the possible features, may place a price constraint on teletext in the consumer market, thus restricting the service to only a small segment of the viewing public.

It should be noted that any teletext standards developed would become mandatory only in the broadcast signal in the public domain where regulatory agencies like the FCC have jurisdiction. Under current circumstances, cable and STV operators can use teletext techniques with or without adherence to a national standard, even though in the long run a standard would be desirable and beneficial in terms of decoder cost. However, there may be cases where the proprietary interests of an organization



Teletext signals are transmitted in the unused lines of the vertical interval, after the equalizing pulses (black bars). The digital data contains the information for making up teletext pages.

The master control room at KMOX-TV during the teletext testing period. Two additional TV receivers were installed: (left) a Thomson-CSF set working on Antiope, and (right) a Zenith receiver modifier to operate on Ceefax/Oracle.

American industry executives visited Antiope Labs (CCETT) in Rennes, France: (left to right) Robert O'Connor (CBS), Jean Guillermin (AVS), Walter Ciciora (Zenith), Bernard Marti (CCETT), Pierre-Yves Schwartz (CCETT), Bernard Lechner (RCA), John Lopinto (HBO), and Ed Martin (Cox Broadcasting).

set up to distribute programs and data for a fee are best served by having a nonstandard teletext system that is accessible only to the accredited subscribers. Broadcast teletext could become a technical quagmire if a national standard is not developed and implemented by the FCC, thus allowing each broadcaster to choose a different system. Substantial effort is being made in various committees to ensure that a single teletext standard is implemented in the next few years. It would offer certain advantages if that same standard were adopted across the board by cable, closed circuit, MDS, and satellite television organizations, and even by the interactive teletext systems (known as "viewdata") that use telephone lines for two-way access to data banks; this is less likely to happen because marketplace needs are simply too large and too varied.

Standardization Activities

After the EIA/BTS Teletext Subcommittee was formed, it received a series of proposals for a U.S. teletext system from three proponents representing the French, British, and Canadian systems, in that chronological order. The subcommittee and its working groups arranged to make comparisons and to monitor field tests.

The U.K. Teletext System

This system is based on a modified Ceefax/Oracle base operating on the U.S. scanning standards. It is a fixed format system with a directed relationship between the characters displayed on a line and the digital data transmitted on a (horizontal) line. It is claimed by its proponents to be the simplest, most robust system, with the lowest cost decoder. With over six years of operating experience in the U.K., there is a substantial amount of information available about its benefits and limitations. The detractors claim that the U.K. system is limited in its future flexibility because of its fixed (synchronous) format and because of its hardware orientation.

The French Teletext System

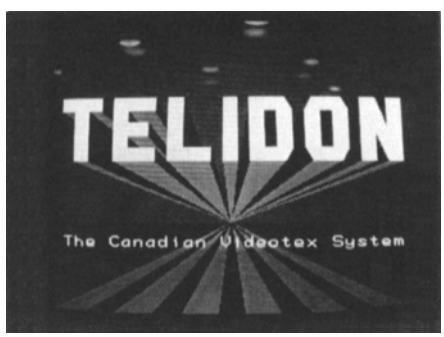
This system, known as Antiope, was developed in France by the CCETT in Rennes. It has also been adjusted to operate on U.S. scanning standards and the NTSC color system. Antiope is a variable format (asynchronous) system not tied to the horizontal line rate. The French have had more than three years of operational experience with the system and claim a number of advantages for it. Among these are greater potential flexibility, software orientation, a wider character set, and the option of better graphics through a downloaded alphabet system. It is also completely compatible with the interactive viewdata system developed in parallel with Antiope. Antiope critics say that the decoder costs will always be greater, and that the system, because of its complexity, is less robust in transmission.

The Canadian Teletext System

This system is known as Telidon and is the most recent entry into the EIA teletext evaluation and review of systems. The Canadian system is also variable format and in many ways resembles the French system in its alphanumeric mode. Its major advantage, claims the Department of Communications, which developed it, is that it produces much better graphics — by means of a technique known as alpha geometric. (The basic British and French systems use alpha mosaic.) The result is smoother edges on pictorial material and better resolution on line drawings. In addition, the Canadians claim to be able to handle a monochrome gray scale, which allows Telidon to display images of limited but useful quality. Those not favoring the Canadian system point out that these graphic advantages are obtained at considerable cost of additional memory and increased *access time*. It is predicted that this decoder would cost more than a decoder for either of the other two systems.

Comparison of the Systems

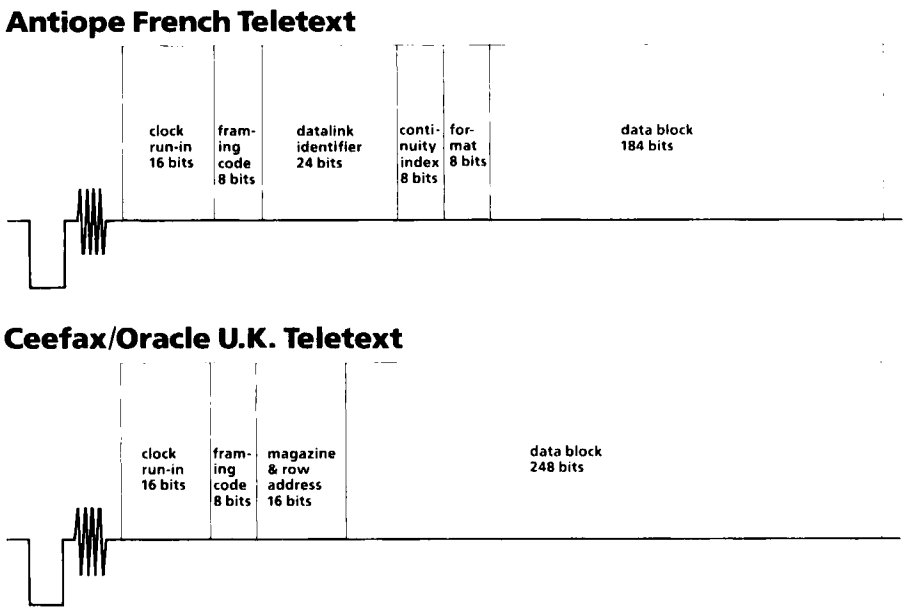
The three systems have been charted by the subcommitee to provide a basis for comparative analysis; how-



The Canadian teletext system, known as Telidon, makes use of an alpha geometric technique.

ever, the problem of deciding on a single system, or a hybrid constructed from the best features of each of them, is a difficult one. Notwithstanding a very heavy work schedule, frequent meetings, and the assembly of a large and highly competent panel of experts, no clear-cut decision has yet been reached, even though the original target date for such a decision has passed.

The current view among the various chairmen is that the subcommittee is about halfway through its work. Since they have spent 18 months to reach this point, if the pace remains the same, a final recommendation to the FCC representing a satisfactory consensus could be expected in February 1982. There would then be a further period of deliberation by the FCC before a national teletext service could be approved and implemented. To many of the representatives on the Teletext Subcommittee, this seems like an excessively long wait in order to achieve a public teletext service.



A comparison of the teletext signal formats for the French and British systems. One full horizontal line is shown for each format, starting with the horizontal sync pulse, then the color burst signal, and finally the digital data in the active line.

CBS Petition and Subcommittee Response

The CBS Petition

CBS has actively participated in activities of the Teletext Subcommittee and has been the first network to get permission from the FCC to run on-air teletext transmissions. CBS has also invested substantially in equipment and has conducted a large engineering effort to execute the field trials stipulated by the Teletext Subcommittee within the ruling of the FCC. As a direct result of these trials, which included side-by-side tests of both the synchronous fixed-format U.K. system and the asynchronous variable-format French system, CBS decided that it had sufficient technical and operational evidence to recommend a teletext system to the FCC. Feeling that the Teletext Subcommittee was unlikely to reach a consensus very soon, and that the time was ripe for implementing a teletext service, CBS decided to apply to the Commission directly.

In late August, 1980, CBS filed a petition for rule-making with the FCC, detailing their reasons for selecting an Antiope-based system for a U.S. teletext standard. The petition was supported by considerable documentation describing their KMOX-TV and network tests, and the specific advantages they felt this system would provide.

The overall posture of CBS as expressed in the petition is that they feel the state of the art of teletext has reached a point where it is ready for FCC action, and that the viewing public could be provided with a useful and practical service if the Commission were to move favorably on their petition.

The Subcommittee Response

The Teletext Subcommittee responded to the CBS petition with mixed reactions. The common denominator among EIA officials, task force chairmen, and subcommittee members was a feeling that CBS had been premature in their request for FCC action — that there were still a lot of facts to be assembled and assessed before a single system could be so definitively supported.

As a result of CBS's action, the EIA has asked the FCC for some time extensions to draft responses, and has encouraged the proponents of the other two systems to file their own petitions with the FCC on their own behalf. The steering committee meeting (on September 4, 1980) that followed the CBS petition included all the task force chairmen, a large roster of members, and continued participation by a CBS representative. At the end of a full day of discussion, Mr. Bailey Neal, Chairmen of the EIA/BTS Committee, announced that Mr. Bernard Lechner of RCA had been named Chairman of the Teletext Subcommittee. Mr. Lechner declared in the same press release that he expected his group to soon publish a preliminary report covering work to date and basic technical recommendations.

Further meetings of the steering committee and the task forces were scheduled for September and October 1980 to continue the work of this active group.

Acknowledgments

The author gratefully acknowledges all those who generously contributed information. Special thanks go to E.M. Tingley, Deputy Manager of Engineering for the EIA; Bernard Lechner, Chairman of the Teletext Subcommittee of the EIA/BTS Committee; and the Chairmen of four of the Task Forces who were interviewed: Carl Eilers, David Sillman, Shri Goyal, and Walter Ciciora.

Glossary of Teletext Terms

Teletext involves technical concepts that may be somewhat unfamiliar to television engineers accustomed to purely analog techniques. The following is a series of short explanations covering some of these items.

access time: the time that a viewer calling up a teletext "page" must wait until the digital data carrying that page first cycles by, and is then detected by the decoder, put in the page memory, and displayed on the screen. Assuming the teletext receiver has only a single page memory, the maximum access time is the full duty cycle of the sequenced pages. Since the viewer selects a page at random, the law of averages predicts that the median access time is half the maximum. Access time is a function of three variables: bit rate, number of lines allocated, and number of pages transmitted.

bit rate: frequency at which the digital data is transmitted, which can vary over a considerable range, depending upon the desired performance. A low bit rate enhances reliability, whereas a high bit rate gives more information or shorter access time for the same amount of information.

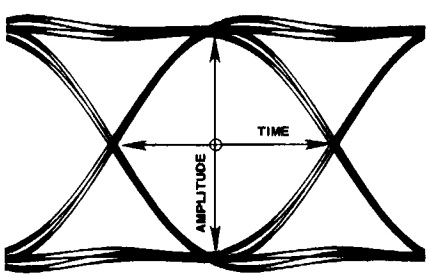
closed captioning: the captioning of a TV program via line 21 or by teletext means, in such a way as to render the captions visible to only those viewers equipped with a decoder. The program seen by other viewers is not affected by the closed captions. When captions are applied over the image so that all viewers can see them, it is referred to as "open captioning."

eye diagram: the pattern on an oscilloscope screen that determines what the data rate will be by characterizing the channel performance. The data are taken in their basic form, zero to one, and one to zero transmission. As the repetition rate produces the zero-one-zero transitions, a plot is made on a common axis. The oscilloscope presentation of this repetitious line sweep looks like an eye opening in the center. The size of the eye opening, or central aperture, gives a measure of the reliability of the transmission path. The larger the eye opening, the closer and more reliable it is to an error-free transmission of the teletext data stream. As the eye closes, it indicates interference due to noise, multipath, intersymbol effects (ringing), or potential decoder errors. The accuracy of the decoder is also measured by the eye signal display.

multipage memory: a memory in a teletext receiver that can reduce access time by storing additional selected pages that can be instantly called up, while the first page is being read or observed.

priority captioning: a captioning arrangement (more sophisticated than *closed captioning*) that uses the teletext page concept but directs caption signals for instant transmission so that there is no delay in putting the caption on the screen in synchronism with the dialogue. Further enhancements are also possible with this system.

teletext: a communication system which operates by inserting high speed digital signals (in the range of 3 to 7 Mbit/s) into the blank lines of the vertical interval for transmission along with the normal TV program. The digital data is sequentially cycled, thus repeating the information contained in it on a regular basis, and television receivers are fitted with a teletext decoder (either as an accessory device or integrated into the set) so that they can intercept the digital data in the vertical interval and display it on command as alphanumeric or graphic information.



The eye *diagram* is a pattern that is obtained by using a special oscillographic technique.

teletext editing console: a device used at the transmitting end to create the "pages" of information that will be "piggy-backed" with the TV program and radiated as a teletext service.

time domain equalizer: a device that compensates for certain types of distortion. The net sum of signals at the antenna includes the direct signal and the multipath reflections. It has been shown that multipath problems are equivalent to linear distortion, and that such distortions can be corrected by time domain equalizers. It is expected that such devices will enhance teletext operation in areas that suffer from ghost patterns on the TV screens.

training signal: a special pulse that is added to the TV signal at the transmitter and is currently being considered as an adjunct to a teletext operating system. The presence, in the TV signal waveform, of this special pulse of known position, amplitude, and duration enables the *time domain equalizer* to be used to detect the TV signal and its multipath reflections in such a way as to provide automatic compensation.

vertical interval blank lines: the few lines in the vertical blanking period that have not yet been allocated. There are still some unallocated lines even though the television signal waveform appears to be filled with analog picture information. At the present time, lines 10 through 16 are considered potentially useful for teletext or other ancillary services; lines 17 through 20 now carry authorized test signals; and line 21 has been allocated for *closed captioning*.