DOCUMENT RESUME

ED 229 808 CS 504 188

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TITLE KSL-TV--First in the U.S. with Teletext.
PUB DATE Nov 82
NOTE 19p.; Paper presented at the Annual Meeting of the Speech Communication Association (68th, Louisville, KY, November 4-7, 1982).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Information Services; *Telephone Communications Systems; *Television; Video Equipment; *Videotex
IDENTIFIERS *Station KSL TV UT; *Two Way Television

ABSTRACT

Under an experimental license issued in 1978, KSL-TV in Salt Lake City, Utah, provided 120 pages of teletext information to its viewers. In choosing this system, the station had to decide between it and a videotext system. Although videotext systems permit two-way communication, usually over telephone lines, teletext broadcast technology is much cheaper. The cost for a decoder, a critical factor in the consumer's acceptance of either system, is expected to decline for both technologies. In teletext, access cost is zero, while in videotext the information provider has the option of charging users. It is possible that videotext's interactive capability and superior graphics will increase its penetration into paying households. Although teletext and videotext provide similar mass market services, videotext has substantially more flexibility and speed. Since systems currently being used in different countries are incompatible, establishing technical standards in the areas of data format, transmission, and display is of key importance. Current trends and the growing home computer market favor the growth of videotext, but KSL-TV's experiment showed the value of teletext as an interim information system. (JL)

KSL-TV -- FIRST IN THE U.S. WITH TELETEXT

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Paper presented to the Annual Convention of the Speech Communication Association November, 1982.

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ABSTRACT

KSL-TV received the U.S.'s first experimental teletext license from the FCC on July 15, 1978. This article examines KSL's project and considers the trade-offs inherent in designing a teletext or videotex system.

KSL-TV FIRST IN THE U.S. WITH TELETEXT

INTRODUCTION

KSL-TV

KSL-TV operates on Channel 5 in Salt Lake City, Utah. Its signal is carried on an extensive translator network throughout Utah and in six surrounding states. In addition, various cable systems carry the KSL-TV signal. KSL-TV is a subsidiary of Bonneville International Corporation, a company privately owned by the Church of Jesus Christ of Latter Day Saints. Bonneville is active in a number of the new media technologies. In addition to the teletext experiment described here, Bonneville is involved in satellite uplink operations in Salt Lake City with plans for downlink facilities worldwide. In short, Bonneville's business philosophy encourages innovation in media technologies and their present holdings in media provide venture capital for experimentation.

KSL's Teletext

The FCC granted KSL-TV an experimental license to provide teletext service on June 15, 1978. The FCC has required renewal of this experimental license every three months since its July 15, 1979 expiration. As part of its license application, KSL-TV

chose to offer its service based on the British CEEFAX/Oracle technology. Oracle has been in use in the United Kingdom since 1973 and is the oldest teletext system in the world. CEEFAX has been operational since 1976.

The KSL-TV teletext signal is carried in lines 15 and 16 of the vertical blanking interval (VBI) as part of its regularly transmitted signal. This portion of the VBI does not conflict with the use of line 21 for deaf-captioning nor does it represent a full utilization of the VBI's information-carrying capacity. For example, CBS has asked the FCC to authorize teletext transmission on lines 10-18 of the VBI (4, p. 102). In response, the FCC proposed an immediate allocation of seven lines of the VBI for teletext and an additional four by 1988 when older, interference-prone TV sets have been retired (11). Therefore, KSL's experiment is being carried-out using less than twenty percent of the proposed bandwidth for VBI transmission of teletext.

In its experimental version, KSL's teletext service carries 120 pages of information. Each page can carry 20 lines of 32 characters. When readability is considered, each page is formatted to carry a maximum of one-and-one-half column inches of newspaper text. The system's potential capacity is 800 teletext pages and is created on a General Automation GA-16/440 minicomputer, a Tektronix R147 NTSC test signal generator and a keyboard for data entry and formatting. This equipment represents an investment of only $40,000 (6, 32).

To examine consumer response to their teletext system, KSL,

with the assistance of Texas Instruments, modified Zenith and Sony television receivers. Thirty of these modified receivers have been revolved through homes in different parts of KSL's service area. The receiver modification consists of a 4-inch by 6-inch circuit board mounted in the set's chassis and attached by a wire to a palm-sized decoder keypad. This modification represents an investment of $300 per receiver, nearly doubling the cost of an average color television. This cost was borne by KSL and not by the home users.

The 120 page data base provided in the experimental version contained a variety of information services. Stock quotations, weather service, news headlines, airline schedules and advertising were all represented. In general, the material was not updated on a regular basis. While this saved data-entry costs, the usefulness of the information was likely reduced.

To fully utilize the 800 available teletext pages, KSL has proposed, but not implemented, a touch-tone telephone access option. Although the standard page cycle would broadcast only 120 entries per cycle, home users could call-up any of the additional 680 pages by telephone. Pages requested by telephone would be interleaved at the end of the regular 120 page cycle. In this expanded version, there would be no physical interconnect between the phone and the decoder keypad.

Each feature of KSL's system represents a choice from among a number of options. The system choice mostly reflects the input of Arch Madsen, President of Bonneville, and Bill Loveless, Chief engineer at KSL-TV (6, p. 34). The next section

of this paper will present alternatives to KSL's choice and the trade-offs all system designers must face when asked to commit to this new technology.

SYSTEM DESIGN ISSUES

Teletext or Videotex?

The most important design decision made by KSL was to field a teletext system rather than a videotex system. Teletext systems can only broadcast text and graphics. Videotex systems permit two-way communication with the phone line usually linking the consumer back to the information provider. Currently, CEEFAX-based teletext is not compatible with the videotex systems operating in France (Antiope), Canada (Telidon) or the PLPS standard proposed for the United States by AT&T and its allies (2, p. 38).

System Costs

From the service providers point of view, teletext is a much less expensive technology for sending information. As mentioned, KSL generates teletext on a minicomputer-based system costing only $40,000. They report a system designed by Motorola that can create a limited number of pages for only $16,000 (12, p. 6). In Great Britain, where teletext is operational rather than in the experimental stage, a CEEFAX head-end computer system was installed for $120,000 in 1980 (7, p. 119). In contrast, Prestel's videotex system uses a computer center demanding a two-million dollar investment (7, p. 119). The recently announced Ridgewood, N.J. experiment is estimated

to require an investment in hardware that will exceed $10 million. AT&T, one of the principle sponsors of this PLPS-based videotex system, will bear this cost. (9. p.22).

Decoder Costs

Until recently, cost comparisons from the consumer's perspective have been equally favorable to the CEEFAX approach. While the KSL decoders cost in the neighborhood of $300 each to build, the decoder's cost is projected to fall to around $25 if economies of scale can be realized (12, p.7). In contrast, a recently displayed functioning PLPS decoder by Norpak has a list price of $1,300 (16, p.64).

However, as the PLPS standard becomes more and more likely to be adopted as the North American standard (1, p. 32), hardware producers have gone on record as predicting significantly lower costs for home decoders compatible with PLPS protocol. At Videotex '82, Texas Instruments demonstrated a prototype board compatible with PLPS at a mass-produced cost of $30 (16, p. 66).

The projected cost reductions reflect the sensitivity of very large scale integrated circuit (VLSI) technology to economies of scale. Currently, much of the costs associated with creating computer chips comes from research and development. Actual production is relatively cheap. Consequently, as the fixed R & D costs are allocated across large numbers of units, per-unit cost falls dramatically. Further, multiple generations of a VLSI technology can be retooled to incorporate improvements that become apparent with experience using earlier batches. For these reasons, prototype productions are inordi

nately expensive and likely to function more poorly than later mass production runs (10, p. 847).

Based on this cost analysis, the consumer's cost for a decoder will ultimately be quite similar, and quite reasonable, regardless of whether the system is CEEFAX or PLPS. The importance of the cost to the consumer for the decoder is reflected in a KSL-sponsored survey: the likely penetration rate for teletex was pegged at 67 percent if the decoder were available for fifty dollars. If the decoder cost were $500, only four percent of those polled expected to purchase one (14, p. 2).

Access Costs

Another component of the total user cost is system access cost. In teletext, users pay nothing for access to the information. In addressable videotex, the information provider has the option of charging users an access fee to defray the cost of creating and maintaining the data bases. Whether consumers would pay enough to support the costs of keeping large data bases updated is unclear. Compuserve, a timeshare system limited to text only (no graphics), may provide some measure of user willingness to pay access charges.

Compuserve's hourly connect charge during the business day is $22.50 per hour. After 5 p.m., the connect charge drops to $5 per hour (Compuserve Rate Card, 1982). The consumer membership has grown to 38,000 (October, 1982) but only constitutes about 5 percent of Compuserve's system's use. It has never made money but it is an economically viable service since it mainly provides an "off-load" revenue base. Most home users

access the system in the evening when the business customers aren't tying up the computer or communication lines. Compuserve expects the home market to someday contribute to the company's profitability.

Whether the home market could serve as a primary revenue source has not yet been determined. Prestel, the British videotex service, presently loses money on its 17,000 member base (2, p.38). And even in Prestel's case, 90 percent of the users are businesses.

CSP international estimates that only two percent of the U.S. households would pay $15-$20 per month for videotex information (5, p.65). George Murray, Vice-president and director of media for Ogilvey and Mather Canada, is considerably more optimistic and projects a 20 percent penetration by 1990 (1, p.33). Although projections must be treated with caution, CSP supports their data by reporting that the average U.S. household spends less than $9/month on all printed information that comes into the home, including newspapers, magazines and books (5, p.65).

Those who predict higher penetration rates for videotex rely on the attraction of noninformational services. Videotex can provide more than information, and teletext cannot. The consumer can transact over the system — paying bills, buying airplane tickets, and shopping at home. Direct mail marketers see videotex as an extension of the impulse buying potential of a mail-order catalog coupled to an 800 toll-free number. The interactive capability and the superior graphic qualities of videotex are important aspects of such a direct marketing

approach.

System Interconnect

One final economic consideration in the selection of teletext or videotex is the possibility of system interconnect. Since teletext is carried as part of the broadcast signal, the teletext bases of different station's cannot be linked together; though a teletext network could distribute a single teletext base among affiliates. The PLPS protocol supported by AT&T, Antiope, Telidon and CBS does provide for the interlinking of different data bases. AT&T has further proposed a "terminal dependent" solution to bring the 26-member CEPT consortium of European countries into the network.

AT&T stands to benefit considerably from a standardized service. Standardization would allow for "gatekeeping", the use of any host computer to access other host computer's in a network operation. This networking requires telecommunications, a service provided by AT&T through long lines, local loops, and satellite (COMSAT) systems. Though AT&T is soon to lose the direct-revenue base from the local loops, its "long lines" dominance would provide a lucrative profit base in a phone-line-based videotex system.

Consumer Acceptance

Consumer acceptance depends on the perceived value of the information received relative to the cost of acquiring it. Teletext and videotex both present similar "mass-market" services which include: (1) advertisements, (2) movie schedules, (3) news headlines, (4) stock market quotes, and (5) Community

bulletin boards. Videotex has substantially more flexibility for providing more detailed information over a wider range of topics.

Videotex's flexibility comes from it's ability to be addressed by individual users who presumably will ask for information of personal interest. From a marketing perspective, videotex services are targeted to meet the needs of young, affluent, two-income households which put a high premium on time. From this point-of-view, videotex will succeed or fail as a function of its relevance to the specific needs of this market (13).

For videotex, the possibility of customized service comes from the possibility to draw on a very large data base. The practical size of a teletext data base is limited by access time: users simply won't wait for information to be displayed on their home monitor. KSL succeeded in keeping average wait time to 15 seconds transmitting at a rate of 5.69 MBITS per second using 20 lines of 32 characters (14, P. 3). KSL concluded that a wait time of over 20 seconds would be unacceptable in the market.

In comparison, the average wait time in a videotex system is about five seconds (7). Further, in videotex the wait time is unrelated to the size of the data base; in teletex wait time is directly related. For example, Prestel's 220,000-page data base would have an average wait time of nearly four-and-one-half hours on teletext compared to five seconds on videotex. Given the need for a large data base to reach users with specialized

interests, videotex has a clear advantage over teletext in access time.

For this advantage to be meaningful, it must be demonstrated that the relative utility of videotex-packaged information exceeds that of other information delivery systems. Don Gale, Public Affairs Director for KSL, criticizes videotex as an "attempt to re-invent television on the vertical interval" (6, p.34). Banks, mail-order retailers, and data bank managers such as Dow Jones News Retrieval disagree, basing their argument on the interactive nature of videotex (13).

TECHNICAL STANDARDS

CEEFAX is incompatible with the "North American Broadcast Teletext Standard" (NABTS), the proposed standard based on AT&T's PLPS which is compatible with Antiope and Telidon. CEEFAX, developed in 1976, was designed to carry only the English language and relatively crude graphics. These limited needs reduce coding complexity and reduce the size of the needed symbol base.

A code that can carry other languages must be capable of mapping more symbols. For example, a coding scheme needs an additional 26 characters to capture the inflections of the Flemish language (7, p. 73). Similarly, sophisticated graphics require additional symbol encoding for detail and color diversity.

By the time a need for flexible coding schemes had become apparent, CEEFAX technology had become well-entrenched and expensive to change. Fortunately for the British, the large

United States market could be served with CEEFAX so their technology could be "exported" to the United States if interested licensees could be found. However, the French (Antiope) and the Canadian (Telidon) systems could also provide the English language service needed in the United States.

Attempts to define a United States standard began in 1978 when CEEFAX/Prestel, Antiope, and Telidon began preliminary marketing activities in the United States. In 1980 (after having experience with CEEFAX at KMOX-TV in St. Louis) CBS petitioned the FCC to accept the Antiope system as the U.S. standard. This was immediately followed by a challenge from the British. The FCC responded by proposing, in November of 1981, an "open environment policy", essentially deferring the issue to the marketplace for solution (11, 1981).

Since each system hopes to recoupe the huge costs associated with introducing their brand of the technology, the technical standards adopted in the potentially-large United States market are of crucial importance. There are three distinct technical standards to consider. They are: (1) data format standards, (2) data transmission standards, and (3) display standards. Each has been "solved" differently depending on which country has introduced the system. For this reason, the British CEEFAX is incompatible with the French Antiope and the Canadian Telidon.

Format Standards

Format standardization is the most serious impediment to technical compatibility. Ceefax requires a fixed format for

transmission. The advantage of this system is that the decoder in the home can be very inexpensive -- it simply generates the characters transmitted in one of 960 places (assuming a 40 character by 24 row system). Or, in the case of KSL, characters are transmitted to one of 640 places (a 32 by 20 matrix). KSL's format reduces the problem of receiver resolution and speeds up transmission by 33 percent (since fewer characters are sent). The trade-off is in graphic quality. The alpha-mosaic system as it is called can only resolve 640 distinct blocks resulting in graphics with "ragged edges."

Telidon and Antiope technology brought together under the NABTS proposed standard, use variable formatting of the data. Instructions are broadcast from the headend which tell the home terminal how to construct the image on the receiver. Theoretically, this allows resolution to be limited only by the number of phosphorescent dots on the receiver. Practically speaking, Telidon graphics are drawn in a 256 by 200 matrix which allows 51,200 addressable elements (15, p. 52).

The other significant advantage of variable formatting is that it allows packet switching of the data when transmitted through phone lines (7, p. 88). This reduces both transmission costs and wait time.

Transmission Standards

Transmission standards refer to the encoding of the signal at the broadcast facility: pulse shape, decay rate and transmission rate of the digitized signal. Of most concern to the consumer is transmission rate -- the faster the data is trans-

mitted the shorter is access time. All of the competing systems have agreed on 5.72 megabitz/second which permits 4-6 pages to be transmitted every second using two lines of the VBI. This translates into a maximum wait time of about 16-25 seconds for the average 100 page data base if the pages are transmitted in a continuous cycle (14, p. 3). If the pages can be randomly accessed as in videotex, transmission is nearly instantaneous. However, delivery over the phone lines is usually limited to 300 baud.

Display Standards

Display standards are the third technical area of incompatibility. Fixed format CEEFAX data must be transmitted within boundaries of the NTSC broadcast signal standards or interference with the picture results. For example, in early KSL tests, interference was a problem in approximately 5 percent of the test homes. The other problem involves the saturation and brightness of the display. Both picture characteristics are degraded in fixed format broadcasting to conform to the compromises necessary for black and white receivers to demodulate color programming (10, p. 847).

Telidon technology which addresses the decoder with instructions rather than data are not bound by the NTSC color broadcast limitations. If the receiver is equipped with a built-in decoder, each pixel can be addressed and the colors can be equivalent to those seen on an RGB color CRT display (10, p. 847).

CONCLUSION

With AT&T and CBS both on the side of the NABTS, its chances for market acceptance seem good (1, p.32). If AT&T's proposed terminal-dependent solution is accepted, every home decoder would be capable of interpreting the NABTS and the Prestel-compatible CEPT protocol (Ibid).

These market forces gain support as more and more potential videotex subscribers purchase home computers, with the "intelligence" to support videotex decoders. Currently, 621,000 U. S. homes are equipped with a home computer. By 1990, the figure is estimated to be around 6.8 million systems in the home. The business market is predicted to be even larger with 15 million units installed by 1990 (8, pp 170-171).

As home computers enter the home and expand in the business market place, cathode-ray tubes (CRTs) also will become more universally available. The CRT has far better resolution and color characteristics than does the typical TV receiver. These hardware trends position videotex as a value-added service rather than a stand-alone service.

Declining decoder costs, superior graphics and interactivity all favor the eventual adoption of the NABTS standard. Nonetheless, the low costs of starting a teletext system may prompt entrepeneurs to establish interim teletext services before market penetration makes videotex viable. Such an outcome would make KSL's modest investment, first-in-the-market experience, well worthwhile.

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