THE HOME INFORMATION TERMINAL—A 1970 VIEW

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Abstract

This article was published in *Man and Computer. Proc. int. Conf., Bordeaux 1970, pp. 48-57 (Karger, Basel 1972).* It is interesting to compare its 1970 proposals with the current situation, 30 years later. I have decorated it with footnotes commenting on the 1970 situation and making comparisons. Some of the improvements advocated in the paper are still yet to come. I claim quite a few prophet points for it.

The 1970 paper

Visionaries have often proposed [1] that homes be equipped with information terminals each consisting of a typewriter keyboard and a screen capable of displaying one or more pages of print and pictures. The terminal is to be connected by the telephone system to a time-shared computer which, in turn, has access to files containing all books, magazines, newspapers, cata-

[1] I was the main visionary. J.C.R. Licklider was another. I had vague hopes for a bandwagon effect by suggesting that there were a lot more. Doug Engelbart emphasized collaborative work on time-shared computers.

logs, airline schedules, much additional public information not now kept, and various files personal to the user.[2][3]

Through the terminal the user can get any information he wants, can buy and sell, could communicate with persons and institutions, and process information in other useful ways. Such a system has never come about because it costs too much, but with each advance in technology, it becomes more feasible. I think that the technology of computers, time-sharing, terminals, and application programming has advanced to the point where realistic estimates are possible of the remaining advances necessary to make home consoles feasible and useful. In this paper, I shall discuss the uses of the home terminal, some potential beneficial effects on society, estimate how far we are from a system people will pay for, and advocate some pilot projects, some standardization efforts, and some laws and regulations to prevent monopoly and secure adequate competition.

We can start with ordinary reading. To get a newspaper or book, I type its name or number and the first page appears. The most obvious benefits are:

(1) I can get any document instantly.

(2) My house is not full of paper to be sorted and put on shelves and dusted or put in the trash. Trees are not cut down, and air pollution does not result from burning the stuff.

Some immediately apparent disadvantages are:

(1) The expense. I will deal with this later;

(2) I cannot read in bed. The book-size portable terminal will come later. A household may require several terminals or perhaps we may have to compromise with sin and provide a hard copy terminal after all.[4]

There are two other immediate negative reactions:

(1) The average citizen is a TV fan and does not read anyway. In the first place, our system does not need so many subscribers to be economical.

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[2]I didn't think much about how many computers would be required. When I did, I underestimated it.

[3]2000 March 2: I did not anticipate the PC or the point-and-click way of using computers. The light pen was already available and it could have been used, but in fact I had a negative attitude towards the mouse. I also expected that the user would have more facilities for controlling the computer, e.g. to make macro operations. Point-and-click contributed to this loss of user control although it needn't have done so if text versions of the actions were kept accessible.

[4]The hard copy terminal would have been an electric typewriter or a teletype. I did not envisage cheap printers.

Secondly, after I have described all the bells and whistles, you will see that even the TV fan will be tempted, and you-oh socially conscious reader–may even want to coerce him into buying one or coerce the government into giving him one for free.[5]

(2) How can you think of one more convenience and comfort when the world will come to an end in 10 years unless menaces A, B, and C are dealt with immediately. In the first place, I do not think the world is about to come to an end or even that it is getting worse, and we Americans like new gadgets. In the second place, you will see that the new information system will make the public more responsive to the careful reasoning of you good guys and more immune to the blatant propaganda of those bad guys.[6]

In order to see the effects of the new information system, suppose that all book and newspaper information were so distributed. What changes would occur?

At present, a newspaper or a book is a package produced by a large organization.[7] In our new system, the physical production disappears allowing a much smaller organization to put out the same packages of text and pictures. Moreover, the user does not face a one shot decision to buy Life or Look. He will be able to read the 'cover' or table of contents of each and read such items as strike his fancy, and the system will bill him for what he reads from each source. In fact, since the cost of keeping a file of information in the computer and making it publicly available will be small, even a high school student could compete with the New Yorker if he could write well enough and if word of mouth and mention by reviewers brought him to public attention. What, then, is a publication in the new information system?

A publication is an organization that puts out a list of material it has edited and recommends to its readers. It helps its authors produce material that it thinks will suit the readers, and it has a financial arrangement with them about splitting the proceeds.[8]

[5] The Government and the socially conscious have noticed the "Internet gap" and aim to fix it. Maybe they will succeed.

[6] I think the 1970 doomsters were a little worse than the present day doomsters. Of course, some of the doomsters of that day are still active, but they have toned down a little.

[7] I didn't think of the resistance to being displaced these organizations would be able to mount. The clearest examples of such resisters are the publication organizations of scientific societies which are in principle non-profit organizations.

[8] The on-line publications do not yet think of themselves in this way.

There can be a wide variety of publications of different standards of writing and editing and different budgets for carrying out these activities.

However, they will all be equally accessible to all readers, and the only justification for an expensive editorial organization will be that it can produce a more popular package. The price of reading a package can be set by the publishers.

A reader may feel that he needs help in finding his way through the totality of literature available to him. Various people will be eager to make a living by providing it. A bookstore or library is a program that when called shows the 'covers' of publications. Reviewers will produce lists for him and make money when he reads their lists or by kickbacks from the publishers. 'Reading advisers' under some catchier name will offer to generate lists just for him according to a profile of his interests.[9].

Advertising in the sense of something that can force itself on the attention of a reader will disappear because it will be too easy to read via a program that screens out undesirable material.[10] However, people will still want to know what is for sale and will still want to see the seller's story about why they should buy it. Probably, Life will still be able to get money from advertisers; many people will still want to know what is advertised in Life, but those who do not want to know will be able to avoid it automatically.

Another effect is the possibility of frequent revisions of articles and books. An author can take into account new facts or other people's criticisms, and the revision will take effect immediately. This raises 1984ish possibilities, so it must be provided that old versions remain available. Those who suspect the whole system will keep their own copies of favorite material in their private files, on microfilm, or even on paper.

Public controversy can be carried out more expeditiously than at present. If I read something that seems controversial, I can ask the system if anyone has filed a reply. This, together with an author's ability to revise his original statement, will lead people to converge on considered positions more quickly than at present even if they do not come to actual agreement.[11][12]

[9] All this has happened

[10] This hasn't really happened yet.

[11] There are various proposals, but this hasn't happened yet. One can imagine Bush and McCain "truth squads" putting on their candidates' web sites arguments against the positions of the other guy. Personal attacks too.

[12] 2000 June 1: Today's New York Times has an article entitled "E-Mail Messages to the Press Have Made the Gore-Bush Race a Cyberwar" recounting how the Gore and

Famous authors will not need publishers because their loyal readers will have the system find their stuff automatically.

To summarize: the new information system will promote intellectual competition by reducing the price of entry, will permit readers to be selective, and will allow authors to revise material until they are satisfied that it withstands criticism as well as it ever will. This should make intellectual life more interesting.

The financial aspect of writing would presumably be as follows: a piece of written material has a price for reading it (this price may be zero for amateur writing, political propaganda, advertising, and for scientific journals). The reader's account is debited and the account to which the material belongs is automatically credited. The reader will have the system balk at what he considers overpriced material.

The new information system will have a profound effect on buying and selling. Sellers of movies, groceries, automobiles, plumbing services and cures for baldness will find it advantageous to list their wares in the information system together with current prices and availability. The user can place an order through the system as he can by telephone, but he can do much more:

(1) He can call on someone's program to scan the sellers of sports cars and propose what it considers the best deal. This program might even negotiate with programs representing the sellers.

(2) He can tell the system whether last year's cure for baldness worked and get a summary of the opinions of those who bothered to record their opinions of the cure he contemplates trying now.

(3) He can make an airplane or hotel reservation by interacting with a program the airline or hotel reservation company has written to tell him what is available. He need not suffer the delays you now get when you call an airline or travel agent at peak hours.[13]

(4) Individual design and construction services can be offered through the system although this requires the development of computer-controlled manufacturing techniques for various types of articles. The idea is that automated design programs can produce designs for articles meeting individual specifications. Either by himself or in consultation with an expert, an individual would use the system to produce a design and display how it would look

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Bush campaigns send dozens of messages per day to reporters. I suppose this is a partial realization of my 1970 prediction.

[13]All this has happened.

and possibly how it would perform. Candidates for individual design include clothing, furniture, boats, electronic equipment, houses, and even cars. The system would then produce the instructions for controlling machine tools, fabric cutters, and also printed instructions for the hand parts of the operation. In general, it should be possible to make single objects at little more cost than present mass produced objects. In some cases, there would even be savings, because mass production requires estimates of demand that are often wrong resulting in inventories that are expensive to sell or even have to be sold at a loss; the cost of this is made up by a general increase in prices.[14]

There are many more useful services that can be offered through the new information system and again the system is conducive to competition. Writing and storing a program and announcing its availability can be a very low capital operation, and the system can collect whatever price has been set for its use.

We could go on listing services that would come to be offered in a fully developed system, but now we shall list some services to smaller groups of users that are cheaper to provide and which will help get the system started.

(1) Calculation and facilities for writing, running, and debugging computer programs: This does not interest the general public much, but it is the present bread and butter of the time-sharing service bureaus that will grow into the new information system. At present, these service bureaus offer a very convenient way of doing small scientific and engineering calculations, but do not offer reasonable prices for big computations, and are only beginning to offer useful services to business firms.

(2) Editing: Anyone who writes (writers, journalists, scientists, advertising men, engineers and students) will benefit from using an editor program. It allows easy revision, can be made to check spelling, grammar, and punctuation, and will produce justified or other forms of elegant output and also indexes.

(3) Filing: Keeping personal files in the computer has great advantages once documents can be entered without retyping them, either because they have been prepared in a computer readable form or because a suitable page reader is available. Namely, one can retrieve any document on the basis of its characteristics without having taken the trouble to file it properly in the first place.

(4) Education: Computer-aided instruction (CAI) has advanced to the

[14]This hasn't happened yet. Maybe it will.

point that a number of courses or aids to traditional courses have been developed and have been shown to be useful. The main obstacle to the widespread use of CAI is economic, but new developments in display technology and communications give a reasonable probability of cost-effective systems within this decade. There is no special problem in having these systems available in the home as well as at school. This would be aided by standardizing course writing languages. Again, we should try to stimulate competition by encouraging the offering of courses in particular subjects independent of the schools.[15].

The development of such a system is probably inevitable (unless it is forbidden by law) as soon as costs come down to the point where it is profitable for time-sharing service bureaus to offer services to individuals. However, favorable policies will bring this about sooner and will make the effects better.

The main danger to be avoided is the creation of services of limited scope that through some avoidable feature cannot be expanded to provide the services mentioned here and many more.[16] Another problem is to avoid monopolies; the intrinsic nature of the system permits any person who can write computer programs to compete with large organizations in inventing and offering imaginative services, but one can worry that the system might develop commercially in some way that would prevent that. In general, we should try to develop information services in such a way as will enhance the individuality of its users.

Between us and the home information system lie a number of problems; some in developing suitable low-cost terminals, some in programming technology of time-sharing, some in the economics and politics of communication systems, and some in the attitude of the public and government towards innovation. In the following sections we shall discuss these problems.

How we Get There from Here

1. Consoles

The quality and price of display consoles is rapidly improving. At present, one can add a display console with keyboard to our laboratory system for about $ 700, but to add another part on the system so that the number of consoles active at one time is increased by one costs about $ 2,500. A reasonable display console that can be located at the end of a telephone line now costs about $ 10,000. These consoles are adequate for any of the services

[15]All these have happened

[16]Minitel in France was such a service, and the promoters of set-top-boxes are trying for such limited devices. I think they'll fail, and this is shown by the fact that companies like Ford are offering their employees PCs and not set top boxes.

mentioned in the previous section, although for reading purposes, it would be desirable to be able to display more than 35 typed lines at a time.[17]

In my opinion, the cost of an adequate display terminal that can be located at the end of a telephone line will be in the \$ 500 to \$ 1000 range by 1975 even without a market of the size of the potential home-terminal market. The business, engineering and science, and government markets will be large enough and price sensitive enough to bring this about.[18]

Another contender as a terminal is the plasma panel, but the above estimates are based on CRT terminals with a mini-computer and an integrated circuit memory.[19]

2. Communications

In the United States, the facilities for digital communications are growing rapidly but in a rather disorderly way because of the multiplicity of requirements of the different applications. Some applications such as credit verification require very low-cost short communications with turn-around times of seconds. Others require very low cost per bit but can stand delays of minutes and hence are candidates for low performance store and forward systems. The terminal systems require long holding times, short response times, and much higher transmission rates from the computer to the user than in the other direction.

For the purposes of the home terminal, the speeds of transmission over present unconditioned voice-grade circuits are a bit too low for such applications as reading. 1200 bits per second would take 20 sec to transmit a typed page and about 4 times that for a page of a dictionary. Eight times this rate is obtained over conditioned voice-grade lines, and this might be barely adequate. Perhaps a better bet is the transmission facility planned for the picturephone service now being introduced experimentally, but the cost of this service for long holding times is not yet determined. The most economical system might be a specially designed store and forward system configured to give fast turn-around for short messages.[20]

Whether such a service will be made available depends on political as well as technical factors. For example, if on the basis of present plans, the

[17] Remember that those numbers represent a larger fraction of a person's income than a PC does today.

[18] It didn't happen that soon, because the terminals were too elaborate.

[19] Plasma panels and the like are still an also-ran. The LCD panel didn't exist then.

[20] The Arpanet met this specification around that time, but its use was limited to laboratories supported by DoD. It gradually expanded till it became the Internet.

digital communication market is divided by regulatory action among AT&T and its potential competitors, it might turn out that no one is obliged or even allowed to offer the service required for home terminals at a reasonable cost.

3. Computer Technology

At present, computer technology can offer the services required for the home terminal at a reasonable cost, provided computer configurations are optimized for the purpose, provided reasonable load factors can be obtained, and provided there are reasonable economies of scale. Unfortunately, IBM computers are organized in such a way that time-sharing is very expensive because of their interrupt-structure, their expensive terminal multiplexors, and their dedication to the archaic half duplex method of communication. The other major computer manufacturers such as CDC, General Electric, and Univac are not in much better shape since they offer for time-sharing machines that were optimized for other purposes. Smaller companies like DEC are in a somewhat better position. However, none of these difficulties are permanent, and better organized computers may be expected once the factors in computer design that make for good cost-performance in time-sharing become clearer to the manufacturers.[21]

The present magnetic disk storage units are a bit marginal in cost effectiveness for use with home terminals. Thus storage on the new IBM 3330 disk would cost a user about \$ 0.03 per month to store a typewritten page making storage of extensive personal files expensive and private copies of books at \$ 5 to \$ 10 per month prohibitively expensive. This would not be too expensive for national libraries, but it would be economically very difficult to get enough readers to support the storage of books on magnetic disk files in the near future.

Fortunately, much larger files are becoming available. The laser file made by Precision Instruments Inc. is claimed to store a trillion bits and costs \$ 1,000,000. This comes to about \$ 4 per book which is reasonable even for single copies. Mass production of such files will reduce the cost even further.[22]

[21] The archaic features of IBMs computers lasted much longer than I expected.

[22] No-one, not even IBM, imagined how much that same old magnetic disk technology could be refined—mainly by IBM. This made the laser file an also-ran. It is now much cheaper to store a single copy of a book on your disk file than on your bookshelves. You still (2000 May) can't get the books you want unless they are among the more than 11,000 books in John Mark Ockerbloom's catalog of free on-line books, which have been entered

4. Computer Programming

The basic technology of writing time-sharing technology is reasonably well-developed in that cost-effective systems have been written, but there is still a lot of chasing of willow-the-wisps, and quite bad time-sharing systems are often produced by otherwise competent firms. Before the programming required to offer the services mentioned in the first part of this paper can be accomplished, some further advances need to be made including at least the following:

(1) the interactive and file reference aspects of programming languages and time-sharing systems need to be standardized so that an interactive system written in one system can be used in another that uses different hardware and a different time-sharing system. Without this it will be very expensive for new user services to get large markets unless some particular timesharing system gets a monopoly;[23]

(2) a system needs to be developed for representing text in a computer that will include the full variety of alphabets, type fonts and character sizes and also be adaptable to diagrams, drawings and photographs. The consoles also have to be adapted to this variety of styles. This is an ultimate requirement; much can be done with texts that are just regarded as sequences of latin letters;[24]

(3) the biggest task, however, is the application programming itself.

5. Commercial Organization

From a social point of view, one of the attractive features of the provision of time-sharing services is that it is not a natural monopoly. Communication is cheap enough for teletype-based time-sharing so that with local multiplexors, time-sharing bureaus can compete all over the United States. In principal, it should be possible to have world wide competition. The major force that might tend to reduce competition is the exclusive possession of proprietary programs or files. Therefore, it is desirable to separate the ownership of programs performing services from the ownership of the service bureaus themselves and to encourage enough compatibility between different time-sharing systems so that the owner of a service program could provide it on a number of machines. It is also important that important files be accessible and modifiable with suitable protections by actions initiated on

by various enthusiasts. The catalog is at http://digital.library.upenn.edu/books/. When I want to read such a book, I read it via Netscape rather than copy it to my own disk.

[23]This is the situation today including Microsoft's attempt to maintain a monopoly.

[24]This still hasn't happened in a uniform way. It's coming. It's coming.

other machines than the one that maintains the file.[25]

6. Needs for Research and Development

The hardware required for home consoles will be too expensive for extensive systems for probably another 5 years. In the meantime, research and development should be undertaken in the following areas:

(l) standarization of the interfaces of time-sharing systems and their languages;[26]

(2) experimentation with services. At present, it is very difficult to get support for development of generally useful services unless either it can be claimed that disaster will result from failure to support the activity or that the supporting organization will itself make a profit. This political fact is one of the reasons for the concentration on military technology in the recent past;[27]

(3) research aimed at devising ways of coordinating the great variety of time-sharing services into a mutually communicating network. Neither sufficient understanding nor sufficient political or commercial force is available to cause the development of timesharing services to proceed according to a unified plan. Nevertheless, computers are flexible enough so that originally incompatible systems can be made to communicate and use each other's services. Experiments with the ARPA network that provides communication between US Government-sponsored research computers will provide useful information.

7. Comments on the Conference

In general, the conference showed a poor situation in the scientific and technological community and also the public affairs community regarding technology and the human future. There were a few technically competent but rather narrow surveys of the state and prospects of particular tool areas of technology. There was much random doom-saying and denunciation of currently fashionable whipping boys. There was a fair amount of opinion that certain things should not be done. There was an almost total lack imaginative discussion of the opportunities technology offers us to improve human life. This lack was especially notable in those individuals and organizations that

[25]The prevalence of personal computers has accomplished the separation between ownership of hardware and the development of programs.

[26]It didn't happen and isn't happening.

[27]In 1972 the Stanford AI Laboratory, with most of the work done by Martin Frost, built an experimental online news service based on the Associated Press news wire. We never attempted to expand it beyond the AI Lab computer. It lasted till 1989.

are supposed to be professionally concerned with the matter. This essay represents a small effort to redress the balance.[28]

[28]This was a particularly bad conference in the above respects, but conferences dominated by equally bad attitudes persist to the present day.