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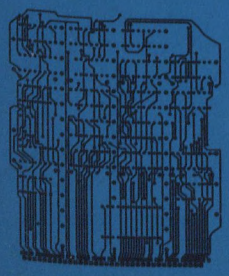
Background Papers

4 CATV Technology for Citizen Feedback to Government



4 CATV Technology for Citizen Feedback to Government

The
Canadian
Computer/Communications
Task Force

Background
Papers

4 CATV Technology for Citizen Feedback to Government

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December, 1971

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Preface and Acknowledgements

Professor Thomas Sheridan, Director of the Man Machines Systems Laboratory at the Massachusetts Institute of Technology (MIT), Cambridge, Mass., provided both research ideas and support for this paper. Noam Lemelshtrich, of MIT, travelled across the U.S. with me, visiting CATV experiments and gathering data for his own design of a CATV home-terminal. He and Taffy Hearne, of the University of Washington, and Dr. John Madden, of the Canadian Computer/Communications Task Force, were continuing sources of informed ideas. Part of the material in this report also appeared in a paper written for the Center for Policy Research, New York, and was sponsored by the Center and the Department of Political Science, MIT. The report was written in the summer and fall of 1971 at MIT and at the Four Winds Farm, Proctorsville, Vermont, thanks to the hospitality of Mrs. Richard Derby. (A further list of acknowledgements will be found in Appendix A, p.35.)

Introduction

In an article published a couple of years ago, Alan Westin constructed an imaginary scenario which described some possible future effects of the new computer technology on the democratic process.

The hero, Cosmo Pragmos, believed that he was participating fully in his government's decision-making. But his votes and opinions were having no impact. They were side-tracked away from the decision process and channelled through ''simtrack'', a mixture of real and manufactured data, designed to give citizens the illusion of participation in government.

This situation had come about because advances in telecommunications and computer-services had made it possible for efficient decision-makers to keep in touch with citizens' needs and opinions without having to cope with the confusion of popular reactions and participation; and for citizens to work for the political candidates of their choice and immerse themselves fully in the satisfying turmoil of democracy without ever leaving home. But the truth was that most of the candidates, issues, and turmoil did not exist. They had been conjured up by the Bureau of Political Simulations as the most cost-effective means of resolving the clash between expert planning and popular participation.[1]

A second scenario, more popular, but perhaps no more realistic than the first, projects the wedding of the new technology and politics in terms of electronically resurrected New England town-meetings. Every citizen would have an at-home computer terminal hooked up, via two-way cables, to a data bank and a computer. Citizens could use this technology to interact both with each other and with their government representatives. By this means, they might keep themselves fully informed and be able to take part in government decisions on a day-by-day basis, in wide-spread public debate and instant referenda. (Again, all this would take place without anybody having to leave

[1] Westin, Alan F., ''Prologue: Of Technological Visions and Democratic Politics'', *Information Technology in a Democracy*, Alan F. Westin (ed.) (Cambridge, Mass., Harvard University Press, 1971), pp.1-11.

their televisions — a kind of Athenian democracy without the need to walk to the Agora.)

Of course, both of these predictions are deliberate caricatures. Nevertheless, they do underline the fact that new and more accessible channels for widespread citizen involvement in government are becoming feasible; that these channels may alter the way we communicate with each other, and with our government representatives; and that new communications technology will be central to the provision of these channels.

Our purpose is to consider a few aspects of the problem: to wit, how to use the new information technology so that it meets the need for adequate "citizen feedback".[2] The paper is divided into four sections. The first presents arguments indicating that current feedback channels are inadequate. The second describes the technological alternatives which were being developed at the time this paper was written. The third section describes some current applications of this new technology, including experiments in which this author took part at MIT. The fourth suggests some possibilities for future action.

1. Citizen Feedback

Citizen feedback consists of information from citizens to their government about existing or proposed government programmes and policies. A telephone call to a town council member, a few tomatoes thrown at a podium, a brief to the government from the wheat farmer's lobby — all these are forms of feedback. This citizen feedback serves two purposes: it provides government decision-makers with the means of evaluating programmes and policies, so

[2] The term "Citizen Feedback" was first used by Chandler H. Stevens when he was science advisor to the Governor of Puerto Rico. See Stevens, Chandler H., "Science, Government, and Citizen Feedback", *Operations Research*, Vol. 18, No. 4 (July-August, 1970), pp. 577-91.

that they can make realistic judgements about future actions; and it provides the individual citizen with an opportunity to participate actively in those decisions which most concern him. Through this combination of feedback and response, the political system could be made to serve the needs of enough of society's members to reduce areas of stress and tension.[3]

Two categories of feedback messages are especially relevant to the present discussion. The first, called involvement feedback, includes any messages from citizens that are aimed at directly influencing government policy and decision-making. The second, called service feedback, makes up the bulk of citizen-to-government communication, and consists of requests, complaints, and a variety of other demands whose primary aim is to achieve access to government services.[4] Our main concern here is with *involvement* feedback; however, the two categories interact with each other, and, in so far as *service* feedback stimulates greater citizen involvement in government decision-making, we will be concerned with it as well.

Direct feedback channels include: elections, political parties, special-interest and pressure groups; letters, telephone calls, visits to elected representatives and government offices; demonstrations, confrontations, and riots. Equally important are supplementary channels, such as letters to the editor and open-microphone radio programmes. In spite of being at one place removed, these forums stimulate feedback that eventually reaches the government.

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[3] Easton, David, *A Framework for Political Analysis* (Englewood Cliffs, N.J., Prentice-Hall, Inc., 1965), p.128.

[4] Stevens analyzed feedback messages coming into the Puerto Rico governor's office and found that only 10.2 percent of messages were of the involvement kind, and 89.8 percent were requests for service of some kind. (Little, John D.C.; Stevens, Chandler H. and Tropp, Peter, "Citizen Feedback Systems: The Puerto Rico Model", *National Civic Review*, Vol.60, No.4 (April, 1971).) Similarly, a recent paper written for a course taught by Benjamin D. Singer at the University of Western Ontario, reported that feedback messages received by federal Members of Parliament representing the London, Ontario, area broke down to about 90-percent service and 10-percent involvement feedback. (See Claxton, John and McDougall, Gordon, "Information and Complaint Channels in a Canadian City", *Communications in Canadian Society*, Benjamin D. Singer (ed.) (Toronto, The Copp-Clark Publishing Company, 1972), pp.312-28.

(a) Direct Channels

Voting, political meetings, and other election activities provide a means of feedback that is accessible to most members of the population. However, the time between elections remains approximately constant, while TV and other media are providing more and more day-to-day information about government actions, and creating greater need for more feedback channels. Public opinion polls *can* provide timely feedback; however, a public opinion poll sample is restricted in size, and even if it accurately reflects public opinion, it still leaves a large number of voters feeling that they have not been heard.

Letters, telephone calls, and visits to elected representatives provide another means of access, but these channels are not equally open to all citizens. Response to letters can be slow, and there is no guaranty of their reaching their intended target. And writing a letter can be a formidable challenge to a citizen with very little formal education.[5] Telephone calls are not always a practical alternative. A $2.00 telephone call to Ottawa is relatively more expensive, for example, for a textile mill-worker in Quebec than for a well-paid executive. Also, the latter is more likely to get through, although his needs are not necessarily more pressing. Last is the alternative of personal visits, but these are limited by time, money, and practical opportunity.[6]

Of course, for all the reasons stated above, political feedback channels have always been biased. But this bias has traditionally reflected the power relationships in the society, and these relationships are now changing. One of the costs may be that the decision-makers will find that biases built into the present system are no longer reliable guide-lines for defining political

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[5] Peter Regenstreif's observation that few Canadians take advantage of their right to send postage-free letters to Members of Parliament indicates that the problem goes much further than the cost of stamps. For Regenstreif's comments, see Department of Communications, *Telecommission Study 6(a): Report on the Seminar on Telecommunications and Participation* (Catalogue No. Co41-1/6A; Ottawa, Information Canada, 1971), p.22.

[6] Singer, Benjamin D., "Access to Information: A Position Paper on Communication Channels and Social Change", paper presented to the Information Overload Panel of the Telecommission Seminar on Access to Information (*Telecommission Study 6(b)*), Ottawa, May 4, 1970.

priorities. Evidence for this is the increasing use of demonstrations and direct confrontations by groups whose feedback responses have been traditionally stifled.

Various attempts are now being made to overcome this problem of non-communication. For example, one experiment took place in Puerto Rico, where toll-free telephones were installed around the island. These connected callers directly to members of the state governor's staff. The immediate result was to make it clear that useful feedback can, indeed, be increased when easier access to government channels is provided. On the other hand, it also made it clear that the new feedback methods were most readily used by citizens who were already in the habit of communicating with their government. There was little indication that it provided an effective stimulus for the involvement of new participants.[7]

Another citizen feedback programme is now being tried in Boston and New York, where small City Hall branch offices have been set up to provide clearing houses which offer information regarding municipal government and related services. A further proposal, now under study in Boston, is to organize the storage of full information about employment programmes, welfare, rent control, and a whole range of locally-available government services. These will be located in one data bank, which will be accessible to staff members at City Hall, the Massachusett's Governor's office and several local service agencies, and its main purpose will be to respond constructively to citizen's questions and requests.

Once this service is developed, it will be integrated into a new feedback handling system, which is now getting underway in the Massachusetts Governor's office. This system involves storing information about citizen feedback messages on a multiple-access computer, to allow staff members to follow up outstanding requests and problems, thereby providing the Governor and his staff with more adequate information about citizens' opinions and

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[7] Gusdorf, N.; Stevens, Chandler H.; Little, John D.C. and Tropp, Peter. *Puerto Rico's Citizen Feedback System, Technical Report No. 59* (Cambridge, Mass., Operations Research Center, MIT, April, 1971).

complaints. Preliminary reports about this computer-aided handling system have been promising.

In conclusion, although these new means of access to feedback channels will not necessarily provide any ultimate solutions, they are an encouraging step forward. Evidence already exists to show that the new uses of information technology can increase access to current channels, as well as expand government awareness of (and responsiveness to) these channels.

(b) Supplementary Channels

An important aspect of this review of current feedback mechanisms is the public-opinion forums, such as letters-to-the-editor and community television. These forums sometimes result in the direct delivery of queries and opinions to the government, but their relevance to the present argument is that they do involve people in a variety of public-affairs discussions, thereby crystallizing a number of opinions that can be later translated into feedback.

Such channels also yield increasing evidence of the growing demand for access to the sources of power. Even though newspapers commonly print only a fraction of letters received, there has been a recent proliferation of "op-ed" pages, which have opened up a second editorial page for the expression of readers' opinions.

The same process is becoming visible (or at least audible) in radio call-in programmes. Even though these are often stridently a-political, they provide an early hint of the possibilities of electronically-aided public-affairs discussions, particularly when the audience can question a public figure, although at present, the programmes are limited by the participation of only one speaker at a time, as well as by the gate-keeping control of the moderator.

Another alternative is community videotape facilities and public-access CATV. Programmes made with these facilities include discussions of public issues, such as the one originated by le Videographe in Montreal, Intermedia in Vancouver, and by the Extension Service of Memorial University in

Newfoundland.[8] However, most of these are limited for purposes of political feedback, because of the number of active participants they can involve at one time.

Some programmes have come a step closer to active audience participation by inviting viewers to state their opinions on a given issue by calling one of two telephone numbers — the first number is for voting Alternative 1, the second for voting Alternative 2 — or by asking viewers to send in postcards or to return specially-printed computer-readable cards. The telephone technique has reportedly been used on local CATV programmes in Fredericton, New Brunswick.[9] However, this method involves the inconvenience of leaving your TV set, as well as having to remember a seven-digit telephone number. It also makes it possible for one individual to vote as many times as he pleases, and, as Edwin Parker of Stanford University has said, ''such ballot-stuffing is frowned on in many democracies''.[10]

A further step toward electronically-aided participation was taken in 1971 by Thomas Sheridan, Chandler Stevens, this writer and other members of the Massachusetts Institute of Technology's (MIT) Citizen Feedback project. Subscribers to a suburban Boston CATV station were given an opinion questionnaire regarding local school-issues, with an attached computer-card reply form. For three consecutive evenings, a programme was then broadcast, showing a studio audience of local citizens involved in a discussion of the questionnaire.

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[8] Salmon, Dallas. *Radical Software*. Canadian Section. No.4 (Summer. 1971). p.4.

[9] The telephone system cannot handle a large number of calls on a single number at a given time. The cumulator, or device which sends the busy signal when a line is occupied, can be used to count the number of calls which do not get through. But even the cumulator cannot handle much more than 1,000 calls in fifteen minutes.

[10] Parker, Edwin B., ''On-Line Polling and Voting''. *Planning Community Information Utilities*. H. Sackman and B. Boehm (eds.) (Montvale, N.J., AFIPS Press, 1972). Chapter 4.

Each member of the studio audience held a small "voting box" in his lap. It was explained to members of the at-home TV audience that their computer-card reply forms were substitutes for "voting-box" responses.

Each box had six switches to indicate alternative responses to multiple-choice questions. While the studio audience was voting, the TV audience was also encouraged to vote by filling in blanks on their computer cards. After each vote, the moderator flipped a switch to display a tally of how many studio votes had been cast for each category, and representatives of each category were then invited to speak. The results were not an unbiased sample, but they provided useful feedback regarding the views of students, parents, and teachers on the subject of education.[11]

(c) Conclusion

Citizen feedback can be increased by giving citizens (i) more opportunity to acquaint themselves with public issues, (ii) more access to feedback channels, and (iii) more government responsiveness to feedback information. The MIT experiments, although just a drop in the bucket, suggested a prototype format for use on broadband two-way direct-to-home distribution systems,[12] which could be either CATV or common-carrier systems. The emphasis in this report is on CATV rather than the common-carrier facilities.[13] However, much of the

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[11] For a thorough report see *New Technology for Citizen Involvement*, preliminary report to the Massachusetts Department of Education, MIT Operations Research Canter, July, 1971. A similar use of audience involvement via computer cards was developed for educational TV five years earlier by Television educative de Québec. Several thousand adult residents of Northern Quebec's Lac St. Jean region signed up for special education courses that raquired daily filling in and mailing of cards corresponding to the lasson of the day. When the system got underway it was handling some 15,000 cards each day and over 6,000 people completed a two-year course and received diplomas certifying ninth grade education. (See Leduc, Nicole, *Radical Software*, Canadian Section, No.4 (Summer, 1971), p.8.)

[12] Broadband cable is used in part of the common carriers' plant as well as in CATV distribution systems. In most cases, only CATV Systems deliver broadband capability into the subscriber's home. The Canadian Radio-Television Commission now allows CATV operators to provide up to 20 TV CHANNELS on this wire. U.S. systems are now being installed with considerably more. These are discussed in the next section.

[13] Over 25 percent of all urban Canadian households are wired for CATV, and the Vancouver system, with over 100,000 subscribers, is the world's largest. (See Canadian Radio-Television Commission, *Cable Television in Canada* (Ottawa, January, 1971).)

discussion about home-terminal design, interactive services, and goals for political participation applies equally to common-carrier facilities regardless of who owns the cable hardware.

The history of CATV companies in Canada does not allay some people's doubts about how well the responsibility for providing two-way services will be handled. Although giant CATV operators in Toronto, Vancouver and Montreal have invested in significant research, the industry-wide investment has been small. Many companies required considerable prodding from the license-controlling CRTC to make any investment in community broadcasting.[14] We can only hope that there was no particular significance in the subject chosen for the world's first CATV election, held on an experimental two-way CATV system in Manhattan, New York. When voters were given push-button vote boxes to make their opinions known, it was not to resolve a burning public issue, but to choose Miss Home Terminal, 1971.

In spite of the reservations one may have about CATV as the vehicle for more citizen participation, CATV has already appropriated a fat piece of the "Wired City" pie. The widespread use of CATV channels for two-way communications with data banks is likely to come about within the next fifteen years.[15] So now our main concern is not *whether* to use this combination of computers, broadband channels, and subscriber terminals — but *how*.

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[14] At least some systems have taken their local origination responsibilities seriously. Systems we visited in Vancouver, Calgary, and Toronto were all actively engaged in local origination programming, and many smaller systems spent more than $20,000 each originating about ten hours a week last year. (See Canadian Radio-Television Commission, *Cable Television in Canada*.)

[15] Department of Communications, *Telecommission Study 6(d): Report on the Seminar on the Wired City* (Catalogue No. Co41-1/6D; Ottawa, Information Canada, 1971).

The following section examines technological alternatives relevant to more effective feedback. To get my own bias on the table, I am not suggesting the technology offers any panacea, any cornucopia of political involvement. Without adequate planning, it is more likely to aggravate than to reduce social and political problems. And, in my opinion, our history of adequate planning for new technology has not been good. If access to feedback channels is already biased, the development of more sophisticated citizen-to-government channels may well increase this inequality. And if feedback messages from whole categories of citizens are often disregarded today, the new technology, if allowed to proliferate without the necessary controls, is likely to increase the isolation of these citizens from the political process.

2. The Technology

The technology of two-way CATV is made up of two quite independent components: the distribution system, including the cables, head-end equipment and paraphernalia that carry information to and from the subscriber, and the terminals that display the information and allow the subscriber to interact with it.

(a) Distribution Systems

There are two alternative kinds of broadband distribution systems: a trunk-type network and a switched network. The trunk-type system is standard for CATV operations in Canada and the U.S. The trunk line, carrying six, twelve, or as many channels as the system provides, is installed in a given community, and subscribers who want CATV service are provided with a branch that carries all the trunk's channels to their TV sets. Signals travelling along the trunk are renewed and passed along by amplifiers spaced at regular intervals. The switched network operates more like a standard telephone system. Each subscriber is provided with private wires, which connect his house to a central programme exchange where he can be plugged into as many channels as are available.

Two-way communications are made possible on trunk-type systems by the use of two-way amplifiers and filters, or by the use of two side-by-side cables, with each carrying information in a different direction. In switched systems, the subscribers' private wire goes direct to the programme exchange. If the distance between the subscriber and the exchange is less than 2,000 feet, amplifiers are not necessary. But the savings in amplifier costs have to be weighed against the expense of the programme exchange centres, and the expense of wiring between the centres. In an average-density community, about ten programme exchanges per square mile would be needed to avoid the need for amplifiers.

In the trunk-type network, if developers want to expand channel capacity beyond what can be done with converters and amplifiers, new cable has to be added throughout the system. And, if they want to expand channel capacity for a high-demand area, they have to expand equally for all areas. In the switched system, more channels can be made available by expanding the capacity of the switching equipment at the programme exchange and expanding the capacity of the cable connecting the programme exchange centres to the head-end; however, a significant part of the system, the wire connecting subscriber exchanges, need not be replaced. In addition, the switching equipment and connections between programme exchanges can be expanded selectively for high-demand neighbourhoods.

Lastly, in trunk-type systems subscribers can transmit considerable amounts of data upstream to the originating centre or central computer, but because of the channel space required to transmit TV pictures, upstream video will probably be limited to three or four channels in a system; this means no more than three or four subscribers can send upstream video at one time. But in the switched system, the only limitation on subscribers' upstream TV originators is in the switching equipment.

The disadvantages of the switched system include high cost of the hardware, and the charges associated with space rental for the programme exchanges. In addition, there are few examples of switched CATV; the British Post Office has been supporting research in the area, and a small demonstration system has been installed in Dennis Port, Massachusetts. A modified switched system

is being installed in Daly City, California, and another in Orlando, Florida. (See Appendix C.)

Table 1 shows some of the costs for four alternatives that seem to be available to Canadian developers. These figures are based on a 10,000-subscriber system with 50-percent market penetration.[16] Per household costs are largely determined by the penetration rate. At a rate of 80 percent or higher, the investment per subscriber could fall by a third or more. Studies of expected CATV penetration in major urban U.S. markets, where several TV channels are often available, indicate that only some 35 percent of households would be willing to pay for current CATV services. In Canada's major urban markets most households are limited to one of two channels without cable; so expected market penetration is substantially higher. The per household cost of both one-way and two-way CATV systems could then be lower in Canada than in the U.S.

The first entry in the Table shows installation costs of a typical existing twelve-channel one-way system. To convert the cable to two-way requires replacement of current amplifiers and the addition of special filters, at a cost of about $25 per subscriber, and another $20 per subscriber to modify the head-end (including costs of a mini-computer, subscriber billing mechanisms and the like) for a total of some $170.

In the second alternative, the channel capacity is doubled by the use of converters worth some $20 each, and the channel is retrofitted for two-way by the same method as above. The problem here is that the expansion from twelve to twenty-four channels assumes a high-quality cable capable of handling 300 MHz and, until recently, these have not been standard equipment.

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[16] Costs shown here are consistent with figures from John P. Thompson of Arthur D. Little, Inc. (*The Optimum Cable Telecommunications System*, paper presented at the 20th Annual National Cable Television Association Conference, Washington, D.C., July 7, 1971), and the Dominion Bureau of Statistics, *Community Antenna Television* (Catalogue 56-205; Ottawa, Information Canada, 1969)). Figures for costs of trunk-type cable systems are somewhat higher than recent estimates by D.A. Dunn of Stanford University ("Cable Television Delivery of Educational Services", *Eascon '71 Conference Record (IEEE), Washington, D.C., October, 1971, pp.157-63).*

Table 1

	Investment/Subscriber			
	Initial Cost	Modify Cable for Two-Way	Modify Head-End for Two-Way	Total for Two-Way
	$	$	$	$
Typical 12-Channel One-Way Cable	125	25	20	170
Convert 12- to 24-Channel One-Way Cable	145 (includes converter)	30	20	195
New 24-Channel Two-Way Cable	150 (includes converter)	—	20	170
Switched 36-Channel for Two-Way Cable	350	—	20	370

This leaves the two alternatives of a new twenty-four-channel trunk-type, or a thirty-six-channel switched system. The latter offers more channels and more versatility in terms of selective expansion of the system and two-way video between the subscriber and the head-end, as well as the possibility of later development into a point-to-point picture-phone-type system. However, the latter costs more than twice as much; and these costs do not include rental costs for the programme exchange centres, video switching gear that has yet to be developed and obsolescence costs of trunk-type systems that have already been installed. And at present there is not sufficient evidence regarding the widespread need for switched systems to justify saddling subscribers with the extra costs.

- *Home-Terminals:* The second component in a two-way CATV system is the subscribers' home-equipment that hooks up to the distribution system. Three examples of terminals will be described here. All are compatible with the two-way distribution systems discussed above.

- *Hughes Aircraft System:* In this system, now being tested in the Los Angeles area, each subscriber uses a standard TV, and a console made up of a keyboard and a small

strip-printer. The TV and console are hooked up to a unit containing a limited digital memory and a converter to translate between the home-equipment and the cable. The cable links subscribers to a computer at the head-end, or programme originating centre.[17]
The subscriber can enter messages of up to twenty-six-bit characters at a time. After twenty characters a ''busy'' signal on the response pad lights up until the data has been transmitted, and the subscriber can enter additional characters. Messages are transmitted when the computer sequentially polls each subscriber, to see whether a request has been ''entered''. Typically, for a system with 10,000 subscribers, the response time would be less than two seconds, although this could vary from one to ten seconds, depending on demand.
Since the message from the subscriber automatically includes a combination of sixteen bits that constitutes his ''address'', it is possible to identify each subscriber and to send the appropriate response to his request, including the bill.
The subscriber's console is not much larger than a telephone. The ''keyboard'' includes ten numbered buttons similar to those on a touch-tone telephone. Additional buttons are for often-used messages such as ''send'' and ''print''. The printer writes messages along a half-inch-wide strip of paper that streams out the side of the console; and if this is not fast enough, a hundred-words-a-minute printer is available.
The cost of the basic home-terminal described here, including the keyboard strip-printer and converter-plus-memory, is approximately $200, excluding the cost of a TV set, and modifications to the cable and head-end of the system.[18]
A lower-cost alternative terminal that is compatible with the system has been suggested by John P. Thompson of Arthur D. Little, Inc.: a simple four-button pad, that could be made available with the necessary peripheral equipment for about $85.[19] However, the forfeiting of print capability or equivalent message-checking and feedback device is a considerable loss: it also means the subscriber cannot receive individualized messages. The price difference between the cost of four buttons and ten buttons is very little. The price difference between the two terminal designs is due to the cost of the memory and strip-printer.
A range of relatively low-cost computing equipment could service the Hughes system. Hardware in the demonstration model includes a PDP-11 mini-computer, modified slightly

[17] Durfee, E.W. and Callais, R.T., ''The Subscriber Response System'', *National Cable Television Association, 20th Annual Convention Official Transcript, Sheraton Park Hotel, Washington, D.C., July 6-9, 1971*, pp.28-48.

[18] Dunn, *op. cit.*, pp.157-63.

[19] Thompson, *op. cit.*

to convert the simultaneous input-output of the computer into serial form.[20]

Designers of the system emphasize pay-TV (first-run movies, special-interest programmes for doctors), shopping from the home (with video camera jacked into the cable at a local supermarket), computer-aided instruction, reservation services, meter reading, and the like.

Through a very simple use of the same hardware, viewers could be polled on a multiple-choice question and their vote tallies translated into a bar-graph on the display screen at the processing centre, and transmitted back to the home. The computer could be programmed to accept no more than one vote from each address; or to accept votes only from a pre-defined sample of the audience.

With access to upstream TV channels, groups in the community could use lightweight video cameras plugged into the cable to transmit sound and picture to the originating centre. Thus, the moderator of a political discussion could interact with TV viewers, mixing tallies of audience voting, sound and video-input from separate groups, and discussion in the studio.

The Hughes system has moved beyond the experimental stage; market tests are now being conducted, and reported plans are for installation of some thirty terminals in El Segundo, California during 1972.

- *The Vicom Manufacturing Co. System:* At least as sophisticated a system is being tested by TeleCable Corporation, in Overland Park, Kansas.[21] Another Vicom installation is in operation in a major Detroit-area automobile plant. Along with hardware design, Vicom officials have focused considerable effort on software development.

In the Hughes system terminals could be modified to permit voice communications; however, every Vicom terminal is equipped with a microphone. Subscribers' comments can be carried up the cable to the programming centre and immediately retransmitted to the whole audience, allowing a sort of party-line format without the complicated switching that such an arrangement requires via telephone. If too many subscribers wanted to talk at one time, access could be controlled by a moderator or by a computer programmed for such predetermined criteria as geographic location, or waiting time. Both Hughes and Vicom terminals have similar telephone-like touch-tone pads.

In the Hughes system, subscribers could send a TV picture upstream by a special jack into the cable. Such jacks could presumably be installed in city council chambers, schools, supermarkets, and the like. In the Vicom terminals the input jack is standard equipment.

Vicom developers estimate current terminal costs at $265, with a projected price of $180 in mass production. A conservative estimate for this paper, assuming mass production, is $225. Modifications for audio and a video jack would cost about $25 per terminal.

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[20] The computer has a core memory of 24,000 words, a disc memory of 256,000 words, a seven-track magnetic tape drive, and a card reader. The processing centre includes a teletype unit and a graphics display screen.

[21] Vicom officers indicated they have discussed doing research on two-way applications in Canada, with representatives from Maclaan-Hunter Cable TV Ltd.

- *The MITRE Corp. System:* A third terminal design is under test in Reston, Virginia. The most interesting aspect of the system is that it uses time-division multiplexing and a "frame-grabber" to permit up to 600 subscribers to receive individualized TV pictures on a channel that would normally carry only a single programme.
A standard TV picture is made up of 525 horizontal lines. In the first 1/60 of a second, lines 1, 3, 5, etc. are transmitted; in the next 1/60, lines 2, 4, 6 are transmitted. Sixty discrete transmissions and thirty full pictures are sent over the cable channel every second, giving the illusion on the screen of continuous movement. Continuous movement is not required for many home uses of computer-aided programming; so instead of sending sixty transmissions per second to all subscribers, the technique used is to transmit individualized pictures to each subscriber. If each subscriber needs a full picture every second then the one channel could provide individualized pictures for thirty subscribers. In the MITRE demonstration, it is assumed that each subscriber needs only half a full picture every ten seconds; thus 600 can share one channel.
The computer can identify each subscriber by a distinct "address" and can include the address in the response.
The home-equipment is made up of a standard television, push-button telephone and helical scan videotape recorder, and a coupler/decoder that checks the cable to find pictures directed to the subscriber's address. An individually addressed picture is then routed to the videotape recorder where it is recorded, and then repeated continually until a replacement arrives.
If the subscriber wants to use the interactive system, he switches the coupler/decoder to "private mode", and telephones the MITRE computer, which, in turn, transmits a directory of services available for the day, and instructs him to press the telephone button corresponding to his interest. The user continues to communicate with the computer through the telephone network, and the computer responds via the TV screen, and at times over the telephone line. If the subscriber wants normal television service, he switches the coupler/decoder to "public mode".
The computer-aided programmes to be made available include two series for teaching mathematics to young children, doctors' appointment schedules, classified advertisements, the Reston Telephone Directory, a weekly calendar of special community events, TV guide, weather forecasts, sports, and stock-market results.
The MITRE experiment is not intended as an operational system but as an example of what can be done with available tools. The most interesting feature, the technique of frame-grabbing, is fully compatible with the two-way systems described above. While current costs for frame-grabbing equipment are high, a variety of storage-tube techniques are becoming available. A single-frame local storage device will probably be available within the next year or two at a cost of some $190. So a conservative estimate of the cost of a subscriber terminal with a push-button response pad, strip-printer, audio capability, video input jack and frame-grabber is $425.
The usefulness of telephone lines for upstream transmission would be

limited in a much larger system, mainly because telephone-switching centres are built for an average connection time of a few minutes instead of the half-hour or more that may be involved with interactional TV programmes. However, it appears that the telephone system could develop special switching centres for such lines that would make the per hour connection costs competitive with upstream CATV transmission.

At least two other home-terminals have been suggested for use with TV and voice-grade telephone lines. One is a combination keyboard-modem that includes an acoustic coupler for a telephone receiver, and an attachment to hook up to a standard TV, to display eight thirty-two-character lines. Noam Lemelshtrich of Man Machine Systems Laboratory (MITs) recently suggested several techniques for providing a screen that could be fitted over a TV picture, and connected to a telephone line, that would register any point on the screen indicated by the user. One technique would be to use a matrix of "electric eyes", that would register where a finger or pointer touched the screen, and then send the information about the two co-ordinates over the telephone wire to the computer. Another would be to use a sound pen that emits ultra-sonic waves; the position of the pen is detected by sensor strips mounted on the edges of the TV screen. A third alternative is to use a "graphic tablet" that includes a matrix of almost invisible wires which sense the location and movement of an indicator. A fourth, recommended by Lemelshtrich, uses two potentiometers, manipulated by a hand-controlled joy-stick that causes a point on the screen to move to any desired position, to indicate some desired choice or command. The latter would be compatible with a frame-grabber and could be produced in quantity for some $70, or including frame-grabber, for some $260.[22]

Two additional two-way systems are briefly described in Appendix D.

(b) Costs

The following Table summarizes costs for the distribution system and home-terminals, and shows estimates of operating expenses. The monthly hardware costs are based on the sum of three components: an annual amortization of cable, home-terminal and head-end equipment at 12-1/2 percent/year; a maintenance cost of 5 percent, and a return on capital investment of 8 percent.

[22] Lemelshtrich, Noam. "Comparative Study of Screen-Feedback Techniques for Home Terminals", to be published in a forthcoming book, *Talking Back: Citizen Feedback and Cable Technology*, Ithiel de Sola Pool (ed.) (Cambridge, Mass., MIT Press, Spring, 1973).

Operating expenses (including salaries, electricity, advertising, office supplies) are only approximate. For the standard one-way twelve-channel system, the figure of $3.24 is based on past CATV industry performance, where ratio of operating costs to annual hardware costs has been about 55:45.[23]

Figures are not available for twenty-four-channel systems; however, it is expected that, per channel, operating costs will be reduced to adjust the operating-costs/hardware-costs ratio to about 40:60, or a monthly per subscriber operating-cost of about $5.00. For the two-way channels, with modified keyboard and printer, with audio and frame-grabber, there is no reason to expect costs for salaries, electricity and the like to climb much higher (although costs for programmes would rise). We have assumed costs of $6.00, $6.25, $6.50, and $7.00 respectively for each of the above.

Table 2 shows that capital investment for two-way cable and home-terminals ranges from about $255 to $585 per subscriber. This compares favourably with the $485 that the Canadian telephone system has invested for every telephone.[24]

Monthly costs for the two-way services range from about $11.50 to $17.50 — considerably more than the $5 most Canadians now pay for CATV, and that now accounts for 89 percent of CATV revenues.[25] And since we may expect that subscribers will be able to choose between alternative terminals, and will use two-way services to differing degrees, then clearly the bulk of

[23] DBS Catalogue 56-205, *op. cit.*

[24] Dominion Bureau of Statistics, *Telephone Statistics* (Catalogue 56-203: Ottawa, Information Canada, 1969). Dunn, *op. cit.* shows a comparable figure of $500 for the U.S.

[25] DBS Catalogue 56-205, *op. cit.*

Table 2

	Hardware Costs*				Operating Costs**	Total Costs**
	Cable and Head-End	Home Terminal	Total	Cost per Month	Cost per Month	Cost per Month
	$	$	$	$	$	$
Standard One-Way 12-Channel	125		125	2.65	3.24	5.89
Standard One-Way 24-Channel	145		145	3.06	4.78	7.84
New Two-Way 24-Channel, with Four-Button Pad	170	85	255	5.42	6.00	11.42
New Two-Way 24-Channel, with Modified Keyboard and Printer	170	200	370	7.86	6.25	14.11
New Two-Way 24-Channel, with Modified Keyboard and Printer and Voice	170	225	395	8.38	6.50	14.89
New Two-Way 24-Channel, with Modified Keyboard and Printer and Voice Frame-Grabber	170	415	585	12.43	7.00	17.43

* For 10,000 subscribers, 50% market penetration

** Program origination costs are not included.

revenues will have to come from individualized charges: pay-TV, advertising, rented channels, or other special services. The method of user payment for such services, if and when they are offered, has not yet been determined.

However, even assuming that users are willing to pay reasonable fees for services, it is unlikely that two-way services will be available to many Canadians within the next three or four years. The reason is that the big two-way service profits, if they appear at all, will not appear until two-way services are available on a mass scale and are widely used. So the earliest entrants into the market will have to bear disproportionately high start-up costs.

It is disturbing that while decisions are being made about what type of two-way system to operate, the choices are being made largely on the basis of the economic risk they present for a handful of investors. But the social and political risks involved will be distributed throughout society.

3. Using the Technology

For most investors in two-way systems, economic efficiency means dollars-and-cents profitability. For our purposes, it means lowest user costs within the constraints of specific social goals. So let us therefore define some social goals, and describe how the technology could be used to help achieve them.

The principal objective is the achievement of more effective citizen feedback and citizen participation in government decision-making. Feedback is only one factor to be considered in designing two-way systems. But feedback is closely tied to information distribution and to some extent power distribution in a society; and a two-way system designed to meet feedback needs may help achieve a number of related social goals.

(a) The Goals

The goals which this paper has so far defined are the following: (i) more widespread access to, and use of, feedback channels; (ii) more informed feedback; (iii) more government responsiveness to feedback messages. These are useful immediate objectives, but ultimately they are bound to come into

conflict with certain basic needs of the political system. Table 3 shows the three goals and some of the conflicting necessities of the political arena. The cells that are marked indicate conflicts that have to be resolved.

- *More Widespread Feedback*: The first goal, of more widespread access to and use of feedback channels, is based on the need already described, which is to bring more groups into interaction with decision-makers and to make the feedback reaching the decision-maker more representative. But as feedback volume begins to rise, a conflict develops between the ideal of continually-increasing involvement and the ability of the political system to handle additional feedback. So, in fact, the goal of more widespread participation in feedback channels is only useful up to a point where the political system becomes overloaded with demands that cannot be handled. The ultimate aim is not maximum participation by all citizens, but a sufficient increase in participation to eliminate many of the previously-mentioned social and economic factors which now keep certain groups away from these channels.
- *More Informed Feedback*: The concept of a continually more enlightened electorate presents two immediate practical problems. The first of these relates to the capacity of the political system to handle the potentially vast increase in messages and demands. The second arises from the fact that, within any electoral group, a certain section, expressing apathy and

Table 3

Conflicts Between Goals and Political System Requirements

Goals	System Requirements		
	Avoidance of Information Overload	Stability Through Some Voter Indifference	Freedom to Compromise
More Widespread Feedback	●		
More Informed Feedback	●	●	
More Government Responsiveness	●		●

indifference, is a necessary component, if any degree of genuine political balance is to be maintained. This may seem a contradiction of our previously-stated aims, but it has a concrete basis in political reality for the following reason.

Those citizens who are the most informed, and the most politically aware are also those who are likely to be the most partisan, and the least willing to accept any choices except their own. And, in Ithiel de Sola Pool's words, "a society consisting entirely of such informed opinionated individuals would consume itself in partisan conflict".[26] So here, again, more informed feedback is a useful immediate objective; but the ultimate goal does not result in the maximum amount of information for as many voters as possible. Rather, it means enough distribution of information so that concerned members of sub-groups, who are now rarely heard, will have access to the tools needed to get through the decision-maker's feedback filtering process; and enough distribution of information to avoid widening the gaps that already exist between the information-rich and the information-poor.

- *More Government Responsiveness to Feedback*: The goal of 100-percent responsiveness to citizen feedback conflicts with the political system's need for "selective responsiveness", or the need for enough leeway to allow some degree of trade-off between the conflicting demands of the electorate. The rationale for the concept of 100-percent government responsiveness is that the elected representative is an intermediary, whose responsibility it is to respond to the majority opinions of his constituents; and the more accurately he reflects these, the better he is at his job. And, according to this rationale, when home-terminals and two-way systems make it possible for voters' opinions to be tapped directly, as often as decisions have to be made, a representative can at last make the correct decision, and be certain that he is voting with the majority of his constituents.

But even if it were possible to overcome the problems of ensuring equal access to ballot-box home-terminals; of protecting voters from being coerced at home and from eavesdroppers at the counting centre; and of keeping enough voters informed about enough issues to provide meaningful elections, we would still have the problem of how to resolve conflicting demands between the voting majority and minority groups. As has already been emphasized, the representative currently has far from complete information about the needs and demands of his constituents. So he does his best to respond selectively, with what Heinz Eulau calls a "third ear", which is alive to such factors as the intensity of any given set of demands, and the political influence of the group making them.[27] If he

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[26] Pool, Ithiel de Sola. "Public Opinion", to be published in a forthcoming book, *Handbook of Communications*. I. Pool, W. Schramm, F. Frey, N. Maccoby and E. Parker (eds.) (Rand-McNally, Spring, 1973).

[27] Eulau, Heinz. "Some Potential Effects of the Information Utility on Political Decision-Makers and the Role of the Representative", and MacRae, Jr., Duncan, "Some Political Choices in the Development of Communications Technology", *The Information Utility and Social Choice* (Papers Prepared for a Conference Sponsored Jointly by the University of Chicago, Encyclopedia Britannica and the American Federation of Information Processing Societies). Harold Sackman and Norman Nie (eds.) (Montvale, N.J., AFIPS Press, 1970), pp 187-99 and 201-16 respectively.

had full knowledge of his electorate's needs, he would be unable to deviate from it without rejecting the mandate of those he represented. But this would mean plugging up the ''third ear'' with the wax of information overload; and disruption of the essential balance which must be achieved between voters' immediate demands and the political realities with which their government has to cope. With only partial information, the representative is not bound to reflect the numerical majority at all times. Thus, he may reflect the views of minorities who are particularly concerned with one issue, or who may be instrumental in bringing about a later outcome of more concern to the majority. And the compromises and trade-offs that result lead to a more adequate representation of conflicting interests than would be possible with full feedback and day-to-day decision-making by majority rule.

But this argument favouring selective responsiveness assumes the representative hears the demands of most sub-groups, and translates these demands into decisions that *in toto* satisfy the maximum number of constituents. So the third goal is not *more* responsiveness to majority opinion on each issue, but more efficient responsiveness to the *demands* of diverse sub-groups so that the representative's ''third ear'' can be made more effective.

These three goals will not automatically be met by the technology of two-way systems and home-terminals. The evidence is in the opposite direction. Given the high costs of the systems, access to them may be more severely restricted than is access to current feedback channels. Given the methods by which new information technologies have been used in the past, the systems will probably widen rather than narrow the gap between information-rich and information-poor. Also, given the tendency of governments, at all levels, to take decisions out of the political arena and transfer them to the ''expert decision'' arena, government responsiveness to feedback may decrease. So how can the two-way systems be used to help meet the goals? What hardware is needed and what policy questions should be considered?

(b) Meeting the Goals

Tables 4 and 4A show three categories of feedback channels, as well as a number of features that are available on the cable, head-end, and home-equipment that have already been described. For each feedback category, the Tables indicate what seems to be the minimum technology needed to help achieve the goals.

Several potentially very useful and currently available technological features have been left out of the Table, because we are not interested in the ideal situation which may be achieved twenty years from now; we are more concerned with a system that will fit meaningfully into developments of the next five to seven years. This implies finding the most reliable low-cost system that is flexible enough to adapt to technological changes, and which also fits in with our social and political, as well as our economic, goals. In the following section, we will justify the claim that the technological features indicated on the Table are indeed minimum requirements.

- *Personal Communications*: The personal communications feedback channels now available consist of letters, telephone calls and visits by citizens to their representatives. Some nine-tenths of messages in this category are aimed at getting some particular service, and one-tenth are aimed at involvement in government decisions.[28] Currently, use of the "service" feedback channel is biased in favour of citizens who have already learned how to operate in a bureaucracy, and who already know about those services to which they are entitled. And use of the "involvement" channel is biased in favour of citizens with sufficient information and influence to get through the message-filtering mechanisms of the representative.
  A home-terminal, made up of a numeric response pad, a standard resolution TV tube, frame-grabber, and some kind of user's directory, could provide access to a head-end data bank that included basic information about available government services and answers to frequently-asked questions. For example, such things as listings of local programmes for unemployed workers or of federal government programmes to aid small-business management, or information about local ordinances regarding house-building and zoning. And more equitable access to information about services means more widespread use of the services, and perhaps more representative participation in the service feedback channel.
  The software, or the data, and computer programs that permit subscriber access to such pre-packaged information could be provided by local agencies, government departments, Information Canada and the like. Currently, government bears most of the costs of responding to such requests and presumably would continue to do so.
  As more citizens get increasing access to government services the result may be a greater interest in government decisions, as well as more widespread feedback, aimed at involvement in decision-making. And just as the technology can provide information about services, it can provide information about public issues.
  Pre-packaged information could answer some needs here; however, public issues change faster than government services, and costs for information with a fast turnover rate would be high. Ultimately, to explore topics in depth, subscribers would require techniques which enabled the ordering of a low-cost search through data banks to prepare individualized packages of information. The minimal home-terminal requirements might be an alpha-numeric terminal, standard resolution TV screen, frame-grabber, and

[28] Little, Stevens, Tropp. "Citizen Feedback System: The Puerto Rico Model", *op. cit.*

Table 4
Minimum Technology Needed *

	Cable		Head-End			
	Trunk-Type Two-Way Capability	Hub or Rediffusion-Type Capability	Program Origination Facilities	Subscriber Identification Capability	Computer-Aided Access to Packaged Local Data	Computer-Aided Access to Files and Libraries
Personal Communications	Yes		Yes	Yes	Yes	Optional
Elections, Referenda, Polls	Yes		Yes	Yes	Yes	
Interest Groups, Participating Media	Yes		Yes	Yes	Optional	

Table 4A

	Home Terminal					
	Numeric Response Capability	Alpha-Numeric Response Capability	Hard Copy Output	Frame-Grabbing Capability	Voice Input Capability	Video Input Capability
Personal Communications	Yes	Optional	Optional	Yes		
Elections, Referenda, Polls	Yes	Optional		Yes		
Interest Groups, Participating Media	Yes	Optional		Optional	Optional	

• Assumes several thousand subscribers, 50% market penetration, within next 5-7 years

access to large data banks. The software for such access has been under development for several years: notably at Stanford's project, Stanford Public Information Retrieval System (SPIRES) and MIT's project, Information Retrieval Experiments (INTREX). Presumably the data here would not come directly from government agencies, but from independent sources such as newspaper files and libraries. Both SPIRES and INTREX have been aiming at electronic access to a network of libraries. And at least two newspapers, the *Financial Post* of Canada and the *New York Times*, have taken steps toward computer access to certain of their files.

However, the barrier to using the technology to meet the goals is only partly in hardware and software; at least as important are the government policies that affect the decision as to who gets to use the resource. One means of encouraging widespread access would be to require that subscribers' fees in some areas reflect population density, so that low-income high-density neighbourhoods would be subsidized. Another might be to hold subscribers' fees and costs of certain basic services artificially low, permitting developers to make up the difference with charges for less essential services. (To some extent policies like these are already in effect; urban mail delivery subsidizes rural delivery, and long-distance telephone rates subsidize costs of local calls.) A more controversial policy might be to regulate home-terminal design to minimize the differences in basic services available to each household. And Parker has suggested that the importance of providing widespread access to information via two-way systems could justify the use of a voucher system, wherein the market forces could be left relatively free. Government intervention, in this case, would be to provide credits to individuals, which could be cashed in for units of programming.[29]

To the extent that the combination of these measures and the technology together lead to more equitable access to information about services and public issues, and to the extent this information is reflected in more informed feedback, the new technology will help meet each of our three goals.

- *Elections and Opinion Polls*: We said that on-line citizen voting for day-to-day "elections" or referenda to determine government policy is not a useful goal. However, there are ways the technology may be useful in traditional periodic elections. For example, the combination of home-terminals and a head-end computer, hooked up to a national data bank, could lead to simpler and more flexible voter registration requirements. There is a significant proportion of disenfranchised voters in every election, particularly among groups who are already under-represented in the political system. This more flexible registration could lead to more representative voting turnouts. The same technology could be used from time to time for referenda — not to control day-to-day decisions, but for occasional policy questions of wide concern. However, elections and referenda require almost universal access to two-way systems, while opinion polls can be carried out with samples representative of

[29] Parker, "On-Line Polling and Voting", *op.cit.*

the population. And a more easily foreseeable use of the technology may be to provide decision-makers with non-binding opinion-poll feedback that is more sensitive to the demands of diverse sub-groups within the society than their current sources. Of course, here we are assuming that policies to encourage widespread and representative participation in the system will be successful.

A multi-button response pad and frame-grabber in the home and a computer memory at the head-end would make it possible for a respondent to answer a questionnaire at his or her convenience. Since each frame-grabber has a distinct address, questions could be sent to every household, or to a sample of households. Questionnaires could be made interactive with the respondent, so that each answer determines the next question. The computer could rotate the order of presentation of questions or of response categories in ways that would make the results more reliable. The way would be open to using a range of audio-visual stimuli that are not now easily available.[30] Providing the subscriber with a full alpha-numeric keyboard would allow more flexibility, letting him make open-ended answers to questions, or to articulate objections. In addition to providing a more satisfying experience for the respondent, this would have the advantage of limiting the control of the questionnaire originator over the results. However, it is not clear that the extra services provided by the larger keyboard justify the extra expense, program complications and operating difficulties.

Using the technology, costs per respondent could fall substantially below current costs for face-to-face interviewing. Because of this the advantages of using relatively small samples may often be outweighed by the advantages of involving more citizens in the feedback process.

Clearly the polling techniques can be used to examine citizens' opinions about government decisions that have already been made and programmes that are already operating. Much more complicated is the question of whether similar techniques can be used to get meaningful information about citizens' judgements about what *should* be done to develop individual preference orderings about future alternatives; and to combine these to develop preference orderings for larger groups.

Considerable debate has surrounded this question. Arrow has argued that if we accept three reasonable assumptions, there is no procedure that will work all the time, capable of translating individual preferences into group preferences.[31] The example that he gives occurs when there are three alternatives, and members of a group are asked to rank the alternatives in order of their preferences. One-third of the group prefer alternative A to B and B to C. One-third prefer

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[30] For a comprehensive discussion, see, Bradburn, Norman M., "Survey Research in Public Opinion Polling with the Information Utility -- Promises and Problems", *The Information Utility and Social Choice*, pp.275-86.

[31] The first assumption is that there is no dictator whose preferences are automatically the preferences of those around him; second is that the preference orderings of a group are based on preference orderings of the individuals in the group; and third that if all the individuals in a group prefer one alternative to another, then the group as a whole will exhibit the same preference. In his original argument, Arrow included a fourth assumption: that alternatives not available to the group are not relevant to the group's preference orderings. See Arrow, Kenneth J., "Public and Private Values"; New York University Institute of Philosophy, *Human Values and Economic Policy: A Symposium*, Sidney Hook (ed.) (New York, New York University Press, 1967), pp.3-21.

B to C and C to A. And one-third prefer C to A and A to B. By adding the results, we would conclude that a majority of voters preferred A to B, a majority preferred B to C and a majority preferred C to A. Since this leads the policy-maker in a circle, the group results are meaningless.

However, as Sheridan has pointed out, Arrow only proves inconsistencies can occur. "In the great majority of cases likely to be encountered in the real world, they would not occur or they would be of minor significance."[32] And, he adds, although clearly we cannot establish preference orderings that provide the policy-maker with precise guide-lines, the chances are good that we can develop more useful information than is now available.

If such opinion-polling techniques succeed in providing more widely representative feedback and in clarifying and identifying demands that might have gone unheard in current channels, the technology will have succeeded in meeting one of our goals. It may be, too, that new polling techniques will develop more informed feedback, thus meeting a second goal. But it is not clear that this will lead to increased government responsiveness to the feedback. Decreased uncertainty about voters' preferences means decreased uncertainty about what has to be done by the representative to stay in office. We will have to look elsewhere for ways to turn this more representative feedback to the advantage of its source, the citizens.

- *Interest Groups and Participatory Media*: Interest groups with which we are concerned include any voluntary citizens' organizations that use their institutional status to influence government decision-making; national and local political party organizations, and unions; local parent-teacher associations, and neighbourhood ethnic societies are examples. Participatory media include letters-to-the-editor, open-microphone radio, and audience-participation TV. Here we restrict our concern as to the means by which participatory TV can be used to further our goals for interest-group feedback.

  Interest groups have traditionally been multi-purpose organizations, serving social and economic, as well as political, needs. Although such groups could potentially provide the principal interface between the private citizen and government, in actual fact, only a small proportion of group membership is usually involved in making specific policy suggestions to the group leadership.[33] One reason for this situation is the investment in time and money that is required for more than occasional participation. Another is lack of interest.

  The combination of home-terminal with a numeric response pad and TV, and a built-in microphone or (for limited numbers of participants) access to a telephone, could help provide low-cost convenient access to interest-group discussions. For groups who

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[32] Sheridan, Thomas B. "Citizen Feedback: New Technology for Social Choice". *Technology Review* (MIT) (January, 1971), p 47; and "Use of Electronic Voting Devices and Formal Models in Group Discussion and Decision Making". unpublished draft report, August, 1971

[33] Zeigler, Harmon. "The Communication Revolution and the Future of Interest Groups". *The Information Utility and Social Choice*, pp 263-74

insisted on restricted access to meetings (*e.g.*, $25-a-plate TV dinners), "attendance" could be controlled by the organizers.

Assuming that the technology is accessible, and widely distributed, how could it be effectively used for interest-group discussions? We have already described one experimental TV programme, conducted by Sheridan, *et al*, at MIT, that involved a studio audience responding with discussion and with six-button response pads to a questionnaire. In that experiment, the home audience responded by filling in and returning computer cards. In another experiment by the same group, this time using closed-circuit TV, several voters came together to discuss the issue of corruption in their city government, and what to do about it. The programme was made up of four short cycles; each began with presentation of information by a moderator, followed by multiple-choice questions and discussion. Participants and the moderator were separated; participants were provided with a TV, a microphone, and individual vote-boxes, hooked up to a mini-computer which translated vote tallies into easily readable bar-graphs. A director was able to select what was presented on TV; he could choose between three camera inputs: one showing the moderator speaking, another showing the participants, and a third showing the vote tallies as they registered on the computer's display screen. It is easy enough to see how this kind of format could be expanded, so that the vote tallies would represent at-home participants throughout the community, the video pictures would include two or three diverse groups separated by geography, income, or some other criterion, and the sound-track would include the moderator, members of the groups, and individuals from the at-home audience.

Yet this format is still restricted. First, button-pushing is not a highly satisfying way of participating in group discussions, when the influence of one button pushed is almost imperceptible. Second, verbal participation, via low-cost microphones built into the home-terminals, or by standard telephone, is restricted to the number of people whose comments can be broadcast during the programme. Third, the costs of calling beyond a local area could restrict participation in other than local discussions. And fourth, the information presented during the programme is likely to be aimed at the general interests of the group instead of the specific needs of an individual participant.

Eugene Leonard, Amitai Etzioni and a group at New York's Center for Policy Research have proposed a multi-level discussion format that could partly answer some of these needs.[34] In their model, now being used in closed circuit and scheduled for testing, using radio and telephones in Nassau County, New York, a participant calling in to discuss an issue would reach a first-level moderator. The moderator, acting as a kind of gatekeeper, could connect him to another caller with similar interests, to an information source who could answer his questions, or up the pyramid to the next level moderator, and so on. As many participants as possible would reach the airwaves, but access would be determined by the need to air a wide range of opinions, or the expert knowledge or geographical

[34] Leonard, Eugene; Etzioni, Amitai; Hornstein, Harvey A.; Abrams, Peter; Stephens, Thomas and Tichy, Noel. "Minerva: A Participatory Technology System". *Bulletin of the Atomic Scientists*, Vol.XXVII, No.9 (November, 1971), pp.4-12.

location of the speaker, or to some extent by random choice. Those who did not get on the air could still participate.

An important part of the model is that it emphasizes group meetings, as well as home participation, and allows groups to communicate with one another and with expert information sources as part of the discussion. The reason for this emphasis is that evidence indicates it is easier to reach a consensus and have a productive discussion by first dealing with smaller groups, and then within a number of groups, than to reach a direct consensus in the larger group.[35]

However, the notion that increased ease of access will necessarily lead to widespread involvement is misleading. The same technology that makes TV channel space plentiful and cheap enough for interest-group members to interact via home-terminals is also likely to bring increased diversity of programmes of all kinds, as well as demand broadcasting, giving the viewer full control over what comes onto his TV screen. A result of this could be an increasingly narrow reflection of individual interests; and an early casualty could be those programmes that failed to make sufficiently specialized or sufficiently entertaining appeals.

So although participation in interest-group discussions could become more widespread and more representative than now, it would still be far from universal. One likely outcome is that members of participatory-TV interest-group discussions would select their topics as a result of some common interests. This could produce more specific demands on their leaders by interest-group members, thus reducing the freedom that such leaders have enjoyed in the past, and threatening the cohesiveness of the group.

As members develop specific demands that the traditional group leadership cannot meet, and as the costs of organizing groups decrease, then more and more citizens may rely on specialized interest groups as a means to a specific political end. One characteristic of the new groups or coalitions could be a membership that is directly concerned with a particular area (*e.g.*, a local nuclear power plant). A second may be temporary membership. Unlike traditional interest-groups, which arise in response to a specific need and then remain active, the new coalitions could find it feasible to organize for a given issue, and then disperse until a similar issue reappeared. A third characteristic could be a local or regional orientation of given issues of concern. CATV systems are essentially local, and two-way systems are likely to follow the same pattern. The advantages include more opportunity for locally-originated ideas, and more community control of information resources. However, there is ample literature to indicate that a sense of community is influenced by boundaries of a communications network.[36] A communications network that is essentially local is likely to encourage local identifications — perhaps at the expense of national consensus. So another design consideration is more-than-local two-way system communications networks. How will the changes affect interest-group feedback in

[35] Leonard, *et al*, *op. cit.*, pp.4-12.

[36] Pool, "Public Opinion", *op. cit.*, and Deutsch, Karl W., *Nationalism and Social Communications* (Cambridge, Mass., MIT Press, 1966).

terms of the goals we defined? First, even though the technology may make it easier for any one person to avoid information about major national issues, it could also make active participation in interest-groups more available. To the extent this happens, the feedback messages that are delivered to government by interest-group leadership may be more representative. Second, more participation by more citizens with specialized interests should lead to more informed feedback. And third, the tendency to more specialized interest-groups may make it more difficult for lobbyists and interest-group leaders to make insupportable claims regarding the opinions of their members. Currently, one of the limitations on interest-group influence in the issue-definition and the decision-making stages of government is that interest-group representatives trying to influence policy often claim to have full support of their membership; and "decision-makers frequently are unable to determine whether or not the claim of legitimacy is justified".[37] But with the new technology, the "legitimate" membership may become a more observable quantity, resulting in more appropriate government responsiveness to the messages, thus helping to make interest groups what Almond and Verba say they should be: "the prime means by which the individual is able to relate himself effectively and meaningfully to the political system".[38]

4. The Future

The Canadian setting is primed for innovative action with two-way systems, but the opportunity is beginning to slip away. Canada leads the U.S. in percentage of urban households hooked up to CATV. The Canadian common-carrier facilities are equal to the best of the U.S. communications grid. The computer software industry is highly sophisticated; the largest CATV systems in the world are here; and video systems, community action, and local origination groups are as active in several Canadian cities as anywhere in the world. At the federal level, government has already established an active relationship with the industry. Several provincial governments have begun to show their interest in greater involvement in CATV. But in spite of the Canadian lead in all these areas, decisive government action, in both the U.S.

[37] Zeigler, *op. cit.*, p 269.

[38] Almond, Gabriel A. and Verba, Sidney. *The Civic Culture* (Boston, Little Brown and Co., 1965), p 245.

and Japan, may soon put Canadian communications experts again at the back of the bus. A few two-way research projects are underway. Bell Canada is proceeding with a five-year development of a broadband network for Erin Mills, a new suburban community near Toronto. The plan is to provide a broadband distribution system which would rent channel space to CATV operators, and any other entrepreneurs who wanted to provide electronic, to-the-home delivery of entertainment, educational material, shopping information, and other services. An interesting proposal has also been made to the Department of Communications for building a ''wired scientific city'', linking the several government, university and private industry research centres in Ottawa.[39] Maclean-Hunter Cable TV Ltd., which has been expanding rapidly in the CATV industry, recently bought an interest in Phasecom Ltd., an electronic equipment manufacturer in Santa Monica, California, and reportedly has been planning some two-way experiments in Canada within the next several months. Cascade Electronics Ltd., producer of two-way CATV equipment for U.S. as well as Canadian systems, is currently installing a two-way plant for Calgary Cable TV Ltd. Two-way experiments are underway in both Vancouver and Montreal. And a research proposal which may get beyond the talking stage is for joint support of ''wired city'' experiments by members of the Canadian CTV Association.

There is a certain urgency in the need to find means of increasing the momentum that has been gathering with this rolling two-way snowball. Currently, in the U.S., plans are underway for a sharp increase in government support for ''wired city'' research. The U.S. Office of Telecommunications Policy has hired a consulting firm to evaluate several proposed experiments.[40] Detailed proposals have already been made to build sophisticated large-scale systems in Washington, D.C. and Dayton, Ohio. Other proposals are being

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[39] Bowen, B.A.; Coll, D.C. and George, D.A., *The Wired Scientific City* (Ottawa, Department of Communications, November, 1971).

[40] Jurgen, Ronald K. ''Two-Way Applications for Cable Television Systems in the '70s''. *IEEE Spectrum*, Vol 8, No 11 (November, 1971), pp 39-54

developed for New York City (Welfare Island), Jonathan, Minnesota, the Stanford University-Palo Alto area in California, and several other places. The Washington, D.C. proposal alone recommends an investment of some $30 million in that city over the next ten years. So what meaningful steps might be undertaken to continue the development of our own two-way feedback systems?

A first step should be a greater commitment of funds for research projects developing two-way broadband services. Several university groups, community and private-citizen groups and CATV developers could begin making plans for experiments and software development if such funds were available. Presumably, such investment would stimulate the development of more two-way distribution systems, and would strengthen relations between educational groups from universities, schools, and vocational training centres with CATV systems. It might also result in the contribution of more funds from those federal, provincial and municipal government agencies that are trying to lower the costs of delivering information and services to the public.

One reason it seems logical to emphasize software development is that the U.S. and Japanese governments are gearing up to invest enormous resources in hardware. Second, hardware is in many ways less culturally biased than information and software, and so can be imported more easily. Third, the kinds of software services that would be of interest to research groups made up of educational and community service personnel are also the least likely to be developed without government support.

Appendix A

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Herbert Goodwin, Rediffusion International, Dennis Port, Massachusetts
Richard Gwyn, Department of Communications, Ottawa, Ontario
Heather Hudson, Stanford University, Stanford, California and Department of Communications, Ottawa, Ontario
Harold Katz, President, Vicom Manufacturing Co., Dexter, Michigan
Murray Knowle, TeleCable Corporation, Overland Park, Kansas
Eugene Leonard, President, Systems Resources Ltd., Plainview, New York
Professor Daniel Lerner, MIT, Cambridge, Massachusetts
Professor Marshall McLuhan, University of Toronto, Toronto, Ontario
Tom McPhail, Department of Communications, Ottawa, Ontario and the MITRE Corp., McLean, Virginia
Professor Edwin Parker, Stanford University, Stanford, California
Garth Pither, Welsh Cablevision, Vancouver, British Columbia
Professor Ithiel de Sola Pool, MIT, Cambridge, Massachusetts
Lawrence Scabar, Calgary Cable TV Ltd., Calgary, Alberta
Hubert Schlafly, President, TelePrompter Corp., New York City, New York
Bud Shepherd, Welsh Cablevision, Vancouver, British Columbia
Ralph Lee Smith, MITRE Corp., McLean, Virginia
Frank Spiller, Canadian Radio-Television Commission, Ottawa, Ontario
Professor Chandler Stevens, Rensselaer Polytechnic Institute, Troy, New York
Ray Taylor, The Canadian Computer/Communications Task Force, Department of Communications, Ottawa, Ontario

Appendix B

The following is a list of proposed interactive services, drawn up by Walter Bauer of the Rand Corporation, compiled from various reports, FCC filings, corporate brochures and advertising materials.* It is clear that some services are more likely candidates for subsidized development than others.

Services for Individuals

Interactive instructional programmes
Interactive vocational counselling
Local ombudsman
Employment, health care, housing, welfare, and other social service information
Library reference and other information retrieval services
Fire and burglar alarm monitoring
Interactive TV games
Subscription television
Remote shopping
Special-interest group conversations
Electronic mail delivery
Electronic delivery of newspapers and periodicals
Computer time-sharing
Catalogue and other directory displays
Stock-market quotations
Transportation schedules
Reservation services
Ticket sales
Banking services
Local auction sales and swap-shops
Direct opinion response on local issues

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* Bauer, Walter S. *Interactive Television, Prospects for Two-Way Services on Cable* (Santa Monica, California. The Rand Corporation, November, 1971)

Subscriber-originated programming

Services for Business

Television-ratings
Utility meter readings
Control of utility services
Opinion-polling
Market-research surveys
Computer data exchange
Business transactions
Credit checks
Signature and photo identification
Facsimile services
Report distribution
Industrial security
Production monitoring
Industrial training
Teleconferencing
Corporate news ticker

Services for Government

Computer data exchange
Teleconferencing
Surveillance of public areas
Fire-detection
Pollution monitoring
Traffic-control
Fingerprint and photograph identification
Civil defense communications
Area transmitters/receivers for mobile radio
Classroom instructional television
Education extension classes
Televising municipal meetings and hearings
Direct response on local issues

Automatic vehicle identification
Community relations programming
Safety programmes
Various information-retrieval services
Education for the handicapped
Programmes on drug and alcohol abuse

Within this list of services, many, such as fire-alarm monitoring, television-ratings and computer data exchange, seem likely to develop satisfactorily under their own steam, whereas others would require subsidies for their development.

At the same time as research is being promoted in the development of two-way services, studies could be funded as a basis for the long-term development of two-way goals. Here we summarize four policy areas that need to be considered, regarding the longer-term development of these services.

- The first concern is *who* pays, and *how*, for use of a two-way system.
- Our second concern is with regard to the conflict between needs for local origination and local political participation versus the need for some kind of nation-wide survey and participation in national concerns.
- A third area concerns relations between CATV developers, common carriers, time-shared computer operators, and programme producers.
- A final problem area concerns subscribers' privacy. The failure to protect this important area could sharply reduce the potential effectiveness of two-way systems for more adequate citizen participation in government.

Appendix C

- *Rediffusion Dial-a-Programme*: A small demonstration of a limited two-way switched system is operating in Dennis Port, Mass., with some 225 subscribers. The system has been developed by Rediffusion Ltd. of England.*
  Home-equipment for the system consists of a standard TV and a small console with a telephone dial and a converter. The TV signal is distributed on a very low-frequency channel (3.19 to 9.19 MHz), and thus is relatively free from interference from local broadcasting stations. Upstream transmissions are carried, using the 9 to 15 MHz bandwidth. In the event the subscriber does not already have more TVs than he can use, he may buy a special simplified model from Rediffusion, with the telephone-dial and the converter built in, at some 30 percent less than standard models.
  When the subscriber turns on the TV, he sees a dialing directory of programmes available at that time. The number he dials is transmitted through his private wire to the programme exchange, where he is plugged into the relevant channel by an automatic switching device.
  The Dennis Port installation offers thirty-six channels, and, at present, all subscribers are hooked up to one exchange.
- *Ameco DISCADE*: A combination of trunk and switched systems is being tried in both Daly City, California and in hotels around the new Disneyworld in Orlando, Florida. Cables are laid along a typical trunk-type network. Most of the trunk consists of ten coaxial cables bunched together. Each is capable of carrying two to four low-frequency channels (below 50 MHz). Low-cost cables can be used. A wire leads from subscribers' homes to small switching centres, spliced right into the main cables. The resulting system costs about the same as a standard trunk-type that offers a similar number of channels. The Ameco system has the advantage over most trunk-types of avoiding transmission interference from frequencies above 50 MHz. And trunk cable can be increased without re-wiring household drops. It has the advantage over Rediffusion of having the switching equipment built into the cable. However, it is not clear whether the system would be effective for upstream transmissions.

* Rediffusion was one of the earliest investors in Canadian television, and provided a two-channel system for Montreal in 1952. (See Canadian Radio-Television Commission, *Cable Television in Canada* (Ottawa, January, 1971).)

Appendix D

Additional two-way systems are being considered in several other locations: Dayton, Ohio; Jonathan, Minnesota; New York City; and one as yet unknown community. Two of the most interesting are described below:

- *Unknown Community*: For the past twelve months, the consulting firm of Arthur D. Little, Inc., has been studying the feasibility of profitable two-way broadband systems. So far, a consortium of major corporations involved in the communications field, including Bell Canada, has invested more than $250,000 in the studies. Not surprisingly, personnel working on the project are tight-lipped about their exact plans.
  However, reportedly the feasibility-study stage is over, and the consortium is seeking additional investors, prior to lining up a "demonstration" community. The proposed installation will be aimed at business as well as private needs. The basic home-terminal will be similar to the simple $85 model described in Section 1 of the paper.*
- *Jonathan, Minn.*: This proposal, until recently kept under wraps, was developed with help from the Stanford Research Institute, for the experimental model-city of Jonathan, Minnesota. The reason for the secrecy was that Jonathan developers had applied to the U.S. Department of Housing and Urban Development, for financial support for a four-stage installation of a two-way broadband system.
  However, as is often the case with such modesty, there was nothing unique to hide. The fourth stage of the project will use home-terminals similar to the Hughes and Vicom installations described in Section 2 of this report.

* For more information see John P. Thompson. *A Program to Implement News Communication Services* (1-0236A; Cambridge, Mass., Arthur D. Little, Inc., May, 1970).

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