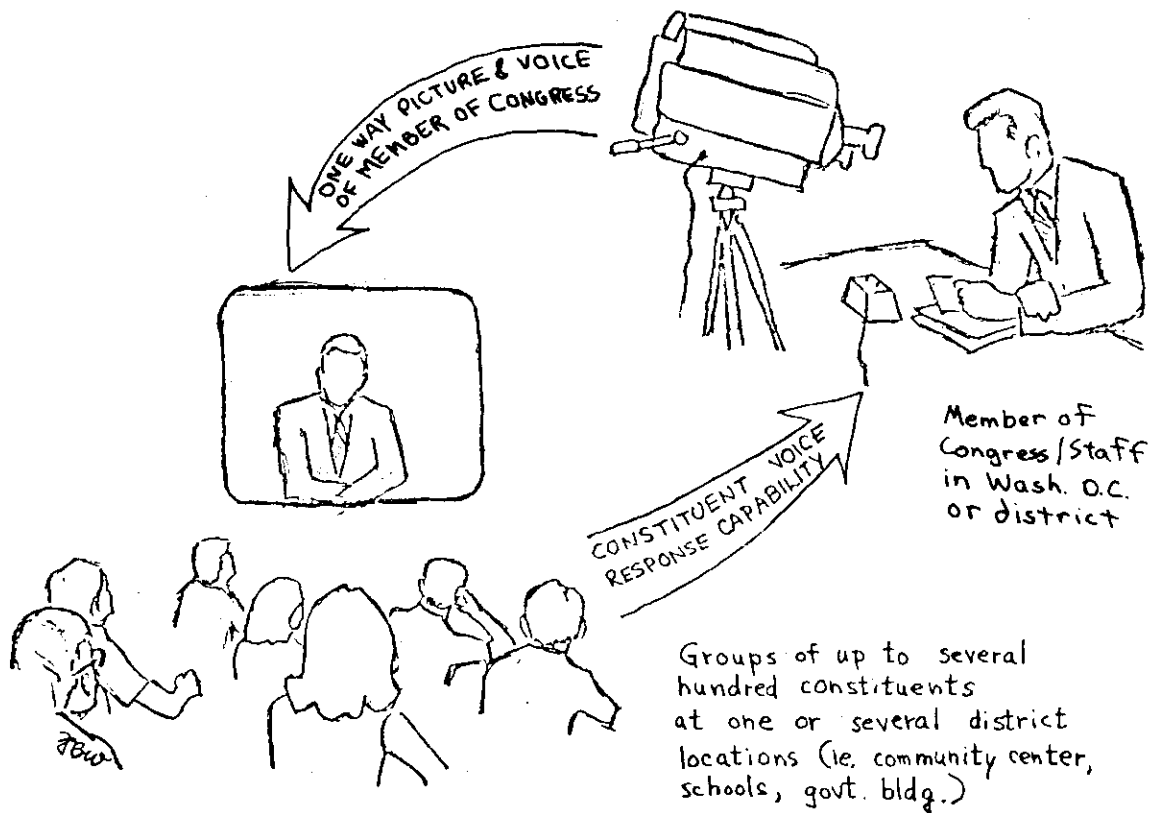


COMMUNICATION THEORY in the CAUSE of MAN

Notes on the application of General Systems Theory, Cybernetics, Information Theory, and related fields of Communication Theory to the strengthening of democratic institutions on our planet.

INSIDE THIS ISSUE:

Politics on the Cable



COMMUNICATION THEORY IN THE CAUSE OF MAN

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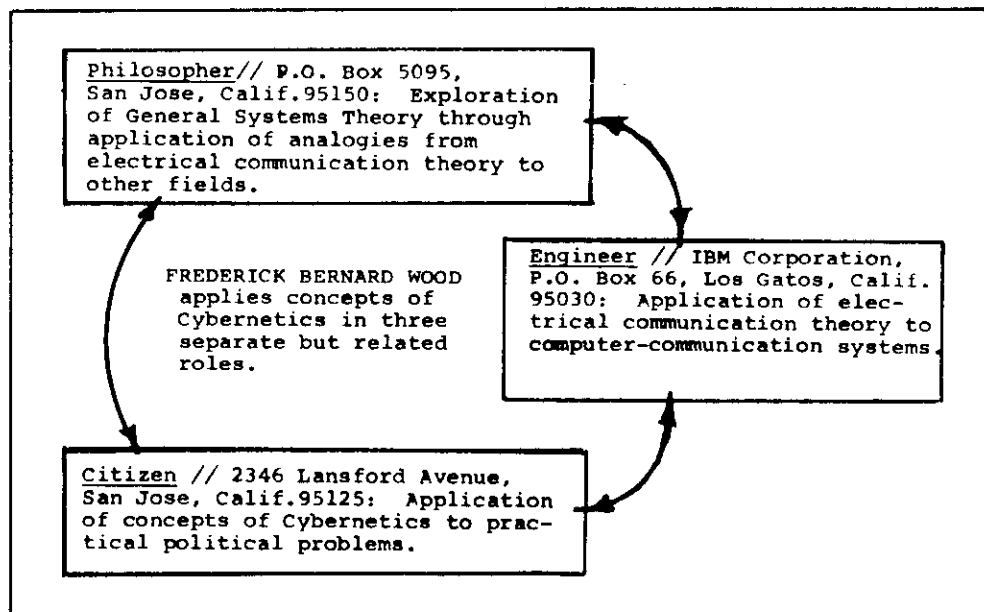
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Section 3.9.7: Editorial Notes, Letters to the Editor, Notices

For a second time various problems have interrupted the publication schedule of this magazine for more than six months. When this occurred the first time, I sent a letter of explanation to paid subscribers (April 12, 1974). Then Volume III, Number 1, was published on 9/28/74 approximately twelve months after the last issue of Volume II. This time after a delay of eight months, a letter of explanation was prepared May 24, 1975, and mailed to paid subscribers with a preprint of my June 1975 paper on "Some Social Implications of the Mathematical Theory of Communication Channels," for the I.E.E. International Communications Conference in San Francisco.

With this second delay, it became apparent that some reorganization was necessary in order to continue publication. Therefore a plan has been developed to resume publication through a combination of obtaining some financial backing to pay for part time editorial assistance and some changes in my time allocation.

One factor that has compounded delays from various sources has been the conflict between interpretations of the code of ethics of the National Society of Professional Engineers requiring full identification of the potential business and financial interests of engineers speaking on public issues with the pressures from my employer to remove any clues indicating my connection with IBM. To clarify such questions I include the diagram below to indicate my three different roles as engineer, philosopher, and citizen:



The views presented in articles in the magazine, COMMUNICATION THEORY in the CAUSE of MAN, are my own views, or those of the particular authors, if signed, and represent neither the IBM Corp., nor any political or religious groups with which I or other authors are affiliated.

Frederick Bernard Wood
Frederick Bernard Wood
Editor and Publisher

CALL FOR PARTICIPATION:
SYSTEMS THINKING AND MATERIALS INFORMATION SYSTEMS

Fred B. Wood

The George Washington University

AN OPPORTUNITY FOR SGSR INPUT

At the January 1975 SGSR National Meeting, many participants spoke of the potential of systems thinking for improving our quality of life. Here is an opportunity to help translate that potential into reality with regard to one important dimension of the quality of life: the management of our natural resources.

In response to congressional concern over possible future shortages of critical metals and other materials resources, the Congressional Office of Technology Assessment (OTA) has undertaken to sponsor an assessment of Materials Information Systems. The assessment is being conducted under contract by the IBM Corporation with the support of The George Washington University's Program of Policy Studies in Science and Technology.

Part of the Program of Policy Studies responsibility is to obtain relevant input from interested individuals and organizations, including public interest and professional groups such as SGSR. Therefore, Policy Studies is collaborating with SGSR and other groups to, first, establish an awareness of the assessment itself and, second, provide an opportunity for interested persons to make a useful contribution to the assessment.

INFORMATION AND MATERIALS MANAGEMENT

The problem of natural resources and materials shortages is clearly a systems problem, and, in the opinion of many, one key element to better management of our natural resources is an improved national materials information system. Our hope is that SGSR members who find this assessment of interest will communicate directly to the Project Manager at the address and phone number given at the end of this article.

This assessment will help OTA provide an analytical base for future congressional policy decisions on national materials management. In considering the information needs for materials management, the assessment will consider the full scope of natural resources, including fuels, which are utilized by industry for the production of goods. This ranges from inorganic metals and minerals to organic substances such as lumber and fibers. However, for the purposes of this study, food is not included in the definition of materials.

Information needs will be examined for all stages of the cycle of materials utilization, from initial acquisition of raw materials through the steps of processing and manufacture and use as products to the eventual disposal as waste and possible availability for re-use or recycling. At each stage, attention will be focused on the interrelationships between information on materials, energy, and the environment.

THE ASSESSMENT PROCESS

Participation of interested SGSR members will be particularly useful in several ways. First, interested SGSR members can choose to participate in an assessment survey (by interview and/or questionnaire) which focuses on (1) the social, economic, political, and other possible impacts (both positive and negative) of a national materials information system, (2) the key policy issues which may emerge from such impacts, (3) advantages and disadvantages of alternative institutional arrangements for the location and operation of a national materials information system, and (4) advantages and disadvantages of alternative actions for implementing the systems and institutional options.

Second, SGSR members with an in-depth information systems background may wish to critique the information systems options developed in the study. Those interested in this aspect will be provided with more detailed interim reports on the information systems concept. Third, SGSR members with a continuing and major interest in the materials area may wish to contribute to, or at the minimum critique, other phases of the assessment, including preparation of papers and reports for ultimate submission to IBM and OTA.

CONTACT THE PROJECT MANAGER

Interested SGSR members are encouraged to contact the Project Manager by mail or phone and indicate your desired level of participation. Address all inquiries to Dr. Fred B. Wood, Project Manager, Program of Policy Studies in Science and Technology, 714 University Library, The George Washington University, Washington D.C. 20052, Phone 202-676-7380. You may also suggest other individuals or organizations with a possible contribution to any phase of the study. We look forward to hearing from you soon.

Section 1.0.OB: "Blue Page" Project Summary. This "blue page" is included to help the new reader of CTCM who hasn't read the preceding issues to get a perspective of the series.

Magazine
'CTCM'

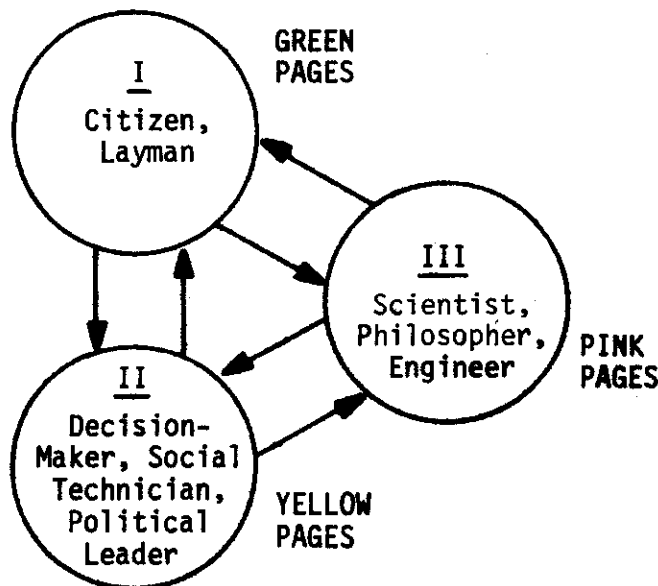
Book
'CTCM'

This periodical is scheduled to be published quarterly and is planned so that each issue will constitute a group of sections which update the loose-leaf book, COMMUNICATION THEORY in the CAUSE of MAN. The first public edition of the book was issued in October 1973 and consisted of Volumes I and II of the magazine, CTCM, rearranged in "file number" sequence. The object of both the book and the magazine is to provide some tools from the mathematical and engineering theory of communication, and in particular from Cybernetics and Information Theory, to help the layman find some ideas by which he can more easily determine his course toward a more democratic society.

Each page is labelled with the volume and issue numbers of the magazine, CTCM, and with the "file numbers" of the book. Thus one may rearrange the pages of the cumulated magazine issues by file numbers to put the sections in the order of the loose-leaf book.

Citizen? and/or Decision-Maker? and/or Scientist?

Who is going to benefit from research in General Systems Theory, Cybernetics, and Information Theory? Are these fields of science and engineering going to be used for the benefit of all mankind? Or are they going to be used primarily for the private benefit of particular ruling classes? How do we insure the use of such knowledge in the interests of strengthening democratic institutions? I have an intuitive feeling that to protect the interests of the people, some way must be found to combine general articles, technical applications articles, and basic scientific articles into the same journals and books, while maintaining proper labels as to the nature of the different sections. The three groups of readers are illustrated by the following diagram:



For the benefit of the new reader who has not followed the earlier issues, an abridged outline of the projected loose-leaf book is displayed below. For a more detailed outline and listing of which sections have been printed to date, see CTCM, Vol. II, No. 6-A, pp. 11-21 (Section 1.0.1).

Short Outline of the Proposed Book

COMMUNICATION THEORY in the CAUSE of MAN:

Book One: Interpretation of Cybernetics, Etc., for the Layman-Citizen

- 1.0 Background Material and Basic Concepts
- 1.1 General Introduction
- 1.2 Analogies in Sociological Problems from the Technical Level
- 1.3 Problems on the Semantic Level
- 1.4 Problems on the Effective Level
- 1.5 More Complex Problems
- 1.6 An Integrative Framework for a New Frontier

Book Two: Application of Principles of Information Theory, Etc., to Practical Problems for the Social Technician and Systems Engineer

- 2.1 Implications of Multidisciplinary Concepts
- 2.2 Application of Cybernetic Technologies
- 2.3 Applications for Implementing Ethical Principles
- 2.4 Theories of Social Evolution
- 2.5 Stimulation of Creative Evolution in Human Society
- 2.6 Application of Cybernetics to Human Communication Problems

Book Three: Mathematical and Scientific Background for the Philosopher and Scientist

- 3.1 Mathematical Concepts
- 3.2 Sample Calculations
- 3.3 Status of Entropy and Information
- 3.4 Information Theory
- 3.5 Cybernetics
- 3.6 Simulation
- 3.7 Physical Science
- 3.8 Glossary
- 3.9 Bibliography, Notes & Index

Section 1.6.8: Telecommunications Technology for Congress

In the summer of 1973 Frederick Bruce Wood, while a graduate student at The George Washington University, Washington, D.C., conducted an in-depth study of the prospects of new telecommunications technologies helping the congressional-constituent relationship. The potential uses of teleconferencing, cable television, videoconferencing, and videophone are illustrated in the sketches on the next two pages. In addition his studies included a survey of the views of a cross-section of members of congress on the present and future uses of conventional communication processes such as face-to-face channels, written or printed channels, news media channels, individual telecommunication channels, and mass telecommunication channels.

The complete report of his studies are contained in his thesis:

"Telecommunication Technology for Congress: An Exploratory Assessment of Its Potential for Congressional-Constituent Communication," by Frederick Bruce Wood, May 1974, The George Washington University, Washington, D.C., 374 pp. Copies can be order from University Microfilms, Ann Arbor, Michigan.

A shorter summary of his studies is available through the National Technical Information Service:

"The Potential for Congressional Use of Emergent Telecommunications: an Exploratory Assessment," by Fred B. Wood, May 1974, Program of Policy Studies in Science and Technology, The George Washington University, Washington, D.C. Monograph No. 20, 60 pp.

Abstract The author summarizes the results of an exploratory inquiry into the potential use of emergent telecommunications technology for communication between congressmen and their constituents. The study employed a number of specific methodologies: interdisciplinary systems model-building, technology analysis, a sample survey, and semi-structured interviews using sketches of the emergent channels.

Six telecommunication configurations were identified as representative of emergent channel characteristics: the teleconference, videoconference, videophone, cable television, cable TV polling, and information retrieval. Analysis of the interview data resulted in an overview of the current congressional-constituent communication system and an assessment of the potential for emergent telecommunications, as perceived by congressmen and senior staff from the 40 offices in the stratified judgment sample.*

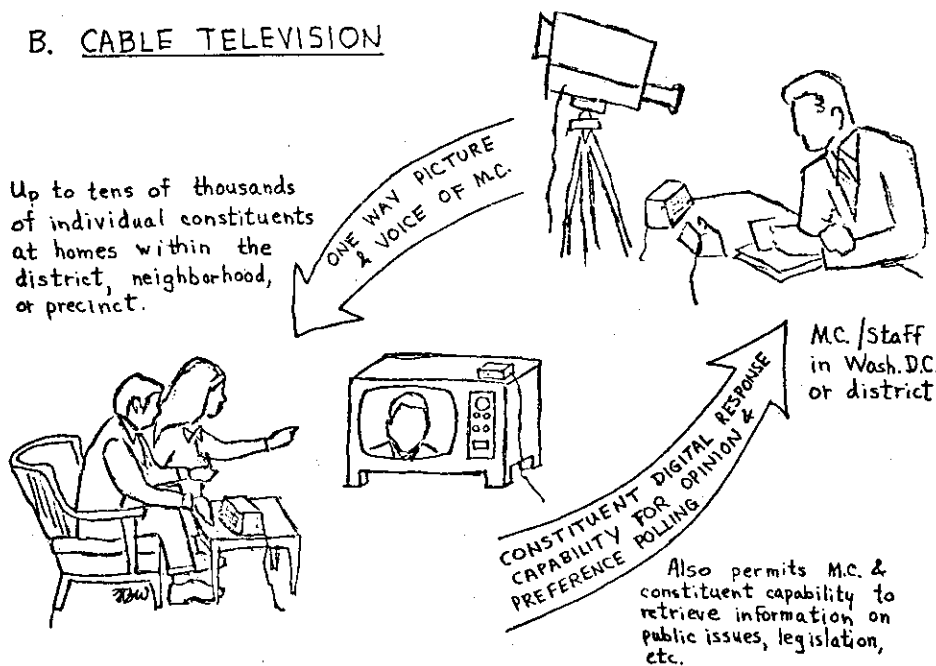
*See Section 2.6.2 of this issue of CTCM for an extension of these studies to the use of cybernetic (or information theoretic) principles to obtain an equitable allocation of cable origination program time among a group of political candidates.

FUTURE CONGRESSIONAL-CONSTITUENT TELECOMMUNICATION:
Four Sketches of Potential Telecommunication Links
Between Constituents and Member of Congress (M.C.)

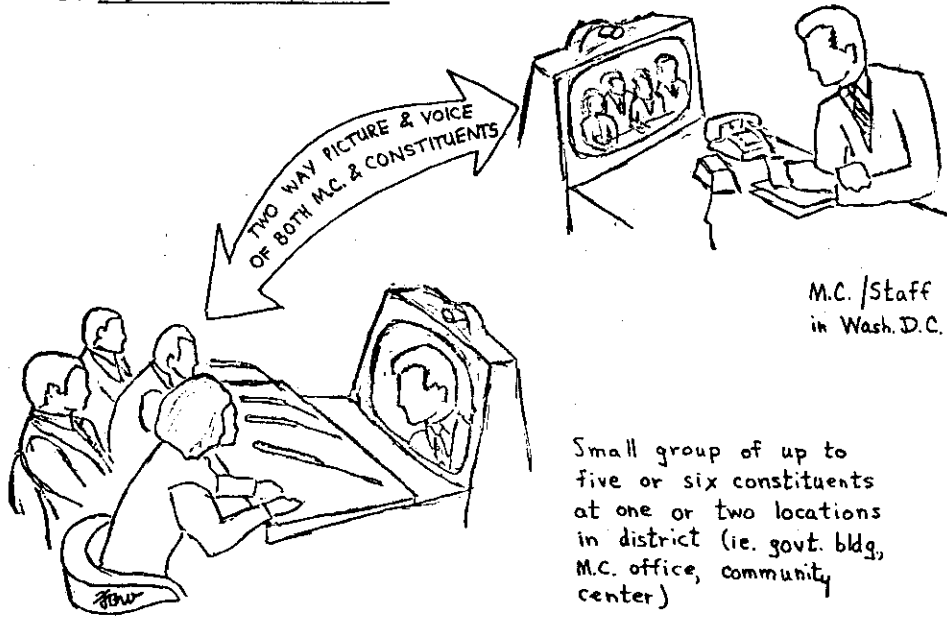
A. TELECONFERENCE



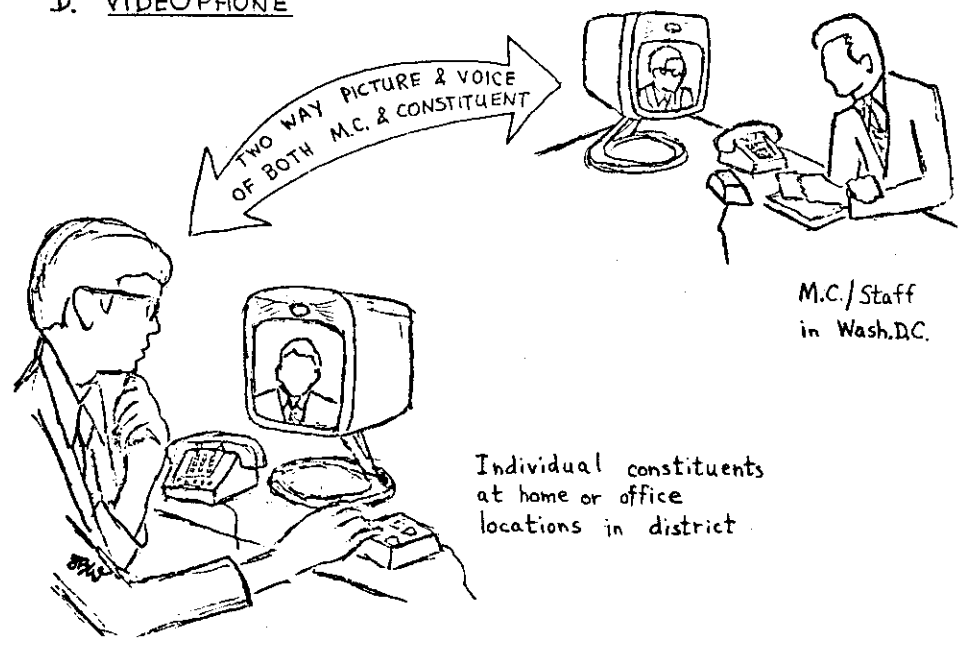
B. CABLE TELEVISION



C. VIDEOCONFERENCE



D. VIDEOPHONE



Biographical Sketch

Fred B. Wood* was born in Cambridge, Massachusetts, on September 18, 1945; grew up and attended public schools in Berkeley and San Jose, California; and received his college education at Oregon State University (B.S. in electrical engineering, 1967), Harvard University (M.B.A. in business administration, 1969), and The George Washington University (D.B.A. in management systems and public administration, 1974), where he completed his dissertation research on "Telecommunications Technology for Congress: An Exploratory Assessment of Its Potential for Congressional-Constituent Communication."

Dr. Wood's professional experience has included short stints with the County Government of Santa Clara, Calif. (Sr. Engineering Trainee), Pacific Gas and Electric Co., San Francisco (Junior Engineer), and International Business Machines Corp., Armonk, N.Y. (Public Affairs Researcher); and a one-year term as Editor and Publisher of The HarBus News and Careers and the MBA at Harvard Business School, Boston.

At The George Washington University, Dr. Wood has served as Graduate Teaching Fellow in Management Science, Assistant Professorial Lecturer of Management Systems, Guest Lecturer on Congressional Information Systems, Research Assistant and Research Associate in the Program of Policy Studies in Science and Technology, where he is currently a Research Scientist. Dr. Wood has authored several articles, is a member of the IEEE, SGSR, APSA, AAAS, and WFS, and has published a monograph on The Potential for Congressional Use of Emergent Telecommunications: An Exploratory Assessment. For details, contact Dr. Wood at the Program of Policy Studies, 714 University Library, The George Washington University, Washington, D.C. 20052.

*Fred B(ruce) Wood

SECTION 2.6.2: POLITICS ON THE CABLE: A CYBERNETIC
APPROACH TO ACCESS ALLOCATION*

by

Fred B. Wood
The George Washington University

The issue of access of political candidates to the mass electronic media is symptomatic of the transition of American society through the so-called Second Industrial Revolution into the "Post-Industrial State" or "Communication Era," a time when the major new tools of society are information amplifying devices.¹

Mass media, and broadcast television in particular, have become an essential part of the modern day political campaign, especially at the congressional level and above.² But the technical and economic limitations of broadcast TV mean that only a few channels are available at very high cost in most media markets.

In order to attempt to protect the public interest, the Federal Communications Commission (FCC) established the "equal time" rule, which requires that TV stations afford equal broadcasting opportunity to all candidates for any particular public office. That is, the same amount of commercial time must be made available at the same price (or free, if public service time) to all candidates for the same office.³

Unfortunately, the net effect of this rule appears to discriminate against political communication in general and especially candidates from major media markets and/or those with limited campaign funds. First, most broadcast stations end up providing very little time, due in large part to their concern about having to provide equal opportunities to third party and minor party candidates. Second, in major markets (like New York,

Los Angeles, Boston, San Francisco-Oakland-San Jose, and Washington D.C.), stations are reluctant to provide time also because most political contests relate to only a small part of the media market and total viewing audience.⁴

Many stations apparently believe that political programming costs them money directly, if on a public service basis (by pre-empting revenue producing shows), and/or indirectly, if on a paid basis (through reduced audience ratings leading to lower advertising rates). The general result is to limit the total political dialogue on television, with a specific media advantage accruing to incumbents or challengers with personal affluence or special interest financing who are better able to raise funds for paid television time.

The purpose of this paper is to explore the potential of some of the information amplifying devices of the Communication Era for solving these problems of political access. Specifically considered are cable television--a physical tool or "hard" technology of communication--and cybernetics-- an intellectual or "soft" technology of communication. These tools are applied here in the context of congressional politics, but the relevance for local politics is perhaps even greater.

Cable Television: The Technology of Abundance

The use of cable for television reception began more than two decades ago with community antenna cable television (CATV) in parts of the country where terrain or distance precluded direct over-the-air broadcast reception. The traditional CATV system employs a tall antenna to pick up distant TV signals which are then relayed and distributed by coaxial cable to individual homes in nearby communities.

Such CATV systems thus simply serve to extend the reach of broadcast television into typically remote or mountainous areas. These systems are

small and of limited channel capacity (about 6 channels on the average). At most, the only extras provided are automatic local origination of time, weather, or news and stock ticker information on otherwise unused channels. This first generation CATV still accounts for perhaps three-quarters of all cable systems but only about one-third of total cable subscribers.⁵

During the 1960s, the second generation of cable came into its own. Unlike the earlier CATV, most recent growth of cable television has been in more populated and urbanized areas, and no longer depends solely on a community antenna for signal reception

In order to attract subscribers in the larger media markets, cable generally provides additional services besides improved reception quality. The most important of these extras are distant signal importation (of network, independent, educational, sports, or special feature programs from other media markets) and non-automatic local origination (live, videotape, or film) offered over a larger number of channels (twelve or more). About 20-25% of all cable systems now provide such a service package.⁶

And it is at this point of evolution that cable really becomes a new telecommunication medium. Due to the limited supply of electromagnetic spectrum in the frequency range most suitable for broadcast television, and the resultant scarcity of channels, cable provides a potentially viable alternative. By transmitting television signals through a coaxial cable rather than over-the-air, as many as twelve, twenty-four, or more channels of programming can be carried simultaneously (over a broad range of frequencies without interference) at low cost to the subscriber (about \$5-6/month).

Thus the key to cable's rapid growth since 1964, averaging 20-25% annually with over seven million current subscribers (about 10-11% of all television households in the country),⁷ is the combination of: better

reception quality, distant signal importation, local origination, many more channels, and low cost. However, whereas in earlier years CATV was restricted to rural areas and minor television markets, cable now appears to pose a competitive threat in many major markets. As a result, the broadcasters, copyright owners, and federal government telecommunication agencies, among others, have moved vigorously to protect whatever they perceive to be their vital interests. The future growth of cable therefore may depend in large part on ultimate outcomes in the regulatory and political, as well as economic and technical, arenas of the United States.⁸

Following several years of intense controversy, in early 1972 the FCC promulgated a new set of cable regulations which appear to be designed to guide cable television development in the direction of a broadband communication system or network.⁹

The essence of the broadband communications concept is that, because of its potential abundance of channels, cable can and should do much more than simply passively carry existing broadcast signals. In addition, cable should provide a diversity of and access to programming and services which are otherwise not available.

Apparently, the intent of FCC regulatory action is in part to realize some of this long-term potential while at the same time hopefully giving cable a viable short-run economic base. Accordingly, the rules permit all cable systems to import some distant television signals (subject to important limitations) but require that systems in the 100 largest markets provide at least twenty channels and the following nonbroadcast services: local origination known as "cablecasting" (for systems with at least 3500 subscribers), leased channels, public access channel, educational channel, local government channel, and a capacity for two-way digital services. These rules

apply immediately to all new systems; existing systems were given up to five years to comply.¹⁰

So, while the cable future is still fraught with many problems and much uncertainty, cable technology does appear to offer potential relief from the technical and economic limitations of broadcast television. Hopefully, through the creative use of intellectual tools like cybernetics, we can learn how to apply cable to solve problems of political access to the media.

Cybernetics: The Science of Communication

Cybernetics is the interdisciplinary science of communication and control in both machine and living systems.¹¹ Articulated originally by Norbert Wiener, cybernetics (from the Greek "kybernetes" meaning steersman, or governor in English) is operational primarily at the level of machine and living systems which are amenable to mathematical formalization and manipulation (like electronic radar and human nervous systems) but clearly has potential application to higher level and less tractable social systems.¹²

Cybernetics is also the branch of general systems theory concerned with models, principles, and laws of communication and control which apply to machine or living systems in different scientific fields and at various levels of phenomena. In its broadest definition, cybernetics can be taken as the science of organized social complexity and focuses on (1) communication--for the exchange of information and transmission of meaning--as the very essence of social systems, (2) control--for the attainment of specified social goals through the use of feedback and feedforward loops--as a prerequisite of self-regulating social systems, and (3) the individual and institutional modes of perception and values which provide the basis for both meaning of communication and goals of control.¹³

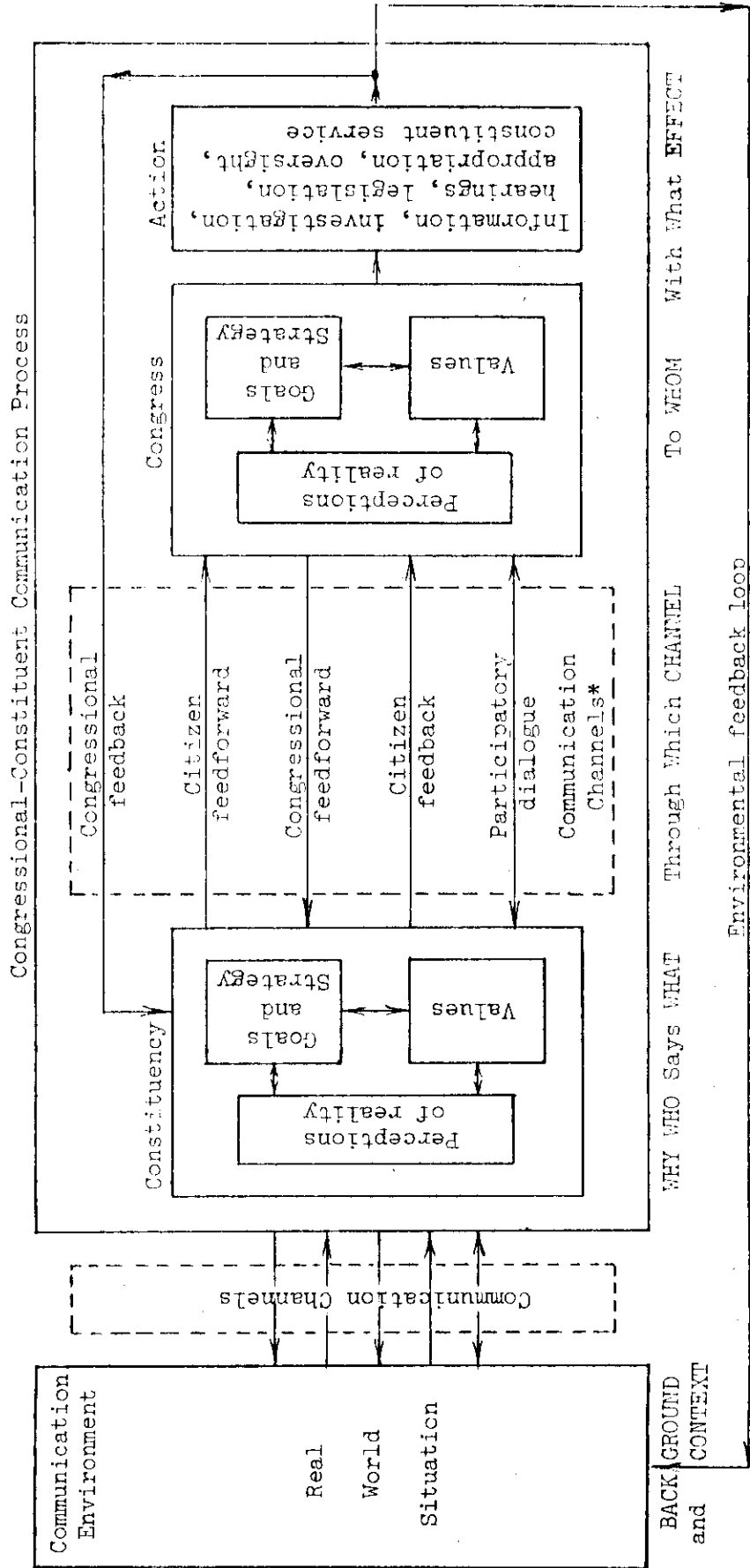
Within the context of political communication at the congressional level, Figure One is a very simplified cybernetic model of such a self-regulating system. A complete model would of course have to include the executive and judicial branches of government with appropriate communication links, and perhaps should be further disaggregated to identify other specific communicating entities such as lobby groups, opinion polling organizations, media commentators, and peer groups.¹⁴ In this simplified version, all components except those in the congressional-constituent communication process are lumped into the environmental block labeled "real world situation."

A typical conceptual application of the cybernetic model might proceed as follows. In the face of a real world characterized by increasing complexity and rates of change, cybernetic principles suggest that the social system or a subsystem thereof can cope with the environment only if it can match the variety or complexity of that environment.¹⁵

Put differently, if the congressional-constituent communication process is to remain viable, its internal variety must increase so as to match the increases in variety of the real world situation. This increase can be accomplished in part through changes in the dynamic structure of the social system, for example by the addition of new internal feedback loops and communication channels.¹⁶

If the net effect of such changes in internal structure is to improve the exchange of information and transmission of meaning both within the system and between the system and its environment, then the system will be better able to adapt to the changing real world environment. In a healthy system, positive and negative feedback processes should modify or reinforce system behavior so as to help insure the setting and attainment of goals which are consistent with system survival.

Figure One. Simplified Cybernetic Model of the
Congressional-Constituent Communication System



*Citizen feedforward = communication of constituent perceptions, values, goals, and strategies to congressmen.
 Congressional feedforward = communication of congressional perceptions, values, goals, and strategies to constituents.
 Citizen feedback = communication of citizen opinions and views in response to congressional action and effects on the real world flowing therefrom.
 Congressional feedback = communication of congressional action in response to citizen feedforward and feedback.
 Participatory dialogue = mutual exchange of information and meaning between and among congressmen and their constituents about alternative perceptions, values, goals, strategies, and actions.

Politics and the Media: The Goal of Balanced Access

Any approach to the allocation of political access to communication media must be based on a value judgment of some sort. In the view of this writer, the basic goal should be to achieve fair and balanced access to communication channels for both incumbent office-holders and challengers. A minimum level of access should be guaranteed to all eligible and qualified candidates in order to achieve a reasonable balance of exposure between the incumbent and challengers, and to increase the flow of information to and dialogue with the voters.¹⁷

To realize this goal with broadcast television, some have proposed the "voters' time" concept which would require television stations to make available specified amounts of time under clearly defined conditions for the purpose of political broadcasts by candidates for the House or Senate. "Voter's time" would be provided free of charge to candidates, with costs absorbed either by the stations as a public service or by the federal government through some sort of public campaign financing.¹⁸

While this approach has merit, and should be pursued, it does not solve the problems inherent in the technical and economic limitations of broadcast TV, and has generated considerable opposition on this basis. In addition, the problems of eligibility, use, and especially allocation have proved difficult to resolve.

As discussed earlier, cable technology can help overcome the technical and economic limitations. And cybernetics can help show how cable could be used so as to improve the political campaign process.

A Cybernetic Approach to Access Allocation

Full equality of access for every candidate, even if possible, might well be harmful. While opportunity for expression and right of access to

communication forums are essential to democratic politics, the political communication system must also keep social stability in balance with social change. Unlimited political communication can lead to communication overload, distortion, and stress which in turn could threaten the viability of the political system itself.

Cybernetics has now developed to the point where it can provide some guidance, albeit tentative, as to how a balance can be struck between stability and change, incumbents and challengers, the "ins" and the "outs."

What follows below is an exploratory application of cybernetics, presented in non-technical language, for the allocation of cable origination time to congressional candidates. The allocation methodology is based on the "modified thermodynamic imperative," a cybernetic hypothesis which suggests that the optimum balance between stability and change (order and freedom) in society can be achieved in part by maximizing the entropy of communication (known as negentropy).¹⁹

The long range objective should be to fully realize the potential of cable television for an improved political dialogue. During primary and general election campaigns for the U. S. Congress (and perhaps for others of local importance like the city council, county board of supervisors, or state assembly), all qualified candidates should have access to cablecasting facilities and origination channels under clearly defined conditions of eligibility, allocation, and use.

But access must be controlled so as to preclude the possibility of communication overload or abuse. The idea proposed here is to move from the present "equal time" rule, which is clear-cut but tends to result in the provision of little or no time and thereby restrict political communication, to the concept of "representative time."

Under a "representative time" provision, eligibility might be defined by limiting access to those legally qualified candidates who (1) represent a political party whose candidate placed first or second in the previous election, (2) represent a political party recording a specified percentage of the total vote in the previous election, (3) receive a designated level of support in voter opinion polls, or (4) gather a given number of voter signatures as evidence of an acceptable minimum level of support.²⁰

Candidates qualifying under these eligibility rules might then be allocated free time according to specified formulas. For example, one-half of the total time available could be allotted on a major-minor-third party proportional basis to assure adequate exposure for candidates of the organized political entities. The other half of the time could be allocated on an individual probability basis to guarantee at least some exposure for independent candidates.

As illustrated in Figure Two, allocation on a party proportional basis favors the established and majority political interests while allocation on an individual probability basis favors the independent and minority political interests. Thus the total combined allocation provides an equitable and efficient balance of representation between established-majority and independent-minority political expression and exposure.

In the example of Figure Two, 20 hours is the total "representative time" available over cable origination channels for a particular congressional general election campaign. One-half of the total--ten hours--is allocated among party candidates in direct proportion to each party's percentage of the total vote in the previous general election. Thus, major party candidate A receives five hours based on party A's 50% of the total vote,