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ABSTRACT
        A one-to-one network of communication, labeled
SYSTEM-1, will come into being as a result of the demands of the
public for information. In general, this form of communication system
serves an asymetric communication need--the user supplies a group of
control signals that modulates the automatic flow of large amounts of
information from a central store. SYSTEM-1 will be able to collect
data from many identified points and to direct information from the
center to some specified subset of the connected terminals. This
paper describes SYSTEM-1 and considers some of its applications:
individualized instruction and education, special information and
inquiry centers, two-way files generated by the user population,
public distribution of materials, interactive entertainment to
increase involvement, creative interaction and experimentation,
provision of computer access to the individual citizen, polling, and
interactive advertising. Following the discussion of applications,
the receiver-terminal and the interconnection of SYSTEM-1 centers to
form a network are described in greater detail, and a final section
considers the organizational, regulatory, and technological
activities which must be undertaken for SYSTEM-1 to be realized.
(SH)

INTERACTIVE TELEVISION:
A MASS MEDIUM FOR INDIVIDUALS
OCTOBER 1969

JORDAN J. BARUCH

PREPARED FOR THE
PUBLIC BROADCASTING
CORPORATION

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introduced him to the tradition/change dichotomy. Most
importantly, her view of the role of personal partici-
pation in the development of a sense of autonomy really
forms the foundation for this paper.

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FOREWARD

Thi? ~aper is an outgrowth of a request made in October
1968 by ... R. Killian, Jr., that EDUCOM deal with the
non-radio/non-video uses of the facilities of the Cor-
poration for Public Broadcasting. Of particular con-
cern to the corporation was the potential for inter-
action between the developing Public Broadcasting System
and the growing worlds of interactive computation and
interactive educational programming.

From our base in the use of interactive information
technology, we examined P.L. 90-129 and the book "Public
Television" [1] containing the report of the Carnegie
Commission that gave rise to the Act. Additional mater-
ial [2,3] was reviewed and our initial views were drafted
and reviewed with many of our colleagues.

The Corporation for Public Broadcasting (The Corporation)
established under Public Law 90-129 by the 90th Congress
in 1967, has wide responsibilities. Under Section 396 of
that Act -- the Congressional Declaration of Policy, we
read:

> "SEC. 396 (a) (1) THAT IT IS IN THE PUBLIC INTEREST
> TO ENCOURAGE THE GROWTH AND DEVELOPMENT OF NON-
> COMMERCIAL EDUCATIONAL RADIO AND TELEVISION BROAD-
> CASTING, INCLUDING THE USE OF SUCH MEDIA FOR IN-
> STRUCTIONAL PURPOSES:"

Section 301, Title II, of this same act, makes it clear
that Congress visualized a wide diversity of activities
to be subsumed under the heading of "Instructional Pur-
poses."

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"INSTRUCTIONAL TELEVISION AND RADIO (INCLUDING
BROADCAST, CLOSED CIRCUIT, COMMUNITY ANTENNA
TELEVISION AND INSTRUCTIONAL TELEVISION FIXED
SERVICES, AND TWO-WAY COMMUNICATION OF DATA LINKS
AND COMPUTERS.)"

To implement these Congressional charges, the Corporation
will "establish and maintain a library and archives",
"arrange...for interconnection facilities..." and "will
conduct (directly or through grants or contracts) research,
demonstrations or training in matters related to non-
commercial educational television or radio broadcasting."
Further, while it is specifically barred from owning any
interconnection or production facility, the Corporation
will "contract with. or make grants to, program production
entities..."

Congress' clear recognition of the wide scope of modern
public broadcasting and its charges to the Corporation
could make P.L. 90-129 one of this nation's most signifi-
cant pieces of communication legislation since the esta-
blishment of the Federal Communications Commission. This
potential for impact was at variance with our initial
draft that dealt largely with the didactic use of the
medium. It was generally felt that an expansion of that
view was in order. The passage of time, the rapidity of
developments in technology and in the nation's needs has
shaped this new result. It is an action-oriented docu-
ment that deals with one view of our future communication
environment. It is very different from the first draft.

Boston, Mass.
October 1969

I. PROLOGUE: AN OVERVIEW

Our society needs and is ready for a third type of national
communications system. This state is a reflection of the
"I am I" cry of our students and of the problems of being
an individual in the ghetto. It is a reflection of the
student programming at a computer console in Massachusetts
and practicing math at one in Mississippi. It reflects
a baby burned with lye in New York and a cop trying to
get a "make" in Illinois. It reflects the need for the
individual to communicate with the system and a demand
that the system recognize the individual. Many commer-
cial and governmental agencies are examining this demand.
We believe that it rests with the Public Broadcasting Cor-
poration to lead in its development and to represent the
public in its management and utilization.

This paper posits the existence of such a third system.
For convenience we call it SYSTEM-3, or extended broad-
casting. The receiver/terminals on SYSTEM-3 have buttons
on them that send data back to the transmitting center -
data about how the viewer feels, what he thinks, what he
wants. Two-way channels - largely on community cables
carry this data back to the center. No hang-ups, no busy
signals, no bureaucrats - data to center - and the center
responds. Back to homes and offices and hospitals and
police-stations and schools come words and pictures and
stories and music. And the viewer reacts, and the center
reacts, and the story changes. And extended broadcasting
isn't to the viewer, or at the viewer, but it's with the
viewer and it's got to be hotter than the media men ever
thought it could be.

But we're getting ahead of ourselves. First we have to
see where we are and where we've been to know where we're

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going and how we're going to get there.

The vast majority of the communications activity in our
society is carried on two kinds of systems, distinguished
from each other by their connection patterns.

One pattern is typical of the common carrier or point to
point communication. The postal service, the telephone
network and the telegraph system fall into this category.
The stations served by such a system can generally take
on the role of either sender or receiver. One node chooses
another node with which to communicate and any technology
that intervenes does so in order to bring about private
point-to-point communication.

Because no one knows who will call whom next, a major cost
of running such a system lies in the apparatus and organ-
ization required to establish the connections. A large,
N-station network requires roughly $N^2/2$ possible connec-
tions.

Philosophically, the role of the organization that manages
a common-carrier network is to connect the nodes to each
other, and to do so as intimately as possible. Because of
this philosophy, privacy is a vital characteristic. Any
intervener functions as a common carrier. He neither adds
to, subtracts from, nor modifies the intelligence being
transmitted nor does he sit in judgment of its content.
He is truly one who carries.

Because of their special role, the common carriers are
closely regulated. Matters of privacy are regulated by
legislation covering wire tapping, disclosure of infor-
mation by the carriers, and the use of transmitted infor-
mation entrusted to the carrier's care. Bookies and lovers,

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priests, lawyers and doctors rely both on the essential
privacy of such point to point, one to one connections,
and on the assurance that their messages will undergo
no modification. The importance of such a point to
point network in our nation cannot be overemphasized.
The Federal control over the postal system and over the
rates and the practices of the common carriers is a clear
indication of the importance that Congress assigns to the
carrier's operation.

The second national system is the one we dedicate to broad-
casting. The term itself is descriptive of the activity.
From yesterday's town crier to the modern television sta-
tion, broadcasting involves a broadcaster, a central node
sending out its information to any and all who will take
the trouble to listen or watch. The relationship of the
broadcaster to his public is a statistical one. That which
goes out from the station does so publicly, unaffected by
the individual listener's identity or his level of attention.
Feedback to the broadcaster is generally a long-term phe-
nomenon, statistical in nature, having only a slow effect
on the character of the program material.

The broadcaster is responsible for the information that
he transmits. Whether he generates it, purchases it, or
contracts to receive it from some other source, its con-
tent and quality are his ultimate responsibility. Because
Congress recognized the finite nature of the spectrum that
all broadcasters share, they are treated by the law as
guardians of a public asset. Because the public has little
influence over what is carried, Congress has appointed
the FCC to guard their interests. More and more the FCC
requires broadcasters to be responsive to the needs of
the community that they serve and indeed to be part of
that community. The listener or viewer dealing with our

broadcast system is extremely limited in the selection
of materials from which he can choose. A handful of
radio and television stations are within the reach of
his receiver and, because of network activities, a fair
degree of program redundancy exists even among these in
dense urban areas.

Economic considerations dictate that the technologies and
the organizations of the two communication systems closely
reflect their functions. That fact, however, severely
limits the ease with which society can extend the function
of either system. The common carrier system is represented
by a network of lines mediated by the world's most complex
and effective switching system. The lines (analagous to
information pipes) used by the carriers have widely differ-
ent capacities that can be subdivided in order to satisfy
the needs of multiple simultaneous users. The rate structure
and organization of the common carriers reflect their point
to point nature. A myriad of central offices exists to
perform the switching and interconnection function and
the carriers make maximum use of local and state by state
legislation to optimize their operational freedom.

The major operational effort of the carriers deals with
their role as interconnectors. The facility with which
they make connections, the accuracy with which they can
predict usage and with which they can reflect those statis-
tics in the allocation of switching equipment has much to
do with their profits. One equipment design will be op-
timum, for example, if a telephone company predicts that
only one local line out of 12 will be in use at any one
time and that the average duration of a connection will
be four minutes. If, however, a change in phone activity
dictates that as many as 30% of the local users will de-
mand simultaneous connection and that the average duration

of that connection will be 40 minutes, a very different
design will be required. Either a major change must then
be made in the switching system or the company will find
that its efforts to meet the new requirements by the first
system will result in markedly uneconomical facilities
utilization. Such changing use does exist, is ill-served
by the common carriers, and represents a major pressure
for SYSTEM-3.

In broadcasting, technology and organization again reflect
system use. Characteristically we find large transmitters
each capable of reaching large numbers of receivers. Since
the financial return to a broadcaster is largely propor-
tional to the number of receivers he reaches, geographical
radiation patterns and program content are both generally
geared to maximizing that number. In order to preserve the
locally responsive nature of the station, however, the FCC
regulates the pattern and requires a reasonable amount of
local content. To further insure a reflection of local
needs, the FCC has declared that the owners of such stations
should be members of the community and be active in the man-
agement and operation of the station.

The feedback that results from public pressure on station
management is extremely slow. The changes it produces
are often perceptible only over months and years. Those
stations that seek to be responsive on a shorter time scale
(generally for educational purposes) have instituted such
innovations as telephone feedback from the listener. Such
systems quickly strangle, however. A station capable of
addressing a million receivers will be coupled to its view-
ers through a switchboard capable of handling three or four

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simultaneous calls. The recognition of the need for a
better match between the number who hear and the number
who can be heard constitutes another pressure for the
establishment of SYSTEM-3.

While it is poor engineering to describe a proposed solu-
tion and then to discuss the needs that that proposed
solution is intended to meet, our joint role of sooth-
sayer and designer gives us that perogative. The prob-
lems for which SYSTEM-3 holds promise, and hence the
uses to which it is likely to be put, have as their
major common factor only the kind of demand that they
place on a communication system. By presenting in Section
II a brief preview of SYSTEM-3, we will have a common con-
text for Section III in which we discuss the various ap-
plications. In Section IV we will attempt to refine and
extend our description of SYSTEM-3 permitting the engin-
eer ascendency over the seer. We can then, in Section V,
deal with the organizational, regulatory and technical
problems that must be overcome in order to bring SYSTEM-3
and its attendant applications to a common stage of de-
velopment. The final section will then briefly discuss
a possible collaborative role for EDUCOM in this develop-
ment.

In all of these sections, the distinction between Public
and Private sector is far smaller than the distinction
between "now" and "then". SYSTEM-3 will develop - is
developing - as a collaborative effort between the Public
and Private Sectors. We take the position that the repre-
sentative of the Public Sector will be the Public Broad-
casting Corporation. We further take the position that
the Public Broadcasting Corporation will be partner to,
and shareholder in, whatever Private entity develops.
Thus, these following sections assume many shared facilities,

shared intellectual investments and shared commitments.
There may well be separate Public and Private channels,
Public and Private satellites, and even Public and Private
computers; but the major distinction will be whose inter-
est is served and who is the guardian. Thus it is not
until Section V that we really discuss the role of the
Corporation with any specificity. Before that we are
busy describing a world in which it will live.

II. SYSTEM-3: AN INTRODUCTION

Since the 1950's, a new style of communication has grown
so rapidly that our existing communication systems have
been severly strained in their efforts to meet its needs.
Characteristically this style is typified by a main,
central node in a two-way communication with many satel-
lite nodes. We shall call this communication style one-
to-many-to-one. In complex configurations, some of the
satellites may serve as central nodes to other, lower
level satellites. In termns of information flow, al-
though not necessarily in terms of structure, such a com-
munication network looks much like a tree, with communi-
cation flowing in both directions along the trunk,
branches and twigs. Because neither of the two existing
forms of communication system is readily transformable
to such a network, we have called the system that will
serve its needs "SYSTEM-3."

It is our thesis that SYSTEM-3 will come into being as
a result of the demands of those who would use its facil-
ities. In a recent survey conducted by EDUCOM for the
U.S. Office of Education, a catalog was developed that
listed and described 82 separate functioning United
States networks concerned solely with the transmission
of digital data. Everyone of them was a one-to-many-to-
one system.

In other studies performed for the legislative background
of the "Networks for Knowledge Act," it was possible to
identify similar non-profit network configurations deal-
ing with

> . Interlibrary loan
> . Computer use in research

. **Bibliogrphic file exchanges**
. **Computer aided instruction**
. **Poison control information**
. **Problem solving**

Among the disciplines and activities represented in the
networks then receiving federal financial support were

. Biomedicine
. Command and Control
. Transportation
. Research Reports
. Toxicology
. Biology
. Urban Renewal
. Civil Defense
. Water Resources
. Oceanography
. Nuclear Energy
. Engineering
. Agriculture
. Chemistry

and some 50 others.

The major national libraries- The Library of Congress,
the National Library of Medicine, and the National Agri-
cultural Library have a joint task force addressing the
problem of a national library network. EDUCOM, and
various small groups have undertaken the interconnection
of institutions of higher education in multimedia net-
works.

This proliferation of network activities is too active
a phenonmenon to arise simply out of desires for organi-

zational aggrandizement. It seems clear that it reflects
a major need on the part of many groups within the public
sector.

In general, this form of communication system serves an
asymmetric communication need. By and large, the amount
of information sent to a user node from the center is
very much larger than the amount transmitted inward from
user to center. In Poison Control Center, for example,
the user supplies a poison name, an amount and perhaps
an age figure. In return he gets a large mass of infor-
mation on contents, therapy, precautions, etc. In Com-
puter Aided Instruction, the user supplies a few bits
of information indicating a choice among a limited set.
In return he gets text, instructions, illustrations,
etc. In an Interactive Television Program a student
calls in a question and he and the rest of the audience
get explanations, illustrations, etc. In a Library Sys-
tem, a subject heading from the user generates citat-
tions and looses a flow of text and other material.

In each case, the user supplies what is essentially a
group of control signals that modulates the the auto-
matic flow of large amounts of information from a cen-
tral store. Such is the general nature of the communi-
cation style that will be served by SYSTEM-3. Central
to the task of mediating this automatic response is the
digital computer. Central to the task of displaying
the large amounts of data that result is the television
transmitter/receiver. This satyr-like hybrid of the
two technologies forms the core of SYSTEM-3.

This hybrid core requires two capabilities of the com-
munication system that links it to its terminals. First,

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the core must be able to receive bursts of data from
each individual terminal. Those data must be identified
as to their terminal of origin. The data may, in the
case of television, represent audience response signals;
they may, in the case of information request systems be
requests for specific information. In each situation
they will have a different semantic content closely re-
lated to the display. In each case, however, they have
the common characteristic of being identifiable as to
their origin. Suddenly the audience has faces. Sud-
denly it is composed of individuals whose responses are
individually collected. We shall call this character-
istic of SYSTEM-3, this ability to collect data from
many identified points, BROADGATHERING.

The second feature that the core requires of the com-
munications system is the ability to direct information
to a given terminal or to any group of terminals con-
nected to the center. In a television program, for ex-
ample, the same program might initially be seen by all
the viewers tuned to that channel. After some action
has been taken by the viewers, some might see one end
to their drama and others might see quite a different
ending. In the case of an information request system,
of course, each individual requesting information will
expect his own information privately displayed on his
terminal. In the case of a teacher, the data he sup-
plies might well control the display on an entire set
of terminals that he designates. This feature of
SYSTEM-3, this ability to direct information from the
center to some specified subset of the connected termi-
nals we shall call NARROWCASTING.

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Clearly the concepts of both narrowcasting and broad-gathering require that the individual terminals or receivers connected to SYSTEM-3 have labels- or, in the current jargon, addresses. A receiver's address may generally be provided either by having each receiver connected to the center by a specific line, or it may be provided electronically with the receivers connected to a single cable or partly line. For more than a very few receivers attached to a single center, the party line solution is more economical. Both the modern intracity cable transmission system and the direct broadcast two-way satellite are examples of party lines capable of handling the information required by SYSTEM-3.

Needless to say, the receiver/terminals on such a party-line are special units. Neglecting for now what goes on inside them, we can describe their external appearance. First and foremost they look like ordinary color TV sets. Only 14 pushbuttons and a light distinguish the simplest terminals from such sets. Twelve of the buttons are arranged along the bottom and right side of the picture tube. Seven divide the horizontal axis and five the vertical. Below them both is the light that lights up "READY" and the green and red buttons that permit or prohibit interrogation of the terminal by the SYSTEM-3 center.

Conservative calculations indicate that the center should be able to poll 750 active sets out of a population of one million sets, receive and store from each one 12 bits of data, and use less than 1/30 of a second to do so. Because the receivers are equipped for narrowcasting, each can be shut off for this 30th of

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a second with no more preceptable image interference
than that occasioned by the blink of an eye. This frac-
tion, 1/30 second will recur frequently. It represents
the time to transmit one complete TV picture or frame.
Actually, such frames are transmitted as two interlaced
halves, so we shall sometimes refer to 1/60 second as
a "half-frame time."

We shall see in Section IV that the transmission of a
37-bit string from the center over the party line is
sufficient to control the reception of any one among
one-million receivers connected to the party line.
Over a single video channel we can conservatively trans-
mit somewhat in excess of 1,000 such control commands
during each frame-time.

The use of a digital computer for the collection and
transmission of control signals at such speed is any-
thing but far-fetched. Modern digital computer fre-
quently have channels that operate more than 10 times
this rapidly. Similarly, the bandwidth required is
not inconsistent with that of a single medium-quality
television channel. At least that bandwidth may be on
either satellite or cable. The redundancy of three pro-
vided for in our calculation will cope with any expected
noise. It should be noted that the blocks of data to
be received from each of the terminals can contain as
few as 12 bits from the simplest home terminal to 600
bits representing a full line of text from the most
complex terminal. The range of audience response that
we are equipped to handle with such a system can be
very wide indeed.

Figure I shows a rough block diagram of a SYSTEM-3

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communication system. The center transmits both picture and terminal-control signals over an outbound channel while it receives data from the connected terminals over an inbound channel. It is assumed that our terminal can store one frame and display it continuously. As a result, the center can transmit a single image to a terminal and have that terminal store that image without using channel capacity for regeneration. While image storage tubes, discs, and other local storage devices still range in cost from $1,000 up, such cost figures will drop rapidly in a growing market.

The SYSTEM-3 center contains equipment for generating images, deciding who gets what, manipulating slides and films and even for calling for help. It is a display management center with library, file and computation capability equal to its task.

In summary the, SYSTEM-3 contains a center capable of broadgathering data from many terminals and capable of narrowcasting images over one or more video channels to its associated terminals. This combination of narrowcasting and broadgathering we combine under the heading of "EXTENDED BROADCASTING." It is the business of SYSTEM-3 and is central to the applications described in the next section.
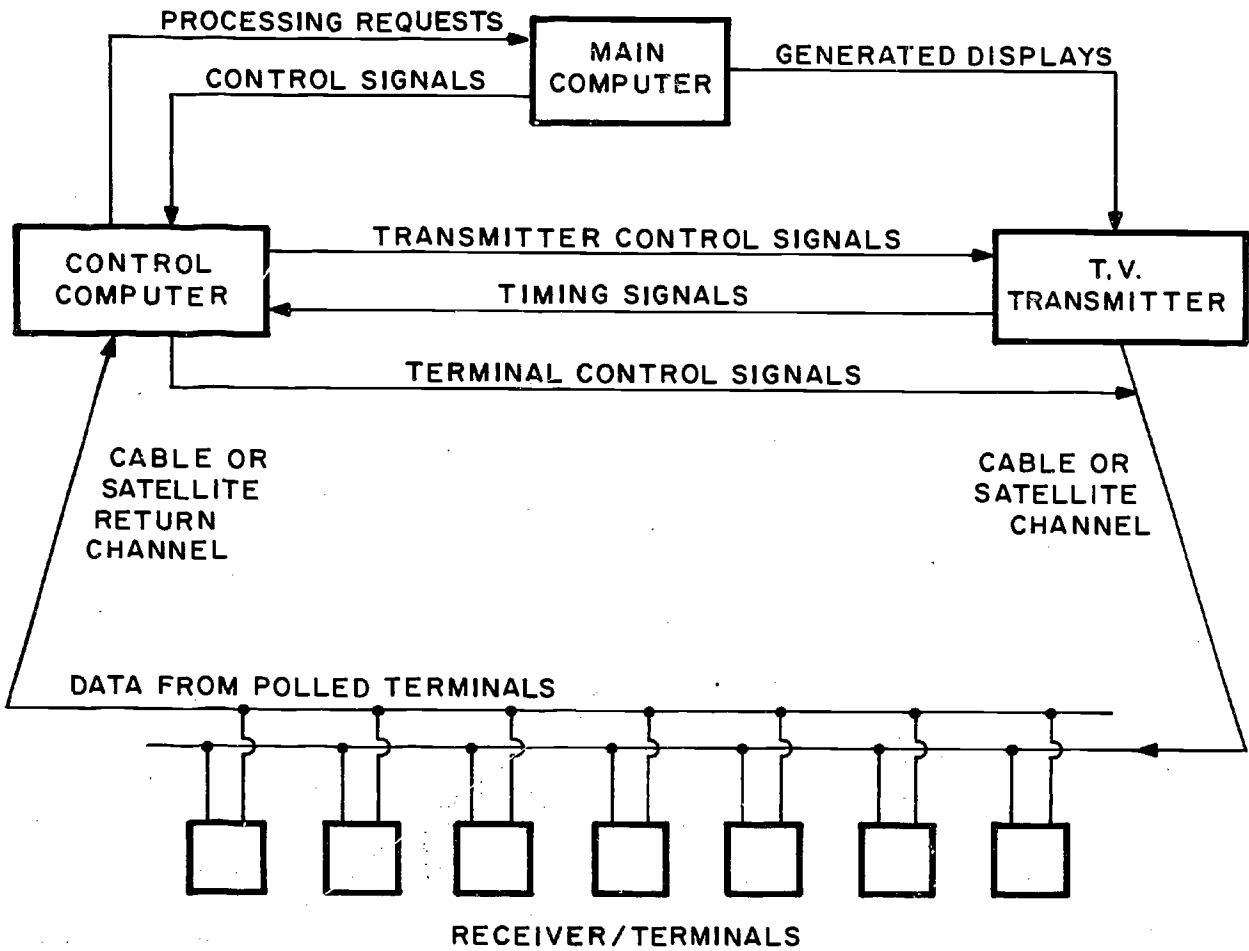
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PROCESSING REQUESTS

CONTROL SIGNALS

MAIN COMPUTER

GENERATED DISPLAYS

TRANSMITTER CONTROL SIGNALS

CONTROL COMPUTER

TIMING SIGNALS

T.V. TRANSMITTER

TERMINAL CONTROL SIGNALS

CABLE OR SATELLITE RETURN CHANNEL

CABLE OR SATELLITE CHANNEL

DATA FROM POLLED TERMINALS

RECEIVER/TERMINALS

FIG.1 A SYSTEM-3 CONFIGURATION

III. APPLICATIONS: RAISON D'ETRE

Broadly speaking, both Public and Commercial applications
require SYSTEM-3. The Public applications are those
normally considered in the public domain: medical,
library, instructional, public safety and other ser-
vice activities. In the Private domain lie the commer-
cial computational service, direct home marketing and
other functions normally conducted for profit. We shall
include in this section a detailed description of the
Public applications and some brief remarks on the others.
The reader must be cognizant of both if he is to under-
stand the ontogeny of extended broadcasting and hence
the development of SYSTEM-3.

A. Instruction: Buy, sell, borrow or cut-back?

It is our belief that a major driving function in the
development of SYSTEM-3 will be its use for instruction.
It has the potential to provide reasonably individualized
participatory instruction at a distance: at home, in
the community and in other non-school locations. Indeed,
we believe that the instructional use of SYSTEM-3 will
not only foster the development of extended broadcasting
but, in true regenerative fashion, will foster the develop-
ment of education. Indeed, we doubt that vital educ-
ation can take place without the kind of responsiveness
that SYSTEM-3 can provide.

One of the basic responsibilities of public education is
the review, examination, and transmission of our past,
our traditions. Much of education is concerned with
passing on past experience and accumulated skills from
generation to generation. This transmission takes place
everywhere, in the arts, the social sciences, and
science; it pervades the whole gamut of educational

activity. It is this aspect of education that provides
the stability for civilization and for society. It is
within this aspect that education provides the tools
and the training that we need in order to function
within society. When the system does this part of its
job too well, however, conservatism rules, students
riot and the sy stem loses vitality. Change is needed
to temper stability.

The other responsibility of education, the one dia-
metrically opposed to the first, but essential to its
survival, is that of facilitating change. Developing
the individual's critical perception, his identification
of himself as a change agent, his courage and the skills
for producing change, are needed to provide for the
continuing development of society.

Educational television is, at present, a powerful tool
for transmitting tradition. As such it has had a sig-
nificant impact in the arts, in lectures, in seminars,
in debates, and in the record that broadcasting makes
of history as it happens. News, commentary, and reviews
summarize our place in the present and our path through
the past; the arts help display this summary in a form
whose attractiveness and appeal has to be experienced
to be appreciated.

Educational television is also a powerful aid in training,
in the teaching of skills. Through its powers, we can
watch skilled craftsmen, examine in detail the most com-
plicated of processes, capture a fleeting phenomenon,
join masters as they work and discuss their work, and
have the vast range of human knowledge and behavior laid
out for us. Little that can be learned through watching
and listening does not benefit from such presentation.

Despite the obvious contribution of educational tele-
vision--of the broadcasting system in this field, despite
the fact that educators have not yet learned to use these
facilities to anywhere near their full potential, we
cannot help but agree with Licklider's comments in his
article TELEVISTAS[8] "Educational television is too
conservative in its estimation of the feasibility of
selective, interactive, and intercommunicational tele-
vision systems, and of the achievability, with the aid
of such systems, of a significant breakthrough in educ-
ation."

While such interaction is being recognized as important
in the educational areas of tradition and skills, timely
interaction is fundamental and vital to the second task,
that aspect of education involved with change.

That is not to say that conventional broadcasting has
no role to play in education for change. Educational
television, has presented program on program showing
the need for change in the human condition in our country.
Certainly, televised riots and confrontations have
served to educate elements of our population in the
potential, and limitations of such means for producing
change. Because it lacks his participation, however,
broadcasting cannot deal with the extremely personal
problem of the individual recognizing himself as an
effective agent for change.

We have lea-ned to see others as such change agents.
Through the medium of dramatic presentation, we often
see an individual as an effective learner/doer, per-
ceiving the need for change and development and producing
it. We have come to know our civilization's heroes and
legends with an intimacy never before achievable. We
meet them, relive their work, understand their rewards

and their struggles, and identify with them. This same
medium of dramatic presentation opens to us the world
of the possible. We observe other individuals taking
effective action to influence their future and society's.
But they're heroes, larger than life, I am only I.

Powerful as this use of television may be then, it still
cries out for augmentation. The final step, that of
transferring the concept of some general individual as
an effective change agent to ME as that agent requires
personal participation. Traditionally, work experiences,
laboratory experiences, group interactions, inter-
personal relations with the teacher, and even the
"exercises in the back of the book" produce that flexing
of muscle, that exercise of agency, that sense of com-
petence and autonomy that rarely seems to arise without
such participation. We see, then, as a major demand of
education, today and tomorrow, a demand for participation.
While some participation is now possible through gross-
sampling techniques via the telephone, or by mail, neither
truly constitutes a form of participation suitable for
education's need. To meet that need, we will require
those rapid responses from identified users and those
means to modify each individual users video environment
that are characteristic of a SYSTEM-3 communication net-
work.

In order to facilitate our discussion of the instructional
application of extended broadcasting, let us define the
term "slide-show" that will be central to that discussion.
A slide-show is a succession of images projected more
slowly than those that make up a motion picture. While
the time interval between slides may vary widely, de-
pending on the content of the accompanying audio, we shall
assume an average interval between images of four seconds.

The storage unit in the receiver holds each image until
the next change. Each show also has a unique audio
channel associated with its sequence of images. Approx-
imately 100 simultaneous slide shows can be transmitted
in the bandwidth required for one video channel of
SYSTEM-3. The control capability of SYSTEM-3 makes it
possible to switch any receiver or group of receivers
from one such slide show to another at will. SYSTEM-3
is therefore potentially a valuable medium for the
future development of computer-aided instruction.

Now that we've described the slide-show, let's imagine
its use in a business school instructional session.
Rather than a case study observed from a distance, we
can make the student take the role of an operating
decision maker in the business under study. For that
we require that the simultaneous slide-shows on the
channel represent alternate worlds of possibility.
The student leaves one and enters the other as a re-
sult of his decisions. For example, there might be six
decision points in a one-hour program. At each of
these points he might be required to chose among two
to five decisions. Allowing for redundancy, dead ends,
and closures in the decision tree, what starts out as
a single world--a common starting point--shown in a
normal video presentation may well branch out to as
many as 100 slide-shows representing alternate worlds--
outgrowths of alternate decisions--during the session.

During our hypothetical case study, there might be one
decision involving inventory, one involving dropping
sales, and one involving a shortage of capital. In
fact, of course, there would be many such decisions--
each depending on what that individual had done before.
At the end of the case, however, each student--the
student who bought and the student who sold, the student

who decided to cut back on production and the one who
decided to increase the sales force, the one who
decided to diversify the line and the one who decided
to start a new advertising campaign, the student who
decided to borrow capital, and the one who decided to
seek equity financing--each student would have moved
through a set of experiences clearly of his own
making. This is the experience of doing, the ex-
perience of "ME" as an agent of change.

Clearly, business is not the only area amenable to
such instructional techniques. Branching programs
of one sort or another are being used from third
grade through medical school. With the aid of extended
broadcasting, however, they can take on a new vitality
and realism. In the medical program the results of
test, examination and therapy decisions would not be
simple text descriptions as they now are, but the dis-
play of tissue-slides, stethoscope sounds, ECG and
other graphic representations, and even patient inter-
views. Rarely will a problem be complex enough to
exceed our limit of 100 possible alternate worlds.
Rarely will the medical student or doctor get more in-
volved with a case study.

We do not, however, believe that the public use of
SYSTEM-3 in education will be restricted to computer-
aided instruction. Because SYSTEM-3 can function as
an extensive inquiry system with a single terminal
requesting and examining information, reacting to it
and getting a new display, we believe that extended
broadcasting will be applied to such educational tasks
as individual self-evaluation, for monitoring one's
own progress in a subject area and for area exploration.
In this type of use, the number of terminals that can
be individually serviced by a single video channel is

very large. Where the study time devoted to a specific
display is in the order of minutes, the number of ter-
minals that may be simultaneously served will be in the
order of thousands. These applications, and the use of
adjunct materials will allow extended broadcasting to
play a significant role in computer managed instruction.

B.   The Information/Inquiry Center: It was a blue bottle...

As society's activities have become more complex, special
information centers have become more common. We are all
familiar with "directory assistance" and some of us are
familiar with the marine and pilot weather information
centers, and others, public and private, of an even more
esoteric nature. In the public area, an information
center representative of the entire genus is the Poison
Control Center. Current Poison Control Centers require
that the physician who has a poisoning case on his hands,
call a special number. He will then be connected with
an individual who will discuss the case with him. He
will be asked such questions as the name of the poison,
how much was taken, the age of the patient, etc. The
attendant at the Poison Control Center will search his
files for the appropriate measures to be taken. A frequent
suggestion that arises is the use of a computer-managed
data bank to be used by the attendant at the control center.
The advantages of such a computer-managed data bank are
many, the most significant medically being its exhaustive-
ness, its ease of updatin g, its speed of its response,
and its multiple cross-indexing.

Even with such an automated data base, the use of the
telephone and an intervening human between the inquirer
and the data combine to produce a traffic bottleneck.
In fact, many Poison Control Centers can only handle one
inquiry at a time. The development of direct access

computation techniques has led many people to suggest
the elimination of the attendant and the substitution
of direct inquiry by the inquirer. The use of special
terminals in hospital settings or in the doctor's
office, and the use of touchtone telephones with voice
answer back from the computer over the common carrier
network are the most generally suggested approaches.
Such approaches could be satisfactory as long as the
inquiry flow rate stayed small and as long as the
information to be displayed could be restricted to
words. Where traffic requirements are high, or where
non-discursive display is required as in the display
of physical things like labels, bottle shapes, physical
signs, etc. direct access inquiry can be better handled
over SYSTEM-3.

We can visualize a physician called to a home where a
child has swallowed a portion of the contents of an un-
labeled bottle. If the home has a SYSTEM-3 receiver/
terminal in it (and it will when they are as popular as
TV sets) we can envision our physician switching to
Channel 97, the emergency medical channel and requesting
help. Using the first of the seven horizontal buttons
and the first of the five vertical buttons he presses
the 1-1 combination to signal an emergency inquiry.
The screen lights up with a matrix seven columns wide
and five rows high. Each of the 35 cells offers the
physician a choice--a decision as to the kind of help
he needs. Our physician now presses the combination
2-4 to indicate "POISON". Successive matrices, each
offering him many choices pass in response to his actions.
When he requests a display of unlabelled containers, he
may be faced by a smaller matrix in which each cell shows
a stylized container in much the same fashion that air-
line baggage damage sheets show an array of stylized

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luggage shakes. Our physician picks the one most
nearly like the one in the house and is faced with
another more detailed group, all of that category.
Fortunately, one is an exact match. Indicating that
one, he is told its contents and its manufacturer and
may then be given a recommendation or may again be
asked questions about the patient's age, etc.

This ill-developed scenario is not intended to bias
the design of a SYSTEM-3 Poison Control Center. We
wish to indicate how effectively a video display system
coupled with a small array of buttons can serve to act
as the input/output terminal for a moderately complex
information/inquiry center. For the many centers that
cannot rely on discursive text, for those whose inform-
ation must be available from the home, for those whose
inquiry rate is too high to justify the cost of using
the switched network system, and for those who must
transfer answers back at video rates because of the
amount of data involved, such an example is probably
appropriate. Fingerprint and facial comparisons; geo-
graphic information such as the location of people,
things, and places; artistic displays in general; the
whole world of graphical inquiries; and inquiry systems
that feed another SYSTEM-3 center will all find that
SYSTEM-3 frees them to develop in ways not now feasible.

Needless to say, each SYSTEM-3 center cannot contain all
of the information represented by the union of such
information centers. They do not have to. SYSTEM-3
centers themselves can be inquiry stations on other
SYSTEM-3 networks. This interconnection pattern will
permit the existence of substantively organized centers.
One will deal with poisons and another with art treasures.
Each will use local, geographically organized, SYSTEM-3
networks for their general information distribution function.

Two interesting developments from the concept of an
information/inquiry center on SYSTEM-3 are the concepts
of a distribution center and of a two-way file. We
shall now consider each of these in turn.

C.   Two-way files:...a small ovoid mass...

In each of the two previous examples, in education and
in the information/inquiry system, we considered the
user response to be of only transient interest, its role
restricted to controlling the information output of
narrowcasting.   It is obvious, of course, that the center's
computer could record the broadgathered data were it
valuable.   Presumably, if a student sought certification
in an area, he could request that his performance on a
given problem or in a given situation become a matter of
record.

In our two previous applications the main corpus of
information originated with a small group of input
agents.   It was stored for subsequent distribution to a
much larger group of information consumers.   There is
another class of information store, however, where the
generators of the information and the consumers of the
information are largely the same people.   These files
are basically our social memory.   They are perhaps best
exemplified by the medical record.   A patient's medical
record is composed of bits and pieces of information
entered into it by the very same people who are concerned
with the examination of that record.   Whether the record
is considered in its entirety or whether it is fragmented
into a radiological record, a pathology record, a
financial record, etc. is irrelevant.   By and large it
represents a collation of the information generated by
the user population.

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While various other such two-way files come to mind,
let us again revert to medicine for our example. We
can visualize our physicina either calling from some-
one's home or utilizing the SYSTEM-3 terminal in his
office. This time he is calling the medical record
"library" in order to review and update the information
concerning his current patient. First, however, he must
establish his identity and that of his patient. Using
the 12 push buttons now in a remember configuration to
generate 12-bit numbers, our physician is able to iden-
tify himself from a population of a million physicians
by two sequential transmissions.

After the center has displayed the doctor's name and
patient's name for verification, it is in a position to
provide the physician at a distance with a most useable
medical record. Text, graphs, x-rays, color photographs
of slides, color photographs of physical signs etc. are
all entities that can be displayed for his examination.
Indeed, it is interesting to note that a single 4"x6"
microfiche can hold about 2,000 images, each in full
color, and having a greater resolution than can be dis-
played on a color T.V. tube. High-speed selectors now
exist - at reasonable cost - capable of selecting a
specific image out of such a matrix in less than a sec-
ond under digital control. We have little doubt that
such image selectors will play a major part in a
SYSTEM-3 center.

Back to our physician, however. Having reviewed his
patient's case, he now signals the computer that he
wishes to update the record. Because he does not have
a text keyboard, he asks for the kind of branching in-
quiry program now being experimentally used for that

purpose. He might, for example, indicate "MEDICATION" on the first matrix, and in only half a dozen choices pin it down as to name, route, dosage, frequency, etc. This action serves to update the record but to give the center an opportunity to check for contraindication. In any case, his input becomes a new part of the file for that patient and thus becomes part of the continuing social medical memory of that community.

Frequently, of course, a freer from of text entry will be needed in medicine. Many SYSTEM-3 terminals will have more complex input devices. Some may have keyboards and internal storage registers capable of holding one or more lines of type. Such terminals will, because of cost, be less widely distributed than the home type terminal and their use will consequently be restricted to special locations such as physician's offices, hospitals and other professional places where their additional cost is warranted by their additional utility.

We do not fall back on medicine for our examples because it is all that exists, but rather because of its probable familiarity to the reader. Indeed such activities as the Social Science Data Archive, EDUCOM's file resource sharing program and the proposed Project Cambridge all recognize the public need for two way files. Most exciting among these developments is the concept of the two-way library. Many of our special interest libraries have author populations that seriously overlap their reader populations. We are recognizing that such libraries should contain not only the literature, but the corpus of commentary on that literature. SYSTEM-3's two-way files operating in conjunction with the distribution center we will discuss net may well bring about the two-way library.

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D.   Distribution Center: Mail it, please, by next week.

Networks for the distribution of material things are
frequently homeomorphic with those for the distribution
of information.   Control information (such as inquiries
and orders) flows from many individuals to a center
which then ships out the required material and frequently
also ships out information such as invoices and bills.
This construction would lead one to expect that the
SYSTEM-3 network might serve as a mediating factor in
goods distribution.   While we will deal with the subject
more fully as a commercial application of SYSTEM-3,
there are certain public distribution functions that
fall within the purview of the Public Broadcasting Cor-
poration.

An obvious public distribution system likely to grow
out of the information/inquiry function is that of
the public library.   It is clear that many inquiries
and requests for information can best be responded to
by means other than direct display.   In thos cases where
a single request would initiate the flow of very large
amounts of text or illustrative material, it is unlikely
that the transmission of such quantities over the party
line would make sense.   The user can neither absorb
them at a rate that warrants tieing up the line, nor,
in general, can he absorb them at a single reading.   As
a result, it is often desirable that the information be
transmitted to him in some non-fugitive form.   The same
situation arises in the public library.   Books, films,
records and other such material represent massive re-
sponses to small inquiries.

In the public library, such inquiries are made either

after direct reference to a catalog or after the inter-
vening activity of the librarian. Direct catalog
reference is an information/inquiry activity. In fact,
the catalog is the information center for the contents of
the collection. Here again the direct intervention of
a human agent, in this case the librarian, represents a
limiting factor in the number of inquiries that can be
handled. If suitable catalog information were contained
in a directly accessible file, and if users were taught
how to conduct probling, effective, exploratory and
relevant searches within that file, we could expect
many simultaneous users to arrive at decisions. Once
such a decision has been made, our SYSTEM-3 user should
be able to determine whether the material is avaiable
and to order it delivered. Whether the material is de-
livered by mail, or by delayed electrical means, whether
it is delivered in microform or as the original, whether
it is a disc or tape or some other recording is irrele-
vant to our discussion. Whether the material is deliv-
ered for his retention or to be subsequently returned,
whether it is delivered free or whether there is a
charge for the service, is also unimportant. In each
case the center's computer can record the order and dis-
play it for action. Similarly, material distribution
network can notify the center of its compliance with
the order so that a record of the complete transaction
can be maintained.

One can easily visualize a frequent merging of the in-
formation/inquiry center function and library distribu-
tion function. A housewife searching for a seafood
souffle recipe may scan through several titles and
finally display several complete recipes. She may
either copy one or "freeze it" on the screen of the

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terminal while she prepares that night's dinner. She
may also request from the center the cookbook from
which it was taken or some other collection of which it
formed a part. This added material is required on a
much slower time schedule and can be forwarded to her
by mail or other delivery system. Indeed, it is this
natural transition from the information/inquiry center
to the library center that makes this such an attractive
public application of SYSTEM-3.

A closely related distribution function, that of news
dissemination involves more blurred boundaries between
the commercial and public sector. Presumably one might
sift through the day's news much as our housewife sifted
through recipes, reading abstracts and even full news
stories of those items that interested us. It is un-
likely, however, that public or private services would
exist (as they now do), whose main function was to
assemble a continuing commentary on the news. Thus,
the individual after pursuing one or more news stories
might order a groups of such commentaries tailored to
his interest, delivered to him on a one-shot or sub-
scription basis. Such "news-magazines" would again
presumably be delivered by mail or by some material
distribution system.

We shall stop here in our consideration of delivery sys-
tems, primarily because there are few "free goods" in
our society. We shall take up the matter again under
the heading of "MARKETING."

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E.   Interactive Entertainment: Take the money and run.

Not all public broadcasting is aimed at bread; part is
reserved for circuses. It is clear that the techniques
that we used for our business school example might just
as well have been applied to a mystery story with the
viewer taking the role of the detective (or of the crim-
inal). This kind of involvement, this sharing the de-
cision-making function with the character in the story
rather than observing him going through the decision
making function will introduce a totally-new dimension
into television entertainment. Even the Czechoslovakian
attempt at the Montreal World's Fair produced heightened
reaction, although it introduced only one decision point
into the program and only reacted to a poll of the audi-
ence.

We can visualize the involvement on the viewers part as
he decides whether to follow the butler or to keep
watch at the front door or to phone for help. How one
resolves the conflicts between members of the family is
hard to guess. Perhaps viewing will not only become
interactive but competitive, with each member of the
family using his own receiver to see who comes out best.
It is fun to move from detective stories to political
dramas and a whole new form of pseudoautobiography -
where a personal drama gives each viewer a chance to
live his life among 100 worlds of his own choosing.

With this kind of interaction and involvement, one hesi-
tates to use the word "entertainment." How different
is such an opportunity to explore various life styles
from the kind of "life simulation" activities advocated
by modern guidance professionals. If Arrowsmith caused

a rash of doctors, how many would have been affected by
participating rather than watching. Even the Brave New
World maintained passivity when if offered feelies.
Which will have more appeal - five sense passive dramas
or two-sense interactive ones?

We are particularly intrigued with the use of computer-
mediated entertainment material for the very young.
Children's stories that involve children in rski-taking,
decision-making, and their natural consequences, cannot
help but produce the transition between entertainment
and education that is so often espoused and so rarely
achieved by modern writers and educators.

In particular, we are impressed with the potential role
of this form of entertainment in the development of the
child's values and psychology. Such things as need
Achievement apparently have major influence on societal
development and can probably be developed in the indi-
vidual by techniques similar to those of computer medi-
ated entertainment. Indeed, this kind of interactive
program material may be just what is urgently needed by
those who would deal with many of our basic urban and
social problems.

But interactive entertainment need not all be in the
theater arts. Certainly such participation will awaken
new forms in music, dance and the graphic arts as well.
In these, it may well be only the degree of pre-program-
ming that distinguishes the interacting viewer from the
creative artist.

F. The Creative Arts

One rarely thinks of the television receiver as a tool
for the creative artist. The interactive television
receiver, however, the SYSTEM-3 terminal, obviously is
just such a tool. We visualize the SYSTEM-3 user
employing his terminal over a wide range of artistic
activities. Those who have seen the Kaleidoscopic and
marvelously intricate moving patterns generated by a
digital computer are aware of the power and beauty of
such displays. Those few who have sat at a terminal
and manipulated such patterns with a few stitches are
aware of the intoxication that accompanies such activ-
ity. We consider this kind of "play" activity as being
wonderfully suited to children of all ages. The experi-
mentation with abstract design by random intervention
on the part of the very young child will gradually de-
velop into a more ordered interventive process as the
child matures. With time, the desire to preserve
pleasant experiences will result in the assembly of
files of such switch settings for storage and later
replay. One can visualize that certain members of the
community will become more skilled at this activity
than others, and that they will make their intervention
files available for replay by other members of the com-
munity. Thus, will the SYSTEM-3 artist be born along
with the SYSTEM-3 art show.

It is not only in the field of abstract design, however,
that such activities will develop, but there will be a
parallel development in music and in authorship. It is,
I am sure, clear that the task of writing a scenario
that contains intervention points and that involves the
viewer through sharing as well as observing is a sig-

nificantly different art form from that performed by
present day palywrights and authors. Just as new play-
wrights evolve to handle the minor transition from stage
to screen to tube, a whole new class of interventive
palywrights will evolve to handle the much larger step
from passive to interactive scenarios. The medium will
not only be their good, however, it will also be their
tool. The computer and the interactive terminal will
be essential to the playwright's craft. It will no
longer be possible, for example, to represent a script
as a simple one-dimensional flow of text and events.
The script for an interventive play is a much more com-
plex topological figure and its representation will re-
quire the file manipluation, management and display
characteristics of a central computer. It is most
likely, therfore, that our playwright will use the same
sort of terminal as does a computer programmer or prob-
lem solver connected to SYSTEM-3.

G. Problem Solving: If a man and a half digs a...

One of the most complex applications of SYSTEM-3 in the
public domain is the provision of computer access to
the individual citizen as a matter of public policy.
It is clear that the provision of such access is appro-
priate in conjunction with many educational activities,
and it is clear that such access is appropriate for
those individuals who are serving in the public's inter-
est. In the latter group we will find those who are
writing the applications programs that permit educators,
doctors, and other to use SYSTEM-3 effectively. In the
first group we will find students in the professional
schools and children in the elementary grades. The
former may be engaged in sophisticated simulation and
the latter in curricula involving data manipulation and
logic constructs.

Regardless of the use, however, it is unlikely that
SYSTEM-3 communication will set the limits on who shall
use the system. The limits will be set by the sheer
economics of supplying computational capability across
a wide spectrun of users as a public service. Even in
the case of the complex terminals that contain an entire
keyboard, we shall find that line by line polling can
serve several thousand simultaneous users with no com-
munication-induced queing. If, as in the case of the
information/inquiry centers we assume a fanning out from
the SYSTEM-3 center to a hierarachy of computers pro-
viding computer access, we may indeed start to approach
Fano's ideal of making computer access and the didactic
material to insure its intelligent use available in
every home.

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We shall not dwell on the specifics of using the
SYSTEM-3 center or its computer in this mode, since
enough has been already written in the literature re-
garding the wonders of time-shared and direct-access
computation. Suffice to say that it could produce a
significant change in society's present view of compu-
tation.

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H. Polling

The last public application of SYSTEM-3 that we wish to
discuss is that of polling. And there we stop more from
a feeling of having exhausted our reader's patience than
our subject.

Clearly, any communication system that provides for the
rapid transmission of wide-band information from a
center to a large number of receivers and for broad-
gathering data from each of the receivers can become
a new political factor. Much has been said in the press
and in our professional societies of the advantages of
bringing to a politician an instantaneous picture of
the desires of his constituency. An almost equal amount
has been written about the dangers of impetuous action
and the loss of deliberation that such a system might
foster. Whether such a system would foster demogogery
or democracy, whether the people would rule as a body
politic or as a body hysteric or whether we would evolve
some new concept such as public advice and consent, it
seems clear that the advent of public SYSTEM-3 communi-
cation would initiate a new era in political evolution.

New stars would arise, new rules would become established
for the game, new Luddites might emerge, and whole new
structures might develop. The marked change in the role
of the president and other elected officials since the
advent of mass instantaneous communication media would,
we believe, be a minute change compared to that occa-
sioned by the advent of instantaneous two-way mass com-
munication.

But polling in the public domain is not restricted to
political activity in the normal sense. Polling of

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wide audiences would introduce a new concept of program
"ratings"; matters of public taste could be explored,
as could the level of public information on vital ques-
tions. In any case responsiveness would become the key-
note. The advent of interactive public broadcasting
will, we believe, bring public broadcasting one step
nearer to being an activity of the public rather than
and activity aimed at the public.

This then is a selection of potential public applica-
tions of SYSTEM-3. This is the broad shape of tomorrows
Public Broadcasting. As exciting as they are, they are
unlikely to happen by themselves. Each one assumes the
existence of a well-equipped center and inexpensive
widely distributed terminals. To provide that wide dis-
tribution will require pressure from the public and pri-
vate sector. Characteristically, in our economy,
public pressure is by far the slower of the two, and so
it behooves us to examine the possible commercial appli-
cation of SYSTEM-3. In that way we may be able to
assess the time frame over which the development of
SYSTEM-3 is likely to take place.

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I. <u>Marketing: Size 26 in ecru and...</u>

Just as television in the United States secured it major
impetus from advertising, it is possible that SYSTEM-3
communication will secure a major part of its support
from what might be called interactive advertising.
Interactive advertising is not a new concept, it is,
what happens with most point-of-sale displays; it is
what happens at our supermarkets. The buyer is offered
a large number of alternatives from which he makes a
choice and to which choice he makes an immediate com-
mitment. While direct selling is rarely expressed in
those terms, they will help to understand the use of
SYSTEM-3 as a marketing tool. In most of our previous
applications the viewer was given a sequence of choices
with which he could interact if he chose. By inter-
acting he could make choices and indeed indicated com-
mitment to those choices. Identifying codes likes
those used by the doctor for security and the unique
address of each terminal could form basis for a reason-
ably secure system for charge purchases.

One can imagine that after a particularly entertaining
and involving drama, White's Department Store or Black's
Emporium might find it easy to involve the viewer in
continuing to make choices right through the "commercial
message." Such commercial messages would be far less
likely to engage in long-term image building than in
direct selling. A 60-second commercial might display
notice of several classes of mechandise currently
offered under "particularly favorable terms." By re-
sponding, our user could request a frame containing
information on one specific class of goods. He might
even continue to the next station break. During that

break he might go further in his inquiries or he might
actually place an order.

If we realize that there will be a very large number of
channels available over any future intracity cable
(current estimates say 80 in a few years) we can expect
that one or more of the channels will be dedicated
wholly to such sales. We shall have catalogs of the
air. Indeed, as in the case of the catalog for the
library, information/inquiry centers and catalogs are
indistinguishable. It is to be expected then that much
effort will be devoted to updating such catalogs and
providing closely linked "serendipitous" information
with the users inquiry. We must expect that these cata-
logs will be referenced by the commercials associated
with the entertainment programs.

In general, fewer than four or five responses would be
necessary to locate any item in a Sear's catalog or
some other similar compendium and one more to place the
order. If Sear's uses SYSTEM-3 for marketing, must not
anyone else in the community who wishes to be competi-
tive in the home market? If they all do - or any reason-
able number of them does - does it not take a very small
percentage of the sales flow to support not only
SYSTEM-3, but to provide the impetus and means for se-
curing wide distribution of responsive receivers?

Needless to say, the commercial end of SYSTEM-3 takes
on a major credit management function under these con-
ditions, for if the user makes a commitment via his
terminal, and if the supplier honors that commitment,
isn't the SYSTEM-3 management in the ideal position to
provide a banking function to both? Again, doesn't it

take a rather small percentage of such activity to both emphasize the impetus and reinforce the means for se- curing widespread distribution of receivers on SYSTEM-3. One cannot help but wonder, given such commercial utili- zation of SYSTEM-3, whether future entrepreneurs engaged in providing cable or satellite connection may not pro- vide that connection free in exchange for the other pre- requisites provided then.

In addition to marketing there is a private or commer- cial version of each of the activities we discussed from Section A thru H.

The training that is done free in the public education system is done at great expense, albeit for more spe- cialized ends, in every major industry.

Baron Rothschild's legendary preoccupation with informa- tion as the foundation for business makes one realize the commercial value of information/inquiry centers dedicated to that end.

Each of the others, not even excluding the creative arts, will offer to some entrepreneur, the chance to construct a business enterprise for gain.

We will someday find SYSTEM-3 carrying bit strings rep- resenting private and public, commercial and philan- thropic, community and corporate applications. The technology, the organization, the hardware, the soft- ware and the communications capabilities required by each sector is required by both. It is likely, there- fore, that the two economic sectors will function syner- gistically, each helping to bring about the other. In

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Section V we shall discuss the organizational regulatory
and technical events that must take place, the processes
that must be initiated for this synergism to produce a
viable system.

IV. SYSTEM-3 REVISITED: A CLOSER LOOK

This section is a return to the more usual organizational
schema. Having discussed a group of applications, we can
now discuss the structure of a system capable of imple-
menting those applications. A broad description of the
system was introduced in Section II. This section is in-
tended to present enough detail to demonstrate a reason-
able degree of feasibility and to serve as the context
for the activities that we will cover in the next section.
In many presentations, the present material would be covered
in an appendix, but the author's loyalty to engineering
as a profession militates against its relegation to such
a subsidiary position. We shall split our discussion into
two parts. First, we shall discuss the receiver itself,
and second we shall discuss the SYSTEM-3 center with par-
ticular attention to the interconnection of such centers
to form SYSTEM-3 network.

The proposed solutions offered in this section are illus-
trative. No coubt other engineers will have more elegant,
more cost-effective, and simpler solutions. The illustra-
tions are offered here largely as an existence proof rather
than as design blueprint for further development.

A. The Receiver/Terminal

To aid in our calculations, we have assumed that a SYSTEM-3
center would serve a maximum of one million receivers (a
reasonable maximum population on a single cable, for ex-
ample). We have assumed that the center can address any
individual receiver, and within that receiver the center
can enable the receipt and storage of the next image frame
or disable such receipt. We have further assumed that
the transmitter can query an addressed receiver, requiring

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it to transmit the string of bits stored in its data
buffer register if that register is ready for transmiss-
ion and that it can subsequently clear that buffer.

In order to facilitate the frequent transmission of slide-
show presentations, we assume that the center can:

(1)   Direct the receiver to display the Nth
      frame (called a time slice) out of every four-
      second series of 120 frames until instructed
      otherwise; and

(2)   select one audio channel out of a possible 120
      such channels being broadcast.

In addition to being able to issue these commands to in-
dividually addressed receiver/terminals, we consider it
desirable that the center be able simultaneously to con-
trol all units connected to a specific time-slice. This
group of receiver/terminals should be further divisable
into those units that are enabled (receiving images) and
those that are disabled (holding an image without receiv-
ing others).

For query purposes, we assume that a local oscillator in
each set, much like the present heterodyne oscillator,
will be modulated by the stored bit string. The query
data can be returned either over the same frequency-
division channel as that to which the receiver is tuned
or over some other channel depending on the traffic.

All commands to the receiver/terminals - all control
signals - we visualize as consisting of bit strings trans-
mitted in the infra-black on the channel to which the
receiver is tuned or on a dedicated channel. In either

case, no confusion with the display signal will be occasioned.

The digital command string that we have chosen consists of a 36-bit word, preceded by a start pulse, for a total of 37 transmitted bits. Their definition might be as follows:

Bit	Meaning
Ø	Start pulse, triggers clock
1	Ø--This is a station address
1	1--This is a time-slice address
2-21	20-bit station address if bit 1 is a zero
13-21	9 bit time-slice address if bit 1 is a one
	The first two bits indicating the state of the units addressed:
	Ø1=disabled units only
	1Ø=enabled units only
	11=all units
	The last 7 bits being the time-slice addressed.
22-29	8-bit operation code (see below)
30-36	7-bit time slice or channel modifier (N) to the operation code. N may equal Ø, the null condition.

The operation codes are (in octal)

001	Connect unit to Audio Channel N
002	Connect unit to Time-Slice N
004	Clear Data Buffer
*010	Disable receipt of images
*020	Enable receipt of images
**040	Power off
100	Transmit Data (station address only)

For economy we have assumed that the operation codes can
be logically added together to form more complex commands,
but only one starred command may appear in such a set.
The double starred command may not be included. Thus,
the operation code 117 means "Disable receipt of images,
transmit data, clear the data buffer and connect the unit
to both audio channel N and time-slice N." That transla-
tion also indicates the execution order.

We assume that there is also a need for the center to con-
trol certain additional peripherals through the receiver.
The first bit of the operation code is, therefore, reserved
to the use of these control activities and a "one" in that
place disables all regular receiver response to the operation
code. The code series 2$\emptyset$0 to 3̄77 is, therefore, reserved
for the control of peripherals.

The $\emptyset$4$\emptyset$ command is included as the ultimate courtesdy. We
assume that the center will transmit it when it has finishod
its home-broadcast schedule for the benefit of those who
fell asleep during the late hours. It shuts off the re-
ceiver.

In addition to the control logic, the receiver that we
have hypothesized requires:

(1) A 120-frequency beat-frequency oscillator --
     for single-sideband use -- followed by a good
     steep audio mixer/filter.
(2) A 120-position electronic commutator advanced
     by the frame-synch pulses and synched on Posi-
     tion 1 every four seconds by a control signal
     superimposed on the broad-pulse, frame-synch
     at that time. Its position defines the time
     slice. At each position, it serves to connect
     the incoming video signal to

(3) a 120·switch, double=pole bank opened and
closed by the address portion of the time-
slice setting commands. When closed, one side
passes the video signal on to

(4) a double-pole switch for enabling/disabling
the receipt of images. One side of this switch
completes the video path.

(5) A manually-set buffer that is read out three
times as a bit-string with a redundancy of
three on receipt of the 1ØØ control command.
The normal reset position of the buffer is
alternate ones and zeros. The receipt of this
or any non-zero pattern indicates that the
set is "on" and willing to be interrogated.
This buffer will vary from a simple 12-button/12-
bit register in the home receiver to alternate
70 character registers in the most complex re-
ceiver.

(6) A 20-bit, hard-wired shift register used for
address decoding.

(7) An 8-bit decoding matrix, operating in con-
junction with the remaining pole of (3) and
(4) above for time-slice addressing.

(8) A storage tube or electromechanical method of
storing and continuously displaying a single
frame.

Depending on regulations, the half-megahertz band required
for the 120 audio channels may be obtained by cutting
back on the bandwidth of the video channel used during
multichannel audio work -- with some loss of horizontal
resolution -- or from added spectrum space. We believe,
however, that some skirt sharpening will provide the
added bandwidth without either loss of horizontal reso-
lution from today's levels or the exceeding of FCC spec-
trum requirements.

Querying the receiver in station-address mode is a frequent
operation in both special inquiry use and in course work.
Its economic use in that mode will require storing, in
the center's computer, the list of all active receivers
to be addressed. For special inquiry use, no problem is
envisioned. In course work, station addressing is used
only where individual responses are required. To poll
the entire population of one million receivers to deter-
mine which are active would take 42 seconds of black
time (37 bits of inquiry, 37 bits of response, 10 bits
of turnaround, 1 million receivers, 2 megabit per second
bandwidth each way). If the course required preregistra-
tion, of course, this time would be unnecessary, since
the list of registrants would be used as sufficiently
accurate for response requests.

The most frequent use of the control signals will be in
polling for viewer responses. Using the same figures as
were used above, we can poll 750 receivers in a single
frame time. If, as in political polls, the audience is
larger, more time will re required. The frames re-
quired need not, however, be successive. Indeed, if 10,000
viewers were to be polled, we would require 12 frames and
would probably spread the polling time over 30 or more
frames, using the alternating interlace positions on alter-
nate frames or on every third frame to produce minimal
image degradation. What degradation did occur would last
for only a second.

Station-address mode for control will be used whenever
unique material is to be shown to a single receiver. This
mode is probably the most important one we have since it
permits the center to use SYSTEM-3 the narrowest form of
narrowcasting. Here the transmitted digital command chain
will have the form:

ØAØ23N   Station A enable and connect time slice and
            audio channel N
            (Frame of information for Station A)

ØAØ1Ø   Station A disable

Note that 37 bits are required before and after the frame
to be displayed. At a two-megabit rate, each such bit
string would require only 19 microseconds. The FCC standards
provide 50-microsecond "broad-pulses" in each half-frame
synch train or more than enough time for two such 37-bit
trains. By superimposing our 37 bits on half the infra-
black crown of one such pulse, we would have no difficulty
securing sufficient control bandwidth. For such single-
frame presentation at a rapid rate, our command chain would
be:

	ØAØ1Ø	Station A disable
Time-Slice (N-1)	ØBØ23N	Station B enable and connect time-slice and audio channel N
		Frame of information for Station B
	ØBØ1Ø	Station B disable
Time-Slice N	ØCØ23(N+1)	Station C enable and connect time slice and audio channel (N+1)

The ability to send out many enable and disable signals
rapidly is important in any case where receivers are
handled in groups. A programmed course using multiple
slide-shows is an example of such a circumstance. Here
we might have 1,000 students and 10 possible branches --
with 200 or more students due to be shown the next frame
of one such segment. During the half-frame time preceding

that display frame the center has more than sufficient
time to send out the 200 enabling commands. Because the
commands are in the infra-black, no hash appears on the
screens. Following the display frame, the receivers can
be disabled with a single command by addressing it to
all enabled receivers in that time-slice. The command
would be 1 - 1ØNØ1Ø - .

A possible usage of the receiver will be to permit the
simultaneous transmission of up to 120 simultaneous un-
correlated slide shows over a single video channel. Such
a capability would permit the simultaneous transmission
of more illustrated lectures than go on in even our largest
and dullest universities. In a parallel set of slide-shows,
each time-slice has associated with it its own audio chan-
nel. At any time before that time-slice comes up, we can
transmit the command:

        Units on time-slice A enable

followed by the frame information and the command:

        Units on time-slice A disable

issued at any time before that slice reoccurs. This string
changes the "slide". Thus, the slides can easily be changed
at times separated by four seconds.

The use of the ØØ2 command (connect unit to time-slice N)
permits added image time slices to be used in that slide
tape presentation if it is desired to use more frequent
changes. The cost of doing so, of course, is more com-
putation. By having the computer establish a queue, the
center can change slides as rapidly as desired as long
as the ensemble average doesn't get shorter than four
seconds.

It should be noted, as implied in the previous section, that slide-show presentations need not be illustrated lectures. Twelve, 10-alternative presentations can be given simultaneously in a 120 time-slice system. Up to 750 students per time-slice could be polled as to their answers in a single frame time. These polling frames count as slide changes in computing the ensemble average. Each such 10-alternative course might serve 3,000 students, and the group of 12 such presentations - might serve up to 36,000 students with only a loss of 40 frames to polling at each decision point.

The codes from 200 to 377 can be used, along with suitable decoding matrices and relays to operate a wide range of auxiliary equipment connected to any receiver. Thus, for example, a receiver equipped with a video tape recorder could request that that recorder be turned on, that a program be transmitted, and that the recorder then be turned off. When we discuss the hierarchical organization of SYSTEM-3, we will see that this same set of codes is used to transfer control among the various levels of the hierarchy.

B. The SYSTEM-3 Center

While Figure 1 served as a good working diagram for the discussion of SYSTEM-3 applications, it is insufficient in detail for our present purposes. The diagram, for example, shows the SYSTEM-3 center as being isolated, transmitting to its little collection of receivers, but with no way of receiving information from the outside. Were this the case, SYSTEM-3's would be extremely limited. Let us examine that center in more detail so that we can uncover those elements of its structure that permit of networking.
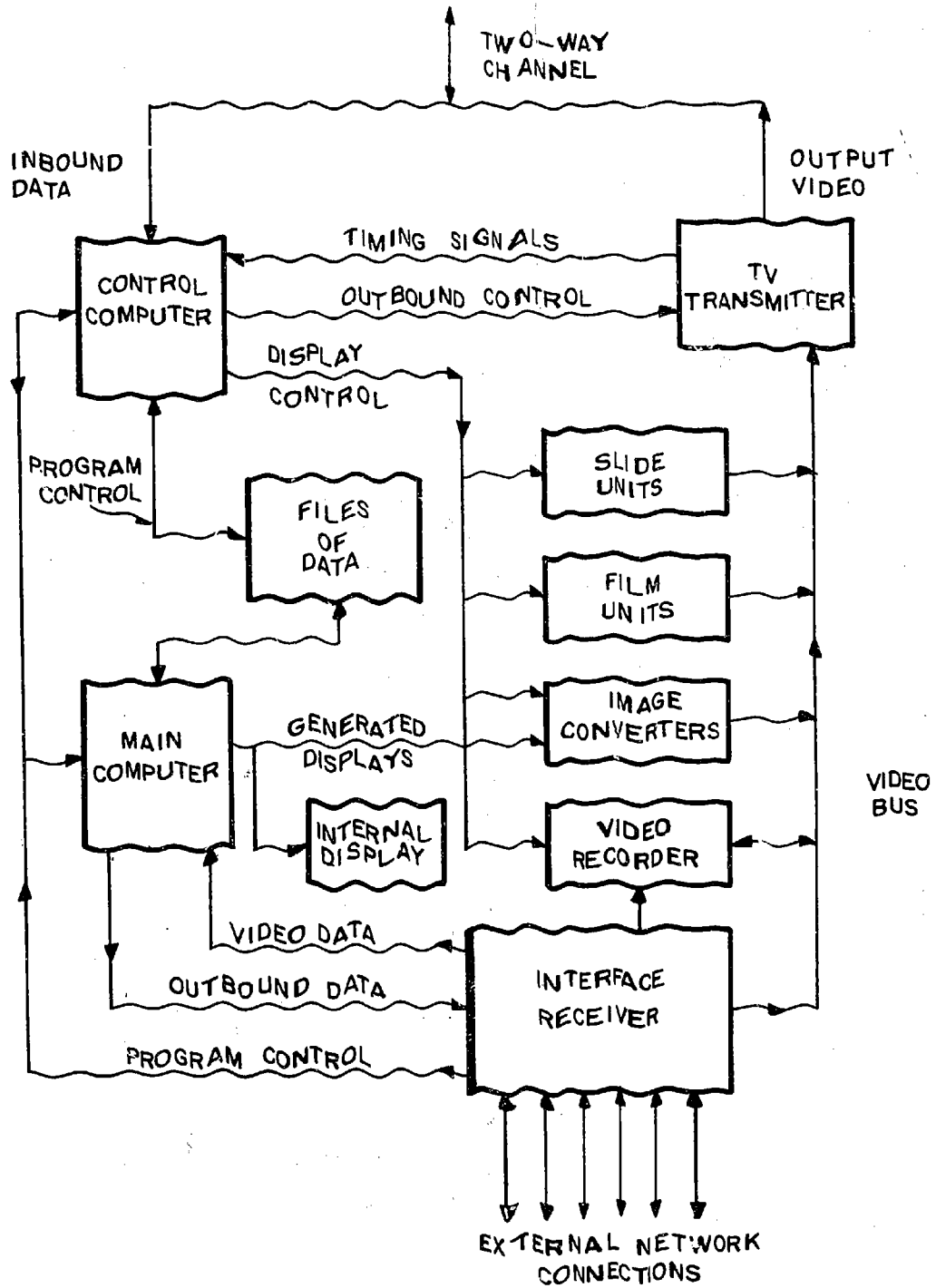
FIG. 2 DETAIL OF SYSTEM-3 CENTER

Figure 2 is a detailed diagram of the inside of a SYSTEM-3
center. As in the case with most recursive structures, its
two ends (shown at the top and bottom of the figure) are
identical, both being connections to a two-way channel.
At the top of the page we assume a network of receivers
and at the bottom of the page we assume connection to other
SYSTEM-3 networks.

Starting with the T.V. transmitter, we see that the trans-
mitter generates both the outbound video signal for the
channel that he center serves, and a set of timing sig-
nals for the control computer. These timing signals are
necessary in order to permit the interlace of the outbound
control information with the outbound picture information
and to synchronize the control of display units. By routing
the outbound control signal through the T.V. transmitter,
it may be handled like any of the other signals on the
video bus. The other signals on the video bus derive from
slide units capable of handling microfiche or other visible
images, from film units for handling motion pictures and
from image converters. These image converters serve to
convert the graphic displays generated by the main computer
to suitable rosters for transmission on the video bus.
Also hung on the video bus is a video recorder which is
subject to control by the output of the control computer
or as a periphe al of the interface receiver.

The control computer feeds the transmitter with outbound
control signals whose function is to set the state of the
receivers connected to the center's channel or to poll
those receivers. It also receives the poll data from the
center's channel and does the computation necessary to
make the decisions reflected by the outbound control sig-
nals, by the display control signals, and by the program
control signals leading to the main computer.

By and large both the display control signals and the
program control signals are of the same nature. The
display control signals are designed to select and dis-
play items of information that are present either in
the video recorder, on the image converters, in the
film unit, or in the slide units. The program control
signals serve to secure such information if it is not
present in one of those locations. They control the
program running in the main computer which then either
secures the information from the data files, secures it
as a result of calculation, or seeks it outside the cen-
ter by means of the interface receiver. It will be noted
that the data files are assumed to be shared by both the
control and the main computers. In that way, incoming
data from polls can be stored on the files for future
use and the files can serve as an adjunct memory to the
control computer.

The recursive nature of the center is secured by the in-
terface receive. For those activities where data is to
be obtained from other networks, the main computer is
assumed to manipulate the interface receiver in the same
way that the user of an ordinary receiver manipulates
his. Outbound data is entered into the interface receiver
buffer by the main computer in a fashion completely
analogous to the push-button operation of that buffer by
the human user. The same outbound data is used to deter-
mine which of the external networks is to serve the inter-
face receiver - an activity closely analogous to the
channel tuning performed by the human user. Incoming data
on the interface receiver can be routed directly to the
video bus (which replaces the picture tube). If one or
more frames represent digital data for the center than
display material, the external network can (through the
use of the control signals between 200 and 377) route
that video data to the main computer. Other control codes

in the range from 200 to 377 serve as program control inputs to the main computer and complete the center's complement of activities.

It should be noted that no difference exists in the signals required at either end of the center and hence, SYSTEM-3 centers can serve as receivers on one or more SYSTEM-3 channels. This characteristic makes it possible to nest such channels to any depth and provides for the interconnection of such channels into one or more major national networks.

We shall see in the next section that the external network connections may be to networks organized on a geographical basis or on a substantive basis. Further, the channels represented at both ends of the center may be coaxial cable, direct broadcast satellite, microwave or other video bandwidth two-way channels.

In terms of information interchange, one important feature has been neglected in the above description. The contents of a full video channel, such as a dozen programmed courses or some other admixture of information can be recorded on video tape. Such prerecordings would carry all of the time-slice addressed commands, but no station poll or other station addressed commands. In place of these commands it would carry a black segment preceded by a control code between 200 and 377. This control code would act as a program control signal to the control computer to conduct its own internal poll or to transmit the other station addressed commands during the time allowed in the black frame. Thus, information can be supplied in prerecorded form to the SYSTEM-3 center by supplying the center with a video tape and a computer program tape that contains the branching logic for it. Thus, the video

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recorder also serves to provide an intersection between
the center and any other SYSTEM-3 network. Each center
so equipped can accept video and program tape combina-
tions or generate such combinations.

It should be noted that while the control computer and
the main computer are shown as separate units in this
diagram, it is likely that most small centers will com-
bine the two into a single computer. We expect that only
in very large centers where either a great deal of com-
putation is being done (necessitating a separate main com-
puter) or where many receivers are being serviced (necess-
itating a separate control computer) will be units be
separate. Indeed, we expect that some very small centers
will come into existence with many of the display elements
also left out. For example, we expect that single schools
will have a center consisting of an interface receiver,
video recorder, small combined control and main computer,
and a local T.V. transmitter. As the school grows in the
use of the center, of course, one would expect the gradual
addition of image converters, slide units, data files, etc.
Some scientists and others may well have "centers" consist-
ing only of a control receiver and a computer - with the
manual input being to the computer.

Missing from Figure II, but of fundamental importance,
is the studio and program preparation equipment. Many
SYSTEM-3 centers will initiate program material as well
as rebroadcasting that secured from outside. In the case
of political broadcasts or live programs in which audience
participation, either on an individual or a statistical
basis, is important, the internal display connected to the
main computer serves as the feedback to the live per-
formers. Such feedback can be a graphical representation
of viewer response, it can be a text representation of

single viewer response, or it can be a quite complex video
display. The same display also serves to notify the operating
staff in the center when slides, films, etc.are to be changed,
or when other human intervention is necessary. Needless to
say, an ordinary SYSTEM-3 receiver can serve as the internal
display if it is connected to the output of the T.V. trans-
mitter rather than to the main computer. Narrowcasting
makes this use of a SYSTEM-3 receiver very simple.

It should be apparent that two SYSTEM-3 centers, each equipped
with live program preparation equipment and response dis-
play equipment can be interconnected to establish what be-
comes a geographically distributed meeting. Individuals
along either SYSTEM-3 channel can also become part of such
a meeting although their response can be represented only
in the form of data rather than in the form of a video
signal. We expect that professional and other learned
societies will take advantage of this facility - particu-
larly if center-facilities are located in some of our univer-
sities.

We anticipate that future meetings of these learned socie-
ties may well take place in comfortable meeting rooms lo-
cated at such centers with small groups at various other
centers. Video presentations given in one such meeting
room could be augmented by audio-visual material drawn
from the local video library or any other library in, or
attached to, the network. They would be transmitted over
the normal professional channel to all interested receivers.
Such a meeting would be recorded and an immediate video
proceeding would result.

There would be a marked reduction in the travel of the
participants, since each would now be travelling only
to his local center. Note also that any other inter-

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ested centers could both observe and secure an immediate
recording of the proceedings for local viewers who are
interested but unable to attend at the scheduled times.

Implied by the diagram of Figure 2, but again not made
specific, is the large story of rapidly accessable visible
material to be used for transmission purposes. We visualize
this large store to consist of films, video tapes, micro-
fiche, slides, books and other illustrative material.
The configuration, content, and extent of such a library
will, however, be a matter that is highly individual to
the particular SYSTEM-3 center.

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V.   ACTIVITIES: WHAT MUST BE DONE

The applications that we have described, the facilities
that make them possible, the financial and social rewards
associated with them, and the anticipated blossoming of
our information environment do not exist today. They
will not exist tomorrow unless we make a national commit-
ment that they will exist and unless that commitment is
translated into a program of activities. These activities
must bridge the gap between our present capabilities and
those needed for the full realization of the potentials
of SYSTEM-3. Broadly speaking, they can be broken down
into three areas: organizational, regulatory and techno-
logical. Let us consider each in turn.

A.   Organization: With People

Commercial television became a feasible activity in this
country not because of the allocation of appropriate band-
width, not because of the development of the image orthicon,
not because of the development of electromagnetic deflection,
but primarily because an enormous reservoir of old motion
picture films was available as program material. As a
matter of fact, that reservoir gave the medium something
to market in its early days without heavy production costs
and the normal flow of commercial interest took over from
there.

As the commercial activity grew, it became possible for
public television to ride its coat tails into existence.
A miniscule portion of television's annual budget is even
now devoted to public television and the percentage is un-
likely to approach anything representing a partnership
in the foreseeable future.

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In extended broadcasting, neither of those two phenomena
is likely to be duplicated. No store of interactive my-
stery films, of participation westerns, or of responsive
comedy films exists. Indeed, nowhere do we evan have
studios equipped to generate such material or writers
trained to write it. There will be no major commercial
coat tail to ride. Quite the contrary, we believe that
extended broadcasting can only come into being through
the concerted collaborative efforts of the public and
private sectors. Indeed, Congress' charge to the cor-
poration to establish archives and to arrange for inter-
connection, to conduct research demonstrations and train-
ing related to public broadcasting and to contract with
program production entities could not have been better
made had extended broadcasting been specifically envisioned
by the framers of the bill.

It is most likely that the early development of extended
broadcasting will take place via applications that do not
involve what we now call television programs. Information/
inquiry centers, as exemplified by the Poison Control Center,
two-way files as exemplified by the central medical record,
the use of SYSTEM-3 by programmers and other problem solvers,
and the library network all require the orderly consolida-
tion of information and the organization of user populations
to interact with that information rather than scripts. Such
professional networks as the Lister Hill Center for Bio-
medical Communications and the National Agricultural Library;
such secondary and tertiary publishing activities as Chem-
ical Abstracts and the Library of Congress MARC-II System
represent foci for such activities. It is they who have
the stored up material ready to be released by extended
broadcasting. These special interest groups are, in these
areas, the analog to Warner Bros., Paramount, etc.

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Much of the information in such special interest groups
is highly dynamic. It can't be distributed in cans or
on video-tape. Such groups are establishing, even now,
centers of their own. As SYSTEM-3 develops, such centers
will be connected to the geographic SYSTEM-3 centers to
form special interest networks. The Lister Hill Center
at the National Library of Medicine, for example, might
establish such a network. It would use a combination of
cable, microwave, satellite and video tape to disseminate
such materials as poison information, medical practice
information, medical didactic information, and other bio-
medical information. Because of its close ties with the
profession, with the National Library of Medicine, and
with the medical schools, it would be in an ideal position
to collate such information and to contract for its gen-
eration and its structuring. We assume that such con-
tracting might be jointly sponsored by the Lister Hill
Center and the Corporation. Alternatively the Corporation
might restrict itself and concentrate on more general
materials.

Presumably, it would be uneconomical for each such special
interest network to reach the individual users for whom
its information is intended. It would, therefore, be the
local SYSTEM-3 distribution center that would make such
information available to the interested individuals in
its area. We can visualize a patient hospital record
network, a public-safety information network, a motor-
vehicle registration network, and other similar substantive
networks functioning primarily as information wholesalers.
Distribution would be through the local SYSTEM-3 public
broadcasting channel. In the early days, when the in-
formation to be marketes is largely of this kind, in-
teractive but not really of a program nature, the Public
Broadcasting Corporation will be needed to coordinate
the activities of the special interest networks, to set

up the governing mechanisms and to ensure an appropriate
division of the limited public broadcasting bandwidth in
a geographic area among the many needs.

As SYSTEM-3 develops, however, there will be a greater
and greater demand for the preparation of new program
material specifically suited for extended broadcasting.
Computer-aided instruction, interactive television pro-
grams, and the creative arts activities will all be part
of this demand by Congressional directive, it falls to
the Public Broadcasting Corporation to train and equip
people capable of meeting that demand. Support for
courses in interactive playwrighting and the maintenance
of filming and editing facilities will become an important
part of the Corporation's organizational task. We have
no doubt that some of the special interest networks and
other information wholesalers as well as some of the more
forward looking commercial publishers will develop and
maintain program origination capabilities. Despite this
fact, the general body of such material will be difficult
and expensive to produce and will require a form of national
financing.

In part C of this section, we will discuss the importance
of the academic community to the preparation of such ma-
terial. Organizationally, it will take a major joint
effort on the part of the Corporation and the Office of
Education to manage the creative activity that will be
required.

But software organization is just one of the Corporation's
problems. If the use of SYSTEM-3 is to be economical,
then the center cost per subscriber and the receiver
costs must be driven down. That need calls for collabora-
tion between the Corporation and the commercial interests.

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A glance at the center shown in Figure 11 will make it
clear that very few commercial C.A.T.V. franchise holders
now in business have either the capital or the personnel
to incorporate SYSTEM-3 communication into their cable
system. Even if they owned such a center, however, it
is unlikely that they could exploit. The lack of appro-
priate program material and the lack of appropriate direct
marketing material on a local basis makes such exploita-
tion impossible.

We believe that organizations analalogous to the Public
Broadcasting Corporation will come into being in the pri-
vate sector. Broader in scope than the now existing pro-
gram distribution networks, we believe that these organ-
izations will provide the nucleus for the commercial ex-
ploitation of extended broadcasting. They may rent centers
or supply them on a franchise basis, they will distribute
SYSTEM-3 program material, both with and without associated
interactive sales segments, they will provide centrally
coordinated credit banking, and they will perform the com-
mercial equivalent of the organizational functions of the
Public Broadcasting Corporation. The financial return to
such a commercial organization will take place not only
through normal advertising revenue, but through direct
participation in the commercial sales made in association
with their material. This latter will also, we believe,
be the major source of revenue to the local SYSTEM-3
operator, although his cable interconnection and operation
fees may in fact continue.

Because no similar source of revenue exists for the Public
Broadcasting Corporation, and because we do not believe
that one can come into existence without the other, we
strongly believe that either the Public Broadcasting
Corporation or some other non-profit entity committed to
extended broadcasting should participate in the establish-

ment of the commercial corporations that will serve ex-
tended broadcasting. Such an equity participation from
the start will provide the capital base and the ongoing
income to insure that the strength of public broadcasting
remains proportional to that of commercial broadcasting.
Such a partnership activity could be a particularly healthy
one considering the impact that SYSTEM-3 communication
will have on the community as a whole. Having established
such a joint relationship, we believe that the natural
melding of public and private interest will lead to a rapid
development of the technical and regulatory actions re-
quired to being SYSTEM-3 communications about.

B.   Regulation: With Government

The primary regulatory problems facing the development
of extended broadcasting lie with the Federal Communica-
tion Commission. Neither fish nor fowl, neither common
carrier nor broadcasting, SYSTEM-3 communication must
challenge both and demands either the establishment of
a new bureau or a new agency. Because SYSTEM-3 does
not provide point to point communication in the sense of
a common carrier, and because it does not provide broad-
cast communication in the sense of a broadcaster, the
FCC must recognize that the development of SYSTEM-3 does
not challenge the present markets of either of those,
although it certainly challenges what both would like to
visualize as a future market. We cannot restrict the
development of SYSTEM-3 communication in order to pre-
serve some future hypothetical market for existing in-
terests.

Specifically, we believe that the Federal Communications
Commission must maintain its jurisdiction over community
cable systems, must reserve a significant portion of each
such systems for public use, and must permit - nay foster -

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experimentation in the two-way use of such cable systems.
Such experimentation can initially be carried on entirely
in the education area. While these experiments do not
require the use of community cables, without the commit-
ment of the FCC, there is no assurance that their success-
ful completion will see permission for SYSTEM-3 cable use.
We feel that the early educational experiments should grow
into other public experiments, in the information/inquiry
area, in library use, etc. and that general experiments
should follow as rapidly as early successes allow. These
initial experiments will not only provide for software
experimentation but for working out many of the technical
and communication problems involved. It is imperative
that, at an early stage, the FCC recognize that for
SYSTEM-3 communication to be viable and to have the impact
that it should on our society, two-way microwave or wire
interconnection of community cables is essential. Only
by such interconnection can any kind of major information/
inquiry and distribution activity be carried on economically.
The real-time interconnection will be largely used for
transferring data rather than program material. The pro-
gram material generally of interest to extended broad-
casting will largely be prerecorded since only that kind
can take on the complexity required by user interaction.
As a result, any interconnection system will be paralleled
by a tape distribution system for more general program
material.

In addition to the Federal Communication Commission it is
most likely that either the Department of Commerce, the
Federal Banking Commission or some other federal agency
will be vitally concerned with the credit control necessary
for the smooth operation of the commercial aspects of ex-
tended broadcasting. As early plans develop in joint
public and commercial areas, Congressional activity will
be required to define the regulatory jurisdiction over

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this realm of extended broadcasting activity.

C. Technical: With Things

To the organizational and regulatory activities that
are prerequisite to the establishment of SYSTEM-3, we
must add a group of technical developments. It is al-
most certain that the burden of sponsoring these develop-
ment activities will fall heavily to the Public Broad-
casting Corporation either in collaboration with such
agencies as the United States Office of Education or
in collaboration with commercial boradcasting interests.

One such required development is the SYSTEM-3 receiver.
Incorporating a fair degree of logical hardware as well
as the other features described in Section IV, the re-
ceiver development will require the collaboration of people
skilled both in digital logic and television communica-
tion. Corporations such as RCA, Westinghouse and others,
as well as many of our engineering schools, are logical
sites for such development activity. Whether the early
receivers actually incorporate any large scale integrated
circuitry, or whether they are simply designed with the
eventual use of such circuitry in mind, is relatively un-
important. The first few thousand prototypes will be
expensive in any case and will require subsidy, probably
from both the commercial and public sector.

A far more complex development program is involved in the
development of the SYSTEM-3 center, although that develop-
ment program is much more amenable to a gradual phased
approach then is the receiver development. The basic
SYSTEM-3 center will consist of a computer, random access
data files, a small set of image converters, and a tele-
vision transmitter. The single, small computer will be
used both for polling and for file manipulation while the

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image converters will handle the display for video trans-
mission. Such a center will be capable of providing re-
stricted services in information inquiry, library distri-
bution, two-way files, problem-solving, or the creative
arts.

In the early experimental stages, such a center can be
established in association an ETV station, an academic
computer group and a community cable. The center will
serve as a test-bed for solving the basic problems of
synchronizing the transmitter time signals with the com-
puter control, of integrating the display control and the
transmission, and all of the problems of polling and con-
trolling the receiver/terminals. Once these basic problems
have been solved, slide units and film units can be added.
These will require the same kind of frame by frame mixing
equipment now used by T.V. stations, as well as synchron-
ized flying spot scanners and multiple single-sideband
audio playbacks. Here the problem will be to cope with
the growing saturation of the control computer and to syn-
chronize the various elements of the video transmission
system.

With the advent of image manipulation equipment, biblio-
graphic problems will arise. It will be necessary to use
sophisticated bibliographic management techniques to
manage the center's library and to mesh in an interactive
environment. It is they who will form the authorship
nucleus for SYSTEM-3 program material. We expect that not
only will didactic material flow from this community, but
that their close association with interactive environments
and their close involvement with the development of inter-
active systems will make the educational community a logical
source for much of the entertainment material in the early
days of extended broadcasting.

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It will also fall to the community of educators to evalu-
ate the impact of such programming on the users. Is learn-
ing enhanced? Do need arousal and involvement occur? Can
achievement be measured? All of these are questions that
the educational community must answer both for itself and
for public broadcasting as a whole. More esoteric questions,
such as the sociological impact of polling as part of the
political process, and the economic effects of this new
marketing channel will also fall to the scholars in the
educational community. We believe that this community
of educators, and particularly those in higher education,
will be central to the development of SYSTEM-3 and ex-
tended broadcasting.

In addition to the substantive software development pro-
gram, a major system software development program faces
the Corporation. The complex real-time control operation
represented by a SYSTEM-3 center is no more complex than
many now handled by digital computers. It nonetheless
represents a sizable software development activity. Poll-
ing, inquiry handling, the management of controllers, and
of terminals, the synchronization of display units, and
interaction with the interface receiver represent a modestly
complex process control problem.

In addition to the control programming, there is another
set of system programs that require development. For a
playwright or other substantive program author to work
efficiently, he needs a set of information management pro-
grams that will allow him to manipulate his files, his
script and display the topology of his scenario as he works
on it. The development of good scenarios is going to
require all of the discursive skills of the author and all
of the spatial skills of the sculptor. The individual
or team tackling such a problem will require all of the
technical augmentation it can muster. The development of

system programs to provide such technical augmentation
will be an early task of SYSTEM-3 development.

While the foregoing developments are extensive, they
need not be frightening. No major breakthroughs are re-
quired in order to bring about even an advanced stage of
SYSTEM-3 communication, and extended broadcasting can be-
gin after onlay a very few initial achievements .

D. EDUCOM: An Existing Resource

Because of its commitment to information and communication
technology in higher education, EDUCOM would like to work
with the Corporation for Public Broadcasting on the develop-
ment of SYSTEM-3. We recognize that the Corporation's
commitments to public broadcasting range over an enormous
spectrum, and that the development of SYSTEM-3 can only
occupy a small part of its attention. EDUCOM, on the
other hand, has the organizational structure that will
permit it to involve a wide range of members of the higher
education community, to call upon a wide range of techni-
cal and organizational disciplines, and to coordinate the
initial development activities required.

Using our staff and others drawn from the academic com-
munity, we would like to consider, with the corporation,
a program involving the development of several hundred
prototype receivers, two basic SYSTEM-3 centers, and the
supporting software necessary to permit a set of extended
broadcasting activities. These experiments would be con-
ducted using a combination of existing ETV facilities,
auxiliary computer equipment, a private cable, and allo-
cated space on a community television cable. We would
aim at target populations of both students and community
members.

From the earliest stages, EDUCOM would propose to involve
the information and communication industry and the regula-
tory agencies in this activity. Our experiences to date
with both segments indicate that such early involvement
can prevent the polarization that has frequently inter-
fered with developments in the past.

The program would require three to five years before an
operating SYSTEM-3 local network would be ready for evalu-
ation. During that time, however, many of the basic tech-
nical, regulatory and organizational problems should have
been solved and extended broadcasting should be ready for
a period of growth. Such a program will cost the order
of six million dollars over a five-year period including
cable charges, equipment costs and personnel costs. We
would expect this money to come half from government or
the Corporation and half from the information/communication
industry.

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