             What Should We Plan Given the Dilemma of the Network?

Status of this Memo

Abstract

   Early last year, as the concluding effort of an 18 month appointment
   at the US Congress Office of Technology Assessment (OTA), I drafted a
   potential policy framework for Congressional action on the National
   Research and Education Network (NREN).

   The Internet community needs to be asking what the most important
   policy issues facing the network are. And given agreement on any
   particular set of policy issues, the next thing we should be asking
   is, what would be some of the political choices that would follow for
   Congress to make?

   It is unfortunate that this was never officially done for or by the
   Congress by OTA. What we have as a result is network policy making
   being carried out now by the Science Subcommittee on the House side
   in consultation with a relatively small group of interested parties.
   The debate seems to be more focused on preserving turf than on any
   sweeping understanding of what the legislation is doing. That is
   unfortunate.

   In the hope that it may contain some useful ideas, I offer a
   shortened version of the suggested policy draft as information for
   the Internet community.

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The Dilemma of an Unregulated Public Resource in a Free Market
Environment

   As currently structured, the NSFnet and american Internet provide
   access to several million researchers and educators, hundreds of
   thousands of remote computers, hundreds of databases, and hundreds of
   library catalogues. Money being invested in the network as a result
   of the High Performance Computing and Communications (HPCC) initiative
   should considerably increase the numbers and variety behind this
   unprecedented collection of resources. No other computer network on
   earth currently comes close to providing access to the breadth and
   depth of people and information. If access to information is access
   to power, access to the national computer network will mean access to
   very significant power.

   Furthermore, access to the american Internet and NREN is also
   access to the worldwide Internet. According to the Director for
   International Programs at the NSF in February 1992, the development
   of the Internet over the past twelve years has been one of
   exponential growth:

                  Date   Connected Hosts

                  August 1981   213
                  October 1985   1,961
                  December 1987   28,174
                  January 1989   80,000
                  January 1991   376,000
                  January 1992   727,000

   These hosts are computers to which anyone in the world with Internet
   access can instantaneously connect and use if there are publically
   available files. Any host may also be used for remote computing if
   the system administrator gives the user private access. These seven
   hundred thousand plus hosts are located in more than 38 nations. But
   they are only part of the picture. By system-to-system transfer of
   electronic mail they are linked to probably a million additional
   hosts. According to Dr. Larry Landweber of the University of
   Wisconsin, as of February 10, 1992, Internet electronic mail was
   available in 106 nations and territories.

   Unfortunately, our current regulatory system does not distinguish
   between the unique nature of the Internet and commercial systems like
   Prodigy and Compuserve where perhaps a million people pay monthly
   fees for access to systems offering a few dozen databases run from
   two or three hosts and electronic mail to several hundred thousand
   people instead of many millions. (The picture is made somewhat fuzzy
   by the fact that Compuserve does provide electronic mail access to
   the Internet through a gateway and for an extra charge.) The Federal
   Communications Commission (FCC) considers all three to be Value Added
   Networks (VANs) run by Enhanced Service Providers. All use common
   carriers to provide their enhanced services and the FCC, in refusing
   to regulate them, reasons that all services are roughly alike. If,
   for example, Compuserve charges too much, the consumer can quit
   Compuserve and move to Prodigy. Or, if the monthly cost of access to
   the Internet were to become too much, access to Prodigy or Compuserve
   would be basically the same thing. Here unfortunately the analogy
   fails: the Internet now and the NREN to be, with its unparalleled
   resources, is not the same. Nevertheless, the FCC points out that
   without Congressional action it is powerless to regulate NREN service
   providers.

Regulation is a key NREN policy issue.

   Perhaps there will be no need for regulation. Hopefully, the
   marketplace for the provision of network services will remain
   competitive and higher prices and cream skimming will not keep the
   national network out of the reach of the general public who wish to
   avail themselves of what it has to offer. However, given the scope
   and power of what is contemplated here, Congress should realize that
   there are important considerations of social and economic equity
   behind the question of access to the network. This is especially
   true since libraries and groups representing primary and secondary
   schools are demanding what could be considered as universal access to
   the network without having any knowledge of how such access might be
   funded.

   The economic stakes are huge. Other players such as US West's
   Advanced Communications division are entering the market and AT&T is
   expected to do so by the spring. When combined with the award of the
   EINet backbone to Uunet, their entry should help to level the playing
   field. While one company is less likely to dominate such an
   uncontrolled, unregulated market, those concerned about widespread
   affordable access to the network would do well to watch unfolding
   events with care.

Technology Transfer Goals Achieved?

   Policy makers may ask how much priority the Federal government should
   continue to give technology transfer in a market where the technology
   that allegedly still needs aiding is showing remarkable signs of
   maturity? As they debate the course on which they wish to take the
   network over the next five years, policy makers may find that one
   answer to the apparent disparity between the emphasis in the
   legislation on the provision of the network by the government, and
   the growing number of commercial sources of network availability is
   that the market matured very rapidly while the HPCC legislation
   remained unchanged.

   In view of all the remarkable commercial achievements (outlined in
   this essay) in the four years since the NREN idea arose, perhaps the
   policy objective of technology transfer for economic competitiveness
   could be considered to be achieved! A commercially viable high speed
   data networking industry, with the entrance of Sprint in January 1992
   and the anticipated entrance of AT&T, has reached maturity.

   Therefore, having successfully achieved its technology transfer
   goals, the Congress must decide whether to continue to underwrite the
   network as a tool in support of science and education goals. It
   seems reasonable to assume that this support could be undertaken in a
   way that would not seriously undermine the commercial TCP/IP data
   networking market place.

The Context for Policy Setting

   In order to make informed choices of goals for the network, Congress
   must understand the context of a rapidly commercializing network.
   The resulting context is likely to produce serious impacts both on
   the user community and the development of future network technology.
   It is likely to make some goals more easily attainable than others.
   Given its maturity, the commercialization of TCP/IP wide area
   networking technology is inevitable.

   Some have already begun to question whether the government should be
   providing backbone services where commercial alternatives are
   currently available and are expected to grow in number.

   Supporters of the NREN vision argue that the NSF is using government
   funds to build a leading edge network faster than the commercial
   alternatives. They say that use of public funds on such technology
   development is appropriate. Their critics state that the T-3
   technology (also called DS-3) is dead end and point out that the next
   logical step is refining the network so that it can use ATM and
   SONET. For aggregate gigabit speeds along the backbone, use of ATM

and SONET will be necessary. Critics claim that the T-1 backbone
could be engineered to accommodate the network for a while longer
while Federal funds would be more appropriately invested now in an
ATM and SONET development effort. They say that Federal policy is
being used to enable IBM to have a testbed for the development of
DS-3 TCP/IP routers when Network Technologies makes a comparable
product that is already proven and reliable. Whether the Federal
Government should be providing backbone services or merely support
for access and improved network features is a key policy issue.

Finding the best answer to the questions raised by this issue is
likely to center on the ability of the Federal mission agencies
involved in high speed network development to articulate a long term
plan for the development of new network technology over the next
decade. How we shall use what is learned in the gigabit testbeds has
not yet been clearly addressed by policy makers. Continuation of the
testbeds is currently uncertain. There is also no plan to apply the
outcome to the production NREN. These are areas deserving of federal
involvement. The current players seem to be incapable of addressing
them. Some possible courses of Federal action will be identified in
the discussion of a Corporation for Public Networking to follow.

In the meantime, we face a period of four to five years where the NSF
is scheduled to take the NSFnet backbone through one more bid. While
Federal support for the current production backbone may be
questionable on technology grounds, policy makers, before setting
different alternatives:

>   -   must understand very clearly the dual policy drivers
>   behind the NREN,
>
>   -   must define very clearly the objectives of the network,
>   and
>
>   -   must carefully define a both a plan and perhaps a
>   governing mechanism for their achievement.

A sudden withdrawal of Federal support for the backbone would be
likely to make a chaotic situation more so. However, the application
of focused planning could define potentially productive alternatives
to current policies that could be applied by the time of the backbone
award announcement in April of 1993.

Whom Shall the Network Serve?

The HPCC legislation gives the FCCSET a year to prepare a report to
the Congress on goals for the network's eventual privatization.
Thanks to the NSF's decision to rebid the backbone, this task may no

longer be rendered moot by premature network privatization. The
FCCSET Report needs to address many questions.

One question is the extent to which, in the higher education
environment, Congress through the National Science Foundation, or
perhaps through another entity of its own choosing will continue to
underwrite networking. A related question is whether or when
Congress should act in order to preserve a competitive networking
provider environment. A question subsidiary to this is whether a
competitive commercial environment is adequate to ensure a fertile
data networking technical R&D environment? Another related question
centers on what is necessary to preserve network access that is as
widely available to post-secondary education as possible? Further
issues center on what type of access to promote. Should Congress
support the addition to the network of many of the expensive
capabilities promoted by the advocates of the NREN vision?   What if
funds spent here mean that other constituencies such as K-12 do not
get adequate support?

Access to the NREN is a key policy issue.

If network use is as important for improving research and education
as its supporters allege it to be, Congress may wish to address the
issue of why, at institutions presently connected to the network,
only a small minority of students and faculty are active users. If
it examines the network reality carefully, Congress may sense that it
is time to leverage investment in the network by improving the
network's visibility and usability within the communities it is
supposed to serve through improved documentation and training rather
than by blindly underwriting massive increases in speed.

How Far To Extend Network Access?

With the broadening discussion of the NREN vision, expectations of
many segments of the population not originally intended to be served
by the network have been raised. An avid group of educators wishing
to use the network in K-12 education has arisen. If
commercialization brought significant price increases, it could
endanger the very access these educators now have to the network.

Native Americans have begun to ask for access to the network. How
will Congress respond to them? And to the general library community
which with the Coalition for Networked Information has been avidly
pressing its desires for NREN funds? And to state and local
government networks?

Congress should recognize that choices about network access for these
broader constituencies will be made at two levels. Access for large

numbers could be purchased by the government from commercial
providers at considerable expense - an unlikely development in view
of the Federal budget deficit. In the meantime, given the current
mix of government supported and commercial providers, the environment
for these user classes is quite competitive. Those who are able to
pay their own way can generally gain access to the network from a
choice of providers at reasonable cost. Congress can act on behalf
of these constituencies by ensuring that the market for the
provisioning of network services remains open and competitive. Short
of either regulating the industry or establishing a new government
operated network, careful use of subsidies will have the most impact
on ensuring an open and competitive network. Congress can also
choose to view access as a function of price. If Congress does opt
for this course, it has several choices to ensure that prices will be
affordable. It could seek to impose regulations on the network
providers through the FCC at a national level or urge the state PUCs
to do it at the local level. (Of course the viability of state PUC
regulation, becomes questionable by the near certainty that there
would be little uniformity in how the PUCs in each state would treat
a national service.) Congress also could impose a tariff on network
providers profits and use the tariff to subsidize universal access.
It should, of course, understand that these courses of action would
raise touchy questions of conflicts between Federal and state
jurisdiction.

Congress may also have been vague in dealing with these broader
network constituencies, because it wishes to sidestep making these
difficult choices. The origin of most of these choices may be traced
to the addition of education policy goals for the Network symbolized
by the changing of its name from the National Research Network to the
National Research and Education Network in the OSTP Program Plan in
September 1989. While this action got the attention and support of
new constituencies for the Network, it did not bring any significant
shift to the science and mission agency oriented direction of network
development. The legislation remained essentially unchanged:
"educators and educational institutions" were as specific as the
language of the bills ever got. Perhaps this was almost on purpose?
Having goals that were more specific might imply the need to justify
with some precision why some individual segments of the networking
community deserved service while some did not.

Unless Congress were able to construct a separate rationale for the
needs of each of the network constituencies - from supercomputer
users to grade school students - specific goal setting by Congress
might imply that Congress was arbitrarily judging some network
constituencies to be more worthy than others. This would be a
difficult course to follow because those who were left out would want
to know what the basis for such a judgment would be? Solid answers

would be difficult to come by because networking as enabling
educational technology is so new that no one is as yet quite sure how
to measure its value. Without such assurances, it may be difficult
for Congress to know how to justify its spread on any other grounds
than equity of opportunity.

Indeed there is a constituency of grass roots-oriented, small-scale
network builders allied with elements of the library community. This
constituency suggests that computer networks will very quickly become
such powerful means of access to information that lack of access to
them will soon will carry serious implications for social and
economic equity within the nation.

These groups can be expected to be very vocal in their demands that
some minimal level of access to the national network be widely
available and affordable. They are likely to ask that Congress turn
its attention to the feasibility of establishing the goal of
universal access to the national network. Although the technology
and economic conditions are quite different from the conditions of
the 1934 Communications Act, they are likely to demand action
analogous to that.

Motivated by these concerns, Mitch Kapor has been arguing very
eloquently for the building of the NREN as a National Public Network.
Asked to define what he saw as being at stake, he said the following
to the author in September 1991:

    "Information networking is the ability to communicate by means of
    digitally-encoded information, whether text, voice, graphics, or
    video. Increasingly, it will become the major means for
    participation in education, commerce, entertainment, and other
    important social functions. It is therefore important that all
    citizens, not just the affluent, have the opportunity to
    participate in this new medium. To exclude some is to cut them
    off from the very means by which they can advance themselves to
    join the political social and economic mainstream and so consign
    them to second-class status forever. This argument is analogous
    to that which was made in favor of universal voice telephone
    service - full social participation in American life would require
    access to a telephone in the home."

Kapor through his Electronic Frontier Foundation, (EFF) is working
hard to make sure that Congress is compelled to address the question
of universal network access. The EFF has also begun to press for the
use of ISDN as a technologically affordable means of bringing the
benefits of a national network to all Americans.

If Congress wishes to promote widespread access to the network and to

design an network that is amenable to widespread use, it will do well
to examine carefully the position that the EFF is articulating. It
would also do well to look outside the confines of the Federal
Networking Council (FNC) and the FNC Advisory Commission that is made
up of members similar in orientation to the FNC and is scheduled for
only four meetings and a two-year-long existence. If it wishes to
increase secondary and elementary school access to the network, it
could investigate enlarging the very small role granted by the
legislation to the Department of Education. Unfortunately, without
careful planning what would be gained by this is unclear. The
Department of Education has never played a significant role in
computer networking. The immediate needs of the K-12 arena are
focused mainly around maintaining the existence of affordable low
bandwidth access and the support of successful pioneering efforts.

When Congress states its intentions for the scope of access to the
network and, as a part of doing so, sets priorities for investment in
network bandwidth versus ease of use, it can then turn its attention
only to one other area.

A Corporation for Public Networking?

Network governance and oversight are key policy issues.

If Congress has doubts about the current situation, it might want to
consider the creation of an entity for NREN management, development,
oversight and subsidization more neutral than the NSF.

Action should be taken to ensure that any such an entity be more
representative of the full network constituency than is the NSF. If
Congress decides to sanction network use by a community broader than
the scientific and research elite, it must understand the importance
of creating a forum that would bring together the complete range of
stake holders in the national network.

While such a forum would not have to be a carbon copy of the
Corporation for Public Broadcasting, given the half billion dollars
to be spent on the network over the next five years and the very
confused and contentious policy picture, it might make sense to spend
perhaps a million dollars a year on the creation of an independent
oversight and planning agency for the network. Such an entity could
report its findings to the Congress and respond to goals formulated
by the Congress.

Congress could declare the development and maintenance of a national
public data network infrastructure a matter of national priority. It
could make it clear the government will, as it does in issues of
national transportation systems, the national financial system, and

national communications systems, maintain an interest in the
development and control of a system that serves both the goals of
improved education and new technology development.

To carry out such a mandate, a Corporation for Public Networking
(CPN) could have fifteen governors nominated by the members of the
network community and subject to the approval of the Congress.

Each governor would represent a network constituency.

        1. The NSF
        2. Department of Energy
        3. National Aeronautics & Space Administration
        4. Advanced Research Projects Agency
        5. Corporate Users
        6. K-12
        7. Higher Education
        8. Public Libraries & State and Local Networks
        9. Commercial Network Information Service Providers
       10. Interexchange Carriers such as AT&T, MCI, Sprint, etc.
       11. The Regional Bell Operating Companies
       12. Personal Computer Users
       13. Computer Manufacturers
       14. Disabled Users
       15. University Computing

Since the legislation calls for backbone nodes in all 50 states, such
a structure would be a reasonable way to coordinate Federal support
for the network on a truly national basis - one that, by
acknowledging the network as a national resource, would give
representation to the full breadth of its constituencies. Governors
could use the network to sample and help to articulate the national
concerns of their respective constituencies.

If it adopted these goals, Congress could give a CPN a range of
powers:

    1.   The CPN could be a forum for the expression of the
         interests of all NREN constituencies. In the event the
         network were to be administered by the NSF, it could be
         serve as a much more accurate sounding board of network
         user concerns than the FNC or the FNC Advisory Council.

    2.   The CPN could be authorized to make recommendations to NSF
         and other agencies about how funds should be distributed.

         Such recommendations could include truly independent
         assessments of the technical needs of the network

community and the most cost effective ways of achieving
them.

3. The CPN could itself be given responsibility for funding
    distribution. Such responsibilities would incur an
    increase in administrative costs and staff. Nevertheless,
    by creating an opportunity to start a process from scratch
    and one that would consequently be free of the vested
    interests of the National Science Foundation in high-end
    network solutions, Congress would likely get a clearer
    picture of where and how effectively public monies were
    being expended. With such responsibility the CPN could
    also keep extensive pressure on network providers to
    remain interconnected. When thinking about cost, Congress
    should also remember that effective oversight of subsidies
    funneled through NSF would imply the hiring of extra staff
    within that agency as well.

4. Congress might want to ask a CPN to examine the use of the
    $200 million in NREN R&D monies. Policy direction
    dictating the spending of Federal funds is still suffering
    from the fuzzy boundaries between the network as a tool
    for leveraging technology competitiveness into commercial
    networking environments and the network as a tool to
    facilitate science and education. If Congress decides
    that the major policy direction of the network should be
    to develop the network for use as a tool in support of
    science and education, then it may want monies directed
    toward ARPA to be focused on improved databases, user
    interfaces and user tools like knowbots rather than a
    faster network used by fewer and fewer people. A CPN that
    was representative of the breadth of the network's user
    constituencies could provide better guidance than the
    FCCSET or ARPA for spending Federal subsidies aimed at
    adding new capabilities to the network.

5. Additional levels of involvement could have the CPN act as
    a national quasi-board of networking public utilities. It
    could be given an opportunity to promote low cost access
    plans developed by commercial providers. If it borrowed
    some of the fund raising structure of National Public
    Radio, it should be able to raise very significant funds
    from grass roots users at the individual and small
    business level who are made to feel that they have a stake
    in its operation.

6. If congress wanted to increase further the role given the
    CPN, it could decide that with network commercialization

and technology transfer goals completed, the majority of
the NREN funds go to the CPN which could then put out a
bid for a CPN backbone. In effect Congress could dictate
that the backbone announced by the NSF for implementation
in 1993 be implemented and run as a joint project between
the NSF and a CPN.

All entities should be considered eligible to join and use
the CPN in support of research and education. Commercial
companies who wanted to use the CPN to interact with the
academic community should pay a commercial rate to do so.

With the availability of a parallel commercial network,
commercial restrictions on the CPN could be very much
loosened to include anything in support of research and
education. The CPN would study and report to Congress on
how gateways between commercial TCP/IP networks and the
CPN network could be maintained.

7.   Some suggest that the Congress go even further. These
     people emphasize that a replacement for the R&D aspects of
     the Internet in the context of commercialization and
     privatization is uncertain. Bell Labs and Bellcore remain
     as the research arms of the Public Switched Telephone
     Network. However neither of them have ever developed
     major strengths in wide area data networking. Nor do they
     appear to be likely to do so in the near future. Despite
     this situation, the major private investment made in the
     Gigabit Testbeds indicate that the american
     telecommunications industry feels a need to invest in
     continued research. This is something that the current
     commercial players are too small to do. Furthermore, it
     is something that the larger players driven by pressure to
     report quarterly profits may find difficult to do.

     Congress could make a decision that Federal investment in
     the technology should emphasize less pump-priming to
     increase the pace of what most see as inevitable
     commercialization and more the continued building of new
     networking technology for both technology transfer and
     support of the technology as an enabling tool. In this
     case Congress could direct the CPN to plan, deploy and
     manage a state of the art public information
     infrastructure. With goals for constituencies and levels
     of service defined, the CPN could produce for Congress
     multiple scenarios for developing and maintaining two
     networks.

The first would be an experimental network where the very
newest technologies could be explored. It could be very
similar to the current gigabit testbeds but this time with
all five projects linked together. The second would be a
state-of-the-art operational network that can provide wide
spread field trials of technology developed on the
experimental network. With the maturation of the
technology on the operational network it would be
available for open transfer to commercial service. It
should be remembered that such a continuous widespread
network R&D environment would provide wide spread training
experience for graduate students that would otherwise be
unavailable.

Initial seed money would come from public funds. However,
the bulk of support could come from a percentage of
profits (as cash or in kind contributions) that
participating companies would be required to contribute to
the CPN as the price of admission for developing and
benefiting from new technology. Care should be taken in
structuring contributions in a way that small start-up
firms would not be locked out. To ensure this, Congress
could mandate that the CPN commissioners (perhaps with
appropriate oversight from the National Academy of
Sciences, the IEEE, or the ACM) develop a plan to ensure
that the cost of entry to such a testbed not exceed the
capitalization of the current small commercial players.

It could also require the development of proposals to
handle the issues of interconnection billing, billing for
actual use versus size of connection, and interoperability
among network providers.

A different financing model could be explored if the CPN
were instructed to report on the feasibility of selling
shares to commercial carriers in a national networking
testbed and R&E network where carriers could, over a long
term basis, develop and mature new networking technologies
before transferring them to the commercial marketplace.

8.   In its November 1, 1991 recommendations to the National
      Science Foundation, FARNET suggested that the NSF should
      consider the issuance of several separate solicitations
      for the development of software tools for end-user
      applications and network management and operations. To
      emphasize its point it added: "we believe that the lack
      of useful tools for information retrieval and display is
      one of the biggest impediments to the productive use of

the network and has impaired the credibility of the NREN
in the eyes of the target user populations." FARNET
admonished the NSF to emphasize open architectures and
standards in its solicitations, adding that "where
standards are not adequately understood or developed, the
NSF should support programs to test, evaluate and improve
them."

FARNET concluded by recommending

"that the NSF, working with the user community and
the providers, define and implement clear criteria
for the award of additional funding to mid-level and
campus networks . . . The new criteria should be
designed to further . . . goals such as the extension
of network services to new or underserved communities
(for ubiquity); the improvement of network
operations, procedures and tools (for reliability);
the enhancement of existing services through
development activities, upgrading of existing
connections to 'have not' institutions; leveraging of
state, local, and private funds (to maximize the
impact of Federal investment), and training and
support for end-users (in cooperation with national
and local programs)."

If a CPN is created, it should be directly involved with
working toward these important goals. If implementation
of the network is left to the National Science Foundation,
Congress should emphasize the importance of the NSF's
meeting these goals.

9.   Finally, a strong and broad-based CPN might be able to
make recommendations to Congress on the identification and
resolution of problems of telecommunications policy
engendered by the continued growth of this network
technology. It could perhaps play an educational role in
advising state Public Utilities Commissions on the long
term implications of their decisions.

Summary

Policy makers must soon decide whether the National Research and
Education Network is a public or a private good. Although
privatization appears to be proceeding apace, since the network
backbone will be rebid, there should be time for some careful
planning for the development and evolution of what can, within 10 to
20 years, become an extraordinarily powerful system that is as

ubiquitous as the current telephone network and provides all
Americans with access to information in much the same way as public
libraries were created for a similar purpose a century ago.

Congress must understand that the NREN is not just a new technology
(indeed much is of it is old technology), but has the potential to
become the most powerful means of access to information ever created.
Within this context it must decide whom the NREN shall serve. It
must decide whom shall have access to the NREN.

Once it has done this further options fall into four major areas:

> First: Congress must decide degree of oversight
>   that is necessary to extend to the network. Such
>   oversight could range from legislating that the
>   FCC regulate the network, to strict reviews of
>   the NSF's actions, to vesting oversight powers
>   in a Corporation for Public Networking.
>
> Second: It must decide whether the appropriate place to
>   subsidize technology transfer is within a
>   privatized operational NREN or within the
>   experimental gigabit testbeds. Without a better
>   understanding both of how the technologies are
>   evolving in the commercial market place, and the
>   evolution of both the testbeds and the NREN, it
>   will be difficult to make make a wise decision.
>   In addition, we must expect that the nature of
>   its choice will be further influenced by its
>   decision on whom the network is to serve.
>
> Third: It must decide whether to subsidize a backbone
>   for an NREN. If it does subsidize such a
>   backbone, it must decide whether it shall be
>   built as a private network or as a part of the
>   PSTN.
>
> Fourth: It must decide whether to subsidize additional
>   connectivity or broader use within connected
>   institutions or both. In other words, should
>   more institutions be connected to the network,
>   or should the network be made easier to use by
>   the members of those institutions already
>   connected?

To the extent that Congress chooses to pursue options three and four,
it will want to explore the scenario for the Corporation for Public
Networking discussed above.

Access to information is access to power. The creation of a National
Research and Education Network based on the NSFnet and the remainder
of the american Internet will mean the creation of a national
information access system of unprecedented power. In its ability to
affect the lives and well being of Americans, the NREN, if properly
designed, will be just as significant as the national Interstate
highway system and the national electric power grid. The national
highway, or the national power grid, or the national telephone system
could serve as models for implementation. The Federal Government
provides a public but otherwise unregulated Interstate highway system
with universal access available to all Americans. Private industry
provides our electric power. However, it was allowed to do so only
in return for submitting to Federal and state regulation designed to
ensure affordable national access by all citizens. The national
telephone system has been established under a similar "social
contract". If the nation is not to be dangerously split into
information rich and information poor classes, policy makers have
about five years in which to choose a Federally provided National
network, or a privately provided but nationally regulated network.

During the development and maturation of the national network, policy
makers should also be very attentive to its impact on the public
switched telephone network (PSTN). The technology involved and the
speed with which it is changing will only increase the potentially
serious impact from the freedom of unregulated components of the
telecommunications industry to pursue market solutions that will keep
regulated companies from becoming viable players. We must realize
that we are about to enter a power struggle for the control of the
information resources of the 21st century that promises to be every
bit as harsh and bruising as the power struggle for natural resources
was at the end of the last century.

While the intentions of most appear to be good, as this study has
shown, the playing field is terribly confused. Gigabit technology (if
properly understood) is desirable. Still we should take great care
that its cost does not raise the price of low bandwidth or "low end"
entry into the network.

Lack of a specific definition of communities to be served, lack of an
agreed upon plan for how they shall be served, and lack of funds to
serve everyone have combined to create the present chaotic situation
in which many of the players have been motivated primarily by a
desire to increase their institutional role in order to get larger
Federal allocations of funds.

In the absence of both a well-thought-out plan agreed to by all
parties and adequate monetary support, the grand push to accelerate
both the speed and scope of the technology could have the ironic role

of weakening the entire foundation of the network. Until the
Congress provides more direction, the squabbling that has developed
is likely to continue. In the absence of such direction, at best
large sums of public funds may be ineffectively spent, and at worst a
picture of empire building could emerge that would make any Federal
support for research or educational networking unlikely.

Such an outcome should be avoided because the potential of a well
designed and developed network to do great good in both policy arenas
is very significant. Unfortunately with the NSF under mounting
criticism, ANS on the defensive and rumored to be financially
weakened, and Congressional hearings scheduled for mid-March, the
potential for a destructive free-for-all is very great.

Security Considerations

    Security issues are not discussed in this memo.

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