

Building The Open Road:
The NREN As Test-Bed For The National Public Network

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Introduction

A debate has begun about the future of America's communications infrastructure. At stake is the future of the web of information links organically evolving from computer and telephone systems. By the end of the next decade, these links will connect nearly all homes and businesses in the U.S. They will serve as the main channels for commerce, learning, education, and entertainment in our society. The new information infrastructure will not be created in a single step: neither by a massive infusion of public funds, nor with the private capital of a few tycoons, such as those who built the railroads. Rather the national, public broadband digital network will emerge from the "convergence" of the public telephone network, the cable television distribution system, and other networks such as the Internet.

The United States Congress is now taking a critical step toward what I call the National Public Network, with its authorization of the National Research and Education Network (NREN, pronounced "en-ren"). Not only will the NREN meet the computer and communication needs of scientists, researchers, and educators, but also, if properly implemented, it could demonstrate how a broadband network can be used in the future. As policy makers debate the role of the public telephone and other existing information networks in the nation's information infrastructure, the NREN can serve as a working test-bed for new technologies, applications, and governing policies that will ultimately shape the larger national network. Congress has indicated its intention that the NREN

would provide American researchers and educators with the computer and information resources they need, while demonstrating how advanced computer, high speed networks, and electronic databases can improve the national information infrastructure for use by all

Americans. (1)

As currently envisioned, the NREN

would connect more than one million people at more than one thousand colleges, universities, laboratories, and hospitals throughout the country, giving them access to computing power and information -- resources unavailable anywhere today -- and making possible the rapid proliferation of a truly nationwide, ubiquitous network... (2)

The combined demand of these users would develop innovative new services and further stimulate demand for existing network applications. Library information services, for example, have already grown dramatically on the NREN's predecessor, the Internet, because the

enhanced connectivity permits scholars and researchers to communicate in new and different ways.... Clearly, to be successful, effective, and of use to the academic and research communities, the NREN must be designed to nurture and accommodate both the current as well as future yet unknown uses of valuable information resources. (3)

So as the NREN implementation process progresses, it is vital that the opportunities to stimulate innovative new information technologies be kept in mind, along with the specific needs of the mission agencies which will come to depend on the network.

Far from evolving into the whole of the National Public Network itself, the NREN is best thought of as a prototype for the NPN, which will emerge over time from the phone system, cable television, and many computer networks. But the NREN is a growth site which, unlike privately controlled systems, can be consciously shaped to meet public needs. For a wide variety of services, some of which might not be commercially viable at the outset, the NREN can

provide selective access that proves feasibility and leads to the creation of a commercial infrastructure that can support universal services.... If we fully focus on ...[current] goals and work our way through a multitude of technical and operational issues in the process, then the success of the NREN will fully support its extension to broader uses in the years to follow. (4)

In order to function as an effective test-bed, one that promotes broad access to a range of innovative, developing services, the NREN must be built so that it is easy for developers to offer new kinds of applications, and is accessible to a diversity of users. For

example, to encourage the development of creative, advanced library services, it must be easy for libraries to open their data bases to users all across the network. And if these library services are to flourish through the NREN, then the services must be available to researchers and students all over the country, through a variety of channels. Though the NREN itself is intended to meet the supercomputing and networking needs of the government-financed research community, Congress has wisely recognized that it can also function as a channel for delivery of a wide range of privately-developed information services. To

encourage use of the Network by commercial information service providers, where technically feasible, the Network shall have accounting mechanisms which allow, where appropriate, users or groups of users to be charged for their usage of copyrighted materials over the Network. (5)

Congress can create an environment that stimulates information entrepreneurship by mandating that the NREN rely on open technical standards whose specifications are not controlled by any private parties and which are freely available for all to use. Such non-proprietary standards will ensure that different parts of the network built and operated by independent parties, will all work together properly. By employing widely-used, non-proprietary standards the NREN will make it easy for new information providers to offer their wares on the network. The market will snowball: as more services are offered, more users will be attracted, who will increase overall demand. The NREN will also be a test-bed for development and experimentation with new networking standards that facilitate even broader, more efficient interconnection than now possible on the Internet. But throughout the stages of the NREN, all concerned should be sure that these functionalities are fostered.

The NREN design and construction process is complex and will have significant effects on future communications infrastructure design:

Building the NREN has frequently been described as akin to building a house, with various layers of the network architecture compared to parts of the house. In an expanded view of this analogy, planning the NII [national information infrastructure] is like designing a large, urban city.

The NREN is a big new subdivision on the edge of the metropolis, reserved for researchers and educators. It is going to be built first and is going to look lonely out there in the middle of the pasture for a while. But the city will grow up around it in time, and as construction proceeds, the misadventures encountered in the NREN subdivision will not have to be repeated in others. And

there will be many house designs, not just those the NREN families are comfortable with.... The lessons we learn today in building the NREN will be used tomorrow in building the NII. (6)

The coming implementation and design of the NREN offers us a critical opportunity to shape a small but important part of the National Public Network.

VISIONS

At its best, the National Public Network would be the source of immense social benefits. As a means of increasing social cohesiveness, while retaining the diversity that is an American strength, the network could help revitalize this country's business and culture. As Senator Gore has said, the new national network that is emerging is one of the "smokestack industries of the information age." (7) It will increase the amount of individual participation in common enterprise and politics. It could also galvanize a new set of relationships -- business and personal -- between Americans and the rest of the world.

The names and particular visions of the emerging information infrastructure vary from one observer to another. (8) Senator Gore calls it the "National Information Superhighway." Prof. Michael Dertouzos imagines a "National Information Infrastructure [which] ... would be a common resource of computer-communications services, as easy to use and as important as the telephone network, the electric power grid, and the interstate highways." (9) I call it the National Public Network (NPN), in recognition of the vital role information technology has come to play in public life and all that it has to offer, if designed with the public good in mind.

To what uses can we reasonably expect people to use a National Public Network? We don't know. Indeed, we probably can't know -- the users of the network will surprise us. That's exactly what happened in the early days of the personal computer industry, when the first spreadsheet program, VisiCalc, spurred sales of the Apple II computer. Apple founders Steve Jobs and Steve Wozniak did not design the spreadsheet; they did not even conceive of it. They created a platform which allowed someone else to bring the spreadsheet into being, and all the parties profited as a result, including the users.

Based on today's systems, however, we can make a few educated guesses about the National Public Network. We know that, like the telephone, it will serve both business and recreation needs, as well as offering crucial community services. Messaging will be popular: time and time again, from the ARPAnet to Prodigy, people have surprised network planners with their eagerness to exchange mail. "Mail" will not just

mean voice and text, but also pictures and video -- no doubt with many new variations. One might imagine two people poring over a manuscript from opposite ends of the country, marking it up simultaneously and seeing each others' markings appear on the screen.

We know from past demand on the Internet and commercial personal computer networks that the network will be used for electronic assembly -- virtual town halls, village greens, and coffee houses, again taking place not just through shared text (as in today's computer networks), but with multi-media transmissions, including images, voice, and video. Unlike the telephone, this network will also be a publications medium, distributing electronic newsletters, video clips, and interpreted reports. (10)

We can speculate but cannot be sure about novel uses of the network. An information marketplace will include electronic invoicing, billing, listing, brokering, advertising, comparison-shopping, and matchmaking of various kinds. "Video on demand" will not just mean ordering current movies, as if they were spooling down from the local videotape store, but opening floodgates to vast new amounts of independent work, with high quality thanks to plummeting prices of professional-quality desktop video editors. Customers will grow used to dialing up two-minute demos of homemade videos before ordering the full program and storing it on their own blank tape.

There will be other important uses of the network as a simulation medium for experiences which are impossible to obtain in the mundane world. If scientists want to explore the surface of a molecule, they'll do it in simulated form, using wrap-around three-dimensional animated graphics that create a convincing illusion of being in a physical place. This visualization of objects from molecules to galaxies is already becoming an extraordinarily powerful scientific tool. Networks will amplify this power to the point that these simulation tools take their place as fundamental scientific apparatus alongside microscopes and telescopes. Less exotically, a consumer or student might walk around the inside of a working internal combustion engine -- without getting burned.

Perhaps the most significant change the National Public Network will afford us is a new mode of building communities -- as the telephone, radio, and television did. People often think of electronic "communities" as far-flung communities of interest between followers of a particular discipline. But we are learning, through examples like the PEN system in Santa Monica and the Old Colorado City system in Colorado Springs, that digital media can serve as a local nexus, an evanescent meeting-ground, that adds levels of texture to relationships between people in a particular locale. As Jerry Berman of the ACLU Information Technology Project has said:

Computer and communications technologies are transforming speech into electronic formats and shifting the locus of the marketplace of ideas from traditional public places to the new electronic public forums established over telephone, cable, and related electronic communications networks. (11)

To both local and long-distance communities, accessible digital communications will be increasingly important; by the end of this decade, the "body politic," the "body social," and the "body commercial" of this country will depend on a nervous system of fiber-optic lines and computer switches.

But whatever details of the vision and names gives to the final product, a network that is responsive to a wide spectrum of human needs will not evolve by default. Just as it is necessary for an architect to know how to make a home suitable for human habitation, it is necessary to consider how humans will actually use the network in order to design it.

In that spirit, I offer a set of recommendations for the evolution of the National Public Network. I first encountered many of the fundamental ideas underlying these proposals in the computer networking community. Some of these recommendations address immediate concerns; others are more long-term. There is a focus on the role of public access and commercial experiments in the NREN, which complement its research and education mission. The recommendations are organized here according to the main needs which they will serve: first ensuring that the design and use of the network remains open to diversity, second, safeguarding the freedom of users. The ultimate goal is to develop a habitable, usable and sustainable system -- a nation of electronic neighborhoods that people will feel comfortable living within.

I. Encourage Competition Among Carriers

In the context of the NREN, act now to create a level and competitive playing field for private network carriers, (whether for-profit or not-for-profit) to compete. Do not give a monopoly to any carrier. The growing network must be a site where competitive energy produces innovation for the public benefit, not the refuge of monopolists.

The post-divestiture phone system offers us a valuable lesson: a telecommunications network can be managed effectively by separate companies -- even including bitter opponents like AT&T and MCI -- as long as they can connect equitably and seamlessly from the user's standpoint. The deregulated telecommunications system may not work perfectly and may produce too much litigation, but it does work. We

should never go back to any monopoly arrangement like the pre-divestiture AT&T which held back market-driven innovation in telecommunications for half a century. Given the interconnection technology now available, we should never again have to accept the argument that we have to sacrifice interoperability for efficiency, reliability, or easy-of-use.

Similarly, the NREN, and later the National Public Network, must be allowed to grow without being dominated by any single company. Contracting requirements in the current legislation advance this goal.

The Network shall be established in a manner which fosters and maintains competition within the telecommunications industry and promotes the development of interconnected high-speed data networks by the private sector. (12)

Absent a truly competitive environment, a dominant carrier might use its privileged access to stifle competitors unfairly: "Use our local service to connect to our undersea international links, without the \$3 surcharge we tack on for other carriers." The greatest danger is "balkanization" -- in which the net is broken up into islands, each developing separately, without enough interconnecting bridges to satisfy users' desires for universal connectivity. Strong interoperability requirements and adherence to standards must be built into the design of the NREN from the outset. (13)

After 1992, private companies will manage an ever-greater share of the NREN cables and switches. The NSF should use both carrot and stick to encourage as much interconnection as possible. For example, the NSF could make funding to NREN backbone carriers contingent on participation in an internetwork exchange agreement that would serve as a framework for a standards-based environment. As the NREN is implemented, some formal affirmation of fair access is needed -- ideally by an "Internet Exchange Association" formed to settle common rules and standards. (Their efforts, if strong enough, could forestall a costly, wasteful crazy-quilt of new regulations from the FCC and 50 State Public Utilities Commissions.) This association should decide upon a "basket" of standard services -- including messaging, directories, international connections, access to information providers, billing, and probably more -- that are guaranteed for universal interconnection. The Commercial Internet Exchange (CIX) formed in 1991 by three commercial inter-networking carriers represents a substantive, initial move in this direction.

II. Create an Open Platform for Innovation

Encourage information entrepreneurship through an open architecture (non-proprietary) platform, with low barriers to entry for information providers.

The most valuable contribution of the computer industry in the past generation is not a machine, but an idea -- the principle of open architecture. Typically, a hardware company (an Apple or IBM, for instance) neither designs its own applications software nor requires licenses of its application vendors. Both practices were the norm in the mainframe era of computing. Instead, in the personal computer market, the hardware company creates a "platform" -- a common set of specifications, published openly so that other, often smaller, independent firms can develop their own products (like the spreadsheet program) to work with it. In this way, the host company takes advantage of the smaller companies' ingenuity and creativity.

Even interfaces rigidly controlled by a single manufacturer, like the Macintosh, embrace the platform concept. Two years ago, when Apple began planning the System 7 release of its Macintosh operating system, one of its first steps was to invite comment from software companies like Macromind, Aldus, Silicon Beach, and T/Maker. In substantive, sometimes very argumentative sessions, Apple revealed the capabilities it planned to these independents, who knew their customers and needs much better than Apple. One multi-media company, after arguing that Apple should take a different technical turn, actually found itself doing the work in a joint project. The most useful job of Apple's famous "evangelists" is not selling the Mac specs, but listening to outsiders, and helping Apple itself stay flexible enough to work with independent innovators effectively.

In the design of the NREN, information entrepreneurship can best be promoted by building with open standards, and by making the network attractive to as many service providers and developers as possible. The standards adopted must meet the needs of a broad range of users, not just narrow needs of the mission agencies that are responsible for overseeing the early stages of the NREN. Positive efforts should be made to encourage the development of experimental commercial services of all kinds without requiring the negotiation of any bureaucratic procedures.

In the early stages of development of an industry, low barriers to entry stimulate competition. They enable a very large initial set of products for consumers to choose from. Out of these the market will learn to ignore almost all in order to standardize on a few, such as a Lotus 1-2-3. The winners will be widely emulated in the next generation of products, which will in turn generate a more refined

form of marketplace feedback. In this fashion, early chaos evolves quickly a set of high-demand products and product categories.

This process of market-mediated innovation is best catalyzed by creating an environment in which it is inexpensive and easy for entrepreneurs to develop products. The greater the number of independent enterprises, each of which puts at voluntary risk the intellectual and economic capital of risk-takers, is the best way to find out what the market really wants. The businesses which succeed in this are the ones which will prosper.

It is worthwhile to note that not a single major PC software company today dates from the mainframe era. Yesterday's garage shop is today's billion-dollar enterprise. Policies for the NPN should therefore not only accommodate existing information industry interests, but anticipate and promote the next generation of entrepreneurs.

The diverse needs of these many users will create demand for thousands of information proprietors on the net, just as there are thousands of producers of personal computer software today and thousands of publishers of books and magazines. It should be as easy to provide an information service as to order a business telephone. Large and small information providers will probably coexist as they do in book publishing, where the players range from multi-billion-dollar international conglomerates to firms whose head office is a kitchen table. They can coexist because everyone has access to production and distribution facilities -- printing presses, typography, and the U.S. mails and delivery services -- on a non-discriminatory basis. In fact, the sub-commercial print publications are an ecological breeding ground, through which mainstream authors and editors rise. No one can guarantee when an application as useful as the spreadsheet will emerge for the NPN (as it did for personal computers), but open architecture is the best way for it to happen and let it spread when it does.

The PC revolution was brought about without direct public support. Entrepreneurs risked their investors' capital for the sake of opportunity. Some succeeded, but many others lost their entire investment. This is the way of the marketplace. We should take a much more cautious attitude about the commitment of public monies. In the absence of proven demand for new applications, government should not be spending billions of dollars on the creation of broadband networks. Neither should telephone companies be allowed to pass on the costs of the NPN in a way which would raise the rates for ordinary voice telephone service.

Instead, we should position the NREN to show there is a market for

network applications. The commercial experiments just beginning on the Internet provides one source of innovation. Deployment of a national ISDN platform in the next few years represents another relatively inexpensive seed bed. As such experiments demonstrate more of a proven demand for public network services, it should be possible for the private sector to make the investments to build the broadband NPN using experience from the NREN.

At the same time as the NREN is being debated and developed, telephone companies continue to push at the limits imposed on them by the "Modification of Final Judgment" (MFJ) of divestiture, the 1982 anti-trust agreement which split up the Bell system. (14) Under pressure from the D.C. Court of Appeals, Judge Greene recently lifted the information services restrictions on the BOCs -- despite the competitive tension between the telephone companies, cable TV carriers, and newspapers. Thus, in the next year or so, Congress may well be forced to define a new set of rules for regulated telecommunications. (15) Like the AT&T divestiture decision, this would represent a fundamental shift in national policy with enormous and unpredictable consequences.

Many consumer and industry groups are concerned that as the MFJ restrictions are lifted, the RBOCs will come to dominate the design of the emerging National Public Network, shaping it more to accommodate their business goals than the public interest. The Communications Policy Forum, a coalition of public interest and industry groups, has recently begun to consider what kinds of safeguards will be needed to maintain a competitive information services market that allows RBOC participation. The role that the RBOCs come to play in the nation's telecommunications infrastructure is, of course, an issue that must be carefully considered on its own. But in this context, the NREN represents a critical opportunity to create a model for what a public network has to offer, free from commercial pressures.

With all of the uncertainty that surrounds the RBOCs entry into the information services market, we should use the NREN to learn how to develop a network environment where competitive entry is easy enough that the RBOCs opportunity to engage in anti-competitive behavior would be minimized. There is evidence that the RBOCs are resisting attempts to transform the public telephone system into a truly open public network (16) notwithstanding the FCCs stated intention to implement Open Network Architecture. (17) But since the NREN standards and procedures can be designed away from the dominance of the RBOCs, a fully open network design is within reach. In this sense the NREN can be a test-bed for "safeguards" against market abuse just as it is a test ground for new technical standards and innovative network applications.

An open platform network model carrier from the NREN to the National Public Network would actually make some MFJ restrictions less necessary. Phone companies were originally prohibited from being information providers because their bottleneck control over the local exchange hubs gives them an unfair advantage. But on a network in which the local switch is open to information providers -- because the platform itself is so rich and well-designed -- creativity and quality triumph over monopoly power. Instead of restricting information providers, the National Public Network developers should encourage the entry of as many new parties as possible. Just as personal computer companies started in garages and attics, so will tomorrow's information entrepreneurs, if we give them a chance. Their prototypes today, small computer networks, electronic newsletters, and chat lines, are among the most vibrant and imaginative "publishers" in the world.

III. Encourage Pricing for Universal Access

Everyone agrees in the abstract with universal service -- the idea that any individual who wishes should be able to connect to a National Public Network. But that's only a platitude unless accompanied by an inclusive pricing plan.

The importance of extending universal access to information and communication resources has been widely recognized:

In light of the possibilities for new service offerings by the 21st century, as well as the growing importance of telecommunications and information services to US economic and social development, limiting our concept of universal service to the narrow provision of basic voice telephone service no longer serves the public interest. Added to universal basic telephone service should be the broader concept of universal opportunity to access these new technologies and applications. (18)

The problem of disparate access to information resources has been recognized in other telecommunications arenas as well. Congressman Edward Markey (D-Mass.), Chairman of the Subcommittee of Telecommunications and Finance of the House Energy and Commerce Committee warns that:

[i]nformation services are beginning to proliferate. The challenge before us is how to make them available swiftly to the largest number of Americans at costs which don't divide the society into information haves and havenots and in a manner which does not compromise our adherence to the long-cherished principles of diversity, competition and common carriage. (19)

To address this problem in the long-term, there is legislation now pending which would broaden the guarantee of universal phone service to universal access to advanced telecommunications services. Senator Burns has proposed that the universal service guarantee statement in the Communications Act of 1934 should be amended to include access to

a nation-wide, advanced, interactive, interoperable, broadband communications system available to all people, businesses, services, organizations, and households..." (20)

In the near term, the NREN can serve as a laboratory for testing a variety of pricing and access schemes in order to determine how best to bring basic network services to large numbers of users. The NREN platform should facilitate the offering of fee-based services for individuals.

Cable TV is one good model: joining a service requires an investment of \$100 for a TV set, which 99% of households already own, about \$50 for a cable hookup, and perhaps \$15 per month in basic service. Anything beyond that, like premium movie channels or pay-per-events is available at extra cost. Similarly, a carrier providing connection to the mature National Public Network might charge a one-time startup fee and then a low fixed monthly rate for access to basic services, which would include a voice telephone capability.

Because regulators are concerned about any telephone service that might cause the price of basic voice service to rise, they are unwilling to approve new services which don't immediately recover their own costs. They are concerned that any deficit will be passed on to consumers in the form of higher charges for standard services. As a result, telephone companies tend to be very conservative in estimating the demand for new services. Prices for new services turn out to be much higher than what would be required for universal digital service. This is a kind of catch-22, in which lower prices won't be set until demand goes up, but demand will never go up if prices aren't low enough.

Open architecture could help phone companies offer lower rates for digital services. If opportunities and incentives exist for information entrepreneurs, they will create the services which will stimulate demand, increase volume, and create more revenue-generating traffic for the carriers. In a competitive market, with higher volumes, lower prices follow.

IV. Make the Network Simple to Use

The ideal means of accessing the NPN will not be a personal computer as we know it today, but a much simpler, streamlined information appliance - a hybrid of the telephone and the computer.

"Transparency" is the Holy Grail of software designers. When a program is perfectly transparent, people forget about the fact that they are using a computer. The mechanics of the program no longer intrude on their thoughts. The most successful computer programs are nearly always transparent: a spreadsheet, for instance, is as self-evident as a ledger page. Once users grasp a few concepts (like rows, cells, and formula relationships), they can say to themselves, "What's in cell A-6?" without feeling that they are using an alien language.

Personal computer communications, by contrast, are practically opaque. Users must be aware of baud rates, parity, duplex, and file transfer protocols -- all of which a reasonably well-designed network could handle for them. It's as if, every time you wanted to drive to the store, you had to open up the hood and adjust the sparkplugs. On most Internet systems, it's even worse; newcomers find themselves confronting what John Perry Barlow calls a "savage user interface." Messages bounce, conferencing commands are confusing, headers look like gibberish, none of it is documented, and nobody seems to care. The excitement about being part of an extended community quickly vanishes. On a National Public Network, this invites failure. People without the time to invest in learning arcane commands would simply not participate. The network would become needlessly exclusionary.

Part of the NREN goal of "expand[ing] the number of researchers, educators, and students with ... access to high performance computing resources" (21) is to make all network applications easy-to-use. As the experience of the personal computer industry has shown, the only way to bring information resources to large numbers of people is with simple, easy-to-learn tools. The NREN can be a place where various approaches to user-friendly networks are tested and evaluated.

Technically trained people are not troglodytes; they approve of human-oriented design, even as they manage to use the network today without it. For years, leaders within the Internet community have been taking steps to improve ease of use on the network. But the training of the technical community as a whole has given them little practice making their digital artifacts appropriate for non-technical consumption. Nor are they often rewarded for doing so. To a phone company engineer designing a new high-speed telephone switch, or to a computer scientist pushing the limits of a data compression algorithm, the notion of making electronic mail as simple as fax

machine may make sense, but it also feels like someone else's job. Being technically minded themselves, they feel comfortable with the specialized software they use and seldom empathize with the neophyte. The result is a proliferation of arcane, clumsy tools in both hardware and software, defended by the cognoscenti: "I use the "vi" editor all the time -- why would anyone have trouble with it?"

If we have the vision and commitment to try this, the transformation of the network frontier from wilderness to civilization need not display the brutality of 19th century imperialism. As commercial opportunities to offer applications and services develop, entrepreneurs will discover that ease of use sells. The normal, sometimes slow, play of competitive markets should cause industry to commit the resources to serve the market by making access more transparent. But at the start transparency will need deliberate encouragement -- if only to overcome the inertia of old habits.

V. Develop Standards of Information Presentation

The National Public Network will need an integrated suite of high-level standards for the exchange of richly formatted and structured information, whether as text, graphics, sound, or moving images. Use the NREN as a test-bed for a variety of information presentation and exchange standards on the road towards an internationally-accepted set of standards for the National Public Network.

Standards -- the internal language of networks -- are arranged in a series of layers. The lower levels detail how the networks' subterranean "wiring" and "plumbing" is managed. Well-developed sets of lower-level standards such as TCP/IP are in wide use and continue to be refined and extended, but these alone are not sufficient. The uppermost layers contain specifications such as how text appears on the screen and the components of which documents are composed. These are the kinds of concerns which are directly relevant to users who wish to communicate. Recently independent efforts to develop high-level standards for document formats have begun, but these projects are not yet being integrated into computer networks.

Today, for example, the only common standard for computer text is the American Standard Code for Information Interchange (ASCII). But ASCII is inadequate; it ignores fonts, type styles (like boldface and italics), footnotes, headers, and other formats which people regularly use. Each word processing program codes these formats differently, and there is still no intermediary language that can accommodate all of them. The National Public Network will need such a language to transcend the visual poverty and monotony of today's telecommunicated information. It will also need additional standards beyond what have been developed for message addresses and headers, a

common set of directories (the equivalent of the familiar white pages and yellow pages directories), common specifications for coding and decoding images, and standards for other major services.

Congress has provided that the National Institute of Standards and Technology

shall adopt standards and guidelines ... for the interoperability of high-performance computers in networks and for common user interfaces to systems. (22)

As the implementation of the NREN moves forward, we must ensure that standards development remains both a public and private priority. Failure to make a commitment to an environment with robust standards would be "the beginning of a Tower of Babel that we can ill afford." (23) Since current standards are so inadequate to the demands of users:

We ... need to endow the NII [National Information Infrastructure] with a set of widely understood common communication conventions. Moreover, these conventions should be based on concepts that make life easier for us humans, rather than for our computer servants. (24) The development of standards is vital, not just because it helps ensure an open platform for information providers; it also makes the network easier to use.

VI. Promote First Amendment Free Expression by Affirming the Principles of Common Carriage

In a society which relies more and more on electronic communications media as its primary conduit for expression, full support for First Amendment values requires extension of the common carrier principle to all of these new media.

Common carriers are companies which provide conduit services for the general public. They include railroads, trucking companies, and airlines as well as telecommunications firms. A communications common carrier, such as a telephone company is required to provide its services on a non-discriminatory basis. It has no liability for the content of any transmission. A telephone company does not concern itself with the content of a phone call. Neither can it arbitrarily deny service to anyone. (25) The common carrier's duties have evolved over hundreds of years in the common law and later statutory provisions. The rules governing their conduct can be roughly distilled in a few basic principles. (26) Common carriers have a duty to:

o provide services in a non-discriminatory manner at a fair

- price
- o interconnect with other carriers
- o provide adequate services

The carriers of the NREN and the National Public Network, whether telephone companies, cable television companies, or other firms should be treated in a similar fashion. (27)

Unlike many other countries, our communications infrastructure is owned by private corporations instead of by the government. Given Congress' plan to build the NREN with services from privately-owned carriers, a legislatively-imposed duty of common carriage is necessary to protect free expression effectively. As Professor Eli Noam, a former New York State Public Utility Commissioner, explains:

[C]ommon carriage is the practical analog to [the] First Amendment for electronic speech over privately-owned networks, where the First Amendment does not necessarily govern directly. (28)

To foster free expression and move the national communications infrastructure toward a full common carrier regime, all NREN carriers should be subject to common carriage obligations. Given that the NREN is designed to promote the development of science, ensuring free expression is especially important. As one academic said:

I share with many researchers strong belief that much of the power of science (whether practiced by scientists, engineers, or clinical researchers) derives from the steadfast commitment to free and unfettered communication of information and knowledge. (29)

A telecommunications providers under a common carrier obligation would have to carry any legal message regardless of its content whether it is voice, data, images, or sound. For example, if full common carrier protections were in place for all of the conduit services offered by the phone company, the terminations of "controversial" 900 services such as political fundraising would not be allowed, just as the phone company is now prohibited by the Communications Act from discriminating in the provision of basic telephone services. (30) Neither BOCs nor IXC's would be allowed to terminate service because of anticipated harm to their "corporate image." Though providers of 900 information services did have their freedom of expression abridged by the BOC/IXC action, First Amendment protection was not available to them because there was no state action underlying the termination.

As important as common carriage is to the NPN, it is equally important that it be implemented in such a way as to avoid sinking

the carriers of these new networks into the same regulatory gridlock that characterizes much of telecommunications regulation. (31) This would have a crippling effect of the pace of innovation and is to be avoided. The controlled environment of the NREN should be taken advantage of to experiment with various open access, common carriage rules and enforcement mechanisms to seek regulatory alternatives other than what has evolved in the public telephone system

Along with promoting free expression, common carriage rules are important for ensuring a competitive market in information services on the National Public Network. Our society supports the publication of many thousands of periodicals and fifty thousand of new books a year as well as countless brochures, mailings, and other printed communications. Historically, the expense of producing professional-quality video programming has been a barrier to the creation of similar diversity in video. Now the same advances in computing which created desktop publishing are delivering "desktop video" which will make it affordable for the smallest business, agency, or group to create video consumables. The NPN must incorporate a distribution system of individual choice for the video explosion.

If the cable company wants to offer a package of program channels, it should be free to do so. But so should anyone else. There will continue to be major demand for mass market video entertainment, but the vision of the NPN should not be limited to this form of content. Anyone who wishes to offer services to the public should be guaranteed access over the same fiber optic cable under the principle of common carriage. From this access will come the entrepreneurial innovation, and this innovation will create the new forms of media that exploit the interactive, multimedia capabilities of the NPN.

VII. Protect Personal Privacy

The infrastructure of the NPN should include mechanisms that support the privacy of information and communication. Building the NREN is an opportunity to test various data encryption schemes and study their effectiveness for a variety of communications needs.

Technologies have been developed over the past 20 years which allow people to safeguard their own privacy. One tool is public-key encryption, in which an "encoding" key is published freely, while the "decoder" is kept secret. People who wish to receive encrypted information give out their public key, which senders use to encrypt messages. Only the possessor of the private key has the ability to decipher the meaning.

The privacy of telephone conversations and electronic mail is already

protected by the Electronic Communications Privacy Act. (32) Without a valid court order, for example, wiretaps of phone conversations are illegal and private messages are inadmissible in court. Legal guarantees are not enough, however. Although it is technically illegal to listen in on cellular telephone conversations, as a practical matter the law is unenforceable. Imported scanners capable of receiving all 850 cellular channels are widely available through the gray market.

Cellular telephone transmissions are carried on radio waves which travel through the open air. The ECPA provision which makes it illegal to eavesdrop on a cellular call is the wrong means to the right end. It sets a dangerous precedent in which, for the first time, citizens are denied the right to listen to open air transmissions. In this case, technology provides a better solution. Privacy protection would be greatly enhanced if public-key encryption technology were built into the entire range of digital devices, from telephones to computers. (33) The best way to secure the privacy and confidentiality Americans say they want is through a combination of legal and technical methods.

As a system over which not only information but also money will be transferred, the National Public Network will have enormous potential for privacy abuse. Some of the dangers could be forestalled now by building in provisions for security from the beginning.

Conclusion

The chance to influence the shape of a new medium usually arrives when it is too late: when the medium is frozen in place. Today, because of the gradual evolution of the National Public Network, and the unusual awareness people have of its possibilities, there is a rare opportunity to shape this new medium in the public interest, without sacrificing diversity or financial return. As with personal computers, the public interest is also the route to maximum profitability for nearly all participants in the long run.

The major obstacle is obscurity: technical telecommunications issues are so complex that people don't realize their importance to human and political relationships. But be this as it may, these issues are of paramount importance to the future of this society. Decisions and plans for the NPN are too crucial to be left to special interests. If we act now to be inclusive rather than exclusive in the design of the NPN we can create an open and free electronic community in America. To fail to do so, and to lose this opportunity, would be tragic.

End Notes

1. High Performance Computing and Communications Act of 1991, H.R 656, S.272 section 2(6).
2. High-Performance Computing And Communications Act of 1991: Hearing before the Subcommittee on Science, Technology, and Space of the Senate Comm. on Commerce, Science, and Transportation, 102nd Cong., 1st Sess. 1 (1991)(Opening Statement by Senator Gore)(hereinafter 1991 Senate NREN Hearing).
3. 1991 Senate NREN Hearing 101, 103 (Statement of the Association of Research Libraries).
4. 1991 Senate NREN Hearing 99 (Statement of Dr. Kenneth M. King, President, EDUCOM).
5. S.272 (Commerce-Energy compromise) section 102(e)
6. Michael M. Roberts, Positioning the National Research and Education Network. EDUCOM Magazine 13 (Summer 1991).
7. 1991 Senate NREN Hearing 1 (Opening statement of Sen. Gore).
8. Details of the visions vary in their content and expression. Senator Gore's bill mandates that federal agencies will serve as information providers, side by side with commercial services, making (for instance) government-created information available to the public over the network. Individuals will gain "access to supercomputers, computer data bases, other research facilities, and libraries." (Gore imagines junior high school students dialing in to the Library of Congress to look up facts for a term paper.) Apple CEO John Sculley has predicted that "knowledge navigators" will use personal computers to travel through realms of virtual information via public digital networks.

Such visions are powerful, but they sometimes seem too much like sales tools; too vague and overconfident to set direction for research. People often infer from the Apple's "knowledge navigator" videotape, for instance, that human-equivalent computer speech recognition is just around the corner; but in truth, it still requires fundamental research breakthroughs. Network users will still need keyboards or pointing devices for many years. Nor will the network be able (as some have suggested) to translate automatically between languages. (It will allow translators to work more effectively, posting their work online.)
9. M. Dertouzos, Building the Information Marketplace, Technology

Review 29, 30 (January 1991).

10. See FCC Hearing on "Networks of the Future" (Testimony of M. Kapor)(May 1, 1991).

11. J. Berman, Democratizing the Electronic Frontier, Keynote Address, Third Annual Hawaii Information Network and Technology Symposium, June 5, 1991.

12. S.272, section 5(d). This section continues: "(1) to the maximum extent possible, operating facilities need for the Network should be procured on a competitive basis from private industry; (2) Federal agencies shall promote research and development leading to deployment of commercial data communications and telecommunications standards; and (3) the Network shall be phased into commercial operation as commercial networks can meet the needs of American researchers and educators."

13. The distinction between strong support for interoperability and something less is illustrated in the NREN compromise debate occurring as this paper is being written. The bill from the Senate Commerce Committee (S.272) calls for "interoperability among computer networks," section 701(a)(6)(A), while the compromise currently being discussed with the Energy Committee adopts a more watered down goal of "software availability, productivity, capability, portability." section 701(a)(3)(B).

14. 552 F.Supp 151 (D.D.C. 1982)(Greene, J.). The MFJ restrictions barred the BOCs from providing long distance services, from manufacturing telephone equipment, and from providing information services.

15. The Senate, under the leadership of Sen. Hollings, has just recently voted to lift the manufacturing restrictions against the BOCs contained in the MFJ.

16. In The Matter of Advanced Intelligent Network, Petition for Investigation, filed by Coalition of Open Network Architecture Parties (November 16, 1990).

17. Amendment of Sections 64.702 of the Commission's Rules and Regulations, 104 FCC 2d 958 (COMPUTER III), vacated sub nom, California v. FCC (9th Cir. 1990).

18. NTIA Telecomm 2000 at 79.

19. Committee on Energy and Commerce, Subcommittee on Telecommunications and Finance, Hearings on Modified Final Judgment,

101st Cong., 1st Sess., 1-2 (May 4, 1989).

20. Communications Competitiveness and Infrastructure Modernization Act of 1991, S. 1200, Title I, Amending Communications Act section 1, 47 USC 151.

21. S.272, section 2(b)(1)(B).

22. S.272 Commerce-Energy Compromise section 203(a).

23. 1991 Senate NREN Hearing at 32 (Statement of Hon. D. Allan Bromley, Director, Office of Science and Technology Policy).

24. M. Dertouzos at 31.

25. See 47 USC section 201.

26. See ACLU Information Technology Project, Report to the American Civil Liberties Board from the Communications Media Committee to Accompany Proposed Policy Relating To Civil Liberties Goals and Requirements of the United States Communications Media Infrastructure. (Draft, July 15, 1991) [hereinafter, ACLU Report]. "Non-discriminatory access to new communications systems must be guaranteed not simply because it is the economically efficient thing to do, but more importantly because it is the only way to ensure that freedom of expression is preserved in the Information Age."

27. Though common carriage principles have historically been applied to telephone and telegraph systems, the preservation of First Amendment values of free expression and free press was not the motivating factor. Professor de Sola Pool notes that telephone and telegraph systems inherited their common carrier obligations not so much out of First Amendment concerns, but in order to promote commerce. The more appropriate model to look to in extending First Amendment values to new communications technologies is the mails. As reflected in the post clause, empowering Congress to "establish post offices and post roads," the Constitutional drafters felt that creation of a robust postal system was vital in order to ensure free expression and healthy political debate. As Sen. John Calhoun said in 1817:

Let us conquer space. It is thus that . . . a citizen of the West will read the news of Boston still moist from the press. The mail and the press are the nerves of the body politic.

Non-discriminatory access to the mails has been secured by the Supreme Court as a vital extension of First Amendment expression. In a dissent which is now reflective of current law, Justice Holmes

argued that

[t]he United States may give up the Post Office when it sees fit, but while it carries it on the use of the mails is almost as much a part of free speech as the right to use our tongues. (Milwaukee Social Democratic Publishing Co. v. Burleson, 255 US 407 (1921) (Holmes, J., dissenting))(emphasis added). This principle was finally affirmed in Hannegan v. Esquire, 327 US 146 (1945) (cited in de Sola Pool).

See de Sola Pool, Technologies of Freedom 77-107.

28. E. Noam, FCC Hearing "Networks of the Future" (May 1, 1991).

29. 1991 Senate NREN Hearing at 52 (Statement of Donald Langenberg, Chancellor of the University of Maryland System).

30. 47 USC section 201. Following much controversy about obscene or indecent dial-a-message services, a number of BOCs and interexchange carriers (IXCs, ie. MCI, Sprint, etc.) have adopted policies which limit the kinds of information services for which they will provide billing and collection services. Recently, some carriers have gone so far as to refuse to carry the services at all, even if the service handles its own billing. See ACLU Report.

31. See J. Berman & W. Miller, Communications Policy Overview 14-24, Communications Policy Forum (April 1991).

32. Electronic Communications Privacy Act of 1986, 18 USC 2510 et seq. See also J. Berman & J. Goldman, A Federal Right of Information Privacy: The Need for Reform, Benton Foundation Project on Communications & Information Policy Options (1989).

33. See Statement In Support Of Communications Privacy, following 1991 Cryptography and Privacy Conference, sponsored by Electronic Frontier Foundation, Computer Professionals for Social Responsibility, and RSA Software. (June 10, 1990).

Security Considerations

Security issues are not discussed in this memo.

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