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Introduction

The year 2022 marks the 25th Anniversary of the May 1, 1997 publication of the print edition of *Netizens: On the History and Impact of Usenet and the Internet* by Michael Hauben and Ronda Hauben. This issue is again part of the celebration of that Anniversary. The articles here are the Preface and Chapters 1, 3, 5 and 7 by Michael Hauben in that book.

The first article, the Preface asks, "What is a Netizen?" Michael answers by telling some of how he came online on local hobbyist-run computer bulletin board systems starting in 1985 and then on global Usenet. He found Usenet discussions to be mentally invigorating and welcoming of thoughtful comments, questions and discussion. He became aware that there was a new social institution, an electronic commons, developing. He discovered from those who wrote to him that the people he was writing about were citizens of the Net, or Netizens.

The second article, "The Net and Netizens" begins with his often quoted opening in 1994, "Welcome to the 21st Century. You are a Netizen (a Net Citizen), and you exist as a citizen of the world thanks to the global connectivity that the Net makes possible." He includes his prediction, "We are seeing a revitalization of society. The frameworks are being redesigned from the bottom up. A new, more democratic world is becoming possible." Much of the article are quotes from the people who wrote to Michael which were Michael's data from which he learned that many Usenet users were acting as citizens of the Net.

The next article was the result of Michael's searching for "The Social Forces Behind the Development of Usenet." The article is a tour through ARPANET, Usenet and UNIX. It sees the Internet as providing a route for the increased distribution of Usenet. Michael focuses on Usenet as a social network whose very nature promotes change. His analysis leads to the conclusion that Usenet is a democratic and technological breakthrough and that the very nature of Usenet means people are going to be working for its expansion.

In the fourth article. "The Vision of Interactive Computing And the Future" Michael explains the role of the time-sharing mode of computer use as a source of the vision. Sharing time on the same computer gave rise to communities of researchers. Expanding that reality give rise to a view of one grand public utility or connecting the communities by connecting their computers. Michael centers the vision for what today we call the Internet on J. C. R. Licklider and his advocacy and financial support as the director of the Information Processing Technologies Office for interactive computing. Licklider's vision was of an "intergalactic network." This article documents what that meant to Licklider and those who developed the ARPANET.

The last article in this issue is "Behind the Net: The Untold Story of the ARPANET and Computer Science." It is the story told in the *ARPANET Completion Report* that the ARPANET was fundamentally connected to and born of computer science rather than of the military. From the founding of ARPA in response to the Soviet Union's launch of the Sputnik in 1957, through Licklider changing the emphasis from command and control to the more fundamental level of interactive computing. The article describes the work of the graduate students in the Network Working Group (NWG) to develop the needed protocols and

functionality to connect dissimilar computers and for the use for practical tasks. In this process these students created a form for the open exchange of ideas documented in reports called Requests For Comments (RFCs). Michael concludes that the work of the NWG blazed the trail which the developers of the TCP/IP protocol suit successfully followed. Fundamentally, Licklider and the ARPANET researcher achieved their many successes because they viewed the computer as a communication device.

[Editor's Note: At the end of November 1995, Michael Hauben visited Japan for two weeks. He was invited to speak at the COARA Hypernetwork '95, Beppu Bay Conference in Beppu, Kyushu, Japan. The theme of the conference was "The Netizen Revolution and the Regional Information Infrastructure." He presented his speech "The Netizens and Community Networks" on November 24, 1995 as part of the Netizens section. That speech was the first version of the article below and can be seen online at: https://www.december.com/cmc/mag/1997/feb/hauben.html. The version below appears as the Preface of *Netizens: On the History and Impact of Usenet and the Internet* by Michael Hauben and Ronda Hauben published in 1997 by the IEEE Computer Society Press, pp. ix-xi.]

What is a Netizen?

The story of Netizens is an important one. In conducting research five years ago online to determine people's uses of the global computer communications network, I became aware that there was a new social institution, an electronic commons, developing. It was exciting to explore this new social institution. Others online shared this excitement. I discovered from those who wrote me that the people I was writing about were citizens of the Net, or Netizens.

I started using local bulletin board systems in Michigan in 1985. After seven years of participation on both local hobbyist-run computer bulletin board systems and the global Usenet, I began to research Usenet and the Internet. I found these online discussions to be mentally invigorating and welcoming of thoughtful comments, questions and discussion. People were friendly and considerate of others and their questions. This was a new environment for me. Little thoughtful conversation was encouraged in my high school. Since my daily life did not provide places and people to talk with about real issues and real world topics, I wondered why the online experience encouraged such discussions and consideration of others. Where did such a culture spring from, and how did it arise? During my sophomore year of college in 1992, I was curious to explore and better understand this new online world.

As part of course work at Columbia University, I explored these questions. One professor encouraged me to use Usenet and the Internet as places to conduct research. My research was real participation in the online community, exploring how and why these communications forums functioned. I posed questions on Usenet, mailing lists, and freenets. Along with my questions, I would attach some worthwhile preliminary research. People respected my questions and found the preliminary research helpful. The entire process was one of mutual respect and sharing of research and ideas, fostering a sense of community and participation. I found that on the Net people willingly help each other and work together to define and address issues important to them. These are often important issues that the conventional media would never cover.

My initial research concerned the origins and development of the global discussion forum Usenet. For my second paper, I wanted to explore the larger Net, what it was, and its significance. This is when my research uncovered the remaining details that helped me recognize the emergence of Netizens. There are people online who actively contribute to the development of the Net. These people understand the value of collective work and the communal aspects of public communications. These are the people who discuss and debate topics in a constructive manner, who e-mail answers to people and provide help to newcomers, who maintain FAQ files and other public information repositories, who maintain mailing lists, and so on. These are the people who discuss the nature and role of this new communications medium. These are the people who as citizens of the Net I realized were Netizens. However, these are not all people. Netizens are not just anyone who comes online. Netizens are especially not people who come online for individual gain or profit. They are not people who come to the Net thinking it is a service. Rather, they are the people who understand it takes effort and action on each and everyone's part to make the Net a regenerative and vibrant community and resource. Netizens are people who decide to devote time and effort into making the Net, this new part of our world, a better place. Lurkers are not Netizens, and vanity home pages are not the work of Netizens. While lurking or trivial home pages do not harm the Net, they do not contribute either.

The term Netizen has spread widely since it was first coined. The genesis comes from net culture based on the original newsgroup naming conventions. Network wide Usenet newsgroups included net.general for general discussion, net.auto for discussion of autos, net.bugs for discussion of Unix bug reports, and so on. People who used Usenet would prefix terms related to the online world with the word net, similar to the newsgroup terminology. So there would be references to net.gods, net.cops or net.citizens. My research demonstrated that there were people active as members of the network, which the words net citizen do not precisely represent. The word citizen suggests a geographic or national definition of social membership. The word Netizen reflects the new non-geographically based social membership. So I contracted net.citizen to Netizen.

Two general uses of the term Netizen have developed. The first is a broad use to refer to anyone who uses the Net, for whatever purpose. Thus, the term netizen has been prefixed in some uses with the adjectives good or bad. The second use is closer to my understanding. This definition is used to describe people who care about Usenet and the bigger Net and work toward building the cooperative and collective nature which benefits the larger world. These are people who work toward developing the Net. In this second case, Netizen represents positive activity, and no adjective need be used. Both uses have spread from the online community, appearing in newspapers, magazines, television, books and other off-line media. As more and more people join the online community and contribute toward the nurturing of the Net and toward the development of a great shared social wealth, the ideas and values of Netizenship spread. But with the increasing commercialization and privatization of the Net, Netizenship is being challenged. During such a period, it is valuable to look back at the pioneering vision and action that made the Net possible and examine the lessons they provide. That is what we have tried to do in these chapters.

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November 1995
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[Editor's Note: The earliest version of the following article first appeared on Usenet in three posts on July 6, 1993. A version also appeared as Chapter 7 of *The Netizens and the Wonderful World of the Net: An Anthology* on January 12, 1994. A version is often cited as Chapter 1 of *Netizens: On the History and Impact of Usenet and the Internet* by Michael Hauben and Ronda Hauben published in 1997 by the IEEE Computer Society Press, pp. 3-34.]

The Net and Netizens
The Impact the Net Has on People's Lives

by Michael Hauben

Welcome to the 21st Century. You are a Netizen (a Net Citizen), and you exist as a citizen of the world thanks to the global connectivity that the Net makes possible. You consider everyone as your compatriot. You physically live in one country but you are in contact with much of the world via the global computer network. Virtually, you live next door to every other single Netizen in the world. Geographical separation is replaced by existence in the same virtual space.

The situation I describe is only a prediction of the future, but a large part of the necessary infrastructure currently exists. The Net – or the Internet, BITNET, FIDOnet, other physical networks, Usenet, VMSnet, and other logical networks – has rapidly grown to cover all of the developed countries in the world.[1] Every day, more computers are attached to the existing networks, and every new computer adds to the user base – at least twenty-seven million people are interconnected today.

We are seeing a revitalization of society. The frameworks are being redesigned from the bottom up. A new, more democratic world is becoming possible. As one user observed, the Net has "immeasurably increased the quality of … life." The Net seems to open a new lease on life for people. Social connections that were never before possible, or relatively hard to achieve, are now facilitated by the Net. Geography and time are no longer boundaries. Social limitations and conventions no longer prevent potential friendships or partnerships. In this manner Netizens are meeting other Netizens from far away and close by that they might never have met without the Net.

A new world of connections between people – either privately, from individual to individual, or publicly, from individuals to the collective mass of many on the Net – is possible. The old model of distribution of information from the central Network Broadcasting

Company is being questioned and challenged. The top-down model of information being distributed by a few for mass consumption is no longer the only news. Netnews brings the power of the reporter to the Netizen. People now have the ability to broadcast their observations or questions around the world and have other people respond. The computer networks form a new grassroots connection that allows excluded sections of society to have a voice. This new medium is unprecedented. Previous grassroots media have existed for much smaller groups of people. The model of the Net proves the old way does not have to be the only way of networking. The Net extends the idea of networking, of making connections with strangers that prove to be advantageous to one or both parties.

The complete connection of the body of citizens of the world that the Net makes possible does not yet exist, and it will be a struggle to make access to the Net open and available to all. However, in the future we might see the expansion of what it means to be a social animal. Practically every single individual on the Net today is available to every other person on the Net. International connection exists on the same level with local connection. Also, the computer networks allow a more advanced connection between the people who are communicating. With computer communication systems, information and thoughts are connected to people's names and electronic-mail addresses. On the Net, one can connect to others who have similar interests or whose thought processes he or she enjoys.

Netizens make it a point to be helpful and friendly – if they feel it will be worthwhile. Many Netizens feel they have an obligation to be helpful, answer queries, and follow up on discussions; to put their opinions into the pot of opinions. Over a period of time the voluntary contributions to the Net have built it into a useful connection to other people around the world. When I posted the question, "Is the Net a Source of Social/Economic Wealth?" many people responded. Several corrected my calling the Net a source of accurate information. They pointed out that it was also a source of opinions. However, readers can train themselves to figure out the accurate information from the breadth of opinions. Presented here is an example of the broad range of views and opinions that I was able to gather from my research on the Net. The Net can be a helpful medium to help one understand the world. Only by seeing many points of view can one figure out his or her position on a topic.

Net society differs from off-line society by welcoming intellectual activity. People are encouraged to be thoughtful and to present their ideas to the Net. People are allowed to be intellectually interesting and interested. This intellectual activity forms a major part of the online information that is carried by the various computer networks. Netizens can interact with other people to help add to or alter that information. Brainstorming among different types of people produces robust thinking. Information is no longer a fixed commodity or resource on the Net. It is constantly being added to and improved collectively. The Net is a grand intellectual and social commune in the spirit of the collective nature present at the origins of human society. Netizens working together continually expand the store of information worldwide. One person called the Net an untapped resource because it provides an alternative to the normal channels and ways of doing things. The Net allows for the meeting of minds to form and develop ideas. It brings people's thinking processes out of isolation and into the open. Every user of the Net gains the role of being special and useful. The fact that every user has his or her own opinions and interests adds to the general body of specialized knowledge on the Net. Each Netizen thus becomes a special resource valuable to the Net. Each user contributes to the whole intellectual and social value and possibilities of the Net.

LICKLIDER'S VISION

The world of the Netizen was envisioned more than twenty-five years ago by J.C.R. Licklider. Licklider brought to his leadership of the Department of Defense's ARPA Information Processing Techniques Office (IPTO) a vision of "the intergalactic computer network." He shared this vision with others when he spoke as a representative from ARPA. Licklider was a prophet of the Net. In the 1968 paper, "The Computer as a Communication Device" written with Robert Taylor, they established several principles from their observations on how the computer would play a helpful role in human communication.[2] They clarified their definition of communication as a creative process, differentiating between communication and the sending and receiving of information. For example, when two tape recorders send to or receive information from each other, that is not communication. They wrote:

> We believe that communicators have to do something nontrivial with the information they send and receive. And … to interact

> with the richness of living information – not merely in the passive way that we have become accustomed to using books and libraries, but as active participants in an ongoing process, bringing something to it through our interaction with it, and not simply receiving from it by our connection to it … . We want to emphasize something beyond its one-way transfer: the increasing significance of the jointly constructive, the mutually reinforcing aspect of communication – the part that transcends know we both know a fact that only one of us knew before. When minds interact, new ideas emerge. We want to talk about the creative aspect of communication.[3]

Licklider and Taylor defined four principles for computers to make a contribution toward human communication:

> 1. Communication is defined as an interactive creative process.
> 2. Response times need to be short to make the "conversation" free and easy.
> 3. Larger networks form out of smaller regional networks.
> 4. Communities form out of affinity and common interests.

Licklider and Taylor's understandings from their 1968 paper have stood the test of time and do represent the Net today. In a later paper Licklider cowrote with Albert Vezza, "Applications of Information Networks,"[4] they explore the possible business applications of information networks. Licklider and Vezza's survey of business applications in 1978 falls short of the possibilities Licklider and Taylor outlined in their 1968 paper and represent but a tiny fraction of the resources the Net currently embodies.

In the 1968 paper, Licklider and Taylor focused on the Net being comprised of a network of networks. While other researchers at the time focused on the sharing of computing resources, Licklider and Taylor kept an open mind:

> The collection of people, hardware, and software – the multi-access computer together with its local community of users – will become a node in a geographically distributed computer network. Let us assume for a moment that such a network has been formed … . Through the network of message processors, therefore, all the large computers can communicate with one another. And through them, all the members of the supercommunity can communicate – with other people, with programs, with data, or with a selected combinations of those resources.[5]

Their concept of the sharing of both computing and human resources matches the modern Net. The network of various human connections quickly forms, changes its goals, disbands, and reforms into new collaborations. The fluidity of such group dynamics leads to a quickening of the creation of new ideas. Groups can form to discuss an idea, focus in or broaden out, and re-form to fit the new ideas that have been worked out.

Netnews, IRC (Internet Relay Chat), mailing lists, and mud/mush/moo/m** (various of the discussion tools available on the Net) are extremely dynamic. Most can be formed immediately for either short- or long-term use. As interests form or events occur, discussion groups can be created. (for example, the mailing list 9NOV89 – L was formed after the fall of the Berlin Wall in November 1989 and continued in order to discuss German unification.)

The virtual space created on noncommercial computer networks is accessible universally. The content on commercial networks, such as Compuserve or America Online, is only accessible to those who pay to belong to that particular network. The space on noncommercial networks is accessible from the connections that exist, whereas social networks in the physical world generally are connected by limited gateways. So the capability of networking on computer nets overcomes limitations inherent in non-computer social networks. This is important because it reduces the problems of population growth. Population growth need not mean limited resources any more – rather that very growth of population now means an improvement of resources. Thus, growth of population can be seen as a positive asset. This is a new way of looking at people in our society. Every new person can mean a new set of perspectives and specialties to add to the wealth of knowledge of the world. This new view of people could help improve the view of the future. The old model looks down on population growth and people as a strain on the environment rather than seeing the intellectual contribution these individuals can make. However, access to the Net will need to be universal for the Net to fully utilize the contribution each person can make. As long as access is limited, the Net and

those on the Net lose the full advantages it can offer. But also, the people on the Net need to be active in order to bring about the best possible use of the Net.

Licklider foresaw that the Net would allow for people of common interests, who are otherwise strangers, to communicate. Much of the magic of the Net is the ability to make a contribution of your ideas and then be connected to utter strangers. He saw that people would connect to others via this Net in ways that had been much harder in the past. Licklider observed as the ARPANET grew to span two continents that this physical connection allowed for wider social collaborations to form. This was the beginning of computer data networks facilitating connections of people around the world.

My research on and about the Net was very exciting for me. When posting inquiries, I usually received the first reply within a couple of hours. The feeling of receiving that very first reply from a total stranger is always exhilarating! That set of first replies from people reminds me of the magic of electronic mail (e-mail). It is nice that there can be reminders of how exciting this new form of communication really is – so that the value of this new use of computers is never forgotten.

CRITICAL MASS

The Net has grown so much since its birth in the 1960s that a critical mass of people and interests has been reached. This collection of individuals adds to the interests and specialties of the whole community. Most people can now gain something from the Net, while at the same time helping it out. There are enough people online now that most anyone new coming online will find something of interest. People are meshing intellects and knowledge to form new ideas. Larry Press made this clear by writing:

> I now work on the Net at least 2 hours per day. I've had an account since around 1975 but it has only become super important in the last couple of years because a critical mass of membership was reached. I no longer work in LA, but in cyberspace.

Although the original users of the Net were from technical and scientific communities, many of them found it valuable to explore the Net for more than just technical reasons. Today, many different kinds of people are connected to the Net. The original users of the Net (then several test-beds of network research) were from only a few parts of the world. Now people of all ages, from most parts of the globe, and of many professions, make up the Net. The original prototype networks (the ARPANET in the United States, the network of the National Physical Laboratory in the United Kingdom, CYCLADES in France, and other networks around the world) developed the necessary physical infrastructure for a fertile social network to develop. Einar Stefferud wrote of this social connection:

> The ARPANET has produced several monumental results. First, it provided the physical and electrical communications backbone for development of the latent social infrastructure we now call "THE INTERNET COMMUNITY."[6]

Many different kinds of people comprise the Net. The university community sponsors access for a broad range of people (students, professors, staff, retired professors, etc.). Many businesses are also connected. A "K-12 Net" that invites younger people to be a part of the online community exists. Special bulletin-board software exists to connect personal computer users to the Net. Various Unix bulletin-board systems exist to connect other users. It is virtually impossible to tell what kinds of people connect to public bulletin board systems (BBSs), as only a computer (or terminal) and modem are the prerequisites to connect. Many, if not all, FIDOnet BBSs (a very common BBS type) have at least e-mail, and many also participate in the larger Net through a gateway to Netnews. Prototype community network systems are forming around the world (for example, Cleveland Free-Net, Wellington Citynet, Santa Monica Public Electronic Network (PEN), Amsterdam Digital City, Hawaii FYI, National Capital Free-Net and others in Canada). Access via these community systems can be as easy as visiting the community library, and membership is open to all who live in the community.

In addition to the living body of resources this diversity of Netizens represents, there is also a continually growing body of digitized data that forms another resource. Whether it is Netizens digitizing great literature of the past (for example, the Gutenberg Project or Project Bartleby), people gathering otherwise obscure or non-mainstream material (for example, on various religions, unusual hobbies, gay lifestyle), or Netizens contributing new and original material, the Net follows in the great tradition of other public institutions, such as the public library or the principles behind public education. The Net shares with these institutions that it

serves the general populace. The data available is just part of the treasure. Often, living Netizens provide pointers to this digitized store of publicly available information. Many of the network access tools have been created on the principle of being available to everyone. The best example is the method of connecting to file repositories via FTP (File Transfer Protocol) by logging in as an "anonymous" user. Most, if not all, World Wide Web sites, Wide Area Information Systems (WAIS), and gopher sites are open to all users of the Net. It is true that the Net community is smaller than it will be eventually, but the Net has reached a point of general usefulness no matter who you are.

This evidence is exactly why it is a problem for the Net to come under the control of commercial entities. Once commercial interests gain control, the Net will be much less powerful for the ordinary person than it is currently. The interests of commercial entities are different from those of the common person. Those pursuing commercial objectives are only interested in making a profit. A user of Compuserve or a similar commercial network pays for access by the hour. If this were extended to the present-day Net, the Netiquette of being helpful would have a price tag attached to it. If people had to pay by the minute during the Net's development, very few would have been able to afford the network time needed to be helpful to others.

The Net has only developed because of the hard work and voluntary dedication of many people. It has grown because the Net is in the control and power of the people at the grassroots level, and because these people developed it. People's posts and contributions to the Net have been the developing forces.

GRASSROOTS

The Net brings people together. People connecting with other people can be powerful. There is power in numbers. The Net allows individuals to realize their power. The Net, uncontrolled by commercial entities, becomes the gathering, discussion, and planning center for many people. The combined efforts of people interested in communication has led to the development and expansion of the global communications system. What's on the Net? Usenet, Free-Net, e-mail, library catalogs, FTP sites, free software, electronic newsletters and journals, Multi-User Domain/Dungeon (mud)/mush/moo, Internet Relay Chat (IRC), the multimedia World Wide Web (WWW) and many kinds of data banks. Different servers, such as WWW, WAIS, and gophers attempt to order and to make it easier to utilize the vast variety of information. There are both public and private services and sources of information. The public and free services often have come about through the voluntary efforts of one or a few people. These technologies allow a person to help make the world a better place by making his or her unique contribution available to the rest of the world. People who have been overlooked or have felt unable to contribute to the world, now can. The networks allow much more open and public interaction over a much larger body of people than possible before. The common people have a unique voice that is now being aired in a new way.

This new communications system introduces every single person as someone special and in possession of a useful resource. Several people described how important is the ability to connect to others at a grassroots level:

> Simple – by access to a vast amount of information and an enormous number of brains — Brian May

> For a geographically sparse group as it is, MU* allows people to get to know one another, the relevant newsgroup gives a sense that there's a community out there and things are happening, and an associated FTP site allows art and writing to be distributed. — Simon Raboczi

> In summary, nets have helped enormously in the dissemination of information from people knowledgeable in certain areas which would be difficult to obtain otherwise. — Brent Edwards

> I get to communicate rapidly and cheaply with zillions of people around the world. — Rosemary Warren

The following examples show how this is possible. People are normally unprotected from the profit desires of large companies. Steven Alexander from California uses the Net to try to prevent overcharging at gas stations, a good example of the power of connecting people to uphold what is fair and in the best interest of the common person in society.

From: Steven Alexander

I have started compiling and distributing

> (on the newsgroup ca.driving) a list of gas prices at particular stations in California to which many people will contribute and keep up to date, and which, I hope, will allow consumers to counteract what many of us suspect is the collusive (or in any case, price gouging) behavior of the oil companies.

A user from Germany also reported using the Net to muckrake:

> A company said they were a [nonprofit organization] … . Someone looked them up in the [nonprofit] … Register … [and] they did not exist there … . Another one said, that he had contact with the person who sent the letter … only [under] another company-name, and that he simply ignored this person since he looked like a swindler. So they are swindlers, and people from the Net proved it to us, we then of course did not engage with them at all.

The Net has proven its importance in other contemporary critical situations. As the only available line of communication with the rest of the world, the Net helped defeat the attempted coup in the former Soviet Union in 1990. The members of the coup either did not know about or understand the role the Russian RELCOM network could play. The connections proved resilient enough for information about the coup to be communicated inside and out of the country in time to inform the world and encourage resistance.[7]

The Net has also proven its value by providing an important medium for students. Students participating in the Chinese pro-democracy movement have kept in touch with others around the world via their fragile connection to the Net. The Net provided an easy way of evading government censors to get news around the world about events in China and to receive encouraging feedback. Such feedback is vital when fighting on seems impossible or wrong. Similarly, students in France used the French Minitel system to organize a successful fight against plans by the French government to restrict admission to government-subsidized universities.

The information flow on the Net is controlled by those who use the Net. Users actively provide the information they and others want. There is much more active participation than what is provided for by other forms of mass media. Television, radio, and magazines are all driven by those who own them and who determine who will write. The Net gives people a medium they can control. This control of information is a great power not available before to the common person. For example, Declan McCreesh describes how this makes possible access to the most up-to-date information.

From: Declan Mccreesh

> You get the most up to date info. that people around the world can get their hands on, which is great. For instance, the media report who wins a Grand Prix, what happened and not a great deal more. On the net, however, you can get top speeds, latest car and technology developments, latest rumors, major debates as to whether Formula 1 or Indy cars are better, etc.

The Net helps to make the information available more accurate because of the many-to-many or broadcast and read and write capability. That new capability, which is not normally prevalent in our society, allows an actual participant or observer to report something. This gives the power of the reporter to the individual, allowing the source to report. This new medium allows everyone online to make a contribution. The old media instead controls who reports and what they say. The possibility of eyewitness accounts via the Net can make the information more accurate. This also opens up the possibility of a grassroots network, where information is passed from person to person around the world. Thus, German citizens learned about the Chernobyl explosion from the Net before the government decided to release the information to the public through traditional media. The connection is people to people rather than government to government. Citizen journalists can now distribute to more than those they know personally. The distribution of the writings of ordinary people is the second step after the advent of the inexpensive personal computer in the early 1980s. The personal computer and printer allowed anyone to produce mass quantities of documents. Personal publishing is now joined by wide personal distribution.

Not only is grassroots reporting possible, but the assumption that filtering is necessary has been challenged. People can learn to sort through the various opinions themselves. Steve Welch disagreed that the Net is a source of more accurate information, but agreed that people develop discriminatory reading

skills.

From: Steve Welch

> When you get more information from diverse sources, you don't always … get more accurate information. However, you do develop skills in discerning accurate information … . Or rather, you do if you want to come out of the info-glut jungle alive.

Governments that rule based on control of information will succumb eventually to the tides of democracy. As Dr. Sun Yat-Sen of the Chinese Democracy Movement (c. 1919) once said, "The worldwide democratic trend is mighty. Those who submit to it will prosper and those who resist it will perish." The Net reintroduces the basic idea of democracy as the grassroots people power of Netizens. Governments can no longer easily keep information from people.

Many groups that do not have an established form of communications available to them have found the Net to be a powerful tool. For example, for people far away from their homeland, the Net provides a new link.

From: Godfrey Nolan

> The Net has immeasurably increased the quality of my life. I am Irish, but I have been living in England for the past five years. It is a lot more difficult to get information about Ireland than you would expect. However a man called Liam Ferrie who works in Digital in Galway, compiles a newspaper on the weeks events in Ireland and so I can now easily keep abreast of most developments in Irish current affairs, which helps me feel like I'm not losing touch when I go home about twice a year. It is also transmitted to about 2000 Irish people all over the first and third worlds.

From: Madhur K. Limdi

> I read your above posting and wanted to share my experience with you. I have been a frequent reader of news in usenet groups! Such as soc.culture.indian misc.news .southasia and both of these keep me reasonably informed about the happenings in my home country India.

Also in the United States, the Net has provided stable communications for people of various religious and sexual persuasions. Many other communities have also found the Net to be a excellent medium to help increase communication.

From: Gregory G. Woodbury

> We will be going to a march on Washington and are coordinating our plans and travel with a large number of other folks around the country via e-mail and conversations on Usenet.

From: Jann Vanover

> I'm a member of a Buddhist organization and just found a man in Berkeley who keeps a Mailing List that sends daily guidance and discussions for this group. So I get a little religious boost when I log on each day.

From: Carole E. Mah

> For me and for many of my friends, the Net is our main form of communication. Almost every aspect of interpersonal communication on the network has a gay/lesbian/bi aspect to it that forms a tight and intimate acquaintanceship which sometimes even boils over into arguments and enmities. This network of connections, friends, enemies, lovers, etc. facilitates political goals that would not otherwise be possible (organizing letter-writing campaigns about the Gays in the Military Ban via the ACT-UP list, being able to send e-mail directly to the White House, finding out about activism, bashing, etc. in other states and around the world, etc.).

From: Robert Dean

> As a member of the science fiction community, I've met quite a few people on the net, and then in person.

COMMUNICATION WITH NEW PEOPLE

In many Netizens' lives the Net has alleviated feelings of loneliness, which seem common in today's society. The Net's ability to help people network both socially and intellectually makes it valuable and irreplaceable in their lives. This is forming a group of

people who want to keep the Net accessible and open to all.

The Net brings together people from diverse walks of life and makes it easier for these people to communicate. It brings them together in the same virtual space and removes the impact or influence of first impressions.

From: Malcolm Humes

> I'm in awe of the power and energy linking thousands into a virtual intellectual coffeehouse, where strangers can connect without the formalities of face to face rituals (hello, how are you today …) to allow a direct-connect style of communication that seems to transcend the "how's the weather" kind of conversation to just let us connect without the bullshit.

Strangers are no longer strange on the Net. People are free to communicate without limits, fears, or apprehension. It used to be that there was a rather generous atmosphere that thrived on the Net and that welcomed new users. People were happy to help others, often as a return for the help they had received. Things have changed, and the welcome to newcomers is not as universally friendly, but there are still many online who are helpful to new users, and goodwill still overpowers any unfriendly comments.

From: Jean-françois Messier

> My use of the Net is to get in touch with more people around the world. I don't know for what, when, how, but that's important for me. Not that I'm in a small town, far from everybody, but that I want to be able to establish links with others. In fact, because of those nets I use, I would !NOT! want to go to a small town, just because the phone calls would be too expensive. I have to say that I'm not an expressive person. I'm not a great talker, nor somebody who could make shows … . I'm more an "introvert."

Yet Jean-François wrote me. This is just one example of the social power of the Net. Another Netizen comments on how the Net helped her befriend strangers.

From: Laura Goodin

> Last summer I was traveling to Denver and I used a listserv mailing list to find out whether a particular running group I run with had a branch there. They did, and I had a wonderful time meeting people with a common interest (and drinking beer with them); I was no longer a stranger.

BROADENED AND WORLDLY PERSPECTIVES

Easy connection to people and ideas from around the world has a powerful effect. Awareness that we are members of the human species, which spans the entire globe, changes a person's point of view. It is a broadening perspective. It is easy for people to assume a limited point of view if they are only exposed to certain ideas. The Net brings the isolated individual into contact with other people, experiences, and views from the rest of the world. Exposure to many opinions gives a person the chance to consider multiple views before settling on a specific opinion. Having access to the "marketplace of ideas" allows a person to make a reasoned judgment.

From: Jean-françois Messier

> My attitudes to other peoples, races and religions changed, since I had more chances to talk with other peoples around the world. When first exchanging mail with people from Yellowknife, Yukon, I had a real strange feeling: Getting messages and chatting with people that far from me. I noticed around me that a lot of people have opinions and positions about politics that are for themselves, without knowing others. Because I have a much broader view of the world now, I changed and am more conciliatory and peaceful with other people. Writing to someone you never saw, changes the way you write, also, the instancy of the transmission makes the conversation much more "live" than waiting for the damn slow paper mail. Telecommunications opened the world to me and changed my visions of people and countries … .

From: Anthony Berno

> I could not begin to tell you how different my life would be without the Net. My life would be short about a dozen people, some

of them central, I would be wallowing in ignorance on several significant subjects, and my mind would be lacking many broadening and enlightening influences.

From: Henry Choy

More things to look at. Increased perspective on life. The computer network brings people closer together, and permits them to speak at will to a large audience. I recommend that the telecommunications and computer industry make large scale computer networking accessible to the general public. It's like making places accessible to the handicapped. People brought closer together will release some existing social tensions. People need to be heard, and they need to hear.

From: Paul Ready

You don't have to go to another country to meet people from there. It is not the same as personally knowing them, but I always pay special attention to information from people outside the States. They are likely to have a different perspective on things.

From: Leandra Dean

I love to study people, and the Net has been the best possible resource to this end. The Net is truly a window to the world, and without it we could only hope to physically meet virtually thousands of people every day to gain the same insights. I shudder to think about how different and closed in my life would be without the Net.

MATERIAL CHANGES TO PEOPLE'S LIVES AND LIFESTYLES

The time spent online can affect the rest of a person's life. The connections, interfaces, or collaborations between times on and off line form an interesting area of study. Netizens attest to the power of the Net by explaining the effect the Net has had on their lives. Because of the information available and the new connections possible, people have changed the way they live their lives. There are examples of both changes in the material possessions and changes in lifestyle. The changes in lifestyle are probably the more profound changes, but the new connections made possible are also important. Often the material gains are not financial. Rather, worthwhile goods can be redistributed – from those to whom the goods may have lost personal value to those who would value them.

NETIZEN COMMENTS ON MATERIAL CHANGES

From: William Carroll

Primarily because of the information and support from rec.bikes, three years ago I gave up driving to work and started riding my bike. It's one of the best decisions I've ever made.

Response Received via E-mail

When I started using ForumNet (a chat program similar to IRC, but smaller – [Now called icb]) back in January 1990, I was fairly shy and insecure … . I had a few close friends but was slow at making new ones. Within a few weeks, on ForumNet, I found myself able to be open, articulate, and well-liked in this virtual environment. Soon, this discovery began to affect my behavior in "real" face-to-face interaction. I met some of my computer friends in person and they made me feel so good about myself, like I really could be myself and converse and be liked and wanted.

Of course, computer-mediated social interaction is not properly a crutch to substitute for face-to-face encounters, but the ability to converse via keyboard and modem with real people at the other end of the line has translated into the real-life ability for me to reach out to people without the mediating use of a computer. My life has improved. I wouldn't trade my experience with the Net for anything.

From: Jack Frisch

I must begin my comments on the Internet with one simple yet significant statement: the availability and use of the Internet is changing my life profoundly.

From: Carole E. Mah

I also used to facilitate a vegetarian list, which radically altered many people's

lives, offering them access to mail-order foods, recipes, and friendship via net-contact with people who live in areas where non-meat alternatives are readily available.

From: Jann Vanover

Well, the first thing I thought of is purchases I've made through the Net which have "changed my life." I drove my Subaru Station wagon until last fall when I acquired a VW Camper van that I saw on a local Net ad. I wasn't looking for a van, wasn't even shopping for another vehicle, but the second time this ad scrolled by me, I looked into it and eventually bought it. I will certainly say that driving a 23-year-old VW camper van has changed my life! I thought I would be ridiculed, but have found that people have a lot of respect and admiration for this car!

Through the Net, I heard that Roger Waters was going to perform "The Wall" again, an event I had promised myself not to miss, so I made a trip to Berlin (East and West) in 1990 to see this concert. This was CERTAINLY a life changing event, seeing Berlin less than one week after the roads were open with no checkpoints required. I don't think I would have known about it soon enough if not for the Net.

From: Robert Dean

As for me, my main hobby is and was playing wargames and role-playing games. Net access has allowed me to discuss these games with players across the world, picking up new ideas, and gathering opinions on new games before spending money on them. In addition, I've been able to buy and sell games via Net connections, allowing me to adjust my collection of games to meet my current interests, and get games that I no longer wanted to people who do want them, whether they live down the road from me in Maryland, or in Canada, Austria, Finland, Germany or Israel. I have also taken an Esperanto course via e-mail, and correspond irregularly in Esperanto with interested parties world wide.

From: Caryn K. Roberts

Usenet & Internet … are available to me at work and by dial-up connection to work from home. I have been materially enriched by the use of the Net. I have managed to sell items I no longer needed. I have been able to purchase items from others for good prices. I have saved money and am doing my part to recycle technology instead of adding burdens to the municipal waste disposal service.

Using the Net I have also been enriched by discussions and information found in numerous newsgroups from sci.med to sci.skeptic to many of the comp.* groups. I have offered advice to solve problems and have been able to solve problems I had by using information in these forums.

THE NET AS A SOURCE OF ENORMOUS RESOURCES

Before the Net was widely seen as an enormous social network, some were experimenting with the sharing of computing resources. The following are some examples of ways Netizens utilize the information resources available on the Net:

From: Tim North

I'm faculty here at … University and I use the Net as a major source of technical information for my lectures, up-to-date product information, and informed opinion. As such I find that I am constantly better informed than the people around me. (That sounds vain, but it's not meant to be. It's simply meant to emphasize how strongly I feel that the Net is a superb information resource.)

From: R. J. White

I used the Net to find parts for my 1971 Opel GT. I was living in North America at the time, and going through the normal channels, like GM, are no good. The Net was like an untapped resource.

From: John Harper

(My] uses of the network [1] I once asked a question about an obscure point in history

of maths on the sci.math newsgroup and got a useful answer from Exeter, U.K. Beforehand I had no idea where anyone knowing the answer might be. I had drawn a blank in Oxford. [2] I asked a question about a slightly less obscure point on comp.lang.fortran which generated a long (and helpful) discussion on the Net for a week or two.

From: Paul Ready

Yes, it is a worldwide rapid distribution center of information, on topics both popular and obscure. It may not make the information more valuable, but it certainly increases the information, and the propagation of information. To those connected, it is a valuable resource. Flame wars aside, a lot of generally inaccessible information is readily available.

From: Lee Rothstein

Usenet and mailing lists create a group of people who are motivated and capable of talking about a specific topic. The software allows deeply contextual conversations to occur with a minimum of rehash. As experience develops with the medium, each user realizes that the other that he talks to or will talk to generally help him/her, and can do him/her no harm because of the remoteness imposed by the cable.

From: Lu Ann Johnson

Hi! Usenet came to my rescue – I'm a librarian and was working with a group of students on a marketing project. They were marketing a make-believe product – a compact disc of "music hits of the 70's." They needed a source to tell them how much it cost to produce a CD – without mastering, etc. I exhausted all my print resources so I posted the question in a business newsgroup. Within hours I learned from several companies that it cost about $1.50 to produce a CD. :) The students were very grateful to get the information.

From: Laura Goodin

I teach self-defense, and in rec.martial-art someone posted information about a study on the effectiveness of Mace for self-defense that I had been looking for years.

From: Cliff Roberts

I have been using Internet through a program in New Jersey to bring the fields of Science and Math to grammar school children grades K-8. We have implemented a system where the classrooms are equipped with PC's and are able to dial in to a UNIX system. There they can send e-mail and post questions to a KidsQuest ID. The ID then routes the questions to volunteers with accounts on UNIX. The scientists then answer or give advice of where to find the information they want. Another well accepted feature is to list out the soc.penpals list and e-mail people in different countries that are being studied in the schools.

From: Joe Farrenkopf

I think Usenet is a very interesting thing. For me, it's mostly just a way to pass … time when bored. However, I have gotten some very useful things from it. There is one group in particular called comp.lang.fortran, and on several occasions when I've had a problem writing a program, I was able to post to this group to get some help to find out what I was doing wrong. In these cases, it was an invaluable resource.

COLLABORATIVE WORK

As new connections are made between people, more ideas travel over greater distances. This allows either like-minded people or complementary people to come in touch with each other. The varied resources of the networks allow these same people to keep in touch even if they would not have been able to be in touch before. Electronic mail allows enough detail to be contained in a message that most, if not all, communications can take place entirely electronically. This medium allows for new forms of collaborative work to form and thrive. New forms of research will probably arise from such possibilities. Here are some examples:

From: Wayne Hathaway

One "unusual" use I made of the Net hap-

pened in 1977 … . Along with five other "Net Folks" I wrote the following paper: "The ARPANET TELNET Protocol: Its Purpose, Principles, Implementation, and Impact on Host Operating System Design," with Davidson, Postel, Mimno, Thomas, and Walden: Fifth Data Communications Symposium, Snowbird, UT; September 27-29, 1977. What's so unusual about a collaborative paper, you ask? Simply that the six of us never even made a TELEPHONE call about the paper, much less had a meeting or anything. Literally EVERYTHING – from the first ideas in a "broadcast" mail to the distribution of the final "troff-ready" version – was done with e-mail. These days this might not be such a deal, but it was interesting back then.

From: Paul Gillingwater

… in Vienna was an on-line computer mediated art forum … with video conferencing between two cities, plus an on-line discussion in a virtual MUD type conference later that evening.

Response Received via E-mail

In response to your question about having fun on the net, and being creative, one incident comes to mind. I had met a woman on ForumNet (a system like IRC). She and I talked and talked about all sorts of things. One night, we felt especially artistic. We co-wrote a poem over the computer. I'd type a few words, she'd pick up where I left off (in the middle of sentences or wherever) and on and on. I don't think we had any idea what it was going to be in the end, thematically or structurally. In the end, we had a very good poem, one that I would try to publish if I knew her whereabouts anymore … .

IMPROVING THE QUALITY OF EVERYDAY LIFE

Information flow can take various shapes. The strangest and perhaps most interesting one is how emotion can be attached to information flow, although they often seem like two very different things. I received a large number of responses that reported real-life marriages arising from Net meetings. The Net facilitates the meeting of people of like interests. The newness of the Net means we cannot fully understand its impact. However, it is worth noting that people have also broken up online. So while it is a new social medium, a range of dynamics will exist.

From: Caryn K. Roberts

I have found friends on the Net. A lover. And two of the friends I met, also met online and got married. I attended the wedding (in California).

From: Scott Kitchen

I think I can add something for your paper. I met my fiancee 4 years ago over the net. I was at Ohio State, and she was in Princeton, and we started talking about an article of hers I'd read in rec.games.frp. We got to talking, eventually met, found we liked each other, and the rest is history. We were married 31 December 1994.

From: Gregory G. Woodbury

I met the woman who became my wife when I started talking to the folks at "phs" (the third site of the original Usenet) during the development of Netnews. I would not have been wandering around that area if I hadn't been interested in the development of the net.

From: Laura Goodin

And now, the BEST story: about eight months ago I was browsing soc.culture.australia and I noticed a message from an Australian composer studying in the U.S. about an alternative tune to "Waltzing Matilda." I was curious, so I responded in e-mail, requesting the tune and just sort of shooting the breeze. We began an e-mail correspondence that soon incorporated voice calls as well. One thing led inexorably to another and we fell in love (before we met face to face, actually). We did eventually meet face to face. Last month he proposed over the Internet (in soc.culture.australia) and I accepted. Congratulatory messages came in from all over the

United States, Australia, and New Zealand. Houston (that's his name) and I keep our phone bills from resembling the national debt by sending 10 or 12 e-mails a day (we're well over 1400 for eight months now), and chatting using IRC. A long distance relationship is hellish, but the pain is eased somewhat by the Internet.

From: Chuq von Rospach

Oh, and in the "how the Net made my non-net life better" category, I met my wife via the net. Does that count?

WORK

The fluid connections and the rapidly changing nature of the networks make the Net a welcome medium for those who are job hunting and for those who have jobs to offer. The networks have a large number of people who are looking for jobs. Placing job announcements is easy, and they can be kept available for as long as the job is offered. Résumés can be sent quickly and easily by e-mail. Companies can respond quickly and easily to such submissions, also by e-mail.

Besides finding work, the Net helps people who are currently employed perform their job in the best manner. Many people utilize the Net to assist them with their jobs. Several examples of each follow:

From: Laura Goodin

My division successfully recruited a highly-qualified consultant (a Finn living in Tasmania) to do some work for us; the initial announcement was over Usenet; subsequent negotiations were through e-mail.

From: JJ

I've hired people off the net, and from meeting them in muds, when I find somebody who can THINK. People who can think are hard to find anywhere.

From: Diana Gregory

I have learned to use UNIX, and as a result may be able to keep/advance in my job due to the 'net'.

From: Neil Galarneau

It helps me do my job (MS Windows programming) and it helps me learn new things (like C++).

From: Kieran Clulow

The Internet access provided me by the university has greatly facilitated my ability to both use and program computers and this has had the direct result of improving my grades as well as gaining me a good job in the computer field. Long live the Internet (and make it possible for private citizens to get access!)

From: Mark Gooley

I got my job by answering a posting to a news-group.

From: Anthony Berno

I develop for NEXTSTEP, and the Net is very useful in getting useful programming hints, info on product releases, rumors, et cetera.

From: Gregory G. Woodbury

Due to contacts made via Usenet and e-mail, I got a job as a consultant at BTL in 1981 after I lost my job at Due. Part of the qualifications that got me in the door was experience with Usenet.

IMPROVED COMMUNICATIONS WITH FRIENDS

Another way of improving daily life is by making communications with friends easier. The ease of sending e-mail is bringing back letter writing. However, the immediacy of e-mail means less care need be taken in the process of writing. E-mail, IRC, and Netnews make it much easier to keep in touch with friends outside one's local area.

NETIZEN COMMENTS ON IMPROVED COMMUNICATIONS

From: Bill Walker

I also have an old and dear friend (from high school) who lives in the San Francisco area. After I moved to San Diego, we didn't do very well at keeping in touch. She and I talked on the phone a couple of times a year. After we discovered we were both

on the net, we started corresponding via e-mail, and we now exchange mail several times a week. So, the Net has allowed me to keep in much closer touch with a good friend. It's nothing that couldn't be done by phone, or snail mail, but somehow we never got around to doing those things. E-mail is quick, easy and fun enough that we don't put it off.

From: Anthony Berno

Incidentally, it is also one of my primary modes of communication with my sister (who lives in N.Z.) It's more meditative than a phone call, faster than a letter, and cheaper than either of them.

From: Carole E. Mah

It also facilitates great friendships. Most of my friends, even in my own town, I met on the network. This can often alleviate feelings of loneliness and "I am the only one, I must be a pervert" feelings among queer people just coming out of the closet. They have a whole world of like-minded people to turn to on Usenet, on Bitnet lists, on IRC, in personal e-mail, on BBSs and AOL type conferences, etc.

From: Jann Vanover

Apart from purchases, I have been contacted by: 1) a very good friend from college who I'd lost track of. She got married to a man she met in a singles newsgroup (they've been married 2 years+) 2) someone who went to my high school, knew a lot of the same people I did, but we didn't know each other. We are now "mail buddies" 3) an old girlfriend of my brothers. They went out for eight years, but I learned more about her from ONE e-mail letter than I had ever learned when meeting her in person.

From: Godfrey Nolan

Above all it helps me keep in touch with friends who I would inevitably lose otherwise. The Net helps those that move around for economic reasons to lessen the worst aspects of leaving your friends in the series of places that you once called home. It's the best thing since sliced bread.

PROBLEMS

With all of the positive uses and advantages of the Net, it is not perfect. The blind view of people on the Net seems to shield most, but not everyone. For example, there is a relatively large male-to-female population ratio on the Net. Women online can feel the effects of this difference. Women who have easily identifiable user names or IDs are prone to be the center of much attention. While that might be good, much of that attention can be of a hostile or negative nature. This attention may be detrimental to women who try to be active on the Net. Net harassment can spread against users for other reasons as well. People with unpopular ideas need to be strong to withstand the abuse they may receive from others.

The worst non-people problem seems to be information overflow. Information adds up very quickly, and it can be hard to organize and sort through it all. Technology is now being developed to handle this problem.

From: Scott Hatton

There is a problem with this brave new world in that a lot of people don't appreciate there's another human being at the other keyboard. Flaming is a real problem – especially in comp.misc. This is all a new facet of the technology as well. People rarely trade insults in real life like they do on Internet. There's a tendency to stereotype your opponent into categories. I think this is because you're not around to witness the results. I find this more on Internet newsgroups than on CompuServe. I think this is down to maturity – a lot of folk on the Internet are students who aren't paying for their time on the system. Those on CompuServe are normally slightly older, not so hotheaded and are paying for their time. Damn. Now I'm at stereotyping now. It just goes to show … .

From: Joe Farrenkopf

There is something else I've discovered that is really rather fascinating. People can be incredibly rude when communicating

through this medium. For example, some time ago, I posted a question to lots of different newsgroups, and many people felt my question was inappropriate to their particular group. They wrote to me and told me so, using amazingly nasty words. I guess it's easier to be rude if you don't have to face a person, but can say whatever you want over a computer.

From: Brad Kepley

I get a little irritated with people always claiming someone else is "wasting bandwidth" because they disagree with them. About half the time it turns out that the person being told to shut up was right after all. Then again, when you look at things like alt.binaries.pictures.erotica and other "non-bandwidth-wasting" activities, it seems almost comical to me when someone says this. There is nothing more wasteful than 95% of what Usenet is used for. it's a joke to say that a particular person is 'wasting' it. To say that they are off-topic makes more sense. I guess this is just a gripe rather than what you are looking for. Wasting bandwidth again. :)

CONCLUSION

For the people of the world, the Net provides a powerful means for peaceful assembly. Peaceful assembly allows people to take control of their lives, rather than that control being in the hands of others. This power deserves to be appreciated and protected. Any medium or tool that helps people hold or gain power is something special that has to be protected.

The Net has made a valuable impact on human society. My research has demonstrated that people's lives have been substantially improved via their connection to the Net. This sets the basis for providing access to all in society. Using similar reasoning, J. C. R. Licklider and Robert Taylor believed that access to the then-growing information network should be made ubiquitous. They felt that the Net's value would depend on high connectivity. In their 1968 article, "The Computer as a Communication Device," they argued that the network's impact upon society will depend on how available the network is to society as a whole.[8]

Society will improve if Net access is made available everyone. Only if access is universal will the Net itself advance. Ubiquitous connection is necessary for the Net to encompass all possible resources. One Net visionary, Steve Welch, responded to my research by calling for universal access:

> If we can get to the point where anyone who gets out of high school alive has used computers to communicate on the Net or a reasonable facsimile or successor to it, then we as a society will benefit in ways not currently understandable. When access to information is as ubiquitous as access to the phone system, all Hell will break loose. Bet on it.

Steve is right. "All Hell will break loose" in the most positive of ways imaginable. The philosophers Thomas Paine and Jean Jacques Rousseau, and all other fighters for democracy would have been proud.

Similar to past communications advances such as the printing press, mail, and the telephone, the Global Computer Communications Network has already fundamentally changed our lives. Licklider predicted that the Net would fundamentally change the way people live and work. It is important to try to understand the Net's impact, so as to help extend and reinforce this achievement.

NOTES

1. See *Internet Society News* 2 (Spring 1993) inside back cover for a map showing Net penetration around the world. Larry Landweber maintains and posts updated connectivity maps and tables. See, for example, https://mappa.mundi.net/maps/maps_011/landweber_map2.html
2. J. C. R. Licklider and Robert W. Taylor, "The Computer as a Communication Device," reprinted in *In Memoriam: J. C. R. Licklider 1915-1990* (Palo Alto, Calif: Digital Systems Research Center, 1990); originally published in *Science and Technology,* April 1968. Available online at http://memex.org/licklider.html
3. *Ibid*., 21.
4. *Proceedings of IEEE* 66 (November, 1978): 43-50.
5. Licklider and Taylor, 32.
6. Stefferud, Einar *et al.,* "Quotes from Some of the Players," *ConneXions – The Interoperability Report* 3 (10): 21.
7. See article by Larry Press posted on the comp.risks newsgroup, September 6, 1991.
8. Licklider and Taylor, 40.

Much thanks is owed to the many who contributed Usenet posts and e-mail responses to requests for examples of how the Net has changed people's lives. Only a few of the many replies received could be quoted but all contributed to this work.

The following people who were quoted indicated that their e-mail addresses be included:

Jim Carroll	jcarmll@jacc.com
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An early version of this chapter by Michael Hauben was made available online in Summer 1993. A revised version was printed in the *Amateur Computerist* 6 (Fall/Winter 1994-1995).

Appendix to Chapter 1

The Posts for the Research

1. Is the Net a Source of Social/Economic Wealth? & Other Thoughts
2. The Magic of E-Mail – Beginnings
3. Does the Net Bring Real-Life Advantages?
4. Looking for Exciting Uses of the Net
5. Connecting Others to the Net
6. Looking for Stories of Net Harassment
7. Does the Net Help You Be Creative or Have Fun?

IS THE NET A SOURCE OF SOCIAL/ECONOMIC WEALTH? & OTHER THOUGHTS

POST:
Newsgroups: news.misc, alt.culture.usenet, alt.amateur-comp, sci.econ, comp.misc, soc.misc, comp.org.eff.talk
Subject: Is the Net a Source of Social/Economic Wealth? *&* Other Thoughts.

There are some notes I have made in trying to form a proposal for a paper I am writing for an Independent Project in College. I would appreciate any ideas or suggestions in e-mail. Please send e-mail to me at: hauben@cs.columbia.edu

The points I would most like some feedback on are 1-6.

However, it might be useful if anyone is interested in the question of whether or not the Net (and its users) is a source of creation of economic, social, or intellectual wealth. This might make an interesting discussion via public follow-ups.

My Proposal

I want to understand this idea of Internetworking and cooperative attitude. The social connections and collaborations that the Internet and other parts of the global computer network make possible are new and very important. This more widespread communication brings the general populace of the world in better intersection/global social intercourse.

Question about Battle for use and right to utilize. And people have taken the battle up in order to keep access open and for all. Forces for restriction and censorship. Only through battle that net has stayed open. Net *inherently* allows people choice to speak.

Is it secret that Usenet did restrict corporations/private from abusing Net as it is research-oriented and developed only via because it was an experiment? (NOT A FLAME)

*****1. What does communication over the networks mean? Is it "value-added" somehow in that any response might bring something added into the amount of information or value. Does communication via the Net represent the quicker building by people on other people's work thus representing advancements (in ideas, products, production, etc.)
*****2. Does the Net represent intellectual wealth? Does the net represent the growth and increase in Gross National Product /Wealth or Wealth of Nations? (What if any theoretical background is there to this?) William Petty maybe Bacon, or Royal Society.
*****3. What does the Net make possible? Is the "Communication" on the net different than normal/before modes of communication? Does the widespread of connections and zero-time (Ability to turnaround information and/or publication or exchange of information in almost no time) of producing things prove revolutionary?
*****4. Provides a Forum that facilitates Intellectual Ferment.
*****5. Net makes knowing real conditions of society possible – because you have a "direct" connection to "many" people – the masses.
*****6. Accurate Information (similar to point 5)
7. How does the network make these "connections" possible easier than before? (These connections being finding people in the world to enjoy exchanging information, debating, connecting intellectually or whimsically – helping to find people who you can or want to interact/communicate with.)
8. Who has access and can gain the advantage of this service/connection/resource/revolution? Is this only an advantaged group of people, or is it growing quickly? Or should it grow quicker? What direction is access going toward for? What is Clinton/etc. doing? (Business?) Is there a fight against the continued openness and/or growing openness of letting the great body of people communicate accurate information that is normally controlled in normal modes of mass media.

Thanks,
– Michael Hauben

THE MAGIC OF E-MAIL – BEGINNINGS

POST:
Subject: The Magic of E-Mail – Beginnings
Newsgroups: comp.mail.misc, alt.amateur-comp, alt.folklore.computers, soc.college, alt.culture.usenet, news.misc

Do you remember the first e-mail message you sent? Do you remember the first e-mail you replied to? Do you remember the first response you received in e-mail? Do you remember the first e-mail response you received seemingly before you sent out the original message? <chuckle> – Do you remember the magic?

Excitement is a key word, as is immense usefulness. Whether you are a scientist, a student or a casual user, person-to-person communication via the computer is *VERY* exciting. Remember your first time and write it down. Keep your memory and save it for posterity. You … We … are all part of what is a relatively early period of the computer communications revolution. Save your experience in order to help recognize and remember this period of change – this beginning.

And if you do write down (or type in) your first (or first couple) of real *exciting* e-mail beginnings please e-mail them to me. I will try to post a summary to Usenet. And talk about e-mail from

e-mail or e-mail in response to Usenet, or e-mail in connection with something before the current e-mail or what you think might come in the future.
Thanks,
– Michael

DOES THE NET BRING REAL-LIFE ADVANTAGES?

POST:
Article 891 of alt.amateur-comp:
Newsgroups: soc.singles, rec.autos, soc.college, alt.amateur-comp, soc.culture.usa, comp.misc
From: hauben@cs.columbia.edu (Michael Hauben)
Subject: Does the Net Bring Real-Life Advantages?
Message – ID: <C5II5B.KJr@cs.columbia.edu>
Summary: Has the Net improved or broadened your off-line world?
Date: Thu, 15 Apr 1993 06:31:58 GMT

How has the Net changed your life? Has anyone who has used the Net actually been able to add to their off-line life successfully? I am doing research for a paper for college, and I am interested in the material changes that the Net helps develop through the increased communication.

Has access to the Net and your participation on it allowed you to do something that you wouldn't have done before – offline? Anything would be interesting – meeting people/new friends, marrying someone from on-line, joining groups, certain opportunities that were there because of the connection via the Net, etc.. I am interested in hearing about actions caused by use of any part of the Net (Usenet, talk, e-mail, etc.). The *KEY* point is that the cause or facilitator of the event needs to be because of the Net somehow. If you have any interesting, or useful stories, or ideas please either e-mail them to me, or post a follow-up to this message!
Thanks,
– Michael

LOOKING FOR EXCITING USES OF THE NET

POST:
Subject: Looking for Exciting Uses of the Net

I am doing research for a paper for a college independent study about the net and communications. I would appreciate hearing about using any part of the net: Usenet News/Netnews, IRC, e-mail, mailing-lists, Freenets, FTP, WAIS, gopher, etc.

I would like to know about people's uses of the network(s) that have been especially interesting, valuable and/or exciting. I want to hear about people's delights and also about disappointments using the Net. Please do NOT send me information about use by businesses or corporations for commercial purposes. I am NOT interested in commercial or proprietary uses. I AM interested in uses that serve the public, that are open, that serve science, research, education, and social aims and objectives. I am also interested in uses that serve to help people personally on their work (programming, et al.) or hobbies.

Either e-mail me at hauben@cs.columbia.edu or post a public follow-up. Both if possible.
Thanks,
– Michael Hauben

CONNECTING OTHERS TO THE NET

Subject: Connecting Others to the Net
Newsgroups: news.misc, alt.culture, Usenet, alt.amateur-comp, comp.misc, soc.misc
Hi,

I would like to hear from people the various ways in how they have introduced others to Usenet and the Internet. What ways have been successful and relatively inexpensive in getting family, friends, and other associates connected?

I am interested because I am interested in people's attempts (consciously or unconsciously) to further the expansion of the Net.

To the further expansion of the Net! :)
– Michael Hauben

LOOKING FOR STORIES OF NET HARASSMENT

POST:
Subject: Looking for Stories of Net Harassment
Newsgroups: alt.censorship, news.misc, comp.mail.misc, alt.amateur-comp

Have you ever experienced harassment on the net? Have you tried to utilize the communicative aspects of Usenet, E-mail or other computer networking capabilities but wound up discouraged? Please let me know if you have been the victim of censorship, harassment or some kind of blocking at some point in your usage of computer-facilitated communication. If so, do you think this "discouragement" was wrong or vicious, or malicious.
Thank you,
– Michael

And lastly maybe it would be helpful to find out why you thought you were treated such.

DOES THE NET HELP YOU BE CREATIVE OR HAVE FUN?

POST:
Subject: Does the Net Help You Be Creative or Have Fun?
Newsgroups: soc.culture.usa, talk.bizarre, alt.mud, alt.irc, news.misc, alt.culture.usenet, alt.amateur-comp, rec.music.misc, rec.arts.misc

I am conducting research for an independent study about computer and communication for college. So far I have asked and received many "serious" answers and replies dealing with work, keeping in touch with friends around the world, etc. However I am also interested in what effect the Net (Netnews, the Internet, other Nets, FTP, IRC, gopher, etc.) has on either creative endeavors you might have, or just plain silly or fun things. Has access to the Net helped you in any creative hobbies you might have, or just given you a chance to have fun?

For example. have your music tastes expanded, or do you know about more plays happening, have you learned about other who are musicians, or artists or writers? And if so, have you gotten a chance to jam, paint, write, or somehow help each other? Have there been any on-going creative collaborative music/art/literary experiments? How has the computer assisted communication helped you be creative or expanded your boundaries?

The other side is, have you found more ways to just have fun, or of new ways of having fun.

As I am not exactly sure where to post this message, I would appreciate any suggestions as to other groups to post the message to.
Thanks!
– Michael Hauben

[Editor's Note: A version of the following article first appeared online on November 30, 1992. It had been prepared for a Computer and Society class at Columbia University. A version appeared online as Chapter 3 of the net book, *The Netizens and the Wonderful World of the Net: An Anthology* on January, 12, 1994. A later version appears as Chapter 3 of *Netizens: On the History and Impact of Usenet and the Internet* by Michael Hauben and Ronda Hauben published in 1997 by the IEEE Computer Society Press, pp. 48-58.]

The Social Forces Behind the Development of Usenet

by Michael Hauben

Right at this moment, somewhere in the world, someone is being helpful (or someone is being helped). At the same time, others are participating in online discussions and debates. A new communications medium is currently in its infancy. Over the past two decades a global computer telecommunications network has been developing. One element of this network is called Usenet (also known as Netnews). The original carrier of this news was called UUCPnet (or just UUCP).

The basic element of Usenet is a post. Each individual post consists of a unique contribution from a user, placed in a subject area called a newsgroup. In Usenet's beginning (and still to some extent today), posts were transferred using the UUCP utility distributed with Unix. This utility allows the use of phone lines to transmit computer data among separate computers.

Usenet grew from the ground up in a grassroots manner. Originally, there was no official structure. What began as two or three sites on the network in 1979 expanded to 15 in 1980, to 150 in 1981, to 400 in 1982. The very nature of Usenet is communication. Usenet greatly facilitates inter-human communication among a large group of users. The rawest principle of Usenet is its importance. In its simplest form, Usenet represents democracy.

Inherent in most mass media is central control of content. Many people are influenced by the decisions of a few. Television programming, for example, is controlled by a small group of people compared to the size of the audience. The audience has very little choice over what is emphasized by most mass media. Usenet, however, is controlled by its audience. Usenet should be seen as a promising successor to other people's presses, such as broadsides at the time of the American Revolution and the penny presses in England at the turn of the nineteenth century. Most of the material written to Usenet is contributed by the same people who actively read Usenet. Thus, the audience of Usenet decides the content and subject matter to be thought about, presented, and debated. The ideas that exist on Usenet come from the mass of people who participate in it. In this way, Usenet is an uncensored forum for debate where many sides of an issue come into view. Instead of being force-fed by an uncontrollable source of information, the participants set the tone and emphasis on Usenet. People control what happens on Usenet. In this rare situation, issues and concerns that are of interest, and thus important to the participants, are brought up. In the tradition of amateur radio and Citizen's Band radio, Usenet is the product of the users' ideas and will. Amateur radio and CB, however, are more restricted than Usenet. The range of Usenet connectivity is international and quickly expanding into every nook and cranny around the world. This explosive expansion allows growing communication among people around the world.

In the 1960s, the Advanced Research Projects Agency (ARPA) of the Department of Defense funded research of fundamental importance to the development and testing of computer communications networks. ARPA sponsored research laid the groundwork for the development of other net works such as UUCPnet. ARPA funded an experiment to attempt to connect incompatible mainframe computers.[1] This experimental connection of computers was called the ARPA Computer Network or the ARPANET. ARPA's stated objectives were:

> *1. To develop techniques and obtain experience on interconnecting computers in such a way that a very broad class of interactions were possible and*
> *2. To improve and increase computer research productivity through resource sharing.*[2]

ARPA was sponsoring both communications research and the study of how to conserve funds by avoiding duplication of computer resources.[3] Bolt Beranek and Newman (BBN), a Cambridge, Massachusetts company, was chosen to construct the IMP subnetwork, and AT&T was chosen to provide the communications lines. The ARPANET was needed because it was found that a data connection over existing telephone voice lines was too slow and not reliable enough to make a useful connection.[4] Packet

switching was developed for use as the protocol for exchanging information over the lines. Packet switching is a communications process in which all messages are broken up into small data packets which are transmitted interspersed and reassembled. In this way, short, medium and long messages get transferred with minimum delay.[5]

The ARPANET was a success. It contributed several advances to communications research. ARPANET researchers were surprised at the enthusiastic adoption of electronic mail (e-mail) as the primary source of communication early on. E-mail was a source of increased productivity through the use of the ARPANET.[6] By 1983, the ARPANET officially shifted from using NCP (Network Control Program) to TCP/IP (Transmission Control Protocol/Internet Protocol.) A key part of TCP/IP's success lies in its simplicity. It is easy to implement over various platforms, and this simplicity has accounted for its continued existence as a *defacto* Internet standard up to the present. The ARPANET's lasting contribution was demonstrating how a backbone infrastructure can serve as a connection between gateways. A gateway is a computer or part of a computer programmed to receive messages from one network and transfer them onto another network.

The ARPANET quickly grew to more than 50 nodes between Hawaii and Norway.[7] However, it did not extend to all who could utilize it. Computer scientists at universities without Department of Defense contracts noticed the advantages and petitioned the National Science Foundation (NSF) for similar connectivity. CSnet was formed to service these computer scientists. CSnet was initially financed by the NSF. Very quickly, the desire for interconnection spread to other members of the university community. Soon CSnet grew to serve other scientists in addition to computer scientists at universities and came to mean "Computer and Science Network" rather than just "Computer Science Network."[8]

By the mid-1980s, the ARPANET was phased out by the Department of Defense and was replaced by various internal networks (such as MILNET). The role of connecting university communities and regional networks was taken over by the NSF-funded NSFnet, which originated as a connection for university researchers to the five National Supercomputer Centers. CSnet and NSFnet were made possible by the research on the ARPANET. The NSFnet became the U.S. backbone for the global network known as the Internet.

ARPANET research was pioneering communications research.[9] Researchers discovered the link between computer interconnection and increased productivity from human communication. The sharing of resources was proven as a way to save money and to increase computer use and productivity. The development of packet switching revolutionized the basic methodology of connecting computers.

The source of these discoveries were the people involved. The people involved in the ARPANET project were very intelligent and forward looking. They recognized that they were developing future technologies, and thus did not develop products that commercial industry could (and would) develop. Instead, they understood that the communications technologies they were developing had to come from a not-for-profit body. ARPA researchers had no proprietary products to support and no commercial deadlines to meet. Either requirement would have made developing networks of incompatible computers impossible or limited. Current users of international computer networks are in debt to the pioneers of the ARPANET.

The ARPANET was successful in its attempt to connect various spatially remote computers, and, thus, more importantly, the people who used those computers. However, these people were either professors at universities with Department of Defense research contracts or employees of a limited number of defense industry companies. There were still many people who wanted a connection but were not in a position to gain one. Duke University and the University of North Carolina at Chapel Hill were two such locations. In these underprivileged fertile grounds the grassroots computer communications breakthrough, Usenet, originated and developed.

The Unix operating system provides the basic tools needed to share information between computers. Unix[10] was developed as "a system around which a fellowship would form."[11] One of the programmers of Unix, Dennis Ritchie, wrote that the intended purpose of Unix was to "encourage close communication."[12] Unix's general principles thus conceptually foreshadowed the basic tenet of Usenet. How else should one go about designing communications programs but on an operating system designed with the basic principle of encouraging communication? The Unix utility UUCP was created at Bell Labs in 1976 by Mike Lesk. It was further developed by David Nowitz and later by Nowitz, Peter Honeyman, and Brian Redman. UUCP provided a simple way of passing files between any

two computers running Unix and UUCP. One of AT&T's motivations in developing Unix was to make software production cheaper in order to bring down the cost of telephone service. Unix's popularity also arose from AT&T's prohibition from profiting from sources other than its main business, phone services, under the terms of the 1956 Consent Decree. Unix was thus available on a "no cost" (or very low cost) basis. The operating system was seen as an "in-house" tool on DEC and other computers and was in use throughout Bell Labs. Many universities used the same type of computer and were licensed by AT&T to utilize Unix. It thus spread widely. Schools picked it up, and computer science students used it to learn about operating systems, as Unix was a model of elegance and simplicity compared to most operating systems of the time. Unix became a widely used operating system in the academic world, paving the way for an international public communications system.

When Usenet was developed in 1979, it was created as a "Unix Users Network." The developers thought Usenet would provide a forum for people to solve problems they had in using Unix, as AT&T initially provided little external support for Unix. In an early handout, Usenet was referred to as a "poor man's ARPANET."[13] In an e-mail message, Stephen Daniel explained that people who didn't have access to the ARPANET were hungry for similar opportunities to communicate.[14]

Usenet has been full of surprises from the beginning. The originators of Usenet underestimated the hunger of people for meaningful communication. As Usenet was originally intended to provide an easy method of communicating with other users at the same site, the programmers thought people would want to have local bulletin boards.[15] However, people were attracted by the possibility of communicating with others outside the local community as well. Even today, the global communication it makes possible is part of what makes Usenet so enticing. It was also thought Netnews would be useful as a method of communication at individual locations, and between sites close to each other.[16] Usenet grew as a grassroots connection of people. The people who utilized Netnews wanted to communicate, and communicate they did! People have a fundamental need to communicate and Usenet aptly fills the bill.[17]

By early 1981, the gap between the ARPANET and Usenet was bridged. The University of California at Berkeley had connections to both the ARPANET and Usenet. This allowed Usenet pioneer Mark Horton to bring mailing-list discussions from ARPANET mailing lists into Usenet news groups.[18] This was a significant achievement. Communities other than ARPA sponsored researchers were finally able to see what the ARPANET had made possible. The gatewaying of ARPANET mailing lists into Usenet attracted a wave of people when two ARPANET mailing lists (SF-Lovers and Human Nets) began to appear on Usenet. These lists provided interesting material and discussions. The size of the news feed (that is, the raw data of Usenet) thus became larger and provided more for people to read. Later, other sites would serve as gateways to even more discussion lists from the ARPANET. Netnews was also seen as a superior method of holding discussions. Gatewaying these FA (From ARPANET) newsgroups proved to be politically courageous. The ARPANET had been accessible to only a certain group of people, and these gateways challenged that notion. The effect on the ARPANET was important, as Steve Bellovin, another of the Usenet pioneers, wrote:

> The impact of Usenet on the ARPANET was more as a (strong) catalyst to force reexamination (and benign neglect) on the strict policies against interconnection. UUCP mail into the ARPANET became a major force long before it was legit. And it was obviously known to, and ignored by, many of the Powers that Were.[19]

Usenet, a network made possible by UUCP, expanded to connect people between two countries when the University of Toronto Zoology Department joined the Net in May 1981.[20] Two companies, AT&T and DEC, proved helpful by distributing Netnews and electronic mail long distance. Each UUCP site had to either pay the phone bill to connect to the next system, or arrange for the other system to make the phone call. System administrators at AT&T and DEC did the legwork necessary to take e-mail and news where it might not have reached. However, easy connections were not always available. In one instance, Case Western Reserve University graduate students had to route mail across the continent twice in order to send mail through UUCP to reach their professors who were connected to the ARPANET next door.[21] Usenet encouraged connectivity to the ARPANET. Gradually, the ARPANET was interconnected with other networks, eventually functioning more as a backbone to other networks than as a self-contained network.[22]

Contributed effort is the crucial foundation of UUCPnet and Usenet. There are those who donate time and energy by contributing to Usenet's content – writing messages and answering messages or participating in debate. Without the time and effort put in by its users, Usenet would not be what it is today. Also important to Usenet's success are the system administrators who make the functioning of Usenet possible. Netnews takes up disk space on computers throughout Usenet, and in some cases phone calls must be made to transfer the raw data of the news. In particular, system administrators at AT&T and DEC found it worthwhile to transport Netnews across the country. Certain sites emerged as clearing houses for Usenet and UUCP e-mail.[23] These computers served as major relay stations of both news and e-mail. A structure grew that became the "backbone" of "the Net." Backbone sites formed the trunk of the circulatory system of news and e-mail. A backbone site would connect to other central distribution computers and to numerous smaller sites. These central backbone sites provided a crucial organization to the Usenet communications skeleton, but people formed the center of these connections. For example, *ihnp4* at AT&T existed mainly because of [AT&T Research Engineer] Gary Murakami's effort and only partially because of management support. Usenet services and support were not officially part of Murakami's job description. After Murakami left the Bell Labs Indian Hill Laboratory in Naperville, Illinois, Doug Price put in the time and effort to keep things running smoothly. Certain system administrators in universities also picked up the responsibility for distributing Netnews and e-mail widely. Often these individuals would find ways of having their site pick up the phone bill. Sometimes sites would bill the recipients. Also, those who received a free connection were expected to provide the same to others.[24]

At the beginning, expansion of the number of sites receiving Usenet was slow.[25] Why was this? Initially, Usenet was only transported via UUCP connections. Soon other resources were used, such as the airmailing of magnetic tape data to provide connectivity.[26] Today, Usenet travels over all types of connections. The evolving ARPANET (and now the Internet) provided a faster way of transporting Netnews. However, a large number of Usenet recipients still only have connectivity via UUCP. Universities and certain businesses can afford to connect to the Internet, but many individuals also want a connection. Even as late as 1992, when 60 percent of Usenet traffic was carried over the Internet via the instantaneous Network News Transport Protocol (NNTP), 40 percent of Usenet was still carried via the slower UUCP connections. There are still many examples of various types of connections using UUCP. These representatives of the "fringe" provide a clue as to what the early days of this communication were like.[27]

The number of sites receiving Usenet is continually increasing, demonstrating its popularity. People are attracted to Usenet because of what it makes possible. People want to communicate and enjoy the thrill of finding others across the country (or across the world) who share a common interest or with whom to be in contact. Besides the common thrill, it is possible to form serious relationships online. Usenet makes this discovery possible because it is a public forum. People expose their ideas broadly, making it possible to find compatriots in thought. The same physical connections which carry Usenet often also transport private electronic mail. However, the interactions and discoveries are only made possible by the public aspect of Usenet. Mailing lists have as wide a range of discussion, but are available to much smaller groups. Being on Usenet can become tiresome at times,[28] but it is rare that anyone leaves it permanently. Unless, of course, a person's life changes and this change means that time once spent online is no longer available. As more universities, schools, libraries, businesses, and individuals connect, the value of Usenet grows. Each new person can eventually add his or her unique opinion to the collection of thoughts and information that Usenet already has. Each new connection also increases the area where new connections can be made through cheap local phone calls. The potential for inexpensive expansion is limited only by the oceans, other natural barriers, or perhaps by mistaken government policies.

The ARPANET was supplemented by CSnet and eventually replaced by U.S. government funding of its successor, NSFnet. Both CSnet and NSFnet were created by the U.S. government in response to research scientists' and professors' pleas to have a network similar to the ARPANET. The NSFnet was also created to provide access to the five supercomputer computing centers around the country. The NSFnet, as the backbone of the U.S. portion of the Internet, provided another route for the distribution of Usenet. Similar to the ARPANET, NSFnet was a constant connection run over leased lines. One of the ways Netnews is distributed is using the NNTP protocol over connections. This allows for Netnews and e-mail to be distributed

quickly over a large area. Internet connections also assist in carrying Usenet and e-mail internationally. The Internet-class networks and connections include the established government and university sponsored connections. However individuals at home are often connected by phone lines using SLIP, PPP, and various versions of UUCP There are also commercial services that, for a fee, provide connections for electronic mail and Usenet access, as well as access to the Internet.

Much of the development of Usenet owes a big thanks to the early restrictions on commercial uses. Where else in our society has the commercial element been so clearly separated from any entity? Forums of discussion and communication become clogged and congested when advertisements use space. Because of the voluntary actions of those who use and redistribute Netnews and e-mail, many people on Usenet feel it wrong to assist commercial ventures. When people feel someone is abusing the nature of Usenet, they let the offender know through e-mail and in public messages. In this manner, users work to keep Usenet a forum free from commercial exploitation. Usenet has not been allowed to be abused as a profit-making venture for any one individual or group. Rather, people are fighting to keep it a resource that is helpful to society as a whole.

On what was the ARPANET and afterward the NSFnet portion of the Internet, there were Acceptable Use Policies (AUP) that existed because these networks were initially founded and financed by public money. On these networks, commercial usage was prohibited, which meant it was also discouraged on other networks that gatewayed into the NSFnet. Unfortunately, the NSF encouraged privatization of the NSFnet backbone.[29] However, the discouragement of commercial usage of the global Usenet is separate and developed differently from the AUP.

The social network that Usenet represents supersedes the physical connection it rides on. The current Netnews rides on many of the physical networks that exist today. However, if ever there were the need, Usenet could reestablish itself outside of the current physically organized networks. The essence of Usenet means it will survive because of its users' determination. Usenet draws its strength from being a peer-to-peer network. People who use Usenet do so because they wish to communicate with others. This communal wish means that people on Usenet find it in their own and in the community's interest to be helpful. In this way, Usenet exists as a worldwide community of resources ready to be shared. Where else today is there so much knowledge that is freely available? Usenet represents a living library and is an important part of the worldwide computer network.

The very nature of Usenet promotes change. Usenet was born outside of established "networks" and transcends any one physical network. It exists of itself and through other networks. It makes possible the distribution of information that might otherwise not be heard through "official channels." This role makes Usenet a herald for social change. Because of the inherent will to communicate, people who do not have access to Usenet will want access when they become exposed to it, and people who currently have access will want Usenet to expand its reach so as to further even more communication. Usenet could grow to provide a forum through which people influence their governments, allowing for the discussion and debate of issues in a mode that facilitates mass participation. This discussion becomes a source of independent information. An independent source is helpful in the search for the truth.

Administrators and individuals who handle the flow of information have been predicting the "imminent death of the Net" since 1982.[30] The software that handles the distribution of Netnews has gone through several versions to handle the ever-increasing amount of information. People who receive Netnews have either had to decrease the number of days individual messages stay at the site or the number of newsgroups they receive; or they have had to allocate more disk space for the storage of Netnews. Despite all predictions and worries, the desire for communication has helped this social network develop and expand. Brad Templeton once wrote, "If there is a gigabit network with bandwidth to spare that is willing to carry Usenet, it has plenty more growth left."[31] Various research labs have been working on producing usable gigabit networks.

Usenet is a democratic and technological breakthrough. The computer networks and Usenet are still developing. People need to work toward keeping connections available and inexpensive, if not free, so as to encourage the body of users to grow. There is a growing number of cities across the world where the public has access to computer networks as a civic service. This direction should be encouraged. Exclusive arrangements for access are to be discouraged. The very nature of Usenet means people are going to be working for its expansion. Others will be working for the ex-

pansion for their own gain, and some forces will be an active force against expansion of Usenet. I can only ask that people attempt to popularize and encourage the use of and fight for Usenet.

Notes

1. "In September 1969, the embryonic (one-node!) ARPANET came to life when the first packet-switching computer was connected to the Sigma 7 computer at UCLA. Shortly thereafter began the interconnection of many main processors (referred to as HOSTS) at various university, industrial, and government research centers across the United States." (Leonard Kleinrock, "On Communications and Networks," *IEEE Transactions on Computers* C-25 (December 1976): p. 1328).
2. F. Heart, A. McKenzie, J. McQuillan, and D. Walden, *ARPANET Completion Report.* Washington, D.C.: DARPA and BBN, 1978, pp. II-2.
3. Alexander McKenzie and David C. Walden, "ARPANET, the Defense Data Network, and Internet" in *The Encyclopedia of Telecommunications,* Volume 1, Fritz E. Froehlich, Allen Kent and Carolyn M. Hall, eds. (New York: Marcel Dekker, 1991), p. 346.
4. Lawrence G. Roberts, "The ARPANET and Computer Networks " in *A History of Personal Workstations,* Adele Goldberg, ed. (New York: ACM Press, 1988), p. 145.
5. Kleinrock, p. 1327.
6. McKenzie and Walden, p. 357.
7. Heart *et al.,* pp. II-25.
8. McKenzie and Walden, p. 369.
9. "For many of the people in government, at the major contractors, and in the participating universities and research centers the development of the ARPANET has been an exciting time which will rank as a high point in their professional careers. In 1969 the ARPANET project represented a high risk, potentially high impact research effort. The existence of the net in practical useful form has not only provided communications technology to meet any short term needs, but it represents a formidable communications technology and experience base on which the Defense Department as well as the entire public and private sectors will depend for advanced communications needs. The strong and diverse experience base generated by the ARPANET project has placed this country ahead of all others in advanced digital communications science and technology."*ARPANET Completion Report,* pp. III-109.
10. Unix was born in 1969, the same year as the ARPANET.
11. Dennis. M. Ritchie, "The Evolution of the UNIX Time-Sharing System," *Bell Systems Technical Journal,* Volume 63, number 8, part 2 (October 1984): p. 1578.
12. *Ibid.*
13. Stephen Daniel, James Ellis, and Tom Truscott, "USENET – A General Access UNIX Network," unpublished leaflet, Durham, North Carolina, Summer 1980.
14. Stephen Daniel, personal communication, November 1992.
15. Steve M. Bellovin and Mark Horton, "USENET – A Distributed Decentralized News System," unpublished manuscript, 1985.
16. *Ibid.*
17. See, for example, Gregory G. Woodbury's "Net Cultural Assumptions," reprinted in *Amateur Computerist,* Volume 6 (Winter/Spring 1994-1995), p. 7.
18. "Correct. The original concept was that most of the traffic would be the form now known as UNIX wizards (or whatever it's called this week). Growth was slow until Mark started feeding the mailing lists in because there was nothing to offer prospective customers. Given a ready source of material, people were attracted." Comment from Steve Bellovin, October 10, 1990, Usenet History Archive, http://www.duke.edu/~mg/usenet.hist/nethist.901010.Z (no longer available)
19. Steve Bellovin, October 10, 1990, Usenet History Archives, http://www.duke.edu/~mg/usenet.hist/nethist.901010.Z (no longer available)
20. Henry Spencer, Usenet History Archives, http://www.duke.edu/~mg/usenet.hist/history.Z (no longer available)
21. Amanda Walker, Oct.16, 1990, Usenet History Archives, http://www.duke.edu/~mg/usenet.hist/nethist.901016.Z (no longer available)
22. "Indeed, during a typical measurement period in June 1988, over 50% of the active ARPANET hosts were gateways, and they accounted for over 80% of the traffic." McKenzie and Walden, p. 369.
23. At AT&T, the computers *research*, then *allegra*, then *ihnp4* served as major mail and/or news distribution sites. At DEC, *decvax* gradually increased its role (for example, *decvax* in New Hampshire would call long distance to San Diego, California.)
24. For example, Duke University fed Usenet data to Greg Woodbury who in turn gave "feeds" to others who requested them from him. See "Net Cultural Assumptions."
25.

Year	Number of Sites	Articles/Day	Megabytes/Day
1979	3	~2	-
1980	15	~10	-
1981	150	~20	-
1982	400	~50	-
1983	600	~120	-
1984	900	~225	-
1985	1,00	~375	1+
1986	2,500	~500	2+
1987	5,000	~1,000	2.5+
1988	11,000	~1,800	4+

26. Andy Tannenbaum is quoted as saying something similar to "Never underestimate the bandwidth of a station wagon full of nine-track tape (or magnetic tape)."
27. Usenet began with a spirit that still exists today. On several newsgroups I posted asking how users were connected to Usenet. In return I received numerous wonderful answers. One new pioneer was going to use packet radio to send e-mail up to the CIS's orbiting Mir Space Station. Others around the world sent me information about their connection. These responses show how the world is still in the infancy of this communications interconnectivity!
28. "Flame wars" (highly emotional attacks) can become annoying. There are ebbs and flows of interesting posts. Even though Usenet is addictive, it can also be overwhelming.
29. See, for example, the U.S. Office of Inspector General's Report "Review of NSFNET" (March 1993) for documentation of the process set in motion to implement the privatization of the NSFnet.
30. Usenet History Archives,

http://www.duke.edu/~mg/usenet.hist/ (no longer available)
31. Usenet History Archives, http://www.duke.edu/~mg/usenet.hist/posthist.Z (no longer available)

Special thanks to Bruce Jones for establishing and archiving the Usenet History Archives at ftp://weber.ucsd.edu/pub/usenet.hist/ Also thanks to the Usenet pioneers for getting Usenet off to the right start.

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The Vision of Interactive Computing And the Future

by Michael Hauben

What is the reality behind all the talk about the so called "Information Superhighway"? This is an important question which U.S. government policy makers seem to be ignoring. However, understanding the history of the current global computer networks is a crucial step toward building the network of the future. There is a vision that guided the origin and development of the Internet, Usenet and other associated physical and logical networks. What is that vision?

While the global computer networks are basically young – the ARPANET started in 1969 – their 25 plus years of growth has been substantial. The ARPANET was the experimental network connecting the mainframe computers of universities and other contractors funded and encouraged by the Advanced Research Projects Agency of the U.S. Department of Defense. The ARPANET started out as a research test-bed for computer networking, communication protocols, computer and data resource sharing, etc. However, what it developed into was something surprising. The widest use of the ARPANET was for computer facilitated human-human communication using electronic mail (e-mail) and discussion lists. (Popular lists included Human-Nets, Wine-Tasters and Sci-Fi Lovers lists.) The human communications achievements of ARPANET research continue to be today's most popular usage of the Net by a growing number and variety of people through e-mail, Usenet discussion groups, mailing lists, internet relay chat, and so on. The ARPANET was the product of previous U.S. government funded research in interactive computing and time-sharing of computers.

Until the 1960s, computers operated almost exclusively in batch mode. Programmers punched or had their programs punched onto cards. Then the stack of punched cards was provided to the local computer center. The computer operator assembled stacks of cards into batches to be feed to the computer for continuous processing. Often a programmer had to wait over a day in order to see the results from his or her input. In addition, if there were any mistakes in the creation of the punched cards, the stack or part of it had to be punched again and resubmitted, which would take another day. Bugs in the code could only be discovered after an attempt to compile the code and therefore "debugging" was a slow process. This batch processing mode was a very inefficient way of utilizing the power of the computer. People began thinking of ways to alter the interface between people and computers. The idea of time-sharing developed among some in computer research communities. Time-sharing makes it possible for people to utilize a computer (then predominately the IBM mainframe) simultaneously. Time-sharing operates by giving the impression that the each user is the only one using the computer. This is executed by having the computer divvy out slices of CPU time to all the users in a rapid, sequential manner.

Crucial to the development of today's global computer networks was the vision of researchers interested in time-sharing. These researchers began to think about social issues related to time-sharing. They observed the communities that formed from the people who used time-sharing systems and considered the social significance of these communities. Two of the pioneers involved in research in time-sharing at MIT, Fernando Corbato and Robert Fano, wrote:

> The time-sharing computer system can unite a group of investigators in a cooperative search for the solution to a common problem, or it can serve as a community pool of knowledge and skill on which anyone can draw according to his needs. Projecting the concept on a large scale, one can conceive of such a facility as an extraordinarily powerful library serving an entire community in short, an intellectual public utility.[1]

Research in time-sharing started in the early 1960s around the country at different research centers.

Some examples were CTSS (Compatible Time-sharing System) at MIT, DTSS (Dartmouth Time-sharing System) at Dartmouth, a system at BBN, Project GENIE at the University of California at Berkeley, and so on. J. C. R. Licklider, the founding director of ARPA's Information Processing Techniques Office (IPTO) thought of time-sharing as interactive computing. Interactive computing meant the user could communicate and respond to the computer's responses in a way that batch processing did not allow.

Licklider was one of the first users of the new time-sharing systems, and took the time to play around with them. Examining the uses of this new way of communicating with the computer enabled Licklider to think about the future possibilities. This was helpful because Licklider went on to establish the priorities and direction for ARPA's IPTO research monies. Many of the interviewees in a series of interviews conducted by the Charles Babbage Institute (CBI) said that ARPA's money was given in those days under Licklider's guidance to seed research which would be helpful to society in general and only secondarily helpful to the military.

Both Robert Taylor and Larry Roberts, future successors of Licklider as director of IPTO, pinpoint Licklider as the originator of the vision which set ARPA's priorities and goals and basically drove ARPA to help develop the concept and practice of networking computers.

> In one of the CBI interviews, Roberts said: What I concluded was that we had to do something about communications, and that really, the idea of the galactic network that Lick talked about, probably more than anybody, was something that we had to start seriously thinking about. So in a way networking grew out of Lick's talking about that, although Lick himself could not make anything happen because it was too early when he talked about it. But he did convince me it was important.[2]

Taylor, also in a CBI conducted interview, pointed out the importance of Licklider's vision to future network development:

> I don't think anyone who's been in that DARPA position since [Licklider] has had the vision that Licklider had. His being at that place at that time is a testament to the tenuousness of it all. It was really a fortunate circumstance. I think most of the significant advances in computer technology, especially in the systems part of computer science were simply extrapolations of Licklider's vision. They were not really new visions of their own. So he's really the father of it all.[3]

Taylor also described how research in time-sharing led to surprising results. He was one of the Directors who succeeded Licklider of the IPTO at ARPA. A phrase that J. C. R. Licklider frequently used to express his vision was "an Intergalactic Network." Taylor explains that Licklider used this phrase to describe the potential community that he realized would emerge from the interconnection of the local communities of Net users that develop from time-sharing. At first, Taylor notes ARPA supported research had as its goal achieving compatibility and resource sharing across different computer systems. However, he explains:

> They were just talking about a network where they could have a compatibility across these systems, and at least do some load sharing, and some program sharing, data sharing that sort of thing. Whereas, the thing that struck me about the time-sharing experience was that before there was a time-sharing system, let's say at MIT, then there were a lot of individual people who didn't know each other who were interested in computing in one way or another, and who were doing whatever they could, however they could. As soon as the time-sharing system became usable, these people began to know one another, share a lot of information, and ask of one another, 'How do I use this? Where do I find that?' It was really phenomenal to see this computer become a medium that stimulated the formation of a human community. And so, here ARPA had a number of sites by this time, each of which had its own sense of community and was digitally isolated from the other one. I saw a phrase in the Licklider memo. The phrase was in a totally different context something that he referred to as an 'intergalactic network.' I asked him about this … in fact I said, 'Did you have a networking of the ARPANET sort in mind when you used that phrase?' He said, 'No, I was thinking about a single

time-sharing system that was intergalactic'[4]

As Taylor explains, the users of the time-sharing systems would form, usually unexpectedly, a new community. People were connected to others who were also interested in these new computing systems.

The vision driving ARPA inspired bright researchers working on computer related topics. Roberts explains that Licklider's work (and that of the IPTO's directors after him) educated people who were to become the future leaders in the computer industry. Roberts describes the impact that Licklider and his vision made on ARPA and future IPTO directors:

> Well, I think that the one influence is the production of people in the computer field that are trained, and knowledgeable, and capable, and that form the basis for the progress the United States has made in the computer field. That production of people started with Lick, when he started the IPTO program and started the big university programs. It was really due to Lick, in large part, because I think it was that early set of activities that I continued with that produced the most people with the big university contracts. That produced a base for them to expand their whole department, and produced excitement in the university.[5]

Roberts describes how ARPA-supported university research had a significant impact on the computer industry as well.

> So it was clear that that was a big impact on the universities and therefore, in the industry. You can almost track all those people and see what effect that has had. The people from those projects are in large part the leaders throughout the industry.[6]

Licklider's vision was of an "Intergalactic Network," a time-sharing utility that would serve the entire galaxy. This early vision of time-sharing spawned the idea of interconnecting different time-sharing systems by networking them together. This network would allow those on geographically separated time-sharing systems to share data, programs, research, and later other ideas and anything that could be typed out. In the article, "The Computer as a Communications Device," Licklider and Taylor predicted the creation of a global computer network. They wrote:

> We have seen the beginnings of communication through a computer – communication among people at consoles located in the same room or on the same university campus or even at distantly separated laboratories of the same research and development organization. This kind of communication – through a single multiaccess computer with the aid of telephone lines – is beginning to foster cooperation and promote coherence more effectively than do present arrangements for sharing computer programs by exchanging magnetic tape by messenger or mail.[7]

They point out how the interconnection of computers leads to a much broader class of connections than might have been expected. A new form of community is generated:

> The collection of people, hardware, and software the multiaccess computer together with its local community of users will become a node in a geographically distributed computer network. Let us assume for a moment that such a network has been formed. Through the network of message processors, therefore, all the large computers can communicate with one another. And through them, all the members of the super community can communicate with other people, with programs, with data, or with a selected combinations of those resources.[8]

Licklider and Taylor consider more than just hardware and software when they write about the new social dynamics that the connections of dispersed computers and people will create. They explain:

> [These communities] will be communities not of common location, but of common interest. In each field, the overall community of interest will be large enough to support a comprehensive system of field-oriented programs and data.[9]

In exploring this community of common affinity, they describe the main advantages that come from connecting to and being part of these new computer facilitated communities. Life will be enriched for those people who can communicate on-line with others who have similar goals and interests, as they won't be limited by geography. Communication will be more productive and thus more enjoyable. And the kind of programs that those on-line will have access to will be customized to one's interests and abilities, and thus more satisfying. And they describe the advantages to

society that the increased opportunities and resources made possible by the Net can provide for everyone.[10]

Since the advantages that computer networks make possible for society will only happen if these advantages are available to all who want to make use of them, Licklider and Taylor realize there is a crucial challenge put on the agenda of our times by the development of the Net. They conclude their article with a prophetic question: Will 'to be on line' be a privilege or a right?"[11] They argue that it must be a right. Otherwise, instead of providing all the many benefits it makes possible, it will only increase the inequities of intellectual opportunity that currently exist.

The challenge they raise is one of access. The authors point out that the positive effects of computer networking will only come about if the networks are made easy to use and available to all. They argue that access should be made available because of the global benefits that would ensue. They conclude by describing how humankind can benefit immeasurably from the educational opportunities the Net makes possible, "if the network idea should prove to do for education what a few have envisioned in hope … surely the boon to humankind would be beyond measure."[12]

Licklider and Taylor raise the important point that access should be made available to all who want to use the computer networks. Therefore it is important to ask if the National Information Infrastructure is being designed with the principle of equality of access. The vision of the interconnection and interaction of diverse communities guided the creation of the original ARPANET. In the design of the expansion of the Net, it is important to keep the original vision in mind to consider if the vision was correct, or if it was just important in the initial development of networking technologies and techniques. However, very little emphasis has been placed on either the study of Licklider's vision or the role and advantages of the Net up to this point. In addition, the public has not been allowed to play a role in the planning process for the new initiatives which the U.S. government is currently undertaking. This is a plea to you to demand more of a part in the development of the future of the Net!

Notes for Chapter 5

1. "Time-sharing on Computers," in *Information, A Scientific American Book*, San Francisco, 1966, p. 76.
2. Lawrence G. Roberts, Interview by Arthur L. Norberg, 4 April 1989, San Mateo, California, Charles Babbage Institute, The Center for the History of Information Processing, University of Minnesota, Minneapolis, Minnesota, p. 29.
3. Robert W. Taylor, Interview by William Aspray, 28 February 1989, Palo Alto, California, Charles Babbage Institute, The Center for the History of Information Processing, University of Minnesota. Minneapolis, Minnesota, p. 8.
4. Ibid., p. 24.
5. Lawrence G. Roberts Interview, p. 29.
6. Ibid., p. 30.
7. "The Computer as a Communication Device," in: *In Memoriam: J. C. R. Licklider: 1915-1990*, p. 28.
8. Ibid., p. 32.
9. Ibid., p. 38.
10. Ibid., p. 40.
11. Ibid.
12. Ibid.

[Editor's Note: A draft of the following article appeared in three parts on Usenet in the alt.amateur.computerist newsgroup on Dec 28, 1993. A version appeared online as Chapter 6 of the net book, *The Netizens and the Wonderful World of the Net: An Anthology* on Jan, 12, 1994. The article also appears as Chapter 7 of *Netizens: On the History and Impact of Usenet and the Internet* by Michael Hauben and Ronda Hauben published in 1997 by the IEEE Computer Society Press, pp. 96-114.]

Behind the Net: The Untold Story of the ARPANET and Computer Science

by Michael Hauben

The global Internet's progenitor was the Advanced Research Projects Agency Network (ARPANET), financed and encouraged by the U. S. Department of Defense. This is important to remember, because the support and style of management by ARPA of its contractors was crucial to the success of the ARPANET. As the Internet develops and the struggle over the role it plays unfolds, it will be important to remember how the network developed and the culture with which it was connected. The culture of the Net as a facilitator of communication is an important feature to understand.

The *ARPANET Completion Report*, published jointly in 1978 by BBN of Cambridge, Massachusetts, and ARPA, concludes by stating:

> … it is somewhat fitting to end on the note that the ARPANET program has had a strong and direct feedback into the support and strength of computer science, from which the network itself sprung.[1]

In order to understand the wonder that the Internet and various other components of the Net represent, we need to understand why the *ARPANET Completion Report* ends with the suggestion that the ARPANET is fundamentally connected to and born of computer science rather than of the military.

The History of ARPA Leading Up to the ARPANET

A climate of scientific research surrounded the entire history of the ARPANET. ARPA was formed to fund basic research, and thus was not oriented toward military products. The formation of this agency was part of the U.S. government's response to the then Soviet Union's launch of Sputnik in 1957.[2] One area of ARPA-supported research concerned the question of how to utilize the military's investment in computers to do Command and Control Research (CCR). J. C. R. Licklider was chosen to head this effort. Licklider came to ARPA from BBN in October 1962.[3] His educational background was a combination of engineering studies and physiological psychology. His multi-disciplinary experiences provided Licklider with a perspective uncommon among engineers.

As a result of Licklider's arrival, the Agency's contracts were shifted from nonacademic contractors toward "the best academic computer centers."[4] The then-current method of computing was batch processing. Licklider saw that improvements could be made in CCR only from work that would advance the current state of computing technology. He particularly wanted to move forward into the age of interactive computing, and Defense Department contractors were not moving in that direction. In an interview, Licklider described how at one of the contractors, System Development Corporation (SDC), the computing research being done "was based on batch processing, and while I was interested in a new way of doing things, they [SDC] were studying how to make improvements in the ways things were done already."[5] To reflect the changed direction Licklider was bringing to ARPA-supported research, his division of ARPA was renamed the Information Processing Techniques Office (IPT or IPTO). The office "developed into a far-reaching basic research program in advanced technology."[6]

The *Completion Report Draft* states that "Prophetically, Licklider nicknamed the group of computer specialists he gathered the 'Intergalactic Network.'"[7] Before work on the ARPANET began, the foundation had been established by the creation of the Information Processing Techniques Office of ARPA. Robert Taylor, Licklider's successor at the IPTO, reflects on how this foundation was based on Licklider's interest in interconnecting communities:

> Lick was among the first to perceive the spirit of community created among the users of the first time-sharing systems … . In pointing out the community phenomena created, in part, by the sharing of resources in one time-sharing system, Lick made it easy to think about interconnecting the communities[,] the interconnection of interactive, on-line communities of people… .[8]

The "spirit of community" was related to Licklider's interest in having computers help people communicate with other people.[9] Licklider's vision of an "intergalactic network" connecting people represented an important conceptual shift in computer science, This vision guided the researchers who created the ARPANET. After the ARPANET was functioning, the computer scientists using it realized that assisting human communication was a major fundamental advance that the ARPANET made possible.

As early as 1963, a commonly asked question of the IPTO directors by the ARPA directors about IPTO projects was "'Why don't we rely on the computer industry to do that?', or occasionally more strongly, 'We should not support that effort because ABC (read, 'computer industry') will do it – if it's worth doing!'"[10] This question leads to an important distinction: ARPA research was different from what the computer industry had in mind to do, or was likely to undertake. Since Licklider's creation of the IPTO, the work supported by ARPA/IPTO continued his explicit emphasis on communications. The *Completion Report Draft* explains:

> The ARPA/IPTO theme … is that the promise offered by the computer … a communication medium between people, dwarfs into relative insignificance the historical beginnings of the computer as an arithmetic engine.[11]

The *Completion Report Draft* goes on to differentiate the research ARPA supported from the research done by the computer industry:

> The computer industry, in the main, still thinks of the computer as an arithmetic engine. Their heritage is reflected even in current designs of "their communication

systems." They have an economic and psychological commitment to the arithmetic engine model, and it can die only slowly….[12]

The *Completion Report Draft* further analyzes this problem by tracing it back to the nation's universities:

> … furthermore, it is a view that is still reinforced by most of the nation's computer science programs. Even universities, or at least parts of them, are held in the grasp of the arithmetic engine concept … .[13]

ARPA's IPTO was responsible for the research and development which led to the success of first the ARPANET, and later the Internet. Without this support and commitment, such a development might never have happened. One of ARPA's criterion for supporting research was that the research had to offer an order of magnitude of advance over the current state of development. Such research is never immediately profitable. In society, therefore, there is the need for organizations that do not pursue profit as their goal, but rather work on furthering the state of the art. Computer networking was developed and spread widely in an environment outside of commercial and profit considerations, an environment that supported such research.

Others understood the communications promise of computers. For example, in RFC-1336, David Clark, a senior research scientist at MIT's Laboratory for Computer Science, describes the impact of the Internet in making possible new means of human-to-human communication:

> It is not proper to think of networks as connecting computers. Rather, they connect people using computers to mediate. The great success of the Internet is not technical, but in human impact. Electronic mail may not be a wonderful advance in Computer Science, but it is a whole new way for people to communicate. The continued growth of the Internet is a technical challenge to all of us, but we must never lose sight of where we came from, the great change we have worked on the larger computer community, and the great potential we have for future change.[14]

Research predating the ARPANET had been done by Paul Baran, Thomas Marill and others.[15] This led Lawrence Roberts and other IPTO staff to formally introduce the topic of networking computers of differing types (that is, incompatible hardware and software) together in order to make it possible for ARPA's Principal Investigators (PI) to share resources. The ARPA Principal Investigators meeting was held annually for university and other contractors to summarize results of the previous year and discuss future research. In the Spring of 1967 it was held at the University of Michigan in Ann Arbor. Networking was one of the topics brought up at this meeting. As a result of discussion at this meeting, it was decided that there had to be agreement on conventions for character and block transmission, error checking and re-transmission, and computer and user identification. These specifications became the contents of the inter-host communication's "protocol." Frank Westervelt was chosen to write about this protocol, and a communication group was formed to study the questions.[16]

In order to develop a network of varied computers, two main problems had to be solved:

> 1. To construct a "subnetwork" consisting of telephone circuits and switching nodes whose reliability, delay characteristics, capacity, and cost would facilitate resource sharing among the computers on the network.
> 2. To understand, design, and implement the protocols and procedures within the operating systems of each connected computer, in order to allow the use of the new subnetwork by those computers in sharing resources.[17]

After one draft and additional work on this communications position paper were completed, a meeting was scheduled in early October 1967 by ARPA at which the protocol paper and specifications for the Interface Message Processor (IMP) were discussed. A subnetwork of IMPs, dedicated minicomputers connected to each of the participant's computers, was the method chosen to connect the computers (hosts) to each other via phone lines. This standardized the subnet to which the hosts connected. Researchers at each site would have to write the software necessary to connect their local host computer to the IMP at their site. ARPA picked 19 possible participants in what was now known as the "ARPA Network."

From the time of the 1967 PI meeting, various computer scientists who were ARPA contractors were busy thinking about the planning and development of the ARPANET. Part of that work was a document outlining a beginning design for the IMP subnetwork. This specification led to a competitive procurement for the

design of the IMP subnetwork.

By late 1967 ARPA had given a contract to the Stanford Research Institute (SRI) to write specifications for the communications network they were developing. In December of 1968, SRI issued the report, "A Study of Computer Network Design Parameters." Elmer Shapiro played an important role in the research for this report. Based on this work, Lawrence Roberts and Barry Wessler of ARPA wrote the final ARPA version of the IMP specification.[18] This specification was ready to be discussed at the June 1968 PI meeting.

The Program Plan, "Resource Sharing Computer Networks," was submitted June 3, 1968 by the IPTO to the ARPA Director, who, with unusual speed, approved it on June 21, 1968. It outlined the objectives of the research and how the objectives would be fulfilled. The proposed network was impressive, as it would prove useful to both the computing research centers that connected to the network and to the military. The proposed research requirements would provide immediate benefits to the computer centers the network would connect. ARPA's stated objectives were to experiment with varied interconnections of computers and the sharing of resources in an attempt to improve productivity of computer research. Justification was drawn from technical needs in both the scientific and military environments. The Program Plan developed into a set of specifications. These specifications were connected to a competitive Request for Quotation (RFQ) to find an organization that would design and build the IMP subnetwork.[19]

Following the approval of the Program Plan, 140 potential bidders were mailed the Request for Quotation. After a bidders conference, 12 proposals were received and from them ARPA narrowed the field to four bidders. BBN was the eventual recipient of the contract.[20]

The second technical problem, as defined by the ad hoc Communications Group, still remained to be solved. The set of agreed upon communications settings (known as a protocol), which would allow the hosts to communicate with each other over the subnetwork, had to be developed. This work was left "for host sites to work out among themselves."[21] This meant that the software necessary to connect the hosts to the IMP subnetwork had to be developed. ARPA assigned this duty to the initially designated ARPANET sites. Each of the first sites had a different type of computer to connect. ARPA trusted that the programmers at each site would be capable of modifying their operating systems in order to connect their systems to the subnetwork. In addition, the sites needed to develop the software necessary to utilize the other hosts on the network. By assigning them responsibilities, ARPA made the academic computer science community an active part of the ARPANET development team.[22]

Stephen Crocker, one of graduate students involved with the development of the earliest ARPANET protocols, associates the placement of the initial ARPANET sites at research institutions with the fact that the ARPANET was ground-breaking research. He wrote in a message responding to questions on the com-priv mailing list:

> During the initial development of the ARPANET, there was simply a limit as to how far ahead anyone could see and manage. The IMPs were placed in cooperative ARPA R&D sites with the hope that these research sites would figure out how to exploit this new communication medium.[23]

The first sites of the ARPANET were picked to provide either network support services or unique resources. The key services the first four sites provided were:[24]

SITE	SERVICE OR RESOURCE
UCLA	Network Measurement Center
SRI	Network Information Center
UCSB	Culler-Fried interactive mathematics
Utah	graphics (hidden line removal)

Crocker recounts that these four sites were selected because they were "existing ARPA computer science research contractors." This was important because "the research community could be counted on to take some initiative."[25]

The very first site to receive an IMP was UCLA. Professor Leonard Kleinrock of UCLA was involved with much of the early development of the ARPANET. His work in queuing theory gave him a basis to develop measurement techniques used to monitor the ARPANET'S performance. This made it natural that UCLA received one of the first nodes, as it would be important to measure the network's activity from early on – one of the first two or three sites had to be the measurement site in order for the statistics to be based on correct data for analysis purposes and UCLA accordingly came to be the Network Measurement Center (NMC).[26]

The Network Working Group

Once the initial sites were chosen, representatives from each site gathered together to talk about how to solve the technical problem of getting the hosts to communicate with each other. The *Completion Report Draft* tells us about this beginning:

> To provide the hosts with a little impetus to work on the host-to-host problems, ARPA assigned Elmer Shapiro of SRI "to make something happen," a typically vague ARPA assignment. Shapiro called a meeting in the summer of 1968 which was attended by programmers from several of the first hosts to be connected to the network. Individuals who were present have said that it was clear from the meeting at that time, no one had even any clear notions of what the fundamental host-to-host issues might be.[27]

This group, which came to be known as the Network Working Group (NWG), was exploring new territory. The first meeting took place several months before the first IMP was configured. The group had to begin with a blank slate. In Crocker's recollections of the important developments produced by the NWG which were provided as the introduction to RFC-1000, the reader is reminded that the thinking involved was ground-breaking and thus exciting. Crocker remembers that the first meeting was chaired by Elmer Shapiro of SRI, who initiated the conversation with a list of questions.[28] Also present at this first meeting were Steve Carr from the University of Utah, Crocker from UCLA, Jeff Rulifson from SRI, and Ron Stoughton from UCSB. These attendees, most of them graduate students, were the programmers described in the *Completion Report Draft*.

According to Crocker, this was a seminal meeting. The attendees could only be theoretical, as none of the lowest levels of communication had been developed yet. They needed a transport layer or low-level communications platform to build upon. BBN would not deliver the first IMP until August 30, 1969. It was important to meet before this date, as the NWG "imagined all sorts of possibilities."[29] Only once they started thinking together could this working group actually develop anything. These fresh thoughts from fresh minds helped to incubate new ideas. The *Completion Report Draft* properly acknowledges what this early group helped accomplish. "Their early thinking was at a very high level."[30] A concrete decision made at the first meeting was to continue holding meetings similar to the first one. This set the precedent of holding exchange meetings at each of their sites.

Crocker, describing the problems facing these networking pioneers, writes:

> With no specific service definition in place for what the IMPs were providing to the hosts, there wasn't any clear idea of what work the hosts had to do. Only later did we articulate the notion of building a layered set of protocols with general transport services on the bottom and multiple application-specific protocols on the top. More precisely, we understood quite early that we wanted quite a bit of generality, but we didn't have a clear idea how to achieve it. We struggled between a grand design and getting something working quickly.[31]

The initial protocol development led to DEL (Decode-Encode Language) and NIL (Network Interchange Language). These languages were more advanced than what was needed and could not be implemented at the time. The basic purpose was to form an on-the-fly description that would tell the receiving end how to understand the information that would be sent. The discussion at this first set of meetings was extremely abstract as neither ARPA nor the universities had conceived of an official charter. However, the lack of a specific charter allowed the group to think broadly and openly.

BBN had provided details about the host-IMP interface specifications from the IMP side. This information gave the group some definite starting points to build from. Soon after BBN provided more information, members of the NWG, of BBN, and of the Network Analysis Corporation (NAC) met for the first time on Valentine's Day, 1969. The NAC had been invited because it had been contracted by ARPA to specify the topological design of the ARPANET and to analyze its cost, performance, and reliability characteristics.[32] As all the parties had different priorities, the meeting was a difficult one. BBN was interested in the lowest level of making a reliable connection. The programmers from the host sites were interested in getting the hosts to communicate with each other either via various higher-level programs. Even when the crew from BBN did not turn out to be the "experts from the East," members of the NWG still expected that "a professional crew would show up eventually to take over the problems we were dealing with."

A step of great importance that began the open

documentation process occurred as a result of a "particularly delightful" meeting a month later in Utah. The participants decided it was time to start recording their meetings in a consistent fashion. What resulted was a set of informal notes titled "Request for Comments" (RFC). Crocker writes about their formation:

> I remember having great fear that we would offend whomever the official protocol designers were, and I spent a sleepless night composing humble words for our notes. The basic ground rules were that anyone could say anything and that nothing was official. And to emphasize the point, I labeled the notes "Request for Comments." I never dreamed these notes would be distributed through the very medium we were discussing in these notes. Talk about Sorcerer's Apprentice![33]

Crocker replaced Shapiro as the Chairman of the NWG soon after the initial meeting. He describes how they wrestled with the creation of the host-host protocols:

> Over the spring and summer of 1969 we grappled with the detailed problems of protocol design. Although we had a vision of the vast potential for intercomputer communication, designing usable protocols was another matter. A custom hardware interface and custom intrusion into the operating system was going to be required for anything we designed, and we anticipated serious difficulty at each of the sites. We looked for existing abstractions to use. It would have been convenient if we could have made the network simply look like a tape drive to each host, but we knew that wouldn't do.[34]

The first IMP was delivered to UCLA in late August, 1969. The next was delivered to SRI a month later in October.[35] As soon as more than one IMP existed, the NWG had to implement a working communications protocol. The first set of pairwise host protocols included remote login for interactive use (Telnet), and a way to copy files between remote hosts (FTP). Crocker writes:

> In particular, only asymmetric, user-server relationships were supported. In December 1969, we met with Larry Roberts in Utah, [and he] made it abundantly clear that our first step was not big enough, and we went back to the drawing board. Over the next few months we designed a symmetric host-host protocol, and we defined an abstract implementation of the protocol known as the Network Control Program. ("NCP" later came to be used as the name for the protocol, but it originally meant the program within the operating system that managed connections. The protocol itself was known blandly only as the host-host protocol.) Along with the basic host-host protocol, we also envisioned a hierarchy of protocols, with Telnet, FTP and some splinter protocols as the first examples. If we had only consulted the ancient mystics, we would have seen immediately that seven layers were required.[36]

The NWG went on to develop the protocols necessary to make the network viable. The group grew as more and more sites connected to the ARPANET. The group became large enough (around 100 people) that one meeting was held in conjunction with the 1971 Spring Joint Computer Conference in Atlantic City. A major test of the NWG's work came in October 1971, when a meeting was held at MIT. Crocker continues the story:

> [A] major protocol "fly-off" – Representatives from each site were on hand, and everyone tried to log in to everyone else's site. With the exception of one site that was completely down, the matrix was almost completely filled in, and we had reached a major milestone in connectivity.[37]

The NWG was creating what was called the "host to host protocol." Explaining why this was important, the authors of the Completion Report Draft wrote:

> … [T]he problem is to design a host protocol which is sufficiently powerful for the kinds of communication that will occur and yet can be implemented in all of the various different host computer systems. The initial approach taken involved an entity called a "Network Control Program" which would typically reside in the executive of a host, such that processes within a host would communicate with the network through this Network Control Program. The primary function of the NCP is to establish connections, break connections,

> switch connections, and control flow. A layered approach was taken such that more complex procedures (such as File Transfer Procedures) were built on top of similar procedures in the host Network Control Program.[38]

As the ARPANET grew, the number of users bypassed the number of developers, signaling the success of these networking pioneers. Crocker appointed Alex McKenzie and Jon Postel to replace him as chairmen of the Network Working Group. The *Completion Report Draft* details how this role changed:

> McKenzie and Postel interpreted their task to be one of codification and coordination primarily, and after a few more spurts of activity the protocol definition process settled for the most part into a status of a maintenance effort.[39]

ARPA was a management body which funded academic computer scientists. ARPA's funding paved the way for these scientists to create the ARPANET. BBN helped by developing the packet switching techniques which served as the bottom level of transmitting information between sites. The NWG provided an important development in its "Request for Comments" documentation which made possible developing the new protocols.

RFCs as "Open" Documentation

The open exchange of ideas initiated from the very first meeting of the Network Working Group was continued in the Request For Comments. As meeting notes, the RFCs were meant to keep members updated on the status of various developments and ideas. They were also meant to gather responses from people. RFC-3, "Documentation Conventions," documents the "rules" governing the production of these notes beginning with the open distribution rule:

> Documentation of the NWG's effort is through notes such as this. Notes may be produced at any site by anybody and included in this series.[40]

These opening sentences invite anyone willing to be helpful into the protocol definition process. This is important because all restrictions are lifted by these words, allowing for the open process aimed for. (RFC-3 is reproduced in the appendix at the end of this chapter.) The guide goes on to describe the rules concerning the content of the RFCs:

> The content of a NWG note may be any thought, suggestion, etc. related to the HOST software or other aspect of the network. Notes are encouraged to be timely rather than polished. Philosophical positions without examples or other specifics, specific suggestions or implementation techniques without introductory or background explication, and explicit questions without any attempted answers are all acceptable. The minimum length for a NWG note is one sentence.[41]

In RFC-3, Crocker continues to explain the philosophy behind the perhaps unprecedented openness represented:

> These standards (or lack of them) are stated explicitly for two reasons. First, there is a tendency to view a written statement as ipso facto authoritative, and we hope to promote the exchange and discussion of considerably less than authoritative ideas. Second, there is a natural hesitancy to publish something unpolished, and we hope to ease this inhibition.[42]

This open process encouraged and led to the exchange of information. Technical development is only successful when information is allowed to flow freely and easily between the parties involved. Encouraging participation is the main principle that made the development of the Net possible.

Statements like the ones contained in RFC-3 are democratic in their support of a process of openness. They were written during the late 1960s, a time of popular protest for freedom of speech. People were demanding more of a say in how their countries were run. The open environment needed to develop new technologies is consistent with the cry for more democracy that students and others raised throughout the world during the 1960s. What is amazing is the collaboration of the NWG (mostly graduate students) and ARPA (a component of the military) during the 1960s and 1970s. This seems unusual given the active student anti-war movement. Robert Braden of the Internet Activities Board reflects on this collaboration:

> For me, participation in the development of the ARPANET and the Internet protocols has been very exciting. One important reason it worked, I believe, is that there were a lot of very bright people all working more or less in the same direction, led by some very wise people in the funding

> agency. The result was to create a community of network researchers who believed strongly that collaboration is more powerful than competition among researchers. I don't think any other model would have gotten us where we are today.[43]

Such collaboration is why the work of these computer scientists led to such amazing and democratic achievements, the Net and the cooperative culture of the Net.[44]

Calling their notes a "Request for Comment" established a significant tradition. It predates the Usenet post, which in a fashion could also be called a "request for comment." Both are the presentation of a particular person's ideas, questions, or comments to the general public for comments, criticism, or suggestions. Early RFCs established this tradition. Many RFCs are in fact comments on previous RFCs.[45]

Conclusion

How were the developments of the ARPANET made possible? None of the participants had previous solutions to any of the problems they faced in establishing a working packet-switched test bed with host-to-host connectivity. They had to put much thought and work into their research. As the resulting ARPANET was tremendously successful and fulfilled ARPA's project objectives, it is important to see what can be learned from the research and research methods from which it emerged. Bernie Cosell, who worked at BBN during this early period, describes the importance of an open process in a developmental situation:

> *no *one* had the necessary expertise [and vision] to figure any of this out on their own. The cultures among the early groups were VERY different [–] multics, sigma-7, IBM … at Rand … PDP-IOs at BBN and SRI … [and possibly] UCSB and Utah had pdp-1O's, too. The pie-in-the-sky applications ranged over a WIDE landscape, with no one knowing quite where it would lead. Some kind of free, cross-cultural info/idea exchange *had* to happen.[46]

The computer scientists and others involved were encouraged in their work by ARPA's philosophy of gathering the best computer scientists working in the field and supporting them.

> IPT usually does little day-to-day management of its contractors. Especially with its research contracts, IPT would not be producing faster results with such management – research must progress at its own pace. IPT has generally adopted a mode of management which entails finding highly motivated, highly skilled contractors, giving them a task, and allowing them to proceed by themselves.[47]

The work of the Network Working Group was vital to the development of the ARPANET. Vinton Cerf, another of the graduate students involved with the early protocol development and still closely connected to the Internet, echoed this sentiment in his paper "An Assessment of ARPANET Protocols":

> The history of the Advanced Research Project Agency resource sharing computer network (ARPANET) is in many ways a history of the study, development, and implementation of protocols.[48]

Cerf supports Cosell's opinion about the uncertainty and newness of the entire project:

> The tasks facing the ARPANET design teams were often unclear, and frequently required agreements which had never been contemplated before (e.g., common protocols to permit different operating systems and hardware to communicate). The success of the effort, seen in retrospect, is astonishing, and much credit is due to those who were willing to commit themselves to the job of putting the ARPANET together.[49]

The NWG's work blazed the trail which the developers of the TCP/IP suite of protocols (Transmission Control Protocol/Internet Protocol) successfully followed when the need to expand and include other networks based on technologies other than NCP arose. The principles embodied in RFC-3 and the open RFC documentation process provided a strong foundation which began with NCP and was continued by the work on TCP/IP. NCP was developed in the field, and versions of it were released early in its development so various programmers could work on implementing and improving the protocol. In addition, all specifications were free and easily available for people to examine and comment on. Through this principle of early release, problems and kinks were found and worked out in a timely manner. The future developers of TCP/IP learned from the developers of NCP a practice of developing from the bottom up. The bottom-up model allows for a wide range of people and experiences to join in and perfect the protocol and make it

the best possible.

The public funding of the ARPANET project meant that the documentation could be made public and freely available. The documentation was neither restricted nor classified. This open process encouraging communication was necessary for these pioneers to succeed. Research in new fields of study requires that researchers cooperate and communicate in order to share their expertise. Such openness is especially critical when no one person has the answers in advance. In his article, "The Evolution of Packet Switching," Larry Roberts described the public nature of the process:

> Since the ARPANET was a public project connecting many major universities and research institutions, the implementation and performance details were widely published.[50]

The people at the forefront of development of these protocols were the members of the Network Working Group, many of whom came from academic institutions, and who therefore had the support and time needed for the research. In summing up the achievements of the process that developed the ARPANET, the Completion Report Draft explains:

> The ARPANET development was an extremely intense activity in which contributions were made by many of the best computer scientists in the United States. Thus, almost all of the "major technical problems" already mentioned received continuing attention and the detailed approach to those problems changed several times during the early years of the ARPANET effort.[51]

Fundamental to the ARPANET, as explained by the *Completion Report*, was the discovery of a new way of looking at computers. The developers of the ARPANET viewed the computer as a communications device rather than only as an arithmetic device.[52] This new view, which came from research conducted by those in academic computer science, made the building of the ARPANET possible. Such a shift in understanding the role of the computer was fundamental in advancing computer science. The ARPANET research has provided a rich legacy for the further advancement of computer science, and it is important that the significant lessons learned be studied and used to further advance the study of computer science.

Notes

1. F. Heart, A. McKenzie, J. McQuillan, and D. Walden, *ARPANET Completion Report* (Washington, D. C.: DARPA and BBN, 1978) III-132 (hereafter, *Completion Report*).
2. *ARPANET Completion Report Draft*, September 9, 1977, unpublished manuscript, III-6. (Hereafter, *Completion Report Draft*).
3. *Ibid.*
4. *Ibid.*, III-7.
5. "Interview with J.C.R. Licklider" conducted by William Aspray and Arthur L. Norberg, tape recording, Cambridge, Massachusetts, 28 October 1988, OH 150, Charles Babbage Institute, University of Minnesota, Minneapolis, Minnesota. https://conservancy.umn.edu/bitstream/handle/11299/107436/oh150jcl.pdf
6. *Completion Report Draft*, III-7.
7. *Ibid.*
8. *Ibid.*, III-21.
9. See, for example, J.C.R. Licklider and Robert Taylor, "The Computer as a Communication Device," in *In Memoriam: J.C.R. Licklider 1915-1990* (Palo Alto, CA.: Digital Systems Research Center, 1990), originally published in *Science and Technology*, April 1968.
10. *Completion Report Draft*, III-23.
11. *Ibid.*, III-24.
12. *Ibid.*
13. *Ibid.*
14. RFC-1336, "Who's Who in the Internet," G. Malkin, May 1992, 15.
15. *Completion Report*, section 1.1.2, starting on III-9.
16. *Completion Report Draft*, III-25, III-26.
17. *Completion Report*, II-7-II-8.
18. *Completion Report Draft*, III-3-III-33.
19. *Ibid.*, 1III-35 and *Completion Report*, II-2.
20. *Completion Report Draft*, III-35, III-36.
21. *Ibid.*, III-67.
22. *Ibid.*, III-39 and personal discussion with Alex McKenzie, November 1, 1993.
23. E-mail message to com-priv mailing list (com-priv@psi.com). Subject: "Re: RFC-1000 (Partial response to part 1)." Date: Nov. 27, 1993.
24. Vinton G. Cerf, private e-mail correspondence, dated Nov. 27, 1993. Subject: "Re: Early Days of the ARPANET and the NWG."
25. "The Origins of RFCs" by Stephen D. Crocker is contained in J. Reynolds and J. Postel, RFC-1000, 1.
26. The following quotes show some of the reasoning that went into the choice of the initial ARPANET sites:
"CCN's (The Campus Computing Network of UCLA] chance to obtain a connection to the ARPANET was a result of the presence at UCLA of Professor L. Kleinrock and his students, including S. Crocker, J. Postel, and V. Cerf. This group was not only involved in the original design of the network and the Host protocols, but also was to operate the Network Measurement Center (NMC). For these reasons the first delivered IMP was installed at UCLA, and ARPA was thus able to easily offer CCN the opportunity for connection (*Completion Report Draft*, III-689).
UCLA was specifically asked to take on the task of a 'Network Measurement Center' with the objective of studying the performance of the network as it was built, grown, and modified; SRI was specifically asked to take on the task of a 'Network Informa-

tion Center' with the objective of collecting information about the network, about host resources, and at the same time generating computer based tools for storing and accessing that collected information (*Completion Report Draft*, II-16).

The accessibility of distributed resources carries with it the need for an information service (either centralized or distributed) that enables users to learn about those resources. This was recognized at the P1 meeting in Michigan in the spring of 1967. At the time, Doug Engelbart and his group at the Stanford Research Institute were already involved in research and development to provide a computer-based facility to augment human interaction. Thus, it was decided that Stanford Research Institute would be a suitable place for a 'Network Information Center' (NIC) to be established for the ARPANET. With the beginning of implementation of the network in 1969, construction also began on the NIC at SRI" (*Completion Report Draft*, III-60).

27. *Completion Report Draft*, III-67.
28. E-mail message to com-priv mailing list. Subject: "Re: RFC-1000 (End of response to part 1)," Date: Nov. 27, 1993.
29. RFC-1000.
30. *Completion Report Draft*, III-67.
31. E-mail message to com-priv mailing list. Subject: "Re: RFC-1000 (Response to part 2)," Date: Nov. 27, 1993.
32. *Completion Report*, III-30.
33. RFC-1000, 3.
34. Ibid.
35. In RFC-1000, Stephen Crocker reports on the process of the installation of the first IMP:

"[T]ime was pressing: The first IMP was due to be delivered to UCLA September 1, 1969, and the rest were scheduled at monthly intervals.

At UCLA we scrambled to build a host-IMP interface. SDS, the builder of the Sigma 7, wanted many months and many dollars to do the job.

Mike Wingfield, another grad student at UCLA, stepped in and offered to get the interface built in six weeks for a few thousand dollars. He had a gorgeous, fully instrumented interface working in five and one-half weeks. I was in charge of the software, and we were naturally running a bit late. September 1 was Labor Day, so I knew I had a couple of extra days to debug the software. Moreover, I had heard BBN was having some timing troubles with the software, so I had some hope they'd miss the ship date. And I figured that first some Honeywell people would install the hardware – IMPs were built out of Honeywell 516s in those days – and then BBN people would come in a few days later to shake down the software. An easy couple of weeks of grace.

BBN fixed their timing trouble, air shipped the IMP, and it arrived on our loading dock on Saturday, August 30. They arrived with the IMP, wheeled it into our computer room, plugged it in and the software restarted from where it had been when the plug was pulled in Cambridge. Still Saturday August 30. Panic time at UCLA.

The second IMP was delivered to SRI at the beginning of October, and ARPA's interest was intense. Larry Roberts and Barry Wessler came by for a visit on November 21, and we actually managed to demonstrate a Telnet-like connection to SRI."

36. RFC-1000, 4.
37. Ibid.
38. *Completion Report Draft*, II-24.
39. *Ibid.*, III-69.
40. RFC-3, "Documentation Conventions," Stephen Crocker, April 1969, 1.
41. Ibid.
42. Ibid.
43. RFC-1336, 5.
44. This democratic community is in danger of being fundamentally altered. This study of the history of the development of the ARPANET is meant to help people understand where the Net has come from, in order to defend it, and try to fight to keep it open and democratic – "the eighth wonder of the world," as some call the Internet.
45. Some examples of comments upon comments include:

RFC-1 Crocker, S. Host software, 1969 April 7

RFC-65 Walden, D. Comments on Host/Host Protocol document #1

RFC-36 Crocker, S. Protocol notes, 1970 March 16

RFC-38 Wolfr, S. Comments on network protocol from NWG/RFC-36

RFC-39 Harslem, E.; Heaftier,J. Comments on protocol re: NWG/RFC-36

RFC-33 Crocker, S. New Host-Host Protocol, 1970 February 12

RFC-47 Crowther,W. BBN's comments on NWG/RFC-33 1970 April 20

46. Bernie Cosell, "Re: RFC-1000 – Questions about the Origins of ARPANET Protocols 2/2," alt.folklore.computers, Nov. 23, 1993.
47. *Completion Report Draft*, III-47.
48. Vinton Cerf, "An Assessment of ARPANET Protocols," Infotech Education Ltd., Stanford University, California, (n.d.), 1.
49. Ibid.
50. Lawrence Roberts, "The Evolution of Packet Switching," *Proceedings of the IEEE 66* (November 1978): 267. http://dx.doi.org/10.1109/PROC.1978.11141
51. *Completion Report Draft*, II-24-II-25.
52. *Ibid.*, III-24.

Special thanks to Alexander McKenzie of BBN, Stephen Crocker of TIS, and Vinton Cerf of MCI for making research materials available.

Appendix

Network Working Group 4689
RFC-3 April 1969
Steve Crocker
, UCLA

DOCUMENTATION CONVENTIONS

The Network Working Group seems to consist of Steve Carr of Utah, Jeff Rulifson and Bill Duvall at SRIand Steve Crocker and Gerard Deloche at UCLA. Membership is not closed.

The Network Working Group (NWG) is concerned with the HOST software, the strategies for using the network, and initial experiments with the network.

Documentation of the NWG's effort is through notes such as this. Notes may be produced at any site by anybody and included in this series.

CONTENT

The content of a NWG note may be any thought, suggestion, etc. related to the HOST software or other aspect of the network. Notes are encouraged to be timely rather than polished. Philosophical positions without examples or other specifics, specific suggestions or implementation techniques without introductory or background explication, and explicit questions without any attempted answers are all acceptable. The minimum length for a NWG note is one sentence.

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FORM

Every NWG note should bear the following information:
1. "Network Working Group"
"Request for Comments:" x, where x is a serial number.
Serial numbers are assigned by Bill Duvall at SRI
2. Author and affiliation
3. Date
4. Title. The title need not be unique.

DISTRIBUTION

One copy only will be sent from the author's site to:
1. Bob Kahn, BB&N
2. Larry Roberts, ARPA
3. Steve Carr, UCLA
4. Jeff Rulifson, UTAH
5. Ron Stoughton, UCSB
6. Steve Crocker, UCLA

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OTHER NOTES

Two notes (1 & 2) have been written so far. These are both titled HOST Software and are by Steve Crocker and Bill Duvall, separately.
Other notes planned are on:
1. Network Timetable
2. The Philosophy of NIL
3. Specifications for NIL
4. Deeper Documentation of HOST Software.

Note: This document is available at:
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