Network Working Group
Request for Comments: 1251
FYI: 9

G. Malkin
FTP Software, Inc.

August 1991

# Who's Who in the Internet
## Biographies of IAB, IESG and IRSG Members

## Status of this Memo

This FYI RFC contains biographical information about members of the Internet Activities Board (IAB), the Internet Engineering Steering Group (IESG) of the Internet Engineering Task Force (IETF), and the the Internet Research Steering Group (IRSG) of the Internet Research Task Force (IRTF).

This memo provides information for the Internet community. It does not specify an Internet standard. Distribution of this memo is unlimited.

## Table of Contents

## 1. Introduction

There are thousands of networks in the internet. There are tens of thousands of host machines. There are hundreds of thousands of users. It takes a great deal of effort to manage the resources and protocols which make the Internet possible. Sites may have people who get paid to manage their hardware and software. But the infrastructure of the Internet is managed by volunteers who spend considerable portions of their valued time to keep the people connected.

Hundreds of people attend the three IETF meetings each year. They represent the government, the military, research institutions, educational institutions, and vendors from all over the world. Most of them are volunteers; people who attend the meetings to learn and to contribute what they know. There are a few very special people who deserve special notice. These are the people who sit on the IAB, IESG, and IRSG. Not only do they spend time at the meetings, but they spend additional time to organize them. They are the IETF's interface to other standards bodies and to the funding institutions. Without them, the IETF, indeed the whole Internet, would not be possible.

## 2. Acknowledgements

In addition to the people who took the time to write their biographies so that I could compile them into this FYI RFC, I would like to give special thanks to Joyce K. Reynolds (whose biography is in here) for her help in creating the biography request message and for being such a good sounding board for me.

## 3. Request for Biographies

In mid-February, I sent the following message to the members of the IAB, IESG and IRSG. It is their responses to this message that I have compiled in this FYI RFC.

> The ARPANET is 20 years old. The next meeting of the IETF in St. Louis this coming March will be the 20th plenary. It is a good time to credit the people who help make the Internet possible. I am sending this request to the current members of the IAB, the IRSG, and the IESG. At some future time, I would like to expand the number of people to be included. For now, however, I am limiting inclusion to members of the groups listed above.
>
> I would like to ask you to submit to me your biography. I intend to compile the bios submitted into an FYI RFC to be published before the next IETF meeting. In order to maintain some

consistency, I would like to have the bios contain three paragraphs. The first paragraph should contain your bio, second should be your school affiliation & other interests, and the third should contain your opinion of how the Internet has grown. Of course, if there is anything else you would like to say, please feel free. The object is to let the very large user community know about the people who give them what they have.

## 4. Biographies

The biographies are in alphabetical order. The contents have not been edited; only the formating has been changed.

### 4.1 Robert Braden, IAB Executive Director

Bob Braden joined the networking research group at ISI in 1986. Since thenf, he has been supported by NSF for research concerning NSFnet, and by DARPA for protocol research. Tasks have included designing the statspy program for collecting NSFnet statistics, editing the Host Requirements RFCs, and coordinating the DARPA Research Testbed network DARTnet. His research interests generally include end-to-end protocols, especially in the transport and network (Internet) layers.

Braden came to ISI from UCLA, where he had worked 16 of the preceding 18 years for the campus computing center. There he had technical responsibility for attaching the first supercomputer (IBM 360/91) to the ARPAnet, beginning in 1970. Braden was active in the ARPAnet Network Working Group, contributing to the design of the FTP protocol in particular. In 1975, he began to receive direct DARPA funding for installing the 360/91 as a "tool-bearing host" in the National Software Works. In 1978, he became a member of the TCP Internet Working Group and began developing a TCP/IP implementation for the IBM system. As a result, UCLA's 360/91 was one of the ARPAnet host systems that replaced NCP by TCP/IP in the big changeover of January 1983. The UCLA package of ARPAnet host software, including Braden's TCP/IP code, was distributed to other OS/MVS sites and was later sold commercially.

Braden spent 1981-1982 in the Computer Science Department of University College London. At that time, he wrote the first Telnet/XXX relay system connecting the Internet with the UK academic X.25 network. In 1981, Braden was invited to join the ICCB, an organization that became the IAB, and has been an IAB member ever since. When IAB task forces were formed in 1986, he created and still chairs the End-to-End Task

Force (now Research Group).

Braden has been in the computer field for 40 years this year. Prior to UCLA, he worked at Stanford and at Carnegie Tech. He has taught programming and operating systems courses at Carnegie Tech, Stanford, and UCLA. He received a Bachelor of Engineering Physics from Cornell in 1957, and an MS in Physics from Stanford in 1962.

---

Regardless of the ancient Chinese curse, living through interesting times is not always bad.

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. This world view persists in the IAB, and is reflected in the informal structure of the IAB, IETF, and IRTF.

Nevertheless, with growth and success (plus subtle policy shifts in Washington), the prevailing mode may be shifting towards competition, both commercial and academic. To develop protocols in a commercially competitive world, you need elaborate committee structures and rules. The action then shifts to the large companies, away from small companies and universities. In an academically competitive world, you don't develop any (useful) protocols; you get 6 different protocols for the same objective, each with its research paper (which is the "real" output). This results in efficient production of research papers, but it may not result in the kind of intellectual consensus necessary to create good and useful communication protocols.

Being a member of the IAB is sometimes very frustrating. For some years now we have been painfully aware of the scaling problems of the Internet, and since 1982 have lived through a series of mini-disasters as various limits have been exceeded. We have been saying that "getting big" is probably a more urgent (and perhaps more difficult) research problem than "getting fast", but it seems difficult to persuade people of the importance of launching the kind of research

program we think is necessary to learn how to deal with Internet growth.

It is very hard to figure out when the exponential growth is likely to stop, or when, if ever, the fundamental architectural model of the Internet will be so out of kilter with reality that it will cease be useful. Ask me again in ten years.

### 4.2 Hans-Werner Braun, IAB Member

Hans-Werner Braun joined the San Diego Supercomputer Center as a Principal Scientist in January 1991. In his initial major responsibility as Co-Principal Investigator of, and Executive Committee member on the CASA gigabit network research project he is working on networking efforts beyond the problems of todays computer networking infrastructure. Between April 1983 and January 1991 he worked at the University of Michigan and focused on operational infrastructure for the Merit Computer Network and the University of Michigan's Information Technology Division. Starting out with the networking infrastructure within the State of Michigan he started to investigate into TCP/IP protocols and became very involved in the early stages of the NSFNET networking efforts. He was Principal Investigator on the NSFNET backbone project since the NSFNET award went to Merit in November 1987 and managed Merit's Internet Engineering group. Between April 1978 and April 1983 Hans-Werner Braun worked at the Regional Computing Center of the University of Cologne in West Germany on network engineering responsibilities for the regional and local network.

In March 1978 Hans-Werner Braun graduated in West Germany and holds a Diploma in Engineering with a major in Information Processing. He is a member of the Association of Computing Machinery (ACM) and its Special Interest Group on Communications, the Institute of Electrical and Electronical Engineers (IEEE) as well as the IEEE Computer Society and the IEEE Communications Society and the American Association for the Advancement of Science. He was a member of the National Science Foundation's Network Program Advisory Group (NPAG) and in particular its Technical Committee (NPAG-TC) between November 1986 and late 1987, at which time the NPAG got resolved. He also chaired the Technical Committee of the National Science Foundation's Network Program Advisory Group (NPAG-TC) starting in February 1987. Prior to the organizational change of the JvNCnet he participated in the JvNCnet Network Technical Advisory Committee (NTAC) of the

John von Neumann National Supercomputer Center. While working as Principal Investigator on the NSFNET project at Merit, he chaired the NSFNET Network Technical Committee, created to aid Merit with the NSFNET project. Hans-Werner Braun is a member of the Engineering Planning Group of the Federal Networking Council (FEPG) since its beginnings in early 1989, a member of the Internet Activities Board (IAB), the Internet Engineering Task Force. He had participated in an earlier, informal, version of the Internet Engineering Steering Group and the then existing Internet Architecture Task Force. While at Merit, Hans-Werner Braun was also Principal Investigator on NSF projects for the "Implementation and Management of Improved Connectivity Between NSFNET and CA*net" and for "Coordinating Routing for the NSFNET," the latter at the time of the old 56kbps NSFNET backbone network that he was quite intimately involved with.

---

The growth of the Internet can be measured in many ways and I can only try to find some examples.

o Network number counts

There were days where being "connected to net 10" was the Greatest Thing Ever. A time where the Internet just consisted of a few networks centered around the ARPAnet and where growing above 100 network numbers seemed excessive. Todays number of networks in the global infrastructure exceeds 2000 connected networks, and many more if isolated network islands get included.

o Traffic growth

The Internet has undergone a dramatic increase in traffic over the last few years. The NSFNET backbone can be used as an example here, where in August 1988 about 194 million packets got injected into the network, which had increased to about 396 million packets per month by the end of the year, to reach about 4.8 billion packets in December 1990. January 1991 yielded close to 5.9 billion packets as sent into the NSFNET backbone.

o Internet Engineering Task Force participation

The early IETF, after it spun off the old GADS, included about 20 or so people. I remember a meeting a few people had with Mike Corrigan several years ago. Mike then chaired the

IETF before Phill Gross became chair and the discussion was had about permitting the "NSFNET crowd" to join the IETF. Mike finally agreed and the IETF started to explode in size, now including many working groups and several hundred members, including vendors and phone companies.

o International infrastructure

At some point of time the Internet was centric around the US with very little international connectivity. The international connectivity was for network research purposes, just like the US domestic component at that point of time. Today's Internet stretches to so many countries that it can be considered close to global in scope, in particular as more and more international connections to, as well as Internet infrastructure within, other countries are happening.

o References in trade journals

Many trade journals just a year or two ago had close to no mention of the Internet. Today references to the Internet appear in many journals and press releases from a variety of places.

o Articles in professional papers

Publications like ACM SIGCOMM show increased interest for Internet related professional papers, compared to a few years ago. Also the publication rate of the Request For Comments (RFC) series is quite impressive.

o Congressional and Senatorial visibility

A few years ago the Internet was "just a research project." Today's dramatically increased visibility in result of the Internet success allows Congress as well as Senators to play lead roles in pushing the National Research and Education Network (NREN) agenda forward, which is also fostered by the executive branch. In the context of the US federal government the real credit should go to DARPA, though, for starting to prototype advanced networking, leading to the Internet about twenty years ago and over time opening it up more and more to the science and research community until more operational efforts were able to move the network to a real infrastructure in support of science, research and education at large. This really allowed NSF to make NSFNET happen.

o Funding

The Internet funding initially consisted of DARPA efforts. Agencies like NSF, NASA, DOE and others started to make major contributions later. Industrial participation helped moving the network forward as well. Very major investments have been made by campuses and research institutions to create local infrastructure. Operational infrastructure comes at a high cost, especially if ubiquity, robustness and high performance are required.

o Research and continued development

The Internet has matured from a network research oriented environment to an operational infrastructure supporting research, science and education at large. However, even though for many people the Internet is an environment supporting their day-to-day work, the Internet at its current level of technology is supported by a culture of people that cooperates in a largely non-competitive environment. Many times already the size of the routing tables or the amount of traffic or the insufficiency of routing exchange protocols, just to name examples, have broken connectivity with many people being interrupted in their day-to-day work. Global Internet management and problem resolution further hamper fast recovery from certain incidents. It is unproven that the current technology will survive in a competitive but unregulated environment, with uncoordinated routing policies and global network management being just two of the major issues here. Furthermore, while frequently comments are being made where the publicly available monthly increases in traffic figures would not justify moving to T3 or even gigabit per second networks, it should be pointed out that monthly figures are very macroscopic views. Much of the Internet traffic is very bursty and we have frequently seen an onslaught of traffic towards backbone nodes if one looks at it over fairly short intervals of time. For example, for specific applications that, perhaps in real-time, require an occasional exchange of massive amounts of data. It is important that we are prepared for more widespread use of such applications, once people are able to use things more sophisticated than Telnet, FTP and SMTP. I am not sure whether the amount of research and development efforts on the Internet has increased over time, less even kept pace with the general Internet growth (by whatever definition). I do not believe that the Internet is a finished product at this point of time and there is a lot of room for further evolution.

### 4.3 Ross Callon, IETF OSI Integration Area Co-director

Ross Callon is a member of the Distributed Systems Architecture staff at Digital Equipment Corporation in Littleton Massachusetts. He is working on issues related to OSI -- TCP/IP interoperation and introduction of OSI in the Internet. He is the primary author of the Integrated IS-IS protocol (RFC1195), and has also worked on guidelines for allocation of NSAP addresses in the Internet. Mr Callon is the co-area director for the OSI area of the IETF, chair of the IETF IS-IS working group, and co-chair of the IETF OSI-General working group.

Previous to joining DEC, Mr Callon was with Bolt Beranek and Newman, where he worked on OSI Standards, Network Management, Routing Protocols and other router-related issues.

Mr Callon received a Bachelor of Science degree in Mathematics from the Massachusetts Institute of Technology, and a Master of Science degree in Operations Research from Stanford University.

---

During eleven years of involvement with the Internet community it has been exciting to see the explosive growth in data communications from a relatively obscure technology to a technology in widespread everyday use. For the future, I am interested in transition to a world-wide multi-protocol Internet. This requires scaling to several orders of magnitude larger than the current Internet, and also requires a greater emphasis on reliability and ease of use.

### 4.4 Dr. Vinton Cerf, IAB Chairman

1960-1965, summer jobs with various divisions of North American Aviation (Now Rockwell International): Rocketdyne, Atomics International, Autonetics, Space and Information Systems Division.

1965-1967, systems engineer, IBM, Los Angeles Data Center. Ran and maintained the QUIKTRAN interactive, on-line Fortran service.

1967-1972, various programming positions at UCLA, largely involved with ARPANET protocol development and network measurement center and computer performance measurements.

1972-1976, Assistant Professor of Computer Science and Electrical Engineering, Stanford University. Did research on networking, developed TCP/IP protocols for internetting under DARPA research grant.

1976-1982, Program Manager and Principal Scientist, Information Processing Techniques Office, DARPA. Managed the Internetting, Packet Technology and Network Security programs.

1982-1986, Vice President of Engineering, MCI Digital Information Services Company. Developed MCI Mail system.

1986-present, Vice President, Corporation for National Research Initiatives. Responsible for Internet, Digital Library and Electronic Mail system interconnection research programs.

Stanford University, 1965 (math) B.S. UCLA, 1970, 1972 (computer science) M.S. and Ph.D.

1972-1976, founding chairman of the International Network Working Group (INWG) which became IFIP Working Group 6.1.

1979-1982, ex officio member of ICCB (predecessor to the Internet Activities Board), member of IAB from 1986-1989 and chairman from 1989-1991.

1967-present, member of ACM; chairman of LA SIGART 1968-1969; chairman ACM SIGCOMM 1987-1991; at-large member ACM Council, 1991-1993.

1972-present, member of Sigma Xi.

1977-present, member of IEEE; Fellow, 1988.

---

The Internet started as a focused DARPA research effort to develop a capability to link computers across multiple, internally diverse packet networks. The successful evolution of this technology through 4 versions, demonstration on ARPANET, mobile packet radio nets, the Atlantic SATNET and at-sea MATNET provided the basis for formal mandating of the TCP/IP protocols for use on ARPANET and other DoD systems in 1983. By the mid-1980's, a market had been established for software and hardware supporting these protocols, largely triggered by the Ethernet and other LAN phenomena, coupled

with the rapid proliferation of UNIX-based systems which incorporated the TCP/IP protocols as part of the standard release package. Concurrent with the development of a market and rapid increase in vendor interest, government agencies in addition to DoD began applying the technology to their needs, culminating in the formation of the Federal Research Internet Coordinating Committee which has now evolved into the Federal Networking Council, in the U.S. At the same time, similar rapid growth of TCP/IP technology application is occurring outside the US in Europe, the Middle East, the Pacific Rim, Eurasia, Australia, South and Central America and, to a limited extent, Africa. The internationalization of the Internet has spawned new organizational foci such as the Coordinating Committee for International Research Networking (CCIRN) and heightened interest in commercial provision of IP services (e.g. in Finland, the U.S., the U.K. and elsewhere).

The Internet has also become the basis for a proposed National Research and Education Network (NREN) in the U.S. It's electronic messaging system has been linked to the major U.S. commercial email carriers and to other major private electronic mail services such as Bitnet (in the US, EARN in Europe) as well as UUNET (in the U.S.) and EUNET (in Europe). The Bitnet and UUCP-based systems are international in scope and complement the Internet system in terms of email connectivity.

With the introduction of OSI capability (in the form of CLNP) into important parts of the Internet (such as the NSFNET backbone and selected intermediate level networks), a path has been opened to support the use of multiple protocol suites in the Internet. Many of the vendor routers/gateways support TCP/IP, OSI and a variety of vendor-specific protocols in a common network environment.

In the U.S., regional Bell Operating Company carriers are planning the introduction of Switched Multimegabit Data Services and Frame Relay services which can support TCP/IP and other Internet protocols. On the research side, DARPA and the NSF are supporting a major initiative in gigabit speed networking, towards which the NREN is aimed.

The Internet is a grand collaboration of over 5000 networks involving millions of users, hundreds of thousands of hosts and dozens of countries around the world. It may well do for computers what the telephone system has done for people: provided a means for international interchange of information which is blind to nationality, proprietary interests, and

hardware platform specifics.

### 4.5 Noel Chiappa, IETF Internet Services Area Director

Noel Chiappa is currently an independent inventor working in the area of computer networks and system software. His principal occupation, however, is his service as the Area Director for Internet Services of the Steering Group of the Internet Engineering Task Force.

His primary current research interest is in the area of routing and addressing architectures for very large scale (globally ubiquitous and larger) internetworks, but he is generally interested in the problems of the packet layer of internetworking; i.e. everything involved in getting traffic

from one host to another anywhere in the internetwork. As a with many novel features intended for use in large programming projects with many source and header files.

He has been a member of the TCP/IP Working Group and its successors (up to the IETF) since 1977. He was a member of the Research Staff at the Massachusetts Institute of Technology from 1977-1982 and 1984-1986. While at MIT he worked on packet switching and local area networks, and was responsible for the conception of the multi-protocol backbone and the multi-protocol router. After leaving MIT he worked with a number of companies, including Proteon, to bring networking products based on work done at MIT to the public. He attended Phillips Andover Academy and MIT. He was born and bred in Bermuda.

His outside interests include study and collection of antique racing cars (principally Lotuses), reading (particularly political and military history and biographies), landscape gardening (particularly Japanese), and study of Oriental rugs (particularly Turkoman tribal rugs) and Oriental antiques (particularly Japanese lacquerware and Chinese archaic jades).

### 4.6 Lyman Chapin, IAB Member

Lyman Chapin graduated from Cornell University in 1973 with a B.A. in Mathematics, and spent the next two years writing COBOL applications for Systems & Programs (NZ) Ltd. in Lower Hutt, New Zealand. After a year travelling in Australia and Asia, he joined the newly-formed Networking group at Data General Corporation in 1977. At DG, he was responsible for

the development of software for distributed resource management (operating-system embedded RPC), distributed database management, X.25-based local and wide- area networks, and OSI-based transport, internetwork, and routing functions for DG's open-system products. In 1987 he formed the Distributed Systems Architecture group, and was responsible for the development of DG's Distributed Application Architecture (DAA) and for the specification of the directory and management services of DAA. He moved to Bolt, Beranek & Newman in 1990 as the Chief Network Architect in BBN's Communications Division, where he serves as a consultant to the Systems Architecture group and the coordinator for BBN's open system standards activities. He is the chairman of ANSI-accredited task group X3S3.3, responsible for Network and Transport layer standards, since 1982; vice-chairman of the ACM Special Interest Group on Data Communications (SIGCOMM) since 1985; and a member of the Internet Activities Board (IAB) since 1989. He lives with his wife and two young daughters in Hopkinton, Massachusetts.

---

I started out in 1977 working with X.25 networks, and began working on OSI in 1979 - first the architecture (the OSI Reference Model), and then the transport and internetwork protocol specifications. It didn't take long to recognize the basic irony of OSI standards development: there we were, solemnly anointing international standards for networking, and every time we needed to send electronic mail or exchange files, we were using the TCP/IP-based Internet! I've been looking for ways to overcome this anomaly ever since; to inject as much of the proven TCP/IP technology into OSI as possible, and to introduce OSI into an ever more pervasive and worldwide Internet. It is, to say the least, a challenge!

### 4.7 Dr. David Clark, IAB Member, IRTF Chairman

David Clark works at the M.I.T. Laboratory for Computer Science, where he is a Senior Research Scientist. His current research involves protocols for high speed and very large networks, in particular the problems of routing and flow and congestion control. He is also working on integration of video into packet networks. Prior to this effort, he developed a new implementation approach for network software, and an operating system (Swift) to demonstrate this concept. Earlier projects include the token ring LAN and the Multics

operating system. He joined the TCP development effort in 1975, and chaired the IAB from 1981 to 1990. He has a continuing interest in protocol performance. He is also active in the area of computer and communications security.

David Clark received his BSEE from Swarthmore College in 1966, and his MS and PhD from MIT, the latter in 1973. He has worked at MIT since then.

---

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 loose 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.

4.8 Dr. Stephen Crocker, IETF Security Area Director

Currently I'm vice president of Trusted Information Systems, Inc. which I joined in late 1986. I set up TIS' Los Angeles office and ran it until summer 1989 when I moved to the home office in Maryland. At TIS my primary concerns are program verification research and application, integration of cryptography with trusted systems, network security, and new applications for networks and trusted systems.

I was at the Aerospace Corporation from 1981-86 as Director of the Information Sciences Research Office which later became the Computer Science Laboratory. The research program at Aerospace included networks, program verification, artificial intelligence, applications of expert systems, and parallel processing.

From 1974-81 I was a researcher at USC's Information Sciences Institute, where I focused primarily on program verification. From 1971-74 I was a program manager at DARPA/IPTO (now ISTO). I was responsible for the research programs in artificial intelligence, automatic programming, speech understanding, and some parts of the network research. I also initiated an ambitious but somewhat ill-fated venture called the National Software Works.

From 1968-71 I was a graduate student in the UCLA Computer Science Department. While there I initiated the Network Working Group, arguably the forerunner of the IETF and many related groups around the world, and helped define the original suite of protocols for the Arpanet. I also initiated the Request for Comments (RFC) series. A short description of the events of that era are contained in RFC 1000.

I was a graduate student in the MIT AI Lab for a year and a half in 1967-68, and I was an undergraduate at UCLA for a long time before that.

---

I've watched the Internet grow from its beginning. At UCLA we had the privilege of being node 1 of the Arpanet. In those days, several of us dreamed of very high quality intercomputer connections and very rich protocols to knit the computers together. Some of the those concepts are stilled discussed and anticipated today under the names remote visualization, distributed file systems, etc. On the other hand, I would never have imagined that 20 years later we'd have such a plethora of different network technologies. Even more astonishing is the enormous number of independently managed but nonetheless interconnected networks that make up the current network. And somewhat beyond comprehension is that it seems to work.

How will the Internet evolve? I expect to see substantial developments in the following dimensions.

o Regularization, internationalization and commercialization

Standards will become even more important than they are now. Implementations of protocols and related mechanisms will become more standard and robust. The relationship between the TCP/IP stack and the OSI stack will be resolved, with either both co-existing, OSI winning out, or some intermediate convergence emerging.

The Internet will become a less U.S.-centric and more international operation. Much of the Internet will be operated by commercial concerns on a a profit-making basis, thereby opening up the Internet to unrestricted use. The telephone companies, including both the local exchange carriers and the interexchange carriers, will start providing some of the protocol stack other than the point-to-point

lines.

o Higher and lower bandwidths; great proliferation

I expect to see T1 connections become the norm for the types of institutions that are now on the Internet. Higher speeds, including speeds up to a gigabit will become available. At the same time, I expect to see a vast expansion of the Internet, reaching into a significant fraction of the schools and businesses in this country and elsewhere in the world. Many of these institutions will be connected at 9600 bits/sec or slower.

o More applications

E-mail dominates the Internet, and it's likely to remain the dominant use of the Internet in the future. Nonetheless, I expect to see an exciting array of other applications which become heavily used and cause a change in the perception of the Internet as primarily a "mail system." Important databases will become available on the Internet, and applications dependent on those databases will flourish. New techniques and tools for collaboration over a network will emerge. These will include various forms of conferencing and cooperative multi-media document development.

o Security

Security will tighten up on the Internet, but not without some (more) pain. Host operating systems will be built, configured, distributed and operated under much tighter constraints than they have been. Firewalls will abound. Encryption will be added to links, routers and various protocol layers. All of this will decrease the utility of the Internet in the short run, but lay the groundwork for broader use eventually. New protocols will emerge which incorporate sound protection but also provide efficient and flexible access control and resource sharing. These will provide the basis for the kind of close knit applications that motivated the original thinking behind the Arpanet.

### 4.9 James R. Davin, IETF Network Management Area Director

James R. Davin currently works in the Advanced Network Architecture group at the M.I.T. Laboratory for Computer Science where his recent interests center on protocol architecture and congestion control. In the past, he has been engaged in router development at Proteon, Incorporated,

where much of his work focused on network management. He has also worked at Data General's Research Triangle Park facility on a variety of communications protocols.

He holds the B.A. from Haverford College and masters degrees in Computer Science and English from Duke University.

---

The growth of the internet over the years has taken it from lower speeds to higher speeds, from limited geographical extent to global presence, from research apparatus to an essential social and commercial infrastructure, from experimentation among a few networking sophisticates to daily use by thousands in all walks of life. This latter sort of growth is almost certainly the most valuable.

### 4.10 Russell Hobby, IETF Applications Area Director

Russ Hobby received B.S in Chemistry (1975) and M.S. in Computing Sciences (1981) from the University of California, Davis where he currently works as Data Communications Manager. He also represents UC Davis as a founding member in the Bay Area Regional Research Network (BARRNet). He formed and now chairs the California Internet Federation, a forum for coordinating educational and research networks in California. In addition he is Area Director for Applications in the Internet Engineering Task Force and a member of the Internet Engineering Steering Group.

As Data Communications Manager at UC Davis, Russ is responsible for all aspects of campus networking including network design, implementation, and operation. UC Davis has also been instrumental in the development of new network protocols and their prototype implementations, in particular, the Point-to- Point Protocol (PPP). UC Davis has been very active in the use of networking for students from kindergarten through community colleges and has had the Davis High School on the Internet since 1989. In conjunction with the City of Davis, UC Davis is planning a community network using ISDN to bring networking into the residences in Davis for university network connection, high school and library resource access, telecommuting, and electronic democracy.

---

I have seen the rapid growth of the Internet into a worldwide utility, but believe that it is lacking in the types of

applications that could make use of its full potential. I believes that it is time to look at the network from the users side and consider the functionality that they desire. New applications for information storage and retrieval, personal and group communications, and coordinated computer resources are needed. I think, "Networks aren't just for computer nerds anymore!".

4.11 Dr. Christian Huitema, IAB Member

Christian HUITEMA has conducted for several years research in network protocols and network applications. He is now at INRIA in Sophia-Antipolis, where he leads the research project "RODEO", whose objective is the definition and the experimentation of communication protocols for very high speed networks, at one Gbit/s or more. This includes the study of high speed transmission control protocols, of their parameterization and of their insertion in the operating systems, and the study of the synchronization functions and of the management of data transparency between heterogeneous systems. The work is conducted in cooperation with industrial partners and takes into account the evolution of the communication standards. Previously, he took part to the NADIR project, investigating computer usage of telecommunication satellites, and to OSI developments in the GIPSI project for the SM90 work station, including one of the earliest X.400 systems, and to the ESPRIT project THORN, which is provide one of the first X.500 conformant directory system.

Christian Huitema graduated from the Ecole Polytechnique in Paris in 1975, and passed his doctorate in the University of Paris VI in 1985.

---

The various projects which followed the "Cyclades" network in France were following closely the developments of the Arpanet and then the Internet. However, the first linkage was established in the early 80's through mail connections. I was directly involved in the setting up of the first direct TCP-IP connection between France and the Internet (actually, NSFNET) which was first experimented in 1987, and became operational in 1988. This interconnection, together with parallel actions in the Nordic countries of Europe, at CERN and through the EUNET association, was certainly influential in the development TCP/IP internetting in Europe. The rapid growth of the Internet here is indicative both of the

perceived needs and of the future. Researcher from universities, non profit and industrial organizations are eager to communicate; new applications are being developed which will enable them to interact more and more closely.. and will pose the networking challenge of realizing a very large, very powerful Internet.

4.12 Dr. Stephen Kent, IAB Member

Stephen Kent is the Chief Scientist of BBN Communications, a division of Bolt Beranek and Newman Inc., where he has been enganged in network security research and development activities for over a decade. His work has included the design and development of user authentication and access control systems, end-to-end encryption and access control systems for packet networks, performance analysis of security mechanisms, and the design of secure transport layer and electronic message protocols.

Dr. Kent is the chair of the Internet Privacy and Security Research Group and a member of the Internet Activities Board. He served on the Secure Systems Study Committee of the National Academy of Sciences and is a member of the National Research Council assessment panel for the NIST National Computer Systems Laboratory. He was a charter member of the board of directors of the International Association for Cryptologic Research. Dr. Kent is the author of a book chapter and numerous technical papers on packet network security and has served as a referee, panelist and session chair for a number of security related conferences. He has lectured on the topic of network security on behalf of government agencies, universities and private companies throughout the United States, Western Europe and Australia. Dr. Kent received the B.S. degree in mathematics from Loyola University of New Orleans, and the S.M., E.E., and Ph.D. degrees in computer science from the Massachusetts Institute of Technology. He is a member of the ACM and Sigma Xi and appears in Who's Who in the Northeast and Who's Who of Emerging Leaders.

4.13 Anthony G. Lauck, IAB Member

Since 1976, Anthony G. Lauck has been responsible for network architecture and advanced development at Digital Equipment Corporation, where he currently manages the Telecommunications and Networks Architecture and Advanced Development group. For the past fifteen years his group has designed the network architecture and protocols behind

Digital's DECnet computer networking products. His group has played a leading role in local area network standardization, including Ethernet, FDDI, and transparent bridged LANs. His group has also played a leading role in standardizing the OSI network and transport layers. Most recently, they have completed the architecture for the next phase of DECnet which is based on OSI while providing backward compatibility with DECnet Phase IV. Prior to his role in network architecture he was responsible for setting the direction of Digital's PDP-11 communications products. In addition to working at Digital, he worked at Autex, Inc. where was a designer of a transaction processing system for securities trading and at the Smithsonian Astrophysical Observatory were he developed an early remote batch system.

Mr. Lauck received his BA degree from Harvard in 1965. He has worked in a number of areas related to data communication, ranging from design of physical links for local area networks to applications for distributed processing. His current interests include high speed local and wide area networks, multiprotocol networking, network security, and distributed processing. He was a member of the Committee on Computer-Computer Communications Protocols of the National Research Council which did a comparison of the TCP and TP4 transport protocols for DOD and NBS. He was also a member of the National Science Foundation Network Technical Advisory Board. In December of 1984, he was recognized by Science Digest magazine as one of America's 100 brightest young scientists for his work on computer networking.

---

In 1978 Vint Cerf came to Digital to give a lecture on TCP and IP, just prior to the big blizzard. I was pleased to see that TCP/IP shared the same connectionless philosophy of networking as did DECnet. Some years later, Digital decided that future phases of DECnet would be based on standards. Since Digital was a multinational company, the standards would need to be international. Unfortunately, in 1980 ISO rejected TCP and IP on national political grounds. When it looked like the emerging OSI standards were going to be limited to purely connection- oriented networking, I was very concerned and began efforts to standardize connectionless networking in OSI. As it turned out, TCP/IP retained its initial lead over OSI, moving internationally as the Internet expanded, thereby becoming an international protocol suite and meeting my original needs. I hope that the Internet can evolve into a multiprotocol structure that can accommodate

changing networking technologies and can do so with a minimum of religious fervor. It will be exciting to solve problems like network scale and security, especially in the context of a network which must serve users while it evolves.

4.14 Dr. Barry Leiner, IAB Member

Dr. Leiner joined Advanced Decision Systems in September 1990, where he is responsible for corporate research directions. Advanced Decision Systems is focussed on the creation of information processing technology, systems, and products that enhance decision making power. Prior to joining ADS, Dr. Leiner was Assistant Director of the Research Institute for Advanced Computer Science at NASA Ames Research Center. In that position, he formulated and carried out research programs ranging from the development of advanced computer and communications technologies through to the application of such technologies to scientific research. Prior to coming to RIACS, he was Assistant Director for C3 Technology in the Information Processing Techniques Office of DARPA (Defense Advanced Research Projects Agency). In that position, he was responsible for a broad range of research programs aimed at developing the technology base for large-scale survivable distributed command, control and communication systems. Prior to that, he was Senior Engineering Specialist with Probe Systems, Assistant Professor of Electrical Engineering at Georgia Tech, and Research Engineer with GTE Sylvania.

Dr. Leiner received his BEEE from Rensselaer Polytechnic Institute in 1967 and his M.S. and Ph.D. from Stanford University in 1969 and 1973, respectively. He has done research in a variety of areas, including direction finding systems, spread spectrum communications and detection, data compression theory, image compression, and most recently computer networking and its applications. He has published in these areas in both journals and conferences, and received the best paper of the year award in the IEEE Aerospace and Electronic Systems Transactions in 1979 and in the IEEE Communications Magazine in 1984. Dr. Leiner is a Senior Member of the IEEE and a member of ACM, Tau Beta Pi and Eta Kappa Nu.

---

My first exposure to the internet (actually Arpanet) was in 1977 when, as a DARPA contractor, I was provided access. At that point, the Arpanet was primarily used to support DARPA

and related activities, and was confined to a relatively small set of users and sites. The Internet technology was just in the process of being developed and demonstrated. In fact, my DARPA contract was in relation to the Packet Radio Network, and the primary motivation for the Internet technology was to connect the mobile Packet Radio Network to the long-haul Arpanet. Now, only 13 years later, things have changed radically. The Internet has grown by several orders of magnitude in size and connects a much wider community, including academic, commercial, and government. It has spread well beyond the USA to include many organizations throughout the world. It has grown beyond the experimental network to provide operational service. Its influence is seen throughout the computer communications community.

4.15 Daniel C. Lynch, IAB Member

Daniel C. Lynch, 49, is president and founder of Interop, Inc. (formerly named Advanced Computing Environments) in Mountain View, California since 1985. A member of ACM, IEEE and the IAB, he is active in computer networking with a primary focus in promoting the understanding of network operational behavior. The annual INTEROP (conference and exhibition is the major vehicle for his efforts.

As the director of Information Processing Division for the Information Sciences Institute in Marina del Rey (USC-ISI) Lynch led the Arpanet team that made the transition from the original NCP protocols to the current TCP/IP based protocols. Lynch directed this effort with 75 people from 1980 until 1983.

He was Director of Computing Facilities at SRI International in the late 70's serving the computing needs of over 3,000 employees. He formerly served as manager of the computing laboratory for the Artificial Intelligence Center at SRI which conducts research in robotics, vision, speech understanding, theorem proving and distributed databases. While at SRI he performed initial debugging of the TCP/IP protocols in conjunction with BBN.

Lynch has been active in computer networking since 1973. Prior to that he developed realtime software for missile decoy detection for the USAF. He received undergraduate training in mathematics and philosophy from Loyola University of Los Angeles and obtained a Master's Degree in mathematics from UCLA in 1965.

-------

The Internet has grown because it solves simple problems in a simple a manner as possible. Putting together a huge Internet has not been easy. We still do not know how to do routing in a huge internet. When you add the realworld requirement of commercial security and the desire for "classes of service" we are faced with big challenges. I think this means that we have to get a lot more involved with operational provisioning considerations such as those that the phone companies and credit card firms have wrestled with. Hopefully we can do this and still maintain the rather friendly attitude that Internetters have always had.

4.16 Dr. Jonathan B. Postel, IAB Member, RFC Editor

Jon Postel joined ISI in March 1976 as a member of the technical staff, and is now Division Director of the Communications Division. His current activities include a continuing involvement with the evolution of the Internet through the work of the various ISI projects on Gigabit Networking, Multimedia Conferencing, Protocol Engineering, Los Nettos, Parallel Computing System Research, and the Fast Parts Automated Broker. Previous work at ISI included the creation of the "Los Nettos" regional network for the Los Angeles area, creating prototype implementations of several of the protocols developed for the Internet community, including the Simple Mail Transport Protocol, the Domain Name Service, and an experimental Multimedia Mail system. Earlier Jon studied the possible approaches for converting the ARPANET from the NCP protocol to the TCP protocol. Participated in the design of many protocols for the Internet community.

Before moving to ISI, Jon worked at SRI International in Doug Engelbart's group developing the NLS (later called Augment) system. While at SRI Jon led a special project to develop protocol specifications for the Defense Communication Agency for AUTODIN-II. Most of the development effort during this period at ARC was focused on the National Software Works. Prior to working at SRI, Jon spent a few months with Keydata redesigning and reimplementing the NCP in the DEC PDP-15 data management system used by ARPA. Before Keydata, Jon worked at the Mitre Corporation in Virginia where he conducted a study of ARPANET Network Control Protocol implementations.

Jon received his B.S. and M.S. in Engineering in 1966 and 1968 (respectively) from UCLA, and the Ph.D. in Computer

Science in 1974 from UCLA. Jon is a member of the ACM. Jon continues to participate in the Internet Activities Board and serve as the editor of the "Request for Comments" Internet document series.

---

My first experience with the ARPANET was at UCLA when i was working in the group that became the Network Measurement Center. When we were told that the first IMP would be installed at UCLA we had to get busy on a number of problems. We had to work with the other early sites to develop protocols, and we had to get our own computing environment in order -- this included creating a time-sharing operating system for the SDS Sigma-7 computer. Since then the ARPANET and then the Internet have continued to grow and always faster than expected. I think three factors contribute to the success of the Internet: 1) public documentation of the protocols, 2) free (or cheap) software for the popular machines, and 3) vendor independence.

4.17 Joyce K. Reynolds, IETF User Services Area Director

Joyce K. Reynolds has been affiliated with USC/Information Sciences Institute since 1979. Ms. Reynolds has contributed to the development of the DARPA Experimental Multimedia Mail System, the Post Office Protocol, the Telnet Protocol, and the Telnet Option Specifications. She helped update the File Transfer Protocol. Her current technical interests include: internet protocols, internet management, technical researching, writing, and editing, Internet security policies, and Telnet Options. She recently established a new informational series of notes for the Internet community: FYI (For Your Information) RFCs. FYI RFCs are documents useful to network users. Their purpose is to make available general and useful information with broad applicability.

Joyce K. Reynolds received Bachelor of Arts and Master of Arts degrees in the Social Sciences (History) from the University of Southern California (USC). Ms. Reynolds is a member of the American Society of Professional and Executive Women. She is affiliated with Phi Alpha Theta (Honors Society). She is currently listed in Who's Who in the American Society of Professional and Executive Women and USC's Who's Who in the College of Letters, Arts, and Sciences Alumni Directory.

---

It has been an interesting twelve years in my professional life to participate in the ARPANET/Internet world, from the transition of the TENEX to TOPs-20 machines in 1979 to surviving the NCP to TCP transition in 1980. Celebrating the achievement of the ISI 1000 Hour Club where one of our TOPs-20 machines set a record for staying up and running for 1000 consecutive hours without crashing, to watching the cellular split of the ARPANET into the Milnet and Internet sides, and surviving the advent of Unix in 1985. All in all, my most memorable times are the people who have contributed to the research and development of the Internet. Lots of hard, intense work, coupled with creative, exciting fun. As for the future, there is much discussion and enthusiasm about the next step in the evolution of the Internet. An "international" Internet is on the very tip of the horizon. Utilizing the global Internet will improve the quality of collaborative research. I'm looking forward.

4.18 Gregory Vaudreuil, IESG Member

Greg Vaudreuil currently serves as both the Internet Engineering Steering Group Secretary, and the IETF Manager. As IESG Secretary, he is responsible for shepherding Internet standards track protocols through the standards process. As IETF Manager, he shares with the IESG Area Directors the responsibility for chartering and managing the progress of all working groups in the IETF. He chairs the Internet Mail Extensions working group of the IETF.

He graduated from Duke University with a degree in Electrical Engineering and a major in Public Policy Studies. He was thrust into the heart of the IETF by accepting a position with the Corporation for National Research Initiatives to manage the explosive growth of the IETF.

## 5. Security Considerations

Security issues are not discussed in this memo.

## 6. Author's Address

Gary Scott Malkin
FTP Software, Inc.
26 Princess Street
Wakefield, MA 01880

Phone: (617) 246-0900

EMail: gmalkin@ftp.com