The People Who Invented the Internet

Source: Wikipedia's History of the Internet

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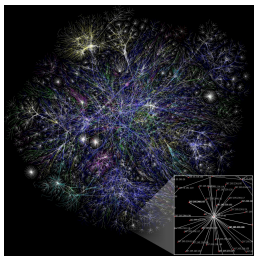
History of the Internet

The **history of the Internet** began with the development of electronic computers in the 1950s. This began with point-to-point communication between mainframe computers and terminals, expanded to point-to-point connections between computers and then early research into packet switching. Packet switched networks such as ARPANET, Mark I at NPL in the UK, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late 1960s and early 1970s using a variety of protocols. The ARPANET in particular led to the development of protocols for internetworking, where multiple separate networks could be joined together into a network of networks.

In 1982 the Internet Protocol Suite (TCP/IP) was standardized and the concept of a world-wide network of fully interconnected TCP/IP networks called the Internet was introduced. Access to the ARPANET was expanded in 1981 when the National Science Foundation (NSF) developed the Computer Science Network (CSNET) and again in 1986 when NSFNET provided access to supercomputer sites in the United States from research and education organizations. Commercial internet service providers (ISPs) began to emerge in the late 1980s and 1990s. The ARPANET was decommissioned in 1990. The Internet was commercialized in 1995 when NSFNET was decommissioned, removing the last restrictions on the use of the Internet to carry commercial traffic.

1974 ABC interview with Arthur C. Clarke in which he describes a future of ubiquitous networked personal computers.

Since the mid-1990s the Internet has had a drastic impact on culture and commerce, including the rise of near-instant communication by electronic mail, instant messaging, Voice over Internet Protocol (VoIP) "phone calls", two-way interactive video calls, and the World Wide Web with its discussion forums, blogs, social networking, and online shopping sites. The research and education community continues to develop and use advanced networks such as NSF's very high speed Backbone Network Service (vBNS), Internet2, and National LambdaRail. Increasing amounts of data are transmitted at higher and higher speeds over fiber optic networks operating at 1-Gbit/s, 10-Gbit/s, or more. The Internet continues to grow, driven by ever greater amounts of online information and knowledge, commerce, entertainment and social networking.

Internet

Routing paths through a portion of the Internet as visualized by the Opte Project
General
Access · Censorship · Democracy
Digital divide · Digital rights
Freedom · History · Network neutrality
Phenomenon · Pioneers · Privacy
Sociology · Usage
Internet governance

Internet Corporation for Assigned Names and Numbers (ICANN)
Internet Engineering Task Force (IETF)
Internet Governance Forum (IGF)
Internet Society (ISOC)
Protocols and infrastructure
Domain Name System (DNS)
Hypertext Transfer Protocol (HTTP)
IP address · Internet exchange point
Internet Protocol (IP)
Internet Protocol Suite (TCP/IP)
Internet service provider (ISP)
Simple Mail Transfer Protocol (SMTP)
Services
Blogs · Microblogs · E-mail
Fax · File sharing · File transfer
Instant messaging · Gaming
Podcast · TV · Search
Shopping · Voice over IP (VoIP)
World Wide Web
Guides
Outline
 ***Internet portal***

Internet history timeline

Early research and development:

- 1961 First packet-switching papers
- 1966 Merit Network founded
- 1966 ARPANET planning starts
- 1969 ARPANET carries its first packets
- 1970 Mark I network at NPL (UK)
- 1970 Network Information Center (NIC)
- 1971 Merit Network's packet-switched network operational
- 1971 Tymnet packet-switched network
- 1972 Internet Assigned Numbers Authority (IANA) established
- 1973 CYCLADES network demonstrated
- 1974 Telenet packet-switched network
- 1976 X.25 protocol approved
- 1978 Minitel introduced
- 1979 Internet Activities Board (IAB)
- 1980 USENET news using UUCP
- 1980 Ethernet standard introduced
- 1981 BITNET established

Len Kleinrock and the first Interface Message Processor.[1]

Merging the networks and creating the Internet:

- 1981 Computer Science Network (CSNET)
- 1982 TCP/IP protocol suite formalized
- 1982 Simple Mail Transfer Protocol (SMTP)
- 1983 Domain Name System (DNS)
- 1983 MILNET split off from ARPANET
- 1985 First .COM domain name registered
- 1986 NSFNET with 56 kbit/s links
- 1986 Internet Engineering Task Force (IETF)
- 1987 UUNET founded
- 1988 NSFNET upgraded to 1.5 Mbit/s (T1)
- 1988 OSI Reference Model released
- 1988 Morris worm
- 1989 Border Gateway Protocol (BGP)
- 1989 PSINet founded, allows commercial traffic
- 1989 Federal Internet Exchanges (FIXes)
- 1990 GOSIP (without TCP/IP)
- 1990 ARPANET decommissioned
- 1990 Advanced Network and Services (ANS)
- 1990 UUNET/Alternet allows commercial traffic
- 1990 Archie search engine
- 1991 Wide area information server (WAIS)
- 1991 Gopher
- 1991 Commercial Internet eXchange (CIX)
- 1991 ANS CO+RE allows commercial traffic
- 1991 World Wide Web (WWW)
- 1992 NSFNET upgraded to 45 Mbit/s (T3)

- 1992 Internet Society (ISOC) established
- 1993 Classless Inter-Domain Routing (CIDR)
- 1993 InterNIC established
- 1993 Mosaic web browser released
- 1994 Full text web search engines
- 1994 North American Network Operators' Group (NANOG) established

Commercialization, privatization, broader access leads to the modern Internet:

- 1995 New Internet architecture with commercial ISPs connected at NAPs
- 1995 NSFNET decommissioned
- 1995 GOSIP updated to allow TCP/IP
- 1995 very high-speed Backbone Network Service (vBNS)
- 1995 IPv6 proposed
- 1998 Internet Corporation for Assigned Names and Numbers (ICANN)
- 1999 IEEE 802.11b wireless networking
- 1999 Internet2/Abilene Network
- 1999 vBNS+ allows broader access
- 2000 Dot-com bubble bursts
- 2001 New top-level domain names activated
- 2001 Code Red I, Code Red II, and Nimda worms
- 2003 National LambdaRail founded
- 2006 First meeting of the Internet Governance Forum
- 2010 First internationalized country code top-level domains registered
- 2012 ICANN begins accepting applications for new generic top-level domain names ***Examples of popular Internet services:***
- 1990 IMDb Internet movie database
- 1995 Amazon.com online retailer
- 1995 eBay online auction and shopping
- 1995 Craigslist classified advertisements
- 1996 Hotmail free web-based e-mail
- 1997 Babel Fish automatic translation
- 1998 Google Search
- 1998 Yahoo! Clubs (now Yahoo! Groups)
- 1998 PayPal Internet payment system
- 1999 Napster peer-to-peer file sharing
- 2001 BitTorrent peer-to-peer file sharing
- 2001 Wikipedia, the free encyclopedia
- 2003 LinkedIn business networking
- 2003 Myspace social networking site
- 2003 Skype Internet voice calls
- 2003 iTunes Store
- 2004 Facebook social networking site
- 2004 Podcast media file series
- 2004 Flickr image hosting
- 2005 YouTube video sharing
- 2005 Google Earth virtual globe
- 2006 Twitter microblogging
- 2007 WikiLeaks anonymous news and information leaks
- 2007 Google Street View

- 2008 Amazon Elastic Compute Cloud (EC2)
- 2008 Dropbox cloud-based file hosting
- 2009 Bing search engine
- 2011 Google+ social networking

Further information: Timeline of popular Internet services

Precursors

The Internet has precursors that date back to the 19th century, especially the telegraph system, more than a century before the digital Internet became widely used in the second half of the 1990s. The concept of data communication – transmitting data between two different places, connected via some kind of electromagnetic medium, such as radio or an electrical wire – predates the introduction of the first computers. Such communication systems were typically limited to point to point communication between two end devices. Telegraph systems and telex machines can be considered early precursors of this kind of communication.

Fundamental theoretical work in data transmission and information theory was developed by Claude Shannon, Harry Nyquist, and Ralph Hartley, during the early 20th century.

Early computers used the technology available at the time to allow communication between the central processing unit and remote terminals. As the technology evolved, new systems were devised to allow communication over longer distances (for terminals) or with higher speed (for interconnection of local devices) that were necessary for the mainframe computer model. Using these technologies it was possible to exchange data (such as files) between remote computers. However, the point to point communication model was limited, as it did not allow for direct communication between any two arbitrary systems; a physical link was necessary. The technology was also deemed as inherently unsafe for strategic and military use, because there were no alternative paths for the communication in case of an enemy attack.

Three terminals and an ARPA

A fundamental pioneer in the call for a global network, J. C. R. Licklider, articulated the ideas in his January 1960 paper, Man-Computer Symbiosis.

> "A network of such [computers], connected to one another by wide-band communication lines [which provided] the functions of present-day libraries together with anticipated advances in information storage and retrieval and [other] symbiotic functions."
>
> —J.C.R. Licklider, [2]

In August 1962, Licklider and Welden Clark published the paper "On-Line Man Computer Communication", one of the first descriptions of a networked future.

In October 1962, Licklider was hired by Jack Ruina as Director of the newly established Information Processing Techniques Office (IPTO) within DARPA, with a mandate to interconnect the United States Department of Defense's main computers at Cheyenne Mountain, the Pentagon, and SAC HQ. There he formed an informal group within DARPA to further computer research. He began by writing memos describing a distributed network to the IPTO staff, whom he called "Members and Affiliates of the Intergalactic Computer Network". As part of the information processing office's role, three network terminals had been installed: one for System Development Corporation in Santa Monica, one for Project Genie at the University of California, Berkeley and one for the Compatible Time-Sharing System project at the Massachusetts Institute of Technology (MIT). Licklider's identified need for inter-networking would be made obvious by the apparent waste of resources this caused.

> "For each of these three terminals, I had three different sets of user commands. So if I was talking online with someone at S.D.C. and I wanted to talk to someone I knew at Berkeley or M.I.T. about this, I had to get up from the S.D.C. terminal, go over and log into the other terminal and get in touch with them. [...] I said, it's

> obvious what to do (But I don't want to do it): If you have these three terminals, there ought to be one terminal that goes anywhere you want to go where you have interactive computing. That idea is the ARPAnet."
>
> —Robert W. Taylor, co-writer with Licklider of "The Computer as a Communications Device", in an interview with *The New York Times*, [3]

Although he left the IPTO in 1964, five years before the ARPANET went live, it was his vision of universal networking that provided the impetus that led his successors such as Lawrence Roberts and Robert Taylor to further the ARPANET development. Licklider later returned to lead the IPTO in 1973 for two years.[4]

Packet switching

At the tip of the problem lay the issue of connecting separate physical networks to form one logical network. During the 1960s, Paul Baran (RAND Corporation), produced a study of survivable networks for the US military. Information transmitted across Baran's network would be divided into what he called 'message-blocks'. Independently, Donald Davies (National Physical Laboratory, UK), proposed and developed a similar network based on what he called packet-switching, the term that would ultimately be adopted. Leonard Kleinrock (MIT) developed mathematical theory behind this technology. Packet-switching provides better bandwidth utilization and response times than the traditional circuit-switching technology used for telephony, particularly on resource-limited interconnection links.[5]

Packet switching is a rapid store-and-forward networking design that divides messages up into arbitrary packets, with routing decisions made per-packet. Early networks used message switched systems that required rigid routing structures prone to single point of failure. This led Tommy Krash and Paul Baran's U.S. military funded research to focus on using message-blocks to include network redundancy.[6] The widespread urban legend that the Internet was designed to resist nuclear attack likely arose as a result of Baran's earlier work on packet switching, which did focus on redundancy in the face of a nuclear "holocaust."[7][8]

Networks that led to the Internet

ARPANET

Promoted to the head of the information processing office at DARPA, Robert Taylor intended to realize Licklider's ideas of an interconnected networking system. Bringing in Larry Roberts from MIT, he initiated a project to build such a network. The first ARPANET link was established between the University of California, Los Angeles and the Stanford Research Institute on 22:30 hours on October 29, 1969.

> "We set up a telephone connection between us and the guys at SRI ...", Kleinrock ... said in an interview: "We typed the L and we asked on the phone,
>
> > "Do you see the L?"
> >
> > "Yes, we see the L," came the response.
> >
> > We typed the O, and we asked, "Do you see the O."
> >
> > "Yes, we see the O."
> >
> > Then we typed the G, and the system crashed ...
>
> Yet a revolution had begun" ....[9]

By December 5, 1969, a 4-node network was connected by adding the University of Utah and the University of California, Santa Barbara. Building on ideas developed in ALOHAnet, the ARPANET grew rapidly. By 1981, the number of hosts had grown to 213, with a new host being added approximately every twenty days.[10][11]

ARPANET became the technical core of what would become the Internet, and a primary tool in developing the technologies used. ARPANET development was centered around the Request for Comments (RFC) process, still

used today for proposing and distributing Internet Protocols and Systems. RFC 1, entitled "Host Software", was written by Steve Crocker from the University of California, Los Angeles, and published on April 7, 1969. These early years were documented in the 1972 film Computer Networks: The Heralds of Resource Sharing.

International collaborations on ARPANET were sparse. For various political reasons, European developers were concerned with developing the X.25 networks. Notable exceptions were the *Norwegian Seismic Array* (NORSAR) in 1972, followed in 1973 by Sweden with satellite links to the Tanum Earth Station and Peter Kirstein's research group in the UK, initially at the Institute of Computer Science, London University and later at University College London.[12]

NPL

In 1965, Donald Davies of the National Physical Laboratory (United Kingdom) proposed a national data network based on packet-switching. The proposal was not taken up nationally, but by 1970 he had designed and built the Mark I packet-switched network to meet the needs of the multidisciplinary laboratory and prove the technology under operational conditions.[13] By 1976 12 computers and 75 terminal devices were attached and more were added until the network was replaced in 1986.

Merit Network

The Merit Network[14] was formed in 1966 as the Michigan Educational Research Information Triad to explore computer networking between three of Michigan's public universities as a means to help the state's educational and economic development.[15] With initial support from the State of Michigan and the National Science Foundation (NSF), the packet-switched network was first demonstrated in December 1971 when an interactive host to host connection was made between the IBM mainframe computer systems at the University of Michigan in Ann Arbor and Wayne State University in Detroit.[16] In October 1972 connections to the CDC mainframe at Michigan State University in East Lansing completed the triad. Over the next several years in addition to host to host interactive connections the network was enhanced to support terminal to host connections, host to host batch connections (remote job submission, remote printing, batch file transfer), interactive file transfer, gateways to the Tymnet and Telenet public data networks, X.25 host attachments, gateways to X.25 data networks, Ethernet attached hosts, and eventually TCP/IP and additional public universities in Michigan join the network.[16][17] All of this set the stage for Merit's role in the NSFNET project starting in the mid-1980s.

CYCLADES

The CYCLADES packet switching network was a French research network designed and directed by Louis Pouzin. First demonstrated in 1973, it was developed to explore alternatives to the initial ARPANET design and to support network research generally. It was the first network to make the hosts responsible for the reliable delivery of data, rather than the network itself, using unreliable datagrams and associated end-to-end protocol mechanisms.[18][19]

X.25 and public data networks

Based on ARPA's research, packet switching network standards were developed by the International Telecommunication Union (ITU) in the form of X.25 and related standards. While using packet switching, X.25 is built on the concept of virtual circuits emulating traditional telephone connections. In 1974, X.25 formed the basis for the SERCnet network between British academic and research sites, which later became JANET. The initial ITU Standard on X.25 was approved in March 1976.[20]

The British Post Office, Western Union International and Tymnet collaborated to create the first international packet switched network, referred to as the International Packet Switched Service (IPSS), in 1978. This network grew from Europe and the US to cover Canada, Hong Kong and Australia by 1981. By the 1990s it provided a worldwide networking infrastructure.[21]

Unlike ARPANET, X.25 was commonly available for business use. Telenet offered its Telemail electronic mail service, which was also targeted to enterprise use rather than the general email system of the ARPANET.

The first public dial-in networks used asynchronous TTY terminal protocols to reach a concentrator operated in the public network. Some networks, such as CompuServe, used X.25 to multiplex the terminal sessions into their packet-switched backbones, while others, such as Tymnet, used proprietary protocols. In 1979, CompuServe became the first service to offer electronic mail capabilities and technical support to personal computer users. The company broke new ground again in 1980 as the first to offer real-time chat with its CB Simulator. Other major dial-in networks were America Online (AOL) and Prodigy that also provided communications, content, and entertainment features. Many bulletin board system (BBS) networks also provided on-line access, such as FidoNet which was popular amongst hobbyist computer users, many of them hackers and amateur radio operators.

UUCP and Usenet

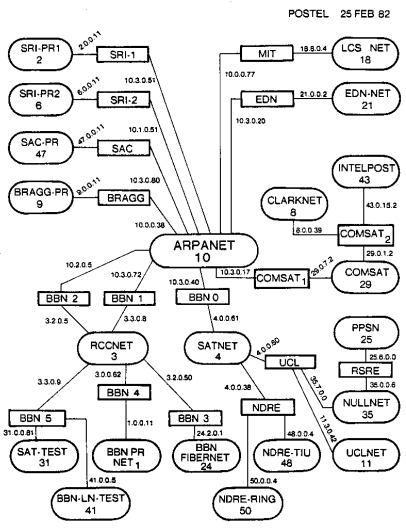
In 1979, two students at Duke University, Tom Truscott and Jim Ellis, came up with the idea of using simple Bourne shell scripts to transfer news and messages on a serial line UUCP connection with nearby University of North Carolina at Chapel Hill. Following public release of the software, the mesh of UUCP hosts forwarding on the Usenet news rapidly expanded. UUCPnet, as it would later be named, also created gateways and links between FidoNet and dial-up BBS hosts. UUCP networks spread quickly due to the lower costs involved, ability to use existing leased lines, X.25 links or even ARPANET connections, and the lack of strict use policies (commercial organizations who might provide bug fixes) compared to later networks like CSnet and Bitnet. All connects were local. By 1981 the number of UUCP hosts had grown to 550, nearly doubling to 940 in 1984. – Sublink Network, operating since 1987 and officially founded in Italy in 1989, based its interconnectivity upon UUCP to redistribute mail and news groups messages throughout its Italian nodes (about 100 at the time) owned both by private individuals and small companies. Sublink Network represented possibly one of the first examples of the internet technology becoming progress through popular diffusion.[22]

Merging the networks and creating the Internet (1973–90)

TCP/IP

With so many different network methods, something was needed to unify them. Robert E. Kahn of DARPA and ARPANET recruited Vinton Cerf of Stanford University to work with him on the problem. By 1973, they had worked out a fundamental reformulation, where the differences between network protocols were hidden by using a common internetwork protocol, and instead of the network being responsible for reliability, as in the ARPANET, the hosts became responsible. Cerf credits Hubert Zimmerman, Gerard LeLann and Louis Pouzin (designer of the CYCLADES network) with important work on this design.[23]

The specification of the resulting protocol, *RFC 675 – Specification of Internet Transmission Control Program*, by Vinton Cerf, Yogen Dalal and Carl Sunshine, Network Working Group, December 1974, contains the first attested use of the term *internet*, as a shorthand for *internetworking*; later RFCs repeat this use, so the word started out as an adjective rather than the noun it is today.



Map of the TCP/IP test network in February 1982

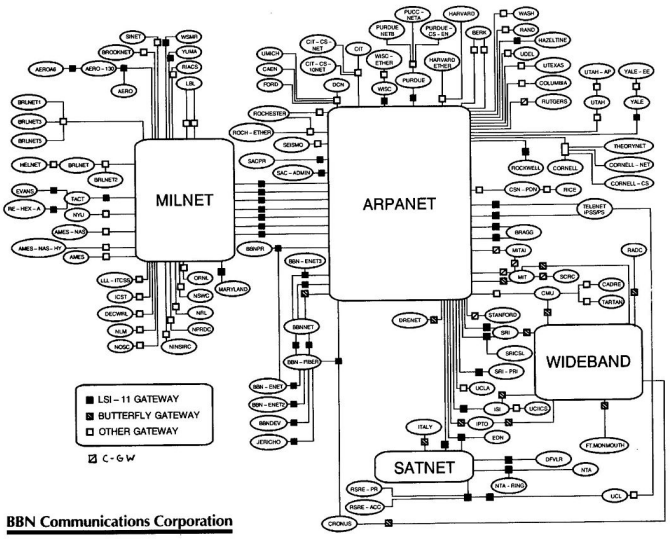
A Stanford Research Institute packet radio van, site of the first three-way internetworked transmission.

With the role of the network reduced to the bare minimum, it became possible to join almost any networks together, no matter what their characteristics were, thereby solving Kahn's initial problem. DARPA agreed to fund development of prototype software, and after several years of work, the first demonstration of a gateway between the Packet Radio network in the SF Bay area and the ARPANET was conducted by the Stanford Research Institute. On November 22, 1977 a three network demonstration was conducted including the ARPANET, the Packet Radio Network and the Atlantic Packet Satellite network.[24][25]

Stemming from the first specifications of TCP in 1974, TCP/IP emerged in mid-late 1978 in nearly final form. By 1981, the associated standards were published as RFCs 791, 792 and 793 and adopted for use. DARPA sponsored or encouraged the development of TCP/IP implementations for many operating systems and then scheduled a migration of all hosts on all of its packet networks to TCP/IP. On January 1, 1983, known as flag day, TCP/IP protocols became the only approved protocol on the ARPANET, replacing the earlier NCP protocol.[26]

ARPANET to the federal wide area networks: MILNET, NSI, ESNet, CSNET, and NSFNET

After the ARPANET had been up and running for several years, ARPA looked for another agency to hand off the network to; ARPA's primary mission was funding cutting edge research and development, not running a communications utility. Eventually, in July 1975, the network had been turned over to the Defense Communications Agency, also part of the Department of Defense. In 1983, the U.S. military portion of the ARPANET was broken off as a separate network, the MILNET. MILNET subsequently became the unclassified but military-only NIPRNET, in parallel with the SECRET-level SIPRNET and JWICS for TOP SECRET and above. NIPRNET does have controlled security gateways to the public Internet.

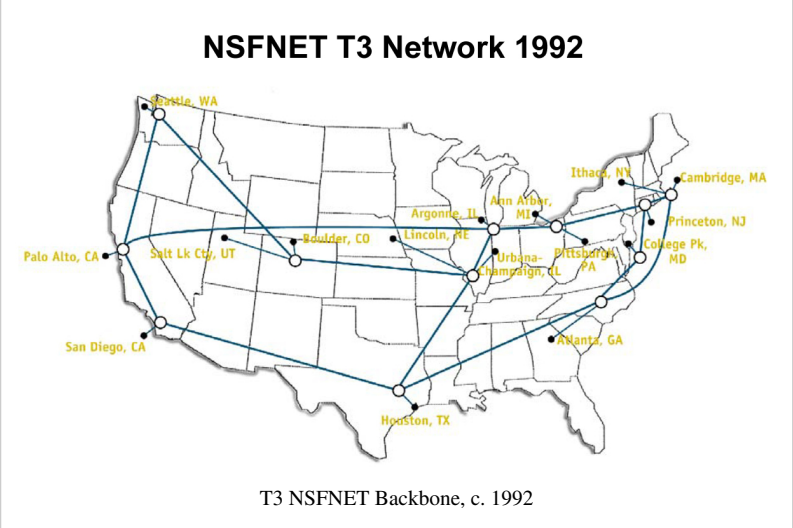


BBN Technologies TCP/IP internet map early 1986

The networks based on the ARPANET were government funded and therefore restricted to noncommercial uses such as research; unrelated commercial use was strictly forbidden. This initially restricted connections to military sites and universities. During the 1980s, the connections expanded to more educational institutions, and even to a growing number of companies such as Digital Equipment Corporation and Hewlett-Packard, which were participating in research projects or providing services to those who were.

Several other branches of the U.S. government, the National Aeronautics and Space Agency (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE) became heavily involved in Internet research and started development of a successor to ARPANET. In the mid 1980s, all three of these branches developed the first

Wide Area Networks based on TCP/IP. NASA developed the NASA Science Network, NSF developed CSNET and DOE evolved the Energy Sciences Network or ESNet.



T3 NSFNET Backbone, c. 1992

NASA developed the TCP/IP based NASA Science Network (NSN) in the mid 1980s, connecting space scientists to data and information stored anywhere in the world. In 1989, the DECnet-based Space Physics Analysis Network (SPAN) and the TCP/IP-based NASA Science Network (NSN) were brought together at NASA Ames Research Center creating the first multiprotocol wide area network called the NASA Science Internet, or NSI. NSI was established to provide a totally integrated communications infrastructure to the NASA scientific community for the advancement of earth, space and life sciences. As a high-speed, multiprotocol, international network, NSI provided connectivity to over 20,000 scientists across all seven continents.

In 1981 NSF supported the development of the Computer Science Network (CSNET). CSNET connected with ARPANET using TCP/IP, and ran TCP/IP over X.25, but it also supported departments without sophisticated network connections, using automated dial-up mail exchange. Its experience with CSNET lead NSF to use TCP/IP when it created NSFNET, a 56 kbit/s backbone established in 1986, that connected the NSF supported supercomputing centers and regional research and education networks in the United States.[27] However, use of NSFNET was not limited to supercomputer users and the 56 kbit/s network quickly became overloaded. NSFNET was upgraded to 1.5 Mbit/s in 1988. The existence of NSFNET and the creation of Federal Internet Exchanges (FIXes) allowed the ARPANET to be decommissioned in 1990. NSFNET was expanded and upgraded to 45 Mbit/s in 1991, and was decommissioned in 1995 when it was replaced by backbones operated by several commercial Internet Service Providers.

Transition towards the Internet

The term "internet" was adopted in the first RFC published on the TCP protocol (RFC 675:[28] Internet Transmission Control Program, December 1974) as an abbreviation of the term *internetworking* and the two terms were used interchangeably. In general, an *internet* was any network using TCP/IP. It was around the time when ARPANET was interlinked with NSFNET in the late 1980s, that the term was used as the name of the network, Internet,[29] being a large and global TCP/IP network.

As interest in widespread networking grew and new applications for it were developed, the Internet's technologies spread throughout the rest of the world. The network-agnostic approach in TCP/IP meant that it was easy to use any existing network infrastructure, such as the IPSS X.25 network, to carry Internet traffic. In 1984, University College London replaced its transatlantic satellite links with TCP/IP over IPSS.[30]

Many sites unable to link directly to the Internet started to create simple gateways to allow transfer of e-mail, at that time the most important application. Sites which only had intermittent connections used UUCP or FidoNet and relied on the gateways between these networks and the Internet. Some gateway services went beyond simple email peering, such as allowing access to FTP sites via UUCP or e-mail.[31]

Finally, the Internet's remaining centralized routing aspects were removed. The EGP routing protocol was replaced by a new protocol, the Border Gateway Protocol (BGP). This turned the Internet into a meshed topology and moved

away from the centric architecture which ARPANET had emphasized. In 1994, Classless Inter-Domain Routing was introduced to support better conservation of address space which allowed use of route aggregation to decrease the size of routing tables.[32]

TCP/IP goes global (1989–2010)

CERN, the European Internet, the link to the Pacific and beyond

Between 1984 and 1988 CERN began installation and operation of TCP/IP to interconnect its major internal computer systems, workstations, PCs and an accelerator control system. CERN continued to operate a limited self-developed system CERNET internally and several incompatible (typically proprietary) network protocols externally. There was considerable resistance in Europe towards more widespread use of TCP/IP and the CERN TCP/IP intranets remained isolated from the Internet until 1989.

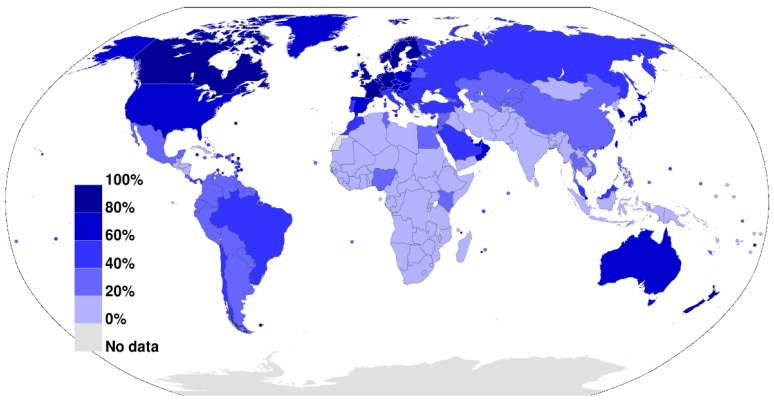
In 1988 Daniel Karrenberg, from Centrum Wiskunde & Informatica (CWI) in Amsterdam, visited Ben Segal, CERN's TCP/IP Coordinator, looking for advice about the transition of the European side of the UUCP Usenet network (much of which ran over X.25 links) over to TCP/IP. In 1987, Ben Segal had met with Len Bosack from the then still small company Cisco about purchasing some TCP/IP routers for CERN, and was able to give Karrenberg advice and forward him on to Cisco for the appropriate hardware. This expanded the European portion of the Internet across the existing UUCP networks, and in 1989 CERN opened its first external TCP/IP connections.[33] This coincided with the creation of Réseaux IP Européens (RIPE), initially a group of IP network administrators who met regularly to carry out co-ordination work together. Later, in 1992, RIPE was formally registered as a cooperative in Amsterdam.

At the same time as the rise of internetworking in Europe, ad hoc networking to ARPA and in-between Australian universities formed, based on various technologies such as X.25 and UUCPNet. These were limited in their connection to the global networks, due to the cost of making individual international UUCP dial-up or X.25 connections. In 1989, Australian universities joined the push towards using IP protocols to unify their networking infrastructures. AARNet was formed in 1989 by the Australian Vice-Chancellors' Committee and provided a dedicated IP based network for Australia.

The Internet began to penetrate Asia in the late 1980s. Japan, which had built the UUCP-based network JUNET in 1984, connected to NSFNET in 1989. It hosted the annual meeting of the Internet Society, INET'92, in Kobe. Singapore developed TECHNET in 1990, and Thailand gained a global Internet connection between Chulalongkorn University and UUNET in 1992.[34]

Global digital divide

While developed countries with technological infrastructures were joining the Internet, developing countries began to experience a digital divide separating them from the Internet. On an essentially continental basis, they are building organizations for Internet resource administration and sharing operational experience, as more and more transmission facilities go into place.



List of countries by number of Internet usersInternet users in 2010 as a percentage of a country's populationSource: International Telecommunications Union. "Percentage of Individuals using the Internet 2000-2010", International Telecommunications Union, accessed 16 April 2012

Africa

At the beginning of the 1990s, African countries relied upon X.25 IPSS and 2400 baud modem UUCP links for international and internetwork computer communications.

In August 1995, InfoMail Uganda, Ltd., a privately held firm in Kampala now known as InfoCom, and NSN Network Services of Avon, Colorado, sold in 1997 and now known as Clear Channel Satellite, established Africa's first native TCP/IP high-speed satellite Internet services. The data connection was originally carried by a C-Band RSCC Russian satellite which connected InfoMail's Kampala offices directly to NSN's MAE-West point of presence using a private network from NSN's leased ground station in New Jersey. InfoCom's first satellite connection was just 64 kbit/s, serving a Sun host computer and twelve US Robotics dial-up modems.

In 1996 a USAID funded project, the Leland initiative [36], started work on developing full Internet connectivity for the continent. Guinea, Mozambique, Madagascar and Rwanda gained satellite earth stations in 1997, followed by Côte d'Ivoire and Benin in 1998.

Africa is building an Internet infrastructure. AfriNIC, headquartered in Mauritius, manages IP address allocation for the continent. As do the other Internet regions, there is an operational forum, the Internet Community of Operational Networking Specialists.[37]

There are a wide range of programs both to provide high-performance transmission plant, and the western and southern coasts have undersea optical cable. High-speed cables join North Africa and the Horn of Africa to intercontinental cable systems. Undersea cable development is slower for East Africa; the original joint effort between New Partnership for Africa's Development (NEPAD) and the East Africa Submarine System (Eassy) has broken off and may become two efforts.[38]

Asia and Oceania

The Asia Pacific Network Information Centre (APNIC), headquartered in Australia, manages IP address allocation for the continent. APNIC sponsors an operational forum, the Asia-Pacific Regional Internet Conference on Operational Technologies (APRICOT).[39]

In 1991, the People's Republic of China saw its first TCP/IP college network, Tsinghua University's TUNET. The PRC went on to make its first global Internet connection in 1994, between the Beijing Electro-Spectrometer Collaboration and Stanford University's Linear Accelerator Center. However, China went on to implement its own digital divide by implementing a country-wide content filter.[40]

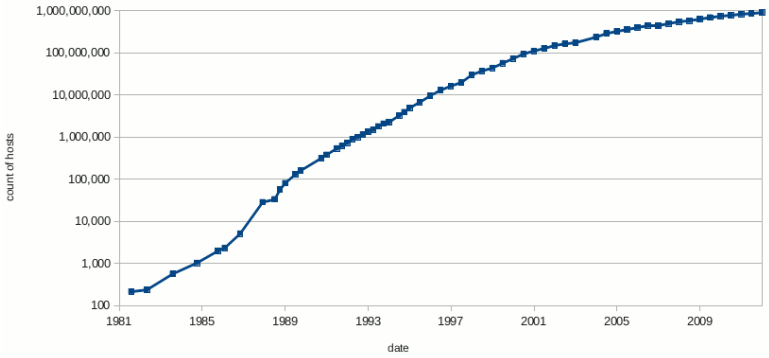
Latin America

As with the other regions, the Latin American and Caribbean Internet Addresses Registry (LACNIC) manages the IP address space and other resources for its area. LACNIC, headquartered in Uruguay, operates DNS root, reverse DNS, and other key services.

Opening the network to commerce

The interest in commercial use of the Internet became a hotly debated topic. Although commercial use was forbidden, the exact definition of commercial use could be unclear and subjective. UUCPNet and the X.25 IPSS had no such restrictions, which would eventually see the official barring of UUCPNet use of ARPANET and NSFNET connections. Some UUCP links still remained connecting to these networks however, as administrators cast a blind eye to their operation.

During the late 1980s, the first Internet service provider (ISP) companies were formed. Companies like PSINet, UUNET, Netcom, and Portal Software were formed to provide service to the regional research networks and provide alternate network access, UUCP-based email and Usenet News to the public. The first commercial dialup ISP in the United States was The World, opened in 1989.[42]



Number of Internet hosts worldwide: 1981-2012Source: Internet Systems Consortium. "Internet host count history". Internet Systems Consortium. . Retrieved May 16, 2012.

In 1992, the U.S. Congress passed the Scientific and Advanced-Technology Act, 42 U.S.C. § 1862(g) [43], which allowed NSF to support access by the research and education communities to computer networks which were not used exclusively for research and education purposes, thus permitting NSFNET to interconnect with commercial networks.[44][45] This caused controversy within the research and education community, who were concerned commercial use of the network might lead to an Internet that was less responsive to their needs, and within the community of commercial network providers, who felt that government subsidies were giving an unfair advantage to some organizations.[46]

By 1990, ARPANET had been overtaken and replaced by newer networking technologies and the project came to a close. New network service providers including PSINet, Alternet, CERFNet, ANS CO+RE, and many others were offering network access to commercial customers. NSFNET was no longer the de facto backbone and exchange point for Internet. The Commercial Internet eXchange (CIX), Metropolitan Area Exchanges (MAEs), and later Network Access Points (NAPs) were becoming the primary interconnections between many networks. The final restrictions on carrying commercial traffic ended on April 30, 1995 when the National Science Foundation ended its sponsorship of the NSFNET Backbone Service and the service ended.[47][48] NSF provided initial support for the NAPs and interim support to help the regional research and education networks transition to commercial ISPs. NSF also sponsored the very high speed Backbone Network Service (vBNS) which continued to provide support for the supercomputing centers and research and education in the United States.[49]

Futurology: Beyond Earth and TCP/IP (2010 and beyond)

The first live Internet link into low earth orbit was established on January 22, 2010 when astronaut T. J. Creamer posted the first unassisted update to his Twitter account from the International Space Station, marking the extension of the Internet into space. (Astronauts at the ISS had used email and Twitter before, but these messages had been relayed to the ground through a NASA data link before being posted by a human proxy.) This personal Web access, which NASA calls the Crew Support LAN, uses the space station's high-speed Ku band microwave link. To surf the Web, astronauts can use a station laptop computer to control a desktop computer on Earth, and they can talk to their families and friends on Earth using Voice over IP equipment.[50]

Communication with spacecraft beyond earth orbit has traditionally been over point-to-point links through the Deep Space Network. Each such data link must be manually scheduled and configured. In the late 1990s NASA and Google began working on a new network protocol, Delay-tolerant networking (DTN) which automates this process, allows networking of spaceborn transmission nodes, and takes the fact into account that spacecraft can temporarily lose contact because they move behind the Moon or planets, or because space "weather" disrupts the connection. Under such conditions, DTN retransmits data packages instead of dropping them, as the standard TCP/IP internet protocol does. NASA conducted the first field test of what it calls the "deep space internet" in November 2008.[51] Testing of DTN-based communications between the International Space Station and Earth (now termed Disruption-Tolerant Networking) has been ongoing since March 2009, and is scheduled to continue until March 2014.[52]

This network technology is supposed to ultimately enable missions that involve multiple spacecraft where reliable inter-vessel communication might take precedence over vessel-to-earth downlinks. According to a February 2011 statement by Google's Vint Cerf, the so-called "Bundle protocols" have been uploaded to NASA's EPOXI mission spacecraft (which is in orbit around the sun) and communication with Earth has been tested at a distance of approximately 80 light seconds.[53]

Internet governance

As a globally distributed network of voluntarily interconnected autonomous networks, the Internet operates without a central governing body. It has no centralized governance for either technology or policies, and each constituent network chooses what technologies and protocols it will deploy from the voluntary technical standards that are developed by the Internet Engineering Task Force (IETF).[54] However, throughout its entire history, the Internet system has had an "Internet Assigned Numbers Authority" (IANA) for the allocation and assignment of various technical identifiers needed for the operation of the Internet.[55] The Internet Corporation for Assigned Names and Numbers (ICANN) provides oversight and coordination for two principal name spaces in the Internet, the Internet Protocol address space and the Domain Name System.

NIC, InterNIC, IANA and ICANN

The IANA function was originally performed by USC Information Sciences Institute, and it delegated portions of this responsibility with respect to numeric network and autonomous system identifiers to the Network Information Center (NIC) at Stanford Research Institute (SRI International) in Menlo Park, California. In addition to his role as the RFC Editor, Jon Postel worked as the manager of IANA until his death in 1998.

As the early ARPANET grew, hosts were referred to by names, and a HOSTS.TXT file would be distributed from SRI International to each host on the network. As the network grew, this became cumbersome. A technical solution came in the form of the Domain Name System, created by Paul Mockapetris. The Defense Data Network—Network Information Center (DDN-NIC) at SRI handled all registration services, including the top-level domains (TLDs) of .mil, .gov, .edu, .org, .net, .com and .us, root nameserver administration and Internet number assignments under a United States Department of Defense contract.[55] In 1991, the Defense Information Systems Agency (DISA)

awarded the administration and maintenance of DDN-NIC (managed by SRI up until this point) to Government Systems, Inc., who subcontracted it to the small private-sector Network Solutions, Inc.[56][57]

The increasing cultural diversity of the Internet also posed administrative challenges for centralized management of the IP addresses. In October 1992, the Internet Engineering Task Force (IETF) published RFC 1366,[58] which described the "growth of the Internet and its increasing globalization" and set out the basis for an evolution of the IP registry process, based on a regionally distributed registry model. This document stressed the need for a single Internet number registry to exist in each geographical region of the world (which would be of "continental dimensions"). Registries would be "unbiased and widely recognized by network providers and subscribers" within their region. The RIPE Network Coordination Centre (RIPE NCC) was established as the first RIR in May 1992. The second RIR, the Asia Pacific Network Information Centre (APNIC), was established in Tokyo in 1993, as a pilot project of the Asia Pacific Networking Group.[59]

Since at this point in history most of the growth on the Internet was coming from non-military sources, it was decided that the Department of Defense would no longer fund registration services outside of the .mil TLD. In 1993 the U.S. National Science Foundation, after a competitive bidding process in 1992, created the InterNIC to manage the allocations of addresses and management of the address databases, and awarded the contract to three organizations. Registration Services would be provided by Network Solutions; Directory and Database Services would be provided by AT&T; and Information Services would be provided by General Atomics.[60]

Over time, after consultation with the IANA, the IETF, RIPE NCC, APNIC, and the Federal Networking Council (FNC), the decision was made to separate the management of domain names from the management of IP numbers.[59] Following the examples of RIPE NCC and APNIC, it was recommended that management of IP address space then administered by the InterNIC should be under the control of those that use it, specifically the ISPs, end-user organizations, corporate entities, universities, and individuals. As a result, the American Registry for Internet Numbers (ARIN) was established as in December 1997, as an independent, not-for-profit corporation by direction of the National Science Foundation and became the third Regional Internet Registry.[61]

In 1998 both the IANA and remaining DNS-related InterNIC functions were reorganized under the control of ICANN, a California non-profit corporation contracted by the United States Department of Commerce to manage a number of Internet-related tasks. As these tasks involved technical coordination for two principal Internet name spaces (DNS names and IP addresses) created by the IETF, ICANN also signed a memorandum of understanding with the IAB to define the technical work to be carried out by the Internet Assigned Numbers Authority.[62] The management of Internet address space remained with the regional Internet registries, which collectively were defined as a supporting organization within the ICANN structure.[63] ICANN provides central coordination for the DNS system, including policy coordination for the split registry / registrar system, with competition among registry service providers to serve each top-level-domain and multiple competing registrars offering DNS services to end-users.

Internet Engineering Task Force

The Internet Engineering Task Force (IETF) is the largest and most visible of several loosely related ad-hoc groups that provide technical direction for the Internet, including the Internet Architecture Board (IAB), the Internet Engineering Steering Group (IESG), and the Internet Research Task Force (IRTF).

The IETF is a loosely self-organized group of international volunteers who contribute to the engineering and evolution of Internet technologies. It is the principal body engaged in the development of new Internet standard specifications. Much of the IETF's work is done in Working Groups. It does not "run the Internet", despite what some people might mistakenly say. The IETF does make voluntary standards that are often adopted by Internet users, but it does not control, or even patrol, the Internet.[64][65]

The IETF started in January 1986 as a quarterly meeting of U.S. government funded researchers. Non-government representatives were invited starting with the fourth IETF meeting in October 1986. The concept of Working Groups

was introduced at the fifth IETF meeting in February 1987. The seventh IETF meeting in July 1987 was the first meeting with more than 100 attendees. In 1992, the Internet Society, a professional membership society, was formed and IETF began to operate under it as an independent international standards body. The first IETF meeting outside of the United States was held in Amsterdam, The Netherlands, in July 1993. Today the IETF meets three times a year and attendnce is often about 1,300 people, but has been as high as 2,000 upon occasion. Typically one in three IETF meetings are held in Europe or Asia. The number of non-US attendees is roughly 50%, even at meetings held in the United States.[64]

The IETF is unusual in that it exists as a collection of happenings, but is not a corporation and has no board of directors, no members, and no dues. The closest thing there is to being an IETF member is being on the IETF or a Working Group mailing list. IETF volunteers come from all over the world and from many different parts of the Internet community. The IETF works closely with and under the supervision of the Internet Engineering Steering Group (IESG)[66] and the Internet Architecture Board (IAB).[67] The Internet Research Task Force (IRTF) and the Internet Research Steering Group (IRSG), peer activities to the IETF and IESG under the general supervision of the IAB, focus on longer term research issues.[64][68]

Request for Comments

Request for Comments (RFCs) are the main documentation for the work of the IAB, IESG, IETF, and IRTF. RFC 1, "Host Software", was written by Steve Crocker at UCLA in April 1969, well before the IETF was created. Originally they were technical memos documenting aspects of ARPANET development and were edited by the late Jon Postel, the first RFC Editor.[64][69]

RFCs cover a wide range of information from proposed standards, draft standards, full standards, best practices, experimental protocols, history, and other informational topics.[70] RFCs can be written by individuals or informal groups of individuals, but many are the product of a more formal Working Group. Drafts are submitted to the IESG either by individuals or by the Working Group Chair. An RFC Editor, appointed by the IAB, separate from IANA, and working in conjunction with the IESG, receives drafts from the IESG and edits, formats, and publishes them. Once an RFC is published, it is never revised. If the standard it describes changes or its information becomes obsolete, the revised standard or updated information will be re-published as a new RFC that "obsoletes" the original.[64][69]

The Internet Society

The Internet Society or ISOC is an international, nonprofit organization founded during 1992 to "to assure the open development, evolution and use of the Internet for the benefit of all people throughout the world". With offices near Washington, DC, USA, and in Geneva, Switzerland, ISOC has a membership base comprising more than 80 organizational and more than 50,000 individual members. Members also form "chapters" based on either common geographical location or special interests. There are currently more than 90 chapters around the world.[71]

ISOC provides financial and organizational support to and promotes the work of the standards settings bodies for which it is the organizational home: the Internet Engineering Task Force (IETF), the Internet Architecture Board (IAB), the Internet Engineering Steering Group (IESG), and the Internet Research Task Force (IRTF). ISOC also promotes understanding and appreciation of the Internet model of open, transparent processes and consensus-based decision making.[72]

Globalization and Internet governance in the 21st century

Since the 1990s, the Internet's governance and organization has been of global importance to governments, commerce, civil society, and individuals. The organizations which held control of certain technical aspects of the Internet were the successors of the old ARPANET oversight and the current decision-makers in the day-to-day technical aspects of the network. While recognized as the administrators of certain aspects of the Internet, their roles and their decision making authority are limited and subject to increasing international scrutiny and increasingly objections. These objections have led to the ICANN removing themselves from relationships with first the University of Southern California in 2000,[73] and finally in September 2009, gaining autonomy from the US government by the ending of its longstanding agreements, although some contractual obligations with the U.S. Department of Commerce continued.[74][75][76]

The IETF, with financial and organizational support from the Internet Society, continues to serve as the Internet's ad-hoc standards body and issues Request for Comments.

In November 2005, the World Summit on the Information Society, held in Tunis, called for an Internet Governance Forum (IGF) to be convened by United Nations Secretary General. The IGF opened an ongoing, non-binding conversation among stakeholders representing governments, the private sector, civil society, and the technical and academic communities about the future of Internet governance. The first IGF meeting was held in October/November 2006 with follow on meetings annually thereafter.[77] Since WSIS, the term "Internet governance" has been broadened beyond narrow technical concerns to include a wider range of Internet-related policy issues.[78][79]

Use and culture

E-mail and Usenet

E-mail is often called the killer application of the Internet. However, it actually predates the Internet and was a crucial tool in creating it. Email started in 1965 as a way for multiple users of a time-sharing mainframe computer to communicate. Although the history is unclear, among the first systems to have such a facility were SDC's Q32 and MIT's CTSS.[80]

The ARPANET computer network made a large contribution to the evolution of e-mail. There is one report[81] indicating experimental inter-system e-mail transfers on it shortly after ARPANET's creation. In 1971 Ray Tomlinson created what was to become the standard Internet e-mail address format, using the @ sign to separate user names from host names.[82]

A number of protocols were developed to deliver e-mail among groups of time-sharing computers over alternative transmission systems, such as UUCP and IBM's VNET e-mail system. E-mail could be passed this way between a number of networks, including ARPANET, BITNET and NSFNET, as well as to hosts connected directly to other sites via UUCP. See the history of SMTP protocol.

In addition, UUCP allowed the publication of text files that could be read by many others. The News software developed by Steve Daniel and Tom Truscott in 1979 was used to distribute news and bulletin board-like messages. This quickly grew into discussion groups, known as newsgroups, on a wide range of topics. On ARPANET and NSFNET similar discussion groups would form via mailing lists, discussing both technical issues and more culturally focused topics (such as science fiction, discussed on the sflovers [83] mailing list).

During the early years of the Internet, e-mail and similar mechanisms were also fundamental to allow people to access resources that were not available due to the absence of online connectivity. UUCP was often used to distribute files using the 'alt.binary' groups. Also, FTP e-mail gateways allowed people that lived outside the US and Europe to download files using ftp commands written inside e-email messages. The file was encoded, broken in pieces and sent by e-mail; the receiver had to reassemble and decode it later, and it was the only way for people living overseas to

download items such as the earlier Linux versions using the slow dial-up connections available at the time. After the popularization of the Web and the HTTP protocol such tools were slowly abandoned.

From gopher to the WWW

As the Internet grew through the 1980s and early 1990s, many people realized the increasing need to be able to find and organize files and information. Projects such as Archie, Gopher, WAIS, and the FTP Archive list attempted to create ways to organize distributed data. Unfortunately, these projects fell short in being able to accommodate all the existing data types and in being able to grow without bottlenecks.

One of the most promising user interface paradigms during this period was hypertext. The technology had been inspired by Vannevar Bush's "Memex"[84] and developed through Ted Nelson's research on Project Xanadu and Douglas Engelbart's research on NLS.[85] Many small self-contained hypertext systems had been created before, such as Apple Computer's HyperCard (1987). Gopher became the first commonly used hypertext interface to the Internet. While Gopher menu items were examples of hypertext, they were not commonly perceived in that way.

In 1989, while working at CERN, Tim Berners-Lee invented a network-based implementation of the hypertext concept. By releasing his invention to public use, he ensured the technology would become widespread.[86] For his work in developing the World Wide Web, Berners-Lee received the Millennium technology prize in 2004.[87] One early popular web browser, modeled after HyperCard, was ViolaWWW.

This NeXT Computer was used by Sir Tim Berners-Lee at CERN and became the world's first Web server.

A turning point for the World Wide Web began with the introduction[88] of the Mosaic web browser[89] in 1993, a graphical browser developed by a team at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign (NCSA-UIUC), led by Marc Andreessen. Funding for Mosaic came from the *High-Performance Computing and Communications Initiative*, a funding program initiated by the *High Performance Computing and Communication Act of 1991* also known as the *Gore Bill*.[90] Mosaic's graphical interface soon became more popular than Gopher, which at the time was primarily text-based, and the WWW became the preferred interface for accessing the Internet. (Gore's reference to his role in "creating the Internet", however, was ridiculed in his presidential election campaign. See the full article Al Gore and information technology).

Mosaic was eventually superseded in 1994 by Andreessen's Netscape Navigator, which replaced Mosaic as the world's most popular browser. While it held this title for some time, eventually competition from Internet Explorer and a variety of other browsers almost completely displaced it. Another important event held on January 11, 1994, was *The Superhighway Summit* at UCLA's Royce Hall. This was the "first public conference bringing together all of the major industry, government and academic leaders in the field [and] also began the national dialogue about the *Information Superhighway* and its implications."[91]

24 Hours in Cyberspace, "the largest one-day online event" (February 8, 1996) up to that date, took place on the then-active website, *cyber24.com.*[92][93] It was headed by photographer Rick Smolan.[94] A photographic exhibition was unveiled at the Smithsonian Institution's National Museum of American History on January 23, 1997, featuring 70 photos from the project.[95]

Search engines

Even before the World Wide Web, there were search engines that attempted to organize the Internet. The first of these was the Archie search engine from McGill University in 1990, followed in 1991 by WAIS and Gopher. All three of those systems predated the invention of the World Wide Web but all continued to index the Web and the rest of the Internet for several years after the Web appeared. There are still Gopher servers as of 2006, although there are a great many more web servers.

As the Web grew, search engines and Web directories were created to track pages on the Web and allow people to find things. The first full-text Web search engine was WebCrawler in 1994. Before WebCrawler, only Web page titles were searched. Another early search engine, Lycos, was created in 1993 as a university project, and was the first to achieve commercial success. During the late 1990s, both Web directories and Web search engines were popular—Yahoo! (founded 1994) and Altavista (founded 1995) were the respective industry leaders. By August 2001, the directory model had begun to give way to search engines, tracking the rise of Google (founded 1998), which had developed new approaches to relevancy ranking. Directory features, while still commonly available, became after-thoughts to search engines.

Database size, which had been a significant marketing feature through the early 2000s, was similarly displaced by emphasis on relevancy ranking, the methods by which search engines attempt to sort the best results first. Relevancy ranking first became a major issue circa 1996, when it became apparent that it was impractical to review full lists of results. Consequently, algorithms for relevancy ranking have continuously improved. Google's PageRank method for ordering the results has received the most press, but all major search engines continually refine their ranking methodologies with a view toward improving the ordering of results. As of 2006, search engine rankings are more important than ever, so much so that an industry has developed ("search engine optimizers", or "SEO") to help web-developers improve their search ranking, and an entire body of case law has developed around matters that affect search engine rankings, such as use of trademarks in metatags. The sale of search rankings by some search engines has also created controversy among librarians and consumer advocates.[96]

On June 3, 2009, Microsoft launched its new search engine, Bing.[97] The following month Microsoft and Yahoo! announced a deal in which Bing would power Yahoo! Search.[98]

File sharing

Resource or file sharing has been an important activity on computer networks from well before the Internet was established and was supported in a variety of ways including bulletin board systems (1978), Usenet (1980), Kermit (1981), and many others. The File Transfer Protocol (FTP) for use on the Internet was standardized in 1985 and is still in use today.[99] A variety of tools were developed to aid the use of FTP by helping users discover files they might want to transfer, including the Wide Area Information Server (WAIS) in 1991, Gopher in 1991, Archie in 1991, Veronica in 1992, Jughead in 1993, Internet Relay Chat (IRC) in 1988, and eventually the World Wide Web (WWW) in 1991 with Web directories and Web search engines.

In 1999 Napster became the first peer-to-peer file sharing system.[100] Napster used a central server for indexing and peer discovery, but the storage and transfer of files was decentralized. A variety of peer-to-peer file sharing programs and services with different levels of decentralization and anonymity followed, including: Gnutella, eDonkey2000, and Freenet in 2000, FastTrack, Kazaa, Limewire, and BitTorrent in 2001, and Poisoned in 2003.[101]

All of these tools are general purpose and can be used to share a wide variety of content, but sharing of music files, software, and later movies and videos are major uses.[102] And while some of this sharing is legal, large portions are not. Lawsuits and other legal actions caused Napster in 2001, eDonkey2000 in 2005, Kazza in 2006, and Limewire in 2010 to shutdown or refocus their efforts.[103][104] The Pirate Bay, founded in Sweden in 2003, continues despite a trial and appeal in 2009 and 2010 that resulted in jail terms and large fines for several of its founders.[105] File sharing remains contentious and controversial with charges of theft of intellectual property on the one hand and charges of censorship on the other.[106][107]

Dot-com bubble

Suddenly the low price of reaching millions worldwide, and the possibility of selling to or hearing from those people at the same moment when they were reached, promised to overturn established business dogma in advertising, mail-order sales, customer relationship management, and many more areas. The web was a new killer app—it could bring together unrelated buyers and sellers in seamless and low-cost ways. Entrepreneurs around the world developed new business models, and ran to their nearest venture capitalist. While some of the new entrepreneurs had experience in business and economics, the majority were simply people with ideas, and did not manage the capital influx prudently. Additionally, many dot-com business plans were predicated on the assumption that by using the Internet, they would bypass the distribution channels of existing businesses and therefore not have to compete with them; when the established businesses with strong existing brands developed their own Internet presence, these hopes were shattered, and the newcomers were left attempting to break into markets dominated by larger, more established businesses. Many did not have the ability to do so.

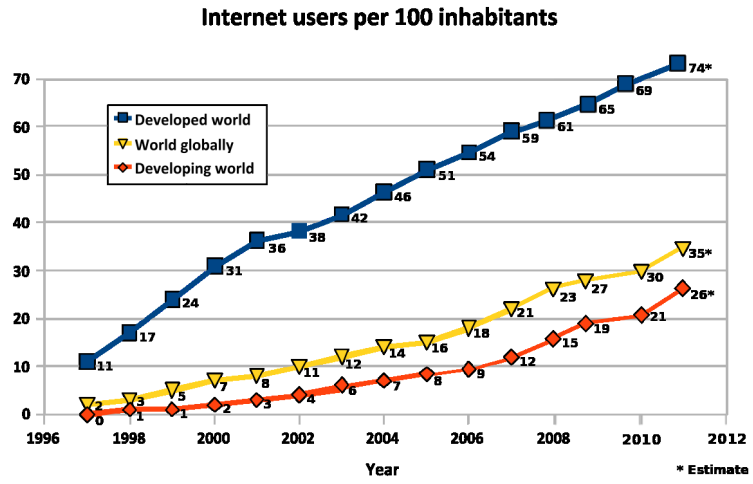
The dot-com bubble burst in March 2000, with the technology heavy NASDAQ Composite index peaking at 5,048.62 on March 10[108] (5,132.52 intraday), more than double its value just a year before. By 2001, the bubble's deflation was running full speed. A majority of the dot-coms had ceased trading, after having burnt through their venture capital and IPO capital, often without ever making a profit. But despite this, the Internet continues to grow, driven by commerce, ever greater amounts of online information and knowledge and social networking.

Mobile phones and the Internet

The first mobile phone with Internet connectivity was the Nokia 9000 Communicator, launched in Finland in 1996. The viability of Internet services access on mobile phones was limited until prices came down from that model and network providers started to develop systems and services conveniently accessible on phones. NTT DoCoMo in Japan launched the first mobile Internet service, i-mode, in 1999 and this is considered the birth of the mobile phone Internet services. In 2001 the mobile phone email system by Research in Motion for their BlackBerry product was launched in America. To make efficient use of the small screen and tiny keypad and one-handed operation typical of mobile phones, a specific document and networking model was created for mobile devices, the Wireless Application Protocol (WAP). Most mobile device Internet services operate using WAP. The growth of mobile phone services was initially a primarily Asian phenomenon with Japan, South Korea and Taiwan all soon finding the majority of their Internet users accessing resources by phone rather than by PC. Developing countries followed, with India, South Africa, Kenya, Philippines, and Pakistan all reporting that the majority of their domestic users accessed the Internet from a mobile phone rather than a PC. The European and North American use of the Internet was influenced by a large installed base of personal computers, and the growth of mobile phone Internet access was more gradual, but had reached national penetration levels of 20–30% in most Western countries. The cross-over occurred in 2008, when more Internet access devices were mobile phones than personal computers. In many parts of the developing world, the ratio is as much as 10 mobile phone users to one PC user.[109]

Online population forecast

A study conducted by JupiterResearch anticipates that a 38 percent increase in the number of people with online access will mean that, by 2011, 22 percent of the Earth's population will surf the Internet regularly. The report says 1.1 billion people have regular Web access. For the study, JupiterResearch defined online users as people who regularly access the Internet from dedicated Internet-access devices, which exclude cellular telephones.[111]



Internet users per 100 inhabitantsSource: International Telecommunications Union. "Internet users per 100 inhabitants 2001-2011", International Telecommunications Union, Geneva, accessed 4 April 2012

Historiography

Some concerns have been raised over the historiography of the Internet's development. Specifically that it is hard to find documentation of much of the Internet's development, for several reasons, including a lack of centralized documentation for much of the early developments that led to the Internet.

> "The Arpanet period is somewhat well documented because the corporation in charge – BBN – left a physical record. Moving into the NSFNET era, it became an extraordinarily decentralized process. The record exists in people's basements, in closets. [...] So much of what happened was done verbally and on the basis of individual trust."
>
> —Doug Gale (2007)[112]

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Barry Appelman

Barry Appelman is recognized as being the father of the "buddy list" and AOL instant messenger. Companies had been using crude forms of Instant messaging within their own networks for over forty years, but the idea of presence, i.e. who is logged on at any given time, was non existent. It was not until Appelman, and his colleagues at the Thomas Watson Research Center, first began to write programs on the mainframe system letting each other know when they were actually online, that modern day Instant Messaging was born.

Barry Appelman	
Born	USA
Nationality	United States of America
Known for	Instant Messaging, TCP/IP
Notable awards	IBM CEO Outstanding Technical Achievement Award

In 1994 while employed at AOL, Appelman hired a single contract programmer, Stephen D. Williams, and for five months they worked together building a prototype system that allowed AOL subscribers to have an early form of the buddy list.

In 1995 AIM was launched internally to AOL employees. It was initially dubbed "the stalker feature" since many employees were uncomfortable having their co-workers know when they were online. AOL decided to make Appelman's system available to its subscribers in May 1997. Ten years later, there were over 53 million AIM users worldwide.

Career at AOL

Appelman joined AOL in 1993 to head up all of AOL server and host development efforts. He authored many innovations and patents: an instant messaging system, a highly scalable email system, ad servers, TCP/IP enabled browsers, among many others. Barry Appelman and his former colleagues from T.J. Watson Matt Korn and Mike Conners who also came to AOL, were crucial to taking AOL from a distant third position in online services to that of a formidable leadership - all within 2-3 years.

Career at IBM T.W. Watson Research

Barry Appelman led IBM's foray into TCP/IP at the Thomas Watson Research Center from 1984 until 1993. Appelman was able to turn complicated IBM politics to the advantage of TCP/IP, open systems and Internet standards. This was not an easy endeavor given that at the time IBM was pushing hard a competing family of internal protocols called IBM Systems Network Architecture. In the end, the work of Barry Appelman proved critical to the IBM's adoption of TCP/IP and its early embrace of the Internet. Mr. Appelman and his group were

active in the Internet standardization. Jacob Rekhter authored several Internet RFCs in routing protocols, including: rfc1092 [1], rfc1105 [2], among others. Mr Appelman's team was also active in SNMP standardization. Carpenter and Wijnen authored rfc1228 [3] on SNMP DPI, among others.

Appelman's small team of developers produced TCP/IP stacks for all IBM operating systems. Dean Hiller authored MVS TCP/IP. Jay Elinsky authored TCP/IP for VM/CMS. Jacob Rekhter authored TCP/IP for AIX. Oleg Vishnepolsky authored TCP/IP for OS/2 and IBM POS terminals. Appelman was one of the first in the industry to recognize the importance of security in the world of open systems. He was the first one to make Kerberos security system out of MIT's Project Athena a commercial product by having Galina Kofman port this security software to various OS. Kofman also did FTP for VM/CMS. Dick Ryniker authored NFS for VM/CMS and MVS.

Mr. Appelman's ability to attract and retain top talent with his remarkable vision, intuition and charisma played a key role in his ability to execute on the Internet strategy for IBM. The stream of his innovation included offloading of TCP/IP processing from IBM mainframes to OS/2 servers, graphical TCP/IP clients, SNMP and FTP APIs, fastest terminal emulator MYTE, S2 Spreadsheet that connected via TCP to IBM DB2, and many others. Particularly noteworthy was the innovation by Appelman and one of his development managers Matt Korn to get voice and video flowing over IP back in 1987 - way ahead of everyone else.

Patents

Barry Appelman authored 77 patents: [4]

Quotes

- “There is some need [Instant Messaging] fulfills. Once you start using it, it’s hard to live without it”
- "You don’t really want to see someone online and then find out they’re not [really] online,”
- "the germ of the idea [for the Buddy List] came from the chat-room list,"
- "If you never been late to a plane, you spend too much time in airports"
- "TCP, TCP - that's the way you want to be" to a group of IBM SNA zealots that included senior managers

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Paul Baran

Paul Baran	
Born	April 29, 1926 Grodno, Second Polish Republic
Died	March 26, 2011 (aged 84) Palo Alto, California, United States
Citizenship	United States
Institutions	RAND Corporation
Alma mater	UCLA, Drexel Institute of Technology, Philadelphia
Known for	Packet Switching
Notable awards	IEEE Alexander Graham Bell Medal, National Medal of Technology and Innovation, National Inventors Hall of Fame
Spouse	Evelyn Murphy Baran, PhD

Paul Baran (1926–2011) was a Polish American engineer who was a pioneer in the development of computer networks. He invented packet switching techniques, and went on to start several companies and develop other technologies that are an essential part of the Internet and other modern digital communication.

Early life

Paul Baran was born in Grodno, Second Polish Republic (now part of Belarus) on April 29, 1926.[1][2] He was the youngest of three children in a Jewish family,[3] with the Yiddish given name "Pesach". His family moved to the United States on May 11, 1928,[4] settling in Boston and later in Philadelphia, where his father, Morris "Moshe" Baran (1884–1979), opened a grocery store. He graduated from Drexel University in 1949 (then called Drexel Institute of Technology), with a degree in electrical engineering. He then joined the Eckert-Mauchly Computer Company, where he did technical work on UNIVAC models, the first brand of commercial computers in the USA.[5] In 1955 he married Evelyn Murphy, moved to Los Angeles, and worked for Hughes Aircraft on radar systems. He obtained his Masters degree in engineering from UCLA in 1959, with advisor Gerald Estrin while taking night classes. His thesis was on character recognition.[1]

Packet switched network design

After joining the RAND Corporation that same year, Baran took on the task of designing a "survivable" communications system that could maintain communication between end points in the face of damage from nuclear weapons.[6] At the time of the Cold War, most American military communications used high frequency connections which could be put out of action for many hours by a nuclear attack. Baran decided to automate RAND director Franklin R. Collbohm's previous work with emergency communication over conventional AM radio networks and showed that a distributed relay node architecture could be survivable. The Rome Air Development Center soon showed that the idea was practicable.[7]

Using the mini-computer technology of the day, Baran and his team developed a simulation suite to test basic connectivity of an array of nodes with varying degrees of linking. That is, a network of n-ary degree of connectivity would have n links per node. The simulation randomly 'killed' nodes and subsequently tested the percentage of nodes who remained connected. The result of the simulation revealed that networks where $n \geq 3$ had a significant increase in resilience against even as much as 50% node loss. Baran's insight gained from the simulation was that redundancy was the key.[8] His first work was published a RAND report in 1960,[9] with more papers generalizing the techniques

in the next two years.[10]

After proving survivability Baran and his team needed to show proof of concept for this design such that it could be built. This involved high level schematics detailing the operation, construction and cost of all the components required to construct a network that leveraged this new insight of redundant links. The result of this was one of the first store-and-forward data layer switching protocols, a link-state/distance vector routing protocol, and an unproved connection-oriented transport protocol. Explicit detail of these designs can be found in the complete series of reports "On Distributed Communications", published by RAND in 1964.[11] The design flew in the face of telephony design of the time, placing inexpensive and unreliable nodes at the center of the network, and more intelligent terminating 'multiplexer' devices at the endpoints. In Baran's words, unlike the telephone company's equipment, his design didn't require expensive "gold plated" components to be reliable.

Selling the idea

After the publication of "On Distributed Communications'", Paul Baran presented the findings of his team to a number of audiences, including AT&T engineers (not to be confused with Bell labs engineers, who at the time provided Paul Baran with the specifications for the first generation of T1 circuit which he used as the links in his network design proposal). In subsequent interviews Baran mentions how his idea of non-dedicated physical circuits for voice communications was scoffed at by the AT&T engineers who at times claimed that Baran simply did not understand how voice telecommunication worked.[12]

Leonard Kleinrock developed a theoretical basis for the operation of packet networks in his Ph.D. thesis in 1961. Baran used the term "message blocks" for his units of communication. Donald Davies at the National Physical Laboratory in the United Kingdom was the first to use the term "packet switching" in 1965, and apply the concept to a general-purpose computer network. Davies' key observation was that computer network traffic was inherently "bursty" with periods of silence, compared with relatively constant telephone traffic.[1][13]

In 1969 when the US Defense Advanced Research Projects Agency (ARPA) was developing the idea of an inter-networked set of terminals to share computing resources, among the number of reference materials considered was Baran and the RAND Corporation's "On Distributed Communications" volumes.[1] The resiliency of a packet switched network that uses link-state routing protocols used on the Internet stems in some part from the research to develop a network that could survive a nuclear attack.[1][14]

Later work

In 1968 Baran was a founder of the Institute for the Future, and then involved in other networking technologies developed in Silicon Valley. He participated in a review of the NBS proposal for a Data Encryption Standard in 1976, along with Martin Hellman and Whitfield Diffie of Stanford University.[15] In the early 1980s, Baran founded PacketCable, Inc, "to support impulse-pay television channels, locally generated videotex, and packetized voice transmission".[16][17] PacketCable (also known as Packet Technologies) spun off StrataCom to commercialize his packet voice technology for the telephony market. This technology led to the first commercial pre-standard Asynchronous Transfer Mode product. He founded Telebit after conceiving its discrete multitone modem technology in the mid-1980s. This was one of the first commercial products to use Orthogonal frequency-division multiplexing, which was later widely deployed in DSL modems and Wi-Fi wireless modems. In 1985, Baran founded Metricom, the first wireless Internet company, which deployed Ricochet,[2] the first public wireless mesh networking system. In 1992, he also founded Com21, an early cable modem company.[5] Following Com21, Baran founded and was president of GoBackTV, which specializes in personal TV and cable IPTV infrastructure equipment for television operators.[18] Most recently he founded Plaster Networks, providing an advanced solution for connecting networked devices in the home or small office through existing wiring.[19]

Baran extended his work in packet switching to wireless-spectrum theory, developing what he called "kindergarten rules" for the use of wireless spectrum.[20]

In addition to his innovation in networking products, he is also credited with inventing the first metal detector, a doorway gun detector.[5][21]

He received an honorary doctorate when he gave the commencement speech at Drexel in 1997.[22]

Death

Baran died in Palo Alto, California at the age of 84 on March 26, 2011,[1][23] due to complications from lung cancer.[14] Upon his death James Thomson, the president of RAND, stated that "Our world is a better place for the technologies Paul Baran invented and developed, and also because of his consistent concern with appropriate public policies for their use."[23] One of the fathers of the internet, Vinton Cerf, stated that "Paul wasn't afraid to go in directions counter to what everyone else thought was the right or only thing to do."[14] According to Paul Saffo, Baran also believed that innovation was a "team process" and he didn't seek credit for himself.[21] On hearing news of his death, Robert Kahn, co-inventor of the Internet, said: "Paul was one of the finest gentlemen I ever met and creative to the very end."

Awards and honors

- IEEE Alexander Graham Bell Medal (1990)[24]
- Marconi Prize (1991)
- Nippon Electronics Corporation C&C Prize (1996)
- Bower Award and Prize for Achievement in Science (2001)[5]
- Fellow of the American Academy of Arts and Sciences (2003)[25]
- Fellow of the Computer History Museum (2005)
- National Inventors Hall of Fame (2007)
- National Medal of Technology and Innovation (2007)[26]
- UCLA Engineering Alumnus of the Year (2009)[27]
- Internet Hall of Fame (2012)[28]

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Vint Cerf

Vint Cerf	
 Vint Cerf in Vilnius, September 2010.	
Born	Vinton Gray Cerf June 23, 1943 New Haven, Connecticut
Residence	USA
Citizenship	United States of America
Fields	Computer science
Institutions	IBM,[1] UCLA,[1] Stanford University,[1] DARPA,[1] MCI,[1][2] CNRI,[1] Google[3]
Alma mater	Stanford University (B.S.) UCLA (M.S. & Ph.D.)
Known for	TCP/IP Internet Society
Notable awards	National Medal of Technology Presidential Medal of Freedom Turing Award

Vinton Gray "Vint" Cerf[1] (/ˈsɜrf/; born June 23, 1943) is an American computer scientist, who is recognized as one of[4] "the fathers of the Internet",[5] sharing this title with American computer scientist Bob Kahn.[6][7] His contributions have been acknowledged and lauded, repeatedly, with honorary degrees and awards that include the National Medal of Technology,[1] the Turing Award,[8] the Presidential Medal of Freedom,[9] and membership in the National Academy of Engineering.

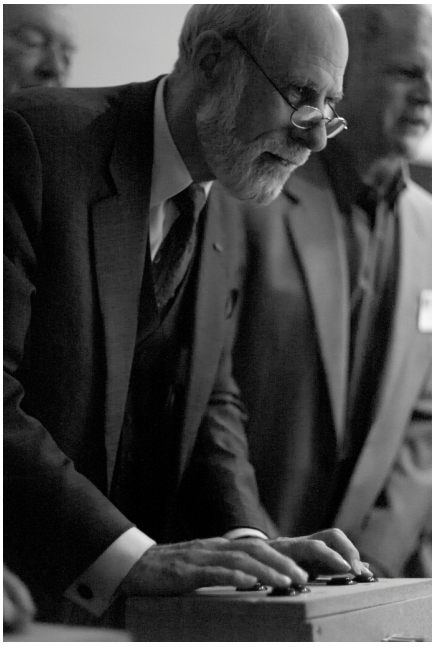
In the early days, Cerf was a program manager for the United States Department of Defense Advanced Research Projects Agency (DARPA) funding various groups to develop TCP/IP technology. When the Internet began to transition to a commercial opportunity during the late 1980s, Cerf moved to MCI where he was instrumental in the development of the first commercial email system (MCI Mail) connected to the Internet.

Vinton Cerf was instrumental in the funding and formation of ICANN from the start. Cerf waited in the wings for a year before he stepped forward to join the ICANN Board. Eventually he became the Chairman of ICANN. Cerf was elected as the president of the Association for Computing Machinery in May 2012.[10]

Cerf also went to Van Nuys High School along with Jon Postel and Steve Crocker; he wrote the former's obituary. Both were also instrumental in the creation of the Internet as we know it (see articles).

Life and career

Cerf was born in New Haven, Connecticut, the son of Muriel (née Gray), a homemaker, and Vinton Thurston Cerf, an aerospace executive.[11][12] Cerf's first job after obtaining his B.S. degree in Mathematics from Stanford University was at IBM, where he worked for less than two years as a systems engineer supporting QUIKTRAN.[1] He left IBM to attend graduate school at UCLA where he earned his M.S. degree in 1970 and his PhD degree in 1972.[13] During his graduate student years, he studied under Professor Gerald Estrin, worked in Professor Leonard Kleinrock's data packet networking group that connected the first two nodes of the ARPANet,[14] the predecessor[14] to the Internet, and "contributed to a host-to-host protocol" for the ARPANet.[15] While at UCLA, he also met Robert E. Kahn, who was working on the ARPANet hardware architecture.[15] After receiving his doctorate, Cerf became an assistant professor at Stanford University from 1972–1976, where he conducted research on packet network interconnection protocols and co-designed the DoD TCP/IP protocol suite with Kahn.[15] Cerf then moved to DARPA in 1976, where he stayed until 1982.



Cerf playing Spacewar! on the Computer History Museum's PDP-1, ICANN meeting, 2007.

As vice president of MCI Digital Information Services from 1982–1986, Cerf led the engineering of MCI Mail, the first commercial email service to be connected to the Internet. Cerf rejoined MCI during 1994 and served as Senior Vice President of Technology Strategy. In this role, he helped to guide corporate strategy development from a technical perspective. Previously, he served as MCI's senior vice president of Architecture and Technology, leading a team of architects and engineers to design advanced networking frameworks, including Internet-based solutions for delivering a combination of data, information, voice and video services for business and consumer use.

In 1992 he co-founded, with Bob Kahn the Internet Society to provide leadership in Internet related standards, education and policy.

During 1997, Cerf joined the Board of Trustees of Gallaudet University, a university for the education of the deaf and hard-of-hearing.[16] Cerf himself is hard of hearing.[17]

Cerf has worked for Google as a Vice President and Chief Internet Evangelist since September 2005.[3] In this function he has become well known for his predictions on how technology will affect future society, encompassing such areas as artificial intelligence, environmentalism, the advent of IPv6 and the transformation of the television industry and its delivery model.[18]

Since 2010, Cerf has served as a Commissioner for the Broadband Commission for Digital Development, a UN body which aims to make broadband internet technologies more widely available.

Cerf joined the board of the Internet Corporation for Assigned Names and Numbers (ICANN) in 1999, and served until the end of 2007.[19]

Cerf was a member of the Bulgarian President Georgi Parvanov's IT Advisory Council (from March 2002 till January 2012). He is also a member of the Advisory Board of Eurasia Group, the political risk consultancy.[20]

Cerf is also working on the Interplanetary Internet, together with NASA's Jet Propulsion Laboratory. It will be a new standard to communicate from planet to planet, using radio/laser communications that are tolerant of signal degradation.[21]

On February 7, 2006, Cerf testified before the U.S. Senate Committee on Commerce, Science, and Transportation's Hearing on “Network Neutrality”.[22] Speaking as Google's Chief Internet Evangelist, Cerf noted that nearly half of

all consumers lacked meaningful choice in broadband providers and expressed concerns that without network neutrality government regulation, broadband providers would be able to use their dominance to limit options for consumers and charge companies like Google for their use of band width.[23]

Cerf currently serves on the board of advisors of Scientists and Engineers for America, an organization focused on promoting sound science in American government.[24] He also serves on the advisory council of CRDF Global.

Cerf is on the board of trustees of ARIN, the Regional Internet Registry (RIR) of IP addresses for United States, Canada, and part of the Caribbean.[25]

Cerf is on the board of directors of StopBadware, a non-profit anti-malware organization that Google has supported since its inception as a project at Harvard University's Berkman Center for Internet & Society.[26][27]

Cerf is on the board of advisors of The Hyperwords Company Ltd of the UK, which works to make the web more usefully interactive and which has produced the free Firefox Add-On called 'Hyperwords'.[28]

During 2008 Cerf chaired the IDNAbis working group of the IETF.[29]

Cerf was a major contender to be designated the nation's first Chief Technology Officer by President Barack Obama.[30]

Cerf is the co-chair of Campus Party Silicon Valley, the US edition of one of the largest technology festivals in the world, along with Al Gore and Tim Berners-Lee.[31]

On May 24, 2012, the Association for Computing Machinery (ACM) announced that Cerf was elected to the 2 year term post of President beginning July 1, 2012.[32]

Awards and honors

Cerf has received a number of honorary degrees, including doctorates, from the University of the Balearic Islands, ETHZ in Zurich, Switzerland, Capitol College, Gettysburg College, George Mason University, Marymount University, University of Pisa, University of Rovira and Virgili (Tarragona, Spain), Rensselaer Polytechnic Institute, Luleå University of Technology (Sweden), University of Twente (Netherlands), Beijing University of Posts and Telecommunications, Brooklyn Polytechnic, UPCT (University of Cartagena, Spain), Royal Roads University (Canada) Polytechnic University of Madrid and Keio University (Japan).

Cerf and Bob E. Kahn being awarded the Presidential Medal of Freedom by President George W. Bush

Further awards include:

- Edward A. Dickson Alumnus of the Year Award from UCLA[33]
- Prince of Asturias award for science and technology
- Fellow of the IEEE, 1988, "for contributions and leadership in the design, development, and application of internet protocols"
- Fellow of the Association for Computing Machinery, 1994, for "vision and leadership in the design, implementation, evolution, and dissemination of the TCP/IP computer communication protocol suite"
- Yuri Rubinsky Memorial Award, 1996

- SIGCOMM Award for "contributions to the Internet [spanning] more than 25 years, from development of the fundamental TCP/IP protocols".[34]
- Certificate of Merit from The Franklin Institute, in 1996.

Cerf and Bulgarian President Parvanov being awarded the St. Cyril and Methodius in the Coat of Arms Order

- In December 1997 he, along with his partner Robert E. Kahn, was presented with the National Medal of Technology by President Bill Clinton, "for creating and sustaining development of Internet Protocols and continuing to provide leadership in the emerging industry of internetworking."[35]
- He received the Living Legend Medal from the Library of Congress in April 2000
- He was inducted as a Fellow of the Computer History Museum in November 2000
- Cerf was selected as a Fellow of the Association for Women in Science (AWIS) in 2000
- Cerf and Kahn were the winners of the Turing Award for 2004,[8] for their "pioneering work on internetworking, including .. the Internet's basic communications protocols .. and for inspired leadership in networking."[36]
- In November 2005, Vinton Cerf and Kahn were awarded the Presidential Medal of Freedom by President George W. Bush for their contributions to the creation of the Internet.[9]
- He and Robert Kahn were inducted into the National Inventors Hall of Fame in May 2006
- Vinton Cerf was awarded the St. Cyril and Methodius in the Coat of Arms Order in July 2006[37]
- Vinton Cerf and Robert Kahn were each inducted as an Honorary Fellow of the Society for Technical Communication (STC) in May 2006
- He and Robert Kahn were awarded the Japan Prize in January 2008.[38]
- Cerf was inducted into the Worshipful Company of Information Technologists and given the Freedom of the City of London in April 2008.
- Dr. Cerf was awarded an honorary membership in the Yale Political Union after keynoting a lively debate on the subject "Resolved: Online Communities are Real Communities." The motion passed.[39]
- In celebration of the five year-anniversary of YouTube he was selected as a guest curator by the site, and chose the six videos on YouTube he found most memorable.[40]
- In May 2011, he was awarded an HPI Fellowship as “[...]a tribute to his work for a new medium which influenced the everyday life of our society like no other one.”[41]
- In September 2011 he was made a distinguished fellow of British Computer Society, in recognition of his outstanding contribution and service to the advancement of computing.[42]
- 2012 Internet Hall of Fame[43]

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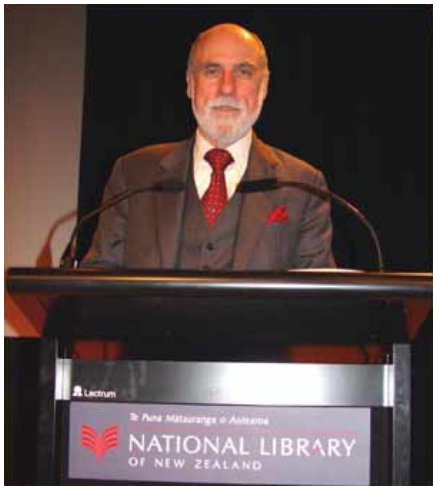
Author



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Cerf at 2007 Los Angeles ICANN meeting.

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Danny Cohen (engineer)

Danny Cohen	
Born	Israel
Residence	Bay Area, California
Fields	Mathematics, Computer Science, Computer Graphics
Institutions	Harvard University, California Institute of Technology, University of Southern California, Myricom, Sun Microsystems
Alma mater	Technion, Harvard
Doctoral advisor	Ivan E. Sutherland
Known for	Internet Pioneer, first to run a visual flight simulator across the ARPANet
Notable awards	National Academy of Engineering member, IEEE Fellow, USAF Meritorious Civilian Service Award

Danny Cohen (born in Israel) is a member of the National Academy of Engineering (2006) [1] and an IEEE Fellow (2010).[2] In 1993 Cohen received a USAF (United States Air Force) Meritorious Civilian Service Award.

In 1967, he developed the first real-time visual flight simulator on a general purpose computer and also developed the first real-time radar simulator. In 1981, he adapted the visual simulator to run over the ARPANet (the forerunner to the Internet) which was the first application of packet switching networks to real-time applications.

Starting in 1973, Cohen led several projects on real-time interactive applications over the ARPANet and the Internet, such as packet-voice (also known as Voice over Internet Protocol) and packet-video.

In 1967, flight simulation work by Cohen led to the development of the Cohen-Sutherland computer graphics line clipping algorithms, created with Ivan Sutherland.[3]

After serving on the computer science faculty at Harvard University (1969–1973) and Caltech (California Institute of Technology) in 1976, Cohen joined USC/ISI (University of Southern California/Information Sciences Institute) to work on a project designed to allow interactive, real-time speech over the ARPANet. Cohen worked at USC/ISI (1973–1993), where he started many network related projects, including Packet-Voice, Packet-Video, and Internet Concepts. He started the MOSIS project in 1980. Cohen also started the FastXchange project (Electronic commerce), Digital Library, and ATOMIC which was the forerunner of Myrinet, a high-performance system area network. In 1993, he worked on Distributed Interactive Simulation through several projects funded by DoD (United States Department of Defense). In 1994, Danny co-founded Myricom (with Chuck Seitz, et al.) which commercialized Myrinet.

Cohen served on several panels and boards for DoD, NIH (National Institutes of Health), and NRC (United States National Research Council), including 5 years on the USAF Scientific Advisory Board. He served as both a factual and expert witness in several patent infringement legal cases about VoIP (Voice over Internet Protocol). Cohen is a commercial pilot with SEL/MEL/SES and Instrument ratings.

Cohen is probably best known for his 1980 paper "On Holy Wars and a Plea for Peace"[4] which adopted the terminology of endianness for computing.

Education and early work

Danny earned a bachelor's degree in mathematics at the Technion (Technion – Israel Institute of Technology) in 1963 and a PhD from Ivan Sutherland at Harvard in 1969. His thesis was titled: "Incremental Methods for Computer Graphics".[5] Danny has served on the computer science faculty at Harvard, Technion, and Caltech. He also spent two years as a graduate student in the math department at the Massachusetts Institute of Technology (MIT), 1965-1967.

Current work

Since 1991 Danny Cohen has been a Distinguished Engineer for Sun Microsystems [6] working on very fast communication over short distances, using optical and electrical signaling, in Sun's CTO (Chief technical officer) organization.

Danny is also an Adjunct Professor of Computer Science at USC.[7]

In 2012, Danny Cohen was inducted into the Internet Hall of Fame by the Internet Society.[8]

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David D. Clark

David Dana Clark	
	
Born	April 7, 1944
Nationality	American
Fields	Computer Science
Institutions	Internet Architecture Board National Research Council MIT
Known for	Clark-Wilson model
Notable awards	SIGCOMM Award Telluride Tech Festival Award of Technology

David Dana Clark (born April 7, 1944) is an American computer scientist. He graduated from Swarthmore College in 1966. In 1968, he received his Master's and Engineer's degrees in Electrical Engineering from the Massachusetts Institute of Technology, where he worked on the I/O architecture of Multics under Jerry Saltzer. He received his Ph.D. in Electrical Engineering from MIT in 1973. From 1981 to 1989, he acted as chief protocol architect in the development of the Internet, and chaired the Internet Activities Board, which later became the Internet Architecture Board. He has also served as chairman of the Computer Sciences and Telecommunications Board of the National Research Council. He is currently a Senior Research Scientist at the MIT Computer Science and Artificial Intelligence Laboratory.

In 1990 he was awarded the SIGCOMM Award in recognition of his major contributions to Internet protocol and architecture. Clark received in 1998 the IEEE Richard W. Hamming Medal.[1] In 2001 he was inducted as a Fellow of the Association for Computing Machinery. In 2001, he was awarded the Telluride Tech Festival Award of Technology in Telluride, Colorado.

Quote

> *We reject: kings, presidents and voting.*
> *We believe in: rough consensus and running code.*[2]

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External links

- David D. Clark's official biography (http://www.csail.mit.edu/user/1526)
- List of online papers of David D. Clark (http://www.informatik.uni-trier.de/~ley/db/indices/a-tree/c/Clark:David_D=.html)
- David D. Clark (http://genealogy.math.ndsu.nodak.edu/id.php?id=69545) at the Mathematics Genealogy Project

Steve Crocker


Steve Crocker in 2005

Stephen D. Crocker (born October 15, 1944 in Pasadena, California) is the inventor of the Request for Comments series,[1] authoring the very first RFC and many more. He received his bachelor's degree (1968) and PhD (1977) from the University of California, Los Angeles.[2] Crocker is chair of the board of the Internet Corporation for Assigned Names and Numbers, ICANN. [3]

Steve Crocker has worked in the Internet community since its inception. As a UCLA graduate student in the 1960s, Steve Crocker helped create the ARPANET protocols which were the foundation for today's Internet. For this work, Crocker was awarded the 2002 IEEE Internet Award.

While at UCLA Crocker taught an extension course on computer programming (for the IBM 7094 mainframe computer). The class was intended to teach digital processing and assembly language programming to high school teachers, so that they could offer such courses in their high schools. A number of high school students were also admitted to the course, to ensure that they would be able to understand this new discipline. Crocker was also active in the newly formed UCLA Computer Club.

Crocker has been a program manager at Advanced Research Projects Agency (ARPA), a senior researcher at USC's Information Sciences Institute, founder and director of the Computer Science Laboratory at The Aerospace Corporation and a vice president at Trusted Information Systems. In 1994, Crocker was one of the founders and chief technology officer of CyberCash, Inc. In 1998, he founded and ran Executive DSL, a DSL-based ISP. In 1999 he cofounded and was CEO of Longitude Systems. He is currently CEO of Shinkuro [4], a research and development company.

Steve Crocker

Steve Crocker was instrumental in creating the ARPA "Network Working Group", which later was the context in which the IETF was created.

He has also been an IETF security area director, a member of the Internet Architecture Board, chair of the ICANN Security and Stability Advisory Committee, a board member of the Internet Society and numerous other Internet-related volunteer positions.

In 2012, Crocker was inducted into the Internet Hall of Fame by the Internet Society.[5]

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External links

- RFC 1
- RFC 1776
- Shinkuro.com executive team info (http://www.shinkuro.com/about.php)
- Steve Crocker is a Geek! (http://www.alpha.geek.nz/)
- Oral history interview with Stephen Crocker (http://purl.umn.edu/107234), Charles Babbage Institute, University of Minnesota. Crocker discusses computer networks, artificial intelligence research, and his work at the Defense Advanced Research Projects Agency (DARPA); interactions with other DARPA personnel including Cordell Green, Barry Wessler, Larry Roberts, Bob Kahn, and David Russell. He discusses his work as a program manager in the Information Processing Techniques Office (IPTO).

Donald Davies

Donald Watts Davies	
Born	7 June 1924 Treorchy, Wales
Died	28 May 2000 (aged 75)
Nationality	British
Fields	Computer science
Institutions	National Physical Laboratory
Alma mater	Imperial College
Known for	Packet switching

Donald Watts Davies, CBE FRS[1] (7 June 1924 – 28 May 2000) was a Welsh computer scientist who was one of the inventors of packet switched computer networking, originator of the term,[2] and the Internet itself can be traced directly back to his work.[3]

Career history

Davies was born in Treorchy in the Rhondda Valley, Wales. His father, a clerk at a coalmine, died a few months later, and his mother took Donald and his twin sister back to her home town of Portsmouth, where he went to school.[4]

He received a BSc degree in physics (1943) at Imperial College London, and then joined the war effort working as an assistant to Klaus Fuchs.[4] on the nuclear weapons Tube Alloys project at Birmingham University.[5] He then returned to Imperial taking a first class degree in mathematics (1947); he was also awarded the Lubbock memorial Prize as the outstanding mathematician of his year.

In 1955, he married Diane Burton; they had a daughter and two sons.[6]

From 1947, he worked at the National Physical Laboratory (NPL) where Alan Turing was designing the Automatic Computing Engine (ACE) computer. It is said that Davies spotted mistakes in Turing's seminal 1936 paper *On Computable Numbers*, much to Turing's annoyance. These were perhaps some of the first "programming" errors in existence, even if they were for a theoretical computer, the universal Turing machine. The ACE project was overambitious and foundered, leading to Turing's departure.[5] Davies took the project over and concentrated on delivering the less ambitious Pilot ACE computer, which first worked in May 1950. A commercial spin-off, DEUCE was manufactured by English Electric Computers and became one of the best-selling machines of the 1950s.[5]

Davies then worked for a while on applications such as traffic simulation and machine translation. In the early 1960s, he worked on Government technology initiatives designed to stimulate the British computer industry.

In 1966 he returned to the NPL at Teddington just outside London, where he headed and transformed its computing activity. He became interested in data communications following a visit to the Massachusetts Institute of Technology, where he saw that a significant problem with the new time-sharing computer systems was the cost of keeping a phone connection open for each user.[5] He first presented his ideas on packet switching at a conference in Edinburgh on 5 August 1968.[7]

In 1970, Davies helped build a packet switched network called the *Mark I* to serve the NPL in the UK. It was replaced with the *Mark II* in 1973, and remained in operation until 1986, influencing other research in the UK and Europe.[8] Larry Roberts of the Advanced Research Projects Agency in the United States became aware of the idea, and built it into the ARPANET, which evolved into the Internet.[5]

Davies relinquished his management responsibilities in 1979 to return to research. He became particularly interested in computer network security. He retired from the NPL in 1984, becoming a security consultant to the banking industry.[5]

Davies was appointed a Distinguished Fellow of the British Computer Society in 1975, a CBE in 1983 and a Fellow of the Royal Society in 1987. In 2012, Davies was inducted into the Internet Hall of Fame by the Internet Society.[9]

Books

- With D. Barber: *Communication Networks for Computers*, Wiley, 1973.
- With W. Price, D. Barber, C. Solomonides: *Computer Networks and Their Protocols*, Wiley, 1979.
- With W. Price: *Security for Computer Networks*, Wiley, 1984.

Family

Davies was survived by his wife Diane, a daughter and two sons.[10]

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[10] "Obituary: Data Pioneer Donald Davies Dies" (http://www.isoc.org/internet/history/davies.shtml), Internet Society (ISOC), 31 May 2000

External links

- Oral history interview with Donald W. Davies (http://purl.umn.edu/107241), Charles Babbage Institute, University of Minnesota. Davies describes computer projects at the U.K. National Physical Laboratory, from the 1947 design work of Alan Turing to the development of the two ACE computers. Davies discusses a much larger, second ACE, and the decision to contract with English Electric Company to build the DEUCE—possibly the first commercially produced computer in Great Britain.
- Biography (http://www.thocp.net/biographies/davies_donald.htm) from the History of Computing Project (http://www.thocp.net/)
- Donald Davies profile page at NPL (http://www.npl.co.uk/people/donald-davies)
- UK National Physical Laboratory (NPL) & Donald Davies (http://www.livinginternet.com/i/ii_npl.htm) from Living Internet (http://www.livinginternet.com/)
- Computer Networks: The Heralds of Resource Sharing (http://video.google.com/videoplay?docid=4989933629762859961), documentary ca. 1972 about the ARPANET. Includes footage of Donald W. Davies (at 19m20s).

Douglas Engelbart

Douglas Carl Engelbart ("Doug")	
 Douglas Engelbart in 2008	
Born	January 30, 1925 Portland, Oregon, USA
Citizenship	United States
Nationality	United States
Fields	Inventor
Institutions	SRI International, Tymshare, McDonnell Douglas, Bootstrap Institute/Alliance,[1] The Doug Engelbart Institute
Alma mater	Oregon State College (BS) UC Berkeley (PhD)
Doctoral advisor	John R. Woodyard
Known for	Computer mouse, Hypertext, Groupware, Interactive computing
Notable awards	National Medal of Technology, Lemelson-MIT Prize, Turing Award, Lovelace Medal, Norbert Wiener Award for Social and Professional Responsibility, Computer History Museum Fellow Award[2]
Website	
dougengelbart.org [3]	

Douglas Carl Engelbart (born January 30, 1925) is an American inventor, and an early computer and internet pioneer. He is best known for his work on the challenges of human–computer interaction, particularly while at his Augmentation Research Center Lab in SRI International, resulting in the invention of the computer mouse,[4] and the development of hypertext, networked computers, and precursors to graphical user interfaces.

He is a committed, vocal proponent of the development and use of computers and networks to help cope with the world's increasingly urgent and complex problems.[5] Engelbart embedded a set of organizing principles in his lab, which he termed "bootstrapping strategy". He designed the strategy to accelerate the rate of innovation of his lab.[6]

Early life and education

Engelbart was born in Portland, Oregon on January 30, 1925 to Carl Louis Engelbart and Gladys Charlotte Amelia Munson Engelbart. He is of German, Swedish and Norwegian descent.[7]

He was the middle of three children, with a sister Dorianne (3 years older), and a brother David (14 months younger). They lived in Portland in his early years, and moved to the countryside to Johnson Creek when he was 9 or 10, after the death of his father. He graduated from Portland's Franklin High School in 1942.[8]

Midway through his college studies at Oregon State University (then called Oregon State College), near the end of World War II, he was drafted into the US Navy, serving two years as a radar technician in the Philippines. On a small island, in a tiny hut on stilts, he first read Vannevar Bush's article "As We May Think", which greatly inspired him.[8] He returned to Oregon State and completed his Bachelor's degree in electrical engineering in 1948. While at Oregon State, he was a member of Sigma Phi Epsilon social fraternity.[9]

He was hired by the National Advisory Committee for Aeronautics at the Ames Research Center, where he worked through 1951.[10]

Career and accomplishments

Epiphany

Engelbart's career was inspired in 1951 when he was engaged to be married and realized he had no career goals beyond getting a good education and a decent job. Over several months he reasoned that:

1. he would focus his career on making the world a better place;
2. any serious effort to make the world better requires some kind of organized effort;
3. harnessing the collective human intellect of all the people contributing to effective solutions was the key;
4. if you could dramatically improve how we do that, you'd be boosting every effort on the planet to solve important problems—the sooner the better; and
5. computers could be the vehicle for dramatically improving this capability.

The first prototype of a computer mouse, as designed by Bill English from Engelbart's sketches.[11]

In 1945, Engelbart had read with interest Vannevar Bush's article "As We May Think",[12] a call to action for making knowledge widely available as a national peacetime grand challenge. He had also read something about computers (a relatively recent phenomenon), and from his experience as a radar technician he knew that information could be analyzed and displayed on a screen. He envisioned intellectual workers sitting at display "working stations", flying through information space, harnessing their collective intellectual capacity to solve important problems together in much more powerful ways. Harnessing collective intellect, facilitated by interactive computers, became his life's mission at a time when computers were viewed as number crunching tools.

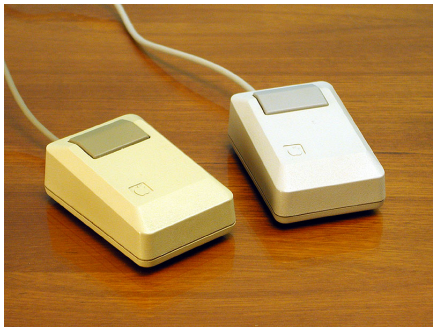
He enrolled in graduate school in electrical engineering at University of California, Berkeley, graduating with an Master of Science degree in 1953, and a Ph.D. in 1955.[10] As a graduate student at Berkeley he assisted in the construction of the California Digital Computer project CALDIC. His graduate work led to several patents.[13] After completing his PhD, Engelbart stayed on at Berkeley as an assistant professor to teach for a year, and left when it was clear he could not pursue his vision there. Engelbart then formed a startup, Digital Techniques, to commercialize some of his doctorate research on storage devices, but after a year decided instead to pursue the research he had been dreaming of since 1951.

SRI and ARC

Engelbart took a position at SRI International (SRI, known then as the Stanford Research Institute) in Menlo Park, California in 1957. He initially worked for Hewitt Crane on magnetic devices and miniaturization of electronics; Engelbart and Crane became lifelong friends. At SRI, Engelbart gradually obtained over a dozen patents (some resulting from his graduate work), and by 1962 produced a report about his vision and proposed research agenda titled *Augmenting Human Intellect: A Conceptual Framework*.[14]

This led to funding from ARPA to launch his work. Engelbart recruited a research team in his new Augmentation Research Center (ARC, the lab he founded at SRI), and became the driving force behind the design and development of the oN-Line System (NLS). He and his team developed computer interface elements such as bitmapped screens, the mouse, hypertext, collaborative tools, and precursors to the graphical user interface. He conceived and developed many of his user interface ideas back in the mid-1960s, long before the personal computer revolution, at a time when most individuals were kept away from computers, and could only use computers through intermediaries (see batch processing), and when software tended to be written for vertical applications in proprietary systems.

Engelbart applied for a patent in 1967 and received it in 1970, for the wooden shell with two metal wheels (computer mouse - U.S. Patent 3541541 [15]), which he had developed with Bill English, his lead engineer, a few years earlier. In the patent application it is described as an *"X-Y position indicator for a display system"*. Engelbart later revealed that it was nicknamed the "mouse" because the tail came out the end. His group also called the on-screen cursor a "bug", but this term was not widely adopted.[16]



Two Apple Macintosh Plus mice, 1986

He never received any royalties for his mouse invention. During an interview, he says "SRI patented the mouse, but they really had no idea of its value. Some years later it was learned that they had licensed it to Apple for something like $40,000."[17] Engelbart showcased the chorded keyboard and many more of his and ARC's inventions in 1968 at the so-called Mother of All Demos.[18]

ARPANET

Engelbart's research was funded by DARPA, and SRI's ARC became involved with the ARPANET, the precursor of the Internet. The first message on the ARPANET was sent by UCLA student programmer Charley Kline, at 10:30 p.m, on October 29, 1969 from Boelter Hall 3420.[19] Supervised by Leonard Kleinrock, Kline transmitted from the university's SDS Sigma 7 Host computer to the Stanford Research Institute's SDS 940 Host computer. The message text was the word "login"; the "l" and the "o" letters were transmitted, but the system then crashed. Hence, the literal first message over the ARPANET was "lo". About an hour later, having recovered from the crash, the SDS Sigma 7 computer effected a full "login".

The first permanent ARPANET link was established on November 21, 1969, between the IMP at UCLA and the IMP at the Stanford Research Institute. By December 5, 1969, the entire four-node network was established.[20] In addition to SRI and UCLA, UCSB, and the University of Utah were part of the original four network nodes.

ARC soon became the first Network Information Center and thus managed the directory for connections among all ARPANET nodes. ARC also published a large percentage of the early Request For Comments, an ongoing series of publications that document the evolution of ARPANET into the Internet. Although the NIC at first used NLS, it was intended to be a production service to other network users, while Engelbart continued to focus on innovative research. This inherent conflict led to establishing the NIC as its own group, led by Elizabeth J. Feinler.[21]

Anecdotal notes

Historian of science Thierry Bardini argues that Engelbart's complex personal philosophy (which drove all his research) foreshadowed the modern application of the concept of coevolution to the philosophy and use of technology.[22] Bardini points out that Engelbart was strongly influenced by the principle of linguistic relativity developed by Benjamin Lee Whorf. Where Whorf reasoned that the sophistication of a language controls the sophistication of the thoughts that can be expressed by a speaker of that language, Engelbart reasoned that the state of our current technology controls our ability to manipulate information, and that fact in turn will control our ability to develop new, improved technologies. He thus set himself to the revolutionary task of developing computer-based technologies for manipulating information directly, and also to improve individual and group processes for knowledge-work.[22]

End of research career

Engelbart slipped into relative obscurity after 1976. Several of his researchers became alienated from him and left his organization for Xerox PARC, in part due to frustration, and in part due to differing views of the future of computing. Engelbart saw the future in collaborative, networked, timeshare (client-server) computers, which younger programmers rejected in favor of the personal computer. The conflict was both technical and social: the younger programmers came from an era where centralized power was highly suspect, and personal computing was just barely on the horizon.

Engelbart served on the board of directors of Erhard Seminars Training (EST). Several key ARC personnel were also involved. Although EST had been recommended by other researchers, the controversial nature of EST and other social experiments reduced the morale and social cohesion of the ARC community.[22]

The Mansfield Amendment, the end of the Vietnam War, and the end of the Apollo program reduced ARC's funding from ARPA and NASA. SRI's management, which disapproved of Engelbart's approach to running the center, placed the remains of ARC under the control of artificial intelligence researcher Bertram Raphael, who negotiated the transfer of the laboratory to a company called Tymshare. Engelbart's house in Atherton, California burned down during this period, causing him and his family further problems. Tymshare took over NLS and the lab that Engelbart had founded, hired most of the lab's staff including its creator as a Senior Scientist, renamed the software *Augment*, and offered it as a commercial service via its new Office Automation Division. Tymshare was already somewhat familiar with NLS; back when ARC was still operational, it had experimented with its own local copy of the NLS software on a minicomputer called OFFICE-1, as part of a joint project with ARC.

At Tymshare, Engelbart soon found himself marginalized and relegated to obscurity. Operational concerns at Tymshare overrode Engelbart's desire to do further research. Various executives, first at Tymshare and later at McDonnell Douglas (which acquired Tymshare in 1984), expressed interest in his ideas, but never committed the funds or the people to further develop them. His interest inside of McDonnell Douglas was focused on the enormous knowledge management and IT requirements involved in the lifecycle of an aerospace program, which served to strengthen Engelbart's resolve to motivate the information technology arena toward global interoperability and an open hyperdocument system.[23] Engelbart retired from McDonnell Douglas in 1986, determined to pursue his work free from commercial pressure.

Teaming with his daughter, Christina Engelbart, in 1988 he founded the Bootstrap Institute to coalesce his ideas into a series of three-day and half-day management seminars offered at Stanford University 1989–2000. By the early 1990s there was sufficient interest among his seminar graduates to launch a collaborative implementation of his work, and the Bootstrap Alliance was formed as a non-profit home base for this effort. Although the invasion of Iraq and subsequent recession spawned a rash of belt-tightening reorganizations which drastically redirected the efforts of their alliance partners, they continued with the management seminars, consulting, and small-scale collaborations. In the mid-1990s they were awarded some DARPA funding to develop a modern user interface to Augment, called Visual AugTerm (VAT), while participating in a larger program addressing the IT requirements of the Joint Task

Force.

Honors

Since the late 1980s, prominent individuals and organizations have recognized the seminal importance of Engelbart's contributions.[24] In December 1995, at the Fourth WWW Conference in Boston, he was the first recipient of what would later become the Yuri Rubinsky Memorial Award. In 1997 he was awarded the Lemelson-MIT Prize of $500,000, the world's largest single prize for invention and innovation, and the ACM Turing Award. To mark the 30th anniversary of Engelbart's 1968 demo, in 1998 the Stanford Silicon Valley Archives and the Institute for the Future hosted *Engelbart's Unfinished Revolution*, a symposium at Stanford University's Memorial Auditorium, to honor Engelbart and his ideas.[25]

Also in 1998, ACM SIGCHI awarded Engelbart the CHI Lifetime Achievement Award. ACM SIGCHI later inducted Engelbart into the CHI Academy in 2002. Engelbart was awarded The Franklin Institute's Certificate of Merit in 1996 and the Benjamin Franklin Medal in 1999 in Computer and Cognitive Science. In early 2000 Engelbart produced, with volunteers and sponsors, what was called *The Unfinished Revolution – II*, also known as the *Engelbart Colloquium* at Stanford University, to document and publicize his work and ideas to a larger audience (live, and online).[26][27][28]

In December 2000, US President Bill Clinton awarded Engelbart the National Medal of Technology, the United States' highest technology award.[29] In 2001 he was awarded a British Computer Society's Lovelace Medal, and in 2005 he was made a Fellow of the Computer History Museum and honored with the Norbert Wiener Award, which is given annually by Computer Professionals for Social Responsibility. Robert X. Cringely did an hour long interview with Engelbart on December 9, 2005 in his NerdTV video podcast series.

On December 9, 2008, Engelbart was honored at the 40th Anniversary celebration of the 1968 "Mother of All Demos".[30] This event, produced by SRI International, was held at Memorial Auditorium at Stanford University. Speakers included several members of Engelbart's original Augmentation Research Center (ARC) team including Don Andrews, Bill Paxton, Bill English, and Jeff Rulifson, Engelbart's chief government sponsor Bob Taylor, and other pioneers of interactive computing, including Andy van Dam and Alan Kay. In addition, Christina Engelbart spoke about her father's early influences and the ongoing work of the Doug Engelbart Institute. In June 2009, the New Media Consortium recognized Engelbart as an NMC Fellow for his lifetime of achievements.[31] In 2011, Engelbart was inducted into IEEE Intelligent Systems' AI's Hall of Fame.[32][33]

Recent work and legacy

Engelbart attended Program for the Future 2010 Conference where hundreds of people convened at The Tech Museum in San Jose and online to engage in dialog about how to pursue his vision to augment collective intelligence.[34]

The most complete coverage of Engelbart's bootstrapping ideas can be found in *Boosting Our Collective IQ*, by Douglas C. Engelbart, 1995.[35] This includes three of Engelbart's key papers, edited into book form by Yuri Rubinsky and Christina Engelbart to commemorate the presentation of the 1995 SoftQuad Web Award to Doug Engelbart at the World Wide Web conference in Boston in December 1995. Only 2,000 softcover copies were printed, and 100 hardcover, numbered and signed by Engelbart and Tim Berners-Lee. Engelbart's book is now being republished by the Doug Engelbart Institute.

Two comprehensive histories of Engelbart's laboratory and work are in *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry* by John Markoff and *A Heritage of Innovation: SRI's First Half Century* by Donald Neilson.[36] Other books on Engelbart and his laboratory include *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing* by Thierry Bardini and *The Engelbart Hypothesis: Dialogs with Douglas Engelbart*, by Valerie Landau and Eileen Clegg in conversation with Douglas Engelbart.[37]

All four of these books are based on interviews with Engelbart as well as other contributors in his laboratory.

Engelbart is now Founder Emeritus of the Doug Engelbart Institute, which he founded in 1988 with his daughter Christina Engelbart, who is now Executive Director. The Institute promotes Engelbart's philosophy for boosting Collective IQ—the concept of dramatically improving how we can solve important problems together—using a strategic *bootstrapping* approach for accelerating our progress toward that goal.[38]

In 2005 Engelbart received a National Science Foundation grant to fund the open source HyperScope project.[39] The Hyperscope team built a browser component using Ajax and Dynamic HTML designed to replicate Augment's multiple viewing and jumping capabilities (linking within and across various documents). HyperScope is perceived as the first step of a process designed to engage a wider community in a dialogue, on development of collaborative software and services, based on Engelbart's goals and research. The Doug Engelbart Institute is now based at SRI International.

Engelbart has served on the Advisory Boards of the University of Santa Clara Center for Science, Technology, and Society, Foresight Institute,[29] Computer Professionals for Social Responsibility, The Technology Center of Silicon Valley, and The Hyperwords Company (producer of the Firefox add-on Hyperwords.[40]

Family

Engelbart has four children, Gerda, Diana, Christina and Norman with his first wife Ballard, who died in 1997 after 47 years of marriage. He has nine grandchildren. He remarried on January 26, 2008 to writer and producer Karen O'Leary Engelbart.[41][42] An 85th birthday celebration was held at the Tech Museum of Innovation.[43]

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External links

External audio	
Audio	
	"Collective IQ and Human Augmentation" (http://www.stranova.com/Podcasts/Stranova28.mp3), Interview with Douglas Engelbart
Videos	
	Doug Engelbart featured on JCN Profiles (http://www.archive.org/details/XD304_95JCNProfile), Archive.org

- Doug Engelbart's official website and home of the Doug Engelbart Institute (http://dougengelbart.org/) (formerly Bootstrap)

Charles M. Herzfeld

Charles M. Herzfeld (born June 29, 1925) is an American scientist and scientific manager, particularly for the US Government. He is best known for his time as Director of DARPA, during which, among other things, he personally took the decision to authorize the creation of the ARPANET, the predecessor of the Internet.

Biography

Herzfeld was born in Vienna, Austria; he is the nephew of Carl Ferdinand Herzfeld, the accomplished physical chemist (brother of his father, August). After the Nazi takeover of Austria, since they were Catholic Monarchists, he and his mother fled Austria, criss-crossing Europe and two years later emigrated to the United States; he became an American citizen in the late 1940s.[1]

He received a BS degree in engineering from the Catholic University of America in Washington, D.C. (1945) and a PhD degree in physical chemistry from the University of Chicago (1951).[2] While at Chicago, he attended a lecture by John von Neumann about von Neumann's early work on computers, a lecture which had a profound influence on him.

He first worked as a physicist; from 1951 to 1953 at the Ballistic Research Laboratory in Aberdeen, Maryland, and from 1953 to 1955 at the Naval Research Laboratory in Washington, D.C. He then spent several years with the National Bureau of Standards.

Later career

He moved to DARPA (or ARPA as it was called at that point) on September 29, 1961 to coordinate the Project Defender program, an early ballistic missile defense program. [3]

One early experience at DARPA would leave a lasting impact on him: a lecture by the noted computer scientist J. C. R. Licklider, which converted him to Licklider's vision of computers as general information accessories; during his time at DARPA, Herzfeld would do much to set Licklider's vision on the road to achievement.

Herzfeld would stay at DARPA until 1967, directing the Ballistic Missile Defense Program from 1961 to 1963, then moving on to serve as Assistant Director from 1963 to 1965, and as Director from June, 1965 to March, 1967.

After leaving ARPA, he worked for a number of different companies, including the ITT Corporation (as Vice President and Director of Research and Technology) from 1967 to 1985, and as Vice Chairman of Aetna, Jacobs, and Ramo Technology Ventures, a high technology venture capital group, from 1985 until 1990.[4]

He returned to the Government in 1990, serving as Director of Defense Research and Engineering from March 12, 1990 to May 18, 1991. He chaired the Nuclear Weapons Council and the Intelligence R&D Council.

He was also a member of the Chief of Naval Operations Executive Panel (since its formation in 1970), the National Commission on Space (to which he was appointed in 1985), the Defense Science Board, the Defense Policy Board and the President's Information Advisory Council (PITAC) National Security Panel, among numerous other government advisory activities.[5]

Memberships

He is a member of the Council of Foreign Relations and the International Institute for Strategic Studies in London. He is also a Fellow of the American Physical Society, and of the American Association for the Advancement of Science. He is also a member of the Cosmos Club (in Washington D.C.), and of the Explorers Club (in New York).

In 2012, Herzfeld was inducted into the Internet Hall of Fame by the Internet Society.[6]

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External links

- Biography (http://www.potomacinstitute.org/index.php?option=com_content&view=article&catid=61:fellows-&id=265:herzfeld&Itemid=110) at the Potomac Institute
- Oral history interview with Charles M. Herzfeld (http://purl.umn.edu/107357) at the Charles Babbage Institute

Internet Engineering Task Force

Internet Engineering Task Force	
Abbreviation	IETF
Formation	January 16, 1986
Type	Standards Organization
Purpose/focus	Creating standards applying to the internet to improve internet usability.
Region served	Worldwide
IETF Chair	Russ Housley
Parent organization	Internet Society
Website	ietf.org [1]

The **Internet Engineering Task Force** (**IETF**) develops and promotes Internet standards, cooperating closely with the W3C and ISO/IEC standards bodies and dealing in particular with standards of the Internet protocol suite. It is an open standards organization, with no formal membership or membership requirements.

All participants and managers are volunteers, though their work is usually funded by their employers or sponsors; for instance, the current chairperson is funded by VeriSign and the U.S. government's National Security Agency.[2]

Organization

The IETF is organized into a large number of working groups and informal discussion groups (BoF)s, each dealing with a specific topic. Each group is intended to complete work on that topic and then disband. Each working group has an appointed chairperson (or sometimes several co-chairs), along with a charter that describes its focus, and what and when it is expected to produce. It is open to all who want to participate, and holds discussions on an open mailing list or at IETF meetings, where the entry fee is currently around USD $650 per person.[3] The mailing list consensus is the primary basis for decision of-making. There is no voting procedure, as it operates on rough consensus process.

The working groups are organized into areas by subject matter. Current areas include: Applications, General, Internet, Operations and Management, Real-time Applications and Infrastructure, Routing, Security, and Transport.[4] Each area is overseen by an *area director* (AD), with most areas having two co-ADs. The ADs are responsible for appointing working group chairs. The area directors, together with the IETF Chair, form the Internet Engineering Steering Group (IESG), which is responsible for the overall operation of the IETF. The groups will normally be closed once the work described in its charter is finished. In some cases, the WG will instead have its charter updated to take on new tasks as appropriate.

The IETF is formally a part of the Internet Society. The IETF is overseen by the Internet Architecture Board (IAB), which oversees its external relationships, and relations with the RFC Editor.[5] The IAB is also jointly responsible for the IETF Administrative Oversight Committee (IAOC), which oversees the IETF Administrative Support Activity (IASA), which provides logistical, etc. support for the IETF. The IAB also manages the Internet Research Task Force (IRTF), with which the IETF has a number of cross-group relations.

A committee of ten randomly chosen volunteers who participate regularly at meetings is vested with the power to appoint, reappoint, and remove members of the IESG, IAB, IASA, and the IAOC.[6] To date, no one has been removed by a NOMCOM, although several people have resigned their positions, requiring replacements.

History

The first IETF meeting was on January 16, 1986, consisting of 21 U.S.-government-funded researchers. It was a continuation of the work of the earlier GADS Task Force.

Initially, it met quarterly, but from 1991, it has been meeting 3 times a year. Representatives from non-governmental entities were invited starting with the fourth IETF meeting, during October of that year. Since that time all IETF meetings have been open to the public. The majority of the IETF's work is done on mailing lists, and meeting attendance is not required for contributors.

The initial meetings were very small, with fewer than 35 people in attendance at each of the first five meetings. The maximum attendance during the first 13 meetings was only 120 attendees. This occurred at the 12th meeting held during January 1989. These meetings have grown in both participation and scope a great deal since the early 1990s; it had a maximum attendance of 2,810 at the December 2000 IETF held in San Diego, CA. Attendance declined with industry restructuring during the early 2000s, and is currently around 1,200.[7]

During the early 1990s the IETF changed institutional form from an activity of the U.S. government to an independent, international activity associated with the Internet Society.

There are statistics available that show who the top contributors have been, by RFC publication.[8]. While the IETF only allows for participation by individuals, and not by corporations or governments, sponsorship information is available from those same statistics.

Operations

The details of its operations have changed considerably as it has grown, but the basic mechanism remains publication of draft specifications, review and independent testing by participants, and republication. Interoperability is the chief test for IETF specifications becoming standards. Most of its specifications are focused on single protocols rather than tightly interlocked systems. This has allowed its protocols to be used in many different systems, and its standards are routinely re-used by bodies which create full-fledged architectures (e.g. 3GPP IMS).

Because it relies on volunteers and uses "rough consensus and running code" as its touchstone, results can be slow whenever the number of volunteers is either too small to make progress, or so large as to make consensus difficult, or when volunteers lack the necessary expertise. For protocols like SMTP, which is used to transport e-mail for a user community in the many hundreds of millions, there is also considerable resistance to any change that is not fully backwards compatible. Work within the IETF on ways to improve the speed of the standards-making process is ongoing but, because the number of volunteers with opinions on it is very great, consensus mechanisms on how to improve have been slow.

Because the IETF does not have members (nor is it an organisation *per se*), the Internet Society provides the financial and legal framework for the activities of the IETF and its sister bodies (IAB, IRTF,...). Recently the IETF has set up an IETF Trust that manages the copyrighted materials produced by the IETF. IETF activities are funded by meeting fees, meeting sponsors and by the Internet Society via its organizational membership and the proceeds of the Public Interest Registry.

IETF meetings vary greatly in where they are held. The list of past and future meeting locations can be found on the IETF meetings[9] page. The IETF has striven to hold the meetings near where most of the IETF volunteers are located. For a long time, the goal was 3 meetings a year, with 2 in North America and 1 in either Europe or Asia (alternating between them every other year). The goal ratio is currently, during a two year period, to have 3 in North America, 2 in Europe and 1 in Asia. However, corporate sponsorship of the meetings is typically a more important factor and this schedule has not been kept strictly in order to decrease operational costs.

Chairs

The IETF Chairperson is selected by the NOMCOM process specified in RFC 3777 for a 2-year term, renewable.

Before 1993, the IETF Chair was selected by the IAB.

- Mike Corrigan (1986)
- Phill Gross (1986–1994)
- Paul Mockapetris (1994–1996)
- Fred Baker (1996–2001)
- Harald Tveit Alvestrand (2001–2005)
- Brian Carpenter (2005–2007)
- Russ Housley (2007–)[10]

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External links

- Official website (http://ietf.org/)
  - IETF Online Proceedings (http://www.ietf.org/old/2009/proceedings_directory.html)
  - Early IETF Proceedings (http://www.ietf.org/old/2009/proceedings/directory2.html) (*note: large pdf files, one for each volume*)
  - Past Meetings of the IETF (http://www.ietf.org/meeting/past.html)
  - Past IESG Members and IETF Chairs (http://www.ietf.org/iesg/past-members.html)
- The Tao of the IETF (http://tools.ietf.org/rfcmarkup?doc=fyi17): details on how IETF is organized
- IAOC information (http://iaoc.ietf.org/)
- MyIETF (http://myietf.unfix.org) Personalized notification service on RFC's and drafts with full archive of old drafts etc.

Bob Kahn

Bob Kahn	
	
Born	Robert Elliott Kahn December 23, 1938 Brooklyn, New York
Nationality	USA
Fields	Computer Science
Institutions	Bell Labs MIT BBN DARPA Corporation for National Research Initiatives
Alma mater	City College of New York Princeton University
Known for	TCP/IP
Notable awards	Presidential Medal of Freedom Turing Award
Spouse	Patrice Ann Lyons

Robert Elliot "Bob" Kahn (born December 23, 1938) is an American Internet pioneer,[1][2] engineer and computer scientist, who, along with Vinton G. Cerf, invented the Transmission Control Protocol (TCP) and the Internet Protocol (IP), the fundamental communication protocols at the heart of the Internet.

Background information

Kahn was born in Brooklyn, New York City, the son of Beatrice Pauline (née Tashker) and Lawrence Kahn, a high school administrator.[3][4][5] Through his father, he is related to futurist Herman Kahn.[3] After receiving a B.E.E. degree in electrical engineering from the City College of New York in 1960, Kahn earned M.A. and Ph.D. degrees from Princeton University in 1962 and 1964 respectively. After finishing graduate school, he worked for AT&T Bell Laboratories, and then became an assistant professor at MIT. He then worked at Bolt, Beranek and Newman (BBN), where he helped develop the IMP.

In 1972, he began work at the Information Processing Techniques Office (IPTO) within ARPA. In the fall of 1972, he demonstrated the ARPANET by connecting 20 different computers at the International Computer Communication Conference, "the watershed event that made people suddenly realize that packet switching was a real technology."[6] He then helped develop the TCP/IP protocols for connecting diverse computer networks. After he became Director of IPTO, he started the United States government's billion dollar Strategic Computing Initiative, the largest computer research and development program ever undertaken by the U.S. federal government.

After thirteen years with DARPA, he left to found the Corporation for National Research Initiatives (CNRI) in 1986, and as of 2009 is the Chairman, CEO and President.[7] CNRI is a nonprofit organization which is intended to provide leadership and funding for research and development of the National Information Infrastructure.

The Internet

While working on a satellite packet network project, he came up with the initial ideas for what later became the Transmission Control Protocol (TCP), which was intended as a replacement for an earlier network protocol, NCP, used in the ARPANET. While working on this, he played a major role in forming the basis of open-architecture networking, which would allow computers and networks all over the world to communicate with each other, regardless of what hardware or software the computers on each network used. To reach this goal, TCP was designed to have the following features:

- Small sub-sections of the whole network would be able to talk to each other through a specialized computer that only forwarded packets (first called a gateway, and now called a router).
- No portion of the network would be the single point of failure, or would be able to control the whole network.
- Each piece of information sent through the network would be given a sequence number, to ensure that they were dealt with in the right order at the destination computer, and to detect the loss of any of them.
- A computer which sent information to another computer would know that it was successfully received when the destination computer sent back a special packet, called an *acknowledgement* (ACK), for that particular piece of information.
- If information sent from one computer to another was lost, the information would be *retransmitted*, after the loss was detected by a *timeout*, which would recognize that the expected acknowledgement had not been received.
- Each piece of information sent through the network would be accompanied by a checksum, calculated by the original sender, and checked by the ultimate receiver, to ensure that it was not damaged in any way en route.

Vint Cerf joined him on the project in the spring of 1973, and together they completed an early version of TCP. Later, it was separated into two separate layers, with the more basic functions being moved to the Internet Protocol (IP). The two together are usually referred to as TCP/IP, and are the basis for the modern Internet.

In 1992 he co-founded with Vint Cerf the Internet Society, to provide leadership in Internet related standards, education, and policy.

Recognition

He was awarded the SIGCOMM Award in 1993 for "for visionary technical contributions and leadership in the development of information systems technology", and shared the 2004 Turing Award with Vint Cerf, for "pioneering work on internetworking, including .. the Internet's basic communications protocols .. and for inspired leadership in networking."

Vint Cerf and Robert Kahn being awarded the Presidential Medal Of Freedom by President Bush

He is a recipient of the AFIPS Harry Goode Memorial Award, the Marconi Award, the ACM SIGCOMM Award, the President's Award from ACM, the IEEE Koji Kobayashi Computer and Communications Award, the IEEE Alexander Graham Bell Medal, the IEEE Third Millennium Medal, the ACM Software Systems Award, the Computerworld/Smithsonian Award, the ASIS Special Award and the Public Service Award from the Computing Research Board. He has twice received the Secretary of Defense Civilian Service Award. He is a recipient of the 1997 National Medal of Technology, the 2001 Charles Stark Draper Prize from the National Academy of Engineering, the 2002 Prince of Asturias Award, and the 2004 A. M. Turing Award from the Association for Computing Machinery.[1] Kahn received the 2003 Digital ID World award for the Digital Object Architecture as a significant contribution (technology, policy or social) to the digital identity industry. In 2005 he was awarded the Townsend Harris Medal from the Alumni Association of the City College of New York, the Presidential Medal of Freedom, and the C & C Prize in Tokyo, Japan. He was inducted into the National Inventors Hall of Fame in May 2006. He was inducted as a Fellow of the Computer History Museum in 2006. He was awarded the 2008 Japan Prize for his work in "Information Communication Theory and Technology" (together with Vinton Cerf).

- In 2001 he was inducted as a Fellow of the Association for Computing Machinery.[8]
- Robert Kahn and Vinton Cerf were each inducted as an Honorary Fellow of the Society for Technical Communication (STC) in May 2006.

The duo were also awarded with the Harold Pender Award, the highest honor awarded by the University of Pennsylvania School Engineering and Applied Sciences, in February 2010.

Kahn has received honorary degrees from Princeton University, University of Pavia, ETH Zurich, University of Maryland, George Mason University, the University of Central Florida and the University of Pisa, and an honorary fellowship from University College, London.

He also serves on the board of directors for Qualcomm.[9]

In 2012, Kahn was inducted into the Internet Hall of Fame by the Internet Society.[10]

Articles

- Vint Cerf & Bob Kahn, *Al Gore and the Internet,* 2000-09-28[11]

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External links

- DBLP Listing of some of Kahn's works (http://www.informatik.uni-trier.de/~ley/db/indices/a-tree/k/Kahn:Robert_E=.html)
- Biography of Kahn (http://www.ieeeghn.org/wiki/index.php/Robert_Kahn) from IEEE
- Oral history interview with Robert E. Kahn (http://purl.umn.edu/107387), Charles Babbage Institute, University of Minnesota, Minneapolis. Focuses on Kahn's role in the development of computer networking from 1967 through the early 1980s. Beginning with his work at Bolt Beranek and Newman (BBN), Kahn discusses his involvement as the ARPANET proposal was being written, his decision to become active in its implementation, and his role in the public demonstration of the ARPANET. The interview continues into Kahn's involvement with networking when he moves to IPTO in 1972, where he was responsible for the administrative and technical evolution of the ARPANET, including programs in packet radio, the development of a new network protocol (TCP/IP), and the switch to TCP/IP to connect multiple networks.
- Bio of Robert E. Kahn (http://livinginternet.com/i/ii_kahn.htm) from the Living Internet.
- "Morning Edition" interview (NPR) (http://www.npr.org/templates/story/story.php?storyId=4809641)
- "Nerd TV" interview (with Robert X. Cringley) (http://pbs.org/cringely/nerdtv/mp4/redir/http://distribution.nerdtv.net/video/ntv012/ntv012.mp4) - Requires QuickTime (transcript (http://www.pbs.org/cringely/nerdtv/transcripts/012.html))
- Computer Networks: The Heralds of Resource Sharing (http://video.google.com/videoplay?docid=4989933629762859961), documentary ca. 1972 about the ARPANET. Includes footage of Robert E. Kahn.
- A short history of Bobs (story/slideshow) in computing, from Bob Kahn to Bob Metcalfe to Microsoft Bob and Alice & Bob (http://www.networkworld.com/news/2006/103006-bob.html)
- "An Evening with Robert Kahn in conversation with Ed Feigenbaum" (http://archive.computerhistory.org/lectures/an_eveninig_with_robert_kahn.lecture.2007.01.09.wmv) - Requires WMV player
- C-SPAN *Q&A* interview with Kahn, August 14, 2005 (http://www.q-and-a.org/Program/?ProgramID=1036)

Peter T. Kirstein

Peter Thomas Kirstein is a British computer scientist who played a role in the creation of the Internet.

Born in Germany but brought up in England, he received a B.A. from Cambridge University in 1954, an M.Sc. and Ph.D. in electrical engineering from Stanford University (in 1955 and 1957, respectively) and a D.Sc. in engineering from the University of London in 1970.

He was a member of the staff at CERN from 1959-1963. He did research for General Electric at Zurich from 1963-1967. He was a professor at the University of London from 1970-1973. After that, he joined the faculty at the University College London, where he has been ever since (serving as head of the computer science department from 1980–1994).

Early in the development of the Internet, he co-authored (with Vint Cerf) one of the most significant early technical papers on the internetworking concept. His research group at UCL played a significant role in the very earliest experimental Internet work.

He was awarded the CBE for his work on the Internet. He is also a Fellow of the Royal Academy of Engineering, a Fellow of the Institute of Electrical and Electronics Engineers, an Honorary Foreign Member of the American Academy of Arts and Sciences, and a Distinguished Fellow of the British Computer Society. He has also received the SIGCOMM Award in 1999, and the Postel Award in 2003, as well as various other award for his contributions to the development of the Internet internationally.

In 2012, Kirstein was inducted into the Internet Hall of Fame by the Internet Society.[1]

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External links

- Home page (http://www.cs.ucl.ac.uk/staff/P.Kirstein/)
- Kirstein recognized with Postel Award (http://www.isoc.org/isoc/media/releases/030716pr.shtml)
- Awarded BCS's distinguished fellowship (http://www.computerweekly.com/Articles/2005/01/14/207786/Unsunginternetpioneerawardedsociety'sdistinguishedfellowship.htm)

Leonard Kleinrock

Leonard Kleinrock	
 Leonard Kleinrock and the first Interface Message Processor	
Born	June 13, 1934 New York City
Residence	Los Angeles
Nationality	United States
Fields	Engineering Computer science
Institutions	UCLA
Alma mater	City College of New York, MIT
Doctoral advisor	Edward Arthurs[1]
Doctoral students	Chris Ferguson
Known for	Internet development
Notable awards	National Medal of Science[2]

Leonard Kleinrock (born June 13, 1934) is an American engineer and computer scientist. A computer science professor at UCLA's Henry Samueli School of Engineering and Applied Science, he made several important contributions to the field of computer networking, in particular to the theoretical side of computer networking. He also played an important role in the development of the ARPANET, the precursor to the Internet, at UCLA.[3]

His most well-known and significant work is his early work on queueing theory, which has applications in many fields, among them as a key mathematical background to packet switching, the basic technology behind the Internet. His initial contribution to this field was his doctoral thesis at the Massachusetts Institute of Technology in 1962, published in book form in 1964; he later published several of the standard works on the subject. He described this work as:

> "Basically, what I did for my PhD research in 1961–1962 was to establish a mathematical theory of packet networks..."

His theoretical work on hierarchical routing, done in the late 1970s with his then-student Farouk Kamoun, is now critical to the operation of today's worldwide Internet.

Education and career

Kleinrock was born in New York City on June 13, 1934 to a Jewish family,[4] and graduated from the noted Bronx High School of Science in 1951. He received a Bachelor of Electrical Engineering degree in 1957 from the City College of New York, and a master's degree and a doctorate (Ph.D.) in electrical engineering and computer science from the Massachusetts Institute of Technology in 1959 and 1963 respectively. He then joined the faculty at the University of California at Los Angeles (UCLA), where he remains to the present day; during 1991–1995 he served as the Chairman of the Computer Science Department there.[5]

ARPANET and the Internet

The first message on the ARPANET was sent by UCLA student programmer Charley Kline, at 10:30 p.m, on October 29, 1969 from Boelter Hall 3420, the school's main building.[6] Supervised by Kleinrock, Kline transmitted from the university's SDS Sigma 7 host computer to the Stanford Research Institute's SDS 940 host computer. The message text was the word "login"; the "l" and the "o" letters were transmitted, but the system then crashed. Hence, the literal first message over the ARPANET was "lo". About an hour later, having recovered from the crash, the SDS Sigma 7 computer effected a full "login". The first permanent ARPANET link was established on November 21, 1969, between the IMP at UCLA and the IMP at the Stanford Research Institute. By December 5, 1969, the entire four-node network was established.[7]

In 1988, Kleinrock was the chairman of a group that presented the report *Toward a National Research Network* to the U.S. Congress.[8] This report was highly influential and was used to develop the *High Performance Computing Act of 1991*,[9] that was influential in the development of the Internet as it is known today.[10] Funding from the bill was used in the development of the 1993 web browser Mosaic, at the National Center for Supercomputing Applications (NCSA).[11]

Room 3420 at Boelter Hall was restored to its condition of 1969 and converted into The Kleinrock Internet Heritage Site and Archive. It opened to the public with a grand opening attended by internet pioneers October 29, 2011.[6][12]

Awards

He has received numerous professional awards. Kleinrock was selected to receive the prestigious National Medal of Science, the nation's highest scientific honor, from President George W Bush in the White House on September 29, 2008. "The 2007 National Medal of Science to Leonard Kleinrock for his fundamental contributions to the mathematical theory of modern data networks, and for the functional specification of packet switching, which is the foundation of Internet technology. His mentoring of generations of students has led to the commercialization of technologies that have transformed the world."[2] In 2010 he shared the Dan David Prize.[13] In 2012, Kleinrock was inducted into the Internet Hall of Fame by the Internet Society.[14]

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John Klensin

John Klensin (left) and Hualin Qian

Dr. **John C. Klensin** is a computer science professional who is active in Internet-related issues.

His career includes 30 years as a Principal Research Scientist at MIT, a stint as INFOODS Project Coordinator for the United Nations University, Distinguished Engineering Fellow at MCI WorldCom, and Internet Architecture Vice President at AT&T; he is now an independent consultant.[1]

His involvement with Internet protocols began in 1969, when he worked on the File Transfer Protocol.[2] In 1992 Randy Bush and John Klensin created the *Network Startup Resource Center*,[3] helping dozens of countries to establish connections with FidoNet, UseNet, and when possible Internet.

In 2003 he received an INCITS Merit Award.[4] In 2008, he was inducted as a Fellow of the Association for Computing Machinery.[5] In 2012, Klensin was inducted into the Internet Hall of Fame by the Internet Society.[6]

IETF work

John Klensin is the author or co-editor of over 40 RFCs,[7] and has served as IETF Applications Area director 1993-1995,[8] Internet Architecture Board member 1996-2002, and IAB chair 2000-2002.[9] In March 2009 he began another term on the IAB ending in 2011.[10]

The RFCs written or edited by John Klensin cover SMTP (RFC 4409 and RFC 5321 among others), IDNA (RFC 5890 and RFC 6055 among others), Unicode (RFC 5137 and RFC 5198 among others), and other fields such as CRAM-MD5 (RFC 2195) or IETF policies (RFC 3933). In March 2011 8BITMIME (RFC 6152) was published as Internet standard STD 71, in November 2011 Mail submission (RFC 6409) was published as STD 72.

His i18n work also included an April Fools' Day RFC in collaboration with Harald Alvestrand (RFC 5242) and MIME in collaboration with Ned Freed (RFC 4289 among others). He is working on several Internet drafts.[11] As of 2011 he is one of the two co-chairs for the IETF EAI working group,[12] and a member of the *RFC Independent Submissions Editorial Board*.[13]

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J. C. R. Licklider

Joseph Carl Robnett Licklider	
	
Born	March 11, 1915 St. Louis, Missouri, USA
Died	June 26, 1990 (aged 75) Arlington, Massachusetts
Nationality	American
Other names	J.C.R Lick "Computing's Johnny Appleseed"
Education	Washington University in St. Louis University of Rochester
Known for	Cybernetics/Interactive computing "Intergalactic Computer Network" (Internet) Artificial Intelligence

Joseph Carl Robnett Licklider (March 11, 1915 – June 26, 1990), known simply as J.C.R. or "Lick" was an American computer scientist, considered one of the most important figures in computer science and general computing history. He is particularly remembered for being one of the first to foresee modern-style interactive computing, and its application to all manner of activities; and also as an Internet pioneer, with an early vision of a world-wide computer network long before it was built. He did much to actually initiate all that through his funding of research which led to a great deal of it, including today's canonical graphical user interface, and the ARPANET, the direct predecessor to the Internet.

He has been called "computing's Johnny Appleseed", for having planted the seeds of computing in the digital age. Robert Taylor, founder of Xerox PARC's Computer Science Laboratory and Digital Equipment Corporation's Systems Research Center, noted that "most of the significant advances in computer technology—including the work that my group did at Xerox PARC—were simply extrapolations of Lick's vision. They were not really new visions of their own. So he was really the father of it all."[1]

Biography

Licklider was born March 11, 1915, in St. Louis, Missouri, USA.[2] He was the only child of Joseph Parron Licklider, a Baptist minister, and Margaret Robnett Licklider.[3] Despite his father's religious background, he was not religious in later life.[4] He displayed early engineering talent, building model airplanes. He carried on with his hobby of refurbishing automobiles throughout his life.

He studied at Washington University in St. Louis, where he received a BA in 1937, majoring in physics, mathematics and psychology, and an MA in psychology in 1938. He received a PhD in psychoacoustics from the University of Rochester in 1942, and worked at the Psycho-Acoustic Laboratory at Harvard University from 1943 to 1950.

He became interested in information technology, and moved to MIT in 1950 as an associate professor, where he served on a committee that established MIT Lincoln Laboratory and established a psychology program for engineering students.

In 1957 he received the Franklin V. Taylor Award from the Society of Engineering Psychologists. In 1958, he was elected President of the Acoustical Society of America, and in 1990 he received the Commonwealth Award for Distinguished Service.[5]

In 1957, he became a Vice President at Bolt Beranek and Newman, Inc., where he bought the first production PDP-1 computer and conducted the first public demonstration of time-sharing.

In October 1962, Licklider was appointed head of the Information Processing Techniques Office (IPTO) at ARPA, the United States Department of Defense Advanced Research Projects Agency.

In 1963, he was named Director of Behavioral Sciences Command & Control Research at ARPA. In April of that year, he sent a memo to his colleagues in which he outlined the early challenges presented in trying to establish a time-sharing network of computers with the software of the era.[6] Ultimately, his vision led to ARPANet, the precursor of today's Internet.

In 1968, J.C.R. Licklider became director of Project MAC at MIT, and a professor in the Department of Electrical Engineering. Project MAC had produced the first computer time-sharing system, CTSS, and one of the first online setups with the development of Multics (work on which commenced in 1964). Multics provided inspiration for some elements of the Unix operating system developed at Bell Labs by Ken Thompson and Dennis Ritchie in 1970.

He retired and became Professor Emeritus in 1985. He died in 1990 in Arlington, Massachusetts.[5]

Work

Psychoacoustics

In the psychoacoustics field, Licklider is most remembered for his 1951 "Duplex Theory of Pitch Perception," presented in a paper[7] that has been cited hundreds of times,[8] was reprinted in a 1979 book,[9] and formed the basis for modern models of pitch perception.[10]

Semi-Automatic Ground Environment

While at MIT in the 1950s, Licklider worked on "SAGE" (Semi-Automatic Ground Environment), a Cold War project to create a computer-aided air defense system. The SAGE system included computers that collected and presented data to a human operator, who then chose the appropriate response. Licklider worked as a human factors expert, which helped convince him of the great potential for human / computer interfaces.[11]

A SAGE operator's terminal

Man–computer symbiosis

In 1960, Licklider wrote his famous paper *Man–Computer Symbiosis*, which outlined the need for simpler interaction between computers and computer users. Licklider has been credited as an early pioneer of cybernetics and artificial intelligence (AI).[12] Unlike many AI practitioners, Licklider never felt that men would be replaced by computer-based beings. As he wrote in that article: "Men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking."[13]

Information technology

Licklider became interested in information technology early in his career. His ideas foretold of graphical computing, point-and-click interfaces, digital libraries, e-commerce, online banking, and software that would exist on a network and migrate wherever it was needed. Much like Vannevar Bush, Licklider's contribution to the development of the Internet consists of ideas, not inventions. He foresaw the need for networked computers with easy user interfaces. He also did some seminal early work for the Council on Library Resources, imagining what libraries of the future might look like.[14].

Licklider was instrumental in conceiving, funding and managing the research that led to modern personal computers and the Internet. In 1960 his seminal paper on *Man-Computer Symbiosis* foreshadowed interactive computing, and he went on to fund early efforts in time-sharing and application development, most notably the work of Douglas Engelbart, who founded the Augmentation Research Center at Stanford Research Institute and created the famous On-Line System where the computer mouse was invented.

Project MAC

During his time as director of IPTO from 1962 to 1964, he funded Project MAC at MIT where a large mainframe computer was designed to be shared by up to 30 simultaneous users, each sitting at a separate typewriter terminal. He also funded similar projects at Stanford University, UCLA, UC Berkeley, and the System Development Corporation. In 1964, Licklider left the IPTO and went to work at IBM. In 1968, he went back to MIT to lead Project MAC.[11]

Global computer network

Licklider played a similar role in conceiving of and funding early networking research, most notably the ARPAnet. He formulated the earliest ideas of a global computer network in August 1962 at BBN, in a series of memos discussing the "Intergalactic Computer Network" concept. These ideas contained almost everything that the Internet is today, including cloud computing.[15]

While at IPTO, he convinced Ivan Sutherland, Bob Taylor, and Lawrence G. Roberts that an all-encompassing computer network was a very important concept.

In 1967 Licklider submitted the paper *Televistas: Looking ahead through side windows* to the Carnegie Commission on Educational Television.[16] This paper describes a radical departure from the "broadcast" model of television. Instead, Licklider advocates a two-way communications network. The Carnegie Commission led to the creation of the Corporation for Public Broadcasting. Although the Commission's report explains that "Dr. Licklider's paper was completed after the Commission had formulated its own conclusions," President Johnson said at the signing of the Public Broadcasting Act of 1967, "So I think we must consider new ways to build a great network for knowledge-not just a broadcast system, but one that employs every means of sending and of storing information that the individual can use."[17]

His 1968 paper *The Computer as a Communication Device* illustrates his vision of network applications and predicts the use of computer networks to support communities of common interest and collaboration without regard to location.[18]

Publications

Licklider has written several articles and books:

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Articles, a selection:

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[4] M. Mitchell Waldrop (2002). *The Dream Machine: J.C.R. Licklider and the Revolution That Made Computing Personal*. Penguin Books. p. 471. ISBN 9780142001356. "Al Vezza was insistent, remembers Louise Licklider. "Lick had said that he didn't want any kind of to-do when he died," she says. "He wasn't religious himself, even though his father had been a Southern Baptist minister, so it would seem totally phony if he'd had a big religious service.""

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- From World Brain to the World Wide Web (http://www.gresham.ac.uk/event.asp?PageId=39&EventId=486), Lecture by Martin Campbell-Kelly at Gresham College, 9 November 2006.
- *Seeding Networks: the Federal Role* (http://bpastudio.csudh.edu/fac/lpress/articles/govt.htm), Larry Press, *Communications of the ACM*, pp 11−18, Vol 39., No 10, October, 1996. A survey of US government funded research and development preceding and including the National Science Foundation backbone and international connections programs.
- *Before the Altair — The History of Personal Computing* (http://bpastudio.csudh.edu/fac/lpress/articles/hist.htm), Larry Press, *Communications of the ACM*, September, 1993, Vol 36, No 9, pp 27−33. A survey of research and development leading to the personal computer including Licklider's contributions.

External links

- J.C.R. Licklider And The Universal Network (http://www.livinginternet.com/i/ii_licklider.htm) — Living Internet
- Oral history interview with J. C. R. Licklider (http://purl.umn.edu/107436) at Charles Babbage Institute, University of Minnesota, Minneapolis. Licklider, the first director of the Advanced Research Projects Agency's (ARPA) Information Processing Techniques Office (IPTO), discusses his work at Lincoln Laboratory and IPTO. Topics include: personnel recruitment; the interrelations between the various Massachusetts Institute of Technology laboratories; Licklider's relationship with Bolt, Beranek, and Newman; the work of ARPA director Jack Ruina; IPTO's influence of computer science research in the areas of interactive computing and timesharing; the ARPA contracting process; the work of Ivan Sutherland.
- Oral history interview with Robert E. Kahn (http://purl.umn.edu/107387) at Charles Babbage Institute, University of Minnesota, Minneapolis, USA. Kahn discusses the work of various DARPA and IPTO personnel including J.C.R. Licklider.

Jon Postel

Jon Postel	
	
Born	August 6, 1943
Died	October 16, 1998 (aged 55)
Residence	United States
Nationality	American
Fields	Computer Science
Alma mater	UCLA
Doctoral advisor	Dave Farber
Known for	Request for Comment Internet Assigned Numbers Authority Postel's Law

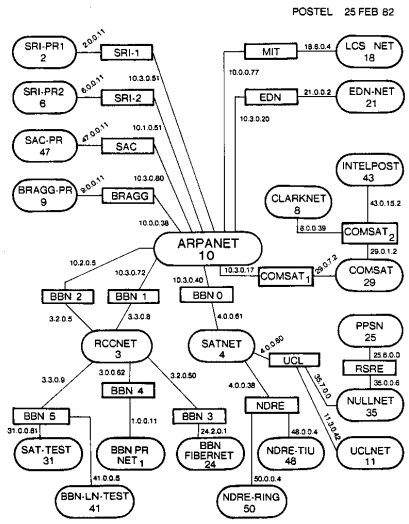
Jonathan Bruce Postel (/pəˈstɛl/; August 6, 1943 – October 16, 1998) was an American computer scientist who made many significant contributions to the development of the Internet, particularly with respect to standards. He is known principally for being the Editor of the Request for Comment (RFC) document series, and for administering the Internet Assigned Numbers Authority (IANA) until his death.

The Internet Society's Postel Award is named in his honor, as is the Postel Center at Information Sciences Institute. His obituary was written by Vint Cerf and published as RFC 2468 in remembrance of Postel and his work. In 2012, Postel was inducted into the Internet Hall of Fame by the Internet Society.[1]

Career

Postel attended Van Nuys High School.[2]

Postel attended UCLA where he earned his B.S. (1966) as well as his M.A. (1968) in Engineering. Attending UCLA, he completed his Ph.D. in Computer Science in 1974. His PhD. thesis advisor was Dave Farber.



Map of the Internet, created by Jon Postel in 1982

While at UCLA, he was involved in early work on the ARPANET. He worked briefly at Mitre Corporation, then helped set up the Network Information Center at SRI. In March 1977 he joined the Information Sciences Institute at the University of Southern California, where he spent the rest of his career.[3] Postel was the RFC Editor from 1969 until his death, and wrote and edited many important RFCs, including RFC 791, RFC 792 and RFC 793, which define the basic protocols of the Internet protocol suite, and RFC 2223, *Instructions to RFC Authors*. He wrote or co-authored more than 200 RFCs.

Postel served on the Internet Architecture Board and its predecessors for many years. He was the Director of the names and number assignment clearinghouse, the Internet Assigned Numbers Authority (IANA), from its inception. He was the first member of the Internet Society, and was on the Board of Trustees of the Internet Society. He was the original and long-time .us Top-Level Domain administrator. He also managed the Los Nettos Network.

All of the above were part-time activities he assumed in conjunction with his primary position as Director of the Computer Networks Division ("Division 7") of the Information Sciences Institute at the University of Southern California.[4][5][6][7][8][9][10][11][12][13][14][15][16]

DNS Root Authority test, U.S. response

On January 28, 1998, Postel, as a test, emailed eight of the twelve operators of Internet's regional root nameservers on his own authority and instructed them to change the root zone server from then SAIC subsidiary Network Solutions (NSI)'s A.ROOT-SERVERS.NET (198.41.0.4) to IANA's DNSROOT.IANA.ORG (198.32.1.98). The operators complied with Postel's instructions, thus dividing control of Internet naming between the non-government operators with IANA and the 4 remaining U.S. Government roots at NASA, DoD, and BRL with NSI. Though usage of the Internet was not interrupted, he soon received orders from senior government officials to undo this change,[17][18][19][20][21][22] which he did.[23] Within a week, the US NTIA issued *A proposal to improve technical management of Internet names and addresses*, including changes to authority over the Internet DNS root zone,[24] which ultimately, and controversially,[25] increased U.S. control.[26]

Legacy

On October 16, 1998, Postel died of complications after heart valve replacement surgery in Los Angeles, 9 months after the DNS Root Authority incident.

The significance of Jon Postel's contributions to building the Internet, both technical and personal, were such that a memorial recollection of his life forms part of the core technical literature sequence of the Internet in the form of RFC 2468 "I Remember IANA", written by Vinton Cerf. (This is no trivial thing given that between April 1969 and October 2010, only 6,044 RFCs were published).

Postel's Law

Perhaps his most famous legacy is from RFC 760, which includes a Robustness Principle which is often labeled *Postel's Law*: "be conservative in what you do, be liberal in what you accept from others" (more familiarly stated in RFC 1122, and often reworded as "be conservative in what you send, liberal in what you accept").

In digital circuits, this principle has long been an important aspect of what is known as the static discipline.

Notes

[1] 2012 Inductees (http://www.internethalloffame.org/inductees/year/2012), Internet Hall of Fame website. Last accessed April 24, 2012

[2] Hafner, Katie; Lyon, Matthew (1996). *Where Wizards Stay Up Late: The Origins of the Internet*. ISBN 0-684-81201-0. "Steve Crocker and Vint Cerf had been best friends since attending Van Nuys High School in L.A.'s San Fernando Valley.... While Cerf and Crocker were academic stars, Postel, who was twenty-five, had had a more checkered academic career. He had grown up in nearby Glendale and Sherman Oaks, and he too had attended Van Nuys High School, where his grades were mediocre."

[3] "USC Memorial Tribute for Jonathan B. Postel" (http://www.usc.edu/webcast/archive/events/postel/). University of Southern California. November 5, 1998. . Retrieved April 8, 2011.

[4] Jon Postel Home page (http://www.isi.edu/div7/people/postel.home/). Information Sciences Institute, USC.

[5] "Jon Postel Biography" (http://www.isi.edu/div7/people/postel.home/bio.html). *Information Sciences Institute web site*. . Retrieved April 8, 2011.

[6] USC/ISI Computer Networks Division ("Div 7") (http://www.isi.edu/div7/)

[7] Internet Assigned Numbers Authority (http://www.iana.org/) web site.

[8] RFC-Editor (http://www.rfc-editor.org/)

[9] Remembering Jonathan B. Postel (http://www.postel.org/remembrances/). Postel Center.

[10] In Memory of Jon Postel (http://www.isoc.org/postel/). Internet Society.

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[12] About the Postel Award (http://www.isoc.org/awards/). ISOC.

[13] The Postel Center (http://www.postel.org/postel.html)

[14] Los Nettos (http://www.ln.net/)

[15] 'God of the Internet' is dead (http://news.bbc.co.uk/2/hi/science/nature/196487.stm). BBC, October 19, 1998.

[16] In Memoriam (http://www.domainhandbook.com/postel.html). Domain Name Handbook.

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[20] Gerwig, Kate (February 9, 1998). "One Man's Attempt to Reroute Internet Traffic" (http://www.internetwk.com/news/news0209-2.htm). InternetWeek.com. .

[21] Cave, Damien (July 2, 2002). "It's time for ICANN to go" (http://www.salon.com/technology/feature/2002/07/02/gilmore/print.html). Salon.com. .

[22] Farber, Dave (July 2, 2002). "a comment on Gilmore: ICANN Must Go (good insights)" (http://www.interesting-people.org/archives/interesting-people/200207/msg00011.html). Interesting-people mailing list. .

[23] Bridis, Ted (AP) (February 5, 1998). "Internet reconfiguration turns out to be rogue test" (http://news.google.com/newspapers?id=q88aAAAAIBAJ&sjid=1kcEAAAAIBAJ&pg=2900,539368&dq=the+clinton+administration+said+wednesday+it+was+confident+a+researcher&hl=en). The Daily News (Kentucky). .

[24] "A proposal to improve technical management of Internet names and addresses. Discussion Draft 1/30/98" (http://web.archive.org/web/19980207224402/www.ntia.doc.gov/ntiahome/domainname/dnsdrft.htm). NTIA.org. January 30, 1998. Archived from the original on 1998-02-07. .

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[26] Cukier, Kenneth (February 16, 1998). "Testing times for Net guardians" (http://www.totaltele.com/view.aspx?ID=430615). Total Telecom. .

External links

- postel.org (http://www.postel.org/) Research center at USC/ISI created in his honor.

Louis Pouzin

Louis Pouzin (born 1931 in Chantenay-Saint-Imbert, Nièvre, France) invented the datagram and designed an early packet communications network, CYCLADES.[1] His work influenced Robert Kahn, Vinton Cerf, and others in the development of TCP/IP protocols used by the Internet.[2]

Having participated in the design of the Compatible Time Sharing System (CTSS), Pouzin wrote a program called RUNCOM around 1963/64. RUNCOM permitted the execution of contained commands within a folder, and can be considered the ancestor of the command-line interface and shell scripts. Pouzin was, in fact, the one who coined the term *shell* for a command language in 1964 or '65. Pouzin's concepts were later implemented in Multics by Glenda Schroeder at MIT.[3]

In 1997, Pouzin received the ACM SIGCOMM Award for "pioneering work on connectionless packet communication".[2] Louis Pouzin was named a Chevalier of the Legion of Honor by the French government on March 19, 2003. In 2012, Pouzin was inducted into the Internet Hall of Fame by the Internet Society.[4]

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[2] "Postel and Pouzin: 1997 SIGCOMM Award Winners" (http://www.sigcomm.org/awards/sigcomm-awards/postel-and-pouzin-award-details), ACM SIGCOMM web site

[3] "The Origin of the Shell" (http://www.multicians.org/shell.html), Multicians, accessed 31 March 2012

[4] 2012 Inductees (http://www.internethalloffame.org/inductees/year/2012), Internet Hall of Fame website. Last accessed April 24, 2012

Lawrence Roberts (scientist)

Lawrence G. Roberts (born 1937 in Connecticut[1]) received the Draper Prize in 2001[1] and the Principe de Asturias Award in 2002 "for the development of the Internet"[2]

As a program manager and office director at the Advanced Research Projects Agency, Roberts and his team created the ARPANET using packet switching techniques.[1] The ARPANET was the predecessor to the modern Internet.

Early life and education

Lawrence (Larry) Roberts grew up in Westport, Connecticut as the son of Elliott and Elizabeth Roberts, who both had earned their doctorates in chemistry.[3] During his youth, he built a Tesla coil, assembled a television, and designed a telephone network built from transistors for his parent's Girl Scout camp.[3]

Roberts attended the Massachusetts Institute of Technology (MIT), where he received his bachelor's degree (1959), master's degree (1960), and Ph.D. (1963), all in electrical engineering.[3]

Career

After receiving his PhD, Roberts continued to work at the MIT Lincoln Laboratory.[3] Having read the seminal 1961 paper of the "Intergalactic Computer Network" by J. C. R. Licklider, Roberts developed the concept of a computer-to-computer network that could communicate via data packets.[3] In 1966, he became program manager in the ARPA Information Processing Techniques Office (IPTO), which funded the development of the ARPANET. When Robert Taylor was sent to Vietnam in 1969 and then resigned, Roberts became director of the IPTO. The second node on the ARPANET was another important research project funded by Roberts: the Augmentation Research Center led by Douglas Englebart.[4]

In 1973, Roberts left ARPA to commercialize the nascent packet-switching technology in the form of Telenet,[5] the first[1] packet switch utility company, and served as its CEO from 1973 to 1980. He was CEO of NetExpress, an Asynchronous Transfer Mode (ATM) equipment company, from 1983 to 1993. Roberts was president of ATM Systems from 1993 to 1998. He was chairman and CTO of Caspian Networks, but left in early 2004; Caspian ceased operation in late 2006.[6]

As of 2011, Roberts was the founder and chairman of Anagran Inc. Anagran continues work in the same area as Caspian: IP flow management with improved Quality of Service for the Internet.[7]

Awards and honors

- IEEE Harry M. Goode Memorial Award (1976), *"In recognition of his contributions to the architectural design of computer-communication systems, his leadership in creating a fertile research environment leading to advances in computer and satellite communications techniques, his role in the establishment of standard international communication protocols and procedures, and his accomplishments in development and demonstration of packet switching technology and the ensuing networks which grew out of this work."* [8]
- L.M. Ericsson Prize (1982) in Sweden [9]
- Member, National Academy of Engineering (1978)[9]
- Computer Design Hall of Fame Award (1982)[9]
- IEEE W. Wallace McDowell Award (1990), *"For architecting packet switching technology and bringing it into practical use by means of the ARPA network."* [9][10]
- Association for Computing Machinery SIGCOMM Award (1998), for *"visionary contributions and advanced technology development of computer communication networks".* [9][11]

- IEEE Internet Award (2000) For *"early, preeminent contributions in conceiving, analyzing and demonstrating packet-switching networks, the foundation technology of the Internet."* [9][12]
- International Engineering Consortium Fellow Award (2001)[9]
- National Academy of Engineering Charles Stark Draper Prize (2001), *"for the development of the Internet"* [2]
- Principe de Asturias Award 2002 in Spain *"for designing and implementing a system that is changing the world by providing previously unthought of opportunities for social and scientific progress."* [13]
- NEC C&C Award (2005) in Japan *"For Contributions to Establishing the Foundation of Today's Internet Technology through...the Design and Development of ARPANET and Other Early Computer Networks that were Part of the Initial Internet."* [14]
- In 2012, Roberts was inducted into the Internet Hall of Fame by the Internet Society.[15]

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[8] "Harry H. Goode Memorial Award" (http://www.computer.org/portal/site/ieeecs/menuitem.c5efb9b8ade9096b8a9ca0108bcd45f3/index.jsp?&pName=ieeecs_level1&path=ieeecs/about/awards&file=HGoode_recipients.xml&xsl=generic.xsl&). IEEE. .

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[10] "W. Wallace McDowell Award" (http://www.computer.org/portal/site/ieeecs/menuitem.c5efb9b8ade9096b8a9ca0108bcd45f3/index.jsp?&pName=ieeecs_level1&path=ieeecs/about/awards&file=WallaceMcD_recipients.xml&xsl=generic.xsl&;jsessionid=H3CQpNFv6QyzpHGF883QFQ3p1MGLLr25rRPQcrQ6LQsqpxsgQxVs!-822946952). IEEE. .

[11] "SIGCOMM Awards" (http://www.sigcomm.org/awards.html). ACM SIGCOMM. .

[12] "IEEE Internet Award Recipients" (http://www.ieee.org/portal/pages/about/awards/pr/internet.html). IEEE. .

[13] "The Internet is one of the most eloquent examples of the benefits that accrue from scientific research and a commitment to technological innovation. A myriad of people and institutions were involved in this work. The jury wishes to acknowledge them all in awarding the prize to the four leaders of so extraordinary a development."The Jury for the Prince of Asturias Award for Technical and Scientific Research 2002 (D. José Luis Álvarez Margaride, D. Ernesto Carmona Guzmán, et al.) (2002-05-23). "Minutes of the Jury - Technical and Scientific Research 2002" (http://www.fundacionprincipedeasturias.org/ing/04/premios/premios7_2002.html). Fundación Príncipe de Asturias. .

[14] "The great success and popularity of the Internet are due to the efforts of a great many people, but it was the three members of Group B who truly created the technological foundation for its success...Dr. Roberts, at ARPA, was responsible for creating the first computer network, the ARPANET, and for its architecture and overall management." "Foundation for C&C Promotion Announces Recipients of 2005 C&C Prize - Mr. Kei-ichi Enoki, Mr. Takeshi Natsuno, Ms. Mari Matsunaga, Dr. Robert E. Kahn, Dr. Lawrence G. Roberts, & Professor Leonard Kleinrock" (http://www.nec.co.jp/press/en/0511/1701.html). NEC. 2005-11-17. .

[15] 2012 Inductees (http://www.internethalloffame.org/inductees/year/2012), Internet Hall of Fame website. Last accessed April 24, 2012

External links

- Personal website (http://packet.cc/)
- Oral history interview with Lawrence G. Roberts (http://purl.umn.edu/107608). Charles Babbage Institute, University of Minnesota. Roberts directed the Information Processing Techniques Office (IPTO) during 1968-1973 and was later chief operating officer of Network Express. The interview focuses on IPTO and the Advanced Research Projects Agency. Much of Roberts' description of the work of ARPA and IPTO is set within the context of his interactions with Congress on budget matters. Topics include J. C. R. Licklider, Ivan

Sutherland, Steve Lukasik, Wesley Clark, ARPA and IPTO support of research in computer science, computer networks, and artificial intelligence, the ARPANET, the involvement of universities with ARPA and IPTO.

- Oral history interview with Robert E. Kahn (http://purl.umn.edu/107387). Charles Babbage Institute, University of Minnesota. Kahn discusses the work of various DARPA and IPTO personnel including J. C. R. Licklider, Vinton Cerf, and Larry Roberts
- Lawrence G. Roberts' (http://www.internetevolution.com/bloggers.asp#Lawrence_G_Roberts) profile on Internet Evolution (http://www.internetevolution.com), "the macrosite for news, analysis, & opinion about the future of the internet."

John Romkey

John Romkey	
Born	United States
Known for	PC/IP, Netwatch

John Romkey developed the first in the industry TCP/IP stack for IBM PC[1][2] [3][4] in 1983. Romkey founded FTP Software, a commercial TCP/IP stack provider in 1986. Romkey also authored the first network analyzer Netwatch, predating Network General Sniffer. He also served on IAB. Romkey is currently an owner of Blue Forest Research, a consulting company.

While at MIT John Romkey authored the first TCP/IP stack for MS DOS. He was the founder of FTP Software company which provided commercial package for MS DOS and MS Windows. With the advent of Microsoft TCP/IP stacks starting with Windows 95, FTP Software as well as all other commercial TCP/IP stacks providers were driven out of business.

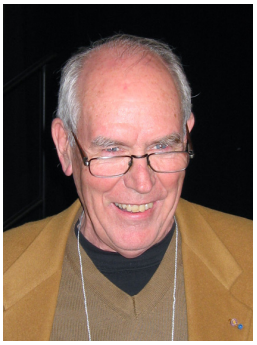
Publications

- The desktop computer as the network participant 1985 [5]
- IAB Report [6]
- A NONSTANDARD FOR TRANSMISSION OF IP DATAGRAMS OVER SERIAL LINES: SLIP [7]

References

[1] (http://www.romkey.com/about/)
[2] (http://www.rfc-editor.org/in-notes/museum/tcp-ip-digest/tcp-ip-digest.v2n17.1)
[3] TCP/IP
[4] (http://aboba.drizzlehosting.com/internaut/pc-ip.html)
[5] http://groups.csail.mit.edu/ana/Publications/PubPDFs/The%20Desktop%20Computer%20as%20a%20Network%20Participant.pdf
[6] http://tools.ietf.org/html/rfc1862
[7] http://www.ietf.org/rfc/rfc1055.txt

Ivan Sutherland

Ivan Edward Sutherland	
	
Born	May 16, 1938 Hastings, Nebraska, United States
Fields	Computer science Internet
Institutions	Harvard University University of Utah Evans and Sutherland California Institute of Technology Carnegie Mellon University Sun Microsystems Portland State University
Alma mater	MIT Caltech Carnegie Mellon
Doctoral advisor	Claude Shannon
Known for	Sketchpad, considered by many to be the creator of Computer Graphics
Notable awards	Turing Award, IEEE John von Neumann Medal, Association for Computing Machinery Fellow, National Academy of Engineering member, National Academy of Sciences member

Ivan Edward Sutherland (born May 16, 1938)[1] is an American computer scientist and Internet pioneer. He received the Turing Award from the Association for Computing Machinery in 1988 for the invention of Sketchpad, an early predecessor to the sort of graphical user interface that has become ubiquitous in personal computers. He is a member of the National Academy of Engineering, as well as the National Academy of Sciences among many other major awards.

Biography

Sutherland earned his Bachelor's degree in electrical engineering from the Carnegie Institute of Technology (now Carnegie Mellon University), his Master's degree from Caltech, and his Ph.D. from MIT in EECS in 1963.

He invented Sketchpad, an innovative program that influenced alternative forms of interaction with computers. Sketchpad could accept constraints and specified relationships among segments and arcs, including the diameter of arcs. It could draw both horizontal and vertical lines and combine them into figures and shapes. Figures could be copied, moved, rotated, or resized, retaining their basic properties. Sketchpad also had the first window-drawing program and clipping algorithm, which allowed zooming. Sketchpad ran on the Lincoln TX-2 computer and influenced Douglas Engelbart's oN-Line System. Sketchpad, in turn, was influenced by the conceptual Memex as

envisioned by Vannevar Bush in his influential paper "As We May Think".

Sutherland replaced J. C. R. Licklider as the head of the US Defense Department Advanced Research Project Agency's Information Processing Techniques Office (IPTO), when Licklider returned to MIT in 1964.[2][3]

From 1965 to 1968, Sutherland was an Associate Professor of Electrical Engineering at Harvard University. Work with student Danny Cohen in 1967 lead to the development of the Cohen–Sutherland computer graphics line clipping algorithm. In 1968, with the help of his student Bob Sproull, he created the first virtual reality and augmented reality head-mounted display system, named The Sword of Damocles.

From 1968 to 1974, Sutherland was a professor at the University of Utah. Among his students there were Alan Kay, inventor of the Smalltalk language, Henri Gouraud who devised the Gouraud shading technique, Frank Crow, who went on to develop antialiasing methods, and Edwin Catmull, computer graphics scientist, co-founder of Pixar and now President of Walt Disney and Pixar Animation Studios.

In 1968 he co-founded Evans and Sutherland with his friend and colleague David C. Evans. The company has done pioneering work in the field of real-time hardware, accelerated 3D computer graphics, and printer languages. Former employees of Evans and Sutherland included the future founders of Adobe (John Warnock) and Silicon Graphics (Jim Clark).

From 1974 to 1978 he was the Fletcher Jones Professor of Computer Science at California Institute of Technology, where he was the founding head of that school's Computer Science department. He then founded a consulting firm, Sutherland, Sproull and Associates, which was purchased by Sun Microsystems to form the seed of its research division, Sun Labs.

Sutherland was a Fellow and Vice President at Sun Microsystems. Sutherland was a visiting scholar in the Computer Science Division at University of California, Berkeley (Fall 2005–Spring 2008). On May 28, 2006, Ivan Sutherland married Marly Roncken. Sutherland and Marly Roncken are leading the research in Asynchronous Systems at Portland State University.[4]

He has two children, Juliet and Dean, and four grandchildren, Belle, Robert, William and Rose. Ivan's elder brother, Bert Sutherland, is also a prominent computer science researcher.

Awards

- Computer History Museum Fellow, 2005[5]
- R&D 100 Award, 2004 (team)[6]
- IEEE John von Neumann Medal, 1998[7]
- The Franklin Institute's Certificate of Merit, 1996
- Association for Computing Machinery Fellow, 1994[8]
- Electronic Frontier Foundation EFF Pioneer Award, 1994[9]
- ACM Software System Award, 1993[10]
- Turing Award, 1988[11]
- Computerworld Honors Program, Leadership Award, 1987[12]
- IEEE Emanuel R. Piore Award, 1986[13]
- Member, United States National Academy of Sciences, 1978[14]
- National Academy of Engineering member, 1973[15]
- National Academy of Engineering First Zworykin Award, 1972
- Kyoto Prize 2012, in the category of advanced technology.[16]

Quotes

- "A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland."[17]
- "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal."[17]
- When asked, "How could you possibly have done the first interactive graphics program, the first non-procedural programming language, the first object oriented software system, all in one year?" Ivan replied: "Well, I didn't know it was hard."[18]
- “It’s not an idea until you write it down.”
- "Without the fun, none of us would go on!"[19]

Patents

Sutherland has more than 60 patents, including:

- US Patent 7,636,361 (2009) Apparatus and method for high-throughput asynchronous communication with flow control [20]
- US Patent 7,417,993 (2008) Apparatus and method for high-throughput asynchronous communication [21]
- US Patent 7,384,804 (2008) Method and apparatus for electronically aligning capacitively coupled mini-bars [22]
- US patent 3,889,107 (1975) System of polygon sorting by dissection [23]
- US patent 3,816,726 (1974) Computer Graphics Clipping System for Polygons [24]
- US patent 3,732,557 (1973) Incremental Position-Indicating System [25]
- US patent 3,684,876 (1972) Vector Computing System as for use in a Matrix Computer [26]
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- Sutherland's 1963 Ph.D. Thesis from Massachusetts Institute of Technology republished in 2003 by University of Cambridge as Technical Report Number 574, *Sketchpad, A Man-Machine Graphical Communication System* (http://www.cl.cam.ac.uk/TechReports/UCAM-CL-TR-574.pdf). His thesis supervisor was Claude Shannon, father of information theory.
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- Oral history interview with Ivan Sutherland (http://purl.umn.edu/107642) at Charles Babbage Institute, University of Minnesota, Minneapolis. Sutherland describes his tenure as head of the Information Processing Techniques Office (IPTO) from 1963 to 1965. He discusses the existing programs as established by J. C. R. Licklider and the new initiatives started while he was there: projects in graphics and networking, the ILLIAC IV, and the Macromodule program.

Robert Taylor (computer scientist)

Robert William Taylor (born 1932), known as **Bob Taylor**, is an Internet pioneer, who led teams that made major contributions to the personal computer, and other related technologies. He was director of ARPA's Information Processing Techniques Office from 1965 through 1969, founder and later manager of Xerox PARC's Computer Science Laboratory from 1970 through 1983, and founder and manager of Digital Equipment Corporation's Systems Research Center until 1996.[1]

His awards include the National Medal of Technology and Innovation and the Draper Prize.[2] Taylor is known for his high-level vision: "The Internet is not about technology; it's about communication. The Internet connects people who have shared interests, ideas and needs, regardless of geography."[2]

Early life

Robert W. Taylor was born in Dallas, Texas in 1932.[3] His adoptive father was a Methodist minister and the family spent an itinerant childhood, moving from parish to parish. He started at Southern Methodist University at 16, served a stint in the Navy during the Korean War, and went back to school at the University of Texas under the GI Bill. At UT he was a "professional student," he says, taking courses for pleasure. He finally put them together for a degree in experimental psychology, with minors in math, philosophy, English and religion. While Taylor was trained as an experimental psychologist and mathematician his earliest career was devoted to brain research and the auditory nervous system.

Taylor taught math and coached basketball at a co-ed prep school in Florida. "I had a wonderful time but was very poor, with a second child -- who turned out to be twins -- on the way," he says.

Taylor took engineering jobs with aircraft companies at better salaries. After working for defense contractor Martin Marietta, he was invited to join to NASA in 1961 after submitting a research proposal for a flight-control simulation display.

Computer career

Taylor worked for NASA in Washington, DC while the Kennedy administration was backing scientific projects such as the Apollo program for a manned moon landing. In late 1962 Taylor met J.C.R. Licklider, who was heading the new Information Processing Techniques Office of the Advanced Research Project Agency (ARPA) of the United States Department of Defense. Licklider had done his graduate work in psychoacoustics as Taylor, and wrote an article in 1960 envisioning new ways to use computers.[4]

He met another visionary, Douglas Engelbart, at the Stanford Research Institute in Menlo Park, California. Taylor directed funding to Engelbart's studies of computer-display technology at SRI that led to the computer mouse. The public demonstration of a mouse-based user interface was later called "the Mother of All Demos." At the Fall 1968 Joint Computer Conference in San Francisco, Engelbart, Bill English, Jeff Rulifson and the rest of the Human Augmentation Research Center team at SRI showed on a big screen how he could manipulate a computer remotely located in Menlo Park, while sitting on a San Francisco stage, using his mouse.[5]

ARPA

In 1965 Taylor moved from NASA to ARPA, first as a deputy to Ivan Sutherland to fund a few large programs in advanced research in computing at major universities and corporate research centers throughout the US. Among the computer projects that ARPA supported was time-sharing, in which many users could work at terminals to share a single large computer. Users could work interactively instead of using punched cards or punched tape in a batch processing style. Taylor's office in the Pentagon had a terminal connected to time-sharing at MIT, a terminal connected to the Berkeley Timesharing System at the University of California at Berkeley, and a third terminal to the

System Development Corporation in Santa Monica, California. He noticed each system developed a community of users, but was isolated from the other communities.[5]

Taylor hoped to build a computer network to connect the ARPA-sponsored projects together, if nothing else to let him communicate to all of them through one terminal. Sutherland returned to a teaching position, and by June 1966 Taylor was officially director of IPTO. Taylor had convinced ARPA's Director Charles M. Herzfeld to fund a network project earlier in February 1966, and hired Lawrence G. Roberts from MIT's Lincoln Laboratory to be its first program manager. Roberts first resisted moving to Washington DC, until Herzfeld reminded the director of Lincoln Laboratory that ARPA dominated its funding.[6] Licklider continued to provide guidance, and Wesley A. Clark suggested the use of a dedicated computer, called the Interface Message Processor at each node of the network instead of centralized control. ARPA issued a request for quotation (RFQ) to build the system, which was awarded to Bolt, Beranek and Newman (BBN). ATT Bell Labs and IBM Research were invited to join, but were not interested. At a pivotal meeting in 1967 most participants resisted testing the new network; they thought it would slow down their research.

A second paper, "The Computer as a Communication Device" published in 1968 by Licklider and Taylor, lays out the future of what the Internet would eventually become.[7] Their paper starts out: "In a few years, men will be able to communicate more effectively through a machine than face to face."[7] The vision would take more than "a few years".

At some point Taylor was sent by ARPA to investigate inconsistent reports coming from the Vietnam War. Only about 35 years old, he was given the military rank equivalent to his civilian position: brigadier general, and made several trips to the area. He helped set up a computer center at the Military Assistance Command, Vietnam base in Saigon. In his words: "After that the White House got a single report rather than several. That pleased them; whether the data was any more correct or not, I don't know, but at least it was more consistent."[6] The Vietnam project took him away from directing research, and "by 1969 I knew ARPAnet would work. So I wanted to leave."[6]

Roberts was promoted to IPTO director, and continued to oversee the ARPANET project. For about a year Taylor joined Sutherland and David C. Evans at the University of Utah, where he had funded a center for research on computer graphics while at ARPA. In 1970 Taylor moved to Palo Alto, California for his next historic job.

Xerox

Jerome I. Elkind from BBN was hired by George Pake to co-manage the Computer Systems Laboratory at the new Palo Alto Research Center of Xerox Corporation.[8] Taylor assumed he would "managed in" and run day to day operations, while Elkind assumed Taylor would be associate director.

Technologies developed at PARC between 1970 and 1983 focused on reaching beyond ARPAnet to develop what has become the Internet, and the systems that support today's personal computers. They included:

- Powerful personal computers (the Xerox Alto) with windowed displays and graphical user interfaces that were the basis of the Macintosh.
- Ethernet, which networks local computers within a building or campus; and the first Internet, a network that connected the Ethernet to the ARPAnet utilizing PUP (PARC Universal Protocol), forerunner to TCP/IP.
- The electronics and software that led to the laser printer and the graphical programs that allowed John Warnock and Chuck Geschke to take off and found Adobe Systems.
- "What-you-see-is-what-you-get (WYSIWYG) word-processing programs, such as Bravo that Charles Simonyi took to Microsoft to serve as the basis for Microsoft Word.

Elkind was involved in a number of corporate and government projects. After one extended absence, Taylor became the official manager of the laboratory in early 1978. In 1983, integrated circuit specialist William J. Spencer became director of PARC. Spencer blamed Taylor for the failure of Xerox's own commercialization efforts.[9]

DEC SRC

Taylor was hired by Ken Olsen of Digital Equipment Corporation, and formed the Systems Research Center in Palo Alto. Many of the former CSL researchers came to work at SRC. Among the projects at SRC were the Modula-3 programming language; the snoopy cache, used in the Firefly multiprocessor workstation; the first multi-threaded Unix system; the first User Interface editor; and a networked Window System.

Retirement

Taylor retired in 1996 and lives in Woodside, California. In 2000 he voiced two concerns about the future of the Internet: control and access. In his words:

> There are many worse ways of endangering a larger number of people on the Internet than on the highway. It's possible for people to generate networks that reproduce themselves and are very difficult or impossible to kill off. I want everyone to have the right to use it, but there's got to be some way to insure responsibility.
> Will it be freely available to everyone? If not, it will be a big disappointment.[2]

Awards

In 1984, Taylor, Butler Lampson, and Charles P. Thacker received the ACM Software Systems Award "For conceiving and guiding the development of the Xerox Alto System demonstrating that a distributed personal computer system can provide a desirable and practical alternative to time-sharing." In 1994, all three were named ACM Fellows in recognition of the same work. In 1999, Taylor received a National Medal of Technology and Innovation. The citation read "For visionary leadership in the development of modern computing technology, including computer networks, the personal computer and the graphical user interface."[10]

In 2004, the National Academy of Engineering awarded him along with Lampson, Thacker and Alan Kay their highest award, the Draper Prize. The citation reads: "for the vision, conception, and development of the first practical networked personal computers."

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- "In Memoriam: J. C. R. Licklider 1915–1990" (http://memex.org/licklider.pdf). Palo Alto, California: Digital Equipment Corporation Systems Research Center. August 7, 1990. Reprints of early papers with preface by Taylor

External links

- The New Old Boys From the ARPAnet (http://www.rheingold.com/texts/tft/10.html?) Extract from 'Tools for Thought' by Howard Rheingold
- 1984 ACM Software Systems Award citation (http://awards.acm.org/citation.cfm?id=8751640&srt=year&year=1984&aw=149&ao=SOFTWSYS)
- 1994 ACM Fellow citation (http://fellows.acm.org/fellow_citation.cfm?id=1076264&srt=all)
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Ray Tomlinson

Raymond Samuel Tomlinson (born 1941) is a US programmer who implemented an email system in 1971 on the ARPANET. It was the first system able to send mail between users on different hosts connected to the ARPAnet. (Previously, mail could be sent only to others who used the same computer.) To achieve this, he used the @ sign to separate the user from their machine, which has been used in email addresses ever since.[1]

The first email Tomlinson sent was a test e-mail. It was not preserved and Tomlinson describes it as insignificant, *something like "QWERTYUIOP"*. This is commonly misquoted as "The first e-mail was QWERTYUIOP". [2] Tomlinson later commented that these "test messages were entirely forgettable and I have, therefore, forgotten them."[3]

At first, his email messaging system wasn't thought to be a big deal. When Tomlinson showed it to his colleague Jerry Burchfiel, he said "Don't tell anyone! This isn't what we're supposed to be working on." [4]

Career

Tomlinson was born in Amsterdam, New York, but his family soon moved to the small, unincorporated village of Vail Mills, New York. He attended Broadalbin Central School in nearby Broadalbin, New York. Later he attended Rensselaer Polytechnic Institute in Troy, New York where he participated in the co-op program with IBM. He received a Bachelor of Science degree in electrical engineering from RPI in 1963.

After graduating from RPI, he entered the Massachusetts Institute of Technology to continue his electrical engineering education. At MIT, Tomlinson worked in the Speech Communication Group and developed an analog-digital hybrid speech synthesizer as the subject of his Master's thesis. He received a S.M. in Electrical Engineering degree in 1965.

In 1967 he joined the technology company of Bolt, Beranek and Newman, now BBN Technologies, where he helped develop the TENEX operating system including ARPANET Network Control Protocol and TELNET implementations. He wrote a file-transfer program called CPYNET to transfer files through the ARPANET. Tomlinson was asked to change a program called SNDMSG, which sent messages to other users of a time-sharing computer, to run on TENEX. He added code he took from CPYNET to SNDMSG so messages could be sent to users on *other* computers — the first email.

Awards and honors

In 2000 he received the George R. Stibitz Computer Pioneer Award from the American Computer Museum (with the Computer Science Department of Montana State University). In 2001 he received a Webby Award from the International Academy of Digital Arts and Sciences for lifetime achievement. Also in 2001 he was inducted into the Rensselaer Alumni Hall of Fame. In 2002 Discover Magazine awarded him its Innovation Award. In 2004, he received the IEEE Internet Award along with Dave Crocker. In 2009, he along with Martin Cooper was awarded the Prince of Asturias award for scientific and technical research.[5] In 2011, he was listed at #4 on the MIT150 list of the top 150 innovators and ideas from MIT. In 2012, Tomlinson was inducted into the Internet Hall of Fame by the Internet Society.[6]

Notes

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External links

- Tomlinsons' E-mail page (http://openmap.bbn.com/~tomlinso/ray/home.html)
- NPR Story on Ray Tomlinson (http://www.npr.org/templates/story/story.php?storyId=120364591)
- Biography (http://rpi.edu/dept/NewsComm/sub/fame/inductees/raymondtomlinson.html)
- H@ppy birthday to you (http://news.bbc.co.uk/2/hi/in_depth/sci_tech/2000/dot_life/1586229.stm) at BBC on Ray Tomlinson and @ Symbol
- Motherboard.tv Interview: Ray Tomlinson Sent the First Email, But His Inbox Is Still a Mess (http://motherboard.tv/2010/4/20/q-a-ray-tomlinson-sent-the-first-email-but-his-inbox-is-still-a-mess--2)

Oleg Vishnepolsky

Oleg Vishnepolsky	
 Oleg Vishnepolsky in 1984 at the time of S2 creation	
Born	Russia
Nationality	American
Fields	Computer science
Known for	S2 Spreadsheet, Aphorisms, Executive [1], OS/2 TCP/IP
Notable awards	IBM CEO Outstanding Technical Achievement Award, 1992

Oleg Vishnepolsky is the author of IBM's S2 Spreadsheet. Vishnepolsky also authored TCP/IP stacks for OS/2 and IBM POS terminals. He also is known as an aphorist.[2][3][4]

S2 spreadsheet

While employed at Thomas Watson Research Center Oleg Vishnepolsky created a Lotus 1-2-3 compatible program S2 in 1984 at about the same time as Lotus was developing 1-2-3. S2 became popular within IBM and was distributed worldwide to 50,000 users. S2 matched 1-2-3 feature by feature, and had a similar user interface. Additionally, S2 had an ability to connect to IBM mainframes via TCP/IP and pull data from IBM databases such as IBM DB2 and IBM SQL/DS.[5] It also had features that allowed for easy visual connection between formulas and their dependencies - those features were later adopted by Lotus 1-2-3 and Microsoft Excel.

Controversy

In 1986 S2 caused a **major controversy** because of the **legal concerns** stemming from the fact that Lotus had filed and won lawsuits against 2 other companies for infringing on the Lotus 1-2-3 copyright. Additionally, IBM at the time was negotiating a major marketing deal with Lotus to market 1-2-3 under IBM's name. A reporter from PC Week got a hold of S2 program and ran an article speculating that the rumored deal between IBM and Lotus was coming apart.[6][7] This PC Week article caused an uproar in the executive circle of IBM. Upon further investigation and given the fact that S2 was already in the hands of 50,000 people the decision was not to withdraw S2 from circulation and allow Vishnepolsky to continue development of S2. However, Vishnepolsky got disheartened by the deal between IBM and Lotus and lost interest in continuing S2 development. He moved to another project and went

on to develop TCP/IP for OS2 and IBM POS terminals.

Career at IBM after S2

Vishnepolsky was active in Internet protocols development and specifically in TCP/IP. He worked in the group of Barry Appelman, a significant Internet notable and the inventor of instant messaging. Appelman's group as a whole proved critical in IBM's early embrace of the Internet despite having a competing family of protocols IBM Systems Network Architecture. Vishnepolsky authored TCP/IP for OS/2[8][9][10] in 1986 and for IBM POS terminals in 1990.[11]

Career after IBM

According to 24/7 Real Media, a WPP company's website[12] and an SEC filing of 2007,[13] Vishnepolsky is currently their CTO having worked at Doubleclick, AOL, and Prodigy_(online_service) in executive positions prior to him joining 24/7 Real Media. Vishnepolsky was also CTO of Inforocket/Liveadvice, an expert site.[14] According to the aforementioned SEC filing, Vishnepolsky received an outstanding technical achievement award from John Akers, the CEO of IBM at the time. According to[15] he launched first in the financial industry website for Prudential Securities.

Personal life

Oleg Vishepolsky's father Yan Vishnepolsky was an editor at Pravda[16] and in charge of the Pravda's party line department. The Vishnepolskys were expelled from the Soviet Russia in 1980 for anti-soviet propaganda. Oleg Vishnepolsky is married to Galina Kofman.

Quotes

- "Instead of getting fired from IBM I received an outstanding technical achievement award from the IBM CEO."
- "It is ok to put your head in the sand if you keep your mouth shut."
- "Advice is best taken like Russian vodka: in small doses but large quantities."
- "Give a man a fish and you feed him for a day; teach him how to fish and you create an environmental problem."
- "We live for the moments to die for."

More can be found at [17] and [18]

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Phil Zimmermann

Phil Zimmermann	
	
Born	February 12, 1954 Camden, New Jersey
Nationality	American
Known for	Creator of Pretty Good Privacy

Philip R. "Phil" Zimmermann Jr. (born February 12, 1954) is the creator of Pretty Good Privacy (PGP), the most widely used email encryption software in the world.[1] He is also known for his work in VoIP encryption protocols, notably ZRTP and Zfone.

Background

He was born in Camden, New Jersey. His father was a concrete mixer truck driver. Zimmermann received a B.S. degree in computer science from Florida Atlantic University in Boca Raton in 1978, and currently lives in the San Francisco Bay Area.

PGP

In 1991, he wrote the popular Pretty Good Privacy (PGP) program, and made it available (together with its source code) through public FTP for download, the first widely available program implementing public-key cryptography. Shortly thereafter, it became available overseas via the Internet, though Zimmermann has said he had no part in its distribution outside the US.

Criminal investigation by US Customs

After a report from RSA Data Security, Inc., who were in a licensing dispute with regard to use of the RSA algorithm in PGP, the Customs Service started a criminal investigation of Zimmermann, for allegedly violating the Arms Export Control Act.[2] The US Government had long regarded cryptographic software as a munition, and thus subject to arms trafficking export controls . At that time, the boundary between permitted ("low-strength") cryptography and impermissible ("high-strength") cryptography placed PGP well on the too-strong-to-export side (this boundary has since been relaxed). The investigation lasted three years, but was finally dropped without filing charges.

After the government dropped its case without indictment in early 1996, Zimmermann founded PGP Inc. and released an updated version of PGP and some additional related products. That company was acquired by Network Associates (NAI) in December 1997, and Zimmermann stayed on for three years as a Senior Fellow. NAI decided to drop the product line and in 2002, PGP was acquired from NAI by a new company called PGP Corporation. Zimmermann served as a special advisor and consultant to that firm until Symantec acquired PGP Corporation in 2010.[1] Zimmermann is also a fellow at the Stanford Law School's Center for Internet and Society. He was a principal designer of the cryptographic key agreement protocol (the "association model") for the Wireless USB standard.

Trivia

In the very first version of PGP, an encryption algorithm was given the humorous name BassOmatic (after a skit on Saturday Night Live) and Pretty Good Privacy itself is named after a Lake Wobegon fictional grocery store named "Ralph's Pretty Good Grocery".[3]

In popular culture

Zimmermann's name appears in the novel *The Da Vinci Code*:

> "Da Vinci had been a cryptography pioneer, Sophie knew, although he was seldom given credit. Sophie's university instructors, while presenting computer encryption methods for securing data, praised modern cryptologists like Zimmermann and Schneier but failed to mention that it was Leonardo who had invented one of the first rudimentary forms of public key encryption centuries ago."[4]

Simon Singh's *The Code Book* devotes a entire chapter to Zimmermann and PGP.[5]

Awards

Zimmermann has received numerous technical and humanitarian awards for his pioneering work in cryptography:

- In 2012, Zimmermann was inducted into the Internet Hall of Fame by the Internet Society.[6]
- In 2008, PC World named Zimmermann one of the 'Top 50 Tech Visionaries' of the last 50 years [7].
- In 2006 eWeek ranked PGP 9th in the 25 Most Influential and Innovative Products introduced since the invention of the PC in 1981 [8].
- In 2003 Reason named him a "Hero of Freedom"[9]
- In 2001 Zimmermann was inducted into the CRN Industry Hall of Fame [10].
- In 2000 InfoWorld named him one of the 'Top 10 Innovators in E-business' [11].
- In 1999 he received the Louis Brandeis Award from Privacy International.
- In 1998, he received a Lifetime Achievement Award from Secure Computing Magazine
- In 1996, he received the Norbert Wiener Award for Social and Professional Responsibility for promoting the responsible use of technology.
- In 1995, he received the Chrysler Design Award for Innovation, and the Pioneer Award from the Electronic Frontier Foundation.

- In 1995, Newsweek also named Zimmermann one of the "Net 50", the 50 most influential people on the Internet.

Publications

The Official PGP User's Guide, MIT Press, 1995[12]

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External links

- Official website (http://www.philzimmermann.com)
- Why I wrote PGP. (http://www.philzimmermann.com/EN/essays/WhyIWrotePGP.html)
- Conversation With Phil Zimmermann (http://grep.law.harvard.edu/article.pl?sid=03/06/06/1441247&mode=nested), Mikael Pawlo, GrepLaw, June 6, 2003.
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