

[Introduction](#) [Origins](#) [Concepts](#) [Proving the Ideas](#) [Transition to Widespread Infrastructure](#)[Role of Documentation](#) [Formation of the Broad Community](#) [Commercialization of the Technology](#)[History of the Future](#) [Timeline](#) [Footnotes](#) [References](#) [Authors](#)

Published 1997

Barry M. Leiner, Vinton G. Cerf, David D. Clark, Robert E. Kahn, Leonard Kleinrock, Daniel C. Lynch, Jon Postel, Larry G. Roberts, Stephen Wolff

[Download](#)

The Internet has revolutionized the computer and communications world like nothing before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities. The Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location. The Internet represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure. Beginning with the early research in packet switching, the government, industry and academia have been partners in evolving and deploying this exciting new technology. Today, terms like “bleiner@computer.org” and “http://www.acm.org” trip lightly off the tongue of the random person on the street.¹

This is intended to be a brief, necessarily cursory and incomplete history. Much material currently exists about the Internet, covering history, technology, and usage. A trip to almost any bookstore will find shelves of material written about the Internet.²

[Learn more about how we are building a bigger, stronger Internet in 2021.](#)

In this paper,³ several of us involved in the development and evolution of the Internet share our views of its origins and history. This history revolves around four distinct aspects. There is the

[Introduction](#) [Origins](#) [Concepts](#) [Proving the Ideas](#) [Transition to Widespread Infrastructure](#)[Role of Documentation](#) [Formation of the Broad Community](#) [Commercialization of the Technology](#)[History of the Future](#) [Timeline](#) [Footnotes](#) [References](#) [Authors](#)

involves many aspects – technological, organizational, and community. And its influence reaches not only to the technical fields of computer communications but throughout society as we move toward increasing use of online tools to accomplish electronic commerce, information acquisition, and community operations.

Origins of the Internet

The first recorded description of the social interactions that could be enabled through networking was a series of memos written by J.C.R. Licklider of MIT in August 1962 discussing his “Galactic Network” concept. He envisioned a globally interconnected set of computers through which everyone could quickly access data and programs from any site. In spirit, the concept was very much like the Internet of today. Licklider was the first head of the computer research program at DARPA,⁴ starting in October 1962. While at DARPA he convinced his successors at DARPA, Ivan Sutherland, Bob Taylor, and MIT researcher Lawrence G. Roberts, of the importance of this networking concept.

Leonard Kleinrock at MIT published the first paper on packet switching theory in July 1961 and the first book on the subject in 1964. Kleinrock convinced Roberts of the theoretical feasibility of communications using packets rather than circuits, which was a major step along the path towards computer networking. The other key step was to make the computers talk together. To explore this, in 1965 working with Thomas Merrill, Roberts connected the TX-2 computer in Mass. to the Q-32 in California with a low speed dial-up telephone line creating the first (however small) wide-area computer network ever built. The result of this experiment was the realization that the time-shared computers could work well together, running programs and retrieving data as necessary on the remote machine, but that the circuit switched telephone system was totally inadequate for the job. Kleinrock’s conviction of the need for packet switching was confirmed.

In late 1966 Roberts went to DARPA to develop the computer network concept and quickly put together his plan for the “ARPANET”, publishing it in 1967. At the conference where he presented the paper, there was also a paper on a packet network concept from the UK by Donald Davies and Roger Scantlebury of NPL. Scantlebury told Roberts about the NPL work as well as that of Paul Baran and others at RAND. The RAND group had written a paper on packet switching networks for secure voice in the military in 1964. It happened that the work at MIT (1961-1967), at RAND (1962-

[Introduction](#) [Origins](#) [Concepts](#) [Proving the Ideas](#) [Transition to Widespread Infrastructure](#)[Role of Documentation](#) [Formation of the Broad Community](#) [Commercialization of the Technology](#)[History of the Future](#) [Timeline](#) [Footnotes](#) [References](#) [Authors](#)

Network measurement system was prepared by Kleinrock's team at UCLA.

Due to Kleinrock's early development of packet switching theory and his focus on analysis, design and measurement, his Network Measurement Center at UCLA was selected to be the first node on the ARPANET. All this came together in September 1969 when BBN installed the first IMP at UCLA and the first host computer was connected. Doug Engelbart's project on "Augmentation of Human Intellect" (which included NLS, an early hypertext system) at Stanford Research Institute (SRI) provided a second node. SRI supported the Network Information Center, led by Elizabeth (Jake) Feinler and including functions such as maintaining tables of host name to address mapping as well as a directory of the RFC's.

One month later, when SRI was connected to the ARPANET, the first host-to-host message was sent from Kleinrock's laboratory to SRI. Two more nodes were added at UC Santa Barbara and University of Utah. These last two nodes incorporated application visualization projects, with Glen Culler and Burton Fried at UCSB investigating methods for display of mathematical functions using storage displays to deal with the problem of refresh over the net, and Robert Taylor and Ivan Sutherland at Utah investigating methods of 3-D representations over the net. Thus, by the end of 1969, four host computers were connected together into the initial ARPANET, and the budding Internet was off the ground. Even at this early stage, it should be noted that the networking research incorporated both work on the underlying network and work on how to utilize the network. This tradition continues to this day.

Computers were added quickly to the ARPANET during the following years, and work proceeded on completing a functionally complete Host-to-Host protocol and other network software. In December 1970 the Network Working Group (NWG) working under S. Crocker finished the initial ARPANET Host-to-Host protocol, called the Network Control Protocol (NCP). As the ARPANET sites completed implementing NCP during the period 1971-1972, the network users finally could begin to develop applications.

In October 1972, Kahn organized a large, very successful demonstration of the ARPANET at the International Computer Communication Conference (ICCC). This was the first public demonstration of this new network technology to the public. It was also in 1972 that the initial "hot" application, electronic mail, was introduced. In March Ray Tomlinson at BBN wrote the basic email message send and read software, motivated by the need of the ARPANET developers for an easy coordination mechanism. In July, Roberts expanded its utility by writing the first email utility program to list, selectively read, file, forward, and respond to messages. From there email took off as the largest network application for over a decade. This was a harbinger of the kind of activity