

# History & Development of the Internet

## - a Timeline

---

### through 1969

---

#### Late 1950's Era of the Arms Race with the Soviet Union

**1957**

- Soviet Union launches Sputnik I, the first artificial satellite. ([1](#))



**Figure 1,**  
Sputnik I

---

**1958**

- President Eisenhower reacts by forming two government agencies to advance space technologies, weapons, and communication systems.
- Advanced Research Projects Agency (ARPA) <http://www.arpa.mil/> and National Aeronautics and Space Administration (NASA) <http://www.nasa.gov> are established. ([2](#))
- **SAGE** (Semi-Automatic Ground Environment) developed by ARPA could receive data from various detection and tracking radar systems, interpret data from unidentified aircraft and direct defensive weapons at incoming hostile aircraft. The SAGE

machine could receive information continuously through the computer's memory from telephone lines. (3)



**Figure 2**, SAGE  
human  
interactive  
computer

## 1960's Formation of "Packet-switching" Technologies and History

1960

- U-2 Shot down in Russia (4)
- 

1961

- Leonard Kleinrock of [MIT](#) writes first paper on packet-switching theory, entitled "Information Flow in Large Communication Nets." <http://www.lk.cs.ucla.edu/LK/Bib/REPORT/PhD/>
  - Russia puts first man in space. (5)
  - Berlin Wall constructed. (6)
- 

1962

- ARPA forms the Information Processing Techniques Office (IPTO), which conducts research on command and control systems. (7)

- J.C.R. (Joseph Carl Robnett) Licklider (1990), <http://gatekeeper.dec.com/pub/DEC/SRC/research-reports/abstracts/src-rr-061.html> a behavioral psychologist and first director, emphasizes time-sharing systems, computer graphics, and improved computer languages. (8)



**Figure 3**, Joseph Carl Robnett Licklider (1990)

- Along with Wesley Clark, [MIT](#) engineer and developer of several systems, Licklider writes "On-Line Man Computer Communication" Galactic Network.

With federal grant funds, the office is directed to research technologies related to human interaction and distributed systems.

The following institutions collaborate as the project increases:

Carnegie-Mellon University  
MIT  
RAND Corporation  
Stanford Research Institute  
System Development Corporation  
University of California at Berkeley, Santa Barbara, and Los Angeles  
University of South Carolina  
University of Utah. (9)

- U.S. space technology also develops. Elvis makes first satellite television broadcast via Telstar. (10)
-

1964

- Paul Baran at RAND develops packet-switching networks and produces several papers on distributed communication networks. <http://www.rand.org/publications/RM/baran.list.html>



**Figure 4**, Paul Baran

Funded by the [Air Force](#), his systems are developed with a nuclear attack in mind, in which networks could switch to one another if one were destroyed. The goal was to build a robust communication network that could survive under adverse conditions. ([11](#))

The system was analogous to a "hot potato" game. In fact, Baran and his colleague Sharla P. Boehm publish memorandum referring to the system as a digital routing scheme "hot potato." ([12](#))

---

1965

- British mathematician, **Donald Davies** (2000) of National Physical Laboratory (NPL) also explores on the idea of networks sending pieces of data in units; thus he coined the term "packet."



**Figure 5**, Donald Davies (2000)

Though funding limited research, he envisions his system having commercial uses in: business, recreational activities, point-of-sale transactions, and even online betting. ([13](#))

- ARPA sponsors study on "Cooperative network of time-sharing computers" and the first "Wide Area Network" (WAN) is created. ([14](#))
- 

1966

- Lawrence G. Roberts and Thomas Marill, at the Lincoln Laboratory at [MIT](#) publish "Towards a Cooperative Network of Time Shared Computers" which documents their computer networking experiments for ARPA. ([15](#))
- 

1967

- Lawrence G. Roberts at [MIT](#) establishes the first ARPANET plan at a meeting in Ann Arbor, Michigan. Robert's idea is to connect all of the time-sharing computers on to one another directly, over dial-up telephone lines. The functions of the computers would be connected to a "host" at each site. ([16](#))



**Figure 6**, Lawrence Roberts

- At the *Association for Computing Machines Symposium on Operating Principles* in Gatlingburg, Tennessee, Lawrence Roberts presents a paper entitled "Multiple Computer Networks and Intercomputer Communication" which summarizes standards for the ARPANET network design. ([17](#))
- Packet theory scientists come together from: ARPA, NPL, and RAND.
- Coincidentally the scientists, who were forming their own packet theories, unite at the Tennessee symposium. Donald Davies and Roger Scantlebury of [National Physical Laboratories](#) present a paper on a packet-network concept. Scantlebury told Roberts of the NPL projects and of Paul Baran of RAND, who had written several papers on communication networks. ([18](#))
- Davies continues with his work and forms the NPL Data Network in Middlesex, England.

---

1968

- Proposals are made for ARPANET to begin the project.
- University of California at Los Angeles (UCLA) is granted Network Measurement Center contract in October.

- Bolt Beranek and Newman, Inc. (BBN) are awarded a million-dollar contract to build Interface Message Processors (IMPs).
- 

1969

- The first ARPANET connections are made. Nodes (hosts) are set as BBN builds each IMP machine, which is a Honeywell DDP-516 minicomputer with 12K memory, set with 50 kbps lines, which AT&T provides.
- Node 1: UCLA (September)
- Node 2: Stanford Research Institute (SRI) (October)
- Node 3: University of California Santa Barbara (UCSB) (November)
- Node 4: University of Utah (December)



**Figure 7**, ARPANET map of first nodes

Charley Kline at [UCLA](#) sends the first packets; however, the system crashes as he types the letter "G" of "LOGIN." Nevertheless, the error was corrected by the programmers at BBN.



**Figure 8**, Frank Heart (top left) and BBN team celebrate the creation of ARPANET.

- U.S. astronauts land on the moon. ([19](#))

# The 1970's

---

## 1970's Connections established, ARPANET expands

1970

- **ALOHAnet**, which is the first packet network, is developed at the [University of Hawaii](#). Funded by ARPA and the [Navy](#), the project explores packet switching as an alternative to costly dial-up telephone connections for accessing the University's computers. ([20](#))
  - **ARPANET** hosts start using NCP, or Network Control Protocol, further developing the first host-to-host protocol.
- 

1971

- **ARPANET** increases up to 15 nodes (23 hosts) which include: [University of California at Santa Barbara](#), and [Los Angeles, Stanford Research Institute, University of Utah](#), Bolt Beranek and Newman, Inc. (BBN), [MIT](#), RAND, System Development Corporation, [Harvard](#), Lincoln Lab, UIUC, CWRU, [Carnegie-Mellon University](#), NASA/Ames.
  - **Ray Tomlinson** of BBN creates an email program that is able to send messages across a distributed network.
- 

1972

- **Ray Tomlinson** modifies his email program for ARPANET and quickly gains popularity. Initially there were some variations of the program, but the "@" was finally chosen as the standard.
- **ARPANET** is demonstrated using 40 terminals at the International Conference on Computer Communications (ICCC)

at the Washington D.C. Hilton. The Terminal Interface Processor (TIP) is organized by Bob Kahn.

- **Louis Pouzin**, a French computer scientist, builds "CYCLADES" which was their own version of ARPANET. ([21](#))
- 

1973

- **ARPA** changes its name to **DARPA**, adding "D" for "Defense".
- **ARPANET** makes its first international connection to the [University College of London](#) (England) and the Royal Establishment in Norway (NORSAR).  
<http://www.norsar.no/NORSAR/> ([22](#))
- **Bob Kahn** starts research at DARPA, working for Lawrence Roberts. Kahn enlists Vinton Cerf of [Stanford](#) to assist in creating solutions for linking diverse systems. Additional net projects are radio-based such as PRnet and SATNET, which is satellite driven; moreover, the systems all have different interfaces, labeling conventions and transmission rates. Kahn and Cerf work together in designing a net-to-net connection protocol. ([23](#))

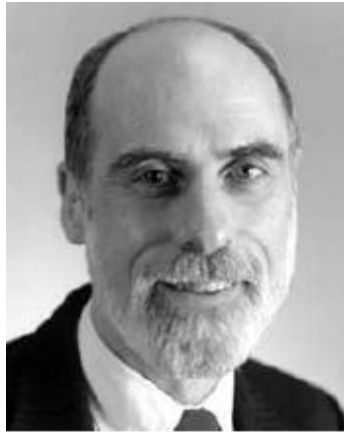


[Figure 9](#), Bob Kahn

- System protocols established for Network Voice Protocol (NVP) which is for conference calls over ARPANET.
-

1974

- **Vinton Cerf** and Bob Kahn publish "A Protocol for Packet Network Intercommunication" which specifies the architecture of a Transmission Control Program (TCP). Messages are encapsulated and decapsulated in "datagrams" to the end user. The paper also introduces the idea of gateways, where only the receiving hosts can read the contents of messages. ([24](#))



[Figure 10](#), Vinton Cerf

- **Bolt, Beranek & Newman** (BBN) announce "Telenet" which is the first public packet data service. The program is a commercial version of ARPANET. ([25](#))
- 

1975

- Internet operations are transferred to the Defense Communications Agency. ([26](#))
  - **Steve Walker**, an ARPA program manager, establishes first mailing list concerning ARPANET.
  - Satellite links across two oceans to Hawaii and UK are formed, and the first TCP tests are layered over them by Stanford, BBN, and UCL.
-

1976

**Queen Elizabeth II** makes early network history by sending an email announcing that the Royal Signals and Radar Establishment in Malvern, is available on the ARPANET system.

According to the Queen's Royal Archives, the brief message was sent on March 26, 1976. Additional information only included the names of the computers that were used over ARPANET. ([27](#))



Copyright (c) Archive Photos

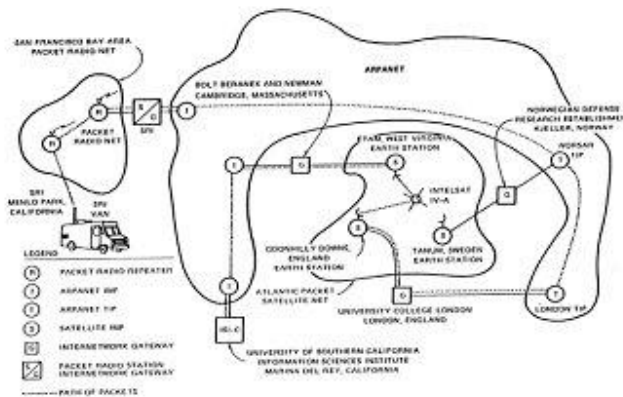
**Figure 11**, Queen Elizabeth II

---

1977

- Email service, "Theorynet" at the [University of Wisconsin](#) provides electronic mail to over 100 researchers in computer science using a system over Telenet.
- First demonstration of ARPANET, San Francisco Bay Packet Radio Net (PRNET) and Atlantic Packet Satellite Network (SATNET) operation of Internet protocols with BBN-supplied gateways.

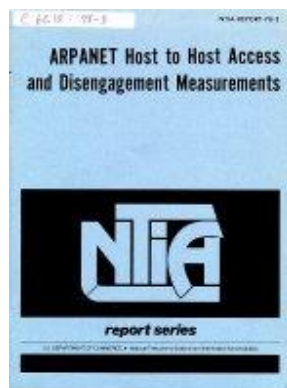
Although ARPANET, SATNET, and PRNET are separate research projects, each system is based on the premise of a network that will communicate with independent equipment, i.e. satellite and radio. ([28](#))



**Figure 12**, ARPANET, SATNET & PRNET network diagram.

1978

- **TCP** split into TCP and IP. TCP or Transmission Control Protocol is designated as the host-to-host protocol and an IP or internetwork protocol, would pass individual packets between machines. The pair become collectively known as "TCP/IP." (29)



**Figure 13**, Early ARPANET technical report

1979

- Meeting at Madison, **Larry Landweber** department head for computer sciences at the [University of Wisconsin](#), meets with representatives of DARPA, [NSF](#) (National Science Foundation) and six other universities to develop a network independent of

ARPANET. The proposed network (CSNET) will be designed to provide greater access to universities. ([30](#))

- **USENET** (newsgroups) is established by Tom Truscott and Jim Ellis, two graduate students at [Duke University](#) and Steve Bellovin at the [University of North Carolina](#). Users from around the world join these discussion groups to talk about the net, politics, religion, and thousands of other subjects. ([31](#))

# The 1980's

---

## 1980's ARPANET expands and other networks emerge

1980

- Due to virus ARPANET comes to a complete halt.
- 
- **ARPANET** has 213 hosts, with a new host added approximately once every 20 days. ([32](#))
  - **CSNET** (Computer Science NETwork) is built by the University of Wisconsin, the University of Delaware, Purdue University, RAND Corp., and BBN through grant funds from the National Science Foundation. CSNET is later known as the Computer and Science Network, and was not connected to ARPANET.
  - **BITNET**, "Because It's Time NETwork"  
<http://www.cren.net/cren/history.html>
  - The system serves as a cooperative network between the City University of New York and Yale. The low-cost network later expands throughout United States and to overseas.
  - **BITNET** provides electronic mail, listserves, as well as, file transfers (FTP) to distribute information. ([33](#))
- 

1982

- **DCA** (Defense Communication Agency) and **DARPA** establish the Transmission Control Protocol (TCP) and Internet Protocol (IP) and the protocol suite, commonly known as TCP/IP for ARPANET.
- **DOD** also declares TCP/IP as a standard.

- Thus, the first definition of an "Internet" is established as a connected set of networks, specifically those using TCP/IP.
  - **EUnet**, the European UNIX Network is formed by EUUG for email and USENET services. The original connections include: the Netherlands, Denmark, Sweden and the UK.
- 

1983

- **[Time Magazine](#)** (Jan. 3) announces "the Computer" as the Man of the Year. ([34](#))
- **[NASA](#)** creates SPAN (Space Physics Analysis Network) as part of their network infrastructure. ([35](#))
- **ARPANET** split into ARPANET and MILNET. The military network, MILNET, became integrated with the Defense Data Network created the previous year. Sixty-eight of the 113 existing nodes went to MILNET.
- A gateway between **CSNET/ARPANET** is created.

Networking usage changes from having a single, large time sharing computer, to connecting entire local networks.

---

1984

- **Domain Name System** or **DNS** <http://www.dns.net/dnsrd/> is introduced to identify the type of institution which represents the host. Six large domains were named: edu (education), gov (government), mil (military), com (commercial), org (organization), and net (network resources). Others were added to represent a country, or government entity, such as "ci.sat.tx.us" for the [City of San Antonio](#). ([36](#))
- Newsgroups on USENET can be moderated to keep topics focused.

- **EARN**, the European Academic and Research Network, is formed with funding from IBM.
- 

1985

- **Information Sciences Institute** (ISI) at the University of Southern California is given responsibility for DNS root management by the Defense Communications Agency, and Stanford Research Institute for DNS Network Information Center registrations.
  - On March 15, **Symbolics.com** is assigned to become the first registered domain. Other firsts include: cmu.edu, purdue.edu, rice.edu, ucla.edu, css.gov, mitre.org, and uk.
  - Electronic Bulletin Boards , such the **WELL**, (Whole Earth 'Lectronic Link) <http://www.well.com/> by Steward Brand are released. Using his personal computer on his houseboat in Sausalito, California, he organized discussion groups, from topics such as the "Grateful Dead" to "Parenting." (37)
  - **National Science Foundation** awards five supercomputer contracts: Cornell Theory Center (CTC), the John Von Neumann Center at Princeton (JVNC), the National Center for Supercomputing Applications (NCSA) at the University of Illinois, the Pittsburgh Supercomputing Center (PSC), the San Diego Supercomputer Center (SDSC) at the University of California, San Diego and the General Atomics Company with nuclear engineer Sid Karin as director. (38)
- 

1986

- **NSFNET** system is created with a backbone speed of 56Kbps.
- **NSF** centers lead to formation of other regional feeder networks and the hub infrastructure expands. (39)

- **Craig Partridge**, a programmer at BBN develops **Mail Exchanger (MX)**, which allows non-IP network hosts to have domain addresses.
  - A severed fiber-optic cable in New England cuts off the Net as AT&T loses connections between Newark/NJ and White Plains/NY. Seven New England ARPANET trunk lines were in one spliced cable.
- 

1987

- **NSF** signs a cooperative agreement to manage the NSFNET backbone with Merit Network Inc., which is assisted by IBM and MCI.
  - Number of hosts breaks 10,000.
- 

1988

- **Robert Morris**, son of a computer security expert for the [National Security Agency](#), sent a worm through the Internet, affecting 6,000 of the 60,000 hosts on the net. He programmed the worm to reproduce itself and filter through network computers; consequently, the size of the files filled computers' memories, thus disabling numerous machines. ([40](#))
  - **CERT** (Computer Emergency Response Team) <http://www.cert.org/nav/aboutcert.html> formed by DARPA in response to the needs exhibited during the Morris worm incident. The worm is the only advisory issued this year.
  - **Internet Relay Chat (IRC)** is developed by Jarkko Oikarinen.
  - **President Ronald Reagan** visits the Soviet Union, and the Cold War, which once was the motive for establishing ARPA is coming to an end. ([41](#))
-

1989

- Commercial services emerge, with CompuServe through Ohio State University.
- First relays between a commercial electronic mail carrier and the Internet are established through MCI Mail and the Corporation for the National Research Initiative (CNRI).
- BITNET and CSNET merge to form CREN, Corporation for Research and Education Networking.

<http://www.cren.net/cren/index.html>

- UCLA holds a Act One symposium to celebrate the ARPANET 20<sup>th</sup> anniversary and its decommissioning.
- Number of hosts breaks 100,000.

# The 1990's

---

## 1990's ARPANET experiment ends and the World Wide Web is born

1990

- February 28, ARPANET was formally decommissioned and the remaining hardware dismantled. The changeover causes little disruption on the network.
- Dr. Vinton Cerf, one of the pioneers of the Internet laments:
- "It was the first, and being first, was best, but now we lay it down to ever rest. Now pause with me a moment, shed some tears. For auld lang syne, for love, for years and years of faithful service, duty done, I weep. Lay down thy packet, now. O Friend, and sleep."
- (Cerf, 1989 in his "Requiem for ARPANET")

Cerf's sentiments of were shared by other ARPANET veterans, who engaged their efforts into an uncertain experiment to a system that presently routinely serves hundreds of thousands of users. (42)

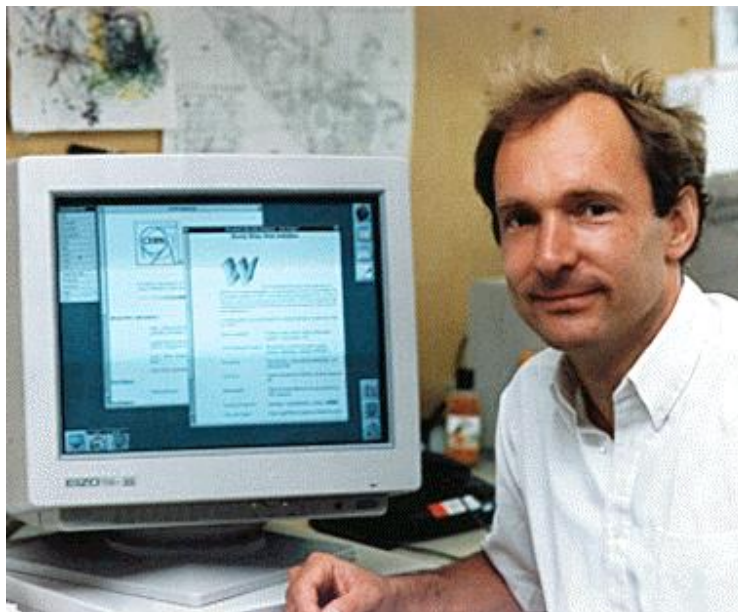
- **Electronic Frontier Foundation** (EFF) <http://www.eff.org/> is established by Mitchell D. Kapor, who also founded the [Lotus Development Corporation](#). (43)
  - **Archie**, which stands for "Archive Server" released by Peter Deutsch, Alan Emtage, and Bill Heelan at McGill.
  - Institutions, such as the [National Library of Medicine](#) go online.
- 

1991

- **National Science Foundation's NSFNET** decides to lift commercial restrictions on the use of the network, thus opening a means for electronic commerce.
- **High Performance Computing Act**, which is authored by Al Gore is signed into law. (44)
- **Wide Area Information Servers (WAIS)**, invented by Brewster Kahle, is released by Thinking Machines Corporation.
- **Gopher** is introduced by Paul Lindner and Mark P. McCahill from the [University of Minnesota](#). **Gopher** allows users to search the network, but in just pure text.

★ **World-Wide Web (WWW)** is released by CERN <http://cern.web.cern.ch/CERN/> in Geneva, Switzerland. British researcher, Tim Berner-Lee creates **HyperText Markup Language (HTML)**, which use specifications for **URLs** or **Uniform Resource Locators**, for web addresses. (45)

- **The web as we know it is born!**



**Figure 14**, Tim Berner-Lee of CERN

1992

- **Internet Society (ISOC)** is formed, the organization's members include the founders of the early Internet, ARPANET. (46)

- **Veronica**, a gopherspace search tool, is released by the [University of Nevada at Reno](#), System Computing Department. The same developers of Archie create Veronica; however, Veronica allows the user to search gopher databases. Each tool is just in plain text on computer monitors. (47)
  - **World Bank** goes on-line.  
<http://www.worldbank.org/>
- 

1993

- [InterNIC](#) formed by the NSF, provides specific Internet services:
- Directory and database services ([AT&T](#))
- Registration services ([Network Solutions Inc.](#))
- Information services (General Atomics/CERFnet)
- US White House goes on-line  
(<http://www.whitehouse.gov>)
- President George W. Bush: [president@whitehouse.gov](mailto:president@whitehouse.gov)
- Vice-President Dick Cheney: [vice-president@whitehouse.gov](mailto:vice-president@whitehouse.gov)
- **Mosaic**, which is one of the first Internet browsers is released and proliferates the web with a 341,634% annual growth rate of service traffic. Mosaic, provides a graphical interface to search the Internet, thus making the Internet more visually appealing. Gopher's growth is 997%



**Figure 15**, Mosaic browser

---

1994

- [NASA](#) establishes the NASA Research and Education Network (**NREN**), which is an experimental backbone at five NASA science centers. (48)
- **MBONE** audio multicast is made by the Rolling Stones for the Voodoo Lounge tour. (49)
- **Yahoo!**, which stands for "Yet Another Hierarchical Official Oracle" is founded by two PhD students from Stanford, Jerry Yang and David Filo. (50)



Copyright 2000 Reuters Limited. All rights reserved.

**Figure 16**, (right to left) Yahoo founder Jerry Yang, [Yahoo Japan](#) President Masahiro Inoue & [Softbank Corp](#) President Masayoshi Son, commemorate their success in electronic commerce.

- **ARPANET/Internet** celebrates 25<sup>th</sup> anniversary, and later it's 30<sup>th</sup> in 1999 at [UCLA](#). (51)



**Figure 17**, Internet pioneers from left to

right: Dr. Vinton G. Cerf, Internet  
Architecture, and Technology, MCI  
WorldCom Inc.; Dr. Robert E. Kahn, Corp.  
for National Research Initiatives; Dr.  
Kleinrock, UCLA, and Dr. Lawrence G.  
Roberts, Packetcom.

**END**