

## Looking Back.. The History of the Internet

- ARPANET (Advanced Research Projects Agency Network)
- TCP/IP (Transmission Control Protocol/Internet Protocol)
- NSFNET (National Science Foundation Network)
- Desktop computers
- Network upgrades
- Web Technology



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## 1950's

1957 USSR launches Sputnik, first artificial earth satellite. In response, US forms the Advanced Research Projects Agency (ARPA) within the Department of Defense (DoD) to establish US lead in science and technology applicable to the military.



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## 1960's

**1969** - The Department of Defense Advanced Research Projects Agency creates an experimental network called ARPANET. This network provides a test-bed for emerging network technologies.

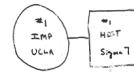
ARPANET originally connected four universities

- Node 1: UCLA - (September)
- Node 2: SRI - Stanford Research Institute (October)
- Node 3: UCSB
- Node 4: Univ of Utah



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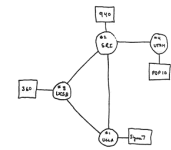
THE ARPA NETWORK

SEPT. 1969

1 NODE

FIGURE 6.1 Drawing of September 1969  
(Courtesy of Alex McKenzie)

The first node on ARPANET at University California Los Angeles (UCLA) on the 2nd of September 1969. (Source: "Casting the Net", page 55)



THE ARPA NETWORK

DEC 1969

4 NODES

FIGURE 6.2 Drawing of 4 Node Network  
(Courtesy of Alex McKenzie)

By the end of the year there are four nodes on the "ARPA NETWORK", as shown in schematic above. (Source: "Casting the Net", page 56. See also The Computer Museum Timeline.)



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## 1960's (continued..)

Information Message Processors (IMP) [Honeywell 516 mini computer with 12K of memory] developed by Bolt Beranek and Newman, Inc. (BBN) First node-to-node message sent between UCLA and SRI (October)

First Request for Comment (RFC): "Host Software" by Steve Crocker University of Michigan

Michigan State and Wayne State University establish X.25-based Merit network for students, faculty, alumni.



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## 1970'S

**1971** ALOHAnet developed by Norman Abrahamson, University of Hawaii, heart of Ethernet and connected to the ARPANET in 1972.

**1972** The National Center for Supercomputing Applications (NCSA) develops the telnet application for remote login, making it easier to connect to a remote computer.

**1973** FTP (file transfer protocol) is introduced, standardizing the transfer of files between networked computers.



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## 1970'S

1972 Ray Tomlinson (BBN) writes basic email message send and read software (March) Larry Roberts writes first email utility to list, selectively read, file, forward, and respond to messages (July)

1973 Bob Metcalfe's Harvard Ph.D. Thesis outlines idea for Ethernet.

1976 Elizabeth II, Queen of the United Kingdom sends out an e-mail (various Net folks have e-mailed dates ranging from 1971 to 1978)

UUCP (Unix-to-Unix Copy) developed at AT&T Bell Labs and distributed with UNIX one year later.



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## 1980's

1981 BITNET, the "Because It's Time NETWORK" Started as a cooperative network at the City University of New York, with the first connection to Yale.

CSNET (Computer Science NETWORK) built by a collaboration of computer scientists and University of Delaware, Purdue University, University of Wisconsin, RAND Corporation and BBN through seed money granted by NSF to provide networking services (especially email) to university scientists with no access to ARPANET.



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## 1980's

- 1983 Name server developed at Univ of Wisconsin, no longer requiring users to know the exact path to other systems.

- Internet Activities Board (IAB) established, replacing ICCB

- Berkeley releases 4.2BSD incorporating TCP/IP.

- EARN (European Academic and Research Network) established. Very similar to the way BITNET works with a gateway funded by IBM. FidoNet developed by Tom Jennings.

- 1984 Domain Name System (DNS) introduced. Number of hosts breaks 1,000

- JUNET (Japan Unix Network) established using UUCP.



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## 1980's

- 1983 The TCP/IP suite of networking protocols, or rules, becomes the only set of protocols used on the ARPANET. This decision sets a standard for other networks, and generates the use of the term "Internet" as the network of networks which either use the TCP/IP protocols or are able to interact with TCP/IP networks.

- To keep military and non-military network sites separate, the ARPANET splits into two networks: ARPANET and MILNET.



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## 1980's Continued..

- In 1982 and 1983, the first desktop computers began to appear. Many are equipped with an operating system called Berkeley UNIX, which includes networking software. This allows for relatively easy connection to the Internet using telnet.

- The personal computer revolution continues through the eighties, making access to computer resources and networked information increasingly available to the general public.



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## 1980's Continued..

**1985-86:** The National Science Foundation (NSF) connects the nation's six supercomputing centers together. This network is called the NSFNET, or NSFNET backbone.

To expand access to the Internet, the NSF supported the development of regional networks, which were then connected to the NSFNET backbone. In addition, the NSF supported institutions, such as universities, in their efforts to connect to the regional networks.

Here is a diagram of the NSF backbone, as it appeared in



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## 1980's

•1987 - The NSF awards a grant to Merit Network, Inc. to operate and manage future development of the NSFNET backbone. Merit Network, Inc. collaborates with IBM and MCI to research and develop faster networking technologies.

•1988 2 November - Internet worm burrows through the Net, affecting ~6,000 of the 60,000 hosts on the Internet.

•1989 - The backbone network is upgraded to "T1" from 56Kbps which means that it is able to transmit data at speeds of 1.5 million bits of data per second, or about 50 pages of text per second.



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## 1990's

1990 - The ARPANET is dissolved.

1991 - Gopher is developed at the University of Minnesota. Gopher provides a hierarchical, menu-based method for providing and locating information on the Internet. This tool makes using the Internet much easier.

1992 - Internet Society (ISOC) is chartered  
Number of hosts breaks 1,000,000

1993 - The European Laboratory for Particle Physics in Switzerland (CERN) releases the World Wide Web (WWW), developed by Tim Berners-Lee. The WWW uses hypertext transfer protocol (HTTP) and hypertext links, changing the way information can be organized, presented and accessed on the Internet.



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## 1990's

1993 - The NSFNET backbone network is upgraded to "T3" which means that it is able to transmit data at speeds of 45 million bits of data per second, or about 1400 pages of text per second.

1993-1994 - The graphical web browsers Mosaic and Netscape Navigator are introduced and spread through the Internet community. Due to their intuitive nature and graphical interface, these browsers make the WWW and the Internet more appealing to the general public.

• 1995 - The NSFNET backbone is replaced by a new network architecture, called vBNS (very high speed backbone network system) that utilizes Network Service Providers, regional networks and Network Access Points (NAPs).



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## 1995

1995 - RealAudio, an audio streaming technology, lets the Net hear in near real-time

1995 Radio HK, the first commercial 24 hr., Internet-only radio station starts broadcasting

Technologies of the Year: WWW, Search engines

Emerging Technologies: Mobile code (JAVA, JavaScript), Virtual environments (VRML), Collaborative tools



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## 1996

ISP Meltdown: AOL (19 hours), Netcom (13 hours), AT&T WorldNet (28 hours - email only)

New York's Public Access Networks Corp (PANIX) is shut down after repeated SYN attacks by a cracker using methods outlined in a hacker magazine (2600)

Various US Government sites are hacked into and their content changed, including CIA, Department of Justice, Air Force  
MCI upgrades Internet backbone adding ~13,000 ports, bringing the effective speed from 155Mbps to 622Mbps.

Technologies of the Year: Search engines, JAVA, Internet Phone



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## 1997

2000th RFC: "Internet Official Protocol Standards"

The American Registry for Internet Numbers (ARIN) is established to handle administration and registration of IP numbers to the geographical areas currently handled by Network Solutions (InterNIC), starting March 1998.

Longest hostname registered with InterNIC:  
CHALLENGER.MED.SYNAPSE.UAH.

Technologies of the Year: Push, Multicasting  
Emerging Technologies: Push, Streaming Media.



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## 1998

Electronic postal stamps become a reality, with the US Postal Service allowing stamps to be purchased and downloaded for printing from the Web

Network Solutions registers its 2 millionth domain on 4 May.

San Francisco sites without off-city mirrors go offline as the city blacks out on 8 December.

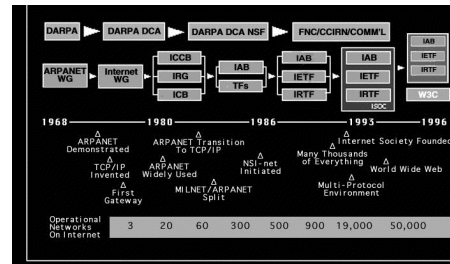
Technologies of the Year: E-Commerce, E-Auctions, Portals  
Emerging Technologies: E-Trade, XML.



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## Summary



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## Research Frontier

73

## Comments

- One of the better kept secrets of the Web is that hypertext markup language, universally known as HTML, is pretty dumb. There's a better option ready to debut: eXtensible Markup Language, or XML. The fatal flaw in HTML is that it has no attributes for handling the business world's complex and endless demands for searching the Web. HTML makes Web pages easy for humans to read but hard for search engines to decipher in a meaningful way, particularly the pinpoint culling of information to the specifications of demanding Web surfers who want 10 highly specific references, not 150,000 random keyword references.
  - Telecomm Magazine on 10 hottest technology of 1998, May 1998



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## Growing Security Concerns

Security (CERT) Incidents:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
Incidents	1	6	132	252	406	773	1334	2340	2412	2573	2134	2497
Advisories	1	1	7	12	23	21	19	15	18	27	28	12
Vulnerabilities	1								171	345	311	200



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## Online Shopping

In the last two months of 1998, 44 percent of US households shopped online, spending an estimated 3.14 billion, almost a billion dollars more than had been predicted before Christmas. The findings are based on a survey of 2,300 online households in the US. It was conducted in conjunction with NFO Interactive.

The three most cited reasons for consumer dissatisfaction were lack of merchandise availability, 15 percent, additional shipping and handling costs, 14 percent, and slow site performance, 13 percent. Jupiter advises merchants that the newer mass market online consumer is far less tolerant of business and technical shortcomings than the early Net shopper.



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## Portals

Jul 22 1998: Patrick Meehan, research director with Gartner Group has predicted that by the year 2000, Internet portals will be analogous to the major broadcast networks of today.

The use of portals is expected to explode over the coming years and Gartner have identified five clear leaders in the portal market by the year 2000.

According to Meehan, Yahoo! will emerge as the leader. In second and third place will be the new Disney-Infoseek portal and the NBC-Snap portal. In fourth place would be Netscape's Netcenter and in fifth Liberty Media.



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## Peer-to-Peer Systems

Now the largest contributor in Internet traffic!



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