

# Timeline of Electronic Communications

Seminal events in red.

- 1833 Telegraph: Carl Friedrich Gauss and Wilhelm Weber, Göttingen Germany.
- 1837 Samuel Morse, the telegraph in the USA and Mores Code.
- 1867 American, Sholes the first successful and modern typewriter.
- 1876 Alexander Graham Bell patents the electric telephone.
- 1877 Thomas Edison patents the phonograph - with a wax cylinder as recording medium.
- 1887 Emile Berliner invents the gramophone - a system of recording which could be used over and over again.
- 1888 George Eastman patents Kodak roll film camera.
- 1894 Guglielmo Marconi improves wireless telegraphy.
- 1902 Guglielmo Marconi transmits radio signals from Cornwall to Newfoundland - the first radio signal across the Atlantic Ocean.
- 1906 Lee DeForest invents the electronic amplifying tube or triode - this allowed all electronic signals to be amplified improving all electronic communications
- 1923 The television or iconoscope (cathode-ray tube) invented by Vladimir Kosma Zworykin - first television camera.
- 1939 Scheduled television broadcasts begin.
- 1944 Barton Phillips born April 11.  
Computers put into public service - government owned - the age of Information Science begins.
- 1948 Transistor invented - enabling the miniaturization of electronic devices.
- 1948-1950 Cable TV and subscription TV services.
- 1950-1961 Development of T-1 transmission lines by Bell Labs.
- 1951 Computers are first sold commercially.
- 1952 CERN ("Conseil Européen pour la Recherche Nucléaire" or European Organization for Nuclear Research) founded in Switzerland.
- 1958 Integrated Circuits invented enabling the further miniaturization of electronic devices and computers.
- 1960 IBM's Generalized Markup Language (GML) precursor of SGML, precursor of HTML.  
Packet Switching: Paul Baran, Donald Davies and Leonard Kleinrock initial work.
- 1961 Host based email CTTS systems (Compatible Time-Sharing System. Big Main Fraims)
- 1964 Barton Phillips graduates from UCLA and enter the Air Force.
- 1965 DARPA (Defense Advanced Research Projects Agency) commissioned a study of decentralized switching systems.  
First demonstration net between MIT's Lincoln Lab and System Development Corporation in California (1200 bits/sec).
- 1969 ARPANET (Advanced Research Projects Agency Network) the first Internet started.  
Backbone running at 50 Kbits/sec.
- 1970 Barton Phillips returns to US from the Air Force
- 1971 The computer floppy disk invented.  
The microprocessor invented.
- 1972 Ray Tomlinson invented network email and the '@' sign.
- 1974 TCP/IP (Transmission Control Program/Internet Protocol RFC 675. Vinton Cerf, Yogen Dalal and Carl Sunshine).
- 1975 Barton Phillips bought the KIM 1 6502 Computer kit.  
Kim 1: Hex keypad, 7 segment display, 1K RAM, 8K ROM.  
Also the S100 bus Altair 8800 a Intel 8080 computer by MITS became available along with the IMSAI 8080.
- 1976 April: Barton Phillips purchased the Apple I home computer also 6502 based.

March: X.25 Network standard approved.

- 1976 October Barton Phillips joins Micropolis Corp. a floppy disk manufacture. Between 1976 and 1980 Barton wrote disk OS, Basic Interpreter, Assembler/Linker and Editor for the Micropolis products. In 1981 Micropolis stopped marketing its OS.
- 1978 X.25 provided the first international and commercial packet switching network, the "International Packet Switched Service" (IPSS).
- 1979 First cellular phone communication network started in Japan.
- 1980 Tim Berners-Lee at CERN in Switzerland developed ENQUIRE a hypertext program. He also created HTML (Hyper Text Markup Language).
- 1981 IBM PC first sold. First laptop computers sold to public.
- 1982 SMTP (Simple Mail Transport Protical) RFC 821.
- 1983 Time magazines names the computer as "Man of the Year."  
Also Ethernet, which was introduced in 1980 was standardized IEEE 802.3.
- 1984 Apple Macintosh released. IBM PC AT released.  
ARPANET backbone via T-1 at 1.5 Mbits/sec.  
POP1 (Post Office Protical 1) RFC 918.
- 1986 IMAP (Internet Mail Access Protocol) was designed by Mark Crispin RFC 1064.  
SGML (Standard Generalized Markup Language) ISO 8879:1986.
- 1988 ADSL (asymmetric digital subscriber line) patented.  
POP3 RFC 1081 (the current standard)
- 1998 Tim Berners-Lee coined "World Wide Web or WWW" again at CERN.
- 1990 HTTP (Hyper Text Transport Protical),  
HTML (Huper Text Markup Protical), first server (CERN httpd) and the first browser all created by Tim Berners-Lee and Robert Cailliau all running on a NeXT computer.  
Nicola Pellow created a browser that could run on almost all computers called the "Line Mode Browser".  
URL of first web site: <http://info.cern.ch>
- 1991 January first HTTP server outside of CERN was activated.  
Comercial restriction on Internet lifted. Backbone via T-3 at 45 Mbits/sec.  
Gopher web protical by Mark McCahill, Farhad Anklesaria, Paul Lindner, Daniel Torrey, and Bob Alberti of the University of Minnesota released.
- 1992 April Erwise first graphical browser available for systems other than the NeXT computer.
- 1993 WWW (World Wide Web).  
January 50 web servers in the world.  
October 500 web servers in the world.  
Mosaic web browser released by National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign (UIUC), led by Marc Andreessen. Funding for Mosaic came from the "High-Performance Computing and Communications Initiative", a funding program initiated by then Senator Al Gore's "High Performance Computing and Communication Act" of 1991 also known as the Gore Bill. June: Cello by Thomas R. Bruce was the first browser for Microsoft Windows.  
August: The NCSA released Mac Mosaic and WinMosaic.
- 1994 Private sector assumes responsibility for the Internet. Backbone via ATM at 145 Mbits/sec  
April: Netscape founder by Mark Andreessen and James H. Clark. Netscape Navigator born.  
Amazon founded.
- 1995 HTML 2.0 published as IETF RFC 1866.
- 1996 Cable Internet. Rogers Communications introduced the first cable modem service in Canada.  
January: Google started as a research project by Larry Page and Sergey Brin at Stanford University.
- 1997 HTML 3.2 published as a W3C Recommendation.
- 1998 September Google incorporated.

HTML 4.0 published as a W3C Recommendation.

- 1999-2001 "Dot Com" Boom, then bust.
- 2001 January: Wikipedia launched.
- 2004 February: Facebook launched.
- 2005 YouTube launched.
- 2006 SONET OC768 40 Gbit/sec optical fiber.

Theoretical Limit to fiber optical cable is one terabit or one trillion bits per second.

- 2008 January: HTML5 was published as a Working Draft by the W3C.  
On October 23, 2008, AT&T announced the completion of upgrades to OC-768 on 80,000 fiber-optic wavelength miles of their IP/MPLS (Multiprotocol Label Switching) backbone network.
- 2012 December: W3C designated HTML5 as a Candidate Recommendation.
- 2014 The W3C (World Wide Web Consortium) plans to finalize the HTML 5 standard by July.

## Transmission speeds

- Mid-1980's: LAN (Local Area Network: Ethernet, Token Ring) 10-100 Mbits/sec.  
WAN (Wide Area Network: modems, T-1) 300-2400 bits/sec to 1.5 Mbits/sec.
- 1990's: WAN (T-1, ADSL, T-3) 1.5
- 2000's: Async cable: downstream: 200-400 Mbits/sec, upstream: 384 Kbits/sec to 20 Mbits/sec.
- In 2000 there were just under 150 million dial-up subscriptions in the 34 OECD (Organisation for Economic Co-operation and Development) countries and fewer than 20 million broadband subscriptions.
- By 2004, broadband had grown and dial-up had declined so that the number of subscriptions were roughly equal at 130 million each.
- In 2010, in the OECD countries, over 90% of the Internet access subscriptions used broadband, broadband had grown to more than 300 million subscriptions, and dial-up subscriptions had declined to fewer than 30 million.

## Making the Connections

The ARPANET, predecessor to the Internet, started with an inspiring vision of a "galactic" network, practical theory about packet switching, and a suite of standardized protocols. But none of this would have mattered if there hadn't also been a way to make and maintain connections.

Author Ronda Hauben described some of the early concerns about network transmission quality this way:

In 1966-67 Lincoln Labs in Lexington, Massachusetts, and SDR in Santa Monica, California, got a grant from the DOD to begin research on linking computers across the continent. Larry Roberts, describing this work, explains,

"Convinced that it was a worthwhile goal, we set up a test network to see where the problems would be. Since computer time-sharing experiments at MIT (CTSS) and Dartmouth (DTSS) had demonstrated that it was possible to link different computer users to a single computer, the cross country experiment built on this advance." (i.e. Once timesharing was possible, the linking of remote computers was also possible.) Roberts reports that there was no trouble linking dissimilar computers. The problems, he claims, were with the telephone lines across the continent, i.e. that the throughput was inadequate to accomplish their goals."

Packet switching resolved many of the issues identified during the pre-ARPANET, time-sharing

experiments. But, higher-speed phone circuits also helped. The first wide area network demonstrated in 1965 between computers at MIT's Lincoln Lab, ARPA's facilities, and the System Development Corporation in California utilized dedicated 1200 bps circuits. Four years later, when the ARPANET began operating, 50 Kbps circuits were used. But, it wasn't until 1984 that ARPANET traffic levels were such that it became more cost-effective to lease T1 lines (1.5 Mbps) than to continue using multiple 50 Kbps lines.

## **From Tim Berners-Lee's first message (web page):**

"The World Wide Web (WWW) project aims to allow all links to be made to any information anywhere. [...] The WWW project was started to allow high energy physicists to share data, news, and documentation. We are very interested in spreading the web to other areas, and having gateway servers for other data. Collaborators welcome!"

1973, Vinton Cerf, the developer of the existing ARPANET Network Control Program (NCP) protocol, joined Kahn to work on open-architecture interconnection models with the goal of designing the next protocol generation for the ARPANET.

By the summer of 1973, Kahn and Cerf had worked out a fundamental reformulation, in which 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 Zimmermann and Louis Pouzin, designer of the CYCLADES network, with important influences on this design.

## **Circuit Switching vs. Packet Switching:**

Packet switching contrasts with another principal networking paradigm, circuit switching, a method which sets up a limited number of dedicated connections of constant bit rate and constant delay between nodes for exclusive use during the communication session.

Circuit switching is a methodology of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes may communicate. The circuit guarantees the full bandwidth of the channel and remains connected for the duration of the communication session. The circuit functions as if the nodes were physically connected as with an electrical circuit.

Circuit switching contrasts with packet switching which divides the data to be transmitted into packets transmitted through the network independently. In packet switching, instead of being dedicated to one communication session at a time, network links are shared by packets from multiple competing communication sessions, resulting in the loss of the quality of service guarantees that are provided by circuit switching.

<http://www.packet.cc/files/ev-packet-sw.html>