http://www.netvalley.com/archives/mirrors/index_files/xcorner_small.jpg

**History of the Internet**

This section is a summary of some of the material contained in [Hobbes' Internet Timeline](http://info.isoc.org/guest/zakon/Internet/History/HIT.html) and also contains sources from [Pros Online - Internet History](http://www.prosonline.com/proshome/inthis1.htm#most), [What is the Internet?](http://www.netvalley.com/archives/mirrors/davemarsh-timeline-1.htm) and [History of Internet and WWW : View from NetValley](http://www.netvalley.com/intval.html) and a variety of text books. Consult these source for more detailed information.

**1836** -- **Telegraph**. Cooke and Wheatstone patent it. Why is this relevant?

* Revolutionised human (tele)communications.
* Morse Code: a series of dots and dashes used to communicate between humans. This is not a million miles away from how computers communicate via (binary 0/1) data today. Although it is much slower!!

**1858-1866** -- **Transatlantic cable**.

* Allowed direct instantaneous communication across the atlantic. Why is this relevant?
* Today, cables connect all continents and are still a main hub of telecommunications.

**1876** -- **Telephone**. Alexander Graham Bell Exhibits. Why is this relevant?

* Telephones exchanges provide the backbone of Internet connections today.
* Modems provide Digital to Audio conversions to allow computers to connect over the telephone network.

**1957** -- **USSR launches Sputnik**, first artificial earth satellite. Why is this relevant?

* The start of global telecommunications. Satellites play an important role in transmitting all sorts of data today.
* 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.

**1962 – 1968** -- **Packet-switching (PS) networks developed** Why is this relevant?

* As we will see later the Internet relies on packets to transfer data.
* The origin is military : for utmost security in transferring information of networks (*no single outage point*).
* Data is split into tiny packets that may take different routes to a destination.
* Hard to eavesdrop on messages.
* More than one route available -- if one route goes down another may be followed.
* Networks can withstand large scale destruction (Nuclear attack - This was the time of the Cold War).

**1969** -- **Birth of Internet**

ARPANET commissioned by DoD for research into networking. Why is this relevant?

* First node at UCLA (Los Angeles) closely followed by nodes at Stanford Research Institute, UCSB (Santa Barbara) and U of Utah (4 Nodes).

**1971** -- **People communicate over a network**

* 15 nodes (23 hosts) on ARPANET.
* E-mail invented -- a program to send messages across a distributed network. Why is this relevant?
  + E-mail is still the main way of inter-person communication on the Internet today.
  + We will study how to use and send E-mail shortly in this course.
  + You will make extensive use of E-mail for the rest of your life.

**1972** -- **Computers can connect more freely and easily**

* First public demonstration of ARPANET between 40 machines.
* Internetworking Working Group (INWG) created to address need for establishing agreed upon protocols. Why is this relevant?
  + Telnet specification
  + Telnet is still a relevant means of inter-machine connection today.

**1973** -- **Global Networking becomes a reality**

* First international connections to the ARPANET: University College of London (England) and Royal Radar Establishment (Norway)
* Ethernet outlined -- this how local networks are basically connected today.
* Internet ideas started.
* Gateway architecture sketched on back of envelope in hotel lobby in San Francisco. Gateways define how large networks (maybe of different architecture) can be connected together.
* File Transfer protocol specified -- how computers send and receive data.

**1974** -- **Packets become mode of transfer**

* Transmission Control Program (TCP) specified. Packet network Intercommunication -- the basis of Internet Communication.
* Telenet, a commercial version of ARPANET, opened -- the first public packet data service.

**1976** -- **Networking comes to many**

* Queen Elizabeth sends out an e-mail.
* UUCP (Unix-to-Unix CoPy) developed at AT&T Bell Labs and distributed with UNIX. Why is this relevant?
  + UNIX was and still is the main operating system used by universities and research establishments.
  + These machines could now ``talk'' over a network.
  + Networking exposed to many users worldwide.

**1977** -- **E-mail takes off, Internet becomes a reality**

* Number of hosts breaks 100.
* THEORYNET provides electronic mail to over 100 researchers in computer science (using a locally developed E-mail system and TELENET for access to server).
* Mail specification
* First demonstration of ARPANET/Packet Radio Net/SATNET operation of Internet protocols over gateways.

**1979** -- **News Groups born**

* Computer Science Department research computer network established in USA.
* USENET established using UUCP. Why is this relevant?
  + USENET still thrives today.
  + A collection of discussions groups, *news groups*.
  + 3 news groups established by the end of the year
  + Almost any topic now has a discussion group.
* First MUD (Multiuser Dungeon) -- interactive multiuser sites. Interactive adventure games, board games, rich and detailed databases.
* ARPA establishes the Internet Configuration Control Board (ICCB).
* Packet Radio Network (PRNET) experiment starts with ARPA funding. Most communications take place between mobile vans.

**1981** -- **Things start to come together**

* 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
  + Provides electronic mail and listserv servers to distribute information, as well as file transfers
* CSNET (Computer Science NETwork) established to provide networking services (specially E-mail) to university scientists with no access to ARPANET. CSNET later becomes known as the Computer and Science Network.

**1982** -- **TCP/IP defines future communication**

* DCA and ARPA establishes the Transmission Control Protocol (TCP) and Internet Protocol (IP), as the protocol suite, commonly known as TCP/IP, for ARPANET. Why is this relevant?
  + Leads to one of the first definitions of an *internet* as a connected set of networks, specifically those using TCP/IP, and *Internet* as connected TCP/IP internets.
* EUnet (European UNIX Network) is created by EUUG to provide E-mail and USENET services. Original connections between the Netherlands, Denmark, Sweden, and UK
* External Gateway Protocol specification -- EGP is used for gateways between (different architecture) networks.

**1983** -- **Internet gets bigger**

* Domain Name Server developed. Why is this relevant?
  + Large number of nodes.
  + Hard to remember exact paths
  + Use meaningful names instead.
* Desktop workstations come into being. Why is this relevant?
  + Many with Berkeley UNIX which includes IP networking software.
  + Need switches from having a single, large time sharing computer connected to Internet per site, to connection of an entire local network.
* Internet Activities Board (IAB) established, replacing ICCB
* Berkeley releases new version of UNIX 4.2BSD incorporating TCP/IP.
* EARN (European Academic and Research Network) established on similar lines to BITNET

**1984** -- **Growth of Internet Continues**

* Number of hosts breaks 1,000.
* Domain Name Server (DNS) introduced.
  + instead of 123.456.789.10
  + it is easier to remember something like

www.myuniversity.mydept.mynetwork.mycountry

( *e.g.* www.cs.cf.ac.uk).

* JANET (Joint Academic Network) established in the UK
* Moderated newsgroups introduced on USENET.

**1986** -- **Power of Internet Realised**

* 5, 000 Hosts. 241 News groups.
* NSFNET created (backbone speed of 56 Kbps)
* NSF establishes 5 super-computing centers to provide high-computing power for all -- This allows an explosion of connections, especially from universities.
* Network News Transfer Protocol (NNTP) designed to enhance Usenet news performance over TCP/IP.

**1987** -- **Commercialisation of Internet Born**

* Number of hosts 28,000.
* UUNET is founded with Usenix funds to provide commercial UUCP and Usenet access.

**1988**

* NSFNET backbone upgraded to T1 (1.544 Mbps)
* Internet Relay Chat (IRC) developed

**1989** -- **Large growth in Internet**

* Number of hosts breaks 100,000
* First relays between a commercial electronic mail carrier and the Internet
* Internet Engineering Task Force (IETF) and Internet Research Task Force (IRTF) comes into existence under the IAB

**1990** -- **Expansion of Internet continues**

* 300,000 Hosts. 1,000 News groups
* ARPANET ceases to exist
* Archie released files can be searched and retrieved (FTP) by name.
* The World comes on-line (world.std.com), becoming the first commercial provider of Internet dial-up access.

**1991** -- **Modernisation Begins**

* Commercial Internet eXchange (CIX) Association, Inc. formed after NSF lifts restrictions on the commercial use of the Net.
* Wide Area Information Servers (WAIS) Why is relevant?
  + Provides a mechanism for indexing and accessing information on the Internet.
  + Large bodies of knowledge available: E-mail messages, text, electronic books, Usenet articles, computer code, image, graphics, sound files, databases *etc.*.
  + These form the basis of the index of information we see on WWW today.
  + Powerful search techniques implemented. Keyword search.

-- **Friendly User Interface to WWW established**

* Gopher released by Paul Lindner and Mark P. McCahill from the U of Minnesota. Why is relevant?
  + Text based, menu-driven interface to access internet resources.
  + No need to remember or even know complex computer command. User Friendly Interface (?).
  + Largely superseded by WWW, these days.

 -- **Most Important development to date**

* World-Wide Web (WWW) released by CERN; Tim Berners-Lee developer. Why is relevant?
  + Originally developed to provide a distributed hypermedia system.
  + Easy access to any form of information anywhere in the world.
  + Initially non-graphic (this came later, MOSAIC, 1993).
  + Revolutionised modern communications and even our, way of life (?).
* NSFNET backbone upgraded to T3 (44.736 Mbps). NSFNET traffic passes 1 trillion bytes/month and 10 billion packets/month
* Start of JANET IP Service (JIPS) using TCP/IP within the UK academic network.

**1992** -- **Multimedia changes the face of the Internet**

* Number of hosts breaks 1 Million. News groups 4,000
* Internet Society (ISOC) is chartered.
* First MBONE audio multicast (March) and video multicast (November).
* The term "Surfing the Internet" is coined by Jean Armour Polly.

**1993** -- **The WWW Revolution truly begins**

* Number of Hosts 2 Million. 600 WWW sites.
* InterNIC created by NSF to provide specific Internet services
  + directory and database services
  + registration services
  + information services
* Business and Media really take notice of the Internet.
* US White House and United Nations (UN) comes on-line.
* Mosaic takes the Internet by storm. Why is this relevant?
  + User Friendly Graphical Front End to the World Wide Web.
  + Develops into Netscape -- most popular WWW browser to date.
  + WWW proliferates at a 341,634

**1994** -- **Commercialisation begins**

* Number of Hosts 3 Million. 10,000 WWW sites. 10,000 News groups.
* ARPANET/Internet celebrates 25th anniversary
* Local communities begin to be wired up directly to the Internet (Lexington and Cambridge, Mass., USA)
* US Senate and House provide information servers
* Shopping malls, banks arrive on the Internet
  + A new way of life
  + You can now order pizza from the Hut online in the US.
  + First Virtual, the first cyberbank, open up for business
* NSFNET traffic passes 10 trillion bytes/month
* WWW edges out telnet to become 2nd most popular service on the Net (behind ftp-data) based on % of packets and bytes traffic distribution on NSFNET
* UK's HM Treasury on-line (http://www.hm-treasury.gov.uk/)

**1995** -- **Commercialisation continues**

* 6.5 Million Hosts, 100,000 WWW Sites.
* NSFNET reverts back to a research network. Main US backbone traffic now routed through interconnected network providers
* WWW surpasses ftp-data in March as the service with greatest traffic on NSFNet based on packet count, and in April based on byte count
* Traditional online dial-up systems (Compuserve, America Online, Prodigy) begin to provide Internet access
* A number of Net related companies go public, with Netscape leading the pack.
* Registration of domain names is no longer free.
* Technologies of the Year: WWW, Search engines (WAIS development).
* New WWW technologies Emerge Technologies
  + Mobile code (JAVA, JAVAscript, ActiveX),
  + Virtual environments (VRML),
  + Collaborative tools (CU-SeeMe)

**1996** -- **Microsoft enters**

* 12.8 Million Hosts, 0.5 Million WWW Sites.
* Internet phones catch the attention of US telecommunication companies who ask the US Congress to ban the technology (which has been around for years)
* The WWW browser war begins , fought primarily between Netscape and Microsoft, has rushed in a new age in software development, whereby new releases are made quarterly with the help of Internet users eager to test upcoming (beta) versions.

**1997** --

* 19.5 Million Hosts, 1 Million WWW sites, 71,618 Newsgroups.

*dave@cs.cf.ac.uk*

**The Internet: Computer Network Hierarchy**

Every computer that is connected to the Internet is part of a network, even [the one in your home](http://www.howstuffworks.com/home-network.htm). For example, you may use a [modem](http://www.howstuffworks.com/modem.htm) and dial a local number to connect to an **Internet Service Provider** (ISP). At work, you may be part of a **local area network** ([LAN](http://www.howstuffworks.com/lan-switch.htm)), but you most likely still connect to the Internet using an ISP that your company has contracted with. When you connect to your ISP, you become part of their network. The ISP may then connect to a larger network and become part of their network. The Internet is simply a network of networks.

Most large communications companies have their own dedicated backbones connecting various regions. In each region, the company has a **Point of Presence** (POP). The POP is a place for local users to access the company's network, often through a local phone number or dedicated line. The amazing thing here is that there is no overall controlling network. Instead, there are several high-level networks connecting to each other through **Network Access Points** or NAPs.

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| http://static.howstuffworks.com/gif/internet-infrastructure1.gif **When you connect to the Internet, your computer** |

<http://computer.howstuffworks.com/internet-infrastructure3.htm>

**Internet Backbone**

The **National Science Foundation** (NSF) created the first high-speed backbone in 1987. Called **NSFNET**, it was a [T1 line](http://computer.howstuffworks.com/question372.htm) that connected 170 smaller networks together and operated at 1.544 Mbps (million [bits](http://www.howstuffworks.com/bytes.htm) per second). IBM, MCI and Merit worked with NSF to create the backbone and developed a T3 (45 Mbps) backbone the following year.

Backbones are typically fiber optic trunk lines. The trunk line has multiple fiber optic cables combined together to increase the capacity. Fiber optic cables are designated OC for optical carrier, such as OC-3, OC-12 or OC-48. An OC-3 line is capable of transmitting 155 Mbps while an OC-48 can transmit 2,488 Mbps (2.488 Gbps). Compare that to a typical 56K modem transmitting 56,000 bps and you see just how fast a modern backbone is.

Internet Protocol Addresses

<http://computer.howstuffworks.com/internet-infrastructure5.htm>

<http://www.howstuffworks.com/question549.htm>

**Internet Protocol: Domain Name System**

When the Internet was in its infancy, it consisted of a small number of computers hooked together with modems and telephone lines. You could only make connections by providing the IP address of the computer you wanted to establish a link with. For example, a typical IP address might be 216.27.22.162. This was fine when there were only a few hosts out there, but it became unwieldy as more and more systems came online.

The first solution to the problem was a simple text file maintained by the Network Information Center that mapped names to IP addresses. Soon this text file became so large it was too cumbersome to manage. In 1983, the University of Wisconsin created the **Domain Name System** (DNS), which maps text names to IP addresses automatically. This way you only need to remember [www.howstuffworks.com](http://computer.howstuffworks.com/index.htm), for example, instead of HowStuffWorks.com's IP address.

Every name in the .COM top-level domain must be unique. The left-most word, like www, is the host name. It specifies the name of a specific machine (with a specific IP address) in a domain. A given domain can, potentially, contain millions of host names as long as they are all unique within that domain.

DNS servers accept requests from programs and other name servers to convert domain names into IP addresses. When a request comes in, the DNS server can do one of four things with it:

1. It can answer the request with an IP address because it already knows the IP address for the requested domain.
2. It can contact another DNS server and try to find the IP address for the name requested. It may have to do this multiple times.
3. It can say, "I don't know the IP address for the domain you requested, but here's the IP address for a DNS server that knows more than I do."
4. It can return an error message because the requested domain name is invalid or does not exist.

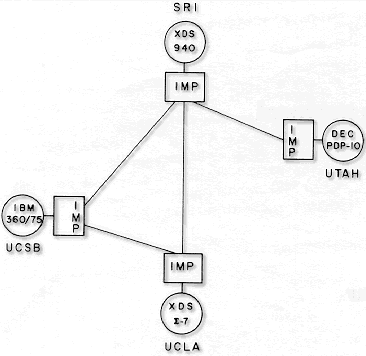
DNS

<http://www.howstuffworks.com/dns.htm>

**1969**: The first **LOG***s*: **UCLA -- Stanford**

According to[**Vinton Cerf**](http://www.netvalley.com/archives/mirrors/cerf-how-inet.txt):   
...the **UCLA** people proposed to **DARPA** to organize and run a *Network Measurement Center* for the **ARPANET** project...

Around *Labor Day* in **1969**, BBN delivered an Interface Message Processor (IMP) to **UCLA** that was based on a Honeywell DDP 516, and when they turned it on, it just started running. It was hooked by 50 Kbps circuits to **two** other sites (**SRI** and **UCSB**) in the ***four****-node* network: **UCLA**, **Stanford** Research Institute (SRI), UC **Santa Barbara** (UCSB), and the University of **Utah** in Salt Lake City.



The plan was unprecedented: **Kleinrock**, a pioneering computer science professor at **UCLA**, and his small group of graduate students hoped to **log** onto the **Stanford** computer and try to send it some data.They would start by typing *"login,"* and seeing if the letters appeared on the far-off monitor.

ARPA chose the initial computer sites based on pre-existing research relationships with the United States government. Each site had its own team of engineers responsible for connecting the site computer to the ARPANET. The four host computers in the initial ARPANET structure included:

* UCLA's university computer, which was an **SDS Sigma 7** running on the Sigma Experimental [operating system](http://computer.howstuffworks.com/operating-system.htm)
* Stanford Research Institute's **SDS-90 Computer**, which ran on the Genie operating system
* an **IBM 360/75** running on the OS/MVT operating system at the University of California's Culler-Fried Interactive Mathematics center
* a **DEC PDP-10** computer with the Tenex operating system at the University of Utah

In August 1969, the UCLA team hooked up its host computer to an IMP, a **Honeywell DDP 516** computer, making it the first of the four sites to connect into ARPANET. Within a few days, the two computers could exchange information. In October, Stanford's team added the second IMP and host to the system. At 10:30 p.m. on October 29, the Stanford and UCLA computers communicated with each other over a 50 kilobit per second (kbps) phone line.

On the first attempt, the system crashed before UCLA could send a complete command to the Stanford computer. Fortunately, everything worked on the second try. The other two host computers joined the network before the end of 1969. For the first time, scientists could harness the power of multiple computers in remote locations.

In 1973, Robert Kahn initiated an experiment with a technique he called **internetting** -- combining two or more separate networks into a larger network. He began to look into ways to integrate ARPANET with the **Defense Advanced Research Projects Agency's** (**DARPA**) **Packet Radio Network**, which was a network that used [radio](http://electronics.howstuffworks.com/radio.htm) waves to send data from one computer to another.

Other ARPANET networks began to go live, including **USENET**, **Ethernet**, **CSNET** and **BITNET**. The ARPANET Request for Comments 827 established an **External Gateway Protocol** that made it possible for separate networks to access each other, even though access to ARPANET was still restricted for official use. In 1983, the military section of ARPANET split off from the network; its only connection to the larger network was a few [e-mail](http://communication.howstuffworks.com/email.htm) gateways. The military renamed its smaller network **MILNET**, which would later become part of the Department of Defense Data Network (DDN) [source: [Living Internet](http://howstuffworks.com/framed.htm?parent=arpanet.htm&url=http://www.livinginternet.com/i/ii_arpanet.htm)].

In 1986, five supercomputer centers formed a network called **NSFNET**. Before long, NSFNET grew to include several universities in its network. Other networks began to consolidate into larger systems. People referred to this larger collection of networks and gateways as the **Internet**. While the era of the [personal computer](http://computer.howstuffworks.com/pc.htm) began in the late 1970s, the Internet still remained a resource for universities, corporations and the government.

ARPANET's infrastructure was beginning to show its age. The system's IMPs weren't as efficient or powerful as the computer nodes in other networks. Organizations on ARPANET began to transition to other networks, mainly NSFNET. In 1990, DARPA pulled the plug on the ARPANET project. The organization's goals had been met. The United States had a nationwide computer network that not only linked powerful resources together, but also could continue operating if a significant portion of the network stopped working. Even more impressive, this network now spanned the globe, connecting computers from one side of the world to the other.

As the Internet evolves, these protocols must also change. That means someone has to be in charge of the rules. There are several organizations that oversee the [Internet's infrastructure](http://computer.howstuffworks.com/internet-infrastructure.htm) and protocols. They are:

* **The Internet Society**: A nonprofit organization that develops Internet standards, policies and education.
* **The Internet Engineering Task Force** (**IETF**): An international organization with an open membership policy that has several **working groups**. Each working group concentrates on a specific topic, such as Internet security. Collectively, these working groups try to maintain the Internet's architecture and stability.
* **The Internet Architecture Board** (**IAB**): An IETF committee, the IAB's mission is to oversee the design of Internet protocols and standards.
* **The Internet Corporation for Assigned Names and Numbers** (**ICANN**): A private nonprofit corporation, ICANN manages the Internet's [**Domain Name System**](http://computer.howstuffworks.com/dns.htm) (**DNS**). ICANN is responsible for making sure that every domain name links to the correct **IP address**.

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The Internet Society and IETF are open membership organizations. Both welcome the participation and input of Internet experts. They shape the way the Internet works and evolves.

ICANN, on the other hand, is a private organization. The exclusive nature of ICANN concerns some people. They argue that ICANN holds a lot of power over anyone who wants to register a domain name. ICANN makes money by accrediting vendors called **registrars**. These registrars then sell domain names to consumers and businesses. If you want to register a specific domain name, ultimately ICANN decides if you can have it.

But the creation of the World Wide Web didn't come until decades later, with the help of a man named Tim Berners-Lee. In 1990, he developed the backbone of the World Wide Web -- the **hypertext transfer protocol** (**HTTP**). People quickly developed **browsers** which supported the use of HTTP and with that the popularity of computers skyrocketed. In the 20 years during which ARPANET ruled the Internet, the worldwide network grew from four computers to more than 300,000. By 1992, more than a million computers were connected -- only two years after HTTP was developed [source: [Computer History Museum](http://howstuffworks.com/framed.htm?parent=internet-versus-world-wide-web.htm&url=http://www.computerhistory.org/internet_history/)].

You might be wondering at this point what exactly HTTP is -- it's simply the widely used set of rules for how files and other information are transferred between computers. So what Berners-Lee did, in essence, was determine how computers would communicate with one another. For instance, HTTP would've come into play if you clicked the source link in the last paragraph or if you typed the http://www.howstuffworks.com **URL** (**uniform resource locator**) into your browser to get to our home page. But don't get this confused with Web page programming languages like **HTML** and **XHTML**. We use those to describe what's on a page, not to communicate between sites or identify a Web page's location.

Simply, the Internet is a network of networks -- and there are all kinds of networks in all kinds of sizes. You may have a [computer network](http://computer.howstuffworks.com/home-network.htm) at your work, at your school or even one at your house. These networks are often connected to each other in different configurations, which is how you get groupings such as **local area networks** ([LAN](http://computer.howstuffworks.com/lan-switch.htm)s) and **regional networks**. Your [cell phone](http://electronics.howstuffworks.com/cell-phone.htm) is also on a network that is considered part of the Internet, as are many of your other electronic devices. And all these separate networks -- added together -- are what constitute the Internet. Even satellites are connected to the Internet. To learn more about how this interwoven mega-network operates, check out [How Internet Infrastructure Works](http://computer.howstuffworks.com/internet-infrastructure.htm).

<http://computer.howstuffworks.com/internet-infrastructure.htm>