Before Google, why we need a registry and lookup

Archie

Bind

Gopher

BackRub

An anecdotal history of the people and communities that brought about the Internet and the Web[1]

(Last updated 1 September 2009)

The Internet was the result of some visionary thinking by people in the early 1960s who saw great potential value in allowing computers to share information on research and development in scientific and military fields. J.C.R. Licklider of MIT, first proposed a global network of computers in 1962, and moved over to the Defense Advanced Research Projects Agency (DARPA) in late 1962 to head the work to develop it. Leonard Kleinrock of MIT and later UCLA developed the theory of packet switching, which was to form the basis of Internet connections. Lawrence Roberts of MIT connected a Massachusetts computer with a California computer in 1965 over dial-up telephone lines. It showed the feasibility of wide area networking, but also showed that the telephone line's circuit switching was inadequate. Kleinrock's packet switching theory was confirmed. Roberts moved over to DARPA in 1966 and developed his plan for ARPANET. These visionaries and many more left unnamed here are the real founders of the Internet.

> When Senator Ted Kennedy heard in 1968 that the pioneering Massachusetts company BBN had won the ARPA contract for an "interface message processor (IMP)," he sent a congratulatory telegram to BBN for their ecumenical spirit in winning the "interfaith message processor" contract.

The Internet, then known as ARPANET, was brought online in 1969 under a contract let by the renamed Advanced Research Projects Agency (ARPA) which initially connected four major computers at universities in the southwestern US (UCLA, Stanford Research Institute, UCSB, and the University of Utah). The contract was carried out by BBN of Cambridge, MA under Bob Kahn and went online in December 1969. By June 1970, MIT, Harvard, BBN, and Systems Development Corp (SDC) in Santa Monica, Cal.

[11] http://www.walthowe.com/navnet/history.html

were added. By January 1971, Stanford, MIT's Lincoln Labs, Carnegie-Mellon, and Case-Western Reserve U were added. In months to come, NASA/Ames, Mitre, Burroughs, RAND, and the U of Illinois plugged in. After that, there were far too many to keep listing here.

Who was the first to use the Internet?
Charley Kline at UCLA sent the first packets on ARPANet as he tried to connect to Stanford Research Institute on Oct 29, 1969. The system crashed as he reached the G in LOGIN!

The Internet was designed in part to provide a communications network that would work even if some of the sites were destroyed by nuclear attack. If the most direct route was not available, routers would direct traffic around the network via alternate routes.

The early Internet was used by computer experts, engineers, scientists, and librarians. There was nothing friendly about it. There were no home or office personal computers in those days, and anyone who used it, whether a computer professional or an engineer or scientist or librarian, had to learn to use a very complex system.

Did Al Gore invent the Internet?
According to a CNN transcript of an interview with Wolf Blitzer, Al Gore said,"During my service in the United States Congress, I took the initiative in creating the Internet." Al Gore was not yet in Congress in 1969 when ARPANET started or in 1974 when the term Internet first came into use. Gore was elected to Congress in 1976. In fairness, Bob Kahn and Vint Cerf acknowledge in a paper titled Al Gore and the Internet that Gore has probably done more than any other elected official to support the growth and development of the Internet from the 1970's to the present .

E-mail was adapted for ARPANET by Ray Tomlinson of BBN in 1972. He picked the @ symbol from the available symbols on his teletype to link the username and address. The telnet protocol, enabling logging on to a remote computer, was published as a Request for Comments (RFC) in 1972. RFC's are a means of sharing developmental work throughout community. The ftp protocol, enabling file transfers between Internet sites, was published as an RFC in 1973, and from then on RFC's were available electronically to anyone who had use of the ftp protocol.

Libraries began automating and networking their catalogs in the late 1960s independent from ARPA. The visionary Frederick G. Kilgour of the Ohio College Library Center (now OCLC, Inc.) led networking of Ohio libraries during the '60s and '70s. In the mid 1970s more regional consortia from New England, the Southwest states, and the Middle Atlantic states, etc., joined with Ohio to form a national, later international, network. Automated catalogs, not very user-friendly at first, became available to the world, first through telnet or the awkward IBM variant TN3270 and only many years later, through the web. See The History of OCLC

> Ethernet, a protocol for many local networks, appeared in 1974, an outgrowth of Harvard student Bob Metcalfe's dissertation on "Packet Networks." The dissertation was initially rejected by the University for not being analytical enough. It later won acceptance when he added some more equations to it.

The Internet matured in the 70's as a result of the TCP/IP architecture first proposed by Bob Kahn at BBN and further developed by Kahn and Vint Cerf at Stanford and others throughout the 70's. It was adopted by the Defense Department in 1980 replacing the earlier Network Control Protocol (NCP) and universally adopted by 1983.

The Unix to Unix Copy Protocol (UUCP) was invented in 1978 at Bell Labs. Usenet was started in 1979 based on UUCP. Newsgroups, which are discussion groups focusing on a topic, followed, providing a means of exchanging information throughout the world . While Usenet is not considered as part of the Internet, since it does not share the use of TCP/IP, it linked unix systems around the world, and many Internet sites took advantage of the availability of newsgroups. It was a significant part of the community building that took place on the networks.

Similarly, BITNET (Because It's Time Network) connected IBM mainframes around the educational community and the world to provide mail services beginning in 1981. Listserv software was developed for this network and later others. Gateways were developed to connect BITNET with the Internet and allowed exchange of e-mail, particularly for e-mail discussion lists. These listservs and other forms of e-mail discussion lists formed another major element in the community building that was taking place.

In 1986, the National Science Foundation funded NSFNet as a cross country 56 Kbps backbone for the Internet. They maintained their sponsorship for nearly a decade, setting rules for its non-commercial government and research uses.

As the commands for e-mail, FTP, and telnet were standardized, it became a lot easier for non-technical people to learn to use the nets. It was not easy by today's standards by any means, but it did open up use of the Internet to many more people in universities in particular. Other departments besides the libraries, computer, physics, and engineering departments found ways to make good use of the nets--to communicate with colleagues around the world and to share files and resources.

While the number of sites on the Internet was small, it was fairly easy to keep track of the resources of interest that were available. But as more and more universities and organizations--and their libraries-- connected, the Internet became harder and harder to track. There was more and more need for tools to index the resources that were available.

The first effort, other than library catalogs, to index the Internet was created in 1989, as Peter Deutsch and his crew at McGill University in Montreal, created an archiver for ftp sites, which they named Archie. This software would periodically reach out to all known openly available ftp sites, list their files, and build a searchable index of the software. The commands to search Archie were unix commands, and it took some knowledge of unix to use it to its full capability.

> McGill University, which hosted the first Archie, found out one day that half the Internet traffic going into Canada from the United States was accessing Archie. Administrators were concerned that the University was subsidizing such a volume of traffic, and closed down Archie to outside access. Fortunately, by that time, there were many more Archies available.

At about the same time, Brewster Kahle, then at Thinking Machines, Corp. developed his Wide Area Information Server (WAIS), which would index the full text of files in a database and allow searches of the files. There were several versions with varying degrees of complexity and capability developed, but the simplest of these were made available to everyone on the nets. At its peak, Thinking Machines maintained pointers to over 600 databases around the world which had been indexed by WAIS. They included such things as the full set of Usenet Frequently Asked Questions files, the full documentation of working papers such as RFC's by those developing the Internet's standards, and much more. Like Archie, its interface was far from intuitive, and it took some effort to learn to use it well.

Domain Name System (DNS) History[2]

> The conclusion in this area was that the current "user@host" mailbox identifier should be extended to "user@host.domain" where "domain" could be a hierarchy of domains.
>
> - J. Postel; *Computer Mail Meeting Notes*, RFC 805; 8 Feb 1982

The Domain Name System was originally invented to support the growth of email communications on the *ARPANET*, and now supports the *Internet* on a global scale.

Alphabetic host names were introduced on the ARPANET shortly after its creation, and greatly increased usability since alphabetic names are much easier to remember than semantically meaningless numeric addresses. Host names were also useful for development of network-aware computer programs, since they could reference a constant host name without concern about changes to the physical address due to network alterations. Of course, the infrastructure of the underlying network was still based on numeric addresses, so each site maintained a "HOSTS.TXT" file that provided a mapping between host names and network addresses in a set of simple text records that could be easily read by a person or program.

It wasn't long before people realized that keeping multiple copies of the hosts file was inefficient and error-prone. Starting with a formal proposal for centralization in *Host Names On-line*, RFC 606, in December, 1973, proceeding through agreement in *Host Names On-Line*, RFC 608, and further discussions in *Comments on On-Line Host Name Service*, RFC 623, it was settled by March, 1974 with *On Line Hostnames Service*, RFC 625, that the Stanford Research Institute Network Information Center (NIC) would serve as the official source of the master hosts file.

This centralized system worked well for about a decade, approximately 1973 to 1983. However, by the early 1980's the disadvantages of centralized management of a large amount of dynamic data were becoming apparent. The hosts file was becoming larger, the rate of change was growing as the network expanded, more hosts were downloading the entire file nightly, and there were always errors that were then propagated network-wide.

[2] http://www.livinginternet.com/i/iw_dns_history.htm

Change was required, but a spark was needed.

As described in *Computer Mail Meeting Notes*, RFC 805, it was initially the need for a real-world solution to the complexity of email relaying that triggered the development of the domain concept. A group of ARPANET researchers, principles, and related parties held a meeting in January, 1982, to discuss a solution for email relaying. As described on the *email addresses* page, email was often originally sent from site to site to its destination along a path of systems, and might need to go through a half a dozen or more links that would connect at certain times of the day. For example, the following actual communication path shows individual systems separated by "!", with the destination user named "grg" tagged on at the end.

utzoo!decvax!harpo!eagle!mhtsa!ihnss!ihuxp!grg

To send an email to someone, you had to first be a human *router* and specify a valid path to the destination as part of the address. If you didn't know a valid route, the software couldn't help you. In order to solve this problem, *domain names* were created to provide each person with one address regardless of where email was sent from. As RFC 805 put it, "The hierarchical domain type naming differs from source routing in that the former gives absolute addressing while the latter gives relative addressing".

RFC 805 outlines many of the basic principles of the eventual domain name system, including the need for top level domains to provide a starting point for delegation of queries, the need for second level domains to be unique -- and therefore the requirement for a registrar type of administration, and the recognition that distribution of individual name servers responsible for each domain would provide administration and maintenance advantages.

Within the year, the concept was developed through a series of communications. In March, the hosts table definition was updated with *DoD Internet Host Table Specification*, RFC 810, and NIC's introduction of a server function to provide individual host name / address translations was described in *Hostnames Server*, RFC 811, both documents including the domain concept. In August, *The Domain Naming Convention for Internet User Applications*, RFC 819, provided an excellent overview of the concept. And then, in October, the full concept of a distributed system of name servers, each serving its local domain, was described in *A Distributed System for Internet Name Service*, RFC 830, providing the main architectural outlines of the system still in use today.

By the following November, 1983, the concept and schedule were developed and published in *The Domain Names Plan and Schedule*, RFC 881, *Domain Names -- Concepts And Facilities*, RFC 882, and *Domain Names -- Implementation And Specification*, RFC 883.

Some of the technical discussion involved in developing the DNS was carried out on the namedroppers list.

BIND. Because the DNS is such a fundamental part of the operation of the Internet network, the software that runs it must be nearly fault free, easily upgraded when a bug is found, and completely trusted by the Internet community -- in other words, free open source software.

The application that runs almost every *DNS server* on the Internet is called BIND, for

Berkeley Internet Name Domain, first developed as a graduate student project at the University of California at Berkeley, and maintained through version 4.8.3 by the university's Computer Systems Research Group (CSRG). The initial BIND development team consisted of Mark Painter, David Riggle, Douglas Terry, and Songnian Zhou. Later work was done by Ralph Campbell and Kevin Dunlap, and others that contributed include Jim Bloom, Smoot Carl-Mitchell, Doug Kingston, *Mike Muuss*, Craig Partridge, and Mike Schwartz. Application maintenance was done by Mike Karels and O. Kure.

Versions 4.9 and 4.9.1 of BIND were released by then the number two computer company, Digital Equipment Corporation. The lead developer was Paul Vixie, with assistance from Paul Albitz, Phil Almquist, Fuat Baran, Alan Barrett, Bryan Beecher, Andy Cherenson, Robert Elz, Art Harkin, Anant Kumar, Don Lewis, Tom Limoncelli, Berthold Paffrath, Andrew Partan, Win Treese, and Christophe Wolfhugel. After Vixie left to establish Vixie Enterprises, he sponsored the development of BIND Version 4.9.2, and became the application's principal architect.

Versions 4.9.3 on have been developed and maintained by the Internet Systems Consortium. A major architectural update called Version 8 was co-developed by Bob Halley and Paul Vixie and released in May 1997. Another major architectural rewrite called Version 9 with enhanced security support was developed and released in the year 2000.

Peter Scott of the University of Saskatchewan, recognizing the need to bring together information about all the telnet-accessible library catalogs on the web, as well as other telnet resources, brought out his Hytelnet catalog in 1990. It gave a single place to get information about library catalogs and other telnet resources and how to use them. He maintained it for years, and added HyWebCat in 1997 to provide information on web-based catalogs.

In 1991, the first really friendly interface to the Internet was developed at the University of Minnesota. The University wanted to develop a simple menu system to access files and information on campus through their local network. A debate followed between mainframe adherents and those who believed in smaller systems with client-server architecture. The mainframe adherents "won" the debate initially, but since the client-server advocates said they could put up a prototype very quickly, they were given the go-ahead to do a demonstration system. The demonstration system was called a gopher after the U of Minnesota mascot--the golden gopher. The gopher proved to be very prolific, and within a few years there were over 10,000 gophers around the world. It takes no knowledge of unix or computer architecture to use. In a gopher system, you type or click on a number to select the menu selection you want.

Gopher's usability was enhanced much more when the University of Nevada at Reno developed the VERONICA searchable index of gopher menus. It was purported to be an acronym for Very Easy Rodent-Oriented Netwide Index to Computerized Archives. A spider crawled gopher menus around the world, collecting links and retrieving them for the index. It was so popular that it was very hard to connect to, even though a number of other VERONICA sites were developed to ease the load. Similar indexing software was developed for single sites, called JUGHEAD (Jonzy's Universal Gopher Hierarchy Excavation And Display).

Peter Deutsch, who developed Archie, always insisted that Archie was short for Archiver, and had nothing to do with the comic strip. He was disgusted when VERONICA and JUGHEAD appeared.

In 1989 another significant event took place in making the nets easier to use. Tim Berners-Lee and others at the European Laboratory for Particle Physics, more popularly known as CERN, proposed a new protocol for information distribution. This protocol, which became the World Wide Web in 1991, was based on hypertext--a system of embedding links in text to link to other text, which you have been using every time you selected a text link while reading these pages. Although started before gopher, it was slower to develop.

The development in 1993 of the graphical browser Mosaic by Marc Andreessen and his team at the National Center For Supercomputing Applications (NCSA) gave the protocol its big boost. Later, Andreessen moved to become the brains behind Netscape Corp., which produced the most successful graphical type of browser and server until Microsoft declared war and developed its MicroSoft Internet Explorer.

MICHAEL DERTOUZOS
1936-2001

The early days of the web was a confused period as many developers tried to put their personal stamp on ways the web should develop. The web was threatened with becoming a mass of unrelated protocols that would require different software for different applications. The visionary Michael Dertouzos of MIT's Laboratory for Computer Sciences persuaded Tim Berners-Lee and others to form the World Wide Web Consortium in 1994 to promote and develop standards for the Web. Proprietary plug-ins still abound for the web, but the Consortium has ensured that there are common standards present in every browser.

Read Tim Berners-Lee's tribute to Michael Dertouzos.

Since the Internet was initially funded by the government, it was originally limited to research, education, and government uses. Commercial uses were prohibited unless they directly served the goals of research and education. This policy continued until the early 90's, when independent commercial networks began to grow. It then became possible to route traffic across the country from one commercial site to another without passing through the government funded NSFNet Internet backbone.

Google History from http://en.wikipedia.org/wiki/History_of_Google

Google began in March 1996 as a research project by Larry Page and Sergey Brin, Ph.D. students at Stanford[1] working on the Stanford Digital Library Project (SDLP). The SDLP's goal was “to develop the enabling technologies for a single, integrated and universal digital library." and was funded through the National Science Foundation among other federal agencies.[2][3][4][5] In search for a dissertation theme, Page considered—among other things—exploring the mathematical properties of the World Wide Web, understanding its link structure as a huge graph.[6] His supervisor Terry Winograd encouraged him to pick this idea (which Page later recalled as "the best advice I ever got"[7]) and Page focused on the problem of finding out which web pages link to a given page, considering the number and nature of such backlinks to be valuable information about that page (with the role of citations in academic publishing in mind).[6] In his research project, nicknamed "BackRub", he was soon joined by Sergey Brin, a fellow Stanford Ph.D. student supported by a National Science Foundation Graduate Fellowship.[2] Brin was already a close friend, whom Page had first met in the summer of 1995 in a group of potential new students which Brin had volunteered to show around the campus.[6] Page's web crawler began exploring the web in March 1996, setting out from Page's own Stanford home page as its only starting point.[6] To convert the backlink data that it gathered into a measure of importance for a given web page, Brin and Page developed the PageRank algorithm.[6] Analyzing BackRub's output—which, for a given URL, consisted of a list of backlinks ranked by importance—it occurred to them that a search engine based on PageRank would produce better results than existing techniques (existing search engines at the time essentially ranked results according to how many times the search term appeared on a page).[6][8]

A small search engine called RankDex was already exploring a similar strategy.[9]

Convinced that the pages with the most links to them from other highly relevant Web pages must be the most relevant pages associated with the search, Page and Brin tested their thesis as part of their studies, and laid the foundation for their search engine. By early 1997, the backrub page described the state as follows:[10]

Some Rough Statistics (from August 29th, 1996)
Total indexable HTML urls: 75.2306 Million
Total content downloaded: 207.022 gigabytes
...

BackRub is written in Java and Python and runs on several Sun Ultras and Intel Pentiums running Linux. The primary database is kept on an Sun Ultra II with 28GB of disk. Scott Hassan and Alan Steremberg have provided a great deal of very talented implementation help. Sergey Brin has also been very involved and deserves many thanks.

-Larry Page page@cs.stanford.edu

Originally the search engine used the Stanford website with the domain *google.stanford.edu*. The domain *google.com* was registered on September 15, 1997. They formally incorporated their company, *Google Inc.*, on September 4, 1998 at a friend's garage in Menlo Park, California.

Both Brin and Page had been against using advertising pop-ups in a search engine, or an "advertising funded search engines" model, and they wrote a research paper in 1998 on the topic while still students. However, they soon changed their minds and early on allowed simple text ads.[11]

The name "Google" originated from a misspelling of "googol,"[12][13] which refers to the number represented by a 1 followed by one-hundred zeros (although Enid Blyton used the word decades earlier in "Google Bun" - Chapter IX, The Magic Faraway Tree). Having found its way increasingly into everyday language, the verb, "google," was added to the *Merriam Webster Collegiate Dictionary* and the *Oxford English Dictionary* in 2006, meaning, "to use the Google search engine to obtain information on the Internet."[14][15]

By the end of 1998, Google had an index of about 60 million pages.[16] The home page was still marked "BETA", but an article in Salon.com already argued that Google's search results were better than those of competitors like Hotbot or Excite.com, and praised it for being more technologically innovative than the overloaded portal sites (like Yahoo!, Excite.com, Lycos, Netscape's Netcenter, AOL.com, Go.com and MSN.com) which at that time, during the growing dot-com bubble, were seen as "the future of the Web", especially by stock market investors.[16]

In March 1999, the company moved into offices at 165 University Avenue in Palo Alto, home to several other noted Silicon Valley technology startups.[17] After quickly outgrowing two other sites, the company leased a complex of buildings in Mountain View at 1600 Amphitheatre Parkway from Silicon Graphics (SGI) in 1999.[18] The company has remained at this location ever since, and the complex has since become known as the Googleplex (a play on the word googolplex, the value of googol multiplied by the power of googol). In 2006, Google bought the property from SGI for $319 million.[19]

The Google search engine attracted a loyal following among the growing number of Internet users, who liked its simple design.[20] In 2000, Google began selling advertisements associated with search keywords.[1] The ads were text-based to maintain an uncluttered page design and to maximize page loading speed.[1] Keywords were sold based on a combination of price bid and click-throughs, with bidding starting at $.05 per click.[1] This model of selling keyword advertising was pioneered by Goto.com (later renamed Overture Services, before being acquired by Yahoo! and rebranded as Yahoo! Search Marketing).[21][22][23] While many of its dot-com rivals failed in the new Internet marketplace, Google quietly rose in stature while generating revenue.[1]

Google's declared code of conduct is "Don't be evil", a phrase which they went so far as to include in their prospectus (aka "red herring" or "S-1") for their IPO, noting, "We believe strongly that in the long term, we will be better served — as shareholders and in all other ways — by a company that does good things for the world even if we forgo some short term gains."

Delphi was the first national commercial online service to offer Internet access to its subscribers. It opened up an email connection in July 1992 and full Internet service in November 1992. All pretenses of limitations on commercial use disappeared in May 1995 when the National Science Foundation ended its sponsorship of the Internet backbone, and all traffic relied on commercial networks. AOL, Prodigy, and CompuServe came online. Since commercial usage was so widespread by this time and educational institutions had been paying their own way for some time, the loss of NSF funding had no appreciable effect on costs.

Today, NSF funding has moved beyond supporting the backbone and higher educational institutions to building the K-12 and local public library accesses on the one hand, and the research on the massive high volume connections on the other.

Microsoft's full scale entry into the browser, server, and Internet Service Provider market completed the major shift over to a commercially based Internet. The release of Windows 98 in June 1998 with the Microsoft browser well integrated into the desktop shows Bill Gates' determination to capitalize on the enormous growth of the Internet. Microsoft's success over the past few years has brought court challenges to their dominance. We'll leave it up to you whether you think these battles should be played out in the courts or the marketplace.

During this period of enormous growth, businesses entering the Internet arena scrambled to find economic models that work. Free services supported by advertising shifted some of the direct costs away from the consumer--temporarily. Services such as Delphi offered free web pages, chat rooms, and message boards for community building. Online sales have grown rapidly for such products as books and music CDs and computers, but the profit margins are slim when price comparisons are so easy, and public trust in online security is still shaky. Business models that have worked well are portal sites, that try to provide everything for everybody, and live auctions. AOL's acquisition of Time-Warner was the largest merger in history when it took place and shows the enormous growth of Internet business! The stock market has had a rocky ride, swooping up and down as the new technology companies, the dot.com's encountered good news and bad. The decline in advertising income spelled doom for many dot.coms, and a major shakeout and search for better business models took place by the survivors.

A current trend with major implications for the future is the growth of high speed connections. 56K modems and the providers who supported them spread widely for a while, but this is the low end now. 56K is not fast enough to carry multimedia, such as sound and video except in low quality. But new technologies many times faster, such as cablemodems and digital subscriber lines (DSL) are predominant now.

Wireless has grown rapidly in the past few years, and travellers search for the wi-fi "hot spots" where they can connect while they are away from the home or office. Many airports, coffee bars, hotels and motels now routinely provide these services, some for a fee and some for free.

A next big growth area is the surge towards universal wireless access, where almost everywhere is a "hot spot". Municipal wi-fi or city-wide access, wiMAX offering broader ranges than wi-fi, EV-DO, 3g, and other formats will joust for dominance in the USA in the years ahead. The battle is both economic and political.

Another trend that is rapidly affecting web designers is the growth of smaller devices to connect to the Internet. Small tablets, pocket PCs, smart phones, ebooks, game machines, and even GPS devices are now capable of tapping into the web on the go, and many web pages are not designed to work on that scale.

As the Internet has become ubiquitous, faster, and increasingly accessible to non-technical communities, social networking and collaborative services have grown rapidly, enabling people to communicate and share interests in many more ways. Sites like Facebook, Twitter, Linked-In, YouTube, Flickr, Second Life, delicious, blogs, wikis, and many more let people of all ages rapidly share their interests of the moment with others everywhere.

As Heraclitus said in the 4th century BC, "Nothing is permanent, but change!"

May you live in interesting times! (ostensibly an ancient Chinese curse)

For more information on Internet history, visit these sites:

- Hobbes' Internet Timeline . ©1993-8 by Robert H Zakon. Significant dates in the history of the Internet.
- BBN Timeline. A look at major developments by BBN in Internet History'.
- A Brief History of the Internet from the Internet Society. Written by some of those who made it happen.
- The Internet Explained. Another look at the developmental history of the Internet.

From Dirt Paths to Superhighways[3]

The Interstate System has been called the Greatest Public Works Project in History. From the day President Dwight D. Eisenhower signed the *Federal-Aid Highway Act of 1956*, the Interstate System has been a part of our culture—as construction projects, as transportation in our daily lives, and as an integral part of the American way of life. Every citizen has been touched by it, if not directly as motorists, then indirectly because every item we buy has been on the Interstate System at some point. President Eisenhower considered it one of the most important achievements of his two terms in office, and historians agree.

Before the Interstate Highway system brought fast, limited access highways to the United States, there was, and still remains, another nationwide system of highways that enabled travelers to follow standardized routes to any part of the nation. This system, known as the United States Highway System or simply as "US" highways, was the first time in history that a national standard was set for roads and highways. This system of highways existed

This system was created by the Federal Aid Highway Act of 1925 as a response to the confusion created by the 250 or so named many named highways, such as the Lincoln Highway or the National Old Trails Highway. Instead of using names and colored bands on telephone poles, this new system would use uniform numbers for inter-state highways and a standardized shield that would be universally recognizable. The most important change was that this new system would be administered by the states, not by for-profit private road clubs. Even then, people decried the idea of giving roads numbers since they felt numbers would make highways cold and impersonal.

The Automobile

At the beginning of the twentieth century, automobiles were a novelty that only could be enjoyed by the very rich. Most Americans contented themselves with either using the horse and buggy or taking the railroads when they needed to go on long trips. Getting around in large cities was fairly easy due to comprehensive networks of streetcars and subways. Even though it is hard to believe today, especially in California, it was generally thought that autos would never catch on. In short, in the early part of this century, there was simply no need for a good system of roads.

Henry Ford changed the status quo with his revolutionary production line techniques. He took the idea of standardization and applied it to creating standard parts for automobile manufacturing. Cars could be produced cheaply, although a few sacrifices had to be made. Ford once said that "you can get the Model T in any color you like as long as it's black." For the first time in history, workers in a factory could afford the

[3] *http://www.gbcnet.com/ushighways/history.html*

products they manufactured. The Model "T" soon became a common sight throughout the United States. A testament to their popularity is that over 16.5 million were sold, a record which was not broken until 1972 when the Volkswagen Beetle surpassed that mark. Needless to say, this created a huge demand for good roads.

The Rise of Named Highways

Colored bands on telephone poles used to mark the named trails.

At the beginning of the century, the supply of good roads was nowhere near the growing demand. Most roads at the time were little more than improved wagon trails. In fact, many of the major "highways" were actually vestiges of old trails, such as the Oregon Trail or Santa Fe Trail. There were paved highways, but most were cobblestone and almost all were in major cities. Good road organizations appeared to remedy this situation. The American Automobile Association and the Automobile Club of Southern California (they were separate organizations originally) were formed in California to promote better roads. Additionally, many trail associations were created to address the need of having marked interstate highways; this was the birth of the named highways. The Lincoln Highway, from New York to San Francisco was the first and by the early 1920s many highway organizations were formed which placed and promoted their own routes. By 1925 there were over 250 named highways, each with their own colored signs often placed haphazardly, a fact which created great confusion.

Several problems arose with the named highways. The lack of a central organization to dictate the placement of interstate highways left the door open for self-serving organizations to "relocate" the famous named roads so they would pass through their cities. More frequently, though, the lack of coordination between states through which the transcontinental routes ran caused confusion since the route was often not even straight. The need for a system of standardized interstate highways had evolved.

The Federal Government Becomes Involved

By 1924 it became clear that a single, unified system of highways was necessary. In that year, the American Association of State Highway Officials (AASHO, today's AASHTO) passed a resolution requesting the Secretary of Agriculture (the Bureau of Public Roads was in this department at the time) to investigate the possibility of creating a system of standardized highways.

Giving highways throughout the United States a standard numerical designation was a radical idea but at the same time fit in with other innovations at the time.

For example, by the 1920s road building was also becoming a standardized process. Road building technology advanced in a logarithmic manner, allowing good roads to be built just about anywhere. Of course, by today's standards these roads are inadequate in all aspects, including width, sight distance, grade, etc. At the time, having a paved road going through places such as the Cajon Pass and over the Ridge Route was an incredible boon.

The Beginning of the End

The passage of the Interstate Highway Act in 1956 spelled the end of the California US highways as the leading. The proposed system would supplant many of the US routes with divided Interstate highways, a fact that obviated the need for them. California, since the late 1930s had been pushing for creating divided highways and a comprehensive freeway and expressway system and by the late 1950s, many of the US routes had already been converted to freeways and expressways or were slated to do so. It appears the original plan was for the Interstate Highways to be co-signed and routed with their corresponding US highway and from about 1960 to 1964 this is exactly what the Division of Highways did.

Despite this effort, it was clear that there was no purpose in maintaining many of the old US highways. Legislation was enacted that would change the face of California's highway system. One thing that was changed was that all highways would have the same sign and legislative number. For example, US 99 was Legislative Routes 3 and 4 but was Sign Route US 99. This legislation also eliminated over half of the existing US highways and renumbered and adjusted many state highways. Portions of US 99 became Legislative Route 5 and were signed as Interstate 5, while about half of its length became Sign Route CA 99 and was Legislative Route 99 in the books.

Almost half of the US highways in California were taken off the map. The list below shows their dispostion.

- US 6: Shortened to Bishop and replaced by SR-1, SR-11, I-5, SR-14.
- US 40: Eliminated and replaced by I-80.
- US 66: Shortened to Pasadena and replaced by SR-2, SR-11.
- US 66 Alternate: Eliminated (no state routes replaced it)
- US 70: Eliminated and replaced by I-10.
- US 91: Eliminated and replaced by SR-1, SR-91, I-15.
- US 99: Initially shortened to Los Angeles and replaced by SR-111, SR-86, I-10.
- US 101: Shortened to Los Angeles and replaced by I-5.
- US 101 Alternate: Eliminated and replaced by SR-1.
- US 101 Bypass: Eliminated and replaced by rerouted US 101.
- US 299: Eliminated and replaced by SR-299
- US 399: Eliminated and replaced by SR-33, SR-119, SR-99.
- US 466: Eliminated and replaced by SR-46, SR-99, SR-58, I-15.

More US highways were to be decommissioned or shortened, although most of them remained signed until their corresponding Interstate highway was completed. I've added the end date for each in parentheses.

- US 50: Shortened to Sacramento and replaced by I-580, I-205, I-5, SR-99. (1972)
- US 66: Eliminated and replaced by SR-66, I-15, I-40. (1972)
- US 60: Eliminated and replaced by SR-60, I-10. (1972)
- US 80: Eliminated and replaced by I-8. (1972 - San Diego Co.; 1974 Imperial Co.)
- US 99: Eliminated and replaced by I-5, SR-99. (1967)

Another major route renumbering occurred in 1972 that set in stone what the remaining US highways in California were to remain. The most significant item, to the US highway buff, is the elimination of US 395 south of Adelanto, which was replaced in whole by I-15E and I-15. It appears that initially (in 1963) there were no plans to eliminate any portion of US 395, so it would have continued all the way to San Diego with I-15 ending at I-10 in Colton. The State of California pulled off a major coup in 1972 by having unconstructed state routes 31 and 71 (slated as 6-8 lane freeways) designated as I-15. This meant that the State saved hundreds of millions of dollars by having I-15 transferred from an already existing freeway to almost entirely new alignment. This also meant that the proposed US 395 freeway south of Temecula could also be built with federal, not state dollars by giving it the I-15 designation. Consequently, US 395 no longer served a real purpose and was truncated.

In a decade, the face of signed highways in California changed dramatically. In 1962 there was but a handful of Interstate highways and 23 US highways. In 1972, only eight truncated US highways remained with over 20 Interstate highways either completed or well on their way toward completion. In no other state has there been such a dramatic change in highway numbering and highway types.

The Highways Today

I have traveled over many of the old highways in California and was surprised to find out how much of the old highways still exist. Some of these highways have been easy to find, such as old US 80 in the mountains east of San Diego or US 6, the Sierra Highway north of Los Angeles. In other cases, the old highways have been actually paved over or modified, like old sections of US 99 buried under I-5. Others, such as the old sections of US 99 that go through bypassed towns, have been swallowed up, transformed to match their surroundings. Many more, such as 99W in northern California, have been relegated to the status of frontage road.

As mentioned above, seven US highways still exist in California. These are routes: 6, 50, 95, 97, 101, 199, and 395. Three of them, routes 95, 97 and 199 have remained unchanged while US 6 has been all but eliminated, save for a short stretch between Bishop and the Nevada border. The other three, routes 50, 101, and 395 have more or less been completely transformed into modern superhighways. Old alignments have mostly been bypassed and covered over, just as they had on the Interstates. Essentially, a lot of modern US highways in California bear little resemblance to their forebears and show the evolution of highway building in California.

The modern style US highway shield, in use since 1956.

The history of US highways is a reflection of the history of 20th Century America. In the 19th Century, the railroads shaped the country, enabling people to travel to and settle in distant places. However, in the invention of the automobile gave everyone unprecedented mobility. The US highway system, itself a reflection of the Progressive Era, shaped the nation by allowing easy access through standardized routes to all parts of the nation.

Myths of the US Interstate Highway System[4]

President Eisenhower conceived the Interstate System.

The Interstate System was first described in a Bureau of Public Roads report to Congress, *Toll Roads and Free Roads*, in 1939. It was authorized for designation by the *Federal-Aid Highway Act of 1944*, with the initial designations in 1947 and completed in 1955 under the 40,000-mile limitation imposed by the 1944 *Act*. President Eisenhower didn't conceive the Interstate System, but his support led to enactment of the *Federal-Aid Highway Act of 1956*, which established the program for funding and building it.

President Eisenhower supported the Interstate System because he wanted a way of evacuating cities if the United States was attacked by an atomic bomb.

President Eisenhower's support was based largely on civilian needs—support for economic development, improved highway safety, and congestion relief, as well as reduction of motor vehicle-related lawsuits. He understood the military value of the Interstate System, as well as its use in evacuations, but they were only part of the reason for his support.

Defense was the primary reason for the Interstate System.

The primary justifications for the Interstate System were civilian in nature. In the midst of the Cold War, the Department of Defense supported the Interstate System and Congress added the words "and Defense" to its official name in 1956 ("National System of Interstate and Defense Highways"). However, the program was so popular for its civilian benefits that the legislation would have passed even if defense had not been a factor.

The Interstate System was launched by the Interstate Defense Highway Act of 1956.

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[4] http://www.fhwa.dot.gov/interstate/interstatemyths.htm

No such legislation passed in 1956 or any other year. Nevertheless, this title appears widely throughout the media instead of the correct title: the *Federal-Aid Highway Act of 1956*.

One in five miles of the Interstate System is straight so airplanes can land in emergencies.

This myth is widespread on the Internet and in reference sources, but has no basis in law, regulation, design manual—or fact. Airplanes occasionally land on Interstates when no alternative is available in an emergency, not because the Interstates are designed for that purpose.

Interstates are intended to serve only traffic going from State to State.

The Interstate System serves interstate, regional, and intra-State traffic, and was always expected to do so. In fact, many routes, including beltways and spurs, are located entirely in one State and serve primarily intra-State traffic.

Beltways are designed to carry Interstate traffic around cities.

Beltways do help traffic avoid cities, but also are intended to serve metropolitan traffic moving from main highway to main highway.

Congress should have put the money into transit instead of the Interstate System.

This was not an option in 1955 and 1956 when the congressional debate took place. At the time, transit was provided mainly by private companies. No one in the industry, in State and local governments, or in Congress imagined that the Federal Government would support these companies financially. In fact, the only thing the American Transit Association asked Congress to do was exempt buses from the gas tax. Congress did so.

Interstate numbers must be consistent with the numbering plan.

The numbering plan is helpful in choosing numbers for added routes. However, in an irregularly shaped country, consistency is not possible. The numbers are consistent for the most part, but irregularities have occurred for a number of reasons, such as addition of a route where a consistent number is not available or withdrawal of a route without concurrent renumbering of routes linked to it. These inconsistencies have no effect on motorists who “navigate” based on maps, new GPS technology, personal knowledge or directions, and other means, not the numbering plan.

The only built object astronauts can see from space is the Interstate System.

From an altitude of about 155 miles (250 kilometers), under the best of conditions, the unaided eye of an astronaut can see many built objects on Earth if he or she knows where to look. The Interstate System is not visible as a network, but astronauts using binoculars can see roads, cities, dams, airports, and other objects.

History of the Transcontinental Railroad[5]

The Proposals

The work of the railroad men cannot be fully appreciated without first understanding the history behind the building of the first Transcontinental Railroad. The history of this great railroad goes back to the time when the first steam locomotives were moving on the first tracks in the nation. At this time, the Railroad was only an idea, and a dream. The first convention for the planning of the Pacific Railroad (as this first transcontinental railroad was called) was held in 1838 by John Plumbe. Pacific Railroad bills that proposed to grant lands, subsidies, and even as much as 90 million dollars towards the construction of this railroad had been periodically introduced in Congress since the 1840's. [McCague 4].

The Route

None of the bills passed, because a route could not be decided on. Congress was split along geographical lines; northerners wanted a northern route and southerners wanted a southern route. This was because of the issue of slavery in the "New West" [Howard 57]. Since the "New West" really was new, there really wasn't any slavery there yet. Congress was split over whether slavery should be permitted at all in these new states.

The discovery of gold near Sutter's mill in California in 1848 resulted in a huge influx of people lured by the promise of "free gold" into California during 1849: 55,000 by overland routes and another 25,000 by sea [Howard 64]. With so many people now heading west, travel and trade across the country became suddenly more important. By 1850, only 57% of the population of the United States lived east of the Alleghenies on the Atlantic seaboard [Howard 65].

That fact, along with the "Yankees' success in barring slavery in California, the popularity of the all-north California Trail, the railroads racing toward Chicago and St. Louis, worried the leaders of the Old South bloc in Congress" [Howard 65]. They pressed for the all southern route (the South & Pacific Railroad), which spurred the Gadsden Purchase in 1853 of 45,535 square miles of land south of the Gila River and east to El Paso del Norte [Howard 66]. With this land, the potential for an all southern route to California was clear.

However, Congress still could not decide on a route, so they sent five surveying teams out in 1853 to explore possible railroad routes to California. But California desperately needed railroads to replace the mule teams, stage coaches, and steamboats on which the entire economy was dependent [Howard 67]. So California's first railroad (the Sacramento Valley Railroad) was started in 1854, with Theodore D. Judah as its chief engineer.

[5] Source: http://www.bushong.net/dawn/about/college/ids100/history.shtml

The railroad surveying teams finished in autumn of 1854. The results of their research was reviewed by the Secretary of War, Jefferson Davis of Mississippi. He concluded that the southern route, running through the newly purchased Gadsden lands, would be the most cost-effective [Howard 84]. Jefferson Davis, of course, who went on to become the president of the Confederate States of America after the secession, had vested Southern interests.

Because of the bad blood involved, no action was taken on his decision; votes taken went against funding the Southern route, because of the split in Congress between Northern and Southern interests. Then, in 1861, the Southern congressmen left Congress as a precursor to Southern secession, whereupon action and funding progressed immediately to begin work on the Northern route. The North's final decision on a route, the central route through Nebraska, hinged greatly on analyses of how use of the Railroad would impact the impending Civil War, which had just broken out [Gordon 151].

In 1853, Grenville M. Dodge had "made a reconnaissance west of the Missouri river with a view of determining the location of the great Pacific Railroad of the future, and the bill authorizing the construction of the Pacific Railroad which was adopted by Congress in 1862 was mostly based upon his surveys and reports" [Granger 4].

The Central Pacific

By April of 1861 Theodore Judah finally brought together the Central Pacific Railroad Co., with president Leland Stanford, vice-president Collis P. Huntington, and treasurer Mark Hopkins. These three men: Stanford, Hopkins, and Huntington, along with Charles Crocker, who handled labor issues, became known as the "Big Four" of the Central Pacific Railroad. In 1862, Judah was appointed secretary of the House and Senate committees on the Pacific Railway Act, and so he finally got to see the beginning of the realization of his dream of a transcontinental railroad...before his death in 1863.

When the ground breaking to signify the beginning of work on the Central Pacific took place in Sacramento on January 8th, 1863, the route they were to take was the one laid out by Theodore Judah many years before, when he had surveyed the Sierras, found a passable route, and then spent years lobbying Congress to convince them his plan would work.

The Union Pacific

The other half of the plan, the Union Pacific Railroad Co., was founded in Chicago on September 2nd, 1862. By December 2nd, 1863, the Union Pacific broke ground on the Missouri River bluffs. With both companies now at work, the Railroad began to creep towards a meeting.

Milestones

The work was progressing, albeit slowly on the western branch by the Central Pacific company. Then, in 1865, silver was discovered in Nevada. Though not the wild gold rush of 1849, it drew a large number of able bodied men to Nevada to search for silver, depleting the work force of the Central Pacific. With a choice between silver hunting, safe jobs in California, or dangerous work on the CP Railroad, fewer and fewer white workers were staying on with the railroad.

So, in 1865, Charles Crocker, amid much dispute, began hiring Chinese workers to fill in for the white labor shortage. This was a decision which profoundly changed the course of race relations in the West. Around the same time, the Union Pacific was having racial issues of their own. As they pushed across the prairie lands moving west, they began to constantly run up against Native American raiding parties. Some of the land across which the Railroad was being built had been bought by the government from white owners, but much more of it was simply taken from land previously promised to the Natives.

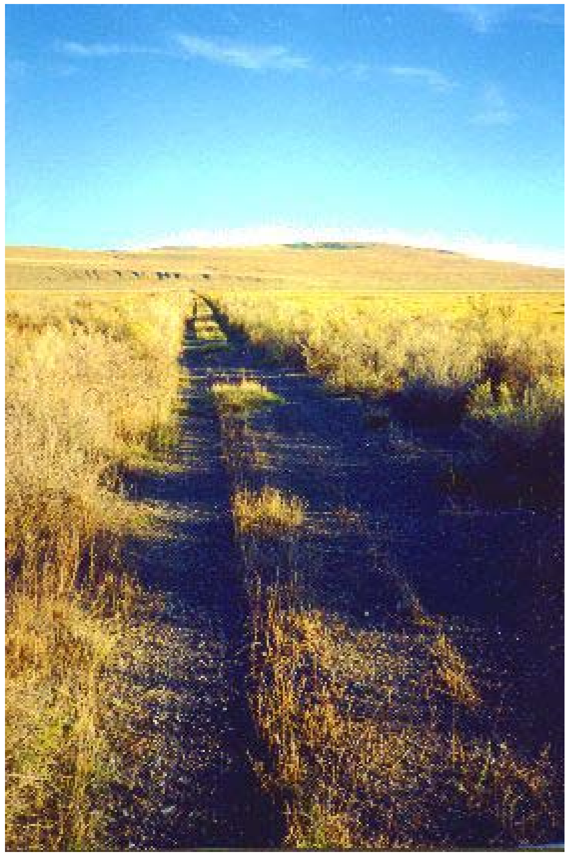
Charles Crocker's assistant was a man named James Harvey Strobridge. Strobridge was a hard man, who was in charge of making sure all of the Central Pacific workers, white and Chinese alike were doing their jobs. While Crocker handled the major hiring decisions, it was Strobridge out there on the line who was overseeing the day to day discipline and pushing the workers on.

Grenville Dodge was appointed Chief Engineer of the Union Pacific railroad in January 1866 [Granger 23]. A former "Indian fighter", his influence on the workers resulted in a constant state of readiness. When the workers weren't at work or asleep, they were at war, their rifles at their sides, ready for the next Indian attack. They kept on working though, and by 1869 were laying track at a phenomenal rate.

The Central Pacific, after much hardship and hard work, had passed the Sierra Nevada mountains, and had reached the point where officially their contract ended. But they kept working at a feverish pace, the competition with the Union Pacific growing ever more fervent. The UP was trying to build west as far and as fast as they could, while the CP screamed eastward. The CP had their track laying down to such a science, that Charles Crocker claimed they could lay 10 miles of track in one day. The UP officials scoffed and bet that they couldn't. With a little planning and engineering though, on April 28th 1869, they set the record by laying 10 miles of track in one day.

Finishing the Job

Twelve days later, on May 10th, 1869, the two railroads met at Promontory Point, Utah, where their tracks were joined, and the last tie laid. The laurelwood tie was hammered in with a bronze spike and a golden spike to commemorate the occasion. The expensive pieces were quickly removed, as well as myriad other bits of the ties by memento hunters present that day.



The Railroad served the North in its Civil War efforts, paved the way for Western expansion, and built the fortunes of influential men. Years later, its importance dwindled with the rise of interstate highways and air travel, and much of it was pulled apart for materials for later war efforts. Today, empty tracks through deserted fields, passed down stories and histories, and the children of the people who worked to make it happen are the legacy it leaves behind.

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[i] References

Gordon, Sarah H. *Passage to Union -- How the Railroads Transformed American Life, 1829-1929.* Chicago: Ivan R. Dee Inc., 1996.

Granger, J. T. *A Brief Biographical Sketch of the Life of Major-General Grenville M. Dodge.* New York: Arno Press, 1981.

Howard, Robert West. *The Great Iron Trail -- The Story of the First Transcontinental Railroad.* New York: Bonanza Books, 1962.

Kraus, George. *High Road to Promontory -- Building the Central Pacific (now the Southern Pacific) across the High Sierra).* Palo Alto: American West Publishing Company, 1969.

McCague, James. *Moguls and Iron Men -- The Story of the First Transcontinental Railroad.* New York: Harper & Row, 1964.