Back 150 Timeline

This timeline is provided to help show how the dominant form of communication changes as rapidly as innovators develop new technologies.

A brief historical overview: The printing press was *the* big innovation in communications until the telegraph was developed. Printing remained the key format for mass messages for years afterward, but the telegraph allowed instant communication over vast distances for the first time in human history. Telegraph usage faded as radio became easy to use and popularized; as radio was being developed, the telephone quickly became the fastest way to communicate person-to-person; after television was perfected and content for it was well developed, it became the dominant form of communication technology; the internet came next, and newspapers, radio, telephones and television are being rolled into this far-reaching information medium.

1830s-1860s

The Telegraph, from development to boom years

1890s-1930s

Radio, from development to boom years

1870s-1930s

The Telephone, from development to boom years

1920s-1960s

Television, from development to boom years

1960s-1990s

The Internet, from development to boom years

Back 150 Resources

Links and books for more info on comm. history

Back 150 - Telegraph - 1830s-1860s

The Development of the Telegraph

The idea behind the telegraph - sending electric signals across wires - originated in the early 1700s, and by 1798 a rough system was used in France. New York University professor Samuel Morse (pictured at left) began working on his version of the telegraph in 1832; he developed Morse Code (a set of sounds that corresponded to particular letters of the alphabet), in 1835; and by 1838 he had presented his concept to the U.S. Congress. He was not the first to think of the idea - 62 people had claimed to invent the first electrical telegraph by 1838 - but Morse beat everyone else to by being the first to get political backing for his telegraph and a business model for making it work.

In 1843, Morse built a telegraph system from Washington, D.C., to Baltimore with the financial support of Congress. On May 24, 1844, the first message "What hath God wrought?" was sent. The telegraph system progressed slowly, and many attempts failed to make the system work for the entire country. Morse slowly continued to spread his invention and he extended the telegraph line to New York. At the same time, other companies began taking notice of the impact of the telegraph and they opened their own systems in other parts of the country. Western Union built its first transcontinental telegraph line in 1861.

At first, telegraph messages were transmitted by trained code users, but in 1914 a form of automatic transmission was developed. This made the message transmission much faster. At the turn of the 20th century, all long-distance communication depended heavily on the telegraph.

In 1864, top telegraph company Western Union operated on 44,000 miles of wire and was valued at $10 million. Within the next year, its worth had jumped to $21 million. It is estimated that between 1857 and 1867 the company's value grew by 11,000 percent. In 1866, its network included about 100,000 miles of wire and its capital stock value was in excess of $40 million.

At the end of the 19th century, demands for constraints on Western Union's power resulted in the passage of the Mann-Elkins Act of 1910, granting the Interstate Commerce Commission regulatory oversight of telegraph rates. Later, the Communications Act of 1934 switched regulation of the telegraph industry to the newly created Federal Communications Commission. By this time, the radio and telephone had diminished the impact of the telegraph.

World Changes Due to the Telegraph

Prior to the telegraph, communication in the 1830s was about the same as it had been in the years just after Gutenberg's invention of the printing press. It took days, weeks, and even months for messages to be sent from one location to a far-flung position. After the telegraph cable was stretched from coast to coast in the 1850s, a message from London to New York could be sent in mere minutes, and the world suddenly became much smaller.

Prior to the telegraph, politics and business were constrained by geography. The world was divided into isolated regions. There was limited knowledge of national or international news, and that which was shared was generally quite dated. After the telegraph, the world changed. It seemed as if information could flow like water.

By the 1850s, predictions about the impact of the new medium began to abound. The telegraph would alter business and politics. It would make the world smaller, erase national rivalries and contribute to the establishment of world peace. It would make newspapers obsolete. All of the same statements were made in the 1990s by people who were wowed by the first-blush potential of the Internet.

Past Predictions About the Future of the Telegraph

In an 1838 letter to Francis O.J. Smith in 1838, Morse wrote:

> "This mode of instantaneous communication must inevitably become an instrument of immense power, to be wielded for good or for evil, as it shall be properly or improperly directed."

The reaction of Senator Smith of Indiana after a demonstration of the telegraph by Morse for members of Congress in 1842, as reported in the 1915 book "A History of Travel in America":

> "I watched his countenance closely, to see if he was not deranged … and I was assured by other senators after we left the room that they had no confidence in it."

When Congress was asked to provide funds for a telegraph line between Baltimore and New York City, the Congressional Globe (28th Congress, second session) reported that Sen. George McDuffie opposed it, explaining that he asked:

"...What was this telegraph to do? Would it transmit letters and newspapers? Under what power in the constitution did Senators propose to erect this telegraph? He was not aware of

> any authority except under the clause for the establishment of post roads. And besides the telegraph might be made very mischievous, and secret information after communicated to the prejudice of merchants."

When Morse offered to sell his telegraph to the U.S. government for $100,000, the postmaster general rejected the offer. James D. Reid explained the rejection in his 1879 book "The Telegraph in America":

> "… the operation of the telegraph between Washington and Baltimore had not satisfied him that under any rate of postage that could be adopted, its revenues could be made equal to its expenditures."

When the first transatlantic cable was built from England to the United States and President Buchanan and Queen Victoria exchanged messages in 1858, a writer for the Times of London raved:

> "Tomorrow the hearts of the civilized world will beat in a single pulse, and from that time forth forevermore the continental divisions of the earth will, in a measure, lose those conditions of time and distance which now mark their relations."

Authors Charles F. Briggs and Augustus Maverick wrote in their 1863 book "The Story of the Telegraph":

> "Of all the marvelous achievements of modern science the electric telegraph is transcendentally the greatest and most serviceable to mankind … The whole earth will be belted with the electric current, palpitating with human thoughts and emotions … How potent a power, then, is the telegraphic destined to become in the civilization of the world! This binds together by a vital cord all the nations of the earth. It is impossible that old prejudices and hostilities should longer exist, while such an instrument has been created for an exchange of thought between all the nations of the earth."

Back 150 - Radio - 1890s-1930s

The Development of Radio

Italian inventor Guglielmo Marconi (pictured at right) first developed the idea of a radio, or wireless telegraph, in the 1890s. His ideas took shape in 1895 when he sent a wireless Morse Code message to a source more than a kilometer away. He continued to work on his new invention, and in 1897 he received the official British patent for the radio - which was really a wireless telegraph system at first. Other inventors in Russia and the United States had

been working on similar devices, but Marconi made the right political and business connections to gain the first real success with the device. By 1900 there were four competing wireless systems.

In the years just before World War I, scientists at companies such as American Telephone and Telegraph, General Electric, and Westinghouse and inventors - including Reginald Fessenden, Lee De Forest and Cyril Elwell - were mapping out ways they could develop the potential of wireless communication so it could broadcast more sophisticated messages than the dots and dashes of Morse Code.

By 1914, Fessenden, a Canadian who was once employed in Thomas Edison's labs, had worked with General Electric to build alternators that could sustain a consistent broadcast wave powerful enough to transmit voices and music over thousands of miles. Radio was developed for its military applications in the pre-World War I years, and the U.S. Navy held the patents.

In 1919, Marconi's resources were sold to General Electric and with that Radio Corporation of America (RCA, which spawned NBC Radio) - led by former Marconi employee David Sarnoff - was formed. The radio boom began, as people found it indispensable for receiving news and entertainment programs. RCA's stock price went from $85 in early 1928 to $500 by the summer of 1929. The stock market crash of 1929 dropped it down to $20 per share, but tough economic times of the 1930s couldn't stop the well-developed NBC network. The development of a vast array of programming choices in the 1930s brought the "Golden Age of Radio," and by 1939 nearly 80 percent of the United States population owned a radio.

World Changes Due to the Radio

In the boom of the 1920s, people rushed to buy radios, and business and social structures adapted to the new medium. Universities began to offer radio-based courses; churches began broadcasting their services; newspapers created tie-ins with radio broadcasts.

By 1922 there were 576 licensed radio broadcasters and the publication Radio Broadcast was launched, breathlessly announcing that in the age of radio, "government will be a living thing to its citizens instead of an abstract and unseen force."

As with television in later years, however, entertainment came to rule the radio waves much more than governmental or educational content, as commercial sponsors wanted the airtime they paid for to have large audiences. Most listeners enjoyed hearing their favorite music, variety programs that included comic routines and live bands, and serial comedies and dramas. Broadcasts of major sports events became popular as the medium matured and remote broadcasts became possible.

Radio was a key lifeline of information for the masses in the years of World War II. Listeners around the world sat transfixed before their radio sets as vivid reports of battles, victories, and defeats were broadcast by reporters including H.V. Kaltenborn and Edward R. Murrow. Franklin D. Roosevelt (seen above), Winston Churchill, Adolph Hitler and other political leaders used the medium to influence public opinion.

Past Predictions About the Future of Radio

A Boston Post editorial from 1865:

> “Well-informed people know it is impossible to transmit the voice over wires and that were it possible to do so, the thing would be of no practical value.”

Sir William Thomson, later Lord Kelvin, a Scottish mathematician and physicist, is quoted as saying in 1897:

“Radio has no future.”

A notice titled "Telegraphy Without Wires" in the Jan. 23, 1897, Scientific American, reporting on a demonstration of Marconi's radio:

"If the invention was what he believed it to be, our mariners would have been given a new sense and a new friend which would make navigation infinitely easier and safer than it now was."

A May 7, 1899 review in the New York Times headlined "Future of Wireless Telegraphy":

> "All the nations of the earth would be put upon terms of intimacy and men would be stunned by the tremendous volume of news and information that would ceaselessly pour in upon them."

According to a report in Dunlap's Radio and Television Almanac, Sir John Wolfe-Barry remarked at a meeting of stockholders of the Western Telegraph Company in 1907:

> "...As far as I can judge, I do not look upon any system of wireless telegraphy as a serious competitor with our cables. Some years ago I said the same thing and nothing has since occurred to alter my views."

A June 1920 article in Electrical Experimenter titled "Newsophone to Supplant Newspapers" reported on an idea for a news service delivered via recorded telephone messages and also predicted the "radio distribution of news by central news agencies in the larger cities to thousands of radio stations in all parts of the world" leading to a time when "anyone can simply listen in on their pocket wireless set."

H.G. Wells wrote in "The Way the World is Going" in 1925:

> "I have anticipated radio's complete disappearance…confident that the unfortunate people, who must now subdue themselves to listening in, will soon find a better pastime for their leisure."

In 1913 Lee de Forest, inventor of the audion tube, a device that makes radio broadcasting possible, was brought to trial on charges of fraudulently using the U.S. mails to sell the public stock in the Radio Telephone Company. In the court proceedings, the district attorney charged that:

> "De Forest has said in many newspapers and over his signature that it would be possible to transmit human voice across the Atlantic before many years. Based on these absurd and deliberately misleading statements, the misguided public...has been persuaded to purchase stock in his company..."

De Forest was acquitted, but the judge advised him "to get a common garden-variety of job and stick to it."

Back 150 - Telephone - 1870s-1930s

The Development of the Telephone

As with many innovations, the idea for the telephone came along far sooner than it was brought to reality. While Italian innovator Antonio Meucci (pictured at left) is credited with inventing the first basic phone in 1849, and Frenchman Charles Bourseul devised a phone in 1854, Alexander Graham Bell won the first U.S. patent for the device in 1876. Bell began his research in 1874 and had financial backers who gave him the best business plan for bringing it to market.

In 1877-78, the first telephone line was constructed, the first switchboard was created and the first telephone exchange was in operation. Three years later, almost 49,000 telephones were in use. In 1880, Bell merged this company with others to form the American Bell Telephone Company and in 1885 American Telegraph and Telephone Company (AT&T) was formed; it dominated telephone communications for the next century. At one point in time, Bell System employees purposely denigrated the U.S. telephone system to drive down stock prices of all phone companies and thus make it easier for Bell to acquire smaller competitors.

By 1900 there were nearly 600,000 phones in Bell's telephone system; that number shot up to 2.2 million phones by 1905, and 5.8 million by 1910. In 1915 the transcontinental telephone line began operating. By 1907, AT&T had a near monopoly on phone and telegraph service, thanks to its purchase of Western Union. Its president, Theodore Vail, urged at the time that a monopoly could most efficiently operate the nation's far-flung communications network. At the urging of the public and AT&T competitors, the government began to investigate the company for anti-trust violations, thus forcing the 1913 Kingsbury Commitment, an agreement between AT&T vice president Nathan Kingsbury and the office of the U.S. Attorney General. Under this commitment, AT&T agreed to divest itself of Western Union and provide long-distance services to independent phone exchanges.

During World War I, the government nationalized telephone and telegraph lines in the United States from June 1918 to July 1919, when, after a joint resolution of Congress, President Wilson issued an order putting them under the direction of the U.S. Post Office. A year later, the systems were returned to private ownership, AT&T resumed its monopolistic hold, and by 1934 the government again acted, this time agreeing to allow it to operate as a "regulated monopoly" under the jurisdiction of the FCC.

Public utility commissions in state and local jurisdictions were appointed regulators of AT&T and the nation's independent phone companies, while the FCC regulated long-distance services conducted across state lines. They set the rates the phone companies could charge and determined what services and equipment each could offer. This stayed in effect until AT&T's forced divestiture in 1984, the conclusion of a U.S. Department of Justice anti-trust suit that had been filed in 1974. The all-powerful company had become popularly known and disparaged as "Ma Bell." AT&T's local operations were divided into seven independent Regional Bell Operating Companies, known as the "Baby Bells." AT&T became a long-distance-services company.

By 1948, the 30 millionth phone was connected in the United States; by the 1960s, there were more than 80 million phone hookups in the U.S. and 160 million in the world; by 1980, there were more than 175 million telephone subscriber lines in the U.S. In 1993, the first digital cellular network went online in Orlando, Florida; by 1995 there were 25 million cellular phone subscribers, and that number exploded at the turn of the century, with cellular phone service replacing land-line phones for most U.S. customers by 2010.

World Changes Due to the Telephone

Within 50 years of its invention, the telephone had become an indispensable tool in the United States. In the late 19th century, people raved about the telephone's positive aspects and ranted about what they anticipated would be negatives. Their key points, recorded by

Ithiel de Sola Pool in his 1983 book "Forecasting the Telephone," mirror nearly precisely what was later predicted about the impact of the internet.

For example, people said the telephone would: help further democracy; be a tool for grassroots organizers; lead to additional advances in networked communications; allow social decentralization, resulting in a movement out of cities and more flexible work arrangements; change marketing and politics; alter the ways in which wars are fought; cause the postal service to lose business; open up new job opportunities; allow more public feedback; make the world smaller, increasing contact between peoples of all nations and thus fostering world peace; increase crime and aid criminals; be an aid for physicians, police, fire, and emergency workers; be a valuable tool for journalists; bring people closer together, decreasing loneliness and building new communities; inspire a decline in the art of writing; have an impact on language patterns and introduce new words; and someday lead to an advanced form of the transmission of intelligence.

Privacy was also a major concern. As is the case with the Internet, the telephone worked to improve privacy while simultaneously leaving people open to invasions of their privacy. In the beginning days of the telephone, people would often have to journey to the local general store or some other central point to be able to make and receive calls. Most homes weren't wired together, and eavesdroppers could hear you conduct your personal business as you used a public phone. Switchboard operators who connected the calls would also regularly invade people's privacy. The early house-to-house phone systems were often "party lines" on which a number of families would receive calls, and others were free to listen in and often chose to do so.

Today, while most homes are wired and people can travel freely, conducting their phone conversations wirelessly, wiretapping and other surveillance methods can be utilized to listen in on their private business. People's privacy can also be interrupted by unwanted phone calls from telemarketers and others who wish to profit in some way - just as Internet e-mail accounts receive unwanted sales pitches, known as "spam."

Yet, the invention of the telephone also worked to increase privacy in many ways. It permitted people to exchange information without having to put it in writing, and a call on the phone came to replace such intrusions on domestic seclusion as unexpected visits from relatives or neighbors and the pushy patter of door-to-door salesmen. The same could be said for the Internet - privacy has been enhanced in some ways because e-mail and instant messaging have reduced the frequency of the jangling interruptions previously dished out by our telephones.

Past Predictions About the Future of the Telephone

President Rutherford B. Hayes to Alexander Graham Bell in 1876 on viewing the telephone for the first time:

“That’s an amazing invention, but who would ever want to use one of them?”

Bell offered to sell his telephone patent to Western Union for $100,000 in 1876, when he was struggling with the business. An account that is believed by some to be apocryphal, but still recounted in many telephone histories states that the committee appointed to investigate the offer filed the following report:

"We do not see that this device will be ever capable of sending recognizable speech over a distance of several miles. Messer Hubbard and Bell want to install one of their 'telephone devices' in every city. The idea is idiotic on the face of it. Furthermore, why would any person want to use this ungainly and impractical device when he can send a messenger to the telegraph office and have a clear written message sent to any large city in the United States? … Mr. G.G. Hubbard's fanciful predictions, while they sound rosy, are based on wild-eyed imagination and lack of understanding of the technical and economic facts of the situation, and a posture of ignoring the obvious limitations of his device, which is hardly more than a toy ... This device is inherently of no use to us. We do not recommend its purchase."

As reported in the book "Bell" by Robert V. Bruce, Kate Field, a British reporter who knew Bell, predicted in 1878 that eventually:

> "While two persons, hundreds of miles apart, are talking together, they will actually *see* each other."

Sir William Preece, chief engineer for the British Post Office, 1878, as reported in "The Telephone in a Changing World" by Marion May Dilts:

> "There are conditions in America which necessitate the use of such instruments more than here. Here we have a superabundance of messengers, errand boys and things of that kind … The absence of servants has compelled America to adopt communications systems for domestic purposes."

AT&T chief engineer and Electrical Review writer John J. Carty projected in his "Prophets Column" in 1891:

> "A system of telephony without wires seems one of the interesting possibilities, and the distance on the earth through which it is possible to speak is theoretically limited only by the curvation of the earth."

Carty also wrote:

> "Someday we will build up a world telephone system, making necessary to all peoples the use of a common language or common understanding of languages, which will join all the people of the earth into one brotherhood. There will be heard throughout the earth a great voice coming out of the ether which will proclaim, 'Peace on earth, good will towards men.'"

In the 1912 article "The Future Home Theatre" in The Independent, S.C. Gilfillan wrote:

> "There are two mechanical contrivances … each of which bears in itself the power to revolutionize entertainment, doing for it what the printing press did for books. They are the talking motion picture and the electric vision apparatus with telephone. Either one will enable millions of people to see and hear the same performance simultaneously .. or successively from kinetoscope and phonographic records … These inventions will become cheap enough to be … in every home … You will have the home theatre of 1930, oh ye of little faith."

Back 150 - Television - 1920s-1960s

The Development of Television

Writers such as Walter Scott, Jules Verne, Mark Twain, and H.G. Wells began postulating the idea of "seeing at a distance" - as the earliest concepts of television were predicted in the 18th and 19th centuries. Scientists from around the world worked to perfect television for decades, with the key breakthroughs coming in the early 20th century, the invention springing from the work of many minds.

Television Now Reality; Device Demonstrated

Secretary Hoover First to Make Use of Latent Scientific Achievement

Image of Speaker is Carried by Phone and Radio.

RESULT OF YEARS OF EXPERIMENT

New York-Washington Tests Complete Success.

New York, April 7.—(AP.)—Television, a scientists' dream ever since the telephone was inventing half a century ago, became an actuality today when Secretary of Commerce Herbert Hoover spoke over the telephone in

HERBERT HOOVER.

American inventor Charles Francis Jenkins transmitted pictures of President Harding from Washington to Philadelphia by radio in 1923, and he demonstrated a mechanical television scanning system using a revolving disk in 1925. He called his invention "radiovision." He correctly predicted: "It will not be very long now before one may see on a small white screen in one's home notable current events, like inaugural ceremonies, ball games, pageants, as well as pantomime performance broadcast from motion-picture film." But Jenkins' system was slow and its images were murky.

American Telephone & Telegraph also got into the act in the early days of television, transmitting moving images of Herbert Hoover from Washington to New York over

phone circuits in 1927 using a 185-line system developed by Herbert E. Ives. In 1928, General Electric began broadcasting a 24-line mechanical image from a New York station thanks to engineer Ernest Alexanderson's development of a mechanical television system. German Denes von Mihaly, Kenjiro Takayanagi of Japan and Scottish engineer John Logie Baird built various systems in the 1920s, but none of them is seen as the "inventor" of TV.

Philo Taylor Farnsworth, 21, (pictured at right) developed what he called the "image dissector," the first working electronic camera tube, in San Francisco in 1927. As a youngster growing up in Utah and Idaho he'd read in a magazine about the idea of the broadcasting of images and sound, becoming so fascinated that he was motivated to study molecular theory and electricity. His work led him to invent the first fully electronic TV system.

In the late 1920s, Radio Corporation of America president David Sarnoff was intrigued with Farnsworth's work, and he sent engineer Vladimir Zworykin to visit Farnsworth's lab. He returned to RCA and by 1933 he had perfected his "inconoscope" - an invention nearly identical to Farnsworth's image dissector. A patent battle ensued. Litigation followed for many years, with a series of appeals before Sarnoff finally agreed to pay Farnsworth royalties.

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WRITTEN SO YOU CAN UNDERSTAND IT

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Television for the Home

Behind a Little Three-Inch-Square Aperture, the Moving Picture from the Radio Studio Appears, While the Watcher, with a Push Button in His Hand, Keeps the Picture Synchronized

In the 1930s, a number of experimental broadcast stations began producing some special television programming. Radio powers NBC and CBS built New York stations. World War II impeded the development of the medium, slowing it as people and materials were directed to this major world conflict. Television replaced radio as the dominant broadcast medium by the 1950s and took over home entertainment. Approximately 8,000 U.S. households had television sets in 1946; 45.7 million had them by 1960.

World Changes Due to Television

The pace of innovation and improvements in television and other information technologies developed in the United States over the past 100 years has been rapid, thanks to a confluence of several factors: the competitive atmosphere of the free-market economy; the laid-back role of government, which is a watchdog thus far preventing wholesale monopolies; and the spirit of invention and entrepreneurship prevalent in U.S. society.

Because other nations usually have had some sort of government control of communications technologies, they have not developed as much quality program content for television over the decades. Regulation stifled creativity and constrained production, and the economics of regulation created a situation in which producers of U.S. programming found themselves making broadcast content for the entire world.

The worldwide success of the freewheeling U.S. film and television industries over the course of the 20th century has spread images of the American culture - good and bad - to the most-distant corners of the planet. It has made entertainment one of the nation's most lucrative and influential exports.

Past Predictions About the Future of Television

Radio pioneer Lee DeForest said in 1926:

> "While theoretically and technically television may be feasible, commercially and financially I consider it to be an impossibility…a development of which we need waste little time dreaming."

A report in the "Radio Mirror" of the Daily News reported Dec. 30, 1926:

> "There may come a time when we shall have 'smellyvision' and 'tastyvision'. When we are able to broadcast so that all the senses are catered for, we shall live in a world which no one has yet dreamt about."

A report in the Indianapolis Star April 9, 1927:

> "Spectacles may be staged in distant cities and be transmitted for the entertainment of individuals hundreds of miles away. Conversations may be held across the sea and the parties see each other as clearly as though they were gathered in the same room. Distance will be annihilated for sound and sight and the world made immeasurably smaller for the purposes of communication."

At a special event unveiling the new AT&T experimental television April 7, 1927, Secretary of Commerce Herbert Hoover said:

"Human genius has now destroyed the impediment of distance in a new respect, and in a manner hitherto unknown."

British television pioneer John Logie Baird - whose experiments were with mechanical television - said during a visit to the U.S. in September 1931:

"There is no hope for television by means of cathode ray tubes."

(And in 1940, Baird said: "Cathode ray tubes are the most important items in a television receiver.")

A 1939 New York Times review of a demonstration of television at the 1939 World's Fair:

"The problem with television is that people must sit and keep their eyes glued on a screen; the average American family hasn't time for it."

George Boar, a farmhand from Suffolk, was quoted in the Feb. 1939 issue of Radio Times in an interview just after he had "invested his whole fortune" to buy a television receiver:

"Television's far more entertaining and much less trouble than a wife would be."

Film mogul Darryl F. Zanuck of 20th Century Fox said in 1946:

"Television won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a plywood box every night."

J.W. Ridgeway, chairman, Radio Industry Council, United Kingdom, Oct. 1950:

"It is inevitable that television will become the primary service and sound radio the secondary one."

Sumner Redstone, president and CEO of the major media company Viacom, as quoted in Screen International, Oct. 21, 1994:

" I am very skeptical of this talk of 500 channels. I just don't know what's going to play on them."

Back 150 - Internet - 1960s-1990s

The Development of the Internet

The public internet came along after four decades of television dominance and decades of private internet use and development. It came along after hundreds of years of inventive thinking and groundbreaking theorizing, and it built on every bit of human intelligence that had come before. The key innovators were dozens of scientists whose work covers decades; the entrepreneurs were thousands of political leaders, policy wonks, technology administrators, government and commercial contractors, and even grassroots organizers

In the early 1960s, J.C.R. Licklider (pictured above), Leonard Kleinrock, Donald Davies, Paul Baran, Lawrence Roberts and other research scientists came up with the ideas that allowed them to individually dream of and eventually come together to create a globally interconnected set of computers through which everyone could quickly and easily access data and programs from any site.

The first group of networked computers communicated with each other in 1969, and ARPANET, or the Advanced Projects Research Agency Network became the start of the internet. Four U.S. universities were connected and became a research system by which computer scientists began solving problems and building the potential for worldwide, online connectivity. ARPANET had its first public demonstration in 1972, and in this same year the first e-mail program was written by Ray Tomlinson. By 1973, a majority of the internet use was for e-mail discussion.

Vint Cerf and Robert Kahn came up with a streamlined networking standard - internet Protocol or IP - in the late 1970s. At the time, there were still only 188 host computers on the network, but IP brought new growth in the next few years. In 1984, a domain-name service was created, allowing the organization and classification of the world's online sites. This address system is still in use today; for example, .com, .org, .edu. More have since been added.

In 1991, the World Wide Web was developed by Tim Berners-Lee (pictured at left) as a way for people to share information. The hyper-text format available through his Web made the internet much easier to use because all documents could be seen easily on-screen without downloading. The first "browser" software - Mosaic - was introduced by Marc Andreessen in 1993, and it enabled more fluid use of images and graphics online and opened up a new world for internet users.

In 1996, there were approximately 45 million people using the Internet. By 1999, the number of worldwide Internet users reached 150 million, and more than half of them were from the United States. In 2000, there were 407 million users worldwide. By 2004, there were between 600 and 800 million users (counting has become more and more inexact as the network has grown, and estimates vary).

The internet is a work in progress. While IP version 6 is now ready for implementation, some scientists - led by internet pioneer David Clark and others - are working toward a complete reinvention of the worldwide internet, starting from scratch. The project is expected to develop over the next decade.

World Changes Due to the Internet

After Berners-Lee brought his "World-Wide Web" to life in 1990, and Andreessen launched Mosaic, the revolutionary browser, in 1993, the Internet had an estimated 16 million users by 1995, and venture capitalists were busy full-time, funding hundreds of new Internet-related business concerns. Individuals all over the world are sharing their interests, hopes and dreams online, and the number of internet users is nearing a billion.

Thanks to the work of thousands of collaborators over the final four decades of the 20th century, today's Internet is a continually expanding worldwide network of computer networks for the transport of myriad types of data. In addition to the names above, there were direct contributions from Ivan Sutherland, Robert Taylor, Alex McKenzie, Frank Heart, Jon Postel, Eric Bina, Robert Cailliau, Tom Jennings, Mark Horton, Bill Joy, Douglas Engelbart, Bill Atkinson, Ted Nelson, Linus Torvalds, Richard Stallman and so many others - some of them anonymous hackers or users - it is impossible to include them all.

Wireless satellite and broadband communications networks are helping people in even the most remote locations find ways to connect. Overcoming the initial concerns that commercialization would limit creativity or freedom of speech, the Internet has become a crazy-quilt mix of commercial sites, government information, and incredibly interesting pages built by individuals who want to share their insights.

The number of people making Internet pages continues to grow. As of mid-2004, more than 63 million domain names had been registered, approximately one for every 100 people living in the world.

Past Predictions About the Future of the Internet

Mondo 2000 editor R.U. Sirius (real name, Ken Goffman), as quoted in a 1992 article in the Bergen (N.J.) Record headlined "Unfolding the Future":

> Who's going to control all this technology? The corporations, of course. And will that mean your brain implant is going to come complete with a corporate logo, and 20 percent of the time you're going to be hearing commercials?

Peter Huber, a senior fellow at the Manhattan Institute, quoted in a 1992 Forbes article titled "An Ultimate Zip Code":

> Combine GPS with a simple transmitter and computer ... If you want to track migratory birds, prisoners on parole or – what amounts to much the same thing – a teenage daughter in possession of your car keys, you are going to be a customer sooner or later.

David Porush, a professor at the Rensselaer Polytechnic Institute, in a 1992 speech for the Library and Information Technology Association:

> If cyberspace is utopian it is because it opens the possibility of using the deterministic platform for unpredictable ends ... We might even grow a system large and complex and unstable enough to leap across that last possible bifurcation - autopoetically - into that strangest of all possible attractors, the godmind.

Author and Wired magazine columnist Bruce Sterling, in a 1993 Wired article headlined "War is Virtual Hell":

> The whole massive, lethal superpower infrastructure comes unfolding out of 21st-century cyberspace like some impossible fluid origami trick. The Reserve guys from the bowling leagues suddenly reveal themselves to be digitally assisted Top Gun veterans from a hundred weekend cyberspace campaigns. And they go to some godforsaken place that doesn't possess Virtual Reality As A Strategic Asset, and they bracket that army in their rangefinder screens, and then they cut it off, and then they kill it. Blood and burning flesh splashes the far side of the glass. But it can't get through the screen.

Futurist Jim Dator, in a speech to the WFSF World Conference in 1993:

> As the electronic revolution merges with the biological evolution, we will have - if we don't have it already - artificial intelligence, and artificial life, and will be struggling even more than now with issues such as the legal rights of robots, and whether you should allow your son to marry one, and who has custody of the offspring of such a union.

Futurist Alvin Toffler, in a 1993 Wired article titled "Shock Wave (Anti) Warrior":

> If we are now in the process of transforming the way we create wealth, from the industrial to the informational … the more knowledge-intensive military action

> becomes, the more nonlinear it becomes; the more a small input someplace can neutralize an enormous investment. And having the right bit or byte of information at the right place at the right time, in India or in Turkistan or in God knows where, could neutralize an enormous amount of military power somewhere else … Think in terms of families. Think in terms of narco-traffickers. And think in terms of the very, very smart hacker sitting in Tehran.

John Perry Barlow, internet activist and co-founder of the Electronic Frontier Foundation, in a 1994 essay for Wired magazine titled "The Economy of Ideas":

> We're going to have to look at information as though we'd never seen the stuff before ... The economy of the future will be based on relationship rather than possession. It will be continuous rather than sequential. And finally, in the years to come, most human exchange will be virtual rather than physical, consisting not of stuff but the stuff of which dreams are made. Our future business will be conducted in a world made more of verbs than nouns.

Tom Maddox, in a 1994 article for Wilson Quarterly titled "The Cultural Consequences of the Information Superhighway":

> The sharp-edged technology of the NII can cut a number of ways: It can enlarge the domain of the commodifiers and controllers; it can serve the resistance to these forces; it can saturate us all, controlled and controllers alike, in a virtual alternative to the real world. Meanwhile, most of humanity will live and die deprived of the wonders of the NII, or indeed the joys of adequate nutrition, medical care, and housing. We would do well to regulate our enthusiasms accordingly - that is, to remember where love and mercy have their natural homes, in that same material world. Otherwise we will have built yet another pharaonic monument to wealth, avarice, and indifference. We will have proved the technophobes right. More to the point, we will have collaborated to neglect the suffering of the damned of the earth – our other selves – in order to entertain ourselves.

Nicholas Negroponte, in a 1995 column for Wired magazine titled "Wearable Computing":

> How better to receive audio communications than through an earring, or to send spoken messages than through your lapel? Jewelry that is blind, deaf, and dumb just isn't earning its keep. Let's give cuff links a job that justifies their name ... And a shoe bottom makes much more sense than a laptop - to boot up, you put on your boots. When you come home, before you take off your coat, your shoes can talk to the carpet in preparation for delivery of the day's personalized news to your glasses.

Greg Blonder, in a 1995 essay for Wired magazine titled "Faded Genes":

> In 2088, our branch on the tree of life will come crashing down, ending a very modest (if critically acclaimed) run on planet earth. The culprit? Not global warming. Not atomic war. Not flesh-eating bacteria. Not even too much television. The culprit is the integrated circuit ... By 2090, the computer will be twice as smart and twice as insightful as any human being. It will never lose a game of chess, never forget a face, never forget the lessons of history. By 2100, the gap will grow to the point at which homo sapiens, relatively speaking, might make a good pet. Then again, the computers of 2088 might not give us a second thought.

Hans Moravec, as quoted in a 1995 article in Wired titled "Superhumanism":

> The robots will re-create us any number of times, whereas the original version of our world exists, at most, only once. Therefore, statistically speaking, it's much more likely we're living in a vast simulation than in the original version. To me, the whole concept of reality is rather absurd. But while you're inside the scenario, you can't help but play by the rules. So we might as well pretend this is real - even though the chance things are as they seem is essentially negligible.

Back 150 - Related Resources

For online information about telegraph history, try these links:

- The History of the Telegraph and Telegraphy (About.com):

http://inventors.about.com/library/inventors/bltelegraph.htm

- Telegraphy, from Wikipedia, the free encyclopedia:

http://en.wikipedia.org/wiki/Telegraphy

- History, Theory and Construction of the Electric Telegraph

http://www.chss.montclair.edu/~pererat/pertel.htm

- Technical History of the Electromagnetic Telegraph

http://www.du.edu/~jcalvert/tel/morse/morse.htm

- History Wired – a Smithsonian Institution online gallery:

http://historywired.si.edu/

- "Building Telegraph Networks" a page at the Connected Earth site sponsored by British Telecom:
http://www.connected-earth.com/Galleries/Telecommunicationsage/Thetelegraph/Buildingtelegraphnetworks/index.htm

For online information about telephone history, try these links:

The History of the Telephone (About.com):
http://inventors.about.com/library/inventors/bltelephone.htm

Telephone, from Wikipedia, the free encyclopedia:
http://en.wikipedia.org/wiki/Telephone

"The Telephone" a page at the Connected Earth site sponsored by British Telecom:
http://www.connected-earth.com/Galleries/Telecommunicationsage/Thetelephone/index.htm

The Telephony Museum website:
http://www.telephonymuseum.com

For online information about radio history, try these links:

The Invention of Radio (About.com)
http://inventors.about.com/library/inventors/blradio.htm

Radio, from Wikipedia, the free encyclopedia:
http://en.wikipedia.org/wiki/Radio

Radio Pioneers, from the Federal Communications Commission site:
http://www.fcc.gov/omd/history/radio/

Marconi's biography on the Nobel Prize site – also use a link here to read the speech that introduced his award:
http://nobelprize.org/physics/laureates/1909/marconi-bio.html

"Wireless" a page at the Connected Earth site sponsored by British Telecom:
http://www.connected-earth.com/Galleries/Telecommunicationsage/Awirelessworld/index.htm

United States Early Radio History, a wonderfully detailed site by Thomas H. White:
http://earlyradiohistory.us/

The History of Radio: Radio the Roots of Broadcasting:
http://www.tvhandbook.com/History/History_radio.htm

Old-Time Radio – about programs from radio's "golden age":
http://www.old-time.com/

For online information about television history, try these links:

Television History (About.com):

http://inventors.about.com/library/inventors/bltelevision.htm

Television, from Wikipedia, the free encyclopedia:
http://en.wikipedia.org/wiki/Television

Historical Periods in Television, from the Federal Communications Commission site:
http://www.fcc.gov/omd/history/tv/

Television History - The First 75 Years
http://www.tvhistory.tv/

The Early Television Museum
http://www.earlytelevision.org/history.html

"The Video Age" a page at the Connected Earth site sponsored by British Telecom:
http://www.connected-earth.com/Galleries/Telecommunicationsage/Thevideoage/index.htm

The History of Television: The Revolution of Television:
http://www.tvhandbook.com/History/History_TV.htm

The History of Digital Television:
http://www.tvhandbook.com/news/history_dtv.htm

For online information about internet history, try these links:

All About the Internet, from the Internet Society:
http://www.isoc.org/internet/history/brief.shtml

W3C's A Little History of the World Wide Web:
http://www.w3.org/History.html

"The Internet: A Short History," from the Federal Communications Commission site:
http://www.fcc.gov/omd/history/internet/

The Internet Archive – packed with history:
http://www.archive.org/ - the home page
http://www.archive.org/details/arpanet - a page with links to original ARPANET info.

The Living Internet:
http://www.livinginternet.com/

Nethistory, and informal history of BITNET and the internet:

http://nethistory.dumbentia.com/

Internet, from Wikipedia, the free encyclopedia:
http://en.wikipedia.org/wiki/Internet

The Internet Society list of history links:
http://www.isoc.org/internet/history

Hobbes' Internet Timeline:
http://www.zakon.org/robert/internet/timeline/

The Wired magazine archive:
http://www.wired.com/wired/archive/

The Internet History Mailing List:
http://www.postel.org/internet-history/

Books offer information-technology history lessons

To read more about the history of the telegraph, see:

Menahem Blondheim, "News Over the Wires" (Cambridge, MA: Harvard University Press, 1994).

Charles F. Briggs and Augustus Maverick, "The Story of the Telegraph" (New York: Rudd & Carleton, 1863).

Lewis Coe, "The Telegraph: A History of Morse's Invention and Its Predecessors in the United States" (Jefferson, NC: McFarland & Company, 1993).

George P. Oslin, "The Story of Telecommunications," (Macon, GA: Mercer University Press, 1992).

Frank Parsons, "The Telegraph Monopoly" (Philadelphia: C.F. Taylor, 1899).

Victor Rosewater, "History of Cooperative News-Gathering in the United States" (New York: D. Appleton & Company, 1930).

Tom Standage, "The Victorian Internet" (New York: Walker & Company, 1998).

Robert Luther Thompson, "Wiring a Continent: The History of the Telegraph Industry in the United States, 1832-1866 (Princeton, NJ: Princeton University Press, 1947).

Frederick Williams, "The Communications Revolution" (Beverly Hills, CA: Sage, 1982).

To read more about the history of radio, see:

Hugh G. J. Aitken, "Syntony and Spark: The Origins of Radio" (New York: Wiley, 1976).

Hugh G.J. Aitken, "The Continuous Wave: Technology and American Radio, 1900-1932" (Princeton, NJ: Princeton University Press, 1985).

W.J. Baker, "A History of the Marconi Company" (London: Methuen & Co. Ltd., 1970).

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Kenneth Bilby, "The General: David Sarnoff and the Rise of the Communications Industry" (New York: Harper & Row, 1986).

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J.C.W. Reith, "Broadcast Over Britain" (London: Hodder & Stoughton, 1924).

To read more about the history of the telephone, see:

H.M. Boettinger, "The Telephone Book: Bell, Watson, Vail and American Life, 1876-1983" (Stearn, 1983).

Robert V. Bruce, "Bell: Alexander Graham Bell and the Conquest of Solitude" (Boston: Little, Brown, 1973).

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Ithiel de Sola Pool, "Forecasting the Telephone: A Retrospective Technology Assessment of the Telephone" (Norwood, NJ: Ablex Publishing Company, 1983).

Claude S. Fischer, "America Calling" (Berkeley: University of California Press, 1992).

Edwin S. Grosvenor and Morgan Wesson, "Alexander Graham Bell: The Life and Times of the Man Who Invented the Telephone" (Harry Abrams, 1997).

John E. Kingsbury, "The Telephone and Telephone Exchanges: Their Invention and Development" (Longmans, Green, 1915; reprinted by Arno Press, 1972).

George B. Prescott, "Bell's Electric Speaking Telephone: Its Invention, Construction, Application, Modification and History" (D. Appleton, 1884; reprinted by Arno Press, 1972).

George Shiers, "The Telephone: An Historical Anthology" (Printed in Arno Press, "Historical Studies in Telecommunications," 1977).

To read more about the history of television, see:

Albert Abramson, "History of Television, 1880-1941" (Jefferson, NC: McFarland, 1987).

Erik Barnouw, "Tube of Plenty: The Evolution of American Television" (New York: Oxford, 1990).

R.W. Burns, "John Logie Baird: Television Pioneer" (London: Institution of Electrical Engineers, 2000).

D.G. Fink, "Television Broadcasting in the United States, 1927-1950," Proceedings of the IRE (February 1951), 116-123.

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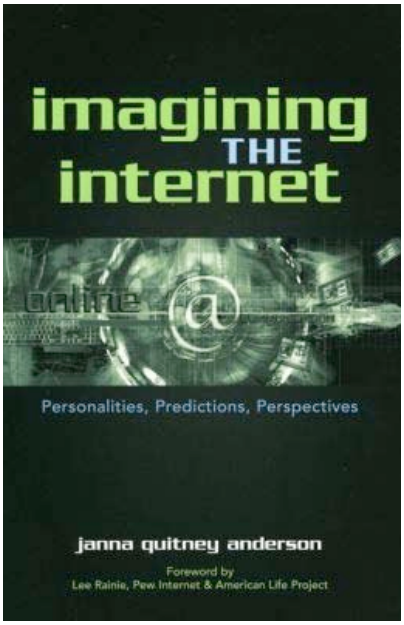
Hugh R. Slotten, "Radio and Television Regulation: Broadcast Technology in the United States, 1920-1960" (Baltimore: Johns Hopkins University Press, 2000).

Joseph H. Udelson, "The Great Television Race: History of the American Television Industry, 1925-1941" (University of Alabama Press, 1982).

To read more about the history of the internet, see:



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Katie Hafner and Matthew Lyon, "Where Wizards Stay Up Late: The Origins of the Internet" (New York: Touchstone, 1996).

Nicholas Negroponte, "Being Digital" (New York: Vintage, 1996): portions available online at http://archives.obs-us.com/obs/english/books/nn/bdcont.htm.

Howard Rheingold, "The Virtual Community" (Cambridge, MA: MIT Press, 2000); 1993 version available online at http://www.well.com/user/hlr/vcbook/vcbookintro.html.

William Mitchell, "City of Bits: Space, Place and the Infobahn" (Cambridge, MA: MIT Press, 1996); available online at http://mitpress2.mit.edu/e-books/City_of_Bits/.

Excerpted from the Elon University/Pew Internet Imagining the Internet site: www.elon.edu/predictions