Appendix A (Thesis)

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1 Appendix A - Technology timelines

Sources: (Anon, n.d.; Firm), 1990; Boyne et al., 1979; Gunston, 1998; Anderson Jr, 1999; Anon, n.d.)

Year	Event	Major event
1855	German, Heinrich Geissler invents the Geissler tube. Created using his mercury pump this was the first practical evacuated (of air) vacuum tube, which was later modified by Sir William Crookes.	YES
1859	German mathematician and physicist, Julius Plucker first identifies and experiments with cathode rays.	YES
1872	Joseph May discovers that selenium's conductivity is enhanced by light.	YES
1878	Englishmen, Sir William Crookes was the first person to confirm the existence of cathode rays by displaying them, with his invention of the Crookes tube, a crude prototype for all future cathode ray tubes.	YES
1878	Mr. Senleq proposes FAX transmission using a selenium scanner and telegraphy.	
1880	First articles appear in Scientific American about the possibility of television.	YES
1884	The first electromechanical television (i.e. television scanning disk) was proposed and patented by Paul Julius Gottlieb Nipkow. Nipkow never built a working model of the electromechanical television.	YES
1888	Liquid Crystals were accidentally discovered by Friedrich Reinitzer. Liquid crystals were a scientific curiosity for about 80 years before they were used to build liquid crystal displays (LCD).	YES
1890s	Victorian Trade Card predicts a device that can transmit picture and sound.	
1897	The Birth of CRT: Karl Ferdinand Braun, a Nobel-prize winning German physicist and inventor, builds the first CRT (Cathode-Ray Tube) oscilloscope, which consists of a vacuum tube that can produce images via electron beams hitting a phosphorescent surface. The technology will later be used to display images on early televisions and computer monitors. The Braun Tube was also the forerunner of radar tubes.	YES
1900	First known use of the word "television" at 1900 Paris Exhibition	
1907	Discovery of Electroluminescence: British radio researcher Henry Joseph Round discovers electroluminescence, a natural phenomena that serves as the foundation upon which LED technology will later be built.	YES
1907	Russian scientist Boris Rosing (who worked with Vladimir Kosma Zworykin) uses a CRT in the receiver of a television system that at the camera end made use of mirror-drum scanning. Rosing is the first to transmit crude geometrical patterns onto a television screen using CRT.	YES
1908	Campbell Swinton proposes CRT for both scanning and receiving.	YES
1911	Rosing and college student Vladimir Kosma Zworykin (as assistant), achieve first transmission of images.	YES
1911	Swinton describes CRT system in detail.	YES
1919	RCA becomes subsidiary of GE. A 28 year old David Sarnoff is named manager.	
1921	Philo T. Farnsworth, at age 14, has a vision of electronic TV scanning whilst plowing hay.	
1922	C. Francis Jenkins transmits still pictures by wireless with a mechanical system.	YES
1922	Farnsworth explains his electronic TV system to his high school teacher.	
1923	As a Westinghouse employee, Zworykin files a patent application for an all-electronic television system. He is not able to build or demonstrate it at this time.	YES
1923	Ernst Alexanderson starts television work at GE.	
1924	Kenjiro Takayanagi starts his television work in Japan.	
1925-1928	Glimpses of TV's Capabilities: John Logie Baird, a Scottish engineer, demonstrates some of the capabilities of television including transmitting recognisable human faces (1925), moving objects (1926) and colour (1928).	YES
1925	Baird demonstrates his mechanical system at Selfridge's Store in London	YES
1925	Jenkins transmits "moving objects" – (a windmill) in Washington, D.C.	YES
1925	Zworykin demonstrates a working system to his bosses at Westinghouse.	YES
1925	Baird builds the world's first working television system. The world's first working television system was electromechanical.	YES
1926	Baird gets his first license to transmit television in London.	YES
1926	Farnsworth receives a $6000 advance from George Everson in Salt Lake City.	
1926	Philo Farnsworth marries Elma Gardner, and moves to San Francisco.	
1926	Alexanderson is proclaimed the "Inventor of Television" by the press in St. Louis.	
1927	January - Alexanderson demonstrates mechanical TV to Radio Engineers.	YES

Year	Event	Major event
1821	Michael Faraday creates the first weak experimental electromagnet	
1828	Hungarian inventor Ányos Jedlik, who had invented an early electric motor, builds a small, model car powered by this motor.	YES
1831	Joseph Henry, a math professor in Albany NY, builds the first electric motor in his quest to understand electro-magnetism. It is modeled along the lines of the "walking beam" used on early steam engines and resembles an electric teeter-totter.	
1832-1839	Scottish inventor Robert Anderson invents the first crude electric carriage powered by non-rechargeable primary cells.	YES
1834	Inspired by reading of Joseph Henry's efforts blacksmith Thomas Davenport and his wife Emily develop the first rotary direct current electric motor and build a miniature electric railcar running in a circle on a tabletop; it is not strong enough to carry the weight of its own battery. The Davenports use silk from Emily's wedding dress as wiring. His invention failed to interest investors. This might have been due to a lack of imagination among his audience, but practical minded people would point out the dependency on relatively expensive single use batteries, as neither practical rechargeable batteries, nor distributed electric power are available. He creates a proof of concept, which is generally ignored until after the Civil War.	YES
1835	In the Netherlands, Professor Sibrandus Stratingh of Groningen and his assistant, Christopher Becker, build a small electric car powered by primary cells (nonrechargeable batteries).	
1837	Thomas & Emily Davenport, and colleague Orange Smalley, receive the first American patent for an electric machine/motor.	YES
1837 & 1841	Large-scale "electric cars" are finally built by chemist Robert Davidson of Aberdeen. Powered by galvanic cells, the larger one, built in 1841, can pull 6 tons at 4 miles per hour for about 1½ miles. It weighs 7 tons. Sadly, it is soon destroyed by railway workers who see it as a potential threat to their livelihood (even though electric cars were still far from economical, with the cost of using zinc in a battery being about 40 times higher than the cost of burning coal in a firebox).	YES
1851	The US Senate funds a prototype electric locomotive, which made a test run from Washington DC to Baltimore MD, a distance of about 40 miles (64 km). Charles Grafton Page, a US patent examiner, designs it and uses his Washington connections to get funding. The motor was like an electric steam engine with a solenoid and iron mass rather than a cylinder and piston. The effort fails when the clay separators in the primary battery cells crack and the solenoid coils overheat and short out as the insulation fails. Steam remains more practical for large-scale power at this point.	
1854	Wilhelm J. Sinsteden invents the rechargeable, lead, sulfuric acid, and lead-oxide battery	
1859	French physicist Gaston Planté improves the lead acid cell to the point of commercial viability with telegraph system use in mind and invents the rechargeable lead-acid storage battery. The original Planté design had smooth, untreated lead plates separated by parchment paper and felt. They had to be cycled (recharged) many times before building up a sufficient peroxide coating on the positive plate to develop full useful capacity. Lead-acid batteries are still used in some electric cars as of 2015, and are used in gas-powered cars to help start the engines. However, most modern electric cars use lithium-ion batteries. The lead-acid batteries used to start cars are still very similar to what Gaston created.	
1869	Zenobe-Theophile Gramme patents the first practical dynamo in Paris.	
1876	Nikolaus August Otto patents a practical four-stroke engine, designed for stationary use, in Germany. The engine is made to run with help from his engineer Gottlieb Daimler.	YES
1880 – January 17th	Thomas Alva Edison is awarded a carbon-filament vacuum tube light bulb patent. This incandescent light becomes popular over the next three decades as the lamps become more affordable. The commercial generation and distribution of electricity for lighting, and light rail, built the necessary infrastructure for electric cars. Edison had to fight for clear patent rights, and eventually the strongest plaintiffs merged to become General Electric.	YES
1881	Camille Alphonse Faure, in France, and Charles F. Brush, in the US, independently	

Year	Event	Major event
Circa 2500 BC	Earliest known glass.	YES
Roman Times	Glass is drawn into fibers.	YES
1713	Réné de Réaumur makes spun glass fibers.	YES
1790s	Claude Chappe invents "optical telegraph" in France.	YES
1841	Daniel Colladon demonstrates light guiding in jet of water in Geneva; it also is demonstrated in London and Paris.	YES
1842	Daniel Colladon publishes report on light guiding in Comptes Rendus; Jacques Babinet also reports light guiding in water jets and bent glass rods.	YES
1853	Paris Opera uses Colladon's water jet in the opera Faust.	
1854	John Tyndall demonstrates light guiding in water jets at the suggestion of Michael Faraday, duplicating but not acknowledging Colladon.	
1873	Jules de Brunfaut makes glass fibers that can be woven into cloth.	YES
1880	Alexander Graham Bell invents Photophone.	YES
1880	William Wheeler invents system of light pipes to illuminate homes from an electric arc lamp in basement, Concord, Mass.	YES
1884	International Health Exhibition in South Kensington district of London has first fountains with illuminated water jets, designed by Sir Francis Bolton. Colladon republishes his 1842 paper to show the idea was his.	
1887	Charles Vernon Boys draws quartz fibers for mechanical measurements.	YES
1887	Royal Jubilee Exhibition in Manchester has illuminated "Fairy Fountains" designed by W. and J. Galloway and Sons.	
1888	Dr. Roth and Prof. Reuss of Vienna use bent glass rods to illuminate body cavities for dentistry and surgery.	YES
1889	Universal Exhibition in Paris shows refined illuminated fountains designed by G. Bechmann.	
1892	Herman Hammesfahr shows glass dress at Chicago World's Fair.	
1895	Henry C. Saint-René designs a system of bent glass rods for guiding light in an early television scheme (Crezancy, France).	YES
1898	David D. Smith of Indianapolis applies for patent on bent glass rod as a surgical lamp.	YES
1920s	Bent glass rods common for microscope illumination.	YES
June 2, 1926	C. Francis Jenkins applies for US patent on a mechanical television receiver in which light passes along quartz rods in a rotating drum to form an image.	YES
October 15, 1926	John Logie Baird applies for British patent on an array of parallel glass rods or hollow tubes to carry image in a mechanical television. He later built an array of hollow tubes.	YES
December 30, 1926	Clarence W. Hansell proposes a fiber-optic imaging bundle in his notebook at the RCA Rocky Point Laboratory on Long Island. He later receives American and British patents.	YES
1930	Heinrich Lamm, a medical student, assembles first bundle of transparent fibers to carry an image (of an electric lamp filament) in Munich. His effort to file a patent is denied because of Hansell's British patent.	YES
December 1931	Owens-Illinois mass-produces glass fibers for Fiberglas.	YES
August 20, 1932	Norman French of Bell Labs applies for patent on an "optical telephone system" using quartz rods.	YES
Mid-1930s	Frank Hyde develops flame hydrolysis to make fused silica at Corning Glass Works.	YES
1939	Curvlite Sales offers illuminated tongue depressor and dental illuminators made of Lucite, a transparent plastic invented by DuPont.	
October 31, 1945	Ray D. Kell and George Sziklai apply for patent on transmitting signals through quartz or glass rods, issued May 9, 1950.	YES
Circa 1949	Holger Møller Hansen in Denmark and Abraham C. S. van Heel at the Technical University of Delft begin investigating image transmission through bundles of parallel glass fibers.	YES

Year	Event	Major event
1807	As European settlers moved westward across the continent, they gravitated toward warm springs. In 1807, the first European to visit the Yellowstone area, John Colter, probably encountered hot springs, leading to the designation "Colter's Hell." Also in 1807, settlers founded the city of Hot Springs, Arkansas, where, in 1830, Asa Thompson charged one dollar each for the use of three spring-fed baths in a wooden tub, making this the first known commercial use of geothermal energy.	YES
1847	William Bell Elliot, a member of John C. Fremont's survey party, stumbles upon a steaming valley just north of what is now San Francisco, California. Elliot calls the area The Geysers—a misnomer—and thinks he has found the gates of Hell.	
1852	The Geysers is developed into a spa called The Geysers Resort Hotel. Guests include J. Pierpont Morgan, Ulysses S. Grant, Theodore Roosevelt, and Mark Twain.	
1862	At springs located southeast of The Geysers, businessman Sam Brannan pours an estimated half million dollars into an extravagant development dubbed "Calistoga," replete with hotel, bathhouses, skating pavilion, and racetrack. Brannan's was one of many spas reminiscent of those of Europe.	
1864	Homes and dwellings have been built near springs through the millennia to take advantage of the natural heat of these geothermal springs, but the construction of the Hot Lake Hotel near La Grande, Oregon, marks the first time that the energy from hot springs is used on a large scale.	YES
1892	Residents in Boise, Idaho, receive the world's first district heating system as water is piped from hot springs to town buildings. Within a few years, the system is serving 200 homes and 40 downtown businesses. Today, there are four district heating systems in Boise that provide heat to over 5 million square feet of residential, business, and governmental space. Although no one imitated this system for some 70 years, as of 2013 there are 17 district heating systems in the United States and dozens more around the world.	YES
1900	Hot springs water is piped to homes in Klamath Falls, Oregon.	YES
1904	The first dry steam geothermal power plant was built in Larderello in Tuscany, Italy, by Prince Piero Ginori Conti. The Larderello plant today provides power to about 1 million households.	YES
1921	John D. Grant drills a well at The Geysers with the intention of generating electricity. This effort is unsuccessful, but one year later Grant meets with success across the valley at another site, and the United States' first geothermal power plant goes into operation. Grant uses steam from the first well to build a second well, and, several wells later, the operation is producing 250 kilowatts, enough electricity to light the buildings and streets at the resort. The plant, however, is not competitive with other sources of power, and it soon falls into disuse.	
1921	Hot Springs National Park in Arkansas is created.	
1927	Pioneer Development Company drills the first exploratory wells at Imperial Valley, California.	
1930	The first commercial greenhouse use of geothermal energy is undertaken in Boise, Idaho. The operation uses a 1000-foot well drilled in 1926. In Klamath Falls, Charlie Lieb develops the first downhole heat exchanger (DHE) to heat his house. As of 2013, more than 500 DHEs are in use around the US.	YES
1940	The first residential space heating in Nevada begins in the Moana area in Reno.	
1948	Geothermal technology moves east when Professor Carl Nielsen of Ohio State University develops the first ground-source heat pump, for use at his residence. J.D. Krocker, an engineer in Portland, Oregon, pioneers the first commercial building use of a groundwater heat pump.	YES
1958	New Zealand builds the first new Geothermal electricity powerplant since Larderello	YES
1960	The United States' first large-scale geothermal electricity-generating plant begins operation. Pacific Gas and Electric operates the plant, located at The Geysers. The first turbine produces 11 megawatts (MW) of net power and operates successfully for more than 30 years. By 2013, 69 generating facilities are in operation at 18 resource sites around the US.	YES
1970	Re-injection of spent geothermal water back into the production reservoir was introduced as a way to dispose of waste water and to extend reservoir life.	

Year	Event	Major event
B.C.	Hydropower was used by the Greeks to turn water wheels for grinding grains more than 2000 years ago.	
1753	French hydraulic and military engineer Bernard Forest de Belidor wrote Architecture Hydraulique, a four-volume work describing vertical- and horizontal-axis machines.	
1832	Reaction water turbine developed by Benoit Fourneyron	YES
1847	Inward-flow water turbine developed by James B. Francis	YES
1880–95	Hydropower was beginning to be used for electricity. The first hydroelectric plants were direct current (DC) stations used to power nearby arc and incandescent lighting.	
1880	Michigan's Grand Rapids Electric Light and Power Company generated DC electricity, using hydropower at the Wolverine Chair Factory. A dynamo belted to a water turbine at the factory generated electricity to light 16 brush-arc lamps in the store front.	YES
1881	Street lamps in the city of Niagara Falls were powered by hydropower (direct current).	YES
1882	The world's first central DC hydroelectric station provided power for a paper mill in Appleton, Wisconsin.	YES
1886	Between 40 to 50 hydroelectric plants were operating in the United States and in Canada.	
1888	About 200 electric companies relied on hydropower for at least part of their generation.	
1889	Pelton machines (jet-driven turbines) introduced	YES
1889	The first AC hydroelectric plant in the US, Williamette Falls Station, began operation in Oregon City, Oregon.	YES
1893	The Austin Dam, near Austin, Texas, was completed. It was the first dam specifically designed for generating hydropower.	YES
1895–96	The Niagara Falls hydropower station opened. It originally provided electricity to the local area. One year later, when a new AC powerline was opened, electric power from Niagara Falls was sent to customers over 20 miles away in Buffalo, New York.	YES
1901	The first Federal Water Power Act required special permission for a hydroelectric plant to be built and operated on any stream large enough for boat traffic.	
1902	The Reclamation Act of 1902 created the United States Reclamation Service, later renamed the U.S. Bureau of Reclamation. The Reclamation Service was formed to manage water resources and was given the authority to build hydropower plants at dams.	
1905	The Reclamation Service installed a hydropower plant at the Arizona construction site of the Theodore Roosevelt Dam. The power plant was originally built to provide electricity for constructing the dam, but sales of extra electricity helped pay for the project and improved life in the local community.	
1920	Federal Power Act established the Federal Power Commission (later replaced by the Federal Energy Regulatory Commission) to issue licenses for hydropower development on public lands in the U.S.	
1933	The Tennessee Valley Authority (TVA) was established to take charge of the hydroelectric potential of the Mississippi River in the Tennessee Valley.	
1933	Construction of the Grand Coulee Dam began on the Columbia River. Originally built to meet irrigation needs, it had more electric generating capacity than any other dam in North America.	
1935	Federal Power Commission authority was extended to all hydroelectric projects built by utilities engaged in interstate commerce.	
1936	Boulder Dam (later renamed the Hoover Dam) began operating on the Colorado River. The hydropower plant produced up to 130000 kilowatts of electricity.	YES
1937	The U.S. Army Corp of Engineers finished the Bonneville Dam, on the Columbia River in Oregon and Washington.	
1937	The Bonneville Power Administration (BPA) was established.	
1941	Grand Coulee, the United States' largest hydroelectric dam, began operation.	
1949	Almost one-third of the United States' electricity came from hydropower.	
1961	The Columbia River Treaty was signed between the United States and Canada. Under the treaty, Canada built two dams for storage and one dam for generation. This resulted in greater power and flood control, which benefited U.S. facilities downstream.	
1977	The Federal Power Commission was disbanded by Congress. A new agency was created, the Federal Energy Regulatory Commission (FERC), to regulate energy production and transmission.	
1978	Congress passed the Public Utility Regulatory Policies Act (PURPA) of 1978. The Act	YES

Year	Event	Major event
1957	USSR launches Sputnik, first artificial earth satellite. In response, US forms the Advanced Research Projects Agency (ARPA), the following year, within the Department of Defense (DoD) to establish US lead in science and technology applicable to the military	YES
1961	Leonard Kleinrock, MIT: "Information Flow in Large Communication Nets" (May 31): First paper on packet-switching (PS) theory	YES
1962	J.C.R. Licklider & W. Clark, MIT: "On-Line Man Computer Communication" (August): Galactic Network concept encompassing distributed social interactions	YES
1964	Paul Baran, RAND: "On Distributed Communications Networks": Packet-switching networks; no single outage point	YES
1965	ARPA sponsors study on "cooperative network of time-sharing computers": TX-2 at MIT Lincoln Lab and AN/FSQ-32 at System Development Corporation (Santa Monica, CA) are directly linked (without packet switches) via a dedicated 1200bps phone line; Digital Equipment Corporation (DEC) computer at ARPA later added to form "The Experimental Network"	YES
1966	Lawrence G. Roberts, MIT: "Towards a Cooperative Network of Time-Shared Computers" (October): First ARPANET plan	YES
1967	ARPANET design discussions held by Larry Roberts at ARPA IPTO PI meeting in Ann Arbor, Michigan (April)	YES
1967	ACM Symposium on Operating Systems Principles in Gatlinburg, Tennessee (October): First design paper on ARPANET published by Larry Roberts: "Multiple Computer Networks and Intercomputer Communication", first meeting of the three independent packet network teams (RAND, NPL, ARPA)	YES
1967	National Physical Laboratory (NPL) in Middlesex, England develops NPL Data Network under Donald Watts Davies who coins the term packet. The NPL network, an experiment in packet-switching, used 768kbps lines	YES
1968	PS-network presented to the Advanced Research Projects Agency (ARPA)	
1968	Request for quotation for ARPANET (29 Jul) sent out in August; responses received in September	
1968	University of California Los Angeles (UCLA) awarded Network Measurement Center contract in October	
1968	Network Working Group (NWG), headed by Steve Crocker, loosely organized to develop host level protocols for communication over the ARPANET.	
1968	Tymnet built as part of Tymshare service	
1969	Bolt Beranek and Newman, Inc. (BBN) awarded Packet Switch contract to build Interface Message Processors (IMPs) in January	
1969	US Senator Edward Kennedy sends a congratulatory telegram to BBN for its million-dollar ARPA contract to build the "Interfaith" Message Processor, and thanking them for their ecumenical efforts	
1969	ARPANET commissioned by DoD for research into networking	YES
1969	First Request for Comment (RFC): "Host Software" by Steve Crocker (7 April)	
1969	First packets sent by Charley Kline at UCLA as he tried logging into SRI. The first attempt resulted in the system crashing as the letter G of LOGIN was entered. (October 29)	YES
1969	Univ of Michigan, Michigan State and Wayne State Univ establish X.25-based Merit network for students, faculty, alumni	
1970	First publication of the original ARPANET Host-Host protocol: C.S. Carr, S. Crocker, V.G. Cerf, "HOST-HOST Communication Protocol in the ARPA Network," in AFIPS Proceedings of SJCC	YES
1970	First report on ARPANET at AFIPS: "Computer Network Development to Achieve Resource Sharing" (March)	YES
1970	ALOHAnet, the first packet radio network, developed by Norman Abramson, Univ of Hawaii, becomes operational (July): connected to the ARPANET in 1972	YES
1970	ARPANET hosts start using Network Control Protocol (NCP), first host-to-host protocol	YES
1970	First cross-country link installed by AT&T between UCLA and BBN at 56kbps. This line is later replaced by another between BBN and RAND. A second line is added between MIT and Utah	
1971	15 nodes (23 hosts): UCLA, SRI, UCSB, Univ of Utah, BBN, MIT, RAND, SDC, Harvard, Lincoln Lab, Stanford, UIU(C), CWRU, CMU, NASA/Ames	

Year	Event	Major event
Throughout history	Voice telegraphs used hundreds of years BC through the Middle Ages and in the Canary Islands today.	
1200 BC	Homer talks about signal fires in the Illiad.	
700 BC to 300 AD	Carrier pigeons used in Olympic games	
1588 AD	Arrival of the Spanish Armada announced by signal fires	
1667	Robert Hooke creates an acoustic string telephone that conveys sounds over a taut extended wire by mechanical vibrations.	
1800 AD	A line of canon from Buffalo to NYC used to announce Gov. DeWitt Clinton's inaugural trip through the Erie Canal. It took 80 minutes.	
1791	The Chappe brothers, in France, were in their teens and were going to schools some distance apart but visible to each other. They obtained permission to set up a signaling system so they could send messages to each other. Their semaphore system consisted of movable arms on a pole whose positions denoted letters of the alphabet.	
1793	The Chappe brothers established the first commercial semaphore system between two locations near Paris. Napoleon thought this was a great idea. Soon there were semaphore signaling systems covering the main cities of France. Semaphore signaling spread to Italy, Germany and Russia. Thousands of men were employed manning the stations. Speed: about 15 characters per minute. Code books came into play so that whole sentences could be represented by a few characters. Semaphores were not very successful in England because of the fog and smog caused by the Industrial Revolution. Claude Chappe headed France's system for 30 years and then was "retired" when a new administration came into power. There were semaphore systems in the U.S., especially from Martha's Vineyard (an island near Cape Cod) and Boston, reporting to Boston's Custom House on the movement of sailing ships. This was also true around New York City and San Francisco. Samuel F.B. Morse, the inventor of the electric telegraph, reportedly saw the semaphore system in operation in Europe. The last operational semaphore system went out of business in 1860. It was located in Algeria.	
1837	Cooke and Wheatstone obtain a patent on telegraph in England. Morse publicly demonstrates his telegraph.	YES
1838	Morse's Electro-Magnetic Telegraph patent approved.	
1840	Congress was requested to provide funding for a semaphore system running from NYC to New Orleans. Samuel Morse, it is said, advised against funding of this system because of his work on developing the electric telegraph.	
1843	FAX invented by the Scotch physicist Alexander Bain.	
1844	Morse demonstrates the electric telegraph. Samuel F.B. Morse demonstrates his telegraph by sending a message to Baltimore from the chambers of the Supreme Court in Washington, DC. The message, "What hath God wrought?," marks the beginning of a new era in communication.	YES
1844	Morse's first telegraph line between Washington and Baltimore opens in May.	
1844	Innocenzo Manzetti first suggests the idea of an electric "speaking telegraph", or telephone.	YES
1846	First commercial telegraph line completed. The Magnetic Telegraph Company's lines ran from New York to Washington.	YES
1846	House's Printing Telegraph patent approved.	
1847 (March 3)	Birth of Alexander Graham Bell, Edinburgh, Scotland.	
1848	Associated Press formed to pool telegraph traffic.	
1849	Antonio Meucci demonstrates a communicating device to individuals in Havana. It is disputed if this is an electromagnetic telephone, but is said to involve direct transmission of electricity into the user's body.	YES
1849	Alexander Bain's Electro-Chemical patent approved.	
1850s	Telegraph expansion in the U.S. and into Europe: The electrical telegraph is broadly introduced in Europe during the 1850s. It is based on a number of discoveries and inventions in the use of electricity. The telegraph implies a	YES

Year	Event	Major event
125000 BC	Widespread control of fire by early humans	
70000 BC	A hollow rock, shell, or other natural found object was filled with moss or a similar material that was soaked in animal fat and ignited	
c. 3000 BC	Candles are invented. Some time later, oil lamps are developed	
1780	Aimé Argand invents central draught fixed oil lamp	YES
1784	Argand adds glass chimney to central draught lamp	
1792	William Murdoch begins experimenting with gas lighting and lights his house and office by means of gas	YES
1800	French watchmaker Bernard Guillaume Carcel overcomes the disadvantages of the Argand-type lamps with his clockwork fed Carcel lamp	YES
1800-1803	Humphry Davy remarks first carbon arc when using Voltaic piles (battery) for his electrolysis experiments	YES
1802	Humphry Davy demonstrates arc lighting	YES
1802	William Murdoch illuminated the exterior of the Soho Foundry with gas	
1805	Philips and Lee's Cotton Mill, Manchester was the first industrial factory to be fully lit by gas	
1809	Humphry Davy publicly demonstrates first electric lamp over 10000 lumens, at the Royal Society	YES
1813	National Heat and Light Company formed by Fredrich Winzer (Winsor)	
1815	Humphry Davy invents the miners' safety lamp	
1835	James Bowman Lindsay demonstrates a light-bulb-based electric-lighting system to the citizens of Dundee, Scotland	YES
1840	First paraffin (kerosene) lamps	YES
1841	Arc lighting used as experimental public lighting in Paris, France	
1853	Ignacy Lukasiewicz invents the petroleum lamp	YES
1854	Heinrich Göbel invents the first true light-bulb, using a carbonised bamboo filament	YES
1856	Glassblower Heinrich Geissler confines the electric arc in a Geissler tube	
1867	A.E. Becquerel demonstrates the first fluorescent lamp	YES
1874	Alexander Lodygin patents an incandescent light bulb	YES
1875	Henry Woodward patents the electric light-bulb	YES
1876	Paul Jablochkoff invents the Jablochkoff candle, the first practical carbon arc lamp, for public street lighting in Paris	
1878/9	Thomas Edison and Joseph Wilson Swan both patent the carbon-thread incandescent lamp, which lasts for approximately 40 hours. Swan successfully sues Edison but eventually sells his patent rights to him	YES
1880	Edison produces a 16-watt lightbulb that lasts 1500 hours	YES
1882	Introduction of large scale direct current based indoor incandescent lighting and lighting utility with Edison's first Pearl Street Station	YES
1885	Incandescent mantle invented, revolutionising gas lighting	YES
1886	Great Barrington, Massachusetts demonstration project, a much more versatile (long distance transmission) transformer based alternating current based indoor incandescent lighting system introduced by William Stanley, Jr. working for George Westinghouse. Stanley lit 23 businesses along a 4000 feet length of main street stepping a 500 AC volt current at the street down to 100 volts to power incandescent lamps at each location	YES
1893	Nikola Tesla uses cordless low-pressure gas-discharge lamps, powered by a high-frequency electric field, to light his laboratory	
1893	GE introduces first commercial fully enclosed carbon arc lamp. Sealed in glass globes, it lasts 100h and therefore 10 times longer than previous carbon arc lamps	YES
1893	Nikola Tesla puts forward his ideas on high frequency and wireless electric lighting which included public demonstrations where he lit a Geissler tube wirelessly	YES
1894	D. McFarlane Moore creates the Moore tube, precursor of electric gas-discharge lamps	
1897	Walther Nernst invents and patents his incandescent lamp, based on solid state electrolytes	
1903	Peter Cooper Hewitt demonstrates the mercury vapour lamp, i.e. a fluorescent lamp	YES

Year	Event	Major event
1895	Wilhelm Roentgen, a German physicist, discovered X-rays.	YES
1897	J. J. Thomson (England) discovered the electron. In 1906, he received the Nobel Prize in Physics for this discovery.	YES
1898	Marie Curie (France), a two-time Nobel Prize winner in Chemistry and Physics, discovered the radioactive elements radium and polonium.	YES
1899	Ernest Rutherford (Canada) discovered two kinds of rays emitting from radium. He called the first rays, alpha rays; and the more penetrating rays, beta rays.	YES
1900	Frederick Soddy (England) observed spontaneous disintegration of radioactive elements into variants. He called these isotopes.	YES
1901	Rutherford and Soddy published the theory of radioactive decay.	YES
1905	Albert Einstein wrote the special theory of relativity. He created a new era of physics when he unified mass, energy, magnetism, electricity, and light. One of the most significant events of the 20th century was Einstein's developing the formula of E=mc^2 (that is, energy equals mass times the square of the speed of light).	YES
1911	Rutherford (United Kingdom) discovered the nucleus of the atom.	YES
1913	Niels Bohr (Denmark) published the theory of atomic structure, combining nuclear theory with quantum theory.	YES
1915	The general theory of relativity was published by Albert Einstein. He proposed that gravity, as well as motion, could affect the intervals of time and space.	YES
1919	Rutherford (United Kingdom) bombarded nitrogen gas with alpha radiation. The transmutation of nitrogen into oxygen was the first artificially induced nuclear reaction.	YES
1925	Werner Heisenberg, Max Born (Germany) and later Erwin Schrödinger (Austria) formulated quantum mechanics.	YES
1927	Herman Blumgart (United States), a Boston physician, used radioactive tracers to diagnose heart disease.	
1929	Ernest O. Lawrence (United States) conceived the idea for the first cyclotron, a device used to produce high-energy beams for use in nuclear physics experiments. He was awarded the 1939 Nobel Prize in Physics for this invention and for results obtained with it.	YES
1929	John Cockcroft and E. T. S. Walton (United Kingdom) developed a high-voltage apparatus for accelerating protons, called a linear accelerator.	YES
1932	James Chadwick (United Kingdom) discovered the neutron as well as studying deuterium (known as heavy hydrogen) for use in nuclear reactors.	YES
1932	Cockcroft and Walton (United Kingdom) split the atom with protons accelerated with their "linear accelerator."	YES
1932	Werner Heisenberg (Germany) was awarded the Nobel Prize in Physics for the creation of quantum mechanics.	
1934	Enrico Fermi irradiated uranium with neutrons. He believed he had produced elements beyond uranium, not realizing that he had split the atom, thus achieving the world's first nuclear fission. He won the Nobel Prize in Physics for this discovery in 1938.	YES
1938	The process of splitting uranium atoms, called nuclear fission, was demonstrated by scientists Otto Hahn and Fritz Strassman (Germany).	YES
1939	President Roosevelt received a letter from Albert Einstein on the possibility of a uranium weapon.	YES
1940	German troops occupied Norway, and seized what was then the world's only heavy-water production plant at Vemork.	YES
1940	Philip Abelson and Edwin McMillan (United States) demonstrated that neutrons captured by uranium-238 lead to the creation of elements 93 and 94, neptunium and plutonium.	YES
1940	A new element (atomic number 94), was found and named plutonium. American physicists confirmed that plutonium was fissionable, thus usable for a bomb.	
1941	British scientists reported that a weapon could be made with 22 pounds of pure uranium 235.	
1942	The Manhattan Project was formed in the United States to secretly build the atomic bomb for use in World War II.	YES

Year	Event	Major event
3000 BC and earlier	The Mesopotamians use round cylinder seals for rolling an impress of images onto clay tablets. In other early societies in China and Egypt small stamps are used to print on cloth. These stamps are gradually replaced by larger wooden blocks. In China such woodblocks are used to print on silk. The earliest known examples consist of flowers printed in three colours. They are likely produced during the Han dynasty (before 220 BC).	
2600–2000 BC	First printing plates: The printing plates discovered are still being investigated. If they are genuine, the Harappan civilization in the Indus Valley is the first one to use fairly modern printing techniques. One of the plates bears 34 characters, which is the longest known single Indus script inscription.	
131 BC	First newspapers: The first Acta Diurna (Latin for 'Daily Acts') are published in Rome in 131 BC. These are daily official notices of the Roman Empire and can be considered the first 'newspaper'. The notices are carved on stone or metal, they do not get printed. Scribes sometimes do make copies to be sent to the provinces.	
Second century	Paper is invented: A Chinese man named Ts'ai Lun is credited with inventing paper around 105 AD. He takes the inner bark of a mulberry tree and bamboo fibers, mixes them with water, and pounds them with a wooden tool. This mixture is poured onto a flat piece of coarsely woven cloth and let the dry, leaving only the fibers on the cloth. From China the knowledge of paper making is passed along to Korea, Samark Baghdad and Damascus.	
Seventh century	Oldest European book: In 687 a small book containing the text of the Gospel of John in Latin is added to the grave of Saint Cuthbert. In 1104 it is recovered from his coffin in Durham Cathedral, Britain. The Cuthbert Gospel is currently the oldest European book still in existence.	
Eighth century	Paper making reaches the arabic world: During the Battle of Talas, near Samarkand in 751 AD, the secret of paper production is made known to the Islamic world, as some of the Chinese prisoners are paper makers.	
Ninth century	First printed book: A copy of the Chinese version of The Diamond S?tra (or Diamond Cutter of Perfect Wisdom) is the earliest surviving example of a printed book. It is produced in 868 AD using woodcut, a relief printing technique in which text and images are carved into the surface of a block of wood. The printing parts remain level with the surface while the non-printing parts are removed, typically with a knife or chisel. The wood block is then inked and the substrate pressed against the wooden block.	
Tenth century	Invention of screen printing: During the Shang Dynasty the Chinese invent screen printing.	
Tenth century	Arabs create a finer sheet of paper by substituting linen fibers for wood and bamboo.	
Eleventh century	Invention of movable type: In 1023 the Chinese emperor establishes a Bureau of Exchange which is charged with issuing what can be considered the first government-issued banknotes. Chinese merchants had already been issuing banknotes themselves since the Tang Dynasty (618–907).	
Eleventh century	A Chinese man named Bi Sheng (or Pi-Sheng, depending on the source) develops type characters from hardened clay, creating the first movable type in 1041. The fairly soft material hampers the success of this technology.	
Twelfth century	Around 1150 the first European paper mill is established in Xàtiva, a city in Spain. Since paper is mainly produced by Muslims it is frowned upon and there are even laws that forbid the use of paper for government documents.	
Thirteenth century	Since books are copied by hand, they are rare and expensive. A copy of Justinian's lawcodes costs £40 in 1240, which is as much as a house or eight year's income for a craftsman.	
Thirteenth century	In 1282 watermarks appear for the first time when they are added to paper in Fabriano, Italy.	
Fourteenth century	Type characters cast from metal (bronze) are developed in Japan and China. The oldest known book printed using metal type dates to the year 1377. It is a Korean Buddhist document, called Selected Teachings of Buddhist Sages and Seon Masters.	

Year	Event	Major event
1767	The Solar Oven: Swiss physicist, alpine explorer, and aristocrat Horace de Saussure is credited with inventing the first working solar oven, amongst other discoveries. Constructed from 5 layers of glass and measuring around 12 inches across, the oven worked by allowing light to pass through the glass before being absorbed by the black lining and turned into heat. The heat is then reflected by the glass, therefore heating the space inside the box up to 87.5 degrees Celsius. He wrote that "Fruits... exposed to this heat were cooked and became juicy."	YES
1839	The Photovoltaic Effect: Edmond Bequerel, born in Paris in 1820, discovered that when two electrodes were placed in an electrolyte (electricity-conducting solution), a voltage developed when light fell upon the electrolyte. This provided the basic principles for solar power.	YES
1860	Auguste Mouchout (France), a mathematics instructor, was able to convert solar radiation directly into mechanical power.	YES
1873	Selenium: An English Electrical engineer, Willoughby Smith, discovered the photoconductivity of selenium entirely by accident. He was developing a method for continually testing underwater telegraph cables as they were being laid and chose selenium rods as a semi-conductor with high resistance for his test circuit. Although selenium appeared to be up to the job, inconsistent results kept occurring. Smith realised that the conductivity of selenium was affected by the amount of light it was exposed to. He described the effect in a paper published in Nature in February of that year.	YES
1876	Electricity from Light: A King's College Professor, William Grylls Adams, and his student, Richard Evans Day, found in 1876 that solidified selenium produced electricity when exposed to light. They attached platinum electrodes to selenium and observed a current in the electrodes when the selenium was exposed to light. Although there was not enough electricity to power anything, they had shown that electricity could be generated from light without the use of any moving parts. They published a paper on the selenium cell: 'The action of light on selenium,' in "Proceedings of the Royal Society, A25, 113 in 1877.	YES
1878	Augustin Mouchot displays a solar power generator at the Universal Exhibition in Paris.	YES
1878	William Adams (England) constructed a reflector of flat-silvered mirrors arranged in a semicircle. To track the sun's movement, the entire rack was rolled around a semicircular track, projecting the concentrated radiation onto a stationary boiler.	YES
1883	The First Working Solar Cell: American inventor Charles Fritts developed the first solar cell, applying selenium to a thin layer of gold. This method was only able to achieve 1 to 2% efficiency, making it impractical for general use.	YES
1883–84	John Ericsson (United States) invented and erected a solar engine that used parabolic trough construction.	YES
1887	Heinrich Hertz investigates ultraviolet light photoconductivity and discovers the photoelectric effect	YES
1887	James Moser reports dye sensitised photoelectrochemical cell.	
1888	Edward Weston receives patent US389124, "Solar cell," and US389125, "Solar cell."	YES
1888-91	Aleksandr Stoletov creates the first solar cell based on the outer photoelectric effect	YES
1894	Melvin Severy receives patent US527377, "Solar cell," and US527379, "Solar cell."	
1897	Harry Reagan receives patent US588177, "Solar cell."	
1901	Philipp von Lenard observes the variation in electron energy with light frequency.	
1904	Wilhelm Hallwachs (German) discovered that a combination of copper and cuprous oxide was sensitive to light.	YES
1905	Einstein's Paper on Light & Electrons: In the paper "On a Heuristic Viewpoint Concerning the Production and Transformation of Light" Einstein set out for the first time the photoelectric relationship between light and electrons on a quantum basis. Although controversial at the time, it was gradually accepted by the scientific community and led to his winning of the Nobel Prize in 1921.	YES
1913	William Coblentz receives US1077219, "Solar cell."	
1914	Sven Ason Berglund patents "methods of increasing the capacity of photosensitive	

Year	Event	Major event
BC-AD	References to use of tides in classical Greece, possibly dating back to the time of Aristotle	
960 AD	Reference to tide mills at Basra in southern Iraq	
1041, 1078	First references to European tide mills (around Venice)	YES
1100 - 1900	Waterwheel-driven mills powered by tidal impoundments and currents operational in England, western Europe, and colonial Boston, among other places	
1135 - WWII	Bromley-by-Bow Tidal Mill near London	
1734	Slade's Tidal Spice Mill, Chelsea, Massachusetts	
1799	Girard files first patent on wave-energy device in France	YES
1800 - 1900	25 tide mills cited in Britain	
1871	Jules Verne's fictional Captain Nemo posits thermoelectricity from ocean water in the novel 20000 Leagues under the Sea	
1881	D'Arsonval proposes concept of ocean thermal energy conversion (OTEC)	YES
1892	Stahl notes 19 wave-power concepts in American Society of Mechanical Engineers (ASME) transactions	
1910	Bochaux-Praceique lights and powers his house at Royan, near Bordeaux in France, using wave power - first oscillating water-column type of wave-energy device	YES
1934	Claude tests open-cycle OTEC in Cuba	YES
1935 - 1977	Succession of studies of Passamaquoddy/Bay of Fundy tidal power stations	
1940s	Pioneering of modern scientific pursuits in wave energy by Yoshio Masuda's experiments in the 1940s	YES
1950s	Yoshio Masuda's concept for extracting power from the angular motion at the joints of an articulated raft	
1959	First of a number of small (<1 MWe) tidal power plants reported in China	YES
1966	Rance River tidal power plant operational in France	YES
1969	Experimental tidal unit constructed in Kislaya Guba, Russia	YES
1972 - 1984	US OTEC program	YES
1973	Renewed interest in wave energy was motivated by the oil crisis in 1973	YES
1974	Stephen Salter's 'nodding duck' is invented (a.k.a. Edinburgh Duck). In small scale controlled tests, the Duck's curved cam-like body can stop 90% of wave motion and can convert 90% of that to electricity giving 81% efficiency.	YES
1976 - 1982	British launch, then suspend, their wave-power program; revised post-2000	YES
1977	Wells invents turbine which rotates in same direction when airflow is reversed	YES
1978	Japanese install 125 kWe wave-power unit off Honshu	
1979	Mini-OTEC operated in Hawaii by the US and by Japanese off Shimane	
1984	20 MW Annapolis tidal station operational in Nova Scotia	
1985	KVAERNER wave-energy converter deployed in Norway; later succumbs to storm	
1986 - 2000	Decline, on the average, of fossil energy prices in constant dollars saps motivation for vigorous pursuit of the more expensive categories of alternatives, e.g., anything out at sea. This is then reinvigorated by post-2000 oil price escalation	YES
1995	2 MWe OSPREY wave-power station wrecked during installation	
2003	European Marine Energy Centre established in the Orkney Islands off northern Scotland (world's first marine energy test facility)	YES
2007	Pelamis devices operational at first commercial wave-power stations off Orkney and	YES

Year	Event	Major event
Pre-historic times	Ordovician period: the first known cephalopods: they swim by a natural built-in reciprocating hydrojet.	
120-150 BC	Hero of Alexandria demonstrates the principles of jet reactions in the Aeolipile (a steam jet/rocket engine on a bearing).	YES
1232	The Chinese begin to use rockets as weapons.	
1500	Leonardo da Vinci sketched a contraption, the chimney jack, that rotated due to the effects of hot gases flowing up a chimney.	
1629	Giovanni Branca develops a stamping mill that utilized jets of steam to operate the machinery.	
1687	Sir Isaac Newton presents his three laws of motion. These form the basis for modern propulsion theory.	YES
1791	John Barber applies and receives the first patent for a simple turbine machine. This is British patent #1833 for 'A Method for Rising Inflammable Air for the Purposes of Producing Motion and Facilitating Metallurgical Operations'. In it he describes a turbine.	YES
1872	First true gas turbine engine designed by Dr. F. Stolze.	
1884	Charles Algernon Parsons patents the steam turbine. In the patent application he notes that the turbine could be driven "in reverse" to act as a compressor. He suggests using a compressor to feed air into a furnace, and a turbine to extract power to run the compressor. Although intended for factory use, he is clearly describing the gas turbine.	YES
1887	Gustaf de Laval introduces nozzles design of small steam turbines.	
1897	Steam turbine used to power a ship for the first time.	
1900	Sanford Alexander Moss publishes a paper on turbocompressors. He builds and runs a testbed example in 1903.	YES
1903	Ægidius Elling builds a gas turbine using a centrifugal compressor which runs under its own power. By most definitions, this is the first working gas turbine.	YES
1903-1906	The team of Armengaud and Lemale in France build a complete gas turbine engine. It uses three separate compressors driven by a single turbine. Limits on the turbine temperatures allow for only a 3:1 compression ratio, and the turbine is not based on a Parsons-like "fan", but a Pelton wheel-like arrangement. The engine is so inefficient, at about 3% thermal efficiency, that the work is abandoned.	
1908	Hans Holzwarth starts work on extensive research on an "explosive cycle" gas turbine, based on the Otto cycle. This design burns fuel at a constant volume and is somewhat more efficient. By 1927, when the work ended, he has reached about 13% thermal efficiency.	
1908	René Lorin patents a design for the ramjet engine.	YES
1909	Marconnt proposes a modification of Lorin's design using a resonant compression chamber, creating the pulsejet.	
1910	Romanian inventor Henri Coand? builds the Coand?-1910 which he exhibits at the International Aeronautic Salon in Paris. It uses a ducted fan for propulsion instead of a propeller. Years later he claimed that it burned fuel in the duct and was thus a motorjet, but historians debate this claim, and his claims that the aircraft flew in December 1910 before crashing and burning.	
1916	Auguste Rateau suggests using exhaust-powered compressors to improve high-altitude performance, the first example of the turbocharger.	
1917	Sanford Alexander Moss starts work on turbochargers at General Electric, which goes on to be the world leader in this technology.	YES
1917	James Stocker Harris patents a "Motor-Jet" design on behalf of his brother inlaw Robert Alexander Raveau Bolton.	YES
1918	General Electric (GE) starts gas turbine division.	YES
1920	W.J. Stern reports to the Royal Air Force that there is no future for the turbine engine in aircraft. He bases his argument on the extremely low efficiency of existing compressor designs. Stern's paper is so convincing there is little official interest in gas turbine engines anywhere, although this does not last long.	YES

Year	Event	Major event
500–900 AD	The first windmills were developed in Persia for pumping water and grinding grain.	
1185	Earliest confirmed reference to a windmill, in Weedley, Yorkshire	
c. 1300	The first horizontal-axis windmills (i.e. pinwheel) appeared in Western Europe.	
14th century	Dutch windmills used to drain areas of the Rhine River delta	YES
18th century	Windmills used to pump water for salt making on the island of Bermuda and on Cape Cod during the American revolution	
1850s	Daniel Halladay and John Burnham worked to build and sell the Halladay Windmill, designed for the American West. It had an open tower design and thin wooden blades. They also started the U.S. Wind Engine Company.	YES
Late 1880s	Thomas O. Perry conducted over 5000 wind experiments trying to build a better windmill. He invented the mathematical windmill, which used gears to reduce the rotational speed of the blades. This design had greater lifting power and smoother pumping action, and the windmill could operate in lighter winds. Perry also started the Aermotor Company with LaVerne Noyes.	YES
Late 1880s	The development of steel blades made windmills more efficient. Six million windmills sprang up across America as settlers moved west. Homesteaders purchased windmills from catalogs or traveling salesmen or, otherwise, built their own. Mills were used to pump water, shell corn, saw wood, and mill grain.	
1887	The first windmill used for the production of electricity was built in Scotland in July 1887 by Prof James Blyth of Anderson's College, Glasgow.	YES
1888	Charles F. Brush created the first large windmill to generate electricity in the U.S. in Cleveland, Ohio. Windmills that produce electricity started to be called wind turbines. In later years, General Electric acquired Brush's company, Brush Electric Co.	YES
1891	The Danish scientist Poul la Cour constructed a wind turbine to generate electricity, which was used to produce hydrogen by electrolysis to be stored for use in experiments and to light the Askov High school. He later solved the problem of producing a steady supply of power by inventing a regulator, the Kratostate.	YES
1893	In Chicago, Illinois, the World's Columbian Exposition (also known as the Chicago World's Fair) highlighted 15 windmill companies that showcased their goods.	
1895	Poul la Cour converts his windmill into a prototype electrical power plant that was used to light the village of Askov	YES
Early 1900s	Windmills in California pumped saltwater to evaporate ponds. This provided gold miners with salt.	
1927	Brothers Joe and Marcellus Jacobs open a factory, Jacobs Wind in Minneapolis to produce wind turbine generators for farm use	YES
1931	Darrieus wind turbine invented, with its vertical axis providing a different mix of design tradeoffs from the conventional horizontal-axis wind turbine. The vertical orientation accepts wind from any direction with no need for adjustments, and the heavy generator and gearbox equipment can rest on the ground instead of atop a tower.	YES
1936	The U.S. starts a rural electrification project that removes the natural market for wind-generated power, since network power distribution provided a farm with more dependable usable energy for a given amount of capital investment.	YES
1941	For several months during World War II, the Smith-Putnam wind turbine supplied power to the local community at "Grandpa's Knob," a hilltop near Rutland, Vermont. Its blades were 53 meters (175 feet) in diameter, and this became the world's first windmill to provide utility scale (i.e. greater than 1 MW) power levels.	YES
1943	The Smith-Putnam wind turbine broke down, and the machine was shut down.	
1945	The Smith-Putnam machine was restarted, but small cracks in the blade caused one blade to break; the turbine was shut down forever.	
1950s	Most windmill companies in the United States went out of business.	YES
1973	The Organization of Petroleum Exporting Countries (OPEC) oil embargo caused the	YES

Year	Event	Major event
1896	Guglielmo Marconi develops the first wireless telegraph system	YES
1927	First commercial radiotelephone service operated between Britain and the US	YES
1946	The first commercial mobile radiotelephone service is introduced in St. Louis	YES
1947	The transistor is invented by scientists John Bardeen, Walter Brattain and William Shockley who later share the Nobel Prize. The transistor replaces vacuum tubes, serving as the foundation for the development of modern electronics and makes possible the marriage of computers and communications.	YES
1947	Engineers at Bell Labs develop the concept of cellular technology.	YES
1948	Claude Shannon publishes two benchmark papers on Information Theory, containing the basis for data compression (source encoding) and error detection and correction (channel encoding).	YES
1950	TD-2, the first terrestrial microwave telecommunication system, is installed to support 2400 telephone circuits.	
1962	The first communication satellite, Telstar, is launched into orbit.	YES
1964	The International Telecommunications Satellite Consortium (INTELSAT) is established.	YES
1964	AT&T's Improved Mobile Telephone Service (IMTS) eliminates the need for push-to-talk operation and offers automatic dialing	
1965	INTELSAT launches the Early Bird geostationary satellite.	
1968	The Defense Advanced Research Projects Agency – US (DARPA) selects BBN to develop the Advanced Research Projects Agency Network (ARPANET), precursor of the modern Internet	YES
1968	The Federal Communications Commission (FCC) opens Docket 18262 to set aside sufficient spectrum to meet the demand for land mobile communications. Congestion on the frequencies then available was approaching unacceptable levels, with a waiting period of several years in some markets to get a mobile phone.	YES
1970	The FCC allocates 75 MHz for common carrier cellular systems out of the UHF spectrum	YES
1971	June: ALOHAnet connected the Hawaiian Islands with a UHF wireless packet network. ALOHAnet and the ALOHA protocol were early forerunners to Ethernet, and later the IEEE 802.11 protocols, respectively.	YES
1971	The FCC modifies its 1970 decision to allow non-wireline carriers (non-telephone companies) as well as wireline (telephone) carriers to access the 75 MHz allocated for common carrier radio cellular systems.	YES
1974	The FCC revises it cellular allocation from 75 MHz to 40 MHz, restricts eligibility to wireline carriers, and adopts a one system per market policy because of its belief that technical complexity and expense would make competing systems in a market unviable. The FCC also decides to license developmental systems.	
1977	FCC authorizes developmental cellular systems launch in Chicago and the Washington, D.C./Baltimore region.	
1981	FCC issues Cellular Communications Systems Order, determining the cellular industry should have two carriers per market and creates cellular "A" and "B" licenses for each area of the country.	
1982	AT&T settles its antitrust lawsuit with the U.S. Government, agreeing to divest itself of local phone service and its cellular licenses.	
1982	In June, the FCC accepts 190 applications for the 30 largest market in the United States. Only three applications were received for Boston, the smallest number for the major markets	
1982	In November, the FCC accepts 353 applications for markets 31 -60	
1983	In January, TCP/IP is selected as the official protocol for the ARPANET	YES
1983	Motorola introduces the DynaTAC mobile telephone unit, the first truly "mobile" radiotelephone. The phone, dubbed the "brick," had one hour of talk time and eight hours of standby.	YES
1983	In March, the FCC accepts 567 applications for markets 61-90. The FCC states this is too many applications to handle effectively by comparative hearings, and in October issues a rulemaking seeking authority to award licenses by lottery.	
1983	On October 13, the first commercial cellular system begins operating in Chicago. In December 1983, the second system is activated in the Baltimore/Washington, D.C. corridor.	YES

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