A LITTLE HISTORY OF RADIO

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I hope that this brief history of radio will make your radio listening even more pleasurable.

The development of radio began with "wireless telegraphy." Some of the earliest experiments in radio were conducted in the mid-1800s, when scientists discovered that electrical impulses could be sent through the air and detected at a short distance away. Way back in 1864, a scientist, James Maxwell, came up with a mathematical theory that electromagnetic waves could propagate through free space. Around 1880, the first transmission of impulses by means of electromagnetic waves was performed by David Edward Hughes. Then in 1888, Heinrich Rudolph Hertz was able to conclusively prove transmitted airborne electromagnetic waves in an experiment confirming Maxwell's theory of electromagnetism. He used a "wave frequency" that later would be called the radio spectrum. According to Maxwell, light and Hertzian electromagnetic waves were the same phenomenon at different wavelengths.

After learning of Hertz demonstrating wireless transmission, inventor Nikolai Tesla began developing his own system, primarily as a means of wireless lighting and power distribution. He hoped to use the earth as a primary conductor of power.

After Tesla, little progress happened until just before the turn of the 20th century, when a young Italian inventor Guglielmo Marconi, demonstrated publicly his ability to transmit wireless signals (in Morse telegraph code) several miles. Within a few years in 1901 he made the S (three clicks) transmission across the Atlantic Ocean. Marconi got rich building the first complete, commercially successful wireless telegraphy system based on airborne Hertzian waves (radio wave transmission). In the early 1900s, Marconi got the key patent rights for wireless transmission.

On the other side of the world, in 1900, a Brazilian Catholic priest Roberto Landel de Moura transmitted the human voice wirelessly for a distance of about five miles. (Knowledge of Hertzian waves had travelled farther than the waves themselves at this point). He then left for the United States to get a patent, which he got in 1904 for "The Wave Transmitter," the precursor of today's radio transceiver. Also in 1904, the Patent Office awarded Marconi a patent for the invention of the key radio circuits. Unfortunately for Father Landel de Moura, when he returned to his homeland, the Brazilian government would not help him with assistance in developing his invention and it languished.

Following Marconi, several other independent scientists, like Dr. Lee DeForest and R.A. Fessenden, working in America, developed techniques of amplitude modulation (AM) by which voice and music could be broadcast through the medium of radio.

In late 1906, DeForest made a huge technological leap by inventing the triode tube, the world's first vacuum-tube detector and amplifier. Until then there wasn't a way to efficiently amplify extremely weak electrical or radio signals. A radio signal now could be amplified enough to drive a loudspeaker.

On Christmas Eve 1906, Reginald Fessenden used a mechanical alternator transmitter for the first radio broadcast from Brant Rock, Massachusetts. Ships at sea heard Fessenden playing "O Holy Night" on the violin and reading a passage from the Bible. That was the first transmission of what is now known as amplitude modulation or AM radio on a carrier wave.

This was the start of much of the electronics industry. DeForest's "audion tube" also made possible long distance telephone service, by using booster amplifiers at intervals along transcontinental phone lines. In June 1912, Marconi opened the world's first purpose-built radio factory in Chelmsford, England.

The electronics industry boomed, like the boom in microprocessors and personal computers 75 years later. During World War One, various militaries developed all kinds of radio communications equipment (including mobile, airborne and shipboard radio transmitters and receivers).

Both before and after World War One, "crystal sets" were a hot item with people fascinated with pulling messages out of the air. It received radio waves by a wire antenna. It gets its name from its most important component, known as a crystal detector, originally made from a piece of crystalline mineral such as galena. The rectifying property of crystals was discovered in 1874 by Karl Ferdinand Braun; inventors Picard and Dunwoody made crystal radio-wave detectors in 1906.

Crystal radios were the simplest type of radio receiver, made with a few inexpensive parts, such as a wire for an antenna, a coil of copper wire for adjustment, a capacitor, a crystal detector, and earphones. They are passive receivers needing no power source. Radios that came afterward use a separate source of electric power such as a battery to amplify weak radio signals to make them louder. Crystal sets produce weak audio and need sensitive earphones; they only receive stations within a limited range.

Crystal radios were the first widely used type of radio receiver. Sold or homemade by the millions, the inexpensive and reliable crystal radio was a major driving force in the introduction of radio to the public in the early 1920s.

Around 1920, the first scheduled public radio broadcasts started, emphasizing music, news and sports events, in the middle of today's Broadcast Band, now 540 KHz to 1.7 MHz. Lee DeForest in San Francisco had a radio station that did these kinds of broadcasts, and Westinghouse had a station in Pittsburg (KDKA) doing broadcasts as well. Both claimed to be first. Overnight hundreds of small and large companies began producing vacuum tube receivers. More radio stations were licensed, having a profound effect on the daily lives of everyone. Like the automobile, it opened people's lives to the rest of the world.

In the early days of radio, almost all the sets were powered by two or three batteries of different voltages. Radio output was capable of powering only headphones at first, but then came the loudspeaker driven by more powerful amplifiers. And, radios were limited in the frequencies they could detect. During the earliest days of broadcast radio, virtually every vacuum tube set was of the Tuned Radio Frequency (TRF) type. To receive a radio transmission required three actions: tune the desired signal from among the signals on the air, amplify the weak radio frequency signal through tuned stages of amplification to a usable strength and detect the signal to extract the amplitude modulation (AM) from the radio frequency carrier.

Then, around 1930, a radical new receiver design called "superheterodyne" was introduced. It had been invented by an Army scientist, Edwin Howard Armstrong. This circuit outperformed anything else at the time. The received signals are combined by mixing with a related internally generated frequency by way of separated grids on the vacuum tube called the mixer. This creates a single "intermediate" or "IF" frequency for all stations. This one IF frequency carrying the modulation is then processed internally for maximum efficiency and amplification. Tuned circuits were the key to this new "superhet" design, especially the tracking internal oscillator. It was complicated, but a significant breakthrough.

The superhet receiver completely outperformed the TRF in all respects, and was soon accepted as the world's standard of design for radio receivers. Even though modern radios have evolved from using vacuum tubes to transistors to integrated circuits today, the fundamental design of today's radios remains the "superhet" circuit, essentially as conceived by Armstrong as early as 1918.

Some years later, Armstrong also invented a new improved mode of broadcasting, "Frequency Modulation" or "FM" which hit the public airways shortly before World War II, but was held up from full development until after the War. The biggest advantage in FM is reduction of the effect of radio noise caused by natural effects such as lightning and electrical static noise. And, because of the greater bandwidth allocated to FM stations, FM broadcast audio quality was better than AM sound. FM operates at higher carrier frequencies (now 88 MHz to 108 MHz) so it can carry a wider range of audio frequencies around the base frequency for higher quality audio and music reproduction.

Around 1960, electrical frequency was renamed from cycles per second to Hertz. One Kilohertz (KHz) is one thousand cycles per second and one Megahertz (MHz) is one million cycles per second. There are thus much higher frequencies in FM. AM broadcast signals range from 540 to 1700 KHz, while the FM broadcast band is 88 to 108 MHz. However, AM and FM receivers use the same superhet circuit design. Many of the later radio sets were constructed as AM / FM combinations. In circuits of this style, all the tubes (and later transistors) served in a dual capacity for both bands, but the tuning elements were separate for AM and FM.

In order to receive AM radio signals, ideally every old radio should have a long wire antenna outdoors, stretched through the trees as high as possible. Because this is impractical, most radio manufactures included an antenna terminal on the back of their sets allowing for an indoor antenna of a few feet of wire. Most common was a built-in antenna, a loop of some sort, made of 50 to 100 turns of wire, as large as possible to fit into the radio cabinet. Starting around 1950 many sets used a ferrite-loop stick antenna, a coil of wire wound around an iron-like core about the size of a small cigar. The human body is actually an excellent antenna and when you touch a radio's built in antenna, lots more stations can be tuned in.

Among collectors of antique radios, the most popular sets are those produced from about 1925 to 1960, the heyday or Golden Age of radio development as an entertainment medium. Almost all radios of that period basically used vacuum tube circuits. Sometimes there were combinations of a radio and a phonograph, both sharing audio amplifier electronics. A majority of the post World War Two sets had a similar tube lineup and nearly the same circuits.

From the late 1930's until the end of the vacuum tube era, the market was dominated by a generic AC / DC superhet design radio with five tubes, known as the "All American Five Tuber" or AA-5. This simple, brilliant design offered excellent performance at extremely low cost, selling for as low as $5 during the Great Depression. The AA-5 type radio set was produced by all the big manufacturers, differing only in cabinet design. These sets had a family of tubes with higher filament voltages than previous types, adding up to 117 volts, enabling the use of a series design without a power transformer. These sets could operate from a 117 ± volt AC or DC line.

Then came the mid-1950s and the transistor radio. Transistor radios made from 1955 to 1966 have become very collectible.

A transistor is a solid-state device made of solid crystal material, usually pure silicon "doped" with special impurities. Some transistors were made of other materials, such as germanium and metal oxide. The transistor is an offshoot of the crystals that were popular in the early days of radio. Transistors replaced tubes, reducing the size of the active components by 90%. And, transistors don't need heater power like vacuum tubes. The biggest advantages of transistors over tubes were that they used way less power, have much lower operating voltages and no filaments to burn out (thus a longer life).

A transistor is inherently like a triode tube. Transistors are manufactured in sizes that vary from a flyspeck size amplifier (on a silicon chip) to a doorknob size high power amplifier, and they can handle a range of frequencies from DC to microwaves just as vacuum tubes did. Practically speaking, all circuit designs created during the days of vacuum tubes have been adapted to transistors. Transistors can be operated at supply voltages from about one volt to several hundred, most being 5 to 15 volts.

Around 1957, the concept of integrated circuits was developed, in which a large number of transistors, resistors and other electronic components were made by photographic and chemical deposition on a chip of pure silicon crystal. Pure silicon won't work as a semiconductor so it has to be carefully “doped” to produce its special electrical characteristics.

In an integrated circuit, an entire electronic system such as a radio receiver can be produced in a fraction of a square inch. The ultimate integrated circuit, the microprocessor, is an electronic computer which might contain a million or more transistors, diodes and related components on a chip measuring as little as a square centimeter. In all these modern devices, the transistor is the main active component. Making integrated circuits also involves an “etching process.” What is amazing is that microprocessors and other integrated circuits are produced in huge numbers with an extremely high yield rate and top quality, yet marketed at astoundingly low prices.

From the beginning of radio to today, this all seems like magic to me, in the realm of the supernatural.

So what is the future of radio?

A recent report by Nielsen found that traditional broadcast radio is still the preeminent means of consuming radio in the US. According to its research, almost two-thirds (63%) of music fans say that (traditional) radio is their chief means of discovering new music. But alternative means are getting more and more popular, such as the podcast on the Internet or satellite radio services, such as Sirius. But, hang on to your old AM / FM radio for now, at least.

From the dots-and-dashes of wireless telegraphy in the late 19th century, through the first public broadcasts of the early 20th century and on to the algorithm-driven, personalized music stations we see across the Web today, radio as a concept has evolved.

People still want and need real radio; there are only a few ways to listen to anything: your personal music collection or the Internet, satellite radio and traditional "terrestrial" or real radio broadcasts. People often grow tired of repetitive playlists. This isn't an issue with real radio. Plus, real radio offers sports, news and talk shows, something you don't hear on an on-demand music service.

With radio, we've seen a big shift towards automation, personalization and democratization, but that doesn't mean that ten years from now radio will be devoid of professional DJs tasked with unearthing new music, giving it context and meaning to their listeners.

With technological changes, listening habits are changing which will eventually mean that growth will be in an online format. The digital platforms that allow consumers to create their own content are ultimately reshaping the industry. You can create your own playlist – a mixture of interviews, news, music – whatever you want, and listen to it at your leisure. The younger generations aren't used to tuning in at a specific time to catch a specific program. They want to be able to curate their own highlights, listen when they want and be able to interact and share with their peers at the touch of a button. Added to that are podcasts – content-based programs that can be downloaded and stored for listening at any time.

I think there will always be a place for traditional terrestrial radio. For me, as a Baby-Boomer, I will want and need traditional "real radio." So, perhaps it will require one or two more generational shifts for radio to completely evolve. What has changed drastically is the access to so much more content through multiple media channels. Radio is just one of them now. But will traditional radio survive? I believe that radio will survive. However, we may have to completely rethink what "radio" actually means.

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