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# CHAPTER A

## ***A Brief History of Radio Regulation***

Radio communication is more than 100 years old. It began with wireless dots and dashes, grew into a world-wide form of voice communications – thanks largely to amplitude modulation (AM) and shortwave frequencies – and today encompasses a wide array of modern technologies that can transmit data, voice, and pictures, employing everything from simple wire antennas to satellites orbiting the Earth.

From its earliest days as a viable form of communication, wireless has been seen as an invaluable tool to assure public safety at sea, in the air, and on land. *Table 1-1* lists some significant events and important actions between 1835 and 1910 that furthered electronic communications, which began with the invention of the telegraph.

**Table 1-1. Electronic Communications 1835-1910**

<b>Year</b>	<b>Event and Action</b>
1835	Electronic communications begin with the invention of the telegraph by Samuel F. B. Morse, a professor at New York University. Morse code is named after him, and was the international CW code used for many decades especially in the Maritime Service. With the advent of GMDSS, the primary use of this code today is in the Amateur Radio Service.
1849	Two European countries are linked by telegraph, causing the development of initial international agreements on rules and regulations governing the sharing of information.
1865	25 European nations meet in Paris to form the International Telegraphic Convention, which later becomes the International Telecommunications Union (ITU).
1865	Italian inventor Guglielmo Marconi proves the feasibility of radio communications, for which he receives a patent in 1897.
1899	Marconi makes the first successful transatlantic radio transmission from England to Newfoundland.
1901	Marine radio is born when the U.S. Navy adopts a wireless system.
1903	First international conference on governing radio communications is held in Berlin. Nine nations agree that public safety takes precedence over squabbles between commercial ventures.
1906	International conferees meeting in Berlin agree to require that ships be properly equipped with wireless transmitters and receivers, and to set the first international distress frequency as 500 kHz for ships to use to call for help. International regulation of wireless radio is added to the ITU's responsibilities.
1906	Reginald Aubrey Fessenden makes the world's first voice radio broadcast on Christmas Eve and again on New Year's Eve, one week later. Other Fessenden firsts besides voice over radio was the first two-way trans-Atlantic radio communications, the first voice heard across an ocean.
1909	Steamships Republic and Florida collide off the coast of New York and 1500 lives are saved by a distress call sent by radio operator Jack Binns. Later in the year, the S.S. Arapahoe calls for help using "SOS," which is adopted this year as the international radiotelegraph distress call. "Mayday" is adopted in 1927 as the international distress call for radiotelephony.

## The Titanic Disaster

During the early years of the 20th century, the use of radio communications remained confined primarily to ships at sea. Few ships operated radio equipment, and those that did saw no reason to staff their stations around the clock. Doing so was considered an unnecessary luxury. All of that changed when the Titanic was ripped open by an iceberg in the North Atlantic and sent to the bottom of the sea just three hours later on the night of April 15, 1912.



*Sinking of the Titanic led to the adoption of important radio regulations to help assure life safety of all ships at sea.*

Source: [www.titanic-experience.com](http://www.titanic-experience.com)

While the Titanic was sinking, her radio operator frantically called for help over the wireless. The Carpathia, 58 miles away, heard the call, responded, and managed to rescue 700 survivors. The Californian was just 20 miles away from the Titanic and could have rushed to the scene much faster. But the Californian radio operator had gone to bed, there was no one to relieve him, and the call went unheard. Some 1,500 passengers and crew perished!

The U.S. Congress had passed the Wireless Ship Act of 1910, which might have helped prevent the loss of so many lives, but the law's requirements were not comprehensive enough. Following the Titanic disaster, the Act was amended to require a minimum of two radio operators on board ships, a constant 24-hour watch, and the installation of backup power supplies to assure radio communications in emergency situations.

## The Advent of Commercial Aviation

While shipping was a mature industry hundreds of years old, aviation was in its infancy. Wilbur and Orville Wright made their historic first flight just 9 years before the Titanic disaster. Aviation grew quickly, and the first U.S. airline was operating – however briefly – in Florida. It was the St. Petersburg-Tampa Airboat Line, which ran the world's first regularly scheduled airline service using heavier-than-air craft from January through March 1914.

## Early Radio Legislation

Congress enacted the first law providing domestic control of general radio communications in 1912, partially in response to the Titanic. The Radio Act of 1912 was the beginning of government radio licensing. The Act placed the control of all wireless stations under the jurisdiction of the Department of Commerce and made access to the electromagnetic spectrum a privilege granted only by government approval. The law regulated the type of emissions, the transmission of distress calls, and set aside certain frequencies for government use.

At the time the Radio Act of 1912 was passed, the radio spectrum was so unoccupied that no one thought that frequencies would ever have to be assigned, much less shared. If you wanted to operate a transmitter, there was plenty of room in which to do it and all you had to do was apply for a license.

Radio was so new that very few understood its potential. Some barely knew what “wireless” meant. Radio pioneer Lee de Forest, the inventor of the Audion three-element vacuum tube amplifier (a very essential ingredient in the advancement of both wired and wireless communications) was prosecuted for mail fraud. The prosecutor accused de Forest of “...willfully and deliberately misleading the public by stating that soon it will be possible to transmit the human voice across the Atlantic Ocean.”

## **A Pause in Development for World War I**

The growth in commercial and public use of radio was placed on hold when the U.S. entered World War I in 1917. The Woodrow Wilson administration was concerned about possible misuse of radio by German spies. So the Federal government took over control of all commercial radio stations. And all amateur radio operators were required to cease operations and dismantle their stations under penalty of imprisonment. Radio manufacturers pooled their knowledge and expertise and turned their attention to putting this new technology to work winning the War.

World War I also provided the impetus for major advances in aircraft. New designs emerged for small fighter planes, as well as large, heavy bombers. These advances would lead to viable aircraft designs for commercial aviation after the War.

When World War I ended in November, 1918, the massive military market for radio transmitters and receivers disappeared.

## **The Growth of Commercial Broadcast Radio**

In 1919, the American Marconi company was purchased by the Radio Corporation of America (RCA). David Sarnoff became its manager, and he led RCA into the radio business. Sarnoff envisioned a “radio music box” that would receive programs broadcast for public information and entertainment. Around the same time, General Electric and Westinghouse also began making radio receivers. Public demand for the new radio receivers was small at first because there were few stations to listen to. At the end of 1920, only 30 radio stations in the U.S. offered regular broadcasts. That changed rapidly as licensed stations went on the air and began regular broadcasting.

In Pittsburgh, Westinghouse engineer Dr. Frank Conrad set up an amateur radiotelephone station, 8XK, in 1916. Four years later, 8XK became KDKA, the nation’s first commercial broadcast station transmitting on a wavelength of 360 meters (833 kHz). It signed on the air on election night, November 2, 1920, and today is the nation’s oldest commercial radio station still in operation.



*Radio history was made at 6:00 p.m. Tuesday, November 2, 1920 when four men gathered in a shack atop the Westinghouse Electric Building in Pittsburgh to broadcast election result reports to the public.*

*KDKA, the world's first commercial broadcast radio station, was on the air!*

Source: News Radio 1020, KDKA, Pittsburgh, PA

The 1920s saw a virtual explosion of growth in radio broadcasting. Licensing of broadcast stations on a regular basis began in 1921 when WBZ, Springfield, MA, became the first licensed station. By the end of 1922, there were 382 licensed stations, a number that nearly doubled to 733 stations by 1927! Most were operated by radio manufacturers, dealers and department stores selling receivers.

In today's connected world, it is difficult to imagine a time when the vast majority of citizens lived their entire lives without ever hearing the voices of the leaders of their own country. Radio changed that, and a great deal more. Radio receivers brought the world right into the home. People eagerly snapped up receivers to hear what was going on in the world around them. Music lovers could hear operas, symphonies, and more on their radios almost every night. Radio dramas and comedies became popular forms of in-home entertainment. Getting election results in hours instead of days was astonishing. Hearing the news faster than newspapers could print it was truly exciting.

The explosion of radio stations joining the airwaves proved overwhelming. From 1923 to 1926, Secretary of Commerce Herbert Hoover repeatedly submitted bills to Congress to straighten out the regulatory process. He convened conferences each year from 1922 to 1925 in an effort to entice voluntary cooperation from the radio industry. As the Federal government's man in charge, he used his power to grant or deny licenses, assign frequencies, and dictate the time of day when a station could operate. But Secretary Hoover understood that the Radio Act of 1912 no longer provided adequate regulation of the burgeoning radio industry.



Source: Herbert Hoover Presidential Library-Museum

*Commerce Secretary Herbert Hoover listened to radio broadcasts on a special receiver installed in his home so he could better understand complaints received by his department and the needs of the listening public.*

Although radio stations held licenses, they began bending the rules. Stations lengthened their broadcasting hours, changed frequencies, and increased power output without authorization. When one of these station's owners, Zenith, was taken to court, Zenith charged that the Secretary of Commerce had no legal authority to tell them when or where to transmit a radio signal. On July 8, 1926, the acting Attorney General of the United States agreed with Zenith, and decreed that the Secretary of Commerce had no legal authority to assign wavelengths, power levels, or hours of operation, or to restrict the length of a station's license. Officially, no government agency controlled radio for the next six months.

The predictable happened. Without regulations, hundreds of stations had a field day. They cranked up power levels and changed frequencies whenever they wished. New, unlicensed stations went on the air. The result was chaos. There was so much interference among stations that millions of listeners all across America switched off their receivers in disgust, and the sale of new radios slowed to a trickle. When radio receiver sales collapsed, the radio industry finally agreed that some form of government control was necessary.

## The Federal Radio Commission

Secretary Hoover met with radio executives to discuss legislation and rules. With passage of the Radio Act of 1927, Congress created the Federal Radio Commission (FRC).

Led by five commissioners, Congress gave the FRC the authority to decide how much of the radio spectrum each service would be granted, and to change those grants if necessary. The FRC could legally refuse to grant license applications or renew them. Engineers were placed in charge of radio stations to keep up with the latest scientific developments, and such developments were incorporated into the FRC's rules and regulations as necessary. These changes were so sweeping and so well received that the Radio Act of 1927 has been called radio's "Magna Carta."

The International Radiotelegraph Convention also took place in Washington, DC, in 1927. Nearly every nation in the world joined in, deciding as a whole who would use what portions of the shortwave bands for different purposes.

## FAA Origins

At the same time Secretary Hoover was dealing with radio regulation issues, he also was concerned about the emerging commercial aviation industry. The Air Commerce Act of May 20, 1926, was the cornerstone of the Federal government's regulation of civil aviation. This landmark legislation was passed at the urging of the aviation industry, whose leaders believed the airplane could not reach its full commercial potential without Federal action to improve and maintain safety standards.

The Act charged the Secretary of Commerce with fostering air commerce, issuing and enforcing air traffic rules, licensing pilots, certifying aircraft, establishing airways, and operating and maintaining aids to air navigation. Radio, of course, would play an important role in aviation navigation and safety.

A new Aeronautics Branch of the Department of Commerce assumed primary responsibility for aviation oversight. The first head of the Branch was William P. MacCracken, Jr., who played a key part in convincing Congress of the need for this new governmental role.

On April 6, 1927, MacCracken received Pilot License No. 1, becoming the first person to obtain a pilot license from a civilian agency of the U.S. Government.

## The FCC

While the FRC was a good beginning, it became clear that the scope of radio regulation needed to be expanded to encompass other forms of electronic communication, including telegraph and telephone services. Passage of the Communications Act of 1934, which expanded on the 1927 Act, replaced the FRC with the Federal Communications Commission (FCC). The President of the United States appoints the five FCC commissioners. No more than three of them may be from the same political party. The five-year terms are staggered so that they all cannot be replaced at one time. Congress continually monitors FCC operations and, because the FCC is no longer a permanent agency, it must be reauthorized by Congress every two years.

From its inception, the FCC has been a very powerful agency. Standards are explicitly laid out and updated continuously to reflect changes in technology. Stations that fail to follow them are subject to criminal prosecution. While the Communications Act of 1934 itself is only about 150 pages long, the regulations set up under the law today occupy many thousands of pages.



Source: Wyoming State Museum

*The Ford Tri-Motor, with a passenger capacity of 11, made its first flight on June 11, 1926. This one, operated by Standard Oil, drew a crowd at an air show in Casper, Wyoming, in 1928.*

Key duties of the FCC include allocating radio frequency bands along international guidelines, assigning frequencies for various radio services and individual stations, and determining the operational and technical qualifications of radio operators. No radio or television station in the United States can be sold, moved, shut down, or change its operating hours or power level without express permission from the FCC. Because of licensing, the FCC's word is law on whether or not a station can legally exist.

As technology changes, the FCC works steadily to keep up. Cable television, digital data transmission over the telephone lines, satellite broadcasting, high-definition television (HDTV), and other advances in radio communication technique all fall under its jurisdiction. Whenever a new format is invented and brought to the FCC's attention, the FCC examines it and makes rules appropriate for its regulation. And, importantly, the FCC also works to make sure that U.S. radio regulations are in harmony with those of the International Telecommunication Union.

## Early Aeronautics Branch Responsibilities

In fulfilling its civil aviation responsibilities, the Department of Commerce initially concentrated on functions such as safety rulemaking and the certification of pilots and aircraft. It took over the building and operation of the nation's system of lighted airports, a task begun by the Post Office Department. The Department of Commerce improved aeronautical radio communications, and introduced radio beacons as an effective aid to air navigation.

As commercial flying increased, the Bureau encouraged a group of airlines to establish the first three centers for providing air traffic control (ATC) along the airways. In 1936, the Bureau itself took over the centers and began to expand the ATC system. The pioneer air traffic controllers used maps, blackboards, and mental calculations to ensure the safe separation of aircraft traveling along designated routes between cities.

## The Civil Aeronautics Act

In 1938, the Civil Aeronautics Act transferred the Federal civil aviation responsibilities from the Commerce Department to a new independent agency, the Civil Aeronautics Authority. The legislation also expanded the government's role by giving the Authority the power to regulate airline fares and to determine the routes that air carriers would serve.

In 1940, President Franklin Roosevelt split the Authority into two agencies, the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB). CAA was responsible for ATC, airman and aircraft certification, safety enforcement, and airway development. CAB was entrusted with safety rulemaking, accident investigation, and economic regulation of the airlines. Both organizations were part of the Department of Commerce. Unlike CAA, however, CAB functioned independently of the Secretary.

On the eve of America's entry into World War II, CAA began to extend its ATC responsibilities to takeoff and landing operations at airports. This expanded role eventually became permanent after the war. The application of RADAR to ATC helped controllers in their drive to keep abreast of the postwar boom in commercial air transportation. In 1946, Congress gave CAA the added task of administering the Federal-aid airport program, the first peacetime program of financial assistance aimed exclusively at promoting development of the nation's civil airports.



*The DC-3 first flew on December 17, 1935, exactly 32 years after the first flight of the Wright brothers. More than 10,000 were built, and many are still flying.*

## The Birth of FAA

The approaching introduction of jet airliners and a series of midair collisions spurred passage of the Federal Aviation Act of 1958. This legislation transferred CAA's functions to a new independent body, the Federal Aviation Agency (FAA) that had broader authority to combat aviation hazards. The act took safety rulemaking from CAB and entrusted it to the new FAA. It also gave FAA sole responsibility for developing and maintaining a common civil-military system of air navigation and air traffic control, a responsibility CAA previously shared with others.

The scope of the Federal Aviation Act owed much to the leadership of Elwood "Pete" Quesada, an Air Force general who served as President Eisenhower's principle advisor on civil aeronautics. After becoming the first Administrator of the agency he helped to create, Quesada mounted a vigorous campaign for improved airline safety.



*Today, air travel is carefully managed by air traffic controllers to ensure passenger safety.*

## The FCC's Aviation Radio Services

The aviation radio service is an internationally-allocated radio service providing for safety of life and property in air navigation. There are two types of aviation radio services:

- Aircraft Radio Stations are stations in the aeronautical mobile service that use radio equipment, such as two-way radiotelephones, RADAR, radionavigation equipment, and emergency locator transmitters (ELTs), on board aircraft for the primary purpose of ensuring safety of aircraft in flight.
- Ground Radio Stations are usually of two types. The Aeronautical and Fixed Service includes stations used for ground-to-air communications with aircraft about aviation safety, navigation, or preparation for flight. The Aeronautical Radionavigation Service is made up of stations used for navigation, obstruction warning, instrument landing, and measurement of altitude and range.

Like all other radio services, the FCC coordinates the U.S. aviation radio services in compliance with the ITU regulations. Part of this work involves issuing licenses for the operation and maintenance of aircraft radio and RADAR equipment.

## The ITU

Almost every nation in the world belongs to the International Telecommunication Union (ITU). This United Nations agency is headquartered in Geneva, Switzerland. Since radio waves do not respect international boundaries, global telecommunications standards are agreed upon through the ITU's Radiocommunication Sector (ITU-R).

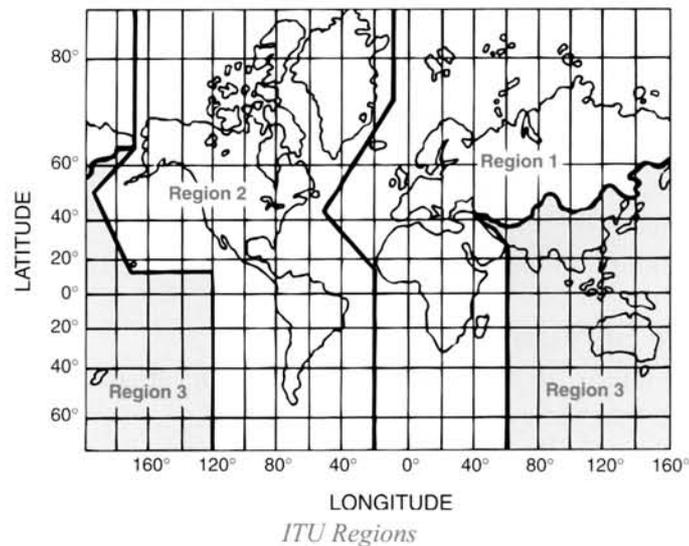
The ITU-R plays a vital role in the global management of the radio-frequency spectrum and satellite orbits. The appropriate use of these limited natural resources ensures safety of life on land, at sea, and in the skies. Use of portions of the radio spectrum is increasingly in demand from a large and growing number of services, such as fixed, mobile, broadcasting, amateur, space research, emergency telecommunications, meteorology, global positioning systems, environmental monitoring and communication services.

The ITU-R's mission is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and to carry out studies and approve recommendations on radio communication matters.

In implementing this mission, ITU-R aims at creating the conditions for harmonized development and efficient operation of existing and new radio systems.

The ITU-R's primary objective is to ensure interference free operations of radio systems. This is accomplished through implementation of the Radio Regulations and Regional Agreements, and the efficient and timely update of these instruments through the processes of World and Regional Radiocommunication Conferences. Furthermore, radio standardization establishes "Recommendations" intended to assure the necessary performance and quality in operating radio systems. It also seeks ways and means to conserve spectrum and ensure flexibility for future expansion and new technological developments.

The ITU divides the world into three general regions. North and South America are located in ITU Region 2, as shown below. As an aid to enforcement of radio laws, radio stations identify themselves using call signs that begin with certain ITU assigned prefixes. All U.S. stations begin with K, N, W and certain A prefixes.



ITU agreements are fine-tuned by individual governments. In the United States, the FCC regulates all non-government radio frequencies. Federal government spectrum is under the jurisdiction of the President and managed by the National Telecommunications and Information Administration (NTIA).

## Summary

The growth of radio technology since its invention more than 100 years ago has required a parallel growth of regulation and spectrum management, both in the United States and internationally. Through the work of the ITU and FCC, we enjoy the benefits of radio in all its forms, from the safety communications systems on sea, land, and in the air, to the entertainment media that bring news, music, sports programming, and so much more into our daily lives.

The purpose of this book is to help you earn your Commercial Radio Operator or Maintainer License from the Federal Communications Commission. Understanding the history of radio licensing provides you with a framework for your study, and an understanding of the necessity of FCC licensing.