1.2: Wireless Technology and Amateur Radio - What and Why?

Learning Objectives

By the end of this section, you will be able to

- Define wireless technology, and provide some examples of it.
- Define Amateur Radio, and provide some examples of how Amateur Radio is used in practice.

Wireless technology is equipment or methods that enable information to be transferred between two locations without an electrical wire, optical fiber, or other guiding medium [1]. Wireless equipment most commonly uses electromagnetic waves to send signals through air or empty space from a sender to a receiver. Contemporary examples of wireless technology include cellular telephones, broadcast and satellite televisions, broadcast AM/FM radio receivers, remote garage door openers, remote controls, cordless telephones and headphones, wireless computer mice and keyboards, Global Positioning System (GPS) receivers, handheld radios ("walkie-talkies"), Amateur Radio transceivers, and other devices that use wireless communication protocols like WiFi and Bluetooth [1] (Fig. 1.2.1). The development of wireless technology combined with the development of small, high-capacity batteries has led to the widespread adoption of wireless devices due to their convenience and portability.

Figure 1.2.1: Examples of wireless technology include (left to right) cellular phone [2], global positioning system (GPS) receiver [3], and wireless mouse and keyboard [4].

Amateur Radio, also known as **ham radio**, is one of several personal radio services which use wireless technology to enable licensed operators to communicate. As suggested by the name, Amateur Radio operators are restricted to using radio for non-commercial purposes [5]. In contrast to other personal radio services (see Table 1.2.1) which are typically limited to local use, amateur radio stations can often communicate with other stations around the world given their higher allowed power levels and wider access to the electromagnetic spectrum. To gain access to these privileges, Amateur Radio operators must typically be licensed by their local government agency (e.g., the Federal Communications Commission (FCC) [6] in the United States) and demonstrate some understanding of the key concepts of electricity and magnetism, electronics, radio equipment, radio wave propagation, radio-frequency safety, and local operating regulations and conventions. It is this overlap between the physics of electromagnetism and the topics of Amateur Radio that make it natural to consider both in the same context.

Table 1.2.1. Types of personal radio services in the United States [7]. Licenses are required to use the GMRS.

Service	Channels	Intended Use	Typical Range
Citizens Band	40	Private/Business	16 km (10 miles)
Marine VHF	50	Maritime	32 km (20 miles)
Family Radio Service (FRS) & General Mobile Radio Service (GMRS)	22	Personal	3.2 km (2 miles)
Multi-Use Radio Service (MURS)	5	Personal	8 km (5 miles)

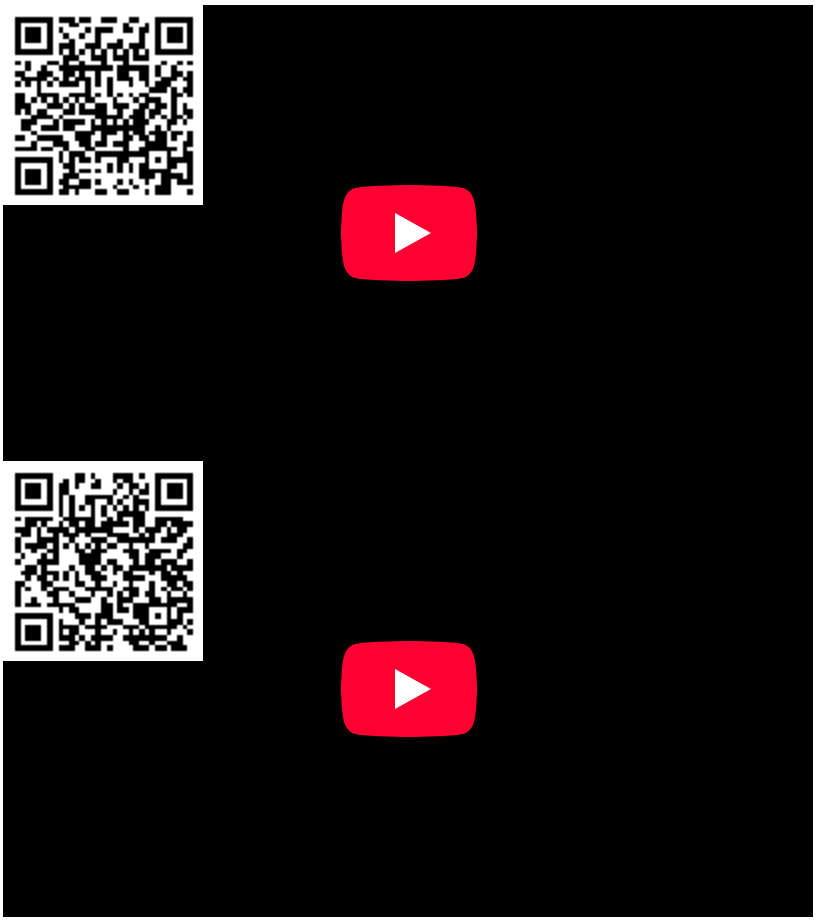
Amateur Radio operators have also developed interesting and novel ways to use radio signals (see Example 1.2.1).

Example 1.2.1

Amateur Radio operators have expanded the service and hobby into a wide variety of directions:

- **Wireless Experimentation & Technical Development**
  As wireless technology developed, Amateur Radio operators were involved in its progress. For example, in the United States, the first Amateur Radio licenses were issued in 1912 [7], not long after the first demonstration of radio communication in the 1890s and early 1900s [8]. Over time, Amateur Radio operators have worked to develop and refine techniques to send images, video, text messages, email, data packets, and other information formats via radio signals. They have also develop and test methods to successfully communicate messages under conditions with a lot of noise or with low power.
- **Emergency Communications**
  Amateur Radio operators are also known for their use of radio in emergency communications and other public service applications [9]. For example, Amateur Radio networks are often activated during hurricanes and other extreme weather events when other means of communications like cellular networks are down due to power outages. In the United States, programs like the American Radio Relay League's Amateur Radio Emergency Service (ARES) and the government's Radio Amateur Civil Emergency Service (RACES) prepare operators to work with local agencies in times of crisis and report severe weather conditions to the National Weather Services via the SKYWARN organization.
- **Radiosport (Contesting)**
  Amateur Radio operators have developed many different ways to practice their operating skills in competition with each other [10]. During contests, operators try to make as many two-way contacts with other operators within a fixed duration of time, often with different categories (e.g., operating teams, operating at low power, operating in different part of the spectrum). Formal or informal contests are also held to test operators' ability to receive or transmit quickly using Morse code, find hidden transmitters (Amateur Radio Direction Finding or "foxhunting"), or quickly deploy, contact, and move to a new location repeatedly (Rapid Deployment of Amateur Radio).
- **Remote Communication**
  Amateur Radio operators practice their transmitting and receiving skills by making contacts with many different geographic regions as possible [11]. Operators may try to work all countries, states, counties, or other entities from their own local station. Some operators take part in expeditions to set up stations in remote locations to make contacts ("DXpeditions" where "DX" is radio shorthand for "distant") or in specific kinds of geographic entities (e.g., Parks on the Air (POTA), Summits on the Air (SOTA), Islands on the Air (IOTA)). Other operators specialize in making long-distance contacts via orbiting satellites or via temporary conditions like aurora (Northern or Southern lights) or meteor showers that would otherwise be difficult to perform.
- **Radio Clubs**
  Amateur Radio operators have formed a variety of organizations to support Amateur Radio [12]. These clubs provide networking, formal or informal education about radio, licensing exams, "hamfests" to buy or sell radio gear, contesting events, field days, and other opportunities. Organizations have been developed to support operators in a common geographic area, with common background (e.g., Collegiate Amateur Radio Program (CARP) for college and university students, Youth on the Air (YOTA) for operators under 25 years old, Young Ladies Radio League for women of all ages) or common interests (e.g, Morse code, radiosport, remote communication, satellite communication). Many countries have national organizations (e.g., the American Radio Relay League, Radio Amateurs of Canada, Radio Society of Great Britain) that help to design and administer license exams, advocate for public policies to protect the Amateur Radio service, perform technical testing of radio equipment, and develop educational materials.
- **Citizen Science**
  While much more is known about radio waves than in the early 1900s, there is still much to be learned, particularly about how radio waves travel from location to location through the atmosphere and ionosphere surrounding the earth. Collaborations between the professional scientists & engineers at universities and government agencies and the broader community of citizen Amateur Radio operators can enable accelerated development of new radio technology and improved understanding of radio wave propagation. For example, the Ham Radio Science Citizen Investigation (HamSCI) [13] has studied how radio wave propagation changes during a total solar eclipse by crowd-sourcing contact reports from the Amateur Radio community.

These videos illustrate some examples of these various aspects of Amateur Radio.



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