

Amateur radio

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Amateur radio (also called **ham radio**) describes the use of radio frequency spectrum for purposes of non-commercial exchange of messages, wireless experimentation, self-training, private recreation, radiosport, contesting, and emergency communication. The term "amateur" is used to specify "a duly authorised person interested in radioelectric practice with a purely personal aim and without pecuniary interest;"^[1] (either direct monetary or other similar reward) and to differentiate it from commercial broadcasting, public safety (such as police and fire), or professional two-way radio services (such as maritime, aviation, taxis, etc.).

The amateur radio service (*amateur service* and *amateur-satellite service*) is established by the International Telecommunication Union (ITU) through the International Telecommunication Regulations. National governments regulate technical and operational characteristics of transmissions and issue individual stations licenses with an identifying call sign. Prospective amateur operators are tested for their understanding of key concepts in electronics and the host government's radio regulations. Radio amateurs use a variety of voice, text, image, and data communications modes and have access to frequency allocations throughout the RF spectrum to enable communication across a city, region, country, continent, the world, or even into space.

Amateur radio is officially represented and coordinated by the International Amateur Radio Union (IARU), which is organized in three regions and has as its members the national amateur radio societies which exist in most countries. According to an estimate made in 2011 by the American Radio Relay League, two million people throughout the world are regularly involved with amateur radio.^[2] About 830,000 amateur radio stations are located in IARU Region 2 (the Americas) followed by IARU Region 3 (South and East Asia and the Pacific Ocean) with about 750,000 stations. A significantly smaller number, about 400,000, are located in IARU Region 1 (Europe, Middle East, CIS, Africa).



An example of an amateur radio station with four transceivers, amplifiers, and a computer for logging and for digital modes. On the wall are examples of various amateur radio awards, certificates, and a reception report card (QSL card) from a foreign amateur station.

Contents

- 1 History
 - 1.1 Ham radio
- 2 Activities and practices
- 3 Licensing
 - 3.1 Licensing requirements
 - 3.2 Reciprocal licensing
 - 3.3 Newcomers
 - 3.4 Call signs
 - 3.5 Privileges
 - 3.6 Band plans and frequency allocations
- 4 Modes of communication

- 4.1 Voice
- 4.2 Image
- 4.3 Text and data
- 4.4 Modes by activity
- 5 See also
- 6 References
- 7 Further reading
- 8 External links

History

The origins of amateur radio can be traced to the late 19th century, but amateur radio as practiced today began in the early 20th century. The *First Annual Official Wireless Blue Book of the Wireless Association of America*, produced in 1909, contains a list of amateur radio stations.^[3] This radio callbook lists wireless telegraph stations in Canada and the United States, including 89 amateur radio stations. As with radio in general, amateur radio was associated with various amateur experimenters and hobbyists. Amateur radio enthusiasts have significantly contributed to science, engineering, industry, and social services. Research by amateur operators has founded new industries,^[4] built economies,^[5] empowered nations,^[6] and saved lives in times of emergency.^{[7][8]} Ham radio can also be used in the classroom to teach English, map skills, geography, math, science, and computer skills.^[9]

Ham radio

The term "ham radio" was first a pejorative that mocked amateur radio operators with a 19th-century term for being bad at something, like "ham-fisted" or "ham actor". It had already been used for bad wired telegraph operators.^{[10][11][12][13]}

Subsequently, the community adopted it as a welcome moniker,^[14] much like the "Know-Nothing Party", or other groups and movements throughout history. Other, more entertaining explanations have grown up throughout the years, but they are apocryphal.

Activities and practices

The many facets of amateur radio attract practitioners with a wide range of interests. Many amateurs begin with a fascination of radio communication and then combine other personal interests to make pursuit of the hobby rewarding. Some of the focal areas amateurs pursue include radio contesting, radio propagation study, public service communication, technical experimentation, and computer networking.

Amateur radio operators use various modes of transmission to communicate. The two most common modes for voice transmissions are frequency modulation (FM) and single sideband (SSB). FM offers high quality audio signals, while SSB is better at long distance communication when bandwidth is restricted.^[15]



An amateur radio station in the United Kingdom. Multiple transceivers are employed for different bands and modes. Computers are used for control, datamodes, SDR and logging.

Radiotelegraphy using Morse code, also known as "CW" from "continuous wave", is the wireless extension of land line (wired) telegraphy developed by Samuel Morse and dates to the earliest days of radio. Although computer-based (digital) modes and methods have largely replaced CW for commercial and military applications, many amateur radio operators still enjoy using the CW mode—particularly on the shortwave bands and for experimental work, such as earth-moon-earth communication, because of its inherent signal-to-noise ratio advantages. Morse, using internationally agreed message encodings such as the Q code, enables communication between amateurs who speak different languages. It is also popular with homebrewers and in particular with "QRP" or very-low-power enthusiasts, as CW-only transmitters are simpler to construct, and the human ear-brain signal processing system can pull weak CW signals out of the noise where voice signals would be totally inaudible. A similar "legacy" mode popular with home constructors is amplitude modulation (AM), pursued by many vintage amateur radio enthusiasts and aficionados of vacuum tube technology.

Demonstrating a proficiency in Morse code was for many years a requirement to obtain an amateur license to transmit on frequencies below 30 MHz. Following changes in international regulations in 2003, countries are no longer required to demand proficiency.^[16] The United States Federal Communications Commission, for example, phased out this requirement for all license classes on February 23, 2007.^{[17][18]}

Modern personal computers have encouraged the use of digital modes such as radioteletype (RTTY) which previously required cumbersome mechanical equipment.^[19] Hams led the development of packet radio in the 1970s, which has employed protocols such as AX.25 and TCP/IP. Specialized digital modes such as PSK31 allow real-time, low-power communications on the shortwave bands. Echolink using Voice over IP technology has enabled amateurs to communicate through local Internet-connected repeaters and radio nodes,^[20] while IRLP has allowed the linking of repeaters to provide greater coverage area. Automatic link establishment (ALE) has enabled continuous amateur radio networks to operate on the high frequency bands with global coverage. Other modes, such as FSK441 using software such as WSJT, are used for weak signal modes including meteor scatter and moonbounce communications.

Fast scan amateur television has gained popularity as hobbyists adapt inexpensive consumer video electronics like camcorders and video cards in PCs. Because of the wide bandwidth and stable signals required, amateur television is typically found in the 70 cm (420–450 MHz) frequency range, though there is also limited use on 33 cm (902–928 MHz), 23 cm (1240–1300 MHz) and higher. These requirements also effectively limit the signal range to between 20 and 60 miles (30–100 km).

Linked repeater systems, however, can allow transmissions of VHF and higher frequencies across hundreds of miles.^[21] Repeater are usually located on heights of land or tall structures and allow operators to communicate over hundreds of miles using hand-held or mobile transceivers. Repeaters can also be linked together by using other amateur radio bands, landline, or the Internet.

Amateur radio satellites can be accessed, some using a hand-held transceiver (HT), even, at times, using the factory "rubber duck" antenna.^[22] Hams also use the moon, the aurora borealis, and the ionized trails of meteors as reflectors of radio waves.^[23] Hams can also contact the International Space Station (ISS) because many astronauts and cosmonauts are licensed as amateur radio operators.^{[24][25]}

Amateur radio operators use their amateur radio station to make contacts with individual hams as well as participating in round table discussion groups or "rag chew sessions" on the air. Some join in regularly scheduled on-air meetings with other amateur radio operators, called "nets" (as in "networks"), which are moderated by a station referred to as "Net Control".^[26] Nets can allow operators to learn procedures for emergencies, be an informal round table, or cover specific interests shared by a group.

Amateur radio operators, using battery- or generator-powered equipment, often provide essential communications services when regular channels are unavailable due to natural disaster or other disruptive events.

Many amateur radio operators participate in radio contests, during which an individual or team of operators typically seek to contact and exchange information with as many other amateur radio stations as possible in a given period of time. In addition to contests, a number of Amateur radio operating award schemes exist, sometimes suffixed with "on the Air", such as Summits on the Air, Islands on the Air, Worked All States and Jamboree on the Air.

Licensing

Radio transmission permits are closely controlled by nations' governments because radio waves propagate beyond national boundaries, and therefore radio is of international concern. Also, radio has possible clandestine uses.

Both the requirements for and privileges granted to a licensee vary from country to country, but generally follow the international regulations and standards established by the International Telecommunication Union^[27] and World Radio Conferences.

All countries that license citizens to use amateur radio require operators to display knowledge and understanding of key concepts, usually by passing an exam.^[28] The licenses grant hams the privilege to operate in larger segments of the radio frequency spectrum, with a wider variety of communication techniques, and with higher power levels relative to unlicensed personal radio services (such as CB radio, FRS, and PMR446), which require type-approved equipment restricted in mode, range, and power.

Amateur licensing is a routine civil administrative matter in many countries. Amateurs therein must pass an examination to demonstrate technical knowledge, operating competence, and awareness of legal and regulatory requirements, in order to avoid interfering with other amateurs and other radio services. A series of exams are often available, each progressively more challenging and granting more privileges: greater frequency availability, higher power output, permitted experimentation, and, in some countries, distinctive call signs. Some countries, such as the United Kingdom and Australia, have begun requiring a practical training course in addition to the written exams in order to obtain a beginner's license, which they call a Foundation License.

In most countries, an operator will be assigned a call sign with their license. In some countries, a separate "station license" is required for



NASA astronaut Col. Doug Wheelock, KF5BOC, Expedition 24 flight engineer, operates the NA1SS ham radio station in the Zvezda Service Module of the International Space Station. Equipment is a Kenwood TM-D700E transceiver.



The top of a tower supporting a Yagi-Uda antenna and several wire antennas



A handheld VHF/UHF transceiver

any station used by an amateur radio operator. Amateur radio licenses may also be granted to organizations or clubs. In some countries, hams are allowed to operate *only* club stations.

An amateur radio license is valid only in the country in which it is issued or in another country that has a reciprocal licensing agreement with the issuing country. Some countries, such as Syria and Cuba, restrict operation by foreigners to club stations only.

In some countries, an amateur radio license is necessary in order to purchase or possess amateur radio equipment.^[29]

Amateur radio licensing in the United States exemplifies the way in which some countries award different levels of amateur radio licenses based on technical knowledge: three sequential levels of licensing exams (Technician Class, General Class, and Amateur Extra Class) are currently offered, which allow operators who pass them access to larger portions of the Amateur Radio spectrum and more desirable (shorter) call signs. An exam, authorized by the Federal Communications Commission (FCC), is required for all levels of the Amateur Radio license. These exams are administered by Volunteer Examiners, accredited by the FCC-recognized Volunteer Examiner Coordinator (VEC) system. The Technician Class and General Class exams consist of 35 multiple-choice questions, drawn randomly from a pool of at least 350. To pass, 26 of the 35 questions must be answered correctly.^[30] The Extra Class exam has 50 multiple choice questions (drawn randomly from a pool of at least 500), 37 of which must be answered correctly.^[30] The tests cover regulations, customs, and technical knowledge, such as FCC provisions, operating practices, advanced electronics theory, radio equipment design, and safety. Morse Code is no longer tested in the U.S. Once the exam is passed, the FCC issues an Amateur Radio license which is valid for ten years. Studying for the exam is made easier because the entire question pools for all license classes are posted in advance. The question pools are updated every four years by the National Conference of VECs.^[30]

Licensing requirements

Prospective amateur radio operators are examined on understanding of the key concepts of electronics, radio equipment, antennas, radio propagation, RF safety, and the radio regulations of the government granting the license. These examinations are sets of questions typically posed in either a short answer or multiple-choice format. Examinations can be administered by bureaucrats, non-paid certified examiners, or previously licensed amateur radio operators.

The ease with which an individual can acquire an amateur radio license varies from country to country. In some countries, examinations may be offered only once or twice a year in the national capital and can be inordinately bureaucratic (for example in India) or challenging because some amateurs must undergo difficult security approval (as in Iran). Currently only Yemen and North Korea do not issue amateur radio licenses to their citizens, although in both cases a limited number of foreign visitors have been permitted to obtain amateur licenses in the past decade. Some developing countries, especially those in Africa, Asia, and Latin America, require the payment of annual license fees that can be prohibitively expensive for most of their citizens. A few small countries may not have a national licensing process and may instead require prospective amateur radio operators to take the licensing examinations of a foreign country. In countries with the largest numbers of amateur radio licensees, such as Japan, the United States, Thailand, Canada, and most of the countries in Europe, there are frequent license examinations opportunities in major cities.

Granting a separate license to a club or organization generally requires that an individual with a current and valid amateur radio license who is in good standing with the telecommunications authority assumes responsibility for any operations conducted under the club license or club call sign. A few countries may issue

special licenses to novices or beginners that do not assign the individual a call sign but instead require the newly licensed individual to operate from stations licensed to a club or organization for a period of time before a higher class of license can be acquired.

Reciprocal licensing

A reciprocal licensing agreement between two countries allows bearers of an amateur radio license in one country under certain conditions to legally operate an amateur radio station in the other country without having to obtain an amateur radio license from the country being visited, or the bearer of a valid license in one country can receive a separate license and a call sign in another country, both of which have a mutually-agreed reciprocal licensing approvals. Reciprocal licensing requirements vary from country to country. Some countries have bilateral or multilateral reciprocal operating agreements allowing hams to operate within their borders with a single set of requirements. Some countries lack reciprocal licensing systems.

When traveling abroad, visiting amateur operators must follow the rules of the country in which they wish to operate. Some countries have reciprocal international operating agreements allowing hams from other countries to operate within their borders with just their home country license. Other host countries require that the visiting ham apply for a formal permit, or even a new host country-issued license, in advance.

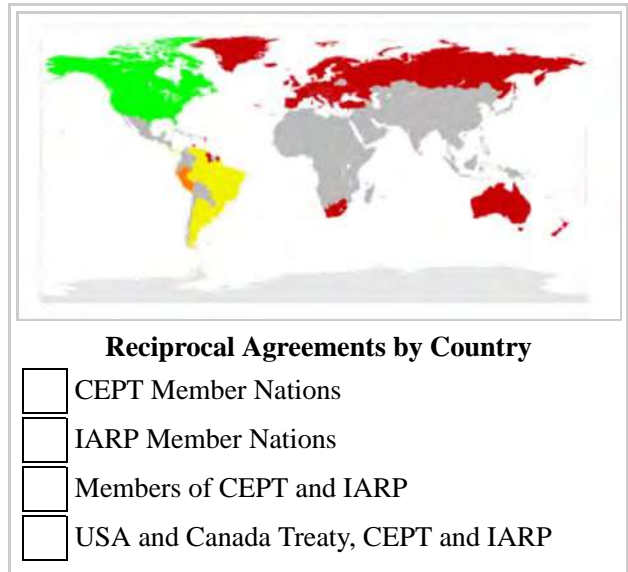
The reciprocal recognition of licenses frequently not only depends on the involved licensing authorities, but also on the nationality of the bearer. As an example, in the US, foreign licenses are recognized only if the bearer does not have US citizenship and holds no US license (which may differ in terms of operating privileges and restrictions). Conversely, a US citizen may operate under reciprocal agreements in Canada, but not a non-US citizen holding a US license.

Newcomers

Many people start their involvement in amateur radio by finding a local club. Clubs often provide information about licensing, local operating practices, and technical advice. Newcomers also often study independently by purchasing books or other materials, sometimes with the help of a mentor, teacher, or friend. Established amateurs who help newcomers are often referred to as "Elmers", as coined by Rodney Newkirk, W9BRD,^[31] within the ham community.^{[32][33]} In addition, many countries have national amateur radio societies which encourage newcomers and work with government communications regulation authorities for the benefit of all radio amateurs. The oldest of these societies is the Wireless Institute of Australia, formed in 1910; other notable societies are the Radio Society of Great Britain, the American Radio Relay League, Radio Amateurs of Canada, Bangladesh NGOs Network for Radio and Communication, the New Zealand Association of Radio Transmitters and South African Radio League. *(See Category:Amateur radio organizations)*

Call signs

An amateur radio operator uses a **call sign** on the air to legally identify the operator and/or station.^[34] In some



countries, the call sign assigned to the station must always be used, whereas in other countries, the call sign of either the operator or the station may be used.^[35] In certain jurisdictions, an operator may also select a "vanity" call sign although these must also conform to the issuing government's allocation and structure used for Amateur Radio call signs.^[36] Some jurisdictions require a fee to obtain such a vanity call sign; in others, such as the UK, a fee is not required and the vanity call sign may be selected when the license is applied for. The FCC in the U.S. discontinued its fee for vanity call sign applications in September 2015.^[37]

Call sign structure as prescribed by the ITU consists of three parts which break down as follows, using the call sign ZS1NAT as an example:

1. ZS – Shows the country from which the call sign originates and may also indicate the license class. (This call sign is licensed in South Africa. CEPT Class is no longer "encoded" in South African call signs. Where specific classes of amateur radio license exist, the call signs may be assigned by class, but the specifics vary by issuing country.)
2. 1 – Gives the subdivision of the country or territory indicated in the first part (this one refers to the Western Cape).
3. NAT – The final part is unique to the holder of the license, identifying that station specifically.

Many countries do not follow the ITU convention for the numeral. In the United Kingdom the original calls G0xxx, G2xxx, G3xxx, G4xxx, were Full (A) License Holders along with the last M0xxx full call signs issued by the City & Guilds examination authority in December 2003. Additional full licenses were originally granted in respect of (B) Licensees with G1xxx, G6xxx, G7xxx, G8xxx and 1991 onward with M1xxx calls. The newer three level Intermediate licensees are 2E1xxx and 2E0xx and basic Foundation license holders are granted a M6xxx or M3xxx call signs.^[38]

In the UK secondary "letters" are used to identify the Stations location - thus a callsign G7OOE becomes GM7OOE when that operator is operating a station in Scotland. "GM" - Scotland, G(E) - England - however the (E) may be omitted, "GW" - Wales, more information from the **Ofcom** (the UK Radio & Media Licensing Authority) website - www.ofcom.gov.uk

In the United States, for non-Vanity licenses, the numeral indicates the geographical district the holder resided in when the license was issued. Prior to 1978, US hams were required to obtain a new call sign if they moved out of their geographic district.

In Canada Call signs start with VA, VE, VY, VO, and CY. All Call signs starting with all prefixes end with a number after to indicate the political region *(Except CY which indicates geographic islands) (VA/VE1 is Nova Scotia, VA/VE2 is Quebec, VA/VE3 is Ontario, VA/VE4 is Manitoba, VA/VE5 is Saskatchewan, VA/VE6 is Alberta, VA/VE7 is British Columbia, VE8 is the NWT, VE9 is New Brunswick, VY0 is Nunavut, VY1 is the Yukon Territory, VY2 is P.E.I, VO1 is Newfoundland and VO2 is Labrador) CY is for amateur who go to Stable and/or St. Paul's Island (which both require coast guard permission to get to) CY0 is Stable Island and CY9 is St. Paul's Island. The last two/three letters of the callsigns is typically the Operator's Choice where upon completing the test write their three most preferred options *(two letter callsign suffixes require a ham to be of 5 years of already being licensed). Callsigns in Canada can be requested with a fee.

Also, for smaller entities, a numeral may be part of the country identification. For example, VP2xxx is in the British West Indies (subdivided into VP2Exx Anguilla, VP2Mxx Montserrat, and VP2Vxx British Virgin Islands), VP5xxx is in the Turks and Caicos Islands, VP6xxx is on Pitcairn Island, VP8xxx is in the Falklands, and VP9xxx is in Bermuda.

Online callbooks or callsign databases can be browsed or searched to find out who holds a specific callsign.^[39]

An example of an online callbook is QRZ.COM. Non-exhaustive lists of famous people who hold or have held amateur radio callsigns have also been compiled and published.^[40]

Many jurisdictions (but not in the UK & Europe) may issue specialty vehicle registration plates to licensed amateur radio operators often in order to facilitate their movement during an emergency.^{[41][42]} The fees for application and renewal are usually less than the standard rate for specialty plates.^{[41][43]}

Privileges

In most administrations, unlike other RF spectrum users, radio amateurs may build or modify transmitting equipment for their own use within the amateur spectrum without the need to obtain government certification of the equipment.^{[44][45]} Licensed amateurs can also use any frequency in their bands (rather than being allocated fixed frequencies or channels) and can operate medium to high-powered equipment on a wide range of frequencies^[46] so long as they meet certain technical parameters including occupied bandwidth, power, and maintenance of spurious emission.

Radio amateurs have access to frequency allocations throughout the RF spectrum, usually allowing choice of an effective frequency for communications across a local, regional, or worldwide path. The shortwave bands, or HF, are suitable for worldwide communication, and the VHF and UHF bands normally provide local or regional communication, while the microwave bands have enough space, or bandwidth, for amateur television transmissions and high-speed computer networks.

In most countries, an amateur radio license grants permission to the license holder to own, modify, and operate equipment that is not certified by a governmental regulatory agency. This encourages amateur radio operators to experiment with home-constructed or modified equipment. The use of such equipment must still satisfy national and international standards on spurious emissions.

The amount of output power an amateur radio licensee may legally use varies from country to country. Although allowable power levels are moderate by commercial standards, they are sufficient to enable global communication. Power limits vary from country to country and between license classes within a country. For example, the peak envelope power limits for the highest available license classes in a few selected countries are: 2.25 kW in Canada,^[47] 1.5 kW in the United States, 1.0 kW in Belgium, Luxembourg, Switzerland and New Zealand, 750 W in Germany, 500 W in Italy, 400 W in Australia, India and the United Kingdom, and 150 W in Oman. Lower license classes usually have lower power limits; for example, the lowest license class in the UK (Foundation licence) has a limit of 10 W. Amateur radio operators are encouraged both by regulations and tradition of respectful use of the spectrum to use as little power as possible to accomplish the communication.^[48] This is to minimise interference or EMC to any other device.

Output power limits may also depend on the mode of transmission. In Australia, for example, 400 W may be used for SSB transmissions, but FM and other modes are limited to 120 W.

The point at which power output is measured may also affect transmissions. The United Kingdom measures at the point the antenna is connected to the signal feed cable, which means the radio system may transmit more than 400 W to overcome signal loss in the cable; conversely, Germany measures power at the output of the final amplification stage, which results in a loss in radiated power with longer cable feeds.

Certain countries permit amateur radio licence holders to hold a Notice of Variation that allows higher power to be used than normally allowed for certain specific purposes. E.g. in the UK some amateur radio licence holders are allowed to transmit using (33 dBw) 2.0 kW for experiments entailing using the moon as a passive radio

reflector (known as Earth-Moon-Earth communication) (EME).

Band plans and frequency allocations

The International Telecommunication Union (ITU) governs the allocation of communications frequencies worldwide, with participation by each nation's communications regulation authority. National communications regulators have some liberty to restrict access to these bandplan frequencies or to award additional allocations as long as radio services in other countries do not suffer interference. In some countries, specific emission types are restricted to certain parts of the radio spectrum, and in most other countries, International Amateur Radio Union (IARU) member societies adopt voluntary plans to ensure the most effective use of spectrum.

In a few cases, a national telecommunication agency may also allow hams to use frequencies outside of the internationally allocated amateur radio bands. In Trinidad and Tobago, hams are allowed to use a repeater which is located on 148.800 MHz. This repeater is used and maintained by the National Emergency Management Agency (NEMA), but may be used by radio amateurs in times of emergency or during normal times to test their capability and conduct emergency drills. This repeater can also be used by non-ham NEMA staff and REACT members. In Australia and New Zealand ham operators are authorized to use one of the UHF TV channels. In the U.S., amateur radio operators providing essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available may use any frequency including those of other radio services such as police and fire and in cases of disaster in Alaska may use the statewide emergency frequency of 5167.5 kHz with restrictions upon emissions.^[49]

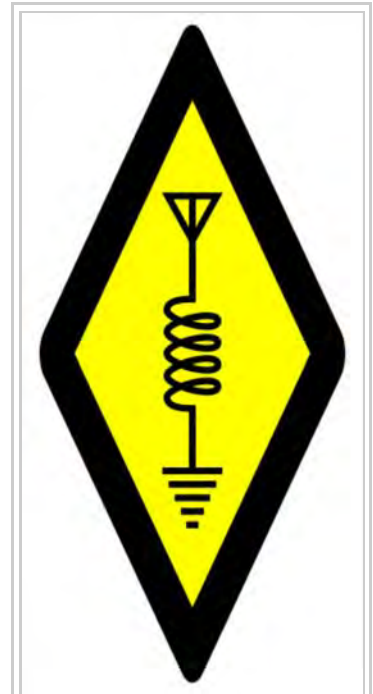
Similarly, amateurs in the United States may apply to be registered with the Military Auxiliary Radio System (MARS). Once approved and trained, these amateurs also operate on US government military frequencies to provide contingency communications and morale message traffic support to the military services.

Modes of communication

Amateurs use a variety of voice, text, image, and data communications modes over radio. Generally new modes can be tested in the amateur radio service, although national regulations may require disclosure of a new mode to permit radio licensing authorities to monitor the transmissions. Encryption, for example, is not generally permitted in the Amateur Radio service except for the special purpose of satellite vehicle control uplinks. The following is a partial list of the modes of communication used, where the mode includes both modulation types and operating protocols.

Voice

- Amplitude modulation (AM)
- Double Sideband Suppressed Carrier (DSB-SC)
- Independent Sideband (ISB)



The international symbol for amateur radio, included in the logos of many IARU member societies. The diamond holds a circuit diagram featuring components common to every radio: an antenna, inductor and ground.

- Single Sideband (SSB)
- Amplitude Modulation Equivalent (AME)
- Frequency modulation (FM)
- Phase modulation (PM)

Image

- Amateur Television (ATV), also known as *Fast Scan television*
- Slow-Scan Television (SSTV)
- Facsimile

Text and data

Most amateur digital modes are transmitted by inserting audio into the microphone input of a radio and using an analog scheme, such as amplitude modulation (AM), frequency modulation (FM), or single-sideband modulation (SSB).

- Continuous Wave (CW), usually used for Morse code
- Automatic Link Establishment (ALE)
- Amateur Teleprinting Over Radio (AMTOR)
- D-STAR
- Digital mobile radio
- Echolink
- Hellschreiber, also referred to as either *Feld-Hell*, or *Hell*
- Discrete multi-tone modulation modes such as Multi Tone 63 (MT63)
- Multiple Frequency-Shift Keying (MFSK) modes such as
 - FSK441, JT6M, JT65, and
 - Olivia MFSK
- Packet radio (AX.25)
 - Automatic Packet Reporting System (APRS)
- PACTOR
- Phase-Shift Keying
 - 31 baud binary phase shift keying: PSK31
 - 31 baud quadrature phase shift keying: QPSK31
 - 63 baud binary phase shift keying: PSK63
 - 63 baud quadrature phase shift keying: QPSK63
- Spread spectrum (SS)
- Radioteletype (RTTY)

Modes by activity

The following "modes" use no one specific modulation scheme but rather are classified by the activity of the communication.

- Earth-Moon-Earth (EME)
- Internet Radio Linking Project (IRLP)
- Low Transmitter Power (QRP)
- Satellite (OSCAR – Orbiting Satellite Carrying Amateur Radio)

See also

- DX Century Club
- Hamfest
- International Amateur Radio Union
- List of amateur radio magazines
- List of amateur radio organizations
- Maritime mobile amateur radio
- Morse code
- Prosigns for Morse code
- Piracy in amateur and two-way radio
- Worked All Continents

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