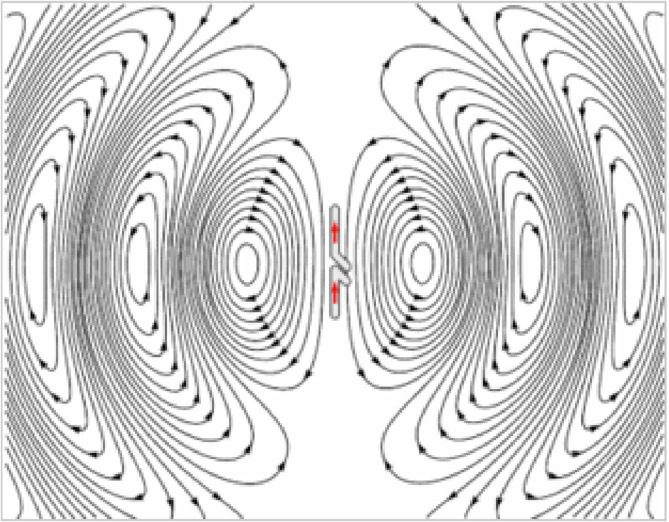
Radio wave

From Wikipedia, the free encyclopedia

This article is about the radiation. For the generic oscillation, see Radio frequency. For the electronics, see Radio frequency engineering. For other uses, see Radio Wave (disambiguation).



Animation of a half-wave dipole antenna radiating radio waves, showing the electric field lines. The antenna in the center is two vertical metal rods, with an alternating current applied at its center from a radio transmitter *(not shown)*. The voltage charges the two sides of the antenna alternately positive *(+)* and negative *(−)*. Loops of electric field *(black lines)* leave the antenna and travel away at the speed of light; these are the radio waves. The action is drastically slowed down in this animation.

Radio Wave are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light. Radio waves have frequencies from 300 GHz to as low as 3 kHz, and corresponding wavelengths ranging from 1 millimeter (0.039 in) to 100 kilometers (62 mi). Like all other electromagnetic waves, they travel at the speed of light. Naturally occurring radio waves are made by lightning, or by astronomical objects. Artificially generated radio waves are used for fixed and mobile radio communication, broadcasting, radar and other navigation systems, communications satellites, computer networks and innumerable other applications. Radio waves are generated by radio transmitters and received by radio receivers. Different frequencies of radio waves have different propagation characteristics in the Earth's atmosphere; long waves can diffract around obstacles like mountains and follow the contour of the earth (ground waves), shorter waves can reflect off the ionosphere and return to earth beyond the horizon (skywaves), while much shorter wavelengths bend or diffract very little and travel on a line of sight, so their propagation distances are limited to the visual horizon.

To prevent interference between different users, the artificial generation and use of radio waves is strictly regulated by law, coordinated by an international body called the International Telecommunications Union (ITU). The radio spectrum is divided into a number of radio bands on the basis of frequency, allocated to different uses.

Contents

Discovery and utilization

Main article: History of radio

Radio waves were first predicted by mathematical work done in 1867 by Scottish mathematical physicist James Clerk Maxwell.[1] Maxwell noticed wavelike properties of light and similarities in electrical and magnetic observations. His mathematical theory, now called Maxwell's equations, described light waves and radio waves as waves of electromagnetism that travel in space, radiated by a charged particle as it undergoes acceleration. In 1887, Heinrich Hertz demonstrated the reality of Maxwell's electromagnetic waves by experimentally generating radio waves in his laboratory,[2] showing that they exhibited the same wave properties as light: standing waves, refraction, diffraction, and polarization. Radio waves were first used for communication in the mid 1890s by Guglielmo Marconi, who developed the first practical radio transmitters and receivers.

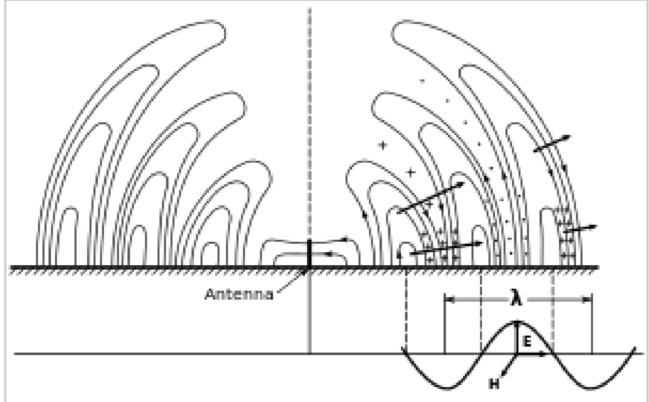
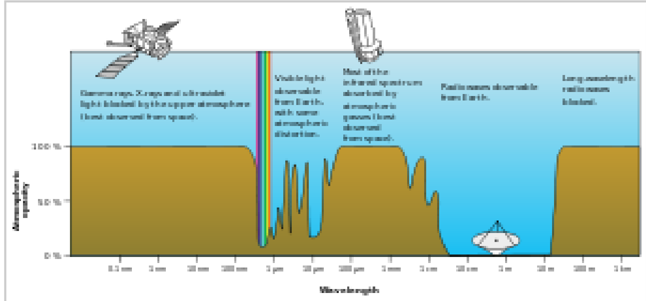


Diagram of the electric fields (E) and magnetic fields (H) of radio waves emitted by a monopole radio transmitting antenna (small dark vertical line in the center). The E and H fields are perpendicular as implied by the phase diagram in the lower right.

Propagation

Main article: Radio propagation

The study of electromagnetic phenomena such as reflection, refraction, polarization, diffraction, and absorption is of critical importance in the study of how radio waves move in free space and over the surface of the Earth. Different frequencies experience different combinations of these phenomena in the Earth's atmosphere, making certain radio bands more useful for specific purposes than others.



Rough plot of Earth's atmospheric transmittance (or opacity) to various wavelengths of electromagnetic radiation, including radio waves.

Speed, wavelength and frequency

Radio waves travel at the speed of light.[3][4] When passing through an object, they are slowed according to that object's permeability and permittivity.

The wavelength is the distance from one peak of the wave's electric field to the next, and is inversely proportional to the frequency of the wave. The distance a radio wave travels in one second, in a vacuum, is 299,792,458 meters (983,571,056 ft) which is the wavelength of a 1 hertz radio signal. A 1 megahertz radio signal has a wavelength of 299.8 meters (984 ft).

Radio communication

Main article: Radio communication

In order to receive radio signals, for instance from AM/FM radio stations, a radio antenna must be used. However, since the antenna will pick up thousands of radio signals at a time, a radio tuner is necessary to *tune in* a particular signal.[5] This is typically done via a resonator (in its simplest form, a circuit with a capacitor, inductor, or crystal oscillator, but many modern radios use Phase Locked Loop systems). The resonator is configured to resonate at a particular frequency, allowing the tuner to amplify sine waves at that radio frequency and ignore other sine waves. Usually, either the inductor or the capacitor of the resonator is adjustable, allowing the user to change the frequency at which it resonates.[6]

See also

- Radio astronomy

Look up ***radio wave*** in Wiktionary, the free dictionary.

Notes

1. Harman, Peter Michael (1998). *The natural philosophy of James Clerk Maxwell*. Cambridge, England: Cambridge University Press. p. 6. ISBN 0-521-00585-X.
2. "Heinrich Hertz: The Discovery of Radio Waves" (http://www.juliantrubin.com/bigten/hertzexperiment.html). Juliantrubin.com. Retrieved 2011-11-08.
3. http://www.1728.org/freqwave.htm
4. http://www.nrao.edu/index.php/learn/radioastronomy/radiowaves
5. Brain, Marshall (2000-12-07). "How Radio Works" (http://electronics.howstuffworks.com/radio8.htm). HowStuffWorks.com. Retrieved 2009-09-11.
6. Brain, Marshall (2000-12-08). "How Oscillators Work" (http://electronics.howstuffworks.com/oscillator3.htm). HowStuffWorks.com. Retrieved 2009-09-11.

References

- James Clerk Maxwell, "A Dynamical Theory of the Electromagnetic Field", *Philosophical Transactions of the Royal Society of London* **155**, 459-512 (1865).
- Heinrich Hertz: "Electric waves; being researches on the propagation of electric action with finite velocity through space" (http://historical.library.cornell.edu/cgi-bin/cul.cdl/docviewer?did=cdl334&view=50&frames=0&seq=5) (1893). Cornell University Library Historical Monographs Collection. Reprinted by (http://www.amazon.com/dp/1429740361/) Cornell University Library Digital Collections.
- Karl Rawer: "Wave Propagation in the Ionosphere". Kluwer, Dordrecht 1993. ISBN 0-7923-0775-5

Categories: Radio technology | Waves | Electromagnetic spectrum

---

- This page was last modified on 13 September 2015, at 08:50.