

SUBJECT

WIRELESS NETWORKS

SESSION 2 WIRELESS Cellular Concepts and Designs"

SESSION 2

Wireless



A handheld marine radio.

Part of [a series](#) on

Antennas



Common types[\[show\]](#)

Components[\[show\]](#)

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- [Antenna farm](#)
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Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor.

The most common wireless technologies use radio. With radio waves distances can be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of applications of radio *wireless technology* include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

Somewhat less common methods of achieving wireless communications include the use of other electromagnetic wireless technologies, such as light, magnetic, or electric fields or the use of sound.

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Introduction[

Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g. radio transmitters and receivers, remote controls etc.) which use some form of energy (e.g. radio waves, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.

History[

Photophone[

Main article: Photophone



Bell and Tainter's photophone, of 1880.

The world's first wireless telephone conversation occurred in 1880, when Alexander Graham Bell and Charles Sumner Tainter invented and patented the photophone, a telephone that conducted audio conversations wirelessly over modulated light beams (which are narrow projections of electromagnetic waves). In that distant era, when utilities did not yet exist to provide electricity and lasers had not even been imagined in science fiction, there were no practical applications for their invention, which was highly limited by the availability of both sunlight and good weather. Similar to free-space optical communication, the photophone also required a clear line of sight between its transmitter and its receiver. It would be several decades before the

photophone's principles found their first practical applications in military communications and later in fiber-optic communications.^{[2][3]}

Early wireless work

Main article: Wireless telegraphy

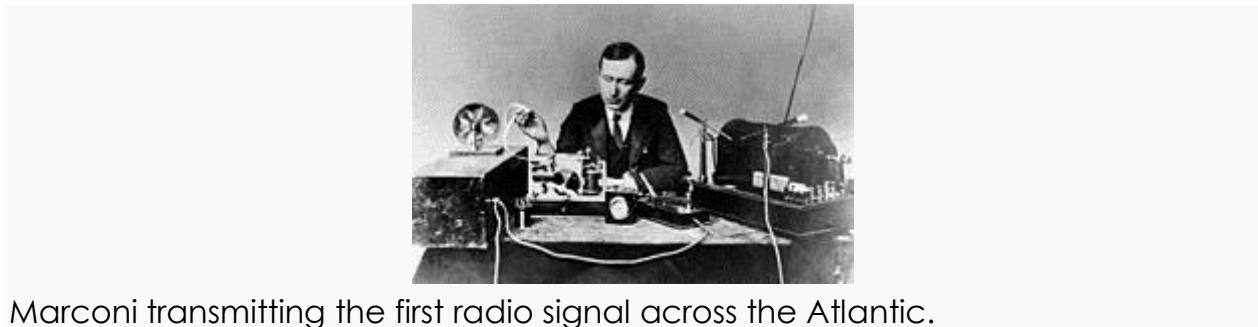
David E. Hughes transmitted radio signals over a few hundred yards by means of a clockwork keyed transmitter in 1878.^[4] As this was before Maxwell's work was understood, Hughes' contemporaries dismissed his achievement as mere "Induction". In 1885, Thomas Edison used a vibrator magnet for induction transmission. In 1888, Edison deployed a system of signaling on the Lehigh Valley Railroad. In 1891, Edison obtained the wireless patent for this method using inductance (U.S. Patent 465,971).

In 1888, Heinrich Hertz demonstrated the existence of electromagnetic waves, the underlying basis of most wireless technology.^{[5][6]} The theory of electromagnetic waves was predicted from the research of James Clerk Maxwell and Michael Faraday. Hertz demonstrated that electromagnetic waves traveled through space in straight lines, could be transmitted, and could be received by an experimental apparatus.^{[5][6]} Hertz did not follow up on the experiments. Jagadish Chandra Bose around this time developed an early wireless detection device and helped increase the knowledge of millimeter-length electromagnetic waves.^[7] Practical applications of wireless radio communication and radio remote control technology were implemented by later inventors.

Further information: Invention of radio

Radio [edit]

Main article: History of radio



Marconi transmitting the first radio signal across the Atlantic.

The term "wireless" came into public use to refer to a radio receiver or transceiver (a dual purpose receiver and transmitter device), establishing its usage in the field of wireless telegraphy early on; now the term is used to describe modern wireless connections such as in cellular networks and wireless broadband Internet. It is also used in a general sense to refer to any type of operation that is implemented without the use of wires, such as "wireless remote control" or "wireless energy transfer", regardless of the specific technology

(e.g. radio, infrared, ultrasonic) used. Guglielmo Marconi and Karl Ferdinand Braun were awarded the 1909 Nobel Prize for Physics for their contribution to wireless telegraphy.

Modes[

Wireless communications can be via:

Radio[

Main article: radio

radio communication, microwave communication, for example long-range line-of-sight via highly directional antennas, or short-range communication,

Free-space optical[

Main article: Free-space optical communication



An 8-beam free space optics laser link, rated for 1 Gbit/s at a distance of approximately 2 km. The receptor is the large disc in the middle, the transmitters the smaller ones. To the top and right corner amonocular for assisting the alignment of the two heads.

Free-space optical communication (FSO) is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking.

"Free space" means air, outer space, vacuum, or something similar. This contrasts with using solids such as optical fiber cable or an optical transmission line.

The technology is useful where the physical connections are impractical due to high costs or other considerations.

Light, visible and infrared (IR) is used in for example consumer IR devices such as remote controls or via Infrared Data Association(IrDA).

Sonic[edit]

Sonic, especially ultrasonic short range communication involves the transmission and reception of sound.

Electromagnetic induction[\[edit\]](#)

Electromagnetic induction short range communication and power. This has been used in biomedical situations such as pacemakers, as well as for short-range RFid tags.

Wireless services[\[edit\]](#)

Common examples of wireless equipment include:^[8]

- Telemetry control and traffic control systems
- Infrared and ultrasonic remote control devices
- Professional LMR (Land Mobile Radio) and SMR (Specialized Mobile Radio) typically used by business, industrial and Public Safety entities.
- Consumer Two way radio including FRS Family Radio Service, GMRS (General Mobile Radio Service) and Citizens band ("CB") radios.
- The Amateur Radio Service (Ham radio).
- Consumer and professional Marine VHF radios.
- Airband and radio navigation equipment used by aviators and air traffic control
- Cellular telephones and pagers: provide connectivity for portable and mobile applications, both personal and business.
- Global Positioning System (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth.^[9]
- Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless using technology such as Wireless USB or Bluetooth
- Cordless telephone sets: these are limited-range devices, not to be confused with cell phones.
- Satellite television: Is broadcast from satellites in geostationary orbit. Typical services use direct broadcast satellite to provide multiple television channels to viewers.

Wireless networks[\[edit\]](#)

Wireless networking is used to meet many needs. Perhaps the most common use is to connect laptop users who travel from location to location. Another common use is for mobile networks that connect via satellite. A wireless transmission method is a logical choice to network a LAN segment that must frequently change locations. The following situations justify the use of wireless technology:

- To span a distance beyond the capabilities of typical cabling,
- To provide a backup communications link in case of normal network failure,

- To link portable or temporary workstations,
- To overcome situations where normal cabling is difficult or financially impractical, or
- To remotely connect mobile users or networks.

Developers need to consider some parameters involving Wireless RF technology for better developing wireless networks:

- Sub-GHz versus 2.4 GHz frequency trends
- Operating range and battery life
- Sensitivity and data rate
- Network topology and node intelligence

Applications may involve point-to-point communication, point-to-multipoint communication, broadcasting, cellular networks and other wireless networks, Wi-Fi technology.

Cordless[\[edit\]](#)

The term "wireless" should not be confused with the term "cordless", which is generally used to refer to powered electrical or electronic devices that are able to operate from a portable power source (e.g., a battery pack) without any cable or cord to limit the mobility of the cordless device through a connection to the mains power supply.

Some cordless devices, such as cordless telephones, are also wireless in the sense that information is transferred from the cordless telephone to the telephone's base unit via some type of wireless communications link. This has caused some disparity in the usage of the term "cordless", for example in Digital Enhanced Cordless Telecommunications.

Electromagnetic spectrum[\[edit\]](#)

See also: *Spectrum management*

Light, colors, AM and FM radio, and electronic devices make use of the electromagnetic spectrum. The frequencies of the radio spectrum that are available for use for communication are treated as a public resource and are regulated by national organizations such as the Federal Communications Commission in the USA, or Ofcom in the United Kingdom. This determines which frequency ranges can be used for what purpose and by whom. In the absence of such control or alternative arrangements such as a privatized electromagnetic spectrum, chaos might result if, for example, airlines didn't have specific frequencies to work under and an amateur radio operator were interfering with the pilot's ability to land an aircraft. Wireless communication spans the spectrum from 9 kHz to 300 GHz.

Mobile telephones[

One of the best-known examples of wireless technology is the mobile phone, also known as a cellular phone, with more than 4.6 billion mobile cellular subscriptions worldwide as of the end of 2010.^[10] These wireless phones use radio waves to enable their users to make phone calls from many locations worldwide. They can be used within range of the mobile telephone site used to house the equipment required to transmit and receive the radio signals from these instruments.

Wireless data communications[

Wireless data communications are an essential component of mobile computing.^[11] The various available technologies differ in local availability, coverage range and performance,^{[12][13]} and in some circumstances, users must be able to employ multiple connection types and switch between them. To simplify the experience for the user, connection manager software can be used,^{[14][15]} or a mobile VPN deployed to handle the multiple connections as a secure, single virtual network.^[16] Supporting technologies include:

Wi-Fi is a wireless local area network that enables portable computing devices to connect easily to the Internet.^[17] Standardized as IEEE 802.11 a,b,g,n, Wi-Fi approaches speeds of some types of wired Ethernet. Wi-Fi has become the de facto standard for access in private homes, within offices, and at public hotspots.^[18] Some businesses charge customers a monthly fee for service, while others have begun offering it for free in an effort to increase the sales of their goods.^[19]

Cellular data service offers coverage within a range of 10-15 miles from the nearest cell site.^[20] Speeds have increased as technologies have evolved, from earlier technologies such as GSM, CDMA and GPRS, to 3G networks such as W-CDMA, EDGE or CDMA2000.^{[20][21]}

Mobile Satellite Communications may be used where other wireless connections are unavailable, such as in largely rural areas^[22] or remote locations.^[22] Satellite communications are especially important for transportation, aviation, maritime and military use.^[23]

Wireless Sensor Networks are responsible for sensing noise, interference, and activity in data collection networks. This allows us to detect relevant quantities, monitor and collect data, formulate meaningful user displays, and to perform decision-making functions^[24]

Wireless energy transfer[

Main article: Wireless energy transfer

Wireless energy transfer is a process whereby electrical energy is transmitted from a power source to an electrical load that does not have a built-in power source, without the use of

interconnecting wires. There are two different fundamental methods for wireless energy transfer. They can be transferred using either far-field methods that involve beam power/lasers, radio or microwave transmissions or near-field using induction. Both methods utilize electromagnetism and magnetic fields.^[25]

Wireless Medical Technologies[

New technologies such as mobile body area networks (MBAN) the capability to monitor blood pressure, heart rate, oxygen level and body temperature, all with wireless technologies. The MBAN works by sending low powered wireless signals to receivers that feed into nursing stations or monitoring sites. This technology helps with the intentional and unintentional risk of infection or disconnection that arise from wired connections.^[26]

Computer interface devices[

[original research?]

Answering the call of customers frustrated with cord clutter, many^[who?] manufacturers of computer peripherals turned to wireless technology to satisfy their consumer base^[citation needed]. Originally these units used bulky, highly limited transceivers to mediate between a computer and a keyboard and mouse; however, more recent generations have used small, high-quality devices, some even incorporating Bluetooth. These systems have become so ubiquitous that some users have begun complaining about a lack of wired peripherals.^[who?] Wireless devices tend to have a slightly slower response time than their wired counterparts; however, the gap is decreasing.^[citation needed]

Computer interface devices such as a keyboard or mouse are powered by a battery and send signals to a receiver through a USB port by way of a radio frequency (RF) receiver. The RF design makes it possible for signals to be transmitted wirelessly and expands the range of effective use, usually up to 10 feet. Distance, physical obstacles, competing signals, and even human bodies can all degrade the signal quality.^[27]

Concerns about the security of wireless keyboards arose at the end of 2007, when it was revealed that Microsoft's implementation of encryption in some of its 27 MHz models was highly insecure.^[28]