

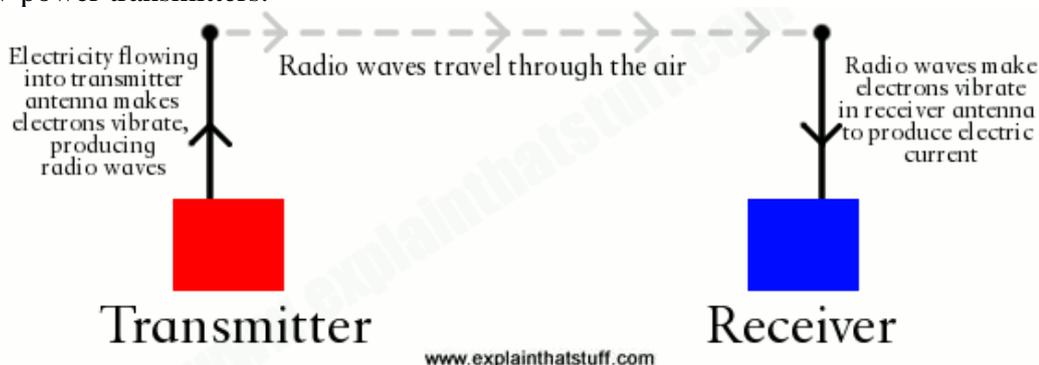
2. Wireless Internet

From wireless to radio

Wireless started out as a way of sending audio programs through the air. Pretty soon we started calling it radio and, when pictures were added to the signal, TV was born. The word "wireless" had become pretty old-fashioned by the mid-20th century, but over the last few years it's made a comeback. Now it's hip to be wireless once again thanks to the Internet. Back in 2007, approximately half of all the world's Internet users were using some kind of wireless access. In 2018, around 80 percent of us use wireless to get online at home, which is hardly surprising now more of us now are using smartphones and tablets (55.3 percent) than desktop computers (44.7 percent). Wireless, mobile Internet is overwhelming popular in developing countries where traditional wired forms of access, based on telephone networks, are not available. Wireless Internet, perhaps best known to us as Wi-Fi®, has made the Internet more convenient than ever before. But what makes it different from ordinary Internet access?

From radio to Wi-Fi

Radio is an invisible game of throw-and-catch. Instead of throwing a ball from one person to another, you send information, coded as a pattern of electricity and magnetism, from a transmitter (the thrower) to a receiver (the catcher)—both of which are kinds of antennas. The **transmitter** is a piece of equipment that turns electrical signals (such as the sound of someone speaking, in radio, or a picture, in TV) into an oscillating electromagnetic wave that beams through the air, in a straight line, at the **speed of light** (300,000 km 186,000 miles per second). The **receiver** is a mirror-image piece of equipment that catches the waves and turns them back into electrical signals—so we can recreate the radio sounds or TV pictures. The more powerful the transmitter and receiver, the further apart they can be spaced. Radio stations use gigantic transmitters, and that's why we can pick up radio signals from thousands of miles away on the opposite side of Earth. Wireless Internet is simply a way of using radio waves to send and receive Internet data instead of radio sounds or TV pictures. But, unlike radio and TV, it is typically used to send signals only over relatively short distances with low-power transmitters.



Artwork: The basic concept of radio: sending messages from a transmitter to a receiver at the speed of light using radio waves. In wireless Internet, the communication is two-way: there's a transmitter and receiver in both your computer (or handheld device) and the piece of equipment (such as a router) that connects you to the Internet.

Wi-Fi

If you have wireless Internet access at home, you probably have a little box called a **router** that plugs into your telephone socket. This kind of router is a bit like a sophisticated modem: it's a standalone computer whose job is to relay connections to and from the Internet. At home, you might use a router to connect several computers to the Internet at once (saving on the need for several separate modems). In other words, the router does two jobs: it creates a wireless computer network, linking all your computers together, and it also gives all your machines a shared gateway to the Internet.

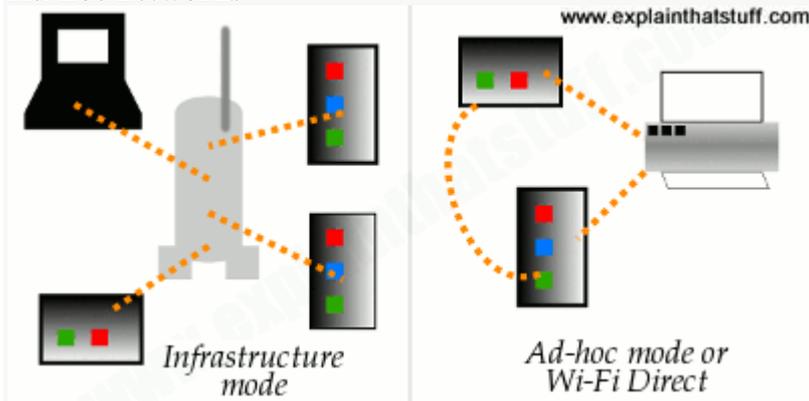
You can connect a router to all your different computers using ordinary network-connecting cables (for the technically minded, these are called RJ-45, Cat 5, or Ethernet cables). This creates what's called a **LAN (local area network)** linking the machines together. A computer network is a very orderly affair, more like an

organized committee meeting, with carefully agreed rules of behavior, than a free-for-all cocktail party. The machines on the network have to be hooked up in a standard way and they communicate in a very orderly fashion. The rules that govern the network setup and the communication are based on an international standard called **Ethernet** (also known as IEEE **802.3**).

A wireless router is simply a router that connects to your computer (or computers) using radio waves instead of cables. It contains a very low-power radio transmitter and receiver, with a maximum range of about 90 meters or 300 ft, depending on what your walls are made of and what other electrical equipment is nearby. The router can send and receive Internet data to any computer in your home that is also equipped with wireless access (so each computer on the wireless network has to have a radio transmitter and receiver in it too). Most new laptops come with wireless cards built in. For older laptops, you can usually plug a wireless adapter card into the PCMCIA or USB socket. In effect, the router becomes an informal **access point** for the Internet, creating an invisible "cloud" of wireless connectivity all around it, known as a **hotspot**. Any computer inside this cloud can connect into the network, forming a wireless LAN.

People sometimes confuse Wi-Fi and Bluetooth. Both are methods of connecting gadgets without wires, so what exactly is the difference? Broadly speaking, Bluetooth is a way of connecting two relatively nearby gadgets without the hassle of using a cable, whereas Wi-Fi is a method of linking wireless computers (and particularly mobile ones, such as laptops, tablets, and smartphones) to the Internet through a shared connection point—your router—which typically makes a wired connection to a telephone or cable line. At least, that's how things used to be.

Ad-hoc networks



Artwork: Wi-Fi modes: Left: In infrastructure mode, all your devices communicate wirelessly with a central router that talks (usually via a wired connection) to the Internet. Here, three tablets and a laptop are talking to a router in the middle. Right: In ad-hoc mode (or with Wi-Fi Direct), devices communicate directly over a temporary network without any kind of central router. In this example, two tablets are talking to one another and to a shared printer using Wi-Fi Direct.

Wi-Fi or Bluetooth?

How does Wi-Fi Direct compare to Bluetooth? It's up to 10 times faster at transferring data (250mbps compared to 25mbps) and has a range several times longer (up to 200m or 650ft compared to a maximum of about 60m or 200ft for Bluetooth). Although both are secure, Wi-Fi Direct uses Wi-Fi's WPA-2 encryption, which uses twice as many bits (256) as Bluetooth's (128 bit) and is theoretically much more secure. In Bluetooth's favor, it allows more devices to connect at once, and while its shorter range might seem like a drawback, it means it uses less power than Wi-Fi (an extremely important consideration for mobile devices).