**How DSL Works**

When you connect to the Internet, you might connect through a regular [modem](http://computer.howstuffworks.com/modem.htm), through a [local-area network](http://computer.howstuffworks.com/lan-switch.htm) connection in your office, through a [cable modem](http://computer.howstuffworks.com/cable-modem.htm) or through a **digital subscriber line** (DSL) connection. DSL is a very high-speed connection that uses the same wires as a regular [telephone line](http://communication.howstuffworks.com/telephone.htm).

**Advantages of DSL**

* You can leave your Internet connection open and still use the phone line for voice calls.
* The speed is much higher than a regular modem.
* DSL doesn't necessarily require new wiring; it can use the phone line you already have.
* The company that offers DSL will usually provide the modem as part of the installation.

**Disadvantage of DSL**

* ADSL connection works better when you are closer to the provider's central office. The further away you get from the central office, the weaker the signal becomes.
* The connection is faster for receiving data than it is for sending data over the Internet.
* The service is not available everywhere.

**Asymmetric DSL**

Most homes and small business users are connected to an **asymmetric DSL** (ADSL) line. ADSL divides up the available frequencies in a line on the assumption that most [Internet](http://computer.howstuffworks.com/internet-channel.htm) users look at, or download, much more information than they send, or upload. Under this assumption, if the connection speed from the Internet to the user is three to four times faster than the connection from the user back to the Internet, then the user will see the most benefit most of the time.

Precisely how much benefit you see from ADSL will greatly depend on how far you are from the central office of the company providing the ADSL service. ADSL is a **distance-sensitive technology**: As the connection's length increases, the signal quality decreases and the connection speed goes down. The limit for ADSL service is **18,000 feet** (5,460 meters), though for speed and quality of service reasons many ADSL providers place a lower limit on the distances for the service. At the extremes of the distance limits, ADSL customers may see speeds far below the promised maximums, while customers nearer the central office have faster connections and may see extremely high speeds in the future. ADSL technology can provide maximum downstream (Internet to customer) speeds of up to 8 megabits per second (Mbps) at a distance of about 6,000 feet (1,820 meters), and upstream speeds of up to 640 kilobits per second (Kbps). In practice, the best speeds widely offered today are 1.5 Mbps downstream, with upstream speeds varying between 64 and 640 Kbps. Some vast improvements to ADSL are available in some areas through services called ASDL2 and ASDL2+. ASDL2 increases downstream to 12 Mbps and upstream to 1 Mbps, and ASDL2+ is even better -- it improves downstream to as much as 24 Mbps and upstream to 3 Mbps.­

You might wonder -- if distance is a limitation for DSL, why is it not also a limitation for voice [telephone](http://communication.howstuffworks.com/telephone.htm) calls?

The answer lies in small amplifiers called **loading coils** that the telephone company uses to boost voice signals. Unfortunately, these loading coils are incompatible with ADSL signals, so a voice coil in the loop between your telephone and the telephone company's central office will disqualify you from receiving ADSL. **Alternatives to DSL**

With DSL's distance limitation and lower availability, what are some other options? There are two major alternatives to DSL -- [cable](http://computer.howstuffworks.com/cable-modem.htm) and wireless.

Cable and DSL are the two big rivals in the world of broadband. Cable isn't limited by distance like DSL -- cable wires reach most neighborhoods, and signal strengths don't weaken over long distances. While DSL allows you to use the telephone and Internet simultaneously, cable lets users watch television and surf the Internet at the same time. Many cable companies are also beginning to bundle services with [cable TV](http://entertainment.howstuffworks.com/cable-tv.htm), Internet and digital telephone on one bill. Although cable and DSL speeds are about the same, the one disadvantage with cable is bandwidth -- connection speeds can slow down if too many people are using a cable service at the same time.

**Splitting the Signal**

**The CAP System**

There are two competing and incompatible standards for ADSL. The official [ANSI](http://computer.howstuffworks.com/dsl.htm/framed.htm?parent=dsl.htm&url=http://www.ansi.org) standard for ADSL is a system called **discrete multitone**, or DMT. According to equipment manufacturers, most of the ADSL equipment installed today uses DMT. An earlier and more easily implemented standard was the **carrierless amplitude/phase** (CAP) system, which was used on many of the early installations of ADSL.

CAP operates by dividing the signals on the [telephone](http://communication.howstuffworks.com/telephone.htm) line into three distinct bands: Voice conversations are carried in the 0 to 4 KHz (kilohertz) band. The upstream channel (from the user back to the server) is carried in a band between 25 and 160 KHz. The downstream channel (from the server to the user) begins at 240 KHz and goes up to a point that varies depending on a number of conditions (line length, line noise, number of users in a particular telephone company switch) but has a maximum of about 1.5 MHz (megahertz). This system, with the three channels widely separated, minimizes the possibility of interference between the channels on one line, or between the signals on different lines.

**The DMT System**

DMT also divides signals into separate channels, but doesn't use two fairly broad channels for upstream and downstream data. Instead, DMT divides the data into 247 separate channels, each 4 KHz wide.

One way to think about it is to imagine that the phone company divides your copper line into 247 different 4-KHz lines and then attaches a [modem](http://computer.howstuffworks.com/modem.htm) to each one. You get the equivalent of 247 modems connected to your [computer](http://computer.howstuffworks.com/pc.htm) at once. Each channel is monitored and, if the quality is too impaired, the signal is shifted to another channel. This system constantly shifts signals between different channels, searching for the best channels for transmission and reception. In addition, some of the lower channels (those starting at about 8 KHz), are used as bidirectional channels, for upstream and downstream information. Monitoring and sorting out the information on the bidirectional channels, and keeping up with the quality of all 247 channels, makes DMT more complex to implement than CAP, but gives it more flexibility on lines of differing quality.

**Filters**

CAP and DMT are similar in one way that you can see as a DSL user. If you have ADSL installed, you were almost certainly given small filters to attach to the outlets that don't provide the signal to your ADSL modem. These filters are **low-pass filters** -- simple filters that block all signals above a certain frequency. Since all voice conversations take place below 4 KHz, the low-pass (LP) filters are built to block everything above 4 KHz, preventing the data signals from interfering with standard telephone calls.

**Alternatives to ADSL**

**(**[**VDSL**](http://computer.howstuffworks.com/vdsl.htm)**)** :**Very high bit-rate DSL**   **(SDSL)** **Symmetric DSL**

**(RADSL)** **Rate-adaptive DSL**  **(IDSL)** **ISDN DSL**

**(Uni-DSL)** **Universal DSL**