

# Internet Connections

## Introduction

As the role of the Internet becomes more and more various, Internet and multimedia can't be thought of separately any more. There may be the common end users who get information provided by the form of multimedia, and there also may be the multimedia developers who are delivering their products across the Internet. In both of these cases, one of the critical factors in determining how enjoyable and effective their internet experience will be how much time will be spent for uploading or downloading, that is, internet access speed. And the Internet access speed depends on which computer system to connect to the Internet we choose.

Most people are familiar with the use of modems and telephone lines to access the Internet, but there are now many other options available, each with their own advantages and drawbacks. In this paper, different types of Internet connections will be introduced with their technical features, and compared according to their pros and cons related to the criteria of speed, costs, availability, etc.

## Understanding terminology relevant to the topic

There are several terms to be good to know before entering the topic.

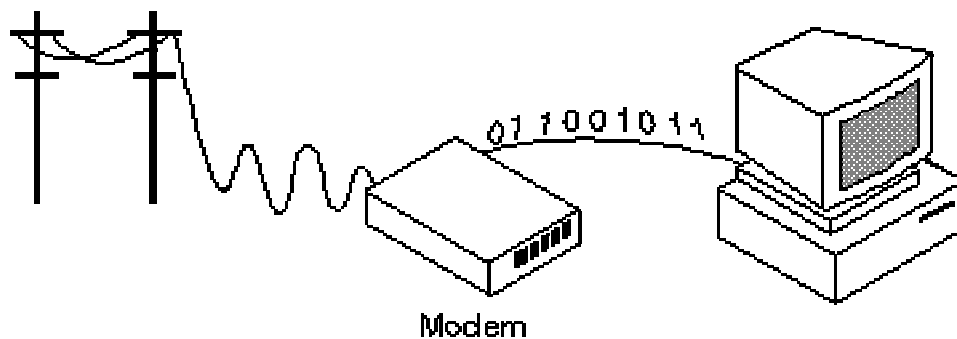
- **Always on:** a feature of Internet connection in which the connection is ready to use immediately as long as the computer has power.
- **Analog signals:** continuously changing natural signal like human voice. The same technology used to record sounds onto an audiotape.
- **Bandwidth:** the amount of data that can be transmitted across a network or cable; usually measured in bits per second (bps) for Internet access. For example, a modem may connect at 28.8 Kbps, which means it can nominally send and receive 28,800 bits of information per second.
- **Broadband:** a high-speed Internet access that offers an always-on connection, which is called in contrast to a dial-up connection using analog modem.
- **Digital signals:** the signals for the performance of computer by turning on and off a series of electronic switches represented by the numerical digits of 0 (the code for off) and 1 (the code for on). The combinations of these digital codes represent computer text, commands and graphics.
- **Internet service provider (ISP):** a company that provides access to the Internet. For a monthly fee, the service provider gives a software package, username, password and access phone number. In addition to serving individuals, this also serves companies, providing a direct connection from the company's networks to the Internet.

## Types of Internet connections

The ways to connect Internet include traditional dial-up access through the analog modems and broadband options such as ISDN, xDSL, Cable, leased lines and wireless.

- **Analog Modems**

Since analog modems are built into most new computers, they represent the most convenient method of connecting to the Internet for the first time and are very familiar to most computer users. “Modems”(a *modulator/demodulator*) convert analog data transmitted over phone lines into digital data that computers can read (demodulation) and also convert digital data into analog data so it can be transmitted (modulation) –see the picture below--. Because they use regular analog phone lines, these are called analog modems to distinguish them from other sorts of modems.



**Speed:** the common speeds were 14.4 kilobits per second (Kbps), 28.8 Kbps and 33.6 Kbps, and currently the fastest speed is 56 Kbps, which is built into almost every computer. Individuals and small businesses that find they surfing the web with increasing frequency often regard these low-speed modems as an inconvenience. There is an important thing to remember regarding the speed-not just of analog modems-. Even if one has a fast modem, this doesn't mean that one is able to connect at the fastest possible speed. For example, 56 Kbps modems are represented as being capable of transmission up to 56 Kbps. In fact, due to quality problems with most conventional phone lines, maximum connection speeds of 40 kbps to 48 kbps are far more typical. The actual connection speed varies depending on the amount of static on the telephone line as well as the amount of traffic caused by Internet and telephone users traveling the networks.

**Cost:** Because most personal computers have equipped with analog modems, there is usually no additional money needed for these hardwares. Just dial-up access accounts usually cost around \$20 per month.

**Availability:** Analog modems are not hard to come by. Any computer store should have them available. ISP probably sells them. Dial-up Internet service is available almost anywhere in the country.

**Related Link:**

<http://isp.webopedia.com/TERM/m/modem.html>

- **ISDN (Integrated Services Digital Network)**

ISDN uses fully digital signals over copper phone wire, a standard telephone line. This means there is no conversion from digital to analog and back again in the manner that an analog modem works. Most ISDN lines offered by telephone companies give users two lines at once, called B channels. The users can use one line for voice and the other for data, or they can use both lines for data to give them data rates of 128 Kbps. Another version, called B-ISDN, is able to support transmission rates of 1.5 Mbps. B-ISDN requires fiber optic cables and is not widely available.

**Speed:** At the time it was introduced (a decade ago), ISDN offered very significant speed advantage over regular modems, which were then limited to 14.4 Kbps or slower. Most of the other broadband connections did not exist at that time either. For many years, therefore, ISDN was the option of choice for those who needed faster internet access, but who could not afford a leased line. ISDN offers connections ranging from 64 Kbps to 128 Kbps. But the speed of ISDN does not come close to that of options such as cable or xDSL.

**Cost:** ISDN terminal adapters, which make it possible for computers to accept ISDN transmissions typically cost \$250 to \$500. Today, many computers already include this equipment. Installation fees vary widely, depending on the type of service ordered and where the users are located, which ranges from a low of \$65 to as much as \$200. A fixed monthly charge costs \$10 to \$50. An additional usage charge if the plan doesn't include unlimited access.

**Availability:** ISDN isn't available everywhere. It tends to be more common in a larger metropolitan area. In the case that this is available in a rural area, it will cost more than in the city. One should check with one's local ISP or telephone company whether it is available in one's area.

→ Here, Austin? : Southwestern Bell Telephone Company offers ISDN in Basic Rate Interface (BRI), which is good for small business and Primary Rate Interface (PRI) for larger business.

- For more information:

<http://www.momswire.com/texas.shtml>

[http://www.swbell.com/Products\\_Services/Business/ProdInfo\\_1/1,1973,26--6-1-.00.html](http://www.swbell.com/Products_Services/Business/ProdInfo_1/1,1973,26--6-1-.00.html)

**Related Links:**

<http://www.nationalisdncouncil.com/index.html>

<http://www.alumni.caltech.edu/~dank/isdn/>

## **DSL (Digital Subscriber Lines)**

DSL, also known as xDSL (a generic name), is another broadband service that many telephone companies and other providers offer to consumers. It is composed of several subcategories, the most common being ADSL (Asymmetric Digital Subscriber Line), SDSL (Symmetric Digital Subscriber Line), and HDSL (High-data-rate Digital Subscriber Line). ADSL technology is a transport that allows faster flow of information downstream than upstream, while SDSL supports one speed regardless of upstream or downstream flow. These all work in the same general fashion. That is, DSL squeezes the maximum capacity out of a telephone line. DSL services let the user use the current copper phone lines in his/her home for both data and voice communication and (s)he can even use them simultaneously over the same copper pair. This means that the user can surf the Internet and talk on the phone at the same time. The DSL services do this by sending and receiving data at a different frequency than the user's voice. ADSL is more popular in North America, whereas SDSL is being developed primarily in Europe.

**Speed:** ADSL supports data rates from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the upstream rate). SDSL supports data rates up to 3 Mbps.

**Cost:** The cost of the modem can range from \$200 to \$300. Installation costs vary across the country--e.g. EarthLink offers DSL installation and equipment for a one-time \$99 set up fee, with monthly service for \$39.95 (which includes ISP charges); Qwest offers a free modem and installation to residential customers, with monthly service for \$29.95 (which does not include ISP charges). Obtaining DSL service from providers throughout the country typically ranges from \$20 to \$40 per month.

**Availability:** DSL has some signal limitations, based on the distance between the customer and the telephone company's Central Office (CO). Because signals carried over DSL lose power as they travel, users must live within a certain distance of a CO to use DSL--e.g. within about three miles of the CO, for ADSL customers. So, even if one lives in a city that offers DSL, one's residence may not fall within the requirement. Because of this limitation, only about 35% of the U.S. population can currently subscribe to at least one form of DSL. Many local telephone companies are building new infrastructure, though, to give more access to DSL.

→ Here, Austin? : Southwestern Bell Internet Service offers DSL in Austin-- the 384 Kbps and the 1.5 Mbps access for ADSL, also, from 144 Kbps to 1.5 Mbps access for SDSL-. To check availability of one's location, enter one's telephone number in check availability form.

- For more info:

[http://www.swbell.com/DSL\\_new/content/0,5289,34,00.html](http://www.swbell.com/DSL_new/content/0,5289,34,00.html)

**Related links:**

<http://www.dslcenter.com/index.html>

<http://www.everythingdsl.com/>

<http://www.dsllife.com/>

- **Cable**

Whereas ISDN and DSL have become popular by taking advantage of copper telephone lines, cable is another broadband option which takes advantage of another setup found in homes-cable TV. A cable modem uses the cable TV provider's hybrid Fiber/Co-ax infrastructure as a shared data network. All of the devices connected to the neighborhood co-ax network talk and listen to each other.

**Speed:** Cable TV systems were originally designed to deliver large amounts of bandwidth (TV pictures and audio) from the head end (central distribution point) to the user (TV sets). These networks are capable of carrying large amounts of computer data in the downstream direction, but the other direction is not the same. Theoretically cable modes can operate at speeds of up to 50 Mbps for downloading, 10 Mbps for uploading. But practically, these can deliver 1 Mbps to 10 Mbps for downloading and 200 Kbps to 2Mbps for uploading. One problem is variability of speed. If many users are using the network simultaneously, the connection speed will decrease, because cable network users share a semi-LAN connection to the internet with other members of their neighborhood. It is basically impossible to precisely predict connection speeds. Also, it is unknown whether the cable TV networks can handle the traffic that would ensue if millions of users begin using the system for Internet access.

**Cost:** Installation costs \$100 or more. Monthly fees are between \$40 to \$60, which often includes an Internet service package with unlimited access, specific software and content, and the option to lease a cable modem.

**Availability:** Cable access has no such restriction as limitation of distance for DSL, but the availability is still an issue with cable access. Not all cable providers offer internet access, but they are steadily increasing service availability. To find out whether one's home qualifies, call one's cable provider or visit the sites of some of the larger, national providers. (See below)

- National cable modem service providers (These carriers are not available in all areas, and most have exclusive contracts with local cable operators.)

@Home Corp. <http://www.home.net>

Cox Communications Inc. <http://www.cox.com>

MediaOne Express <http://24.128.1.116/express>

Road Runner <http://pathfinder.com/rdrun>

DigitalNATION <http://www.cablemodems.com>

High Bandwidth Web Page <http://www.specialty.com/hiband/cable.html>

→ Here, Austin? : Several cable providers such as Time Warner Cable (Road Runner), Grande Communications, and Convergence Cabling provides Internet access.

○ For more information:

<http://www.rr.com/rdrun/>

<http://www.grandecom.com/>

### **Related Links:**

<http://www.cabledatcomnews.com/cmhc>

<http://www.cabledatcomnews.com/cmhc/cmhc2.html>

- **Leased Lines**

A leased line is a telephone line that is rented directly from the telephone company, and sometimes is referred to as direct connections to the Internet.

**Speed:** A common option, T-carrier Level (T1) line, enables data transmissions at speeds of 1.544Mbps. A T-1 line actually consists of 24 individual channels, each of which supports 64 Kbps. Each 64Kbps channel can be configured to carry voice or data traffic. Most telephone companies allow the consumer to buy just some of these individual channels, known as fractional T-1 access. Another type of leased line, T-carrier Level 3 (T3) line, has a speed of about 43Mbps. A T-3 line actually consists of 672 individual channels each of which supports 64 Kbps.

**Cost:** Because the cost runs into between hundreds and thousands of dollars per month, leased lines are not viable for home and small-business users. If smaller companies are willing to share, it is often possible for them to lease portions of the channels of T1 lines. In this case, the bandwidth is less, so is the cost. Prices vary according to location, connection demands and other factors.

**Availability:** Users should contact their local telephone companies about obtaining a leased line.

### **Related links:**

<http://www.dcbnet.com/notes/9611t1.html>

<http://www.everythingt1.com/>

- **Wireless**

There are several wireless options, available for special Internet access applications. They can be extremely useful for some Internet users.

**Cellular modems:** Much the way a regular modem interfaces the PC to the Internet over standard phone lines, cellular modems can perform a similar function over cellular phones. These are slow (usually 9600 bps) and expensive (because cellular phone time

is still expensive), but they offer the freedom to allow the user to access the Internet from virtually anywhere.

**Satellite:** This technology is a method by which Internet content is downloaded to a satellite dish and then transmitted directly from the dish to the user's PC. Download speeds are typically about 600 kbps. During peak Internet usage times, though, speeds could drop to around 150 kbps. This option may be particularly appealing to those who already have a satellite dish for TV purposes, With two-way satellite –for uploading and downloading-- internet access, the satellite company serves as the ISP, and the cost is around \$40 to \$ 70 per month. Satellite dishes capable of carrying Internet data cost around \$250. Unlike its cable and telephone counterparts, satellite technology is not faced with the problem of pulling wire through the desert and over mountains. For about 50 million American households, in many rural areas, satellite access is their only current broadband option while they wait for cable and DSL to reach them. Experts expect that in 3-4 years, the network of satellites will include nearly the entire Earth, covering 95% of its landmass.

There is a phenomenon called rain fade that most subscribers to satellite-based TV services report. Rain fade occurs when a wall of rain is so dense that the satellite signal has trouble making it to the user's satellite dish. This degradation of the satellite signal can result in decreased picture quality, ideation, and even total signal loss. Rain fade can pose a serious problem to the new, upcoming satellite-based Internet technologies. However, rain fade is usually experienced at the beginning of a storm and only lasts for a few minutes. Satellite signals have no trouble passing through most rain showers. From the current information available, users of satellite Internet services may need some sort of terrestrial Internet connection as a backup option so that they can maintain an Internet connection during severe weather.

**Related Links:**

<http://www.direcpc.com>

<http://www.gilat2home.com>

<http://www.teledesic.com>

**Other connections:** There are very high-end connections available, such as microwave links, normally used only by businesses, which can be regarded as wireless leased lines. There are also other connections, which are deploying or still underutilized. For those connections, speeds vary widely, from 1.5 Mbps to very high speeds (i.e., 45 Mbps). The connection speed varies depending on the carrier, technology used, and the user's distance from a receiving station.

**Related Links:**

<http://hydra.carleton.ca/info/wlan.html>

<http://isp.webopedia.com/TERM/d/DSS.html>

<http://isp.webopedia.com/TERM/I/IOS.html>

## Summary

Faced with the various types of Internet connections, from the traditional dial-up access to the many different broadband options, Internet users probably would like to ask “which is the best?” The answer really depends on the user’s priorities and needs. For example, analog modem access may be enough for those who use the Internet for only a few hours a week. If someone uses the Internet heavily, and needs a high-bandwidth connection for a job in a multimedia area, (s) he has to consider the more advanced technologies. Also, because some of the high-speed options are available only in some locations, this will play an important role in selection.

I believe that the features of each connection type described in this paper will give useful information to the Internet users who want get an appropriate kind of access to the Internet.

### **Advantages and Disadvantages**

<b>Types</b>	<b>Advantages</b>	<b>Disadvantages</b>
Analog Modem	<ul style="list-style-type: none"> <li>• Low cost</li> <li>• Availability: able to get internet service almost anywhere in the country</li> <li>• Simplicity</li> </ul>	<ul style="list-style-type: none"> <li>• Slowest type of connection available</li> <li>• Unable to talk on the telephone when using internet</li> </ul>
ISDN	<ul style="list-style-type: none"> <li>• Faster than analog modems</li> <li>• Widely available in most metro areas</li> <li>• Still a valid option, especially those who are too far away from the telephone company’s Central Office to qualify for DSL service</li> <li>• Able to talk on the telephone and surf the web simultaneously</li> <li>• Always on connection</li> </ul>	<ul style="list-style-type: none"> <li>• Not dramatically faster than analog service</li> <li>• The access charge is usually per-minute.</li> <li>• Not available everywhere</li> </ul>
DSL	<ul style="list-style-type: none"> <li>• Always on connection</li> <li>• Also able to use dial-up connections</li> <li>• High speed</li> <li>• Promise of affordability</li> <li>• Uses existing lines</li> </ul>	<ul style="list-style-type: none"> <li>• Not available everywhere due to the signal limitations based on the distance.</li> <li>• Upstream speed limited of a common type--ADSL</li> </ul>
Cable	<ul style="list-style-type: none"> <li>• Always on connection</li> <li>• High speed</li> </ul>	<ul style="list-style-type: none"> <li>• Variability of speed</li> <li>• Upstream speed limited</li> </ul>
T-1	<ul style="list-style-type: none"> <li>• Available virtually everywhere in the regional serving area</li> <li>• Always on connection</li> </ul>	<ul style="list-style-type: none"> <li>• Too expensive to the individual and small business</li> </ul>

Satellite	<ul style="list-style-type: none"> <li>• Available virtually everywhere in the regional serving area</li> <li>• Always on connection</li> </ul>	<ul style="list-style-type: none"> <li>• Sensitive to the heavy rainy day</li> </ul>
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### Transfer Rate For A 10-Megabyte File

Speed/Type	Transfer Time
9.6Kbps Analog Modem	2.3 hours
14.4Kbps Analog Modem	1.5 hours
28.8Kbps Analog Modem	46 minutes
56Kbps Analog Modem	24 minutes
128Kbps ISDN Modem	10 minutes
1.5Mbps to 9Mbps ADSL Line*	8 to 52 seconds
1.54Mbps T1 Connection	52 seconds
4Mbps Cable Modem	20 seconds
10Mbps Cable Modem	8 seconds

Chart statistics (except ADSL) are courtesy of digitalNATION (<http://www.dn.net>). \*The ADSL statistics (added by Smart Computing) are based upon varying connection types and service providers.

### References

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fg0705%2F087w%2F087w%2Easp>

Different Ways To Gain Internet Access

<http://www.rci.rutgers.edu/~au/workshop/int-def.htm>

Internet Terminology and Definitions prepared by Steven C. Perkins

[http://www.gseis.ucla.edu/etu/training/materials/internet\\_introduction/default.php?page=3](http://www.gseis.ucla.edu/etu/training/materials/internet_introduction/default.php?page=3)

Introduction to the Internet-connection methods

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2F0501%2F25r01%2F25r01%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

ISDN Tries To Compete In A Broadband World

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2F1999%2Fs1009%2F07s09%2F07s09%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

Affordable Broadband Technologies Such As ISDN, DSL & Cable Modems Put High-Speed Internet Access Within Your Reach

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fg0903%2F50g03%2F50g03%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

Choose The Internet Route That's Right For You

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fi0607%2F07i07%2F07i07%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

Tools & Tips For Staying Online When You're Away From Home

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fi0601%2F14i01%2F14i01%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

How To Choose The Right Hardware For Your Internet Needs

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fi0307%2Fbeg16%2Fbeg16%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

All about Modems

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fi0610%2F35i10%2F35i10%2Easp&guid=z6ymrfce&searchtype=0&WordList=ISDN>

High Speed Options Are Heating Up

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fr0501%2F24r01%2F24r01%2Easp&guid=z6ymrfce&searchtype=0&WordList=DSL>

An In-Depth Look At Digital Subscriber Line Technology

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2F2001%2Fs1203%2F18s03%2F18s03%2Easp&guid=z6ymrfce&searchtype=0&WordList=DSL>

Phone Lines & Cable Speed Up Your Internet Connections

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2F2001%2Fs1208%2F10s08%2F10s08%2Easp&guid=z6ymrfce&searchtype=0&WordList=cable>

Buying, Replacing, Installing & Troubleshooting Computer Cables

<http://www.smartcomputing.com/editorial/article.asp?article=articles%2Farchive%2Fg0807%2F09g07%2F09g07%2Easp&guid=z6ymrfce&searchtype=0&WordList=satellite>

## E-mail By Satellite

This paper is written by Hojeong Kang for the course EDC385G Multimedia Authoring at the University of Texas - Austin