

This note begins by showing you some results from free Internet tools to determine your bandwidth, either at home via your DSL or Cable Modem, or at the office. A discussion of the various factors that determine your bandwidth follows.

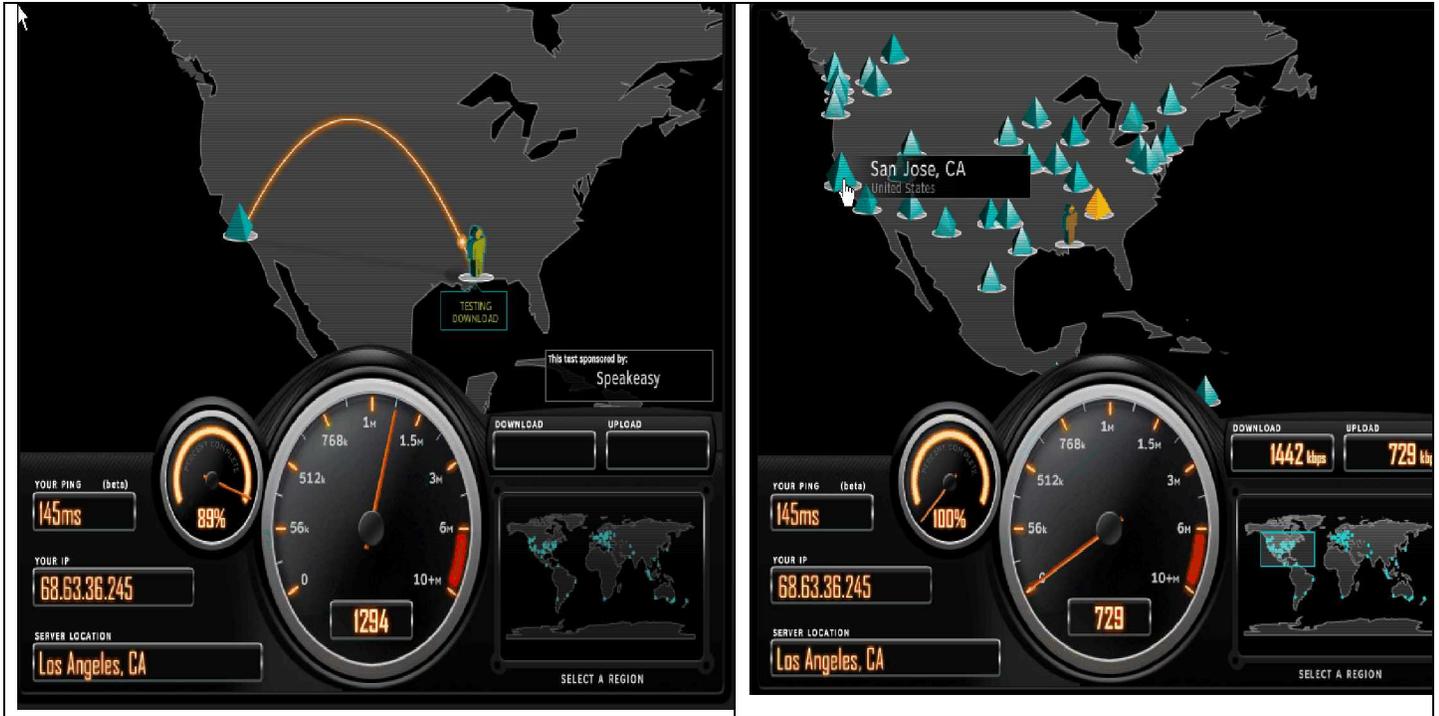
Remember some basic VOIP facts. A VOIP call made using the G.711 codec will take 155Kbps and then with silence suppression and echo cancellation, about 55Kbps. Because we cannot always control echo cancellation, most published information (for example, Vonage) says that about 83Kbps is needed for a single VOIP call.

Thus before you begin a VOIP project, you need to determine how many calls you will make and then plan your network to accommodate the bandwidth needs for this number of calls.

PART 1: USING BASIC BANDWIDTH TOOLS

The following graphic shows the test interface. Following this table, there is another table showing download speeds, taken from 2:43 PM to 3:04 PM on a Monday, from a Mobile, AL., Comcast site to various sites on the internet. These were done with the Speedtest tool, available through www.speedtest.net. It is an interesting tool that uses graphics and a speedometer so that you can see the results as they are generated. You pick servers in the differing cities and then run both the upload and the download tests.

First, to use the speedtest tool, you select a city and then the tool does a ping first, and then the download, and then the upload test. Finally, it shows the statistics for that time and site. If you pick all the sites, it will build a table which contains your results, as shown in the chart below the two graphics.



Date	Time CST	Download Speed	Upload speed	Ping Round Trip	Destination Server	Miles to Server
1/29/2007	3:04	895 kb/s	721 kb/s	136 ms	Twin Cities, MN	~ 950 mi
1/29/2007	3:03	979 kb/s	591 kb/s	120 ms	Olympia, WA	~ 2150 mi
1/29/2007	3:02	1306 kb/s	731 kb/s	132 ms	San Jose, CA	~ 2000 mi
1/29/2007	3:01	1516 kb/s	731 kb/s	162 ms	Los Angeles, CA	~ 1750 mi
1/29/2007	2:58	883 kb/s	718 kb/s	173 ms	New York, NY	~ 1050 mi
1/29/2007	2:54	1335 kb/s	726 kb/s	98 ms	Washington, DC	~ 850 mi
1/29/2007	2:54	1135 kb/s	728 kb/s	169 ms	Saint Louis, MO	~ 550 mi
1/29/2007	2:53	4326 kb/s	735 kb/s	48 ms	Dallas, TX	~ 550 mi
1/29/2007	2:50	1740 kb/s	574 kb/s	84 ms	Chicago, IL	~ 750 mi
1/29/2007	2:45	1188 kb/s	687 kb/s	201 ms	Atlanta, GA	~ 300 mi
1/29/2007	2:44	741 kb/s	720 kb/s	87 ms	Montreal	~ 1300 mi
1/29/2007	2:43	1726 kb/s	724 kb/s	178 ms	Los Angeles, CA	~ 1750 mi

Another interesting bandwidth testing site is www.speakeasy.com. Their interface is similar, as are the test cities. You pick the city on the left and then the speakeasy tool computes both the upload and

download speeds. First, we have the graphic, and then we have the test results, when were done from about 3:50 PM to 4:05 PM, CST.

🕒 Test Your Connection Speed

Take the Speakeasy Speed Test and test your connection speed! By measuring the download and upload rate from the following locations you are able to accurately judge your current line throughput or internet connection speed. To take the speed test, choose the server nearest you.

The Speakeasy Speed Test requires the latest version of [Macromedia Flash Player](#) installed to use with your preferred browser. Also, temporarily disable any Adblock extensions on your browser.

- » [Link to the Speakeasy Speed Test](#)
- » [Understand Your Speed Test Results](#)

CHOOSE A SERVER:

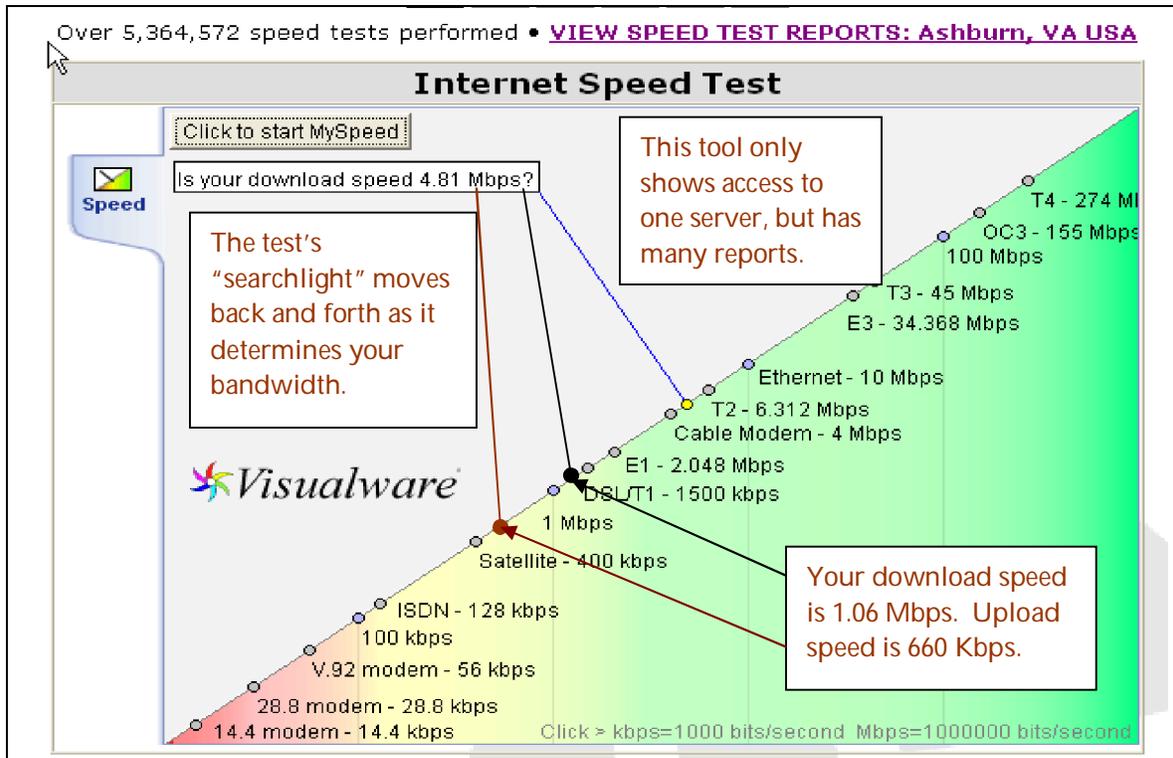
- » SEATTLE, WA
BEGIN THE SPEED TEST
- » SAN FRANCISCO, CA
BEGIN THE SPEED TEST
- » LOS ANGELES, CA
BEGIN THE SPEED TEST
- » DALLAS, TX
BEGIN THE SPEED TEST
- » CHICAGO, IL
BEGIN THE SPEED TEST
- » ATLANTA, GA
BEGIN THE SPEED TEST
- » NEW YORK CITY, NY
BEGIN THE SPEED TEST
- » WASHINGTON, DC
BEGIN THE SPEED TEST

Your IP: 68.63.36.245

Here are the results from testing the eight sites you can test with Speakeasy tool.

Site	Down Speed	Up Speed	Site	Down Speed	Up Speed
Washington, DC	930	730	Dallas, TX	4774	735
New York City	1239	723	Los Angeles	1226	730
Atlanta, GA	1381	732	San Francisco	1345	725
Chicago, IL	2746	729	Seattle	1261	727

A third testing system appears on several sites, with an interfacing interface: <http://myspeed.visualware.com/>



There are many other sites, such as PC Pitstop. Like many of these free testing sites, PC Pitstop uses its free bandwidth test to advertise various commercial products designed to speed up your PC. The Pitstop GUI consists of a few mouse-clicks and then the two results below appear.

PC Pitstop Download Result	PC Pitstop Upload Result
3277 kilobits per second	Upload speed: 738 kilobits per second

Each of these tools allows us to see certain things about our internet connection. If you are going to use these tools to size up your local network for VOIP, make sure that you do the tests several times per day to the places where your calls will go to. In addition, remember that with G.711, you need at least 83Kbps for each line in both the upload and download directions.

Part 2: General Ideas About Bandwidth

Internet bandwidth is, in simple terms, the transmission speed or throughput of your connection to the Internet. However, measuring bandwidth can be tricky, since the lowest bandwidth point between your computer and the site you're looking at determines the effective transmission speed at any moment.

Three factors outside of your computer control how quickly you can view Web pages:

1. The Internet bandwidth between your computer and the site you're viewing.
2. The round-trip time between your computer and the site you're viewing.
3. The response time of the site you're viewing.

The tests referenced on this page address the first issue, and measure the Internet bandwidth between your computer and PC Pitstop's servers. The Pitstop site has tests that can measure the round-trip time between your computer and seven different sites on the Internet, [here](#).

Tests: Download vs. Upload

The differences between our Download and Upload tests aren't as obvious as they may initially seem. Yes, the basic difference is the direction of the data transfer: Simply put, the Download test measures your connection speed for viewing Web pages; the upload test measures the speed for maintaining them--or sending data over your connection.

However, the rated upload and download speeds may not be the same for your connection. Some connections, such as 33K and lower, are "symmetric," meaning the rated upload and download times

should be the same. Other connections, such as cable modems and ADSL, are "asymmetric" (the "A" in ADSL stands for asymmetric). This means the upload and download times won't necessarily be the same; upload times are generally not as fast as download times. For instance, the rated speeds for ADSL are 1.4Mbps down, and 400Kbps up. Cable modems are typically rated at 1.5 to 3Mbps down, and 400 to 600Kbps up.

Occasionally, you may even see opposite results, especially on cable modems during the evening hours. If your connection has a heavy user load, the download times may suffer, while the upload times remain unchanged. This is because the majority of Internet users download data instead of uploading it.

In addition, the ways we actually conduct the tests aren't quite comparable. Our Download test uses the *http* protocol and grabs one big stream of data. Our upload test uses the *ftp* protocol, which involves a lot of handshaking across Internet servers. As a result, the test is more susceptible to interruptions because of bad ping times on a server or servers.

Bottom line: You should regularly run both tests to make sure you're getting the rated upload and download speeds from your connection.

About throughput and reproducibility

The Internet changes from one moment to the next in ways that are impossible to predict. You cannot expect to see the same bandwidth value every time you measure it. Furthermore, you cannot expect to see the full nominal speed of your connection for your bandwidth measurement: There are always delays *somewhere*.

As a rule of thumb, if you can measure throughput that is 85% of your nominal bandwidth, more often than not your connection is performing at par. If your site is not performing properly, you may

need to contact your service provider or modem manufacturer to determine the rated speed of your connection and/or modem.)

This is especially true with modems. Most 56Kbps modems connect at a speed less than 46Kbps, because of the limitations of analog phone lines and telephone company switches.

To get the best picture of your Internet bandwidth, *test several times*. Also test at *different times of the day*: Your bandwidth measurement at 7 AM may be *much* better than your bandwidth measurement at 10 PM.

About bandwidth units

You will often see bandwidth and transfer speed quoted in two different units: kilobits per second, abbreviated kbps or Kb/s, and kilobytes per second, abbreviated KB/s. The difference between the two units is the number of bits in a byte, which is 8. The small 'b' stands for bits, and the big 'B' stands for bytes. Transfer speeds are often shown in KB/s, and connect speeds are usually quoted in Kb/s.

So, for instance, if a progress dialog for a modem shows you a download speed of 4.3 KB/s, it is the same as 34.4 Kb/s. If a progress dialog for a cable modem shows you a transfer speed of 100 KB/s, it is the same as 800 Kb/s.

We display our measured transfer speeds in Kb/s, to make them easier to compare with your rated line speed.

About bandwidth and modems

Bandwidth over a modem connection can sometimes be difficult to understand. There are two connections to a modem: one from your computer to its modem, and one from the computer's modem to the ISP's modem.

The connection speed between the computer and its modem (called the Maximum speed under Control Panel/Modem/General tab/Properties) should be set as high as possible without causing errors. On most computers this is 115200, also written as 115.2 Kb/s.

The connection speed between your modem and the ISP's, and the compression and error checking, are negotiated between the two modems when they establish the call. In the very best possible case, which is rarely seen, two V.90 (56 Kb/s) modems will be able to connect at 53 Kb/s with compression, and the compression on normal text transfer will average 50%, giving an effective transmission rate of 106 Kb/s. Very highly compressible material could be transferred at the maximum rate of 115.2 Kb/s. Incompressible material like ZIP files could be transferred at a maximum rate of 53 Kb/s.

Our download test transmits an incompressible block of random text. The theoretical maximum transfer speed for this over a V.90 modem is 53 Kb/s, if there was no latency at all on the line--that is, if there was no delay between the times your computer asked for a packet, our computer sent it, and your computer received it. With normal latency, however, transfer speeds are reduced to roughly 85% of the maximum, which for a V.90 modem would be about 45 Kb/s. If your modem connects to your ISP at the more typical 44 Kb/s, then you can expect our test to report about 37 Kb/s on a connection with normal latency.