

# Appendix F How Much Speed Do I Need?

2016-10-24

## Introduction

There are two characteristics of an Internet connection that affect how fast we perceive it to be; bandwidth and latency. Bandwidth, also referred to as speed, is the amount of data that can be transferred per second and is measured in megabits per seconds (Mbps). Latency is delay. Latency is how long it takes data to travel between its source and destination, measured in milliseconds (ms).

## Bandwidth Needed for Various Internet Tasks

All Internet tasks are made up of one or more of the three following functions: **Downloading**, **Uploading** and **Streaming**.

**Downloading** is the process of receiving data from a location on the Internet and storing it on your computer or device. **Uploading** is the reverse, i.e. sending data from your computer or device to a location on the Internet. **Streaming** is a type of downloading or uploading where data is not saved on your device but is consumed as it is received or created on the fly as it is sent.

Examples of downloading are viewing websites, photos or documents or saving songs. The entire webpage, photo, document or song is downloaded and stored on your device which then displays or plays it either immediately or later.

Examples of uploading would be sending e-mail or saving data (documents, photos, audio data, etc) to a location on the Internet, for example "the cloud".

Examples of download type streaming would be watching movies, videos or listening to songs where the data is played in real time as it is received. Skype and voice over Internet are examples of combined downloading and uploading streaming.

In typical home Internet use downloading and download streaming accounts for the vast majority of data flow although with the increased home use of "the cloud", uploading is becoming more important. For businesses, the direction of data is dependent on the business type and in most cases upload speeds needed are much higher than for home use. Note that working from home via the Internet would be considered a business use (see Appendix E Work-From-Home Possibilities ) .

In the past, for both business and technical reasons, Internet service providers (ISPs) have sold Internet access to home users with upload speeds a fraction of download speeds while selling symmetrical access (download and upload speeds equal) to business users.

The following tables lists some typical file data sizes for common content and gives the time required to upload or download this content at various speeds.

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Content	File Size MB	1 Mbps	15 Mbps	100 Mbps	1000 Mbps
Typical Web page	2.5	2.5 sec	1.33 sec	0.2 sec	0.02 sec
Average MP3 song	3.5	28 sec	1.9 sec	0.28 sec	0.03 sec
16 Megapixel Photo	14	112 sec	7.5 sec	1.1 sec	0.1 sec
PowerPoint file with embedded pictures	100	13 min	53 sec	8 sec	0.8 sec
Hard disk file online backup	10,000 (10 Gb)	22 hrs	1.5 hrs	13 min	80 sec

The times listed in this table are *per item*. If three users in one household are simultaneously down or uploading 16 megapixel photos the time required to do this would be  $3 \times 112 = 336$  seconds or 5.5 minutes. Note that if you have a decent DSL connection, say 15 down and 1 up you can download a 16 Megapixel photo in a few seconds but it takes almost 2 minutes to upload it.

The next table lists speeds required for various streaming activities.

Activity	Required Speed
You Tube Videos	0.7 Mb/s
Skype, GoToMeeting, Facetime	1+ Mb/s
High-Def Movie & TV Shows	5.0 Mb/s
Online University Lecture	4.0 Mb/s
2-Way HD Gaming	4.0 Mb/s
4K Movie	15 Mb/s

Note again that the figures in the table above are *per user*. If three users are trying to stream three different high-def movies or TV shows the speed required would be  $3 \times 5$  Mb/s or 15 Mb/s.

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## Latency

Latency is the amount of delay (or time) it takes to send information from one point to another. As noted above, latency is usually measured in milliseconds and is also referred to as a ping rate or ping speed. Latency is measured by using a utility program on your computer called ping that sends a special packet of data to a server on the internet and measures the time between when it was sent and when it was received. The name ping comes from sonar technology where a short burst of sound is sent out (a ping) and a listening device listens for an echo.

## Factors Affecting Latency

### Distance

The amount of time it takes for electrons or photons to travel from your computer to the server on the internet it is talking with depends on how far away it is. The laws of physics will tell you it takes about 25 ms for data to travel from Maine to California. If you add in the normal delays caused by Internet switching devices along the route, the actual time is more like 75-80 ms. If you have a satellite connection, you can add 500 ms to the trip. That's the time it takes to get up to the satellite and back.

Here's a simple illustration. Check the difference between the results of pinging [www.baidu.com](http://www.baidu.com) and [www.google.com](http://www.google.com). All Baidu servers are located in China, while most Google data centers in the US are located in the eastern half of the country.

### Network Congestion

Although the big Internet pipes can carry huge amounts of data, they can fill up, and your packets will have to wait to get onto the highway. This adds latency.

## What's a Good Latency Value?

The smaller the better, but anything around 100 ms is OK. Very high latency speeds can make even a high bandwidth connection seem slow. For example, video conferencing via a satellite connection can be impracticable.