

Problems with the Internet at home

The Internet is bursting with use. These two articles provide information about the current situation. From today's NYT

<https://www.nytimes.com/2020/03/26/business/coronavirus-internet-traffic-speed.html>

From: Computerworld

<https://www.computerworld.com/article/3533333/to-save-the-economy-we-must-reduce-video-bandwidth-use-now-updated.html>

How residential Internet works

Residential Internet services, whether from cable or satellite, offer a large pipe (volume+speed) for downloads and a much smaller pipe (volume+speed) for uploads. (Pipe here is a shorthand way to talk about the amount of bandwidth (volume of packets) and the pace at which those packets can travel through your connection. The volume of data transferred through a connection in a given amount of time is that connection's internet speed.) Having the capacity for larger speeds (often expressed as some number of Mbps (megabits per second) for download is consistent with the way the country has designed, managed and used the Internet since it became available as a mass consumer item. I just tested my home connections and I have 66.4 Mbps for download and 10.8 Mbps for upload. I pay for a package that offers Internet speed of up to 100 Mbps.

About your Mbps speed

Your Internet Service Provider (ISP) will say that they provide speeds up to some amount of Mbps for some monthly charge. This does not mean that your speed will be at that "up to" number all of the time or even very often in some cases. Your available speed or bandwidth capacity will vary based on the available capacity from you to your ISP and from your ISP to whatever destination you are trying to reach. None of us have a personal, dedicated slice of the Internet network - we share through our ISP and that ISP shares through their connections to larger networks, and so on. Each ISP has negotiated contracts for routes and available bandwidth with physical networks that span the globe. Some ISPs have their own private networks linking geographic locations they serve to key other locations to better reliable network

speeds for their customers from certain places to certain places. Internet routing and broadband availability for every section of your connection are complex, especially for residential customers, and can have significant impacts on the Mbps that you are paying for.

What is happening for faculty, students and staff

Videoconferencing requires uploads and downloads simultaneously. If you have multiple people in a household trying to do videoconferencing, some of that activity is happening through the small pipe. If you have children at home trying to do everything in simultaneously online sessions and perhaps a partner also trying to do videoconferencing as part of a job, and you are a faculty member trying to teach in blocks of 45-60 minutes at a time, most likely, someone or perhaps all of you, will have a less than optimum experience.

Your children's teacher is uploading large amounts of content (on the screen and talking or showing slides, etc.) through her own smaller pipe so that her students can download through their larger pipe. As a faculty member, you are doing the same thing - small pipe to student's larger pipes. The total amount of bandwidth for the children's session or the session for your students is also increased by the number of people participating in that session. Visualize your last Zoom or Hangouts session and recognize that each person's image, voice, and actions - mute and unmute, chat, etc. takes bandwidth to send out and bandwidth to receive. A simple group video call with 8 people could take 1.5 megabits per person - if the school class is 25, then we're talking about 37.5 Mbps in a combination of uploads and downloads.

Let's look at this one other way. Here is a chart of how much speed is needed at a minimum. The first 4 activities rely primarily on your big downloading pipe. The last two rely on downloading and using the smaller uploading pipe. Remember my speeds from above - 66.4 Mbps for download and 10.8 Mbps for upload. If I have multiple sessions of videoconferencing going on at the same time, all of them will be affected, resulting in freezing and pixelated images.

| Activity type | Minimum speed required |
|---------------|------------------------|
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|---------------------------------------|-----------|
| General browsing/email/social media | 1 Mbps |
| Streaming music | <0.5 Mbps |
| Streaming video (standard definition) | 3–4 Mbps |
| Streaming video (high definition) | 5–8 Mbps |
| Online multiplayer game | 4 Mbps |
| Video conference call | 6 Mbps |

What are some mitigations or possible solutions?

1. Run a speed test on your Internet connection. You can try Spectrum’s <https://www.spectrum.com/internet/speed-test> or <https://www.speedtest.net/>. You might need to restart your Internet router if the reported speeds are far below what you should be getting from your ISP. You can also connect your computer directly to your router with an ethernet cable and bypass your home wifi network which could also be reducing your bandwidth to a particular device or activity.
2. You can purchase the biggest Internet access package that your provider makes available. Every increase in the size of the download pipe comes with an increase in the

upload pipe, but no residential service outside of a major metropolitan area is going to provide anything like what you are used to having on campus.

3. You can divide your day and calendar for everyone's Internet activities - a difficult proposition if every need in your household is for synchronous activity. But even stopping video (movies, shows, etc.) streaming during video conferencing will help provide a better experience for videoconferencing.
4. You can try to do as much as possible in asynchronous mode. Record your lecture or presentation and upload it to Google Drive or YouTube where your students can access it. The upload of a video file takes significant bandwidth, but it is a finite activity for a short period of time. You could contact the teachers for your children and explain the difficulties of having your kids all trying to do synchronous Internet sessions at the same time.
5. You can try to use your phone as a hot spot with its cellular service (a different set of networks) as your connection to the Internet if you have an unlimited data plan. Without the unlimited data plan, this could be a costly option. Verizon says it can provide download between 5 and 12 Mbps and upload speeds between 2 and 5 Mbps. That might work for someone's need for the Internet and reduce the pressure on your ISP connection.