

How Much Bandwidth Do I Need?

Choosing an Internet Service Provider (ISP) has never been more complicated. The patchy introduction of new technologies means that the connection types available at any particular school will be dependent on how lucky you are with your local providers.

Broadband networks can be thought of as having 3 layers. The performance of each of these layers is important in delivering the bandwidth speeds users experience:

The **Core Layer** is maintained by the ISP. It provides:

- key services, such as Firewalling, DNS, Virus protection and Email relay;
- transition services such as access to the internet, Janet and the NEN and;
- optional services, such as filtering, email and access to other service providers.

The **Distribution Layer** aggregates local connections for backhaul to the core layer. This should be sized and managed to avoid contention (bandwidth sharing) between schools.

The **Access Layer** is the connectivity to the end point at the school. Bandwidths will be based upon need, finance and available technologies but should have guaranteed throughputs. Connections will terminate at a router, supplied by the ISP. The quality of that router will affect performance and ensure local security.

Networks need to be actively managed so that developing faults can be logged and actions triggered before the faults are reported. Also, all configurations and changes should be logged so that systems can be restored as required.

Despite the interdependence of these three layers most ISPs concentrate on the access layer when marketing their services. Pretty much all the wires in the ground are provided by the two wholesalers (BT Wholesale and Virgin Media Business). Other ISPs, and there are hundreds, lease circuits from these two, bundle them with some sort of service wrap and resell them to customers. Choosing between offers is a challenge! All come with headline figures about bandwidth, but what do they mean?

First, statements such as “up to 10 Mbps” and “subject to survey” are necessary to cover over-promising but they mean little when it comes to planning your service. There are so many variables, including choice of technology, distance from the local exchange, condition of the wires, that all such statements can only be tested after installation.

In general though, the Connection Rate is the one usually quoted and is the theoretical, physical speed at which your line could talk to the exchange. The theoretical download speed is approximately 20% less than the Connection Rate. And the ACTUAL download speed (recorded by downloading a file of a set size) is the speed experienced by a User.

So, the higher your connection rate the higher your theoretical and actual download speeds, but each depends upon local conditions. If the connection rate is quoted at 10 Mbps, the theoretical download speed is, at best, 8 Mbps and the actual speed is likely to be even lower as it will depend upon variables in the school, like the condition of wiring, throughput on the router and switches and so on.

Also, there are two important metrics in bandwidth allocation - **downstream** and **upstream** - which denote the speed of inbound and outbound traffic respectively.

Downstream Bandwidth

This reflects how much data can be transmitted from your broadband service to your computers at one time, affecting the speed of web page loading, file downloading, video/audio streaming, etc. For comfortable web browsing, it would be ideal to have 1-2

Mbps per user. If you watch a lot of streaming media, such as BBC iPlayer, you probably want more like 4-5 Mbps per user. This is not to say that a school with 100 PCs needs a (100x2=) 200Mbps connection. As it is not likely that all users will be trying to download at the same time, you can probably get away with a 4:1 ratio (or as much as 10:1. Only you will know how your school works) so that 50 Mbps would be sufficient.

Upstream Bandwidth

In web browsing and media streaming, upstream bandwidth sends the initial request for web pages and files to the server. After that, the entire load is carried on by the downstream bandwidth. For this reason domestic ISPs typically provide much less upstream bandwidth to their subscribers, sometimes as little as 1/10th the downstream. However, in a school, upstream bandwidth is important as it determines how quickly your computers can transmit data to a remote location. Upstream bandwidth has significant impact on certain operations. Does it take a long time to attach files to your email? That is due to the limitation of your upload speed. Stuttering in Skype or video conferencing calls? That too is probably a lack of upstream bandwidth. Offsite backup systems rely exclusively on your outbound bandwidth to transmit your files to their servers and sufficient outbound bandwidth is also critical when hosting remotely accessible (Cloud) services from your school's computers. Similarly, if you allow remote access to your school computers from home, you are using the upstream capacity.

Thus, estimating upstream requirements depends upon usage but a school with 50 Mbps download will probably require at least 10 Mbps upstream.

Connection Types

As indicated above, the connection types available at any particular school will vary. Those developed for the home market are usually asymmetric, with higher download speeds than upload. The simplest, ADSL, is designed as a download product and upload speeds are restricted to less than 1 Mbps. SEGfL cannot recommend such products for schools. The need for off-site backups, the drive to use more internet based services and increasing use of collaboration technologies makes 2 Mbps upload the minimum, even for small schools.

Some technologies that might be considered are:

Access Circuit	Supplier	Download Speed Up to	Upload Speed Up to
ADSL Business up to 20 Mbps (Bonded Copper)	BT Wholesale	20 Mbps	2.5 Mbps
VDSL Business (Fibre and Copper FTTC)	BT Wholesale	40 Mbps	2 – 4 Mbps
Etherstream Fibre (Fibre – leased line)	Talk Talk Business	10 Mbps	10 Mbps
Etherstream Fibre (Fibre – leased line)	BT Openreach	100 Mbps	100 Mbps
Etherstream Fibre (Fibre – leased line)	Virgin Media Business	100 Mbps	100 Mbps

Table of Bandwidth Requirements (Downstream)

Bandwidth (per machine)	What it's fast enough for...
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< 1 Mbps	Email Instant Messaging Frustrating Web Browsing
1-2 Mbps	Web Browsing Streaming Audio Simple Online Educational Games Facebook
3-4 Mbps	Video Chat Streaming Video (YouTube, iPlayer,) High Quality Photos Peer to Peer File Sharing
5-9 Mbps	Streaming HD Video

Table of Bandwidth Requirements (Upstream)

Bandwidth (per machine)	What it's fast enough for...
< 256 Kbps	Email & Instant Messaging Web Browsing Audio/Video Streaming
512 Kbps	Audio Chat Remote Desktop
1 Mbps	Video Chat Emailing with large attachments Hosting a network game (2-4 players) Screen Sharing (for remote support)
2 Mbps	Skype with more than 2 people Hosting a network game (4-8 players) Remote Backup for single server VPN Web server for a small site
3-5 Mbps	Multicast Video Streaming Web server for a mildly popular site
10+ Mbps	Remote backup for large schools

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See also:

http://www.nen.gov.uk/files/NEN_InfoSheet_4_Selecting_Broadband_Connectivity.pdf