

How Broad is your Band?

Mike Bromwich, Technical Director, PDMS

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We'll have infinite bandwidth in a decade's time.

Bill Gates, PC Magazine, Oct. 11, 1994

In recent times, there has been a seemingly endless advance in the performance of computers, and this has necessarily been matched by a parallel set of advances in telecommunications. Although the last century has seen a steady increase in the rate at which we are able to communicate information using electrical or optical means, the growth of the Internet over the last decade has served to accelerate these advances, as well as to bring them into the public eye. The nirvana of high-speed Internet access has been promised many times, but each step forward in connection speeds always seems to be an anti-climax. This is for several reasons.

As more and more bandwidth is available, more and more exotic applications are dreamt up to make use of it. A few years ago, many web designers were careful to ensure that sites made sparse use of graphics, thus ensuring that the site was efficient and fast to access. In contrast, now that the majority of web users have moved to faster connections, many sites are crammed full of graphics, animations and other media - many of which add very little to the usability and functionality of the site. As such, although connection speeds may have multiplied ten-fold, the apparent speed of the sites has not shown such a drastic improvement.

Our expectations have also matured and increased. Society is speeding up, patience seems to be almost non-existent. We click a link, and if the page hasn't appeared within a second or so, we are cursing and clicking furiously trying to encourage the technology to keep pace with our demands. In most cases, the sites are operating many times more quickly than they were a few years ago, but as customers, we are become ever more demanding.

A further factor is related to the industry providing the connectivity - the Internet service providers and telcos. They are facing a difficult quandary, and have been for several years. As technology develops allowing information to be delivered to the consumer more and more quickly, there is an ever-increasing demand to fill that capacity. The business of being an ISP is very similar to any other commodity supplier - it's a game of buying enough bandwidth to meet the demands of your clients, and (preferably) making some money in the process. The difficulty arises since connection speeds to the clients have multiplied up to fifty-fold over the last five years, yet the cost to the ISP of the bandwidth has only reduced to approximately one fifth over the same period. Although technology has been developed which allows providers to make more of their bandwidth, something has to give for this equation to balance: contention.

Contention is how many times over an ISP sells the bandwidth they buy, and typically ISPs use sophisticated equipment to control the contention applied to different classes of client. It is

inevitable that domestic customers paying a small monthly subscription have their traffic prioritised below that of corporate clients paying significantly more for connections with a service level agreement (SLA). As connection speeds increase, including to domestic clients, contention becomes more and more apparent.

Any connection over the Internet will pass through infrastructure owned by many organisations, and contention can be applied at each hop. If you are unlucky, then this contention is compounded, and the result can be an almost unusable service. Normally, however, differing time zones and careful traffic management result in a usable, if not perfect, connection.

Only five years ago, the latest thing in Internet connections was the 9,600 baud modem - 9,600 bits of information per second, (accepting that the relationship between bits and baud is not quite that simple). That seems like quite a lot of information. The next step-change was to ISDN, able to deliver information at over ten times the speed. The current 'flavour of the month' for Internet access is ADSL - this introduces another tenfold increase in capacity. Surely this is a vast capacity, and compared with five years ago, it seems gargantuan. However, even an ADSL circuit running at full capacity cannot carry enough information for a single broadcast-quality television channel in its raw form. It can only just cope with CD quality sound unless some form of compression is used. It is also fifty times slower than the typical office network.

ADSL is an ingenious use of the existing pair of copper wires connected to almost every household in the developed world, yet it represents just about as far as we can go using this existing infrastructure. As such, it is undoubtedly a transitory technology, and as requirements and expectations continue to develop, it too will be retired to the OAL (Outdated Acronyms List). Future methods of connecting to the Internet will probably take a very different form.

It is likely that wireless technology will take over from cable-in-the-ground infrastructure. Replacing the pair of copper wires connecting each and every location with an optical connection would be prohibitively costly and time consuming, whereas implementing wireless connectivity is no more complex than receiving satellite TV. The speeds achievable using wireless delivery are several orders of magnitude greater than will ever be achievable over a telephone line, and they are more reliable, cost effective and flexible.

Due to its flexibility, this 'wireless local loop' can be used to deliver far more than Internet access. It will become a channel for voice, video, connection to localised 'metropolitan area networks' (MAN), all over a single link. These are all promises that have been heard before, yet for the first time a technology is in sight that can genuinely deliver the capacity required to support these applications.

Some years ago, engineers predicted that it would never be possible to use a telephone line to deliver more than about thirty thousand bits of information per second. This was based on a respected and proven scientific rule called Shannon's Law. ADSL technology cunningly sidestepped this law without violating it, and has thus extended the life of the humble copper pair for a few more years. Wireless technology is now available to allow us to break free of the constraints of the legacy telephone network, however I do think that Bill Gates' prediction is probably somewhat ambitious given that we only have two years to go.