"Please sir, I want some more."

The aim of this short article is to discuss the issues of increasing bandwidth and the ever-increasing demand for faster broadband speeds. In particular, we discuss what speeds are currently considered sufficient, what constitutes super-fast broadband (SFBB) and Next Generation Access (NGA), and what applications may drive our future needs.

Broadband Speed Units

Broadband speeds are measured in units of bits per second (bps or b/s), but with standard SI prefixes used such that:

1000 b/s = 1 kilobit/s = 1 kb/s
1000 000 b/s = 1 Megabit/s = 1 Mb/s
1000 000 000 b/s = 1 Gigabit/s = 1 Gb/s
1000 000 000 000 b/s = 1 Terabit/s = 1 Tb/s

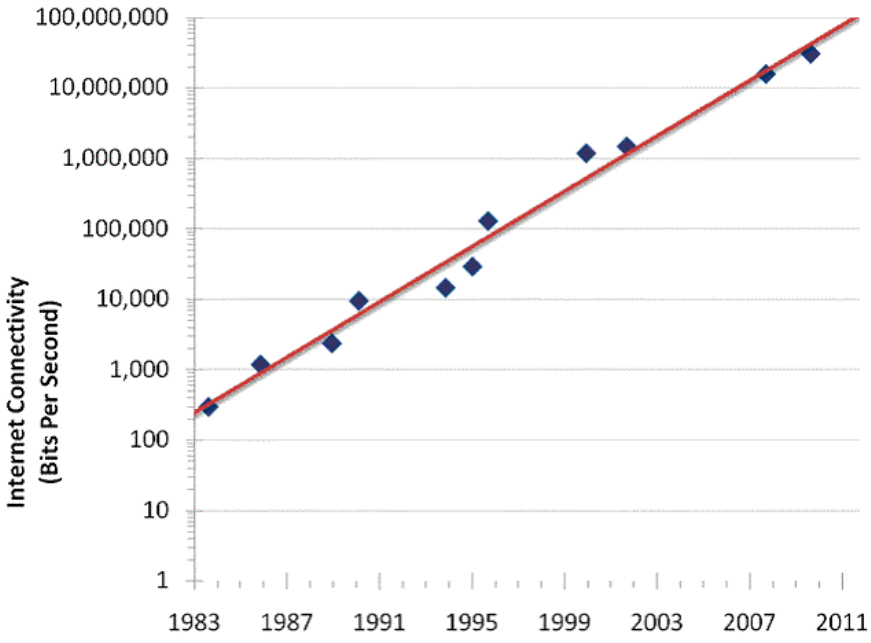
Where a bit is a '1' or a '0' in a binary encoded digital signal. For a 'non-return-zero' coding format in an optical fibre this could be a flash of light and absence of light respectively.

By comparison, data storage levels are typically measured in Bytes, with a typical Byte comprising 8 bits. The Byte uses a capital letter 'B' to distinguish it from the lower case 'b' for a bit. A byte can be thought of as the digital equivalent of a word, with the bits, which make up the Byte, being the letters that make up the word.

The UK telephone line rate is 64 kb/s, with broadband speeds being defined as bit rates of 2 Mb/s or greater. Rates of less than 2 Mb/s, but higher than the telephone line rate are known as wideband.

Nielsen's Law

Nielsen's law describes the exponential growth of data transmission speeds for a typical 'high-end' user:



The above graph reproduced from Jakob Nielsen's alert box.

Standard "low-end" users typically lag high-end users by approximately 2 to 3 years.

UK 2011 Super-Fast Broadband Definition.

The UK government decided this year that super-fast broadband will be defined as 24 Mb/s, which is broadly in line with a European target of 30 Mb/s minimum for all of Europe by 2020. The European target also aims for a minimum of 100 Mb/s for at least 50% of the population by the same date.

The UK government has set a target of the best broadband in Europe by 2015, and this means that most of the country must aim for 100 Mb/s or higher. A modest improvement in broadband speed to around 24 Mb/s

is nice to have, but does not bring much new – this is like a lottery win, where a small amount is nice but a larger win is potentially life changing.

Applications
Many of the applications that will require super-fast broadband speeds have not yet been developed or even invented, but those we know about already are typically associated with video applications, and in particular streaming media.

Video format	Uncompressed bandwidth	Compressed bandwidth
SD TV (480p)	250 Mb/s	4 Mb/s (MPEG-2)
HD TV (1080p)	1.5 Gb/s	20 Mb/s (MPEG-2)
HD TV (1080p Blu-ray quality)		25 Mb/s
Super HD TV (2160p)	15 Gb/s	100 Mb/s (MPEG-2)
Std. Def 3D TV	38 Gb/s	126 Mb/s
HD 3D TV	112 Gb/s	280 Mb/s
Ultra HD TV (4320p)	60 Gb/s	400 Mb/s (MPEG-2)
Super HD 3D TV	400 Gb/s	800 Mb/s
Ultra HD 3D TV	1.5 Tb/s	2.6 Gb/s

With the above video formats, it is the compressed video that we would transmit and receive, and it is always possible to compress further, but at the expense of quality and with the problem of introducing delay in any real-time video transmission. By way of example, compression of video signals to an MPEG-4 format rather than MPEG-2 format in the table above would mean an approximate halving of the required bit-rate or bandwidth.

It remains to be seen which formats are adopted, but the BBC and Japanese company NHK have been working on Ultra HD TV, also known as Super-High Vision (SHV), and are planning to use screens at this resolution for the London Olympics in 2012. Transmission of this standard has already been demonstrated, but there is a target to reduce the required bit-rate to 65 Mb/s in order to allow wide-spread transmission over broadband networks by 2020.

Video Telephony & Video Conferencing.
For video telephony and video conferencing to become truly useful will require good quality video, which means good resolution, fast refresh rate and low delay (latency). This means that high compression is not really feasible, and a high symmetrical bit rate will be required, since the quality of such systems is often determined by the slower upload speed.

At present, most video conferencing systems are designed to operate at relatively low speeds and hence relatively low quality, but newer systems will make better use of increasing broadband speeds.

Access Network Requirements
As the broadband access network becomes the main source of communication, information and entertainment in the home, it is likely that there will be multiple simultaneous users, and hence the required speed will be a multiple of the required application bit rates. With this in mind fibre-optic access networks being installed now have speeds of at least 100 Mb/s with 1 Gb/s fast becoming standard, and scope to increase to 10 Gb/s when required. For example in April 2011, Fujitsu announced that their UK FTTH networks would be able to provide 1 Gb/s initially with 10 Gb/s to the home available later.

Fibre GarDen Approach
The fibre GarDen approach is simply to provide FTTH to all premises with spare fibre and spare duct to ensure we are not only NGA compatible now, but also we have scope to update and ensure we can comply with the next NGA definition. Initial speeds supported will be at least up to 100 Mb/s, with a possibility of 1 Gb/s if required, and scope to upgrade to 10 Gb/s when appropriate.

*This information note was written for **fibre GarDen** by John Colton, FInstP. John is a director of fibre GarDen,technical director of Lucid Optical Services, a fibre optic technology specialist training company, and a director of the Fibre-optic Industry Association (FIA).*

