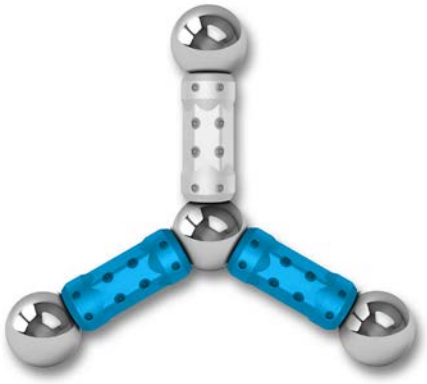
Deloitte.

The dawn of the Gigabit Internet age: every bit counts



Deloitte Global predicts that the number of Gigabit per second (Gbit/s) Internet connections will surge to 10 million by year-end, a tenfold increase, of which about 70 percent will be residential connections. Rising demand is likely to be fueled by falling prices and increasing availability: in 2015, the number of Gbit/s tariffs almost doubled in just three quarters, from just over 80 to over 150 (see Figure 15)[302]. The 10 million subscribers will likely, however, represent a small proportion of the 250 million customers on networks capable of Gbit/s (or 1,000 Mbit/s) connections as of end-2016.

Looking further ahead, we forecast about 600 million subscribers may be on networks that offer a Gigabit tariff as of 2020, representing the majority of connected homes in the world. At this stage between 50 and 100 million broadband connections may be Gbit/s, or marketed as such[303]. This would be between 5 and 10 percent of all broadband connections. Of these about 90 percent would be residential, and the remainder for business.

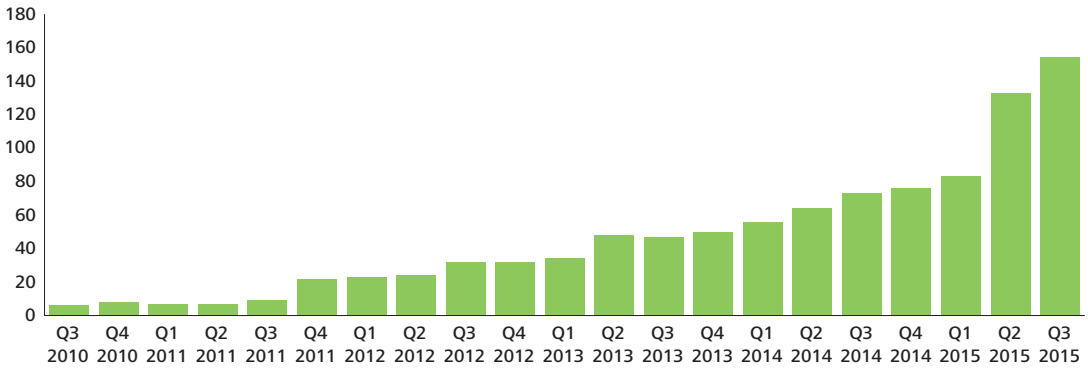
While Gbit/s subscriptions should surge this year (albeit from close to nothing to niche) the sharpest inflection point for the service may be in terms of perception. This would follow a flurry of announcements about the launch of Gbit/s around the world[305].

The perceived reasoning for Gbit/s service will likely evolve from identifying a single application running on a single device that requires a gigantic pipe to meet the aggregate demand from dozens of connected devices in a home.

Over the past 20 years, data connectivity has progressed from serving a single device and a low-speed application, to serving multiple, ever more powerful devices. Demand for connectivity has evolved symbiotically: as faster speeds have become available, the range of applications supported has increased, and the viable number of devices per person has steadily risen.

Small businesses have also experienced a significant increase in bandwidth demand, with the move to cloud-based services for a growing range of applications being a key driver of this.

Figure 15: Global Gigabit tariff count



Source: Point Topic[304], 2015

The number of Gigabit per second (Gbit/s) Internet connections will surge to 10 million by year-end, a tenfold increase, of which about 70 percent will be residential connections.

302. Gigabits are go? Tariff count takes off in 2015, Point Topic, 9 December 2015: http://point-topic.com/free-analysis/gigabits-are-go-tariff-count-takes-off-in-2015/

303. It is possible that some packages that are marketed as Gigabit services may aggregate down (for downloads) and uplink (for uploads) speeds to attain the Gigabit. For example a service presented as Gbit/s may comprise 800 Mbit/s down, and 200 Mbit/s up.

304. For more information, see: http://point-topic.com/

305. Recent announcements will benefit countries including Portugal, Ireland and Canada. For more information, see Vodafone rolling out 1Gbps FTTH in Ireland and Portugal, Telecoms.com, 2 Dec 2015: http://telecoms.com/457462/vodafone-to-start-offering-1gbps-ftth-in-ireland-and-portugal/; Bell promises to bring fastest internet possible to Toronto, CBC News, 26 June 2015: http://www.cbc.ca/news/canada/toronto/bell-promises-to-bring-fastest-internet-possible-to-toronto-1.3127407

306. Hands on with Hyperoptic's gigabit fibre: The UK's fastest residential Internet connection, Ars Technica UK, 19 August 2015: http://arstechnica.co.uk/information-technology/2015/08/hands-on-with-hyperoptic-gigabit-fibre-the-uks-fastest-residential-internet-connection/

307. Prices in dollars, adjusted for purchasing power parity. See Gigabits are go? Tariff count takes off in 2015, Point Topic, 9 December 2015: http://point-topic.com/free-analysis/gigabits-are-go-tariff-count-takes-off-in-2015/

308. Ibid.

309. For example, see BT Openreach begins 330Mbps G.fast broadband trial this August, Ars Technica UK, 20 June 2015: http://arstechnica.co.uk/business/2015/07/bt-openreach-begins-330mbps-g-fast-broadband-trial-this-august/

310. Liberty Global Preps for DOCSIS 3.1, Light Reading, 10 August 2015: http://www.lightreading.com/cable/docsis/liberty-global-preps-for-docsis-31/d/d-id/717498

311. For a technical explanation of how this works, see DOCSIS 3.1 Enables Rapid Deployment of Gigabit Broadband, Light Reading, 7 July 2015: http://www.lightreading.com/cable/docsis/docsis-31-enables-rapid-deployment-of-gigabit-broadband/a/d-id/716814

312. For example, Comcast in the US is planning to make Gbit/s services available across its markets by 2017-18. See Comcast planning gigabit cable for entire US territory in 2-3 years, Ars Technica, 24 August 2015: http://arstechnica.com/business/2015/08/comcast-planning-gigabit-cable-for-entire-us-territory-in-2-3-years/

313. Compressed files require 25 Mbit/s; live TV with a high frame rate can require double that. For more information, see Netflix, as accessed on 10 December 2012: https://help.netflix.com/en/node/13444;

314. Marc Scarpa, Wikipedia, as accessed on 15 December 2015: https://en.wikipedia.org/wiki/Marc_Scarpa

315. For a history of YouTube, see YouTube, Wikipedia, as accessed on 10 December 2015: https://en.wikipedia.org/wiki/YouTube

316. For a view on the Internet connection speed required for a 4K file, see Recommended upload encoding settings (Advanced), Google, as accessed on 10 December 2015: https://support.google.com/youtube/answer/1722171?hl=en-GB

317. Facebook Hits 8 Billion Daily Video Views, Doubling From 4 Billion In April, TechCrunch, 4 November 2015: http://techcrunch.com/2015/11/04/facebook-video-views/#.eai6wa:OGnj

318. International Space Station on UStream, NASA, as accessed on 15 December 2015: https://www.nasa.gov/multimedia/nasatv/iss_ustream.html

319. For example, see How to Watch All the Beautiful New Apple TV Screensavers, Gizmodo, 19 October 2015: http://gizmodo.com/how-to-watch-all-the-beautiful-new-apple-tv-screensaver-1737421102

Advances in data connectivity speeds to the home, 1995-2015

In the mid-1990s, most people used dial-up connections, running typically at 30 Kbit/s. In the following decade, broadband went mass market in developed countries. In 2005, a typical speed offered to the mass market was 1 Mbit/s. In the last five years basic broadband has been complemented by fiber-enhanced connections, which currently offer speeds of 30 Mbit/s and faster. As of summer 2015, FTTx (all types of fiber-based broadband connection) overtook Digital Subscriber Line (DSL) as the most common form of fixed Internet access technology. FTTx offers speeds of 30 Mbit/s and higher. At each point in time much faster speeds have been available, but were only chosen by a minority.

At the start of 2016, upper quartile homes in developed countries may have accumulated a dozen connected devices, each of which may individually 'sip' data, but collectively, at peak time, might 'gulp' data. Through 2020 that dozen may well become dozens.

Furthermore, some subscribers may select a Gbit/s tariff to improve their chances of addressing aggregate demand for 500 Mbit/s at a given time. Advertised broadband speeds are often maxima; they may not be medians or averages. The reality of broadband is that it is a best efforts service. Multiple factors can diminish the actual speed obtained on a device.

Faster connection speeds can also enable more 'bursty' connections, with files downloading or uploading far faster, meaning that each device is connected for less time to the Internet, freeing up capacity for the next request for data[306].

A further driver of Gbit/s demand is likely to be price. At the end of 2012, the average entry level price for service was over $400[307]. By Q3 2015, the average had fallen to under $200, and the cheapest package was priced at under $50[308].

As of 2016, only a limited number of connectivity technologies are likely to be capable of Gbit/s service, namely Fiber to the Home (FTTH), Premise (FTTP), Basement (FTTB) and DOCSIS 3.1. FTTH is relatively rare due to the cost, but FTTP and FTTB are well suited to delivering high speeds to apartment blocks. DOCSIS 3.1 is the upgrade to DOCSIS 3.0 which enables Gbit/s speeds on cable broadband networks.

The other fiber technology, known as Fiber to the Cabinet (FTTC) is unlikely to deliver Gbit/s speeds in 2016, but an evolution of the technology known as G.FAST (also known as Fiber to the Street, or FTTS), in trial phase in 2016, should offer speeds in the hundreds of megabits per second (Mbit/s)[309], and Gbit/s (with the headline speed an aggregate of uplink and downlink speeds) by 2019, if not earlier. For carriers with copper-based networks, FTTS could offer much higher speeds over existing copper connections running into homes, significantly reducing the upgrade costs.

Indeed a relatively modest network upgrade cost is likely to be a key enabler of Gbit/s services. One major cable operator has quantified the cost to upgrade its network to be able to deliver a Gbit/s would be about $22 per home passed[310]. DOCSIS 3.1, the cable network upgrade, is 25 percent more efficient than earlier versions of DOCSIS. Operators can offers speeds that are hundreds of megabits faster without having to change the network[311].

The faster and more ubiquitous that FTTS and other fiber technologies become, the greater the incentive for cable networks to upgrade their networks, and vice-versa[312].

As average data connections get faster, we expect existing services to become steadily more bandwidth consumptive, new formerly unviable data-intensive services to launch, and new 'data-gulping' devices to come to market. Over time many data services have consumed an increasing quantity of bandwidth, rising in line with availability. Video streaming offers the clearest example of this. Its quality has increased steadily along with data connectivity speeds (see side bar: A history of video streaming). Over the past decade, video streaming services have progressed from offering 0.5 Mbit/s streams, which is inferior to standard definition (SD) television, to ultra-high 4K resolution, using 25-50 Mbit/s, or up to 100 times more bandwidth (also see side bar: A history of video streaming)[313].

320. For an example of a cloud-based video monitoring service, see Nest Support, Nest, as accessed on 10 December 2015: https://nest.com/support/article/What-are-the-pricing-differences-for-Nest-Aware-subscription-plans

321. The maximum permitted size of apps on Apple's App Store online store has increased from 2GB to 4GB.

322. See The Beauty of Inefficient Code, The Atlantic, 29 July 2010: http://www.theatlantic.com/technology/archive/2010/07/the-beauty-of-inefficient-code/60613/; iPhone, iTunes, App Store, Apple Pay, Apple TV, Safari are trademarks of Apple Inc., registered in the U.S. and other countries. Deloitte Global's TMT Predictions 2016 is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc..

323. Ukko Networks hits 507Mbps in LTE-A trial, plans Europe's fastest network, ZDNet, 12 February 2015: http://www.zdnet.com/article/ukko-networks-hits-507mbps-in-lte-a-trial-plans-europes-fastest-network/; for a comprehensive list of offerings and trials, see LTE Advanced, Wikipedia, as accessed on 15 December 2015: https://en.wikipedia.org/wiki/LTE_Advanced

324. Verizon has stated that it may have "some level of commercial deployment of 5G" in 2017; Korea plans to have a 5G trial network in 2018. See Verizon sets roadmap to 5G technology in US; Field trials to start in 2016, PR Newswire, 8 September 2015: http://www.prnewswire.com/news-releases/verizon-sets-roadmap-to-5g-technology-in-us-field-trials-to-start-in-2016-300138571.html; China, South Korea commit to 5G leadership, while Japan and US rely on private efforts, Fierce Wireless Tech, 8 June 2015: http://www.fiercewireless.com/tech/story/china-south-korea-commit-5g-leadership-while-japan-and-us-rely-private-effo/2014-06-08

325. One study found that over half of UK households expected to add at least one connected device on 25 December 2015. Source: https://www.cable.co.uk/news/ cited in Christmas Day set to place added strain on home broadband networks, uSwitch, 11 December 2015: http://www.uswitch.com/broadband/news/2015/12/christmas_day_set_to_place_added_strain_on_home_broadband_networks/

326. For example Vodafone is planning on launching Gigabit/s services in Ireland, Spain, Portugal and Italy. For more information, see Vodafone Commits to Gigabit in Europe, Light Reading, 2 December 2015: http://www.lightreading.com/gigabit/fttx/vodafone-commits-to-gigabit-in-europe/d/d-id/719615?

327. Supersonic DOCSIS: 15 Gigabit Cable 2020, 50-80 Gigabits 2030, Fast Net News, 5 September 2015: http://fastnet.news/index.php/cable/230-supersonic-docsis-15-gigabit-cable-2020-50-80-gigabit-2030

A history of video streaming: 1995 to 2015

The first Internet-streamed broadcast took place 20 years ago. It barely counted as a video stream: it blended high quality audio with a series of real-time images. Most of the 36,000 online viewers accessed the content from Internet Cafes as home connections were too slow[314].

A decade later, in 2006, a year-old YouTube was receiving 65,000 uploads a day which could then be streamed in low quality (320x240 pixels and mono audio)[315]. In 2008, quality was upgraded to 720p (entry level high definition). A year later full HD, or 1080p became available. In 2010, 4K files (2160p) became available, many years ahead of traditional TV broadcasters. A 4K upload can be at up to 68 Mbit/s[316]. In 2014, 8K was offered, albeit possibly many years ahead of the commercial availability of screens able to display that level of detail.

Video calls have also experienced a significant upgrade in quality. In 2006, video calls were typically made using aftermarket webcams attached to PCs. This year, video calling is supported by billions of smartphones, tablets and PCs, for one-on-one or one-to-many calls. The faster the data connection, the greater the number of possible participants: an eight-way video call would require a dedicated 8 Mbit/s stream.

As available bandwidth increases, we would expect it to change all aspects of communication. Instant messages have already evolved from being predominantly text-based to incorporating photos (in ever higher resolution) and video (at ever higher frame rates). Social networks, which are a variant of instant messaging, are hosting growing volumes of video views. As of November 2015, there were eight billion daily video views on Facebook, double the quantity in April[317].

It is possible that the telephone call may be replaced by a video wall, offering always-on portals to friends, or distant family or remote teams. In 2016 the video wall may be a small screen, such as a tablet, but over time, dedicated video-wall devices might become available, with a commensurate increase in data speed required.

Faster data connections have enabled high definition (HD) video-on-demand to a television set, and are likely to be a factor in encouraging purchases of 4K TV sets. As at end-2015, the majority of 4K services were via streaming.

It is likely that faster bandwidth may also create additional uses of the TV set: it is possible, for example, that the set, when not being used to watch programs or movies, may be used to display images and video, in the same way that screensavers have filled computer screens when idle. We expect it will become increasingly common to download or stream high resolution screensavers for display on TV sets, with imagery ranging from cityscapes to fireplaces, from HD views from the International Space Station[318] to live webcams from tourist hotspots[319].

Gbit/s connections may change the approach to home security solutions. Historically, connected home security relied on a call center making a telephone call to the home. Many home video camera solutions currently record on to hard drives. As uplink speeds increase, cameras are likely to stream video, back-up online, offer better resolution and higher frame rates[320]. A single HD webcam may stream at 1 Mbit/s, and as the cost of security cameras declines, they may well proliferate in homes. As their resolution increases, their network demand will likely grow too.

In addition to the bandwidth usage that is triggered by human activity, from video-on-demand to browsing, there is likely to be a growing volume of background data usage. Every additional device, from smartphones to smart lighting hubs, is likely to require online updates, be this for apps or for operating systems. Over time, these may well grow in size – for example the maximum size of a downloadable app has risen steadily over the years to reach 4GB now; the current limit on downloadable PC files is now 250 GB[321]. Every photo taken may trigger a chain reaction of back-ups to other devices and to remote hosting sites.

The more bandwidth available, the more likely people are to squander it, at least in relative terms. This is similar to the evolution of programming. When processing power was limited, coding was very efficient. As processing power steadily increased, it made less and less sense to spend time refining code such that it 'sipped' power[322]. A similar transition has happened with bandwidth: the more availability of it at the same price, the more consumption.

This prediction has focused on Gbit/s services via fixed lines to homes and premises, but by end-2020 it is possible that such speeds will also be attainable over cellular mobile connections. LTE advanced currently offers up to about 500 Mbit/s in trials, and up to 250 Mbit/s in commercial offerings[323]. Carriers that deploy 5G branded services are likely to offer Gbit/s services, and there is likely to be a mixture of trials and limited commercial launches of service in the run up to 2020[324].

Bottom line

A Gbit/s Internet connection might appear frivolous, but a decade ago some commentators may have questioned the need for a touchscreen-based device capable of transmitting data at 150 Mbit/s, with storage for tens of thousands of HD photos, video quality sufficient for broadcast, a pixel density superior to most TV sets, a secure fingerprint reader, and billions of transistors within a 64-bit eight core processor. Yet modern smartphones with this specification are likely to sell in the hundreds of millions of units this year.

While a Gbit/s connection for a single device and a single application may be overkill, consumers are likely to continue accumulating connected devices in the long term[325].

ISPs should proceed cautiously and be able to respond rapidly. ISPs that launch Gigabit/s too early, and increase speeds on all other service tiers at the same time, may encourage some subscribers to downgrade to a lesser tier. However the offer of Gbit/s service by some ISPs may oblige a rapid response by other players in the same market[326].

Device vendors and application developers should constantly review how the increasing pace of broadband speeds, or response rates, is likely to make previously unviable gadgets or services possible.

As broadband speeds rise, TV broadcasters should consider the extent to which they need to continue using traditional broadcast technologies to deliver content to homes. It may be the case that for some neighborhoods they no longer need to use satellite, cable or terrestrial broadcast to deliver programs into customers' homes.

While this prediction focuses on 2016, and the Gigabit/s era, it is most likely that the speed race will not conclude upon reaching this speed. We would expect Internet speeds to continue rising in the long term; 10 Gbit/s has already been announced, and 50 Gbit/s connections are being contemplated for the future[327].

Designed and produced by The Creative Studio at Deloitte, London. J3774