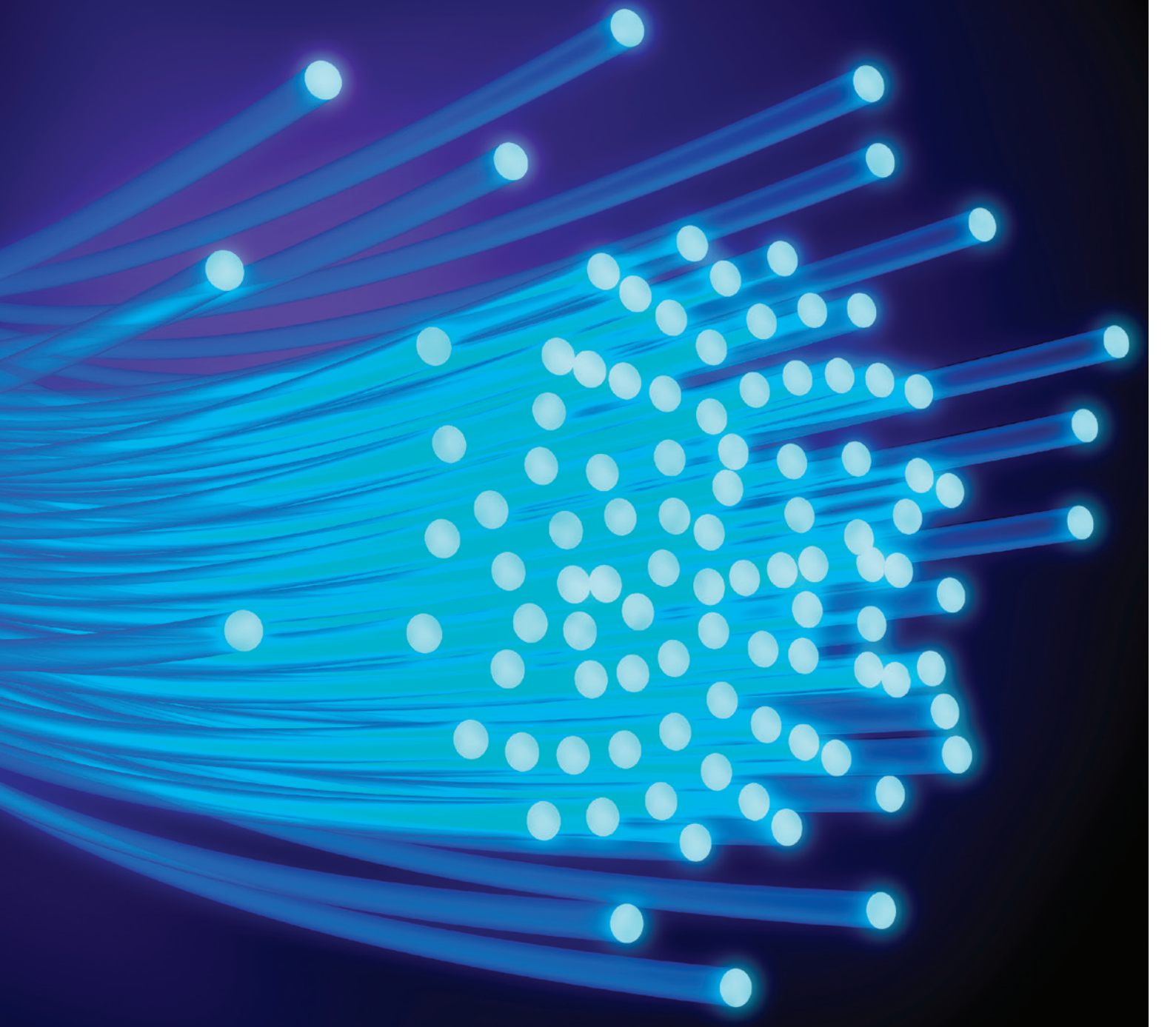
# Towards Ultrafast Britain 2030

## Broadband report

*Author: Dan Lewis*



# About the authors

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Dan Lewis has been working with the IoD since 2011 on Energy Policy. Since March 2014, his brief has been expanded more broadly to include Infrastructure, incorporating energy as well as roads, railways, airports, ports, utilities, telecommunications, flood defences, waste and local amenities. His role is to meet and engage with the business community on infrastructure and energy issues, develop and write policy papers and contribute to the media on behalf of the IoD.

Dan has been working in the public policy world and contributing to the broadcast and print media for over 10 years; originally as Research Director of the Economic Research Council from 2003-2009. He subsequently left to start two new organisations - Future Energy Strategies www.future-es.com and the Economic Policy Centre www.economicpolicycentre.com which has fostered two new platforms - www.ukcrimestats.com, the leading independent crime, property price and energy data platform by postcode and www.ukgovspending.com (in development) - a deep insight into government spending.

Prior to 2003, he worked in banking, asset management and corporate treasury in both Luxembourg and London.

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# Summary

## Key business findings from IoD Policy Voice Survey:

- 50% agree that an increase in broadband speed would encourage them to offer more flexible working opportunities to staff
- 38% agree that an increase in broadband speed would lead to greater revenues
- 34% agree that faster broadband would encourage them to invest more in their organisations
- 60% agree that faster broadband would increase the overall competitiveness of their organisation
- 77% agree that faster broadband would improve their organisation's productivity
- 30% of members store data on the cloud while 48% use their own dedicated servers and 8% used leased servers – the cloud still has some way to go

## The History

- Britain's early 21st Century communications network is still reaping the consequences of misguided anti-competitive policy decisions made by the Victorians and Edwardians in the 19th and early 20th centuries
- The telegraph, telephone and radio spectrum were all nationalised leading to absolute dominance by a single player, with no market competition
- Embedding inefficiency, unionised workforces, rising costs, taxpayer subsidies and precluding entrepreneurial activity in the leading technology of the day
- Throughout the 20th Century technology has delivered better sound, reduction in transmission costs and an increase in the capacity of data that can be transmitted
- The final mile however or local loop, that brings copper to the premise has barely changed at all for decades
- Demonopolisation and Privatisation reversing the Victorian and Edwardian decisions came 100 years later in 1981
- BT was privatised, a regulator, Oftel was set up and telecoms markets for supplies and services were progressively opened up
- The pace of demonopolisation slowed considerably under Ofcom from 2003
- The Strategic Review of 2005 was successful in creating service-based competition with local loop unbundling
- But failed to engender infrastructure competition, particularly at the fixed access level

## Today

- Line rental charges have rocketed ahead of inflation, suggesting that Ofcom was premature in lifting price regulation because competition would fill the regulatory gap
- On the plus side, Ofcom has overseen easier switching, lower costs for leased lines and opening up the mobile spectrum
- Britain has 6 connectivity chokepoints; large rural areas, not-spots and city centres, suboptimal competition, poor knowledge about the final leg of the copper network and limited knowledge about the whole network
- The current policy framework is inadequate to those challenges

## The Future

- The drivers of demand for the internet and data are huge and growing almost exponentially
- Each year sees incrementally faster broadband but much more capable devices begets 40% growth in data demand
- Video is the biggest driver at 67% of traffic today
- With HD and 4K increasingly common, this will grow much faster
- The Internet of Things promises billions more sensors all transmitting data
- Virtual Reality data demands could be even greater
- The internet is going to become a two-way immersive exchange
- Investment in the network today is short-term and incremental, unable to cater for the non-linear growth in demand that is present now

## How we compare

- Government policy has more or less succeeded in reaching its own narrow, short term goal of the best superfast broadband in Europe
- But economic activity is not evenly distributed and London is one of the worst performing capital cities in Europe for download speed, ranked 26th just ahead of Minsk
- With a global ranking of 23 for download speed
- While Fibre to the Home penetration can hardly be measured at 0.003%

- And according to Eurostat's Telecommunications CPI, prices have risen the last few years uniquely in the UK compared to other major European nations

## Competition

- The lack of competition for Broadband Delivery UK funds is very disappointing
- BT won all 44 of Phase 1 contracts and 42 of the 47 Phase 2 contracts
- Not enough was done to ensure new entrants and lower the price of the Physical Infrastructure (ducts and poles) to non-BT players
- BT's market share is growing, reversing demonopolisation progress since the 1980s
- According to Ofcom, 74% of new superfast connections have gone to BT
- While in the SME market, BT's share is 50%, with the next nearest player only 5%
- Left unchanged, operators will find it hard to do much more than resell BT's Generic Ethernet Access
- To have a more resilient telecoms network, the UK must aim to retreat from key dependency on one future network investor
- The new Universal Service Obligation of 10 Mbps by 2020 will make a very minimal impact on the economy

## Key Foreign experience

- Britain can learn most from two countries that have had the most enlightened approach to solving the connectivity challenge
- Lithuania from 2004 enforced pole and duct sharing, very low access costs and embraced infrastructure competition, leading to 61% of new networks built by AltNets
- It now has amongst the fastest speeds in Europe and with high fibre to the home penetration can easily upgrade to much faster network speeds
- New Zealand in 2011 structurally separated New Zealand Telecom into Chorus and Spark creating additional value for existing shareholders
- And creating additional investment in the network that the incumbent would not have been able to deliver

## The Road Ahead

- There is room for more than one investor in a future Openreach
- Under great pressure Openreach performance has improved, but not enough to silence its major users
- The UK paradoxically has the leading internet economy in the G20
- And some of the worst coverage and speeds of any industrialised nations
- Incremental improvements based on the existing copper network will not close the gap or unleash infrastructure competition
- Gigabit speeds open up dramatic improvements that will come from virtual reality, self-driving cars and always present and on video cameras
- Fibre to the premise has to be a big part of the solution
- As does a longer term near universal target of 10 Gbps by 2030 and bringing in pension funds to invest who have longer term time horizons

# Introduction

There are times in economic history when making the right decision has long and lasting repercussions for an entire nation and getting the information revolution right is one of those seminal decisions. The good news is that Britain leads the way in embracing the digital revolution. Some 12.4% of our GDP in 2016 is expected to come from the internet economy, more than double our closest competitor in the G20 - South Korea, which sits at 8%.[1] Silicon Valley may be the mecca for start-ups in the shape of Silicon Valley, but the internet is set to account for only 5.4% of the US economy this year. Equally impressive, some 23% of all transactions this year are expected to take place online, streets ahead of our nearest competitor.[2]

The entrepreneurial revolution is not limited to digital products, of course, but for start-ups and larger firms alike the internet can represent a fast, easy and cheap route to existing and new markets. With the world's most advanced internet economy permeating every area of British life, it provides opportunities even for non-digital firms to start, operate and flourish. The fashionable firms may be in financial technology in east London, but even crofters need to fill in online tax returns. The infrastructure that surrounds the digital economy – broadband and mobile internet – is now the fourth utility. Its importance cannot be overstated.

Yet Britain lives a paradox. It has some of the worst broadband speeds in the developed world, some of the least reliable broadband in rural and urban areas like, and patchy mobile coverage. Our digital economy has grown in spite of, not because of, our digital infrastructure.

Our digital infrastructure therefore needs improvement now, but that is not enough. We must attempt to future-proof it for increased demand in the future.

But no analysis of Britain's connectivity woes is complete without a historical understanding of how we got to where we are today.

# How we got here: a short history of the telecoms network

Britain's telecommunications network and resulting broadband and connectivity issues did not appear overnight. They are the genesis of nearly two centuries of evolution and the compound impact of decisions made long ago. So what were they and how did we get here?

As the first modern industrialised nation, built on trade and mostly living in urban centres, enabling lower cost short range communications, the United Kingdom stands out as being the first to experience the full range of political and public difficulties in the meteoric rise of telecommunications in the nineteenth, twentieth and twenty-first centuries.

The early drivers of the nascent telecoms market in the 1840s were the railway companies. The railway telegraph electric signalling system, sometimes known as the "Victorian Internet"[3], boosted railway capacity by creating a signalling system, reducing blocked lines, the need for double tracks and preventing many accidents. Crucially, unlike on the continent, the private telegraph companies did not operate under state ownership and/or under the Post Office and the government did not interfere in its running. It was soon realised that the network could be used commercially to transmit messages and in particular, news. By 1868 the telegraph network comprised some 91,000 miles of wire and sent 6 million messages annually[4]. These messages or telegrams were known for their brevity – telegraphese - and not unlike today's tweets on twitter. Telegraph companies were very much the technology unicorns of their day, the most dynamic and entrepreneurial sector of their time.

However, the private telegraph companies – by the late 1860s, had arguably become an oligopoly of 5 companies[5], with often incompatible wires, circuits and regulations. They were Electric and International Telegraph, British and Irish Magnetic Telegraph Company, United Kingdom Electric Telegraph Company, London District Telegraph Company and Universal Private Telegraph Company. And they were not without their enemies.

[1] Boston Consulting Group, *The Internet Economy in the G-20*, 2015

[2] Ibid

[3] See "The Victorian Internet" by Tom Standage, published in 1998

[4] See BT Archives Information "Private Telegraph Companies"

[5] See "Victoria Telegraphy before Nationalisation" by Professor Simone Fari, published September 2015

The deemed success of the Uniform Penny Post Campaign that led to a single charge of 1 penny for posting a letter anywhere in the UK from 1840 with a Penny Black stamp, set a precedent for the accumulation of Post Office power in the name of universal service. The Post Office was able to claim a historic legal monopoly right, for any type of communications that involved sending and receiving. The Post Office wanted control and had already started purchasing the lines. Another constituent who were unhappy with the Telegraph companies was the Press. They were very dependent on telegrams for news reports and were to a large extent, captive customers, with no alternative. Many others complained about the lack of universal coverage (not-spots of the Victorian era), high tariffs by international comparison, delays and inaccurate transmissions.

It would be wrong though to assume that all parties were in favour of nationalisation. The Telegraph companies argued of course for their continued independent existence. The railway companies protested much more so and not just because they were the major shareholders. They feared that the railway companies themselves would be the next wave of nationalisation. And some others, although not many, worried about freedom of speech and privacy in a government owned communications network.

There was also a wider issue about whether universal service should be an aspiration for telegraphy at all. Telegraph companies saw themselves more as an exclusive service for medium to high-end numbers-focussed professionals who required speed. The information they required was usually about prices – people like ship-brokers, stockbrokers, mining agents, bookies and merchants of perishable goods according to a report for the Select Committee on Telegraph Bill 1869. A telegram was just not the same beast as a letter in language, length or time sensitivity.

Britain was also under some pressure from the European continent to acquiesce, surrender sovereignty for future influence and join the world's first supranational government organisation; the Telegraph Union. In a faint echo of the EU's Single Market, it established technological standardisation and norms and tariff uniformity across the international network. But you could only become a member if the Telegraph service was run by the State. That didn't matter so much when most telegram traffic was national, but there was an ambition and expertise for the UK to lead the world in submarine cables, changing Britain from being at the edge of the emerging European telegraph network, to potentially a hub. This is actually not unlike Britain has become today a hub for liquefied natural gas trading or transatlantic airline traffic because it has acquired the infrastructure to join up transatlantic trade.

As with all nationalised monopolies, received wisdom could justify them by aiming to achieve greater economies of scale, a universal service and standardization.

All of these are laudable end goals.

But as the leading academic expert on Victorian Telegraphy, Simone Fari[6] argues, despite the introduction of a flat one shilling charge per telegram, *"...ordinary costs grew well beyond what had been foreseen . . . over the long period the cost of the personnel (partly inherited from the telegraph companies and partly transferred from the Post Office) went out of control. It is well-known today that one of the main defects of a public monopoly is the ever-increasing rise in the cost of work, often encouraged by the string-pulling strategies of the strongest unions within the structure. If it is true the nationalisation of the telegraph service was the first in modern times and therefore there were no previous examples to look to, it is also true that the country had at hand the example of the Post Office itself, which in spite of its efficiency, had been registering an increase in personnel costs for decades. It is surprising, therefore, that during the long and intense debates preceding nationalisation, the possibility had never been mooted of rising work costs leading to problems of efficiency".*

[6] Simone Fari is an Assistant Professor of Economic History at Grenada University in Spain and author of "The Formative Yars of the Telegraph Union" and "Victoria Telegraphy Before Nationalization"

For all that, Disraeli's government nationalised the companies with the 1869 Telegraph Act handing the Postmaster General all of the inland telegraph systems operated by not just the telegraph companies and the railway companies. Clearly, little was known about competition at the policy level in 1870. The nationalisation cost the government a little over £7 million – a generous settlement that arguably financed Britain's leading role in putting down the submarine cables around the globe.

Given such a situation in the 21st Century, ways would have been found to regulate the oligopoly, the state-owned Post Office would not have been allowed to crowd out private Telegraph company investment with government cash (illegal state aid) and Adverse Effects on Competition and Barriers to Entry would have been identified a plenty.

However the long-term impact that reverberates still through to today, was the creation of absolute dominance by one player, with no market competition to hold in check the underlying costs or drive the requirement for efficiency. Only from 1979 did a British government see fit to sell-off, open up to competition and regulate and start to undo 100 years of monopoly allocation of capital.

Technology and innovation did not stop advancing however[7]. Local systems of public telephony first appeared in 1879 in London. The move away from iron and steel to copper wires with the invention of hard-drawn copper made it possible for long distance overhead lines. This opened up a new market for voice communications between towns. A further Telegraph Act in 1892 nationalised the provision of the long distance Trunk network.

Before then however, a flourishing of new telephone companies emerged in the 1880s across the country. The first was in London in 1881, in fact the first in Europe, "The Telephone Company". It later became the National Telephone Company and started to amalgamate the smaller companies under its wing in the 1890s. In 1912, the government nationalised the National Telephone Company, putting it under the control of the General Post Office.

Nor did the centralisation of communications technology under a monopoly stop there. The 1904 Wireless Telegraphy Act effectively nationalised the radio spectrum and levied a registered license fee on radio communications users obtainable from the General Post Office. This was the start of a process that would later lead to the establishment of the BBC in 1922 and the license fee.

[7] See "A Short History of Telecommunications Transmission in the UK" by Keith Ward, published in the Journal of the Communications Network, Volume 5, Part 1; January – March 2006

## Technology developments

Throughout the 20th century, a tremendous amount of work was done to increase capacity of the backbone network of the UK's telecom infrastructure and enable international connections while the most local part of it, known as the local loop or the last mile, the wires that run from poles and cabinets to the premise remained largely unchanged. The big breakthroughs were the improvements in sound quality, the reduction in the cost of transmission and the increase in the capacity of data that could be sent, thanks to the increase in radio channels and coaxial cables. Further innovations came with the use of microwave radio systems to deliver voice and TV broadcasting. The BT Tower was built tall enough to broadcast TV, voice and radar microwaves over the Chiltern Hills and did so until the 1980s when replaced by a national optical fibre network. Through BT, the UK was actually a very early adopter of optical fibre and in 1981 had the then world's longest fibre link between London and Birmingham.

## Policy developments

Throughout the course of the 20th century, as the communications industry grew, in post, broadcasting and telecoms, the GPO was progressively broken into separate but largely still monopolised constituents. For radio broadcasting licences, demand was very high, with nearly 100 licence applications in 1922 alone from radio manufacturers. Nervous of radio interference and much more comfortable with a monopoly culture, a sole broadcasting license was awarded by the GPO to a group of radio manufacturers represented by the British Broadcasting Company who would then finance it with a license fee and a tariff on wireless sets. Demand grew fast (including for unlicensed pirate radio), particularly for news not available from newspapers during the National Strike of 1926. The original BBC was later reformed as the British Broadcasting Corporation in 1927 under Royal Charter, led by John Reith, taking with it the broadcasting responsibilities and revenues of the GPO.

Table 1

### Timeline of BT demonopolisation[8] - from 1981-2000

| Date | Event |
|---|---|
| 1981-January | Permission given for new independent suppliers of telephones |
| 1981-February | Mercury consortium licensed and allowed to compete across all telecoms services |
| 1981-June | In competition to BT, independent suppliers are permitted to sell telephones |
| 1983-May | Cellnet and Vodafone given licenses to deliver national cellular radio networks |
| 1984-August | Office of Telecommunications (OFTEL) established to promote competition and act in the interests of consumers within the telecommunications market through regulation |
| 1985-January | BT's monopoly on the supply and maintenance of the prime telephone ended |
| 1986-December | BT's sole ownership of the right to supply and maintain extension wiring and sockets repealed |
| 1987-October | Windsor Television signs a deal with Mercury to offer a Mercury phone and cable TV in one package. Mercury also permitted to build call boxes in competition with BT. |
| 1987-May | BT's monopoly on payphones in private premises is ended |
| 1991-March | An end to the Mercury BT duopoly (i.e. opening up of the market to more than 2 players) and the enabling of international simple resale (ISR); ISR reduced BT's share for the UK market for international calls to 50%[9] by 2001. BT also had the telephone numbering scheme removed from their responsibility to OFTEL, enabling number portability. |
| 1993-July | First broadband cable TV licences modified to allow cable TV companies to offer telephone services |

[8] See "A short history of telecommunications in the UK" most text here taken from the BT website http://home.bt.com/news/bt-life/history-of-bt/a-short-history-of-telecommunications-in-the-uk-11363870786446

[9] See "Commuications Liberalisation in the UK: Key Elements, History and Benefits" – published by the Department for Trade and Industry, March 2001.

Table 1 (continued)

| Date | Event |
|---|---|
| 1993-September | Vodafone launches GSM service |
| 1995-October | Oftel publishes proposals to boost competition for directory of enquiry information and other data products |
| 1996-January | Oftel orders BT to stop unfair cross-subsidy of its Managed Networks Services business and predatory pricing in value-added data services |
| 1996-December | Oftel decrees that BT modify its payphones so that Mercury customers can access Mercury by dialling 133 |
| 1997-March | Oftel orders BT to drop its "Winback" marketing campaign for failing to obtain their permission to do so at below cost and for unduly targeting other operators customers |
| 1997-May | Oftel rejects BT proposal to offer all schools affordable access to the "information superhighway" as it would have in effect excluded all Internet Service Providers other than BT |
| 1997-September | Oftel orders BT to stop cross-subsidising its chargecards from other areas of its business |
| 1997-October | Oftel calls for sharing of telegraph poles and cabling ducts between all telecom operators |
| 1997-December | BT ordered by Oftel to stop running their call minder service in a way that disadvantages competitors |
| 1998-August | Oftel announces reduction in BT's payphone access charge, citing the pass-through of too many of BT's operating costs |
| 1999-June | Oftel's DG, David Edmonds, announces that BT's Talking Pages new call completion service appears to be anti-competitive and must be withdrawn |
| 1999-August | At Oftel's insistence, BT Cellnet agrees to let third parties market their own pre-pay packages to customers on its network |

The Post Office Act of 1969 reconstituted the GPO as a public corporation known as the Post Office, rather than a Department of State overseen by a cabinet level Minister, the Postmaster General.

The 1981 British Telecommunications Act was the first time in over 100 years that any government had seen fit to roll back the monopoly powers of the Post Office and set in motion a near continuous period of demonopolisation that continues to this day. The starting point was to separate the telecommunications and postal businesses, establishing BT as a public corporation, later to be privatised and sold off to the public as a Plc in 1984.

Many of these measures taken by the government and Oftel were small, but they should not be underestimated for their long-term impact. And whilst the UK led the way – or rather was alone - in demonopolisation of the telecoms market in the 1980s, it would be wrong to underplay the growing international dimension in the 1990s. EU telecommunications markets were fully liberalised from 1998 and the World Trade Organisation brought into force the Basic Telecommunications Agreement which established competition and globalisation of the industry as the norm. Crucially, a Local Loop Unbundling Regulation was handed down from the European Commission and came into force from January 2001, requiring all dominant parties across Europe to provide third parties with unbundled access to their Local Loops – the ability to install equipment and sell services from the exchange to customers at the end of the network. One other event that fell between the winding down of Oftel and the creation of Ofcom was BT exiting the mobile phone market, when selling BT Cellnet in 2002.

# The OFCOM Era 2003-Present

OFCOM formally came into being at the end of 2003, as a merger of 5 separate regulators; the Broadcasting Standards Commission, the Independent Television Commission, the Office of Telecommunications (Oftel), the Radio Authority, and the Radio Communications Agency. In 2011 it later took over the role of the Postal Services Commission.

# Strategic Review of Telecommunications 2005

Ofcom's Strategic Review set the tone and shaped the fast-emerging marketplace up until today. The review posed five questions and reached the following conclusions;

i) **In relation to the interests of citizen-consumers, what are the key attributes of a well-functioning telecoms market?** Ofcom decided that businesses and consumers needed much deeper competition, down to the level of infrastructure to deliver more choice, innovation and new services as well as low prices.

ii) **Where can effective and sustainable competition be achieved in the UK telecoms market?** Ofcom concluded that fixed telecoms had economic bottlenecks in parts of the network that were not open to competition and that regulation should promote competition through equality of access.

iii) **Is there scope for a significant reduction in regulation, or is the market power of incumbents too entrenched?** Ofcom viewed that there was potential for deregulation if equality of access to bottleneck parts of the network led to a lessening of Significant Market Power (SMP).

iv) **How can Ofcom incentivise timely and efficient investment in next generation networks?** Ofcom was concerned that regulation should not disincentivise efficient investment and that a challenge remained in how to get incentives right for access networks and as copper switched telecoms become due for replacement.

v) **At varying times since 1984, the case has been made for the structural or operational separation of BT, or the delivery of full functional equivalence. Are these still relevant questions?** Under threat of being referred to the Competition Commission by Ofcom, BT gave a set of undertakings that 3rd party operators would have access to BT's network, under the name of a new company that would be called BT Openreach, still owned by BT, but functionally separate. This access later became more widely known as local loop unbundling.

## Other measures since 2005 by Ofcom

Since the Review, Ofcom has been very busy in what could be described as a period of high frictional growth. With regard to broadband and related telecoms infrastructure, there have been several main developments.

**Overseeing commercial disputes between third parties often involving BT and sometimes between other players**. In a typical year there would be several of these and occasionally Ofcom would initiate its own investigation.

**Reviewing Openreach local loop unbundling access pricing and wholesale line rental pricing once a year.** Ofcom sets these because of the Review's finding that BT has Significant Market Power in these areas. Ofcom currently regulates six prices in this domain;

i) **Metallic Path Facility -** MPF rental, the price at which third parties like Sky can install equipment at the exchange and sell voice and broadband services to sell downstream to customers.

ii) **Shared Metallic Path Facility -** SMPF rental, the price at which a third party Internet Service Provider (ISP) can offer broadband services over the copper network.

iii) **Wholesale Line Rental -** WLR is the price that gives access to third parties to offer own brand telephone services without needing to own a network.

iv) **WLR Transfer –** this is the price at which WLR users can gain a new customer from another provider. Information is provided about the customer's existing line setup so it can be mirrored if necessary.

v) **MPF Single Migration –** the price at which third parties can switch customers on to their own voice and broadband services.

vi) **SMPF Single Migration/Provide –** the price at which an ISP can transfer in a new customer or connect up a customer in a new premise.

**Easier switching –** Ofcom has overseen a big drive to speed up, simplify and lower the cost of switching which was complex and non-uniform between suppliers across the Openreach network. Today it is possible to switch broadband suppliers by only informing the new supplier who oversees the whole process.

**Leased lines –** this started with Oftel but there has been a continued push to lower the cost and create more competition for and across leased lines – a dedicated line that might be required for example for a High Street Bank's cash machines. Leased lines are deemed to be operating in a disaggregated market because they are very customer specific in their requirements and pricing.

## Opening up the mobile spectrum

Today the UK has 7 spectrum bands that mobile phone companies operate in; 800MHz, 900MHz, 1800MHz, 1900MHz, 2100MHz, 2.6GTHz and 3.5GHz. Generally speaking, the lower the frequency, the greater the geographical coverage and the ability to maintain a signal indoors. On the other hand, the higher the frequency, the more potential there is for an operator to deliver broadband and data but over a much smaller area, ideally within cities or densely populated areas. So mobile phones first operated in the lower ranges and as the requirement for 3G and now 4G smartphones grew, the higher spectrums became necessary. The lower spectrum of 800MHz had a recent boost in capacity for mobiles, as this used to be used for analogue terrestrial TV and was then made available post the digital switchover. Under the compulsion of an EC Directive, Ofcom has played a major role in opening up the spectrum to competition, allowing the 900 and 1800MHz bands to be used for 3G as well as 2G from 2008. In 2011, Ofcom also allowed trading of the spectrum bands between players from 2011, which created a more efficient use of the spectrum, pricing scarcity more efficiently. EE was also granted permission in 2011 by Ofcom to use part of its 3G spectrum to run 4G services, making it the first 4G provider. There was and continues to be a lot of wholesale trading of spare capacity that allows the 4 main players Vodafone, O2, EE and Three to sell on bandwidth to the likes of Virgin, TalkTalk, Lebara and Tesco who do not own any mobile infrastructure. In October 2015, BT was given the green light by the Competition and Markets Authority to purchase EE[10] for £12.5 billion.

## Proposals to open up BT's Dark Fibre for more competing services

Much energy and political capital since 1984 has been expended on creating more competition for telecom services at the retail level. One area though that appears to have been left behind is the market for leased lines, currently worth £2 billion a year which could be improved with greater use of "dark fibre". Dark fibre is optical fibre infrastructure not in use, nearly all of which is owned by BT Openreach. There is always surplus capacity in fibre as it makes sense to overbuild to future-proof against future demand and additional capacity is created by advances in data compression technology. However this spare capacity remains dark when it is not used, because no light is being flashed through it to transport data. Last year, Ofcom consulted [11] on how it would be possible to make more available the dark fibre and increase competition in the leased lines market. Ofcom proposed a dark fibre access obligation, which requires BT to provide third parties with unlit optical fibre circuits, enabling them to provide leased line, backhaul and other services, using their own electronic equipment.

[10] EE was known as Everything Everywhere, a joint venture of Orange and T-Mobile, now owned by BT which bought it for £12.5 billion in 2015.

[11] See http://stakeholders.ofcom.org.uk/consultations/llcc-dark-fibre/

# 2015 Strategic Review of Communications

In March 2015, Ofcom announced a new Strategic Review, which is due to report at the end of February 2016. In Ofcom's own words, it was due to report and take action on three areas in particular (listed below in their own words) and so set the framework for the next 10 years:

1. Ensuring the right incentives for private-sector investment, which can help to deliver availability and quality of service;
2. Maintaining strong competition and tackling obstacles or bottlenecks that might be holding the sector back; and
3. Identifying whether there is scope for deregulation in some areas.

In July 2015, Ofcom produced a discussion document that went further outlining 4 possible futures;

1. **Continue with the current approach.** We may conclude that the current strategic regulatory framework remains appropriate, and that any concerns can be fully addressed through the normal cycle of market reviews, or via existing dispute resolution mechanisms.
2. **Strengthen the current model of functional separation.** Under this approach we would address any concerns with the current regulatory settlement, either by variations in the existing BT Undertakings, or by new regulatory conditions set within the European Framework. Examples might include revisions to the Openreach boundary; more detailed monitoring and enforcement of cost allocation rules; charge controls that contain stronger incentives to improve quality of service; and more severe penalties for sustained non-compliance.
3. **Consider structural separation.** This has the potential to deliver benefits, since it would address BT's underlying incentive to discriminate against competitors, and enable a simplified regulatory framework. It may also increase Openreach's management focus on, and control over, network investment decisions and performance issues. However, to the extent those issues arise from a lack of competition to Openreach, it may not fully address them. It would be an intrusive and complex intervention both for BT and the rest of industry, with substantial implementation challenges. It would also require ongoing regulation to guard against excess returns by the structurally separate upstream 'monopolist'.
4. **Substantial deregulation and greater reliance on end-to-end competition.** Access-based competition can be effective in promoting competition downstream of an access bottleneck, but is unlikely to drive improved performance in relation to the access bottleneck itself. Better performance by Openreach may therefore come through us encouraging a greater degree of direct end-to-end competition, by being more selective as to where and how we apply access remedies. However, this can result in increased costs, and therefore higher prices, if networks are duplicated. We have seen a variety of models internationally, delivering a range of different outcomes.

Before Ofcom publishes its deliberation, it's hard to judge which way they will go. But there have been two very prominent comments by key people.

In late September 2015, Ed Vaizey, Minister of State at the DCMS and responsible for the Telecoms brief, told the FT he was *"a sceptic"* about the need to split BT from Openreach. *"I think full separation would be an enormous undertaking, incredibly time consuming [and have]*

*lots of potential to backfire . . . Ofcom is looking at it, I am a sceptic but we will have to see what Ofcom comes out with."* Then adding, "*We would go with the trend of the [Ofcom] review,"* but "regulations have proved very effective" so far [12]. These comments were not well-received by the companies calling for a break-up of BT, as they felt it was a prejudicial intervention by a Minister during an Ofcom consultation.

On the other hand, Sharron White, Director General of Ofcom, told the BBC in December 2015 "I think there will be change," she tells me. "We're looking at a number of options, but I think it is very unlikely we will conclude that the status quo which has worked over the last 10 years is where we are likely to be over the next decade."

# Where we are now and how it works

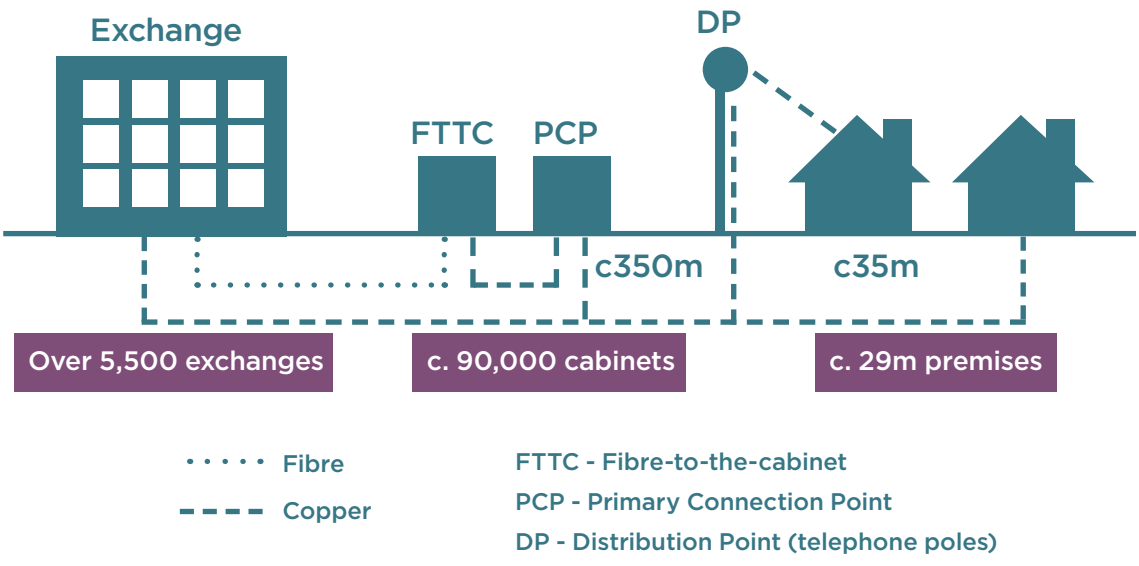
Beyond the left of Figure 1, data is transmitted from the Exchanges to one of 9 internet exchange points dotted around the UK (3 in London, 2 in Manchester, the others in Brighton, Cardiff, Edinburgh and Leeds) and from there via mostly undersea cable (some satellite) to around the world via the global carriers like AT&T. Alongside and connected to this network via cable to the exchanges, are approximately 52,500 mobile base stations or masts, supporting 90 million UK mobile phone subscriptions[13]. Finally, there are several thousand satellite broadband subscribers in the more remote regions of the UK who connect via satellite to internet exchange points.

[12] See http://www.ft.com/cms/s/0/cbe4900c-6601-11e5-a57f-21b88f7d973f.html#axzz3wvx12Auy

[13] See http://www.mobilemastinfo.com/base-stations-and-masts/

Figure 1

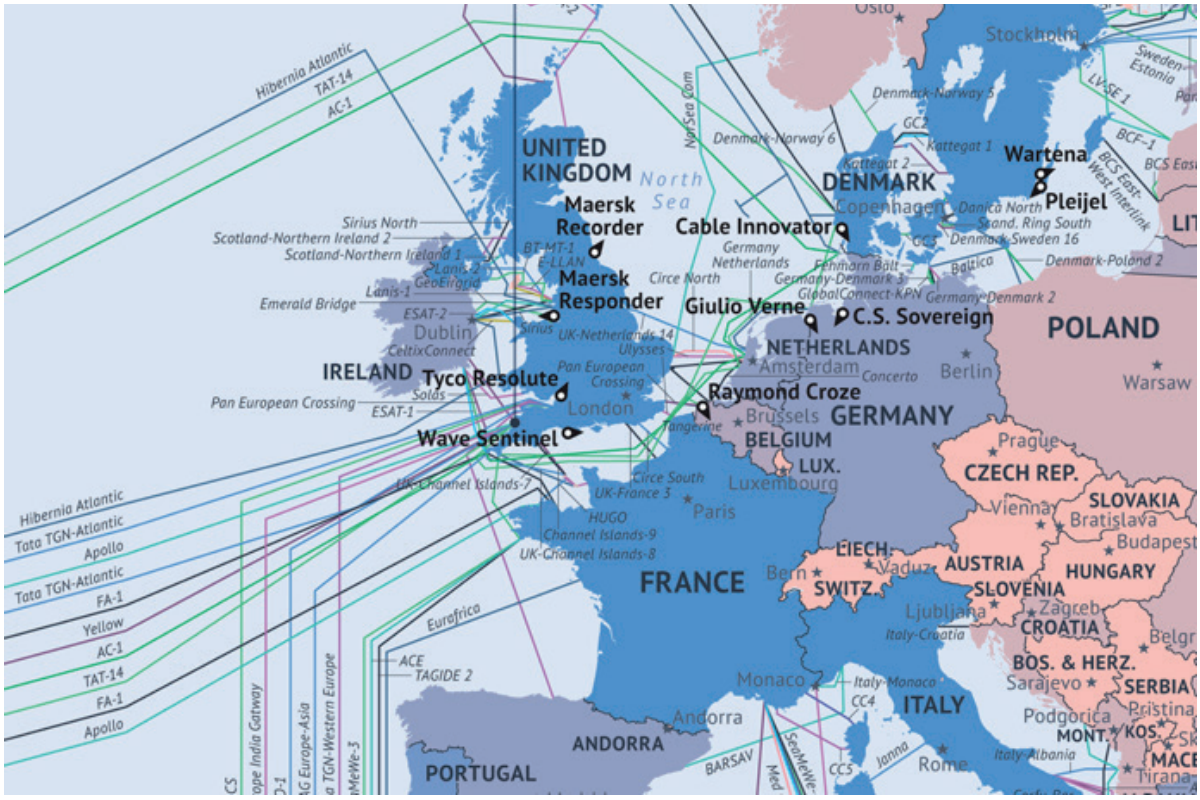
## Broadband Infrastructure in the UK




Source: BT

Figure 2

## Submarine data cables around the UK[14]




[14] See https://gigaom.com/2014/01/29/heres-what-the-internets-arteries-look-like-in-2014/ - there are approximately 300 and not all are used or lit.

## How and what to compare in connectivity

- **Download speed** is measured in megabits per second and is the speed at which data is downloaded to a computer or device.
- **Upload speed** is also measured in megabits per second and is the speed at which data in transferred from a computer or device to the internet.
- **Latency** is the speed measured in milliseconds at which a chosen action on a device is processed on the internet and is a measure of network efficiency, capturing how long it takes to transmit a packet of data.
- **"Jitter"** is a subset of latency and describes the volume of dips and spikes in packets of data delivered from one computer to another held up by some momentarily busy part of the intervening network infrastructure. It is particularly important in low latency dependent computational tasks like video gaming. Jitter free would be a consistent flow of data and no sudden changes in a video game.
- **"Buffer"** rate is a measure of when live streaming video, exceeds in quantity what the broadband network speed can provide and the video has to buffer to catch up. Before recent superfast broadband upgrades, this used to be common on YouTube and iplayer.
- **High or Low Contention –** speed can slow down as a larger number of people in a local vicinity log on, at a certain time, sharing the same local network infrastructure and reducing its capacity to serve individual households.

- **Line Attenuation -** this is a measure in dB of how much the signal degrades between the modem and the Digital Subscriber Line Access Multiplexer (DSLAM) which is usually installed at the Exchange. The higher the dB, over a longer distance, the lower the throughput of data. E.g.

1.0km = 13.81dB = 23Mbit

5.0km = 69dB = 2Mbit

# Where are Britain's connectivity chokepoints?

## Large Rural areas

Broadband: According to Ofcom's Connected Nations Report of December 2015, 63% of rural areas are without superfast broadband, defined as having a download speed of 30Mbit/s or more. Today about 1.5 million premises – about 48% of all rural premises – are not even able to access speeds of 10Mbits/s.

Mobile: for mobile coverage, the UK still lags far behind in rural connectivity in 2, 3 and 4G with particularly poor reception indoors. Just 46% of the countryside is able to access 4G.

Figure 3

### Superfast, slow and slower

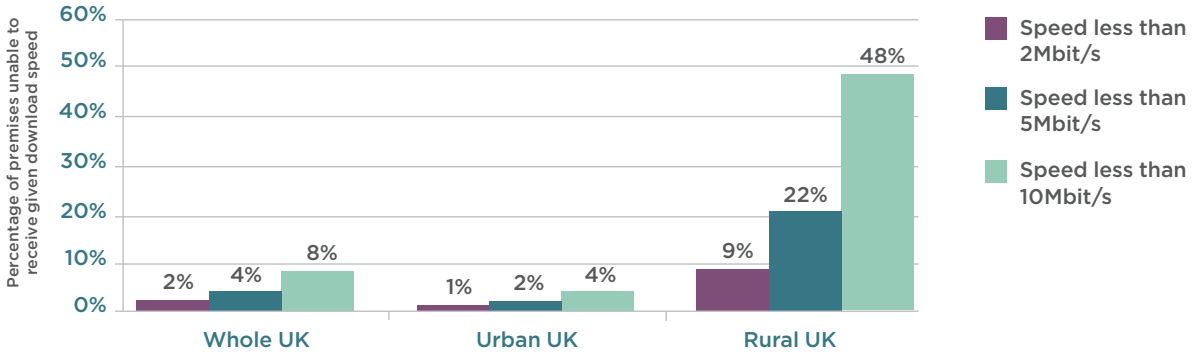



Table 2

### 2G and 3G combined for Voice Network Coverage

| | None of the voice networks have coverage | Some, but not all voice networks have coverage | All voice networks have coverage |
|---|---|---|---|
| **Outdoor premises coverage** | | | |
| Urban | <1% | 1% | 99% |
| Rural | 3% | 25% | 72% |
| **Indoor premises coverage** | | | |
| Urban | <1% | 9% | 91% |
| Rural | 13% | 57% | 31% |

Source: Ofcom analysis of operator data

Table 3

## Outdoor mobile coverage from all operators in the UK and regions:

| | PERCENTAGE OF PREMISES COVERED | | | | |
|---|---|---|---|---|---|
| Technology (coverage threashold) | Scotland | England | Wales | Northern Ireland | Whole of UK |
| 2G (-81dBm) | 90% | 94% | 84% | 83% | 93% |
| 3G (-100dBm) | 79% | 91% | 67% | 73% | 88% |
| 4G (-115dBm) | 37% | 50% | 20% | 0% | 46% |

Source: Ofcom analysis of operator data

## Not-spots and city centres

A not-spot is an area not covered by a fixed or mobile network. In reality, most not-spots are partial not-spots as they tend to have one or the other. As well as remote corners of rural UK having no mobile or broadband coverage, partial not-spots can also occur in city centres, such as the constituency of the Cities of London and Westminster. Despite having one of the densest and most successful central business districts on earth, the area has limited fixed broadband coverage because of the Council's restriction on additional green cabinets and the lack of cabling space which is taken up by exchange only lines serving sole business customers. An exchange only line is not connected via a green cabinet but goes direct to the exchange.

## Suboptimal Competition

As pointed out earlier in this paper, the early years of Oftel were very much geared to creating competition where there was none. Whilst Ofcom has done much in the intervening years to open up previously closed markets, BT's market share appears to be increasing.

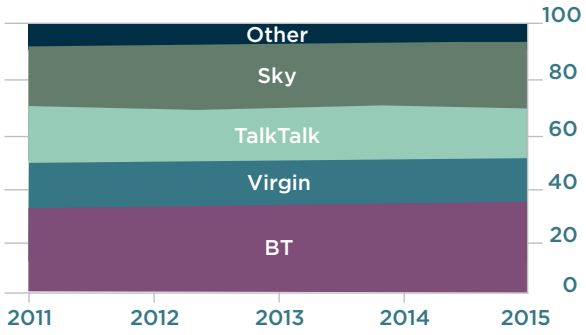
When surveyed, IoD Policy Voice members actually had a much larger market share given over to BT at 53%, with the next competitor, Virgin at just 9% followed by TalkTalk at 5%.

Local loop unbundling has been successful in increasing the quantity of standard broadband providers (up to 17 Mbps), 93 according to one source[16], albeit not all simultaneously available in one location[17]. However there are only around half as many providers of superfast broadband; dominated by BT, TalkTalk, Sky and Virgin Media. And the tiny market share of the non-Big 4 is declining. This alone ought to put into perspective the much maligned Big Six Utilities which have lost 10% market share to the smaller suppliers over the last 2 years, to 86%[18], during which the Competition and Markets Authority investigated the lack of competition in the energy suppliers' marketplace.

Of those consumers upgrading to superfast broadband, according to Ofcom, at least 74%[19]of the upgrades have gone to BT, compared to 40% for all connections. Moreover, in the SME market, BT's retail share is a commanding 50%[20], with the next nearest player only having 5%.

Figure 4

### UK Broadband Market Share in Percent[15]




[15] See http://www.ft.com/cms/s/0/215cc6da-1b52-11e5-8201-cbdb03d71480.html#axzz3wq5jDU4S – source Citi

[16] See http://www.ispreview.co.uk/isp_list/ISP_List_Fixed_Line_Broadband.php?page=1

[17] BT claims to have over 500 CPs accessing its networks via Openreach

[18] See http://uk.reuters.com/article/uk-britain-energy-utilities-idUKKCN0RM2TT20150922

[19] See Ofcom's VULA Margin Final Statement of March 2015 http://stakeholders.ofcom.org.uk/consultations/VULA-margin/statement/, pdf page 27, paragraph 3.55. Based on BT having more than 2.5m retail superfast broadband customers and Openreach connecting approximately 3.4m premises.

[20] These figure are cited in the June 2015 submission to Ofcom entitled "TalkTalk comments on Ofcom Terms of Reference" to the Ofcom Strategic Review of Digital Communications

In a time of deflation, in the last few years, consumers were surprised to see BT and others increasing line rental charges well above the level of inflation, easily outstripping rises in energy bills. Line rental is often bundled and has to be paid for by non-BT and non-fixed line users who may only wish to have broadband.

Ofcom's decision then in 2006, to lift price controls to limit the increase of line rental costs, citing increased competition, no longer requiring regulation, therefore seems premature.

This rising market share of the lead incumbent has emboldened critics of the government's tax-funded programme to roll out broadband faster across the whole UK. Some commentators feel this ongoing increase in market share would not have been possible if BT had not won all 44 of the contracts for Phase 1 to enable 90% of the country to have access to superfast broadband by 2016. For the Phase 2 contracts, to reach 95% of the country by the end of 2017, BT has won 42 of the 47 contracts. Phase 3 appears to be much more open thus far, both in diversity of suppliers and technology deployed but it is a much smaller segment. As Stephen Timms MP opined in an October 2015 Commons debate on broadband[22], the structural design of the auction for broadband contracts, unlike with 3G in 2000, failed to make sure that there would be a new entrant, instead handing all the money to BT, *"the consequence today is that BT has Ministers over a barrel"*.

Overall this has led to some fears of impending re-monopolisation in fixed access (the space between the cabinet and the premise), which according to a research note by Citi[23], *"is potentially negative long term not just for consumers, but also for investors, who may as a result face an increasingly interventionist regulatory regime over time"*.

This concern of rising regulation was recently echoed in research from Redburn, which showed that BT has substantially higher GEA prices than Deutsche Telekom or Telecom Italia, anticipating a regulatory intervention to lower the price.

[21] See Redburn October 2015 submission to Ofcom

[22] See http://www.publications.parliament.uk/pa/cm201516/cmhansrd/cm151012/debtext/151012-0002.htm#15101217000001

[23] See July 2015 Citi Research Note entitled "Letter to Ofcom: Do you Really Want to Encourage Infrastructure Investment?"

Figure 5

## BT Line Rental Charges[21]

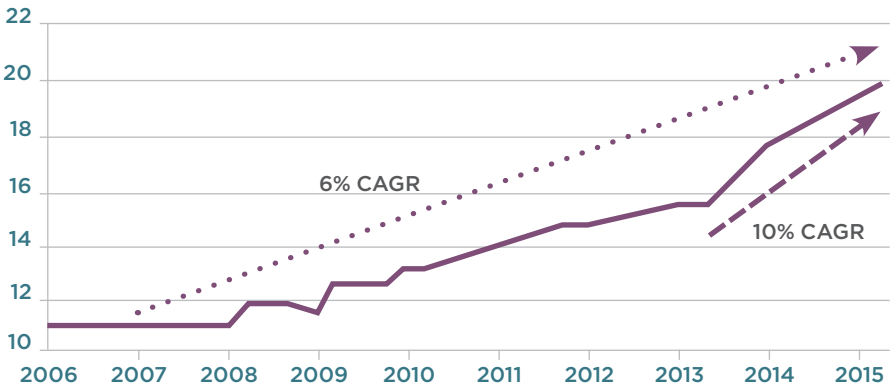
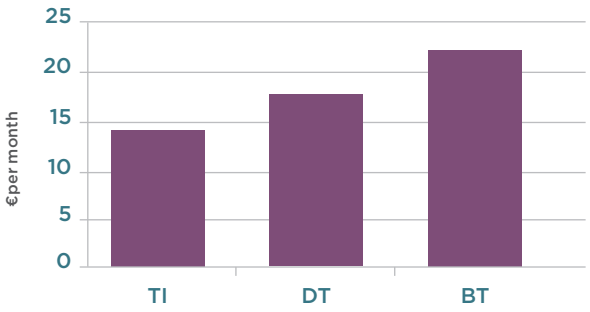


Figure 6

## GEA Access Prices – BT, Deutsche Telekom and Telecom Italia [25]




## Poor knowledge about the final leg of the copper network

BT does not have a clear record on the quality, positioning and connectivity of the copper network at the local level. The quality of the copper varies quite a lot, depending on whether it is pure copper, a copper aluminium alloy, copper coated aluminium or even just aluminium, all at variable thickness. Such variance has a big impact on the throughput of data. Pure, thick copper is the best while aluminium is fine for voice but not for data. However pure copper is also most likely to be stolen. Some say that the quality of the copper network in a given place can be matched to the price of copper at the time. Equally, it has been alleged that when copper has been stolen, BT has replaced 0.5mm copper wires with 0.3mm[26]. This makes it hard for third parties to know what level of service they can offer customers.

An illustrative example of the frustration for 3rd parties about the local loop was revealed in a recent submission to Ofcom. Sky noted that when they together with Vodafone formally submitted a SoR (Statement of Requirements) requesting detailed copper network information in March 2013 from BT, it was finally rejected months later in November 2013. Openreach stated the reason why was there was no commercial benefit for it in gathering and disseminating the data for 3rd parties although two large players, Sky and Vodafone clearly did see a benefit[27].

Similarly, there is no database stipulating which address point within which postcode is connected to which distribution point or the length of the drop wire from the Distribution Point to the premise. Again, this makes it hard for third party Content Providers to assess broadband deployment options.

Finally, BT offers a service of marking footways, to show where pipes and cables of other utilities are buried and at what depth to prevent other operators disrupting them. However, a lack of proper record-keeping in the early days of cable and pipe-laying means that there is even sometimes uncertainty about which side of a road they are located on, leading to unnecessary expense and time in digging up tarmac and pavements. This is not unlike to Network Rail not always having maps or detailed knowledge of where cables were laid in the 1960s and 1970s, which has impacted costs of the rail upgrade programme.

## Limited knowledge about the whole network

Unlike our power, gas and water networks that have to match capacity and demand in real time with prices, there are great unknowns within the whole telecoms network about quality, reliability and consistency of service. Actual Experience Plc, co-founded by Dave Page and Professor Jonathan Pitts, has a cloud platform app which measures and captures the digital chain, identifying where the weak points are in the entire internet network that result in sudden changes of speed or dropouts. Ofcom has commissioned work from Actual Experience, in particular looking at Sync speed (maximum connection speed between the ISP and the consumer's premises) and Line speed (a more representative measure that incorporates peaks and troughs throughout the day according to the level of congestion). The results are certainly revealing;

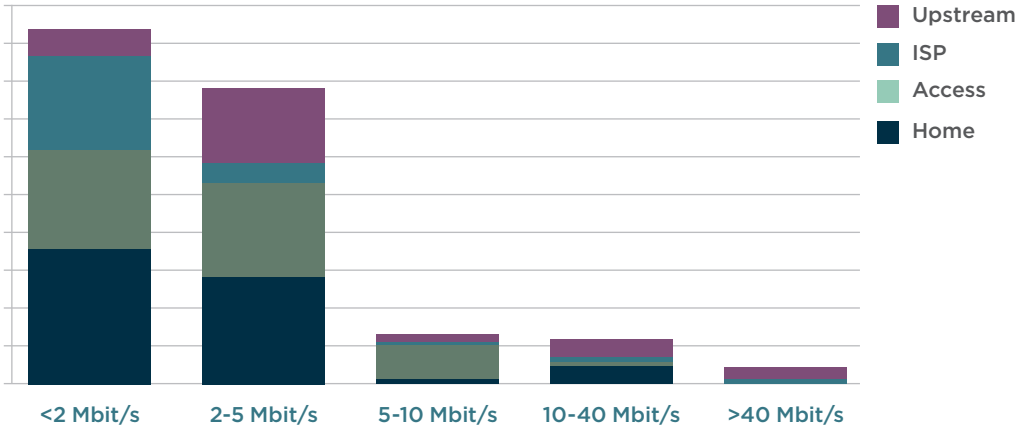
[25] See "Copper into Gold – the Sequel" research note by Redburn Telecommunications Services, 5th February 2016

[26] See http://www.alphr.com/news/367111/bt-denies-downgrading-copper-cables

[27] See "Ofcom's Strategic Review of Digital Communications – Initial Submission by Sky"

Figure 7

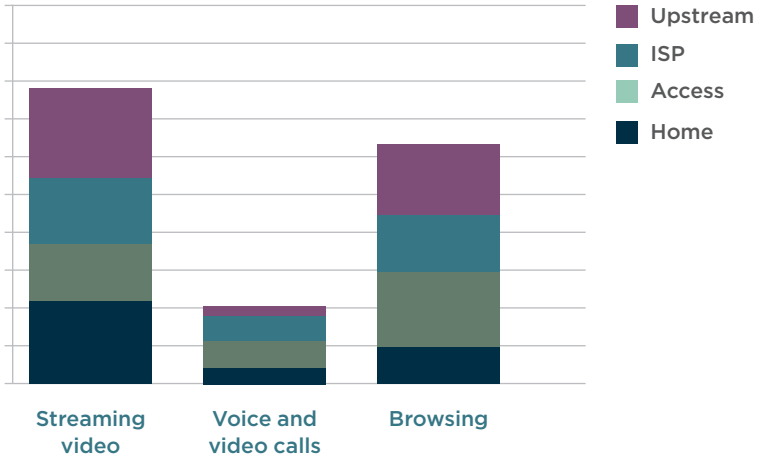
## The effect of different parts of the broadband connection chain on the consumer experience, at different broadband connection speeds [28]




Here, the faster the speed, the more it becomes an issue for the fixed access network and the upstream network. The results are equally varied according to the type of online service.

Figure 8

## The effect of different parts of the broadband connection chain on the consumer experience when using different online services




Here we see a major contribution to impairment being the home use, particularly for streaming video and a large impact from ISPs, the fixed access network and the upstream network for browsing and streaming video.

[28] See "Fixed Broadband Networks" Ofcom 2014 Infrastructure Report – Section 3

# Capacity crunch

There are two parts to this – ipv4 addresses and fibre capacity.

Every internet connected device needs an internet address. However, last September in the USA, that country run out of IPv4 addresses to allocate and there are only 4.3 billion worldwide – Latin America and the Caribbean had already run out of theirs. Britain has not run out and BT have announced that they will be IPv6 ready in April this year. But for British companies hosting websites or using cloud services in the USA, South America and the Caribbean, this matters when the intention is to show that that is where the websites are located. IPv6 however increases the total number of internet addresses to 3.4×10 to the power of 38.

The capacity crunch for fibre is the concept that internet traffic is growing faster than the ability of the backbone fibre optic network to carry it. At the forefront of this argument is Professor Andrew Ellis of Aston University who has suggested that consumers may have to be rationed and pay more to access the internet when maximum capacity is reached in perhaps 5-8 years' time. The specific technical issue is that there is a limit to how many beams of light can be introduced into a cable without leading to increased interference or crosstalk putting the limit at 100 Tbps. However, this may have been solved (but not yet deployed) by researchers at the University of California who have boosted this limit to 2000 Tbps using a frequency comb[29] that unscrambles the signal's predictable crosstalk at the receiving end without requiring additional signal repeaters.

## What are today's connectivity bandwidth demand drivers?

Cisco and Ofcom have looked closely at what is driving demand for data in the UK whether mobile or broadband, currently growing at around 50% or more per year. There are several main drivers;

## Faster broadband speeds beget more demand for internet use.

Between 2014 and 2015, the average broadband speed increased from 23 to 28 Mbit/s and the average monthly data usage increased from 58 to 82GB.

Equally for mobile, growth in data consumption has been just as pronounced, driven by the increasing penetration of 3G and 4G and an increase in public WiFi hotspots.

[29] See here http://www.sciencemag.org/content/348/6242/1445.abstract and here http://www.itworld.com/article/2948956/consumer-tech-science/internet-capacity-crunch-staved-off.html

[30] See Ofcom report "Connected Nations 2015"

[31] See Ofcom report "Connected Nations 2015"

Table 4

### Growth in broadband download speed and data usage [30]

| | 2015 | 2014 | 2013 |
|---|---|---|---|
| Average download speeds, Mbit/s | 28 | 23 | 18 |
| Average data usage, GB (monthly per premise) | 82 | 58 | 30 |

Table 5

### Growth in mobile data consumption [31]

| | 2015 | 2014 |
|---|---|---|
| Total number of active mobile connections | 83.7 million | 83.2 million |
| Total mobile data usage | 72.9PB | 44.3PB |
| Number of public Wi-Fi hotspots | 44,804 | 41,798 |
| Total data usage in June 2015 | 3.3PB | 2.3PB |
| Average data usage per hotspot in June 2015 | 73GB | 54GB |

Faster internet speeds has enabled the use of video on demand services which are the highest consumers of data.

Today internet connected TVs present a choice of Standard Definition or High Definition. In the near future, there will be more widespread use of Ultra High Definition. The higher the definition, the higher the bandwidth requirement and the slower the download time. Here there is clearly already congestion, as even with a superfast connection, downloading an HD movie at peak times, can take up to an hour and an Ultra HD movie would take at least twice as long.

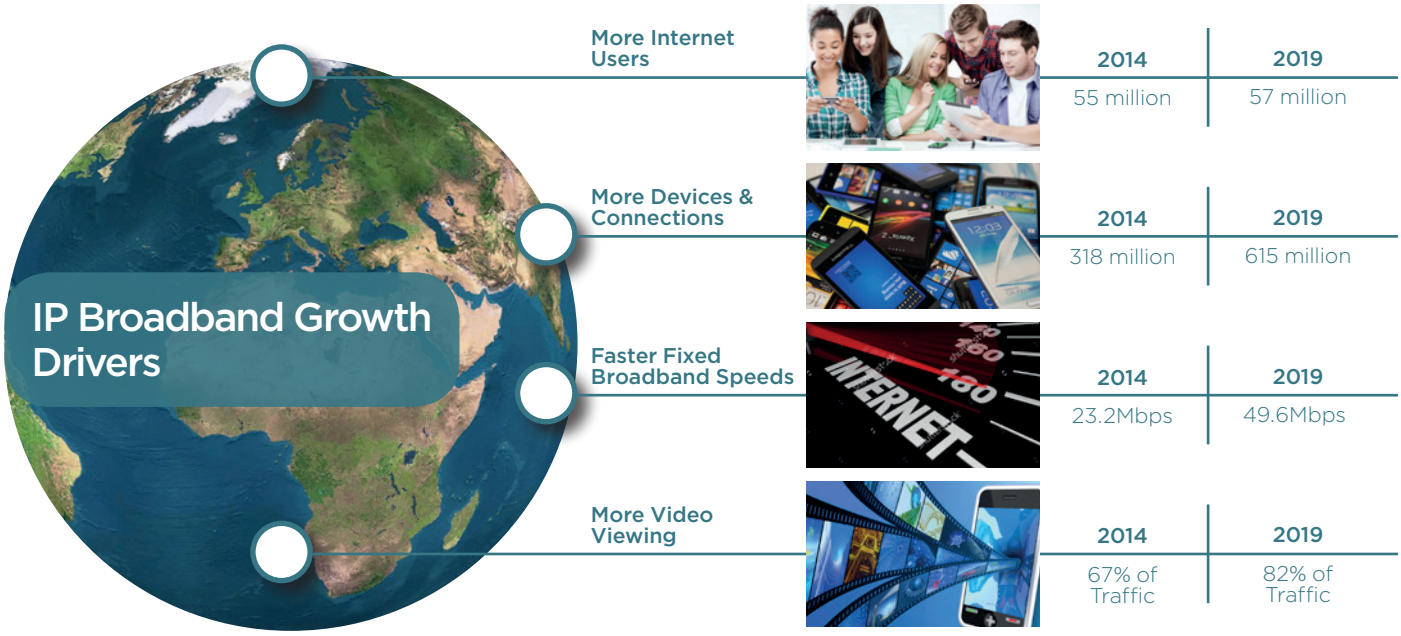
There are potentially several non-linear wildcards however that suggest that these forecasts may be a conservative underestimate. Immersive 360 degree virtual reality, the headsets which will be available for the first time this year will require much greater bandwidth than any flat screen. And since March 2015, YouTube, the top video content provider, has provided 360 degree content support.

At the other end of the scale, there is also huge potential for many billions of new battery-powered wireless sensors making up the Internet of Things that will be internet connected, sending out new packets and volumes of data that did not exist before where the internet and broadband do not reach. These may be connected via "LoRa" – a low power wide area network aka LoRaWAN, a joint venture between IBM and Semtech. The advantage of LoRaWAN is that it operates in a wide range of very low frequencies, from 107 to 1020 MHz which enable it to penetrate buildings and underground at speeds between 300 bits to 100 Kbits per second at great distance, from 62 miles in favourable environments down to 1.2 miles in city centres. Using only a single AA battery for 10 years, these IoT sensors would send data, such as GPS coordinates, smart building and city data like rubbish bins content and micro environmental readings.

Above all though it would be a mistake to see the future as being dominated by video entertainment download speeds, just as technology is coming through that requires much higher upload speeds and the internet becomes much more of a two-way immersive experience.

Figure 9

## UK IP Traffic and Service Adoption Drivers




Source: Cisco, Presentation by Matt Houlihan

# Rival technologies and what they can offer

There are actually many competing and complimentary broadband and connectivity technologies available or soon to be available now.

## Fibre to the premise

FTTP is for now the highest performing internet connection. By bringing a fibre cable into the home or office, symmetrical upload and download speeds become available of 1GBps with very low latency rates. Costs to serve a premise have fallen dramatically due to the use of micro-trenching. Micro-trenching is achieved by using a motorised saw that can dig a shallow trench at a depth of 23 inches in the pavement or road above any other utility connections, at a rate of 400 metres per day. Today in the UK, FTTP is being deployed by CityFibre, Gigaclear, Hyperoptic, Community Fibre and others. It is also easy to upgrade and maintenance light, typically 20-30% of the cost of maintaining a copper network. Gigaclear is currently trialling a 5 GBps service. US Internet in Minneapolis have for a year been offering a 10 GBps service. However, by comparison with other European countries, the penetration of FTTP in the UK is very low, 0.003%[32] and does not register on this chart.

[32] See Ofcom Connected Nations Report – Section 1 Dashboard, page 1

## Micro-trenching in York

## Satellite broadband

Many Britons have been receiving data from satellites for years since the advent of satellite TV broadcasting in the late 1980s. Satellite broadband is the same principle but higher bandwidth and can serve remote, poorly connected locations at much lower cost, more quickly. All of today's broadband satellites operate in geostationary orbit at a height of 22,000 miles which creates longer latency, 250 microseconds or more. However download speeds are improving. ViaSat1 offers 24 Mbps and ViaSat2 in orbit from 2017 will offer 100 Mbps. ViaSat3 from 2020 will offer 1 Gbps and largely uncapped data. Other players in the sector include Avanti and Tooway. It is well established in America, with 700,000 subscribers but only a few thousand in the UK. It is also used by commercial airliners, who offer internet access to passengers, even able to offer streaming video services like Netflix. Today, the satellite broadband industry in the UK suffers from a lack of spectrum to operate in and were they to have more access, the industry feels it could help build a hybrid and more resilient infrastructure that is not purely reliant on terrestrial hardware.

In the near future, there are several players planning to launch a global network of Low Earth Orbit satellites for broadband, operating at 100 to 1,250 miles up and much lower latency of 20 milliseconds. This will require many more satellites as low earth orbits are not stationary and OneWeb plan to have 650 satellites in service by 2020 while Space X aim to have 4,000 by the same date. The prospects for LEO satellites have greatly improved with the successful launch and recovery of a Space X rocket, on 21st December 2015 making it reusable, having launched 6 LEO satellites.

## Fibre to the cabinet

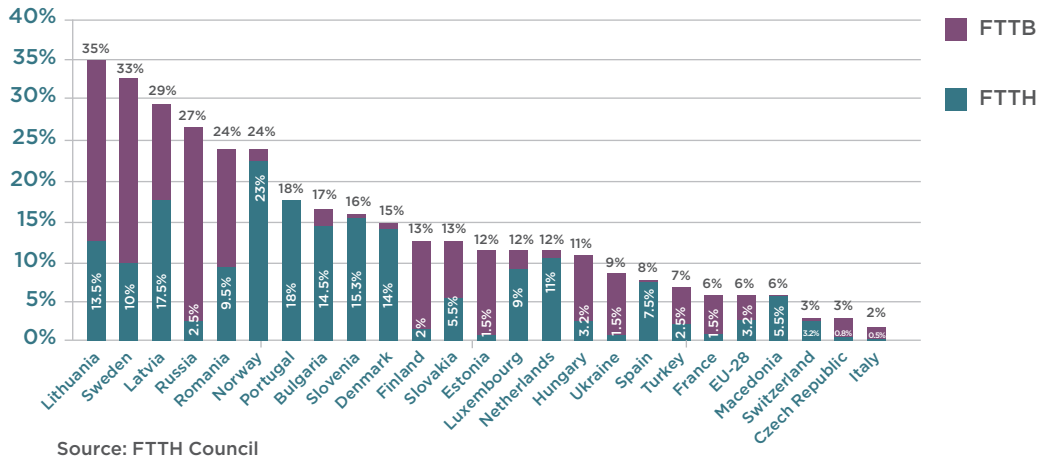
FTTC brings fibre optic cable between the cabinet and the exchange for a very high bit rate digital subscriber line (VDSL). This is the superfast option being deployed across the UK by Openreach and can deliver speeds at up to 76 Mbps depending on the distance to the cabinet. In the near future, Vectoring technology which reduces interference or crosstalk may increase this speed to above 100 Mbps.

## Fibre to the remote node

FTTrN essentially moves the fibre one step closer to the premise, by connecting fibre from the cabinet to the telegraph pole and so should be slightly faster than FTTC. It may have more application for Exchange Only Lines in City Centres or where building a new cabinet is not possible.

Figure 10

### Penetration of FTTP by % of homes




Source: FTTH Council

## G.Fast or Fibre to the distribution point

BT is currently trialling G.Fast which promises download speeds of 300-500 Mbps and upload speeds of around a tenth of that with upgraded or new cabinets. XG.Fast is a further iteration and promises to deliver speeds up to 5 Gbps. However, in both cases, performance deteriorates rapidly with distance from the cabinet and this is a highly localised and unpredictable performance. Moreover, BT is only planning for the connectivity to be ultrafast in one direction – download – although this can be adjusted but it is not truly symmetrical without halving the download capacity. It also has much greater power requirements than a passive optical network made up of fibre using unpowered optical splitters. BT believe they can roll out G.Fast to 10 million homes and premises by 2020.

## Hybrid fibre-coaxial cable using DOCSIS standards.

This is fibre optic cable to a proprietary street cabinet, followed by a coaxial cabinet to the home. This is what Virgin Media have who took over the NTL and Telewest who laid the cables in the 1990s. Virgin Media is now owned by Liberty Global. The latest DOCSIS upgrade takes the download speed up to 200 Mbit/s.

## Asymmetric digital subscriber lines and ADSL2+.

In the UK, these are the standard broadband services and offer speeds from 0.5 to 24 Mbit/s.

## Aerial fibre

To avoid the costs of digging trenches in pavements and to the premise, in some cases it may be possible to deliver FTTP wound around existing telegraph poles and lines.

## Line of sight or Fixed Wireless Access

Line of sight broadband connections essentially place a transmitting tower on top of a hill and relay either satellite or mobile wireless connections to anywhere that is within range and has line of sight of the connection.

## Mobile wireless

In the UK, Relish has led the way with this offering, using 3G and 4G signals only for data to deliver 50-60 and up to 700 Mbps to a router in areas like central London or rural not-spots that are poorly served by broadband.

## Mobile broadband -3G, 4G, 5G

The average download speed for mobile today is 6.1 Mbps rising to 15.1 Mbps for 4G[33]. 5G promises to have a speed of at least 1 Gbps and may be available from 2020. Latency for most of today's mobile broadband offerings is around 110 milliseconds and 50 for 4G. As with fixed lines, there is quite a big gap between theoretical highest speeds in testing and real world speeds with the theoretical limit for 4G of 150 Mbps. In the meantime, 4.5G or LTE Advanced-Pro may well lift that limit to 1 Gbps using more advanced modulation, carrier aggregation and an increase in antennas.

[33] See http://www.ispreview.co.uk/broadband_mobile.php

# Existing government policy and results

All governments since the mid-1990s have promised to do great things with the internet, originally more widely known as the information super highway. For the purposes of this section of the paper, we have focussed on policy since the formation of the Coalition government in May 2010.

In December 2010, the government published *Britain's Superfast Broadband Future*, with the express aim of Britain having the best Superfast broadband network in Europe by 2015. Best though is a vague superlative when without qualification and does not really take into account the wide variance in what constitutes best for different consumers. Best was later redefined to include price, coverage and speed by then Culture Secretary Jeremy Hunt in a 2012 speech[34]. So did the government achieve that?

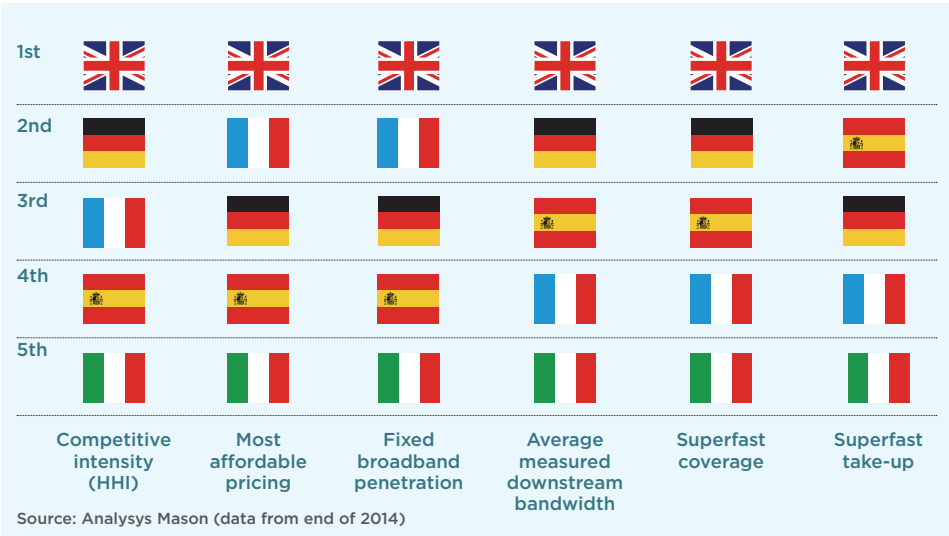
Based on this data compiled by Analysys Mason for BT[35], it appears that the UK did achieve its aim of having the best superfast broadband network by 2015. But the wider picture is more complex and as always, it does not mean the UK could not have done better.

First of all, a national average of download speed would be a much more important measure, if the UK had an equal geographic distribution of population and economic activity. However, it clearly doesn't. Very high bandwidth in remote corners of the UK will never have the same positive dynamic impact as in a concentrated bustling city centre. So it has to be a concern that London, Europe's biggest city by economic output, has such a poor ranking compared to other capital European cities, ranking 26th, just above Minsk.

And for winning the global race, the UK does not seem well placed, either, ranking 23 for download speed when so many countries, not least in the developing world, are planning giant leaps in speed with the advent of new non-copper technologies.

Figure 11

## How Britain Compares (data from end 2014)




Source: Analysys Mason (data from end of 2014)

[34] See speech by Jeremy Hunt MP on 23rd August 2012 Broadband in the UK – Faster, Higher, Stronger – *"In my very first speech as a Minister I said that I wanted us to have the "best" superfast broadband network in Europe by 2015. In defining "best" you include factors like price and coverage as well as speed. But over the past two years it has become clear, as Usain Bolt wouldn't hesitate to say, to be the best you need to be the fastest.*

*So I am today announcing an ambition to be not just the best, but specifically the fastest broadband of any major European country by 2015."*

[35] See Report for BT: International Benchmarking report by Analysys Mason, August 2015

Table 6

## European Capital City Average Download Broadband Speeds [36]

| Rank | City | Country | Jan-15 Speeds (Mbps) |
|---|---|---|---|
| 1 | Bucharest | Romania | 80.14 |
| 2 | Paris | France | 78.6 |
| 3 | Vilnius | Lithuania | 59.99 |
| 4 | Stockholm | Sweden | 59.46 |
| 5 | Reykjavik | Iceland | 49.95 |
| 6 | Bern | Switzerland | 49.37 |
| 7 | Copenhagen | Denmark | 47.81 |
| 8 | Bratislava | Slovakia | 44.47 |
| 9 | Riga | Latvia | 42.9 |
| 10 | Helsinki | Finland | 42.79 |
| 11 | Vienna | Austria | 42.41 |
| 12 | Oslo | Norway | 40.25 |
| 13 | Budapest | Hungary | 40.1 |
| 14 | Luxembourg | Luxembourg | 40.03 |
| 15 | Dublin | Ireland | 39.43 |
| 16 | Amsterdam | Netherlands | 39.41 |
| 17 | Tallinn | Estonia | 39.34 |
| 18 | Sofia | Bulgaria | 38 |
| 19 | Prague | Czech Republic | 37.04 |
| 20 | Lisbon | Portugal | 34.73 |
| 21 | Madrid | Spain | 33.26 |
| 22 | Kiev | Ukraine | 32.76 |
| 23 | Berlin | Germany | 27.2 |
| 24 | Brussels | Belgium | 26.72 |
| 25 | Warsaw | Poland | 25.97 |
| 26 | London | UK | 25.44 |
| 27 | Minsk | Belarus | 17.79 |
| 28 | Sarajevo | Bosnia & Herzegovina | 13.41 |
| 29 | Zagreb | Croatia | 11.74 |
| 30 | Rome | Italy | 11.65 |
| 31 | Belgrade | Serbia | 10.91 |
| 32 | Athens | Greece | 9.76 |
| 33 | Nicosia | Cyprus | 9.11 |

[36] See Make or Break: The UK's Digital Future – House of Lords Select Committee on Digital Skills, published 17 February 2015

Table 7

## World Ranking – sorted by Download speed [36]

| Rank | Country | Download speed | Upload speed |
|---|---|---|---|
| 1 | Singapore | 97.67 | 78.69 |
| 2 | Hong Kong, China | 96.12 | 89.25 |
| 3 | Romania | 62.53 | 31.85 |
| 4 | Sweden | 49.25 | 27.66 |
| 5 | Lithuania | 47.93 | 45.64 |
| 6 | Switzerland | 46.32 | 8.7 |
| 7 | Netherlands | 44.03 | 19.03 |
| 8 | Iceland | 43.4 | 36.95 |
| 9 | Latvia | 42.03 | 38.07 |
| 10 | Denmark | 41.76 | 31.01 |
| 11 | Taiwan, China | 41.67 | 18.27 |
| 12 | Luxembourg | 37.65 | 18.71 |
| 13 | France | 35.1 | 12.76 |
| 14 | Korea (Rep. of) | 34.97 | 30.51 |
| 15 | Norway | 34.09 | 23.02 |
| 16 | Belgium | 33.86 | 4.62 |
| 17 | Bulgaria | 33.66 | 22.45 |
| 18 | Finland | 33.4 | 13.45 |
| 19 | Estonia | 33.35 | 19.49 |
| 20 | Hungary | 2.26 | 10.23 |
| 21 | United States | 32.14 | 9.54 |
| 22 | United Arab Emirates | 29.44 | 10.68 |
| 23 | UK | 29.34 | 6.98 |

Source: www.internetsociety.org

Surveyed IoD members appear to be somewhat below this national average with 31% achieving in excess of 24 Mbps, over 40% below and the remainder stating they did not know.

Where the UK particularly underperforms in this table is in fact with upload speed – a sure sign of limited penetration of fibre to the premise. This can be seen when comparing the UK across the OECD for build-out of Fibre to the Home.

Figure 12

## FTTH coverage – OECD countries

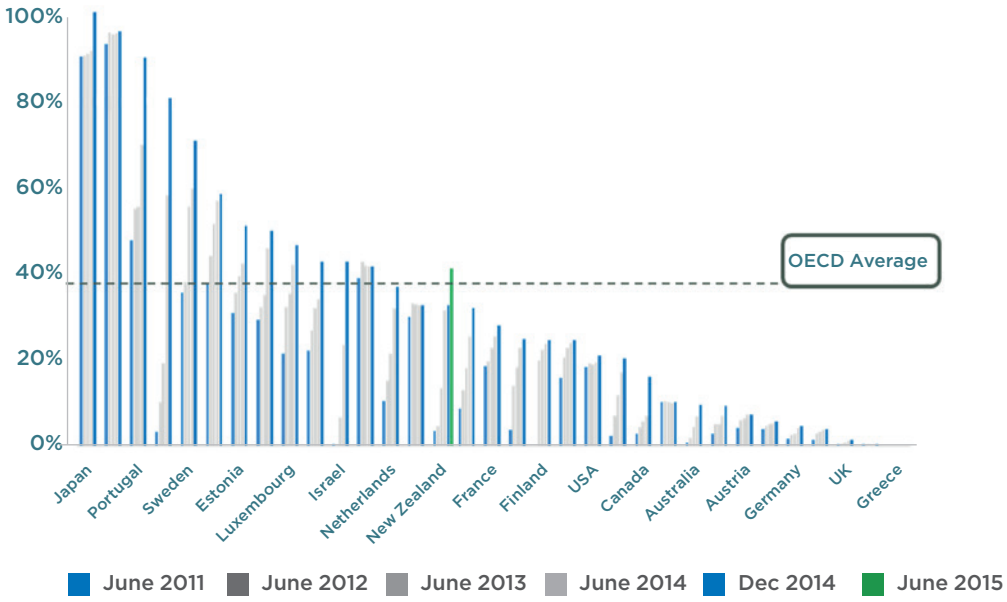
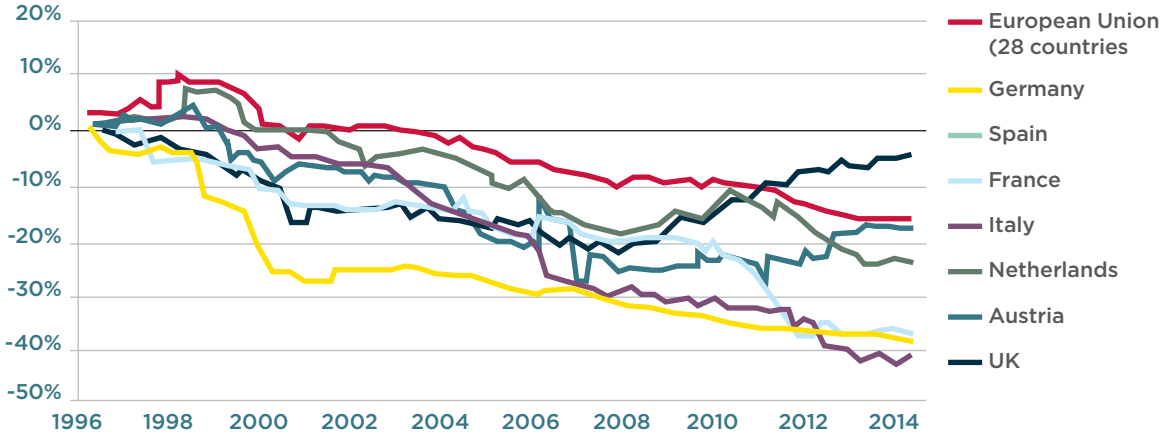



Figure 13

## Rising prices in UK



And while prices in the UK are relatively low by international standards, they do appear to have been rising, quite uniquely compared to other major European nations, according to Redburn when measuring the Telecommunications CPI (telephone, post and internet) produced by Eurostat and not just because of the Line rental price increases referred to earlier.

## So what policy mechanism was devised to achieve these results?

In 2011, the government set up a body, Broadband Deliver UK to oversee four pots of taxpayer subsidies to speed up and extend the reach of superfast broadband across the UK.

On top of these subsidies, the devolved administrations in Wales, Northern Ireland and Scotland have their own programmes as well as some European structural funding from the European Regional Development Fund[37], while council and local authorities make their own contributions. The headline figures were further topped up by the Chancellor in March 2012 by £100 million and £250m in June 2013 from the BBC's license fee digital switchover budget. In 2013, the capital cost was revised to £1.547 bn, plus a local authority contribution of £200m and BT contributing around £360m according to a National Audit Office Report[38]. All in all, the government funded contract for Phase 1 has been worth £400m per annum to BT according to research by Redburn.

[37] By way of example, for the Wales fibre broadband project, £58m comes from the Welsh Government, £57m from BDUK and £90m from the European Regional Development Fund with £220m on top of that from BT, totalling £425m.

[38] See http://www.theregister.co.uk/2013/07/05/national_audit_office_rural_broadband_report/

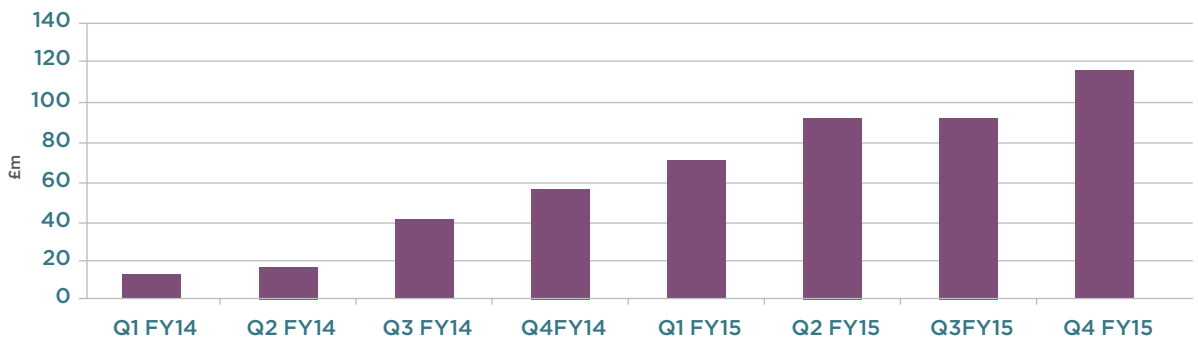
Table 8

### BDUK programme

| Programme name | Funding in £m | Target | Projects |
|---|---|---|---|
| Phase 1 Rural Broadband Programme | 530 | 90% Coverage by 2015 | 44 |
| Phase 2 Superfast Extension Programme | 250 | 95% Coverage by end 2017 | 47 |
| Phase 3 Competitive Fund | 10 | Pilot projects for final 5% | 5 |
| Superconnected Cities (Urban Broadband Fund) | 150 | Voucher scheme for businesses | |
| Mobile Infrastructure Project | 150 | To eliminate mobile blackspots and areas of poor coverage | |

Figure 14

### BDUK subsidies to BT



As state aid, all of these programmes were delayed pending clearance from the European Commission. Phase 1 will be fully complete in April 2016, about 16 months later than planned.

Apart from the understandable delay, a great disappointment of Phase 1 has to be the lack of competition. Originally, there were 9 serious contenders, including Geo Networks, Fujitsu and Cable and Wireless Worldwide while others like Virgin who did not even attempt to bid. And one by one, they either peeled off or lost out to BT, the last contender, Fujitsu walking away in July 2012, having originally offered to connect 5 million homes with fibre all the way to the premise at gigabit speeds. This meant that BT won all of the 44 contracts. So how did this happen?

Smaller and newer network companies allegedly found it difficult to be considered as the eligibility conditions included criteria such as needing to have been in business for 3 years and to have had a record in public sector work. They were also very large contracts usually running into tens of millions. An ideal competition has more plausible bidders than there are contracts, with the end result of lower prices, innovation and new entrants. By setting the boundary at the size of the local authority, this immediately became a limiting of the competitive scope to large scale established players.

Connecting fibre from the exchange to a new cabinet is not actually very challenging and theoretically, there could have been a competitive tender for each of the 5,500 exchanges. But the CEO of Geo Networks, Chris Smedley withdrew the company from the competition, citing the prohibitive cost of accessing BT's Physical Infrastructure (PIA) of ducts and poles, especially in rural locations where long distances had to be covered. BT of course would not have to pay to access its own PIA. Said Smedley;

**" PIA cannot be used for the far more costly task of crossing the long distances in rural areas to get to these remote communities – making the idea of being able to build new fibre connections within them faintly ludicrous. Quite simply, our business case does not stack up because of these restrictions. BT does not suffer from any of these restrictions when it has to assess the business case for deploying new optical fibre cable over its existing infrastructure. Only BT can deploy fibre for backhauling traffic long distances from local exchanges for itself and the wholesale ISP market. Only BT can build a business case including the revenues from the fast-growing mobile and wireless data market. Only BT can deploy services for businesses over this fibre. These inadequacies of the current PIA product are fatal to infrastructure competition".**

**Chris Smedley** *CEO of Geo Networks*

The government did have warning of this. A joint letter from Fujitsu, Virgin Media, TalkTalk, Geo and Vtess Networks was sent to Ed Vaizey in April 2011, imploring him to intervene, saying *"We are unanimous in the belief that the BDUK competitive procurement process will lack a credible alternative to BT, should BT fail to make substantial revisions to PIA [physical infrastructure access] product pricing"*[39]. But no major action appears to have been taken.

Another issue that arose was the lack of contract transparency. BT insisted that all councils sign Non-Disclosure Agreements which meant that they could not compare with one another prices to establish fair value, a criticism made explicitly by the Public Accounts Committee[40]. This translated into an alleged huge discrepancy between the costs of installed cabinets, ranging from £16,000 to £100,000 because the secrecy of the contracts allegedly enabled BT to inflate costs[41]. The whistle-blowing contractor who was working for BDUK, Mike Kieley, was sacked in 2013 for sharing different cost information between councils. However he appears to have been vindicated by a 2015 National Audit Office report which found 38% excess costs in BT's financial models[42].

A further point touched on earlier was the problematic issue of defining where the 10% not covered by Phase 1 would start or finish. The UK's 1.7 million postcode shapes do not overlay exactly areas served by different cabinets and exchanges. No one in fact definitively knows, as new homes with separate mail points are built within existing postcodes and so it might have been better to have gone with 100% rather than 90% coverage in the area of the contract. Nor was it revealed from the start, precisely where BT would and would not upgrade and when. In BT's defence, this was a decision that they left to the local authorities as to where to upgrade. For all that, this has led to some overbuild, beyond the 90% target. On the other hand, BT's biggest rival and several AltNets (alternative network providers) eyeing up future opportunities claimed that such a high threshold for an undisclosed area, crowded out the rationale for their own expansion plans.

Then there's the distribution of the upgrades. It could be argued if it is deemed that left alone, market forces will not deliver universal superfast broadband fast enough in line with government targets, then the taxpayer should step in. This argument has much more merit in the remotest corners of the UK, where there is a very limited commercial case for upgrades. But Phase 1 appears to have focussed on not the hardest places, but the easier large villages and rural towns, that already had reasonable speeds of 10-20 Mbps and viable near future competitive infrastructure alternatives.

A key element of the Phase 1 contracts was that the contractee would meet a large section of the costs themselves. BT claims to have invested £2.5 billion since 2009[43]. But there seems to be some dispute about how much BT has contributed, how to account for it and whether the BDUK contracts inadvertently gave BT the financial muscle to expand into the pay per view market for TV by buying sports rights and purchasing a mobile phone company, EE.  According to Chart x below produced by Redburn, it does seem that Openreach capex has been broadly flat while receiving up to £400 million a year in subsidies from BDUK.

[39] See http://www.computerweekly.com/news/1280095607/Telecoms-firms-threaten-BDUK-boycott-over-BT-terms-and-conditions

[40] See http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news/rural-broadband-report-publication/

[41] See http://www.bbc.co.uk/news/uk-24285662

[42] See http://www.bbc.co.uk/news/technology-31043548

[43] See http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/digital-media/11862314/Openreach-boss-A-huge-mistake-if-Openreach-were-spun-off-as-an-independent-company.html

Figure 15

## Openreach Capex by financial year

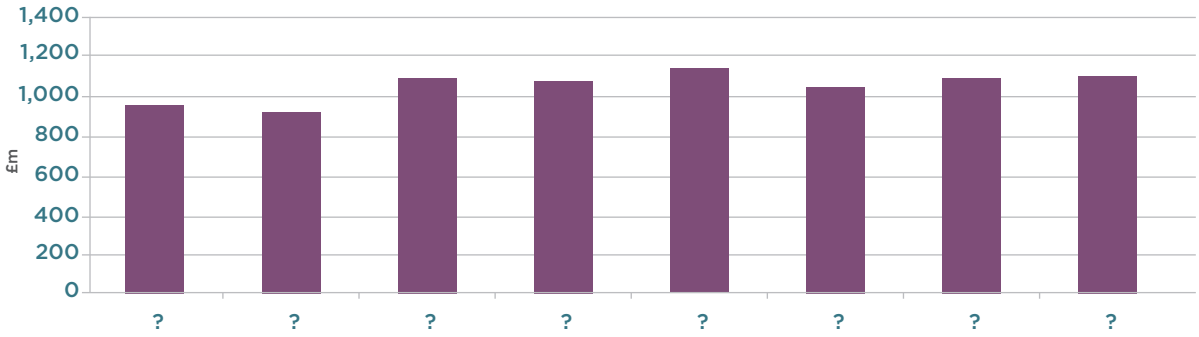
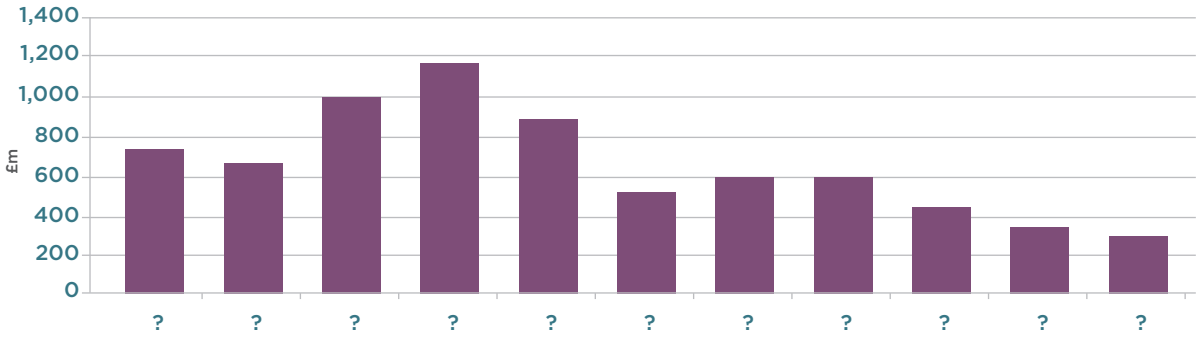



Figure 16

## BT Group Capital Expenditure by Financial Year




While BT Group capex has been decidedly lower since the great recession of 2008/09.

The contract design has not all been negative though. Take-up of superfast broadband far exceeded BT's expectation of 20% so the government has been able to "clawback" funding of £129m (from greater than expected revenue to BT) to reinvest in future network developments. And a report commissioned by BDUK from Atkins, concluded after examining some sites in Suffolk, that BT's costs were 20% lower than could be hypothetically charged by another supplier, because of the scale economics of bulk purchasing.

# The Universal Service Obligation – too low or unnecessary?

In November 2015, the Prime Minister David Cameron said that the government would establish a Universal Service Obligation for broadband from the current aspiration of 2 Mbps to 10 by 2020.

A USO is beyond a government pledge because it is legally binding. This raises several questions.

## What was wrong with 2 Mbps?

2 Mbps was deemed adequate in the mid-2000s, just as BBC iplayer was launched. The assumption then that rapidly became outdated with the advent of tablets and smartphones, was that there would only be 1 connected device needing to stream video, in standard definition. For businesses too, it was woefully short for cloud-based backups and storage.

## Will 10 Mbps be high enough?

On the face of it, a five-fold increase is highly significant to those communities that have 2 or less mbps. But the shift to streaming and downloading High Definition and soon Ultra High Definition TV (4K – requiring 24 Mbps) via the internet, not to mention virtual reality, will within a decade mean that anything less than symmetrical ultrafast – 300 mbps and above – will not suffice.

## Is it possible to achieve 10 Mbps by 2020?

Yes, no one across the broadband and telecoms industry is racking their brains about how to do this by 2020. A universal coverage by today's 4G network and existing satellite broadband capabilities would solve this quite easily in existing not-spots.

Table 9

### Europe's Minority USO Broadband League

| USO Speed | Nations |
|---|---|
| 1 Mbps | Belgium, Croatia, Finland, Spain and Sweden |
| 2 Mbps | Malta |
| 10 Mbps | United Kingdom (TBC) |

## Do we even need a USO for broadband?

The UK has a USO for basic fixed telephone lines and has had one for postal services since the 19th century. But the countryside and quite large swathes of the nation have long managed without gas connections (around 5 million households), water and even mains electricity. To connect up all households to the internet does not mean that they can afford the monthly cost of broadband, let alone know how to best use or even operate an internet-connected device. The digital divide is not just about connectivity but about skills too. Across all of Europe, of the EU28, only 6 other nations have a broadband USO and they have set the bar very low.

All in all policy can be seen to be a limited success. Incremental progress has been made at the cost of competition, technological diversity and has failed to match the dramatic rise of the UK's internet economy and the capacity it will need in the years to come.

# Foreign experience – what can the UK learn from abroad?

All countries of course are different and work with different legacy telecoms structures, regulatory environments, players and standards of living. However there are two very successful examples that the UK should pay close attention to when considering future broadband growth and investment.

## Lithuania

Lithuania officially has the third fastest connections in Europe. This is no small achievement considering it has a GDP per head approximately a third of the UK's and a fifth of the population density. Nonetheless it is the leader in FTTH across Europe, with 35%[44] of households served and over 100 ISPs competing for business for 1.2 million households[45]. The question is how were they able to do this?

In 2004, Lithuania's equivalent of Ofcom, RRT, mandated the compulsory sharing of all passive infrastructure *"suitable for construction of electronic communications networks"*. To further incentivise network investment, RTT went for a very low cost of access model to the Ducts and Poles. Together, these two measures led to a rapid build-out predominantly (61%) by the AltNets in strong competition with the national incumbent, TEO who were then were forced to make further investments[46] to keep up. In Lithuania, the typical price per metre per month of duct access in EUR is 0.028 whereas in the UK it is 0.078 (£0.06 facility in spine duct – single bore[47]). There are also no limitations on use in Lithuanian ducts and the can be freely used by mobile operators as well as AltNets.

## New Zealand

Across the UK, many telecommunications companies apart from Virgin Media have been calling for Ofcom to refer BT to the Competition and Markets Authority in order to split off BT Openreach as a separate company. They do have a well-functioning example of where this has worked in New Zealand, the first incumbent to split in the world. In 2011, overseen by the regulator and approved overwhelmingly by shareholders, Telecom NZ Ltd was structurally separated into two separate companies – Chorus and Telecom New Zealand which became Spark New Zealand. Chorus, the Kiwi equivalent of Openreach is responsible for the network infrastructure and Spark provides internet, mobile and fixed line telephone services. Crucially, Chorus was spun-off, not sold off.

This meant that existing shareholders were able to see an increase in value and retain enough cash flow for future investments. Since both being listed on 25th November 2011, Spark's share price has risen from 2.04 to 3.33 while Chorus has risen from 3.29 to 3.71[48]. In the meantime, New Zealand is racing ahead not just in delivering more fibre network investment and subscriptions, but in a flourishing range of consumer choice in video on demand, ISPs and fixed line services with a goal to have FTTH to 75% of the country by 2020.
It was not all plain sailing though. In 2013, New Zealand's regulator, the Commerce Commission reduced the copper wholesale broadband fees, at a stroke undermining the business case for fibre investment by Chorus. This was later reversed; post a big fall in the share price from late 2013-14.

The financing of New Zealand's rollout is unique too[49]. The government is spending NZD 929m over 8 years but it is not technically a subsidy but an investment because it is it split 50/50 between unsecured and non-interest bearing debt and dividend free equity until 2025. The government has also been careful to limit Chorus' building share of the ultra-fast network to 70%.

So successful has the separation been that O2 in the Czech Republic voluntarily structurally separated in August 2015, spinning off the fixed and mobile infrastructure into a new company called CETIN. Other countries, not just the UK, are looking at this as a way to fund future network infrastructure investment beyond the resources of the incumbent.

[44] See http://www.teo.lt/en/press/FTTH/12308

[45] See case study on Lithuania by Fibre to the Home Council Europe

[46] See very well researched paper by Citi Research "European Telco Regulation – Towards an Open Duct Future" February 2013

[47] See https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.

[48] As at COB 18th January 2016

[49] See Redburn paper "BT Group – Why BT Should Volunteer the Split" 24th September 2015

# The separation of Openreach – the case for and against

Separation can take many forms; legal, governance or corporate whilst appreciating that today it is functionally separate with its own accounts, assets and employees. IoD Policy Voce members were polled and asked whether BT's ownership of Openreach is positive or negative for the quality (coverage, speed, reliability and cost) of broadband services in the UK?

The results were certainly more negative than positive, but not overwhelmingly so as nearly 40% either didn't know, or thought that it would make no difference, either positive or negative .

In the for and against, there are several main points to consider;

## The anchor tenant argument

BT contends that as an anchor tenant of Openreach, it has a benign vested interest in investing in the business, which it is dependent on to sell network-demanding content like BT Sport and now EE. Detractors counter that this mistakenly conflates anchor tenancy such as large department store in a shopping mall with vertical integration. With vertical integration, a service provider owns a downstream supplier, such as an energy company that sells gas and electricity, also owning the connecting pipes, cables and power stations. They also contend that the network demands of BT Sport are not very great, only 440 Kbps and emphasise that Openreach has not made significant investment. They also argue that they would also have an incentive to directly invest and become shareholders in Openreach themselves and so there would room for many more than one anchor tenant.

## Baby Bells experience in the USA

Should BT be forced to divest itself of Openreach, Gavin Patterson, CEO of BT warned that there would be a decade long legal quagmire, as BT would do everything to hold on. Legal delays following a break up are not without precedent. This did happen when the Bell system was broken up in the USA in the early 1980s, between AT&T providing long distance services, the Regional or Baby Bells providing local services and Western Electric, owned by AT&T, supplying the hardware. In the long run, it was a success. There was however a long period of disruption and legal disputes when Baby Bells, as captive users of the network, were unable to make Western Electric, effectively a sole source supplier, deliver equipment at reasonable price or in time. As sole suppliers, they had no incentive to expend cash to invest and increase production, but instead chose to raise prices. This led a huge number of legal disputes between the Baby Bells and AT&T. So post-separation, Openreach would still be a monopoly and a cash-cow that could increase its profitability by reducing investments. Detractors argue though that much as BT may want to retain ownership of Openreach, it would not be in the interests of BT shareholders to have a drawn-out legal dispute. And they point to the example of New Zealand where separation actually increased the value to shareholders.

Table 10

| | Options | TOTAL | PERCENT |
|---|---|---|---|
| 01 | Very positive | 61 | 5.26 % |
| 02 | Slightly positive | 179 | 15.44 % |
| 03 | Neither positive nor negative | 229 | 19.76 % |
| 04 | Slightly negative | 238 | 20.53 % |
| 05 | Very negative | 231 | 19.93 % |
| 06 | Don't know/it makes no difference | 221 | 19.93 % |

## Quality and incentive of service

Many of the communications providers (CPs) who use Openreach are not of the view that Openreach has served them with "zeal, energy and enthusiasm" as was originally intended by BT.

Vodafone in particular has cited its experience in the UK, in comparison to its ability to access the PIA in Spain and Portugal, where it has been able to roll out ultrafast FTTH networks to 7.95m premises in Spain and 2 million in Portugal. For Vodafone it is not just about the cost of accessing the PIA, but about inadequacy of the existing regulation governing the PIA.

Sky has claimed many missed appointment times, line faults, repair times and the length of time it takes to install a line. They have also raised the point that whenever Openreach does make an upgrade for Sky, their competitor, BT Retail is still capturing a percentage of the value as it feeds into the share price, a lower cost of debt and BT Group's sales. This creates a conflict of interest, that the greater the responsiveness to non-BT rivals like Sky, the greater the potential commercial downside to BT Group as a whole.

TalkTalk claim that Openreach's product innovation has been "slow and discriminatory" citing in particular the failure to develop a single jumper MPF product because BT did not use them and would not have benefitted itself. They also felt that service quality was very poor and unreliable.

In Openreach's defence, it does seem under Jo Garner, quite a lot of improvement was made, such as live-tracking of engineers and responsiveness has improved but not enough to satisfy its captive critics.

# Conclusion

Today, the United Kingdom finds itself at a crossroads. There is a profound disconnect between having the leading internet economy of the G20, making up 12.4% of GDP[50]. And yet it has some of the poorest universal coverage and download speeds of any industrialised nation. The demand for data, largely driven by video and hand-held devices is growing exceptionally fast, but the fixed access network investment has been woefully behind the curve, especially in comparison to many other nations. The lack of network infrastructure competition has been a huge hindrance to this. BT have done very well to extend the life of the copper network, but the UK cannot be getting ready for the future with a mere 0.003% pentration level of fibre to the premise. Incremental improvements with pre-existing assets based on short-term targets are no longer appropriate in a non-linear digital world.

Britain needs to have ambition, vision and longer-term infrastructure planning. This requires looking further into the future than the next 5 years and estimating what demand and technologies will look like.

With multi-gigabit speeds, many new capabilities become possible. Virtual reality, long-lampooned, is finally coming to market this year, with headsets from Oculus Rift, Samsung, Google and HTC. The ultimate promise of Virtual Reality is a new internet in and of itself. A virtual world will be lower cost, more varied, spontaneous and flexible than the real world and not just because it will defy the laws of physics. Above all, the marginal cost of adding new Stock Keeping Units – a measure of products in a given economy – will be close to zero and quickly exceed those in the real world.

Likewise, working from home and the death of distance has been much anticipated. Commuting in Britain at least to centres of commerce has in fact increased over the last 2 decades. However, very high network speeds and computational power open up the possibility of a virtual telepresence which ultimately may even start to undermine city centre property values and tax-funded public transport, further lowering the cost

[50] See http://www.consultancy.uk/news/1988/bcg-uk-internet-economy-the-largest-of-the-g20

of doing business. And even before we get to this point, a finding of IoD Policy Voice members was very clear; faster broadband would encourage just over 50% of their organisations to offer more flexible working opportunities to staff.

Equally, the digitisation and automation of transport will be dramatic and requires low latency and very frequent updates. Fully self-driving cars, expected on our roads from the middle of the next decade will require high bandwidth in both directions.

Network Rail believe digitising the signalling system can increase capacity by 40%. And NATS, the National Air Traffic System, already plan to make huge improvements by reducing the gaps between planes from 9-10 miles to 1 in the airspace above us. And of course flying drones – inevitably for deliveries and maybe for people too will rely on high capacity, resilient two way networks.

Britain already has many street cameras, but as the cost of data storage falls, very much more will be recorded on video which is again a big ask of networks.

Going forward, fibre to the premise has to be a big part of the solution for two reasons. First of all, in pure bandwidth limits, it is future proof. At approximately 100,000 times that of copper[51], once it is in place, maintenance costs are very low, it lasts decades and hardware upgrades to much faster speeds for optical splitters, optical network units and terminals are simple and off the shelf. A 1 Gbps connection does not upgrade to 1,040 Mbps but more likely to 2, 5 or 10 Gbps.

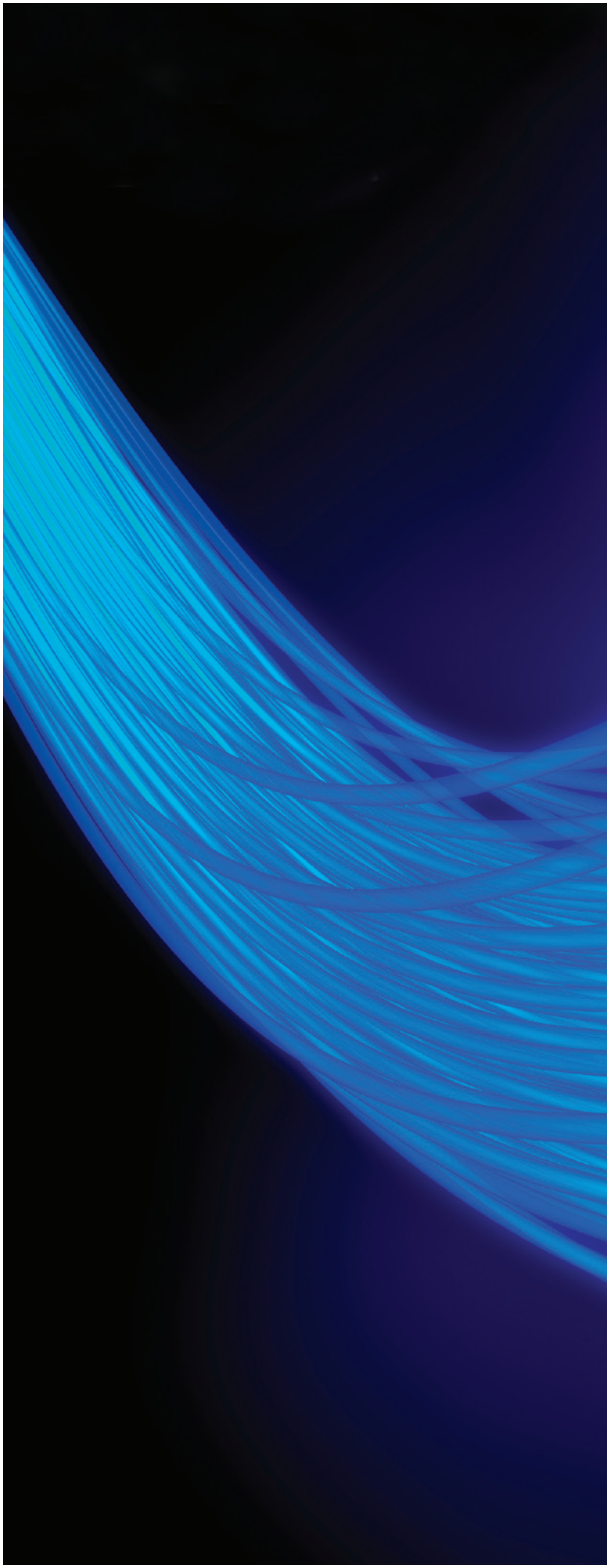
Secondly, it allows for high speed modular innovation for connectin upg satellite, wireless, mobile and other connecting technologies for those areas of the country where laying cables is not financially practical.

As and until 2030, policy needs to look at some more immediate concerns. There has been a priority given to connectivity to the home to serve the retail market. But business needs much higher priority given to faster networks and competition for services to the workplace. Today's cloud and video services depend on symmetrical upload and download speeds but they are severely held back by the current mostly copper fixed access network. Investing for the future cannot only be determined by the current download-driven TV watching habits of the retail marketplace.

Above all, we need new investors who seek a longer term return beyond the typical 3-5 year telecom company investment cycles. That means setting a longer term target for higher capacity and finding a way to bring in some of the world's $36 trillion pension funds that are comfortable with 15-20 year returns.

As big infrastructure projects go, upgrading UK broadband is much lower cost, easier and much more likely to make a healthy return than many other unfunded and larger infrastructure ambitions on paper today. The alternative of business as usual runs the terrible risk of spending twice or possibly three times on upgrading copper networks, while running the risk of remonopolisation and inevitably increased regulatory oversight. The cost in lost business and opportunity before eventually moving to fibre is not to be underestimated.

[51] See House of Lords Select Committee on Communications report "Broadband for all – an alternative vision" May 2012

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