
Ultra-fast digital infrastructure in the UK: are we missing a trick?

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SUMMARY

The UK government is caught between a rock and a hard place: it needs to show long-term commitment to upgrading the UK's digital infrastructure to ensure its industries can continue to innovate and compete with the likes of those in Korea, Japan and Singapore; but it cannot justify spending billions of pounds of taxpayers' money when the full future benefits of ultra-fast¹ speeds are impossible to foresee. However, the government need not be paralysed when faced with this quandary. We propose that it invests in the form of a £100 million Ultra-fast Digital Infrastructure Demonstrator Fund for creative and tech clusters to test the efficacy of new technologies and applications and measure customer demand.

1. INTRODUCTION

In 1858, the UK Parliament enacted legislation enabling the construction of London's sewer system. This colossal infrastructure project – worth £50–60 billion in today's prices – entailed the building of 132 km of underground brick main sewers to intercept sewage outflows, and 1,800 km of street sewers to channel the raw sewage which up until then had flowed through London's streets. When planning the project, the project's visionary and chief engineer, Joseph Bazalgette took the densest population, assumed the most generous allowance of sewage per person and calculated the diameter of pipe needed. He then doubled the diameter to be used, on the grounds that the investment would be made only once and there would always be unforeseen circumstances. This decision, it turned out, allowed London to cope with the unanticipated increase in its population density following the introduction of the tower block in the 1960s.

Jump forward 151 years to April 2009, when the Australian government announced a US\$43 billion infrastructure plan to build and operate an open access fibre National Broadband Network (NBN). The project would replicate the copper lines that connected Australia's 5,000 or so exchanges to its 11 million households ('fibre to the home', FTTH) and business premises with fibre ('fibre to the premises', FTTP), promising to deliver download speeds of 100 Mbps to 90 per cent of premises within eight years. The Prime Minister, Kevin Rudd talked a lot about history.² *"Like the building of the Snowy Hydro, like the building of the Sydney Harbour Bridge, this is an historic act of nation building."* *"Going beyond fibre optic to the node to the premises... puts us in the slot when it comes to being competitive with the world economy."*³ Long on national vision but short on evidence, the project was described five years later by one journalist as having been "Conceived and planned literally on the back of a drinks coaster... the most financially irresponsible project ever undertaken by either a state or federal government." With a new government at the helm the project was scrapped and replaced by a cheaper 'multi-technology mix' strategy, where the public sector invested in a variety of technology solutions.⁴

These two cases illustrate the quandary facing governments today considering their role in the adoption of next generation digital infrastructures. As it is impossible to fully anticipate what social and technological innovations will benefit from 1 Gbps speeds – roughly 50 times greater than average broadband speeds today – traditional approaches to policy evaluation such as cost-benefit analysis (CBA) are necessarily biased against public investment. At the same time, allocating vast sums of taxpayer money to projects without a CBA encourages governments to make decisions without considering the costs and benefits of the full range of options and recognising the differences in time frames over which costs are incurred and benefits enjoyed. Without a transparent CBA assumptions risk going unchallenged, making it difficult to refine and re-optimize the investment strategy as uncertainties get resolved over time.⁵

Such considerations are all the more important when there are heightened levels of scrutiny over the public purse, as has been the UK in recent years. They may go some way to explain **a tension in current UK policy: on the one hand, politicians are reluctant to back public investments of a multi-billion scale⁶ unless a case can be made on grounds of market failure and CBA; on the other, there is a widespread concern that the UK needs a world-leading digital infrastructure to develop the next generation of content, services and apps but is in this regard badly lagging competitors like Korea, the US and Singapore.⁷ Is the UK missing a trick?**

GOOGLE FIBER

In the US, FTTH has been pursued by telecoms companies with far greater zeal than in the UK, and arguably, more so than in any other nation outside of Asia. One of these is Google, with its burgeoning Google Fiber network offer now set to cover 12 US cities.

The service provides speeds of up to 1Gbps and was first rolled out to Kansas City via a competitive process. In February 2014, another 34 cities in nine metro areas were chosen as prospective candidates for the next competition round. Google subsequently selected Atlanta, Charlotte, Raleigh, Durham, and Nashville as the next cities that would receive FTTH deployment in 2015.

To avoid underground cabling complexity for the last mile, Google Fiber has pursued innovation in infrastructure delivery. This has led to reliance on aggregators dubbed 'Google Fiber Huts'. From these huts, cables travel along utility poles into neighbourhoods and homes, and stop at a 'Fiber Jack' in each home.

Google Fiber is continuing to grow; Evercore Partners speculates that Google could sign up as many as three million customers in the next seven to nine years, which would put it in the top ten US broadband providers.⁸

In answering this question it is important to understand that the fast-changing nature of the digital technology environment means that governments must at each point in time ask themselves whether their policy towards digital infrastructure is right. In Rob Kenny's words, "*decisions about broadband infrastructure are not 'for the ages', rather they sit in a dynamic environment with irreversible investments and great uncertainties about new access technologies and new applications.*"⁹ Given the stakes, a challenge therefore is to ensure that policymakers are fully informed about technological and market developments and have a process for continuous reflection and assessment, while avoiding creating policy uncertainty which itself holds back private investment. Viewed in this way, the optimal policy may actually have features of a transparent 'watching brief', to look out for and track developing opportunities.

However, as in other policy areas where technological and market uncertainties are great, governments should not underestimate the vital role they can play in uncovering opportunities through experimentation with digital technologies, on behalf of and jointly with the commercial sector.¹⁰ **Our answer is for the government to adopt a dynamic, experimental approach, working with the private sector to generate knowledge about workable technologies, applications and customer demand for ultra-fast speeds where this may unlock barriers to investment.** This would include working with those commercial providers who are at the cutting edge in already devising different ultra-fast solutions for their communities.

At the centre of this approach, the Government should set up a targeted demonstrator programme of at least £100 million to support the adoption of ultra-high-speed digital infrastructure in the UK's creative clusters - on the basis that these places are best positioned to be the earliest to exploit these speeds.¹¹ Adopters would be tracked, with the advent of any benefits acting as a trigger to government and the private sector for consideration of wider spread roll out.¹²

The costs of universal FTTH deployment in particular in the UK depend on a wide range of factors.

The biggest cost component is 'civils' - the physical installation of the infrastructure - which can represent 80 per cent of the total. These see only moderate benefit from technology development, and are primarily driven by labour costs. Areas with denser population are cheaper to serve, since the costs of civils per household are lower (because fibre lengths are shorter). This means that the wider the coverage the higher the unit cost, since more sparsely populated geographies fall within the scope of the calculation. Analysys Mason (2008) estimates that providing FTTH to 'the last 20 per cent' of homes in the UK would cost roughly as much as providing it to all of the other 80 per cent in more densely populated areas.¹³

A further cost consideration is the extent of spare capacity in existing ducts – that is, the amount of space left in the routes where cables can be laid: if they are full, new ducts have to be dug and this costs money. The 2012 House of Lords report – *Broadband for all – an alternative vision* – notes that different countries have very different starting points in this regard.¹⁴

With a mature infrastructure like the UK's comes an incumbent provider – in the shape of BT. Generally, the incumbent provider has advantages in terms of access to existing assets, such as ducts and a large and experienced workforce, which can reduce the costs of building FTTH. BT descends from The English Telegraph Company and dates back to 1846 (from which point the company has been developing its telecoms infrastructure); it now employs 87,800 people. Compare this to a new entrant Internet Service Provider (ISP), with perhaps 100 employees (many of whom may be contractors) and which as a result enjoys fewer economies of scale.

The type of property that the fibre is delivered to also impacts on costs; for instance, multiple dwelling housing can be cheap to serve due to the high density of people, requiring less cabling per home (though actually running the cables through people's homes may be challenging, not least for the prosaic reason that permissions of building owners need to be secured). Older or historic buildings can be problematic too, because new in-home wiring may be needed requiring separate permissions and (costly) modifications. For new developments, it turns out that the costs of FTTH are generally similar to copper. However, they tend to be much more expensive for existing properties because of the aforementioned civils, cabling, labour, and time implications.

So, as argued by Kenny, any estimate of FTTH deployment costs needs to be seen with these considerations in mind. In the following table, we provide a range of published FTTH deployment cost estimates – with those for other countries scaled by the UK's population to provide rough and ready estimates of UK costs. A number of these estimates are provided in the form of costs per household, and often for particular geotypes. Given the wide variation in costs for different geotypes, we do not attempt to scale these to national figures. Analysys Mason's well-known estimate for the Broadband Stakeholder Group in 2008 of (a costly) £25 billion does not look too conservative.¹⁵

FTTH Cost estimates

Report	Authors	Date	Scope and Coverage	Estimated cost (and £ equivalent) ²⁰
The costs of deploying fibre-based next-generation broadband infrastructure	Analysys Mason (for BSG) ²¹	2008	UK (split by geotype)	£25 billion for national coverage, £13 billion for 80 per cent coverage
Business Plan V5.2	B4RN	2013	UK rural roll-out	£1,116 per home (assuming 100 per cent take-up)
Innovative FTTH Deployment Technologies	FTTH Council	2014	Parham village, UK. ('Tractor broadband' using local agricultural contractors)	£2,000 per home
Szenarien und Kosten für eine kosteneffiziente flächendeckende Versorgung der bislang noch nicht mit mind. 50 MBit/s versorgten Regionen	TÜV Rheinland (for German government)	2013	Germany, nationwide	€85.5 - €93.8 billion [£53-58 billion for UK]
The Cost of Nationwide Fibre Access in Germany	WIK	2012	Germany, nationwide	€70 - €80 billion [£43-50 billion for UK]
A cost effective topology migration path towards fibre	Frank Phillipson, TNO [Netherlands Organisation for Applied Scientific Research]	2013	Urban Netherlands	€968 [£545] per connection
Modification and development of the LRAIC model for fixed networks 2012-2014 in Denmark	Tera Consultants (for Danish Business Authority)	2013	Denmark national coverage	DKK32.7 billion [£39 billion for UK]
The Italy and Spain NGA cases from a commercial and regulatory point of view	Analysys Mason	2013	'Western European Country' (with 20-25 per cent of premises in MDUs, 33 per cent uptake)	\$2,300 [£1,400] per connection
Costs of deploying FTTHdp with G.fast	Huawei	2014	Generic model for 'European country'	Per home connected (with 60 per cent market share): Urban \$2,100 [£1,300], Suburban \$3,300 [£2,100], Rural \$5,000 [£3,100]
NBN Co Strategic Review	NBN Co	2013	93 per cent coverage for Australia	A\$38.2 billion [£57 billion for UK]
Connect America Cost Model Overview	FCC	2013	Cost model for US carriers	Approx \$1,300 [£800] per premise passed investment cost for major carriers (higher for those in more rural areas)
Why Are You Not Getting Fiber?	Calix	2010	Cost for Verizon (in their selected roll-out areas)	\$700 per home passed plus \$650 per home connected [£440+£410]

2. WHAT WOULD YOU HAVE TO BELIEVE TO JUSTIFY PUBLIC INVESTMENT IN FTTH ROLLOUT?

Looking to the future, one way to consider what government policy on FTTH should be is to look at what it would have to believe in order to justify commitment to FTTH rollout today, as compared with our proposed experimental approach (Figure 1).

FIGURE 1 WHAT GOVERNMENT HAS TO BELIEVE TO JUSTIFY COMMITMENT TO FTTH ROLL OUT TODAY



Derived from: Kenny, R. (2015) 'Exploring the Costs and Benefits of FTTH in the UK.' London: Nesta

3. WHAT WOULD AN EXPERIMENTAL APPROACH TO ULTRA-FAST DIGITAL INFRASTRUCTURE LOOK LIKE?

Government would set up an Ultra-fast Digital Infrastructure Demonstrator programme, administered by Innovate UK. Different service providers would compete to trial the provision of ultra-fast services in creative and high-tech clusters (as informed by Nesta's report *The Geography of the UK's Creative and High-Tech Economies*).

This competitive fund might provide first round funding of £50,000 for around 30 applicants (which could be consortia), drawing on the model used for Innovate UK's Future Cities Demonstrator.¹⁶ Applicants might include Internet Service Providers, Local Enterprise Partnerships, development agencies like Creative England, local government, creative businesses, universities and technology companies. This would enable the consortia to carry out a feasibility study and to develop their Demonstrator project proposal. Those that have successfully completed the feasibility study would then be invited to submit a proposal for the Demonstrator itself.

Awards might be made to, say, a university to create an ultra-fast speed testbed environment that enables researchers, companies and other agencies to collaborate with the aim of exploring connectivity options within (and between) clusters. The role of private sector organisations in the Demonstrator is critical, where responsiveness to change rests on timely investment in infrastructure. One instance where this is already happening is through Bristol is Open, a joint venture between Bristol City Council and the University of Bristol. In a move to combine university research and advanced technology with council-owned infrastructure, the venture is developing an innovative high-performance, ultra-fast city-wide network.¹⁷

The fund would need to be flexible, as digital infrastructure needs, and therefore the precise activities of the Demonstrator, will vary from place to place. The experience of initiatives like the £11.38 million Gigabit Bristol¹⁸ programme (grant funded by BDUK under the Super Connected Cities programme) and the £24 million Glasgow Future City programme (funded by Innovate UK) should be studied carefully. In all cases the Demonstrator's aim would be to generate dynamic and timely data and insights that would be shared with other clusters.

The activities the Demonstrator would undertake would be expected to include (though not be restricted to) the following activities:

- Testing methods for reducing the cost of 'civils' (installing fibre in the ground and into people's homes) which can represent 80 per cent of total costs. This is as much about reducing labour costs and disruption to households as it is technology-related.
- Tracking the development of new commercial applications of and services delivered through ultra-fast provision.
- Monitoring the development of new civic applications which may not be sustainable on purely commercial grounds (including those aimed at innovative delivery of public services).
- Analysis of the behaviour of households moving to higher speed connections, to understand if this results in changed behaviour and in particular increased usage of applications with positive externalities.
- Collection and publication of anonymised longitudinal data sets adhering to the ODI's Open Data Certificate standards.¹⁹

4. THE UK SHOULD THINK BIG, BY ALSO THINKING SMALL...

A strong partnership between the state and commercial providers goes to the heart of the policy we advocate. This need not be restricted to just large incumbents and big, city-level infrastructure projects, however. In particular, the government should also work with smaller agencies and Alt Nets who are adopting innovative models of ultra-fast provision throughout the UK. These projects may not only have great impacts on the local places they serve, but – supported appropriately – act as testbeds for the development of lower cost, locally-responsive provision in other parts of the country. One of the priorities of the proposed Demonstrator fund would be to explore which local characteristics these innovative models of delivery are best suited to.

When we talk about Alt Net broadband provision in particular, we think of ventures like Broadband for the Rural North (B4RN) where people in the community come together, offering labour and time for free or with payment in kind. But there are many examples of innovative urban developments, at multiple spatial scales, and with varying scope – a few of which we highlight here.

BRISTOL IS OPEN: THE CITY DEMONSTRATOR

Bristol Is Open is a joint venture between the University of Bristol and Bristol City Council. It is funded by local, national and European governments, with additional funding from academic research, and by the private sector. Launched on the 10 March 2015, it aims to deliver research and development initiatives that contribute to the development of a smart city and the ‘Internet of Things’.

Once ultra-fast networks are established in Bristol, they will be extended out to the wider city region, to Bath, parts of North Somerset and South Gloucestershire. The West of England Local Enterprise Partnership outlines details of the Local Growth Fund in its Strategic Plan, which will support this further roll out over the next three years.²⁰ These networks are for research and development projects, they will not provide free or commercial broadband or Wi-Fi. However, Bristol is Open suggest that there will be opportunities for people to join one of the experimental projects.

Large amounts of data will be generated by the programme, which will be available for research purposes through an ‘open data portal’. Bandwidth capacity will also be used for the dissemination and production of creative content, which will flow through the network at ultra-fast speeds.

A range of partners are involved in the programme, including large telecoms and software companies, small hi-tech start-ups, public service delivery organisations, and academics. The active, wireless and mesh network will be technology agnostic, and built on open network principles using software defined network technologies, that enable network function virtualisation.²¹

BROADBAND FOR THE RURAL NORTH (B4RN): THE RURAL COMMUNITY

B4RN (Broadband for the Rural North) is a community-led project to bring FTTH to domestic and business properties in rural Lancashire, in the north of England. It is rolling out a FTTH network – ultra-fast with 1 Gbps capability, which is community-built and also functions as an ISP.

B4RN was formed to raise funds from the sale of shares and own and operate the network. However, much of the labour to dig trenches was supplied by local volunteers, who were rewarded with the chance to get a connection for their families or businesses, and some work is also rewarded in the form of shares. Farmers and other landowners allowed free access for buried cables to cross their land.

According to B4RN, the purpose of the project is to take a new approach to the ownership, financing and deployment models used traditionally by incumbent telecommunications companies. These models invariably leave rural areas outside of the scope of economic viability, and have helped to create the ‘Digital Divide’ between rural and urban Britain.

The grassroots development of ultra-fast broadband by community volunteers forms part of a broader sharing movement – an economy that is growing in the UK (Nesta, 2014).

HYPEROPTIC: THE BUILDING

Hyperoptic is a fibre-based ISP installing and maintaining its own dedicated network, based in West London. The company began rolling out services in 2011 to large residential properties throughout the city – with the installation at Prices Court in Wandsworth credited as the first residential property to receive a 1 Gbps connection in the UK. Now with activity in almost all major UK cities, Hyperoptic is crossing the 75,000 home mark for those using their services.

Founded by Boris Ivanovic (Chairman) and Dana Tobak (Managing Director), Hyperoptic works with freeholders, developers, property managers and residents to facilitate gigabit fibre installation in viable properties. The company was named ‘Best Superfast broadband’ provider and ‘Best Use of Digital’ at the 2014 Internet Service Providers’ Association awards and ‘Most Innovative Provider 2013’ by Broadband Genie.²²

ULTRAFast YORK: THE CITY

CityFibre is building an ultra-fast, city-wide, FTTP network in the City of York to deliver broadband speeds of up to 1 Gbps to tens of thousands of homes and businesses.

The provider is collaborating with Sky and TalkTalk, who will retail competing broadband services over the new infrastructure, with the first York customers expected to be online this year. The network will enable Sky and TalkTalk to offer customers better value for higher speeds than is currently available, providing increased choice and innovation in broadband for consumers.

CityFibre, Sky and TalkTalk will work in partnership with the community in York to help ensure the network delivers the benefits that better broadband can provide, including helping to grow the local economy and supporting York businesses to better compete in the UK and abroad.

CityFibre also operates an extensive FTTH network in Bournemouth. Their open access network connects over 21,000 homes, providing consumers and service providers with next generation digital infrastructure.

ENDNOTES

1. By 'ultra-fast' we refer to the highest speeds, in the hundreds of Mbps and as much as 1Gbps, which can be delivered by pure fibre as well as hybrid technologies like G.fast.
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16. For more information see: <https://connect.innovateuk.org/web/future-cities-special-interest-group/demonstrator>
17. For more information see: <http://www.bristolisopen.com/>
18. Gigabit Bristol was the predecessor of Bristol is Open and provided businesses with connection vouchers to incentivise ultra-fast connectivity across the city
19. For more information see: <https://certificates.theodi.org/about>
20. West of England LEP (2015) 'Local Growth Fund.' Available at: <http://www.westofenglandlep.co.uk/funding/local-growth-fund>
21. Bristol is Open (2015) 'Overview.' Available at: <http://www.bristolisopen.com/>
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