



# Building GIGABIT Britain

The pivotal role of the Altnets  
in delivering the connectivity  
the UK needs to prosper

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## Introduction

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The past few years have seen a flowering of businesses building new digital networks in competition with BT. They provide pure fibre networks (Fibre to the Premise (FTTP)), fixed wireless networks (FWA), hybrid networks and satellite broadband services. They operate in urban and rural areas and have a range of business models. However, none own a copper phone network and, with limited exceptions, they do not rely on state aid. Instead they use commercial investment to build brand new networks and establish close relationships with the communities they serve. These companies are INCA's members – the Altnets.

Extensive FTTP, with complementary wireless networks, is fundamental to the UK's future success. *Building Gigabit Britain* presents a comprehensive overview of the benefits of investment in pure fibre networks, as well as comparisons between the performance of FTTP and other technologies, such as G.fast, concluding that wide-scale deployment of FTTP is necessary to deliver Gigabit Britain.

The UK has done well in the deployment of first generation and superfast broadband, but it lags behind all its international competitors in the deployment of FTTP networks. BT continues its strategy of extending the life of the copper network, while the Altnets are already building Gigabit Britain, stepping up to the challenge of investing in and constructing digital infrastructure fit for the 21st century.

Altnets already offer FTTP connections to twice as many premises as BT and by 2020 we forecast they will reach 18% of the UK with FTTP – 1.5m premises more than BT and Virgin Media's planned FTTP builds combined. Together, the Altnets form the UK's third digital infrastructure competitor.

In this report we present six recommendations, which, if followed, will help the Altnets to meet and exceed their current deployment plans. Our recommendations do not demand Government subsidies, but Government does have a vital role to play. It needs to set out a clear Gigabit Britain Strategy, including a target for the majority of the UK to have access to an FTTP connection by 2026 – we think that 80% FTTP coverage can be delivered competitively by the market in the next ten years.

If INCA's recommendations are implemented we believe the Altnets can deliver around half of these FTTP connections by 2026. This sector is ambitious, capable and central to Building Gigabit Britain.

**David Cullen**, INCA Chair and **Malcolm Corbett**, INCA CEO

8 September 2016

## Executive Summary

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- 1.1 Digital connectivity is already a critical building block for a strong modern economy and is set to become even more important. The world is on the verge of the next phase of the digital revolution, which will transform all aspects of our lives through tech-enabled developments such as the Internet of Things, smart cities and automated vehicles. Only countries with digital infrastructure fit to support a “Gigabit Society” will be able to fully exploit this new digital wave.
- 1.2 The UK is at an important juncture in determining how to develop the digital infrastructure needed to build on its existing digital strengths. The regulator Ofcom declared in its Strategic Review that “fibre is the future”<sup>1</sup> and is putting plans in place to deliver this vision. The previous Digital Economy Minister, Rt Hon. Ed Vaizey MP, spoke of the need for “Gigabit Britain”<sup>2</sup> to succeed today’s Superfast Britain and a Digital Strategy outlining further details is expected shortly.
- 1.3 A mix of digital networks will be needed to support Gigabit Britain, with wireless networks in particular playing a critical role. However, INCA argues that to meet the Government’s goal of ensuring “the UK builds the right infrastructure to maintain [its] position as a world leading digital nation”<sup>3</sup>, a significant step-up in the extent of Fibre to the Premise (FTTP) networks is required. The alternative networks – or “Altnets” – are already building these future-ready networks and can play a central role in delivering the scale of FTTP required in the UK, if the right policy and regulation is in place.
- 1.4 Gigabit Britain will need networks that deliver not just fast download speeds to some of the people some of the time (as is the case with copper-based networks such as Fibre to the Cabinet (FTTC) and G.fast, the next copper upgrade), but networks that consistently, reliably and securely deliver high upload speeds, low latency and ultrafast download speeds. FTTP is the only fixed-line network able to fully deliver against these criteria and support a Gigabit Society. Fibre is also essential for the roll out of 5G and other wireless networks, has far lower operating costs and energy consumption than copper, and can help the UK meet wider policy objectives, such as increased productivity, a balanced economy and a smart approach to energy and public services.
- 1.5 Most of the UK’s international competitors have already understood that strong future economies will be built on FTTP and are making firm progress towards widespread coverage, often spurred on by clear government visions for a Gigabit future and a supportive regulatory environment. However,

while the UK performs well against its peers on today's key connectivity metrics – superfast speed, coverage, take-up and price – it performs poorly against the critical metric for tomorrow's connectivity – the extent of FTTP deployment. Unless there is a swift and significant increase in FTTP deployment, the UK will trail behind all other developed nations on connectivity, significantly undermining its long-term economic growth and competitiveness.

- 1.6 BT has made clear that its plans for the future rest not on fibre, but copper. The upgrade of the Openreach network to G.fast promises eye-catching potential top download speeds but the copper in the connection will simply repeat today's broken broadband problems: unreliable service, a patchwork of “up to” speeds and post-code variations and potentially an even greater digital divide between those with 1Gbps+ speeds and those without. The UK must therefore look to BT's competitors to lead the FTTP charge. Virgin Media will play a significant role in providing competition, but a third competitive force is required to deliver FTTP deployment at scale, sufficient competitive pressure on BT and choice for consumers.
- 1.7 Collectively, the Altnets provide the additional competition required. They are deploying FTTP, growing fast and attracting significant and rising investment. INCA's 2016 Member survey<sup>4</sup> shows that Altnets already pass more than twice as many

premises with FTTP as BT<sup>5</sup>. By 2020 the Altnets forecast their FTTP networks will pass nearly 5m premises (or 18% of the UK) – 1.5m premises more than BT and Virgin Media's planned FTTP builds combined<sup>6</sup>. The Altnets' say that their deployment plans could increase by between 25% and 50% in a more supportive policy and regulatory environment<sup>7</sup>. To build Gigabit Britain, Government and other stakeholders must therefore recognise the significance of the Altnets and ensure that policy and regulation maximise their potential.

- 1.8 To do this the Government needs to build on Ofcom's Strategic Review announcements and go further, by setting out an ambitious and coherent “Gigabit Britain Strategy” focused on encouraging commercial investment in FTTP networks. To give focus to the Strategy and confidence to investors, network builders and operators, the Government should announce a target for the majority of UK citizens to have access to a FTTP connection by 2026 and near universal coverage by 2030. INCA suggests that coverage of 80% of the UK with commercial FTTP by 2026 is an attainable goal, which is also in line with the level of competitive infrastructure that Ofcom believes can be achieved<sup>8</sup>. Based on their current deployment trajectory, and on the condition that the recommendations in this paper are adopted, the Altnets are confident they are on track to reach around half of the 80% commercial coverage target by 2026.

- 1.9 The target is ambitious but achievable through commercial deployment rather than public subsidy: the cost of delivering FTTP has fallen significantly in the last decade and the Altnets' deployment forecasts, combined with the sharp increase in commercial investment in FTTP elsewhere in the world, prove there is commercial appetite to deploy at scale – in the right policy and regulatory conditions.
- 1.10 The coming digital revolution provides an opportunity for the UK to translate its existing digital strengths into significant social and economic gains. However, to do so requires a quantum leap in the quality of our digital infrastructure. The Altnets are already building FTTP networks fit for Gigabit Britain and are on course to reach a significant proportion of the UK by 2020. However, a clear Government strategy that prioritises competition and investment in truly future-ready networks is required to unlock the Altnets' full potential.

## Recommendations for Building Gigabit Britain

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### **Recommendation 1: Government should set out a Gigabit Britain Strategy, specifying the UK's ambition for fixed-line digital infrastructure, which includes:**

- announcing a target for the majority of the UK to have access to a FTTP connection by 2026 and near universal coverage by 2030, with 80% coverage commercial deployment by 2026 suggested as an attainable goal;
- encouraging the UK's devolved administrations, cities and local authorities to create their own local Gigabit strategies, which should include exploring the feasibility of anchor tenancy arrangements and agreeing wayleaves to bring Gigabit services to council housing stock;
- asking the National Infrastructure Commission to advise on the development of the Strategy as part of a broader Government review, including developing an up-to-date costing analysis of commercial FTTP deployment;
- aligning all relevant Government policies and programmes to support the Strategy, including ensuring the broadband USO policy does not undermine incentives to invest in competitive infrastructure.

### **Recommendation 2: To encourage greater investment in FTTP networks, Government should:**

- oversee a fundamental review of the business rates for fibre, including removing all rates on new fibre assets for 10 years;
- ensure the launch of the Broadband Investment Fund, to give confidence to the wider investor market and provide an important source of capital to alternative networks.

### **Recommendation 3: To remove barriers to FTTP deployment, Government should:**

- make amendments to the New Roads and Street Works Act 1991 to reduce the notice required on minor roads, review the circumstances under which Permits are required and charged for, and adopt a more common sense approach to builds on recently laid footpaths and roads;
- work to retain the key elements of the Electronic Communications Code as it becomes law (including provisions on fair valuation, the right to upgrade and contracting out) and ensure that a connectivity-focused Code of Practice is in place to underpin the working relationship between Communications Providers and landowners.

**Recommendation 4: To ensure efficient use of public subsidies and assets, Government must:**

- ensure that tight and strictly enforced rules are in place prohibiting the overbuild of FTTP networks using public subsidy (which will also reduce the negative impact of overbuild on the FTTP investment case);
- commission a comprehensive inventory of existing public sector infrastructure assets and make those assets available to builders of FTTP networks on a fair and non-discriminatory commercial basis.

**Recommendation 5: To deliver its vision of a “fibre future”, Ofcom must place competition and investment in FTTP networks front and centre of all its work by:**

- ensuring that BT Openreach’s governance does not inhibit investment by alternative networks;
- ensuring that BT Openreach fully commits to making Duct and Pole Access work by providing timely, effective and fit for purpose access to its ducts and poles;
- applying passive remedies consistently across all fixed markets, through the DCR, the BCMR and the forthcoming fixed market reviews;

- requiring that procurement of BT Openreach services by BT Consumer takes place in an open and transparent way;
- creating an independent tribunal to resolve disputes between BT Openreach and alternative operators.

**Recommendation 6: To stimulate the demand needed to drive FTTP investment, the ASA should review its guidelines to ensure that future advertising of both FTTP and copper-fibre hybrid products gives consumers the accurate information required to make informed choices.**

## Sponsors

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To download the full *Building Gigabit Britain* report go to: <http://inca.coop/building-gigabit-britain>

## About “Building Gigabit Britain”

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- 2.1** The UK is at critical point in determining how to build a digital infrastructure fit for the future. At the start of 2016 the UK Government began to talk about the need for a “Gigabit Britain”<sup>9</sup> to supersede today’s Superfast Britain and the regulator, Ofcom, called for a “new fibre future”<sup>10</sup> in its Strategic Review.
- 2.2** In the autumn of 2016, against a challenging and uncertain political and economic backdrop, and with concerns about the UK’s digital infrastructure continuing to be voiced, it is imperative that Government and Ofcom take the right steps to secure the UK’s future prosperity. In this context, the Independent Networks Cooperative Association (INCA), which represents the UK’s alternative networks or “Altnets”, publishes *Building Gigabit Britain* to offer constructive and forward-looking ideas.
- 2.3** Fixed-line and wireless networks<sup>11</sup> will be as important as each other in delivering future connectivity, given that most networks are increasingly fixed-line with wireless providing the final connection to the device. *Building Gigabit Britain* focuses on the fixed-line side of that equation and argues that the UK should be aiming for the majority of those fixed-line connections to be Fibre to the Premise (FTTP).
- 2.4** The verdict that FTTP is “best in class” is not new<sup>12</sup>. However, the case against widespread deployment to date has centred on the view that there is neither a case for public subsidy nor commercial deployment at scale because most citizens’ needs are met with “good enough” connectivity and because the investment required for FTTP is significant. It was in this context that the incumbent BT, supported by the Government, chose to upgrade its existing copper network to Fibre to the Cabinet (FTTC) to deliver the Superfast Broadband programme, rather than build the more future proof FTTP.
- 2.5** Regardless of whether or not this was the right decision at the time, *Building Gigabit Britain* argues that the context has now changed and that Government policy urgently needs to adapt. The paper’s central argument is that the UK does now need widespread FTTP coverage to continue to thrive economically and that the market can deliver FTTP to the majority of the UK without public subsidy, if it has the right public policy support. Furthermore, it will be the competitors – and in particular the Altnets – rather than the incumbent, that will drive that deployment. Key to building Gigabit Britain, therefore, is maximising the potential of the Altnets:

- Part One of *Building Gigabit Britain* briefly looks at why the UK urgently needs to achieve a significant step up in FTTP deployment, with a more extensive explanation in Annexes One and Two;
- Part Two looks at how that step-up can be delivered by the market – and in particular the Altnets – where progress is taking place, but needs to be super-charged;
- Part Three offers a series of recommendations for policy-makers and regulators to help the Altnets to deliver what the UK requires.

## Terminology

- 2.6 “FTTP” is used throughout the paper to refer to access networks that take fibre right to the premise (including Fibre to the Building (FTTB) and Fibre to the Home (FTTH)).
- 2.7 “Gigabit” is used not just in the literal sense, to mean connections that are capable of 1Gbps+ download speeds, but also in the wider sense: networks that can support the next generation of digital applications and services (see Ed Vaizey MP talking about “Gigabit Britain”<sup>13</sup> and EU Commissioner Günther Oettinger talking about “Gigabit Europe”<sup>14</sup>.)

## Methodology

2.8 *Building Gigabit Britain* was written between March and August 2016, using desk research, the findings of the INCA 2016 Member Survey (conducted in June and July 2016 and based on 22 responses), and consultation with the following people (noting that consultation does not constitute endorsement):

- **Ali Law**, *Head of UK Policy, Sky*
- **Ben King**, *Chief Executive, WarwickNet*
- **Brett Wilde**, *Business Development, Rala*
- **Brian Robertson**, *Partner, Cameron Barney*
- **Clive Carter**, *Director of Strategy, Ofcom*
- **Craig Jones**, *Broadband Business Development Director, Hellerman Tyton Data*
- **Craig Ormsby**, *Business Development Manager, Tratos*
- **Dana Tobak**, *Managing Director, Hyperoptic*
- **Daniel Heery**, *Project Manager, Cybermoor*
- **Dave Russell**, *Solutions Marketing Director, Calix*
- **David Cullen**, *Group Commercial Director, ITS Technologies Ltd and INCA Chair*
- **Dr Peter Cochrane**, *Peter Cochrane Associates*
- **Gavin Young**, *Head of Fixed Access Centre of Excellence, Vodafone Group Services*
- **Grant Forsyth**, *Director, Plum Consulting*

- **Hieran Dhimar**, BDUK
- **Ian Dabson**, HM Treasury
- **James Enck**, Head of Corporate Development and Investor Relations, CityFibre
- **Jill Mckenzie**, Department of Culture, Media and Sport
- **Joe Wilson and Tom Jenkins**, Investors, Business Growth Fund
- **John Light**, Managing Director, Tratos
- **Karen Wray**, Regulatory Lead, Vodafone UK
- **Karin Ahl**, Rala and Chair, Policy and Regulatory Experts Group, FTTH Council Europe
- **Louise Lancaster**, Head of Regulation and Government Affairs, UK Broadband & Relish
- **Mark Collins**, Director, Strategy and Public Affairs, CityFibre
- **Mark Swarbrick**, Department of Culture, Media and Sport
- **Matilda Dunker**, Department of Culture, Media and Sport
- **Matt Agar**, Deputy Director, BDUK
- **Matthew Evans**, CEO, Broadband Stakeholder Group
- **Matthew Hare**, Chief Executive, Gigaclear
- **Navin Sankersingh**, kikiri.co.uk ltd
- **Nick Delfas**, Partner, Telecommunications Services Research, Redburn
- **Oliver Bradley**, HM Treasury
- **Paul Morris**, Head of UK Government Affairs and Sustainability, Vodafone UK
- **Philip Higgins**, Project Manager, Bristol Futures
- **Rob Leenderts**, Director, Next Generation Internet Services Ltd
- **Samira Gazzane**, Policy Manager, Broadband Stakeholder Group
- **Seamus Given**, Director of Construction, CityFibre
- **Stefan Stanislawski**, Co-Founder Commercial, Ventura Next
- **Stephen Hilton**, Director, Bristol Futures
- **Thalia Baldwin**, HM Treasury
- **Yih-Choung Teh**, Competition Policy Director, Ofcom

## **PART ONE: Building Gigabit Britain** requires a significant step up in FTTP deployment

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*Note that a fuller explanation of future connectivity needs, the ability of different networks to meet those needs and an overview of the UK's competitors' FTTP deployment progress, can be found in Annexes One and Two.*

- 3.1** We are approaching the end of the first phase of the digital revolution, which over the past 25 years has changed how we communicate, shop and are entertained, and are about to enter a second, with the advent of tech-enabled developments such as the Internet of Things, big data, e-health, industry 4.0, virtual reality, smart energy, cloud computing and smart cities. As the House of Commons Business, Innovation and Skills Select Committee recently noted, “technology is going to revolutionise, or is already revolutionising, business, transforming virtually all aspects of the economy and society”<sup>15</sup>.
- 3.2** Harnessing this new digital revolution sits at the heart of the UK's future success – in driving productivity, rebalancing our economy, boosting employment, finding smart ways to provide public and civic services and securing affordable energy. Underpinning all of this is connectivity: there can be no driverless cars without connectivity to traffic lights and sensors; no remote working without business-grade connectivity at home and on the move; no online diagnosis and consultations without adequate

connectivity for both patients and healthcare professionals. Creating a fit for purpose digital infrastructure that can support a “Gigabit Society” is therefore a key public policy objective for the UK.

### **The connectivity requirements of Gigabit Britain**

- 3.3** An analysis of future connectivity requirements shows that our networks will need to deliver much more than ultrafast download speeds. The vast majority of end users, whether they are an individual consumer, a business or a connected object, located in a suburban house, a city centre tech hub or a rural village, will require the following Quality of Experience:
- **Ultrafast download speeds** – at and beyond 1Gbps
  - **Higher upload capacity** – a more balanced upload/download ratio
  - **Low latency** – as little as tens of microseconds for data to move from one point to another
  - **Consistent, reliable and secure service** – dependable, seamless and uniform access regardless of location, weather or device
  - **Good consumer outcomes** – including innovation, value for money and competition (for example with multiple retail providers using networks to offer different product to consumers).

### FTTP can meet Gigabit Britain's requirements

- 3.4 As we explain fully in Annex One, although a mix of network types – and in particular wireless – will be required to support Gigabit Britain, Fibre to the Premise (FTTP) is the only fixed-line network able to fully deliver against these criteria. A copper-fibre hybrid network – Fibre to the Cabinet – makes up the majority of BT Openreach's network, which BT, Sky, TalkTalk and other ISPs use to deliver today's Superfast Broadband. BT has chosen a copper-fibre upgrade – G.fast – as the basis for its plan for the future. However, while G.fast will be able to deliver very high potential top download speeds to those living close to the cabinet, it falls short against almost every other Quality of Experience criteria, thanks to the physical limitations of copper.
- 3.5 Like today's FTTC, G.fast speeds will vary considerably according to location, with around 100Mbps drop for every 50m increase in distance<sup>16</sup> (bearing in mind that the "typical distance from a cabinet to a customer is 350m"<sup>17</sup>). Also like FTTC, it will be weak on reliability and consistency of performance because copper is vulnerable to external interference from sources such as bad weather, lightning strikes<sup>18</sup>, radio transmitters and power lines<sup>19</sup>.
- 3.6 BT Openreach's FTTC is already causing UK consumers and businesses considerable frustration because of its unreliable service<sup>20</sup>. However, the demands of future applications will expose

copper's fundamental weaknesses yet further. This means that although G.fast will deliver very high download speeds to some premises, it will repeat the reliability and consistency problems that the UK currently experiences with FTTC and accentuate the patchwork provision of "up to" download speeds. This may create an even greater digital divide between those close to the cabinet, who benefit from very high "peak" download speeds, and those living further away, especially in rural areas. G.fast will also be less able to deliver other important Quality of Experience criteria, such as higher upload speeds and low latency.

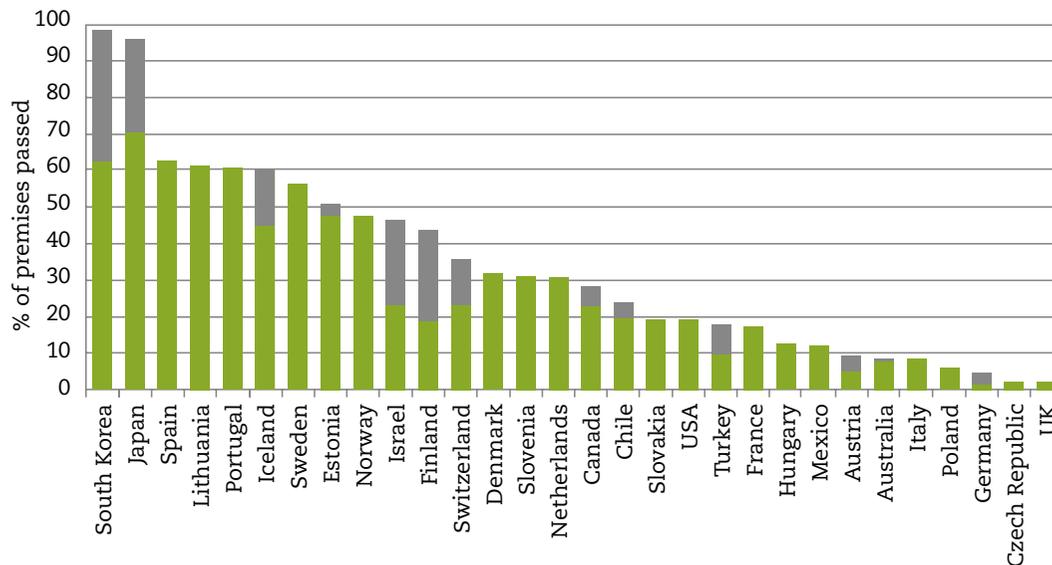
- 3.7 Cable, through the expected upgrade to Docsis 3.0, will be able to offer both improved speed and quality of connectivity, meaning that it will have an important role to play in Gigabit Britain. However, it is more limited in its ability to offer wholesale access and therefore competition in the retail market.
- 3.8 By comparison FTTP is able to deliver gigabit speeds, very low latency and greater upload speeds consistently, reliably and securely to all users regardless of location, and is much more resilient to external interference such as bad weather. It can also bring competition to markets because of its potential to offer wholesale access to multiple providers. Furthermore, it performs well against important wider criteria (as we explain in Annex One):
- Extensive fibre is critical to the UK's wireless networks, including 5G and the Internet of Things;

- Emerging studies on the socio-economic impact of fibre-based gigabit societies reveal their ability to create employment and deliver savings and benefits in energy, healthcare, telecommuting and electricity;
- Fibre networks are much cheaper to maintain and have lower energy requirements than copper;
- Fibre networks are also future proof, only requiring equipment changes at each end to increase or change capacity.

3.9 Together these characteristics mean that fibre stands out as the only fixed-line technology that can truly support a Gigabit society. The extent of a nation's FTTP deployment is therefore the key metric for future digital readiness. However, while the UK performs well against its peers on today's connectivity terms – superfast speed, coverage, take-up and price – its very low level of FTTP deployment means it risks falling behind other developed nations on connectivity.

### The UK lags behind on FTTP deployment

Figure 1: Fibre coverage to premises in OECD nations, end-2015



■ FTTB/VDSL  
■ FTTP

Source: A reset version of Figure 7 from Making Communications Work for Everyone, Ofcom's DCR Statement, February 2016, using Analysys Mason source material from September 2015. Note: Analysys Mason figures are based on actuals for 1H 2015 and forecasts for 2H 2015. FTTB/VDSL is fibre-to-the-building where in-building distribution is via VDSL (very high bit rate digital subscriber line) over copper connections.

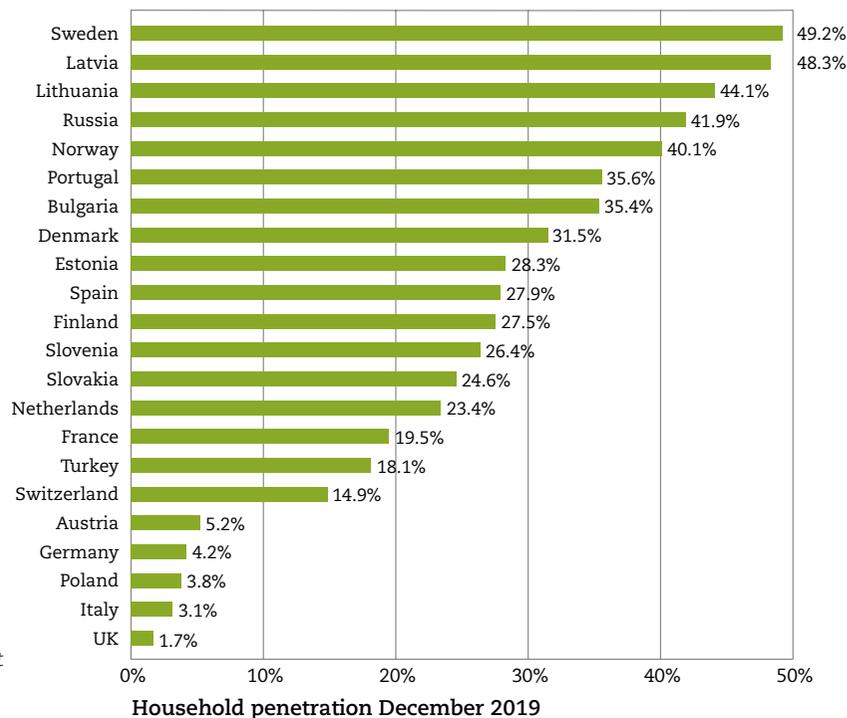
3.10 As Ofcom notes, the UK currently has the lowest FTTP deployment in the OECD, with around 2% coverage. All of the EU countries that the UK leads on today's terms – including France, Germany, Italy and Spain – are out-performing the UK in their preparation for tomorrow (see Figure 1).

3.11 Even more concerning is the trajectory the UK is on compared to these key competitors. FTTP deployment projections for 2019 show the UK sitting at the bottom of the list of 22 EU countries (see Figure 2).

3.12 As the country-specific stories in Annex One show, the majority of the UK's peers are now making firm strides towards significant FTTP deployment, often spurred on by decisive government and regulatory plans for the future.

**3.13** BT's decision to upgrade its copper network to FTTC to deliver the Superfast Broadband programme has given the UK short-term advantages and provides a strong platform from which to maintain its position as a leading digital economy. However, the UK now rapidly needs to get out of the FTTP starting blocks if it is to avoid significantly trailing behind in a decade's time, with disastrous consequences for its economic prosperity.

**Figure 2: FTTH countries in Europe 2019\* by household penetration**



Source: A reset version of chart on page 19 of "European FTTH Forecast, 2014-2019: Behind The Numbers", FTTH Council, April 2015.

\*Among the 22 countries analysed in detail

### B4RN – Broadband for the Rural North

One of the most inspiring local fibre projects is B4RN based in rural Lancashire and extending into North Yorkshire and Cumbria. Set up by a volunteer group in late 2011, B4RN has connected more than 2100 premises to its pure fibre network, offering speeds of 1Gbps at very cost-effective prices. The project was founded as a community benefit society (a form of co-operative) and has raised £4m in community shares and loans to finance its operations. An army of volunteers, now numbering in the hundreds, helps the core B4RN team keep costs down and guarantees a high level of local community involvement. It also means B4RN can reach all properties in their catchment area. They are literally digging their own gigabit fibre network, with nobody left behind. Not surprisingly take-up is excellent, averaging 65% in the communities B4RN serves. This is astonishingly high by industry standards. As word spread B4RN has experienced a snowball effect with more and more neighbouring parishes wanting to get involved.

B4RN features regularly in the media as a demonstration of rural community empowerment. In 2015 their efforts received royal recognition with a visit by HRH The Prince of Wales.

[www.b4rn.org.uk](http://www.b4rn.org.uk)

## PART TWO: The critical role of the Altnets in **Building Gigabit Britain**

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4.1 INCA believes that the UK, led by a competitive market, can catch-up on FTTP roll-out and retain its leadership if political and regulatory rhetoric is translated into enabling measures that allow the market to accelerate deployment. The last 12 months have seen a series of major infrastructure investment and deployment announcements from both BT and competitors. However, a closer look shows that BT is unlikely to lead the UK's charge up the FTTP rankings and that competition is needed to boost FTTP deployment to the level required.

### BT will not deliver the scale of FTTP required

4.2 BT announced its vision for the future in September 2015: extending FTTC beyond 95% and using G.fast to deliver ultrafast broadband to 10m premises “with speeds of 300-500Mbps by end of 2020”<sup>21</sup>. Connections of 1Gbps using G.fast will be available to those who request it. Under regulatory pressure, this plan was extended from 10m to 12m premises with an “ambition to pass 2m of those homes and businesses with FTTP”.<sup>22</sup> BT has said it will invest £6bn to deliver this plan, “subject to regulatory certainty”.

4.3 However, if BT's announcements are examined further, the game-changing impact of its plan on the UK's FTTP future comes under question:

- 2m premises is 8% of the UK by 2020, which barely moves the UK up the FTTP leaderboard, especially as international competitors will have further advanced their own deployment plans by then;
  - The FTTP connections will be “mainly in new housing developments, high streets and business parks”<sup>23</sup>: the mass residential market will be left untouched by BT's FTTP as we enter the next decade;
  - The FTTP “ambition” was not accompanied by a capex budget increase, which raises questions about whether it is realistic;
  - The “ambition” is conditional on BT getting a BT Openreach governance settlement it can live with, which will take time and may not be realised;
  - £6bn covers BT's mobile investments through EE, as well as its fixed-line investment, with the split between the two unclear.
- 4.4 Despite the promise to “deliver Britain's digital future”<sup>24</sup>, it is clear that BT's plans rest on the deployment of a copper-based technology – G.fast – that maximises returns on its current assets but fails to provide the digital infrastructure the

UK requires for the future. This is not to point the finger at BT, a commercial company acting in its commercial interests. For BT it is not that G.fast is a better technology than FTTP, but that it does not believe it is in shareholders' interests to deploy FTTP at scale. It is also to be expected: decades of experience shows that efficient investment in next generation networks only takes place when providers – and in particular incumbents – are under competitive pressure. As Ofcom's Sharon White has said "how do we support companies to deliver the ultrafast networks that will drive our digital future? One word: competition".<sup>25</sup>

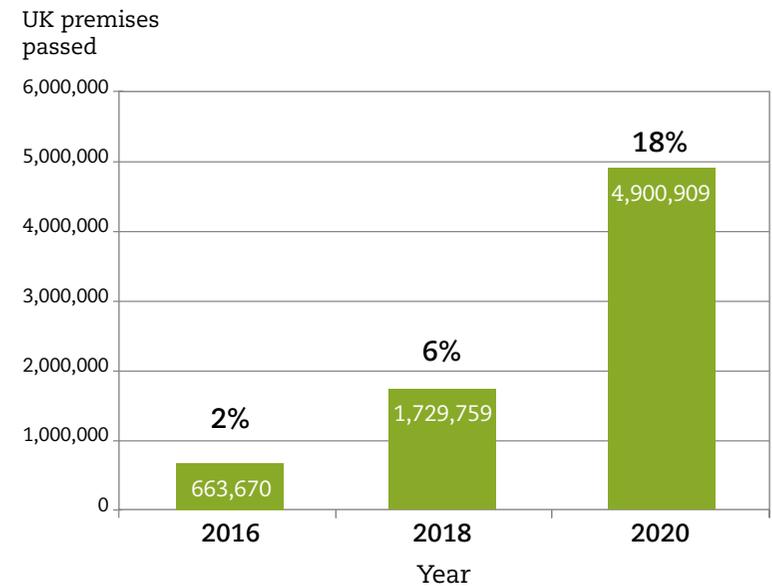
### The competitive potential of the third player in the market: the Altnets

4.5 A degree of commercial pressure is already building. Virgin Media's Project Lightning will invest £3bn to expand its network to an additional 4m homes, which would take its coverage to between 60-65% of the UK<sup>26</sup>. Virgin has said that at least 1m of these new connections will be FTTP, not cable<sup>27</sup>. This investment will place competitive pressure on BT in these areas and Virgin's choice of FTTP underlines the business case for this type of network at scale.

4.6 However, while Virgin will certainly play a significant role in building Gigabit Britain, a third player is required to realise FTTP deployment at scale, choice for consumers and competitive pressure on BT to follow suit. Collectively, the Altnets are that third player. The sector has evolved

rapidly in recent years from small businesses and community-based organisations, primarily addressing rural not-spots, to a series of larger players who are now attracting substantial and rising investment to fund their significant deployment plans.

**Figure 3: Altnet FTTP deployment projections**



Source: INCA Member Survey 2016.

4.7 INCA's Member Survey 2016 reveals that the Altnets already play an important role in the market and shows that they are on track to deliver a significant proportion of the FTTP the UK requires (see Figure 3):

- In 2016 Altnets already pass more than twice as many premises with FTTP as BT: 663,670 versus 300,000<sup>28</sup>.
- By 2020 Altnets forecast they will pass 4.9m premises with FTTP (or 18% of UK premises), which is 1.5m more than the combined number planned by BT and Virgin Media for that year<sup>29</sup>.

4.8 These projections are in line with Ofcom’s view, that “a good long-term outcome would be to achieve full competition between three or more networks for around 40% of premises, with competition from two providers in many areas beyond that”<sup>30</sup>, implying that one or more Altnet would need to be present in at least 40% of the country in order for that competition to exist.

4.9 The Altnet forecast of 18% of the market by 2020 will provide FTTP to a significant proportion of the UK’s consumers and businesses. However, competitive investment will need to increase yet further if the market is to deliver the widespread FTTP required. Importantly, even if Virgin does extend its network to 65%, the UK will require competing future proof networks to deliver choice to consumers. Crucially, the INCA survey shows that the potential for even greater deployment and competition exists, with the Altnets stating<sup>36</sup> that their current forecasts would grow by between 25% and 50% in an optimum policy and regulatory environment, as captured by the recommendations outlined in Part 3.

## CityFibre profile

CityFibre is the company behind the growing ranks of Gigabit City projects and the UK’s largest alternative provider of wholesale fibre network infrastructure. It has major metro duct and fibre footprints in 37 cities across the UK and a national long distance network that connects these cities to major datacentres across the UK and to key peering points in London.

Founded in 2011 CityFibre has gone on to establish a successful anchor tenant model enabling it to build fit-for-purpose pure fibre infrastructure across UK towns and cities. Typically anchored by a major public sector customer or business internet service provider, CityFibre’s networks are capable of serving every business, mobile site, public building and home in an entire city for decades to come. CityFibre listed on AIM in early 2014 and has since raised over £226.5m in financing.

The company has an extensive customer base spanning system integrators, enterprise and consumer service providers and mobile operators. Providing a portfolio of active and dark fibre services, CityFibre’s networks are capable of addressing 26,000 public sites, 7,400 mobile masts, 260,000 businesses and 3.7 million homes.

To date CityFibre has undertaken a number of industry-leading projects across its footprint, including the UK’s first deployment of Fibre-to-the-Tower (FTTT) with EE and Three UK, the Fibre-to-the-Home (FTTH) deployment in York with Sky and TalkTalk and a master services agreement with Vodafone.

[www.cityfibre.com](http://www.cityfibre.com)

## Funding the Altnets' growth

**4.10** The Altnets have achieved recent growth thanks to an increase in investment from large institutional investors, pension funds, individual investors, debt providers and on the public markets. However, realising the sector's full potential will require significantly greater levels of investment. The scope of this paper does not include a detailed investigation of the investment market for competitive FTTP infrastructure. However, consultation with a number of investment professionals<sup>37</sup>, as well as INCA members themselves, confirms that while not viewed as "risk-free", the past 2-3 years have seen a marked change in how the investor community views the sector, fuelled by:

- The fact that future connectivity requirements – which FTTP is best placed to meet – are coming into sharper view.
- The success and rapid progress of companies such as CityFibre, Gigaclear and Hyperoptic, who all have business models that de-risk investment by securing pre-subscription to services in advance of building (either through demand aggregation with end customers, creating anchor contracts with major service providers, or negotiating access with building owners and managers). The take-up rates of these companies are also proving the demand side of the investment equation.

- The rapid deployment and take-up of FTTP in the rest of Europe, which lessens the risks associated with investment and makes the UK ripe for growth.
- The increasing availability and lowering of the cost of capital that makes such infrastructure investments attractive.
- A succession of large-scale investments in fibre taking place across Europe. For example, KKR's €450m investment to fuel the expansion of Deutsche Glasfaser in rural and suburban Germany<sup>38</sup>; private equity group Wahlburg Pincus's investing in Polish operator Inea<sup>39</sup> and German fibre optic company Inexio (€250m)<sup>40</sup>.
- The growing interest of utilities companies in FTTP: ESB and Vodafone<sup>41</sup> have a joint venture to invest "€450 million in building a 100% fibre-to-the-building broadband network" in Ireland<sup>42</sup>; Enel, the Italian energy company plans to spend 2.5bn Euros running a fibre network alongside its power network, with the potential to reach 7.5m homes<sup>43</sup>.

**4.13** Investors' appetite for FTTP could be further enhanced by:

- A clear future-facing Government vision and policy on digital infrastructure to show the direction of travel and timeframe. The proposed Broadband Investment Fund, for example, is seen as an important signal to the market that the Government is committed to the growth of alternative networks

## Gigaclear profile

Gigaclear has fast established itself as the leading provider of pure fibre connections in rural areas. By the end of 2016 Gigaclear expects to reach more than 50,000 homes and businesses, with big plans for future expansion.

The company started in 2010 building its first FTTP network in association with Rutland Telecom. Having successfully attracted private investment and loans from the European Investment Bank, Gigaclear now has networks in 15 counties and is winning projects under the Government's BDUK rural programme.

Once a new network goes live local residents and businesses can choose from a range of service packages – from 50Mbps to 1Gpbs or higher. All services are symmetric and are competitively priced. Gigaclear also offers access to its network to other ISPs through the Fluidata aggregator platform.

In the communities Gigaclear serves it is fair to say that broadband services are transformed. Despite central and local government having invested around £1.5bn with BT to upgrade rural broadband, many villages and communities still remain poorly served. Gigaclear is one of the Altnets that

is providing a step-change in connectivity from slow to ultrafast broadband.

Rural businesses in particular benefit from vastly improved connectivity. A good example is Safety Services UK in Stanton Harcourt, Oxfordshire. Jon Austin, commercial director explained “Gigaclear has had an incredible impact on our business and enabled us to become more forward thinking. The old network just slowed the business processes down. By alleviating the problem, we’ve been able to shift everything – from back-up to management systems – to the cloud and become more efficient as a result. We were always a web-based business, we’re just now much better at it.”

[www.gigaclear.com](http://www.gigaclear.com)

and is even more important given the uncertainty around UK companies' ability to access EU funds in future;

- Initiatives that stimulate consumer demand, or assist in aggregating demand, to provide visibility of future revenue streams;

- Clarity about the future shape of the market, including how regulation will affect the incumbent (and thus competitive providers).

**4.14** The long-term impact of Brexit on investment in fibre, as well demand-side factors, such as consumer confidence and public sector procurement, is still unclear. However, a straw poll of INCA members indicates that Altnets remain bullish and deals continue to be made – recent EIB investments in Gigaclear and Hyperoptic for example.

**4.15** In an uncertain post-Brexit context, working strongly in favour of investing in the UK's digital infrastructure is the key role it plays in underpinning economic growth – for businesses concerned about their access to overseas markets, for cities and regions who need future-proof infrastructure to attract investment, and for consumers, who increasingly view connectivity as indispensable, as Ofcom outlines in its latest Communications Market Report<sup>44</sup>. Indeed a number of influential stakeholders have spoken about the importance of the UK investing in infrastructure post-Brexit for these reasons<sup>45</sup>.

**4.16** Despite the clear rationale for infrastructure investment post-Brexit and the Altnets' growing confidence, a coherent and ambitious Government strategy and a series of enabling measures are required by Government and regulators to fully deliver what the UK requires.

## **PART THREE:** The role of policy and regulation in **Building Gigabit Britain**

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**5.1** This paper argues that it will be the competitors in the market who will lead the step-up in FTTP deployment the UK requires. But while the Altnets have been viewed with growing interest by Government and Ofcom in recent years, policy and regulation has continued to focus first and foremost on the two other players in the market. INCA argues that the ambitious Altnet deployment plans justify a rethink about the role they can play in building Gigabit Britain. If the UK is to achieve the digital infrastructure it requires to thrive, Government policy and regulation must assist them in maximising their potential.

### **The role of Government in setting the ambition, encouraging investment and removing barriers**

#### **A Gigabit Britain Strategy**

**5.2** With the Government's Superfast Broadband programme on track to deliver its target of 24Mbps or more to 95 per cent of the country by the end of 2017, attentions are turning to "what next?" The Government's 2015 Digital Communications Infrastructure Strategy<sup>46</sup> attempted to answer that question. Although there was much to support, including an acknowledgment that future infrastructure must deliver against multiple metrics ("high capacity, reliable, resilient, secure, affordable and fast"), the Strategy's headline – "a new national

ambition to bring ultrafast broadband of at least 100 megabits per second to nearly all homes in the country, so Britain is out in front" – did not provide detail about when or how the vision would be delivered.

**5.3** There have been welcome policy developments elsewhere, including plans for a Broadband Investment Fund and the reform of the Electronic Communications Code. However, the UK urgently needs a detailed future-facing connectivity plan. The previous Digital Minister, Ed Vaizey, told Parliament that "now is the time to start looking at a Gigabit Britain"<sup>47</sup> and a Digital Strategy outlining how that will be delivered is expected. It is vital that this next digital infrastructure policy announcement is sufficiently ambitious and that it does not settle for a plan focused on download speeds alone or assume that G.fast will provide the connectivity the UK requires.

**5.4** Instead, the Government must set out a coherent Gigabit Britain Strategy that places accelerating the market's FTTP deployment at its heart. Such a Strategy would provide a context and focus for the devolved administrations, cities, local authorities, Ofcom and the ASA, as well as confidence to industry and investors. This Strategy must only be judged a success if the UK's networks are able to

deliver the truly first-class connectivity required: reliable and secure networks that consistently deliver higher upload capacity, low latency and ultrafast download speeds.

**Recommendation: Government should set out a Gigabit Britain Strategy, specifying the UK's ambition for fixed-line digital infrastructure.**

#### A target for FTTP deployment

- 5.5 Government targets as part of wider national broadband plans can play a pivotal role in stimulating FTTP roll out: the Broadband Strategy for Sweden (100Mbps to 90% by 2020) and New Zealand's Ultrafast Broadband Initiative (100Mbps to 80% by 2022) have driven FTTP deployment in each case. The European Commission's Digital Agenda for Europe target (30 Mbps available to all Europeans; take-up of 100Mbps by at least 50% of European households by 2020) has provided focus for EU Member States in setting their own targets. According to a recent study of National Broadband Plans in the EU<sup>48</sup>, only three nations' plans neither reach nor exceed those DAE targets: Germany, the UK and Finland. The need for the UK to have a new ambitious but deliverable target is clear.
- 5.6 A new UK target should be based on the majority of the UK having access to FTTP within the next decade. INCA suggests that 80% market-led deployment by 2026 is a sufficiently ambitious but attainable goal. Our suggestion is informed by Ofcom's view that "a good long-term outcome

### Hyperoptic Profile

Hyperoptic was the first provider to make 1Gbps speeds available to broadband subscribers in the UK. Set up in 2011 Hyperoptic focuses on providing urban residential apartment blocks with ultrafast fibre connections (Fibre to the building – FTTB). Since then it has won many awards for its outstanding services including the prestigious ISPA award for Best Superfast Broadband, four years in a row. Now present in 20 cities, Hyperoptic has connected buildings with around 200,000 premises making it one of the largest of the Altnets.

All services are symmetric and subscribers can select from 20Mbps, 100Mbps or 1Gbps services. Around 20% of customers immediately opt for the 1Gbps offer. The installation process starts following negotiations with landlords and their agents. Residents are asked to complete an online demand registration scheme and once the threshold is reached installations begin.

Backed by an investment fund managed by Soros Fund Management LLC, Hyperoptic has recently attracted £21m of European Investment Bank funding, taking total investment to £75m. They aim to expand the network by more than 300,000 homes in the next three years.

One interesting fact is that around 50% of Hyperoptic's footprint is in BDUK 'white' areas – i.e. places that don't yet have BT's superfast broadband – despite the fact they are an urban provider.

[www.hyperoptic.com](http://www.hyperoptic.com)

would be to achieve full competition between three or more networks for around 40% of premises, with competition from two providers in many areas beyond that”<sup>49</sup> (which implies that at least one Altnet would need to be present in 40% of the country), as well as the deployment trajectory from INCA’s member survey, which puts the Altnets on course to reach around half of the 80% commercial coverage target by 2026, if the recommendations outlined in this paper are adopted.

**Recommendation: The Government should announce a target for the majority of the UK to have access to a FTTP connection by 2026 and near universal coverage by 2030, with 80% coverage commercial deployment by 2026 viewed as an attainable goal.**

#### Local Gigabit strategies

5.6 By its nature, digging and laying physical networks requires the support and co-operation of local residents and administrations. To succeed, the Gigabit Britain Strategy must therefore be delivered through every level of government in every region of the UK. Some municipalities have already fully understood the critical role of digital infrastructure in their futures and established comprehensive strategies to deliver them. Bristol is Open<sup>50</sup> is a joint venture between the University of Bristol and Bristol City Council to create a programmable city region, ready to use new technologies to tackle challenges and create opportunities. Digital infrastructure sits right at the heart of the project. York is one of an increasing number of cities striving to become a

Gigabit City: James Alexander, Leader of City of York Council saying that “turning York into a Gigabit City is hugely important for businesses, residents and visitors”<sup>51</sup>.

5.7 INCA recommends that the UK’s devolved administrations, cities and local authorities create area-specific Gigabit strategies, which consider how the recommendations in this paper can be delivered at a local level. One approach that should be encouraged is for local governments and public bodies to act as anchor tenants to FTTP deployments. Investors are supportive of FTTP deployments that secure pre-subscription to their services before build takes place because it de-risks the investment. Securing long-term commitments through contractual arrangements between network builders and an anchor tenant, very often a local authority or city, has been shown to “significantly contribute towards unlocking increased investment to achieve the UK Government’s broadband targets”<sup>52</sup>, at the same time as bestowing benefits to cities, local authorities and investors.

5.8 INCA also recommends that local Gigabit strategies look at the role of wayleaves in rolling out FTTP. In many INCA members’ experience, while developers, private freeholders and housing associations understand the importance of partnering with Altnets to upgrade their residential property portfolios, local councils (particularly in urban areas where BDUK has been less active) are often reluctant to sign wayleaves to support commercial rollout of

gigabit services. With a more pro-active approach to wayleaves, hundreds of thousands of council properties could be upgraded, giving residents access to the benefits of FTTP, while simultaneously alleviating the social divide issues usually associated with demographic and market forces.

**Recommendation: Government should encourage the UK's devolved administrations, cities and local authorities to create their own local Gigabit strategies, which should include exploring the feasibility of anchor tenancy arrangements and agreeing wayleaves to bring Gigabit services to council housing stock.**

#### **Independent long-term strategic advice: National Infrastructure Commission**

5.9 Given its central role in delivering many UK policy objectives, Government strategy for fixed-line infrastructure must be considered on a par with other national infrastructure. Ofcom has contributed hugely to the long-term debate through its Strategic Review, but is restricted by its regulatory remit. The Government should therefore ask the National Infrastructure Commission to review the UK's long-term fixed-line digital infrastructure strategy, as it is currently doing for 5G, as part of a wider government review. Provided a review can be conducted in a timely manner, this would provide the sound independent evidence base and long-sighted view on which to base the Gigabit Britain Strategy.

5.10 One area the NIC should examine is the commercial cost required to deliver widespread FTTP. The most cited figure for nationwide FTTP roll out is the Analysys Mason report for the Broadband Stakeholder Group (BSG) in 2008, which estimated that nationwide FTTP coverage would cost in the region of £28.8bn<sup>53</sup>, with 80% of the country costing £15bn. This large figure has been used to justify why widespread FTTP deployment should not be considered, BT CEO Gavin Patterson telling MPs recently that £28.8bn “is not an investment the UK, and certainly not the BT board, would support.”<sup>54</sup>

5.11 However, a lot has changed since 2008 and the overwhelming majority of INCA members (84%) say FTTP deployment costs are either “substantially” or “to some extent lower” than in 2008. For example, INCA members indicate that:

- The cost of electronics has reduced by around 15-25% since 2008;
- New construction methods, for example micro trenching in urban areas, deliver a cost saving of around 30% for premises passed compared to conventional trenching;
- Fibre optic cable is around 15-20% cheaper now than in 2008, because of increased demand;
- Point to point electronics have come down by 50%;

- The price of GPON in urban areas has come down<sup>55</sup>;
- Altnets often use local civil contractors, with local experience and lower costs than the national contractors, who have high overheads and are used to getting premium rates;
- Costs come down considerably when fibre is installed alongside other works such as water mains or combined heat and power systems, as is often the case in Scandinavian projects.

**5.12** A much wider range of companies building FTTP networks can also now contribute to such a study, giving a more accurate understanding of costs.

**5.13** An up-to-date costing analysis of FTTP deployment would challenge the myth that widespread commercial FTTP deployment in the UK is neither a realistic public policy goal nor commercially viable. In addition, the NIC could explore the current and future capabilities of fixed wireless, mobile and satellite, which have increased substantially in recent years and may be able to deliver many of the Quality of Experience criteria identified in Part One, where FTTP is not commercially viable.

**Recommendation: The Government should ask the National Infrastructure Commission to advise on the development of the Strategy, as part of a broader Government review, including developing an up-to-date costing analysis of commercial FTTP deployment.**

### **The importance of joined up policy-making: Universal Service Obligation**

**5.14** The proposed FTTP target will require a joined-up Government-wide effort to achieve it. The most relevant Government policy at present is the Universal Service Obligation for broadband. INCA agrees that no one should be left behind as the UK moves towards an increasingly connected future. However, the way that USO is designed, funded and allocated is crucial in ensuring that the rollout of future networks is not inadvertently undermined. To prevent the USO from distorting the market:

- Areas where commercial or subsidised broadband exists but has yet to be taken up by consumers should not be subject to USO provision. Careful modelling using existing Ofcom data, estimates of BDUK intervention and existing/planned coverage by all operators will be required.
- To avoid a repeat of the BDUK programme, where BT was awarded all but one of the initial contracts, the allocation of a Universal Service Provider should be a competitive process, including multiple providers. The definition of the USO will be fundamental in determining whether a competitive response is achieved.
- The USO scheme should wait for the current BDUK programme and any subsequent local projects to be completed.

### ITS Technology Group Profile

Set up in 2011 ITS Technology Group deploys a mix of FTTP and wireless networks in both urban and rural locations. ITS currently has 17 rural networks servicing business parks and local communities. It has also pioneered urban concession agreements utilising under-used local authority assets (ducts and rooftops) to provide open access wholesale services.

In Bristol ITS formed a joint venture with Net Support UK to commercialise 150km of Bristol City Council owned duct network. Overhauling the existing infrastructure and putting in new duct and fibre, enables the JV to deliver ultrafast services to businesses and residential areas in one of the UK's leading Smart Cities. Bristol City Council benefits directly through a share in the revenues, plus gets the economic benefits of new digital infrastructure. There are four such concession contracts now in place across the UK and growing.

One of the rural beneficiaries of ITS services is the Queen's estate at Sandringham where business tenants now benefit from superfast and ultrafast fixed wireless and FTTP services.

Another pioneering project is Cotswold Broadband in Oxfordshire where ITS has partnered with the local community, West Oxfordshire District Council, Gigaclear and BDUK to deliver FTTP ultrafast broadband to more than 4000 rural premises.

[www.itstechnologygroup.com](http://www.itstechnologygroup.com)

5.15 Finally, but crucially, as well as being cost-effective, easy to administer and transparent, the funding mechanism for the USO must avoid negatively impacting Altnets' FTTP investment incentives. This means that all other sources for funding should be thoroughly considered before an industry levy is adopted, including BT (should they be the designated USP), as this would ensure cost-effective deployment, and Government, because of the wider social benefits of a USO. If industry funding is deemed unavoidable, it should take place on an investment basis, with those contributing to the fund taking an equity stake in the investment.

**Recommendation: Government should align all relevant policies and programmes to support the Strategy, including ensuring the broadband USO policy does not undermine incentives to invest in competitive infrastructure.**

### Encouraging greater investment: business rates on fibre and Broadband Investment Fund

5.15 INCA does not advocate that Government subsidises the target of FTTP to 80% of the UK by 2026. However, there are measures it can take to bring forward and maximise private investment. A review of the current approach to tax on fibre (non-domestic rates) would have a significant impact on investment incentives. At present every metre of previously dark (unlit) fibre is taxed when lit according to a business rate that is calculated and collected by the Valuation Office Agency. Rates vary by operator and are set using an opaque and

complex methodology. The system has proved disproportionately expensive for many Altnets and is having a significant negative impact on the business case for fibre deployment and take-up – for example analysis of Ofcom data indicates the rates payable by a typical Altnet are between 10 and 35 times that of BT.

- 5.16 It is vital that a revised approach to business rates on fibre is equitable and does not create further market distortions. At the very least the rates for smaller operators should be levelled down to create equity between larger and smaller operators. This would have an immediate and transformative impact on the business case for fibre investment. If the Government is really committed to increasing FTTP deployment, it should go further and remove all business rates on new fibre assets (be they ducts, fibre, poles or cabinets) for a period of 10 years: a cost neutral policy that would give a significant boost to those who invest in fibre. Again in the interests of equity, if a revised approach were to include assigning the business rate liability to the provider of the dark fibre instead of the party lighting the fibre (as is currently the case), this rule should be applicable to all suppliers of dark fibre, not just BT.

**Recommendation: Government should oversee a fundamental review of the business rates for fibre, including removing all rates on new fibre assets for 10 years.**

- 5.17 INCA strongly welcomes the proposed Broadband Investment Fund<sup>56</sup>. Aside from the promise of capital, the Fund gives a clear signal to the wider investor market about Government's support for alternative networks. It is even more vital that this fund is launched now that other sources of capital from EU subsidies may be out of reach to UK companies. The attractiveness of the fund to individual operators will depend on the terms it offers in comparison to other sources of capital on the market and details are keenly anticipated.

**Recommendation: Government must ensure the launch of the Broadband Investment Fund, to give confidence to the wider investor market and provide an important source of capital to alternative networks**

**Remove barriers to deployment: New Roads and Street Works Act and Electronic Communications Code**

- 5.18 Many INCA members report that the barriers to FTTP deployment are not financial, but bureaucratic, with rules relating to planning, permissions and permits holding back scheduled builds. Altnets report significant frustrations with a number of aspects of the New Roads and Street Works Act:
- It is usual for network builders to have to give 3 months notice for work on all roads, even minor roads where works undertaken would not cause significant delay.

- Permits often impose very limiting restrictions on working hours, which much reduces the number of metres that can be dug in a day and are required in circumstances where disruption from the build is likely to be minimal.
- The current approach to building on recently laid footpaths and roads also causes considerable delay because of the length the embargo, which can be up to 5 years, and a disjointed approach to agreeing with Local Authorities.

**5.19** If Government wants to meet an ambitious FTTP target, it must work with Local Authorities to address these “roadblocks”, whilst respecting local residents and businesses, so that planned builds can take place in a timely and efficient way. Gigaclear, with the support and agreement of BT, Virgin Media and Vodafone, set out more details on this issue in a letter to the then Minister Rt Hon. Ed Vaizey on 8 March 2016.

**Recommendation: Government should make amendments to the New Roads and Street Works Act 1991 to reduce the notice required on minor roads, review the circumstances under which Permits are required and charged for, and adopt a more common sense approach to builds on recently laid footpaths and roads.**

**5.20** With the goal of putting “in place modern regulation which fully supports the rollout of digital communications infrastructure”<sup>57</sup>, the Government has published a new Electronic Communications Code – the legal basis for the relationship between land owners and Communications Providers (CPs), including those that build and run fibre, wireless and other networks. The Code will pass into law through the Digital Economy Bill and is an important step in creating Gigabit Britain, as it will significantly reduce the barriers to infrastructure building and maintenance. As the new Code is debated in Parliament, it is vital that the following aspects of the Code – which are already Government policy – are not watered down.

- **Fair valuation:** Paragraph 23 (3) (b) sets out that “the market value of the code right must not be assessed on the value to the operator of the right or agreement or having regard to the use which the operator intends to make of the land in question”. To ensure that there are no ransom rents, it is vital this paragraph is retained in the final Code.
- **No contracting out:** to ensure the Code is effective, a provision has been created prohibiting all parties from contracting out and circumventing the Code. This is an important provision, which must be retained.
- **Right to upgrade:** An important feature of the new Code is the right for CPs to upgrade their equipment without additional payment unless new equipment

takes up more space. This essential feature of the Code must be retained.

- 5.21 Once the Code becomes law, it is vital that a workable Code of Practice is in place to help parties to work constructively together on a day-to-day basis to deliver the network and services on which the UK relies. INCA supports the commitment of Government to introduce a Code of Practice, overseen by Ofcom, and welcomes the initial steps that have been taken to draft the document. It is crucial that the objective of improving connectivity remains central during the process of drawing up the Code of Practice.

**Recommendation: Government should work to retain key elements of the Electronic Communications Code as it becomes law (including provisions on fair valuation, the right to upgrade and contracting out) and ensure that a connectivity-focused Code of Practice is in place to underpin the working relationship between Communications Providers and landowners.**

#### **Fair and efficient use of public subsidies and public assets**

- 5.22 Overbuild, and the threat of overbuild, is a significant investment deterrent. There are countless examples of BT Openreach, and in some instances other operators, overbuilding INCA members in areas where they are in the process of rolling out networks. In some cases overbuild has taken place by BT Openreach using the public funds awarded to it under the BDUK scheme, on the

### **Relish profile**

Relish is a provider of high capacity fibre and wireless networks and services. Relish (the new trading name of UK Broadband and UKB Networks) is part of the PCCW-HKT Group in Hong Kong. HKT is Hong Kong's leading fibre and wireless provider, with a market capitalisation of \$10bn.

Relish provides fibre and wireless broadband services to university students, military personnel and key workers living in accommodation on hospital sites, as well as FTTP connections to private individuals and businesses in multi-tenanted properties.

In 2014 Relish launched its high speed fixed wireless broadband service in Central London, which utilises its 124 MHz of high capacity licensed LTE spectrum. Its network now covers 400,000 London premises, and is set to expand throughout the Greater London area to cover 2 million premises by 2019. Relish customers enjoy high speeds, flexible contracts and freedom from copper line rental.

Relish has partnered with Swindon Borough Council to offer superfast broadband services to almost 20,000 premises in rural parts of Swindon from 2016.

Relish also offers dedicated point to point microwave links for businesses, with speeds of up to 100 Mbps.

[www1.relish.net](http://www1.relish.net)

basis that there was no prospect of market-driven build occurring in the area during the original open market review and public consultation process. Not only is overbuild a waste of public money, but it significantly reduces the potential revenue of the FTTP network builder and undermines the future investment case. For example, Gigaclear estimates that 45% of all its commercially funded networks were partially or substantially overbuilt by BT Openreach up to December 2015, generally using BDUK money, either before Gigaclear has launched or within a few months of it doing so.

**5.23** In an open and competitive market there will inevitably be some areas where more than one operator plans to build a network. However, the use of public money to do so is anti-competitive and massively undermines investment. State aid rules already prohibit the displacement of private investment in this way, but there are concerns that these rules are not being sufficiently enforced. Regardless of whether the application of State Aid rules will change in light of the EU referendum result, the UK must have strict rules in place to prohibit the use of public money to overbuild FTTP networks, and these rules must be properly enforced.

**Recommendation:** Government should ensure that tight and strictly enforced rules are in place prohibiting the overbuild of FTTP networks using public subsidy, to allow efficient use of public money and reduce the negative impact of overbuild on the FTTP investment case.

**5.24** Public sector bodies such as JANET (Joint Academic Network), the Ministry of Defence, Network Rail and NRTS (National Roads Telecommunications Services) own an extensive range of infrastructure assets (including existing fibre networks, ducts, masts, and buildings) that could be used to aid commercial FTTP deployment. These assets can be strategically useful because of their large footprints, rural locations and high capacity.

**5.25** Giving private FTTP builders commercial access to these assets on an equivalent and equal basis and at a fair price has the potential to lower the cost of deployment and generate revenue for the public sector. In some instances, this is already happening: JISC is giving organisations (including telecoms providers) commercial access to its JANET network, which serves the research and education community. Others, such as NEXUS, the Newcastle metro-rail network, are exploring the option.

**Recommendation:** Government should commission a comprehensive inventory of existing public sector infrastructure assets and work to make those assets available to builders of FTTP networks on a fair and non-discriminatory commercial basis.

### The role of regulation in driving competition, investment and demand: Ofcom and the ASA

5.26 Ofcom’s Strategic Review statement in February 2016 marked a watershed moment. It moved away from the regulator’s previous technology neutral position to set out a 10-year vision of a “new fibre future, with widespread availability of competing ‘fibre to the premise’ and cable networks to homes and businesses”<sup>58</sup>. This change was driven by a recognition that “many people and businesses will demand significantly more from their communications networks over the next decade” and a desire to reduce “the UK’s reliance on the Openreach network.”<sup>59</sup> Ofcom has said that “40-50% of FTTP availability in 4-7 years”<sup>60</sup> – (i.e. by 2020-2023) – would be viewed as a good result.

5.27 To deliver this vision Ofcom plans to use two regulatory levers:

- Short of structurally separating BT from its network Openreach (an option that remains on the table), they will negotiate a new governance arrangement for BT Openreach that increases its strategic and operational independence<sup>61</sup>;
- They will mandate access to BT Openreach’s active and passive assets (including the ducts and poles that carry copper and fibre cables, as well as dark (i.e. unlit) fibre) on terms that encourage efficient investment from alternative networks as deep into the network as possible<sup>62</sup>.

5.28 INCA strongly welcomes Ofcom’s headline ambition and the recognition of the importance of competitive networks. However, the impact of Ofcom’s proposed remedies on FTTP deployment is contingent on a number of factors, as outlined below. Other stakeholders, and in particular Government, should note that even if the remedies are successful, they must be delivered alongside the other measures we propose in order to deliver the necessary step up in FTTP deployment.

### BT Openreach governance

5.29 Ofcom’s Strategic Review concluded that “it is necessary to reform the relationship between Openreach and BT Group, to give Openreach greater independence and ensure it serves all of its customers equally”, with the expectation that this will deliver a more competitive market and continued investment in new networks<sup>63</sup>. The Government concurs that “a more independent Openreach is needed to benefit consumers and the UK’s digital infrastructure<sup>64</sup>. INCA agrees that given its dominant position in the market, it is vital to arrive at an Openreach governance structure that enables it to work with the rest of the industry to deliver Gigabit Britain.

5.30 With negotiations on Openreach’s governance on-going, INCA supported Sky, Vodafone, TalkTalk and the FCS in submitting a 10-point plan to Ofcom setting out the approach needed to create a better Openreach<sup>65</sup>. This plan outlines the importance of ensuring: Openreach is a legally separate

company, with an independent Board; is financially independent with autonomy over its budget; that it owns and controls its own assets; has its own distinctive and independent branding; provides its services and information on an equal basis; and properly consults with all its customers on strategy, capital expenditure and product design.

5.31 Of particular significance to INCA members – and to Ofcom’s goal of encouraging investment in competitive networks – are three points:

- Point 3: “An independent body [that on] an ongoing basis, act[s] in an adjudication capacity to help resolve issues that are not capable of being agreed between Openreach and providers, including BT Consumer” – Many barriers to FTTP deployment relate not to cost but to bureaucratic disputes; a new tribunal body, or potentially the extension of the OTA’s remit to non-regulated areas, to hear and quickly resolve conflicts between BT Openreach and communications providers would perform an important role in removing these barriers.
- Point 9: “Openreach is no longer the only provider BT can use” – Creating demand on competing infrastructures is a vital part of the FTTP investment case. At present BT Consumer, the UK’s biggest ISP, overwhelmingly uses the Openreach network rather than alternative networks<sup>66</sup>. Increasing Openreach’s independence and requiring procurement of BT Openreach’s services by BT Consumer to take place in open and transparent way<sup>67</sup> will increase BT

Consumer’s incentives to use other networks, and help deliver true competition at the infrastructure level.

- Point 10: “Openreach does not inhibit investment by independent network operators” – BT Openreach’s governance arrangements are an important mechanism for reducing the negative impact of overbuild (with public money) on Altnet investment (as above).

5.32 If Ofcom wishes to create a regulatory environment that supports investment in alternative networks, these three BT Openreach issues must be addressed, through Openreach’s governance negotiations where appropriate, or through other means.

**Recommendation:** To deliver its vision of “a fibre future”, Ofcom must place competition and investment in FTTP networks front and centre of all its work by:

- ensuring that BT’s revised BT Openreach governance does not inhibit investment by alternative networks;
- requiring that procurement of BT Openreach services by BT Consumer takes place in an open and transparent way creating an independent tribunal to resolve disputes between BT Openreach and alternative operators.

## WarwickNet profile

WarwickNet specialises in connecting SMEs on poorly served business parks to superfast and ultrafast broadband services.

Set up eight years ago, WarwickNet is now active throughout the UK. The company leverages its 10Gbps core network and multiple points of presence to deliver superfast broadband and high capacity leased lines in over 80 sites and serving over 1,000 businesses nationwide.

WarwickNet deploys a range of technical solutions – FTTC, sub-loop unbundling and FTTP – to deliver its services.

A flagship project is Stoneleigh Park near Coventry. Located at the heart of England's rural economy, Stoneleigh Park exerts a powerful draw for any business interacting with the agriculture or equine sectors.

In August 2013, the management of Stoneleigh Park introduced an exclusive fibre campus network in a major capital investment programme to revitalise the site as an internationally renowned centre for agriculture, rural business, science and innovation. WarwickNet was appointed to manage the campus-wide network and provide connectivity solutions to the over 70 businesses based there.

[www.warwicknet.com](http://www.warwicknet.com)

## Mandated access to BT Openreach's active and passive assets

- 5.33 Ofcom argues that it is inefficient to build new networks that replicate BT's existing passive infrastructure in cases where BT's infrastructure can be made available to competing networks. Mandating access to BT Openreach's passive network, through Duct and Pole Access (DPA) and Dark Fibre Access (DFA), is therefore a central plank of Ofcom's strategy. INCA fully supports this aim. Indeed, some INCA members are already working closely with Ofcom, the OTA and BT Openreach to improve the forerunner of DPA, Passive Infrastructure Access (PIA).
- 5.34 DPA has the potential to reduce the number of new ducts to the absolute minimum, thereby speeding up the rollout of FTTP networks and reducing the network constructing costs. If successful, it will result in competitive end-user prices and benefits to the overall UK economy. PIA has been used successfully by a group of INCA members to help deploy their networks. CityFibre has recently announced plans to trial it in Southend, one of its Gigabit City projects.<sup>68</sup>
- 5.35 However, it is stressed that DPA has "potential" to significantly enhance competitive investment, but it is unclear the extent to which DPA will work at scale. There are a significant number of unknowns, including the location and quality of the ducts and poles, and the process of engagement with BT Openreach. Even when questions have been

answered, the outcomes may be different for different operators, and in different locations. If DPA is to work at a scale that will make a significant difference to alternative operators' deployment plans, the full and open co-operation BT Openreach is essential. INCA advocates that:

- BT Openreach is properly incentivised to make DPA successful – a BT Openreach governance structure that supports this is therefore essential;
- Parity is achieved between BT Openreach and alternative operators – this could be achieved through the development of an Equivalence of Inputs (EoI) framework;
- BT Openreach is given the necessary independence from BT Group to enable it to establish appropriate safeguards to prevent alternative operators' requests for information on BT Openreach's assets triggering BT Openreach to deploy its own FTTP in that area;
- BT Openreach publishes a full geographic database of its passive assets, the costs of using them, the cost to get up to specification and the rental costs. This should be published as soon as possible and updated regularly, with the same toolset that Openreach uses. Without this open and transparent information, competing providers will not be able to accurately assess whether using BT Openreach's ducts and poles is commercially viable.

5.36 INCA also stresses that while the viability of the DPA remedy is being explored, which will take many months (or even years), Ofcom must develop alternative approaches to encouraging investment in competing infrastructure in the event that DPA does not deliver the desired outcomes. Undue reliance on the DPA remedy before it is proven could destroy the investment incentives in alternative FTTP networks.

5.37 INCA is also concerned that principle of mandating access to active and passive assets has been applied differently to different markets. In the DCR Ofcom proposes access to ducts and poles in the residential market, but in the Business Connectivity Market Review (which addresses the business leased lines market) it mandates access to BT Openreach's dark fibre, but not to its duct and poles. This inconsistent approach fails to recognise that Altnets do not build separate networks for the business and residential markets, but a single network designed to address both markets. This is supported by the INCA member survey, which shows that 71% of members serve both business and residential markets.

5.38 BT uses the same network (and the same ducts and poles) to serve the voice, broadband and leased lines markets and therefore benefits from economies of scale and scope across different markets and services. Those synergies mean that the unit cost for BT of using its own ducts is quite low. Regulation should encourage effective and

efficient competition but by mandating inconsistent passive remedies in different markets. Ofcom risks making it impossible for Altnets to be as efficient as BT if they can only use passive infrastructure for a subset of customers and services. This does not make technical or economic sense and significantly undermines Altnets' ability to invest and build.

- 5.39 Although the European Broadband Cost Reduction Directive has been transposed into UK legislation, this legislation does not present a clear and transparent access mechanism, which can replace a well-structured SMP remedy.

**Recommendation: To maximise the potential impact of mandated access to BT Openreach on the Altnets' investment case, Ofcom must:**

- **ensure that BT Openreach fully commits to making Duct and Pole Access work, including by providing timely, effective and fit for purpose access to its ducts and poles;**
- **apply passive remedies consistently across all fixed markets – in the DCR, the BCMR and the forthcoming fixed market reviews.**

**Review advertising regulation to drive consumer demand**

- 5.40 Advertising regulation is an area of vital importance to the FTTP investment case. Many INCA members contend that demand for pure fibre connectivity is constrained by two features of the rules governing broadband advertising. Firstly, ISPs are permitted to advertise hybrid copper-fibre networks as “fibre optic”. The Advertising Standards Authority

(ASA) approved this practice in 2014 by upholding a complaint against BT's superfast broadband product<sup>69</sup>. The ASA argued that given the low availability and take up of FTTP that it “was extremely unlikely that consumers would expect that a service promoted as “fibre optic” was FTTP”. They also reasoned that “consumers who might be interested in “fibre optic” broadband of one sort or another would primarily be concerned with the improved speed and performance which could be delivered in comparison to an ADSL connection” rather than the exact technology mix behind that “fibre optic” connection. This approach is already causing significant consumer confusion, with “two thirds of copper-fibre broadband customers on BT's Openreach network are unaware their so-called ‘fibre’ service arrives at their home through a standard copper telephone line”<sup>70</sup>.

- 5.41 Secondly, ISPs are only required to demonstrate that 10% of the relevant customer base can achieve the headline advertised speed<sup>71</sup>. This means that consumers are unable to gain an accurate understanding of the performance they can expect from their broadband connection.
- 5.42 If the UK wishes to become a Gigabit Society, then 10s of millions of consumers will need to switch from their current broadband product to FTTP. Consumers will not have the information they need to switch if they:

- are unaware of the actual, rather than advertised performance of their current connections;
- do not understand that different networks offer a different quality of experience across an increasingly important range of measures, and not just potential download speed;
- believe that they already have “fibre” broadband, when they actually have a copper-fibre hybrid.

5.43 The enforcement of the CAP code is strictly a matter for the independent regulator, the ASA. However, if the UK government wants to pursue a policy of rapid FTTP deployment, this approach may need to change going forwards. Former Digital Minister Ed Vaizey appeared to agree, on the issue of broadband speeds at least<sup>72</sup>. The French government has also recently issued a decree<sup>73</sup>, which only permits FTTP connections to be described as “fibre” and requires that upload speeds are as prominent as download speeds in adverts.

**Recommendation:** To stimulate the demand needed to drive FTTP investment, the ASA should review its guidelines to ensure that future advertising of both FTTP and copper-fibre hybrid products gives consumers the accurate information required to make informed choices.

## Conclusion

5.44 The imminent digital revolution provides a huge opportunity for the UK to translate its existing digital strengths into significant social and economic gains. However, it can only do this if it makes a quantum leap in the quality of its digital infrastructure. It urgently needs to invest in reliable and secure networks that consistently deliver ultrafast download speeds, high upload speeds and low latency.

5.45 The Altnets are already building networks fit for Gigabit Britain and are on course to deliver FTTP to a significant proportion of the UK by 2020. However, a clear Government Strategy that prioritises competition and investment in truly future-ready networks is required to unlock the Altnets’ full potential.

## ANNEX ONE: The case for widespread FTTP deployment in the UK

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### Connectivity at the heart of the UK's future prosperity

- 6.1** The digital revolution of the past 25 years has dramatically changed how we communicate, shop and are entertained. The arrival of game-changing services, devices and applications, such as Google and Amazon in the mid-90s, the iPhone in 2006 and Netflix in 2012, has driven an explosion in data consumption that shows no sign of abating. Ofcom's latest Communications Market Report shows that in the UK in 2015 "the average fixed broadband line used 82GB of data per month [...] a 41% increase compared to the 58GB per month recorded in June 2014"<sup>74</sup>.
- 6.2** To meet the connectivity demands of this revolution, the UK has relied on network operators to incrementally upgrade fixed (and mobile) infrastructure from dial-up to broadband to superfast broadband. With 12.4% of the UK's GDP in 2016 expected to come from the Internet economy (more than double its closest G20 competitor<sup>75</sup>) and despite some very notable exceptions in coverage<sup>76</sup>, it is possible to argue that the UK is a leading digital nation<sup>77</sup>.
- 6.3** But the world is on the cusp of a new digital revolution<sup>78</sup>. As the House of Commons Business, Innovation and Skills Select Committee noted, "technology is going to revolutionise, or is already revolutionising, business, transforming virtually all aspects of the economy and society"<sup>79</sup>. This new industrial revolution includes tech-enabled developments such as the Internet of Things, big data, virtual reality, cloud computing, smart cities and Artificial Intelligence.
- 6.4** If we look at the UK's main public policy goals for the next decade and beyond it is clear that harnessing this new digital revolution sits at the heart of our future success:
- According to the CBI, "prioritising the digital revolution [...] is a key step to propelling the UK's productivity"<sup>80</sup>;
  - Key sectors such as manufacturing (where digitisation is set to bring £350bn to the UK economy by 2030<sup>81</sup>), and the creative industries (already digitised and worth £84.1bn a year to the UK<sup>82</sup>) will play an important role in rebalancing the UK economy<sup>83</sup>;

- Maximising the potential of emerging technologies, such as cyber security and autonomous systems, can help address the UK's export challenge<sup>84</sup>;
- Enabling new forms of income generation, such as remote working and the sharing economy, both dependent on technology, can boost the number of jobs and create a flexible labour market<sup>85</sup>;
- Finding new ways to provide civic services through technology-enabled smart cities is vital if our urban areas – which are tied to our economic futures – are to prosper<sup>86</sup>;
- Finding cost efficient ways to deliver health, social care and education, using telehealth and big data for example, is essential to help under pressure public services;
- Developing a smart approach to power, through smart grid applications for example, can help achieve secure, clean and affordable energy supplies<sup>87</sup>.

6.5 Underpinning all these tech-led developments is connectivity: there can be no driverless cars without connectivity to traffic lights and sensors; no remote working without business-grade connectivity at home and on the move; no online diagnosis and consultations without adequate connectivity for both patients and healthcare professionals. The question is not “how vital is connectivity to the UK?” but “what kind of connectivity does the UK need to flourish in this next digital revolution?”

## Fit for purpose digital connectivity means moving beyond speed

- 6.6 Alongside improved access and lower prices, the main connectivity goal of politicians and the market over the past decade has been to increase download speeds. To understand if that focus is appropriate for the future, INCA looked at connectivity needs (as defined by key Government and industry papers) of some of the sectors, public services and technologies that will play a defining role in the UK's future<sup>88</sup>. The findings show that “ultrafast” download speed is just one of five “Quality of Experience” criteria that users will require in future, regardless of whether that “user” is an individual or family, a business, or a connected object:
- Ultrafast download speeds (at and beyond 1Gbps):** Exact predictions for speed differ – the BSG says median households will need 19Mbps by 2023, with the top 1% needing 35-39Mbps<sup>89</sup>; Nielsen's Law of Internet Bandwidth, (which has accurately predicted bandwidth needs 1983-2014<sup>90</sup>), says top users will need 1Gbps by 2019<sup>91</sup>. But with Cisco saying “global IP traffic will increase threefold over the next 5 years”<sup>92</sup>, the direction of travel is clear. Ofcom confirms that the more bandwidth users have, the more they use.<sup>93</sup>
  - Higher upload capacity (more symmetric):** Today's networks are configured to enable much faster download than upload speeds, but future applications will require a more balanced upload/

download ratio. Demand for upload capacity is predicted to rise 44% CAGR 2013–2020<sup>94</sup>.

**c) Low latency:**

Boston Consulting Group says that low latency – how long it takes for data to move from one point to another – is critical for many future applications<sup>95</sup>.

**d) Consistent, reliable and secure:**

As connectivity comes to underpin all aspects of our lives, users and applications will become increasingly vulnerable to and intolerant of downtime, faults and breaches. Connectivity needs to be steady, seamless and uniform access regardless of location, weather or device.

**e) Good consumer outcomes:**

As well as meeting technical criteria, future networks need to deliver other consumer outcomes such as innovation, value for money and competition (for example through multiple retail providers using networks to offer different product to consumers).

**6.7** The conclusion that we can no longer judge fit for purpose according to download speed alone is clear and echoed by other stakeholders:

- The UK’s manufacturing body, EEF, says the “UK’s ongoing focus on speed is potentially distracting policy makers from delivering what industry really needs”, and that broadband needs to be “reliable, resilient and future-proof”.<sup>96</sup>

- The French regulator ARCEP now issues a scorecard for fixed services against a range of metrics including download and upload speeds, latency, quality of video streaming and time taken for web pages to load.<sup>97</sup>
- A draft of the European Commission’s upcoming Gigabit Society Communication says that “feedback from users, industries and individuals confirms that quality of connectivity is becoming increasingly important”...“this includes not only download speed but also upload speed, latency, jitter, reliability, uninterrupted access and ubiquity.”<sup>98</sup>
- In considering the key connectivity demands of 8 key growth areas (including big data and cloud computing), the UK Government’s 2015 Digital Connectivity Infrastructure Strategy only lists ‘fast’<sup>99</sup> once, with the need for reliability, resilience, security and low latency all being cited more often.

**6.8** There are two further points to take from an assessment of future connectivity needs:

- Each device will not require all five Quality of Experience Criteria all of the time, but the extent of connected devices means that our digital infrastructure will need to meet all of these criteria all of the time<sup>100</sup>.
- It will not just be high-tech business parks or niche residential consumers that will need this quality of experience. Connected objects and

devices will be pervasive, enabling public services and employment, for example, to take place at the individual's location rather than at the public service or location for many people. The deployment of fit for purpose digital infrastructure therefore needs to be nationwide.

### Fibre to the Premise best meets the Quality of Experience Criteria

6.9 The success of the UK's fixed-line infrastructure depends on it meeting all five Quality of Experience criteria. Which of the current – or future – technologies tick all those boxes and at a nationwide scale? The contenders are:

- **Copper-fibre hybrid (FTTC and G.fast):** The majority of today's superfast "fibre" connections are not pure fibre, but an upgrade of BT Openreach's copper phone network: fibre to the cabinet (FTTC) and then copper from the cabinet to the home or business (using VDSL technology). G.fast is the next copper upgrade and provides the basis of BT's ultrafast vision of Britain's digital future<sup>101</sup>.
- **Cable (Hybrid fibre-coaxial cable):** Virgin Media's cable network, which currently covers 44% of UK premises<sup>102</sup>, comprises a fibre optic cable to a street cabinet and then a coaxial cable to the home. Virgin Media plans to connect 3m additional homes with HFC by 2019 as part of its Project Lightning project<sup>103</sup>.

- **Fibre to the Premise (FTTP):** a fibre optic cable directly to the home or building. Some providers such as Gigaclear, CityFibre and Hyperoptic already deploy FTTP networks, Virgin Media has recently announced that Project Lightning will also deploy FTTP to at least 1m premises<sup>104</sup> and BT says it aims build 2m new FTTP connections, mainly in new housing developments, high streets and business parks by 2020<sup>105</sup>, in addition to its existing 279,000 FTTP connections<sup>106</sup>.

### Ultrafast (at and beyond 1GBps)

- 6.10 Most of today's FTTP services are capable of at least 1Gbps symmetric connections – a speed that even the most bandwidth-heavy users do not currently make use of continuously. This means that speed ceases to be a constraining factor. For the lucky few with a 1Gbps FTTP connection, a 4K movie takes seconds rather than minutes to download, Google Drive and Dropbox are effectively on their desk, and high quality video-conferencing with multiple colleagues is an everyday reality. Further more, FTTP technology has a clear roadmap to deliver speeds of 10Gbps to customers<sup>107</sup>. Cable's DOCSIS 3.0 standard is currently capable of delivering ultrafast download speeds of up to 200Mbps (for homes<sup>108</sup>) and 300Mbps (for business), and trials of DOCSIS 3.1 have reached up to 10Gbps<sup>109</sup>.
- 6.11 By comparison, BT's FTTC connections only deliver download speeds of up to 80Mbps<sup>110</sup> and actual speeds are dependent on a variety of factors (see below), meaning that they are no match for FTTP or

cable on download speed. However, BT's planned<sup>111</sup> G.fast roll out promises to deliver top download speeds of up to 500Mbps to 10 million homes and businesses<sup>112</sup>.

### Higher upload speed, low latency, consistent, reliable and secure

6.12 However, against almost every other Quality of Experience Criteria copper-based networks fall short. Speed on copper is heavily dependent on distance from the cabinet. As Dan Howdle of cable.co.uk explains, the performance of copper drops “not over miles, but over metres, not a steady decline, but a cliff. When you increase the speed at the cabinet (as BT has recently done in raising its basic fibre speed from 38Mbps to 52Mbps), you marginally improve the fortunes of those living distantly from the cabinet, but mainly you steepen the cliff.”<sup>113</sup> For G.fast this means that there will be around a 100 Mbps drop for every 50m increase in distance, bearing in mind that the “typical distance from a cabinet to a customer is 350m”<sup>114</sup>. This means that G.fast will not only repeat, but accentuate today's patchwork provision of “up to” download speeds and post-code variations, with an even greater digital divide being created between those who live close to the cabinet and are able to experience higher “peak” speeds and those living further away. This is especially the case in more rural areas.

- 6.13 Copper also suffers from interference between customers who share the cable, which means that most operators' plans for VDSL (the technology behind FTTC) and G.fast still maintain highly asymmetric downstream and upstream speeds<sup>115</sup>. By comparison the physical characteristics of pure fibre networks mean they can more easily offer higher upload speeds.
- 6.14 While G.fast does have a much lower latency than FTTC's VDSL (of <1ms), from a transmission system perspective it cannot offer latency as low as fibre<sup>116</sup>. The ITU (International Telecommunication Union) is also working on low latency FTTP systems that could result in latencies as little as tens of microseconds, which G.fast simply could not match<sup>117</sup>. ARCEP, the French regulator, seems to agree, with its most recent Quality of Service scorecard “clearly reveal[ing] the contribution made by fibre to the home access [particularly for] upstream throughput and for latency”<sup>118</sup>.
- 6.15 G.fast and other copper-based networks are also very weak on reliability and consistency of performance compared to FTTP, the electronics in the system meaning they are more prone to external interference from sources such as lightning strikes<sup>119</sup>, radio transmitters, power line communications<sup>120</sup> and power control systems<sup>121</sup>.

**6.16** On the otherhand, FTTP usually has no “active” components deployed in the external network environment, meaning that the potential for faults, weather interference and security breaches is much reduced, allowing it to offer a very consistent and reliable service. For example, Vodafone reports 50% fewer faults on their Spanish FTTH network compared with the incumbent’s copper network<sup>122</sup>. During recent floods in York, BT’s copper-based network was badly interrupted, while CityFibre’s pure fibre network was unaffected<sup>123</sup>. The World Economic Forum also observes that for future networks “security becomes a significant issue given the sensitivity and frequent urgency of data handled in IoT applications”<sup>124</sup>. Fibre-optic cables also score highly against copper on this count, as they are extremely difficult to tap<sup>125</sup>.

### Consumer outcomes

**6.17** FTTP’s superior technical performance has led to the view that it is a premium product<sup>126</sup>, which cannot offer good consumer outcomes, including value for money, to the mass market. The business-grade price of BT’s residential Fibre on Demand product added weight to this idea<sup>127</sup>. However, gigabit services are being offered at a variety of price points, with strong take-up levels. INCA members’ experience demonstrates strong take-up and customer satisfaction levels: in areas where Hyperoptic is active, 20% of users opt for the 1Gbps symmetric service, priced at £47 per month. Gigaclear reports 36% take up of its products in May 2016 with zero churn in the month.

**18** In terms of competition, one advantage that FTTP has over cable is the potential to use standardised architectures and capabilities to offer wholesale access at both the passive and active level<sup>128</sup>. However, while many FTTP networks across the world are made available on a wholesale basis to offer competition to consumers, there are very few examples of wholesale access to cable infrastructure, as unbundling the coaxial cable presents technical challenges. While wholesale and open access networks have a number of advantages, it is not an approach that should be mandated for the Altnets, given the early stage of the market and the importance of allowing those players who are making substantial investments in FTTP to have first mover advantage. The creation of FTTP networks by competing providers also injects competition into the market by allowing providers to choose between multiple networks to offer their services, rather than being dependent on BT’s Openreach network, as is largely the case today.

### Quality of Experience Summary

**6.19** BT Openreach’s FTTC is already causing UK consumers and businesses (and their ISPs) considerable frustration because of its unreliable service<sup>129</sup>. However, the demands of future applications will expose copper’s fundamental weaknesses yet further, even if the upgrade to G.fast gives those living very close to the cabinet faster potential top download speeds. Cable offers both improved speeds and quality of connectivity, but it is more limited in its ability to offer wholesale

access, and therefore competition in the market. By comparison it is FTTP's ability to deliver the same service consistently and reliably to all users regardless of location, combined with its gigabit speeds, lower latency and greater symmetry and potential for competition that marks it out as the right choice as the basis for the UK's national fixed-line infrastructure.

### Future networks need to deliver for the UK

**6.20** A user's Quality of Experience is only half the story, however. FTTP also performs well against important wider criteria.

#### Supports our wireless infrastructure

**6.21** Gigabit Britain will depend as much on wireless networks, including mobile and fixed wireless access, as fixed-line networks. Fixed wireless networks will play a vital role in delivering superfast services in the short- and medium-term for some parts of the market and will continue to serve other areas over the longer-term where fixed-lines are less commercially or physically viable. Wide-area and short-range wireless will underpin future developments such as IoT and smart cities<sup>130</sup>. Crucially, wireless will operate hand-in-hand with fixed-lines across all parts of the country, given that "a wireless network is only wireless at its edges"<sup>131</sup>. The quality of fixed-line networks in delivering wireless services is therefore vital and as the OECD concludes "fibre is critical to support greater use of wireless networks"<sup>132</sup>.

**6.22** This is particularly the case for 5G, the next generation of mobile networks, which as former Chancellor George Osborne made clear is strategically important to the UK<sup>133</sup>. Rather than 5G rendering the widespread deployment of FTTP unnecessary, 5G accentuates the need for it. As Vodafone explains, 5G "will require fibre backhaul to unleash [its] full potential" with insufficient FTTP rollout meaning that "5G could be delayed"<sup>134</sup>.

#### Delivers good socio-economic outcomes

**6.23** While there is a significant body of academic evidence on the positive socio-economic impact of broadband versus dial-up, there are fewer studies showing that even greater benefits can be achieved by leaping from broadband to "gigabit services"<sup>135</sup>. As the OECD notes, this is not surprising because "they have only recently started to be widely deployed and there has been limited availability of data."<sup>136</sup> Some early evidence is now emerging, however, in the US and Sweden in particular.

**6.24** A well cited case is Stokab in Stockholm, which used commercial funds to "invest 5.4 billion SEK (over €600 million) in the development of an open, operator neutral fibre network"<sup>137</sup>. Stokab now makes FTTP available to "about 90% of households and almost 100% of enterprises". A study found that "Stokab's own financial results, cost savings for the municipality and the county administration, as well as benefits for businesses and end users [alone] amount to USD 2.5 billion, over three times

the investment.”<sup>138</sup> Also in Sweden, OECD research shows that a 10% increase in fibre penetration is correlated with up to 1.7% higher employment, greater business creation and reduced car use.<sup>139</sup>

**6.25** In the US the best-known case is Chattanooga, Tennessee, where the Electric Power Board provides 1Gbps fibre to all 150,000 homes and businesses<sup>140</sup>. The development is prominently cited as a major contributor of increased economic activity in the town<sup>141</sup>. For example, in 2011 Amazon and Volkswagen joined a growing number of start-ups and venture capitalists by opening major facilities there<sup>142</sup>, helping to transform what was once a manufacturing town into a high-tech hub. The University of Tennessee estimates that “over the period 2011-2015, the fiber infrastructure has generated incremental economic and social benefits ranging from \$865.3 million to \$1.3 billion, while additionally creating between 2,800 and 5,200 new jobs<sup>143</sup>. Elsewhere in the US, another study shows that “14 communities with widely available gigabit broadband [...] enjoyed over \$1 billion in additional GDP when gigabit broadband became widely available.”<sup>144</sup>

**6.26** Until more evidence on the socio-economic impact of FTTP emerges, the alternative approach is to assess the cost of not having widespread access to the connectivity characteristics that FTTP is able to deliver:

- **Lost GVA and Productivity:** The UK Broadband Impact Study predicts the “availability and take-up of faster broadband speeds”<sup>145</sup> will add £17bn GVA, the “bulk” from productivity gains.
- **Failure to close regional imbalances:** The ability of cities and regions to attract economic activity will be increasingly dependent on their digital infrastructure.
- **Threat to key UK sectors:** for example, “fast, ubiquitous and reliable connectivity is critical to the future of all the UK creative industries”, which are collectively worth £84.1bn a year to the UK<sup>146</sup>.
- **Lost inward investment:** The UKTI recognises that “business-ready infrastructure”, including world-class digital connectivity are key to attracting overseas business into the UK<sup>147</sup>.
- **Failure to expand UK’s labour capacity:** “Improved home connectivity” will enable “increased participation of carers and disabled people” with a resulting net GVA rising “to about £1.4 billion p.a. by 2024”<sup>148</sup>.
- **Undermine the promise of 5G:** The National Infrastructure Commission is looking at “what the UK needs to do to become a world leader in 5G deployment”<sup>149</sup> ahead of the 5G strategy due in spring 2017. Success in 5G is not possible without widespread fibre.

**6.27** In all these cases, socio-economic gains are predicated on technologies that require connectivity that delivers not just fast download speeds, but the more rounded and reliable service that FTTP, working hand-in-hand with wireless, is best placed to deliver.

#### **Efficient to operate**

**6.28** To ensure the UK benefits from high quality connectivity 24/7/365, networks must be cost effective and easy to maintain. Fibre networks use fewer electronics and less hardware than copper-based networks, meaning that they are less prone to faults and cheaper to run (requiring less space and power per customer). In the US, Verizon’s migration from copper to full fibre has resulted in savings of 60-80% in real estate costs; 60% savings in dispatches; CAPEX savings of 10-15%; energy savings of 40-60% and maintenance savings of 40-60%, forcing Verizon to conclude that fibre “pays for itself”<sup>150</sup>.

#### **Minimise energy demands and environmental impact**

**6.29** The collective energy needs of a rising number of connected devices will become increasingly important as nations look to reduce energy use and environmental impact. A detailed PWC study for the FTTH Council analysed the lifespan of a FTTH network, concluding that that the “the environmental cost of building and operating fibre access networks [is] far lower than for copper.”<sup>151</sup>

#### **Future proof**

**6.30** As Ofcom notes, “we cannot today predict what future demand will be”<sup>152</sup> and therefore require networks that can be upgraded easily and cost-effectively. Consultants Communications Chambers have pointed out that “copper technologies are developing rapidly”<sup>153</sup> and may develop further. However, once laid FTTP only requires equipment changes at each end to increase or change capacity, allowing operators to raise the speed ceiling as consumers begin to hit it. According to Peter Cochrane, ex-BT CTO, this means that FTTP “is future proofed for decades to come as bandwidth is effectively infinite by today’s measures”<sup>154</sup>.

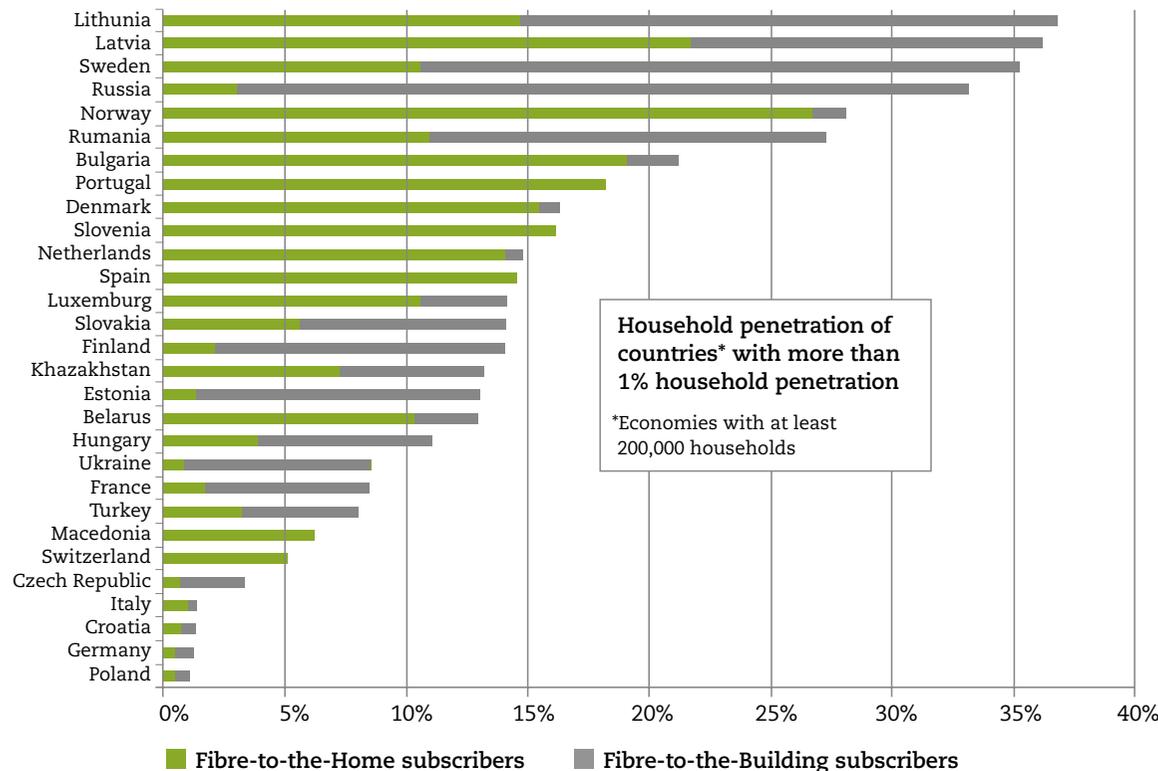
#### **Future networks must deliver for the UK: Summary**

**6.31** The next digital revolution will place incredible demands on our infrastructure. The performance delivered by networks will need to improve across the board, at the same time as delivering socio-economic benefits in a way that is environmentally friendly, energy efficient, cost effective and supportive of our wireless networks.

**6.32** A mix of technologies will be required to meet these needs. Wireless networks of all sorts have a central role to play in delivering Gigabit Britain. In some situations copper-based networks, such as G.fast, may be used to meet some of the Quality of Experience Criteria. Cable – with a footprint soon to cover over half of the UK’s population and an ability to deliver very high speeds – has a vital role to play in the development of a Gigabit Society. Satellite has

advantages in delivering increasingly high-speed connectivity across large areas. However, against an increasingly tough set of criteria, there is one type of fixed-line network – FTTP – that stands out above the others. The UK should therefore be striving to deliver FTTP connections to as many of its citizens as possible.

**Figure 4: European ranking – end September 2015**



Source: Reset graph from FTTH Council Conference 2016 press release, using IDATE for FTTH Council, February 2016.

### The international picture: is the UK ready for the future?

#### The UK is at the back of the pack

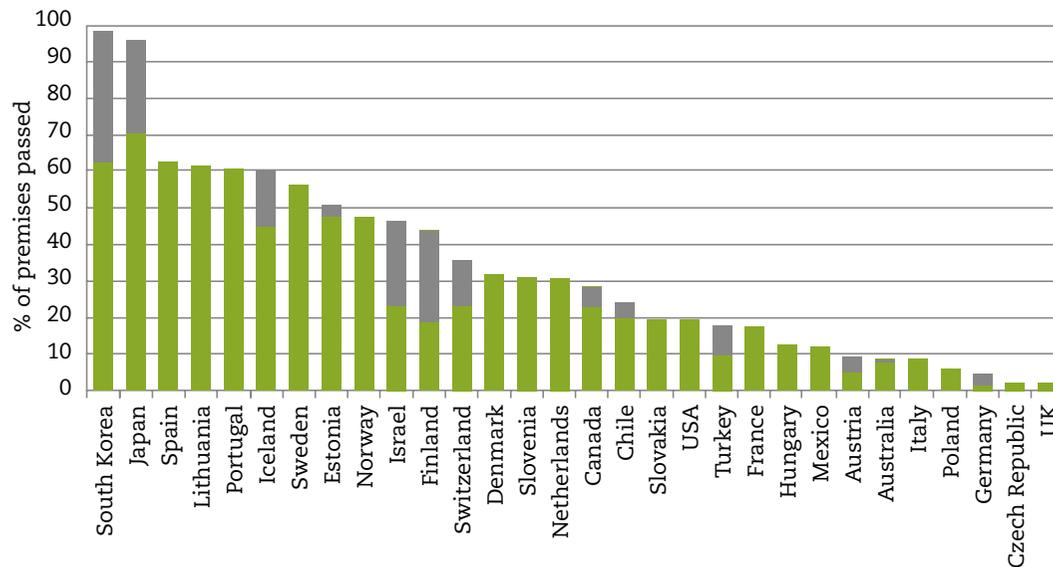
**6.33** A number of stakeholders have argued that the UK is a leading digital nation, thanks in part to the Superfast Broadband programme. The Government uses Ofcom’s EU scorecard<sup>155</sup> to demonstrate that the UK has “the best superfast coverage of all five leading European economies”<sup>156</sup>. Meanwhile BT refers<sup>157</sup> to Analysys Mason, who predict the “UK will lead the EU ‘big five’ on broadband for the next five years”<sup>158</sup>. While these statistics may be correct about the UK’s current position, the headlines present a misleading picture about how ready the UK is for the future. Both Ofcom and Analysys Mason’s studies show the UK performing well against its peers on today’s terms – superfast speed, coverage, take-up and price. If we instead judge the UK’s preparedness against the most appropriate future metric – the extent of deployment of FTTP – then the UK is set to slide down to the bottom of the pile of developed nations.

**6.34** The UK does not even make it onto the FTTH Council’s latest European Ranking chart<sup>159</sup> (see Figure 4). All of the EU countries that the UK leads on today’s terms, including France, Germany, Italy and Spain, are out-performing the UK in their preparation for tomorrow.

6.35 The picture is even worse if the UK is compared to its international competitors. As Ofcom notes, the UK has the lowest FTTP deployment in the OECD (see Figure 5)<sup>160</sup>.

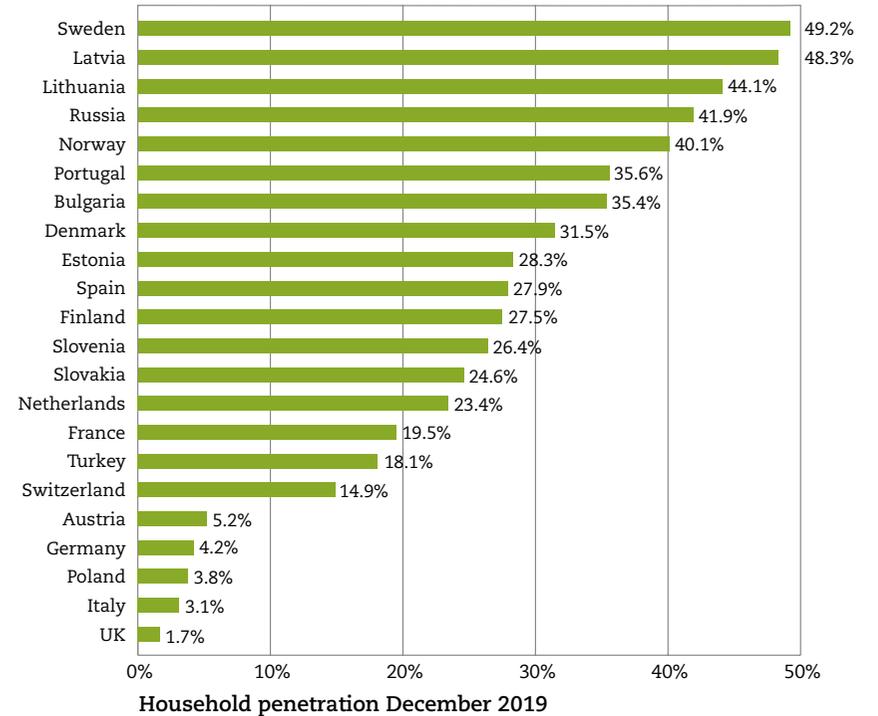
6.36 Even more concerning is the trajectory the UK is on compared to these key competitors. In a chart showing FTTP projections for 2019, the UK sits at the bottom of the list of 22 EU countries<sup>161</sup>.

**Figure 5: Fibre coverage to premises in OECD nations – end 2015**



■ FTTB/VDSL Source: A reset version of Figure 7 from Making Communications Work for Everyone, Ofcom's DCR Statement, February 2016, using Analysys Mason source material from September 2015.  
 ■ FTTP Note: Analysys Mason figures are based on actuals for 1H 2015 and forecasts for 2H 2015. FTTB/VDSL is fibre-to-the-building where in-building distribution is via VDSL (very high bit rate digital subscriber line) over copper connections.

**Figure 6: FTTH countries in Europe 2019\* by household penetration**



\*Among the 22 countries analysed in detail

### The UK's key competitors are making FTTP progress

**6.37** The country-specific stories behind these charts support the conclusion that the majority of the UK's peers are now making firm strides towards significant FTTP deployment. Sweden has long featured at the top of the FTTP charts with 56.4% coverage by the end of 2014<sup>162</sup> (compared with the UK's 1.4% FTTP coverage at the end of 2014<sup>163</sup>), giving it the highest proportion of fibre connections outside Asia among OECD countries<sup>164</sup>. But it is the recent upward trajectory of some of the UK's key European competitors, often from a slow start, that is particularly worth noting:

- **France** (13.6% FTTP coverage at end of 2014<sup>165</sup>): France is currently a mid-ranking FTTP nation, but is experiencing strong growth, with analysts predicting France will become “the second largest market for FTTH after Russia”<sup>166</sup> by 2019 and with subscriptions rising 31% in 2015<sup>167</sup>. Progress has been stimulated by a fibre-based Government plan worth 20bn Euros<sup>168</sup>, regulated duct access, and incumbent Orange's aggressive rollout plans<sup>169</sup>.
- **Spain** (44.8% FTTP coverage at end of 2014<sup>170</sup>): There has been rapid FTTP progress since 2013 following regulation of duct access<sup>171</sup>, with coverage rising 22% between 2013 and 2014<sup>172</sup>. Subscriptions are also rising rapidly, with 65% growth over nine months in 2015<sup>173</sup>. Progress is set to continue: Telefónica is planning FTTP to 20m building units (77% of the total building units in Spain) by 2017<sup>174</sup>;
- **Portugal** (65.8% FTTP coverage by end of 2014<sup>176</sup>): FTTP rollout increased 16% between 2013 and 2014 stimulated by regulated duct access, which has allowed both the incumbent (MEO) and Vodafone to deploy heavily, with the latter planning to reach “2.75 million homes and businesses across the country by the end of 2016”<sup>177</sup>. Progress towards full FTTP deployment is going so well that MEO is planning “to start ripping out its legacy network next year with a view to going copper-free by 2020”<sup>178</sup>.
- **Germany** (4.4% FTTP coverage at end of 2014<sup>179</sup>): Germany's low FTTP ranking and the position of the incumbent DT (who like BT has chosen not to prioritise FTTP), is often cited as proof that the UK's equally poor standing is nothing to worry about. However, Germany is now making progress, having joined the FTTH ranking for the first time this year<sup>180</sup> thanks to the pro-FTTP stance of some of its regions and municipalities (see Stadtwerke München.)
- A third of homes in **The Netherlands** are now connected to FTTP<sup>181</sup>, and rapid deployment is also taking place in Eastern European, in particular countries such as **Poland**, which also joined the FTTH Council rankings this year<sup>182</sup>.

Vodafone is “building a new gigabit FTTH network in Spain serving more than two million homes and businesses through a co-investment agreement with Orange”<sup>175</sup>.

- 6.38** The pattern repeats itself across the world, with many countries starting to increase deployment in the wake of more established Gigabit nations like Japan, South Korea and Singapore.
- 6.39** In **New Zealand**, the Ultra-Fast Broadband Initiative is a high profile government programme building FTTP with speeds of up to 100Mbps to 80% of the population by 2022, using private investment and supported by public funding.<sup>183</sup> Explaining in 2008 why he was proposing a nationwide FTTP rollout, Prime Minister Jon Key said that New Zealand's legacy copper-based networks were like "a dirt track when compared to the fibre highways" that "would truly future-proof New Zealand."<sup>184</sup> The significant public investment – NZ\$1.5bn – was justified on economic grounds, with benefits predicted to be more than "NZ\$32.8 billion over 20 years".<sup>185</sup> It is too soon to understand if these benefits have been delivered, but the planned build hit its halfway mark in June 2015 and 2014 saw annual take-up grow by 272%, the fastest growing take-up of fibre in the OECD<sup>186</sup>.
- 6.40** The **United States** is currently a mid ranking FTTP nation, with 19% FTTP penetration<sup>187</sup> but "FTTH activity is predicted to grow to record levels by 2017"<sup>188</sup>. This growth is largely due to the competition injected into market by Google Fiber, which is currently in 5 markets, with plans for 17 more<sup>189</sup>. It has forced others to respond: AT&T says its 100% fibre Gigapower service is now operational

in 20 metropolitan areas, will be delivered to 30 more in 2016, and is looking at up to 100 cities longer term<sup>190</sup>. FTTP networks are also being built on a smaller scale<sup>191</sup> across the States, in addition to the 19.8 million FTTP connections already built by Verizon<sup>192</sup>. Commentators observe that "Google Fiber seems to have lit a fire under the feet of the broadband industry", with many believing that this was Google's intention all along – "to invest just enough into fiber to encourage more traditional providers to build out their own networks"<sup>193</sup>. Regardless of how progress is achieved, the market is certainly moving the US towards greater FTTP coverage<sup>194</sup>.

### **The UK needs to find its own path to widespread FTTP**

- 6.41** There are diverse and complex reasons why many countries have succeeded in achieving much greater FTTP deployment than the UK, including topography, historic market conditions, regulatory frameworks and population density<sup>195</sup>. In some instances incumbents, following interventions from the government or regulator, have led the march: in Europe they accounted for "over half of all FTTH lines in 2014"<sup>196</sup>. In other markets challengers have made the first move, usually followed by the incumbent: in the Netherlands Reggefiber is responsible for 80% of all FTTP connections<sup>197</sup>. In some countries, in particular Spain and Portugal, rapid roll out has resulted from the aggressive competition triggered by regulatory action and good quality duct and pole access<sup>198</sup>.

6.42 A number of countries, for example New Zealand and Singapore, have adopted national broadband policies that specify FTTP and deployment targets. Others have broadband policies that do not specify FTTP, but do set out ambitious criteria that effectively discount less future-proof networks: Sweden's broadband strategy states that 90 % of households and businesses will have access to at least 100 Mbit per second by 2020 through "resilient and reliable" broadband access, for example<sup>199</sup>. In some cases municipalities and regions rather than central governments have driven deployment: in Germany, Stadtwerke Munich connects fibre to half of all housing in the city<sup>200</sup>.

## Conclusion

43 BT's decision to upgrade its copper network to FTTC to deliver the Superfast Broadband programme has given the UK short-term advantages and provides a strong platform from which to maintain its position as a leading digital economy. However, the UK now needs rapidly to find a way to get out of the FTTP starting blocks to avoid significantly trailing behind in a decade's time, with disastrous consequences for its economic prosperity.

## ANNEX TWO: Connectivity requirements of key sectors, public services and technologies

INCA reviewed the future connectivity requirements (as cited by government, regulator or industry papers) of a sample of 10 sectors, public services and technologies that will play a defining role in the UK's economic prosperity.

About	Importance to the UK	Connectivity requirements
<b>Audiovisual and virtual reality</b>		
<p>Video and gaming applications already dominate today's internet traffic and will drive consumer demand for future networks. With HD increasingly common and 4K/8k on their way and with real-time and streamed video and gaming becoming commonplace, Cisco predicts video will account for 80% of all consumer Internet traffic in 2019 (up from 64% in 2014). Virtual Reality, with immersive 360 degree headsets, will take audio-visual applications to the next level.</p>	<p>High quality audiovisual and virtual reality applications will not just play a central role in the UK's media and entertainment, but feature in health, education, military, tourism, manufacturing, retail, the justice system.<sup>201</sup> Deloitte says that VR may be a niche product now, but sees it as a "powerful tool" for consumer-facing businesses such as retail and tourism.<sup>202</sup></p>	<p>Cisco predicts "consumer VoD traffic will nearly double by 2020. Ultra-high definition (UHD) will be 20.7% of IP video-on-demand (VoD) traffic in 2020, up from 1.6 percent in 2015".<sup>203</sup> Low latency is critical to the future of the gaming industry, where the "latency of more than 100 millisecond can affect the experience of the gamer," and prove make or break for a game.<sup>204</sup> According to Tata Communications, "VR's success will be largely dependent on last-mile networks" and their ability to cope with "the huge increase in bandwidth demand generated by VR content (about five times as much bandwidth as HDTV), as well as very low latency to support an immersive experience."<sup>205</sup></p>

About	Importance to the UK	Connectivity requirements
<b>Cloud Computing</b>		
With its ability “to store, process and manage the vast volumes of real-time data being created through digital innovation”, <sup>206</sup> cloud computing is the brain power that underpins other developments such as IoT, Smart Cities and big data.	Cloud computing is estimated to be worth an additional €449 billion to the European economy alone by 2020. <sup>206</sup>	techUK’s Cloud 2020 vision says that “having in place a reliable high speed, low latency and ubiquitous fixed and mobile communications infrastructure is essential to realising mass adoption and take up of cloud computing services” <sup>206</sup> in the UK.
<b>Creative Industries</b>		
DCMS defines 10 sectors <sup>209</sup> including: Advertising and marketing, architecture, crafts, design and fashion, film and TV, IT and computer services, publishing, museums and galleries, music and performing arts.	Collectively worth £84.1bn a year to the UK, the creative industries grew by 8.9 per cent in 2014 – almost double UK economy as a whole. <sup>210</sup>	The Creative Industries Council says that “fast, ubiquitous and reliable connectivity is critical to the future of all the UK creative industries”, adding that “metrics such as upload speed and latency can be more important to companies than is often appreciated.” <sup>211</sup>

About	Importance to the UK	Connectivity requirements
<b>eHealth</b>		
<p>A wide variety of tech-enabled approaches to health and wellbeing: connected devices that monitor fitness and activity levels; video conferencing and connected devices for remote diagnosis and post-operative care; consultants remotely assisting in surgery and consultation via a remote HD video link; remotely managed intensive care units (ICU); large scale medical experimentation and research, using big data and cloud storage.</p>	<p>eHealth applications could generate significant savings for the UK: remote patient monitoring is projected to result in global cost savings of up to \$36 billion by 2018;<sup>212</sup> a US-based telehealth pilot led to a 45% reduction in hospitalisations and reduced costs of care by 27%.<sup>213</sup> Remote consultation and diagnostics will save time and money for patients and doctors, especially in rural areas.<sup>214</sup></p>	<p>Karolinska University Hospital, Sweden is a leader in digital health innovation. It uses HD video conferencing to conduct home monitoring of Parkinson’s patients and to allow specialist consultants to assist surgery remotely, both of which require secure, high bandwidth, low latency connections.<sup>215</sup> Philips is a leading ehealth provider, providing remote real-time ICU monitoring. Secure, high-bandwidth, low-latency networks are crucial for this. Philips say that “Connectivity is crucial for digital health solutions ... low latency and reliability is paramount to save lives using critical care solutions”.<sup>216</sup></p>
<b>Elderly care</b>		
<p>The use of technology to enable the elderly and others who require social support to live independently for longer, with improved security. Applications include video communication to allow communication with home care personnel, family and friends to complement physical visits; nightvision cameras to monitor individuals at night; monitoring to look for patterns and to enable early intervention, for example if an elderly person is likely to fall.</p>	<p>The number of people aged 65+ in the UK is projected to rise by over 40 per cent in the next 17 years to over 16 million.<sup>217</sup> Supporting those people is major public policy priority.<sup>218</sup> A study on FTTH-enabled digital services for home care in the Västerås, Sweden showed that “between 2014 and 2020, [...] Sweden could save up to between €3 and €6 billion if such services were massively deployed today.”<sup>219</sup></p>	<p>The OECD found that “it is possible to use high speed networks to provide more cost efficient home care services” and that “a widespread introduction of digital services could stabilise the cost for home care or even decrease it by up to 50% for sparsely populated municipalities, but it requires that end-users have access to high quality, reliable broadband connections”.</p>

About	Importance to the UK	Connectivity requirements
<b>Future of Work</b>		
Rise of flexible/remote working, micro-entrepreneurship and the sharing economy. <sup>220</sup> The UK Commission for Employment and Skills (UKCES) predicts “increasing virtual workforces” and not just in the knowledge sectors. <sup>221</sup>	The Centre for Economics and Business Research says flexible working could boost the UK economy by 90bn. <sup>222</sup> The UK Government wants “Britain to lead the way on the sharing economy” which PWC estimates could be worth around \$15bn (or £9bn) to the UK by 2025. <sup>223</sup>	Debbie Woskow, Chair of Sharing Economy UK says “fast, reliable and consistent broadband throughout the entire UK is vital for the continued growth of the sharing economy”. <sup>224</sup> The Institute of Directors says “faster broadband would encourage just over 50% of their [members] to offer more flexible working opportunities to staff.” <sup>225</sup>
<b>Industry 4.0</b>		
Described by McKinsey as “the next phase in the digitization of the manufacturing sector”, Industry 4.0 comprises the rise in data volumes, computational power; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction such as touch interfaces and augmented-reality. <sup>226</sup>	Former Business Minister, Baroness Neville-Rolfe says “the fourth industrial revolution will fundamentally change the way we do business in this country [...] the expectation must be that the net effect will be positive for almost everyone”. <sup>227</sup> Digitisation of products and services estimated to add €110 billion+ revenue per year in Europe in the next 5 years. <sup>228</sup>	The UK’s manufacturers association, EEF, says for Industry 4.0 to deliver £350bn to the UK economy by 2030, a high speed, secure and reliable digital infrastructure <sup>229</sup> is required. Germany’s Industrie 4.0 working group, cites “guaranteed latency times, reliability, quality of service and universally available bandwidth” <sup>230</sup> as vital to industry 4.0.

About	Importance to the UK	Connectivity requirements
<b>Internet of Things</b>		
<p>The growing network of physical objects connected to the internet and able to transmit data without human interaction; takes the internet beyond smartphones, laptops and tablets to cars, buildings, waste bins, baby's cots – anything with a sensor; Ofcom estimates that there are already 40 million IoT connected devices in the UK; the figure is expected to grow eightfold by 2022.<sup>231</sup></p>	<p>With its potential impact on health, smart cities, smart buildings, utilities, transport industry and energy, the UK's Chief Scientific Advisor Mark Walport predicts IoT will “have a greater impact on society than the first digital revolution”, “bringing with it significant economic and societal benefits [to the UK] over the next 10 years.”<sup>232</sup></p>	<p>Walport lists a fit for purpose infrastructure as key to UK IoT success and cites resilience, continuity and coverage<sup>233</sup> as key. Ofcom says networks delivering IoT must be “robust and reliable” and that data must be delivered over them “securely”. Some devices (fitness monitoring) can cope with interrupted connectivity, others (e.g. smart grid service or heart monitor), require a highly resilient network to ensure real time and continuous connectivity.<sup>234</sup></p>
<b>Smart Energy</b>		
<p>The move from passive networks that move power from power plants to end users, to the emergence of smart solutions, which rely greatly on communication networks. Includes applications such as automated demand response; Smart metering; IoT sensors; vibration, temperature or voltage sensors measuring the state of the distribution network; consumption visualization and behaviour change</p>	<p>The UK's energy system needs to be modernised and decarbonised; a smart approach to power is vital to the UK's future. The National Infrastructure Commission has said that the UK is “uniquely placed to lead the world in a Smart Power Revolution” and that by managing the use of electricity more efficiently – in part by using “digital communications which can make our networks smarter and able to react to changes in real time” – there is potential for savings up to £8bn a year.<sup>235</sup></p>	<p>According to Arthur D Little, smart energy solutions “rely on real-time two-way communication between the utility organisations on one side and the consumers as well as suppliers on the other” through “a low latency and highly secured connection”.<sup>236</sup></p>

About	Importance to the UK	Connectivity requirements
<b>SMEs</b>		
<p><b>Small and Medium sized Enterprises represent 99% of UK businesses, employing 14m people.</b><sup>237</sup></p>	<p>The Gross Value Added of SMEs is estimated to be €473 billion or 49.8% of the UK economy.<sup>238</sup> “Small businesses are the bedrock of the UK economy and critical to growth and job creation.”<sup>239</sup></p>	<p>The Federation of Small Businesses says “now and in the future, small businesses will become ever more dependent on better, faster and more reliable broadband services”.<sup>240</sup> “While upload and download speeds are important to small firms, reliability and quality of service are also critical.”<sup>241</sup></p>

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- 6 Based on BT's current 300,000 premises plus the 2m FTTP planned by 2020 as per announcement on 5 May 2016 (although unclear from BT's release whether the 2m is in addition to or including existing 300,000) plus the 1m FTTP connections by 2019 announced by Virgin Media on 27 April 2016. INCA's Member Survey 2016 showed that by 2020 Altnets are on track to pass 4,900,909m premises or 18% of UK premises.
- 7 In the INCA Member Survey 2016 a third of members said that if all the recommendations in this paper were adopted their deployment plans would increase by 25%, a third said they would increase by 50% and a fifth by 100%.
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