Final Report for BT

Comparative analysis of outcomes in the UK broadband market: coverage, connections and competition

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1 Executive summary

In the context of Ofcom's ten-year *Strategic Review of Digital Communications*, and in response to Ofcom's stated ambition for a third fibre-to-the-premises (FTTP) network to cover 40% of premises in the UK, we have conducted a comparative analysis of the UK's broadband infrastructure, including the outlook for future development. The analysis comprises two parts: an updated benchmarking exercise which compares the UK to a range of developed broadband markets; and new economic analysis which considers the economic viability of a third FTTP operator.

The benchmarking analysis shows that the UK is performing well on key broadband measures. Compared to previous reports, we have considered an expanded range of benchmark countries: Australia, France, Germany, Italy, New Zealand, Portugal, Spain and Sweden. The UK continues to lead our benchmarks in terms of next-generation access (NGA) broadband coverage, and ranks first on availability of 10Mbit/s, and second on average broadband speeds (the UK is number one when compared to the 'big five' European countries). For NGA take-up, the UK is currently third in our benchmark countries (again, number one in the European 'big five'), and is expected to be number one in all benchmarks by 2020 due to the availability of NGA infrastructure and the highly competitive nature of the UK market.

This report further extends our previous benchmarking analysis by considering the overlap of different NGA infrastructures. Competition between infrastructures will have a key impact on the UK realising the outcome of 40% coverage by a third FTTP network that Ofcom suggests. We find that Portugal and Spain (and to a certain extent France) are the only countries in our benchmarks that are expected to see widespread coverage of three competing ultrafast networks. However, these countries have very different characteristics to the UK, including a high proportion of homes in multi-dwelling units (MDUs) and quite different regulatory regimes.

The importance of considering the specific characteristics of the UK has led us to conduct the second piece of analysis included in this report: estimating the economic viability of a third FTTP operator. We have assumed that the operator uses duct and pole access (DPA), where it is available, which is a key element of Ofcom's strategy. Our results show that it is highly unlikely that an operator will be able to reach 40% coverage on a commercially viable basis, and that the achievable coverage is highly sensitive to market share. Under our base-case assumptions, a new-entrant operator, deploying a new FTTP network using DPA, and growing its customer base from zero, could viably deploy to up to 7% of the UK (2 million premises), if it achieved a long-term market share of 25%. At a more realistic 20% market share (which aligns with our base case), the limit of viable coverage would fall to 4% of the UK (1.1 million premises). In both cases, we assume that the new entrant would allocate more revenue to the access network than the current wholesale price of FTTC. If an operator with an existing customer base were to make the deployment, and therefore were able to migrate subscribers onto the network more quickly, the coverage results would increase to 10% and 5% of the UK in the two cases.

In February 2016, Ofcom published its initial conclusions from the *Strategic Review of Digital Communications*,[1] which included, among other proposals, Ofcom's plan for a strategic shift to large-scale investment in more fibre. Ofcom believes that the key to achieving this goal is to make improvements in the 'passive' duct and pole access (DPA) regime relating to Openreach's network, and it has also suggested 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*".[2] Ofcom has further indicated that in areas where network competition is viable, regulation could be removed; and in the remaining areas, 'active' wholesale products will continue to be important.

In the light of these developments, we have conducted two pieces of analysis to assess the current status of UK infrastructure and the outlook for future development:

- Firstly, we present an updated version of the analysis we provided in previous reports for BT,[3] which compared the performance of the UK broadband market against a range of other countries. In this case, the list of benchmark countries has been expanded and includes Australia, France, Germany, Italy, New Zealand, Portugal, Spain and Sweden. This list was selected as it includes (a) the largest European countries; (b) countries where DPA has been used by competitors to deploy their own fibre; and (c) countries where there has been a government policy push for fibre.

- However, this report goes further than previous reports by presenting *new analysis* of the prospects for infrastructure competition based on DPA, and the likelihood of the UK realising the outcome of 40% coverage by a third fibre-to-the-premises (FTTP) network that Ofcom suggests. To do this, we start by analysing the infrastructure outcomes in the other benchmark countries and consider the extent to which those countries are a useful indicator of what could happen in the UK. We then present the results of new economic modelling which highlights the viability of, and risks associated with, a widespread competitive deployment of FTTP in the UK market context.

1.1 International benchmarking

Definitions

One of the major themes in Ofcom's review is the shift from superfast to ultrafast broadband networks. In this report, 'superfast broadband' means fixed connections which typically can support a downstream bandwidth of at least 30Mbit/s; for 'ultrafast broadband' we mirror the definition used by the UK Government and the European Commission, i.e. downstream bandwidth of at least 100Mbit/s.[4]

1 Ofcom (2016), *Making communications work for everyone: Initial conclusions from the Strategic Review of Digital Communications*. Available at http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/

2 Ofcom (2016), *Strengthening Openreach's strategic and operational independence, Proposal for comment*. Available at http://stakeholders.ofcom.org.uk/binaries/consultations/strengthening-openreachs-independence/summary/condoc.pdf

3 Analysys Mason report for BT, *International benchmarking report*, 21 September 2015. Available at http://www.analysysmason.com/About-Us/News/Press-releases/Broadband-benchmarks-Sept2015/

4 We note that Ofcom has defined ultrafast broadband to include services of 300Mbit/s or more.

UK market developments

The UK has seen network investment announcements from a range of operators, including BT, Virgin Media, CityFibre, Hyperoptic and Gigaclear, among others. All of these operators are increasing the level of network infrastructure competition in the UK, and it is notable that many of them are not relying on the current passive infrastructure access (PIA) product available from Openreach. Furthermore, there have been recent announcements in Hull (where KCOM is the incumbent operator and BT is not present), with both CityFibre[5] and MS3[6] having announced FTTP investment plans.

International comparisons

Figure 1.1 below summarises how the UK compares against our set of nine benchmark countries.

Figure 1.1: Comparison of the UK against benchmark countries for key wireline broadband measures [Source: Analysys Mason, ThinkBroadband, Akamai, 2016]

Metric	2016 value	Rank vs. benchmarks	Rank vs. EU5	2020	Rank vs. benchmarks	Rank vs. EU5
Coverage of high-speed broadband (10Mbit/s+)	96%	1	1	100%	1	1
Coverage of superfast broadband (30Mbit/s+)	91%	1	1	98%	1	1
Coverage of ultrafast broadband (100Mbit/s+)	50%	5	3	85%	4	2
Average broadband speed	14.9Mbit/s	2	1	–	–	–
Premises covered by two superfast networks	41%	5	3	76%	3	2
Take-up of broadband (all speeds)	85%	2	1	91%	1	1
Take-up of superfast broadband (30Mbit/s)	43%	3	1	77%	1	1
Total broadband ARPU share of wallet	0.60%	3	2	0.53%	3	2
NGA broadband ARPU share of wallet	0.68%	3	2	0.55%	3	2

5 http://www.ispreview.co.uk/index.php/2016/08/cityfibre-opens-hulls-gigabit-fibre-optic-network-businesses.html

6 http://www.ispreview.co.uk/index.php/2016/09/ms3-takes-kcom-hull-uk-launches-ftth-home-broadband-network.html

We maintain our view that the UK is performing well on key broadband measures. For example:

- In superfast broadband, the UK continues to lead our benchmarks with coverage of over 90% of premises.[7] This level of coverage has been delivered through a combination of investment from the private sector, government and local authorities.

- In terms of more general broadband metrics, the UK ranks second in our benchmark countries on average broadband connection speeds, and first in terms of the proportion of premises that can receive speeds of at least 10Mbit/s. In the case of average broadband speeds, the UK is top when compared to the 'big five' European countries (France, Germany, Italy, Spain and the UK).

- The UK is also second in our benchmarks for overall broadband take-up (first in the European big five), though third for next-generation access (NGA) (again, first in the big five). By 2020, we expect the UK to have the highest take-up of NGA among our benchmarks, driven by the availability of NGA networks and strong competition.

- The UK continues to enjoy a highly competitive broadband market: it has the lowest incumbent market share, and the second-lowest Herfindahl-Hirschman Index (HHI) score.[8] Regarding the HHI score, we note that the UK score (0.25) is very close to the top performer (Germany, 0.24).

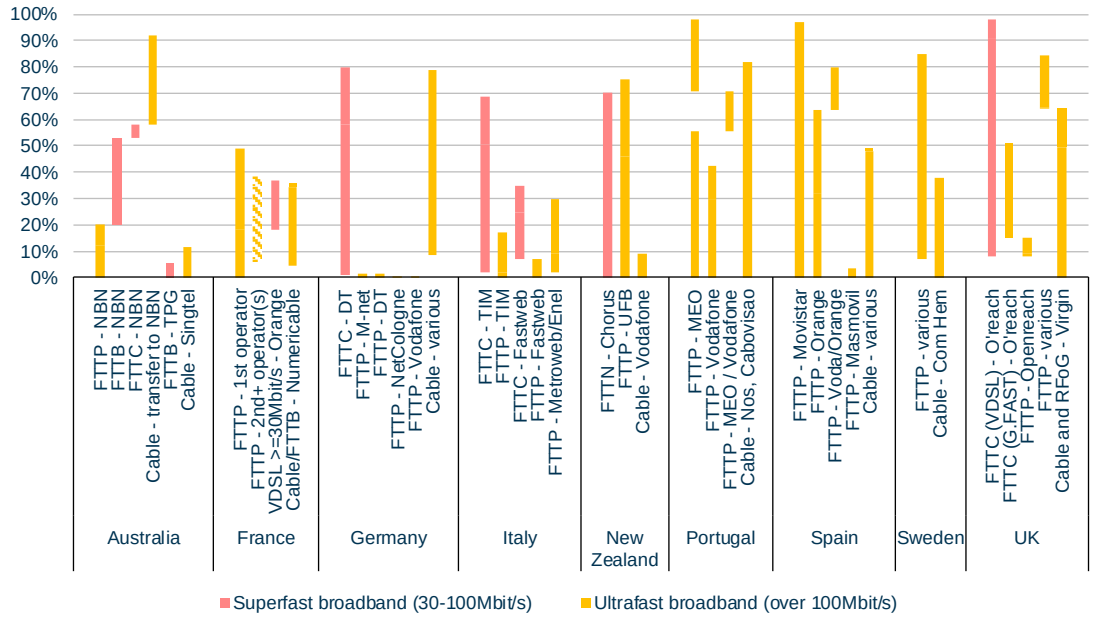
- Despite an upturn in the average revenue per user (ARPU) for broadband services (caused by an increased take-up of NGA services), the UK market continues to deliver affordable access to the Internet, especially when compared against benchmarks as a proportion of disposable income.

For this report, we have produced a new analysis of infrastructure competition to demonstrate which countries have multiple, competing, parallel networks. This analysis includes the current status and a forward-looking view based on operators' announcements, and takes account of expected network overlap. The summary of the expected coverage of superfast and ultrafast networks in the benchmark countries in 2020 is shown in Figure 1.2 below. This chart plots the coverage of technology by type (e.g. FTTP, FTTC, cable) against the proportion of the population covered by that technology (% of total premises). Where two or more columns are shown overlapping in parallel, this shows competing networks covering the same areas of the country. Where bars do not overlap, the networks serve different parts of the country.

7 Source: https://labs.thinkbroadband.com/local/

8 The Herfindahl-Hirschman Index (HHI) is a measure of market concentration. The lower the score, the lower the concentration of the market (and therefore the higher the levels of competition).

Figure 1.2: Expected level of infrastructure competition in 2020 in the benchmark countries [Source: Analysys Mason, 2016]



The above figure shows some interesting features, most notably relating to deployments in France, Portugal and Spain. These are the three countries where we expect to see three competing *ultrafast* networks of significant scale: around 30% premises coverage in France, around 40% in Portugal and around 50% in Spain, if operators' plans are realised. These three countries are good examples of where DPA has been used successfully by competitors to deploy fibre.

It may be tempting to conclude that the successful use of a DPA offer is the main reason why these market outcomes appear to be so different to the UK. Ofcom acknowledges that a "simple read across" cannot be made, and we would agree, as there are a number of factors that are at play. In Figure 1.3 below we have summarised a range of country-specific characteristics which affect the deployment of telecoms infrastructure.

Figure 1.3: Comparison of characteristics affecting the deployment of telecoms infrastructure in the benchmark countries [Source: Eurostat, HIA Economics, Statistics New Zealand, Analysys Mason]

Country	**NGA wholesale regime**	**Incumbent** retail market share	HHI	Proportion of homes in MDUs*	Relative labour rates
Australia	Dark fibre and active access	47%	0.29	49%	–
France	DPA, dark fibre, active access (not FTTP)	40%	0.28	36%	155%
Germany	DPA, dark fibre, active access	41%	0.24	55%	141%
Italy	DPA, dark fibre, active access	47%	0.29	58%	127%
New Zealand	Dark fibre (post 2020), active access	45%	0.32	17%	–
Portugal	DPA	44%	0.35	40%	59%
Spain	DPA	44%	0.32	68%	96%
Sweden	DPA, dark fibre	38%	0.26	42%	168%
UK	DPA, active access	36%	0.25	12%	100%

* MDU: Multiple dwelling unit

Of particular note are the following points:

- There is no active wholesale access product available in Portugal. This means that NGA-based competitors either use DPA or they do not enter the market at all. This contrasts markedly with the UK where generic Ethernet access (GEA) has been available since BT started to deploy its FTTC network in 2008; and it has since been taken up by many of BT's competitors, including Sky and TalkTalk.

- The situation in similar in Spain, where there is no requirement for an active wholesale access product in areas where there is infrastructure competition. In fact, it is only in recent months that the regulator has requested that Telefónica provide an equivalent to virtual unbundled local access (VULA) in non-competitive areas.

- In France, operators share infrastructure between the 'mutualisation point' and the home. Indeed, based on current data, most of the coverage of the 2nd FTTP network in France is based on sharing with the 1st FTTP network beyond the mutualisation point.

In addition to the very different evolution of these national regulatory regimes, there are major market and structural differences between the UK, and other countries, which impact the fundamental economics of DPA. These are especially prevalent in Portugal and Spain, where the largest coverage of three competing networks is expected:

- The main difference relates to market share. In both Portugal and Spain, the incumbent operators have a much higher market share than BT; and the collective share of competitors in those countries is also much more concentrated than in the UK. In essence, the UK retail broadband market is more competitive, with lower market concentration (lower HHI) – a situation that is a result of Ofcom's regulatory strategy over the last ten years.
- The other key differences are structural, relating to the geographical distribution of demand and the historical network architecture choices made by the incumbent operators many years ago. Of particular importance is the prevalence of MDUs in the main cities in Portugal and Spain where competing networks have been built. The economics of FTTP networks are much more favourable in cities with a high density of MDUs than other household types, such as Lisbon, Porto and Madrid. Furthermore, our interviews with stakeholders have confirmed that the coverage and availability of underground duct is very high in Portugal and Spain, which is not the case in the UK.

When combined, these market-share and structural differences dramatically impact the viability of a DPA-based FTTP deployment. Indeed, it is these factors that mean that the very high coverage of FTTP networks (both current coverage and planned expansions) in Portugal and Spain is unlikely to be replicated in the UK under the current market structure. Overall, it is important to consider the prospects for widespread, competing FTTP infrastructure in the context of the UK's specific market characteristics. We examine this issue in more detail in the next sub-section.

It is also surprising that, despite the apparently different outcomes at an infrastructure level, the average broadband speeds in the UK are higher than in most of the benchmark countries. This is shown in Figure 1.4 below.

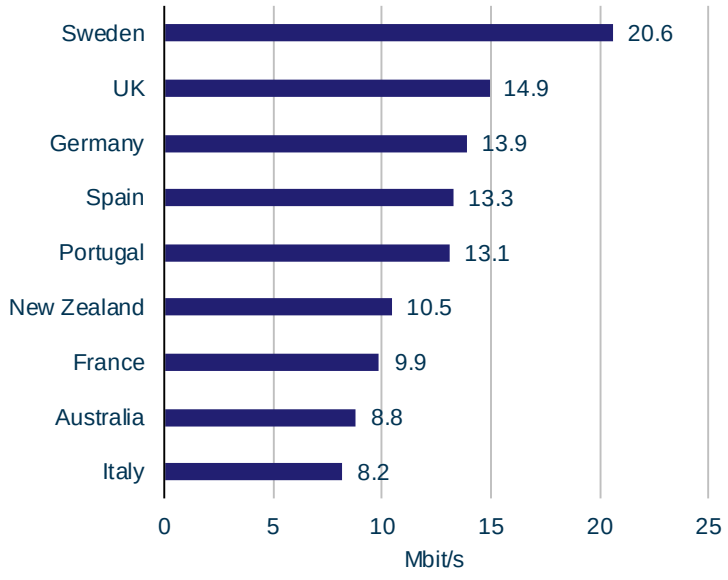


Figure 1.4: Average connection speed in benchmark countries [Source: https://www.akamai.com, 2016]

One of the reasons why average broadband speeds in the UK are higher than in most of the benchmark countries is likely to be the higher *rural* broadband speeds available in the UK (driven by BDUK's rural broadband programme), but it may also indicate something about UK consumers' willingness to adopt ultrafast services at this time. If that is indeed the case, then it would support the view that incremental upgrades to the access network – e.g. from VDSL2 to G.Fast, with targeted deployments of FTTP – is a rational strategy for BT to pursue.

1.2 Prospects for infrastructure competition

We have conducted a detailed economic analysis of the commercial viability of a third network operator which deploys GPON-based[9] FTTP on a large scale, using a combination of DPA and (where this is not available) new-build infrastructure. Our economic model assumes that the operator would target densely populated areas first (and then move to less dense areas); the network cost per subscriber would increase as the deployment extends out. We assume that this cost is recovered by a geographically constant revenue from each subscriber. Our model determines the commercial viability[10] per subscriber at a given percentage of premises coverage.

Our economic analysis suggests that a new-entrant operator, deploying a new FTTP network using DPA, and growing its customer base from zero, could viably deploy to up to 7% of the UK (2 million premises), if it achieved a long-term market share of 25%. However, this figure is higher than that of any operator at present (excluding BT and Virgin Media). At a more realistic 20% market share (which aligns with our base case), the limit of viable coverage would fall to 4% of the UK (1.1 million premises).

Even for an operator with an existing customer base – and therefore able to migrate its customers over to FTTP more quickly – the results are 10% of the UK (2.8 million premises) at 25% market share, and 5% of the UK (1.4 million premises) at 20% market share.

Given these results, we think it is extremely unlikely that three competing networks could be expected over 40% of the UK. We can see substantial financial risks associated with the viability of a third network (or a combination of geographically distinct 'third' networks) that we believe operators and their investors could find hard to accept.

Market share is a key determinant of the viability of FTTP, and the viable level of coverage is very sensitive to relatively small changes in market share. This high level of sensitivity is important for investors and operators alike. Figure 1.5 shows one example of the results of our viability modelling (for one set of input assumptions). The results show the point at which the NPV per subscriber falls to zero, representing the extent of the viable coverage, for three retail market shares (15%, 20% and 35%). We assume that the take-up of NGA services in covered areas reaches 95% of premises over the 15-year forecast period (this represents an increase in the take-up of NGA services in covered areas from 37% at the end of 2015).

9 GPON: Gigabit passive optical network.

10 Defined as net present value (NPV) + terminal value (TV).

Figure 1.5: Commercial viability of a new-entrant FTTP operator at different long-term market shares [Source: Analysys Mason, 2016]

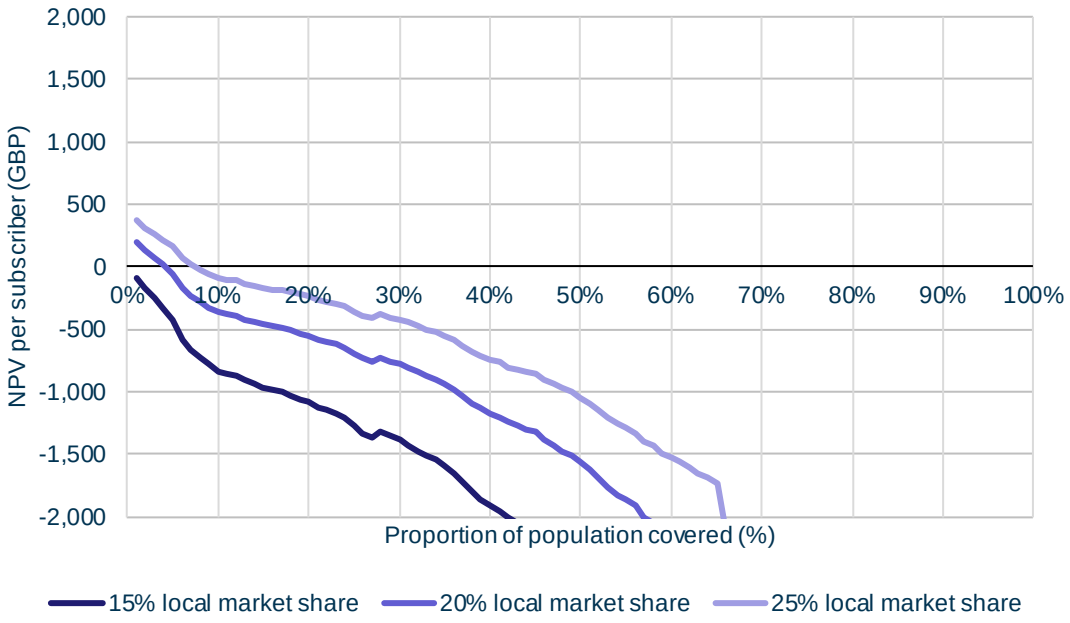


Figure 1.6 shows the sensitivity of the viability results to variations in the main input assumptions, i.e. ARPU, rate of growth in market share, weighted average cost of capital (WACC) and the business model (which drives the proportion of retail ARPU allocated to the investment in the access network). Our base-case assumptions are as follows:

- Local market share = 20% – which lies between the market shares of Sky (23%) and TalkTalk (13%).[11]
- Retail ARPU = GBP42.50, excluding VAT – which sits in the range of GBP38.00 to GBP50.00 defined by BT, Sky and Virgin Media's ARPUs.[12]
- Allocation of retail ARPU to recovering cost of access network = 50% – which allocates a similar level of revenue to the access network as the current FTTP-related wholesale prices from Openreach.
- Rate of increase in market share = 'steady' – representing a steady growth in subscribers of a new entrant.
- WACC = 12% (pre-tax, nominal) – which is commensurate with the risky nature of FTTP investments.

11 Source: Ofcom facts and figures. See http://media.ofcom.org.uk/facts/

12 Source: Operator website, ISP review.

Each set of results in the figure below varies two of the input assumptions (according to the column- and row-labels), while keeping the other assumptions as in the base case. The results of the base case are highlighted in red.

Figure 1.6: Summary of the sensitivity of commercially viable coverage to key deployment parameters [Source: Analysys Mason, 2016]

Local market share					
Retail ARPU excl. VAT	**10%**	**15%**	**20%**	**25%**	**33%**
GBP35.00	None	None	None	3%	8%
GBP42.50	None	None	4%	7%	24%
GBP50.00	None	2%	7%	20%	37%

Local market share					
Allocation to the access network	**10%**	**15%**	**20%**	**25%**	**33%**
40% to the access network	None	None	None	2%	7%
50% to the access network	None	None	4%	7%	24%
60% to the access network	None	3%	7%	21%	38%

Local market share					
Share increase rate	**10%**	**15%**	**20%**	**25%**	**33%**
Pessimistic	None	None	None	4%	8%
Steady	None	None	4%	7%	24%
Optimistic	None	1%	5%	10%	31%

Local market share					
WACC	**10%**	**15%**	**20%**	**25%**	**33%**
10%	None	3%	7%	20%	38%
11%	None	1%	5%	12%	32%
12%	None	None	4%	7%	24%
13%	None	None	2%	5%	17%
14%	None	None	1%	4%	10%

It is informative to consider how these results relate to the following three cases:

- Firstly, the viability of an **established operator** with a significant (e.g. >20%) market share that could choose to migrate its existing customer base over to the new FTTP network relatively quickly. A reasonable set of input assumptions are: 20% market share, ARPU of GBP42.50 per month (excluding VAT), an optimistic rate of increase in market share, 12% WACC, and 50% of ARPU (excluding VAT) attributable to the access network. This results in a level of viable coverage of 5% (see final row of the third table above).

- Secondly, the viability of a **new entrant** that would need to grow its customer base from scratch. In this case, the only input assumption that changes is the rate of market share growth, which would be reduced to the steady rate. This results in a level of viable coverage of 4%, and demonstrates the challenges facing a late entrant to the UK broadband market.

- Thirdly, the viability of **two or more existing operators forming an alliance** to deploy a shared FTTP access network, to which they both have 'internal' wholesale access. Compared to the first case, the change in the assumptions would be the market share. If a long-term market share of 33% could be achieved, the viable coverage could reach 31%. However, if the market share reached 25% (still a significant share in the context of the UK market), the viable coverage level would fall by more than half, to 10%. This sensitivity shows the strong impact of market share on the results, and highlights the risks faced by a third network operator in the UK's highly competitive broadband market.

It is perhaps unsurprising that, even within a market in which 95% of covered premises might take NGA broadband, market share is so important for viability. Back in 2006, Analysys Mason's work for the Dutch regulator OPTA showed that the economics of sub-loop unbundling (SLU) were very challenging for competitors due to the poor economies of scale achievable at the cabinet level; later work in other countries reached a similar conclusion. The UK has seen very little SLU to date, and it seems likely that the main reason for this relates to the risks around economic viability, particularly when those risks are set in the UK context, i.e. a highly competitive market (low market concentration, with a number of successful retail providers), and with active wholesale access products (GEA) that have been available for many years.

The economics of DPA are more challenging than for SLU since the capital investment required is generally higher and economies of scale are harder to realise. Furthermore, from an operational point of view DPA will require significantly more resources to deploy at scale (especially when compared with local loop unbundling (LLU) and SLU); this is because operators will need to deploy new cabling all the way to customers' premises rather than relying on some of the cabling that is already in place. Notwithstanding Openreach's plans to improve its DPA processes and information systems, any deployment using DPA may induce a deployment response from existing network operators already present in those areas. Therefore, we believe investors are likely to perceive greater risks in their assessment of a DPA-based investment, and this is likely to be reflected in their views on the achievable rate of market share growth, and the long-term market share, among other things.

Our analysis suggest that the combination of conditions required for a third network to approach anywhere near 40% coverage are very unlikely in the context of the UK market. For example:

- Very high levels of ARPU (e.g. GBP50 excluding VAT) and market share (e.g. 33%) do not sit well together. This would very likely require a comprehensive triple-play offer with exclusive content. We would expect such an offer to take time to fully develop, and the market share and available ARPU will be constrained by the size of the pay-TV market in the deployment area.

- Similarly, if an operator is investing in exclusive content to drive higher ARPU, due to the high costs of that content it is likely that a lower proportion of the ARPU would be available to recover the costs of the new access network – i.e. higher ARPU is likely to be associated with a lower *proportion* of ARPU allocated to the network access, due to the cost of content.

- Finally, it is difficult to envisage the case of very high market share (e.g. 33%) with a relatively low WACC (e.g. 10% or 11%), as a high target market share is likely to be perceived as higher risk.

1.3 Conclusions

We have summarised our conclusions and implications for policy around four themes: the characteristics of the UK market; the role that DPA will play; the impact on universal service; and the implications for active access and GEA. These are set out below.

The characteristics of the UK market place the major constraints on FTTP

The specific characteristics of the UK market are an essential factor in its future evolution, including the move towards more extensive commercial deployments of FTTP. The UK broadband market is continuing to generate good outcomes, with high levels of take-up (83% of premises at the end of 2015) and planned investment driven by one of the most competitive market structures (0.25 HHI) in our benchmark countries. These outcomes have been fostered by the regulatory approach taken to date. The focus on LLU and then active NGA products has led to a number of successful players at the retail level. This needs to be considered when comparing the UK to other countries that exhibit high levels of FTTP coverage and the presence of three competing networks. Amongst our benchmark countries, only Portugal and Spain are expected to deliver such an outcome. However, the market characteristics in these two countries differ significantly from the UK: they have relatively high market shares (higher HHI), and crucially, no option for active access to offer NGA services.

Because of the large amount of fixed costs associated with deploying FTTP, and the way that costs increase non-linearly as the deployment moves from dense to less-dense areas, the local market share is critical to the commercial success of any deployment. The importance of this demand-side factor, coupled with the competitive nature of the UK market, means that an investor is likely to perceive significant risk in a widespread competitive roll-out of FTTP in the UK.

DPA will play a role in UK broadband development

Openreach and Ofcom are currently working together to refine the UK's DPA offer and remove some of the perceived procedural barriers to its use.[13] The re-use of Openreach's existing duct and pole infrastructure represents a useful option for competing operators to deploy their own networks in a cost-efficient manner. Our analysis shows that the pricing of DPA makes up a small proportion

13 Ofcom (2016), *Progress update: supporting investment in ultrafast broadband networks, Strategy focussed on network investment and competition.* Available at http://stakeholders.ofcom.org.uk/binaries/telecoms/policy/digital-comms-review/July_2016_progress_update.pdf

of the total cost of deploying FTTP. Indeed, if the DPA pricing were reduced by half, the base case result of 4% coverage would increase to just 5%.

There is, however, still a high degree of uncertainty over the extent to which the existing ducts and poles can accommodate new fibre cables. Once the use of DPA is requested at scale, the subsequent planning and survey activity will provide the information on duct and pole availability that will resolve the debate over how DPA can support ultrafast broadband.

Impact on universal service

Ofcom and the UK government are investigating a possible universal service obligation (USO) for broadband, intended to ensure that all premises have access to broadband of at least 10Mbit/s. We note that the UK is number 1 in our benchmark countries for availability of 10Mbit/s with an availability of 96%[14]. Hence, the extent of any potential USO at 10Mbit/s would relate to around 4% of households, based on current coverage figures.

We also note that the aim of securing a third network is not complementary with the aim of a 10Mbit/s broadband USO, since the new network would most likely overbuild BT and Virgin Media (or a combination of BT/VM/other existing operator); it is therefore very unlikely to affect the proportion of premises that could receive a broadband USO.

On the other hand, planned smaller-scale FTTP deployments by operators focusing on rural areas may have an impact on the broadband USO, but these areas are unlikely to feature another network (as they are generally targeted at under-served areas), and therefore will not contribute to the coverage of three networks.

Active wholesale products will continue to be relied upon by most of the industry

Ofcom's proposed strategy appears to include two separate components: competition from a third network operator (using DPA) in some areas of the country, and continued reliance on Openreach's active products (i.e. GEA) in other areas of the country.

Our economic modelling analysis suggests that the area in which the 'three-networks' model will be viable will be much smaller than Ofcom hopes.

We have considered the current pricing of GEA services (both FTTC and FTTP variants) against the cost per subscriber of deploying an FTTP network, and how changes to GEA pricing could impact operators' 'build or buy' decision. If there were to be any reduction in GEA pricing, for example, then this would reduce the area in which it is more cost-effective for an operator to deploy its own network using DPA. Ofcom will need to carefully balance any potential price regulation of GEA with its aim of securing a third network in significant parts of the UK.

14 Source: ThinkBroadband

2 Introduction

In February 2016 Ofcom published its initial conclusions from the *Strategic Review of Digital Communications*,[15] which included, among other proposals, Ofcom's plan for a strategic shift to large-scale investment in more fibre.

In the context of Ofcom's review, we have conducted an analysis of the UK broadband industry and prospects for future infrastructure. Our analysis is split across two main work areas:

Modelling of the economic frontier of a third network

Ofcom has suggested that a '*good outcome*' would be achieved if there was a third fibre-to-the-premises (FTTP) network which covered 40% of premises using duct and pole access (DPA). We have considered the economic frontier of such a network to test the feasibility of Ofcom's suggestion.

Assuming that an operator would target dense areas first, the cost per subscriber would increase as the deployment extends out. Our modelling determines the commercial viability (net present value (NPV) + terminal value (TV)) per subscriber at a given percentage of coverage.

Updated and expanded benchmarking analysis

We have updated the previous benchmarking approach[16] to give a solid factual 'core' to the analysis.

We provide a series of benchmarks relating to the availability, take-up, level of competition and pricing of broadband services in the UK compared with the largest countries in Europe, together with other countries where DPA has been used by competitors to deploy their own fibre, and countries where there has been a government policy push for fibre.

Standard benchmarks include coverage, take-up and pricing of broadband services for selected countries. We have expanded the work to include: the overlap between networks and a classification into 'class' of network (e.g. 'superfast' *versus* 'ultrafast').

The remainder of this document is laid out as follows:

- Section 3 describes our economic modelling approach
- Section 4 presents the updated benchmarking analysis
- Section 5 sets out our conclusions and implications for policy.

15 Ofcom (2016), *Making communications work for everyone: Initial conclusions from the Strategic Review of Digital Communications*. Available at http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/

16 Analysys Mason report for BT, *International benchmarking report*, 21 September 2015. Available at http://www.analysysmason.com/About-Us/News/Press-releases/Broadband-benchmarks-Sept2015/

3 Economic modelling

Ofcom has suggested that a "*good outcome*" would be achieved if there was a third FTTP network which covered 40% of households using DPA. In its *Initial conclusions from the Strategic Review of Digital Communications* Ofcom stated the following:[17]

> "*A good outcome in the long term would be to achieve network competition of around 40% of households.*"

Ofcom further clarified this ambition in its subsequent consultation document *Strengthening Openreach's strategic and operational independence*:[18]

> "*We have suggested 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.*"

In this section we analyse the viability of a third broadband network achieving 40% coverage.

Although a number of small operators are deploying new infrastructure, the UK broadband market is mainly dependent on two network infrastructures: Openreach's FTTx network and Virgin Media's hybrid fibre coaxial (HFC) network. Therefore, we have considered how far a third network operator could viably deploy a competing FTTP network, in the context of the UK's highly competitive market.

3.1 Overview of modelling approach

3.1.1 Overall approach

We have considered the economic frontier of FTTP deployment in the UK to test the feasibility of Ofcom's aim.

We have considered a *large-scale* deployment of a Gigabit passive optical network (GPON)-based FTTP architecture. Assuming that an operator would target densely populated areas first (and then move to less dense areas), the network cost per subscriber would increase as the deployment extends out. We assume that this cost is recovered by obtaining a geographically constant revenue from each subscriber.

Our model determines the commercial viability (NPV+TV) per subscriber at a given percentage of premises coverage.

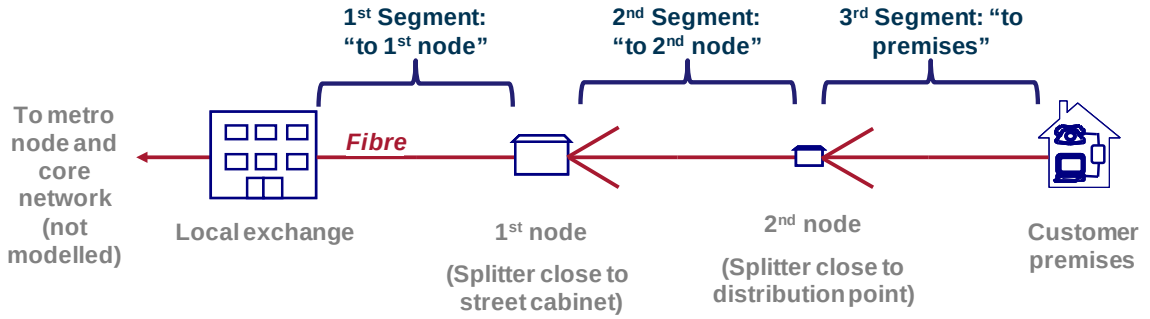
17 *Ibid*.

18 Ofcom (2016), *Strengthening Openreach's strategic and operational independence, Proposal for comment*. Available at http://stakeholders.ofcom.org.uk/binaries/consultations/strengthening-openreachs-independence/summary/condoc.pdf

3.1.2 Conceptualisation of the access network

Ofcom's aim centres around the use of the existing physical network assets (i.e. the use of DPA)[19] to deploy FTTP. Therefore, we have conceptualised the access network according to the existing structure of Openreach's duct and pole assets. This is summarised in Figure 3.1 below.

Figure 3.1: Conceptualisation of the UK access network [Source: Analysys Mason, 2016]



It is important to note the following points:

- The scope of our model includes the access network only. We do not model the backhaul and core network (i.e. from the local exchange towards the core nodes), nor any retail costs. We make an adjustment to the revenue assumptions to account for this approach (see Section 3.2.3 below).
- We assume that the deployment is made using DPA where it is available, i.e. where there is space available in ducts or on poles. Where space is *not* available, we assume that new infrastructure must be deployed. Where space *is* available, but ducts must be repaired or unblocked, we include the associated costs.
- Our modelling approach reflects a wide area deployment and assumes a random distribution of duct availability (i.e. no scope for 'cherry picking' of areas with high availability of ducts).
- We model the amount of fibre and duct (where duct cannot be re-used) based on the distance between nodes. We estimate the total distance between nodes based on the number of nodes and the population density.
- While the first two segments are deployed in the initial deployment phase, the final drop is deployed when a user takes service.
- At the exchange we include the cost of optical line termination (OLT) equipment and optical distribution frames (ODFs).

19 We understand that Openreach and Ofcom are progressing with a series of refinements to the current DPA offer in the UK. We have assumed that these refinements will remove any 'procedural' impairment of the use of DPA, and therefore the only barrier to re-using the existing infrastructure is if there is sufficient space available.

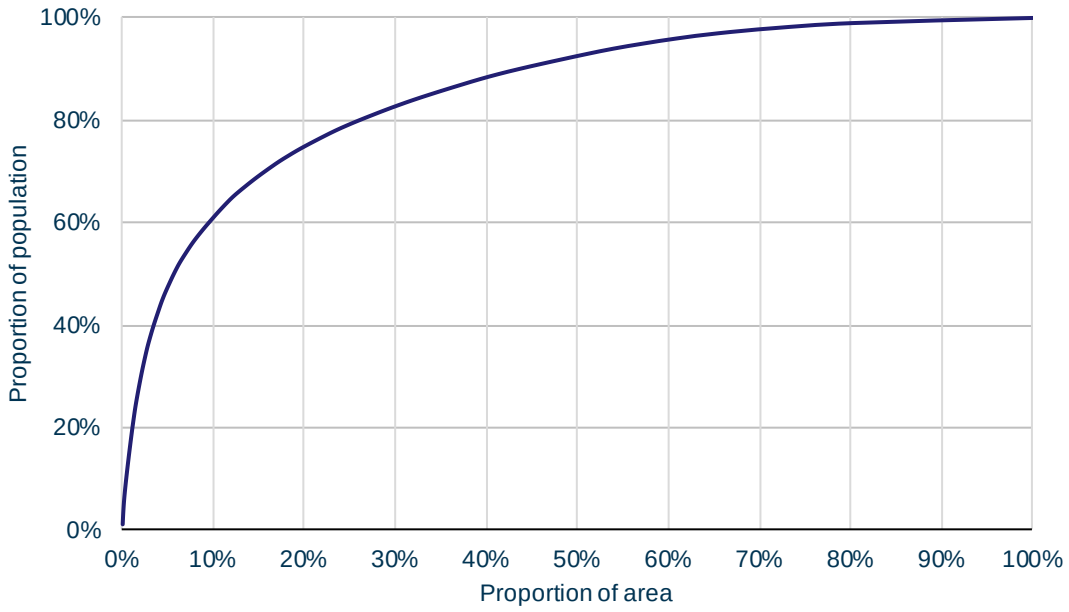
- We assume a 1:8 splitter close to the cabinet, and another 1:8 splitter close to the distribution point or DP (creating a total split ratio of 1:64).
- At the customer premises, we include the cost of customer premises equipment (CPE) and a one-time connection charge. This is in addition to any fibre deployment costs (e.g. access to existing infrastructure, or laying new duct).
- In addition to the deployment costs, the model considers the relevant operational expenditure (opex) costs, including rental of DPA assets, network maintenance costs, power and exchange space.

3.1.3 Approach to deriving line length from population density

An important dynamic of the model is to capture how line length increases as the deployment moves from urban to rural areas. We calculate this for each centile of population coverage, enabling us to capture the way in which line lengths increase in rural areas.

The first input to the calculation is the distribution of population across the area of the UK. We use data on the density of UK local exchanges, supplemented by data from Eurostat, to create a distribution of population by area. The results are shown in Figure 3.2 below.

Figure 3.2: Population distribution in the UK [Source: Analysys Mason, Eurostat, 2016]

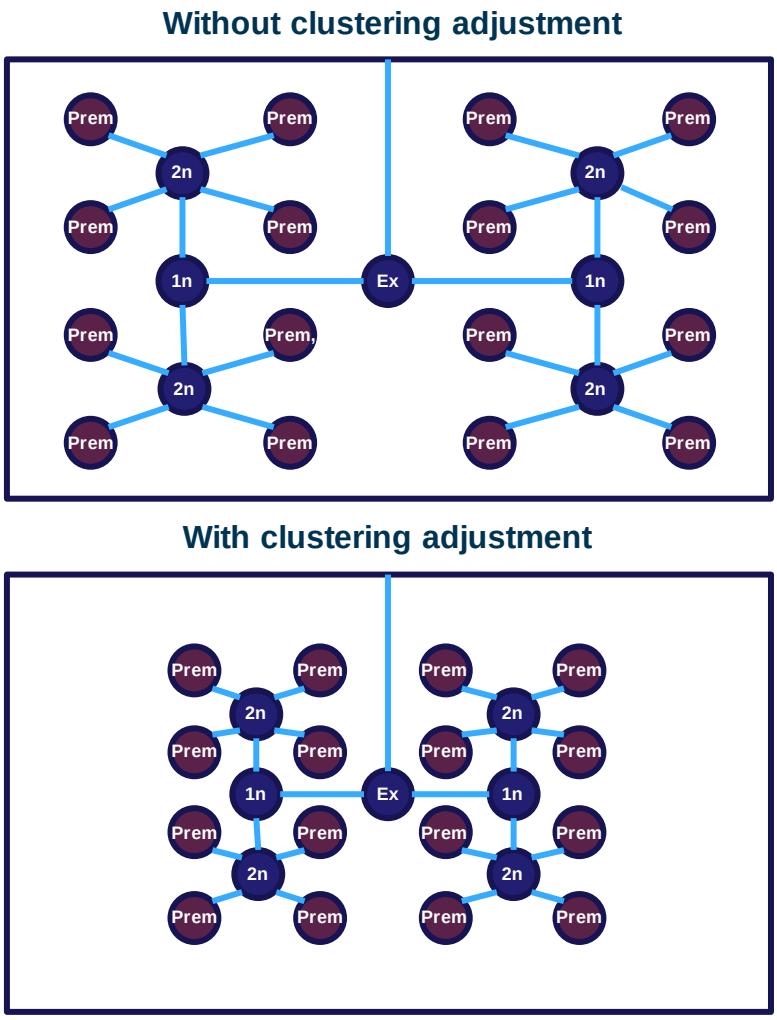


The model considers the density of premises of a small area with a known number of premises.[20] Based on the number of premises, and the premises density, we can calculate the area occupied by those premises. Having calculated the area, we can derive the associated line lengths, which are the key driver of cost in an FTTP deployment.

20 We use the areas covered by existing street cabinets as the 'units' of area to drive the results in the model. This allows us to consider the deployment at a granular level. We note that the street cabinet is not a relevant cost for an FTTP model. We do not include the costs of the street cabinet in our model.

However, an artefact of the approach described so far is that the premises and the access network nodes are assumed to be evenly distributed across the area being considered. In reality, premises and nodes are 'clustered' together, and without an adjustment the model would overstate the costs of deployment. We therefore make an adjustment to the length of each segment of the access network in order to account for this clustering.[21] This is shown in Figure 3.3.

Figure 3.3: Illustration of the impact of implementing a clustering adjustment [Source: Analysys Mason, 2016]



The factors used to create the clustering are calibrated from our previous UK fibre costing work for the Broadband Stakeholder Group, which used a highly granular piece of geo-analysis, based on the location of individual post-points.[22]

21 We note that some areas are clustered more than others. Our approach applies an average level of clustering to the distribution of premises in the UK.

22 *The costs of deploying fibre-based next-generation broadband infrastructure*, Analysys Mason for the Broadband Stakeholder Group, 8 September 2008. Available at http://www.analysysmason.com/PageFiles/5766/Analysys-Mason-final-report-for-BSG-(Sept2008).pdf

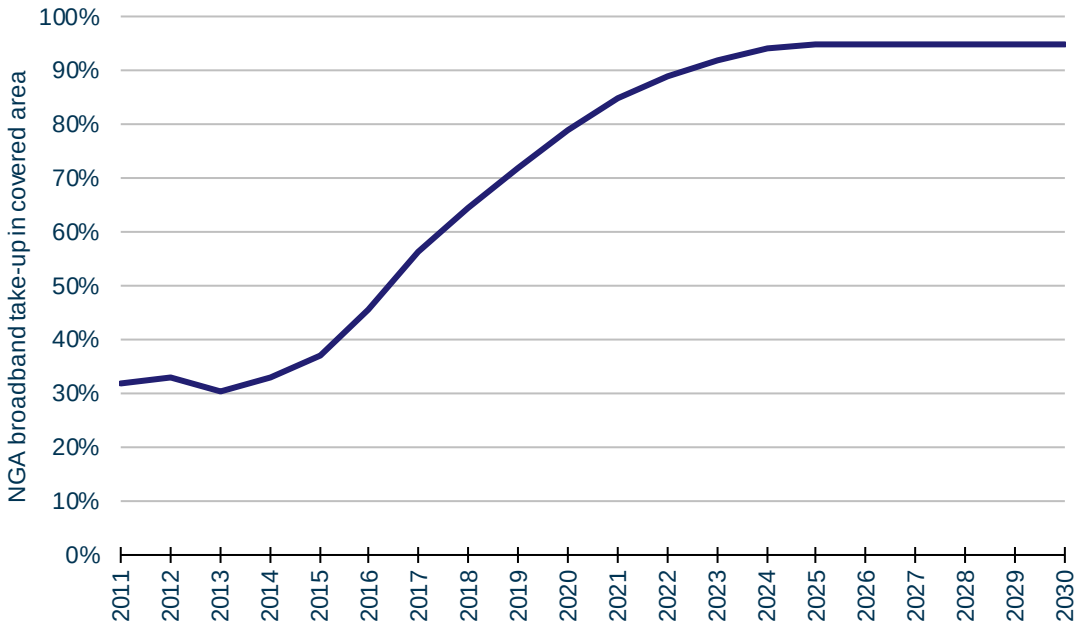
3.2 Modelling assumptions

In the following sub-sections, we document the main input assumptions used in the model.

3.2.1 Take-up in covered areas

The first assumption is a forecast of the overall take-up of broadband services that are delivered over next-generation access (NGA) networks in the UK. We consider the take-up in covered areas, which is the relevant metric for calculating the economic frontier for an access network deployment. The forecast covers the 15-year business case timeframe applied in the model, as shown in Figure 3.4 below.

Figure 3.4: Forecast of NGA broadband take-up in covered areas [Source: Analysys Mason, Digital Agenda Scorecard, BDUK, 2016]



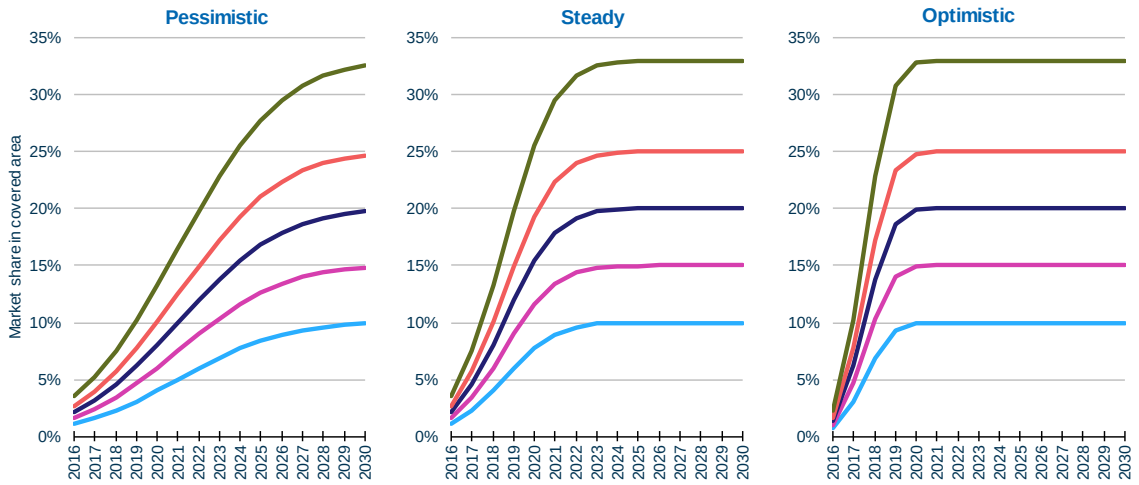
We assume that NGA broadband take-up in covered areas will approach 95% of premises over the next 15 years. Given the increasing importance of the Internet to our daily lives we expect very few premises to not take NGA services (if they are available) by the end of the forecast period. The above forecast includes a simplifying assumption that all broadband connections in the target deployment area will be via an NGA network by around 2024. In reality, there may be some end-users who require only basic broadband speeds. We would expect there to be very few end users of this type by 2024, and it may be more cost-effective for operators to serve these users from their NGA network (albeit with a lower connection speed).

3.2.2 Market share

The UK broadband market is highly competitive. The long-term market share that a third network operator might achieve, along with the *rate* at which it could be achieved, is one of the major drivers of the model.

Therefore, we have defined a range of market share curves to test the sensitivity of modelling to this input. The long-term market shares are guided by the current market shares seen in the UK broadband market (see Section 4.4), while the rates at which market share is achieved are defined to give a sensible range. The options for market share input are shown in Figure 3.8.

Figure 3.5: Local market share gain across three different scenarios [Source: Analysys Mason, 2016]



3.2.3 Revenue

We consider the monthly average revenue per user (ARPU) for each subscriber on the new network. As with many existing broadband offers in the UK market, we assume that this metric does not vary with geography. Similar to the market share, the actual ARPU available from the new network is quite uncertain and depends on the pricing strategy of the new operator, including the specifics of its proposition. Therefore, we have defined a sensible range of 'retail' ARPU.

Figure 3.6: Retail ARPU assumptions [Source: Analysys Mason, 2016]

ARPU assumption	Retail revenue per subscriber per month (excluding VAT)	Comments
Low	GBP35.00	Range of ARPU defined to give a sensible range, based on the UK market We assume the new network operator includes an element of triple play in its proposition FTTP offers in the market range from GBP25 to GBP63–82[23] (including VAT) We have selected GBP42.50 (excluding VAT) as a reasonable base case ARPU from major triple-play operators (Sky, Virgin Media and BT) is between GBP38 and GBP50, excluding VAT
Medium	GBP42.50	
High	GBP50.00	

As noted above, the scope of the model includes only the access network. It is therefore necessary to consider the proportion of the retail ARPU which is available to cover the investment and operating costs associated with the access network. The remainder of the ARPU will be needed to cover other network costs (e.g. backhaul and core, IP transit), retail operational costs (e.g. customer services, marketing and subscriber acquisition) and where a triple-play proposition is offered, the cost of content. Our range of assumptions for the proportion of retail ARPU which is attributable to the access network is shown in Figure 3.7.

Figure 3.7: Assumptions regarding the proportion of retail ARPU that is attributable to the access network [Source: Analysys Mason, 2016]

Assumption	Proportion of retail revenue attributable to the access network	Comments
Low	40%	Our benchmarks show that wholesale broadband access prices account for c.30–80% of retail revenue in other countries In the UK, current wholesale prices for FTTP are GBP7.30 per month for Metallic Path Facility (MPF), and GBP12.90 per month for Generic Ethernet Access (GEA)-FTTP (100Mbit/s variant).[24] This represents 48% of the base-case retail ARPU (GBP42.50, (excluding VAT)
Medium	50%	
High	60%	

23 Max refers to 1Gbit/s data + voice from Hyperoptic/Gigaclear

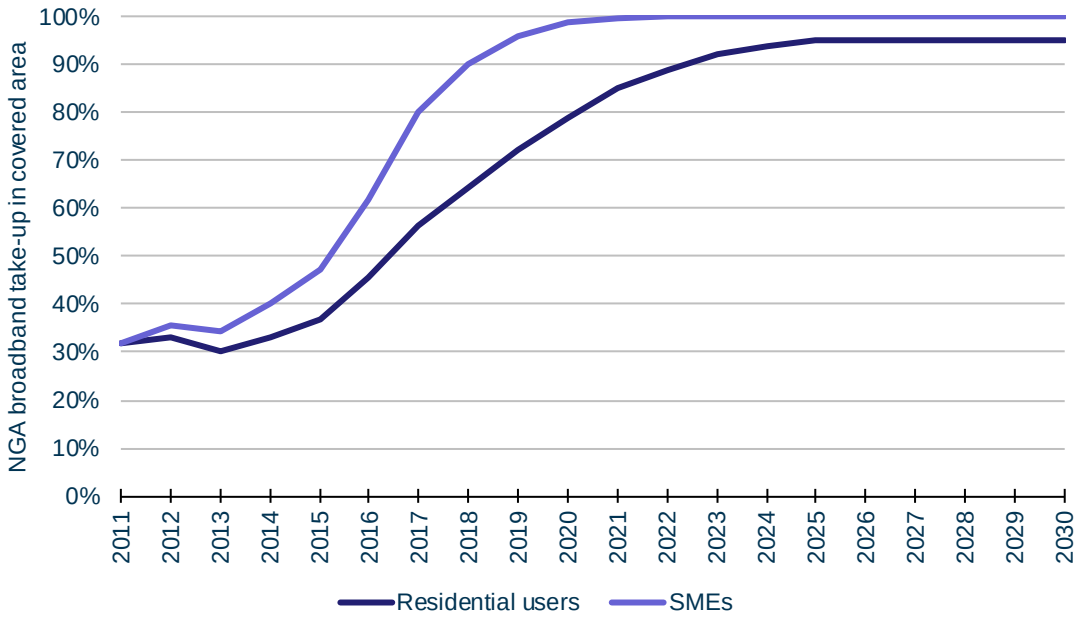
24 Source: Openreach product pricing. See https://www.openreach.co.uk/orpg/home/products/pricing/loadPricing.do

3.2.4 SMEs

We have also accounted for the impact of providing services to small and medium enterprises (SMEs). We have used the following assumptions:

- SMEs generate 33% more ARPU than residential users
- SMEs follow a more optimistic take-up curve for NGA broadband than residential users, as shown in Figure 3.8 below.

Figure 3.8: Comparison of consumer and SME take-up of NGA services in covered areas [Source: Analysys Mason, 2016]



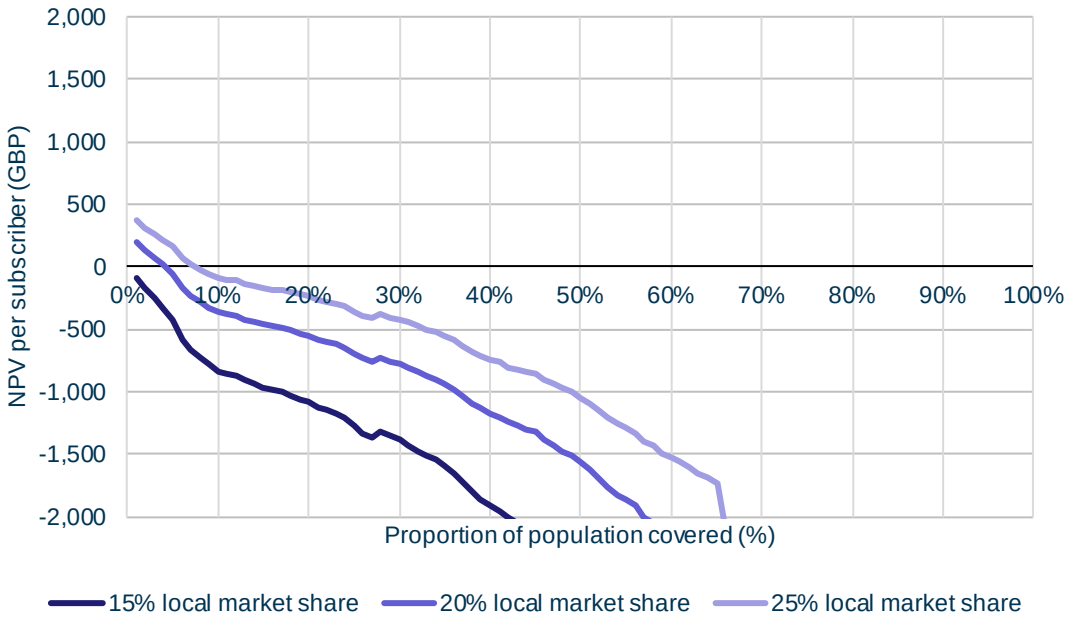
3.3 Results

In the following sub-sections, we present and discuss the results of the modelling. We start by examining the form of the model output and the sensitivity of the results to the key parameters. This is followed by a review of specific infrastructure deployment scenarios, and finally by an analysis of the cost per subscriber (which will inform a build *versus* buy decision).

3.3.1 Model output and sensitivity analysis

Based on the revenue and cost assumptions described above, the model calculates the NPV+TV per subscriber at each centile of population coverage. Because line lengths increase as population density decreases, and because we assume the available revenue does *not* vary with geography, the NPV+TV per subscriber falls as the target deployment area is expanded from dense areas to less dense areas. The point at which the NPV+TV passes through zero represents the economic frontier and the limit of a commercially viable deployment of FTTP. This dynamic is shown in Figure 3.9.

Figure 3.9: Commercial viability of a new-entrant FTTP operator at different long-term market shares [Source: Analysys Mason, 2016]



The results show the way in which commercial viability falls quite steeply as the target deployment area is extended into lower density areas. In addition, the results highlight the very high sensitivity of the results to the long term market share achieved in the local deployment area.

Figure 3.10 below summarises the sensitivity of the results to the key parameters which would affect the commercial viability of a third network operator deploying FTTP. The colour-coded values in the tables summarise the commercially viable coverage according to the values in the column- and row-labels. In all cases, the base-case parameters are:

- GBP42.50 retail ARPU (which is similar to the ARPU of the major triple-play operators)
- 50% of the retail ARPU attributable to recover the cost of the access network (which gives a wholesale ARPU for recovering access network costs of GBP21.25, similar to GEA-FTTP plus MPF)
- steady increase in market share gain (which is commensurate with a new entrant to the market)
- 12% weighted average cost of capital (WACC) (pre-tax, nominal, which is also commensurate with a new entrant to the market).

Figure 3.10: Summary of the sensitivity of commercially viable coverage to key deployment parameters [Source: Analysys Mason, 2016]

Local market share					
Retail ARPU excl. VAT	**10%**	**15%**	**20%**	**25%**	**33%**
GBP35.00	None	None	None	3%	8%
GBP42.50	None	None	4%	7%	24%
GBP50.00	None	2%	7%	20%	37%

Local market share					
Allocation to the access network	**10%**	**15%**	**20%**	**25%**	**33%**
40% to the access network	None	None	None	2%	7%
50% to the access network	None	None	4%	7%	24%
60% to the access network	None	3%	7%	21%	38%

Local market share					
Share increase rate	**10%**	**15%**	**20%**	**25%**	**33%**
Pessimistic	None	None	None	4%	8%
Steady	None	None	4%	7%	24%
Optimistic	None	1%	5%	10%	31%

Local market share					
WACC	**10%**	**15%**	**20%**	**25%**	**33%**
10%	None	3%	7%	20%	38%
11%	None	1%	5%	12%	32%
12%	None	None	4%	7%	24%
13%	None	None	2%	5%	17%
14%	None	None	1%	4%	10%

The first two sets of results are related, and show the impact of the available revenue to recover the costs of the access network. In the first table, we vary the retail ARPU and the retail market share. The results show that a commercially viable coverage of 40% could only be achieved with both a high retail ARPU and high market share. In the context of the UK's competitive market, winning market share while maintaining a high ARPU would be very challenging without a unique proposition that few operators can offer (e.g. exclusive content). However, a further constraint is demonstrated in the second table: if an operator must spend a large amount on content, the operator will have a smaller proportion of its retail ARPU available to recover the costs of the access network. An operator of a new FTTP network will face a difficult balance between the need to keep prices competitive, but also bring in enough revenue to cover the cost of its network deployment *and* fund a compelling proposition.

The third table shows that the results are less sensitive to the *rate* at which market share is gained, though a viable deployment could still only approach 40% if a high market share and a rapid increase in customers could be achieved.

The fourth table highlights another key constraint faced by an operator of a new FTTP network: a commercially viable coverage over 40% can only be achieved through a combination of high market share and low WACC. However, these two factors are likely to work in opposition, as aiming for a high market share is likely to be perceived as high risk, in the context of the UK market.

In the following sub-section, we consider the results for specific infrastructure scenarios.

3.3.2 Infrastructure deployment scenarios

We have considered two infrastructure deployment scenarios:

- a 'new entrant' deploys an FTTP network and looks to build up a customer base, and
- an 'alliance' whereby two existing operators collaborate to deploy a shared access network, onto which they can migrate their existing customer base.

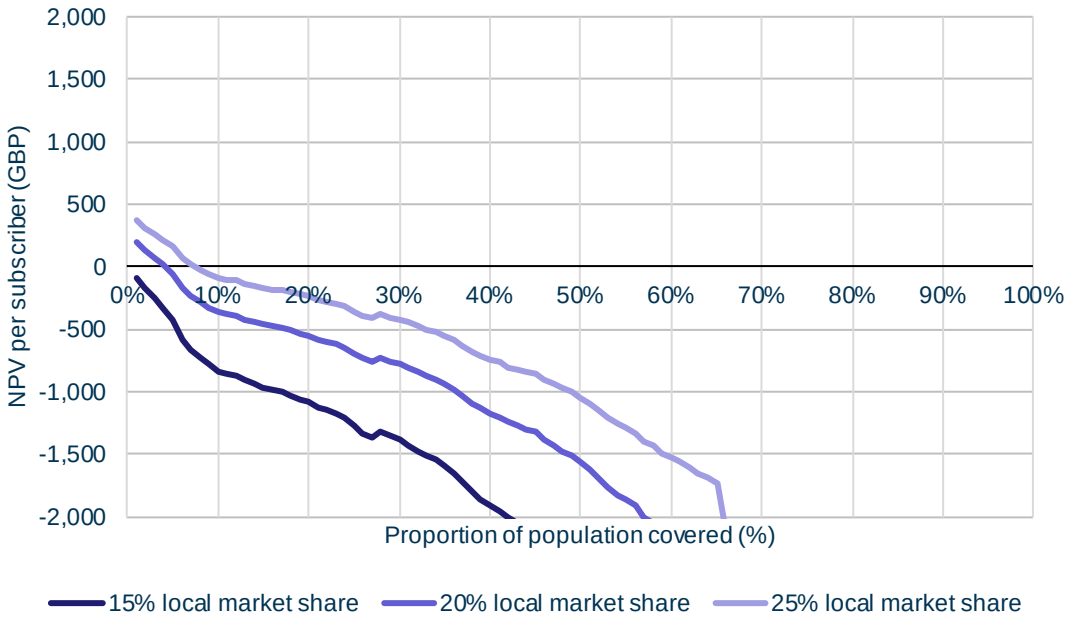
We note that there are other deployment models currently being employed in the UK, notably a focus on apartment blocks (also called multi-dwelling units or MDUs) and a focus on rural areas. However, these models are generally targeting areas where Virgin Media does not have coverage, and therefore are less relevant for the analysis of a 'large scale' *third* network operator.

The 'new entrant'

Figure 3.11 shows again the commercial viability of a new entrant deploying an FTTP network in the UK. The scenario assumes the following:

- 12% WACC due to new entry
- GBP42.50 retail ARPU per residential subscriber (50% to the access network; this represents GBP21.25, which is similar to the cost of GEA-FTTP plus MPF)
- other non-Virgin operators stay on the Openreach network
- steady increase in subscribers to 15–25%.

Figure 3.11: Commercial viability of a new-entrant FTTP operator at different long-term market shares [Source: Analysys Mason,2016]



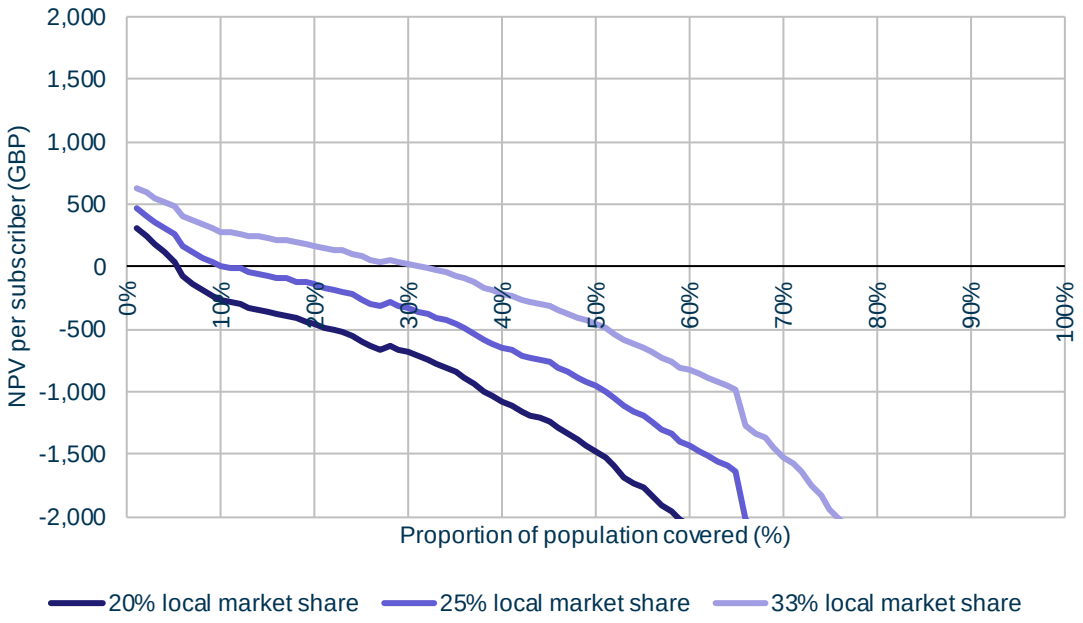
The results show that for a new entrant, a commercially viable deployment to 40% coverage would not be possible, even with a 25% share of the market in covered areas. If a 20% market share can be reached, only a small area is commercially viable, though if market share reaches just 15% no deployment will make a return. This high level of sensitivity to market share would represent a significant risk to a potential investor.

The 'alliance'

Figure 3.12 shows the commercial viability of two (or more) broadband retailers forming an alliance to deploy a competing FTTP network. The crucial difference between this scenario and the previous one is the ability of the existing operators to rapidly migrate their existing subscriber base from the Openreach network to their new FTTP network. The scenario assumes the following:

- 12% WACC as although the operators are established, the deployment would be based on a joint venture, which brings higher risks than if each operator were deploying separately
- GBP42.50 retail ARPU per residential subscriber (50% to the access network; this represents GBP21.25, which is similar to the cost of GEA-FTTP plus MPF)
- rapid increase in subscribers to 20–33% (as the existing subscriber base is migrated onto the new network).

Figure 3.12: Commercial viability of a new FTTP operator, formed from an alliance between existing retail operators, at different long-term market shares [Source: Analysys Mason, 2016]



The ability of an alliance of existing operators to rapidly migrate their existing subscriber base onto the new network creates a boost to the results compared to the 'new entrant' scenario: the viable coverage for 33% market share is around 30%. Such an arrangement would also increase the likelihood of achieving a higher market share.

However, it is interesting to note that at 25% market share (still a large share in the context of the UK market), the viable coverage drops significantly. Similar to the 'new entrant' case, this high level of sensitivity to market share would increase the risk perceived by a potential investor.

Also, the scenario assumes a residential ARPU which is similar to the wholesale cost of FTTP access in the UK. This is slightly higher than the wholesale cost of FTTC, and therefore assumes that the retail operators would be prepared to pay a premium over their current NGA wholesale charges for the use of the joint FTTP network. If the retail operators cannot justify such a premium, and will be looking to pay a similar amount for their access network, then the viability results will be lower.

4 Benchmarking analysis

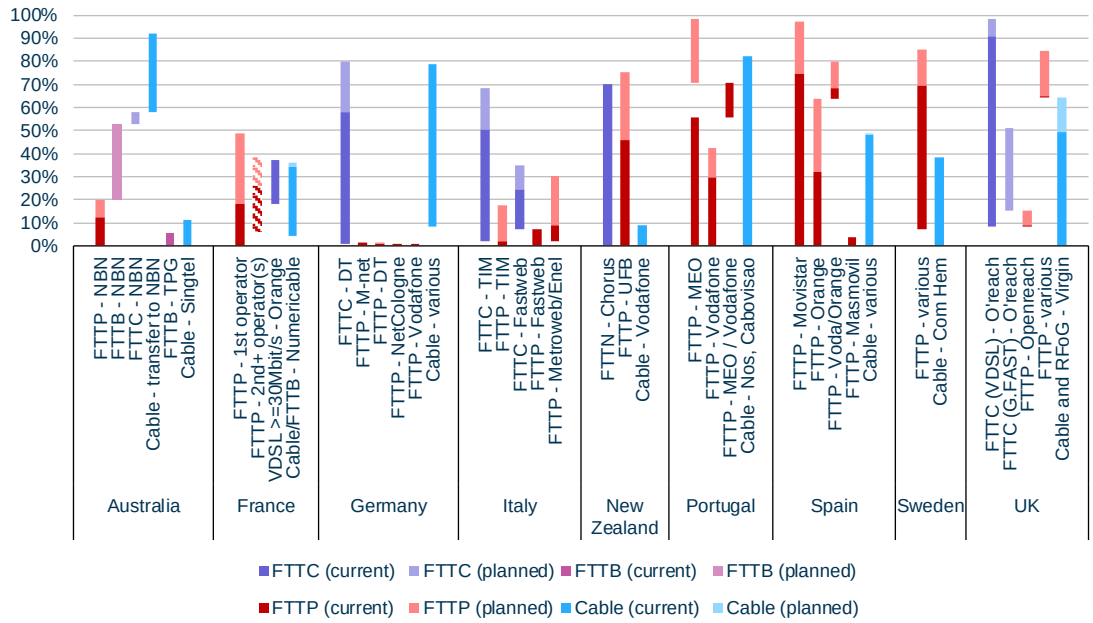
In this section we present an updated version of our previous benchmarking analysis.[25] We provide a series of benchmarks relating to the availability, take-up, level of competition and pricing of broadband services in the UK compared with the largest countries in Europe, together with other countries where DPA has been used by competitors to deploy their own fibre, and countries where there has been a government policy push for fibre.

The list of benchmark countries covered are (in alphabetical order): Australia, France, Germany, Italy, New Zealand, Portugal, Spain, Sweden and the UK.

4.1 Broadband coverage

We have reviewed current (2016) and planned (2020) coverage of NGA networks in the benchmark countries, including FTTC/VDSL, FTTB[26], FTTP and cable technologies. Our analysis is presented in Figure 4.1 below. In should be noted that our analysis of planned NGA coverage is based on operator announcements only (we have not undertaken any viability modelling to verify the plans).

Figure 4.1: Current (2016) and planned (2020) NGA coverage in benchmark countries [Source: Analysys Mason, TeleGeography, 2016]



25 Analysys Mason report for BT, *International benchmarking report*, 21 September 2015. Available at http://www.analysysmason.com/About-Us/News/Press-releases/Broadband-benchmarks-Sept2015/

26 FTTC: Fibre to the cabinet; VDSL: Very-high-bit-rate digital subscriber line; FTTB: Fibre to the building; FTTN: Fibre to the node.

The analysis shows the following approaches to NGA infrastructure in each country:

- Australia is combining multiple network technologies to create a single continuous NGA network.
- In France, operators will share fibre cables between the mutualisation point and the premises.
- In Germany, the FTTC and cable networks will provide NGA coverage for the foreseeable future. We note that there is an emerging fibre operator not shown on the chart (Glasfaser) due to lack of data on current and planned coverage.
- In Italy, Telecom Italia has plans to significantly expand its current FTTC network, while both Telecom Italia and the Metroweb-Enel venture have plans to expand their FTTP networks. There is no cable network in Italy.
- In New Zealand, the government's ultra-fast broadband initiative will see the majority of the country covered with FTTP infrastructure.
- In both Spain and Portugal, a mix of parallel deployments of FTTP and joint-venture deployments will provide competition to the cable operator.
- In Sweden, there are a large number of independently owned FTTP networks offering wholesale access, which are available alongside the cable operator.
- In the UK, NGA coverage (mainly using FTTC) is towards the top of the benchmarks, and Virgin Media's cable expansion plans will see the area covered by two networks increase.

Overall, the analysis shows that a range of technologies can be implemented to achieve NGA coverage, and each country has taken a unique approach.

One of the major themes in Ofcom's review is the shift from 'superfast' to 'ultrafast' broadband networks. As per our previous reports, in this document 'superfast broadband' means fixed connections which typically can support a downstream bandwidth of at least 30Mbit/s; for 'ultrafast broadband' we mirror the definition used by UK Government and the European Commission, i.e. downstream bandwidth of at least 100Mbit/s.[27]

Figure 4.2 shows *current* NGA coverage presented in terms of connection speed (i.e. we have assumed that it is only the speed of connection that is important, not the technology over which it is delivered). We present the results in this way in order to show the proportion of each country that offers a choice between competing network infrastructures.

[27] We note that Ofcom has defined ultrafast broadband to include services of 300Mbit/s or more.

Figure 4.2: Current (2016) NGA coverage in benchmark countries [Source: Analysys Mason, TeleGeography, 2016]

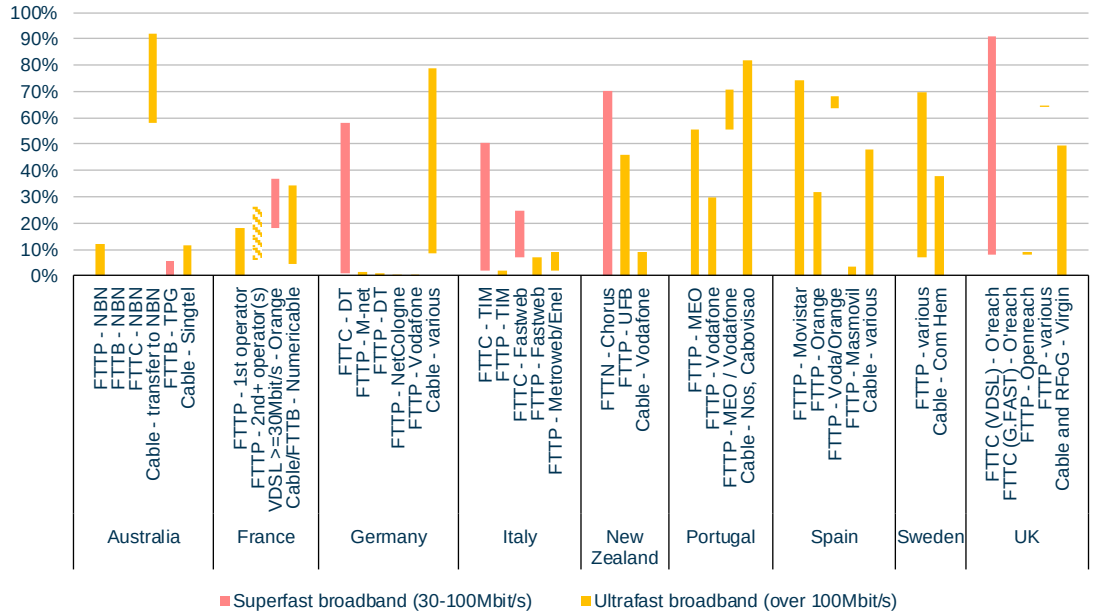
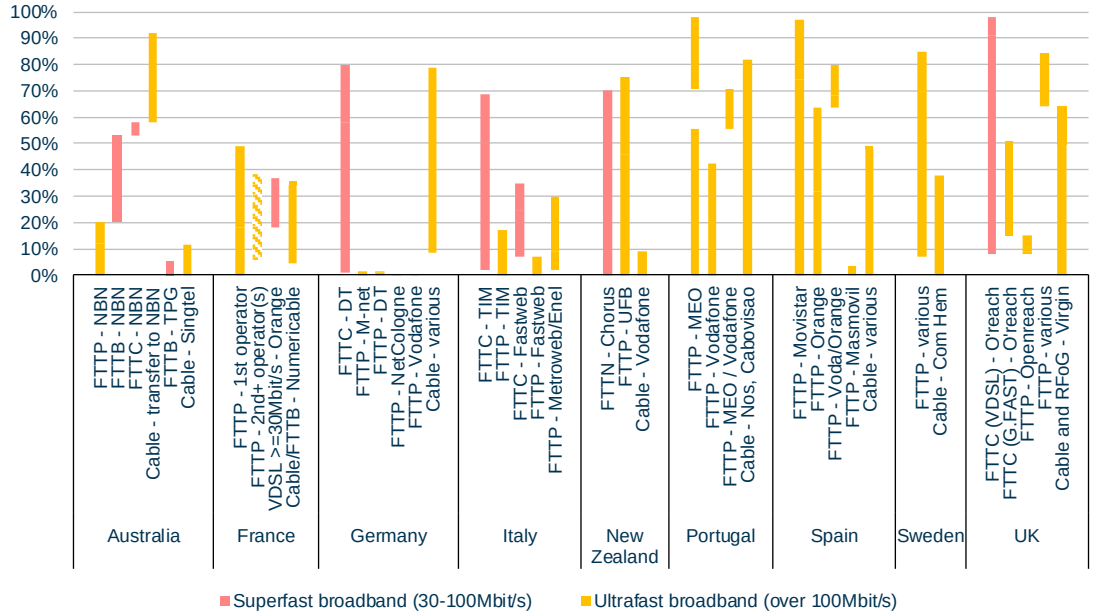


Figure 4.3 shows *planned* NGA coverage presented in terms of connection speed. We assume that by 2020, FTTP, G.fast-enabled FTTC and cable networks are able to provide ultrafast connections.

Figure 4.3: Planned (2020) NGA coverage in benchmark countries [Source: Analysys Mason, TeleGeography, 2016]

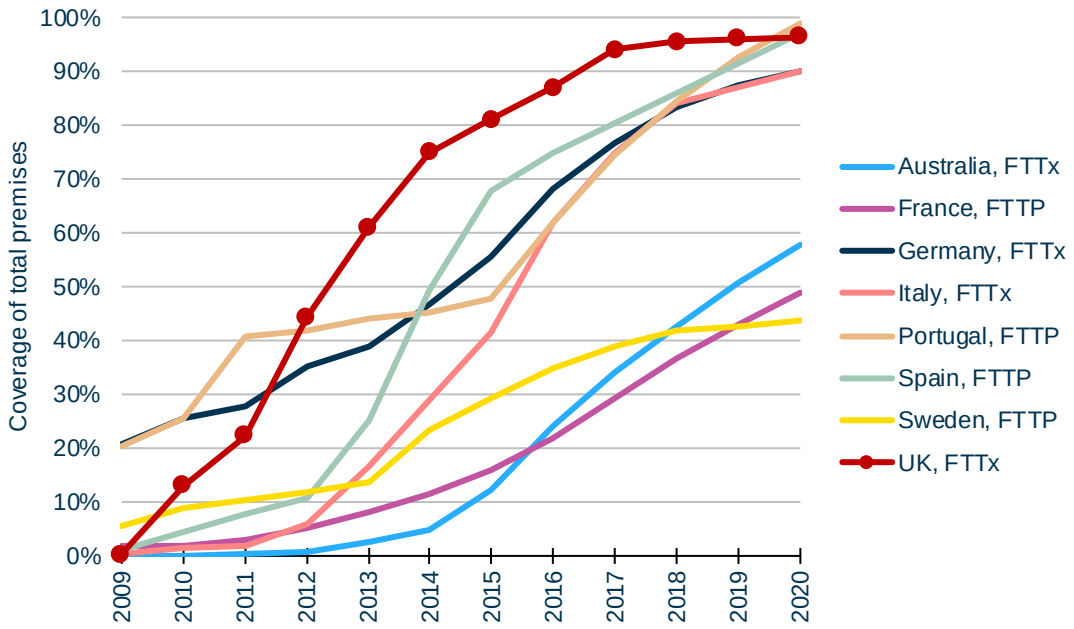


The analysis shows that most of our benchmark countries are expected to feature only one or two ultrafast broadband networks covering large portions of premises. In the two figures above, only France, Portugal and Spain are expected to have a choice of three networks available to a significant

portion of each country. As we discuss in Section 1.1, there are specific circumstances in these countries which have led to this outcome.

In Figure 4.4 we show the historical and forecast rate of deployment of NGA technologies by the incumbent operator in each of the benchmark countries.

Figure 4.4: Benchmark of coverage with NGA technologies provided by the incumbent operator [Source: Analysys Mason,2016]



The analysis presented in Figure 4.4 highlights the rapid progress that has been made in the UK with the roll-out of the (mainly) FTTC network. In contrast, and with the exception of Spain, FTTP networks have been deployed at a much slower rate.

In addition to the provision of superfast and ultrafast speeds, we have also considered some other more general broadband metrics. Figure 4.5 shows a benchmark of current average connection speed, while the proportion of each country that is able to receive 10Mbit/s or more is presented in Figure 4.6. It should be noted that the ability to receive speeds of at least 10Mbit/s is based on previous modelling work for countries other than the UK.

Figure 4.5: Average connection speed in benchmark countries
[Source: https://www.akamai.com,2016]

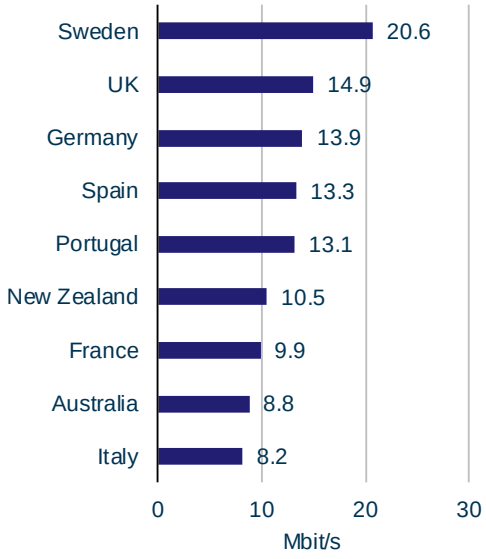
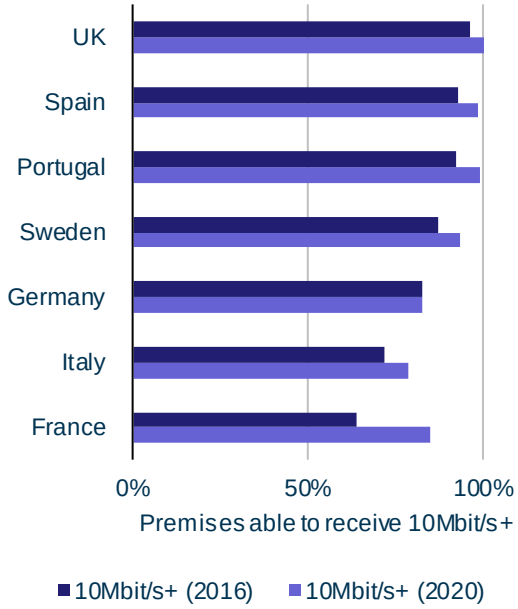


Figure 4.6: Proportion of premises able to receive a wireline download speed of at least 10Mbit/s
[Source: Analysys Mason, ThinkBroadband, 2016]



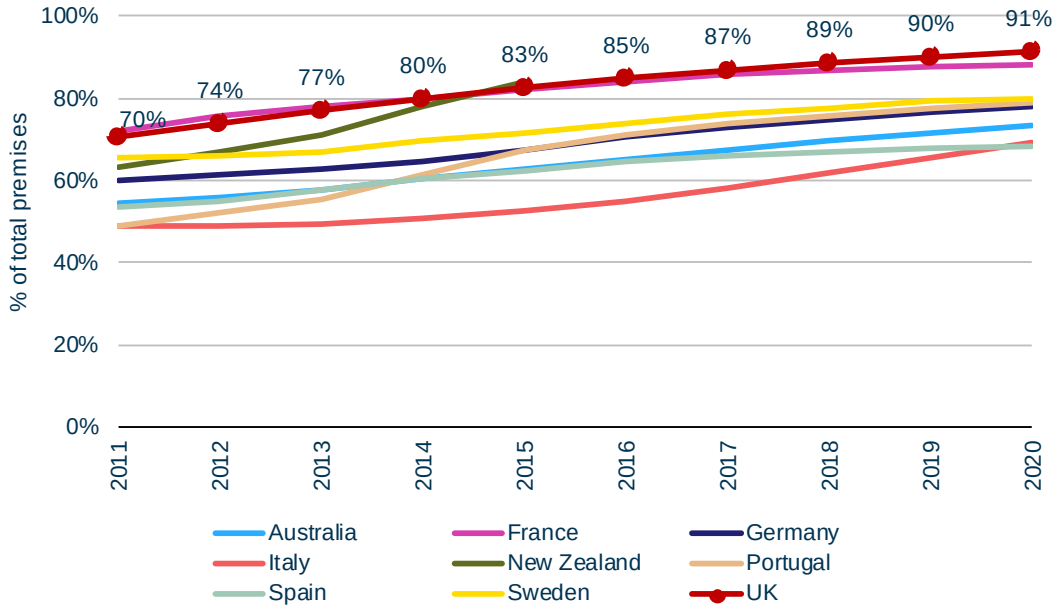
As can been seen in the two figures above, the UK is well placed across both of the general broadband metrics. The UK has the second-best average speed of all the benchmark countries, while in terms of availability of at least 10Mbit/s (suggested by Ofcom as the speed appropriate for a broadband universal service obligation or USO), the UK ranks first.[28]

[28] We have shown the availability of 10Mbit/s to be 100% in 2020. This will either be delivered by BT's plans to provide 10Mbit/s to the final few percent of premises in the UK and/or the UK government's commitment for a broadband USO. Where the USO is relied upon, the actual coverage may be slightly lower than 100% due to a threshold for the maximum cost per line. It should be noted that the analysis does not consider the availability of mobile, fixed wireless or satellite networks.

4.2 Take-up of fixed broadband

Figure 4.7 shows the level of fixed broadband take-up in benchmark countries, defined as a share of connections to the total number of premises. The analysis includes all fixed broadband connections (xDSL, FTTB/FTTB, cable, other) and excludes dedicated leased connections.

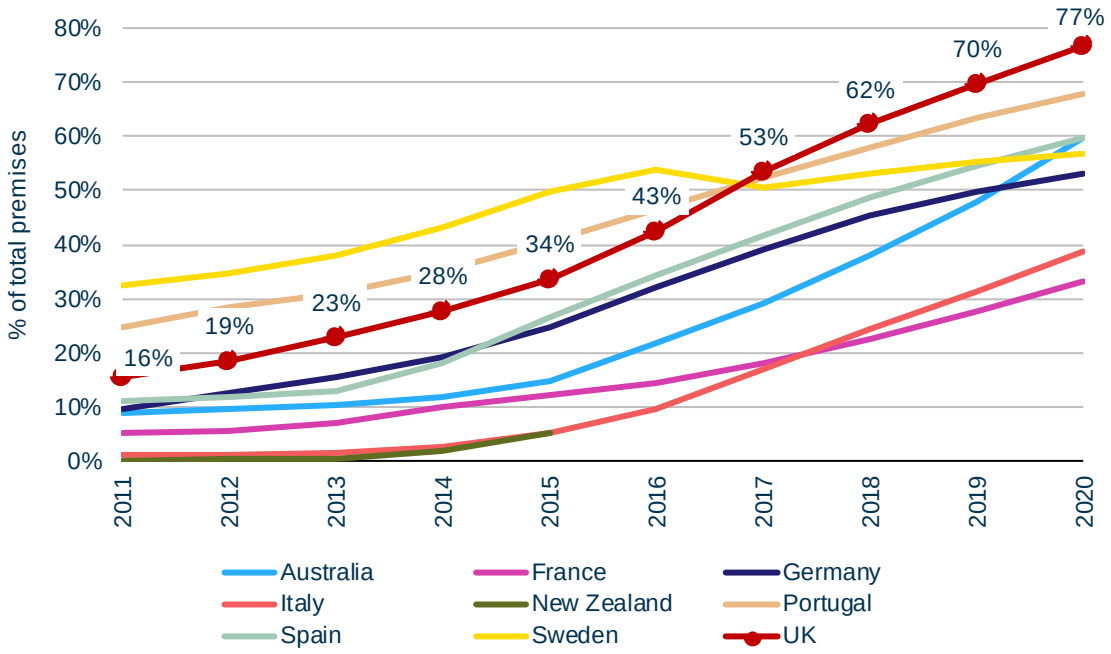
Figure 4.7: Benchmark of total fixed broadband take-up (premises connected as a percentage of total premises) [Source: Analysys Mason,2016]



The analysis shows that fixed broadband take-up across the benchmark countries has been growing in recent years, and we expect this trend to continue. The historical increase in take-up can be attributed to such factors as growing coverage of broadband networks and increasing usage of online services. Strength of the economy and ICT literacy also contribute to the high levels of broadband take-up in the benchmark countries. It should be noted, however, that high take-up of mobile broadband may hold back fixed broadband take-up – as is the case in Sweden. Overall, the UK is expected to maintain its position at near the top of benchmarks, due to its wide availability of different broadband services, and a competitive market.

Figure 4.8 shows total take-up of NGA broadband across all benchmark countries.

Figure 4.8: Benchmark of total NGA broadband take-up (premises connected as a percentage of total premises) [Source: Analysys Mason (FTTx coverage, conversion and capex: worldwide trends and forecasts 2015–2020), 2016]



The forecasts shown above are based on the following drivers:

- Australia can be expected to show significant growth in take-up as subscribers migrate to the new National Broadband Network (NBN)
- the low take-up in France can be attributed to the slow pace of network roll-out and a lack of rural coverage
- in Germany and the UK, fast and extensive roll-out of FTTC networks, coupled with highly competitive markets, are supporting rapid growth of NGA take-up
- Italy has historically shown relatively low take-up rates, which are expected to be reinvigorated with the entrance of Enel to the market and FTTP network roll-out
- Spain and Portugal have stated their intention to achieve full FTTP coverage by 2020, and this is expected to significantly drive NGA take-up
- Sweden is exhibiting low take-up growth rates due to limited coverage in rural areas.

Overall, the analysis shows that the UK is well positioned in relation to the benchmark countries in terms of current and expected take-up of fixed broadband.

4.3 Intensity of competition in fixed broadband

We have analysed the level of competition across fixed broadband markets in the benchmark countries. Figure 4.9 illustrates the market shares of operators that are present in the countries included in our benchmark, while Figure 4.10 shows market concentration, defined in terms of the Herfindahl-Hirschman Index (HHI). [29]

Figure 4.9: Market shares of operators in benchmark countries, 2015 [Source: Analysys Mason (Telecom Market Matrix Q1 2016), TeleGeography, 2016]

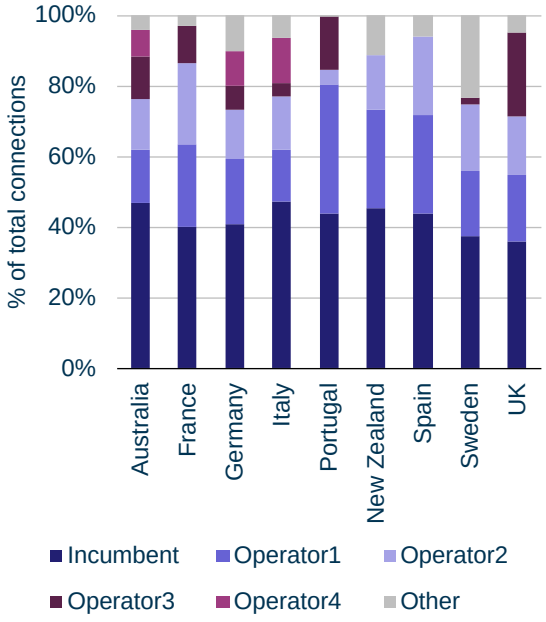
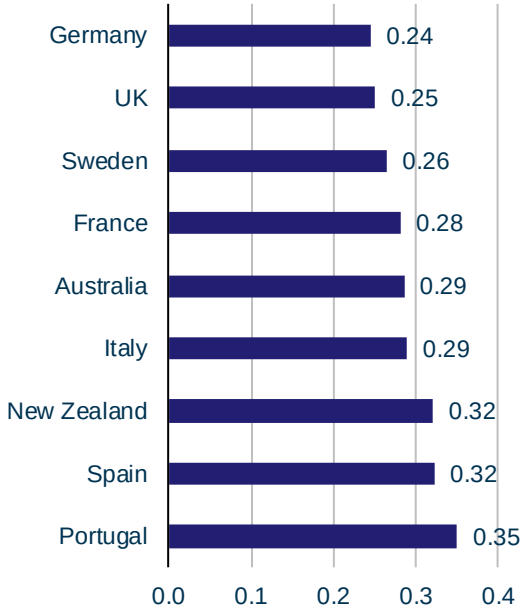


Figure 4.10: Benchmark of the HHI in the fixed broadband market, 2015 [Source: Analysys Mason,2016]



Among the benchmark countries, the UK fixed broadband market is one of the most competitive, featuring four large operators (BT, Sky, Virgin Media and Talk Talk) as well as a number of smaller players. Competitive pressures help maintain broadband prices at an affordable level and have contributed to the UK being well-positioned in relation to benchmarks in terms of network coverage and connection speed (demonstrated in Figure 4.1 and Figure 4.2, respectively).

29 The Herfindahl-Hirschman Index (HHI) is a measure of market concentration. The lower the score, the lower the concentration of the market (and therefore the higher the levels of competition).

4.4 Incumbent operators' share of retail broadband

Figure 4.11 shows how the retail broadband market share of the incumbent operators in the benchmark countries has evolved in the last five years.

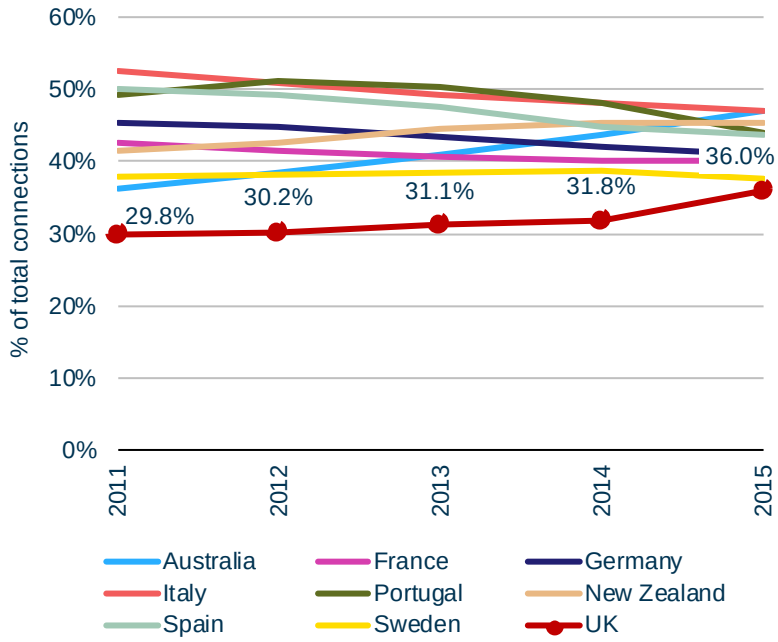


Figure 4.11: Benchmark of the evolution of the incumbent operators' market share in fixed broadband markets [Source: Analysys Mason (Telecom Market Matrix Q1 2016), TeleGeography, 2016]

The 2015 increase in the market share of the UK incumbent operator (BT) reflects its acquisition of EE's fixed operations that completed in early 2016. However, despite the recent rise in BT's market share, the UK was still at the bottom of benchmarks for this metric at the end of 2015.

4.5 Broadband pricing

In this sub-section we have analysed two metrics to compare broadband pricing across benchmark markets:

- absolute ARPU values, and
- broadband ARPU as a 'share of wallet' – share of median monthly disposable income of a household.

ARPU and its 'share of wallet' are shown below for total fixed broadband (Figure 4.12 and Figure 4.13), total NGA broadband (Figure 4.14 and Figure 4.15).

Figure 4.12: Total fixed broadband ARPU [Source: Analysys Mason (Fixed services in Western Europe and developed Asia-Pacific: trends and forecasts 2015-2020), 2016]

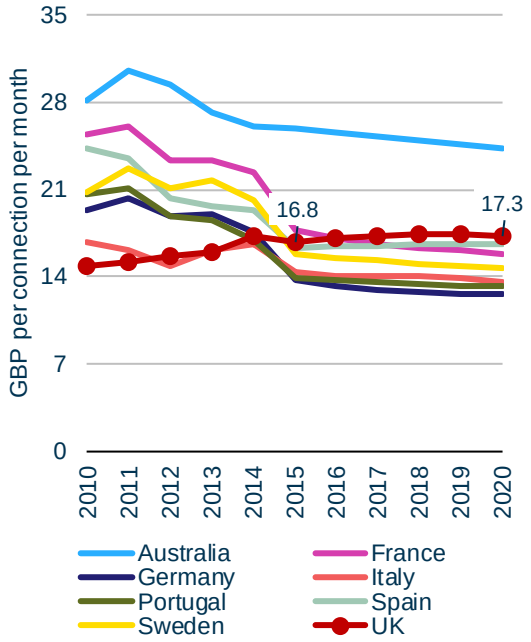


Figure 4.13: Total fixed broadband 'share of wallet' [Source: Analysys Mason (Fixed services in Western Europe and developed Asia-Pacific: trends and forecasts 2015-2020), 2016]

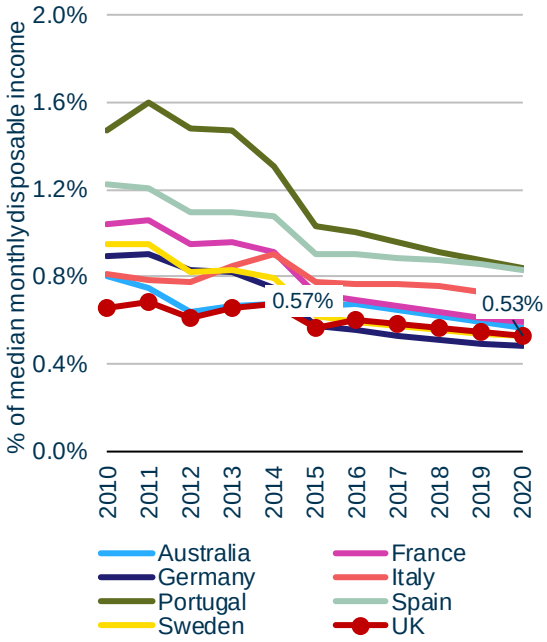


Figure 4.14: Total NGA broadband ARPU [Source: Analysys Mason (Fixed services in Western Europe and developed Asia-Pacific: trends and forecasts 2015-2020), 2016]

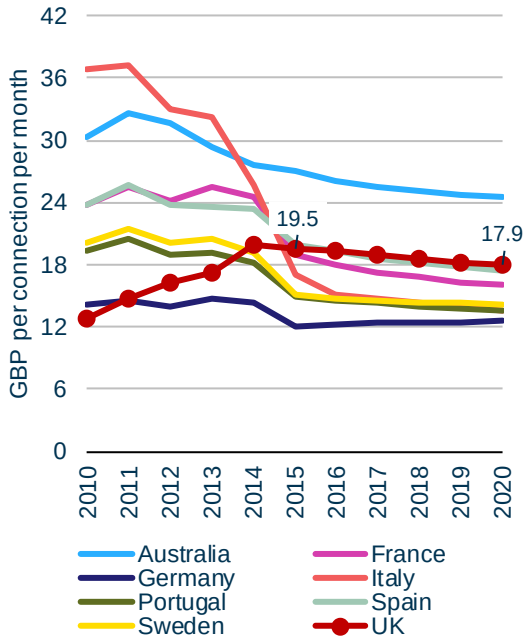
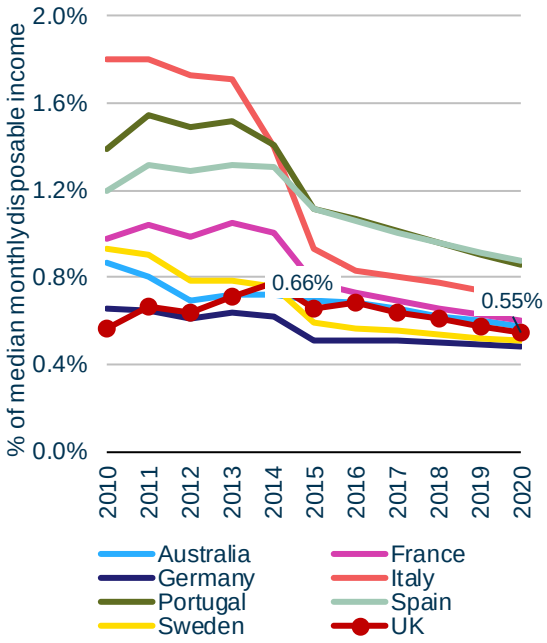


Figure 4.15: Total NGA broadband 'share of wallet' [Source: Analysys Mason (Fixed services in Western Europe and developed Asia-Pacific: trends and forecasts 2015-2020), 2016]



The forecasts presented above are driven by the fact that fixed broadband ARPU is boosted by NGA take-up (and generally high-value services) but offset by competition and increasing saturation of the market. Notably, the UK is the only benchmark country which is expected to retain the upward trend in NGA ARPU throughout the forecast period. This reflects the strong growth rates of NGA take-up that are forecast for the UK, as shown in Figure 4.8.

5 Conclusions

We have summarised our conclusions and implications for policy around four themes: the characteristics of the UK market; the role that DPA will play; the impact on universal service; and the implications for active access and GEA. These are set out below.

The characteristics of the UK market place the major constraints on FTTP

The specific characteristics of the UK market are an essential factor in its future evolution, including the move towards more extensive commercial deployments of FTTP. The UK broadband market is continuing to generate good outcomes, with high levels of take-up (83% of premises at the end of 2015) and planned investment driven by one of the most competitive market structures (0.25 HHI) in our benchmark countries. These outcomes have been fostered by the regulatory approach taken to date. The focus on LLU and then active NGA products has led to a number of successful players at the retail level. This needs to be considered when comparing the UK to other countries that exhibit high levels of FTTP coverage and the presence of three competing networks. Amongst our benchmark countries, only Portugal and Spain are expected to deliver such an outcome. However, the market characteristics in these two countries differ significantly from the UK: they have relatively high market shares (higher HHI), and crucially, no option for active access to offer NGA services.

Because of the large amount of fixed costs associated with deploying FTTP, and the way that costs increase non-linearly as the deployment moves from dense to less-dense areas, the local market share is critical to the commercial success of any deployment. The importance of this demand-side factor, coupled with the competitive nature of the UK market, means that an investor is likely to perceive significant risk in a widespread competitive roll-out of FTTP in the UK.

DPA will play a role in UK broadband development

Openreach and Ofcom are currently working together to refine the UK's DPA offer and remove some of the perceived procedural barriers to its use.[30] The re-use of Openreach's existing duct and pole infrastructure represents a useful option for competing operators to deploy their own networks in a cost-efficient manner. Our analysis shows that the pricing of DPA makes up a small proportion of the total cost of deploying FTTP. Indeed, if the DPA pricing were reduced by half, the base case result of 4% coverage would increase to just 5%.

30 Ofcom (2016), *Progress update: supporting investment in ultrafast broadband networks, Strategy focussed on network investment and competition.* Available at http://stakeholders.ofcom.org.uk/binaries/telecoms/policy/digital-comms-review/July_2016_progress_update.pdf

There is, however, still a high degree of uncertainty over the extent to which the existing ducts and poles can accommodate new fibre cables. Once the use of DPA is requested at scale, the subsequent planning and survey activity will provide the information on duct and pole availability that will resolve the debate over how DPA can support ultrafast broadband.

Impact on universal service

Ofcom and the UK government are investigating a possible universal service obligation (USO) for broadband, intended to ensure that all premises have access to broadband of at least 10Mbit/s. We note that the UK is number 1 in our benchmark countries for availability of 10Mbit/s with an availability of 96%[31]. Hence, the extent of any potential USO at 10Mbit/s would relate to around 4% of households, based on current coverage figures.

We also note that the aim of securing a third network is not complementary with the aim of a 10Mbit/s broadband USO, since the new network would most likely overbuild BT and Virgin Media (or a combination of BT/VM/other existing operator); it is therefore very unlikely to affect the proportion of premises that could receive a broadband USO.

On the other hand, planned smaller-scale FTTP deployments by operators focusing on rural areas may have an impact on the broadband USO, but these areas are unlikely to feature another network (as they are generally targeted at under-served areas), and therefore will not contribute to the coverage of three networks.

Active wholesale products will continue to be relied upon by most of the industry

Ofcom's proposed strategy appears to include two separate components: competition from a third network operator (using DPA) in some areas of the country, and continued reliance on Openreach's active products (i.e. GEA) in other areas of the country.

Our economic modelling analysis suggests that the area in which the 'three-networks' model will be viable will be much smaller than Ofcom hopes.

We have considered the current pricing of GEA services (both FTTC and FTTP variants) against the cost per subscriber of deploying an FTTP network, and how changes to GEA pricing could impact operators' 'build or buy' decision. If there were to be any reduction in GEA pricing, for example, then this would reduce the area in which it is more cost-effective for an operator to deploy its own network using DPA. Ofcom will need to carefully balance any potential price regulation of GEA with its aim of securing a third network in significant parts of the UK.

31 Source: ThinkBroadband