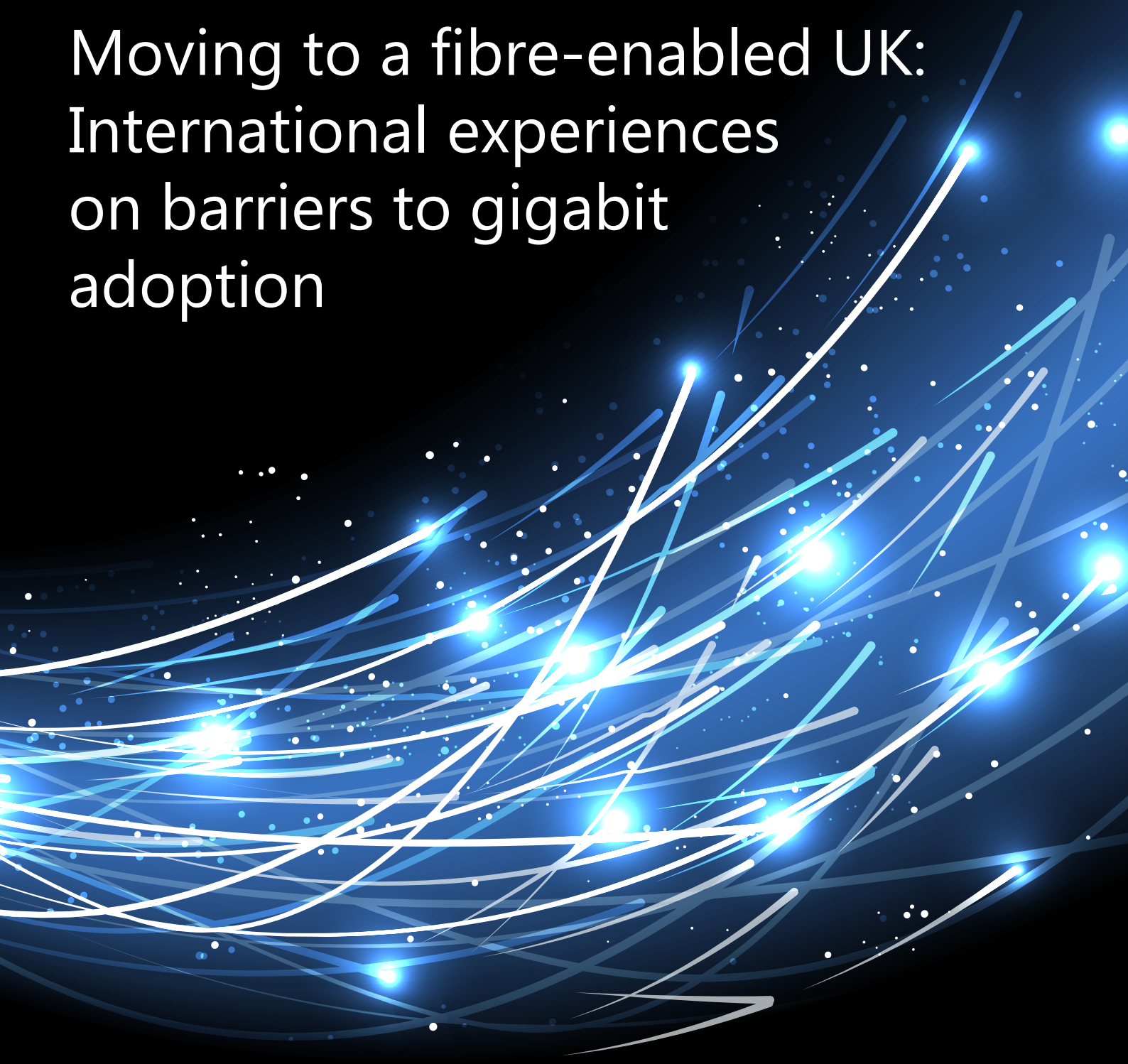
wik CONSULT

BSG Broadband Stakeholder Group

Moving to a fibre-enabled UK: International experiences on barriers to gigabit adoption



Foreword from the BSG

The current UK context

The COVID-19 pandemic means that the UK economy and society at large are in unchartered waters. In this era of uncertainty, digital connectivity has never been as critical to our ability to navigate our new normal, socially-distanced lives as citizens, businesses and consumers. UK broadband and mobile operators have worked tirelessly to meet demands for increased capacity on networks and changed patterns of usage, whilst rightly prioritising the NHS, and the most vulnerable customers with targeted support.

With the impact of COVID-19 on both the economy and our reliance on digital connectivity likely to be ongoing for some time, the case for sustained investment in gigabit connectivity in support of the UK Government's 2025 ambitions has surely never been stronger, nor the need for regulatory and policy certainty greater. The expectation that digital connectivity will be one of the key pillars to economic recovery gives this an even sharper focus. The UK urgently needs to reset the dial in recovery and build to anticipate future demand and future-proof our networks with the resilience and flexibility required to support the needs of a 21st century digital economy.

Accelerated efforts to remove barriers to deployment must be pursued with vigour and have been highlighted in previous BSG reports[1]. But as deployment quickens pace, and millions more consumers have the option to switch to gigabit connections, attention now needs to turn to the demand-side of our gigabit journey, to support the business case and to ensure that the maximum number of UK consumers and businesses benefit from the significant investments now being made. Government, regulators and industry all have a strong interest in fast adoption to support investment and unlock benefits from faster services, so it is important to consider how we get customers using these new, improved services, ahead of copper switch-off.

WIK four-country research

BSG commissioned the consultancy WIK to look at the international experience of network roll-out and the customer experience of new fibre service, and to consider how these findings can inform the UK's approach. The report analyses the experiences of France, Germany, Italy and Sweden.

The research found differences in approaches and some commonalities. Across the board it found that there isn't always a direct correlation between the pervasiveness of gigabit networks and the pace of consumer and business adoption. The latter may have more to do with attractiveness of alternatives, such as FTTC, which may be perceived to be adequate. This is particularly true in markets when triple-play is offered at the same price on lower-speed networks, such as in France and Italy. Conversely, where there are currently only low speed broadband offerings, as in many rural areas, migration on to high speed gigabit services becomes an attractive proposition, particularly when well-marketed in those localities. There is evidence of this in Germany and France as well as in the UK.

The WIK research inevitably reflects a variable geometry. Some countries are in a similar, primary, stage of fibre deployment as the UK, such as Germany. Germany however lacks the high digital adoption indicators that are present both in Sweden and the UK, and consumers exhibit a low willingness to pay a premium for fibre.

The report also sheds light on how consumers engage with and understand fibre broadband as a product. For example, Italy has adopted a "traffic light" labelling scheme

1 BSG and Analysys Mason, May 2017, Lowering Barriers to Telecoms Infrastructure Deployment and Lowering Barriers to 5G Deployment, July 2018

to improve consumers understand of the characteristics of different services, while the French regulator has also sought to provide greater transparency for advertised fibre products. The examples could help shape the approach of UK Communications Providers as they develop and market new products, and also the regulatory approach to advertising and consumer marketing. There are also cultural, behavioural and demographic factors that influence adoption. In France and Italy, for example, adoption has been inhibited by some consumers' reluctance to allow telecoms engineers to enter homes to install fibre.

Whilst there is no single killer application, there are undeniably four pillars that drive adoption: strong demand, a well-informed customer base, a willingness to pay for fibre, and a high usage of data-intensive services. All four are evident in Sweden. Yet, even in a nation with a strong affinity to tech and high fibre penetration, adoption by two-thirds of the Swedish population is the result of a decade's steady progress which is why the UK needs to focus on these barriers and enablers now. The Swedish Government's stated, and shared ambition with the UK, is for near-ubiquitous gigabit penetration by 2025.

From a price perspective, whilst there is a clear willingness to pay for fibre-based broadband in Sweden, this is not present in France and Italy. For the UK, given that many consumers have yet to switch to superfast broadband and many are unaware of fibre-based offers, it could perhaps be deduced that they would be unlikely to pay significantly more for broadband based on gigabit technology than they already pay for superfast.

Lessons for the UK

Widespread adoption of gigabit services in the UK may present many of the similar challenges that are currently faced with UK adoption of FTTC and cable. Consumers may be insufficiently aware of the benefits or are aware but consider their existing offering to be sufficient or to migrate to a different service would be more costly than in reality it often is. Having analysed the patterns of gigabit adoption in these four countries, WIK has identified four broad areas where BSG believe there could be useful lessons for the UK and these form our recommendations:

1. Address advertising and customer communications to improve consumer and business understanding of the benefits of gigabit broadband - and ability to distinguish between the broadband networks available to them.

2. Incentivise take-up of new gigabit broadband connections and address issues of affordability for businesses and consumers.

3. Leverage digitisation to support the economy and society in a post COVID-19 era.

4. Facilitate eventual switch-off of the legacy copper network by securing buy-in from all relevant broadband industry stakeholders.

No gigabit nation was built in a day, but several, like Sweden, have largely been achieved in the course of a decade, with favourable demand-side conditions a critical factor. As the UK leverages its position as an evolved digital nation, and deployment of new digital infrastructure accelerates, we need to aim for a similar levels of fibre adoption so that consumers and businesses benefit from the investments being made. Now is the time to grasp the opportunity to build on the constructive collaboration achieved between industry, Government and the regulator during these last months of national crisis to take forward these recommendations, so that we create the conditions needed to bring consumers and businesses with us as we move to a fibre-enabled UK.

Clare MacNamara
CEO, BSG

I Executive summary

I.I The challenge of moving to a fully gigabit society

The UK has nearly full coverage of superfast broadband at speeds of 30Mbit/s and above, predominantly via FTTC.[2] As of September 2019, more than 70% of broadband connections were provided on the basis of cable or FTTx technologies enabling at least superfast broadband speeds.[3] Operators have also made significant strides towards achieving wider coverage of full fibre and other gigabit-capable networks. As of January 2020, full fibre broadband was available to more than 3.5m homes, an increase of a half a million in just over 3 months,[4] while around 4.3m premises could access a gigabit-capable broadband network when other technologies such as cable are included.[5] This signals that momentum is building behind Government's ambitious target to achieve full coverage of gigabit-capable infrastructure by 2025.[6] Strategies pursued by the Government to support the funding of rural gigabit-capable infrastructure,[7] and by Ofcom to foster infrastructure-based competition and provide incentives for fibre upgrades should provide further impetus for the deployment of gigabit-capable networks.[8]

However, the business case for full fibre and ambition to ultimately switch-off the copper network depends strongly on take-up of the new fibre infrastructure.[9] In this context, the UK faces a challenge that a significant proportion of customers are already using superfast services, and may consider these capabilities sufficient to meet their needs. Moreover, despite the fact that FTTC has been in place for some time, around 30% of consumers are still relying on basic broadband services. As fibre deployment accelerates, it will therefore be important to place emphasis on supporting demand specifically for gigabit capable networks, to maintain momentum for deployment, as well as ensuring that UK consumers and businesses reap the full benefits of the services that can be provided via gigabit infrastructure. The importance of investing in gigabit broadband for society and the economy has been further highlighted during this period

2 Coverage stood at more than 95% in January 2020
3 https://www.ofcom.org.uk/__data/assets/pdf_file/0020/190442/q3-2019-telecoms-data-update.pdf
4 Connected Nations Update: Spring 2020 https://www.ofcom.org.uk/__data/assets/pdf_file/0028/195256/connected-nations-spring-update-2020.pdf
5 https://www.ispreview.co.uk/index.php/2020/02/gigabit-broadband-speeds-available-to-14-3-of-uk-premises.html
6 Details of Government policy for building a nationwide gigabit-capable full fibre broadband infrastructure are available in the Jan 2020 House of Commons Briefing paper: full-fibre broadband in the UK https://commonslibrary.parliament.uk/research-briefings/cbp-8392/ These ambitions build on measures that were originally set out in the UK Government's 2018 Fixed Telecoms Infrastructure Review https://www.gov.uk/government/publications/future-telecoms-infrastructure-review
7 The Johnson Government has allocated £5bln to tackle the hardest to reach 20% of UK premises
8 Further proposals have been made in Ofcom's consultation for the Wholesale Fixed Telecoms Market Review, released in January 2020 https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review
9 The importance of the demand-side in supporting investment is also raised in the April 2020 study Delivering Gigabit Britain: Broadband for all https://www.assemblyresearch.co.uk/latest-news-items/gigabit-britain

of crisis. The lockdown imposed as a result of COVID-19 has required large swathes of the population to rely on remote working, eHealth and eLearning solutions, alongside cloud usage and video conferencing for business and social engagement.[10] There is the prospect that changes in working practices and delivery of public services could persist following the outbreak,[11] providing an opportunity for digital transformation to provide a route out of the deep recession which is likely to follow the outbreak. However, widespread availability and take-up of gigabit infrastructure will be needed to underpin these developments and ensure that no corner of the UK is left behind.

In this study, we describe barriers and initiatives to support gigabit broadband take-up that have been adopted in four European countries (France, Germany, Italy and Sweden)[12] and discuss potential solutions that could be relevant to aid the UK in migrating to a fully gigabit-enabled society, in which digital innovation can thrive.

Although the study reveals a number of solutions that have been pursued in various countries, there are four broad areas that we conclude may be particularly relevant for the UK. These are measures to:

- Address advertising and customer communications to improve understanding of the benefits of gigabit broadband and drive consumer-led demand
- Incentivise take-up of new gigabit broadband connections and address issues of affordability for businesses and consumers (including vulnerable consumer groups)
- Leverage digitisation to support the economy and society in a post COVID-19 era
- Facilitate eventual switch-off of the legacy copper network by securing buy-in from all relevant broadband industry stakeholders.

We outline some of the measures that could be relevant below.

I.II Advertising and customer communication to raise awareness of the benefits of gigabit broadband

One of the key challenges for the UK's gigabit broadband ambitions is that customers may not see the need to upgrade their existing broadband service, even where gigabit-

10 For example, a 2020 survey from EY suggests that as a result of the lockdowns imposed in connection with the coronavirus, 29% have used streaming TV services more often, 30% reported an increase in home working via collaboration applications, and 35% are making more mobile phone calls. https://www.computerweekly.com/news/252481133/Coronavirus-Video-calling-collaboration-applications-usage-rise-steeply-in-UK-homes

11 For example, in a survey conducted by Censuswide, 68% of respondents claimed they were equally or more productive working from home than in an office environment, and 28% considered that their employers might retain some flexible working practices, in the aftermath of the pandemic https://www.personneltoday.com/hr/remote-working-after-covid-19-coronavirus/

12 Evidence from further countries is also cited

capable services are available.[13] Evidence from surveys in both the UK and elsewhere, suggests that one reason may be that customers may not value or be aware of the capabilities offered through higher bandwidths, and/or may find it difficult to compare the offers available in the market today.[14] A survey conducted by WIK in Germany, confirms that there is confusion amongst many customers (and potentially especially those in countries where FTTC is widespread) about what fibre is and what it may offer, as it showed that many customers did not know the technology on which their service was based, and wrongly believed that they were already subscribed to fibre broadband.

Another effect of the current approach to advertising may be that other technically complex, but important characteristics for future services such as reliability, symmetry, low latency and the ability to readily upgrade capacities to meet future needs, may not be fully understood by small businesses and consumers.

One solution to this problem has been developed in Italy. Under a 2018 Regulation adopted by the National Regulatory Authority AGCOM, all broadband advertisements must have a colour coded label, where green indicates the highest quality connections, and red indicates those which are provided via legacy copper or wireless networks. Rules to limit which services can be described as "fibre" in advertising also exist in France.[15]

In the context of the objective of achieving nationwide gigabit-capable connectivity by 2025, the UK Government and Ofcom could consider developing and adopting a labelling system that enables consumers to make informed purchasing decisions, including by allowing them to better compare services they are contemplating.[16] Options pursued in other countries include labelling systems based on "traffic lights.

Pre-marketing around the benefits of higher bandwidths has also proved to be effective in supporting the take-up of superfast broadband in rural communities under UK State Aid programmes for broadband. Interviews with service providers in France and

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13 A 2020 EY survey, conducted during the coronavirus lockdown, suggests that, notwithstanding additional use of broadband, only 11% of households saw a need to upgrade to full fibre broadband https://www.computerweekly.com/news/252481133/Coronavirus-Video-calling-collaboration-applications-usage-rise-steeply-in-UK-homes

14 For example, research commissioned by the ASA suggests that the term "fibre" was not one of the priorities identified by participants when choosing a broadband pattern – and was seen as one of many buzzwords to describe modern, fast broadband https://www.asa.org.uk/news/asa-concludes-review-of-fibre-broadband.html.

15 Solutions which make use of technologies other than fibre in the access connection may not be marketed as "fibre". Upload bandwidths must be referenced wherever download bandwidths are advertised.

16 This is also relevant in the context of the UK's transposition of Article 3 of the EU Electronic Communications Code, which is due to be completed in the course of 2020. The UK Government has proposed in this context in it 2019 consultation (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819964/EECC_Consultation_-_Publication_Version__4_Updated_.pdf) that it may clarify that Ofcom should aim for the highest capacity networks and services economically sustainable in a given area.

Germany have confirmed that these strategies have also proved effective in driving take-up of full fibre connections,[17] thus improving the business case for deployment.

The Government could consider providing funding to local authorities to support the marketing of gigabit broadband which is being deployed through Government aid programmes.

I.III Incentivising take-up and addressing specific issues with the affordability of gigabit connections for consumers and small businesses

The COVID-19 crisis has clearly illustrated the importance of widespread accessibility to broadband connections, including to those with school aged children and vulnerable people requiring ongoing monitoring and care.

The research found that operators in countries migrating to FTTP, tended to charge retail prices for the service that were similar to those for legacy technologies, at least in the initial phases.

This kind of commercial strategy could help to support affordability and incentivise take-up. However, affordability may still be a barrier for some people to access gigabit capable broadband (as well as equipment), and this may be further exacerbated during this period and in the recession that is expected to follow the outbreak.

One barrier to gigabit-capable services can be high upfront costs to extend and/or connect to a new network. The UK Government's Gigabit Voucher Scheme, which was designed to provide support for new gigabit-capable connections, has proved to be extremely popular, but it has now been closed to applications as the funds are expected to be fully allocated from the existing requests that have been made.[18] Voucher systems have also been set up in the other countries which we studied, including systems to subsidise equipment for wireless connectivity in France, and to install gigabit connectivity for businesses and cultural centres in Germany. A common theme of these schemes is that they focus on providing assistance with the initial connection cost for newly constructed networks (or customer equipment in the case of wireless connections). Such schemes will continue to be important in supporting construction and take-up during the period while gigabit-capable networks are being rolled out.

However, a different approach could be relevant once gigabit-capable networks are available in certain areas. One initiative that has been introduced to support gigabit take-up in areas where infrastructure has already been deployed, is the Greek

17 Uptake rates of 40-60% have been reported as a result of pre-marketing activities in (primarily) rural areas of France and Germany

18 The GBVS was launched in March 2018 and was intended to run until 31 March 2021, but as of 14 May 2020 it closed to new applications. Under this scheme applicants were offered up to £2,500 to help businesses and homes gain access to a 1Gbps capable broadband connection (homes can only get £500 and up to 10 homes can participate for every 1 SME). https://www.ispreview.co.uk/index.php/2020/05/governments-uk-gigabit-broadband-voucher-scheme-ends-today.html

Government's Superfast Broadband scheme, which has involved providing vouchers to contribute to the cost not only of the connection, but also to subsidise the rental of 100Mbit/s broadband services provided over gigabit-capable infrastructure for 2 years. As there is some evidence that the value of gigabit broadband becomes apparent only after exposure, such a scheme could help pave the way for customers to transition to gigabit broadband and become familiar with its benefits in the longer term. This approach could be particularly valuable when seeking to promote the transition from existing Superfast services to gigabit-capable services which for some consumers may result in higher rental costs.

A recently introduced scheme in Italy also highlights how vouchers can be specifically targeted towards schools and vulnerable school children to improve learning outcomes.

Building on previous experience, the Government could consider expanding on its existing voucher schemes. Besides extending schemes which subsidise the cost of new connections, the Government could consider whether there may be value in schemes which incentivise customers to upgrade to gigabit-capable broadband lines in areas where such lines have been deployed. Such support could be universal, or, if desired, could be targeted towards those facing specific challenges with affordability or groups which risk being left behind. Vouchers to support the provision of gigabit connectivity for public institutions including schools and hospitals could also be considered.

I.IV Leveraging digitisation to support the economy and society in the post COVID-19 era

UK citizens and business are already relatively digitally aware, compared with many other countries in Europe. Internet traffic in the UK per household is amongst the highest in Europe, and usage of cloud services by businesses, eHealth applications and reliance on home working are considerably further advanced in the UK, than is the case in France, Germany and Italy.[19]

However, experience in Sweden and Denmark shows that even more can be done to leverage digital technologies to support education, healthcare, Government services and industry. Moreover, the exposure that has been given to these applications during the confinement imposed as a result of the coronavirus, provides an important opportunity to further level up the UK's digital service infrastructure and embed digitisation within the culture of British industry and society.

Relevant schemes in other countries have included programmes to support telemedicine and remote monitoring (including in a social care setting), installation of technology to support online lectures and distance learning, as well as digital innovation hubs, tax incentives, and innovation vouchers for SMEs to subsidise the cost of training and/or consulting to install and utilise digital solutions.

19 For example, 30% of UK businesses were reported as purchasing cloud services in 2018, more than double the levels of France, Germany and Italy

The Government could consider revitalising and refocusing initiatives around the digitisation of industry and public services to leverage lessons from the coronavirus experience. Such initiatives could support and extend the potential for remote working, delivery of healthcare and education services, as well as supporting businesses in utilising new technologies such as AI and robotics to aid production and increase efficiency. Support could for example include funding for central as well as local Government to support the delivery of remote healthcare, social care and monitoring, and innovation vouchers for SMEs to support their purchase of consulting and training services to adapt to the use of new technologies. In this context, the Government could also highlight, for example through a national marketing campaign, how gigabit broadband connections could support SMEs in pursuing flexible working and implementing digital solutions and could potentially consider a voucher scheme for this purpose. Tax incentives could also be explored.

I.V Facilitating the eventual switch-off of legacy copper networks by securing buy-in from relevant broadband industry stakeholders.

Significant attention is being given to the question of how to achieve copper switch-off in the UK. Thus far, much of the debate has centred around the mechanics of switch-off and the associated conditions and timescales. In the study, we give examples of positive practices in this respect from Estonia and Sweden, which have made significant progress towards switch-off. Measures are also under way in the UK to support the development of switching processes, which should help to facilitate customers moving to gigabit-capable platforms, where a choice of network is available.

However, international experience shows that, in addition to settling the procedural and regulatory questions, a common sense of direction amongst operators, and where necessary collaboration, will also be important. This is because a nationwide switch-off of the copper network will only be possible if all broadband service providers "buy in" to the new technology, once it is available, and play their part in facilitating the migration process, initially by encouraging customers to switch (or automatically switching them) and later by obliging them to migrate to the new technology, noting that the switch may be to a competitor network in some cases.

Co-investment or long-term pricing is one mechanism that could incentivise and enable broadband service providers to migrate their customers to gigabit infrastructures while providing flexibility over retail price-setting for gigabit technologies. France provides one example of a co-investment approach,[20] and this mechanism to bring all operators on the new fibre network will be an important enabler for the copper switch-off process that is due to begin in France in 2023, with a target completion date of 2030. In France, this mechanism was developed under a regulatory scheme, but in other countries including Italy, Spain and Portugal, co-investment measures have been agreed commercially

20 In areas where only one fibre network is considered viable, operators can purchase Indefeasible Rights of Use (IRUs) to slices of 5% of access lines, giving them the right to use those lines for period of 20 years or more in exchange for an upfront payment.

amongst various parties. Commercial wholesale offers for fibre have also been made at attractive rates by competing wholesale only providers in Sweden and Italy in order to foster migration to gigabit-capable networks.

Another challenge will be achieving full migration and copper switch-off in areas where only one gigabit network is viable[21] and where the new network has been deployed by an operator other than the incumbent or where there are competing new networks. The constraints in duplicating fibre networks in some areas have prompted incumbent operators to access or co-invest in alternative networks in all of the countries considered in this report,[22] and such strategies could be important in enabling a nationwide copper switch-off.

Experience from countries which are further progressed towards copper switch-off such as Sweden and Estonia also confirms that wireless broadband (and in future 5G Fixed Wireless Access) is likely to be important in enabling copper switch-off to a gigabit network in the most remote areas.

Ofcom and Government together with industry, could consider what role if any, could be played by co-investment, in the context of ongoing discussions on migration to fibre networks and switch-off of copper networks. Consideration is also needed, through industry dialogue supported by Government, of how migration to gigabit networks and switch-off of the copper network can be achieved in areas where fibre has been deployed by alternative investors or where there are competing networks. Government, together with Ofcom, could also consider whether any additional measures may be needed to support the deployment of 5G fixed wireless access, especially in the most remote areas. A holistic solution will be needed across the different operators and technologies present to achieve nationwide copper switch-off.

21 Experience from fibre deployments in France, Portugal, Spain and Sweden also shows that the majority of households are likely to fall within such areas. In France around 90% of households are considered to fall into this category, while in Spain the figure is around 65%. In Portugal two gigabit networks are present across a large portion of the country, but provision of additional services has been reliant to a large extent on infrastructure swaps.

22 Orange has co-invested in 5% slices in the networks of alternative operators and regional investors present in France. Deutsche Telekom is coinvesting with EWE, an energy utility active in deploying fibre networks, Telecom Italia has co-invested in fibre networks with the alternative operator Fastweb, although it has yet to negotiate an access arrangement with the largest supplier of fibre broadband infrastructure in Italy, Open Fiber and Telia makes use of the fibre networks of municipal fibre operators in Sweden.

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1 Introduction

The UK has nearly full coverage of superfast broadband at speeds of 30Mbit/s and above, predominantly via FTTC.[23] As of September 2019, more than 70% of broadband connections were provided on the basis of cable or FTTx technologies enabling at least superfast broadband speeds.[24] Operators have also made significant strides towards achieving wider coverage of full fibre and other gigabit capable networks. As of January 2020, full fibre broadband was available to more than 3.5m homes, an increase of a half a million in just over 3 months,[25] while around 4.3m premises could access a gigabit capable broadband network when other technologies such as cable are included.[26] This signals that momentum is building behind the Government's ambitious target to achieve full coverage of gigabit-capable infrastructure by 2025.[27] Strategies pursued by the Government to support the funding of rural gigabit-capable infrastructure,[28] and by Ofcom to foster infrastructure-based competition and provide incentives for fibre upgrades should provide further impetus for the deployment of gigabit-capable networks.[29]

However, the business case for full fibre and ambition to ultimately switch-off the copper network depends strongly on take-up of the new fibre infrastructure.[30] In this context, the UK faces a challenge that a significant proportion of customers are already using superfast services, and may consider these capabilities sufficient to meet their needs. Moreover, despite the fact that FTTC has been in place for some time, around 30% of consumers are still relying on basic broadband services. As fibre deployment accelerates, it will therefore be important to place emphasis on supporting demand specifically for gigabit-capable networks, to maintain momentum for deployment, as well as ensuring that UK consumers and businesses reap the full benefits of the services that can be provided via gigabit infrastructure.

The importance of investing in gigabit broadband for society and the economy has been further highlighted during this period of crisis. The lockdown imposed as a result of COVID-19 has required large swathes of the population to rely on remote working, eHealth and eLearning solutions, alongside cloud usage and video conferencing for

23 Coverage stood at more than 95% in January 2020
24 https://www.ofcom.org.uk/__data/assets/pdf_file/0020/190442/q3-2019-telecoms-data-update.pdf
25 Connected Nations Update: Spring 2020 https://www.ofcom.org.uk/__data/assets/pdf_file/0028/195256/connected-nations-spring-update-2020.pdf
26 https://www.ispreview.co.uk/index.php/2020/02/gigabit-broadband-speeds-available-to-14-3-of-uk-premises.html
27 Details of Government policy for building a nationwide gigabit-capable full fibre broadband infrastructure are available in the Jan 2020 House of Commons Briefing paper: full-fibre broadband in the UK https://commonslibrary.parliament.uk/research-briefings/cbp-8392/ These ambitions build on measures that were originally set out in the UK Government's 2018 Fixed Telecoms Infrastructure Review https://www.gov.uk/government/publications/future-telecoms-infrastructure-review
28 The Johnson Government has allocated £5bln to tackle the hardest to reach 20% of UK premises
29 Further proposals have been made in Ofcom's consultation for the Wholesale Fixed Telecoms Market Review, released in January 2020 https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review
30 The importance of the demand-side in supporting investment is also raised in the April 2020 study Delivering Gigabit Britain: Broadband for all https://www.assemblyresearch.co.uk/latest-news-items/gigabit-britain

business and social engagement.[31] There is the prospect that changes in working practices and delivery of public services could persist following the outbreak,[32] providing an opportunity for digital transformation to provide a route out of the deep recession which is likely to follow the outbreak. However, widespread availability and take-up of gigabit infrastructure will be needed to underpin these developments and ensure that no corner of the UK is left behind.

In this study, we describe barriers and initiatives to support gigabit broadband take-up that have been adopted in four European countries (France, Germany, Italy and Sweden) and discuss potential solutions that could be relevant to aid the UK in migrating to a fully gigabit-enabled society, in which digital innovation can thrive.

- Chapter 2 contrasts progress in the UK towards take-up of gigabit technologies with that of other countries in Europe and Asia
- In Chapter 3, we explore potential barriers to take-up in the UK and elsewhere
- In Chapter 4, we discuss potential solutions to foster take-up on both the demand side, and supply side, with reference to experience in the case study countries
- We conclude by identifying in chapter 5, solutions which may be most relevant to the UK

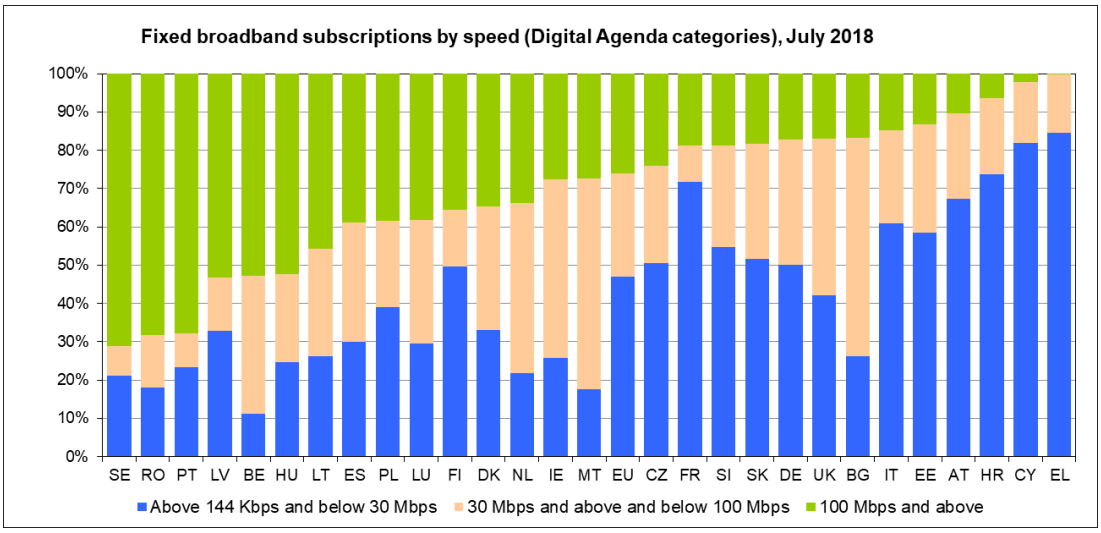
31 For example, a 2020 survey from EY suggests that as a result of the lockdowns imposed in connection with the coronavirus, 29% have used streaming TV services more often, 30% reported an increase in home working via collaboration applications, and 35% are making more mobile phone calls. https://www.computerweekly.com/news/252481133/Coronavirus-Video-calling-collaboration-applications-usage-rise-steeply-in-UK-homes

32 For example, in a survey conducted by Censuswide, 68% of respondents claimed they were equally or more productive working from home than in an office environment, and 28% considered that their employers might retain some flexible working practices, in the aftermath of the pandemic https://www.personneltoday.com/hr/remote-working-after-covid-19-coronavirus/

2 Take-up of gigabit-capable technologies

The UK has very high levels of broadband take-up at speeds of between 30-100Mbit/s. However, its take-up rate of services at higher speeds lies below that of many other European countries, with only 17% of connections at speeds of 100Mbit/s or above as of July 2018, compared with more than 70% in Sweden, one of Europe's gigabit broadband leaders.

Figure 2-1: Fixed broadband subscriptions by speed, July 2018

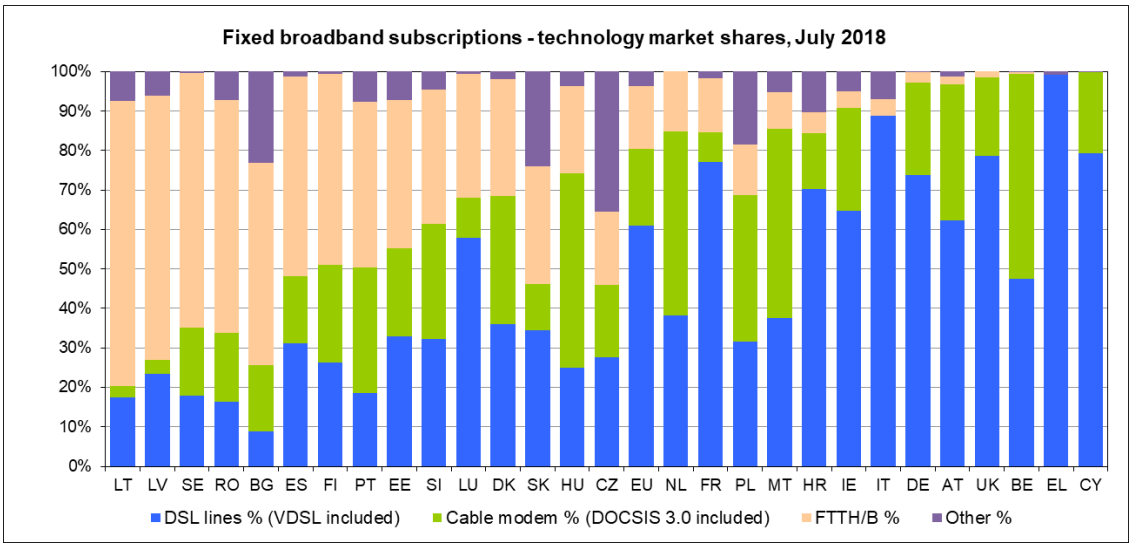


Source: EC Broadband indicators July 2018

The low share of higher bandwidths is reflected in the technology mix of broadband connections in the UK. Most of the higher speed subscriptions in the UK (at bandwidths of 100Mbit/s or above) are based on cable technology. As of September 2019 only 3% of subscriptions were based on FTTH/B.[33] This represents an increase from the 2% recorded for the UK in July 2018, but remains significantly lower than the FTTH/B take-up of 64% in Sweden and 51% in Spain, that were recorded at that time.

33 IDATE for the FTTH Council Europe https://www.ftthcouncil.eu/documents/FTTHB%20European%20Ranking%20September%202019.pdf?utm_source=NEW+FTTH+Council+Europe+Newsletter+List&utm_campaign=7a61cdc0eb-2+-+Market+Panorama+PR23%2F4%2F20+1%3A36+PM&utm_medium=email&utm_term=0_f3ba5d6e4b-7a61cdc0eb-68156969

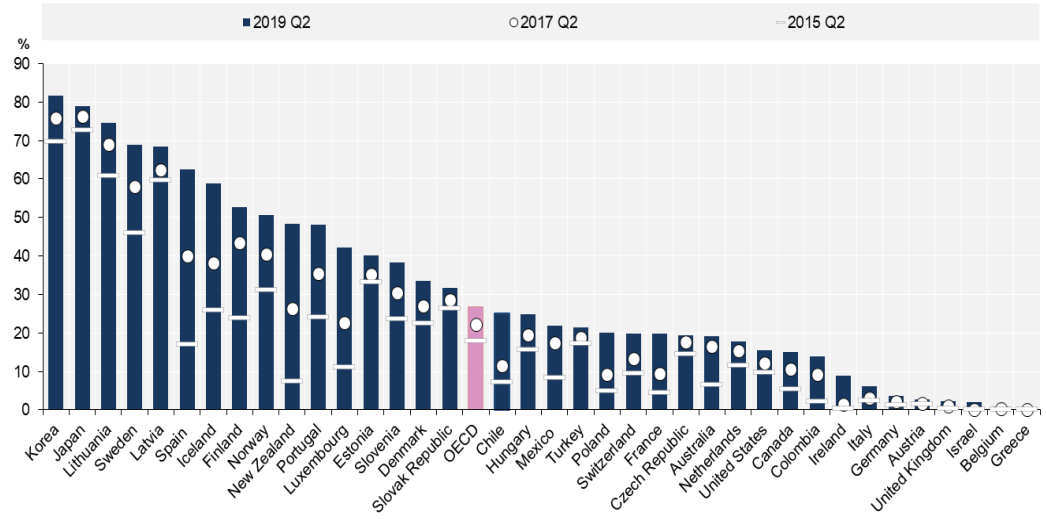
Figure 2-2: Fixed broadband subscriptions by technology, July 2018



Source: EC Broadband indicators July 2018

Looking globally, the relatively slow progress towards fibre take-up in the UK (inevitably constrained by limited availability of the technology) also contrasts with very high take-up levels in countries such as Korea and Japan (where around 80% of connections are based on fibre), and the expanding uptake of fibre in Australia and especially in New Zealand. While Australia increased their share of fibre connections in total broadband from 6.4% in mid-2015 to 19.25% in mid-2019, New Zealand increased their share from 7.5% to 48.44% within these four years.

Figure 2-3: Evolution in uptake of FTTH/B in OECD countries



Source: OECD

However, the overall picture of low fibre take-up in the UK conceals significant regional variations. For example in Hull, the incumbent KCom reported that 71% of broadband subscribers were taking a fibre-based product as of the end of March 2019 (an increase from 50% the previous year).[34] These high take-up levels may reflect the fact that, in contrast with the rest of the UK in which an FTTC strategy was pursued by the incumbent, KCom chose to pursue a strategy of moving directly to FTTH from ADSL, completing its FTTH deployment in 2019.

34 KCom annual financial statement 2018/19 https://www.kcomgroupltd.com/media/1473/rns-fy19-final.pdf

3 Key challenges to the take-up of gigabit broadband

In this chapter, we consider factors which influence consumers' and small businesses' incentives and willingness to upgrade, alongside challenges which could affect operators' incentives and ability to market gigabit services to existing and potential new customers.

There are interlinkages between these problems, as customers are more likely to upgrade to gigabit services if these services are effectively promoted by service providers.

The main challenges we consider are:

- Limited availability of gigabit broadband
- The presence of alternative technologies such as FTTC/VDSL which close the gap between the performance of basic broadband and gigabit services
- A lack of "killer applications"
- Limited willingness to pay
- Limited awareness of which technologies are being used to provide broadband and the different performance characteristics of each
- Lack of marketing of gigabit broadband by retail broadband service providers

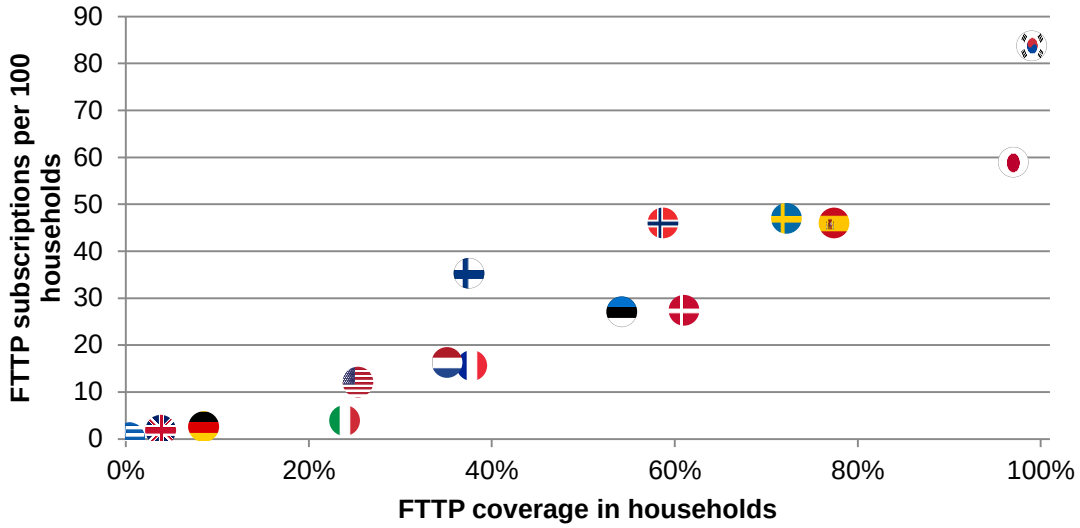
The challenges and underlying reasons are illustrated with reference to case studies included in the Annex to this report.

3.1 Limited availability of gigabit broadband

A key challenge in the uptake of full fibre broadband is the limited availability of fibre. As can be seen in the following figure, there is a strong link between FTTP coverage and the take-up of FTTP-based broadband services. However, FTTP coverage is not the only factor affecting take-up. For example, Finland, Norway and South Korea show take-up levels that are above what might be expected on the basis of the availability of fibre in those countries,[35] while take-up levels in Italy lie below the trend line.

35 Sweden also has take-up above the trend line when penetration as a proportion of the population is considered

Figure 3-1: FTTP coverage and take-up, 2018[36]



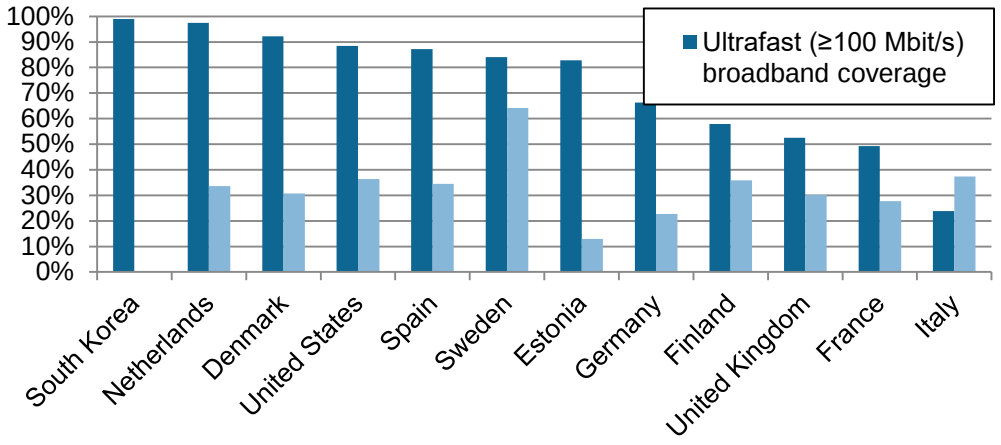
Source: WIK based on EU Commission, IHS Markit, OECD

An examination of coverage of technologies enabling ultrafast (cable and FTTH/B) broadband speeds compared with take-up of broadband at speeds of 100Mbit/s or more (see below) also illustrates that Sweden has achieved very high take-up levels in proportion to availability (76% of those households where ultrafast speeds are available subscriber to services at those speeds or above). However, it is also interesting to note that take-up of ultrafast broadband as a proportion of available connections are also relatively high in the UK (at around 57%) – suggesting that there is demand by consumers in the UK for bandwidths of 100Mbit/s or more. The same is true of France.[37] On the other hand, the data suggests that demand for higher speeds (of at least 100Mbit/s) is considerably more limited in Germany, as well as countries such as the US and Netherlands, where these bandwidths are widely available as a result of ubiquitous cable coverage, but are not used by a majority of broadband customers.

36 FTTP subscriptions also includes business subscriptions. The number of households also includes second residences, which may affect interpretation of the figures

37 Figures in Italy are misleading, since – unusually amongst the countries, FTTH or cable is not required for 100Mbit/s and these bandwidths are widely available through FTTC.

Figure 3-2: Ultrafast broadband coverage and penetration in %, 2018, 2017 for US, 2016 for KR.

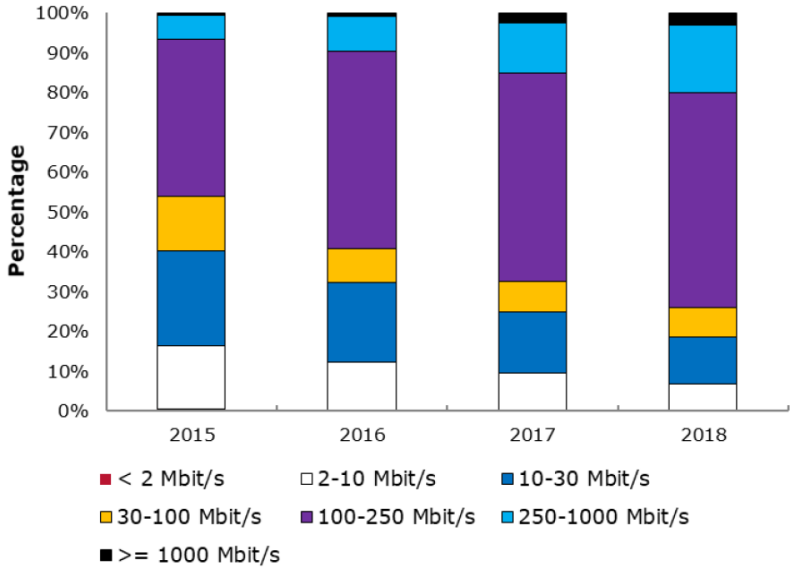


Source: WIK based on EU Commission, IHS Markit and FCC ; the value for the US is based on population, not households; no take-up available for KR

There is no standardised data on take-up of gigabit speeds that would allow us to compare the degree of demand for gigabit offers across different countries, but it can be presumed that demand is limited in most countries thus far. For example, in Sweden, although around 3m subscriptions to gigabit-capable fibre or cable networks were reported in 2018,[38] only 123,000 of connections were reported to be at speeds of 1Gbit/s or more (around 4%). However, growth in gigabit subscriptions in Sweden is strong (with a 28% increase from 2017-2018) and can be expected to expand in the coming years. Take-up of gigabit speeds is also likely to be linked to approaches to pricing, which are discussed in section 3.5.

38 https://www.pts.se/contentassets/70e598b7a817445cafae5b6f1e12eae9/swedish-telecoms-market-2018.pdf

Figure 3-3: Proportion of fixed broadband connections by speed in Sweden



Source: PTS

3.2 Availability of alternative technologies

One of the reasons behind low take-up of FTTH/B in some countries, including the UK, is likely to be the widespread availability of FTTC/VDSL technology. By increasing the performance of the legacy copper infrastructure, FTTC/VDSL could contribute to increased satisfaction with existing services and reduce the perceived need by consumers to upgrade to higher quality connections. A focus by the incumbent on upgrading copper infrastructure rather than deploying full fibre, also limits its incentives to promote full fibre offers to its retail and wholesale customers.

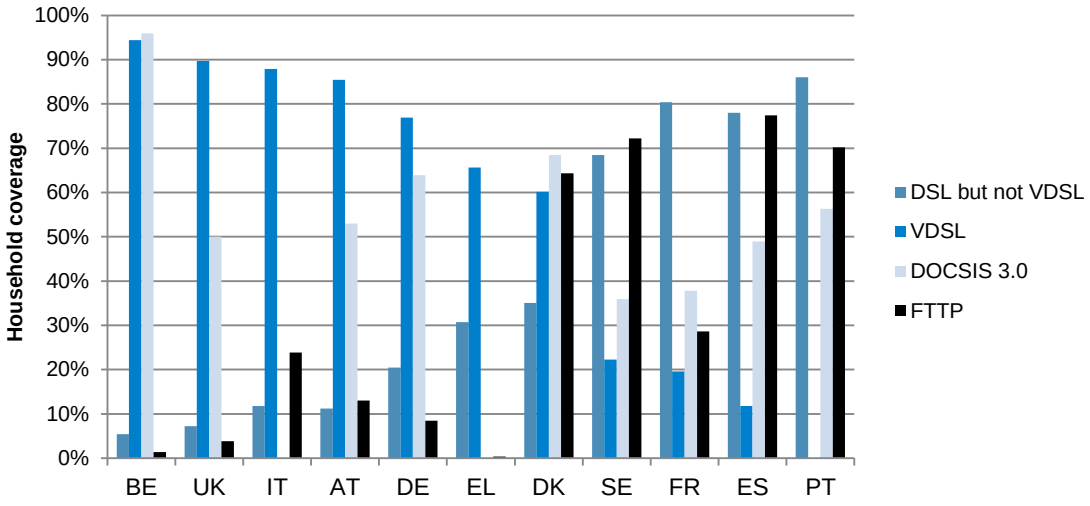
It is notable that in the countries with the highest levels of FTTH/B take-up, incumbents have generally focused solely or predominantly on FTTH/B deployment, without passing through FTTC/VDSL as an intermediate step.[39] This is also true of Hull. In these cases, consumers would have needed to upgrade directly to FTTH/B in order to experience a higher level of quality broadband than is available through ADSL connections, and may have done so, even if they did not require the ultrafast capabilities that fibre offers. Conversely, countries where FTTC/VDSL coverage is high, such as the UK, Belgium, Germany, Austria, Greece and Italy, have experienced more limited FTTH/B

39 Incumbents in Spain, France, Portugal, Japan and South Korea had an initial focus on FTTH/B. In Sweden, the incumbent switched its focus from FTTC/VDSL to FTTH/B in response to fibre deployment by municipalities.

deployment as well as lower take-up rates, as consumers may have found that their needs were satisfied by the incremental upgrades offered by this technology.[40]

Challenges in encouraging migration from FTTC to FTTH/B are magnified in countries, such as Italy and Germany, where high bandwidths of more than 100Mbit/s can readily be provided via FTTC/VDSL connections (in Italy due to short subloop lengths, and in Germany due to the deployment of FTTC/VDSL vectoring technology).

Figure 3-4: Broadband coverage by technology 2018, selected countries, ranked from highest to lowest coverage of VDSL



Source: EC broadband coverage in Europe 2018

A similar dynamic can be seen in the delays that the UK experienced in moving from narrowband to broadband Internet compared with some European countries in the early 2000s. As UK customers could benefit from flat-rate narrowband Internet access, this may have reduced incentives by customers to migrate to “always-on” broadband Internet access.[41]

3.3 Lack of killer applications

Interviews with operators in the UK as well as in countries such as France, which have experienced limited customer demand, suggest that a key factor underlying the lack of interest and willingness to pay for gigabit broadband, may be the absence of a “killer application” which would make fibre or other very high bandwidth connections worth the

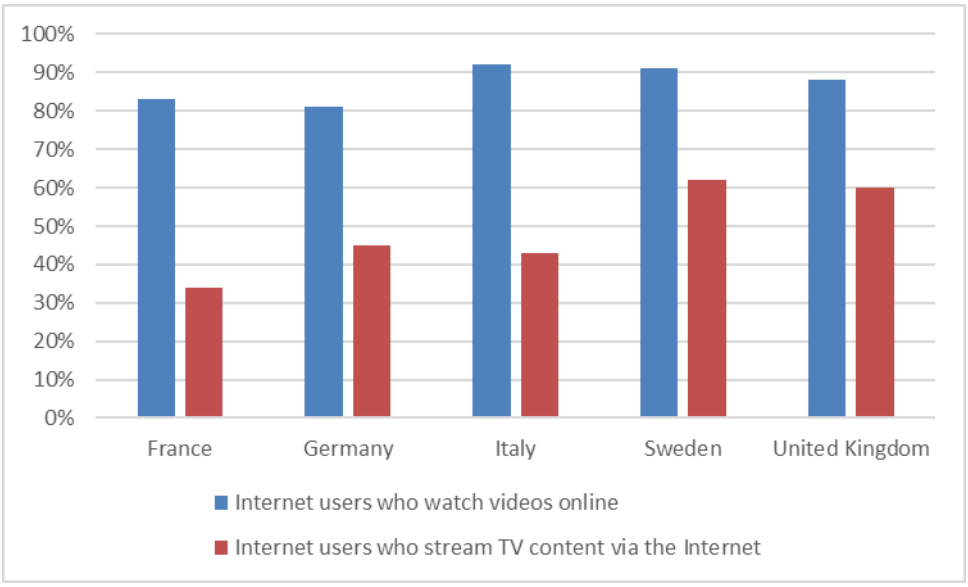
40 In France, FTTC/VDSL has been deployed mainly in rural areas as a means to improve available bandwidths to those with long loop lengths. It does not compete with FTTH/B, which is the predominant technology deployed in urban areas and in some rural areas (with the support of state aid).

41 UK Parliament Select Committee on Trade and Industry report https://publications.parliament.uk/pa/cm200304/cmselect/cmtrdind/321/32106.htm

additional cost or trouble that may be associated with switching. Examples of applications which might benefit from higher bandwidth connections, especially if used simultaneously within a household, include high definition video streaming and cloud usage. Future developments in video quality including 8K TV, and applications relying on alternative or virtual reality are also likely to require higher bandwidths and/or better-quality connections.[42]

Available data on the use of bandwidth intensive applications suggests that UK consumers are relatively advanced when it comes to demand for digital services. Indeed, on nearly all measures of demand for "bandwidth", including the use of streaming video (see following figure), the UK came close behind Sweden, a global leader in connectivity and digitisation. This could indicate that demand for higher bandwidth services could emerge in the UK, as higher quality video and new gaming and other applications come online. On the other hand, the data suggests that limited interest in streaming and other digital services could be a factor underlying limited demand for gigabit connectivity in France, and to a lesser extent Germany and Italy.

Figure 3-5: Percentage of Internet users watching videos or streaming content 2019

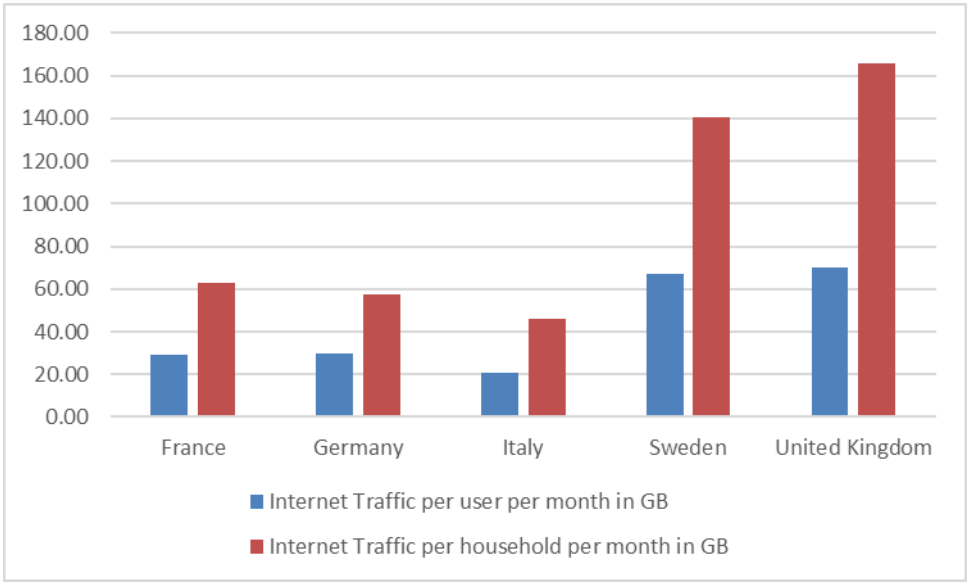


Source: WIK based on globalwebindex via datareportal

The intensity of Internet usage (and thus potential for demand for higher bandwidth connections) in both Sweden and the UK in contrast with the other countries studied can also be seen from data on traffic per user and household per month, as shown in the figure below.

42 See WIK (2018) Benefits of Ultrafast Broadband for further details https://www.ofcom.org.uk/__data/assets/pdf_file/0016/111481/WIK-Consult-report-The-Benefits-of-Ultrafast-Broadband-Deployment.pdf

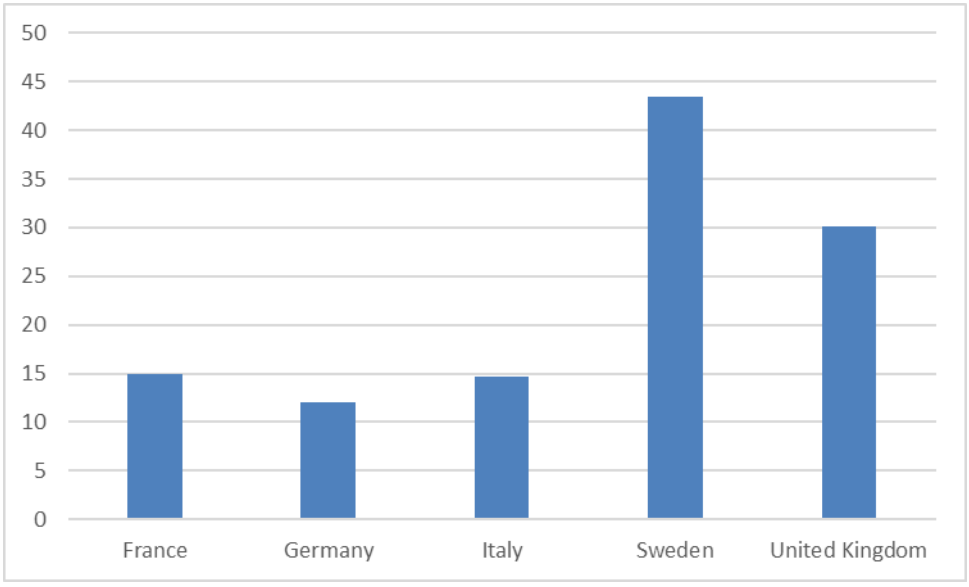
Figure 3-6: Internet traffic per user and household per month 2017



Source: WIK based on Cisco VNI

However, available metrics suggest that the UK is behind Sweden in the development and usage of other applications which could necessitate gigabit connectivity in the home and for small businesses. EU data suggests that while 43% of businesses in Sweden purchased cloud computing services in 2018, the figure for the UK was 30%. Even lower proportions are seen in the other studies countries which have experienced challenges in stimulating take-up of gigabit connectivity.

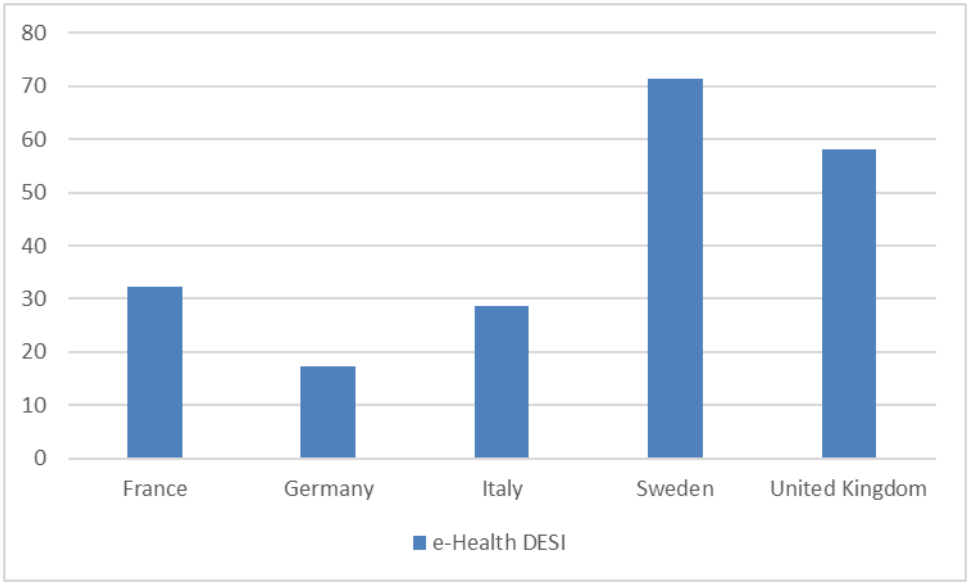
Figure 3-7: % Businesses purchasing cloud computing services 2018



Source: European Commission

Similar patterns can be seen in indices for the diffusion of eHealth and eGovernment, with Sweden taking a leading position according to the EU's DESI index, with the UK in second or third position out of the studied countries, and others falling further behind.

Figure 3-8: EU DESI index measuring diffusion of eHealth services 2018

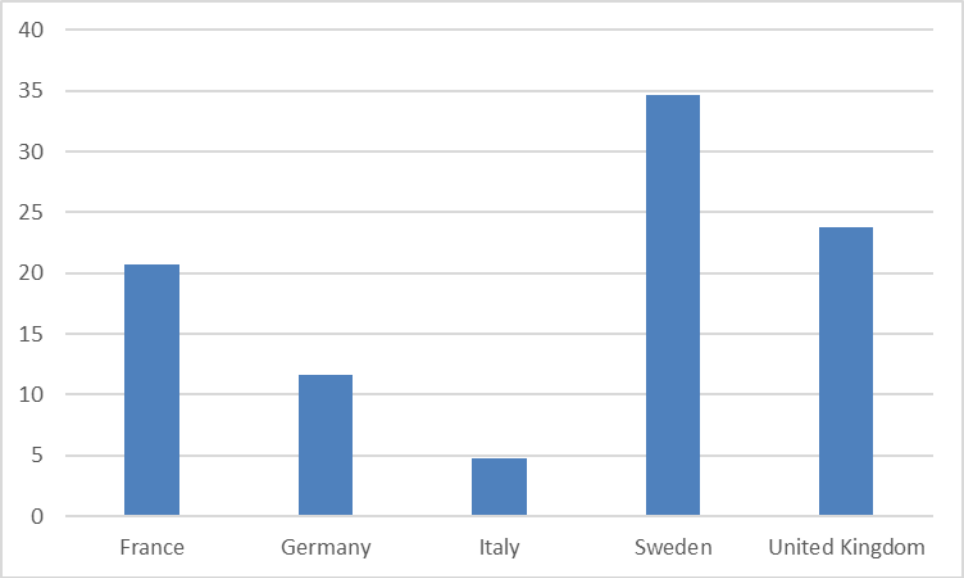


Source: EC Digital Economy and Society Index[43]

Sweden is also a leader in terms of the proportion of employed people, which work (usually or sometimes) from home. More than one third of Swedes worked in this way in 2018. Nearly a quarter of British quarters worked from home in this period (although ONS statistics report that just 5% of workers considered the home as their main place of work).[44] The prevalence of home working in France is similar to the UK, but reliance on home working is much more limited in Germany and Italy.

43 https://ec.europa.eu/digital-single-market/en/desi
44 https://www.businessleader.co.uk/how-many-people-in-the-uk-worked-from-home-prior-to-coronavirus-outbreak/81646/

Figure 3-9: Percentage of employed people working from home (usually or sometimes) 2018



Source: European Commission

Overall, data on broadband usage suggest that there could be potential demand in the UK for gigabit connectivity (similar to Sweden), and that there may be the prospect of further stimulating demand if home working expands and applications such as eHealth, remote learning and cloud usage amongst businesses develops further. These applications have been put to the test during the lockdowns imposed in March 2020 as a result of the coronavirus and could become more prevalent following the pandemic. Virgin Media reported that downstream broadband traffic increased by 90% following school closures while upstream traffic more than doubled.[45] Cloud providers have also reported massive increases in the use of cloud and remote working applications. For example, the CEO of Cloudreach reported a surge in the use of Microsoft Teams to record 44 million users daily, while Zoom increased daily users to over 200 million in March.[46] Market research groups anticipate that the COVID-19 experience will trigger increased reliance on cloud computing in the coming years.[47]

However, there is limited evidence that increased use of digital applications during the COVID-19 lock-down and its aftermath will by itself prompt increased demand (and in particular increased willingness to pay) for gigabit-capable broadband in the UK. Rather, a survey, conducted by Ernst & Young during the coronavirus lockdown,

45 https://www.independent.co.uk/life-style/gadgets-and-tech/news/coronavirus-uk-lockdown-internet-broadband-wifi-virgin-usage-traffic-data-a9424441.html
46 https://www.information-age.com/coronavirus-diary-the-effects-of-covid-19-on-the-cloud-industry-123489018/
47 https://www.marketsandmarkets.com/Market-Reports/covid-19-impact-on-cloud-computing-market-86614844.html

suggests that, notwithstanding additional use of broadband during this period, only 11% of British households saw a need to upgrade to full fibre broadband.[48]

3.4 Perceptions and understanding of the differences between technologies

Evidence from surveys in both the UK and elsewhere, suggests that one of the key factors that may be holding back demand for gigabit-capable technologies is a lack of understanding of the advantages offered by these technologies in comparison with other technologies which offer lower bandwidths and/or quality of service and/or have less capacity for upgrade.

Indeed, in a survey conducted for the UK's Advertising Standards Authority in 2017,[49] researchers found that:

- The term 'fibre' was not one of the priorities identified by participants when choosing a broadband package and was not considered a key differentiator.
- The word 'fibre' was not spontaneously identified within ads – it was not noticed by participants and did not act as a trigger for taking further action. It was seen as one of many buzzwords to describe modern, fast broadband.

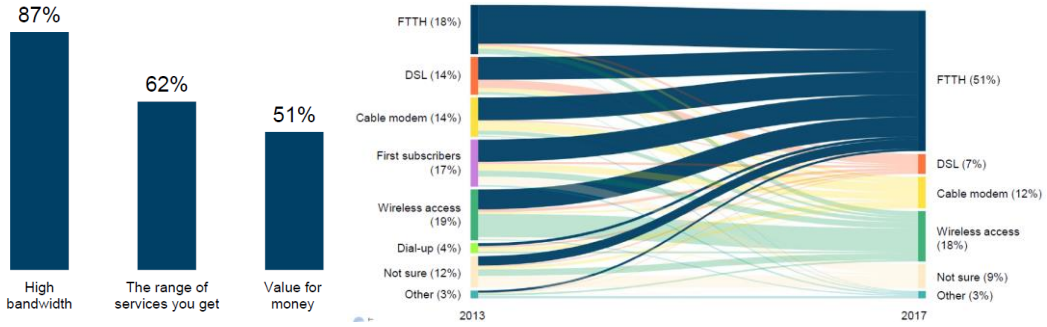
When the term "fibre" was explained, the consumers questioned in this survey did not believe they would change their previous purchasing decisions. This may suggest that there are significant barriers to be overcome in persuading customers to migrate.

However, there are indicators in this and other research, which suggest that benefits might become more apparent once customers experience broadband based on fibre or other gigabit technologies. For example, the survey for the ASA observes that the term "fibre" did provoke interest from the most knowledgeable heavy users, "who knew they needed it to get the speeds they required".[50] Moreover, research by Diffraction Analysis on experience of consumers using different technological solutions in Sweden suggests that consumers making use of fibre were more satisfied with their broadband connection than those using other technologies,[51] and that over time consumers were willing to pay more for their fibre connectivity. This mirrors findings from a 2017 survey[52] conducted by WIK-Consult of consumers in the Swedish market which

48 https://www.computerweekly.com/news/252481133/Coronavirus-Video-calling-collaboration-applications-usage-rise-steeply-in-UK-homes
49 Research for the ASA: Broadband fibre qualitative research 2017 https://www.asa.org.uk/uploads/assets/uploaded/d791272c-805a-495d-8e25650af1740ab7.pdf
50 Page 6 https://www.asa.org.uk/uploads/assets/uploaded/d791272c-805a-495d-8e25650af1740ab7.pdf
51 Felten, Benoit 2015. FTTH/B makes a real difference – Usage survey (Sweden). Diffraction Analysis. See also Arnold R, Kroon P, Taş S, Tenbrock S. 2018. The socio-economic impact of FTTH, WIK-Consult, Bad Honnef
52 https://www.wik.org/fileadmin/Vortraege/2018/IH_FTTH_Conference_PLENARY.pdf

highlighted that Swedes associate full fibre with high bandwidths and a greater range of services – as well as considering that it offers "value for money". This suggests that fibre may be a service for which actual experience of the service is needed to appreciate its value, which could explain why British consumers which have not had exposure to fibre, appear reluctant to switch.

Figure 3-10: Advantages of full fibre as perceived by Swedish consumers alongside their migration from other technologies to full fibre



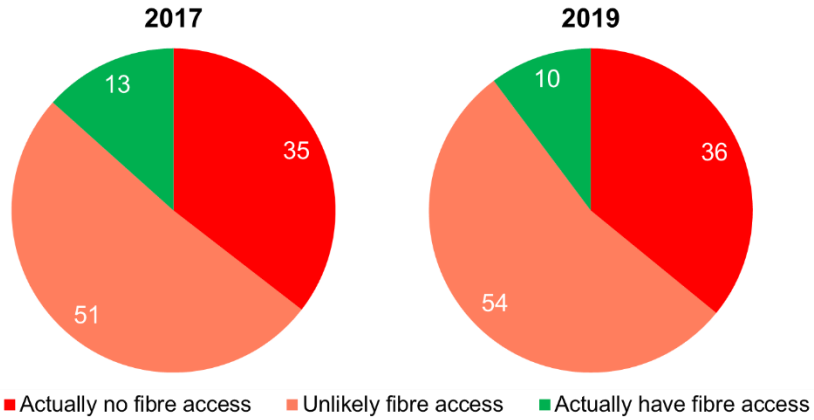
Advantages represent percentage share of the maximum available points in a ranking exercise.

Source: Representative consumer survey conducted on behalf of WIK-Consult (2017), N=347.

Moreover, it is not known whether the consumers addressed in the 2017 UK survey for the ASA had an accurate view of the technology they were currently receiving.

Representative online surveys conducted by WIK-Consult in the German market in 2017 and 2019 illustrate the confusion experienced by consumers about what is meant by "fibre", and whether they are currently benefiting from it. In both years, only around one in ten consumers who stated that they had a full fibre connection at home actually did given the cross-check for their ISP and the region they live in, while the fibre status for a further proportion of respondents was uncertain (see following figure).

Figure 3-11: Consumers in Germany thinking they are on a full fibre IAS (2017 and 2019)



N(2017) = 274 out of a total 4160; N(2019) = 214 out of a total 2750. This translates into a stated fibre penetration of 6.4% and 7.7% respectively when the actual penetration according to VATM was 2.4% and 4.3% respectively.

Source: WIK-Consult survey data

Similar findings were made in research conducted by Kantar Milward Brown in August 2018 for SIRO in the Irish market. Based on a nationally representative sample of 1,000 adults, the researchers found that over half of respondents were confused by the different uses of the term 'fibre' (e.g. 'fibre-powered', 'fibre broadband', '100% fibre' etc.) in marketing campaigns.[53]

This confusion means that consumers may not be aware of the benefits that could be obtained by switching to a full fibre solution, and therefore may decide not to switch.

3.5 Pricing and willingness to pay

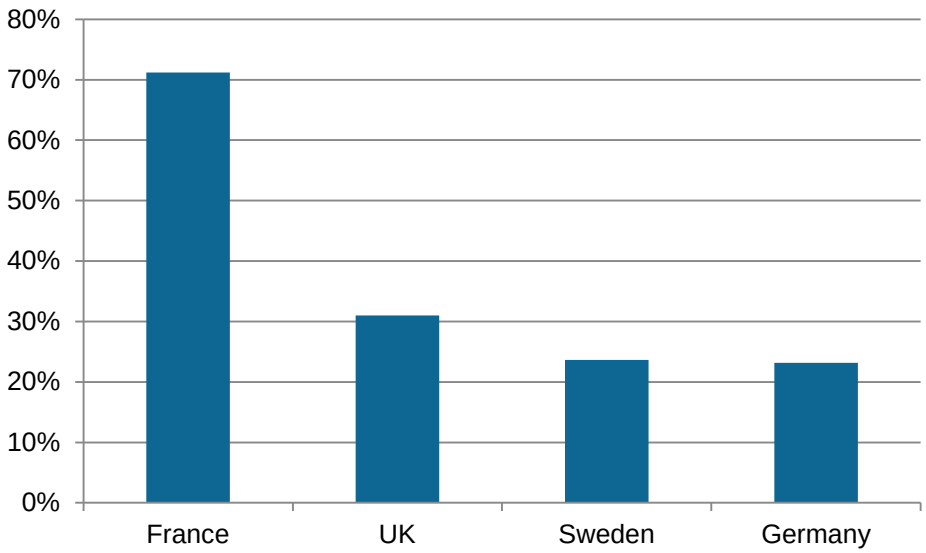
Another factor that could impede demand for full fibre, and gigabit connectivity more widely is the price differential between gigabit speeds and lower bandwidths. This may be a particular concern in cases where end-users make limited use of high bandwidth applications or, as may be the case in the UK, do not perceive any significant added value from upgrading their connection (see section 3.4).

A first observation is that the nature of Internet offers varies in the countries examined. Whereas triple (Internet, telephony and TV) and even quadruple play (also including mobile) bundled offers are very common in France, and account for around 30% of broadband subscriptions in the UK, they are less common in Germany (where double play packages prevail), and Sweden, where a significant proportion of households take

53 https://siro.ie/news-and-insights/siro-welcomes-new-asai-guidelines-relating-to-broadband-advertising/

an Internet only subscription and rely on mobile telephony and video streaming services to complete their offer.

Figure 3-12: Share of broadband subscriptions that include Internet, phone and TV services, 2018

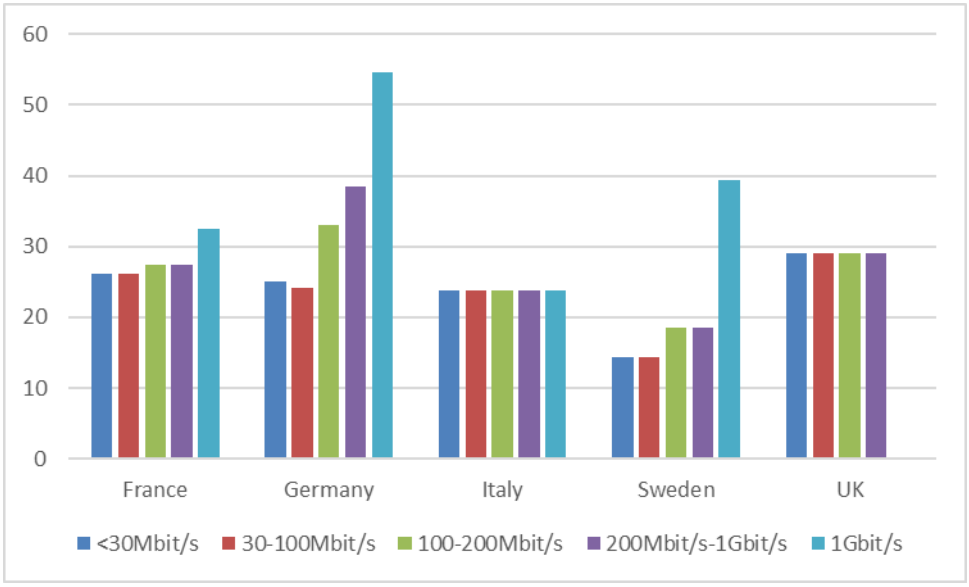


Source: National regulatory authorities[54]

Strategies around pricing differentials for different speeds also vary, with tiered pricing and substantial premia for gigabit broadband evident in Germany and Sweden, while the same or very similar prices are used across all bandwidths in France and Italy. At the time when data was collected, gigabit offers were not widely available in the UK, but there is evidence of a tiered pricing strategy – at least regarding triple play offers.

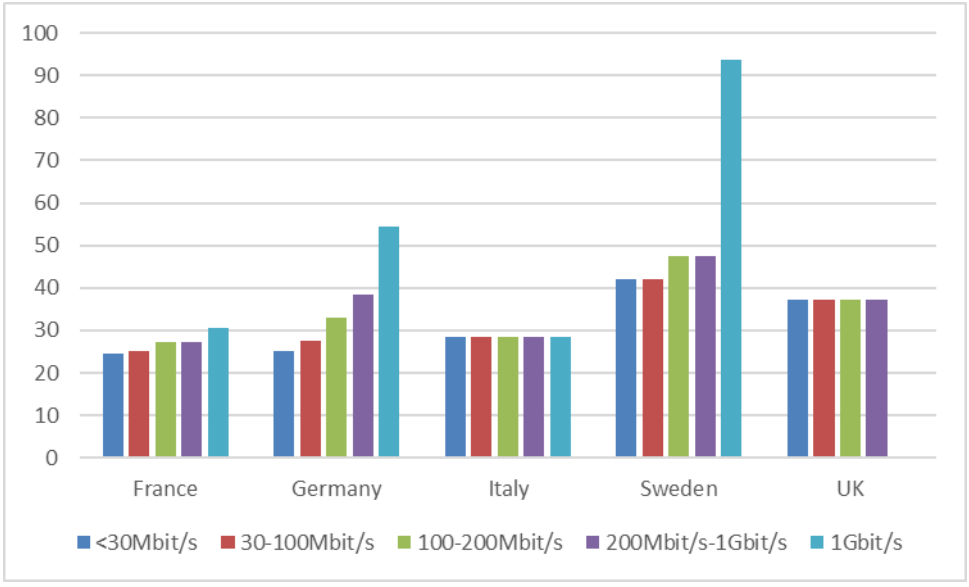
54 For Italy, the regulator did not publish this information.

Figure 3-13: Lowest price by bandwidth € per month, Internet access only 2018



Source: EC Fixed broadband prices in Europe 2018[55]

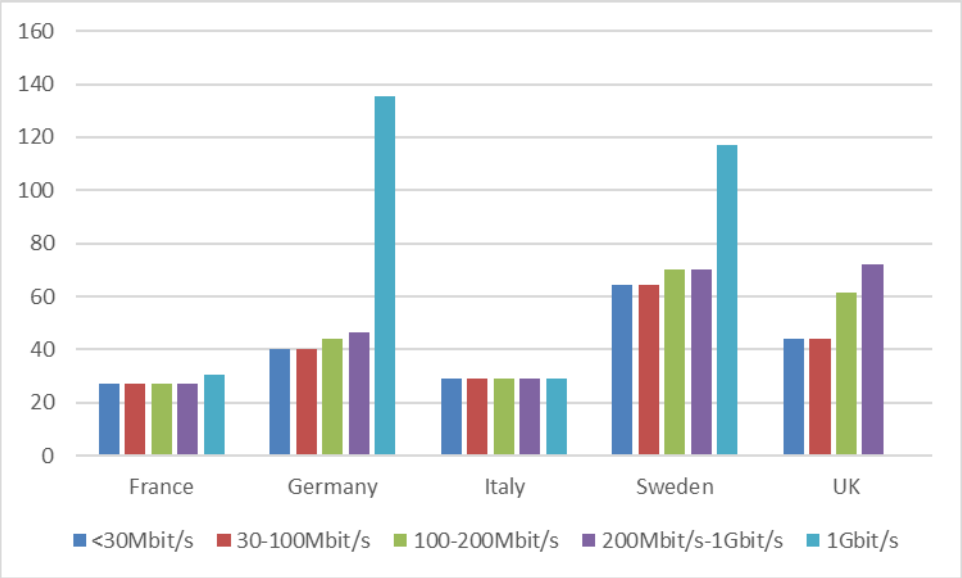
Figure 3-14: Lowest price by bandwidth € per month, Internet + telephony 2018



Source: EC Fixed broadband prices in Europe 2018[56]

55 https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=62757
56 https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=62757

Figure 3-15: Lowest price by bandwidth € per month, Internet + telephony + TV 2018



Source: EC Fixed broadband prices in Europe 2018[57]

A closer analysis of current offers in the countries examined coupled with insights from interviews, confirms that:

- In France, no premia are charged for higher bandwidths as a strategy to encourage migration. Marketing tends to focus on service (content) bundles and technology (fibre vs ADSL/VDSL2 (the latter in rural areas)) rather than bandwidth.
- In Italy, the focus is also on the technology used to deliver the service. The customer is offered the highest performing technological solution that is available at their house for a fixed price, which is generally the same for all technologies, incentivising uptake of the most advanced technology provided by the operator concerned. The generally low and identical prices for different technologies reflect limited willingness to pay for higher performing connections.
- Marketing in Sweden focuses on both technology and bandwidth. The pricing distinction between ADSL and higher speed connections is limited, with some evidence that pricing for ADSL-based connections has increased in recent years to approach that of entry-level offers on fibre technologies, as a strategy to support migration. 100Mbit/s is a standard entry-level broadband offer. A price premium is sometimes charged for services at bandwidths of 1Gbit/s or more, but gigabit offers can also be obtained at low prices in apartment buildings

57 https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=62757

served with fibre. Although prices charged for double and triple play offers in Sweden lie above those of the other countries considered, standalone Internet is a popular option – and is reasonably priced, with gigabit offers available for less than €40 per month. Rather than internally distributing all costs of network expansion e.g. to unserved homes, the incumbent markets new fibre connections at an upfront cost of €1,500-€2,000. The cost of new fibre connections can also be distributed over time, with monthly contributions added to the price of the broadband service provision.

- In Germany, marketing focuses on bandwidth as well as technology. Prices for ADSL and entry level FTTC/VDSL-based offers are similar to incentivise migration. Slightly higher prices have been charged for higher speeds (often provided through FTTC/VDSL vectoring or cable), with a more significant premium for gigabit offers.

- In contrast with Sweden, France and Italy, marketing of broadband in the UK is based mostly on speed and associated terminology (e.g. superfast, lightning) rather than technology. The term fibre is widely used in offer descriptions for various technologies and therefore does not itself allow for distinctions to be made between offers. Pricing for headline products is often tiered based on speed and the composition of the bundle, but promotions are common.

These pricing strategies alongside take-up of higher bandwidth connections give insights into the willingness of consumers to pay in the countries considered. Whereas there is a clear willingness to pay for fibre-based broadband (including new connections) in Sweden, this is not present in France and Italy, and may also not be present in Germany in areas where alternative solutions such as FTTC/VDSL vectoring and cable are available, although there is evidence of higher levels of demand for and take-up of FTTH in rural areas, where copper networks have not been upgraded.

As gigabit offers are not widely available in the UK, there is no direct evidence of willingness to pay for such offers. The fact that UK consumers are not aware of the advantages of fibre-based offers (see section 3.4), and that many consumers have yet to switch to superfast broadband, even where it is available, could signal however, that they would be unlikely to pay significantly more for broadband based on gigabit technology than they already pay for superfast broadband.

3.6 Lack of migration incentives for service providers

One of the main mechanisms by which take-up of gigabit technologies can be increased, is if existing providers of retail broadband services, automatically upgrade or promote these services to their customers. There has for example been a pattern of

automatic upgrades of broadband speeds by cable operators in some countries, as evidenced also in the UK .[58]

However, for this mechanism to operate effectively, broadband service providers must have widespread access to and be “invested” in the new technology in order to have incentives to migrate and/or market it to customers.

Challenges in achieving migration can occur when not all providers have bought into the new technology. For example, incumbents may lack an incentive to deploy or seek access to other investors’ fibre networks if they have invested in upgrading the legacy network. This may have hampered take-up on fibre networks in Italy, where the incumbent maintains a parallel FTTC network to the alternative Open Fiber network, which has deployed the largest number of full fibre lines.

As seen in Germany, access seekers could also be reluctant to market fibre-based products if they have made upfront payments linked to upgrades to the legacy network. Specifically, access to Deutsche Telekom’s FTTC/VDSL network is primarily based on a “risk sharing” model (contingent model), originally approved by BNetzA in 2012, which provides long-term discounts for operators prepared to make an upfront commitment. DT concluded similar commercial agreements with Vodafone, Telefónica and 1&1. The contingent model led to a marketing offensive in VDSL connections by competitors, which has been reflected in significantly increasing VDSL customer numbers.

However, the long-term nature of the agreement and volume discounts may have contributed to a continued reliance by alternative operators on FTTC/VDSL technology rather than seeking alternatives where these are available (such as wholesale access on the networks of local FTTH providers).

Even in the absence of long-term discounts, access seekers might also be deterred from marketing fibre-based services if the wholesale access terms for copper-based services provide a higher profit margin than those which could be achieved by switching to wholesale fibre access.

3.7 Switching reluctance by end-users

Even in cases where operators are keen to upgrade customers, there can be a reluctance on the part of customers themselves to accept the disruption associated with FTTH installation. For example, operators in France report a reluctance by customers to allow technicians to enter their house to install CPE associated with the fibre upgrade. Customer reluctance towards switching was also reported by operators in Germany,

58 For example Virgin Media recently announced a free upgrade for 1m customers to bandwidths of more than 100Mbit/s https://www.virginmedia.com/corporate/media-centre/press-releases/virgin-media-starts-2020-with-a-broadband-bang-as-more-than-a-million-customers-get-a-free-ultrafast-speed-boost. There is further discussion of these trends in the Ofcom draft Wholesale Fixed Telecoms Market Review

Poland, the UK and Sweden (amongst certain customer groups), in the context of interviews conducted by WIK in 2018 for a report on copper switch-off.[59]

Businesses can be even more reluctant than residential consumers to switch to fibre-based services as some legacy systems, including alarms and PABXs may rely on analogue systems. This challenge is linked to the migration from PSTN to all-IP, which is a prerequisite for the provision of fibre-based services.

Switching challenges associated with legacy equipment, were reported by operators[60] in France, Poland, Portugal, the UK and even Sweden – where some safety and monitoring systems (e.g. in relation to dams) rely on legacy technologies.

59 https://www.wik.org/index.php?id=1097&L=1
60 2018 interviews conducted by WIK-Consult for the study: Copper switch-off, a European benchmark https://www.wik.org/index.php?id=1097&L=1

4 Solutions

In this chapter, we explore potential solutions to the challenges impeding take-up of gigabit broadband, with reference to international experience. Solutions can be distinguished between those which aim to inform and encourage end-users to upgrade to gigabit broadband and those which support operator-driven migration towards higher bandwidth technologies, culminating in the switch-off of the legacy copper network.

4.1 Providing incentives for end-users to migrate to gigabit services

Solutions that have been used to stimulate migration by end-users to gigabit broadband include retail pricing strategies by ISPs, measures by regulators and authorities to inform customers about the distinctions between modern and legacy broadband technologies, measures to foster the use of digital applications which benefit from higher capacity connections, and subsidies for connections and/or monthly rental. Examples from the case studies are shown below.

4.1.1 Retail pricing strategies

A summary of retail pricing strategies is shown in the following table for the countries where gigabit broadband is widely available.

Table 4-1: Summary of retail and wholesale pricing practices for full fibre/gigabit broadband

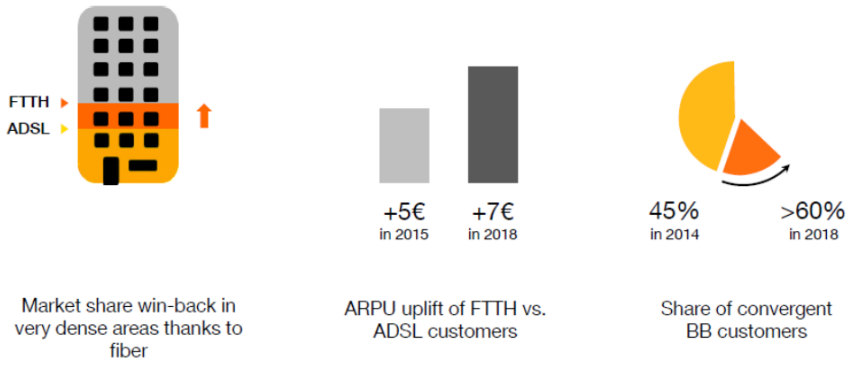
	Retail pricing for rental	**New fibre connections**	**Wholesale pricing**
France	Same pricing for FTTH/ADSL (c€30) Focus on increased value through upselling triple/quad play bundles	N/A	Co-investment in fibre (in slices of 5% lines paid mostly in advance) supports retail pricing flexibility
Sweden	ADSL prices have increased to match entry level (fibre-based) 100Mbit/s product. Higher charges for gigabit broadband	Can be ordered directly from incumbent (bundled with or independent from broadband rental) at €1,500-€2,000 or 30 per month	Competition from municipal wholesale only providers keeps fibre wholesale prices competitive with copper
Italy	Same price for rental (c €30) regardless of technology e.g. FTTH, FTTC, wireless – highest quality technology available in location is used	N/A	Competition from utility wholesale only provider (Open Fiber) keeps fibre wholesale prices competitive with copper

A common strategy used to encourage migration towards gigabit-capable technologies is to charge the same price (temporarily or permanently) for services offered over the legacy and new technology. Different approaches have been taken to this end in the

countries studied, influenced by willingness to pay for fibre-based services. This would need to be underpinned by wholesale pricing.

In France, where willingness to pay for gigabit broadband is limited, the same low retail prices (around €30 per month for a triple play offer) are charged for gigabit fibre as for copper-based services, but prices may be increased following an initial 12-24 month period. Operators such as Orange also report that customers purchasing fibre-based connections make more use of bundled offers, which can contribute to increased ARPU (see following figure). KCom in Hull also reported increased ARPU levels linked to higher take-up of full fibre, with an increase of 2% in ARPU during a year when take-up of fibre increased from 50-70% of its broadband connections.[61]

Figure 4-1: Impact of FTTH on ARPU and take-up of bundled offers



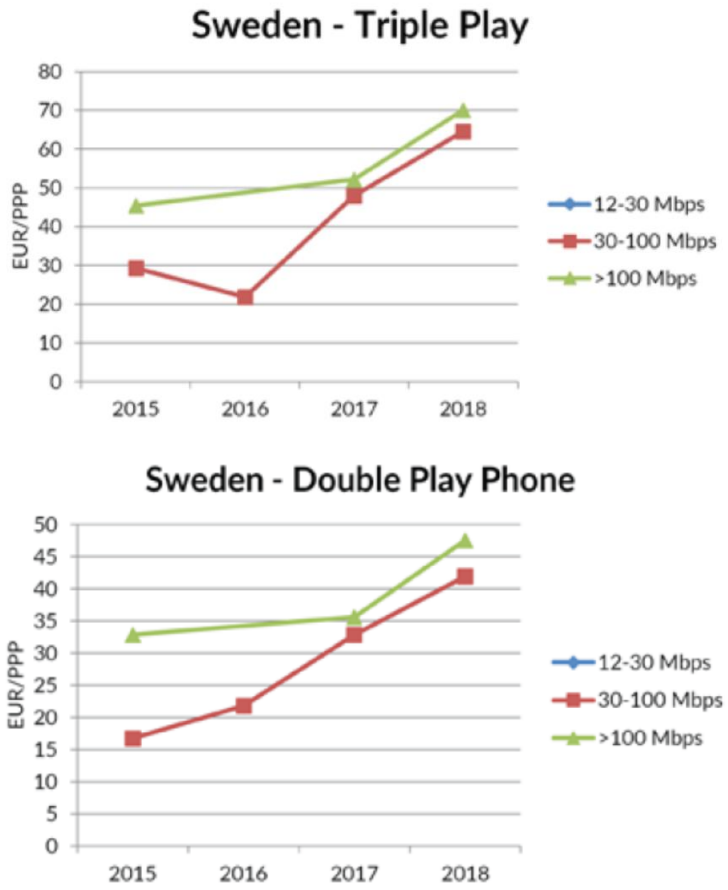
Source: Orange France investor statements

Operators in Italy also charge the same low (<€30 per month) price for broadband for all technologies and install the most performant technology available at the customers' location.

In Sweden, prices for legacy copper-based services have increased in recent years and now lie at the same (higher) level as those charged for the "entry-level" fibre-based product at 100Mbit/s.

61 2018/19 KCom annual report https://www.kcomgroupltd.com/media/1473/rns-fy19-final.pdf

Figure 4-2: Prices for triple and double play bundles in Sweden over time[62]



For those not able to pay the upfront cost of €1,500-€2,000 to install a new fibre line (where one is not already available), the incumbent Telia offers the option for customers to pay in monthly instalments of around €30 per month.[63]

These retail pricing strategies (of low pricing for fibre – at least at the initial phase in deployment) have been underpinned by wholesale pricing and co-investment strategies that facilitate equal charges at retail level for copper and fibre or provide flexibility over how operators charge over time. For example, in Italy and Sweden, the majority of fibre connections are provided not via the incumbent but through alternative wholesale only providers (Open Fiber in Italy and municipal operators in Sweden), which are not regulated, but have an incentive to charge wholesale rates which are comparable to or lower than copper in order to encourage service providers (and end-users) to switch to fibre. Meanwhile in France, the option of wholesale access based on co-investment, which entails an upfront fee amounting to around €500 per line for a right of use of 20 or more years and a smaller rental fee (e.g. of around €5), provides flexibility for service

62 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

63 https://www.telia.se/privat/bredband/fiber/villa/pris?intcmp=villastart_erbjudanden

providers to pursue dynamic pricing policies, starting from a low level with the potential to increase charges over time.

4.1.2 Advertising and awareness

A summary of advertising practices for full fibre and/or gigabit broadband is shown in the following table.

Table 4-2: Summary of advertising practices for full fibre/gigabit broadband

	Marketing strategy	**Applicable regulations**
France	Fibre and ADSL are clearly distinguished in advertising. Cable offers refer to “very high bandwidths”. Content/set-top boxes and mobile also used to distinguish offers	2016 Government Decree limits references to fibre in advertising to full fibre (including in-house wiring), requires upload speeds to be advertised wherever download speeds are advertised
Sweden	Fixed, ADSL and wireless solutions are clearly distinguished in advertising.	None
Italy	Operators tend to advertise only their highest quality offer e.g. fibre even if it is not widely available, to avoid highlighting offers that would attract a yellow or red label	2018 Decision by telecom regulatory authority to require “traffic light” labels on broadband advertising. Green=fibre, yellow=part fibre, red=copper/ low bandwidth wireless.
UK	Advertising based primarily on speed and speed-related slogans. As fibre is commonly used in advertising, it is not a distinguishing feature	ASA rules governing accuracy of reporting of speeds, but not references to technology

A feature that is common to the countries in which FTTH deployment is more advanced is that operators distinguish offers on the basis of technologies, often making explicit reference to fibre, ADSL or wireless connectivity, as a means of highlighting to customers the distinction between the quality of different offers. Most operators in Sweden have made this distinction on a voluntary basis. However, in Italy and France, the authorities have intervened to establish rules around the marketing of broadband offers, to provide clarity for customers and prevent customers from being misled around the technologies used to provide their service. A particular concern in these cases, as well as in other countries such as Ireland, has been to ensure that the term “fibre” is reserved for full fibre deployments.

In 2016, the French Government adopted a decree to limit the circumstances in which "fibre" may be used in advertising to FTTH (including fibre for the in-building wiring) and required the indication of upload speeds in addition to download speeds. [64] The decree followed legal proceedings brought by Iliad against SFR/Numericable on the grounds that the merged entity had advertised services which were partly based upon cable infrastructure as "fibre". As a consequence, operators in the French market now

64 https://www.arcep.fr/actualites/les-communiques-de-presse/detail/n/larcep-se-felicite-de-ladoption-de-larrete-fibre-et-de-la-prise-en-compte-par-le-gouvernement.html

distinguish clearly between “fibre” and “ADSL” offers, while cable offers are marketed as "very high bandwidth" without explicit reference to fibre.

In 2018, the Italian regulator AGCOM implemented a mandatory traffic light labelling system for advertising broadband products. For fixed networks, ADSL offers are marked in red with an R (for rame, Italian for copper), FTTC offers are marked in yellow with an FR (for Misto fibra-rame, Italian for mixed fibre-copper) and FTTB/H offers are marked in green with an F for fibra. Only FTTB/H based-services are allowed to be advertised as fibra/fibre.[65] Cable is not present in the Italian market.

Figure 4-3: Traffic light system for advertising broadband in Italy[66]

The green traffic light marked with an “F” can be seen in the advertising of Fastweb (see illustration below):

65 https://www.consumatori.it/telefonia/bollini-agcom-internet/
66 Agcom (2018): Allegato C alla delibera n. 292/18/CONS

Figure 4-4: FTTB/H advertising by Fastweb[67]

Although like labelling for energy efficiency, the traffic light system should alert customers to the general performance characteristics of the services they are buying, it has had some unintended consequences on the marketing conduct of operators.

In order to highlight their best offer (associated with a green traffic light), Italian service providers typically only advertise their FTTB/H offers, even though FTTH/B is not widely available from the incumbent,[68] and the deployment of the fibre network of the alternative investor Open Fiber (marketed via alternative operators) is not yet complete.[69]

Although users are redirected to the technology that is available to them (often FTTC), as a result of the marketing strategy, it is possible that some users may nonetheless believe that they subscribed to a full fibre subscription. This could negate or even undermine the effect of the labelling system.

As a result, some Italian stakeholders have called for advertising to reflect the actual availability of technologies, and for colour labels to be clearly included on the contracts that customers sign before they can receive their service.

Attention in Italy and France has focused on the challenges that might be posed to take-up as a result of perceived "misleading" advertising. However, pre-marketing and advertising has also been used to positive effect to support take-up of gigabit broadband technologies. Examples of these strategies can be seen in rural areas of Germany and France, where specialist operators engaging in pre-marketing prior to the

67 https://www.fastweb.it/adsl-fibra-ottica/fastweb-casa/
68 At the start of 2018, Flash Fiber, the JV leading the fibre deployment for the Italian incumbent TI (together with Fastweb) had connected 430,000 addresses, and by mid-2018, the company reported that it had completed half its planned network development https://www.flashfiber.it/en/2018/07/19/coverage-progress/
69 Open Fiber, reached 8m premises with fibre, by the end of 2019.

deployment of fibre infrastructure have achieved take-up rates on their infrastructure of 60% or more. These take-up rates are often higher than those that have been achieved by traditional operators, which have not deployed localised advertising strategies to such good effect, or have faced more intense competition from services based on upgraded copper networks in the areas they are aiming to serve.

4.1.3 Vouchers

A summary of the voucher programmes is provided in the following table

Table 4-3: Summary of voucher programmes

	Voucher programme	**Description**
Germany	Gigabit premium until end 2020	Companies/non-profit and cultural institution can obtain subsidy of up to 25% of construction costs for fibre connection
France	Digital Cohesion of Territories programme	€100m subsidies available from 2019 to provide vouchers for households and businesses that do not have access to at least 30Mbit/s speeds and are not expected to be connected with high speed broadband by 2020. Vouchers of up to €150 to install wireless solutions
Greece	Superfast Broadband project	€50m subsidies to cover connection fee of €48 and recurring costs of €13 for max 24 months. Vouchers eligible for single or multi-play services including Internet of at least 100Mbit/s based on gigabit-capable infrastructure
Italy	Voucher scheme for schools	€400m fund announced in May 2020 with aim to equip >32,000 buildings (>80% schools) with fibre within next 2 years. €500 vouchers to qualifying low-income families to install broadband and acquire IT equipment for children
UK	Gigabit Broadband Voucher Scheme Rural Gigabit Connectivity programme	£68.5m subsidies available, up to £2,500 to support business connection to gigabit-capable broadband (speed at least 100Mbit/s). Up to 10 homes may join with the business connection application to receive £500 subsidies each. Funds fully allocated in May 2020. New voucher introduced in May 2019 drawing funding from £200m RGC programme to provide subsidies for connections in rural areas. Up to £3,500 for small businesses and £1,500 for residential. A total of 24,127 premises connected under both schemes with 16,087 in the pipeline[70]

In order to address challenges in willingness and ability pay, many Governments in Europe have introduced or are planning voucher schemes to subsidise very high capacity connections for both businesses and consumers.

The UK's Gigabit Broadband Voucher Scheme has used funding from two programmes (Local Full Fibre Networks and Rural Gigabit Connectivity) to support the cost of new gigabit connections. The Rural Gigabit Connectivity programme targets rural

70 https://www.ispreview.co.uk/index.php/2020/05/governments-uk-gigabit-broadband-voucher-scheme-ends-today.html

communities with potential subsidies of up to £3,500 for gigabit-capable connectivity for small businesses and £1,500 for households. The original LFFN funded gigabit vouchers apply more widely to support the cost of installing gigabit-connections to businesses with subsidies of up to £2,500. Up to 10 homes may also join an application to connect a business and receive subsidies of £500 each. Demand for both vouchers has been high, with nearly 25,000 premises connected. The funds for the LFFN funded vouchers were exhausted in May 2020, well before the expiry of the programme, which was due in 2021.

Some of the other countries studied offer similar programmes focused on the cost of installing connections.

For example, in the German state of Saarland (about 1 million inhabitants) the state is offering until the end of 2020 a “gigabit premium”, under which companies and sponsors of non-profit or cultural institutions can obtain a subsidy of up to 25% of the construction costs for a fibre connection. The gigabit bonus is targeted at users with high bandwidth requirements, regardless of their current bandwidth and location. A practical guide is available for interested high demand users.[71]

In 2019 Italy started working on a possible broadband voucher programme. Small and medium-sized businesses would be able to receive a 3.000 € subsidy for migrating to a fibre-based connection, while schools can receive 5.000 € for doing so.[72] In May 2020, the Italian Government announced that it would set aside €400m to equip more than 80% of schools with gigabit connectivity and provide €500 vouchers to qualifying low-income families to install broadband and acquire IT equipment for children.

Vouchers have also been used in France to support wireless connectivity to unserved households. Under the French "Digital Cohesion of Territories" programme up to 100 million euros of subsidies were made available from 2019 for provision of vouchers to households and businesses that currently do not have access to at least 30 Mbps download speeds and that are not expected to be connected to a high-speed broadband network by 2020. Eligible individuals and businesses can receive financial support of up to €150 for the cost of equipping and installing the chosen wireless solution.[73]

A voucher system has also been introduced in the context of state aid in Greece to provide support for residential and business customers to purchase ultrafast broadband. Unusually, this scheme covers rental fees as well as connection charges. Under Greece’s “superfast broadband project”, €50m has been made available to provide vouchers which would cover a one-off connection fee of €48 and recurring broadband costs of €13 for a maximum of 24 months. The voucher can be redeemed for purchase of “SFBB” services from a published approved list of offers. Eligible superfast broadband services can be standalone or multi-play, but must offer Internet access with

71 See https://www.saarland.de/gigabitpraemie.htm
72 https://www.commsupdate.com/articles/2019/04/12/more-details-on-italian-broadband-voucher-scheme/
73 https://www.economie.gouv.fr/particuliers/cohesion-numerique-territoires-aide-linstallation-haut-debit and

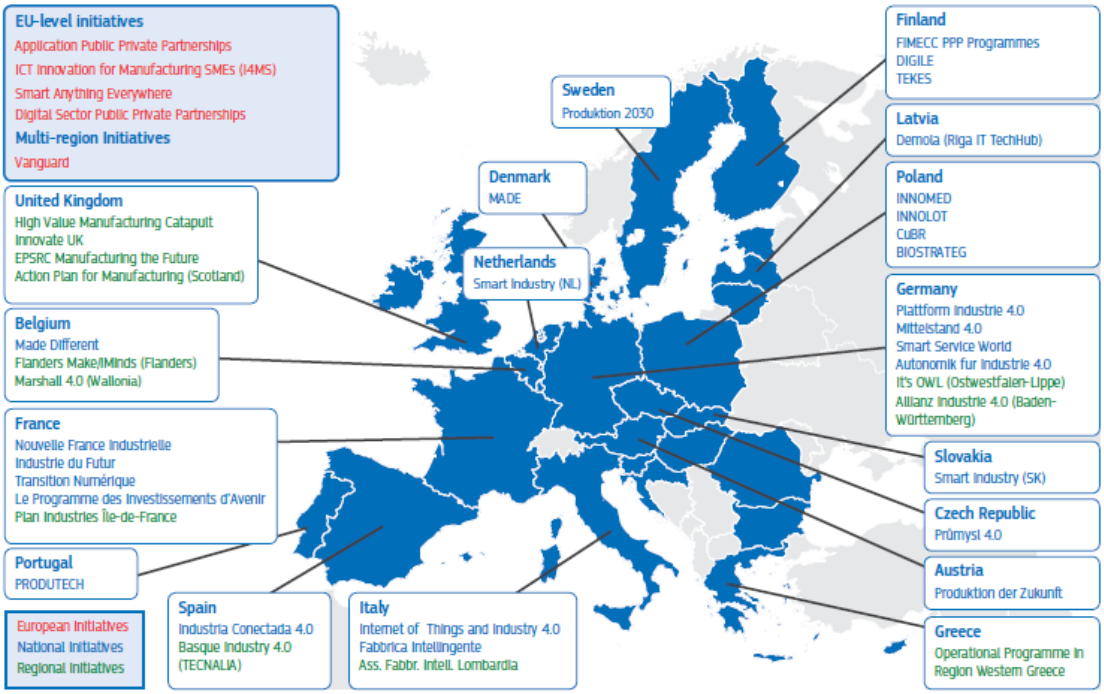
downstream speeds of at least 100Mbit/s, include relevant terminal equipment and be based on VULA type wholesale offers with a real downlink speed of at least 100MBit/s, readily upgradable to 1Gbit/s. All authorised telecoms operators are eligible but must be registered in the information system developed for this purpose.

4.1.4 Promoting the use of digital applications and home working

A common strategy in many EU countries is the implementation of a variety of programmes and initiatives that drive the diffusion of digitisation within industry and the public sector and/or support the development of new digital services and applications.

Highlights of some of these programmes are illustrated in the following figure.

Figure 4-5: National initiatives for digitising industry in Europe



Source: European Commission[74]

Many countries have overarching initiatives, which are intended to serve as a central platform to support digitisation and the digital transformation of the economy and society. These overarching initiatives are often complemented by further local and regional policies, e.g. in the fields of E-Government, Smart Mobility and Smart Energy.

74 https://ec.europa.eu/digital-single-market/en/news/brochure-digitising-european-industry

Some countries have placed a particular focus on supporting cities and municipalities in their digital transformation towards becoming a "smart" city or a "smart" region by reporting on relevant developments and good practices as well as organising networking meetings and local / regional workshops. Smart city initiatives are particularly widespread in Sweden, where a large part of the FTTH/B deployment has been driven by municipal networks. Connecting public infrastructure including hospitals and schools is also typically given priority when the municipalities play an active role in fibre rollout. The involvement of local authorities in network deployment may also have contributed to early development and adoption of public E-services in Sweden.

Many countries focus have also implemented programmes to foster the diffusion of smart industry technologies aiming to increase productivity and global competitiveness, e.g. through automation, sophisticated robotics, and additive manufacturing technology. Since SMEs make up more that 95% of all companies in some EU countries (e.g. Germany), digitisation by SMEs is a focus in many initiatives, with “Mittelstand Digital” as a prominent example in Germany. Such digitisation initiatives can also be an important driver for FTTH/B take-up by smaller businesses coupled with wireless connectivity, as high and symmetric bandwidths and/or low latency requirements make fibre connectivity an important enabler for these use cases.

Smart industry initiatives may also include sectors that are not typically associated with digitalisation and smart solutions at first glance, like forestry in Sweden and agriculture in Germany and Sweden, potentially increasing demand for connectivity in more remote settings.

Many countries including Germany, France, Denmark and Sweden, have also fostered initiatives that have introduced a broad spectrum of innovative E-learning solutions. These are available for both learners and teachers and cover all age groups and disciplines. A range of these initiatives are taking place on a regional and local level and some also include vocational training.

Many countries have also implemented programmes to diffuse E-health services and applications, e.g. in the areas of teleconsultation, telemonitoring and telecare. Denmark and Sweden emerge as frontrunners in Europe with the most developed E-Health solutions.

eHealth and eLearning applications, especially when they involve mass-video conferencing and the use of alternative and virtual reality (e.g. to support training, guide surgical procedures, share and process large volumes of data (e.g. relating to students or patients) are likely to require significant bandwidth both for the institutions providing remote services and (to a lesser extent) the patients and students as well doctors and teachers accessing such services remotely.

The surging demand for telework (currently due to the coronavirus crisis) also necessitates comprehensive coverage of high capacity broadband to reach all parts of the population. Applications such as videoconferencing and cloud solutions as well as the parallel usage of data-intensive services are likely to increase the demand for high and symmetric bandwidths in the home. Network operators are already experiencing

significant increased upload as well as download traffic, in peak and off-peak times. While operators with extensive fibre networks describe their infrastructure as very robust and do not report any problems in terms of disruption or network congestion, copper networks might reach the limits of their capacity if these patterns of consumption are partly maintained following the pandemic, while measures that have been applied to limit bandwidth consumption are lifted. The coronavirus has also highlighted connectivity deficiencies in rural areas, which may have impact the ability of rural communities to take part in a more digitised society.

4.2 Promoting operator-driven migration

Operators themselves can also play a vital role in marketing and upgrading customers to gigabit-capable technologies.

4.2.1 Promoting the availability of gigabit broadband

A first and important prerequisite towards encouraging take-up of gigabit offers, is to promote the widespread availability of gigabit-capable infrastructure. Efforts have been made in the UK as well as other countries to create a regulatory regime which incentivises the commercial deployment of gigabit infrastructure both by alternative investors (e.g. through regulation of Physical Infrastructure Access) and by the incumbent (e.g. through differentiated approaches to wholesale price regulation for higher bandwidth services compared with services offered via copper and entry-level FTTC/VDSL).[75]

State aid can also play a role in upgrading rural areas which are currently served with FTTC/VDSL (and are thus classified as NGA “grey” under the EU’s Broadband State Aid guidelines) to full fibre infrastructure.

The German region of Bavaria may become the first case in Europe where fibre deployment will be funded through state aid in areas which already have NGA (primarily FTTC) infrastructure capable of at least 30 Mbit/s. Municipalities within the Bavarian state were due to start the application procedure in March 2020.[76]

Key conditions are that:

- The area to be developed under the state aid (development area) is a "grey or white NGA spot".
- In the development area there is still no network that can reliably transmit 100 Mbit/s in download mode for private connections and 200 Mbit/s symmetrically for commercial connections.

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75 More details are available in Ofcom’s 2020 proposals for the Wholesale Fixed Telecom Market Review https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review

76 See https://www.schnelles-internet-in-bayern.de/breitbandzentrum/presse/12.

- A network which can reliably transmit 100 Mbit/s download for private connections and 200 Mbit/s symmetrically for commercial connections is unlikely to be rolled out by private network operators in the next three years.
- The funding will lead to a significant improvement in the current broadband coverage or the broadband coverage achieved through a commercial expansion within a period of three years.
- Significant new investments are being made (e.g. optical components that are brought closer to end customers).[77]

As the focus shifts from NGA towards gigabit infrastructure, further applications for state aid to upgrade FTTC to fibre in rural zones, can be expected elsewhere.

Another mechanism that is being pursued in certain countries to extend the availability of gigabit connectivity is the deployment of 5G fixed wireless access. 5G FWA could provide a means of supporting gigabit connectivity to homes in rural, remote and hard-to-reach areas.

It is also being used in some cases to provide a mechanism for new entrant operators to compete with end-to-end fixed broadband offers. For example, Fastweb has carried out 5G Fixed Wireless Access trials in Italy and commercially deployed FWA in 2 cities. They have announced a target of reaching 90% national coverage by 2026. Fastweb claims that speeds up to 1 Gbps can be achieved with a maximum of 500 meters. In the USA, 5G FWA was also launched at the end of 2018 with a performance of at least 300 Mbit/s, which makes this form of FWA a substitute for lower end FTTH services. In Korea, 5G FWA has been launched not only for residential customers (with national coverage by end of 2019) but also for businesses.

4.2.2 Promoting buy-in by all operators to the new platform

In addition to ensuring availability of gigabit infrastructure, another important factor in stimulating operator-driven take-up is to ensure the buy-in of all operators to the new network. Co-investment provides one means of doing this, and the following table provides a summary of some of the co-investment schemes that have been introduced in the countries studied.

77 Details can be found in https://www.verkuendung-bayern.de/baymbl/2020-76/.

Table 4-4: Summary of co-investment schemes

	Operators involved	Description and legal basis
Germany	Incumbent (DT) and EWE	Joint Venture agreed on commercial terms in 2019: “Glasfaser NordWest" will result in deployment of FTTH to 1.5m households and businesses in parts of Lower Saxony, North Rhine-Westphalia, and Bremen.
France	All major operators including Orange, SFR, Iliad, Bouygues and State aid specialist operators	National legislation requires all operators deploying fibre into premises in areas defined as “less dense” by the regulator (in practice c90% of households), to construct their networks to allow physical access at points aggregating at least 1,000 households. Wholesale access must be made available on the basis of “co-investment” (in practice based on IRUs giving rights to 5% slices of lines) in addition to access in the absence of commitment
Italy	Telecom Italia and Fastweb	Joint Venture Flash Fiber established in 2016 for the deployment of and access by the parties to fibre lines commercial agreement. Goal to connect 3 million homes in 29 major Italian cities already covered by FTTC by 2020

As discussed in section 3.6, incumbents are unlikely to promote gigabit broadband unless they have a stake in gigabit infrastructure. Likewise, alternative operators will not have an incentive to promote gigabit offers, unless the commercial conditions for gigabit technologies result in higher returns or other advantages compared with making use of wholesale access on legacy networks.

One mechanism that has been used in France to promote buy-in to fibre networks is the system of co-investment or so-called “mutualisation” of the fibre terminating segment. Outside very dense areas where infrastructure-based competition is viable, it is presumed that only one operator (the incumbent, an alternative operator, or rural (state aid) specialist), will deploy fibre in a given region. However, competitors can participate in the investment before or after the fibre deployment and in return receive network access at more favourable conditions than "normal" (short term) wholesale customers relying on a rental agreement. Co-investment in the fibre terminating segment in France, takes the form of Indefeasible Rights of Use over a period of 20-30 years. Rights to access customers are purchased in slices of 5% of potential connections (premises) in a given region. Due to the upfront fee and long-term nature of the commitment, this pricing model provides incentives for co-investing access seekers to fill up the fibre network up to the share of customers in which they have invested. It is also intended to provide demand certainty and upfront financing to investors in FTTH.

The fibre co-investment regime in France is based on regulation. However, it is worth noting that alternative operators have entered into voluntary co-investment (reciprocal access) agreements covering part of the Spanish territory, and incumbents have participated in commercial co-investment arrangements with other players deploying fibre infrastructure in Portugal, Germany and Italy.

In 2019, Deutsche Telekom entered into a joint venture agreement with EWE called "Glasfaser NordWest", which will result in deployment of FTTH to 1.5m households and businesses in parts of Lower Saxony, North Rhine-Westphalia, and Bremen. The two partners will build the infrastructure through a competitive selection process, acting as general contractor. In the first two years after the joint venture is founded, Glasfaser NordWest will designate the expansion areas in advance. The two parent companies, Deutsche Telekom and EWE, will carry out the upgrades. After this period, Glasfaser NordWest will also offer the expansion areas for bidding by third parties through a selection process. Once the lines have been laid, EWE, Deutsche Telekom, and all other interested telcos will compete directly for the respective customers.[78]

Although deployment is understood to have stalled, in 2016 the incumbent TI established a joint venture with Fastweb (Flash Fiber),[79] to deploy FTTH. The goal of TI and Fastweb is to connect 3 million homes in 29 major Italian cities already covered by FTTC by 2020 for a total investment of €1.2 billion, financed part in equity and part in debt. [80]

Joint ventures involving incumbents and alternative fibre investors may result in incumbents having an incentive to market and transfer customers to gigabit infrastructure in the areas concerned rather than maintaining a parallel legacy network.

Rather than pursuing joint venture or other co-investment arrangements, incumbents in Sweden and Denmark are understood to be using wholesale fibre access on the networks of municipal and utility fibre companies. As alternative operators are responsible for the majority of fibre network deployments in Sweden and Denmark, and duplication is limited, any switch-off of the copper network in these countries would require a large-scale migration of the incumbents' retail and wholesale customers onto alternative operators' networks.

Wholesale access terms for copper e.g. unbundling, FTTC/VDSL VULA, which are more attractive than the wholesale terms available for FTTH, could also deter alternative operators from promoting the new technology. There is a range of literature available on this point,[81] highlighting how the relative pricing of wholesale copper and fibre-based products may affect migration incentives for alternative operators. In principle, copper wholesale prices which are at the same level as, or even higher than fibre wholesale prices should provide a switching signal for alternative operators (assuming that fibre would also allow for a similar or higher margin). However, the relative level of wholesale prices for copper and fibre also has impacts on the investment incentives of both incumbents and alternative operators, and the cashflows available for investments by alternative operators.

78 https://www.telekom.com/en/media/media-information/archive/deutsche-telekom-and-ewe-sign-contract-for-joint-venture-566330
79 TI holds an 80% stake, with Fastweb holding the remainder
80 https://advanced-television.com/2016/07/28/fastweb-telecom-italia-partner-on-ftth-network/.
81 For an overview see Bourreau et al (2013) Access regulation and the transition from copper to fibre networks in telecoms https://cadmus.eui.eu/bitstream/handle/1814/27597/RSCAS_2013_52.pdf?sequence=1

Taking into account all these factors, the French NRA ARCEP considered whether copper prices should be allowed to rise in future to support migration to fibre-based services. In a February 2020 consultation[82] on the evolution of regulation from 2020-2023, ARCEP observed that:

- For the 2020-2023 period LLU should be cost-oriented, because otherwise the incumbent could benefit from excess profits that could distort investment and (infrastructure) competition in UFBB, as well as risking retail price increases for copper-based services; however
- In areas where FTTH infrastructure deployments would allow the emergence of competitive conditions equivalent to those observed on the copper local loop, "the price control on access to the copper loop could be adjusted over time"

Discussions about the relative wholesale price of copper compared with fibre are likely to intensify as fibre becomes more widely available, and as pressure to incentivise migration increases.

4.2.3 Facilitating copper switch-off

The previous sections have focused on strategies that have been used to boost migration to gigabit broadband on a voluntary basis. However, ultimately, once fibre is widely available and there is buy-in from both the incumbent and alternative operators, the focus is likely to shift towards switching off the legacy infrastructure and moving to a forced migration to fibre and alternative technologies such as wireless, which may be more suited to serving very remote areas (i.e. copper switch-off).

It should be noted that progress towards copper switch-off in Europe (and indeed worldwide) is relatively limited.

The following table indicates those countries in Europe which had initiated or indicated a switch-off plan as of 2019.

Table 4-5: Progress towards copper-switch-off

	start	2018	2020	2023	2030	Replacement technology
Estonia	2015	70%	R			FTTH (50%), fixed wireless (10%) FTTC (40%)
Sweden	2009	42%				Fixed wireless
Spain		2%	7.40%			FTTH
Portugal					R 75%	FTTH
Italy		0%		P 60%		FTTC
France	2023	0%	0%	start	100%	FTTH

Source: WIK-Consult. R=regional switch-off, while P=partial switch-off (only to FTTC)

82 https://www.arcep.fr/uploads/tx_gspublication/adm-fixe-3a-20200206.pdf

Estonia has made the most progress towards copper switch-off of all the countries analysed in studies conducted by WIK.

Estonia's incumbent Telia, which operated the copper network, switched off the PSTN completely in July 2017 after a swift migration process of 2.5 years, starting from 2015. By the end of 2018, Telia had switched off 70% of its copper exchanges and it plans for all ADSL connections to be switched off by the end of 2020.

However, this does not mean that a complete switch-off will be achieved. Ultimately, the copper subscriber access lines will be replaced by access lines based on a mixture of fibre (50%), Fibre to the Curb (FttC) in combination with G.fast (40%) and Fixed Wireless Access (10%).

The swift copper switch-off in Estonia was facilitated by the swift prior PSTN switch-off and was made more straightforward by the fact that there was very limited reliance on wholesale access to Telia's copper loops (less than 1% of all of Telia's active loops).

A further factor supporting the switch-off process was that regulatory barriers in Estonia were limited. The NRA permitted a relatively short notice period of 6 months for the closure of copper exchanges. This was however on the condition that alternative operators should have access to alternative wholesale services such as bitstream, fibre local loops or ducts at a similar price as the previous copper loops[83].

Telia, the incumbent in Sweden has also made progress towards copper switch-off, but the switch-off has focused mainly on rural areas. Although about 42% of the MDFs have been shut down so far, this corresponds to only 100,000 households (out of more than 5.2 million households in Sweden as a whole). Where available, customers migrate to fibre connections. Where there is no fibre network (which is common in rural areas), Telia usually offers end-users FWA solutions, which involves connecting to Telia's LTE network.

There are no specific wholesale products in connection with the copper switch-off: Fibre optic unbundling (where fibre is available), fixed wireless and mobile services are alternative solutions. Moreover, there is no obligation for Telia to provide alternative wholesale access if Telia does not have a fibre network in the affected area. Telia has to notify its competitors of the switch-off 5 years in advance, but in practice the period is often reduced to 18 months if Telia and competitors enter into commercial agreements.

More than 450 additional MDFs are to be closed by mid-2020: Most of these are MDFs in rural areas, with just over 10% in suburban areas. A target date for the complete shutdown has not yet been communicated.[84]

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83 See Estonian Consumer Protection and Technical Regulatory Authority 16.06.2017 decision no 1-10/17-228 point 260 (9) and 285 (4) https://www.ttja.ee/sites/default/files/content-editors/Sideturg/II/lisa_1._t3a_turu_analuus_mte_maaramine_ja_kohustused_veebi.pdf (in Estonian language).

84 See Tenbrock, S. et al. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU, WIK discussion paper no 430, https://www.wik.org/index.php?id=meldungendetails&tx_ttnews%5BbackPid%5D=85&tx_ttnews%5Btt_news%5D=2293&cHash=8a1fdd2ac8d544650dd51759f9b9180d

In France, there are medium-term plans to switch off the copper network. The incumbent Orange plans to start switch-off in 2023 and complete by 2030. However, the concrete path to switching off the copper network has not yet been established. Currently, the focus is on the shutdown of the PSTN (a prerequisite for copper switch-off) where significant progress is expected by 2023.[85]

Copper switch-off is not yet a relevant debate in Germany, due to the limited availability of FTTH and focus by the incumbent on FTTC/VDSL vectoring. However, Germany is well-progressed towards PSTN switch-off. As of 2019, less than 2% of the connections in Germany were still based on PSTN. IP migration was due to be completed by the end of 2019 for private customers and by the end of 2020 for business customers, but some delays have been experienced.

The Italian incumbent has announced plans to close down certain copper exchanges, but its intention is to migrate customers to FTTC rather than FTTH.[86]

A benchmark of the main regulatory conditions associated with copper switch-off in nine European countries as of 2019 (including those included in this report) is shown in the following table.

Table 4-6: Regulatory conditions associated with copper switch-off

	Notice period for exchange closure	Wholesaling obligations linked to exchange closure
EE	6 months	None, but fibre wholesale access is available on similar conditions to copper wholesale access
FR	5 years - shorter period may be requested for copper in "fibred" zones, but 5 years applies to PSTN switch-off	Wholesale offers must allow altnets to replicate „in an equivalent manner“ offers available on the copper network
DE	1 year notice to withdraw LLU	Alternative wholesale offers must be made - in practice cabinet VULA, regional bitstream
IT	3 years if no LLU, 5 years if LLU - can be reduced to 3 if suitable wholesale	Technically and economically equivalent VULA guaranteed for 2 years after switch-off
NL	3 years or 1 if suitable wholesale	Unbundled FTTH, VULA FTTH or WBA FTTH - KPN must offer different price model if scale is obstacle for access seekers
PL	12 months	No specific wholesale requirements
PT	5 years or 3 if equivalent wholesale	Products "equivalent" to copper wholesale
ES	5 years (LLU), 1 year (no LLU)	No specific wholesale requirements
SE	5 years for exchanges with co-located operators, but commercial agreements made with 18 month notice	No specific wholesale requirements

Further details about copper switch-off processes as well as progress towards PSTN switch-off in 10 European countries are contained in a study published by WIK in 2019.[87]

85 See WIK 2019 benchmark https://www.wik.org/index.php?id=1097

86 The incumbent Telecom Italia announced in 2017 and 2018 first plans regarding a reduction for main distribution frames (MDFs) from 10,000 to 4,000, with a focus on small MDFs which have few customers connected. Depending on the competitive situation (regarding wholesale access) the switch-off needs to be announced 12 to 24 months in advance. See Tenbrock, S.; Knips, J.; Wernick, C. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU. WIK Discussion Paper 459. Bad Honnef, 2020. Available in German.

5 Potential lessons for the UK

High take-up of digital applications in the UK suggests that, if gigabit connectivity were widely available, there could be an interest in making use of these connections. However, challenges may nonetheless persist in achieving migration.

There is limited evidence of willingness to pay for higher bandwidths in the UK thus far, and affordability may be further stretched in the aftermath of the coronavirus lockdown. Consumers may not be aware of the benefits that can be gained from higher bandwidth technologies, and service providers may not have an interest or incentives to market higher bandwidth services, if their commercial interests are better served by offering services based on legacy technologies.

It is possible that some of the strategies and policies that have been pursued elsewhere could potentially support greater buy-in to gigabit technologies by end-users and service providers, facilitating increased take-up in gigabit services in the post-coronavirus era.

Based on analysis of the relevance of the problems to the UK situation and feedback from operators, we have identified four broad areas where there could be lessons to be learned for the UK and these form our recommendations:

1. Address advertising and customer communications to improve consumer and business understanding of the benefits of gigabit broadband - and ability to distinguish between the broadband networks available to them.

2. Incentivise take-up of new gigabit broadband connections and address issues of affordability for businesses and consumers.

3. Leverage digitisation to support the economy and society in a post COVID-19 era.

4. Facilitate eventual switch-off of the legacy copper network by securing buy-in from relevant broadband industry stakeholders.

We outline some of the measures that could be relevant below.

5.1 Advertising and customer communication to raise awareness of the benefits of gigabit broadband

One of the key challenges for the UK's gigabit broadband ambitions is that customers may not see the need to upgrade their existing broadband service, even where gigabit-capable services are available.[88] Evidence from surveys in both the UK and elsewhere,

87 WIK (2019) Copper switch-off, a European benchmark https://www.wik.org/en/veroeffentlichungen/studien/weitere-seiten/copper-switch-off

88 A 2020 EY survey, conducted during the coronavirus lockdown, suggests that, notwithstanding additional use of broadband, only 11% of households saw a need to upgrade to full fibre broadband

suggests that one reason may be that customers may not value or be aware of the capabilities offered through higher bandwidths, and/or may find it difficult to compare the offers available in the market today.[89] A survey conducted by WIK in Germany, confirms that there is confusion amongst many customers (and potentially especially those in countries where FTTC is widespread) about what fibre is and what it may offer, as it showed that many customers did not know the technology on which their service was based, and wrongly believed that they were already subscribed to fibre broadband.

Another effect of the current approach to advertising may be that other technically complex, but important characteristics for future services such as reliability, symmetry, low latency and the ability to readily upgrade capacities to meet future needs, may not be fully understood by small businesses and consumers.

One solution to this problem has been developed in Italy. Under a 2018 regulation adopted by the National Regulatory Authority AGCOM, all broadband advertisements must have a colour coded label, where green indicates the highest quality connections, and red indicates those which are provided via legacy copper or wireless networks. Rules to limit which services can be described as "fibre" in advertising also exist in France.[90]

In the context of the objective of achieving nationwide gigabit-capable connectivity by 2025, the UK Government and Ofcom could consider developing and adopting a labelling system that enables consumers to make informed purchasing decisions, including by allowing them to better compare services they are contemplating.[91]

Pre-marketing around the benefits of higher bandwidths has also proved to be effective in supporting the take-up of superfast broadband in rural communities under UK State Aid programmes for broadband. Interviews with service providers in France and Germany have confirmed that these strategies have also proved effective in driving take-up of full fibre connections,[92] thus improving the business case for deployment.

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https://www.computerweekly.com/news/252481133/Coronavirus-Video-calling-collaboration-applications-usage-rise-steeply-in-UK-homes

89 For example, research commissioned by the ASA suggests that the term "fibre" was not one of the priorities identified by participants when choosing a broadband pattern – and was seen as one of many buzzwords to describe modern, fast broadband https://www.asa.org.uk/news/asa-concludes-review-of-fibre-broadband.html.

90 Solutions which make use of technologies other than fibre in the access connection may not be marketed as "fibre". Upload bandwidths must be referenced wherever download bandwidths are advertised.

91 This is also relevant in the context of the UK's transposition of Article 3 of the EU Electronic Communications Code, which is due to be completed in the course of 2020. The UK Government has proposed in this context in it 2019 consultation (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819964/EECC_Consultation_-_Publication_Version__4_Updated_.pdf) that it may clarify that Ofcom should aim for the highest capacity networks and services economically sustainable in a given area.

92 Uptake rates of 40-60% have been reported as a result of pre-marketing activities in (primarily) rural areas of France and Germany

The Government could consider providing funding to local authorities to support the marketing of gigabit broadband which is being deployed through Government aid programmes.

5.2 Incentivising take-up and addressing specific issues with the affordability of gigabit connections for consumers and small businesses

The COVID-19 crisis has clearly illustrated the importance of widespread accessibility to broadband connections, including to those with school aged children and vulnerable people requiring ongoing monitoring and care.

The research found that operators in countries migrating to FTTP, tended to charge retail prices for the service that were similar to those for legacy technologies, at least in the initial phases.

This kind of commercial strategy could help to support affordability and incentivise take-up. However, affordability may still be a barrier for some people to access gigabit-capable broadband (as well as equipment), and this may be further exacerbated during this period and in the recession that is expected to follow the outbreak.

One barrier to gigabit-capable services can be high upfront costs to extend and/or connect to a new network. The UK Government's Gigabit Voucher Scheme, which was designed to provide support for new gigabit-capable connections, has proved to be extremely popular, but it has now been closed to applications as the funds are expected to be fully allocated from the existing requests that have been made.[93] Voucher systems have also been set up in the other countries which we studied, including systems to subsidise equipment for wireless connectivity in France, and to install gigabit connectivity for businesses and cultural centres in Germany. A common theme of these schemes is that they focus on providing assistance with the initial connection cost for newly constructed networks (or customer equipment in the case of wireless connections). Such schemes will continue to be important in supporting construction and take-up during the period while gigabit-capable networks are being rolled out.

However, a different approach could be relevant once gigabit-capable networks are available in certain areas. One initiative that has been introduced to support gigabit take-up in areas where infrastructure has already been deployed, is the Greek Government's Superfast Broadband scheme, which has involved providing vouchers to contribute to the cost not only of the connection, but also to subsidise the rental of 100Mbit/s broadband services provided over gigabit-capable infrastructure for 2 years. As there is some evidence that the value of gigabit broadband becomes apparent only

93 The GBVS was launched in March 2018 and was intended to run until 31 March 2021, but as of 14 May 2020 it closed to new applications. Under this scheme applicants were offered up to £2,500 to help businesses and homes gain access to a 1Gbps capable broadband connection (homes can only get £500 and up to 10 homes can participate for every 1 SME). https://www.ispreview.co.uk/index.php/2020/05/governments-uk-gigabit-broadband-voucher-scheme-ends-today.html

after exposure, such a scheme could help pave the way for customers to transition to gigabit broadband and become familiar with its benefits in the longer term. This approach could be particularly valuable when seeking to promote the transition from existing Superfast services to gigabit-capable services which for some consumers may result in higher rental costs.

A recently introduced scheme in Italy also highlights how vouchers can be specifically targeted towards schools and vulnerable school children to improve learning outcomes.

Building on previous experience, the Government could consider expanding on its existing voucher schemes. Besides extending schemes which subsidise the cost of new connections, the Government could consider whether there may be value in schemes which incentivise customers to upgrade to gigabit-capable broadband lines in areas where such lines have been deployed. Such support could be universal, or, if desired, could be targeted towards those facing specific challenges with affordability or groups which risk being left behind. Vouchers to support the provision of gigabit connectivity for public institutions including schools and hospitals could also be considered.

5.3 Leveraging digitisation to support the economy and society in the post COVID-19 era

UK citizens and business are already relatively digitally aware, compared with many other countries in Europe. Internet traffic in the UK per household is amongst the highest in Europe, and usage of cloud services by businesses, eHealth applications and reliance on home working are considerably further advanced in the UK, than is the case in France, Germany and Italy.[94]

However, experience in Sweden and Denmark shows that even more can be done to leverage digital technologies to support education, healthcare, Government services and industry. Moreover, the exposure that has been given to these applications during the confinement imposed as a result of the coronavirus, provides an important opportunity to further level up the UK's digital service infrastructure and embed digitisation within the culture of British industry and society.

Relevant schemes in other countries have included programmes to support telemedicine and remote monitoring (including in a social care setting), installation of technology to support online lectures and distance learning, as well as digital innovation hubs, tax incentives, and innovation vouchers for SMEs to subsidise the cost of training and/or consulting to install and utilise digital solutions.

The Government could consider revitalising and refocusing initiatives around the digitisation of industry and public services to leverage lessons from the coronavirus experience. Such initiatives could support and extend the potential

94 For example, 30% of UK businesses were reported as purchasing cloud services in 2018, more than double the levels of France, Germany and Italy

for remote working, delivery of healthcare and education services, as well as supporting businesses in utilising new technologies such as AI and robotics to aid production and increase efficiency. Support could for example include funding for central as well as local Government to support the delivery of remote healthcare, social care and monitoring, and innovation vouchers for SMEs to support their purchase of consulting and training services to adapt to the use of new technologies. In this context, the Government could also highlight, for example through a national marketing campaign, how gigabit broadband connections could support SMEs in pursuing flexible working and implementing digital solutions and could potentially consider a voucher scheme for this purpose. Tax incentives could also be explored.

5.4 Facilitating the eventual switch-off of legacy copper networks by securing buy-in from relevant broadband industry stakeholders.

Significant attention is being given to the question of how to achieve copper switch-off in the UK. Thus far, much of the debate has centred around the mechanics of switch-off and the associated conditions and timescales. In the study, we give examples of positive practices in this respect from Estonia and Sweden, which have made significant progress towards switch-off. Measures are also under way in the UK to support the development of switching processes, which should help to facilitate customers moving to gigabit-capable platforms, where a choice of network is available.

However, international experience shows that, in addition to settling the procedural and regulatory questions, a common sense of direction amongst operators, and where necessary collaboration, will also be important. This is because a nationwide switch-off of the copper network will only be possible if all broadband service providers “buy in” to the new technology, once it is available, and play their part in facilitating the migration process, initially by encouraging customers to switch (or automatically switching them) and later by obliging them to migrate to the new technology, noting that the switch may be to a competitor network in some cases.

Co-investment or long-term pricing is one mechanism that could incentivise and enable broadband service providers to migrate their customers to gigabit infrastructures while providing flexibility over retail price-setting for gigabit technologies. France provides one example of a co-investment approach,[95] and this mechanism to bring all operators on the new fibre network will be an important enabler for the copper switch-off process that is due to begin in France in 2023, with a target completion date of 2030. In France, this mechanism was developed under a regulatory scheme, but in other countries including Italy, Spain and Portugal, co-investment measures have been agreed commercially amongst various parties. Commercial wholesale offers for fibre have also been made at attractive rates by competing wholesale only providers in Sweden and Italy in order to foster migration to gigabit-capable networks.

95 In areas where only one fibre network is considered viable, operators can purchase Indefeasible Rights of Use (IRUs) to slices of 5% of access lines, giving them the right to use those lines for period of 20 years or more in exchange for an upfront payment.

Another challenge will be achieving full migration and copper switch-off in areas where only one gigabit network is viable[96] and where the new network has been deployed by an operator other than the incumbent or where there are competing new networks. The constraints in duplicating fibre networks in some areas have prompted incumbent operators to access or co-invest in alternative networks in all of the countries considered in this report,[97] and such strategies could be important in enabling a nationwide copper switch-off.

Experience from countries which are further progressed towards copper switch-off such as Sweden and Estonia also confirms that wireless broadband (and in future 5G Fixed Wireless Access) is likely to be important in enabling copper switch-off to a gigabit network in the most remote areas.

Ofcom and Government together with industry, could consider what role if any, could be played by co-investment, in the context of ongoing discussions on migration to fibre networks and switch-off of copper networks. Consideration is also needed, through industry dialogue supported by Government, of how migration to gigabit networks and switch-off of the copper network can be achieved in areas where fibre has been deployed by alternative investors or where there are competing networks. The Government together with Ofcom could also consider whether any additional measures may be needed to support the deployment of 5G fixed wireless access, especially in the most remote areas. A holistic solution will be needed across the different operators and technologies present to achieve nationwide copper switch-off.

96 Experience from fibre deployments in France, Portugal, Spain and Sweden also shows that the majority of households are likely to fall within such areas. In France around 90% of households are considered to fall into this category, while in Spain the figure is around 65%. In Portugal two gigabit networks are present across a large portion of the country, but provision of additional services has been reliant to a large extent on infrastructure swaps.

97 Orange has co-invested in 5% slices in the networks of alternative operators and regional investors present in France. Deutsche Telekom is coinvesting with EWE, an energy utility active in deploying fibre networks, Telecom Italia has co-invested in fibre networks with the alternative operator Fastweb, although it has yet to negotiate an access arrangement with the largest supplier of fibre broadband infrastructure in Italy, Open Fiber and Telia makes use of the fibre networks of municipal fibre operators in Sweden.

6 Annex: Case studies

6.1 France

6.1.1 Summary

Table 6-1: Key lessons from France

France
• NGA and Gigabit coverage are limited compared with the EU average • The main urban NGA technology is FTTH/N • Cable plays a secondary role in urban areas, and VDSL in rural areas • The regulated co-investment regime incentivises access seekers to migrate customers to fibre as they must pay upfront to receive significant discounts. Agreements in less dense areas are based on 20-30-year IRU for the right to serve slices of 5% households in the area concerned. • Prices for fibre-based services are amongst the lowest in Europe (and close to those for ADSL), but FTTH/B take-up is slow as triple play is available on ADSL and many customers do not see a killer application (usage of existing high bandwidth applications is limited). • Notwithstanding low headline prices, some operators have achieved ARPU increases associated with fibre, due to price increases after the initial subscription period (1-2 years) and increased take-up of bundled services. • France has experienced significant increases in bandwidth demand as a result of the coronavirus, but the longer-term implications for Gigabit demand are not yet clear. • The French Government issued a decree in 2016 regulating advertising standards for “fibre” • ARCEP has concluded that copper wholesale prices should remain cost-oriented in the current review (to 2023), but noted that in areas where FTTH deployments would allow the emergence of competitive conditions equivalent to those for copper, the price control for copper access could be adjusted over time. • Orange has set a time frame for copper switch-off (between 2023-2030), but the path is unclear

6.1.2 Context

Table 6-2: Demographics in France

France[98]		
Population		67,012,883
Number of households		29,778,200
Population density in people per km^2		105.6
% of people living in	Cities	47.6
	Towns and suburbs	19.3
	Rural areas	33.1
% of people living in	Houses	66.0
	Flats	33.9
GDP per capita in € PPP		33.360

6.1.3 Main players and technologies used

FTTH has been deployed to 17.1 million French households (out of c.28 million). The incumbent Orange has deployed the most FTTH lines, while other players including Iliad, SFR and "public initiative" specialist operators such as Covage, Altitude etc. have deployed FTTH in regional areas.

The major retail broadband operators Orange, Iliad, SFR and Bouygues have concluded long-term access agreements with each other (and in some cases with the "public initiative operators" as well) to provide fibre broadband over their respective networks. These agreements are governed by regulatory rules regarding "symmetric access to the fibre terminating segment". In many cases, prices and terms have been set or amended by the NRA in the context of disputes.

In addition to its FTTH-based network, SFR also operates a DOCSIS cable network, which it acquired from Numericable, and which is present in a limited area in France covering 9.2 million households.

Three or more VHC networks have been deployed in very dense areas covering around 10% of the population, but outside these areas, FTTH networks are deployed by operators in different areas following the principle of regional monopolies (albeit with the co-existence of copper for the moment).

Orange and Iliad provide services via FTTH and ADSL, while SFR and Bouygues provide services via cable,[99] FTTH and ADSL, depending on network availability in different areas of the country.

98 Population and GDP data: 2019; rest: 2018. Source: Eurostat
99 Bouygues relies on bitstream access to the cable operator SFR

6.1.4 Trends in deployment and take-up of gigabit capable technologies

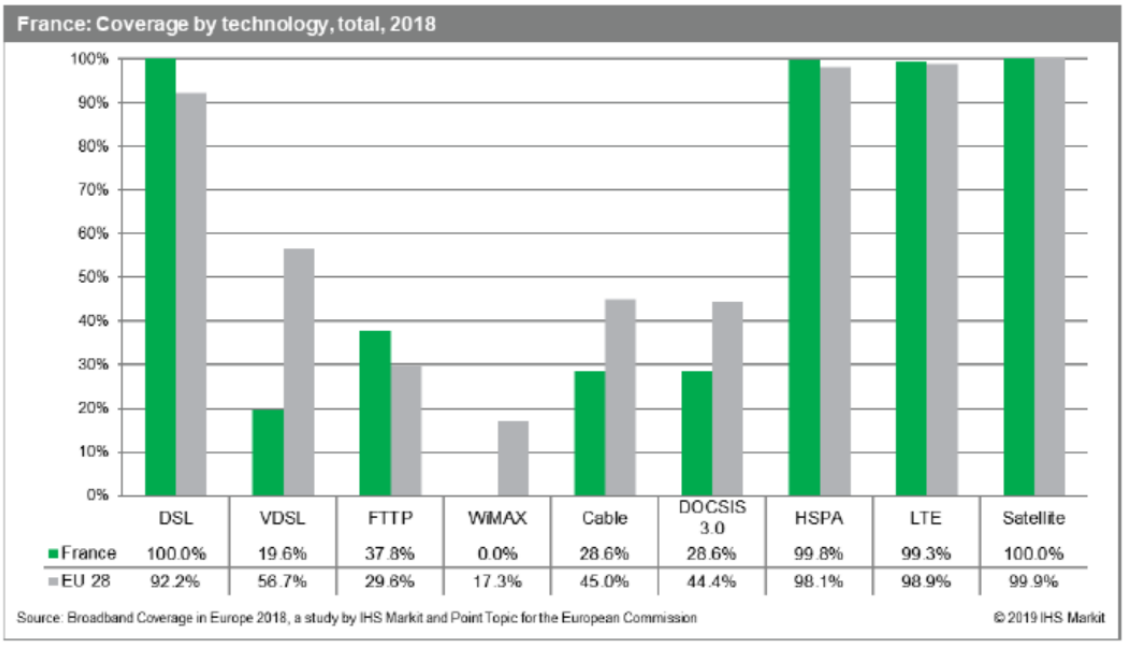
In France, broadband networks are available throughout the country, including in rural areas. Looking at the technologies, DSL remained the most widespread fixed broadband technology in France, with over 99.9% of homes passed. Cable availability increased slightly in recent years, passing 28.6% of homes in France. However, the cable coverage is well below levels in the UK and the EU average (45%).

In areas where FTTH has not been deployed, the main consumer providers offer copper-based ADSL services. FTTC/VDSL is not widespread with less than 20 % coverage in France (primarily in rural areas as means of improving broadband quality).

While cable and FTTC coverage rank below EU average, FTTB/H coverage has been increasing and reached 37.8% of households by mid-2018, an increase by 9.5 percentage points within one year.

This development is promoted by symmetric regulation in France, which requires operators of wholesale fibre networks to provide access via co-investment models. This allows competitors to participate in the investments before and after the expansion and in return receive network access at more favourable conditions than "normal" (short term) wholesale customers relying on a rental agreement; network access via the regulated co-investment arrangements takes the form of Indefeasible Rights of Use over a period of 20-30 years and are purchased in slices of 5% of potential connections in a given region. This pricing model provides incentives for co-investing access seekers to fill up the fibre network up to the share of customers in which they have invested. It is also intended to provide demand certainty and upfront financing to investors in FTTH.

Figure 6-1: Coverage by technology (June 2018)[100]



A different picture is seen in rural areas, where VDSL remains the most prevalent NGA technology (more than 40 % coverage), often deployed with the support of municipalities. Although FTTB/H recorded a significant increase in the last year (and doubled), it only passes less than 10 % of the rural households. DOCSIS 3.0 remains insignificant, passed by only about 1.3% of French rural households.

Overall coverage with broadband connections enabling speeds above 30 Mbps (NGA) is below the EU average. 58.5% of French households are covered with NGA bandwidths (30Mbit/s+), while in rural areas, the proportion is 46.5 % of households.[101]

In terms of subscriptions, DSL is still the most prevalent broadband technology in France. However, it has been in constant decline. Due to the low cable coverage, the technology only plays a minor role with less than 10% of total subscriptions; this market share has been relatively stable in the past 5 years. While the share of FTTB/H as a proportion of broadband lines is only roughly 15 %, the share is continuously rising at the expense of DSL. The growth of the FTTB/H market share in 2018 was also the largest compared to previous years.

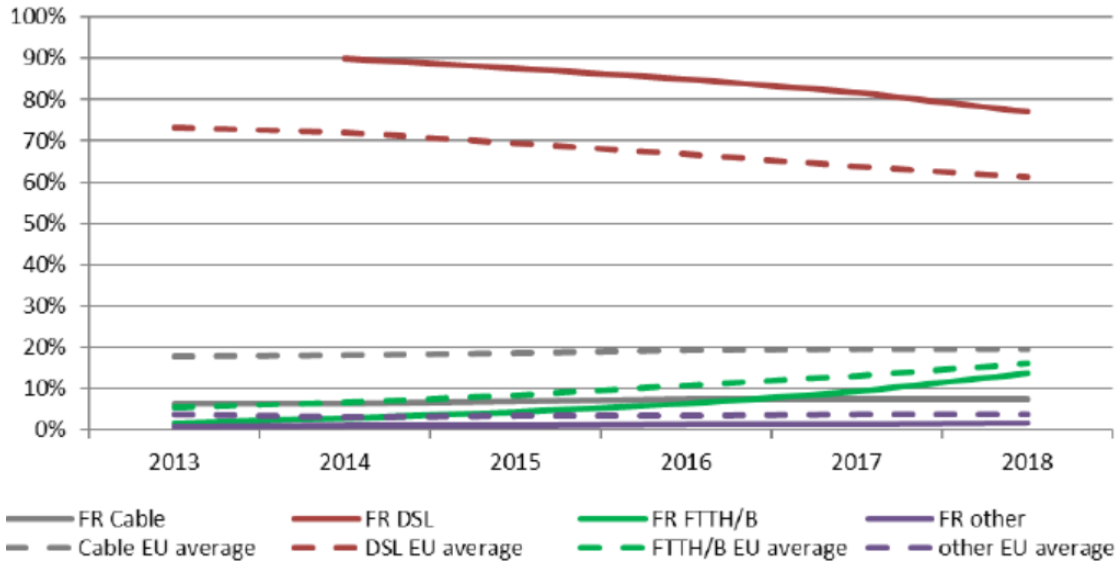
Product bundles in France are popular with end customers. Nearly all offers are triple or quad play: Bundles often range from about 20 Euro (for Internet and telephone) to

100 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

101 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

about 40 Euro (television included). Recently, some operators have begun to offer dual play at low cost without IPTV. These offers target students or those without television. At the end of September 2019, slightly more than seven out of ten internet subscribers (21 million) subscribed to a bundle including television, a proportion that has remained stable over the last two years. For FTTH internet subscriptions, this proportion reaches 90%, compared with around 70% for DSL access.[102]

Figure 6-2: Broadband market shares at Member State level by technology, % of fixed broadband lines, 2013-2018[103]



To improve the availability of high-performance telecommunications infrastructure, France intends to accelerate the roll-out of the fibre network and is considering alternative technological approaches in remote areas such as hybrid solutions combining 4G and fixed networks. Under the "New deal" for mobile, agreed in 2018,[104] the Government, acting on the advice of ARCEP, awarded frequencies in the 900Mhz, 1800MHz and 2.1GHz band to Bouygues Telecom, Free Mobile, Orange and SFR, without charge, but with an obligation to achieve ubiquitous coverage of 4G – reaching more than one million customers that had previously not been served. This development has meant that customers in rural areas can be provided with NGA speeds via wireless technologies from competing carriers.

5G roll-out is being prepared by the Government and the national regulatory authority Arcep. Under the roadmap for 5G, frequencies in the 3.4 - 3.8 GHz band will be

102 https://www.arcep.fr/fileadmin/cru-1582218129/reprise/observatoire/3-2019/obs-marches-services-T32019-160120.pdf

103 See European Commission (2019): DESI Report– Electronic communications markets overview per Member State (Telecom Chapters), https://ec.europa.eu/digital-single-market/en/news/2019-desi-report-electronic-communications-markets-overview-member-state-telecom-chapters referring to data from Communications Committee (COCOM), annual data as of July 1st.

104 https://en.arcep.fr/news/press-releases/p/n/new-deal-for-mobile-2.html

allocated in the near future not (only) through an allocation procedure but also through an auction: The Government plans to sell 50 MHz of 5G

spectrum to each approved network operator for 350 million euros and then auction another 11 lots (10 MHz each) with a minimum price of 70 million euros each. Arcep's specifications stipulate that each operator must introduce 5G services in at least two cities by the end of 2020. In addition, the network operators must develop 3,000 sites by 2022, 8,000 sites by 2024 and 10,500 sites by 2025.**106**

Use of applications[105]			
	France	EU average	Rank within the EU-28
Regular Internet users (at least once a week) in % of population; 2019[a)]	86.5	85.3	12
Entertainment			
% of Internet users watching internet streamed TV or videos; 2018[a)]	63	72	19
Daily time spent watching television including streaming (by Internet users in minutes); 2019[b)]	199	N/A	N/A
% of Internet users playing or downloading games; 2018[a)]	33	33	13
% of internet users that download/play video games, listen to music or watch internet streamed TV or videos; 2018[a)]	75	81	21
E-Learning and remote work			
% of Internet users doing an online course (in any subject); 2019[a)]	8.5	11.2	16
% of employed people working from home (usually or sometimes); 2018[a)]	20.7	15	9
Cloud			
% of Internet users that used Internet storage space to save files (e.g. photos); 2019[a)]	30.2	34.4	18
% of businesses that buy cloud computing services of medium-high sophistication; 2018[a)]	15	17.8	17
E-Government and E-Health			
% of internet users that interacted online with public authorities; 2019[a)]	82.4	61.8	6
DESI index score E-Health; 2019[a)]	32.3	37	15

105 Source: a) EU, b) GlobalWebIndex via datareportal.com. Survey data from globalwebindex is not available for all EU countries and therefore no averages can be calculated

106 https://en.arcep.fr/news/press-releases/p/n/5g-7.html and https://en.arcep.fr/news/press-releases/p/n/5g-8.html

6.1.5 Use of high bandwidth applications

Although the proportion of the population using the Internet in France lies around the EU average, usage of cloud services and storage, online streaming and eLearning lie below average, which may have limited the perceived need for higher bandwidths.

However, as a consequence of the coronavirus, network operators in France have identified an increase in the volume of data and voice. According to their estimates, the data volumes have increased by about 20-30 % while the voice traffic has intensified even more with an increase of between 50-100 %. Moreover, the traffic increase is spread out over the day whereas peak traffic has also increased, but to a lesser degree. As a result, the daily utilisation curve has become flatter.

According to the operators, it is currently too early to predict the extent to which the coronavirus will lead to an increased demand in FTTB/H. There is currently limited upgrade or churn by customers as the shops, through which orders are commonly made, have been shut.

6.1.6 Challenges in driving take-up of gigabit technologies

According to network operators, consumers are not switching to fibre connections due to the lack of killer applications. End customers report that they are satisfied with the quality of their ADSL services and find them sufficient for their main requirements (including IPTV). A share of customers have also resisted switching due to desire not to allow technicians into their premises to install in-house cabling.

Research by the consumer organisation Que Choisir suggests that speed and technology are factors when consumers choose their broadband supplier, but that these factors are less important than the price.[107]

Some operators note however, that IPTV (which is fast displacing broadcasting television) has become a driver for gigabit broadband for some consumers and they perceive better TV quality as a key reason to migrate to gigabit or fibre-based access. However, the migration from copper to fibre is still slow.

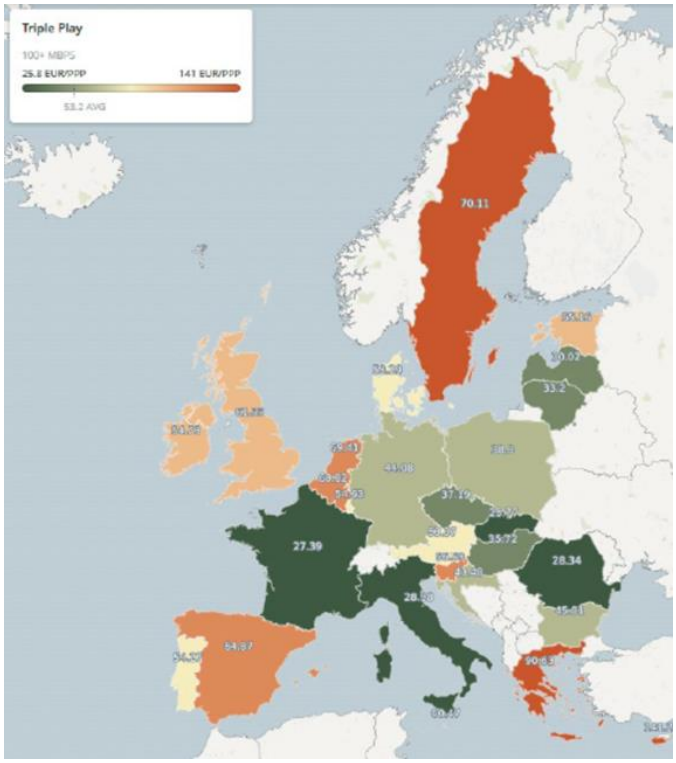
The intensity of competition for fibre-based services on the French market varies greatly according to population density. While intensive (infrastructure) competition prevails in urban regions, supported by symmetrical regulation in in-building wiring, the intensity of competition is significantly lower in rural regions. However, competition in so-called “less dense” areas is increasing as operators commit to co-investment arrangements.

107 https://www.quechoisir.org/actualite-fournisseur-d-acces-a-internet-infographie-vous-et-votre-fai-n53421/

6.1.7 Pricing and willingness to pay

In general, France has amongst the lowest prices across EU countries in most Single Play, Double Play TV, Double Play Phone and Triple Play bundles across three different speed categories. For instance, the average price for the highest advertised download speed category (100+ Mbps) in France is the second lowest among the EU-28 member states.

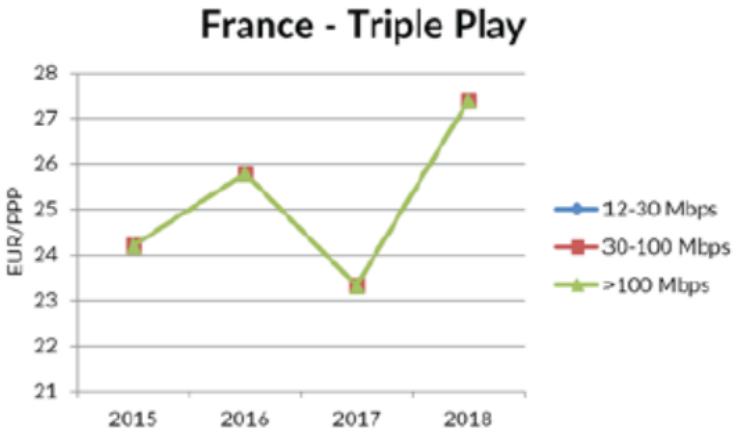
Figure 6-3: Prices for triple play bundles across Europe (100 Mbps+)[108]



The prices for broadband triple play bundles in 2018 rose noticeably compared to the previous year. Prices for different triple play speed categories in France are the same. Despite the recent increase, the prices for all bundles in every speed category are clearly below the European average ranking France among the cheapest countries.

108 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

Figure 6-4: Prices for triple play bundles in France over time[109]

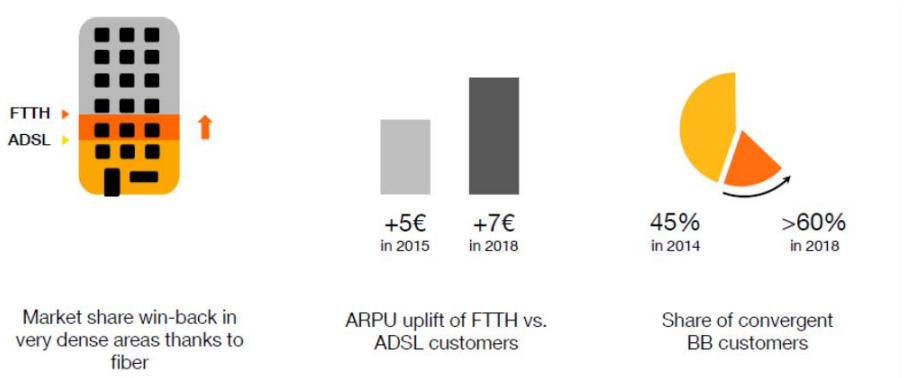


However, the low broadband prices have not translated into a rise in demand of high capacity broadband access in France. In terms of take up of different broadband speeds, France ranks above average among take up of speeds between 10 and 30 Mbps in Europe. However, it is visibly outranked in take up with speeds between 30 and 100 Mbps as well as above 100 Mbps.

The migration to fibre is supported in the pricing regimes offered by many operators. When fibre becomes available, migration is proposed to end customers with no upfront costs (free migration). For one or two years, end customers pay the same price as before. However, after that period, some operators raise their prices. Incumbent Orange has for example reported that an uplift of around €7 in ARPU was achieved for customers taking FTTH as opposed to ADSL services, and this uplift has increased over time. Orange also reports a higher share of customers taking triple or quad play bundles, which has been associated with the migration to fibre.

109 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

Figure 6-5: Orange increases in FTTH ARPU



Source: Orange investor presentation

An empirical study based on survey data for the years until 2017 shows that the average willingness to pay of the consumer has increased in France and that the introduction of FTTH has had a lasting positive impact on consumer surplus.[110]

6.1.8 Wholesale pricing measures (where relevant)

The price for wholesale access to both copper and fibre (via dispute resolution under the symmetric regulatory regime) is cost-based. ARCEP has to date focused on fostering investment rather than migration incentives through the pricing regime for copper and fibre.[111]

ARCEP has however considered whether copper prices should be allowed to rise in future to support migration to fibre-based services. In a February 2020 consultation[112] on the evolution of regulation from 2020-2023, the French NRA ARCEP observed that:

- For the 2020-2023 period LLU should be cost-oriented, because otherwise the incumbent could benefit from excess profits that could distort investment and (infrastructure) competition in UFBB, as well as risking retail price increases for copper-based services; however
- In areas where FTTH infrastructure deployments would allow the emergence of competitive conditions equivalent to those observed on the copper local loop, “the price control on access to the copper loop could be adjusted over time”.

110 See Bensassi-Nour, K.; Liang, J. (2019): Discrete Choice Analysis of Demand for broadband in France. Available at: https://dx.doi.org/10.2139/ssrn.3333238

111 Access to fibre is subject to a risk premium on the WACC associated with the cost-based price which is least for those committing to co-invest before deployment, occurs, increases for those committing to co-investment after deployment, and is highest for those relying on short term rental of access to the fibre terminating segment.

112 https://www.arcep.fr/uploads/tx_gspublication/adm-fixe-3a-20200206.pdf

6.1.9 Awareness and advertising standards

A representative survey of French consumers in 2019 showed that 80% of the population deems access to fixed broadband as very useful or fairly useful (62% find it very useful), however only 65% believe their internet connection (fixed or mobile) is sufficient for watching videos, reducing in rural areas to only 53%.[113]

The Government intervened in 2016 by means of a decree to limit the circumstances in which "fibre" may be used in advertising to FTTH cases and required the indication of upload speeds in addition to download speeds.

The decree followed legal proceedings brought by Iliad against SFR/Numericable on the grounds that the merged entity had advertised services which based upon cable infrastructure as "fibre".

As a consequence, operators on the French market now distinguish clearly between “fibre” and “ADSL” offers to enhance transparency for the end customers. Cable-based offers are not actively marketed nationwide but are now sold as "very high bandwidth" without explicit reference to fibre.[114]

6.1.10 End-user voucher schemes (where relevant)

No federal voucher scheme for fixed broadband is present in France.

However, in December 2017, the Prime Minister announced the "Digital Cohesion of Territories" programme (as part of the France Très Haut Débit) from 2019 with a budget of up to 100 million euros: Subsidies under the scheme will be made available to households and businesses that currently do not have access to at least 30 Mbps download speeds and that are not expected to be connected to a high-speed broadband network by 2020, according to current forecasts. Under this programme, the aim is to provide eligible recipients with high-speed broadband connections via wireless technologies; eligible individuals and businesses can receive financial support of up to €150 for the cost of equipping and installing the chosen wireless solution.[115]

6.1.11 Forced migration measures/copper switch-off

In France, there are medium-term plans to switch off the copper network. The incumbent Orange plans to start switch-off in 2023 and complete by 2030. However, the concrete path to switching off the copper network has not yet been established.

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113 https://www.arcep.fr/uploads/tx_gspublication/rapport-barometre-num-2019.pdf (p. 105; 145-146, only available in French)

114 https://www.arcep.fr/actualites/les-communiques-de-presse/detail/n/larcep-se-felicite-de-ladoption-de-larrete-fibre-et-de-la-prise-en-compte-par-le-gouvernement.html

115 https://www.economie.gouv.fr/particuliers/cohesion-numerique-territoires-aide-linstallation-haut-debit and

Currently, the focus is on the shutdown of the PSTN (a prerequisite for copper switch-off) where significant progress is expected by 2023.[116]

A first pilot project for copper switch-off was launched in 2014 in the municipality of Palaiseau in the Hauts-de-Seine region. The project was conducted in close cooperation with the French Government and ARCEP and was positively received by the end customers: More than 90% of private users switched to a fibre connection in 2015. However, negotiations between Orange and alternative competitors for the closure of the MDFs failed and Orange had to maintain them until 2018.

For Orange as an incumbent, switch-off is a very relevant issue: Orange has focused its roll-out activities on FTTB/H. In addition, due to symmetrical regulation via co-investment models, Orange also has access to FTTB/H network infrastructures in areas where alternative operators have deployed FTTB/H networks.[117]

ARCEP has proposed shorter notice periods for discontinuing MDFs depending on competitive situation in an area and other factors (availability of fibre, number of operators offering fibre products, population density of the area).[118]

6.1.12 Initiatives to boost digital applications

In France, a number of programmes and initiatives have been implemented that drive the diffusion of digitisation as well as digital services and applications.

“La nouvelle France industrielle” was set up in 2013 with the goal of making France the world's leading industrial player. The programme is committed to modernising the French industrial base by transforming its economic model through digital technology. It also aims to accompany industrial companies in the transformation of their business models, their organisation, their methods and marketing via digital technology. A second phase of the project was launched in 2015.

The initiative Industrial New France is based on 9 industrial solutions that provide concrete solutions that aim to address major economic and societal challenges. These solutions position companies for the markets of the future in a world where digital technology is breaking down the barrier between industry and services: Data Economy, Smart Objects, Digital Confidence, Smart Power, New Resources, Sustainable City, Ecological Mobility, Smart Transport, Medicine of the Future.[119]

Another initiative is the alliance “industrie du future” (industry of the future) that supports companies towards a connected, optimised and innovative industry. Created in July

116 See WIK 2019 benchmark https://www.wik.org/index.php?id=1097
117 See Tenbrock, S. et al. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU, WIK discussion paper no 430, https://www.wik.org/index.php?id=meldungendetails&tx_ttnews%5BbackPid%5D=85&tx_ttnews%5Btt_news%5D=2293&cHash=8a1fdd2ac8d544650dd51759f9b9180d
118 https://www.arcep.fr/uploads/tx_gspublication/synthese-doc-adm-fixe-2020-2023-20200206.pdf
119 https://www.gouvernement.fr/action/la-nouvelle-france-industrielle

2015, the alliance brings together industry and digital professional organisations as well as academic, technological and corporate funding partners.

Each of the strategic areas is supported by operational working groups and cross-cutting actions to ensure their implementation and deployment throughout the country.[120]

Le Programme d'investissements d'avenir (The Future Investment Program) was set up by the French Government to finance innovative and promising investments in the country. With 57 billion Euro, the programm d'investissements d'avenir (PIA) is steered by the General Secretariat for Investment (SGPI). Since the launch of the PIA, the Government has co-financed several thousand projects.

Part of this forward-looking investment programme, endowed with 10 billion euros, is linked to the Major Investment Plan (GPI) committed by the Government in 2017 (with the aim of completion within 5 years). One of the four major challenges in this plan is to support structural reforms to digitise the state.[121]

France has a national E-Health Strategy 2020 that aims to unite representatives of industry professionals, users, industry and public institutions to contribute to its implementation. Key focus areas include developing a “connected medicine”, fostering co-innovation between health professionals, citizens and economic players, administrative simplification for patients and strengthening the security of health information systems.[122]

A number of regional and local initiatives revolve around smart city and smart regions in France. Not only large cities but also smaller towns have established programmes in this area. Key areas involve Open Data (for businesses as well as citizens), electronic governmental services and the creation participative platforms to facilitate contact with the administration.[123] Local initiatives and programmes have also been launched to introduce E-learning tools and courses.

120 http://www.industrie-dufutur.org/
121 https://www.gouvernement.fr/le-programme-d-investissements-d-avenir
122 https://solidarites-sante.gouv.fr/IMG/pdf/strategie_e-sante_2020.pdf
123 https://www.journaldunet.com/economie/services/1176221-smart-city-france/

6.2 Germany

6.2.1 Summary

Table 6-3: Highlights

Germany
• Coverage of FTTC and cable comparable to UK • Cable is currently the main Gigabit technology. Take up of FTTB/H limited so far, deployments mainly by local providers • Parts of 5G spectrum used for campus networks • Prices for higher speeds are converging with NGA speeds, but there is a low willingness to pay for faster broadband connections, which may be linked to Germany's limited use of cloud and streaming services, and lower reliance on digital applications such as eHealth compared with more digitally advanced countries such as Sweden • Take-up on regional fibre networks is higher than take-up on DT's fibre network. Pre-commitments and localised advertising, community activities play an important role in driving rural take-up. • Contingent (long-term discount) model for wholesale VDSL access by Deutsche Telekom very successful. May have contributed to FTTC focus by large altnets, which may have locked in access to FTTC and discouraged alternative solutions. On the other hand, long term discounts, if applied to FTTH, could help to provide incentives for more widespread marketing of fibre-based solutions and incentives to migrate • Bavaria is the first in the EU to grant state aid for FTTH deployments in FTTC zones (NGA grey areas). • In one of the regions, a voucher scheme to subsidise Gigabit connections has been introduced for companies and sponsors of non-profit or cultural institutions • Numerous initiatives to support the diffusion of digital applications

6.2.2 Context

Table 6-4: Demographics in Germany

Germany[124]		
Population		83,019,213
Number of households		40,806,600
Population density in people per km^2		234.7
% of people living in	Cities	36.3
	Towns and suburbs	40.7
	Rural areas	23.0
% of people living in	Houses	42.2
	Flats	56.3
GDP per capita in € PPP		35.970

6.2.3 Main players and technologies used

Germany has a virtually nationwide telecommunications infrastructure based on twisted copper pairs, which dates from the time of the postal monopoly and was transferred to the incumbent Deutsche Telekom in the course of the liberalisation of the telecommunications markets. xDSL plays a major role in the nationwide basic broadband service in Germany. The incumbent is mainly focused on upgrading its network with FTTC/VDSL vectoring. The deployment of FTTB/H by DT is very limited.

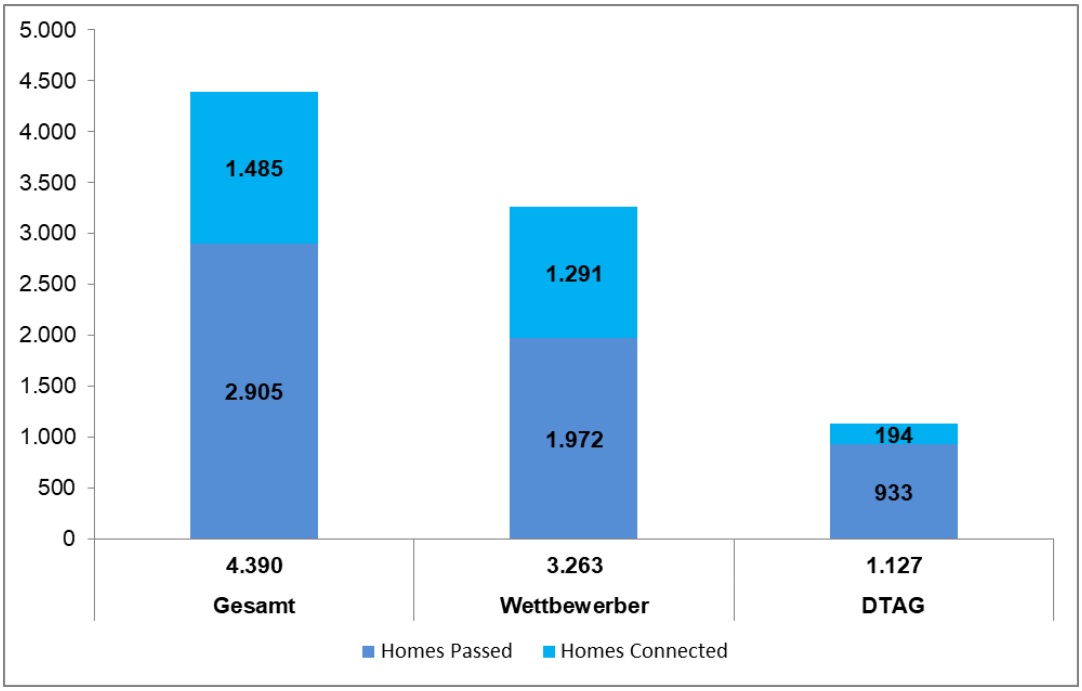
65% of all German households have access to a cable connection. There is limited expansion of this network, which mainly focused on within its area of coverage. Large parts of the cable network (>90%) are owned and operated by Vodafone. The company is also expanding FTTB/H in Germany in the context of some state-aid projects and in new development areas. The other large retail broadband providers 1&1 and Telefónica mainly rely on access to wholesale products (LLU and FTTC/VDSL Ethernet bitstream) from the incumbent.

In Germany, the expansion of the FTTB/H network is being driven primarily by competitors of Deutsche Telekom, e.g. Deutsche Glasfaser, EWE, M-Net, NetCologne and wilhelm.tel. Many of these are municipal operators and/or utility fibre companies. Most of these offer triple play and quadruple play bundles.

A glance at the state of roll-out shows that of the almost 4.4 million FTTB/H (homes passed) lines, more than 3.2 million (74%) are provided by alternative competitors. Competitors' fibre lines account for an even higher proportion of take-up. Of the almost 1.5 million households that purchase FTTB/H (Homes Connected) connections, just under 1.3 million (86%) are provided by alternative competitors.

124 Population and GDP data: 2019; rest: 2018. Source: Eurostat

Figure 6-6: Number of FTTB/H lines in Germany (in thousands)[125]



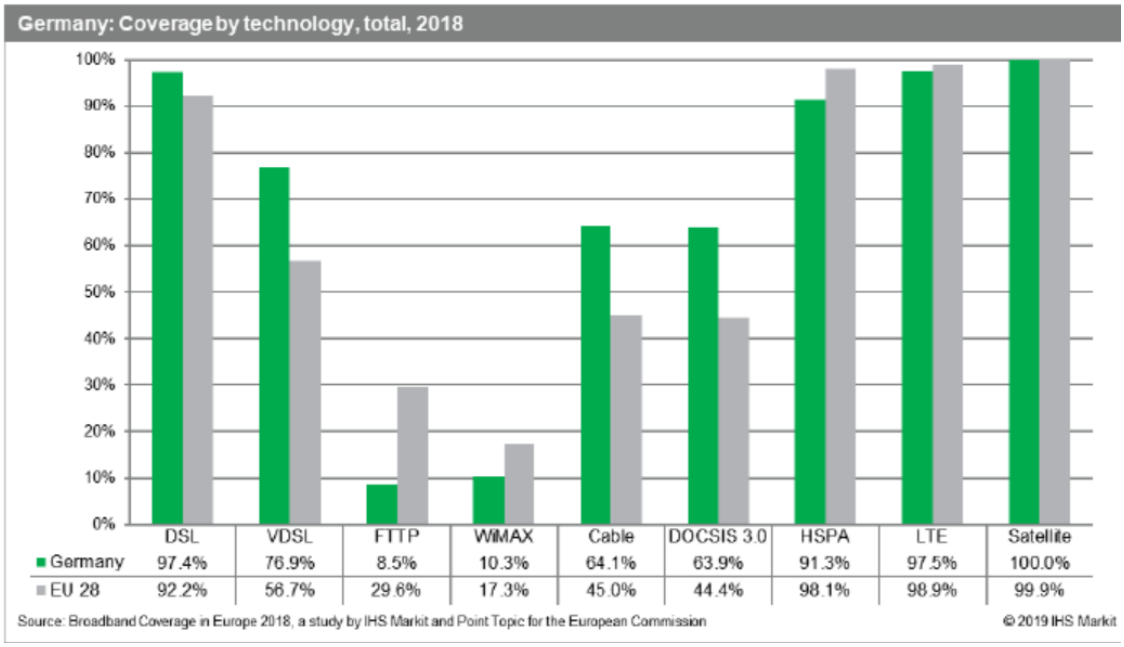
As of 2018, Deutsche Telekom had a market share of 39,4 % of all fixed broadband lines. Vodafone is in second place with 19.9 %, followed by 1&1 with 12.4 % market share, ahead of the cable-only operator Unitymedia with 10.7 % (which became part of Vodafone in 2019). The providers smaller than O2/Telefónica (6.4 %), the fifth largest provider, each have a market share of less than 2 %. Due to the very localised fibre roll out in Germany, however, these providers may well be significant to the competitive situation in individual regions.[126]

125 See VATM-Marktstudie (2019): https://www.vatm.de/wp-content/uploads/2019/10/VATM_TK-Marktstudie_2019_091019.pdf

126 See VATM-Marktstudie (2019): https://www.vatm.de/wp-content/uploads/2019/10/VATM_TK-Marktstudie_2019_091019.pdf

6.2.4 Trends in deployment and take-up of gigabit-capable technologies

Figure 6-7: Coverage by technology (June 2018)[127]



In terms of the individual technologies, DSL is still the most widespread fixed broadband technology, as in previous years, with 97.4% of households. VDSL is still the most widespread NGA technology in Germany. At the end of June 2018, VDSL networks passed 76.9% of German households.

The cable networks in Germany are of high relevance for the availability of high and very high bandwidths - a large part of the cable network (58%) already enables service provision with at least 400 Mbit/s download, and at the end of 2018, gigabit speeds were available via cable for 24% of the German households. In contrast, FTTH/B infrastructures reached only around 9% of German households at the end of 2018.[128]

In rural areas, DSL was the most widespread fixed broadband technology, covering 89.2% of rural households. Cable networks reached 15.5% of rural households while FTTB/H passed only 3.6% of German rural homes.[129]

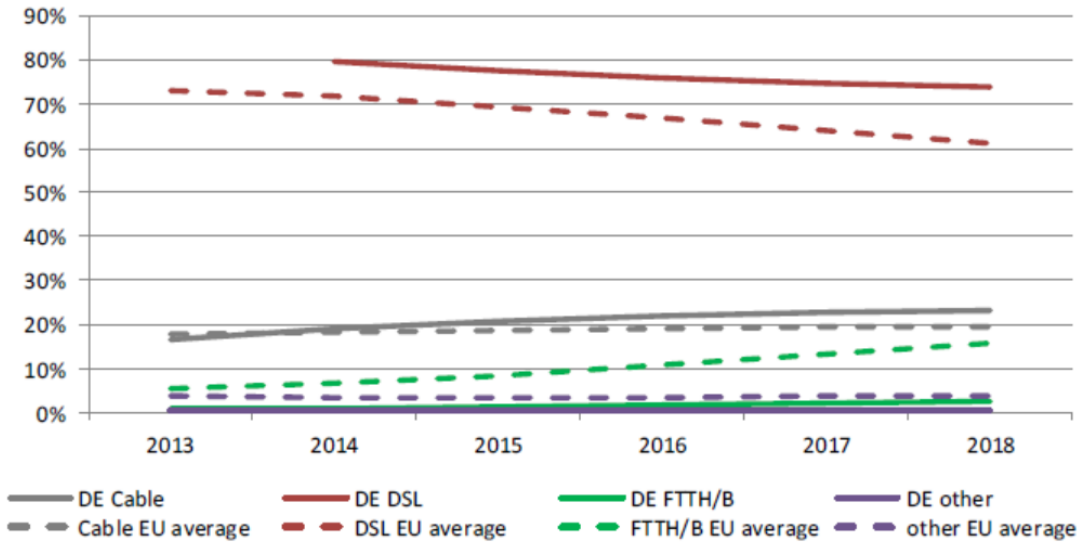
127 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

128 Bundesministerium für Verkehr und digitale Infrastruktur (2018): Aktuelle Breitbandverfügbarkeit in Deutschland (Stand Ende 2018) https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/breitband-verfuegbarkeit-ende-2018.pdf?__blob=publicationFile

129 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

Broadband lines with speeds in excess of 200 Mbps are available to barely a quarter of the population in rural areas. In this performance class, more than half of the population is already covered in suburban areas and more than 80% in urban areas. Less than 8% of the population in rural areas can access gigabit connections, while this is possible for around 15% of the population in suburban areas and almost 40% of all city dwellers. Today, gigabit connections are mostly offered via cable connections.[130]

Figure 6-8: Broadband market shares at Member State level by technology, % of fixed broadband lines, 2013-2018[131]



A breakdown of subscribers by access technology over time reveals a strong increase in the importance of VDSL/vectoring at the expense of conventional DSL connections. Today, VDSL accounts for around 50% of all DSL connections. Of these, 7.1 million VDSL connections are to direct customers of Deutsche Telekom and 5.5 million to competitors. On the other hand, the number of cable connections rose from 5.9 million (2014) to 8 million (2018). At the end of 2018, 1.1 million FTTB/H lines were in use by German households; other alternative technologies such as satellite or fixed wireless play only a minor role. However, increasing demand for higher bandwidths and high-quality parameters (e.g. real-time transmission, lack of interference, reliability, etc.) can be observed due to the rising variety of applications in all areas of life and work.

The auction of the first frequencies used for 5G started in March 2019 and lasted almost four months. Spectrum in the 2 GHz and 3.6 GHz frequency ranges was auctioned off.

130 Bundesministerium für Verkehr und digitale Infrastruktur (2018): Aktuelle Breitbandverfügbarkeit in Deutschland (Stand Ende 2018) https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/breitband-verfuegbarkeit-ende-2018.pdf?__blob=publicationFile

131 European Commission (2019): DESI Report– Electronic communications markets overview per Member State (Telecom Chapters), https://ec.europa.eu/digital-single-market/en/news/2019-desi-report-electronic-communications-markets-overview-member-state-telecom-chapters referring to data from Communications Committee (COCOM), annual data as of July 1st.

In addition to the three established wireless network operators Deutsche Telekom Vodafone and Telefonica, a provider which had previously only operated as a service provider (real MVNO) - 1&1 Drillisch - also participated in the auction. A total of 6.55 billion euros was raised.

The frequencies in the 3.7-3.8 GHz spectrum range will not be allocated by auction but will be reserved for local and regional use. These frequencies will be used for campus networks, for example in the industrial sector. The application procedure started in November 2019. Germany was the first country to adopt this strategy internationally.[132]

6.2.5 Use of high bandwidth applications

The volume of data processed on the basis of broadband connections in fixed networks continues to steadily increase. By the end of 2018, a total of around 46 billion GB had been generated by consumers. This corresponds to an average monthly data volume per line of approximately 112 GB.

The mobile data volume continues to rise steeply. While the data volume was 1,993 million GB at the end of 2018, preliminary calculations by the Federal Network Agency indicate that it will be around 2,765 million GB at the end of 2019. However, the annual growth rates have been increasingly lower since 2017.[133]

Business customers generally have higher requirements in regard to their broadband connection than residential customers. Their demand cannot be met by standard mass-market products and require higher performance features. Typically, business customers require flexible, tailor-made solutions with high levels on (symmetrical) bandwidths, quality (latency, packet loss rates, jitter) and security. In addition, high availability and reliability as well as short fault clearance times are relevant. This applies not only to larger companies, but also to a large number of SMEs whose business operations depend upon a reliable broadband access (e.g. ICT companies, financial service providers, industrial companies, but also numerous freelancers e.g. architects, programmers).

A summary of the use of applications in Germany is shown in the following table.

132 See 5G Observatory (2019). Quarterly Report 6 - Up to December 2019, http://5gobservatory.eu/wp-content/uploads/2020/01/90013-5G-Observatory-Quarterly-report6_v16-01-2020.pdf

133 See Bundesnetzagentur (2019): Tätigkeitsbericht Telekommunikation 2018/2019, https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Taetigkeitsberichte/2019/TK_20182019.pdf?__blob=publicationFile&v=9

Table 6-5: List of selected indicator for use of applications in Germany

Use of applications[134]			
	Germany	**EU average**	**Rank within the EU-28**
Regular Internet users (at least once a week) in % of population; 2019[a)]	91.2	85.3	7
Entertainment			
% of Internet users watching internet streamed TV or videos; 2018[a)]	74	72	13
Daily time spent watching television including streaming (by Internet users in minutes); 2019[b)]	186	N/A	N/A
% of Internet users playing or downloading games; 2018[a)]	27	33	22
% of internet users that download/play video games, listen to music or watch internet streamed TV or videos; 2018[a)]	82	81	14
E-Learning and remote work			
% of Internet users doing an online course (in any subject); 2019[a)]	8.5	11.2	15
% of employed people working from home (usually or sometimes); 2018[a)]	11.6	15	15
Cloud			
% of Internet users that used Internet storage space to save files (e.g. photos); 2019[a)]	31.0	34.4	17
% of businesses that buy cloud computing services of medium-high sophistication; 2018[a)]	12.0	17.8	21
E-Government and E-Health			
% of internet users that interacted online with public authorities; 2019[a)]	62.9	61.8	18
DESI index score E-Health; 2019[a)]	17.3	37	24

According to network operators, the impact of the coronavirus on network utilisation and end customers' data usage is clearly visible. It is assumed that teleworking and related services are prime drivers of this development. However, gaming and video streaming applications have also been more frequently used.

During peak times in the evening hours, an increase in data volumes of 10-20 % can be observed. In addition, an increase in off-peak times, e.g. morning and afternoon hours,

134 Source: a) EU, b) GlobalWebIndex via datareportal.com. Survey data from globalwebindex is not available for all EU countries and therefore no averages can be calculated

can be seen, presumably due to the increase of teleworking employees and the parallel use of different data-intensive applications. As a result, the data usage curve over the day has become flatter, and the previous peaks in usage are less visible.

With the increasing data volumes, some operators add that popular sports broadcasting in 8k (as envisioned with the Olympics and Soccer championships) would be problematic and might push the networks to the limits of their capacity. This in turn might be a driver boosting demand for fibre-based products by end customers.

Fibre operators are not reporting increased take-up in FTTB/H connections due to the coronavirus but according to them, it is too early to judge whether the coronavirus will prompt a shift in demand.

6.2.6 Challenges in driving take-up of gigabit technologies

Due to a low FTTB/H availability in Germany, a disproportionately high number of customers in Germany still use xDSL connections compared to neighbouring countries. The focus of the expansion activities of Deutsche Telekom and many competitors in recent years has been on FTTC.

Since Deutsche Telekom and the largest broadband retail providers rely on access to the DT network, they can only provide a small part of the population with gigabit broadband due to the low coverage. FTTB/H is also not widely advertised by the large providers with extensive marketing and sales budgets, which may limit demand. In contrast, a number of regional and local alternative network operators actively market FTTB/H connections, but their efforts are mainly visible in the areas which they serve.

Moreover, in areas where copper networks have been upgraded with vectoring and super-vectoring, there is limited demand-side pressure to opt for very high bandwidths. Nevertheless, the marketing successes of regionally active fibre providers as well as those of cable network operators indicate that very high bandwidths can also be successfully marketed in Germany.

The low FTTB/H coverage in Germany is partly structural in nature. The comparatively good condition of the network infrastructure, combined with relatively short cable lengths, has encouraged the incumbent's FTTC expansion strategy. In addition, due to the lack of empty duct infrastructure, strict specifications in the choice of deployment methods, in some cases long-term approval procedures, resource bottlenecks in civil engineering and a comparably high proportion of households in rural areas, the deployment costs for FTTB/H in Germany are disproportionately high. Furthermore, investments in FTTC were favoured by regulatory decisions and state aid funding policy until 2018.

However, following a policy review and the start of pilot projects in 2018, the focus on state aid support has now shifted towards supporting fibre deployment, and the region of Bavaria will become the first country in Europe to fund fibre deployment through state

aid in areas which already have NGA (primarily FTTC) infrastructure capable of at least 30 mbps (so-called NGA grey areas).

The Bavarian funding scheme now enables state-wide support in areas that already have broadband and where, for instance, enterprise users have a particularly high demand. Private users will also benefit from the promotion of fibre. Bavaria plans to focus subsidies on fibre connections all the way into buildings. The municipalities within the Bavarian state could start the application procedure from March 2020.[135]

Key conditions are that:

- The area to be developed under the state aid (development area) is a "grey or white NGA spot".
- In the development area there is still no network that can reliably transmit 100 Mbit/s in download mode for private connections and 200 Mbit/s symmetrically for commercial connections.
- A network which can reliably transmit 100 Mbit/s download for private connections and 200 Mbit/s symmetrically for commercial connections is unlikely to be rolled out by private network operators in the next three years.
- The funding will lead to a significant improvement in the current broadband coverage or the broadband coverage achieved through a commercial expansion within a period of three years.
- Significant new investments are being made (e.g. optical components that are brought closer to end customers).[136]

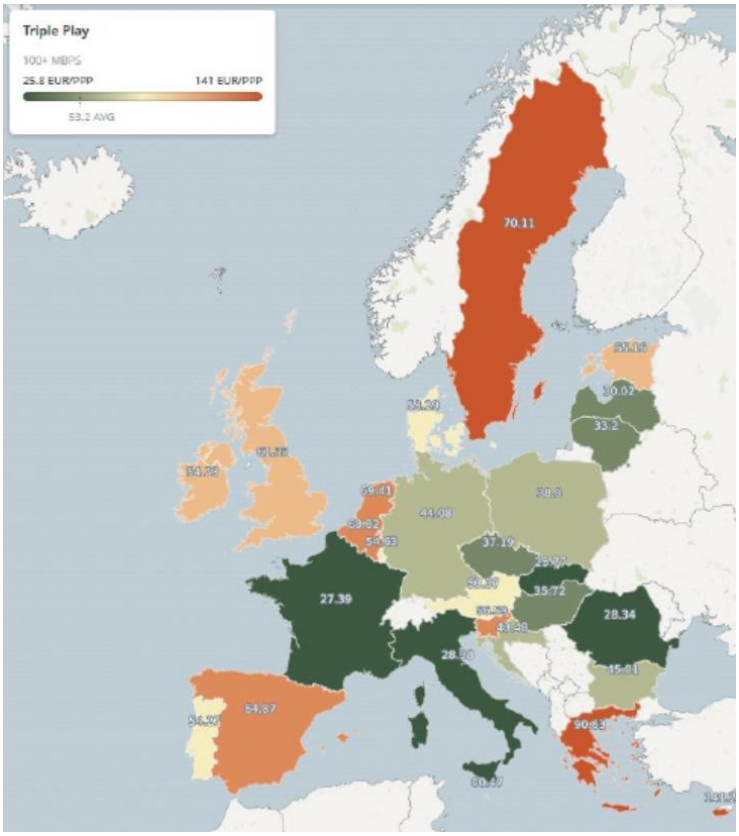
6.2.7 Pricing and willingness to pay

Germany ranks below average among the EU countries in most Single Play, Double Play TV, Double Play Phone and Triple Play bundles each across three different speed categories.

For instance, the average price for the highest advertised download speed category (100+ Mbps) in Germany belongs to the lower prices among the EU-28 member states.

135 See https://www.schnelles-internet-in-bayern.de/breitbandzentrum/presse/12.
136 Details can be found in https://www.verkuendung-bayern.de/baymbl/2020-76/.

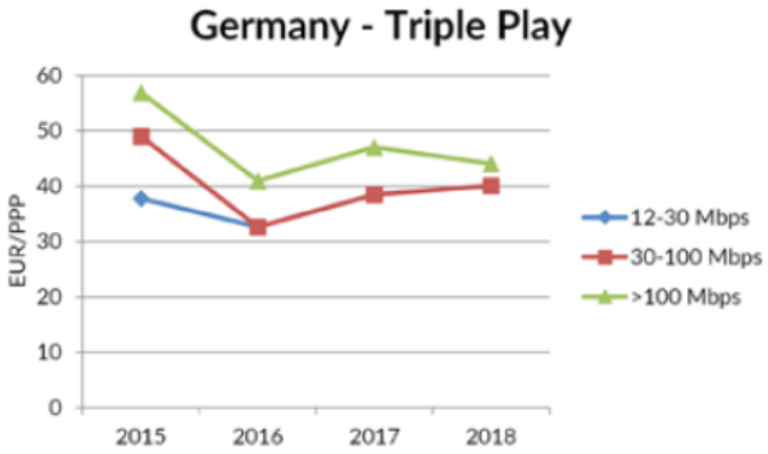
Figure 6-9: Prices for triple play bundles across Europe (100 Mbps+)[137]



In 2017 and 2018, triple play broadband prices for lower bandwidth increased. However, triple play broadband prices for bandwidth >100 mbps decreased. Thus, a convergence in prices can be observed which can also be seen in other double play bundles.

137 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

Figure 6-10: Prices for triple play bundles in Germany over time[138]



Despite the relatively low prices for higher speed broadband, German customers do not necessarily request high capacity broadband access: While Germany lies above EU average with speeds between 30 and 100 Mbps, it is noticeably outranked in take up of services with speeds above 100 Mbps, despite the relatively widespread availability of such offers via cable.

Some operators state that the end customers' additional willingness to pay for fibre products (compared with less performant broadband products) is limited in general. Many end customers seem satisfied with their existing broadband access and have not experienced regular disruptions and quality reductions during their daily activities. Thus, end customers might not be able to perceive the quality improvements of fibre compared with other broadband products.

The limited willingness to pay can also hinder roll out activities of specialist regional fibre investors as many of these companies take into account the expected revenues of a region or city when targeting areas and concluding pre-contracts with end customers for the provision of fibre in an area not yet served. They state that several factors influence the customers' willingness to pay such as receiving "best" (fastest and most reliable) product and a relatively low premium compared to their current connection. That said, regional investors report that rural areas might be willing to pay more because of existing connectivity problems. It is also noted that due to a need to reach a certain quota of pre-contracts in order to proceed to deployment, solidarity towards the community may play a role in securing the necessary number of commitments in rural areas.

138 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

6.2.8 Wholesale pricing measures (where relevant)

The wholesale pricing regime has not been designed to support migration from copper or FTTC/VDSL towards fibre products and may perversely have hindered it.

Copper based products are subject to access regulation based on long run incremental costs. Fibre based products that are not subsidised via state aid are not currently subject to access regulation, although in 2017 BNetzA issued a public consultation in 2017 in which they proposed the use of economic replicability (margin squeeze) tests for fibre-based products.

Access to DT's FTTC/VDSL network is primarily based on a "risk sharing" model (contingent model), originally approved by BNetzA in 2012, which provides long-term discounts for operators prepared to make an upfront commitment. DT concluded similar commercial agreements with Vodafone, Telefónica and 1&1. The contingent model led to a marketing offensive in VDSL connections by competitors, which has been reflected in significantly increasing VDSL customer numbers.

The long-term nature of the agreement and volume discounts may have contributed to a continued reliance by alternative operators on FTTC/VDSL technology rather than seeking alternatives where available (such as wholesale access on the networks of local FTTH providers).

On the other hand, this development suggests that appropriate wholesale pricing models for fibre could encourage marketing by alternative operators, which in turn could stimulate demand and create incentives for the roll-out of new broadband infrastructures.[139]

6.2.9 Awareness and advertising standards

Consumer protection in the telecommunications sector lies within the responsibilities of the national regulatory authority, the Bundesnetzagentur (BNetzA). Transparency clauses in the Telecommunications Law require that end customers should be able to compare telecom services with regard to their price and quality.

Currently, no specific provisions or decisions governing "fibre" advertising or broadband-ready labels exist in Germany. There has been no significant public debate about the misleading use of "fibre" in advertising or formal complaints or decisions on this subject.

However, the NRA has required ISPs to provide a product fact sheet on their website containing the maximum advertised speed, the normally and minimum available speeds since 2017.

139 Gries et al. (2017): Treiber für den Ausbau hochbitratiger Infrastrukturen, https://www.wik.org/fileadmin/Studien/2016/VATM_Hochbitratige_Infrastrukturen.pdf

Despite the absence of specific rules to designate broadband products, operators such as . Deutsche Telekom, Vodafone and Deutsche Glasfaser have tended to refer only to “fibre optics” in the context of full fibre products.

More generally, Germany lags behind in FTTB/H-availability and the willingness-to-pay of consumers is low. Against this background, the public debate has revolved around fibre deployment rather than fibre advertising. Thus, the roll-out is often driven by companies with a strong local anchoring and a focus on pre-marketing activities. Their campaigns usually inform customers very precisely on the expansion and advantages of fibre products. This type of advertising is relatively expensive. However, with further expansion of fibre into urban areas, clear wording in relation to "fibre" could become increasingly important.

6.2.10 End-user voucher schemes (where relevant)

No federal voucher scheme is present in Germany.

However, in the small state of Saarland (about 1 million inhabitants) a gigabit premium is granted until end of 2020 if specific conditions are met. For new connections, the state grants companies and sponsors of non-profit or cultural institutions a subsidy of up to 25% of the construction costs for a fibre connection in accordance with the funding guidelines. In contrast to other broadband subsidy programmes, the gigabit bonus is directly aimed towards users with high bandwidth requirements - regardless of their current bandwidth and location. A practical guide is available for interested high demand users.[140]

6.2.11 Forced migration measures/copper switch-off

There are currently no known plans in Germany for a complete FTTB/H roll-out of the incumbent Deutsche Telekom. Some network operators highlight the benefits of declining operational and maintenance costs that could arise from a switch off of the copper network. However, the limited FTTB/H expansion and the incumbent's focus on FTTC are regarded as the greatest obstacles to copper switch-off in Germany.

PSTN switch-off is a prerequisite of copper switch-off, and this is already far advanced in Germany. As of 2019, less than 2% of the connections in Germany were still based on PSTN. IP migration was due to be completed by the end of 2019 for private customers and by the end of 2020 for business customers.

Some technical problems with PSTN migration were solved by the Bundesnetzagentur via a structured dialogue with the incumbent and consumer representatives.[141]

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140 See https://www.saarland.de/gigabitpraemie.htm

141 See Tenbrock, S. et al. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU, WIK discussion paper no 430, https://www.wik.org/index.php?id=meldungendetails&tx_ttnews%5BbackPid%5D=85&tx_ttnews%5Btt_news%5D=2293&cHash=8a1fdd2ac8d544650dd51759f9b9180d

6.2.12 Initiatives to boost digital applications

Germany has a number of programmes and initiatives that drive the diffusion of digitisation as well as digital services and applications.

The overarching initiatives, which cover various areas of life and work across sectors, include the “Digitaler Gipfel “(digital summit), an annual congress organised by the Federal Ministry of Economics and Energy since 2006, which is intended to serve as a central platform for shaping digitisation and the digital transformation of the economy, state and society in Germany.

The initiative “Initiative Stadt.Land.Digital” supports cities and municipalities in their digital transformation. It acts as competence and contact centre for all relevant actors and topics on the way to the "smart" city and the "smart" region by reporting on relevant developments and good practices as well as organising networking meetings and local workshops in various regions.[142]

For the industry SME, “Mittelstand-Digital” is an important programme, since 99% of German companies are SMEs and mostly family-owned medium-sized companies. The programme started in 2012 (start of Mittelstand-Digital as an umbrella initiative) while in 2015 the launch of the Mittelstand 4.0 competence centres within Mittelstand-Digital took place. These competence centres are located across Germany. SMEs are informed and educated about digital transformation solutions and are invited to demonstration centres and can participate in workshops.[143]

At special focal locations in German universities and research institutions, complex production and logistics systems are tested and further developed in test environments under realistic conditions. Since the test environments are networked with each other, production and application processes can be realistically simulated in specific test environments.

In dialogue with industry, associations, and science facilities, the Federal Government wants to create the conditions for the success of the fourth industrial revolution. The aim of the "Platform Industry 4.0" is to secure and further expand Germany's leading international position in the manufacturing industry.[144]

In Germany, there is a broad spectrum of services and applications for digital education in which new and innovative e-learning solutions are implemented. These are available for both learners and teachers and cover all age groups and disciplines.

Most initiatives are taking place on a regional and local level: For example, e-learning provides solutions designed specifically for children at a young age to increase their digital literacy: Students in entire classes or schools (sometimes even in primary school) are equipped with their own devices (such as laptops or tablets) specifically for

142 See https://www.de.digital/DIGITAL/Navigation/DE/Stadt-Land-Digital/stadt-land-digital.html
143 See https://www.mittelstand-digital.de/MD/Navigation/DE/Home/home.html.
144 See https://www.bmwi.de/Redaktion/DE/Dossier/industrie-40.html.

educational purposes. Students can use these as learning tools that can be adapted to their individual level and learning progress.

In secondary schools, vocational schools and education, these solutions, which target a group of pupils or entire classes, are even more prevalent. Some innovative solutions include augmented reality (e.g. with playful learning approaches), while others introduce tactile Internet (e.g. with a haptic overlay that brings students and teachers together). Especially in tertiary education, services and applications for a large number of users are emerging that involve interaction amongst groups and demand high quality broadband connections. Against this background, interactive Massive Open Online Classes (MOOC) are playing an increasingly important role.

Compared to other European countries, Germany is clearly lagging behind in Smart Health and is only in mid-field. However, on regional and local level an increasing number of services and applications are implemented. This includes teleconsultations that enable hospitals, practices and other medical institutions to be connected so doctors can consult each other and sometimes even interact virtually. Telemonitoring solutions that enable doctors and medical staff to remotely monitor patients or senior citizens with health problems in their homes in real time have also become increasingly widespread.

With the E-Health-Initiative, Germany aims to improve the use of digital technologies in healthcare as well as identify implementation hurdles for the establishment of digital applications and develop packages of measures to reduce these hurdles.[145]

In addition, numerous initiatives in other areas exist, e.g. E-Government[146], Smart Mobility[147], Smart Farming[148] and a variety of local and regional Smart City and Smart Region initiatives.[149]

145 See https://www.bundesgesundheitsministerium.de/e-health-initiative.html
146 See https://www.bmi.bund.de/DE/themen/moderne-verwaltung/e-government/e-government-node.html
147 See e.g. https://www.bmvi.de/EN/Topics/Digital-Matters/mFund/mFund.html.
148 See e.g. https://www.bmel.de/DE/Landwirtschaft/_Texte/Digitalisierung-Landwirtschaft.html
149 https://www.bitkom.org/Presse/Presseinformation/50-deutsche-Staedte-sind-auf-dem-Weg-zur-Smart-City

6.3 Italy

6.3.1 Summary

Italy
• There is no cable coverage, in contrast with the UK • FTTC/VDSL is widespread and been deployed extensively by the incumbent, as well as – to a lesser extent – by Fastweb (an entrant) • FTTH/B is primarily being deployed by the alternative wholesale only investor Open Fiber. Alternative operators are offering services via OF, but the incumbent has not yet reached an agreement to buy wholesale services, and instead provides FTTC/VDSL in many of the areas where OF is installing fibre. • Operators have adopted very aggressive pricing strategies (best technology/speed available to the user for €29.99/month or less). There is no differentiation in pricing for different speeds or technologies • The regulator has introduced a clear labelling system which highlights through traffic lights the quality of the underlying technology. However, its effectiveness has been undermined by a strategy whereby operators typically market only their fibre-based service (showing a green label), even where fibre is not available. • Italy was a frontrunner regarding auctions for 5G spectrum. FWA plays a significant role in the market compared with other countries, and 5G FWA offers are planned, for urban as well as rural areas. • Italy was hit hard by the coronavirus. This has resulted in a dramatic increase in bandwidth use as well as the digitisation of entertainment and professional activities

6.3.2 Context

Italy[150]		
Population		60,359,546
Number of households		25,925,800
Population density in people per km^2		202.9
% of people living in	Cities	34.3
	Towns and suburbs	41.2
	Rural areas	24.5
% of people living in	Houses	47.2
	Flats	52.6
GDP per capita in € PPP		26,860

150 Population data: 2019; rest: 2018. Source: Eurostat

6.3.3 Main players and technologies

A significant distinction between Italy and the UK (as well as the other case study countries) is the absence of a cable network, which left Telecom Italia (TI) with an effective monopoly in basic broadband infrastructure. However, like the UK, Italy features an extensive FTTC/VDSL deployment.

This deployment was initially triggered through infrastructure competition. Supported by favourable regulatory conditions,[151] the alternative operator Fastweb (a Swisscom subsidiary), deployed FTTC/VDSL on the basis of subloop unbundling, which stimulated a competitive response in FTTC/VDSL by the incumbent. TI has continued to expand its FTTC/VDSL deployments, and recently announced the launch of FTTC/VDSL services in several rural areas.[152] Due to the short loop lengths, comparatively speeds can be achieved via FTTC/VDSL in Italy – of up to 200Mbit/s download.

However, Government concerns about Italy falling behind in the deployment of ultrafast broadband, spurred efforts to support the entry of an infrastructure competition focused on fibre provision. Open Fiber was founded in December 2015 with the objective of installing, supplying and operating FTTH communications networks across Italy. The company operates as a joint venture between the energy utility Enel, and the equity arm of the national investment bank Cassa Depositi e Prestiti (CDP).[153]

Open Fiber operates on a wholesale-only basis, with a range of wholesale offers including bitstream and resale, alongside fibre unbundling. Retail customers are served through service providers such as Vodafone, Wind Tre or Melita. In areas where FTTB/H is not available, these providers also seek wholesale (VULA-based) access to the FTTC network of the incumbent. Recently there have also been rumours about a possible merger of Telecom Italia and Open Fiber, but no decision has been made yet[154], despite the Government being in favour of a merger.[155]

Following the establishment of Open Fiber, the incumbent TI established a joint venture with Fastweb (Flash Fiber), to deploy FTTH. The goal of TI and Fastweb is to connect 3 million homes in 29 major Italian cities already covered by FTTC by 2020 for a total investment of €1.2 billion, financed part in equity and part in debt.[156]

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151 In order to foster infrastructure competition in NGA, the regulator initially focused on providing attractive conditions for competitors to deploy FTTC/VDSL, reducing subloop prices, facilitating backhaul deployment through duct access, and prohibiting the deployment by the incumbent of vectoring unless this could be done in a manner which did not exclude competitors for unbundling the subloop.

152 https://www.commsupdate.com/articles/2020/03/26/tim-expands-fttc-broadband-as-mobile-tower-merger-nears-completion/

153 Cassa Depositi e Prestiti is a company under the control of the Italian government active in the acquisition and management of shareholdings in Italian companies.

154 https://www.businessinsider.com/italys-tim-holds-out-for-control-of-single-broadband-network-2020-3?r=DE&IR=T

155 https://www.commsupdate.com/articles/2020/02/27/italian-government-pushes-for-tim-open-fiber-deal/

156 https://advanced-television.com/2016/07/28/fastweb-telecom-italia-partner-on-ftth-network/.

At the start of 2018, Flash Fiber had connected 430,000 addresses, and by mid-2018, the company reported that it had completed half its planned network development.[157] Areas covered by Flash Fiber are shown in the map below.

Figure 6-11: Areas covered by Flash Fiber

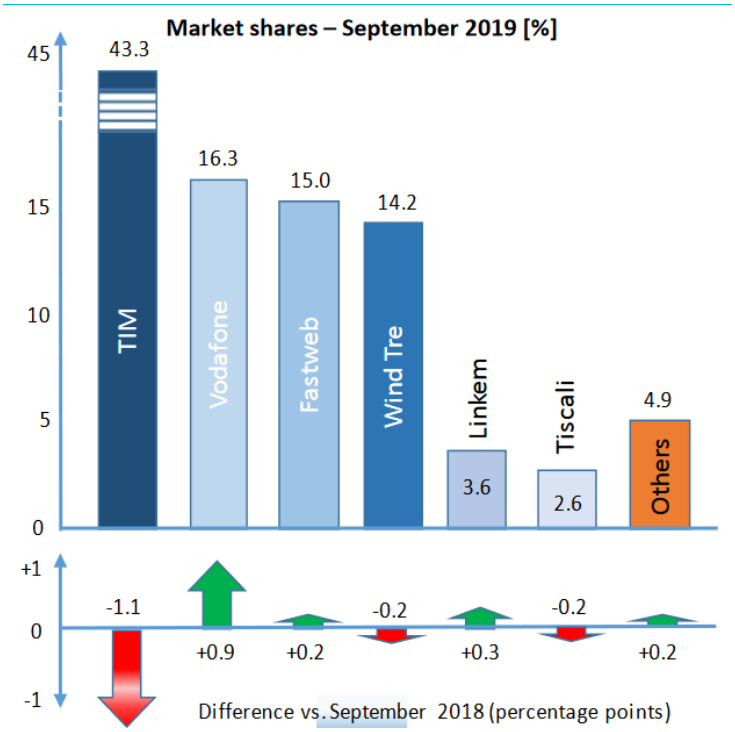
Source: https://www.flashfiber.it/en/coverage/

However, Flash Fiber's FTTH deployment is dwarfed by that of Open Fiber, which had reached 8m premises (including more than 2m premises in rural areas – supported by state aid), by the end of 2019.

At the retail level, Telecom Italia currently has a market share of more than 40 percent, while a further ~45 percent is shared almost equally between Vodafone, Fastweb and Wind Tre. Other operators play smaller roles in the market.

157 https://www.flashfiber.it/en/2018/07/19/coverage-progress/

Figure 6-12: Market shares (broadband fixed lines, i.e. no voice-only lines) and recent development[158]



The operators that also operate in the mobile market as MNOs (Telecom Italia, Vodafone, Wind Tre), offer bundles including both fixed and mobile services. Fastweb is operating as an MVNO on the network of Wind Tre[159], but plans to become an MNO itself with the introduction of 5G into the mass market.[160] Most operators offer TV packages alongside broadband, and some have broadened their portfolio further and also sell Smart TVs (Telecom Italia) or energy services in cooperation with partner companies (Fastweb).

Commercial launches of 5G started in June 2019 by Vodafone and Telecom Italia.[161] The two companies also formed a joint venture building and administrating telecom towers.[162] Italy is a frontrunner in assigning spectrum for 5G, and is the only European country that has assigned not only the 700 MHz and the 3.6-3.8 GHz band but also

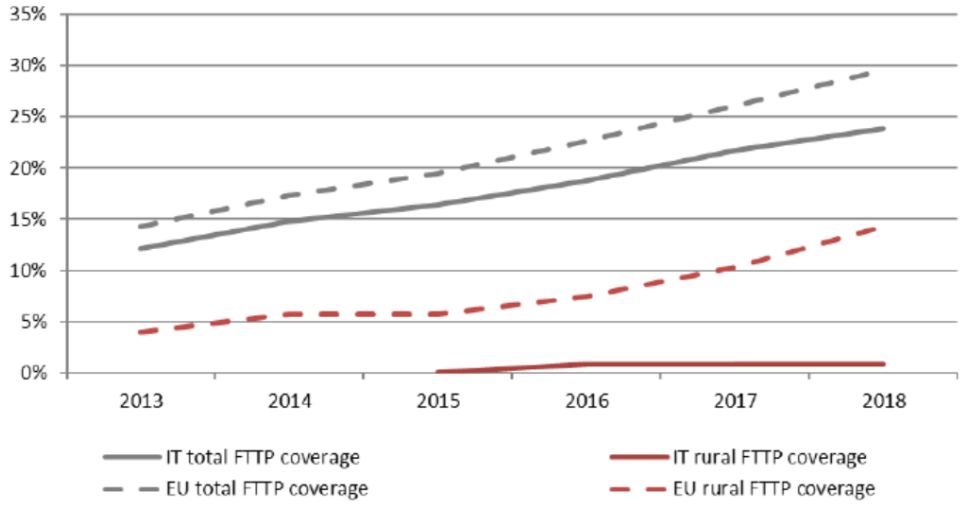
158 See https://www.agcom.it/documents/10179/4386532/Allegato+23-1-2020/7b245499-7f9f-45af-80c0-76b41a197b7c?version=1.0
159 https://www.fastweb.it/corporate/media/comunicati-stampa/fastweb-e-wind-tre-annunciano-un-accordo-strategico-per-la-realizzazione-di-una-rete-5g-a-livello-nazionale/?lng=EN
160 https://www.fastweb.it/corporate/media/comunicati-stampa/fastweb-e-il-quinto-operatore-mobile-italiano/?lng=EN
161 http://5gobservatory.eu/tim-launches-5g-services-in-parts-of-rome-and-turin-with-new-5g-plans/
162 https://europeansting.com/2020/03/09/mergers-commission-clears-acquisition-of-joint-control-over-inwit-by-telecom-italia-and-vodafone-subject-to-conditions/

frequencies in the 26 GHz band. Several market players are investing in enabling 5G FWA in the future.[163]

6.3.4 Trends in deployment and take-up of gigabit-capable technologies

FTTB/H coverage in Italy is growing slowly but steadily by 2-3 percentage points of households per year. In the past the deployment was mostly focused in urban areas, while the deployment in rural areas remained flat (see Figure 6-13). However, recently, Open Fiber has started to deploy fibre in more areas, including rural areas, with the support of state aid programmes.[164]

Figure 6-13: FTTP coverage, total and rural (% of households), 2013-2018[165]



The expansion of FTTC has been rapid in the last few years. While in June 2015, 32.8% of households had access to a FTTC/VDSL network, this number rose until mid-2018 to 87.9%, leaving only about 12% of households with ADSL lines (or, to a far smaller extent, no DSL at all).

The deployment of FTTB/H in the coming years is expected to vary in different parts of the country. High coverage is expected in the area around Venice (Veneto) as well as in the rest of Northern Italy and in Rome, while parts of Southern Italy and Sardinia are not likely to benefit from substantial coverage soon (see Figure 6-14).

163 https://www.rcrwireless.com/20191227/5g/italian-telcos-accelerate-5g-fixed-wireless
164 https://www.corrierecomunicazioni.it/telco/banda-ultralarga/banda-ultralarga-a-open-fiber-la-seconda-gara-infratel/
165 See DESI 2019 – Telecom Chapters Italy, available at: https://ec.europa.eu/digital-single-market/en/news/2019-desi-report-electronic-communications-markets-overview-member-state-telecom-chapters

Figure 6-14: Coverage with gigabit-capable technology projected in 2021 based on the operator answers to a 2019 public consultation[166]

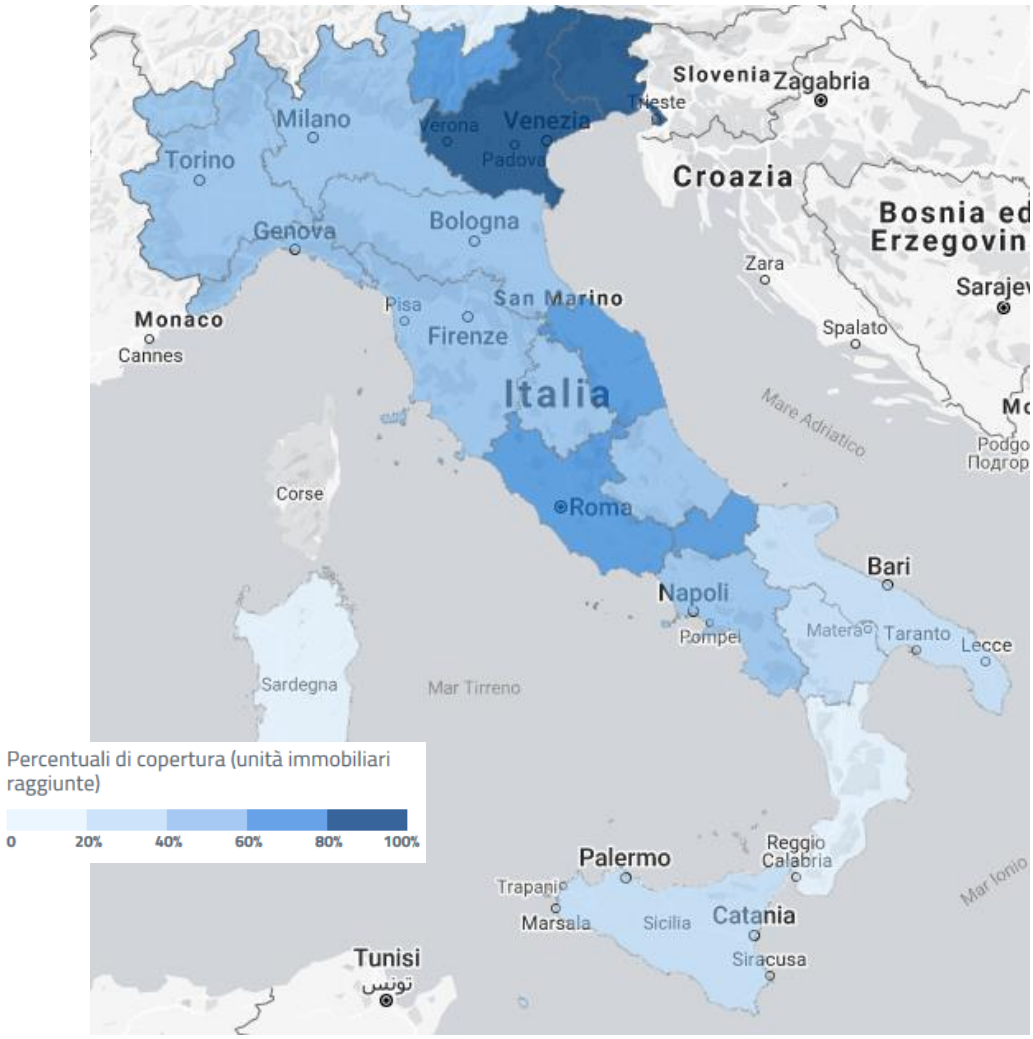
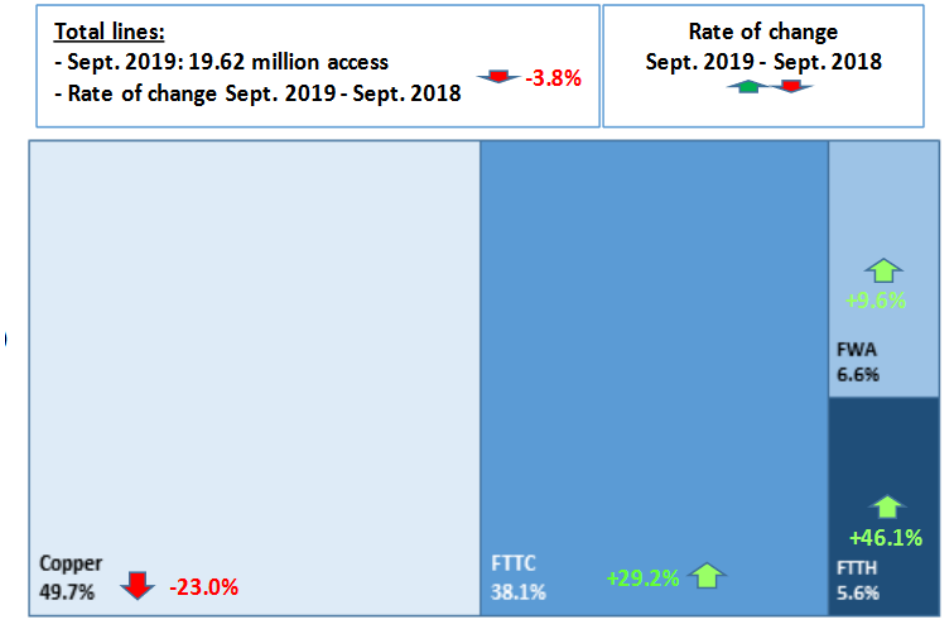


Figure 6-15 shows that copper lines still account for around half of all fixed access lines[167] but are in rapid decline with users increasingly migrating to FTTC and, and more recently FTTH. Fixed wireless broadband solutions (FWA) play a larger role in Italy than in many other European countries with 6.6% market share in September 2019.

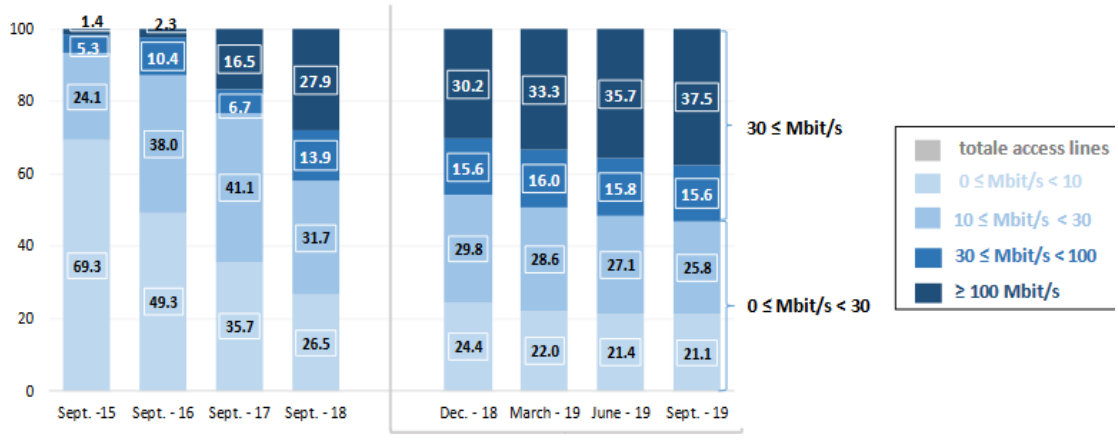
166 http://bandaultralarga.italia.it/en/italy-ultra-broadband-map/
167 This figure not only includes fixed access broadband lines but also voice-only lines using copper technology.

Figure 6-15: Distribution of fixed access lines by infrastructure and its trend, comparison between September 2019 and September 2018[168]



This trend is also reflected in the take-up of broadband access lines by speed, which is heavily influenced by the way fixed broadband is priced and marketed in Italy as explained in section 6.3.7:

Figure 6-16: Access lines by speed classes (in %)[169]



168 https://www.agcom.it/documents/10179/4386532/Allegato+23-1-2020/7b245499-7f9f-45af-80c0-76b41a197b7c?version=1.0

169 https://www.agcom.it/documents/10179/4386532/Allegato+23-1-2020/7b245499-7f9f-45af-80c0-76b41a197b7c?version=1.0

The measured speeds of fixed broadband are relatively low in Italy, likely due to the still relatively low penetration of full fibre lines. The average download speed as measured by Speedtest.net/Ookla (based on user speed tests on their site) was at about 60 Mbit/s in the beginning of 2020[170], lower than in most other EU member states. With the Covid-19 pandemic and its increased network load, the speeds dropped by around 10% during the course of March 2020.[171]

6.3.5 Use of high bandwidth applications

Use of high bandwidth applications is illustrated in the following table. Italy has a relatively low proportion of users making use of Internet services (perhaps commensurate with the age profile of Italian citizens). E-learning and remote working as well as cloud use are relatively low by European standards. However, the proportion of Italian Internet users that make use of gaming or video streaming is around the EU average.

Use of applications[172]			
	Italy	**EU average**	**Rank within the EU-28**
Regular Internet users (at least once a week) in % of population; 2019[a)]	73.9	85.3	24
Fixed broadband data usage			
Entertainment			
% of Internet users watching internet streamed TV or videos; 2018[a)]	72	72	15
Daily time spent watching television including streaming (by Internet users in minutes); 2019[b)]	187	N/A	N/A
% of Internet users playing or downloading games; 2018[a)]	27	33	22
% of internet users that download/play video games, listen to music or watch internet streamed TV or videos; 2018[a)]	80	81	19
E-Learning and remote work			
% of Internet users doing an online course (in any subject); 2019[a)]	9.4	11.2	12
% of employed people working from home (usually or sometimes); 2018[a)]	4.8	15	23
Cloud			
% of Internet users that used Internet storage space to save files (e.g. photos); 2019[a)]	26.1	34.4	22

170 https://www.speedtest.net/global-index/italy
171 https://www.speedtest.net/insights/blog/tracking-covid-19-impact-global-internet-performance/
172 Source: a) EU, b) GlobalWebIndex via datareportal.com. Survey data from GlobalWebIndex is not available for all EU countries and therefore no averages can be calculated. Survey data from the EU is based on the age group 16 to 74, GlobalWebIndex surveys the age group 16 to 64.

Use of applications[172]			
	Italy	EU average	Rank within the EU-28
% of businesses that buy cloud computing services of medium-high sophistication; 2018[a)]	14.7	17.8	18
E-Government and E-Health			
% of internet users that interacted online with public authorities; 2019[a)]	29.9	61.8	27
DESI index score E-Health; 2019[a)]	28.7	37	16

6.3.6 Challenges in driving take-up of gigabit technologies

The main factor preventing the take-up of gigabit broadband in Italy is the lack of deployment of gigabit-capable technologies with no cable infrastructure and less than 24% FTTB/H coverage as of Mid-2018.**173** However, this is not the only factor deterring upgrades.

Market participants observe that the relatively low take-up of FTTB/H may be due to potential customers not being aware of the benefits of full fibre subscriptions. Some consumers are also resistant to allow technicians into their home to install the necessary equipment. This is especially true for consumers which only recently migrated from ADSL to FTTC and are satisfied with the service levels experienced (noting that high bandwidths are possible over FTTC due to the short loops). For a satisfied customer, even small inconveniences because of the installation are seen as problematic for take-up. Challenges associated with advertising are discussed in section 6.3.9.

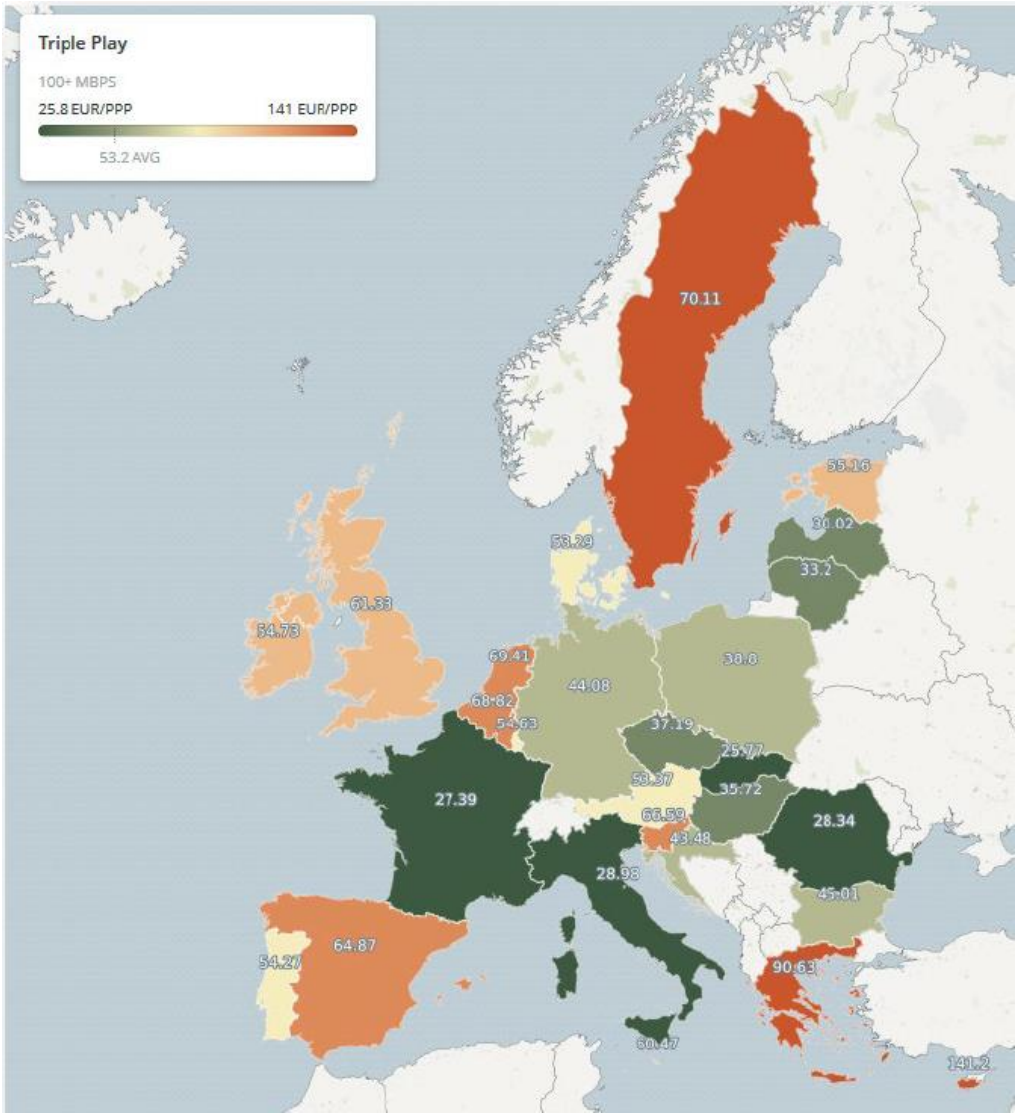
Although take-up challenges persist for the moment, it is possible that an agreement between the incumbent and the wholesale only network provider Open Fiber might support increased take-up in the future. Talks on a potential agreement for TI to buy wholesale from Open Fiber are ongoing. However, buying fibre wholesale may undermine TI's previous investments in FTTC/VDSL.

6.3.7 Pricing and willingness to pay

In recent years, prices for fixed broadband, especially for higher speeds has decreased dramatically in Italy, and by more than the average decline in the rest of the EU. This holds for single play offers as well as for bundles including telephony and/or TV offers. The development in take-up of higher speed offers can be found in section 6.3.4.

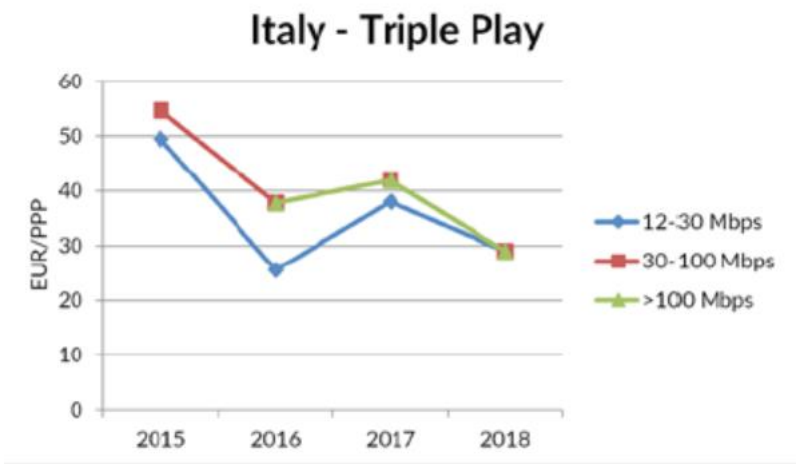
173 See Broadband Coverage in Europe 2018. Projections based on the plans of the operators see a FTTB/H coverage of 53% in 2021, see: http://bandaultralarga.italia.it/en/italy-ultra-broadband-map/

Figure 6-17: Prices for Triple Play 100+ Mbit/s access lines in Europe[174]



174 See Study on Fixed broadband prices in Europe 2018

Figure 6-18: Development of prices for triple play products in Italy[175]



In general, prices for fixed broadband (in PPP) are relatively low in Italy, especially for higher speeds. Moreover, pricing and advertising for gigabit/fibre[176] is different in Italy than in other countries, explaining the convergence of prices for all speed tiers in pricing benchmarks. Operators only advertise one fixed broadband product[177] with one price. As seen in Figure 6-19 for Telecom Italia, this product is an FTTH-based gigabit line (100 Mbit/s upload) for 24.90€/month.[178]

Figure 6-19: Advertising of Telecom Italia's full fibre product[179]

175 See Study on Fixed broadband prices in Europe 2018
176 Because of the absence of a cable network and no widespread use of 5G FWA yet, all gigabit lines are based on FTTB/H in Italy currently.
177 Voice only lines and FWA are typically advertised separately.
178 Currently it is bundles with three months of Disney's video streaming service Disney+. Similar broadband access including a router and unlimited calls costs 5€/month more.
179 https://www.tim.it/

If a customer is not within reach of Telecom Italia's fibre network, the same price applies to the best possible offer available to the user. If the user is in reach of their FTTC network, the speed is either 200/20 or 100/20 Mbit/s (depending on the exact architecture at that point). If only ADSL is available, the speed is 20/1 Mbit/s.

This means that a user always receives the best possible Internet speed at their residence at a fixed price. There is no high-speed premium and there are no different speeds available through the same technology as it is the case in most, if not all, other European countries.

The pricing scheme of all significant competitors such as Vodafone, Wind Tre or Fastweb is the same, often with slightly cheaper prices. Because of that, the willingness to pay for high speeds (and fibre) does not play a significant role in Italy, as there is no speed premium. FWA is also offered, typically at a lower price than fibre but capped after a certain amount of traffic (e.g. Wind Tre offers 100 gigabyte with the maximum speed their mobile network allows for 12.99€/month).

6.3.8 Wholesale pricing measures (where relevant)

Prices for wholesale broadband on the incumbent network in Italy have been set at cost-oriented rates with differentiated premia for FTTC/VDSL and FTTH-based services.[180] Thus, the focus of regulatory pricing strategy, has been on supporting investment rather than migration from one technology to another.

However, it can be assumed that the wholesale FTTH prices charged by Open Fiber, the main (unregulated) provider of FTTH infrastructure, have been constrained by wholesale FTTC/VDSL offers, as Open Fiber has a strong incentive to attract service providers onto its wholesale only network.

6.3.9 Awareness and advertising standards

The regulator AGCOM has decided to implement a mandatory traffic light labelling system for advertising broadband products. For fixed networks, ADSL offers are marked in red with an R (for rame, Italian for copper), FTTC offers are marked in yellow with an FR (for Misto fibra-rame, Italian for mixed fibre-copper) and FTTB/H offers are marked in green with an F for fibra. Only FTTB/H based-services are allowed to be advertised as fibra/fibre.[181]

180 Case IT/2014/1585-1587.
181 https://www.consumatori.it/telefonia/bollini-agcom-internet/

Figure 6-20: Traffic light system for advertising broadband in Italy[182]

The green traffic light marked with an “F” can be seen in Figure 6-20 as well as in the advertising of Fastweb (see illustration below):

Figure 6-21: FTTB/H advertising by Fastweb[183]

The advertising system clearly distinguishes between the quality that should be available for given offers. However, there are some drawbacks, which may be associated with the fact that no rules have been put in place to restrict the use of

182 Agcom (2018): Allegato C alla delibera n. 292/18/CONS
183 https://www.fastweb.it/adsl-fibra-ottica/fastweb-casa/

advertising for services which are not widely available to those viewing the advertisement.

Potentially influenced by the traffic light system, operators in Italy typically advertise their FTTB/H broadband product, and if the user is not able to use the FTTB/H network (which is the case for most customers today), the fastest alternative is used instead at the same price.

As the operators currently only advertise the FTTB/H offers on their main pages, they can freely advertise them with the green traffic light, although it is not available for every customer depending on the network coverage. If potential customers enter an address where the FTTB/H offer is not available, they are automatically redirected to the product available to them, marked with the respective traffic light.

It is possible that some users may believe that they booked a full fibre subscription because of the way the advertising works on the operators' websites, even though they were redirected to the FTTC offer. This could negate or even reverse the effect of the labelling system.

As a result, some stakeholders have called for advertising to reflect the actual availability of technologies, and for colour labels to be clearly included on the contracts that customers sign before they can receive their service.

6.3.10 End-user voucher schemes

In 2019 Italy started working on a possible broadband voucher programme. Small and medium-sized businesses would be able to receive a 3.000 € subsidy for migrating to a fibre-based connection, while schools can receive 5.000 € for doing so.[184] This potential measure to stimulate gigabit demand has not yet been implemented and is still in development. According to market participants, from the 1.3 billion € that were planned for the scheme, 200 million € will be allocated for connecting schools with full fibre and the exact use of the rest is still to be determined, likely after the coronavirus pandemic.

6.3.11 Forced migration measures/copper switch-off

The incumbent Telecom Italia announced in 2017 and 2018 first plans regarding a reduction for main distribution frames (MDFs) from 10,000 to 4,000, with a focus on small MDFs which have few customers connected. Depending on the competitive situation (regarding wholesale access) the switch-off needs to be announced 12 to 24 months in advance.[185] Because of the widespread use of FTTC by the incumbent, a

184 https://www.commsupdate.com/articles/2019/04/12/more-details-on-italian-broadband-voucher-scheme/

185 See Tenbrock, S.; Knips, J.; Wernick, C. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU. WIK Discussion Paper 459. Bad Honnef, 2020. Available in German.

copper replacement is mainly performed between the MDF and the street cabinets and not on the "last mile" towards the customer's homes.[186] Thus, the switch-off is to FTTC/VDSL rather than to FTTH.

6.3.12 Initiatives to boost digital applications

Digitisation of Government has become a bigger focus in Italy in recent years. In September 2019 this led to the appointment of Paola Pisano as the minister of innovation, technology and digitisation. She was previously involved in enabling the smart city project in Turin.[187] In March 2019 the Government approved the "Three-Year Plan for Information Technology in public administration 2019 – 2021"[188], which is especially targeted at developing better public digitisation strategies. E-Health initiatives are being implemented by local authorities. However, these have mainly been targeted towards eliminating bureaucratic overhead (such as switching from paper-based to electronic prescriptions) rather than as a demand driver for higher bandwidths.[189]

In terms of the digitisation of industry, analysts believe that Italy is in a good position to make intensive use of cloud services, IoT and especially industrial robots.[190] One important measure supporting demand is investment in building technical skills regarding industry 4.0, which is budgeted with 355 million Euro in the Italian plan to digitise industry.[191]

In general, Italy has relatively large parts of the population that are not yet online (see section 6.3.5) with more than a quarter using the internet less than once a week or not at all. This has likely changed recently. As the country is heavily impacted by the coronavirus, more and more cultural events such as classical concerts are broadcasted over the internet, targeting parts of the population that were not yet used to the idea of receiving their entertainment through online means.[192] The Government has also supported this idea by offering a page for companies to showcase the free services they offer during the time of the pandemic.[193]

The coronavirus and consequent effects on the increased number of people staying and working from home has also led to a rise in data usage. First indicators that show this

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186 See Godlovitch, I.; Kroon, P.; Strube Martins, S.; Eltges, F. (2019): Copper switch-off – A European benchmark. Study for the FTTH Council Europe. Electronically available at: https://www.ftthcouncil.eu/documents/Reports/2019/Copper_switch-off_analysis_12032019_short.pdf

187 This is a ministry without a complete ministerial body, see https://www.joeducation.eu/the-new-italian-ministry-of-innovation-technology-and-digitalization/

188 https://pianotriennale-ict.italia.it/assets/pdf/2019-2021/Piano-Triennale-ICT-2019-2021.pdf (English AI-based translation available at: https://docs.italia.it/italia/piano-triennale-ict/pianotriennale-ict-doc/en/stabile/index.html)

189 https://library.fes.de/pdf-files/id/13006.pdf

190 https://www2.deloitte.com/us/en/insights/focus/industry-4-0/italy-4-0-digital-future-technology.html

191 https://ec.europa.eu/futurium/en/system/files/ged/it_country_analysis.pdf

192 https://www.forbes.com/sites/federicoguerrini/2020/03/14/how-the-coronavirus-is-forcing-italy-to-become-a-digital-country-at-last/#66b320606f75

193 https://www.opengovasia.com/italys-government-set-up-digital-solidarity-site-to-help-citizens-amid-covid-19-lockdown/

has led to a decrease in mobile (4G) network speed[194] as well as an increase of the share of time that users spend with their smartphones in WiFi-networks.[195] In fixed networks, an increase of up to 70% in Internet traffic was recorded, which may have been due to many people downloading video game updates at once.[196] Vodafone claims an increase of traffic in their Italian fixed network of about 50% and even higher numbers for the upstream traffic.[197] Facebook reports that group calls through their apps have increased by more than 1,000% while the general usage of these apps has increased by 70%.[198] Political measures to enable people to work from home at the time of this crisis have been taken by allowing companies to implement “smart work” (remote working) without a prior agreement between the company and the employees. Smart working can potentially be enabled for up to 8 million Italian workers that have jobs that can be performed remotely.[199]

6.3.13 Conclusions

As there is no price mark-up for FTTB/H over FTTC and ADSL in Italy, it is unlikely for new customers in the range of the FTTB/H network to choose any other fixed broadband technology.[200] More and more existing customers are also likely to migrate as they can benefit from a better product for the same price. This price policy should also limit possible problems when users may have to undergo a mandatory migration to fibre at some point in the future.

This pricing scheme may however offer disadvantages to operators from a revenue standpoint as there is no differentiation between speeds within a technology or potential to profit from a higher willingness-to-pay by intensive users of broadband. This contrasts with pricing strategies in the UK. It is possible however, that prices for higher bandwidths in Italy could rise following the initial contract period.

There remain however barriers to take-up due to the fact that TI’s FTTC/VDSL network is competing with the expanding fibre network deployed by Open Fiber, and FTTC/VDSL-based operators’ advertising strategy of focusing on marketing fibre-based offers may misleadingly suggest that they are offering the same quality of service as operators providing service on full fibre via Open Fiber.

194 https://www.opensignal.com/2020/03/19/declining-4g-download-speeds-in-quarantined-italy-indicate-rising-mobile-congestion
195 https://www.opensignal.com/2020/03/16/italians-changed-behavior-and-spent-more-time-on-wifi-before-quarantine-extensions
196 https://www.bloomberg.com/news/articles/2020-03-12/housebound-italian-kids-strain-network-with-fortnite-marathon
197 https://www.vodafone.com/covid19/news/update-on-vodafone-networks
198 https://www.bbc.com/news/business-52029737
199 https://www.quotidiano.net/economia/coronavirus-telelavoro-1.5047928
200 Very price sensitive customers may choose a fixed wireless product or are mobile only users.

6.4 Sweden

6.4.1 Summary

Table 6-6: Key lessons from Sweden

Sweden
• FTTB/H coverage is very advanced due to the participation of municipalities in fibre deployment, alongside the incumbent Telia Municipal providers have high wholesale market shares (above 80%) in several cases, while Telia dominates in others. • Cable and VDSL play a secondary role, and copper is in decline. The NRA has concluded that it no longer constrains very high capacity (fibre and cable) technologies. • Almost ¾ subscribers have access to > 100Mbit/s. Offers below 100Mbit/s are no longer commonly marketed. 100Mbit/s is an entry level product • There is strong demand for FTTB/H, potentially linked to high levels of usage of online entertainment and content, as well as the prevalence of digital services including eGovernment, eHealth and eLearning • A relatively high proportion of Swedish consumers purchase standalone broadband (i.e. without bundles) illustrating the popularity of OTT services and mobile voice. • Relatively low-cost broadband offers are available on fibre, but evidence shows customers are also willing to pay. New fibre connections are marketed by Telia for an upfront fee of around €1,500-2,000 or can be paid in monthly instalments. A 250 Mbps broadband connection from Telia for customers ordering fibre costs €34 in the first 2 years. • Copper is in the process of being switched off in rural areas. The main replacement technology in these areas is 4G mobile connections. 300Mbit/s is offered via mobile for €34 but is presented as a solution where fibre is not available. • The price for copper unbundling has been set on the basis of a model which assumes fibre (and rural wireless) as the “modern equivalent asset”, thereby incentivising fibre build by non-incumbents. • Standardised wholesale offers support take up across the large number of municipal fibre players – facilitating retail competition on fibre, that may have helped to spur demand. • Full fibre is clearly distinguished from other (ADSL and mobile) technologies in marketing. There are no specific broadband labelling rules. • There are numerous initiatives to support the diffusion of digital applications. Sweden is a leader in many digital applications including eHealth, eEducation. Such services are often prioritised by municipal networks.

6.4.2 Context

Table 6-7: Demographics in Sweden

Sweden[201]		
Population		10,230,815
Number of households		5,239,500
Population density in people per km^2		25.0
% of people living in	Cities	39.9
	Towns and suburbs	40.3
	Rural areas	19.8
% of people living in	Houses	53.6
	Flats	46.2
GDP per capita in € PPP		43.900

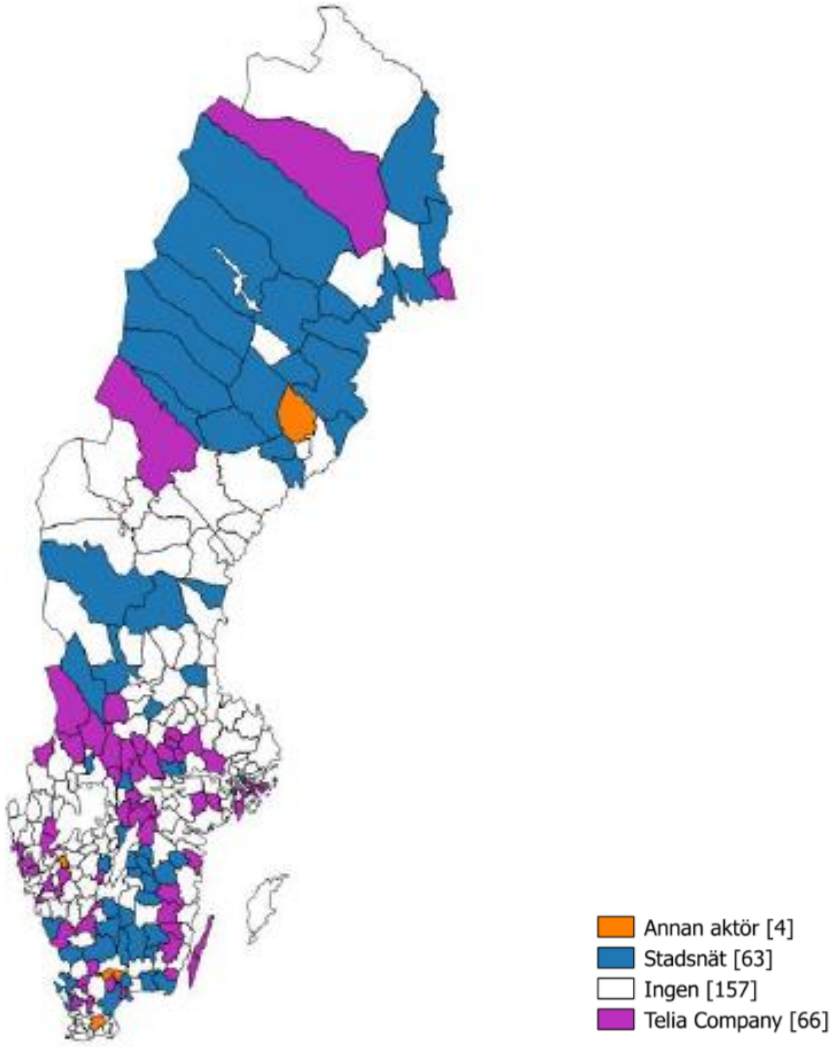
6.4.3 Main players and technologies used

Most of the fibre infrastructure in Sweden has been developed by local municipality networks accounting for more around 60% of fibre coverage. Around 180 of Sweden's 290 municipalities have built fibre networks in the last ten to fifteen years. One of the first to do so, starting in the 1990s, was Stokab, the municipal network for the Stockholm area.

Many municipal networks offer passive access to fibre ("unbundled fibre") and operate wholesale only business models. The utilisation of these network infrastructures has benefited significantly from Open Access and the intensive demand from third parties, which in turn has been promoted by the widespread availability of dark fibre offers, and the emergence of intermediaries which have integrated offers from different municipalities to provide bitstream to service providers. In the most recent analysis of the wholesale broadband access market, the NRA PTS found that municipal providers had a wholesale market share of 80% or more in several cases (see following diagram).

201 Population and GDP data: 2019; rest: 2018. Source: Eurostat

Figure 6-22: Municipalities where a network owner has over 80 % of the number of connections



Source: PTS Building Database.

The Incumbent Telia is the largest retail broadband service provider with a market share of 32,7 %, followed by cable operator Com Hem with 21,7 % and Telenor with 18,1 %. The incumbent Telia also actively roll outs own FTTB/H networks in Sweden having pledged to invest SEK12 billion (EUR1.15 billion) to expand its FTTB/H network starting in 2015.[202]

In large parts of the capital Stockholm there are three very high capacity networks (Stokab, Telia and the cable operator Com Hem). However, apart from this, infrastructure-based competition between very high bandwidth networks in Sweden is

202 https://www.teliacompany.com/en/news/news-articles/2018/the-fall-of-copper-watch-telia-shift-technologies/

limited, and there seems rather to be a tendency towards regional strongholds in gigabit-capable broadband, operated either by municipal networks or the incumbent.

The number of bundled subscriptions was 2.2 million (out of 4 million in total). Telia Company, Com Hem, Telenor and Three together accounted for a combined 94 % of the bundled subscriptions.[203] Sale of unbundled "Internet only" subscriptions is common in Sweden, and typically involves consumers buying separate broadband connections and using mobile telephony as their primary voice line.[204] A number of the smaller broadband retail providers focus on standalone high bandwidth broadband offers, based on inputs from municipal fibre networks.

6.4.4 Trends in deployment and take-up of gigabit capable technologies

Sweden is amongst the leaders in Europe for FTTB/H coverage. The coverage of VDSL and also Cable / DOCSIS 3.0 is significantly lower than FTTH/B. DSL coverage in Sweden is still above 90% but declining in recent years due to the partial switch off of copper networks in rural areas.

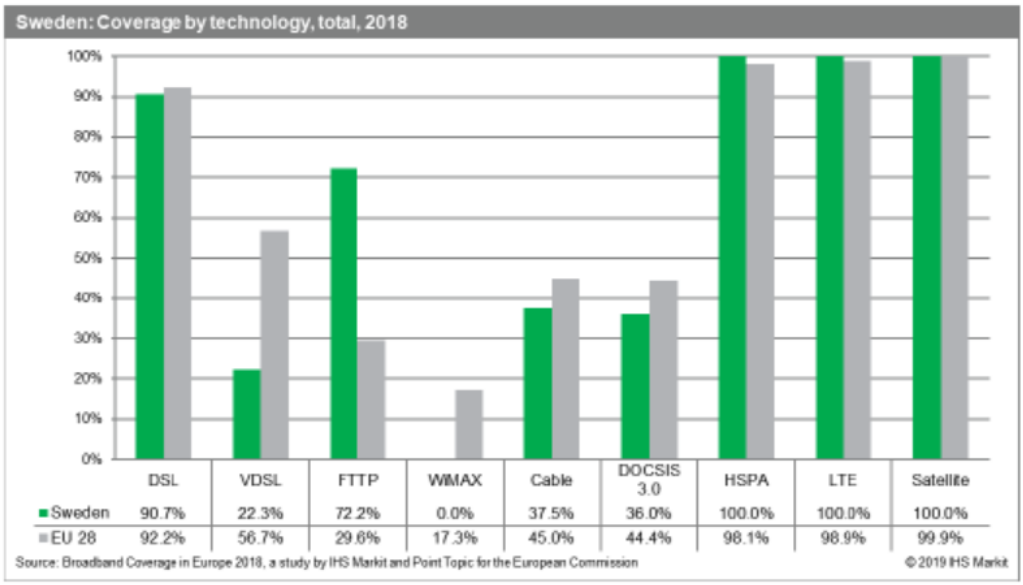
In Swedish rural areas, FTTB/H is the only significant NGA technology available (around 31 % of households), while VDSL and Cable / DOCSIS 3.0 each remain under 1% coverage.[205]

203 See PTS (2018): The Swedish Telecommunications Market 2018, https://www.pts.se/contentassets/70e598b7a817445cafae5b6f1e12eae9/swedish-telecoms-market-2018.pdf

204 https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf

205 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

Figure 6-23: Coverage by technology (June 2018)[206]



There are around 4.0 million fixed broadband subscriptions. In 2018, the number of subscriptions via fibre was 2.7 million, an increase of 11 % compared to 2017. Thus, fibre accounted for more than two thirds (67 %) of all fixed broadband subscriptions. While the number of fixed broadband subscriptions via cable network remained steady (about 0,7 million), the subscriptions via xDSL decreased by about 19 % and dropped to 0.6 million. Although not reflected in statistics which focus on fixed broadband, wireless broadband access (including mobile broadband access) is relied upon in most rural areas which have been subject to copper switch-off.[207]

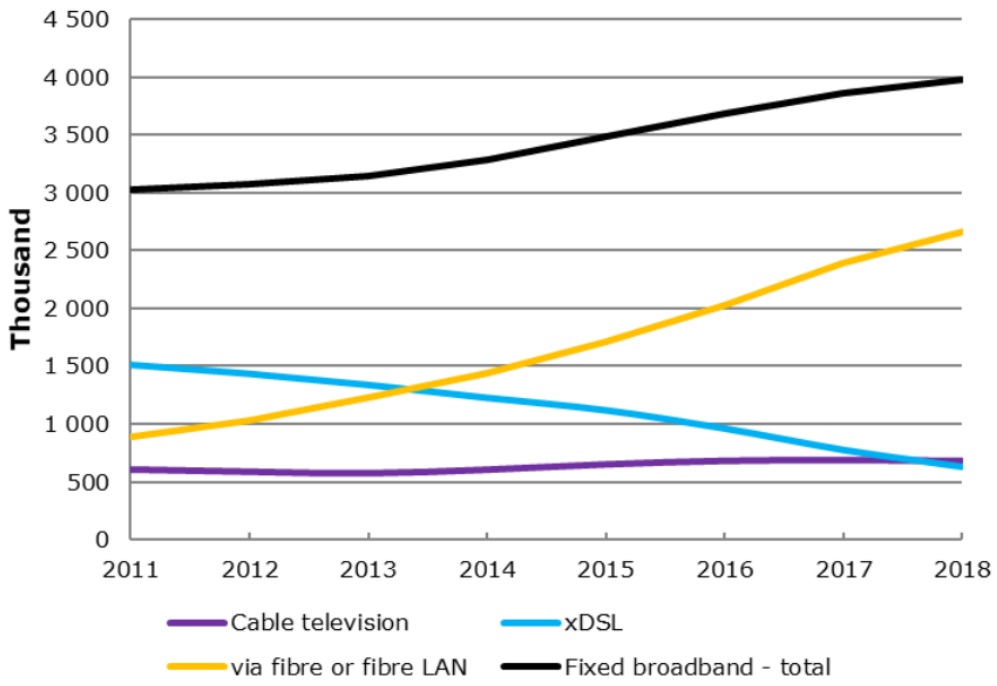
With 2.9 million subscriptions with download speeds exceeding 100 Mbps, almost three-quarters (74 %) of all broadband subscriptions in Sweden were at 100 Mbps or more in 2018. This accounted for an increase of about 13 %. 2.4 million of these were fibre subscriptions. The number of subscriptions exceeding 1 Gbps amounted to 123,000, an increase of 28 %.[208]

206 European Commission (2019): Broadband Coverage in Europe 2018 - Mapping progress towards the coverage objectives of the Digital Agenda, https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018

207 https://www.ftthcouncil.eu/documents/Reports/2019/Copper_switch-off_analysis_12032019_short.pdf

208 See PTS (2018): The Swedish Telecommunications Market 2018, https://www.pts.se/contentassets/70e598b7a817445cafae5b6f1e12eae9/swedish-telecoms-market-2018.pdf

Figure 6-24: Number of subscriptions or fixed broadband[209]



Sweden has formulated even more ambitious broadband targets for the future: By 2020, 95% of all households and businesses should have broadband access of at least 100 Mbps. Furthermore, by 2025, 98% of all households and businesses should have gigabit Internet access.[210]

By the end of 2018, the spectrum in the 700 MHz band was allocated and should be available for 5G use by 2020. In Sweden, 14 test licences have been issued at 9 different locations for spectrum in the 5G pioneer bands 3.4-3.8 GHz & 24.25-27.5 GHz and in 2.3 GHz. It is expected that uninterrupted 5G wireless broadband coverage in all urban areas in Sweden will be met through commercial roll-out, especially in the 3.4-3.8 GHz band, which will be auctioned in 2020.[211]

209 See PTS (2018): The Swedish Telecommunications Market 2018, https://www.pts.se/contentassets/70e598b7a817445cafae5b6f1e12eae9/swedish-telecoms-market-2018.pdf

210 See Government Offices in Sweden (2016): A Completely Connected Sweden by 2025− a Broadband Strategy, https://www.government.se/496173/contentassets/afe9f1cfeaac4e39abcdd3b82d9bee5d/sweden-completely-connected-by-2025-eng.pdf

211 See 5G Observatory (2019). Quarterly Report 6 - Up to December 2019, http://5gobservatory.eu/wp-content/uploads/2020/01/90013-5G-Observatory-Quarterly-report6_v16-01-2020.pdf

6.4.5 Use of high bandwidth applications

Table 6-8: List of selected indicators for use of applications in Sweden

Use of applications[212]			
	Sweden	**EU average**	**Rank within the EU-28**
Regular Internet users (at least once a week) in % of population; 2019[a)]	95.4	85.3	2
Entertainment			
% of Internet users watching internet streamed TV or videos; 2018[a)]	88	72	3
% of Internet users playing or downloading games; 2018[a)]	34	33	12
% of internet users that download/play video games, listen to music or watch internet streamed TV or videos; 2018[a)]	93	81	3
E-Learning and remote work			
% of Internet users doing an online course (in any subject); 2019[a)]	18.3	11.2	3
% of employed people working from home (usually or sometimes); 2018[a)]	34.7	15	2
Cloud			
% of Internet users that used Internet storage space to save files (e.g. photos); 2019[a)]	62.7	34.4	1
% of businesses that buy cloud computing services of medium-high sophistication; 2018[a)]	43.4	17.8	2
E-Government and E-Health			
% of internet users that interacted online with public authorities; 2019[a)]	88.0	61.8	4
DESI index score E-Health; 2019[a)]	71.3	37	2

According to a WIK study, fibre users are more active online in comparison to DSL and cable users. This included the areas of information (+ 7%), entertainment (+ 15%), social interaction (+ 15%) and local services (+ 10%). FTTH users also use more mobile and stationary devices than non-FTTH users.[213]

The advantages of fibre have also become evident during the present Corona virus situation. Although fibre network operators state that they have experienced a

212 Source: a) EU, b) GlobalWebIndex via datareportal.com.
213 https://www.ftthcouncil.eu/documents/20180129_RA_FTTH_CE_Valencia_WORKSHOP-update.pdf

significant increase in data volume per capita, they describe their infrastructure as very robust and could not report any problems in terms of disruption or network congestion.

The operators also note that the traffic volumes in off-peak times are rising due to the increasing number of teleworking employees in Sweden. As a result, the difference in data and voice traffic between peak and off-peak times has declined.

6.4.6 Challenges in driving take-up of gigabit technologies

A strong demand, high willingness to pay for fibre connections and high usage of data-intensive services are the main drivers behind the high take-up of gigabit-capable technologies in the Swedish broadband market. According to network operators, it took some time for the demand to pick up after the deployment of the networks. However, in the last 10 years the demand for high capacity access has been growing steadily. Currently, few challenges in terms of demand remain. However, the remaining, sparsely populated areas are difficult to serve. Thus, there are some complaints from end customers in rural regions about being unable to benefit from the advantages of fibre networks.

The regulatory authority PTS is working with authorities and stakeholders to find solutions to remove obstacles to efficient broadband availability and use (such as laying fibre along roads). In addition, a national aid programme is currently being discussed to channel public funds to the areas where they are most needed.

Standardisation was an enabler of FTTB/H wholesale offers and thus was essential in driving up FTTB/H wholesale demand. The standardisation was significantly advanced by the cooperation between the Local Fibre Alliance (SSNf) and the Service Provider Alliance (TLF). Uniform API, SLA levels and the standardisation of wholesale products were agreed to reduce costs for service providers and network operators. The aim was to increase the attractiveness of wholesale procurement on regional networks by standardizing processes and products, thereby increasing network utilisation by service providers.[214]

6.4.7 Pricing and willingness to pay

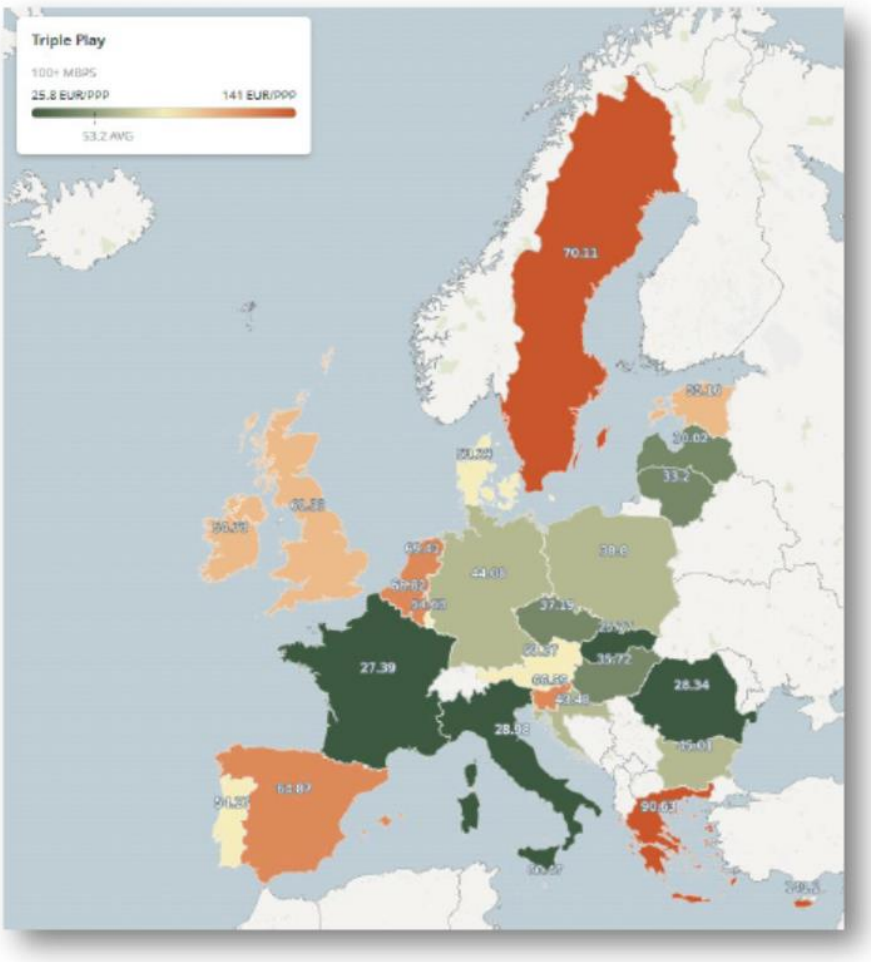
Sweden has prices above the EU average for most Double Play TV, Double Play Phone and Triple Play bundles across three different speed categories. However, in standalone Internet offers, its prices are below European average.

For instance, the average price for the highest advertised download speed category (100+ Mbps) with triple play in Sweden is amongst the highest across the EU-28. This may be linked to expensive fixed telephony services in Sweden.[215]

214 https://www.netadminsystems.com/blog/how-standardization-works-in-different-countries
215 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

Despite that, Sweden's take up rate of NGA technologies is amongst the highest in the EU. This may be linked not only to willingness to pay, but also to the popularity of cheaper standalone broadband offers (often based on municipal networks), which can lie below €30 per month for a 100 Mbps symmetric connection[216] and the availability of lower cost offers within apartment buildings that have been served with fibre.[217]

Figure 6-25: Prices for triple play bundles across Europe (100 Mbps+)[218]



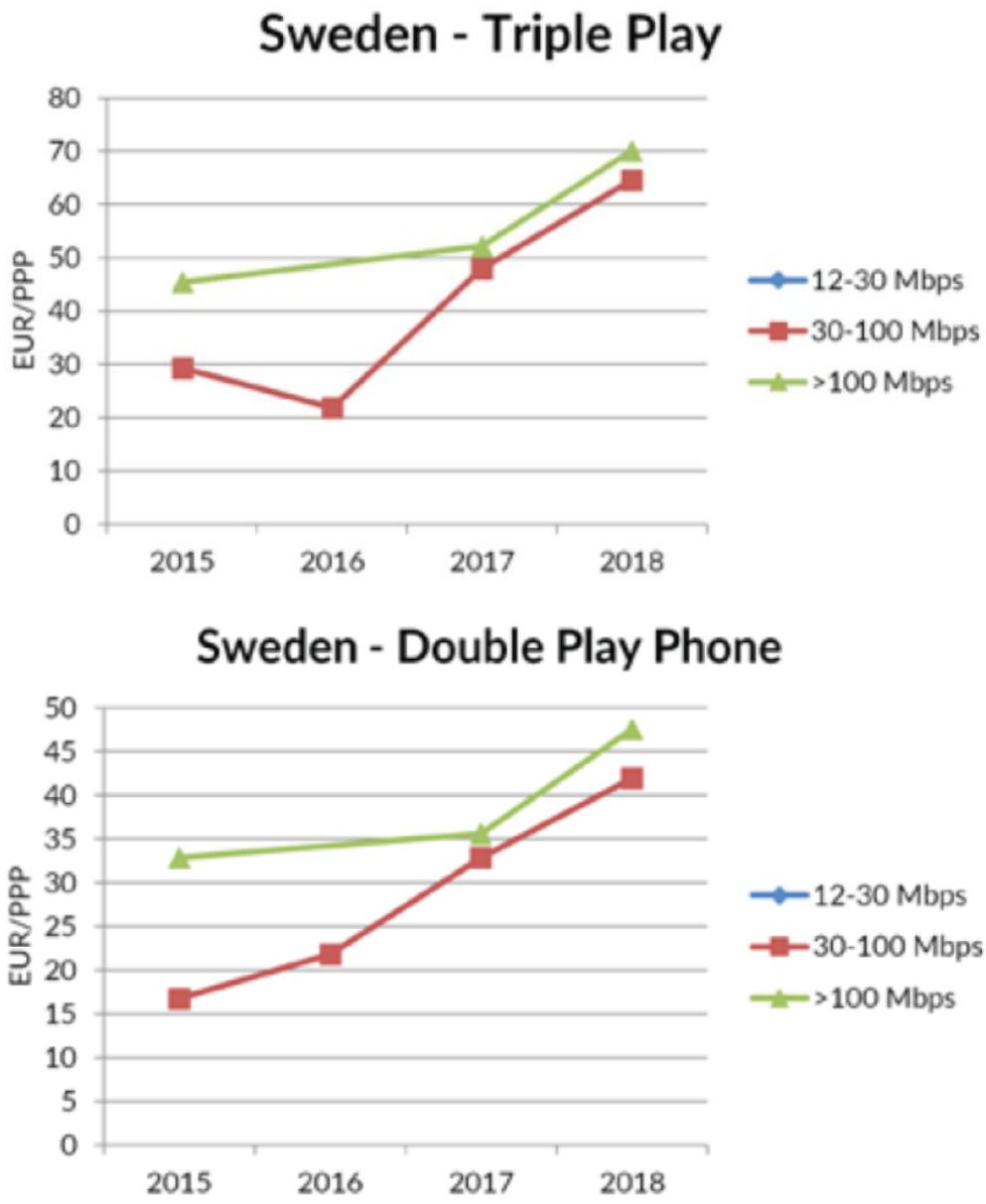
The price for triple play products below 30 Mbps is not reported in benchmarks as they are rarely marketed in Sweden, showing the degree to which higher bandwidth have become normalised.

The declining relevance and reduced marketing efforts on lower bandwidth broadband can be seen in recent pricing developments whereby prices for lower speeds (between

216 See sample prices in Table 13-4 https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf
217 See https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf
218 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

30-100 Mbps) have increased to converge with products offering bandwidths of 100 Mbps or above.

Figure 6-26: Prices for triple and double play bundles in Sweden over time[219]



The pattern of migration to higher bandwidth is also reflected in take-up: The take up of broadband connections between 10 and 30 Mbps as well as between 30 and 100 Mbps

219 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018

are significantly below the EU average, while the take up of connections exceeding 100 Mbps clearly outranks most EU countries.[220]

The Swedish affinity towards technology, may have contributed to a high demand for fast broadband connections and a high willingness to pay (especially in rural areas) which can be regarded as important factors contributing to the degree of fibre deployment and take up. The high demand may be linked to the high uptake of services and applications that focus on high capacity audio-visual services (such as video streaming, some social media applications and gaming) as well as end customers' simultaneous use of more than one device which is also responsible for the steadily increasing data volumes of private customers in Sweden. Indeed, many Swedes regard their fibre access as a "utility" which becomes part of their digital lifestyles. Other trends such as E-Government, E-Health, E-Learning and teleworking appear to have contributed to the growing demand for increasing bandwidths as well but were not the main drivers.

As digitisation is present in all areas of work and private life, a high capacity connectivity at home is very important to Swedish customers. Instructions on how to order a new fibre line are prominently displayed on Telia's website. End-users can pay an upfront connection fee to have a connection built to a single dwelling, or can pay in monthly instalments.[221] Discounts for installation are available for those ordering broadband from Telia for a minimum of 24 months (from €1,540 upfront or €27 per month by instalment). It is also possible to order a connection only (without discount from €1,817 up front or €33 by instalment) and select the retail broadband provider separately.

Telia's fibre broadband offer for customers ordering a new fibre line is €34 for an initial 24-month period, followed by an uplift to €45. The advertised download speed is 250Mbit/s.

Telia markets 4G mobile broadband as suitable for those who do not have a fibre connection. Services of up to 300Mbit/s are also available on LTE for around €34 per month.[222]

6.4.8 Wholesale pricing measures (where relevant)

Copper unbundling is subject to cost-orientation on the basis of BU-LRIC model which uses fibre (and mobile in rural areas) as the Modern Equivalent Asset. In 2016, the total monthly charge for copper LLU in Sweden was reported by the European Commission at €11.80,[223] at the top end of the pricing range within the EU. The use of fibre as the MEA for copper in wholesale pricing should in theory incentivise the deployment of fibre as an alternative (where it is viable), especially by non-incumbent operators, which are

220 See European Commission (2019): Fixed Broadband Prices in Europe 2018, https://ec.europa.eu/digital-single-market/en/news/fixed-broadband-prices-europe-2018
221 https://www.telia.se/privat/bredband/fiber/villa/pris?intcmp=villastart_erbjudanden
222 https://www.telia.se/privat/bredband/bredband-via-mobilnatet?intcmp=bbPlus
223 Digital agenda scoreboard

not affected by considerations around the relative profitability of legacy and modern technologies.

Fibre access is mandated on the incumbent Telia, but the pricing is flexible, subject only to a replicability test. In a benchmark conducted by WIK in 2017, fibre unbundling was available from Telia for €18 per month.[224]

The new 2018 WLA market analysis by PTS proposes to segment the market between copper (including FTTC) and very high capacity connections (fibre and cable), on the basis that lower speed connections no longer constrain those offered via VHC networks.

Municipal fibre operators are not currently subject to access obligations in Sweden, but many are wholesale only and offer wholesale access on commercial terms designed to increase the capacity utilisation of their networks. The conditions and details of these commercial agreements are not publicly disclosed.

The PTS's conclusion that copper (which is the preserve of Telia) is no longer in the same market as VHC technologies, and the strength of municipal fibre companies has prompted questions as regards whether there may be separate regional markets for VHC technology in Sweden.[225]

6.4.9 Awareness and advertising standards

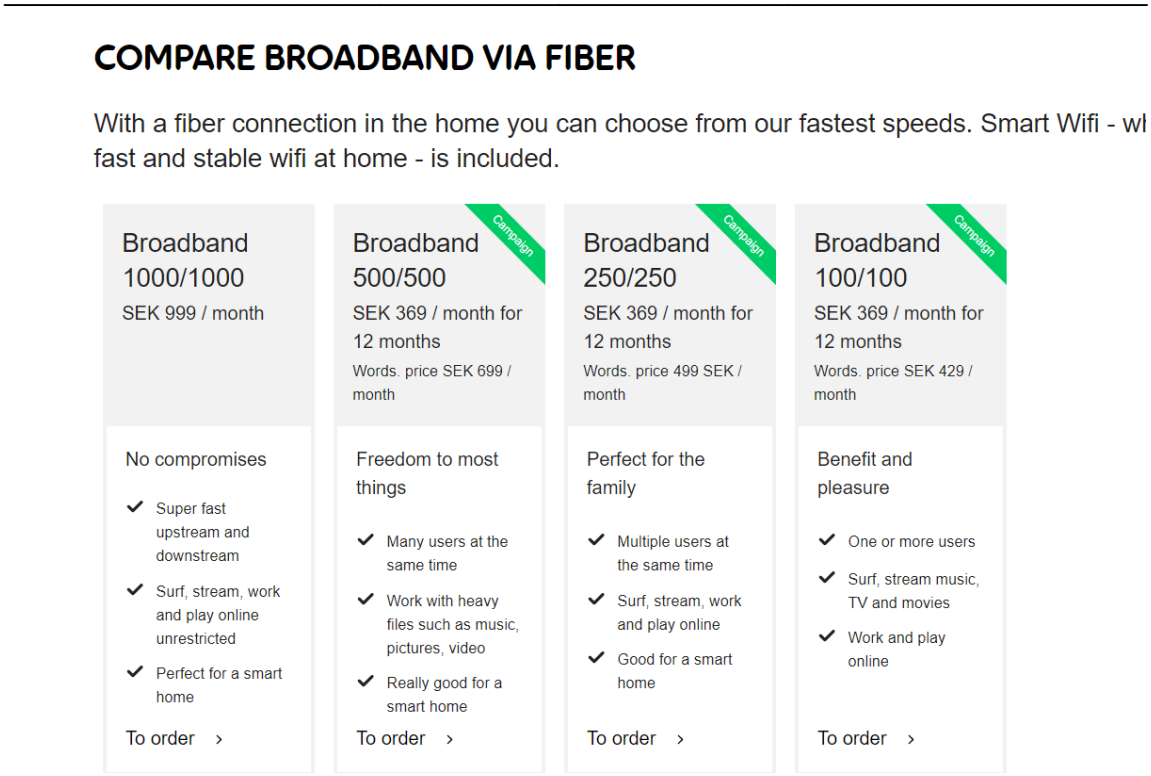
Sweden is very advanced in digital services and applications due to digitally very aware consumers. Swedish consumers are in general aware of the benefits of fibre: More than 70% of those who made the switch to fibre technology noticed a difference compared to their previous Internet access technology. According to a survey in 2017, the majority of FTTH users choose fibre due to higher speed and better value for money. Customer satisfaction with fibre is visibly higher (83%) than cable (72%) and DSL (52%). In addition, 94% of non-FTTH users would consider subscribing to FTTH if the technology was available in their area.[226]

Even in 2014, FTTH/B users were significantly more satisfied than DSL users on their broadband product. On technical aspects of the broadband service, FTTH/B users were more satisfied on all counts, e.g. download and upload speed, latency.[227]

Broadband connections offered over fibre, are typically clearly marketed as such, with invitations to compare fibre offers to broadband via ADSL and via mobile. The example below is from Telia, [228] but a similar distinction (and focus on fibre) is given by

224 Based on Telia published reference offer
225 https://circabc.europa.eu/sd/a/c04ce6b3-bed7-4838-8134-5dce237eb953/SE-2019-2216-2217-2218%20Adopted_EN.pdf
226 https://www.ftthcouncil.eu/documents/20180129_RA_FTTH_CE_Valencia_WORKSHOP-update.pdf
227 https://www.ftthcouncil.eu/documents/Reports/2014/Consumer_Experience_Study_2014.pdf
228 https://www.telia.se/privat/bredband/jamfor-bredband

Telenor.[229] Instructions on how to order a new fibre line are prominently displayed on Telia's broadband webpage.[230]



Source: Telia

There are no "broadband labelling" schemes or advertising rules in Sweden according to the operators. One reason for this is the relatively low FTTC coverage, and clear labelling by some operators. Furthermore, as shown in the studies mentioned above, Swedes are aware of their broadband technology and its benefits.

6.4.10 End-user voucher schemes (where relevant)

No federal voucher scheme is present in Sweden.

6.4.11 Forced migration measures/copper switch-off

Sweden is one of the countries in Europe where copper network switch-off and NGN migration are relatively advanced. The switch-off of the copper network on a voluntary

229 https://www.telenor.se/handla/bredband/
230 https://www.telia.se/privat/bredband/fiber

basis has taken place mainly in rural areas. Although about 42% of the MDFs have been shut down so far, this corresponds to only 100,000 households (out of more than 5.2 million households in Sweden as a whole). Where available, customers migrate to fibre connections. Where there is no fibre network (which is common in rural areas), Telia usually offers end-users FWA solutions, which involves connecting to Telia's LTE network.

There are no specific wholesale products in connection with the copper switch-off: Fibre optic unbundling (where fibre is available), fixed wireless and mobile services are alternative solutions. Moreover, there is no obligation for Telia to provide alternative wholesale access if Telia does not have a fibre network in the affected area. Telia has to notify its competitors of the switch-off 5 years in advance, but in practice the period is often reduced to 18 months if Telia and competitors enter into commercial agreements.

More than 450 additional MDFs are to be closed by mid-2020: Most of these are MDFs in rural areas, with just over 10% in suburban areas. A target date for the complete shutdown has not yet been communicated.[231]

6.4.12 Initiatives to boost digital applications

Sweden has a number of programmes and initiatives that drive the diffusion of digitisation as well as digital services and applications. In rankings that benchmark the digital progress among countries in Europe, Sweden regularly scores among the front-runners.[232]

Having a long history of political initiatives, Swedish municipalities promoted and participated in roll out programmes to offer services that enhance welfare in their community and/or region. This includes municipal information and public e-services but also services in healthcare, care, and education. Connecting public infrastructure including hospitals and schools is typically given priority when the municipalities play an active role in fibre rollout. Promoting the advantages of these services may also have contributed to early adoption of public e-services.

The “Smart industry – a strategy for new industrialisation for Sweden” was published in 2016. It envisions Sweden to become a “world leader in the innovative and sustainable industrial production of goods and services”. Through various measures, the objective is to enhance “its competitiveness and participation, primarily in the high-quality segments

231 See Tenbrock, S. et al. (2020): Status quo der Abschaltung der Kupfernetzinfrastruktur in der EU, WIK discussion paper no 430, https://www.wik.org/index.php?id=meldungendetails&tx_ttnews%5BbackPid%5D=85&tx_ttnews%5Btt_news%5D=2293&cHash=8a1fdd2ac8d544650dd51759f9b9180d

232 See e.g. Desi Index: https://ec.europa.eu/digital-single-market/en/desi; IMD World Digital Competitiveness Ranking 2019 https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2019/ and Digital Planet 2017 – How Competitiveness and Trust in Digital Economies vary across the World: https://sites.tufts.edu/digitalplanet/files/2017/05/Digital_Planet_2017_FINAL.pdf

of global value chains". Key focus areas include Industry 4.0, sustainable production, an industrial skills boost and the establishment of test beds in Sweden.[233]

For the key focus area of Industry 4.0, Produktion2030 is another important programme that intends to create "relevant and innovative solutions; by building up and strengthening networks and collaborations, both within Sweden and internationally; and by bringing together ideas, players and funding opportunities in order to create valuable solutions for the manufacturing industry of the future". One important pillar is the inclusion of SME companies by offering technical workshops and courses to obtain in depth knowledge about new production techniques and production methods as well as exchange knowledge and experience.[234]

The provision of high capacity broadband services with high bandwidths and quality parameters is becoming increasingly important with the digitalisation of industry and public services and the rising use and demand of smart solutions. The installation of fibre networks in business areas enables the communication of machines and components in smart factories via in-built sensors.[235] The characteristics of fibre with symmetric high bandwidth and very low latency enable the provision of innovative solutions in real time without disruption, e.g. automation, sophisticated robotics, and additive manufacturing technology (known as 3D printing).

Smart industry initiatives in Sweden also include sectors that are not typically associated with digitalisation and smart solutions at first glance. The forestry and agriculture sectors play an important role for the Swedish economy. Both sectors are traditionally very labour- and resource-intensive but the usage and demand of innovative solutions and technologies has increased in recent years. Precision farming and forestry aims at the target-oriented and site-specific cultivation of agricultural areas using data from sensors in field or utility vehicles.[236]

E-Learning initiatives in Sweden play a very important roles for primary, secondary, tertiary and vocational education. With municipalities installing their own fibre networks, schools, universities, and other educational facilities are connected to the fibre network in most instances. Numerous programmes exist on a local and regional level and make E-learning services and applications available for students and teachers. They encompass every age group and field of study. In many communities all students are equipped with their own devices (laptops or pads) for educational purposes. In some cities, this also includes children in kindergarten. With individual devices students can use learning tools that refer to their individual level and learning progress.

As Sweden encompasses wide rural areas, long distance learning is highly relevant, e.g. in the Northern parts of the country or the archipelago. Innovative solutions are not

233 https://www.government.se/498615/contentassets/3be3b6421c034b038dae4a7ad75f2f54/nist_statsformat_160420_eng_webb.pdf
234 https://produktion2030.se/en/about-us/
235 https://www.government.se/496173/contentassets/afe9f1cfeaac4e39abcdd3b82d9bee5d/sweden-completely-connected-by-2025-eng.pdf
236 https://news.cision.com/sodra/r/forestry-is-becoming-increasingly-digitised,c2133506

only developed for university students, but also for primary and secondary school students. Massive Open Online Classes (MOOC) become more important for students in Sweden as a wide variety of specialised classes and courses are supplied by tertiary institutions.[237]

In the area of health and care, Sweden is also among the frontrunner in Europe with the most developed E-Health solutions.[238] The Swedish Government committed to support E-Health solutions in its "Vision for eHealth 2025" and also participate in creating a regulatory frameworks as well as settle on more consistent use of terms and standardisation issues.[239] In Sweden, municipalities focus on connecting hospitals and other medical facilities when rolling out their own fibre networks. These networks enable a plurality of innovative services and applications that enhance the provision of healthcare.

E-Health encompasses a wide spectrum of solutions in Sweden. As hospitals and medical practices are connected, doctors can consult with one another and interact. Broadband connections also make remote consultations and intervention possible.

Sweden is among the frontrunners in Europe enabling a variety of care services and applications that address the needs of senior citizens. Telemonitoring solutions (also called "telecare") – portable and fixed – play an important role in Sweden: These not only provide visual surveillance but also only monitor vital functions of the human body via sensors.[240]

Digitisation policy also encompasses E-Government initiatives, i.e. using digital policy to make the activities of Government agencies more efficient and simplify the interaction and contacts between public administration and citizens – for example through electronic identification, electronic signatures and open data.[241]

The Government also supports Smart City Sweden, a state-funded platform for sustainable city solutions. The platform identifies and highlights best practice in terms of smart city services in Sweden within five key focus areas: climate, energy & environment, mobility, digitalisation, urban planning and social sustainability.[242]

237 https://www.mooc-list.com/countries/sweden
238 https://ec.europa.eu/digital-single-market/en/news/transforming-ehealth-political-and-economic-advantage
239 https://ehalsa2025.se/wp-content/uploads/2017/10/vision-for-ehealth-2025.pdf
240 https://sweden.se/society/elderly-care-in-sweden/
241 https://www.government.se/government-policy/digital-policy/
242 https://smartcitysweden.com/about/