FTTH adoption drivers and hurdles in Europe

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Policy & Regulation Committee

FTTH COUNCIL EUROPE

Full fibre for a digital and sustainable Europe

Foreword

The FTTH Council Europe is pleased to bring to you this first-of-its-kind study by Plum Consulting on FTTH/B drivers and hurdles in Europe.

Within the FTTH Council Europe, we are relentlessly working to fulfil our mission: to advance ubiquitous full fibre-based connectivity to the whole of Europe. While we are pleased to see that the FTTH/B rollout coverage in Europe amounts to 57% and is progressing steadily, the take-up rate is yet to reach the 50% mark, with significant differences at country level. This is where the study comes in as a clarion call on what needs to be done to increase the take-up. By carrying out thorough analysis of the FTTH Council Europe data and doing a deep dive into 8 selected countries, Plum Consulting team has developed recommendations of measures that both the policy makers and industry executives will find useful when considering how to increase the FTTH/B adoption.

For the FTTH Council Europe this is only the first step in what we see as our industry's next big challenge. We want to ensure that there is wide awareness about the results of this study, which would pave way for future actions aimed at increasing the FTTH/B take-up. In our view, high rate of FTTH/B adoption is key to ensure that our fellow citizens and businesses fully reap the benefits of full fibre connectivity.

I thank Plum Consulting team for their thorough work on this study and hope that you will find it a useful and insightful read.

Vincent Garnier

Director General

FTTH Council Europe

About Plum

Plum offers strategy, policy and regulatory advice on telecoms, spectrum, online and audio-visual media issues. We draw on economics and engineering, our knowledge of the sector and our clients' understanding and perspective to shape and respond to convergence.

About this report

This report has been commissioned by FTTH Council Europe It presents our study on the drivers and hurdles of FTTH take-up in Europe.

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Executive Summary

Since 2018, the European Commission has focused its digital infrastructure policy on the deployment of Very High-Capacity Networks (VHCN). This resulted in an acceleration of the deployment of fibre to the home in the EU, in parallel with a similar investment wave in the UK. Yet as important as this improvement of the availability of VHCNs in Europe is, it has also brought the discrepancies in VHCN adoption into sharper contrast. Countries like Spain, France or Sweden have very high availability and very high adoption while others, like Italy or Ireland have relatively high availability but low adoption. In countries where deployment is recent, like Germany, the UK or Austria, adoption is low and also not growing as fast as deployment, which may be a cause for concern.

A high-level data analysis of various indicators that could explain adoption reveals three key findings:

- There's a symbiotic relationship between deployment of FTTH/B and take-up. The causality is hard to establish, and it looks like deployment drives adoption, but adoption drives further deployment.
- A high price gap between legacy and fibre broadband prices hinders take-up.
- Socio-economic factors don't seem to be clear drivers or hurdles for take-up at EU level.

This high-level analysis does not allow us to identify all the factors that explain why some countries perform better than others on adoption. In order to drill down, we selected 8 countries for a more in-depth analysis: Denmark, France, Germany, Italy, Poland, Spain, Sweden and the United Kingdom. The key findings of that deeper dive are as follows:

- Focus on deployment of FTTC or Docsis 3.1 in the last decade is the biggest hurdle to FTTH/B adoption. Differentiation is harder for FTTH/B offers and consumers are often less eager to upgrade to fibre. This situation is made worse when advertising rules have allowed market players to sell FTTC and/or cable as "fibre".
- Effective network competition as in Spain and France has been a strong initial driver for adoption although other models such as those seen in Sweden or Denmark seem to have been very effective as well, particularly when network monopolies have been open to competing ISPs.
- Wholesale models are boosted when national brands are available on wholesale networks. This can be the result of commercial agreements (as in Spain), industry standardization agreements (as in France) or the near ubiquitous availability of wholesale solutions (as in Sweden or Denmark).
- In all markets, to varying degrees, some end-users are reluctant to let network operators do the necessary civil works to install fibre inside their homes.
- In some countries analysed (Poland, Italy), digital literacy and income levels look to be hurdles to adoption.

Some countries have put in place demand stimulation schemes, which we have found not to have been very effective. In Spain, they are targeted at very small pockets of the market where low income is a big issue, but the schemes have no wider impact on adoption. In Italy, the schemes were put on hold because the policy makers could see that they weren't targeted properly and didn't seem to make a difference.

This leads us to the following recommendations for policy makers and NRAs who want tools to help them meet their VHCN adoption obligations as set out in Article 3 of the EECC:

- Demand stimulation in the form of voucher schemes should be targeted exclusively towards VHCN adoption. It would be paradoxical going forward for the same governments who fund or funnel EU funds towards VHCN deployment to then build demand voucher schemes that encourage inferior broadband solutions. Digital literacy and low income may often be correlated, but not always. Current voucher schemes only address income and could be to provide instead (or also) assistance with installation and usage of digital services.

- Governments (including local governments) can lead by example through anchor tenancy, making their adoption of fibre public and visible and actively promoting the benefits of VHCN adoption.

- Solving the issue of unclear advertising rules that have created customer confusion around the word fibre is necessary but may no longer be sufficient as its misuse may have "tainted" the term. A shift towards better regulating advertising of broadband speeds may be the solution to ensure clarity when it comes to consumers knowing what they are getting.

- In markets where wholesale is an important element of availability of VHCN, the visibility of national retail brands on wholesale platforms is a key driver for adoption. Policy could impact this by creating incentives or obligations for brands with significant market power to offer their services on wholesale platforms.

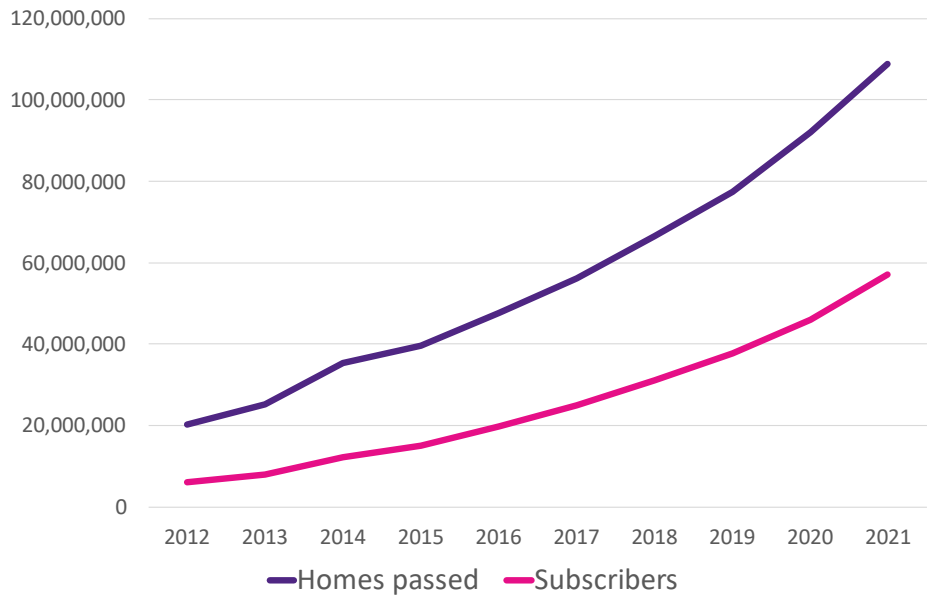
- Finally, the gradual switching-off of the legacy copper platform creates an opportunity to boost VHCN adoption but cannot be put on a realistic time horizon if a large proportion of the population isn't already on VHCN solutions. In the more advanced countries when it comes to adoption, the plans for copper switch-off can represent a key lever to further accelerate adoption and get additional benefits across the board in terms of service providers economics, consumer satisfaction and sustainability.

1 Introduction

Gigabit connectivity is at the centre of the European Commission digital strategy for the next decade and is key to fully harness the economic and social benefits of a European digital society. The ambition is that by 2030 all European households will be covered by a Gigabit network[1]. To achieve its ambition, the European Commission has focussed since 2018 on promoting Very-High-Capacity Networks (VHCN) which include Fibre to the Home (FTTH), Fibre to the building (FTTB) and Cable DOCSIS 3.1, as well as any future technology capable of delivering 1Gbps downlink. The UK has also implemented an ambitious digital strategy that aims to achieve at least 85% gigabit coverage by 2025 and at least 99% gigabit coverage by 2030.[2]

As of September 2021, 66.2% of households[3] in the EU27+UK region were covered by at least one type of VHCN. FTTH/B networks appear to be the leading technology chosen by the telecom industry to deliver Gigabit connectivity to European households, and coverage has reached 48.5%. Since 2012, there has been considerable progress in terms of coverage which has grown fivefold (21% Average Annual Growth Rate (AAGR) over 2012-2021), and an even more rapid increase of take-up which is nine time higher in 2021 as in 2012(25% AAGR).

Figure 1.1: Evolution of FTTH/B Coverage and take-up in EU 27+UK



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

The European Commission's policy has played a major role in driving both coverage and take-up. FTTH/B deployment has largely benefitted from the support of public policy that enabled the acceleration of network rollout – in the form of an investment friendly Regulatory Framework (the EECC), subsidies for white areas[4] within a coherent state aid regime, investment by the European Investment Bank and other more targeted measures. Additionally, significant funds have been allocated to demand stimulation measures like voucher schemes for low-income households (to finance either the subscription or the purchase of connected devices), training programs to improve digital skills and other such measures. However, as Figure 1.1 shows, subscriptions

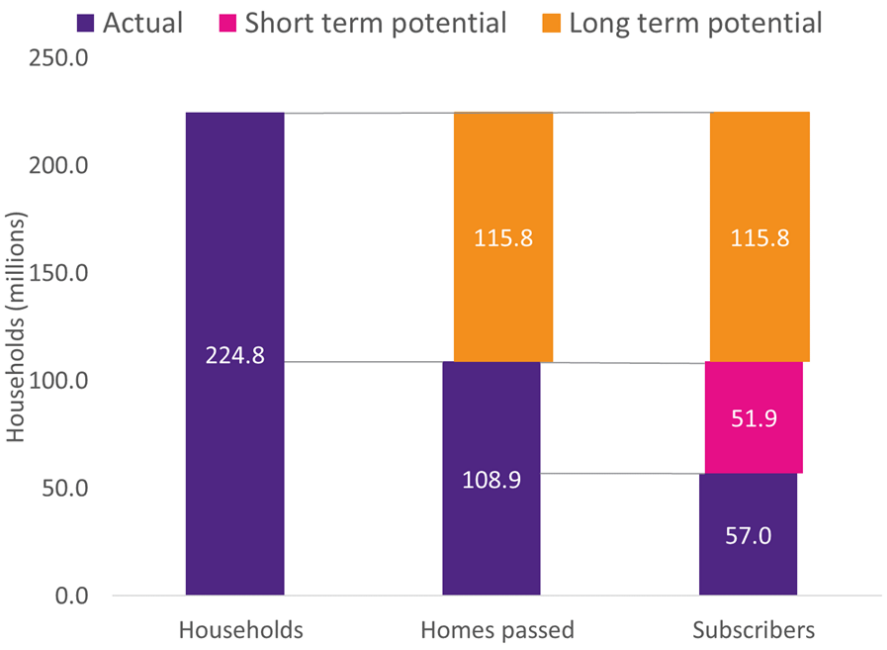
[1] European Commission. 2030 Digital Compass: the European way for the Digital Decade. Available at : https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021DC0118
[2] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1089103/UK_Digital_Strategy_web_accessible.pdf
[3] European Commission – Broadband coverage in Europe 2013-2021
[4] Areas where no broadband infrastructure exists or is unlikely to be developed in the near term.

lag behind network build, and so more work is needed to boost take-up in the regions and particularly in countries where take-up is low. In fact, European countries have had different patterns of deployment as well as different public policies and priorities, and that has resulted in an uneven level of FTTH/B take-up across Europe. In some countries where fibre deployment is a relatively recent development, take-up remains low, but there is also low take-up in some countries where fibre was deployed earlier and which have relatively high coverage. At the opposite end of the spectrum, some countries have very high take-up early-on in their deployment cycle and seem to retain that across the history of the deployment.

From a business perspective, it means that there is a substantial opportunity for operators to increase their customer base and their revenue by targeting households that are yet to adopt FTTH/B services.

The potential for short-term additional subscribers is estimated at around 52m (see **Figure 1.2**). This is the number of households that have access to FTTH/B networks but have not subscribed. If 100% coverage is achieved, this would give a total addressable market for additional subscribers of 115.8m.

Figure 1.2: Short-term and long-term potential for take-up



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe.

Purpose of this report

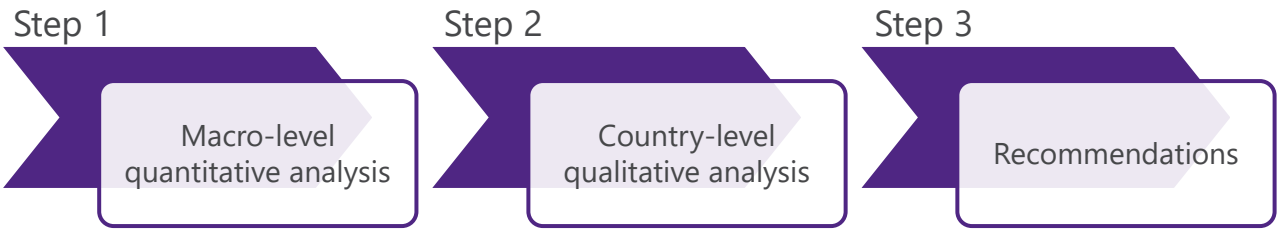
The FTTH Council Europe (FTTHCE) has asked Plum Consulting to help them understand the reasons for the discrepancies in FTTH/B adoption across Europe and particularly the differences in take-up between countries at comparable levels of deployment. The aim of the study is – through a better understanding of the drivers and hurdles to take-up - to produce recommendations for policy makers on levers to accelerate FTTH/B adoption.

2 Our approach and methodology

2.1 Overview of our approach

We used a funnel-approach to conduct this study. First, we performed a quantitative analysis on the EU 27+UK countries using data from the FTTHCE and other sources (Step 1). Second, we focused on a specific set of countries that include both over-performers and under-performers in terms of take-up to deepen our analysis and investigate more qualitative factors (Step 2). Finally, the lessons we learned from the two first steps of the project were used to formulate actionable policy recommendations (Step 3).

Figure 2.1: Overview of our approach



2.2 Detailed methodology

We identified three types of factors that could explain the level of FTTH/B take-up in the different countries under study.

- **Socioeconomic factors**, such as income levels and distribution, poverty rates, GDP etc.
- **Digital supply factors**, such as broadband prices, quality of existing copper network, broadband speeds, etc.
- **Digital demand factors** such as digital literacy, consumer equipment ownership, broadband usage levels, etc.

Some of these factors are easily quantifiable (socioeconomic factors, broadband prices, digital literacy) while others are not (migration strategies, the level of competition). In the first part of the project, we focused on the quantifiable factors to conduct a macro-level analysis for the EU27+UK countries. When possible, we collected EU-wide quantitative indicators to analyse correlation between potential explanatory factors and FTTH/B take-up.

Data availability was a key issue in this first step of the study, which raised two types of limitations:

- when there are no publicly available indicators, we could not perform the analysis on the entire set of countries; and

- some publicly available data did not enable us to comprehensively analyse the factors because of definition or collection methodology.

Consequently, we could not measure the impact of all the factors we identified. However, we were able to identify some key explanatory factors that could be drivers of take-up.

Step 2 of the study focussed on a specific set of countries that includes Denmark, France, Germany, Italy, Poland, Spain, Sweden, and the United Kingdom. The countries were selected to represent different levels of deployment, adoption, market models and geographies. Generally, the countries selected are either overperforming compared to EU27+UK average or underperforming.

We did a deep dive analysis on these countries to derive insights on why take-up levels are high or low. For these eight countries, we examined various quantitative and qualitative factors, investigated the policy measures implemented by governments and engaged with local stakeholders (government, regulators, service providers and wholesale network operators).

Step 3 of the report provides a set of recommendations based on the key take-up drivers and hurdles as well as the most effective measures we identified in the selected countries.

2.3 Terminology

This section provides a definition of the terms we use throughout the report.

	Definition
FTTH/B	Fibre to the home or fibre to the building as defined by the FTTH Council Europe and Idate in their panorama.
Take-up	The proportion of FTTH/B homes-passed with an active subscription
Coverage	FTTH/B homes passed as a proportion of total households in the country
Deployment	Coverage
VHCN	Very High-Capacity Networks
Penetration	The proportion of total households with an active FTTH/B subscription
Homes-passed (HP)	FTTH/B homes passed as a proportion of total households in the country

3 Quantitative analysis

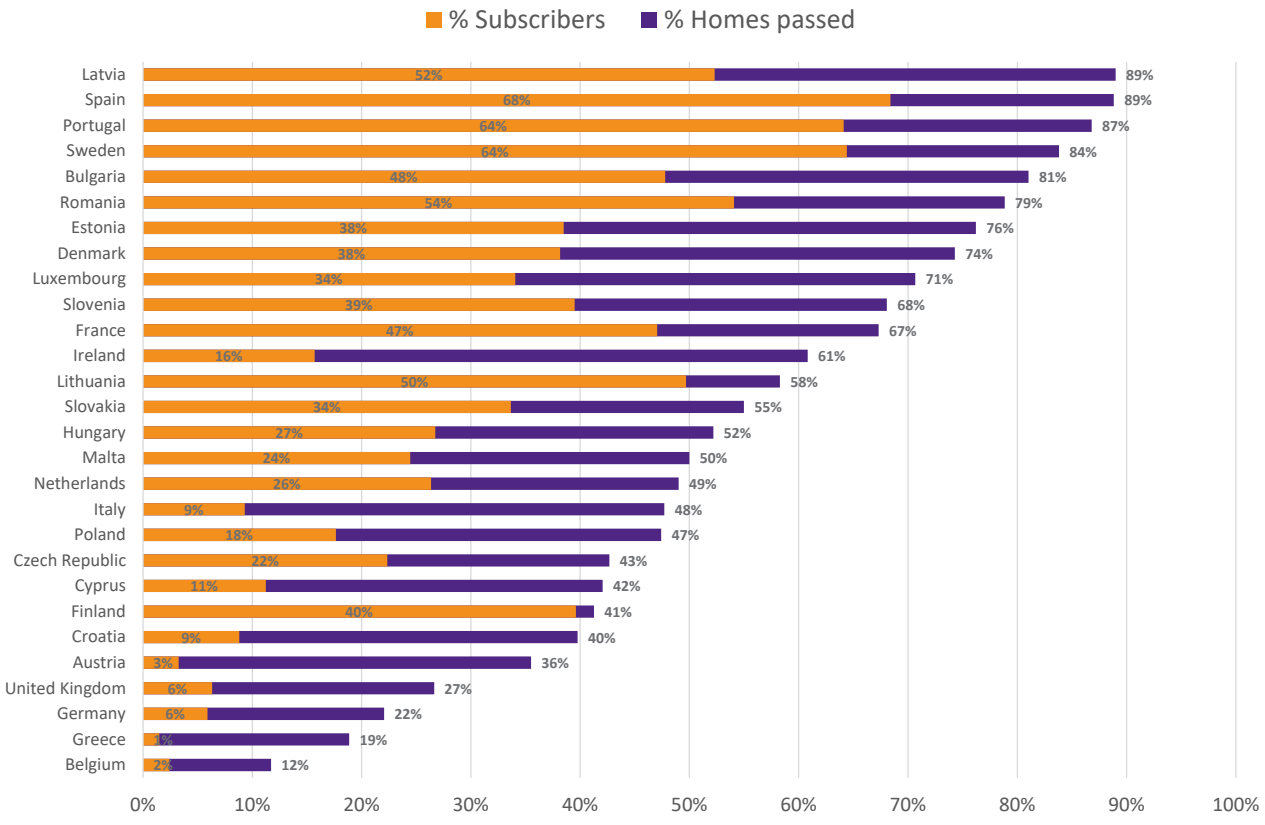
3.1 General considerations on take-up and take-up drivers

An uneven FTTH take-up in the EU

As of September 2021, there were around 57m FTTH/B subscribers in the 27 EU member states and the UK which represent 52% of households passed by FTTH/B. The five most advanced countries have take-up rates above 70% and include Finland (96%), Lithuania (85.3%), Spain (77%), Sweden (76.9%) and Portugal (73.9%). The lowest take-up rates are recorded in Greece (7.9%), Austria (9.2%), Italy (19.5%), Belgium (20.6%) and Croatia (22.17%).

Figure 3.1 below shows the number homes passed and subscribers as a percentage of total households in the 27 EU member states and the UK.

Figure 3.1: FTTH/B take-up overview (EU27+UK)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe.
Note: Subscribers and homes passed figures are shown as a percentage of total households.

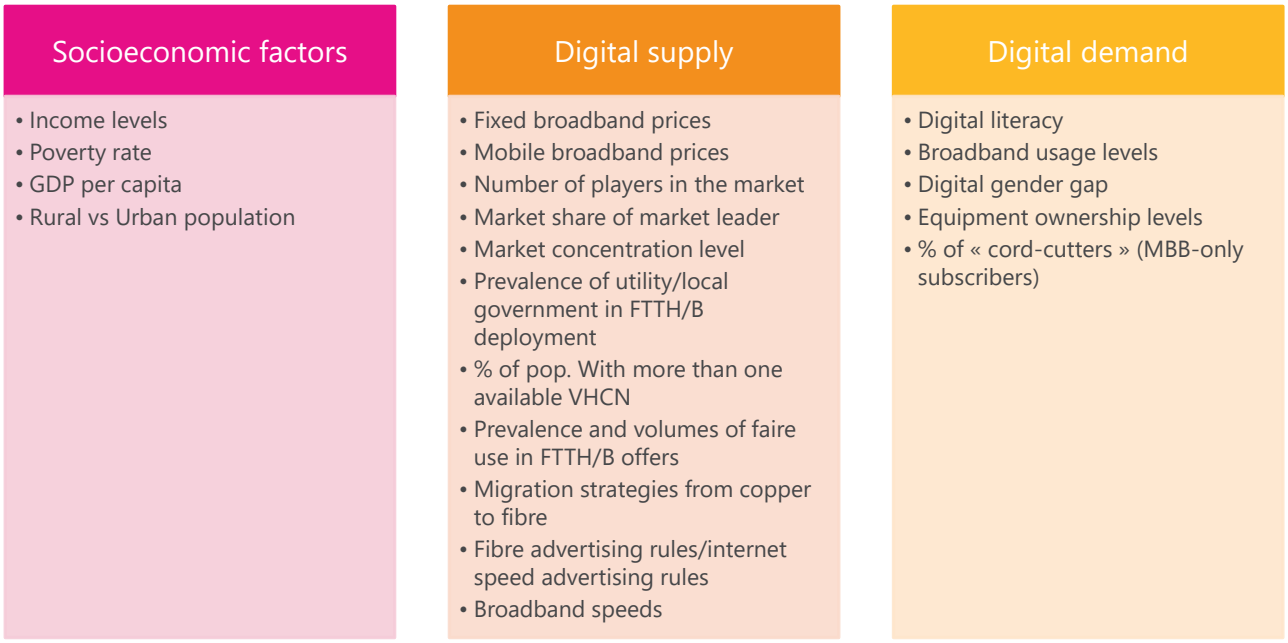
Measuring fibre adoption

We use a range of metrics to measure fibre adoption, including penetration, coverage, and take-up (see the definitions of these terms on page 9).

Typology of take-up drivers

We identified three types of factors to try and explain take-up. Figure 3.2 shows a comprehensive list of the indicators we used.

Figure 3.2: Take-up potential explanatory factors



Source: Plum analysis

When these factors are measurable, we identified publicly available data sources to collect relevant corresponding indicators. Then we looked at how these different indicators correlate with fibre adoption in the different countries under study. This section highlights the main results of the quantitative analysis.

Some of these factors are harder to quantify, and we couldn't identify relevant metrics in the public domain for all of them. In these cases, we performed a qualitative analysis based on interviews with operators and regulators across Europe (see Section 4.).

3.2 Data and scope

For this part of the study, we used country-level data for the 27 EU members states and the United Kingdom and collected variables from several different data sources as shown in figure x.

Figure 3.3: Factors, corresponding indicators and data sources

Factor	Indicator (source, year)
FTTH/B coverage	% of households covered (FTTHCE 2021)
FBB Speed	Median FBB speed (Ookla, 2022)
MBB subs	Active MBB subscriptions (ITU, 2020)
Urban population	% Urban population (World Bank, 2021)

Factor	Indicator (source, year)
Digital literacy	% of individuals with basic or above basic digital skills (Eurostat, 2021)
MBB price	Monthly charges in EUR/PPP for the least expensive 20 GB mobile data offer (Eurostat, 2020)
GDP per capita.	GDP in constant 2015 USD (World Bank, 2021)
Income levels	Mean equivalised income, PPS (Eurostat, 2021)
GDP	GDP in constant 2015 USD (WB, 2021)
Equipment level	% of households with a PC (Eurostat, 2021)
FBB price	Monthly charges in EUR/PPP for the least expensive 100-200 Mbps fixed internet offer (Eurostat, 2020)
MBB Speed	Median MBB speed (Ookla, 2022)

Our variable of interest is the FTTH/B take-up, expressed as a percentage of homes passed in each country. This is provided by the FTTHCE proprietary dataset collected annually by Idate since 2012.

3.3 The interdependent relationship of coverage and take-up

Network deployment is the first necessary step to ensure that customers will subscribe to FTTH/B services. We therefore expected to observe a positive correlation between coverage and take-up. This is empirically verified by mapping take-up and coverage as shown in Figure 3.4. We can observe a relatively strong positive correlation between the two variables, which means that, other things being equal, the more fibre networks are deployed in the country the higher the take-up.

There are countries that show outstanding levels of take-up while coverage is below European average. This is the case of Finland for example that has a 97% take-up while only 43% of households have access to FTTH/B networks. This may suggest that as soon as fibre is deployed in Finland, customers tend to largely subscribe to the proposed service[5]. One possible reason for this could be a high level of awareness regarding the benefits of very high-speed connectivity and reliability of FTTH/B networks. Another reason could be that operators in Finland are particularly effective in marketing and selling their FTTH/B services in the country. Other countries such as Ireland show an above average level of coverage but a comparatively low level of take-up.

Figure 3.4 below highlights three main categories of countries:

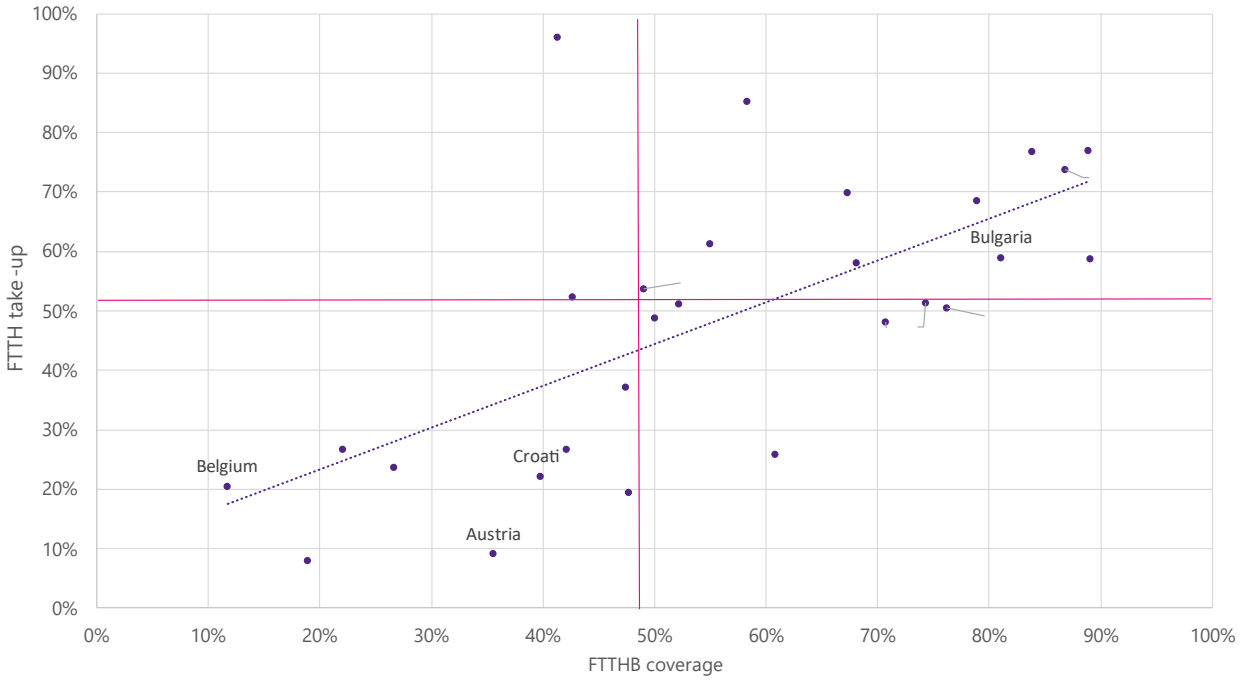
- Countries at the bottom-left end of the chart: Belgium, Germany, the UK, Greece, Croatia, Austria, Cyprus, Italy and Poland. These countries have relatively low take-up and a possible obvious reason for that is the relatively low coverage.

- Countries at the bottom-right end of the chart: Ireland, Hungary, Malta, Denmark, Luxembourg and Estonia. These countries have higher than average coverage but lower than average take-up. With the exception of Ireland, they are close to the European average take-up, and we can reasonably assume that they are likely to "move" to the upper-right end of the chart in the short-time.

- Countries in the upper-right end of the chart: Lithuania, France, Slovakia, The Netherlands, Slovenia, Romania, Bulgaria, Latvia, Portugal and Spain. These countries are amongst the 10 best performers in terms of take-up and have also higher than average coverage rates.

[5] In reality there is a time lag at play here that is not captured in this chart.

Figure 3.4: Correlation between take-up and coverage



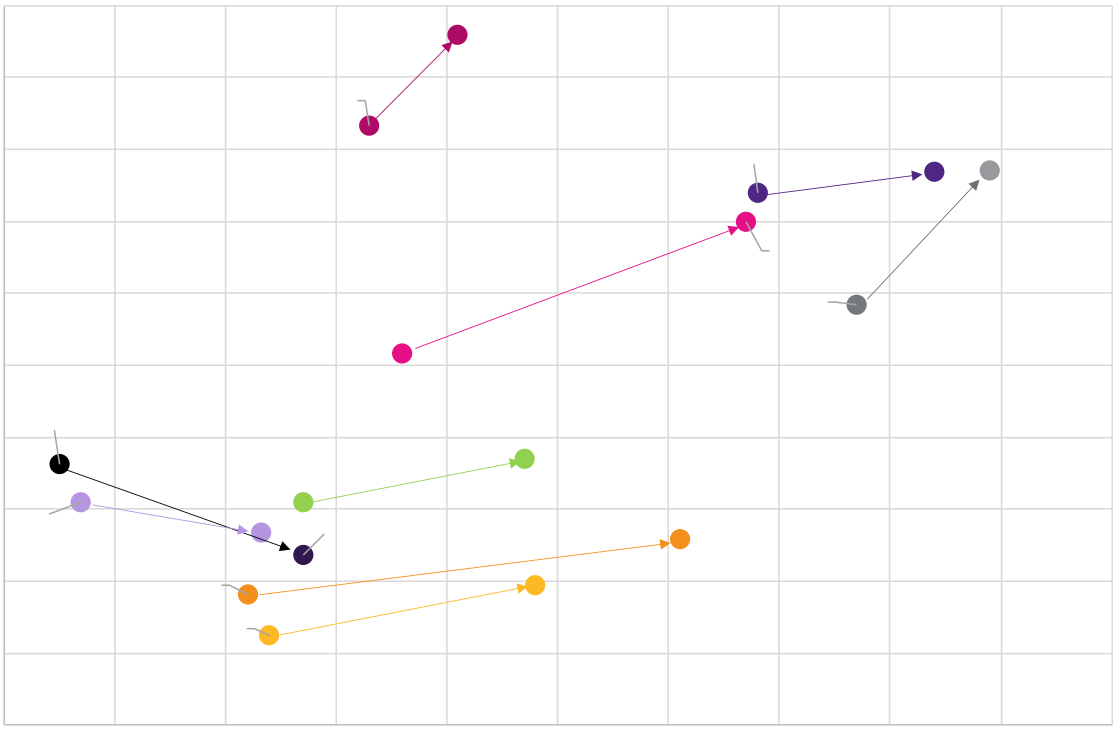
Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

Looking at take-up and coverage more dynamically, we observe that countries have had different trajectories. Figure 3.5 below shows how take-up and coverage evolved between 2018 and 2021 in selected countries, including Sweden, Germany, Poland, Ireland, Italy, France, Finland and Spain[6]. Evolution of take-up is shown by the direction of the arrow (up when take-up has increased, down when take-up has decreased). Changes in fibre coverage are shown by the length of the arrow (the longest it is the larger the coverage increase during the timeframe).

We observe two categories of countries: those that managed to increase both their coverage and take-up rates such as France, Spain, Sweden, Finland, Ireland, Poland and Italy; and those that increased coverage but didn't manage to drive take-up such as the UK and Germany.

[6] Including all countries in the same chart makes it difficult to read

Figure 3.5: Correlation between take-up and coverage 2018-2021



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe.

It is important to emphasize that we are analysing correlation and not causality which would necessitate more advanced quantitative techniques (e.g. econometric analysis) to control for the different factors that could also have an impact on take-up. Nonetheless we can draw two conclusions:

- We can observe that coverage is a key driver of take-up. Countries with low coverage tend to have low take-up rates although there are some outliers.
- We can also assume that coverage is to some extent driven by take-up. This is easily explained by the fact that a successful fibre network operation (i.e. one with a comparatively high take-up) is likely to find it easier to fund further development and thus coverage.

In fact, the dynamics of take-up and coverage are such that there is likely a virtuous cycle where deployment drives take-up, which in return encourages deployment. The reverse may also be true, poor take-up may slow deployment.

3.4 The importance of broadband pricing

Economic theory suggests that in most markets the level of demand for a product is affected by not only its price but also by the price of relevant alternatives. In the context of FTTH/B broadband, we assume that the alternative for most consumers would be the copper-based connectivity services such as xDSL or FTTC and we should therefore consider prices of both fibre-based internet offers and copper-based internet offers to better understand the importance of broadband pricing. One way to do this is to analyse the two following aspects:

- the correlation between FTTH/B take-up and FTTH/B broadband prices; and
- the correlation between take-up and the differential price between FTTH/B broadband packages

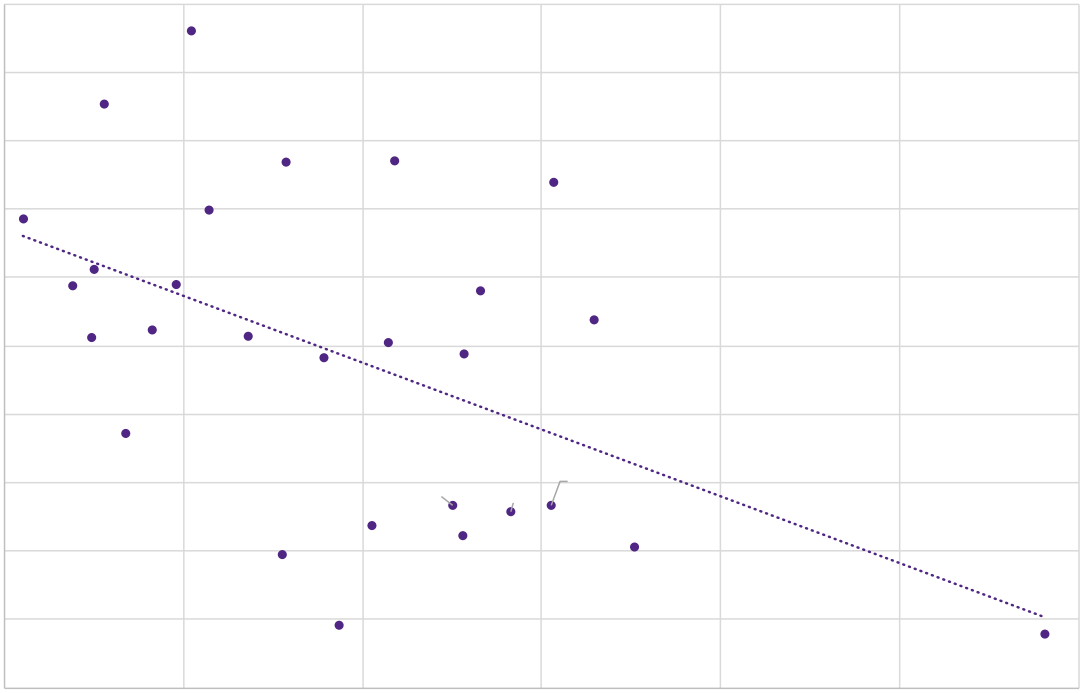
Using data from the European Commission on broadband prices[7], we identified two variables of interest:

- the price of the least expensive 100-200 Mbps fixed internet offer which we use as a proxy for the price of FTTH/B-based broadband services, and
- the price of the least expensive 12-30 Mbps fixed internet offer which we use as a proxy for the price of the copper-based alternative.

First, we observe that, as expected, there is a relatively strong negative correlation between take-up and the price of very-high speed broadband (See figure 3.6). Average price of the least expensive 100-200 Mbps fixed internet offer in the EU27+UK is 28.95 euros but there is significant variance across Europe: While Romania, Latvia, Slovakia and Lithuania have prices below 20 euros, the least expensive fixed internet offer can cost more than 40 euros in Portugal, Belgium and the Netherlands and almost 70 euros in Greece. In four out of the five countries with the lowest FTTH/B take up (Greece, Austria, Belgium and Croatia), fibre-based broadband internet costs more than the average price in the countries in scope (EU27+UK).

Looking at these prices as a share of income show that in most countries, FBB costs between 1% and 2.5% of monthly average income. In Portugal, Croatia and Greece however, consumers have to spend a higher share of their income to get the least expensive offer on the market - respectively 3.4%, 3.4% and 7.2%.

Figure 3.6: Correlation between take-up and very high-speed broadband price

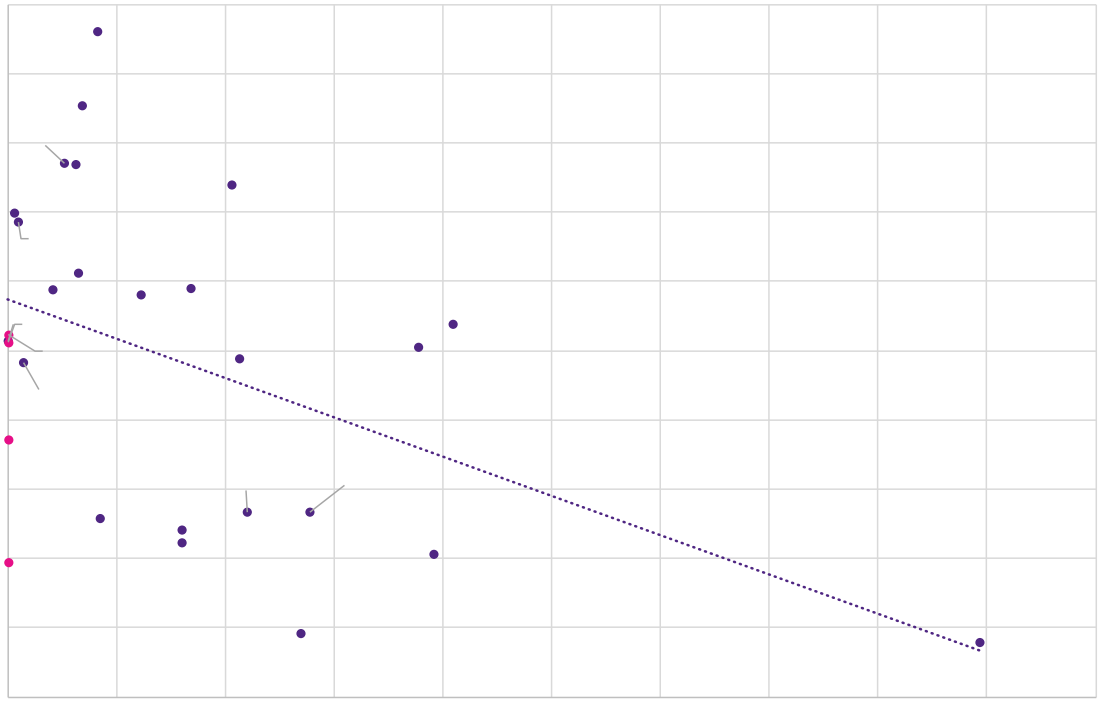


Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/Eurostat

[7] The data we used is available here: https://digital-strategy.ec.europa.eu/en/library/mobile-and-fixed-broadband-prices-europe-2020

Additionally, we also observe a positive correlation between take-up and the price differential of very high-speed broadband and copper-based alternative. Fibre-based broadband costs 38% more than the copper-based broadband -21.18 euros- and the average monthly price differential is 7 euros. Greece stands out with the highest price differential of 44.7 euros which represents 5% of the monthly national mean net income per capita.

Figure 3.7: Correlation between take-up and price differential of very high-speed broadband and copper-based alternative



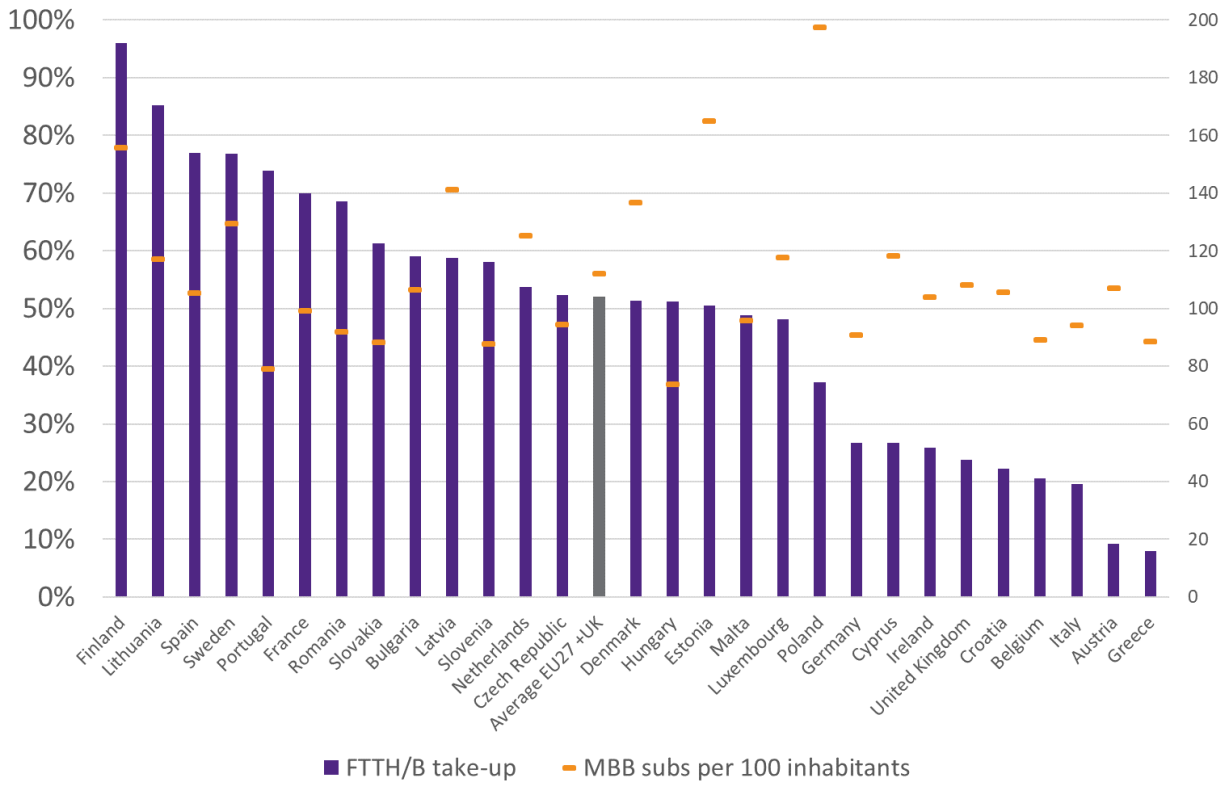
Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/Eurostat

3.5 Mobile and fixed broadband dynamics

The dynamics of mobile and fixed broadband have been the topic of a longstanding debate in the telecom industry and amongst economists. This is a complex issue characterized by the existence of both complementarity and substitutability effects that may vary by use cases and type of population. In this study we focused on how the state of the mobile broadband market may be affecting FTTH/B take-up and we looked at both penetration and price of mobile broadband.

Mobile broadband subscriptions are >1 per capita in the in-scope countries with an average of 111 subscriptions per 100 inhabitants and we observe no correlation between the number of mobile broadband subscribers and FTTH/B take-up. This suggests a predominant complementarity between the two types of broadband services and invalidates the idea that a high level of mobile broadband penetration hampers FTTH/B take-up. Finland for example, which has the highest level of FTTH/B take-up has also one of the highest levels of mobile broadband penetration – 158 subs per 100 inhabitants. In addition, there is no correlation between FTTH/B take-up and mobile broadband prices either, but it does not mean that the price of mobile broadband has no effect at all on FTTH/B take-up.

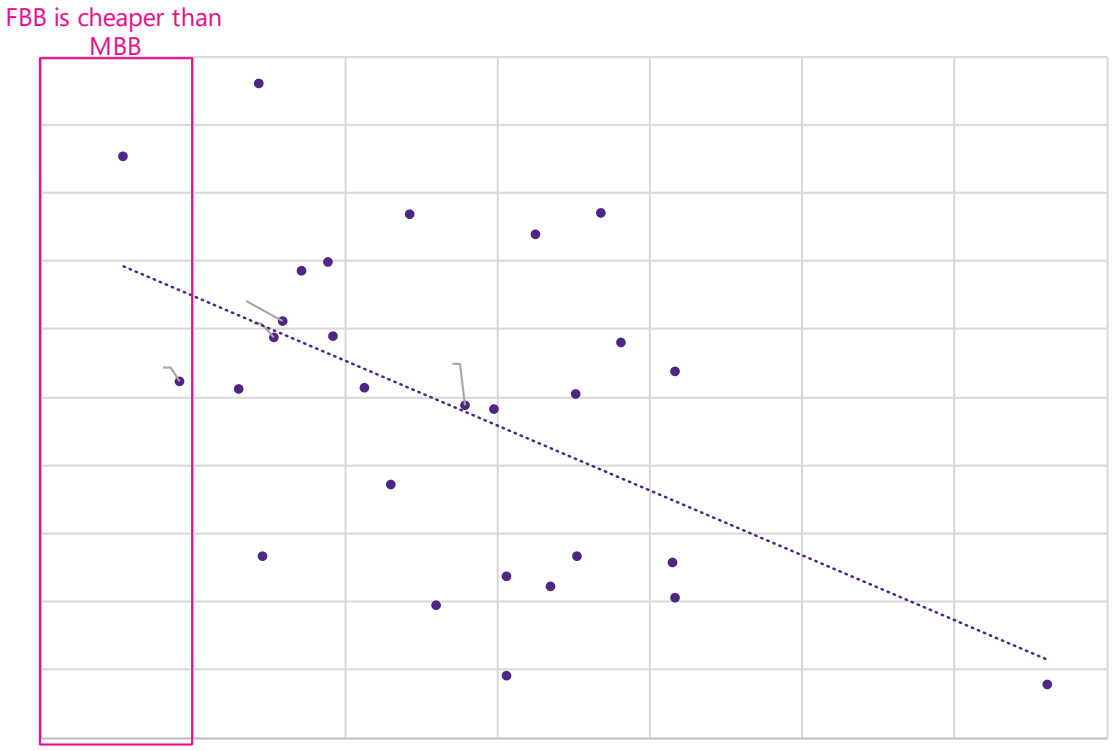
Figure 3.8: FTTH/B take-up and mobile broadband subs



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/ITU

In fact, the analysis of the difference in prices tells a different story. When plotting FTTH/B take-up against the price differential between fibre-based broadband and mobile broadband, we observe a negative correlation which suggests that on average, countries with high level of FTTH/B take-up tend to have a lower price difference between fibre-based broadband and mobile broadband. Lithuania, for example which has one of the highest levels of FTTH/B take-up in the region seems to have a fibre-based broadband offer that is cheaper than mobile broadband. This indicates that when fibre-based broadband is significantly more expensive compared to mobile broadband, FTTH/B take-up is likely to be constrained which suggests that there is also a potential effect of substitutability that appears at a certain level of relative prices. In other words, when FTTH/B services are too expensive, some customers tend to prefer a less expensive mobile broadband-only form of connectivity.

Figure 3.9: Correlation between FTTH/B take-up and FBB/MBB price differential



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/European Commission

3.6 Socioeconomic factors

None of the socioeconomic factors we analysed seem to be statistically correlated with FTTH/B take-up. This inevitably raises the question of whether these factors have any impact on the level of take-up we observe in European countries. In fact, we cannot infer from our analysis that they have no impact on take-up and there are several potential reasons that could explain the absence of correlation. For example, it is possible that the size of the country sample we analysed is too small to capture the heterogeneity in some of the indicators and performing the same analysis on a larger set of countries may lead to a different result. It is also possible that some of the indicators we used did not enable us to comprehensively analyse the factors because of definition or collection methodology. To better illustrate this last point, let's focus on digital literacy for instance.

In Europe, more than 90% of professional roles require a basic level of digital knowledge and while the use of digital is spreading across all sectors there are still around 42% of the population that lack basic digital skills, including 37% of those in the workforce[8]. Improving digital literacy amongst the population is therefore a key objective for the EU which has invested in various programmes such as the European Skills Agenda, the Digital Education Action Plan and the Digital skills and jobs coalition. In the context of the EU Digital Single Market Strategy[9] and the Skills Agenda for Europe[10], Eurostat has developed digital skills indicators based on selected

[8] *https://digital-strategy.ec.europa.eu/en/policies/digital-skills#:~:text=In%20Europe%2C%20more%20than%2090,transport%20and%20even%20to%20farming.*
[9] *https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age*
[10] *https://education.ec.europa.eu/news/2016/0610-education-skills-factsheet_en.htm*

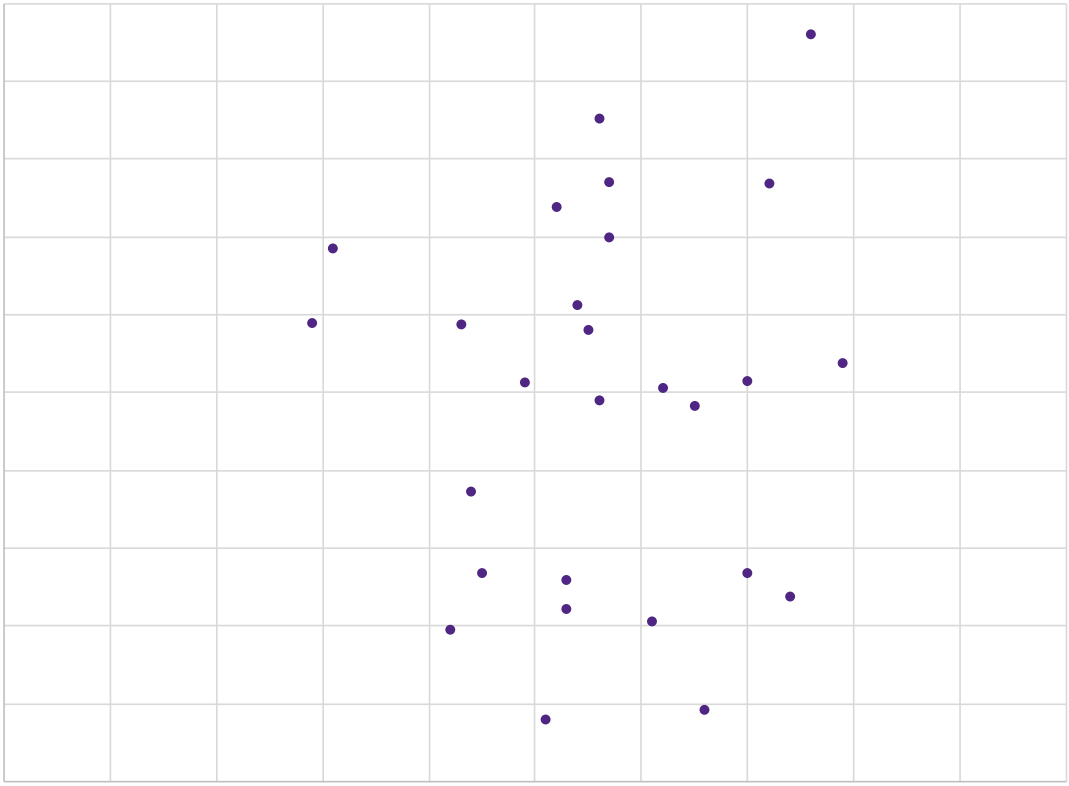
activities related to internet or software use performed by individuals aged 16-74 in four specific areas (information, communication, problem solving, software skills). These composite indicators include the following:

- % Individuals who have basic or above basic overall digital skills
- % Individuals who have above basic overall digital skills
- % Individuals with no overall digital skills

Our initial hypothesis was that digital literacy would likely be a key driver of take-up and we expected a strong positive correlation between at least one of these indicators and FTTH/B take-up. We analysed the three different composite indicators available and found no obvious correlation with FTTH/B take-up. While seemingly counter intuitive, this result can be explained by the fact that the benefits of FTTH/B span many in-home activities such as video streaming, which do not require specific digital skills. Additionally, there is also a possibility that the available indicators are not very good proxies for digital literacy.

Unfortunately, we couldn't find any other relevant indicator for digital literacy at the EU level. Eurostat and the European Commission seem to be aware that these indicators may need to be improved or changed and work has started in cooperation with users, NSIs and researchers to improve these[11].

Figure 3.10: Correlation analysis between FTTH/B take-up and % of adults with basic or above basic digital skills



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/Eurostat

[11] *https://ec.europa.eu/eurostat/cache/metadata/en/tepsr_sp410_esmsip2.htm*

3.7 Conclusion

The key findings of this data analysis exercise are mostly as expected, but they are nonetheless important to keep in mind going forward:

- FTTH/B coverage and take-up are in something of a symbiotic relationship. If early take-up is rapid, it drives deployment and further take-up, pushing the market in a virtuous circle as a sound business model generates more appetite for investment. If that knock-on effect doesn't happen however, a fibre network can become stagnant with low take-up, limited ability to raise funds for further deployment, etc.

- Pricing is – of course – all important. Not only is the price difference between legacy offers and FTTH/B important in creating attractiveness for fibre offers, but the price difference with mobile offers, if too significant, can also push users towards mobile substitution solutions.

- Socioeconomic factors do not seem to be a key driver for FTTH/B take-up. That's not to say that in individual countries local socioeconomic factors will not represent either a driver or a hurdle, but it does suggest that there is no deterministic impact of demographics.

This last point deserves to be explored a little further because some might misinterpret this finding to mean that, for example, digital literacy is not important to fibre adoption. Our interpretation of these results (or lack thereof) are rather as follows: first, digital literacy may (in general) not be as important to FTTH/B take-up as was initially anticipated because the primary use cases are no longer IT related (video streaming, gaming, etc.); secondly, even though statistically digital literacy doesn't look like a significant driver, this doesn't mean that in a few specific countries in Europe, it remains an issue; lastly, and perhaps most importantly, even if a correlation between digital literacy and FTTH/B adoption isn't evident, that doesn't mean that digital literacy isn't a crucial aspect of participation in civil society.

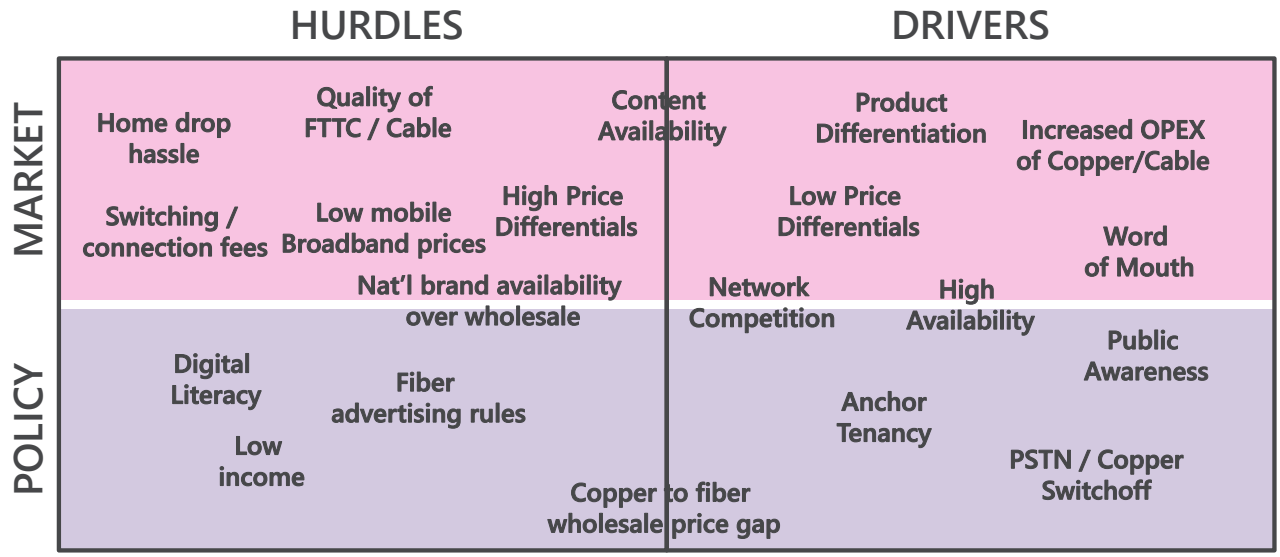
More broadly, the fact that socioeconomic indicators do not seem to be strong drivers for FTTH/B adoption reinforces the notion that market conditions, service providers' choices and specific regulatory and policy decisions impact take-up also and need to be examined. This is what was undertaken in Step 2 of the study.

4 Country case studies

4.1 Conceptual framework

In order to identify and compare the hurdles and drivers to adoption in various markets, we have created the following framework. We distinguish hurdles (on the left) from drivers (on the right) and market hurdles and drivers (on the top) from policy hurdles and drivers (on the bottom).

Figure 4.1: Conceptual analysis framework



Source: Plum analysis

Market hurdles and drivers are mostly in the hands of market players. They are tactical or strategic choices in how they deploy, commercialise and market FTTH services, or they are market conditions they are facing that can help or hinder the adoption of FTTH. Policy hurdles and drivers are mostly in the hands of governments, regulators and policy makers. They are policy decisions that have been or could be made to accelerate fibre adoption.

In each country analysis, the framework will be adjusted to reflect the situation in that country. A hurdle marked in red is particularly relevant to that market and actively hindering adoption of FTTH/B. A driver marked in green is particularly relevant to that market and actively driving adoption. A hurdle marked in green has been addressed by market players or policy makers and is no longer actively hindering adoption.

The following is a high-level description of all the drivers and hurdles in this framework matrix:

Hurdles:

- **Home drop 'hassle':** in some markets, end-users are reluctant to let fibre network companies do the physical installation needed to get fibre inside the home. This reluctance may emerge at the moment of purchase (in which case users don't subscribe) or at the point of installation (when users realise the work that will need to be done).

- **Switching / connection fees:** there are two ways in which switching, or connection fees can be an adoption issue. The first is when end-users have to pay for the costs of their home drop: network operators usually cover those costs up to the boundary of privately owned land, but in rural markets, the costs to landowners of connectivity between the boundary and their premises may be significant and hence a barrier to investment. The second way is when on wholesale networks the ISP needs to renew the customer's router to switch from copper to fibre. ISPs are sometimes reluctant to bear that cost proactively and would rather leave the customer on copper.

- **Quality of FTTC / Cable:** in markets where FTTC was aggressively deployed, the gap in performance between the legacy copper platform and the fibre platform is lower than in other markets and creates issues for service providers to differentiate the fibre services.

- **Low mobile broadband prices:** while mobile broadband and/or FWA are rarely a broad substitute for fixed broadband, especially FTTH/B, in some markets the price gap between mobile broadband and fixed may be such that some customers decide to go mobile only.

- **High price differentials:** in markets where FTTH/B prices are still significantly higher than xDSL prices, fibre adoption is slower.

- **Content availability:** while not as dominant as it once was, linear content availability may still be a driver or a hurdle (depending on which platform offers it), especially in markets with a strong history in cable and/or satellite.

- **National brand availability over wholesale:** in markets where wholesale is an important part of the FTTH/B platform, national brands are sometimes not present on wholesale networks. The absence of recognisable national brands on fibre hinders the adoption of the FTTH/B as consumers mistrusts the brands they don't know.

- **Digital Literacy:** while we established in Section Error! Reference source not found. that digital literacy was not a key driver for FTTH/B adoption at EU27+UK level, that doesn't mean that in some specific markets it's not an important consideration.

- **Low income:** many programs and social tariffs exist to address the issue of affordability of broadband, so it stands to reason that low income is an accessibility issue for some consumers.

- **Fibre advertising rules:** FTTC and copper providers have used the word fibre in their advertising when not explicitly forbidden to do so by advertising authorities. This created consumer confusion as to what really was FTTH/B and tainted the use of “fibre” in advertising. This can represent a hurdle for proper FTTH/B adoption.

Drivers:

- **Product differentiation:** the marketing strategy of operators and particularly how they make their fibre packages different from existing copper or cable solutions can make a big impact on driving adoption.

- **Increased OPEX of copper / cable:** the aging copper / cable plant combined with increased energy costs creates an incentive for incumbent network operators to accelerate the sunset of the copper network and for cable operators to migrate towards FTTH/B based network solutions.

- **Low price differentials:** low price gaps between copper/cable products and FTTH/B products makes the adoption of FTTH/B faster and easier.

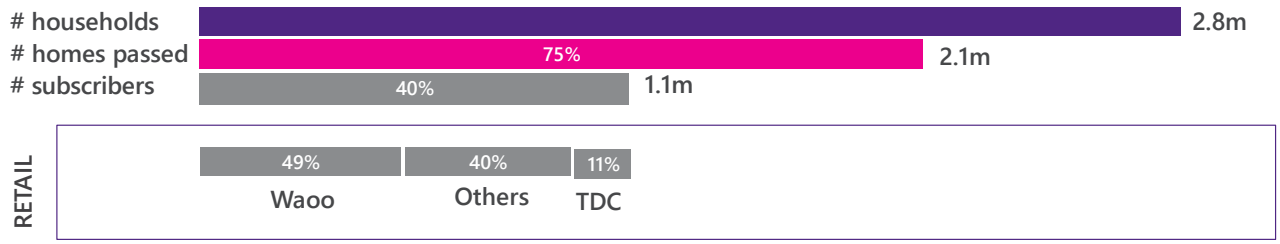
- **Word of mouth:** there's a hard to identify tipping point beyond which consumers know what fibre is and see it as beneficial. Past that point, word of mouth reinforces ISP marketing and fibre adoption accelerates.
- **Network competition:** when multiple fibre network providers compete in the market, there is theoretically more customer awareness and more attractive offers, which leads to higher adoption.
- **High availability:** availability of FTTH/B not only drives adoption (to an extent, as seen in part 1) it also allows service provider to scale up marketing and establish more effective go to market strategies.
- **Copper to fibre wholesale price gap:** in many markets where incumbents have wholesale obligations, there is a temptation to increase wholesale copper prices, relative to fibre to incentivise fibre deployment and take-up.
- **Public Awareness:** awareness campaigns on the benefits of FTTH/B (or more likely VHCN) run by national or (more often) local government can represent important measures in educating customers.
- **Anchor Tenancy:** national or (more often) local government migrating their own locations as well as schools, hospitals, etc. to FTTH/B constitutes an important component of adoption for network operators.
- **PSTN / Copper Switch off:** for incumbent operators, the ability to switch off copper is a significant driver as it means very important OPEX savings. However, this is unlikely to incentivise stakeholders to drive greater fibre take-up until pre-existing take-up represents a majority of connections

4.2 Denmark

4.2.1 Market overview

Denmark is the smallest country in our sample in terms of households (2.8m). Coverage has reached 75% of all households totalling 1.1m subscribers. This represents a 51% take-up rate.

Figure 4.2: Denmark Market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

Key market players include:

- **Waoo** is the second largest retail service provider overall, but the largest when looking only at fibre connectivity which is its sole platform. The operator has a 49% share of FTTH/B connections. Waoo started as an aggregator brand for utility FTTH/B providers but evolved to a full services ISP brand in recent years.

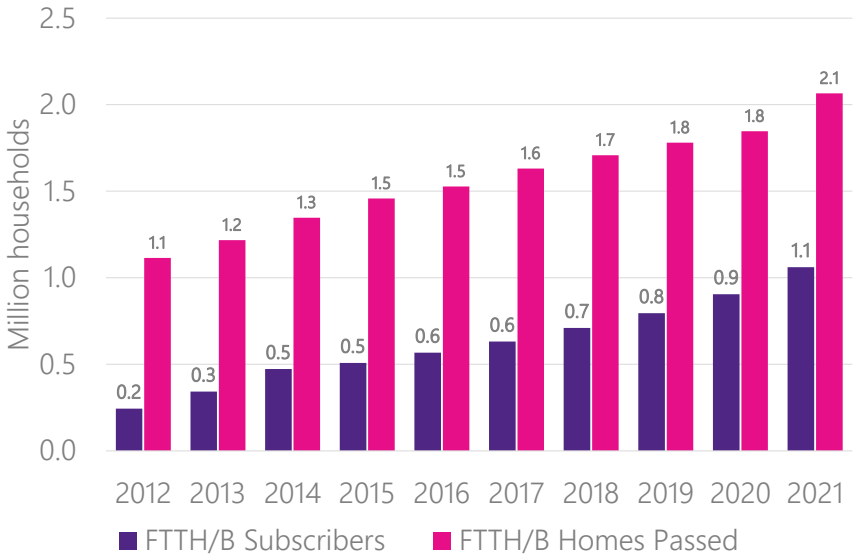
- **Other providers**, include utility companies offering fibre connectivity such as Norwegian Altibox, or Stofa and accounts for 40% of the subscriber market.

- **TDC,** the incumbent provider. It was previously a vertically integrated company providing access, network, wholesale and retail services but it underwent legal and operational separation in 2019 after it was acquired by Macquarie.[12] Both newly created companies, TDCNet and Nuuday are subsidiaries of TDC Holdings. TDCNet is the network division serving downstream markets across its legacy and new networks., including FTTH/B, FTTX/VDSL, FTTX/DOCSIS and mobile platforms. Nuuday is the downstream operation, incorporating a number of consumer facing brands, and connecting customers across FTTH/B, FTTX/VDSL and FTTX/DOCSIS platforms. It has 11% of FTTH/B connections,

There is also a well-established market for wholesale provision of FTTH/B connectivity in Denmark.[13] This is based on commercial principles and coordination of technical harmonisation and standardisation.

In 2012, there were 1.1m homes passed in Denmark and take-up was at 18% only (Figure 4.3). Coverage grew by 7% on average annually to reach 2.1m homes passed by 2021 while take-up grew even more rapidly by an average 19% annually to get to 1.1m in 2021.

Figure 4.3: Coverage and take-up evolution in Denmark (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.2.2 The national Broadband policy and regulatory framework

Strategic and policy initiatives

Denmark's current broadband strategy was put in place in 2021 with objectives to:

- provide all households and businesses with 100/30 Mbps connection by 2025;

[12] See: *https://tdcgroup.com/en/investor-relations/announcement-list/2021/6/tdc-as-to-finalize-the-separation-of-tdc-group-as-of-january-1-2022-3922962*

[13] See for example: *Danish fibre co-op expands wholesale reach through OpenNet | Capacity Media*

- provide 98% of households and businesses with 1 Gbps download speeds by 2025; and
- identify the needs and demand for gigabit speeds by 2030.

This is an evolution of a framework in which Denmark has created a coordinated digital strategy since 2001. The centrepiece of Denmark's current digital strategy is the Joint Government Digital Strategy 2022 – 2025[14] which includes principles covering the purpose of digitisation, inclusivity, transparency, ethical use of data, and clear standards. This part of the framework does not cover technology or speeds requirements.

Regulatory framework and initiatives

Telecoms policy in Denmark is overseen by the Ministry of Climate, Energy and Utilities which is responsible for Danish broadband policy development and administration. The Danish Business Authority (DBA)[15] is the sector regulator.

A review of Danish broadband wholesale and access markets was carried out in 2020-2022. Twenty-one geographical markets were identified in what had previously been a national market. From the market reviews, the regulator proposed to designate fourteen operators (seven of which were wholesale only, and seven vertically integrated) as having significant market power (SMP) in seventeen of the geographical markets.

The European Commission investigated five of the SMP designations considering infrastructure competition and concluded that there was insufficient evidence of SMP in these markets.[16] As a result, four SMP designations were withdrawn, leaving one which the DBA did not withdraw. The Commission withdrew its reservation in relation to this designation following a Phase II investigation. This leaves 10 geographic markets with an identified competition issue which may lead to less dynamic retail markets.

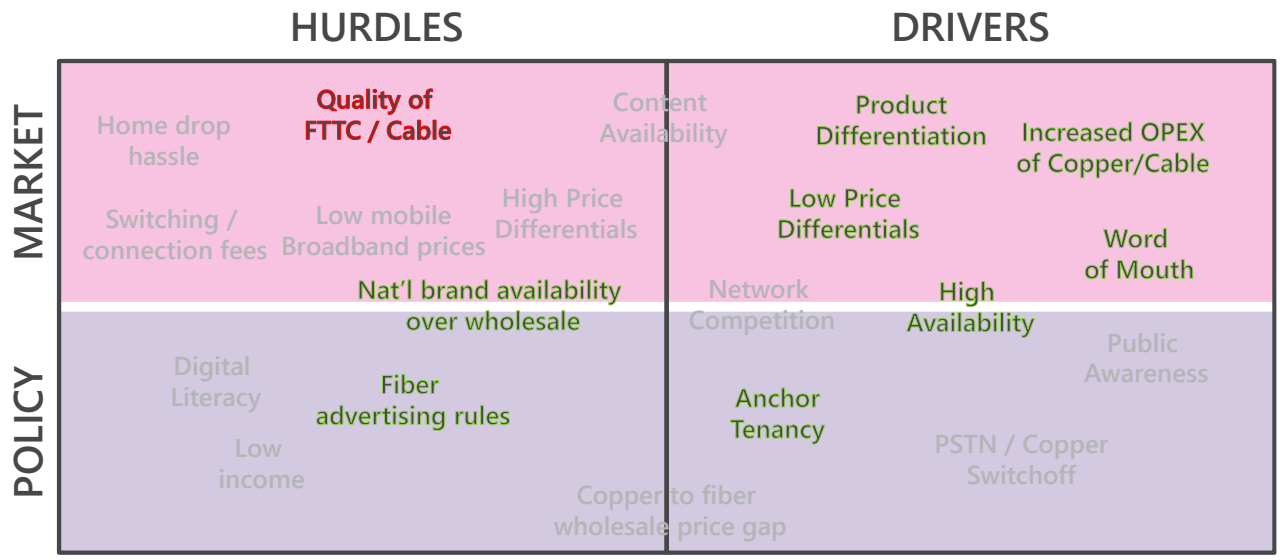
4.2.3 Policies to boost adoption

There do not appear to be initiatives in place specifically to boost fibre adoption. We note that the DBA does not appear to include demand side competition remedies in its programme.

[14] See: *The Joint Government Digital Strategy (digst.dk)*
[15] *Telecom and Internet Regulation | Danish Business Authority*
[16] *DK-2021-2346 Adopted_EN_Redacted.pdf (europa.eu)*

4.2.4 Drivers and hurdles to VHCN adoption

Figure 4.4: Drivers and hurdles to VHCN adoption in Denmark



Source: Plum analysis

Despite a comparatively high take-up of rate of 51% (40% adoption), Denmark is in an odd position due to the history of its FTTH/B deployment. Unlike most other advanced FTTH/B European countries, the bulk of the deployment was not the choice of the incumbent until its takeover and restructuring in 2018. Instead, regional utility companies, paradoxically operating in relatively low-density areas, spearheaded fibre deployment. This explains why Denmark is the only country in the EU with a higher rural than urban availability of FTTH/B. This also explains in part why adoption isn't higher: while incumbent TDC is now actively and aggressively deploying FTTH, the legacy cable plant is gigabit capable in most places, and cable customers are therefore reluctant to shift over to fibre even when offered by the same provider. As a consequence, while Denmark is still amongst the more advanced markets when it comes to FTTH/B adoption, it is lagging behind where it could be if the high quality of cable wasn't a hurdle to more massive adoption.

Market players have been effective in Denmark at driving differentiation both through attractive offers and low price differentials between legacy copper/cable and FTTH/B. This has resulted in positive word of mouth promotion. The fact that the Danish Consumer ombudsman ruled as early as 2013[17] on clarity in broadband advertising also helped drive that differentiation. Interestingly, unlike in other countries this ruling didn't address the particular use of the word 'fibre' in advertising or even the notion of fibre as an advertising tool, but rather the way broadband speeds were allowed to be advertised.

The board of the regional utility companies deploying FTTH/B includes a number of municipal authorities who have become anchor tenants, creating both higher demand and visibility for the fibre solutions.

An interesting specificity of the Danish market is the fact that for close to a quarter of the market, broadband bills are paid for by employers. Sometimes this is an employee benefit and sometimes it's deducted from the employee's salary, but in both cases the employer benefits from tax rebates in doing this. While we haven't found any numbers on the impact of this measure on VHCN adoption, it's likely that it has an impact.

[17] See : *https://www.forbrugerombudsmanden.dk/media/46464/2016-bilag-1-om-markedsfoering-af-bredbaandsforbindelser.pdf*

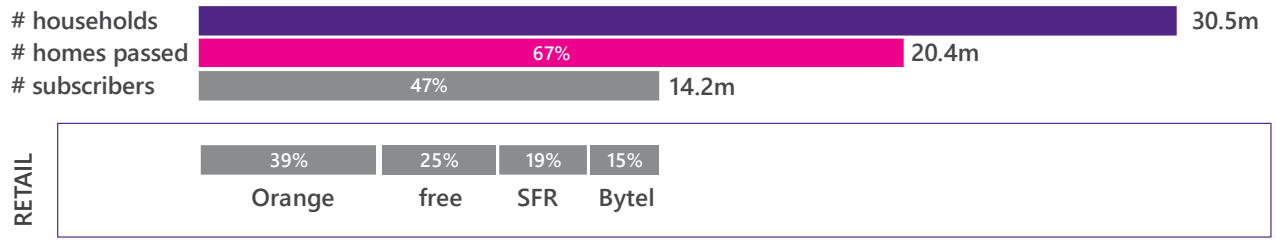
Finally, while there is currently no national plan for copper switch-off, TDC has been running some field trials in this direction, so it likely will be a driver for migration to fibre in the coming years.

4.3 France

4.3.1 Market overview

France is a large and developed telecommunications market, with around 20.4m homes passed (67% of Households) and 14.2m FTTH/B subscribers which represents 47% of the total households and a 69.9% take-up rate.

Figure 4.5: France Market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

The market is highly competitive with four main operators offering both fixed and mobile services. These include the following:

- **Orange,** the former incumbent France Télécom. Orange is the market leader in terms of FTTH/B subscribers with 39% market share. It has been deploying FTTH/B for a number of years and is also active in the mobile market with 34% share of mobile connections and a 33% share of mobile broadband connections. As the former incumbent, Orange operates the legacy copper network.

- **Free Mobile (Iliad)** operates a fixed backbone network, providing fixed broadband services to customers via unbundled local loops. It has also been deploying an FTTH/B network and as of 2021, reported 2.8m FTTH/B customers which represent 24.9% of the market. Free has a 19% share of mobile connections and 20% share of mobile broadband connections.

- **Altice-SFR** has a 19.4% share of FTTH/B subscriptions. Additionally, the operator also operates a cable network with a footprint of around 40% of the population. In the mobile market, the operator has 25% share of mobile connections and a 24% share of mobile broadband connections.

- **Bouygues Telecom** (Bytel) is the smallest operator in terms of FTTH/B subscriptions with a 14.8% share and 2.1m subscribers. In 2020 it formed a joint venture with Cellnex Telecom to deploy a national fibre optic network, with the intention of supporting 5G in France. It also formed a joint venture with Vauban Infrastructure Partners to deploy FTTH networks to 'medium density' areas, building on a previous joint investment. Bouygues Telecom has a 22% share of mobile and of mobile broadband connections.

In addition to the four main operators, there are public initiatives networks (RIP) in France that recorded 230,000 subscribers[18] in 2021 (1.6%). In terms of infrastructure deployment, there are additional infrastructure operators

[18] We should note that in most case subscribers mentioned here are not direct customers of public initiative networks but belong to local ISPs and not the big operators.

that deploy fibre in France. Figure 4.6 below shows FTTH/B homes passed by main operators. Note that these numbers reflect existing wholesale agreements, not only the own network footprint of the operators listed.

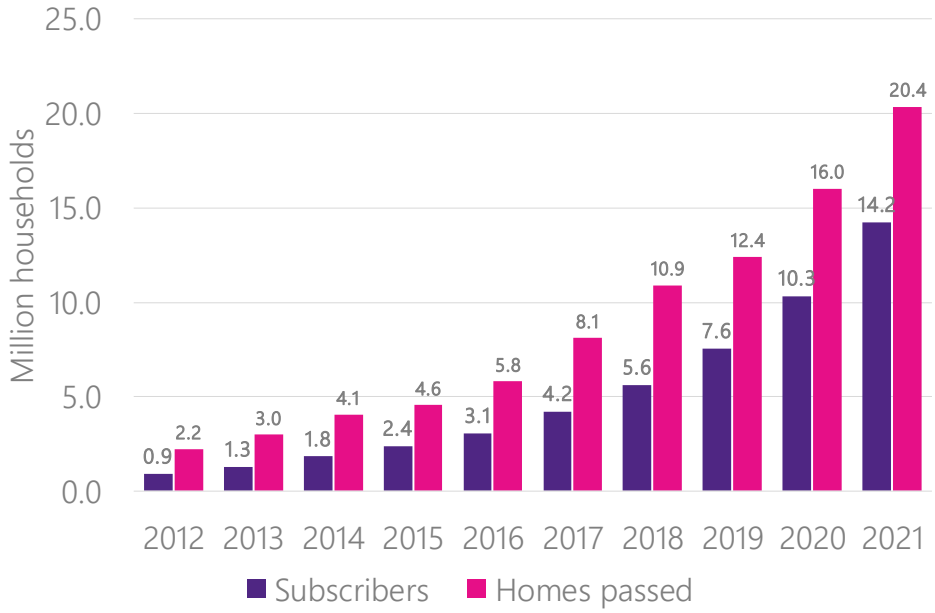
Figure 4.6: Main network operators in France

Operator	#Homes passed
Orange	27,444,367
SFR-Altice	23,500,000
FREE	24,000,000
Bouygues Telecom	22,500,00
Axione	1,672,000
Altitude Infra	1,261,000
Covage	908,000
Orange concessions	1,474,000
XP Fibre (SFR FTTH)	1,079,000
TDF	239,000

Source: Arcep

Evolution of homes passed and subscribers in France is shown in Figure 4.7 below. In 2012 the country had 2.2m homes passed and 0.9m subscribers.

Figure 4.7: Homes passed and subscribers evolution in France (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.3.2 The national Broadband policy and regulatory framework

France Very High Broadband Plan

The French national broadband policy called the "France Very High Broadband Plan" ("France Très Haut Débit") was launched in 2013 with two objectives[19]:

- to provide the whole population with access to very high-speed broadband services (>30mbit/s) by the end of 2022; and
- to expand fibre networks through the whole country.

A €20 billion investment over 10 years was announced and the funding is shared among local government, the central State and private operators in order to cover both rural and urban areas. To achieve its objectives, the Plan identified three types of geographic areas:

- **Areas with high population density**: Very high-speed broadband is deployed and funded by private operators. In these areas, ISPs compete with each other in network deployment and the only regulated network sharing happens inside multi-dwelling units for the vertical drop.
- **Areas of Expression of Investment Interest (AMII)**: The less dense areas under private initiative are commonly referred to as the "AMII areas". It was initially defined following a call for expressions of investment intent (AMII) organized by the Government to reveal projects for the deployment of fibre networks using operators' own funds outside very dense areas. As part of this AMII, Orange and SFR informed the Government in January 2011 of their intention to cover approximately 3,600 municipalities with their own funds. These intentions materialized in 2018, within the framework of article L. 33-13 of the CPCE, through deployment commitments in these municipalities by the two operators, on separate perimeters. The Government accepted them by two decrees dated July 26, 2018. The operators have thus undertaken to make 100% of the premises of these municipalities "connectable" or "connectable on demand" at the end of 2020 (with less than 8% being "connectable on demand"). Orange has also committed to making 100% of premises "connectable" by the end of 2022. In these areas, network operators have a de facto network monopoly and commit to offer wholesale access to their competitors.
- **Areas of Public Initiative Networks (RIP)**: in these lower density areas where no operator expressed an interest to deploy on a commercial basis, local governments can organize tenders for the deployment of partly subsidized neutral wholesale networks. These networks are run by infrastructure companies such as Altitude Telecom, Axione, and some subsidiaries of national operators (Orange, SFR and Bouygues Telecom). These networks are wholesale only and resell access to all ISPs on an equal terms basis.

Regulatory framework

There are two aspects to French fibre access regulation. Firstly, "asymmetric" regulation for the following markets:

- Physical infrastructure;
- Wholesale local access provided at a fixed location;

[19] *https://www.economie.gouv.fr/plan-de-relance/mesures/plan-france-tres-haut-debit-fibre-optique*

- Wholesale central access provided at a fixed location for mass-market product; and
- High-quality dedicated active solutions for businesses.

ARCEP noted that, in 2020, Orange controlled 99.99% of copper accesses and (directly or via a Public Initiative Network) 69% of FTTP accesses. Orange's wholesale market share (excluding self-supply) of fibre is 67%. ARCEP proposed to designate Orange as the operator with significant market power (SMP) in each of the notified markets and imposed a range of regulatory obligations, including access, non-discrimination and price controls.

The other aspect to fibre access regulation is "symmetric" regulation, which sets up passive access to terminating segments of FTTP networks. The rules require all operators installing FTTH/B in buildings to deploy it in such a way as to allow access to be provided to passive (dark fibre) at concentration points aggregating at least 1,000 lines. Offers must include the potential for co-financing (on the basis of indefeasible right of use or IRU) before the investment occurs, after the investment – or on the basis of short-term rental. The terms and conditions as well as prices were established through a series of disputes resolved by the regulator in 2011. Prices were cost-based, but with mark-ups on the WACC to account for increased risk.

Plans for remaining coverage

As of 2021, 32.7% of the 20.4m households passed have not subscribed to an FTTH/B service. This represents a short-term potential of 6.1m additional subscribers in France.

The latest figures from ARCEP indicate that as of March 2022, 70.6% of premises in France are eligible for fibre[20]. Eligibility does vary from one region to an another. For example, the Ile de France region has 93% of premises passed while Brittany has only 43.1% of premises passed.

In January 2020[21], the government has announced an additional funding of €570 million for fibre rollout in rural areas, including €420 million to be distributed to public initiative networks not yet subsidised by the government.

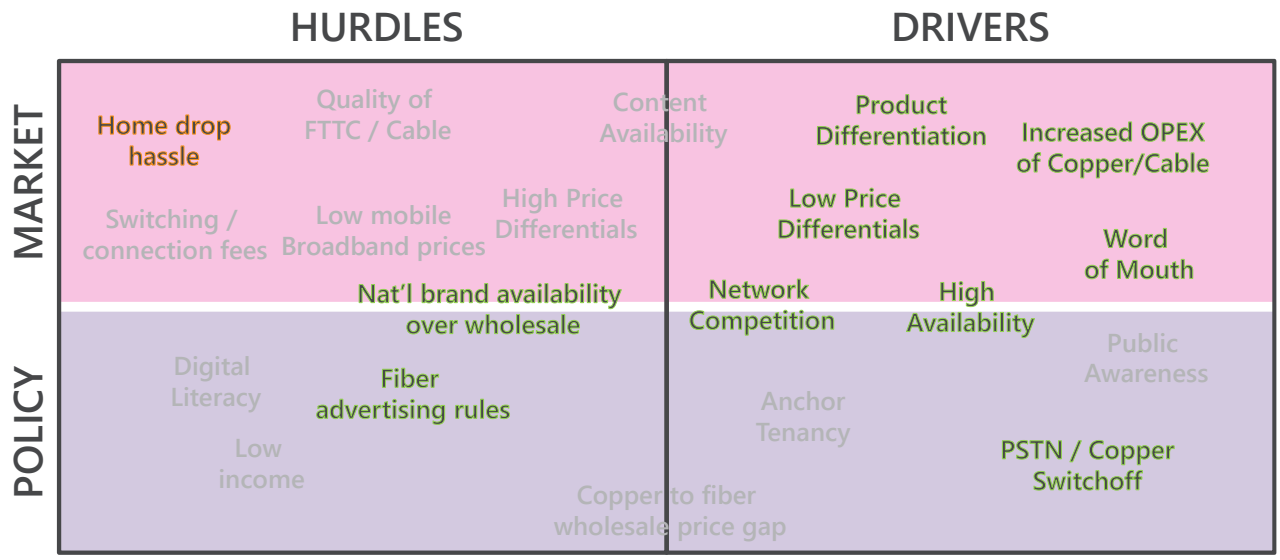
4.3.3 Policies to boost adoption

There do not appear to be any public policy put in place specifically to boost fibre adoption in France.

[20] *https://www.arcep.fr/cartes-et-donnees/nos-cartes/visualisations-ma-connexion-internet.html*
[21] *https://www.economie.gouv.fr/plan-de-relance/fibre-optique-570-millions-euros-supplementaires-generaliser-ensemble-territoire#*

4.3.4 Drivers and hurdles to VHCN adoption

Figure 4.8: Drivers and hurdles to VHCN adoption in France



Source: Plum analysis

In France as in many other markets, there is reluctance by some residential customers to let network operators do the necessary civil works to install an optical network termination (ONT) unit inside their homes. This is (unsurprisingly) more pronounced in lower density areas where single homes prevail, but partly compensated there by the low quality of legacy copper solutions. Apart from select rural uses as part of the "montée en debit" program in 2010, VDSL was never cleared for use by the French regulatory authorities. This has made it comparatively easy for service providers to differentiate their FTTH offers, and market competition, particularly the aggressive push by Free and Bouygues Telecom, has maintained prices at a comparatively low level.

Legacy copper will be phased out. ADSL offers are no longer visible on service providers' websites, and a first large scale testing of copper switch-off will be implemented in 2023 to ensure that the processes in place are effective[22]. The phasing out of copper will then be fully implemented and is likely to further accelerate fibre adoption. As considerations around energy efficiency come at the forefront, both for cost and environmental reasons, copper switch-off is an obvious win for both the incumbent and the market as a whole.

A combination of high availability and network competition in dense urban areas precipitated FTTH adoption in those areas, further generating positive word of mouth for fibre solutions. This was reinforced by a 2016 ruling[23] on use of the term "fibre" in advertising which forbade cable in particular to advertise their DOCSIS solutions as "fibre".

Finally, despite the multiplicity of comparatively small publicly funded networks in low density areas, there is no availability issue for national brands as all four national operators are present on all RIPs. This is due in large part to the work of Interop' Fibre[24], a trade association that established common protocols to facilitate operational and ordering interoperability between service providers and network operators. Presence of all four national brands on (comparatively) small regional networks ensures a high level of take-up on these networks.

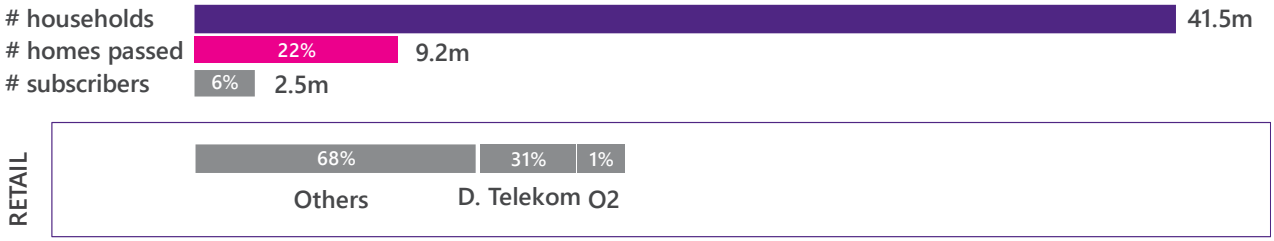
[22] *https://www.fftelecoms.org/communiques-et-dossiers-de-presse/experimentation-sur-la-fin-du-reseau-cuivre-fermeture-commerciale-au-31-mars-2022-dans-six-communes/*
[23] See: : www.legifrance.gouv.fr/loda/id/JORFTEXT000032291369 and www.legifrance.gouv.fr/loda/id/LEGIARTI000032429295/2016-06-01/
[24] *https://www.interop-fibre.fr/*

4.3.5 Germany

4.3.6 Market Overview

Germany can be considered as a less developed FTTH/B market. The main NGA networks in Germany are the upgraded copper network (FTTC) of the incumbent operator Telekom Deutschland and HFC networks. Figure 4.9 shows that both FTTH/B deployment and adoption are still low. There are 9.2m homes passed which represents 22% of the 41.5m households in the country and 2.5m subscribers.

Figure 4.9: Germany market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

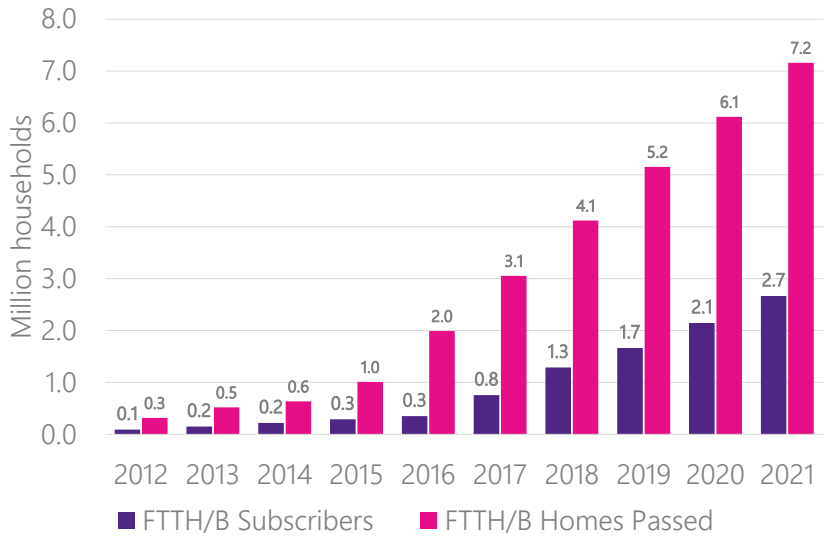
The major players in the German market are listed below:

- **Deutsche Telekom** is the German incumbent telecom operator and one of the largest telecommunications companies in the EU. It has a 31 % share of the FTTH/B market in terms of subscribers and a 33.5% share of the mobile market by active sim cards.
- **Telefonica O2** is present in the fixed and mobile markets. It has 10,000 FTTH/B subscribers which represents 1% of the market. and a 28.2% percent share of the mobile market, by active sim cards.
- **Vodafone** has acquired 76.5% of KDG in 2013 and is now one of the leading players in the broadband market with cable and VDSL-based infrastructure. As of 2021, it has around 5m subscribers.

Other players include smaller local/regional operators, and networks deployed by municipalities and/or utilities. Some are vertically integrated, like Deutsche Giganetz, and others, such as Deutsche Glasfaser, are wholesalers.

Figure 4.10 below shows how FTTH/B coverage and take-up evolved since 2012. At that time, take-up was around 33.3%.

Figure 4.10: Coverage and take-up evolution in Germany (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.3.7 National Broadband Policy and Framework

In Germany, the National Broadband Plan is a policy program that aims to ensure that all citizens have access to high-speed broadband internet. The plan was developed by the Federal Ministry of Economics and Energy and is implemented by the Federal Network Agency (Bundesnetzagentur), the national regulatory authority responsible for telecommunications and postal services. The National Broadband Plan consists of several measures that are designed to improve broadband coverage and increase competition in the market.

Additionally, the German Federal Government released the country's digital strategy[25] and the Gigabit strategy[26] in 2022. These are aimed at helping Germany become a leading digital nation and at ensuring that all citizens can fully participate in the digital economy. The nationwide supply of FTTH and 5G networks is set as a priority.

Plans for remaining coverage

In November 2021, Deutsche Telekom announced[27] it would be cooperating on network rollout with the financial investor 'IFM investors'. A joint venture, 'GlasfaserPlus GmbH' is to be set up to provide four million households with fibre-to-the-home connections, targeting rural and subsidised areas.

Additionally, Telefónica group and the insurance company Allianz AG have created the joint venture 'Unsere Grüne Glasfaser' to invest up to EUR 5 billion to connect about 2.2 million households with fibre, mainly in rural and in underserved areas[28]. In December 2021, the fibre operator Deutsche Glasfaser announced that, with backing from a consortium of creditors, it would be investing EUR 5.75 billion in a fibre roll-out to four million households.

[25] *https://digitalstrategie-deutschland.de/*
[26] *https://www.bundesregierung.de/breg-de/themen/digitaler-aufbruch/gigabitstrategie-2017464*
[27] *https://www.reuters.com/business/media-telecom/deutsche-telekom-announces-1-bln-fibre-optic-deal-with-australian-investor-2021-11-05/*
[28] *https://www.telefonica.com/en/communication-room/telefonica-and-allianz-create-a-partnership-to-deploy-fibre-in-germany-through-an-open-wholesale-company/*

These plans would therefore extend the coverage to an additional 10.2m households which would result in a total coverage of 47% of total households.

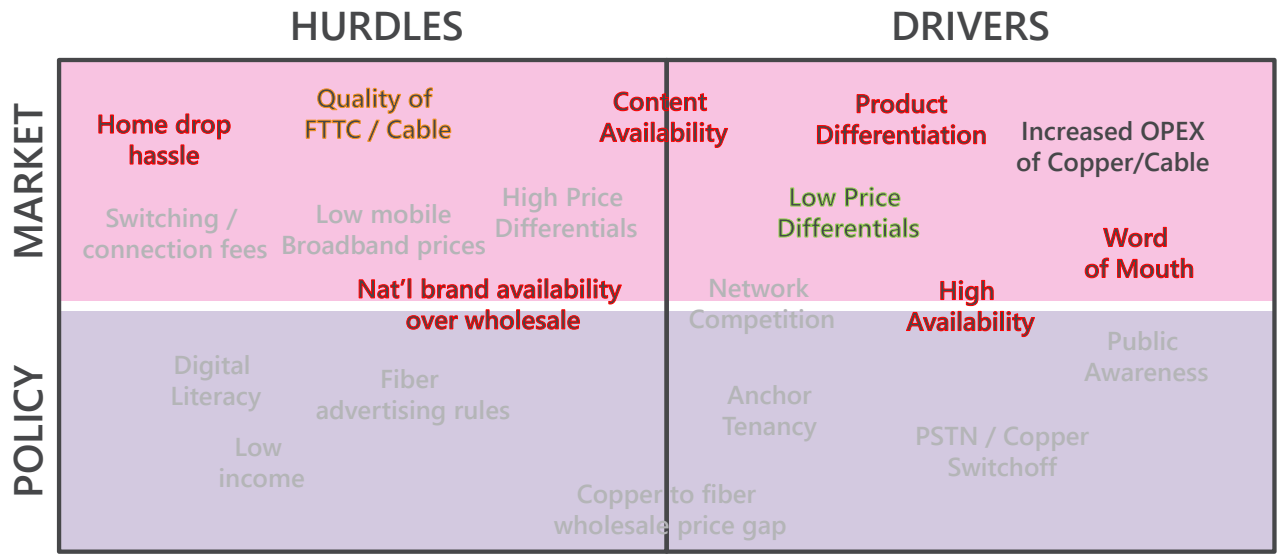
4.3.8 Policies to boost adoption

We identified the following policies to boost FTTH/B adoption in Germany:

- The new Telecommunications Act (Telekommunikationsgesetz, TKG) entered into force on December 2021, provides the phasing-out of the option for landlords to charge for TV and broadband subscriptions as part of a rental contract. The option will be withdrawn by mid-2024 and will offer consumers more flexibility in switching to new connectivity providers and addresses the inertia that was a part of the existing obligations.

4.3.9 Drivers and hurdles to VHCN adoption

Figure 4.11: Drivers and hurdles to VHCN adoption in Germany



Source: Plum analysis

The German market is behind in availability and deployment of FTTH. Incumbent Deutsche Telekom has had limited appetite for widespread fibre rollout and is primarily living off its investment in FTTC. This creates an issue for differentiating FTTH offers, although it should be stressed that where fibre is available, take-up is reasonably high compared to what is seen in other markets at the same level of maturity. This is especially true in low density areas.

Despite commitments in the various national plans for broadband, aside from subsidies to connectivity in white areas[29] the German government and regulator seem to have adopted a very low intervention approach when it comes to FTTH adoption. There seems to be a laissez-faire philosophy that the market will get there in its own time if it deems it necessary.

[29] Areas where no broadband infrastructure exists or is unlikely to be developed in the near term.

As a consequence, many of the issues that affect other markets are also present in Germany (like the reluctance of residential customers to see civil works in their gardens and homes) but are not addressed. Similarly, wholesale networks struggle to attract national ISP brands on their networks which may hinder their take-up.

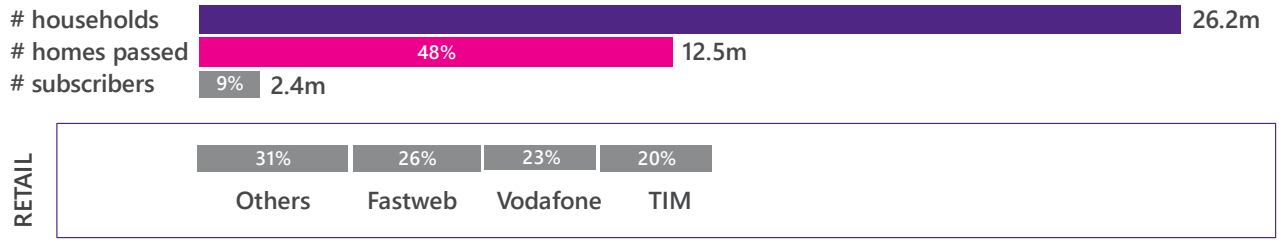
The low availability of FTTH nationally means that even though fibre offers are priced competitively compared to both FTTC and cable, this is unlikely to be sufficient to create the groundswell of word of mouth that would boost demand for the fibre already deployed. Finally, while content consumption in Germany is moving towards streaming like everywhere else, there's a strong legacy of IPTV and cable content offerings that create further drag on migration to fibre scenarios.

4.4 Italy

4.4.1 Market overview

Several operators are active on the broadband market in Italy offering broadband services over a mix of FTTH/B and FTTX/VDSL connectivity. At the retail level, the three largest providers are Telecom Italia (TIM), Fastweb and Vodafone, and there is also a significant "tail" of other providers with a sizeable share of the market (31%). Fibre deployment has passed 48% of homes, but adoption lags significantly behind as only 9% of the country's households have subscribed to FTTH/B.

Figure 4.12: Italy market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

The key players are:

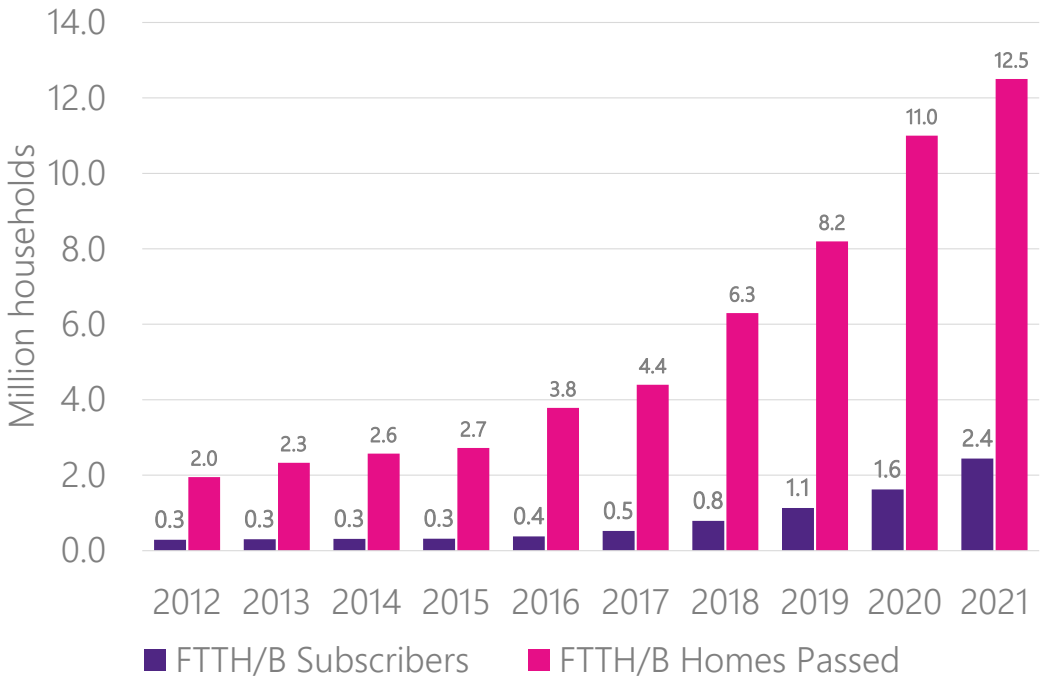
- **Fastweb** is the second largest fixed broadband provider and the market leader in terms of FTTH/B subscribers with a 26% share. A significant portion of this market presence is in its native city of Milan where FTTH has been available for close to two decades. Fastweb is also active on the mobile broadband market.
- **Vodafone Italia** has a 23% share of FTTH/B connections, and 20% of FTTx/VDSL connections. Vodafone provides broadband and mobile services.
- **Telecom Italia (TIM)** is the incumbent operator and has the biggest share of broadband connections, but the majority of these are on FTTX/VDSL. It has a 20% share of FTTH/B connections, and 40% of FTTx/VDSL connections. TIM also provides TV and mobile services.

In addition to these players, there are other small operators, including Sky Italia, Tiscali and Wind, which altogether represent a 31% share of FTTH/B connections, and 20% of FTTx/VDSL connections.

At the wholesale level, Open Fibre is a key player with significant FTTH/B deployed. Its network accounts for 67.5% of total FTTH sockets.[30] Open Fibre deploys FTTH both in urban areas and in rural areas with public (including European) subsidies[31].

FTTH/B deployment in Italy grew by 24% on average (AAGR) from 2m in 2012 to 12.5m in 2021. Adoption, however, was slow and hasn't changed significantly in this time frame. It is in 2017 that take-up started increasing and by 2021 Italy has reached 2.4m FTTH/B subscribers.

Figure 4.13: Coverage and take-up evolution in Italy (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.4.2 The national Broadband policy and regulatory framework

Strategic and policy initiatives

In 2021 the Government published its strategy for Ultra Broadband.[32] It includes information on initiatives to boost connectivity in areas of the country and society which are underserved. Funds to support this were identified in the Italian National Recovery and Resilience Plan. The Strategy includes seven intervention areas, amongst which coverage of underserved areas, a voucher plan and a gigabit connectivity plan.

Implementation of the strategy has €6.7 billion funding allocated[33] (€3.8 billion for the gigabit plan).

[30] We have analysed sockets connected as well as homes passed as there is overbuild in Italy.
[31] https://telecoms.com/515552/tim-and-open-fiber-pick-up-e3-4-billion-in-broadband-funding/
[32] See: *The Italian ultrabroadband strategy (mise.gov.it)*
[33] See: *The Italian ultrabroadband strategy (mise.gov.it)*

Regulatory framework and initiatives

Policy and regulation of telecoms markets in Italy is overseen by:

- The Department of Telecommunications, which is responsible for telecommunications policy including planning and implementation of broadband initiatives.
- The Agency for Digital Italy works on digital connectivity to public offices and special public users.
- The regulator, AGCOM regulates the market, including broadband access conditions.

AGCOM has established a framework for next generation network access.[34] This includes measures to facilitate fibre deployment, including access to physical network infrastructures and bitstream access services over fibre.

4.4.3 Policies to boost adoption

There have been interventions at national and European levels to encourage and support broadband adoption,[35] but these include measures targeted at lower speeds than what is offered on fibre. This reflects that the Ultra Broadband strategy does not specify fibre as the policy solution to all of Italy's connectivity challenges.

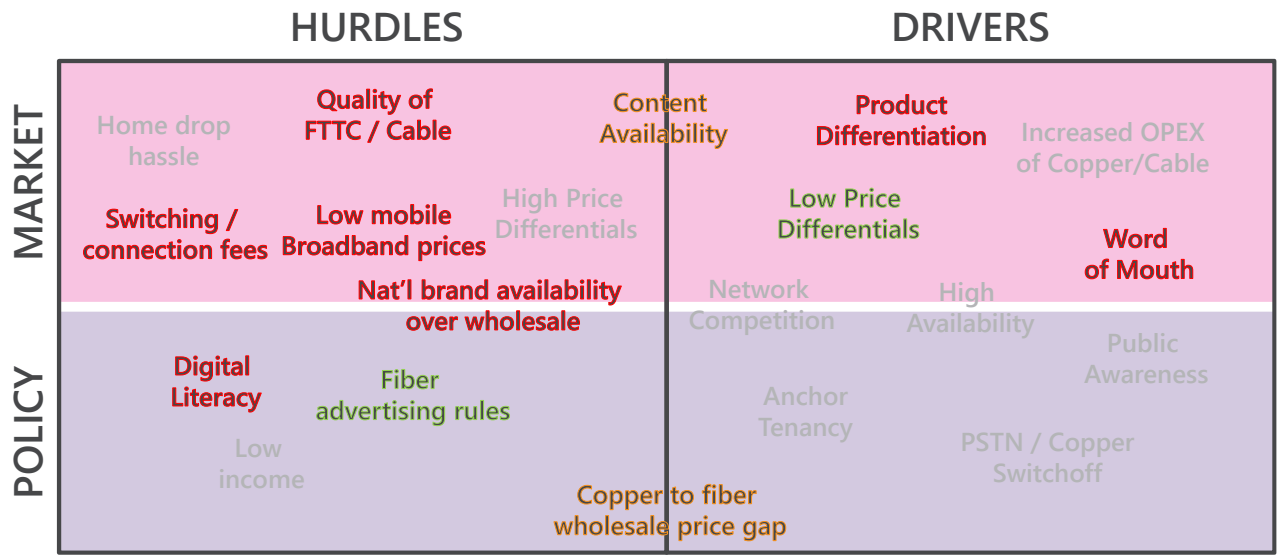
AGCOM also provides information to enable consumers to make informed choices,[36] these cover all services and are not aimed at fibre adoption.

There is a specific measure in place to support economically vulnerable citizens through a voucher scheme. The scheme subsidises connectivity (connection and subscription charges) for low-income households to create new or upgrade current subscriptions. The scheme also includes provision of end-user devices (tablet or PC) for use by the voucher recipient. The subsidised connection must provide speeds greater than 30 Mbps, and if there is a choice of connection, the subscriber must select the highest speed option. The scheme is technology neutral and there is no data on whether the scheme has been used to subsidise fibre connections. The Italian Government estimates that 5 million families are eligible for the 400,000 vouchers available. A detailed assessment of the efficiency of this (and other) voucher schemes will follow in Section 4.9.

[34] See: *Conditions of access to the NGAN network - AGCOM*
[35] In August 2020, the European Commission approved €200 million (US$220.3 million) for an Italian voucher program supporting access to higher-speed Internet for low-income households. The program provides vouchers worth €500.00 (US$550.69) to low-income households to go towards installing broadband with at least 30Mbps download speeds and purchasing equipment such as laptops and tablets.
[36] See: *Choose the most suitable offer - AGCOM*

4.4.4 Drivers and hurdles to VHCN adoption

Figure 4.14: Drivers and hurdles to VHCN adoption in Italy



Source: Plum analysis

Of the eight markets we analysed in depth in this second phase of the study, Italy is by far the one with the biggest issues. FTTH/B has been deploying for a number of years there, with adoption lagging far behind deployment and virtually non-existent in some rural areas.

There appear to be two root causes to the lag in FTTH adoption in Italy. The first one, that we see in other markets with similar circumstances, is the strong push for FTTC in the last decade on Telecom Italia's part. This has created a high availability of fast broadband services that make it harder to differentiate FTTH offers. In order to reinforce the differentiation opportunities, Italian authorities have recently implemented an advertising ruling based on a traffic light system where green is full fibre, orange is FTTC and red is ADSL.

However there is another, potentially more deeply-rooted issue that is likely related to digital literacy in Italy. A significant portion of the market is still on ADSL despite availability of FTTC at often cheaper prices. More generally, pricing does not seem to be the cause of this disaffection, but rather a fear of change and a lack of ease by some customers (mostly older people, and mostly rural populations) when it comes to handling technological change. This has led some customers, especially in lower density areas to switch to mobile broadband solutions when dissatisfied with ADSL, mobile solutions being perceived as both affordable and easier to install.

This does not explain the entire lag however. Where FTTH is available and demand for fast broadband services exists, two phenomena have combined to slow down migration to fibre. One is the absence of two large national brands on Open Fibre's platform (Telecom Italia and Fastweb), and the other is the reluctance of the other ISPs on Open Fibre's platform (Wind and Vodafone) to encourage their existing FTTC customers to switch over to fibre. This is likely due to the service providers' reluctance to pay for the cost of new CPEs. This hesitancy has slowed down fibre adoption considerably.

While it has been argued that the market presence of Sky Italia, utilising satellite distribution, and its content offers may have also slowed down adoption of FTTH, consensus seems to be now that most of the content that consumers care for (particularly live sports) is also available as streaming services, so it's likely that if content availability has hindered adoption in the past, it's less likely to do so in the future.

The government and regulator have tried to address issues of FTTH/B adoption. The government's voucher scheme aimed at addressing a perceived reluctance to switch in low-income families, was not only not targeted specifically for FTTH, it also allowed targeted consumers to purchase equipment rather than subscriptions.

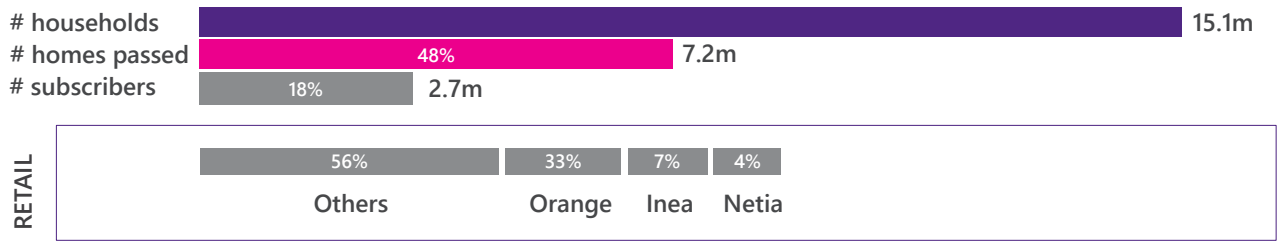
There is ongoing dialogue between the regulator AGCOM and stakeholders about addressing the regulated wholesale price of copper as a remedy to make copper / ADSL offers less comparatively attractive and accelerate migration towards better broadband solutions. Neither the outcome of this discussion nor the impact of intervening in this way are yet known.

4.5 Poland

4.5.1 Market overview

Poland has developed a competitive but fragmented telecommunications market. Cable and Docsis 3.0 are currently the main technologies used to provide fixed broadband services across the country, representing about 38% of broadband subscriptions. Fibre deployment is widespread and growing, with around 7.2 m homes passed which represents 48% of all households. There are 2.7m FTTH/B subscribers which represents 18% of the total households.

Figure 4.15: Poland market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

The market is fragmented with significant share of FTTH/B connections (56%) held by local players. In 2021, only seven companies out of almost 1200, provided services to more than 1% of customers each and the remaining companies together serve 56% of users. We notice however that the share of small entities decreases year on year in favour of larger telecommunications providers.

The main operators in Poland include the following:

- **Orange Polska,** the incumbent operator. It provides Internet services over its FTTH/B and VDSL network. It is the largest ISP with a 33% share of FTTH/B connections, and 70% share of FTTx/VDSL connections. Orange Poland offers both fixed and mobile services.
- **Inea** is the second largest FTTH/B provider, but because of the fragmented nature of the market they only represent a 7% share of connections. It has a 23% share of FTTx/VDSL connections and provides broadband, TV and mobile services as well.
- **Netia** is the third largest FTTH/B provider and has 4% market share. Netia has 6% share of FTTx/VDSL connections and has some FTTx/DOCSIS connections deployed (2% share). Netia provides broadband, TV and mobile services.

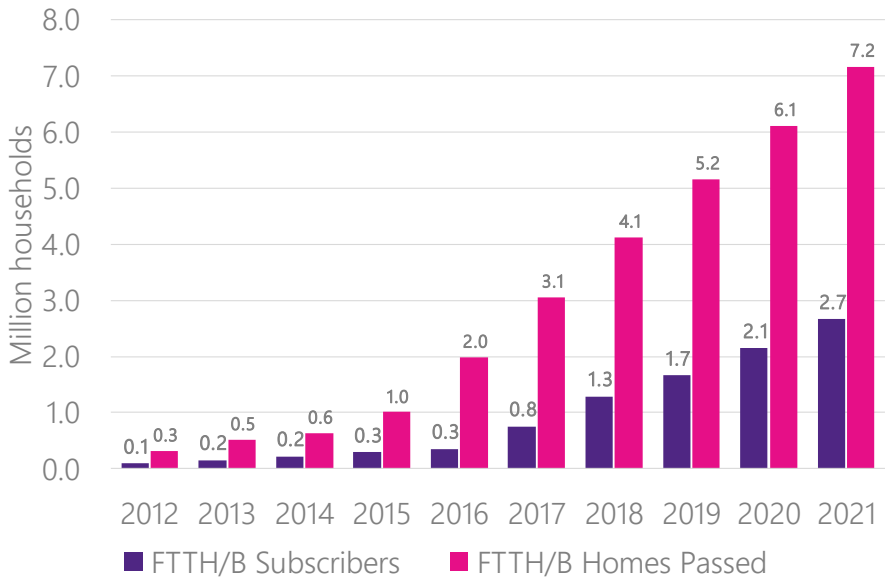
- **UPC Polska** is the largest provider of services over a cable FTTx/DOCSIS platform. It has 45% of FTTx/DOCIS connections and does not deploy other fixed network platforms. UPC provides broadband, TV and mobile services.

- **Multimedia Polska** also deployed a FTTH/B network and has 3% of connections. It also deploys FTTx/DOCSIS where it has 14% of connections. Multimedia Pollska provides broadband, TV and mobile services.

At the wholesale level, Nexera is the only pure wholesale player. Other operators such as Inea and Orange have launched separate infrastructure entities that offer wholesale products to other operators (Fibrehost for Inea and Światłowód Inwestycje for Orange).

Both coverage and take-up have significantly increased in Poland since 2012. The number of homes passed grew by 45% annually (AAGR) while take-up grew even faster by 48% annually (See Figure 4.16).

Figure 4.16: Coverage and take-up evolution in Poland (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.5.2 The national Broadband policy and regulatory framework

Poland's National Broadband Plan and other coverage initiatives

The Government of Poland adopted the National Broadband Plan[37] in 2020. The Plan is a five-year program with goals for high-speed broadband, 5G development and universal service. Specifically, the Plan sets out the following goals:

- Universal access to the Internet with a bandwidth of at least 100 Mb/s, with the possibility of modification to Gbps speeds. Part of this objective was aimed at achieving 100% FTTH coverage by 2022.

[37] See: *https://www.gov.pl/web/cyfryzacja/narodowy-plan-szerokopasmowy---zaktualizowany*

- Internet access of at least 1 Gbps for all places that are the main driver of socio-economic development. These are schools, transport hubs and the main places where public services are provided. This also applies to companies with intensive activities on the Internet.

- Fully developed 5G connectivity on all major transport routes and major urban centres.

To help deliver the plan, the Government of Poland is working with the European Investment Bank to fund fibre deployment in underserved areas.[38]

The plan builds on government and regulatory initiatives since 2015 which have been aimed at developing broadband availability and take-up. This included:

- In 2015 the Digital Poland Programme (DPP)[39] was launched. At the time, a DPP objective was to deliver the EC targets of 100% of homes with at least 30Mbps by 2020.

- Also in 2015, the Government of Poland deployed open fibre infrastructure to boost coverage in some underserved areas in Eastern Poland.

Regulatory framework

Policy and regulation of telecoms markets in Poland is overseen by:

- The Department of Telecommunications within the Ministry of Digital Affairs which is the policy maker for the sector including in matters related to the development of fibre and broadband infrastructure.

- The Office of Electronic Communications (UKE) which is the sector regulator.

In addition, The Digital Poland Project Centre has an important role in implementation of broadband policy and fibre deployment. It is responsible for the Operational Programme Digital Poland (OPDP) under the Digital Poland programme.

The focus of broadband access and wholesale regulation has been on Orange Polska pursuant to its SMP designation. In 2012 the UKE defined rules for wholesale access to Orange Polska's network, and these were subsequently modified when the regulator determined there to be sufficient competition in 76 districts to remove regulation.[40] Orange Polska has established a separate unit, FiberCo (50% owned by Dutch pension fund APG), to roll out and run its fibre network.[41] The network is open access, i.e. available to third parties.

In 2019 the UKE announced its approach to margin squeeze tests to support the OPDP.[42] This is aimed to prevent the prices for wholesale inputs to downstream services being set inefficiently. This included a determination of the weighted average cost of capital (WACC) for Orange Polska.

[38] See: *FIBRE OPTIC NETWORK EXPANSION POLAND (FONEXP) (eib.org)*
[39] See: *Digital Poland - Ministerstwo Funduszy i Polityki Regionalnej (polskacyfrowa.gov.pl)*
[40] *Investegate |Orange Polska Announcements | Orange Polska: 66/2014 Changes in regulations for Orange Polska*
[41] *Orange Polska S A : partners with APG for the deployment of an additional 1.7m FTTH plugs in Poland through a 50-50 joint venture valued at 605 million euros | MarketScreener*
[42] *Margin Squeeze Test for Operational Programme Digital Poland (OPDP) - Office of Electronic Communications (uke.gov.pl)*

4.5.3 Policies to boost adoption

Whilst there have been policy and regulatory initiatives to incentivise infrastructure build and competition, adoption of broadband fibre is low. Deployment has resulted in fibre passing 48% of households, but penetration of connections lags significantly behind at 18%.

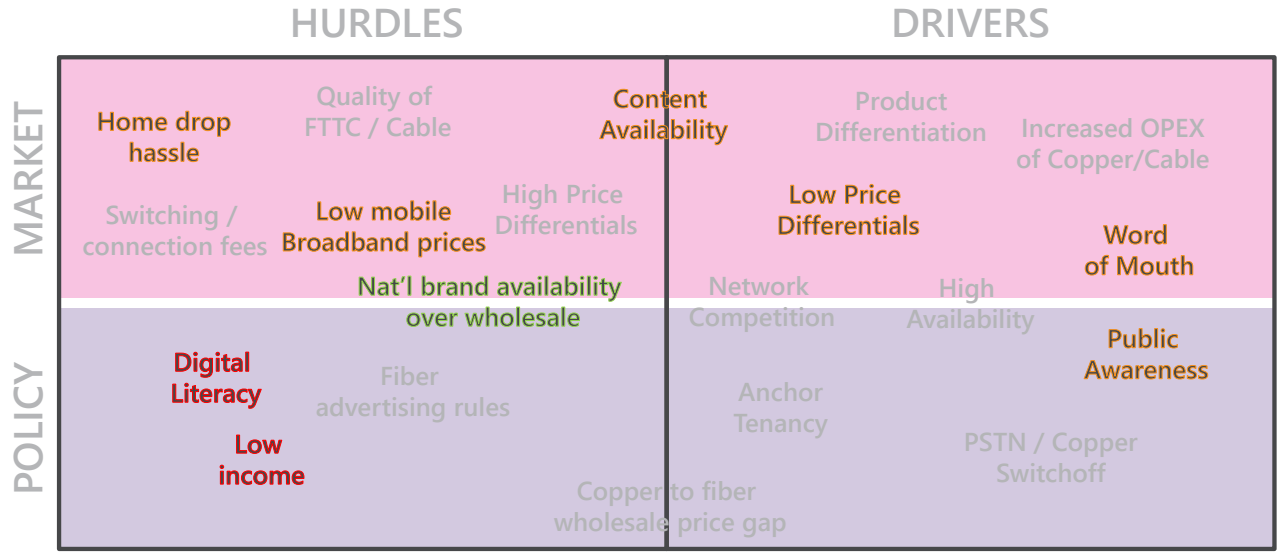
As part of its strategy to provide universal access to high-speed broadband, the Government of Poland says it will address digital competencies, including the following components:

- the development of society's digital skills, mainly in rural areas and small towns. More active participation in social life and more frequent involvement in local communities and activities in non-governmental organizations;
- educational and information campaigns that will promote the benefits of developing digital skills; and
- strengthening and developing the potential of programmers, which can be used for the digital development of the country.

Apart from that, there are no demand-side policies in place to foster FTTH/B take-up.

4.5.4 Drivers and hurdles to VHCN adoption

Figure 4.17: Drivers and hurdles to VHCN adoption in Poland



Source: Plum analysis

While take-up rates for Poland are in the average range for EU27+UK, adoption rates are on the low side. This is due to the fact that a significant proportion of the Polish population does not use the internet. According to regulator UKE, about 30% of Polish citizens do not use the internet at all, and about 40% do not use fixed internet services.[43] While it's difficult to translate these numbers into households, it strongly suggests that the low adoption of FTTH is at least in part related to this portion of non-internet users in the population.

[43] Raport o stanie rynku telekomunikacyjnego w Polsce w 2021 r. – UKE, 2022

Low income issues and digital literacy issues, particularly amongst the older population contribute to this lower than average internet usage patterns. Amongst urban and younger consumers however, usage patterns are comparable to what is seen elsewhere in Europe.[44] While FTTH/B prices are quite low in absolute terms compared to most of Europe, it is still more expensive than ADSL, which creates something of a hurdle. Furthermore, low mobile broadband prices, and the prevalence in the last decade of aggressive mobile marketing that equated mobile broadband performance to FTTH/B has created some cannibalism by mobile broadband, but operators are now more keen to differentiate FTTH/B and the dynamic is shifting towards fibre.

While cable was the dominant fixed access technology for a long time, it has been losing market share to FTTH/B over the last few years. While most of the high profile content (movies, sports) is now available on all platforms, cable still retains consumers in smaller towns and areas because of the existence of local television channels not available anywhere else.

In the last few years, the FTTH/B market has been on a dynamic growth path both due to aggressive deployment and due to adoption. All national operators are present on wholesale platforms and the market is shifting towards a clearer distinction between retail and wholesale providers with both Orange and Netia functionally separating their wholesale fibre divisions. The Tier 2/Tier 3 market is dynamic as well with hundreds of local fibre operators deploying and selling on a small scale, some of whom are also present on the wholesale platforms to extend their commercial footprints.

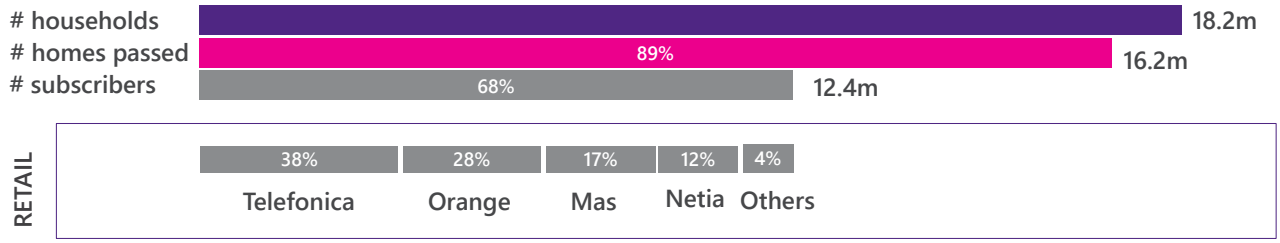
One thing that is missing for a real boost on adoption is word of mouth. In the tier 1 cities, operators are saying word of mouth is now a reality, but in lower density markets this isn't the case yet. While local governments have been quick to adopt fibre services for schools, hospitals and administrative buildings when available, they have not publicised this much and do not contribute to educating their citizens on the benefits of fibre.

4.6 Spain

4.6.1 Market overview

Spain has a developed and competitive telecommunications market. Fibre deployment is widespread, with around 16.1m homes passed (89% of Households). There are 12.4m FTTH/B subscribers which is 68% of the total households. The high level of adoption means that FTTH/B is the largest type of fixed connectivity in Spain. In addition, there are 2.1m cable FTTx/DOCSIS connections. FTTX/VDSL connections account for connections to only 4% of premises.

Figure 4.18: Spain market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

[44] www.regionynexery.pl/en/report

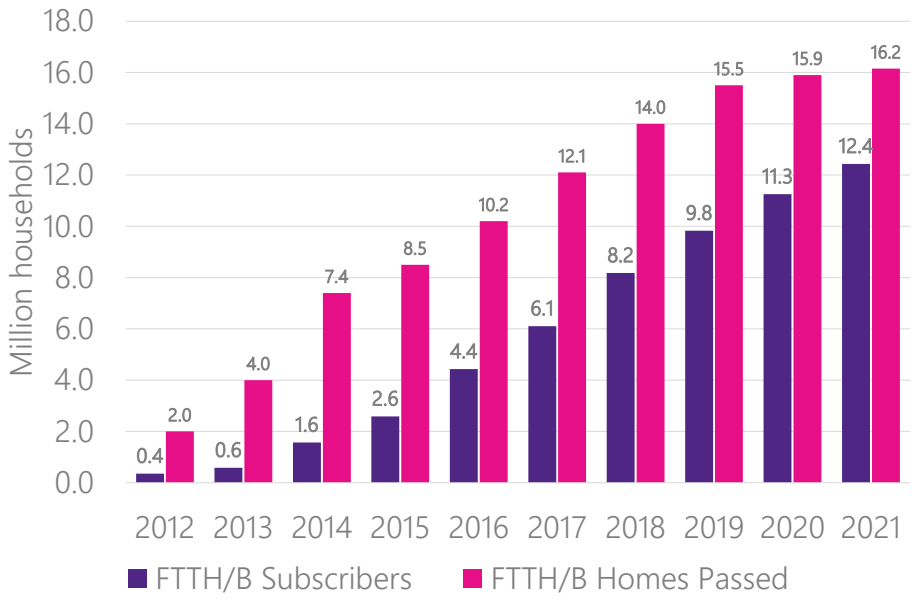
The main operators compete across full portfolios of service (broadband, TV and phone). These include

- **Telefonica**, the incumbent. It provides Internet services over its FTTH/B and VDSL network. It is the largest ISP with a 38% share of FTTH/B connections, and 80% of FTTx/VDSL connections (noting that FTTx/VDSL in total connects only 4% of premises). Telefonica provides broadband, TV and mobile services.
- **Orange Espana** is the second largest broadband provider. It has a 28% share of FTTH/B connections, and provides broadband, TV and mobile services.
- **MasMovil** has a 17% share of FTTH/B connections. It does not operate on any other platform. MasMovil provides broadband, TV and mobile services.
- **Vodafone/ONO** is the third largest provider by connections, with both its FTTH/B and cable FTTx/DOCSIS deployed. It has a 12.5% share of FTTH/B connections and 74% of cable FTTx/DOCSIS. Vodafone provides broadband, TV and mobile services.

There are a number of smaller national and regional players in the market, including Netia.

Coverage and take-up evolution in Spain is illustrated in Figure 4.19. The Spanish market has been remarkable in both deployment and take-up of FTTH/B services. In 2012, there were 2m homes passed and 20% of those had subscribed to FTTH/B. Coverage grew by 30% annually to reach 16.2m households and take-up has increased even faster by 54% annually.

Figure 4.19: Coverage and take-up evolution in Spain (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.6.2 The national Broadband policy and regulatory framework

Strategic and policy initiatives

A number of initiatives are in place to drive broadband development, including:

- The UNICO broadband program and predecessor PEBA, which have provided public aid worth €655m and covered 4 million homes with ultrafast broadband networks. In total, since the beginning of this particular broadband extension programme, aid amounting to €872m has been granted, and investments amounting to €1,603m have been mobilized, covering 7.6 million homes with broadband coverage, expected to reach 94% by the end of 2023.
  - Additionally, in 2021, investments of €480m under the scheme were sanctioned, with 1.3m homes expected to be covered. This scheme is expected to run until the end of 2023.
  - In 2022, further investment of €250m was sanctioned.
- The Digital Spain 2025 programme[45] sets priorities for digital transformation. Part of this is providing 100 Mbps coverage everywhere to close the digital divide between urban and rural areas. Public funding has been released for implementation of Digital Spain 2025, around €20 billion and approximately €15 billion from EU programmes, including the EU Recovery Plan. To support Digital Spain 2025, the Government also issued the Digital Infrastructure and Connectivity Plan[46] in December 2020
- The Digital Spain programme included a target of 300 Mbps to 95% of premises by 2021 with funds allocated for this..
- Digital Spain 2025 included ten strategic priorities[47] including:
  - Digital connectivity. Guaranteeing suitable digital connectivity for the entire population in order to foster the eradication of the digital gap between different rural and urban areas aimed at ensuring that the entire population has access to 100 Mbps coverage by 2025.
  - Continuing to lead the roll-out of 5G technology in Europe and incentivising its contribution to an increase in economic productivity, social progress and regional structure. The goal is for the entire radioelectric spectrum to be ready for 5G by 2025.
  - Strengthening digital skills in employees and the population in general. A particular emphasis will be placed on labour market needs and closing the digital gap in education. The goal is for 80% of people to have basic digital skills by 2025 and for half of them to be women.
  - Improving the attractiveness of Spain as a European audio-visual platform for generating business and jobs, with the target of increasing audio-visual production in Spain by 30% by 2025.
  - Transitioning to a data economy, guaranteeing safety and privacy and harnessing the opportunities offered by artificial intelligence in order for at least 25% of companies to use artificial intelligence and big data within five years.

[45] Available at: *Ministry of Economic Affairs and Digital Transformation - Digital Spain 2025 (mineco.gob.es)*
[46] See : *El Gobierno presenta el Plan para la Conectividad y las Infraestructuras Digitales y la Estrategia de Impulso a la Tecnología 5G, dotados con 4.320 millones de euros hasta 2025 (mineco.gob.es)*
[47] See: *La Moncloa. 23/07/2020. Pedro Sánchez presents Digital Spain 2025 Agenda to mobilise public and private investment of 70 billion euros in 2020-2022 [President/News]*

  - Guaranteeing rights in the new digital environment, especially labour rights, consumer rights and the rights of citizens and companies. The goal for this priority is to draw up a digital rights charter.

- The National Telecoms and Information Society Observatory (ONTSI) provides public information on digital transformation.

Regulatory framework and initiatives

Policy and regulation of telecoms markets in Spain is overseen by:

- The Ministry of Economic Affairs and Digital Transformation is responsible for policy to develop connectivity and digital transformation in Spain.

- The National Commission of Markets and Competition (CNMC) is the regulator responsible for all markets and productive sectors of the Spanish economy and the cross-sectoral competition authority (hence a converged regulator).

Regulation in Spain has been focused on the infrastructure level. CNMC's predecessor imposed requirements for access to Telefonica's ducts, and a symmetric obligation on "first to building" operator to grant access to in-building fibre. Charges for in-building fibre access were not regulated and so could be set at commercial rates.

In 2016 the CNMC set regulatory requirements for broadband at the wholesale level and in markets where Telefonica was found to have significant market power (SMP). As a vertically integrated operator, Telefonica is subject to non-discrimination obligations. In its decision, the CNMC determined that infrastructure competition was sufficiently developed for Telefonica not to be required to provide wholesale FTTH in 66 municipalities covering 35% of the population.[48] In 2021 this was expanded to 696 municipalities.

4.6.3 Policies to boost adoption

Whilst we have not identified initiatives targeted directly at fibre adoption, the strategic priorities for Digital Spain 2025 include elements to improve digital skills and to boost digitisation of public services and companies.

The new generation broadband extension program (PEBA – NGA), was used to support the investment efforts of private operators. The aim was to support the rollout and adoption in rural and less populated areas where there was a market failure. The initiative was co-financed with the European regional development fund (ERDF)[49].

The Government of Spain issued a detailed programme in The National Plan for Digital Skills.[50] This aims to narrow digital divides and ensure no Spanish citizen is "left behind".

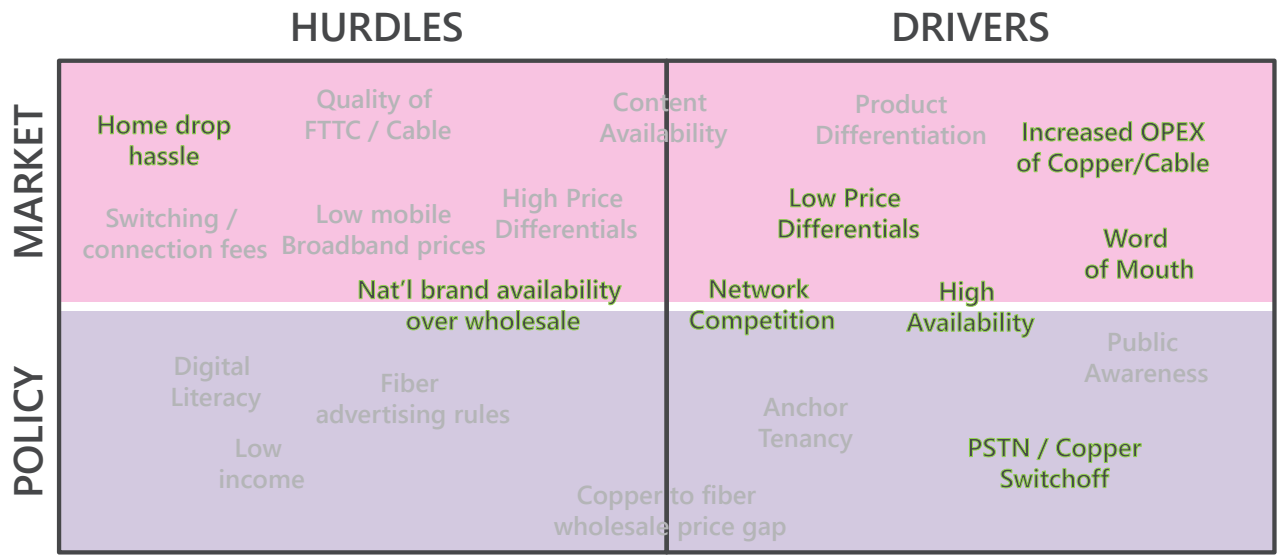
The program for the Universalization of digital infrastructure for cohesion (UNICO), broadband program, which is part of the transformation and resilience (PRTR) plan of the Spanish economy is another initiative to boost adoption and coverage. This scheme is financed by the European Union. The aim of this program is to provide aid to telecommunications operators, to assist in procuring electronic communications networks capable of providing very high speed services (More than 300 Mbps Symmetrical) to areas without adequate coverage.

[48] Telefonica was also set wholesale bitstream obligations covering 42% of copper connections.
[49] See: https://avancedigital.mineco.gob.es/banda-ancha/cobertura/Documents/InformeCoberturaBandaAncha2021.pdf
[50] Spain - National Plan for Digital Skills | Digital Skills and Jobs Platform (europa.eu)

In addition, there is a specific measure in place to support economically vulnerable citizens through a voucher scheme.[51] The scheme subsidises connectivity for households or individuals with low income to create new or upgrade current subscriptions where the speed of existing connectivity is below 30 Mbps (at peak usage times). The scheme, which will run to 2023, is funded through the Recovery and Resilience Facility (RRF), and the Government has budgeted for the provision of 125,000 vouchers. The scheme was assessed by the European Commission as state aid, the Commission concluded that the scheme was compatible with the single market and hence did not raise objections. The scheme is technology neutral, there is no data on whether the scheme has been used to subsidise fibre connections, but this seems unlikely given the objective to support economically vulnerable citizens.

4.6.4 Drivers and hurdles to VHCN adoption

Figure 4.20: Drivers and hurdles to VHCN adoption in Spain



Source: Plum analysis

The framework for the development of FTTH in Spain was initially a strong push towards infrastructure competition. Incumbent Telefonica's well-maintained duct and pole network was made available for competitors to deploy fibre to the home, and this enabled several national networks to be deployed in parallel. In time, some of Telefonica's competitors started signing wholesale deals between themselves to extend commercial coverage, and Telefonica itself opened up its network to competitors on an unregulated wholesale basis. This combination of network competition and broad wholesale availability created the dynamic for high availability and word of mouth to boost fibre adoption.

As a consequence of the low deployment costs, prices are competitive and the transition from copper to fibre is mostly done now. ADSL offers are no longer commercially available to most of the country and Telefonica is pushing hard to accelerate its copper switch-off initiatives, driven in part by the OPEX savings that this represents.

One issue that many other countries face which Spain did not have to face, was the reluctance of residential customers when it comes to in-building connectivity. A majority of homes are in multi-dwelling units in Spain. Building regulation put in place in the 1990s mandates the installation of in-building ducting for cable and fibre in all new buildings. In addition, few facades are listed in Spain which means that façade deployment is allowed

[51] See :https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_100138

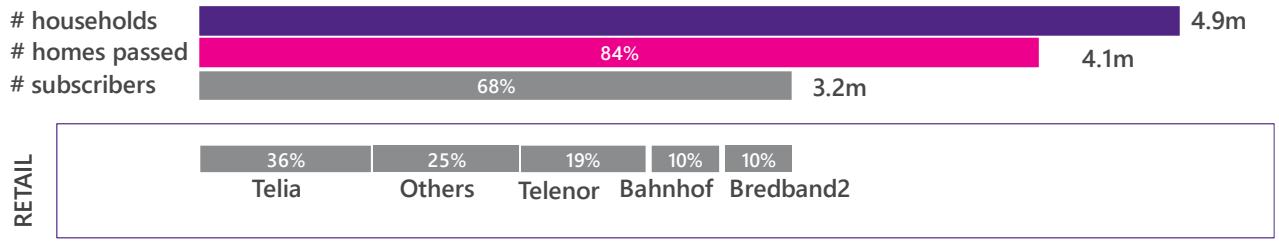
in most places. Altogether, this makes for a very smooth home installation process, so much so that the mandated sharing of in-building access fibre is rarely used by market players today.

4.7 Sweden

4.7.1 Market Overview

Sweden has a developed and competitive fixed broadband market with FTTH/B representing about 76% and cable 16%. 4.1m of all households have access to FTTH/B and 3.2m homes have subscribed to FTTH/B services, which represents 68% of total homes in the country.

Figure 4.21: Sweden market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe/PTS 2022

Sweden is characterized by the involvement of municipalities in the FTTH/B market. Several municipalities have deployed their own open access FTTH/B infrastructure to boost the local economy. According to the Swedish Local Fibre Alliance, municipalities own some 86% of local fibre networks (LFNs). As of September 2020, more than 220 municipality projects have been identified.

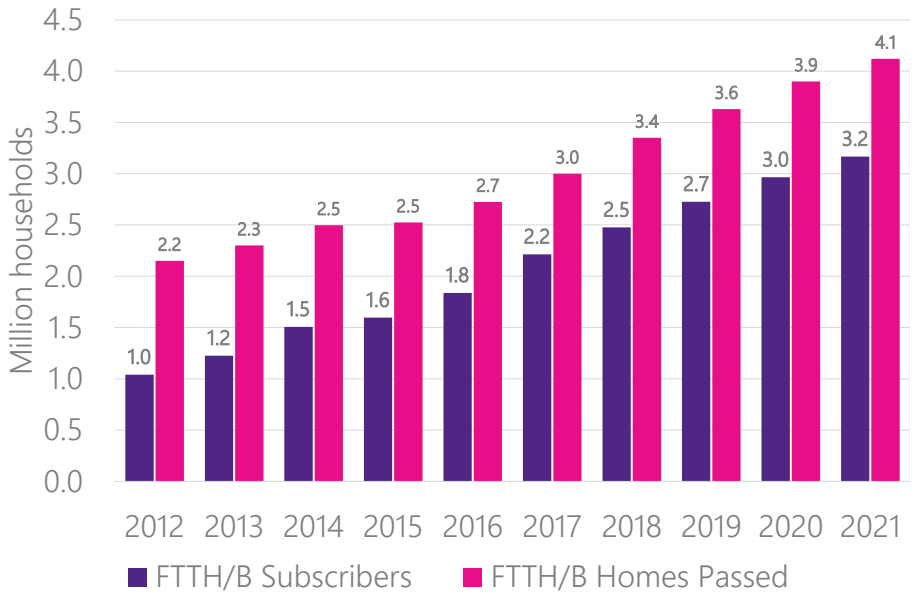
Key market players include the following:

- **Telia**, the Swedish incumbent operator. It is involved in several municipality projects deploying FTTH/B architecture and providing VDSL and fibre services to end users. Telia has a fibre network covering at least 2m households, representing 50% of total homes passed. Telia has a 31% share of the FTTH/B market.
- **Telenor** has been formed by acquisition of tele2's Fibre and cable networks. The company provides Fixed services using FTTH/B and VDSL technologies. Telenor has 676,000 subscribers representing a 21% share of the FTTH/B market. Telenor has a network covering slightly less than 2m households.
- **Bahnhof** was established in 1994 and provides connectivity services as well as datacenter solutions. It mostly uses networks deployed by municipalities and utilities.
- **Bredband2** was established in 1989 and offers fixed and mobile telecommunications services. The operator uses networks deployed by municipalities and utilities.

The total number of homes passed takes into account overbuilding. Most municipalities do not offer services directly to end users. The number of homes passed in municipalities includes homes passed by privately owned local fibre networks.

Coverage and take-up evolution in Sweden is shown in Figure 4.22. In 2012, Sweden had 2.2 million homes passed. Take-up stood at 48%. Coverage has since grown by 8% annually (AAGR) and take-up by 13% (AAGR).

Figure 4.22: Coverage and take-up evolution in Sweden (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.7.2 National Broadband Policy and regulation

The Swedish post and telecom authority (PTS) is responsible for the administration, monitoring and regulation of electronic communication and post sectors. The ministry of Enterprise and innovation is responsible for digitization and broadband policy and the Brendbandsforum is responsible for fostering cooperation to promote effective expansion of the broadband infrastructure.[52]

Sweden's broadband strategy sets out the following objective: By 2020, 95% of all households and companies should have access to broadband at a minimum speed of 100 Mbps, and by 2025 all of Sweden should have access to high-speed broadband. The Swedish government has identified the following areas to be addressed in order to meet the goals set in the strategy.

- roles and rules on the broadband market;
- cost efficient expansion of the broadband infrastructure; and
- services for everyone.

The Main measures for broadband development include broadband mapping – with the aim of sharing information on infrastructure – and a primarily market-driven broadband deployment strategy, with complimentary public funding in areas with no incentive to invest.

[52] See: https://www.regeringen.se/4b00e7/contentassets/a1a50c6a306544e28ebaf4f4aa29a74e/sverige-helt-uppkopplat-2025-slutlig.pdf and https://vxfiber.com/wp-content/uploads/2020/09/sweden-completely-connected-by-2025-eng.pdf

Regulatory Framework

The regulatory framework in Sweden covers the following aspects;

- Access – The Swedish Post and Telecom Authority shall ensure that individuals and businesses that lack access to telephony and functional internet access are supported for measures providing such access. Support may be provided if funds are available. A network holder shall allow access to physical infrastructure on fair and reasonable terms at the request of a broadband developer. The network holder must apply for such permits as are necessary for the realisation of access and which the broadband provider himself cannot apply for.[53]

- Expansion and information – A network operator who is a public body and who carries out a construction project shall, under fair, non-discriminatory and transparent conditions, allow coordination of the project with a broadband developer, if the broadband provider so requests. The authority determined by the Government shall be responsible for a broadband network deployment information service through which information on network owners' existing physical infrastructure and planned.

- Technology neutrality – Implementation of the regulatory framework is widely understood to be technology neutral. The broadband objectives are to be achieved using a combination of fibre, copper and mobile coverage where appropriate and where the business case for fibre rollout is not there. The government has stated aims to support the deployment of very high-speed connectivity networks in areas where telecommunications companies do not invest under the conditions of competition

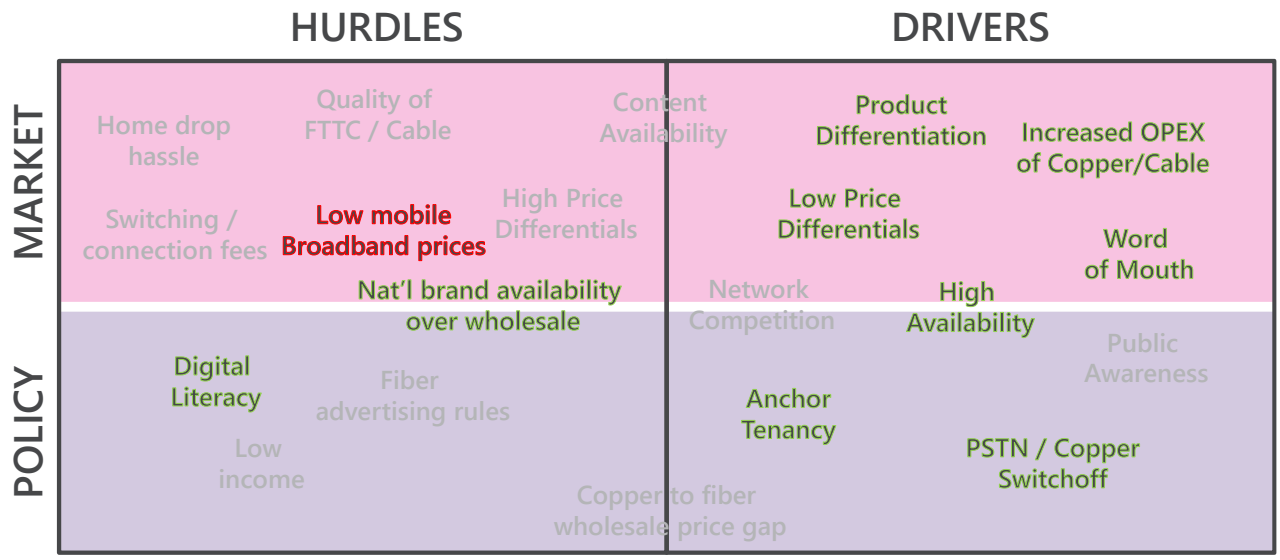
4.7.3 Measures to boost adoption

For areas where next generation access either does not exist or is not planned for the next 3 years, there is a state aid scheme in place to ensure connectivity with speeds of at least 1 Gbps. This scheme is administered by the Swedish Post and Telecom Authority (PTS) and, in 2022, it is expected to grant financial aid using national funds amounting to approximately EUR 130 million, in addition to the EUR 160 million for 2021.

[53] See: Ordinance (2018:20) on support for measures that provide access to telephony and functional access to the internet Swedish Code of Statutes

4.7.4 Drivers and hurdles to VHCN adoption

Figure 4.23: Drivers and hurdles to VHCN adoption in Sweden



Source: Plum analysis

A combination of high digital literacy dating back from home computing support programs in the 1990s and early involvement in FTTH deployment by local government has made Sweden the earliest adopter of FTTH on a nationwide level. While fragmented at the network layer with over 150 municipal fibre networks, the market is unified at the service level by a broad adoption of open access solutions offered by multiple providers at a national level. The exception to these open access provisions concern about 20% of the market, often social housing or large housing programs which still tend to bulk sign broadband deals with single providers for a set period.

ADSL products are virtually non-existent in the market and cable has been losing a lot of ground to FTTH/B over the years. Telia's copper switch-off program is advanced with entire portions of the territory off of copper entirely already. Due to the open nature of most of the market, competition between service providers is fierce and prices are very aggressive. There is also a lot of product innovation in Sweden to deliver new services to end consumers around healthcare, home safety, in-home automation, etc.

The one potential threat for FTTH adoption going forward is the high proportion of users who are mobile-only compared to other countries. Operators, particularly Telia, have been deploying FWA solutions in areas where they wanted to switch off the copper, and quality and aggressive pricing of mobile broadband solutions in general makes mobile an attractive alternative for some consumers.

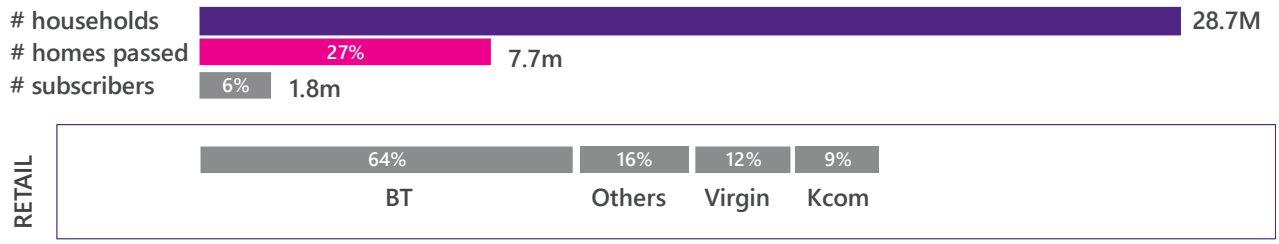
While no plans have been implemented yet, government and regulator are keen to address the skill gap remaining that may explain that some pockets of the population aren't yet on FTTH. Work has been done in identifying the profiles of those who do not yet use fibre, and programs are being devised to educate them to the benefits of fibre and/or facilitate their migration. Such groups include (but are not limited to) elderly people and immigrant communities.

4.8 United Kingdom

4.8.1 Market Overview

The United Kingdom is a mature and developed telecommunications market, but fibre deployment and adoption is weak compared to other countries. There are around 7.7 million homes passed with FTTH/B (27% of households) and 1.8m FTTH/B subscribers (6% of total households).

Figure 4.24: UK market overview



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

A key feature of the UK market is the legal separation of Openreach from BT. Openreach is owned by the BT Group but required by formal voluntary Undertakings[54] given by BT to the regulator, Ofcom, to operate separately. This is achieved through a legal separation of Openreach from the BT Group, meaning that Openreach has independent management and is required to provide the same services to all of its downstream customers (including other units of the BT Group).

In terms of retail fixed broadband connection by ISP providers in the United Kingdom, BT is the largest with a market share of 34% overall. Sky and Virgin Media have market shares of 23 and 20 percent respectively followed by TalkTalk at 10% and all others with the remaining 14% of the market.[55]

The major infrastructure players in the UK are:

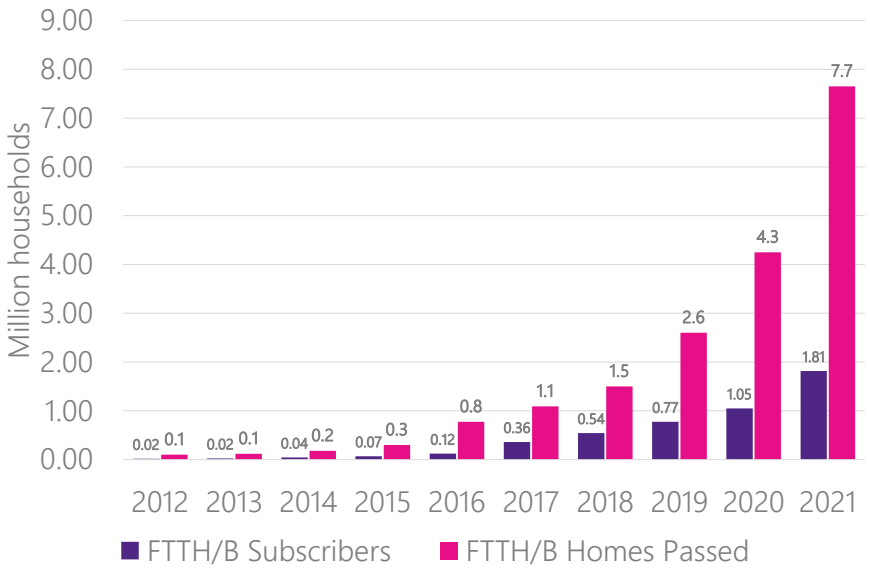
- **Openreach** supplies connectivity services to downstream ISPs, including BT Retail, Sky and TalkTalk.
- **Virgin Media** (a subsidiary of Liberty Global) provides connectivity services over its FTTx-DOCSIS 3.0 and FTTH/B network. Since 2015/16, Virgin Media has deployed fibre through its "Project Lightning" build, and it has a FTTH/B market share of 12%.
- Altnets There are a number of other companies building FTTH/P networks in the UK, some of which provide connectivity services to businesses and downstream ISPs, and some of which also sell high speed broadband services directly to consumers. Prominent altnets are CityFibre, Hyperoptic and Gigaclear. More geographically focussed altnets are also deploying fibre in smaller networks around the country.

The evolution of coverage and take-up in the UK is shown in Figure 4.25.

[54] BT agrees to legal separation of Openreach - Ofcom

[55] Sky and Talk Talk connect to their customers using wholesale and access services through the Openreach network, and do not operate their own access infrastructure.

Figure 4.25: Coverage and take-up evolution in the UK (2012-2021)



Source: Plum Analysis/Market panorama Sept 2021-Survey by Idate for FTTH Council Europe

4.8.2 National policy and regulatory framework

The sector is overseen by:

- The Department of Communications Media and Sport (DCMS), which sets national policy for the sector.[56]
- Ofcom, which is responsible for regulation of the sector.

Plans for remaining coverage

- The UK Government has committed £5 billion in investment to "Project Gigabit" to provide gigabit capable connectivity to the hardest to reach premises.[57] This includes a voucher scheme for eligible citizens.
- The Welsh Government has contracted Openreach to provide full fibre to 39,000 premises by June 2022.[58] This will be achieved with £56m of public subsidy from the Welsh Government and EU funding. The scheme is focused on tackling premises in the final 4% of Wales that can't yet access speeds of 30Mbit/s.
- The Scottish Government has committed to ensuring every home and business in Scotland can access superfast broadband, and is delivering this through the "Reaching 100%" (R100) programme which is investing in connectivity through contracts and a voucher scheme.[59]

[56] Note that the devolved administrations in Northern Ireland, Scotland and Wales do not have formal vires for the sector, though they are involved in connectivity schemes.
[57] Project Gigabit – Building fast reliable broadband for everyone in the UK
[58] Rolling out fibre broadband | GOV.WALES
[59] R100 - Access for all | Digital Scotland Superfast Broadband

- In Northern Ireland, Project Stratum is utilising £165m of public funding to target premises that can't get a service capable of delivering a download speed of 30 Mbit/s (Superfast).[60]

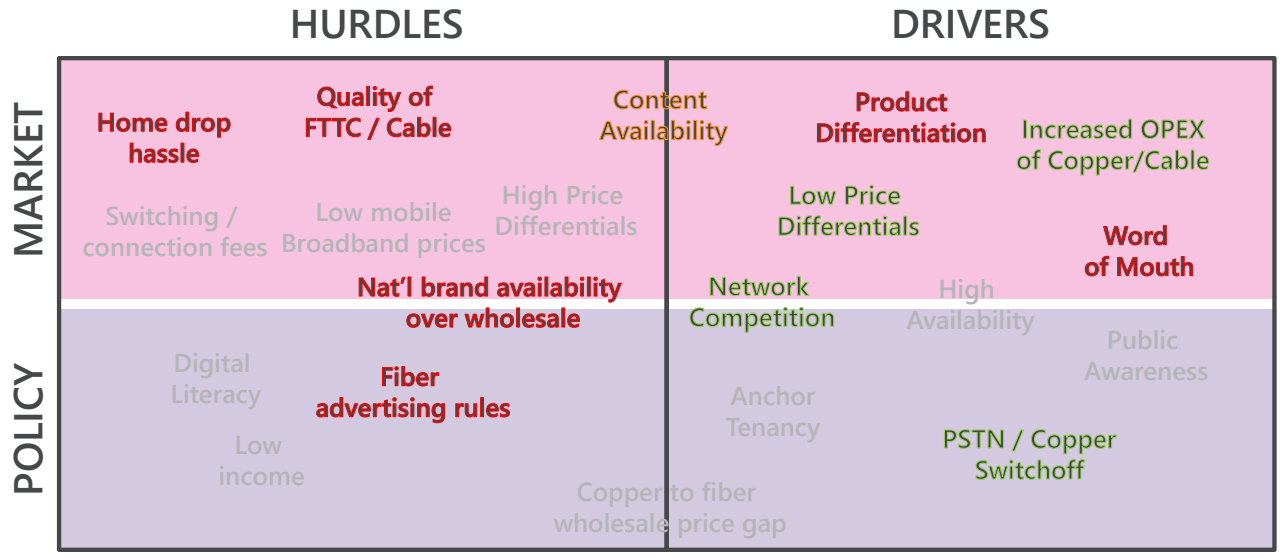
4.8.3 Policies to boost adoption

Whilst policies to encourage FTTH/B take-up are generally included within Project Gigabit and national coverage schemes (e.g. voucher schemes), a number or regulatory initiatives may help consumers to select and then switch to the best service for them. For example:

- Providers are required to send prompts to their customers when contract periods are coming to an end, so they know when to look around for a better deal.[61]
- Ofcom is implementing a new "one touch" switching process, making it easier for consumers to switch between broadband providers.[62]

4.8.4 Drivers and hurdles to VHCN adoption

Figure 4.26: Drivers and hurdles to VHCN adoption in the UK



Source: Plum analysis

FTTH/B deployment in the UK has lagged behind some EU nations but is now accelerating through a mix of private sector investment and public funding. Take-up is also low, at just 6% of households, and a number of factors likely contribute to this.

First, widespread deployment of FTTC by Openreach means that many customers experience good quality connectivity to meet their current needs and so have limited impulse to upgrade to FTTH/P. To compound this,

[60] Project Stratum - Strategic Investment Board (sibni.org)
[61] Helping consumers get better deals: A review of the impact of end-of-contract notifications and pricing commitments by broadband and mobile providers - Ofcom
[62] h*ttps://www.ispreview.co.uk/index.php/2020/04/summary-of-full-fibre-build-progress-across-uk-broadband-isps.html/2*

FTTC based services have been described and advertised as "fibre" creating a challenge for marketing of genuine FTTH/P propositions.

New connections to homes or switching between providers can be difficult for consumers because of the predominance of single homes in UK residential buildings.

There is so far a reluctance by some of the major retail ISP brands to deploy altnet wholesale fibre connectivity, meaning there are fewer competitive options and fewer recognizable brands for consumers in some fibre coverage areas. Part of that reluctance stems form the lack of a common wholesale operational support system (OSS): meaning that retailers like who have traditionally taken wholesale access from Openreach, will need to adjust to using one or more different OSS to utilize the FTTH/B networks of altnets.

4.9 Analysing demand-side policies and their efficiency

It is not always evident to distinguish policies designed to boost adoption of better broadband solutions and policies designed to promote digital inclusion in a more general sense. In most countries, one can find social broadband tariffs that may be part of a universal service obligation, part of a general policy implemented by the government for all operators or just an encouragement on the part of government to include some form of social tariff in a ISPs product portfolio. The impact of social tariffs is not measured (or at least, if measured, the results are not published) which makes it difficult to say more than just the fact that they exist.

More explicit demand-side policies take the form of vouchers designed specifically to facilitate access to better broadband solutions. While several countries in our qualitative sample have voucher schemes, some of these are directed at supply issues rather than demand (for example in the UK and in France where subsidies are aimed at addressing cost of deployment issues in targeted circumstances). The two clear examples of demand-side voucher schemes are to be found in Spain and in Italy.

The Spanish "social connectivity vouchers for economically vulnerable categories of end-users"[63] is targeted at low-income households and runs from May 2022 until the end of 2023. It was fed through the European "Recovery and Resilience Facility Fund". With a total budget of 30 million EUR, it was targeted at a maximum of 125,000 households, subsidising 240 EUR over 12 months for broadband solutions of at least 30Mbps.

The Italian program was rather more ambitious, consisting of two streams of funding, one aimed at households and one at businesses. 1.2Bn EUR was set aside for these programs, targeted as follows:

- The household program had an envelope of 200m EUR and was targeted at families with income below 20k EUR per year. Vouchers of 150 EUR were awarded to either subsidise devices (mobile phones or computers primarily) or broadband access subscriptions above 30Mbps bandwidth. The program was put on hold after 103m EUR had been awarded. Most households opted to spend the voucher on devices, and the remainder funded FTTC offers primarily. The program had very limited impact on broadband adoption overall and even less on VHCN adoption.

- The business program had an envelope of 608m EUR of which 106m were spent before the program was put on hold. The program subsidised businesses with 2000 EUR provided they subscribed to offers above 1Gbps. Service providers were quick to launch offers just above that speed based on existing FTTH solutions, but the overall impact on adoption was very limited because of the excessively broad targeting.

While both programs are currently on hold, the Italian government is considering a new wave of subsidies that would likely be targeted exclusively at households and only for broadband solutions, not devices. The income

[63] See: *https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_100138*

limit could be increased as well to household incomes above 50k EUR per year. There is no talk of targeting only FTTH/B solutions for subsidies though.

The Spanish program seems to have been designed primarily at social inclusion with no expectation that it would boost VHCN adoption in an otherwise dynamic market. The Italian program on the other hand seems to have been designed to boost better broadband solution (FTTC or FTTH/B) with limited impact. In particular, it is likely that the impact on actual VHCN adoption would have been negligible. While it's too early to judge the upcoming changes to the program, the current discussions suggest that as currently envisaged, the program would again have very limited impact.

4.10 Key findings

Our in-depth look into the 8 countries selected for Step 2 identifies several key drivers or hurdles that seem to apply uniformly across all countries.

First of all, the analysis confirms that price differentials between FTTH/B products and copper or cable alternatives is a significant aspect of the dynamic of fibre adoption. It is however clear that low price differentials alone aren't enough of a driver, simply a necessary condition. If other strong hurdles exist, adoption will still struggle despite low FTTH/B prices.

Similarly, while high coverage is a clear driver for both effective marketing and word of mouth to drive adoption forward, it is not a panacea for adoption.

Beyond the drivers identified in Step 1, a number of key aspects emerge:

- First and probably foremost, is the impact of technology strategies implemented in the last decade when it comes to boosting the existing copper networks. In countries where FTTC or Docsis 3.1 have been implemented and heavily marketed, FTTH/B providers find it harder to create differentiation with FTTH/B products, thus slowing down adoption. This is particularly prevalent in the UK and Italy, but also to an extent in Germany and Denmark. It can be said therefore with some degree of confidence that the strongest hurdle to FTTH/B adoption is the quality of existing alternatives. It should be noted in fact that while their impact is less noticeable, there's a likely effect of fixed wireless access solutions where mobile networks are dense and high quality, particularly in the Nordic countries. This may be less visible because it impacts countries where FTTH/B adoption is already high, but is worth noting nonetheless.

- In many cases, the competition of alternative fixed broadband solutions to FTTH/B is made all the stronger by advertising rules that allow these competing solutions to use the term fibre in their advertising, thus making marketing differentiation even harder. Inversely, in countries that ruled early to allow the use of the "fibre" term exclusively for FTTH/B (or in countries, like Denmark, who ruled on accurate advertising of broadband speeds), providers of genuine fibre broadband have been able to drive differentiation more effectively, with visible impacts on adoption.

- Effective network competition as seen in Spain and France seems to have been a strong initial driver for adoption although other models such as those seen in Sweden or Denmark seem to have been very effective as well, particularly when network monopolies have been open to competing ISPs. It should be noted that in Spain and France, market models are slowly evolving towards more wholesale, even without regulatory measures enforcing said wholesale deals. A broader point might be made that clarity in the market model being aimed for is in itself a driver for deployment and adoption, which could explain at least in part issues facing Italy, the UK and to some extent Germany.

- Wholesale models are boosted when national brands are available on wholesale networks. This can be the result of commercial agreements (as in Spain), industry standardization agreements (as in France) or the near ubiquitous availability of wholesale solutions (as in Sweden or Denmark). In markets where national ISPs aren't available on wholesale networks, such as the UK, Germany or Italy, take-up on these networks is impacted negatively.

- In all markets, to varying degrees, some end-users are reluctant to let network operators do the necessary civil works to install fibre inside their homes. While not measured statistically, this seems to be a bigger issue in markets where single homes constitute a majority of dwellings, like the UK. Inversely, in markets where real-estate is both recent and predominantly multi-dwelling (like Spain), this is less of an issue. Building construction regulation that imposes shared ducting in MDUs can mitigate this, but only has impact now if it was decided 20 years ago.

- Finally, while the results of Step 1 of the study seemed to imply that digital literacy and low income were not strong barriers to FTTH/B adoption at EU level, some of our country analyses clearly show that in particular instances, they can be significant. This is obvious looking at Poland, where close to a quarter of the market is not connected to any fixed broadband solution, or Italy where ADSL still connects 20% of broadband users despite high prices and multiple commercial and policy attempts to shift those customers over to FTTC or FTTH/B.

This overview of drivers and hurdles supports our analysis that policy remedies can address some of these issues while others are more firmly in the hands of the service providers themselves. We will develop the former (and briefly touch on the latter in the next section.

5 Recommendations

While the digital decade objectives expressed by the European Commission do not explicitly create an adoption target ("All European households will be covered by a Gigabit network, with all populated areas covered by 5G"), adoption of VHCN *is* part of the primary objectives of national regulatory agencies. This is expressed in Article 3(2)(a) of the EECC to 'promote connectivity and access to, and take-up of very high-capacity networks' (VHCN)'.

In analysing the broadband demand-side policy initiatives in the EU, an apparent paradox is made evident: the deployment of VHCN networks is strongly encouraged, including through the use of considerable national and European funds to subsidise the buildout of said networks, but demand side policies do not particularly encourage the adoption of the same VHCN solutions whose deployment is being facilitated. It should stand to reason that governments pushing for the deployment of VHCN networks should, if they implement demand side policy schemes, target these schemes exclusively towards VHCN adoption.

This leads us to a first set of recommendations for policy makers to ensure that deployment and adoption goals are aligned:

1. Voucher schemes and associated programs designed to facilitate broadband adoption for low-income households should promote the best network solution available in a given location. If that solution is a VHCN one, only that solution should be included in the scheme. In addition, it should be recognised that the scope of application of low-income schemes is only as large as the income brackets it decides to target. If such schemes are seen as having a positive long-term effect on digital inclusion, expanding the income levels to which these programs are applicable can be a way to expand their impact on VHCN adoption.

2. As demonstrated in markets such as Italy or Poland, while income can be a strong hurdle, it is often combined with digital literacy issues. Voucher schemes only target the former. Programs designed to facilitate adoption for households with limited digital literacy and long-term digital education can make a lasting difference. Some of the public funding targeted at vouchers could perhaps be more effectively allocated to accompanying programs that would help low literacy populations (often elderly or rural households) shift to VHCN in a more lasting way and with greater benefits to their daily lives.

3. Governments, particularly local governments, can encourage VHCN adoption through anchor tenancy and awareness. Too often, local governments are more willing to switch their own digital needs over to VHCN networks but don't explain to the population why, and what benefits they will derive from it.

4. Awareness can also be addressed through clear advertising rules. Networks that are end-to-end fibre should be able to differentiate from solutions that aren't[64]. In some markets like the UK, the word "Fibre" can still be used in advertising for FTTC or cable solutions. It should be noted that this is unlikely to be a panacea as the fibre "brand" may already be tainted but should nonetheless be clarified. Shifting broadband advertising rules towards transparency in performance metrics as done in Denmark may be the more effective route.

5. Finally, digital literacy can also be encouraged through employer related tax incentives. This was put to great use in the 1990s in Sweden with tax rebates for businesses that purchased personal computers for their employees. The current Danish model where employers pay for their employees' broadband could be built upon to promote digital literacy and adoption in the age of remote work. As businesses shift to more flexible work organisations, it would make sense for them to ensure that their employees get the best broadband available and for governments to build tax incentives for them to do so.

[64] See: FTTH Council Europe Study on Identifying European Best Practice in Fibre Advertising, by WIK Consult, June 2020.

Wholesale dynamics can make a big difference in the speed of VHCN adoption provided that all market players participate. This leads to a second set of recommendations on wholesale dynamics:

6. In markets where the dominant VHCN delivery model is through wholesale platforms, the participation of national brands to this dynamic can make a significant difference in adoption. Some markets have achieved this simply through commercial negotiations, but in others, large market players refuse to join the wholesale platforms, thus hindering market development. In the same way that wholesalers have an obligation to work with any ISP brand, ISPs with a strong market position could be incentivised or obligated to offer services on wholesale platforms provided these are at scale.

7. More generally, switching networks implies civil works in the home, and that generates varying degrees of consumer reluctance. Policy can impact this by establishing standards that all network operators would need to follow and facilitate switching in general. The UK governments One Touch Switching (OTS) program aims to do just that.

8. Since pricing is known to impact adoption, some countries are looking at regulated wholesale prices of copper and the price gap between that and wholesale prices of fibre. The issue with copper pricing changes is that they create a set of paradoxical incentives: increasing the price of regulated copper would increase prices and create a market incentive to shift to fibre, but would also increase incumbent revenues, creating an opposite incentive to preserve that additional revenue. If used, this lever would need to be geographically targeted in areas where VHCNs are already available and applied dynamically as access conditions change. Even then, its efficiency has never been proven. As availability and adoption of VHCNs increase, the legacy copper network revenues decrease to a point where in some areas (and gradually everywhere) it becomes non-profitable to operate. Increase in energy costs and sustainability considerations create further incentives for incumbents to streamline their outside plants and focus on future-proof fibre networks. This generates a third set of recommendations:

9. While PSTN and copper switch-off create potential competitive issues, any market where VHCN adoption is over 50% should have plans in place to manage the gradual switching off of copper assets. This should not be based solely on the coverage of the incumbent operator: switch-off provisions should be triggered when altnets reach sufficient coverage as well. This should be done in a way that does not favour the incumbent commercially and encourages the migration of customers to a fibre platform. A clearly delineated copper switch-off policy will mechanically boost VHCN adoption as customers become aware of a deadline to adopt alternative solutions for their broadband needs.

While policy can address a lot of the hurdles that hinder VHCN adoption, it cannot do everything, and network providers deploying VHCN solutions also need to become more effective. Creating differentiation between FTTH/B services and FTTC/Cable can be done through more effective marketing, promotion, communication, but also by demonstrating the superior quality of service customers can expect with fibre. We encourage FTTH/B providers to be more disruptive to overcome some of the hurdles they face in certain markets. A few areas where changes may have impact on adoption are:

- Better integration of deployment and sales to minimise consumer disruption and maximise initial take-up.
- Streamlined portfolios with fewer offers, better differentiated.
- Entry level offers at speed levels significantly higher than FTTC in markets where it is prevalent.
- Automatic switchover mechanisms for retailers on copper wholesale in areas covered by fibre.

Regarding the FTTH Council Europe

The FTTH Council Europe is an industry organisation with a mission to advance ubiquitous full fibre based connectivity to the whole of Europe. Our vision is that fibre connectivity will transform and enhance the way we live, do business and interact, connecting everyone and everything, everywhere. Fibre is the future-proof, climate-friendly infrastructure which is a crucial prerequisite for safeguarding Europe's global competitiveness while playing a leading global role in sustainability.

The FTTH Council Europe consists of more than 160 member companies.

Please visit our website for more information: ***www.ftthcouncil.eu***

About the Policy & Regulation Committee

The Policy and Regulation Committee is the cornerstone of the FTTH Council's strategy on Public Affairs. It brings together all members interested in shaping the Council's positions on public policy and regulation, and is under the supervision of the Executive Board and fully aligned with the vision and mission of our organisation.

Public vision and action are essential to progressing towards a sustainable and digital European society. We encourage policy makers to facilitate, through regulation, a fair and competitive market and to support investments in areas where the private business case does not exist.

For more information about our positions on policy and regulation, please visit the dedicated section of the website.

You can also access all publications from this committee by filtering "Policies and regulation" category in our Knowledge Center.

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