Ultrafast network developments, competition and the EU Telecoms Regulatory Framework

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Executive Summary

Frontier Economics has been asked by Telenor to consider how the development of ‘ultrafast’ broadband networks (i.e., networks that are capable of delivering speeds far in excess of 100 Mb/s) in five of the countries where Telenor operates affects competition and how regulators should respond to such developments. This report sets out our findings.

_Ultrafast is different from DSL competition_

Having analysed five of the European markets in which Telenor competes – Sweden, Norway, Denmark, Hungary and Bulgaria - we find that the competitive dynamics of ultrafast networks differ significantly from those over existing copper networks. In particular:

- Competition over copper networks tends to be national in character and to involve national networks, whereas competition for ultrafast broadband services is often highly localised and differs between towns and regions within the same country.

- Ultrafast services are often provided by a range of local networks under different ownership, whereas copper based services are supplied based on a single national network under single ownership.

- Whereas DSL services over copper networks are generally provided by a vertically integrated operator with regulatory obligations to provide access to its infrastructure to third parties, ultrafast network providers pursue a much wider variety of business models, including vertical integration, but also including ‘wholesale only’ networks. Most non-incumbent ultrafast networks have no regulatory obligations to provide access.

- Network competition over ultrafast networks can be greater for those living in multi-dwelling units (MDUs) than those in single dwelling units (SDUs). As with copper, there may also be significant differences in competition for businesses and households.

- The local nature of ultrafast networks means that prices for ultrafast broadband (UFBB) services are not nationally uniform across the country as a whole, as they are for copper services provided by the regulated incumbent. Regulators cannot, therefore, in general rely upon ultrafast competition in one area constraining prices in those areas where no competition exists.
Finally, the owners of existing copper networks are often not the first to build ultrafast networks and generally do not control the majority of ultrafast connections.

Understanding these differences is important because very large numbers of households are now switching from DSL services to ultrafast FTTB/H and cable networks, wherever they are being deployed. In the markets we considered, by 2020 over 60% of all broadband connections will be on ultrafast cable and FTTB/H networks, with less than 20% on each of VDSL and ADSL networks. A key question for regulators, therefore, is whether, in switching to these ultrafast networks, householders will enjoy more or less competition as a result.

More or less choice?

On the one hand, the addition of new competitors and new fibre networks to the existing broadband market ought to increase the number of network choices available to households. We have used data from the EC and discussions with Telenor experts in the different countries to arrive at estimates of the percentages of households that could obtain UFBB services from one, two or three UFBB networks (see Chart below).

In two of the Nordic markets we have studied (Sweden and Norway), ultrafast broadband networks allow around a quarter of households to have a choice of at least three competing networks, whilst 60-70% of households will have a choice of at least two. Please see Annex 1 for an explanation of the methodology.
On the other hand, if we were to exclude copper based (ADSL and VDSL) services from our assessment, on the basis that these may not exert a material competitive constraint on UFBB, then only 22% - 44% households in those Nordic markets would have a choice of more than one ultrafast network provider.
Figure 2. Degree of competition in ultra-fast broadband (assuming ADSL/VDSL is excluded)

Source: Frontier estimates based on the EC data

Competition between ultrafast networks is stronger in Bulgaria and Hungary although we have been unable to quantify this. However, importantly, the localised and non-overlapping nature of ultrafast networks means that the presence of a large number of ultrafast network operators in any country does not necessarily translate into more network competition in any one location.

In addition to potentially limited network competition between UFBB providers, service based competition (i.e., competition between different retail offers provided over the same network), could also be limited. This is because most non-incumbent ultrafast networks today do not have regulatory obligations to offer wholesale access to third parties (whereas the copper network provider invariably does). This means that whilst around 90% of all households in the same Nordic markets have some choice of provider for DSL services, only around half of all households have a choice of ultrafast services over cable or fibre networks in Sweden, and fewer than 10% in Norway.

Do ADSL and VDSL constrain UFBB pricing?

Since competition between cable and FTTB/H and amongst FTTB/H networks is limited, the question of whether the development of ultrafast networks ‘adds’ or ‘subtracts’ from competition in a given Member State depends critically on
whether ADSL and VDSL services can compete effectively with ultrafast services over FTTB/H and/or cable.

An initial examination of prices may suggest that prices for comparable services offered on copper/DSL, cable and fibre networks do not differ much and many households who switch to ultrafast networks continue to buy packages which offer speeds that could be delivered by ADSL or VDSL.

However, existing DSL services may not, or may not in the future, be effective competitors to ultrafast services and may not effectively constrain the pricing of such services. For example,

- We see large volumes of households switching away from DSL to FTTH/B (and to a lesser extent to cable) wherever they have this option, but we see no evidence that DSL providers are able or willing to discount their services in order to win customers back.
- We also find that some copper network providers have decided not to invest in VDSL in areas where they face competition from FTTH/B (e.g. Telia in Sweden).
- Finally, consumer survey evidence also shows a strong preference for FTTH/B over both VDSL and cable.

Why do so many households prefer FTTH/B over DSL when prices for comparable products are similar and the speeds required can be offered by both networks today? We believe that the evidence indicates that many households, whilst uncertain about their future broadband requirements, consider that only FTTH/B networks can really claim to be ‘future proof’ and capable of meeting all future needs (offer ‘future proof-ness’). And where consumers have a choice between cable and FTTH/B, the evidence indicates that they tend to prefer the higher speed service (but not UFBB) offered by FTTH/B.

We also find that there is a significant price premium for speeds above 100 Mb/s which can only be offered by FTTH/B or cable. Whilst this price premium may be explained by the demand characteristics of the smaller number of households that are willing to purchase the very highest speed products, it is also consistent with DSL competition not providing an effective constraint on these ultra-high speed products.

**The urgent need for proper market analysis**

Given the potential for limited ultrafast network competition, combined with the lack of a wholesale access regulatory framework for non-incumbent UFBB providers and the rapid migration to ultrafast networks, it is important to consider how regulators should respond in order to ensure that competition is maintained (whilst not dampening investment incentives). Most notably, the current approach to market analysis, based predominantly on national markets,
appears increasingly unable to reflect the new environment, as it fails to recognise the changes in competitive dynamics which are clearly visible in the markets we have studied. The Commission and national regulators therefore need to consider now the implications of these developments, where they are occurring.

It is far from clear that national regulators are prepared to assess competition in ultrafast markets because, based on our analysis, there seems to be a lack of basic data required to undertake such a task. This includes:

- Understanding the network choices faced by individual households (as we have attempted to do in this report) instead of focussing on the number of households passed by each network at an aggregate or national level, the number of operators in a particular national market or the national market shares, all of which are often relied upon by regulators today.

- Understanding that an incumbent’s national market share may be a very poor indicator of competition in ultrafast markets. Unlike DSL, a low national incumbent market share could be consistent with a lack of competition in ultrafast services.

- Understanding that current prices may not be able to support a robust ‘SSNIP test’ analysis, in view of the pricing of broadband services by UFBB providers and when the ‘option value’ of FTTH/B or cable is a factor in a household’s switching decision. Reliance on existing pricing data will therefore not be sufficient to apply such tests and may produce misleading results.

A failure to appreciate these points may lead to ‘false negatives’ in which households are thought to have competitive choices when they do not. Given the rate at which households are switching to ultrafast networks (even if not to ultrafast speeds yet), the European Commission (with BEREC) should urgently revisit its List of Relevant Markets in order to provide guidance on these points, particularly the data that national regulators will require from market participants to properly assess competition in ultrafast markets.

**Options for regulation**

Most national regulators already seek to promote further ultrafast network competition by promoting access to existing ducts and poles for new ultrafast network providers, planning reforms, or adopting measures such as those associated with the Commission’s Broadband Cost Reduction Directive, all of which would be intended to reduce the scope of monopoly or duopoly in ultrafast markets.

Despite these efforts, our research suggests that the majority of individual households in the countries we have examined are likely to face duopoly or
monopoly ultrafast networks, the majority of which are not currently subject to wholesale access obligations. There are different ways in which national regulators could potentially attempt to address resulting competition concerns:

- They could continue to apply the existing SMP framework to individual firms, but at a significantly more granular level, using the data referred to above. This could result in a number of new ultrafast networks being found to hold SMP (including within the same Member State).

- BEREC has advocated a change to the current SMP framework to replace ‘joint dominance’ with a ‘tight oligopoly’ test in order to more easily capture oligopolies which they think may develop between DSL and cable, or between DSL and FTTH/B or between all three. Such a test would however be less relevant in the countries we have analysed, as there will be fewer oligopolies (and more monopolies) if DSL or VDSL does not constrain cable and FTTB/H.

- Adopt what is referred to as ‘symmetric’ regulation, under which the national regulator specifies an ‘aggregation’ or handover point in advance (before the networks are built) and then requires the monopoly (“first-to-building”) provider of the ‘terminating segment’ to provide access to third parties on regulated terms. Competition then occurs between networks connecting to the aggregation point. This approach could potentially also be applied to existing UFBB networks.

- Use the fact that many ultrafast networks have limited national coverage to promote ‘two way access’ arrangements between them, allowing network operators to supply services to each other on commercial terms. Depending on the outcome of such arrangements, regulation could potentially be withdrawn (or delayed) if access was provided on terms that did not raise significant competition concerns or were considered to promote longer term consumer interest (for example by encouraging investment).

These approaches are not likely to be mutually exclusive – instead, regulators are likely to need an expanded toolbox which allows them to apply different approaches in different circumstances.

We therefore recommend that in markets that depict the characteristics of the markets we have analysed:

- The Commission/NRAs revisit the data required to properly assess the evolution of competition in (superfast broadband (SFBB)/UFBB markets, including sub-national data on the choices faced by householders. They should consider market research approaches, that take into account recent advances in understanding of consumer behaviour, to evaluate the impact of non-price factors on switching
decisions (including ‘option value’). They should also place more emphasis on the prospective analysis of competition, taking into account the evidence on the speed of transition to ultrafast networks.

As part of the current review of the Telecoms Regulatory Framework, the Commission investigate how a ‘symmetric approach’ could be applied to greenfield UFBB deployments (and potentially also to existing deployments). This will require defining the conditions under which a firm would be obliged to provide access to its network, the boundary at which that access was to be supplied, and an assessment of the impact of any such intervention on the incentives to invest.

The Commission should revisit the DSL-based distinction between ‘Local Access’ and ‘Central Access’ in the existing List of Relevant Markets and consider instead how national regulators might define a new set of ‘handover points’ to support the application of ‘symmetric’ remedies to different geotypes. The Commission should also consider whether segmentation between MDUs and SDUs may be required when analysing ultrafast markets.

The Commission should continue to examine both the opportunities and risks that might arise from ‘two way’ commercial access arrangements and measures that might both promote the emergence of such agreements, whilst safeguarding competition.
2 Introduction

The European Commission has been keen to support the deployment of ultrafast networks which are capable today of delivering speeds far in excess of 100 Mb/s. These networks involve fibre to the home (FTTH) or building (FTTB), or fibre and coaxial/cable technologies. Coaxial or cable networks are being upgraded where they already exist and some cable operators are making additional investments to extend their geographic scope\(^1\). FTTB/H networks generally involve the deployment of new infrastructure rather than the upgrading of existing assets, although they often use existing ducts or conduits or involve aerial deployment on existing poles.

Although the Commission has paid great attention to efforts to deploy ultrafast networks, and has set targets for the adoption of ultrafast connections (being at least 50\% of households to be connected at 100 Mb/s by 2020), it has paid less attention to date to regulatory measures which might be required to ensure that competition is safeguarded as and when these networks are deployed. In the absence of such guidance, some national regulators have taken differing approaches to promote or safeguard competition in ultrafast networks\(^2\), whilst others have yet to take any action at all.

This report considers:

- How ultrafast networks are being deployed in Europe;
- How ultrafast networks are changing the dynamics of competition in broadband markets;
- Whether the existing regulatory framework, or at least its current application, is able to safeguard competition as the dynamics of competition change;
- Changes that may be required in order to ensure that competition is sustained in the future.

The paper considers these issues with reference to five of the European markets in which Telenor is present – Norway, Sweden, Denmark, Hungary and Bulgaria – although our main focus is the three Nordic markets for which there is more reliable data. Data is also presented for the EU as a whole, where available, and

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1 Liberty Media, Europe’s largest Cable operator, announced plans to extend their UK cable network by up to 4 million homes (http://about.virginmedia.com/press-release/9467/virgin-media-and-liberty-global-announce-largest-investment-in-uk-s-internet-infrastructure-for-more-than-a-decade) and since indicated that it may undertake further additional build in Germany and some other markets.

2 These are discussed in more detail in Section 6.
for other markets where relevant. In so doing, we do not suggest that the markets in which Telenor operates are necessarily representative of other European broadband markets, although we find that these markets do provide an insight into a wide range of different market conditions and dynamics. Most notably, all of these markets are seeing significant new ultrafast network deployment by operators who do not own the existing copper infrastructure. This distinguishes them from other European markets, such as the UK or Germany, where ultrafast deployment has been largely confined to cable to date\(^3\) and from Spain, where a greater proportion of new ultrafast network deployment is being undertaken by the incumbent operator.

\(^3\) Although recent evidence from the FTTH Council shows that FTTH/B deployment is accelerating in both markets, see [http://ftthcouncil.eu/documents/Reports/2015/IDATE-European_FTTH_B_panorama_2015_public.pdf](http://ftthcouncil.eu/documents/Reports/2015/IDATE-European_FTTH_B_panorama_2015_public.pdf)
3 How ultrafast networks are being deployed in Europe

FTTH/B is being deployed under a wide variety of conditions, but it is common for deployment to be initiated by operators who have no existing interest in the copper network. In late 2011, the FTTH Council found that only one in five of the homes passed by fibre networks were passed by an incumbent operator who owned existing copper assets (Figure 3). This figure has increased to 45% by late 2015, suggesting that incumbent operators are expanding their FTTH/B investments, partly in response to competition from other FTTH/B operators – though a significant share of homes passed in the period is accounted for by one operator⁴.

Figure 3. Percentage of homes passed by category of player

![Percentage of homes passed per category of player](image)

Source: FTTH Council

3.1 Overview of main players and their strategies

Non-incumbent FTTH/B operators

The non-incumbent operators who account for the majority of ultrafast connections in Europe today are generally:

⁴ Telefonica has passed over 14 million homes in Spain. Excluding Telefonica, we estimate the proportion of homes passed by incumbent operators to be about one third of the total in 2015.
Utility companies seeking to extend the services they offer to households and to exploit the passive infrastructure – ducts and poles – which they already own (examples include Viken and Lyse in Norway, SE and Trefor in Denmark or proposed plans by ENEL in Italy and ESB in Ireland);

Privately financed (including private equity financed) independent fibre operators (such as IP Only in Sweden);

Cable operators upgrading their existing networks and/or extending their footprint to new premises (such as UPC in Hungary).

From this, it appears that the majority of ultrafast network owners are exploiting economies of scope between existing assets, often ownership of or control over ducts or poles, but also existing commercial relationships with householders, in order to add ultrafast broadband services to their portfolio. As mentioned above, these network owners generally do not own existing copper network assets. With some exceptions, incumbent operators who own copper assets have been reluctant to write them off and replace them with fibre whilst they have access to VDSL and G.Fast technologies, which allow for the continued improvement in the performance of the existing copper assets. However, as indicated above, there is evidence that some incumbent operators have invested in FTTH/B networks when they face the prospect of competition from other FTTH/B network competitors. In these circumstances, we understand there are examples of incumbent operators, such as Telia in Sweden, that have abandoned VDSL/FTTC\(^5\) and G.Fast technologies altogether.

Different models for providing ultrafast services are possible:

- **Wholesale only** providers who rely entirely on others to run the retail relationship with the households - We understand (from our discussions with Telenor) that most of the Swedish municipal networks operate in this way. They may sell either managed wholesale services or dark fibre, or both.

- **Networks who retail their own services on a non-exclusive basis and who also wholesale to rivals on commercial terms** - This model has been adopted in Sweden, where Telia offers a virtual access product to allow third parties to deliver services to households connected to the Telia fibre network.

- **Networks who retail their own services on an exclusive basis**, such as Viken in Norway or cable operators in most Member States.

There is some evidence of a tendency towards greater vertical integration of network and retail activities over time, as former ‘wholesale-only’ operators

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\(^5\) VDSL usually refers to VDSL equipment in street cabinets. Telia has VDSL equipment in many of its MDFs (local exchanges), but not in street cabinets.
engage in the provision of retail services themselves. This was the case for the networks now being retailed under the Waoo brand in Denmark, which had previously provided wholesale access to third parties but who we understand do not do so today, and for some municipal networks in Sweden, who now manage the network themselves, rather than offering dark fibre for others to manage as they had done in the past⁶.

However, it appears that few, if any, of the local/regional FTTB/H based operators have ambitions to deploy their networks on a national basis. Some (such as local municipalities) are subject to legal restrictions which limit the scope of their activities, whereas others are subject to financial or economic constraints.

Furthermore, in most cases we have seen, the operators of FTTH infrastructures do not seem to build to individual households which are already capable of being served by another FTTH provider, although Bulgaria is an exception to this.⁷

In markets we studied, it appears that fibre deployment started as a relatively localised activity, often with small providers serving individual towns or cities. Often, however, efforts are then made to aggregate these operations in order to obtain greater economies of scale. These economies of scale appear relevant to both retailing services over ultrafast networks and to the operation of networks themselves.

Consolidation in ultrafast retailing activities has occurred in several ways.

- In Denmark, for example, the energy companies market their fibre networks under a common brand (as Waoo), as do networks in Norway (as Altibox⁸). Networks who participate in these arrangements offer their retail services under common branding and, importantly, under common (i.e. national or regional) pricing plans. This means that although a number of fibre networks may fall under different ownership, they may act on the retail market as if they are a single firm.

- In other cases, consolidation has arisen through the acquisition and combination of existing ultrafast networks. In Denmark, TDC has extended its fibre footprint by acquiring rather than building fibre. Of course, cable operators have also used acquisition to consolidate their operations and obtain greater economies of scale, including in Germany (UnityMedia/Kabel BV), the Netherlands (Ziggo/UPC), Poland (UPC/Aster) and Hungary.

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⁶ This information was provided to Frontier by Telenor.
⁷ The position is different for FTTB (and for some businesses), where direct competition between several fibre providers appears feasible.
⁸ Altibox is a subsidiary of Lyse, which is a diversified energy and telecommunications company owned by 16 Norwegian municipalities. Lyse operates fibre networks but also resell services over third party networks under the Altibox brand in both Norway and Denmark.
In addition, Liberty Global, a pan-European cable operator, has begun to consolidate operations across Member States, announcing that it will integrate its operations in Ireland, the UK, and in Slovakia and the Czech Republic.

Regulators and competition authorities have generally allowed the consolidation of ultrafast networks. For example, KPN was allowed to acquire a controlling interest in Reggefiber, an FTTH/B network in which it had previously held a non-controlling interest, in 2014 without the imposition of access obligations. On the other hand, the French competition authority imposed wholesale access obligations upon Numericable for a transitional period, in order to safeguard competition specifically in ultrafast services as a result of the former’s acquisition of SFR in 2014. Last year, in 2015, the European Commission required Orange to divest an FTTH/B network serving 700-800k households as a condition of approving its acquisition of Jazztel.

**Cable operators**

The position with cable networks differs from FTTH/B.

- Firstly, cable networks are already deployed and only require upgrades (to DOCSIS3.0 and then 3.1) to network and customer equipment (and to augment core transmission and backhaul capacity) in order to function as ultrafast networks. This means the incremental network cost faced by cable operators to obtain higher speeds may often be substantially lower than that faced by either DSL or FTTH/B networks – a source of competitive advantage which we discuss later in this report.

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9 These had been imposed when KPN originally took a stake in 2008, but in 2014 the ACM concluded that it would address access obligations through the ex ante market review process rather than as part of the merger approval.

10 In this case, Numericable already offered ultrafast services on a network which passed 8 million homes. Very few of these faced competition from FTTH/B at the time, although Orange and other operators (including SFR) were expected to deploy FTTH/B networks in future that would compete with Numericable. The Conseil de Concurrence was concerned both that SFR would no longer provide a competitive constraint on Numericable after the merger, and that the other FTTH/B providers would find it much harder to do so given Numericable’s first mover advantage. Implicit in this view is the assumption that Orange’s (and others’) DSL products did not constitute effective substitutes. Numericable was therefore required to provide wholesale access until such time as the other operators had deployed their own FTTH/B networks, see http://www.autoritedelaconcurrence.fr/user/standard.php?id_rub=592&id_article=2445

11 http://europa.eu/rapid/press-release_IP-15-4997_en.htm. The European Commission has also imposed various ‘access’ obligations in relation to cable mergers – UPC/Ziggo and Telenet/BASE. These are generally intended to safeguard competition in TV markets by requiring the merged network to provide carriage for rival TV channels or capacity for rival OTT services such as Netflix. These measures do not directly affect inter-network competition since there is rarely any overlap between cable networks.
Second, the scope of the cable infrastructure is often already established in many markets, although, as noted earlier, some limited extension of the cable footprint is occurring in some markets, being mainly those in which there is no significant fibre deployment (the UK and Germany).

Cable networks (with the exception of TDC’s network in Denmark, Telenet in Belgium, and Magyar Telekom in Hungary, all of whom are regulated) do not wholesale to third parties. Instead they retail their own networks on an exclusive basis.

**Incumbent operators**

Incumbent operators have taken several approaches to deploying NGA services:

- A number of incumbent operators have chosen often to deploy VDSL/FTTC over their existing copper networks in areas that are not served by other ultrafast networks, or which are already served by cable. Fewer deploy VDSL to compete with FTTH/B, which may suggest that incumbent operators do not think they can earn a return on their VDSL investments in areas where fibre already holds a significant market share. At a meeting organised by the Danish regulator, for example, a spokesman for TDC said ‘…the company do not see a need to upgrade the copper network if other operators are ready with the roll out of fibre in the same area. TDC has observed an end-user preference for fibre compared to copper.’

- Some incumbent operators have deployed their own FTTH/B networks, normally in areas not already served by other FTTH/B providers. This is the case for Telia, which abandoned VDSL and has now built around half of the fibre network in Sweden and, to a lesser extent, Telenor in Norway and Magyar Telekom in Hungary (as well as Portugal Telecom and Telefonica).

- Some incumbent operators may also acquire existing fibre networks, as TDC (and KPN) have done.

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12 Minutes of DBA VULA Forum meeting, 18 December 2014

13 It is important to note that in this context we consider ‘deployment’ to involve the ‘cabinetisation’ of the existing DSL network in order to provide VDSL speeds to the majority of households in the area (often referred to as ‘FTTC’), and not simply the provision of VDSL services to a limited number of households or businesses that are directly connected to the existing exchange.

14 TDC acquired a fibre network from DONG Energy in 2009. KPN acquired Reggefiber in 2014 (it was a JV between 2008 and 2014).
Some incumbent operators obtain wholesale access to the fibre networks of other providers and retail their services over them. TDC has done this, for example, by reselling over Trefor, a rival non-incumbent fibre network (as has Portugal Telecom in purchasing wholesale access from Vodafone\(^{15}\)).

### 3.2 The growth of ultrafast connections

The Commission’s efforts to promote investment in ultrafast networks appear to be succeeding, and the number of households connecting to ultrafast networks is growing strongly in every market we have studied. Figure 4 shows the shares of households connecting to networks employing different technologies in the markets we have analysed.

These charts show:

- A significant decline in ADSL connections in all markets as households switch to ultrafast alternatives;
- Modest growth in VDSL connections, reflecting limited VDSL deployments in the face of FTTH/B growth;
- Very significant growth in FTTH/B in all markets as fibre is deployed, with exceptional levels of FTTB connections in Bulgaria and Sweden;
- Cable growth varying significantly between markets. In Denmark, Sweden and Norway we see little change in the proportion of connections to cable but substantial growth in Hungary and Bulgaria.

\(^{15}\) See Vodafone’s response to Ofcom’s DCR for more details (http://stakeholders.ofcom.org.uk/binaries/consultations/dcr_discussion/responses/Vodafone_Annex_4.pdf)
Figure 4. Shares of households by technology

Norway

Denmark

Sweden

Bulgaria
These results suggest a strong customer preference for FTTB/H services over ADSL and, to a lesser extent, VDSL and cable. The total number of connections may, however, also reflect differences in the speed at which the respective networks can be deployed. In particular, we would expect the roll out of VDSL, which involves the installation of electronics and some cabinets but little additional work on the access lines which connect to the property, to proceed much more rapidly than the deployment of a greenfield FTTB/H network. In contrast, cable networks are also already established and extensive in some markets, but are less likely to expand further.

To take these factors into account, we show below the same graph, but adjusted for the number of homes passed by each technology in each year (Figure 5). This allows us to show changes in penetration rates for each technology over time. We use Sweden to illustrate the point and find that FTTH/B is obtaining both much higher and growing levels of penetration relative to both VDSL and cable, whilst ADSL is declining.¹⁶

¹⁶ Although not the focus of this report, the very high levels of penetration – at 6 in 10 homes passed (vs 3-4 in 10 for cable and 2 in 10 for VDSL) – achieved by FTTH/B networks suggests why they may be viable, despite the relatively much higher costs of deployment relative to cable and VDSL.
High levels of penetration can be expected to translate into high absolute market shares as FTTB/H networks expand, or as cable penetration rates grow. This is reflected in the projections for switching between ADSL and ultrafast technologies in each of the markets out to 2020. In every market the combination of cable and FTTB/H is projected to capture (nationally) over 60% of all connections by 2020, with VDSL obtaining no more than 10% (except in Denmark).
Figure 6. Projected market shares by technology to 2020
How ultrafast networks are being deployed in Europe

Source: Analysys Mason data provided by Telenor
4 Competition between ultrafast networks

Although it is clear that ADSL will be largely replaced by VDSL, cable and FTTH/B in Europe over the next 5-10 years, it is not clear whether householders will benefit from more or less competition as a result.

If the existing copper network can provide ultrafast services which compete with the new cable and FTTB/H products then, assuming no other changes\textsuperscript{17}, the addition of new ultrafast networks could increase the overall level of competition and add to the number of choices available to households. In this scenario, regulators will then need to consider the extent to which competition is enhanced and whether this is sufficient to enable some (further) deregulation of broadband markets. If they do not compete, regulators may instead need to consider how to encourage competition over the new networks.

In order to assess whether the ADSL and VDSL services provided over the existing copper network offer effective substitutes to those offered by the cable and FTTB/H networks, we consider next evidence of retail pricing and switching between networks / technologies.

4.1 Evidence on pricing

Before examining the pricing evidence available, it is useful to start by considering the incentives which different providers might be expected to face in light of the market trends described in the previous sections. This is because such incentives could differ significantly:

- Incumbent copper network providers who provide existing DSL or VDSL services may have different incentives depending upon the extent to which they themselves also own fibre or cable assets. This varies between the markets we have studied – Telia, for example, has quite significant FTTH/B investments in Sweden, whilst neither Telenor nor TDC have significant FTTH/B networks in their respective markets. On the other hand, Telenor and TDC (and Magyar Telekom) are unusual amongst European incumbents in also owning cable networks.

  In those instances where the incumbent owns significant ultrafast infrastructure, they may be content to see the rapid migration of householders from DSL to the fibre or cable network. This may reduce the period during

\textsuperscript{17} Such as the retirement of the copper network, or the withdrawal of existing access regulation on the copper network
which they have to incur the expense of maintaining both the copper and the fibre or cable networks.\footnote{Incumbents, such as Orange in France, Telia in Sweden and Verizon in the United States, are already planning for the phased retirement of the copper network, which otherwise remains a relatively high cost network to maintain.}

On the other hand, even incumbents who own a significant ultrafast network face competition in other geographic regions from non-incumbent ultrafast network providers. Thus, incumbent operators can only expect to retain a proportion of the DSL customers who switch to ultrafast networks, whilst losing others to alternative providers. Moreover, where non-incumbent ultrafast providers are vertically integrated, they will capture the entire revenues of the customer (both retail and wholesale), whereas in the DSL case the incumbent operator might expect to capture some wholesale revenues in the form of regulated unbundling charges.

In those areas where no ultrafast network has yet been deployed the incumbent operator’s pricing incentives remain unchanged. The incumbent’s pricing may or may not be constrained by competition from other DSL resellers, and by the regulation of its wholesale prices.

- Non-incumbent DSL providers are likely to be constrained by the incumbent’s DSL pricing and by the regulated wholesale charges, over which they have no direct control. In the markets we have studied, we have found that only a small proportion of existing non-incumbent DSL providers also have a significant position in the market for the provision of ultrafast services. This may be in part because a wholesale market for ultrafast services has yet to develop in most markets (Sweden is an exception, but only in relation to MDUs), and in part because these firms may not generally have the assets which create the kinds of economies of scope we identified as facilitating the deployment of new FTTH/B networks.

- Non-incumbent FTTH/B providers are likely to set prices at a level which enable them to capture a large share of the households wishing to migrate from DSL to ultrafast networks.

- Cable operators face similar incentives to the incumbent copper networks. They have a significant existing base of customers who subscribe to standard or superfast broadband products, often as part of a larger bundle which includes TV and other services. Whilst cable providers have an incentive to acquire additional subscribers as they switch out of DSL, they also need to consider the trade off from any discounting to attract such subscribers on the upgrading of their own subscribers, and the implication of unbundling the services provided to their existing base. They face competition for DSL...
subscribers from FTTH/B in some areas and, appear to suffer some competitive disadvantage in this context, despite DOCSIS providing them with the capacity to match FTTH/B networks in terms of headline (download) speed\(^\text{19}\).

The pricing incentives faced by the different firms are complex and may differ even within a particular national market. For example, one obvious strategy would be for the incumbent DSL providers to selectively discount their DSL prices (or, in the presence of national uniform headline tariffs, to offer other types of localised non-price promotions) in areas where they face competition from FTTH/B networks (and perhaps cable), but not to do so in areas where they face no such competition. However, such selective discounts are difficult to capture in publically available tariff data, and we have seen no evidence of DSL pricing to suggest these practices.

Furthermore, broadband offers often involve additional fees and/or have other services bundled with them, which can make it challenging to compare prices on a like for like basis. Our results should always be considered with this in mind\(^\text{20}\). However, the evidence we have considered shows:

- No evidence that DSL pricing is being discounted despite significant switching away from DSL to FTTH/B in all markets studied.

- FTTH/B is not generally priced at a significant premium to comparable DSL products at this point in time, and is often cheaper.

- However, genuine ultrafast FTTH/B services, offering speeds above 100 Mb/s which cannot be matched by DSL, are priced at a significant premium to lower speed products offered over the same FTTH/B network.

We illustrate this with data from Sweden\(^\text{21}\), but similar results are found in other markets:

- Telia’s ADSL services at 2 and 8 Mb/s respectively are priced at €851.25 and €986.55\(^\text{22}\) respectively whereas;

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\(^{19}\) FTTH/B networks generally provide much higher upload speeds than DOCSIS cable networks, often on a symmetric basis. However, we have seen no evidence to suggest that higher upload speeds account for the tendency of households in some markets to favour FTTH/B over cable.

\(^{20}\) We have relied upon pricing data provided by Analysys Mason comparing broadband tariffs in each market during 2015 and excluded bundles with TV and mobile (to ensure a that broadband products are directly comparable).

\(^{21}\) We use Analysys Mason pricing data for 2015.

\(^{22}\) These are costs over 24-months in euros, taking into account discounts, activation costs, etc.
Telenor’s 100Mb/s fibre product is priced at €765 and the 100 Mb/s symmetric product at €862. Telia’s 100/100 product is priced at €993.

However, Telia’s charges for ‘ultrafast’ products are €1,264 for 250Mbps, €1,565 for 500 Mb/s and €2,338 for 1 Gb/s. These represent a significant premium on the 100 Mb/s product and are likely substantially greater than the incremental costs of providing these ‘ultrafast’ products.

Our results appear consistent with the findings of a recent report by PTS, the Swedish regulator, which also reviewed pricing of copper, fibre and cable products. The results of this study are reproduced below:

Figure 7. Pricing data in Sweden

Source: PTS

We understand that the authors of the report for PTS use these results to infer that DSL does not constrain fibre and that the market is bifurcating (i.e. dividing

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23 Telenor is mostly an entrant in the fixed market in Sweden and largely relies on access to Telia’s dark fibre.

24 These costs, however, do not take into account a one-off connection charge of c. €2,000 (SEK 19,000) for those households, which are not yet connected to fibre. Even if amortised over 5 years, it significantly increases the cost of fibre products for these households, potentially delaying their decision to switch to fibre.

25 PTS, “Ingår bredband levererat över fiber respektive koppar på samma slutkundsmarknad?”, 2015
into separate superfast DSL/cable and ultrafast FTTB/H broadband markets\textsuperscript{26}. Their view appears to be that copper and fibre prices are similar not because the former constrains the latter, but because fibre providers are discounting prices in order to induce switching from DSL. This is effectively a hypothesis about ‘one way’ substitution in which households will switch from DSL to fibre in the event of a price increase for DSL, but would not switch from fibre to DSL in the event of a price increase for fibre. This is potentially plausible for the reasons explained in the next section (though we note that this conclusion cannot be unambiguously drawn from the pricing data presented in the PTS report, or the other pricing data that we have reviewed)\textsuperscript{27}.

Our conclusion is that, nationally averaged prices (and national switching data), which are generally the only ones that are available in public data sets, whilst providing some useful context in assessing the substitutability of different broadband offerings, do not allow us to fully understand how competitive dynamics are developing within different areas.

We need also to consider the potential impact of non-price factors (which are also not readily captured in a simple SSNIP test). We consider a potentially important non-price factor – the ‘option value’ of fibre – in the next section.

### 4.2 The role of ‘option value’ in ultrafast competition

Although ultrafast networks, as the term implies, are associated with very high broadband speeds (typically above 100 Mb/s), fibre networks have many other characteristics which are relevant to customers. For example, fibre networks are generally regarded as being more reliable and less prone to faults than copper networks, partly because they use more modern equipment and have been more recently installed, partly because they are not susceptible to attenuation due to climatic conditions or to interference from cross talk, and partly because they rely upon fewer active components in the network and have fewer cabinets or other chambers which are exposed to the elements or susceptible to faults or vandalism. There can also be improvements in the service provided by operators of fibre networks which may not be directly related to the technology employed in the network (e.g. billing or customer service) but which may also lead householders to prefer one network provider over another.

We have reviewed proprietary market research data which considers how consumers in some markets perceive cable, FTTB/H and DSL networks. The results are shown below and reveal a strong preference for fibre, with over 50%...
of households surveyed preferring fibre and fewer than 20% preferring cable\textsuperscript{28}. Although the cable and fibre networks may have similar technical characteristics and be capable of delivering similar speeds, it appears that fibre networks are regarded by many consumers as being more ‘modern’ and ‘future proof’.

**Figure 8.** The choice of technology (if free to choose between all alternatives)

![Graph showing technology choice over time]

Source: Consumer research in one of the markets

**Figure 9** also confirms that when subscribers subscribe to FTTB/H networks they are generally more satisfied than DSL households, and also that those FTTH/B customers of a given operator are significantly more satisfied than those subscribing to both the cable and DSL products offered by that same operator (and that cable also scores higher than DSL\textsuperscript{29}).

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\textsuperscript{28} This appears to be without reference to comparative prices or to precise speeds.

\textsuperscript{29} This controls for differences such as customer service, billing or brand which may otherwise explain differences in satisfaction between firms.
Figure 9. Customer satisfaction

The above evidence indicates that a significant factor in the minds of many households when switching to fibre networks, in addition to the actual speed at the time of switching, may well be the ‘future proof’ or option value character of FTTB/H. In other words, fibre offers customers the reassurance that they will be able to easily increase the speed of their connection in the future should they find themselves in a position of needing to do so. This is not assured if they remain connected to a DSL or copper network.

The evidence we have to date suggests that although many of those switching from DSL to FTTH/B may obtain higher speeds\(^{30}\), a much smaller proportion obtain the ‘ultrafast’ speeds which only FTTB/H or cable are capable of providing\(^{31}\). As such, it could be the case that fibre providers might advertise 1 Gb/s tariffs not because they expect a significant proportion of customers to take them today, but because, by doing so, they reassure those taking 50 Mb/s services that a 1 Gb/s option already exists if they should ever require it.

\(^{30}\) We find that in Norway and Denmark, DSL customers have broadband products with an average speed of 20Mb/s, while fibre customers – with an average speed of 60Mb/s. In Sweden, average speed customers subscribe to is 20Mb/s on DSL and 120 Mb/s on fibre.

\(^{31}\) Although the symmetric nature of many FTTH offers means the upload speed is likely to be higher, even if the download speed remains comparable to their previous DSL service.
To illustrate this, **Figure 10** shows the distribution of broadband connections by speed and by technology, using data produced by the Norwegian national regulator. We have used 100Mb/s as a threshold for presenting the distribution of subscribers by speed, in part because data is presented in this way and in part because it is speed which households generally may not expect to be provided over copper networks under any circumstances in the foreseeable future\(^{32}\).

It shows:

- The vast majority of DSL subscribers, and about 30% of the total broadband connections, subscribe to services at less than 30Mb/s.

- The vast majority of FTTH/B connections today are at speeds of less than 100 Mb/s – far short of the speeds of which FTTH/B is capable. A non-trivial proportion of these connections are at speeds of less than 30 Mb/s – a product which could readily be provided by DSL technology in many cases\(^{33}\). These are therefore a group of users who can be described as having switched to fibre in order to access the ‘option value’ which FTTH/B offers and which DSL does not.

- Although the number of households switching to fibre in order to obtain speeds of 100 Mb/s or more is growing, it remains less than 10% of all broadband connections and less than 25% of all FTTH/B connections. These are the group of users who have both access to and who are realising the ‘option value’ of higher speeds provided by fibre.

- The remaining connections are provided by cable.

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32 G.Fast standards may offer the possibility of providing speeds significantly in excess of 100 Mb/s over copper infrastructure in the future. We would not expect consumers to be aware of such developments in the absence of any active marketing/promotion of such speeds. Hence this should not be expected to influence their behaviour when switching between broadband network providers.

33 Although we have no data to verify, we expect that a significant proportion of sub-30 Mb/s FTTH/B connections may be provided to MDUs rather than SDUs. Within a particular MDU, some households may have no wish to obtain ultrafast broadband services whilst others will. The former group may be served by the sub-30 Mb/s product.
Figure 10. Distribution of customers by speed and technology in Norway

![Figure 10](image)

Source: Norwegian national regulator.

In Figure 11 we provide the same data for Denmark. The results are similar:

- A large but declining proportion of connections are served by DSL at speeds below 30 Mb/s;
- The majority of FTTH/B connections (around 75%) are provided at speeds below 100 Mb/s, although the proportion of households who ‘exercise the option’ and migrate to speeds of 100 Mb/s or more is growing over time.
**Figure 11.** Distribution of customers by speed and technology in Denmark

![Distribution of customers by speed and technology in Denmark](image)

Source: national regulator in Denmark

In **Figure 12**, we show the position in Sweden:

- As before, DSL connections are declining rapidly, whilst FTTH/B connections are growing strongly and the cable share of connections remains broadly unchanged.

- A significantly higher proportion of Swedish households have subscribed to FTTH/B services at speeds of 100 Mb/s or more. In 2010, about 50% of all FTTH/B connections were already at 100 Mb/s or more, and 75% of all connections were at 100 Mb/s or more in early 2015. In contrast, in early 2015 only 25% of all connections were at 100 Mb/s or more in Denmark and Norway.

- The trends observed in Sweden nonetheless remain the same: a significant proportion of households appear to join an FTTH/B network at speeds below 100 Mb/s, including speeds at which DSL would be a viable alternative, all else the same. This is consistent with households choosing FTTH/B over DSL because it gives them higher speeds and the option to migrate to much higher speeds, above 100 Mb/s, at a later date. In all three markets, a growing proportion of households are doing this, although the trend is far more advanced in Sweden than in the other two.
Although we have not attempted to replicate this analysis for cable networks, due to data limitations, we understand (from our discussions with Telenor) that many DSL subscribers who switch to cable will also subscribe to products at speeds below 100 Mb/s, despite those operators also offering much higher speeds (at up to 500 Mb/s).

Churn rates might be another relevant factor in testing the ‘option value’ hypothesis. Households who subscribe to a network because it provides an option to upgrade in future should, all else the same, be much less likely to churn than those who might be opportunistically switching between one provider and another in order to meet their current needs. Lower churn rates may indicate other things too – such as higher levels of satisfaction with existing services (as we showed in Figure 9) – but it may also indicate that subscribers to FTTH/B networks take a longer term view of the expected benefits and costs of switching. Data on churn amongst FTTH/B networks is difficult to source (since many subscriptions are comparatively recent and the sample selection may be biased), but the evidence we do have confirms that FTTH/B churn rates are lower than those for cable. Figure 13 shows additions and leavers for Norway in 2015.
In conclusion, given the evidence presented above, the importance of ‘option value’ in explaining why consumers favour fibre over copper is likely to be significant. However, it does not seem to be well understood or articulated today:

- Broadband remains a relatively new phenomenon for many households and the technical language about speeds and network performance is not often understood. It is therefore reasonable to suppose that few households will predict accurately their future needs and many may not be confident about precisely what they require today. Recognising this, a number of consumers may not select networks on the basis of just what they offer today, or on whether current speeds meet or exceed current requirements. Instead, they may attach weight to what the networks would be able to offer tomorrow, should the household require it. This may be a significant factor in their decision, and for some households, the most significant. Seen in these terms, fibre network operators can offer clearer commitments to support much higher speeds than copper network operators, who may not be as certain about what speeds will be obtained from G.Fast or other technologies on average.

- Second – and important for our analysis, ‘option value’ is not captured in current regulatory practice, which defines the boundaries of broadband markets or segments by reference to the adoption of services at current speeds. The Commission, for example, publishes data in its Implementation Reports which distinguish between services above 30 Mb/s and services above 100 Mb/s (reflecting the boundaries drawn in the Digital Agenda targets and used to distinguish ultrafast networks from their ‘superfast’
counterparts). As shown above, in the markets we study (with the exception of Sweden), both FTTH/B and copper networks have the majority of their customers in sub-100 Mb/s segment and a proportion of FTTH/B households are provided with sub-30 Mb/s speeds. This may suggest that there is two-way substitutability between copper and fibre networks.

However, an analysis of current speed or current price will miss the impact of ‘option value’, which is seen as being available to those on FTTH/B networks, to a lesser extent on cable and not at all (or to any significant extent) to those on copper. On this view, the more relevant boundary for the purposes of market definition is not speed, but technology (as a proxy for ‘option value’).

This does not mean that regulators should adopt a ‘technology specific’ approach to market definition in broadband. The use of the network technology in assessing household switching should be regarded as a proxy for the ‘option value’ which ultrafast networks offer but which the copper network does not (or at least does not to the same extent). Another way of thinking about this is to define connections by reference to the potential speeds of which they are capable rather than by reference to the actual speed which the household obtains today. On this view, technologies other than fibre could have an ‘option value’ that was as great or greater than that offered by FTTH/B networks, though we are not aware that such a technology has yet been identified (in terms of customers’ perception).

Of course, if there is an option value for FTTH/B, it could be reasonable to expect that this would be captured by those network providers today, for example in the form of higher prices. However, there is no clear evidence to suggest this is happening. One potential reason for this is that FTTH/B providers may decide to defer the FTTH/B premium until a later point in time, just as householders themselves may decide to defer the exercise of the option to a later date rather than when they first switch. This avoids the risk that FTTH/B providers are viewed as seeking to charge inflated prices without providing anything tangible in return, and allows them to extract the rents when the households receives the value from the option (i.e. when it is exercised and they move to a higher speed service). Viewed in this way, this is simply another form of ‘introductory discount’. The relatively high prices and steep tariff gradients for FTTH/B services above 100 Mb/s would support this interpretation, and the growing and rather rapid migration of households to these ‘premium’ tariffs (particularly in Sweden, but also evident in other markets) and the low rates of churn away from FTTB/H would suggest that the strategy is successful. If Sweden provides an early indication of future trends in other European markets, then a large and growing proportion of householders will migrate to more expensive or ‘premium’ tariffs within a matter of years and FTTH/B providers will extract their share of the ‘option value’ when they do.
Final Competition between ultrafast networks
5 Network competition in ultrafast broadband

In the previous sections we have examined whether ADSL and VDSL services provided over the existing copper network will discipline the conduct of new ultrafast FTTB/H and cable networks. We have concluded that although current pricing may initially suggest that this is the case (and that it may indeed be the case in some Member States or at some points in time), the ‘option value’ speed advantage of ultrafast networks, and FTTB/H in particular, means that this cannot simply be assumed. If ADSL and VDSL no longer constrain ultrafast FTTB/H and cable networks, then the development of new ultrafast networks may not unambiguously increase competition.

In this section we assess the impact of ultrafast networks on competition without assuming that ADSL and VDSL will constrain FTTB/H and cable. However, as noted earlier, the deployment of ultrafast networks is not undertaken on a national level, meaning that we cannot assume networks will overlap or compete directly with each other. Indeed, in many cases it appears that ultrafast networks are deployed in areas so that such overlaps are avoided.

Most existing data fails to account for this feature of ultrafast networks and instead provides aggregated data on a national basis, which reveals very little about competitive dynamics as a result. However, Figure 14 provides our estimates of the extent to which different network technologies compete against each other in the markets we have studied. These estimates are derived from a wide range of sources and should be treated with some caution, but serve to illustrate:

- The wide differences in the competitive environment both between different Member States and within them. This makes analysis at a national level inappropriate and means it is likely to produce erroneous conclusions about competition.

- The addition of new ultrafast FTTH/B networks in the market adds another alternative network (to existing DSL or cable) for 25-50% of households, but leaves many other households unaffected.

- A significant proportion of FTTH/B and cable networks do not compete with each other, with fewer than 20% of households typically enjoying competition amongst all three technologies (Fibre/Cable/VDSL).

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34 The details of our calculations and a sensitivity analysis are provided in Annex 1

35 Note that in Bulgaria, many of the 53% of homes passed by FTTH/B networks will have a choice of more than one FTTH/B network. This is not the case in the other markets.
**Figure 14. Coverage overlaps between technologies**

![Coverage overlaps between technologies](image)

Source: Frontier estimates based on the EC coverage figures

In **Figure 15** we translate this data to show the number of networks from which households can choose. We do this first assuming that copper ADSL and VDSL is considered to be an effective competitor to FTTB/H and to cable. This is the traditional approach adopted by national regulators in Europe and proposed by the Commission in its most recent List of Relevant Markets.

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36 We note that the European Commission categorises some Bulgarian networks as being ‘cable’ whilst we categorise them as ‘fibre’. These networks involve the use of coaxial cable inside the MDU, but the provision of fibre to the foot of the building. As such, we classify these as fibre.

37 We assume that in areas where fibre, cable and ADSL or VDSL are present we have three network-based competitors; in areas where cable and ADSL/VDSL, or fibre and ADSL/VDSL are present – there are 2 competitors, and in ADSL areas – one competitor. Denmark is, however, an exception, because the incumbent, TDC, owns three networks – fibre, cable and ADSL/VDSL. Our understanding is there are no areas with three competing networks in Denmark and most areas of overlap would have only two networks.
Figure 15. Degree of competition in ultra-fast broadband (assuming ADSL/ VDSL in the same market)\textsuperscript{38}

![Bar chart showing degree of competition in ultra-fast broadband](chart.png)

Source: Frontier estimates based on the EC data

This shows:

- In all three markets 60-70\% of all households will have a choice of more than one network provider, with one of those providers being the incumbent’s copper network and the other being FTTH/B and/or cable. Technology overlaps do not directly translate into the number of competitors. For example, while there is a significant overlap of fibre, cable and VDSL coverage in Denmark, this is not translated into the equivalent number of choices. This is because one operator, TDC, operates all three technologies, with significant overlaps between them\textsuperscript{39}. If, however, we assume that neither DSL nor VDSL are or will be competitive constraints upon fibre and cable (but that FTTB/H and cable impose constraints upon each other), then the number of network choices available to householders in these markets changes quite dramatically. This is shown in Figure 16:

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\textsuperscript{38} The totals reflect overall broadband coverage in these markets (which is 99\% or below).

\textsuperscript{39} Note that there is different, but important, issue of what ‘choice of networks’ means in the Swedish context where we understand that ComHem, which we consider to be a cable operator in Figure 12 (and which describes itself as such), often uses the FTTB network of Telia to connect to certain MDUs. We have characterised the use of dark fibre in this context as representing another ‘network choice’ in Figure 13, although it could also be characterised as ‘service provision. The choice of definition does not alter our key results.
- The number of households with more than one network provider falls from 60-70% to 44% in Sweden and 22% in Norway.

- The number of households with no choice of network provider for ultrafast services (one or none) increases from 30% to 50-80%.

We conclude that if competition is confined to cable and FTTB/H but excludes services provided over the copper network, then about half the population of Sweden and Norway will be faced today with a monopoly network provider of ultrafast services (or no provider at all), having previously had a choice of providers of broadband services. This, if sustained in future, would represent a very material redefinition of the scope of competition, with significant implications for regulation.

**Figure 16. Degree of competition in ultra-fast broadband (assuming ADSL/ VDSL is excluded)**

![Bar chart showing degree of competition in ultra-fast broadband](chart.png)

Source: Frontier estimates based on the EC data

Any reduction in choice and competition at the network level might be alleviated, in whole or in part, if those monopoly network providers were to allow, or be obliged to ensure, competition over the network by third party resellers. The charts in **Figure 17** below assess this claim and show:

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40 More details on our calculations are provided in the Annex 1.
In the case of Sweden, 56% of households (those served by the Telia fibre network and by non-incumbent fibre providers, the vast majority of whom offer wholesale access to third parties) may have a choice of service providers despite having no choice of network provider\(^4\). Of course, some proportion of the 56% of households may also be served by more than one network provider (i.e. they may form part of the 24% of households with a choice of more than one ultrafast provider identified above). We do not have data which would allow us to distinguish between households in this situation and those which are not.

In the case of Norway, only 7% of households (those served by Telenor's fibre network) may have a choice of service providers despite having no choice of network provider. Again, some proportion of the 7% may also form part of the 22% of households who we identify as having a choice of network provider. But, if they do not, the maximum number of households to have a choice of provider for ultrafast broadband services is 29%. Given the prospect of overlap, the number is likely to be lower than this.

In the case of Denmark, only 15% of all households are likely to have a choice of service providers over a fibre network, but the obligations upon TDC to wholesale access to its cable network – although not yet implemented – may provide a significant proportion of other households with a choice of ultrafast service provider in the future.

\(^4\) We ignore here the question of whether the wholesale products which these networks offer or are required to offer are adequate to ensure effective competition. This is discussed later in our considerations of the wholesale products which are required to safeguard competition in ultrafast markets. We are aware, however, that a number of respondents to a recent PTS study of fibre competition have suggested that existing wholesale products provided by Telia and others do not enable product differentiation or otherwise enable effective retail competition.
Figure 17. Coverage by technology and whether the network is ‘open’ (offers wholesale access) or ‘closed’ (in 2014-15)
In practice, wholesale access markets for ultrafast services remain relatively underdeveloped throughout Europe. The regulatory obligations to offer wholesale access to cable networks, which apply in Denmark (and in Hungary and Belgium but not otherwise in Europe) are relatively recent and we understand that no commercial offer was launched in Denmark until April this year (by a minor broadband player). Orange has recently launched cable service in Belgium using the Telenet network, but this is not yet on a fully commercial basis. We understand that there has yet to be any purchase of the cable wholesale services which Magyar Telekom in Hungary is required to offer.

The wholesale access obligations which apply to the FTTB/H networks owned and operated by the incumbent operators are more established, but also appear to have had relatively limited impact on competition so far. Of the markets we have considered, Sweden has the most established wholesale markets, but we understand that whilst competition over Telia’s FTTB network (to serve MDUs) is reasonably robust, service-based competition over Telia’s FTTH network remains undeveloped. The result is that service-based competition and wholesale access products remain of marginal significance in the provision of ultrafast services in Europe today.

Conclusions on competition

The development of ultrafast networks can be expected to have a significant impact on broadband competition. If the broadband market is extended to include these new networks within the existing market served by copper-based...
technologies, then these developments represent an important extension of network competition and, in the specific markets we have studied, we might expect 60-70% of households to face a choice of at least two networks and a significant proportion of households (mainly those in MDUs) to have a choice of three.

Moreover, as Figure 18 illustrates, the share of broadband connections controlled by the incumbent operator Telia will fall as the incumbent’s share of fibre and cable connections is invariably significantly smaller than its share of copper connections. We see below that Telia’s share of DSL connections increases as more households migrate to fibre and cable (since Telia will tend to retain DSL connections in more rural areas where there is neither service nor network based competition) even as Telia’s total broadband market remains broadly flat (at around 37-38%).

**Figure 18. Incumbent (Telia) share of connections**

![Incumbent (Telia) share of connections](image)

Source: Analysys Mason

Ultrafast broadband could, on this view, be said to diminish the position of the existing SMP operator and to enhance and expand broadband competition and choice, at least in some areas, as additional networks are deployed. That ought to prompt European regulators to consider further deregulation in some markets.

However, there may also be good grounds for coming to the opposite conclusion. This is as a result of two effects:

- Whilst the scope of network competition with ultrafast may increase (relative to the position in which no new networks had been built), we find that only
around 20-45% of households in the markets\footnote{Total NGA coverage in these markets is between 69% and 92%}. we have considered face a competitive choice between networks capable of delivering ultrafast services (assuming that VDSL is excluded).

- For the remaining households, the absence of wholesale access obligations or offers on most ultrafast networks means that the scope of services-based competition will reduce significantly. Although over 90% of households in most European markets now have a choice of services based competition over DSL, the number of households with such a choice over fibre and cable varies from over 50% in Sweden to 7% in Norway (see Figure 17 above).

If there is the prospect of a significant reduction in competition as ultrafast broadband networks develop and increasing number of households switch to them, then national regulators will need to consider what further actions are required to safeguard competition. We discuss this in the next Section.
6 Changes required to safeguard competition in ultrafast markets

Based on the analysis presented in the previous section, in this section we consider the options available to regulators to safeguard competition.

6.1 Timing of any potential intervention

Timing plays an important part in any proposals for change, and there are a number of reasons why regulators may consider that action may not be required in the short term.

We start by noting that regulators may take comfort from the fact that the incumbent operators’ market shares may continue to fall - the trend may even accelerate – as ultrafast networks are being deployed, for the reasons explained in the previous section. The Commission and many national regulators have traditionally used ‘incumbent market’ share, at a national level, as a proxy measure for the effectiveness of regulatory measures and of competition. Regulators may also take comfort from market data which typically segments by reference to speed and which shows that in most markets (although not all), the majority of households are purchasing broadband services in the 10-30 Mb/s range in which copper might be considered a credible substitute for FTTB/H and cable. If markets are also defined on a national basis, then the evolution of market shares may suggest a degree of substitutability and competition between the various platforms. For the reasons explained earlier, and irrespective of whether or not there is a case to intervene today, national regulators in the markets we have considered (and likely elsewhere in Europe too) likely currently lack the full data necessary to fully/properly assess the ultrafast markets which are developing now, and which will serve the majority of households in the markets we have studied before 2020. Whilst current ultrafast pricing may not raise concerns, without the tools to undertake a proper assessment (and then consider the appropriate response), there is a risk that ultrafast pricing could emerge which would be inconsistent with a competitive market outcome, as a result of a ‘false negative’ finding that broadband markets are competitive when in fact they are not. In ultrafast markets, competition is localised and these pricing constraints may no longer apply.

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43 This point is particularly acute when regulators cannot rely upon the national averaging of prices to safeguard those households who face a monopoly supplier. To date, national averaging of prices has ensured that any attempt by the incumbent to exploit households in monopoly areas risks the loss of share in other areas where the incumbent faces effective network competition.
The Commission has also in recent years been understandably concerned to encourage the deployment of, and investment in, new ultrafast networks. Dealing with the consequences of such deployment, particularly when the competitive dynamics are so uncertain, might be regarded as something to address at a later date, whilst regulators may consider that operators may require an opportunity to make higher profits in order to incentivise such investment \(^{44}\). Regulators may therefore believe that any temporary monopoly can be undone at a later date through the application of wholesale access obligations once the nature of the competitive problems become clearer.

Furthermore, some national regulators have considered measures to counter the prospect of monopoly or duopoly by promoting more ultrafast network competition \(^{45}\). Measures such as regulatory access to the duct and pole infrastructure of the existing copper network, reform of planning processes or other measures envisaged by the Commission’s Broadband Network Cost Reduction Directive, currently being implemented by Member States, are all examples of measures to achieve this aim.

In view of the likely time required in order to develop and then implement any remedies that may be required in order to deal with competition issues raised by the development of UFBB, in what follows we assume that despite these efforts, a significant proportion of households will face the longer term prospect of monopoly (or duopoly) supply of ultrafast services. In this case, regulators may wish to intervene in order to safeguard competition in ultrafast services. Doing so requires two steps:

- The focus of regulation will move to those controlling the ultrafast networks, which may include the incumbent copper operator that is already subject to existing SMP obligations, but often does not.

- Access obligations and products will need to reflect the requirements of ultrafast competition rather than existing copper remedies.

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\(^{44}\) This could involve either a period of ‘forbearance’ from access regulation or the application of different remedies, such as the use of ‘retail minus’ rather than ‘cost plus’ pricing rules.

\(^{45}\) The evolution of G.Fast technology could also potentially provide a constraint to FTTB/H based UFBB pricing – we have seen no evidence of this being promoted currently in the countries we studied.
6.2 The scope of regulation

One option could be for regulators to extend the scope of existing regulation to firms who are not subject to an existing finding of Significant Market Power (and hence to the kinds of wholesale access obligations presented in the existing Costing Recommendation). The approaches we present for this are not necessarily mutually exclusive, for example ‘symmetric’ remedies (discussed below) could be combined with an asymmetric requirement on the incumbent to provide access to ducts and poles. On the other hand, different approaches may be suitable in different Member States, or within the same Member State (e.g. to greenfield ultrafast networks as compared to existing networks). Given the variety of ultrafast competitive conditions in Europe, an extensive and flexible regulatory toolkit is likely to be required. Some approaches may also be faster to implement (e.g. because they do not require changes to existing legislation or the collection of significant additional market data), whilst others may take longer to develop or to refine.

Applying the existing framework

The existing regulatory framework could, in theory, be applied without modification but in way which ensured that new (non-incumbent) ultrafast network providers were found to have Significant Market Power and thereby, if the overall assessment of the competitive conditions and investment incentives justified it, be subject to wholesale access obligations of some kind.

Some national regulators have already attempted to undertake this exercise:

- Most notably the Belgian national regulator who has imposed wholesale broadband access obligations upon the Belgian cable operators via a finding of SMP in a related TV market.

- The Danish national regulator has also proposed to impose standalone wholesale broadband access obligations on TDC, which operates both a copper and a cable network within the same market (it does not propose to extend those obligations to the other Danish cable network, Stofa, and so is of less relevance to the issue we are considering here).

- In similar terms, the Hungarian national regulator has imposed wholesale access obligations on Magyar Telekom’s cable network, although no buyers have emerged.

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46 This is currently applied in France.
As noted earlier, the French competition authority also obtained wholesale access commitments from Numericable pursuant to its SFR acquisition.

It is important to note that the emergence of non-incumbent ultrafast networks can also lead to the withdrawal of existing regulation, rather than its extension to the new networks, where the assessment of the competitive conditions (and investment incentives) warrants it. For example, the Romanian regulator recently became the first national regulator to remove all wholesale access regulation in the broadband market, largely as a result of competition provide by non-incumbent ultrafast networks.

Changing the way in which the existing regulatory framework might apply in an ultrafast broadband context could take several forms, each of which is derived from observations made earlier in the report:

- The delineation on a sub-national geographic ultrafast market, often on a very localised basis, with a focus on the number of network choices available to households in a particular area. This is an approach which national regulators such as Ofcom have already adopted in defining sub-national geographic markets for the former Market 5 (bitstream) market. The evidence presented in this report suggests that this should become more the norm than the exception when analysing broadband competition.

- Sensitivity to the differences in customer segments within the same geographic area. We have found, for example, that Swedish householders in MDUs face significantly greater competitive choices than those living in ‘Single Dwelling Units’ (or SDUs). Moreover, the way in which ultrafast services are bought and sold may differ between MDUs (where services may be bought on a collective tender process and where the consumer and the purchaser differ) and SDUs (where services are offered at standard prices and where the consumer and purchaser are one and the same). These differences have often led national regulators to distinguish between ‘business’ and ‘consumer’ markets or segments in the past, but other forms of segmentation are likely to be relevant to ultrafast market assessments.

- As already noted, identification of a separate ‘ultrafast’ broadband market in which firms with FTTH/B and cable networks participate, and from which DSL and VDSL services would be excluded. Participation in this market would be assessed not just by reference to speeds actually provided today, but also to the ‘option value’ such networks could offer for the future, as reflected in the ‘lifetime revenues’ the network provider can expect to earn from the customer (as opposed to current prices).

In those areas where ultrafast services are offered by a vertically integrated FTTH/B provider, or by a vertically integrated cable operator, the likely result of
these modifications would be a finding of single firm SMP. In some markets, such as Sweden, the fragmentation of the industry could result in many such findings, reflecting the very granular approach that would be required to geographic market definition.

The Commission and BEREC should also explore the merits of developing a standardised, technology agnostic ‘ultrafast access remedy’ which might allow ultrafast competition at the local retail level to develop, despite being based upon wholesale products that are provided by a wide range of different local ultrafast network providers and technologies.

None of these approaches would require modification to the framework itself or the application of the SMP test within it.

6.3 Modifications to the existing regulatory framework

Alternatively, the existing regulatory framework could be modified in various ways so as to overcome or reduce some of the challenges which might otherwise arise in the application of the framework described in the previous section.

6.3.1 Tight oligopolies

One option considered by BEREC is to modify the ‘joint SMP’ threshold so as to more easily allow intervention in duopolistic broadband markets. BEREC has argued that the existing SMP framework, aligned as it is with EU competition law, limits national regulators’ ability to impose wholesale access obligations on markets which they characterise as being ‘tight oligopolies’.

Although BEREC appears to harbour concerns about developments in and the performance of mobile markets, such provisions would apply to fixed broadband markets as well.

It is beyond the scope of this report to provide a detailed analysis of ‘joint SMP’ or the implications of moving, or supplementing it with, another standard (or what that standard might be). BEREC itself recognises that there are significant practical difficulties to overcome and the proposal has attracted considerable criticism from the industry and other parties.

However, it is important to note, as we showed earlier, that the assessment of the number of households that are presented with a choice of two or more network providers in a ‘tight oligopoly’ (as opposed to monopoly) will depend critically upon whether ADSL and VDSL are considered to exercise an effective

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constraint on FTTB/H and cable. Based on estimates in Figure 15 and Figure 16, for example:

- For Norway, over 65% of households are served by a ‘tight oligopoly’ if we include VDSL, but only 22% if we exclude VDSL;
- For Denmark, the equivalent numbers are 64% and 30%.

Although the results will differ by Member State, this suggests that the ‘tight oligopoly’ concept is likely to have greater relevance if national regulators continue to define broadband markets to include ADSL and VDSL as a competitor to FTTB/H and cable. If, national regulators were instead to take a more granular approach to market definition and to exclude ADSL and VDSL from the ultrafast market, then the application of the ‘tight oligopoly’ test would likely assume much less significance in a number of member states in future. ‘Tight oligopoly’ could therefore be relevant if national regulators continue to regard ADSL and VDSL as ultrafast competitors, but much less relevant if they do not.

6.3.2 Symmetric regulation

Another option is to pursue a concept that is often associated with the French regulatory approach, and to which reference has been made earlier in this report, and apply ‘symmetric’ access obligations to all firms of a particular kind, without requiring the kind of detailed market analysis which the existing framework generally envisages. This approach has also been advocated recently by the Nordic regulators.

The French approach has been interpreted as an extension of regulation to ‘every firm’ in order to constrain monopoly power. We consider however that it can be interpreted pro-competitively, as an effort to establish a set of conditions under which SMP can be minimised to the part of the supply chain that is genuinely a natural monopoly, and competition therefore extended to the maximum possible extent.

The French regulatory framework for NGA is based on a twofold approach:

- A symmetric obligation to provide access to the last part of the fibre network that applies to any first-to-building fibre operator. The scope of the obligation differs depending on population density.
- An asymmetric obligation, i.e. an SMP obligation imposed on FT to grant access to ducts and poles (see Figure 19 below).

Therefore, the French regulatory framework implies competition between networks on the ‘trunk side’ of the aggregation point, whilst the network on the ‘distribution side’ is regarded as a monopoly input that is available to all parties to use and which will (outside areas of competition with cable) not be duplicated.

Figure 19. The French NGA regulatory framework

The French approach can be interpreted as an attempt to extend this model of MDU competition (which appears to work well in the markets we have studied) to SDUs. Since there is no obvious aggregation point for SDUs in the way that there is for an MDU, and since the degree to which demand needs to be aggregated in order for network competition to be viable may vary between regions and within regions, the French regulator has had to intervene in order to define how the networks will be built and where the aggregation points are to be placed. This differs depending on the density of the housing and other factors. The French national regulator has determined, for example, that in areas with lower density of housing, the aggregation point must serve at least 1000 households if there is no existing backhaul available, and at least 300 households if backhaul is provided. These decisions followed lengthy and detailed analysis and collaboration between the national regulator and industry participants.* Having established these aggregation points, the French national regulator anticipates that there will be competition amongst network operators to connect to these, and that there will be a single, regulated monopoly (“first-to-the-building”) provider of the connection between the aggregation point and the individual SDUs. Since different operators are expected to provide the connection from the aggregation point to individual SDUs in different areas, the resulting regulatory approach is often referred to as being ‘symmetric’.

* It is beyond the scope of this report to consider whether the decisions taken by the French national regulator are correct. In any event different requirements would be appropriate in other Member States.
Importantly, ‘symmetric’ regulation in this context is not simply a matter of replacing an SMP test with regulated access to ‘every’ network. As applied in France, it can be seen as a more sophisticated attempt to extend competition into the SDU market and to define the boundaries of both competition and regulation. It is, of course, also quite complex and requires the regulator to make decisions (most critically the location of the ‘aggregation point’) which have a profound effect on the architecture of the networks which the operators then deploy, and which shape the prospects for competition thereafter.

The rationale for considering symmetric regulation

There seem to be two main reasons for which regulators may wish to consider some form of symmetric regulation. First, it may be that as a question of principle/approach, they may take a view similar to the one taken by the French regulator:

‘Unlike the copper network, which was already installed when it was opened to competition through unbundling, the fibre network architecture is an ex ante regulatory issue. The operator deploying the fibre network could indeed be tempted to make choices regarding the architecture that could limit the possibilities for the competitors to provide end users with electronic communications services. These choices happen to be generally non-reversible at a reasonable cost, particularly in less dense areas. It is therefore essential that ex ante regulation can control them’  

Secondly, some regulators may be attracted to the ‘symmetric’ approach because it may avoid the challenges which might otherwise arise with the application of the existing framework, whether in current or modified form.

In previous sections, we have explained how the localised and complex nature of ultrafast competition means that national regulators will require significantly more detailed information and analysis about competitive conditions in ultrafast markets. ‘Symmetric’ regulation could do away with some of these requirements by seeking to apply a ‘general’ rule: any network which controls a ‘terminating bottleneck’ to an MDU or collection of SDUs would be required to provide access to the bottleneck, likely on some regulated terms.


51 National regulators would also need to determine the critical number of networks needed (on the ‘trunk side’ of the aggregation point) for that part of the market to be de-regulated. For example, Ofcom has de-regulated exchange areas where there are three of more principle operators present (http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/summary/WBA_July_2013.pdf)
Whilst the application of a general ‘rule’ may be seen as attractive, in practice it would be unlikely to wholly avoid complexity. For example, should these provisions apply to cable networks or only to FTTH/B?\(^{52}\)

In other Member States where networks have already developed without the involvement of the national regulator, the question of how to superimpose symmetric regulation on the resulting networks will be challenging. Not only will regulators have to decide which networks have access obligations, but they will have to determine the conditions under which they are required to offer access. For example, should a network provide access to facilities which have been duplicated by another network, if they are part of a larger network which also includes ‘terminating bottleneck’ elements? It is also unlikely that the ‘bottleneck’ elements of an existing ultrafast network will perfectly map on to the ‘handover points’ implied by the existing network architecture, and so regulators will need to decide when and whether to alter the ‘handover point’ and when to accept that some potentially competitive components of the network may nonetheless fall within the scope of the access obligation.\(^{53}\) Getting this right will be important if ‘symmetric’ regulation is not otherwise to lead to an inappropriate extension of access regulation, with potentially adverse effects for competition and investment.

On balance, it would seem that the ‘symmetric approach’ merits consideration by the Commission and other national regulators, as a way to extend the prospects for competition for SDUs (rather than a way of avoiding the challenges presented by the existing framework’s requirement for market analysis and a finding of SMP). Applying ‘symmetric’ rules will likely be challenging in practice and will require, in particular, careful consideration of how ‘aggregation points’ are to be defined, both in cases where FTTH/B deployment has yet to be undertaken (ex ante) and in case where it has (ex post).

Finally, another issue to consider is the technical aspects of such access (we consider some of the related issues in Annex 2), and the possibility and merits of developing a ‘technology agnostic’ UFBB VULA type access product given the diversity of technologies/architectures used for UFBB deployment.

6.3.3 Reciprocal access and other commercial arrangements

Ultrafast FTTH/B and cable networks may often be deployed so as not to overlap directly with each other and many will be controlled by different owners.

\(^{52}\) In the French case, it appears the latter is the case. The regulator has effectively ‘architected’ the fibre networks to align them with the regulatory analysis, whereas existing cable networks may not operate with the same kinds of aggregation points.

\(^{53}\) This will likely require the development of detailed criteria which will need to take into account differences between networks, and differences in the competitive conditions faced by the same networks under different conditions.
These characteristics of the ultrafast broadband market – which distinguish it from the traditional DSL market - may give rise to new opportunities for regulators to promote greater competition through the establishment of reciprocal access arrangements between the firms, rather than by regulating access to these firms’ networks directly. Given some of the challenges of applying regulation that were outlined in the previous section, this may be attractive, under certain circumstances.

These opportunities might arise, for example, if local FTTH/B providers sought to extend their retail propositions to serve customers outside of their existing network footprint, and were either unwilling to engage in acquisition of other networks in order to do so, or unwilling to build a new network in order to compete with rival networks in those other areas. Under these conditions, the local FTTH/B providers may have incentives to instead pursue reciprocal access arrangements with each other, with each granting the other access to wholesale services and allowing the other to compete in the downstream market as a result.

We have found some evidence that ultrafast markets may be more conducive to such voluntary or commercial wholesale arrangements than we have seen in the past with copper-based DSL competition – as the former are more akin to two-way access arrangements, and the latter to one-way access. A vertically integrated incumbent controlling a network which already allows them to address the entire market may (under certain conditions) have a limited unilateral incentive to grant access to third parties under attractive commercial terms, which is why European regulators have invariably imposed wholesale access obligations upon them. In a situation where local UFBB access providers can offer access to their own local network in exchange for obtaining access to another UFBB provider’s local network, there are stronger incentives for both locally focused UFBB providers to reach a bilateral access arrangement.

These incentives may strengthen further in future, particularly if firms have reciprocal requirements for access. We noted earlier in this report that TDC has sought access to the Trefor network in order to resell another operator’s network – something we have not generally seen before54. In Portugal, Vodafone and Portugal Telecom have each built FTTH/B networks in different parts of the country and have then entered into what we understand to be reciprocal arrangements for each to provide access to the other’s network55. We understand that similar arrangements apply between Vodafone and Telefonica in Spain and exist in some Central and Eastern European markets too56.

55  See Vodafone’s response to Ofcom’s DCR.
56  Ibid
Other versions of commercial arrangements in which parties share access are also possible under ultrafast network deployments, although we have seen few actual examples to date. The European Commission has itself shown considerable interest in the concept of ‘co-investment’, which can involve either ex ante agreement to share the costs of the initial network deployment (as between Orange and Vodafone in Spain) or ex post agreement for the access seeker to contribute to the capital costs of the investment that has already been made, either in return for access, in return for an equity interest in the venture, or both (as with KPN/Reggefiber in the Netherlands\footnote{See Hesseling and Vermeulen (2011) “Access to networks through competition law: the case of KPN – Reggefiber”, Network Industries Quarterly}).

The emergence of such commercial arrangements could lead to the emergence of bilateral access terms that may not be consistent with a competitive market outcome, either because the access terms are not consistent with a competitive outcome, or because the arrangements could raise exclusionary effect risks. Such emergence does not therefore necessarily obviate the need for regulatory intervention.

In relation to the first concern, national regulators in Europe have long experience of overseeing other kinds of reciprocal access arrangements, such as call termination services or wholesale international roaming. In roaming, for example, the issues raised in the previous paragraph have arisen in relation to differences in the wholesale terms that may be offered to MVNOs (who buy wholesale services but do not themselves sell) and foreign network operators willing to engage in two-way access arrangements. In those cases, it was also claimed that operators engaged in two way access agreements had incentives to set reciprocal wholesale charges to each other at excessive levels, even if they were still competing away profits in the downstream retail markets. Similar outcomes could potentially arise in relation to two-way agreements for wholesale access to ultrafast networks, although we have no information on any of the arrangements referred to above to be able to take a view on their merits at this stage.

Reciprocal agreements between two parties may also have exclusionary effects. If such arrangements emerge, one important issue for regulators will be whether (and on what basis) third parties who do not have their own networks and so do not have ‘access’ to trade would nonetheless be granted wholesale access to these other networks.

In summary, commercial reciprocal arrangements would provide useful information to regulators about market demand for access products. Whilst they may raise competition concerns, regulators should consider whether such competition concerns are sufficiently severe to warrant early or premature...
intervention to ‘control’ such arrangements, which could in practice ‘crowd out’ the opportunities for such arrangements to emerge\textsuperscript{58} in the first place.

### 6.4 Issues relating to the remedies then applied to ensure competition in ultrafast markets

One of the challenges in developing regulatory access remedies for ultrafast networks is that any remedy is likely to need to apply to a much wider variety of firms, each operating different networks which employ different network architectures and technologies, rather than applying to a single, national copper network that falls under the control of a single incumbent operator. This will raise important questions such as:

- Should different access remedies apply to different access providers or technologies? (or, as noted above, to different purchasers of those access products\textsuperscript{59}\textsuperscript{[two-way vs. one-way]})

- To what extent should national regulators be constrained by existing network architecture and to what extent can or should they require operators to re-engineer their networks to alleviate competition concerns or to redefine the boundary between the network monopoly and competitive areas? How would any costs of such re-engineering be recovered?

- How do national regulators approach access remedies which may apply to a small sub-set of the network in question (which otherwise faces effective competition)? Is it proportionate to require the provision of wholesale access services on a highly granular basis?

We note that BEREC has already undertaken significant work on questions about the nature of the ‘terminating access’ products\textsuperscript{59}\textsuperscript{10} and expect that these questions should be capable of being resolved. An important issue raised by ultrafast network deployment, and one which appears to have received less attention from national regulators and the Commission to date, remains the question of defining the point at which the ‘last mile’ or ‘terminating segment’ actually starts (or finishes).

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\textsuperscript{58} ETNO has argued, for example, that the conclusion of commercial access arrangements between parties on a voluntary basis ought to provide the basis for the withdrawal of regulated terms under its ‘indispensable input’ proposals.

We have already noted that the location of the aggregation point is likely to determine both the scope of wholesale access regulation beyond that point, and the prospects for ultrafast network competition on the trunk side of the aggregation point. In the existing List of Relevant Markets, the Commission distinguishes between ‘local’ and ‘central’ handover points but does not provide any specific guidance in the accompanying explanatory documents as to how these points are to be defined.

It is beyond the scope of this project to undertake the kind of detailed analysis which has been undertaken by the French national regulator, to determine the ‘handover’ points in areas with differing housing densities or other relevant features. A simple ‘high density/low density’ distinction might be appropriate, but equally it may be that national regulators will need to develop many categories and define a large number of different handover points to suit different conditions and different networks. It is, however, likely to be the case that the Commission’s current distinction between ‘Local Access’ and ‘Central Access’ will not be sufficient to address the challenge presented by ultrafast network deployment. It therefore seems desirable that the Commission or BEREC develop more precise views on the nature and location of ‘aggregation’ or ‘handover’ points in ultrafast networks as a matter of some urgency.

6.5 Summary of recommendations

We have examined in this report the implications for regulatory policy of the evolution of UFBB networks based on an analysis of such evolution in Sweden, Norway, Denmark, Hungary and Bulgaria. In summary, and in relation to markets that are expected to depict the characteristics that we have found in the markets we have analysed, we would recommend that:

- The Commission/NRAs revisit the data required to properly assess the evolution of competition in SFBB/UFBB markets, including sub-national data on the choices faced by householders. They should consider market research approaches, that take into account recent advances in understanding of consumer behaviour, to evaluate the impact of non-price factors on switching decisions (including ‘option value’). They should also place more emphasis on the prospective analysis of competition, taking into account the evidence on the speed of transition to ultrafast networks.

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61 We are not aware of a similar exercise having been undertaken by another regulatory authority.
62 See Annex 2 for more details.
As part of the current review of the Telecoms Regulatory Framework, the Commission investigate how a ‘symmetric approach’ could be applied to existing ultrafast networks as well as to greenfield deployments. This will require defining the conditions under which a firm would be obliged to provide access to its network and the boundary at which that access was to be supplied.\footnote{National regulators would also need to assess the impact of such intervention on the incentives to invest in new networks (e.g. to continue to roll out fibre).}

The Commission should revisit the DSL-based distinction between ‘Local Access’ and ‘Central Access’ in the existing List of Relevant Markets and consider instead how national regulators might define a new set of ‘handover points’ to support the application of ‘symmetric’ remedies to different geotypes. The Commission should also consider whether segmentation between MDUs and SDUs may be required when analysing ultrafast markets.

The Commission should continue to examine both the opportunities and risks that might arise from ‘two way’ commercial access arrangements and measures that might both promote the emergence of such agreements, whilst safeguarding competition.
Annex 1: coverage overlaps – our detailed calculations

The purpose of this annex is to provide more details on the sources of information and the assumptions we made to estimate the degree of overlaps between different NGA technologies (VDSL, cable and fibre in Telenor’s countries of operation (Sweden, Norway, Denmark, Hungary and Bulgaria).

Data sources

We use the European Commission data on coverage by technology and on total NGA coverage by country.

Table 1. Coverage by technology

<table>
<thead>
<tr>
<th></th>
<th>Sweden</th>
<th>Norway</th>
<th>Denmark</th>
<th>Bulgaria</th>
<th>Hungary</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADSL</td>
<td>99%</td>
<td>94%</td>
<td>99%</td>
<td>95%</td>
<td>94%</td>
</tr>
<tr>
<td>VDSL</td>
<td>18%</td>
<td>47%</td>
<td>66%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Fibre</td>
<td>57%</td>
<td>41%</td>
<td>52%</td>
<td>57%</td>
<td>21%</td>
</tr>
<tr>
<td>Cable</td>
<td>34%</td>
<td>50%</td>
<td>63%</td>
<td>16%</td>
<td>60%</td>
</tr>
<tr>
<td>Total NGA</td>
<td>69%(^{64})</td>
<td>82%</td>
<td>92%</td>
<td>69%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Source: the EC, Broadband coverage in Europe

Table 1 suggests that there are overlaps between technologies (as the sum of coverage by technologies is greater than the total NGA coverage), but we were unable to find any external data on the degree of overlaps between these technologies.

Below we explain our methodology for estimating these overlaps.

Our methodology

For each country, we effectively attempt to solve a system of equations:

\[
V = v + vc + vf + vf c
\]

\[
C = c + vc + cf + vf c
\]

\[
F = f + vf + cf + vf c
\]

\(^{64}\) The total NGA number for Sweden in the EC document is 76%. However, we understand that 7% is provided by LTE. Given that LTE is in general not considered to be a substitute for cable and fibre. We do not consider LTE coverage is part of NGA coverage.
NGA = v + f + c + vc + vf + cf + vfc

where

- V, C and F stand for total coverage by technology (VDSL, cable and fibre);
- v, c and f – stand for areas covered by VDSL, cable and fibre where there are no overlaps with other technologies;
- vc – stands for the overlap of VDSL and cable;
- vf – the overlap of VDSL, and fibre;
- cf – cable and fibre;
- vfc – stands for overlap between all three technologies;
- NGA stands for total NGA coverage.

Overall, we have 4 equations and 7 unknowns. This does not allow us to solve this system in a unique way. We rely on other information we have acquired about each market, to make some plausible assumptions about some of these unknowns, and find solutions for the remaining ones. This is illustrated below.

Sweden

We understand that in Sweden VDSL is not prevalent (just 18% coverage) and primarily deployed in urban areas where both cable and fibre are likely to be present (for example, alternative fibre networks have overbuilt Telia’s VDSL). We assume that vfc = 16%.

We also assume that vf = 0% and vc = 0% (i.e. VDSL was not deployed in pure fibre areas or pure cable areas). These two assumptions are not unreasonable, given that vf and vc cannot jointly exceed 2% (vf+vc <V−vfc =18% - 16% = 2%).

Taking these assumptions as given, we find that v=2%; f=33%; c=10% and cf=8%. That is a third of the country is covered by fibre only; 10% of the country by cable only, 8% by both cable and fibre and 16% - by all three technologies.

Overall, this means that:

- 67% of the population have a choice of technology if NGA and ADSL/VDSL are considered to be in the same market65 (the remaining 25% have ADSL only);

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65 This is calculated as total NGA coverage minus areas with VDSL only: 69%−2% = 67%
this falls to 24% if ADSL/VDSL are excluded\textsuperscript{66}.

While only 24% have a choice of technology, it appears that a larger proportion of the Swedish population benefits from competition (some of it may be intra-platform competition).

For example, we understand from Telenor that 2m households out of 4.5m live in MDUs where there is competition (either between fibre and cable, or between 2 fibre providers). This is equivalent to 44% of the population. Therefore, at least 44% of population in Sweden is likely to have competition from 2 NGA providers (other than VDSL). The remaining 56% have one provider or no NGA providers at all.

\textbf{Norway}

As in Sweden, we expect that in Norway all three NGA technologies serve the MDU market. We assume vfc = 15\% (i.e. for 15\% of population all three technologies overlap - this is roughly equivalent to the population of MDUs, where competition is more intense).

We also understand that in Norway, unlike in Sweden, there is an overlap between cable and VDSL. For example, Telenor’s VDSL network overlaps with cable networks, but does not have significant overlaps with other operators’ fibre. We assume that vc = 20\% and vf = 0\%.

These assumptions allow us to find the remaining variables, fc = 7\%; f = 19\%; c = 8\% and v = 12\%.

This means that:

\begin{itemize}
  \item 70\% have a choice of more than one network if ADSL/VDSL are included in the same market (NGA – v: 82\% - 12\% = 70\%);
  \item but only 22\% have a choice of networks if ADSL/VDSL are excluded (vfc+fc: 15\% +7\%);
\end{itemize}

Unlike in Sweden, intra-platform competition does not appear to be prevalent in Norway, i.e. pure fibre areas are likely to be served by non-overlapping fibre networks; the same seems to be true for pure cable areas. Therefore, in Norway, only 22\% of population benefit from NGA competition (if copper-based technologies are excluded).

\textsuperscript{66} This is calculated as vfc + cf: 16\% + 8\% = 24\%
Denmark

In Denmark, given that coverage for each individual technology is high, the overlaps between technologies are also high. We assume that the overlap between all three technologies (vfc) is 20%, and the overlaps between cable and VDSL (vc), and fibre and VDSL (vf) is similar 16-17%.

These assumptions allow us to find the remaining ‘unknowns’: c = 12%, v = 13%, f = 0%; fc= 15%.

We estimate that:

- 79% have a choice of more than one technology if ADSL/ VDSL is included (NGA – v: 92% - 13%);
- This is reduced to 35% if ADSL/VDSL is excluded.

While a large proportion of population have a choice of broadband technology in Denmark, the intensity of competition is likely to be weaker than these numbers might suggest. This is because the incumbent (TDC) has deployed/acquired all three types of networks: copper, cable and fibre. Hence, some overlaps between technologies do not constitute genuine competition. In particular, we estimate that at least 5 percentage points in vfc areas is controlled by TDC (TDC’s fibre network overlaps with VDSL and cable).

Therefore, in terms of the number of distinct competitors, it is likely that only 30% of the Danish population have a choice of more than one competitor (if ADSL/VDSL services are excluded).

Bulgaria

In Bulgaria there appears to be no VDSL deployed, just fibre and cable. This allows us to the fine the unique solution: fc = 4%, c = 12% and f = 53%.

Although this solution is unique, we do not attempt to estimate the number of competitors in Bulgaria. There appears to be some anecdotal evidence that there may be a significant degree of competition in pure fibre areas (intra-platform competition). However, the existing evidence does not allow us to quantify it.

Hungary

In Hungary, as in Denmark, there is a significant degree of overlap between technologies. We assume that VDSL primarily overlap with cable, but not with fibre. Hence, vf = 0%, vfc = 0%. We also assume that there is a degree od overlap between cable and fibre fc = 10%.

Then the remaining variables are c = 10%, f = 11%, v = 10%, vc = 40%.

As in Bulgaria, there is some anecdotal evidence that cable areas in Hungary are competitive. But there is not enough data to provide a more precise estimate.
Therefore, we do not attempt to estimate the proportion of population that have only one provider for Hungary.

**Sensitivity analysis**

In this section, we carry out sensitivity analysis with respect to our assumptions for Sweden and Norway. We demonstrate that flexing these assumptions does not fundamentally change our results. The sensitivity analysis is available for the other markets and can be provided upon request.

- **In Sweden,** our main assumptions are $v_f c = 16\%, v_f = 0\%$ and $v_c = 0\%$.
  
  Suppose these are replaced with a different set of assumptions: $v_f c = 5\%$, $v_f = 6\%$ and $v_c = 6\%$ (i.e. VDSL is more equally distributed across fibre and cable areas rather than being concentrated in the most urban areas). The impact of these alternative assumptions on our findings is minimal:

  - 68% of the population have a choice of technology if NGA and ADSL/VDSL are considered in the same market (vs. 67% before);
  - this falls to 23% if ADSL/VDSL are excluded (vs. 24% before).

  We find no set of assumptions for Sweden, which would change our results significantly as VDSL coverage is relatively low (18%). This, to a significant extent, constraints plausible ranges for a number of variables ($v_f$, $v_c$, $v$).

- **In Norway,** the assumptions can be flexed more widely. For example, we replace our assumptions of $v_f c = 15\%, v_c = 20\%$ and $v_f = 0\%$, with an alternative set of assumptions $v_f c = 0\%$, $v_c = 24\%$ and $v_f = 20\%$. Under these alternative assumptions, the other variables are $f c = 12\%; f = 9\%; c = 14\%$ and $v = 3\%$.

  The implications for competition are as follows:

  - 79% have a choice of more than one network if ADSL/VDSL are included (vs. 70%);
  - but only 12% have a choice of networks if ADSL/VDSL are excluded (vs. 22%).

  These alternative assumptions do not change our high-level prediction that NGA competition is much weaker if ADSL/VDSL technologies are excluded (only 12% of population have a choice of more than one technology if only fibre and cable are included (vs. 79% if copper-based technologies are considered to be part of the same market).

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67 $v_f c$ by definition cannot be higher than 18% as $V=18\%$
Annex 2: technical characteristics of wholesale access remedies

It is beyond the scope of this report to consider the technical characteristics and relative merits of the various wholesale access remedies that might be provided over DOCSIS, GPON or P2P networks. Our understanding is that significant issues arise in relation to the question of whether wholesale access products provided by cable networks should, or should not, include the capacity to multicast TV services in addition to providing access to a ‘data only’ point to point ultrafast broadband capability. We understand, for example, that the former would require the development of additional functionality in the DOCSIS standards, whereas the latter would not. The issue is made more difficult still by the fact that household demand for broadcast TV services is changing rapidly in a number of markets (as ‘cord cutting’ accelerates). As actual cable wholesale access products begin to be deployed in Europe – in Denmark and Belgium today and perhaps Hungary in future – then these issues may also be addressed. The resolution of such issues is likely to take time, and the Commission/National Regulators may therefore need to consider measures to support their resolution within a reasonable timeframe.

Similar issues arise in relation to FTTH/B wholesale access products, where WDM over GPON standards allow for new forms of ‘wavelength unbundling’ and new wholesale products. Again, the wholesale market for access over fibre in Europe remains relatively underdeveloped (with some P2P dark fibre provision to Swedish MDUs but minimal wholesale activity in most of the other markets we have considered) and there remain open questions here too, both about the requirements of buyers and the technical options available to sellers.
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In this report we used:

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