WIK-Consult • Report

Study for Open Fiber

Benefits of the wholesale only model for fibre deployment in Italy

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Executive summary

What are wholesale only networks?

"Wholesale only" refers to a business model in which a telecoms network operator focuses its activities at the wholesale level, and does not sell broadband services directly to the mass-market.[1]

Wholesale only has been pursued primarily by non-telecom operators such as utility companies and municipalities The entry of new investors such as these has been a key driver of FTTH deployment in Europe. "Neutral" telecom networks have also been deployed or supported in some cases by infrastructure investors, alongside investments in tower companies and other enabling infrastructure.

Wholesale only models are required in the context of the Broadband State Aid Guidelines when state aid is granted to support infrastructure improvements in so-called "black" areas,[2] as a means of demonstrating that the new network will provide significant improvements in openness as well as quality, compared with the existing networks.

The EU Electronic Communications Code (hereafter Code) also recognises that some competition risks may be lower from companies pursuing genuine wholesale only business models than may be the case for vertically integrated providers.[3] It thus envisages lighter touch regulation for wholesale only providers which are found to have significant market power.[4]

The Code also recognises that co-investment can play a role in supporting competing VHC broadband services, especially in areas where it is not viable to duplicate fibre networks. However, in the context of the Code, co-investment by operators with significant market power is considered to warrant full regulatory forbearance, only under very specific conditions.[5] Moreover, WIK found in a study[6] which compared outcomes between cities which benefited from wholesale only networks and those which did not – that there was a greater diversity of offers in the city featuring a wholesale only passive

1 A wholesale only operator may nonetheless sell services to large business users (i.e. those larger than SME). – see EECC recital 208.
2 Paragraph 84 Broadband Guidelines, downloadable at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF.
3 EECC Recital 208.
4 In contrast with the obligations applicable on vertically integrated firms, additional obligations to those envisaged under the light touch rules, are possible under the EECC only if competition problems to the detriment of end-users are found or considered likely.
5 See article 76.
6 WIK (2017): A tale of 5 cities, downloadable at: https://www.stokab.se/download/18.52d820ca1732323a3ca4eb/1594711942698/A%20tale%20of%20five%20cities:%20The%20implications%20of%20broadband%20business%20models%20on%20choice,%20price%20and%20quality%20(2017),%20WIK-Consult.pdf.

network than in those which were characterised by competition between vertically integrated operators.

How does wholesale only differ from separation models pursued by some incumbent operators?

A number of incumbent operators in Europe have sought to separate their wholesale from their retail divisions in order to increase shareholder value or respond to pressure from the National Regulatory Authority to address concerns over discrimination. Approaches range from the functional separation initially pursued by BT in the UK and TIM to structural and legal separation pursued by operators such as CETIN/O2 in the Czech Republic[7] and TDC in Denmark.[8]

While such separation by incumbents may have been positively received by long-term investors, as explained in a WIK (2016) study for the European Commission,[9] this approach does not create the same incentives for investment in FTTH or support for competition as are provided by independent companies pursuing a wholesale only model.

One key difference is that wholesale only operators do not own legacy infrastructure, and thus their primary goal is to invest in the latest technologies, whereas incumbents with a legacy of largely depreciated copper networks may (in the absence of impetus from infrastructure competition) have incentives to maintain the cashflows of their historic networks and delay investments into new technologies which could cannibalise these revenues. Wholesale only operators can also be designed so as to maximise operational efficiency, as they lack ownership of the historic network and its associated legacy operational systems and workforce. As discussed below, wholesale only companies also attract long-term investors, in contrast with vertically integrated firms or groups, whose investment horizons may be shorter, making long-term investments in technologies such as fibre, more challenging.

Wholesale only operators which meet the definition set out in the EECC also do not own or have a preferential relationship with any retail service provider and therefore have incentives to maximise the uptake on their network without engaging in discriminatory conduct between different service providers. On the other hand, even if they are legally separated, an incumbent which lies under the same corporate ownership as a retail service provider, may still face pressure to prefer the service provider which lies within

7 See https://www.ppf.eu/en/case-studies/telefonica-o2-czech-republic-and-its-uniquevoluntary-division.

8 See https://tdcgroup.com/en/investor-relations/announcement-list/2019/6/tdc-completed-partial-demerger-3616939.

9 WIK, IDATE, Deloitte (2016) Regulatory, in particular access, regimes for network investment in Europe. Available at: https://op.europa.eu/en/publication-detail/-/publication/c0da75d9-9a8c-11e6-9bca-01aa75ed71a1.

the same group, and requires strong and ongoing supervisory measures to avoid such conduct.

The expansion of the wholesale only business model in Europe

Wholesale only models are expanding across Europe. Swedish municipalities were amongst the first to pursue this model to deploy FTTH in the late 1990s. Since 2015/16 there has been a resurgence in wholesale only deployments. Utility-backed new entrants within this period include Open Fiber in Italy, SIRO in Ireland and Fluvius in Flanders, Belgium. This period has also seen the expansion of Cityfibre in the UK, and the launch of wholesale only rural initiatives in Austria. It is also notable that wholesale only business models are also playing an important role in the deployment of fibre in countries such as France, Portugal, Spain and Switzerland which have mostly been associated with infrastructure-based competition and co-investment.[10]

Some incumbents in Europe have also moved towards a network separation model, including those in the UK, Czech Republic and Denmark, and the incumbent in New Zealand successfully moved towards a wholesale only model with a focus on fibre deployment, to meet requirements imposed in the context of State Aid.

The wholesale only operator Open Fiber has been responsible for the majority of FTTH deployments in Italy. As of September 2020, Open Fiber had reached more than 9,5m premises, including more than 3m households in rural areas. Open Fiber is the largest wholesale only operator in Europe and its deployment of FTTH infrastructure is one of the most extensive in the region.

Open Fiber has signed agreements with a range of telecommunication operators. These include the largest alternative operators in Italy: Vodafone, Fastweb, Tiscali and Wind, as well as to SKY, the main pay-TV broadcaster in Italy. Open Fiber also provides access to other operators in the entertainment sector and companies providing services in fields such as energy and e-learning.

The role of open fibre in fixed and mobile applications of the future

Demand models developed by WIK and applied in countries such as the UK, Germany and Belgium suggest that, if demand is not constrained by the lack of high bandwidth infrastructure, by 2025 a high proportion of consumers and small businesses are likely to require downstream bandwidths of 1Gbit/s or more and upstream bandwidths of 600Mbit/s or more, along with lower latencies. Demand is likely to be driven not only by higher quality video, but by growing reliance on cloud services, the proliferation of

10 Wholesale only models are prevalent in rural deployments in France and Portugal, while commercial wholesale only initiatives have recently been launched in Spain and Switzerland.

devices, eEducation and eHealth, and the evolution of applications using augmented or virtual reality. These requirements are likely to necessitate fibre in or very close to the building.

As of 2018, only around 20% of enterprises in Italy were making use of cloud computing services, and only 7% of enterprises were analyzing "big data". One of the factors (although not the only factor) contributing to Italy's lagging performance in business ICT use may be the very low levels of Italian businesses which had a fast fixed broadband connection of more than 30Mbit/s (only 37% in 2019).

Fibre is needed not only for fixed connections to households and businesses, but to provide the backbone for the 5G mobile networks of the future. WIK research suggests that an increasing proportion of mobile base stations will need to be connected to fibre (up to 90%), and further fibre connectivity will be required when small cells are deployed.

An open fibre network provider has an incentive to give commercial access to all mobile network operators without discrimination, whereas an integrated operator that builds fibre networks as well as providing mobile services may favour its own sites over its competitors. Thus, as noted in a 2018 report by WIK,[11] open fibre networks could potentially strengthen competition in the mobile market.

Trials and early use cases in Italy show how fibre could support digitisation of industry and public services:

- In Bari, Open Fiber's network will be used to provide connectivity for traffic lights, video surveillance and street lighting, as well as to increase the speed and effectiveness of repairs. In total, 15.000 lights will be connected to the network.

- Under Turin's "Smart Road" project, autonomous and remote control vehicles will be tested, using 5G and fibre connectivity. This "Smart Road" project also includes traffic detection systems, smart cameras and digitized road signs, to facilitate the capabilities of autonomous driving.

- A field experiment in Sardinia involving an audiovisual connection from a rural clinic to a bigger hospital enabled rural patients to benefit from the expert opinion of a heart specialist.

- A trial for "5G cities" is being conducted from 2017 to 2020 by Open Fiber and Wind Tre in Prato and L'Aquila. A multitude of use cases are set to be trialled in these cities, including constant smart monitoring of buildings for earthquake prevention. being one of them.

11 See https://www.stokab.se/Documents/Nyheter%20bilagor/The%20role%20of%20wholesale%20only_WIK.pdf.

Remotely provided healthcare and education, supported by high bandwidth connections, may play a vital role in supporting Italy's society and economy though the period of turmoil and uncertainty created by the Coronavirus crisis.

Open fibre networks can permit a variety of service providers to innovate in smart applications on top of the infrastructure.

Environmental benefits of fibre and digitisation

A number of studies confirm that fibre access networks are significantly more energy efficient than legacy copper or coax networks, and thus produce less carbon dioxide in proportion to the data transmitted. For example, a 2014 study by Aleksic and Lovric found that deployment of all FTTH/B infrastructure could lead to 88% less greenhouse gas emission per bit in Europe than using copper and coax infrastructure. A survey among ETNO members also found that between 2010 to 2018, due to increasing use of fibre, emissions were reduced by 40%, despite an increase in increase of 1,100%.

A 2018 study by Carbon Smart also assessed the environmental implications of deploying fibre, thereby assessing the environmental impact over the full lifecycle of the network. The authors noted that extracting the 2kg copper ore needed to produce a 200-foot length of copper wire would produce around 1,000 kgCO2e, while creating the equivalent length of fibre optic cabling would produce just 0.06 kgCO2e.

The study also concluded that the adoption of data dependent ICT-enabled solutions has the potential to reduce global emissions by 16.5% per annum by 2020. Examples cited include the potential for increased teleworking to reduce traffic, energy efficiency through smart metre use, the use of telemedicine to replace physical appointments and reductions in congestion due to autonomous cars. Further evidence of the importance of fibre in supporting home working and facilitating environmental goals comes from the experience of the Coronavirus lockdown. Following the lockdown on 9 March, nitrogen dioxide (NO2) levels in Milan and other parts of northern Italy fell by about 40%. Columbia University also identified a 5-10 per cent decline in emission of the greenhouse has CO2 in Northern Italy, as traffic levels fell by 35%.

A positive model for infrastructure investors

Theoretical business models developed by WIK-Consult illustrate how, given certain conditions, wholesale only business models can improve the business case for FTTH deployment, compared with vertically integrated approaches, enabling the expansion of

the number of areas which can be commercially served, and reducing the overall need for subsidies.[12]

A number of investors have also highlighted the attractions of specialist fibre infrastructure businesses in offering an essential service with predictable cashflows. Specifically, while the provision of retail fixed and mobile telecom services and other services offered via the connection such as content, IOT are subject to fluctuating demand, competition from various sources and relatively short lifecycles, the underlying infrastructure displays some characteristics of an essential service, and may have a lifetime spanning several decades.

Investor interest in telecom infrastructure as a standalone investment, is exemplified by the activities of investors such as Margueritte in France and Communication Infrastructure Partners in the Netherlands,[13] as well as the acquisition by Macquarie of MasMovil's infrastructure in Spain.

The potential for stable and predictable returns and reduced risk from pure infrastructure investments has also been observed in Germany. In April 2018, Berenberg announced the launch of a "Digital Infrastructure Debt Fund" with the aim of targeting the "substantial backlog of necessary investment in Germany and other countries of Europe". The fund will focus on expanding fibre-optic networks, 5G masts and data centres in leading industrialised nations. Berenberg notes that fibre-optic projects are noteworthy for having technical and economic lifetimes of up to 50 years, and "as a result, stable cash flows and predictable returns are generated".

Steffen Leiwesmeier, Head of Financing for Digital Infrastructure at the Hamburg Commercial Bank, noted in an interview for this study that: "A concern with integrated models is that penetration can be limited, while providing access to third parties significantly reduces the investment risk." According to Leiwesmeier, the solution for the future is for everyone to focus on what they do best. "There is a need to implement a new ecosystem where at every level of the value chain, different parties may play a role."

Evidence of the success of the wholesale only model can be seen from investor interest in Open Fiber itself. On 16 September 2020, ENEL received a binding offer from Macquarie Infrastructure & Real Assets, for the acquisition of the 50% stake held by ENEL in Open Fiber.[14] The offer assumes an implicit Enterprise Value of Open Fiber between 7 and 8 billion significantly more than the investments made by CDP and ENEL, which each originally contributed around 1 billion euro to the venture.

12 See Wernick, C. et al. (2017): Ansätze zur Glasfaser-Erschließung unterversorgter Gebiete, available at: https://www.wik.org/fileadmin/Studien/2017/2017_DIHK_Studie.pdf.
13 See the WIK (2018) study on the role of wholesale only models in future networks and applications.
14 See https://www.reuters.com/article/us-open-fiber-m-a-macquarie-enel-idUSKBN2682HH.

Conclusions

Open Fiber's wholesale only approach has supported the rapid deployment of fibre to homes, businesses and schools in Italy, contributing to the doubling of fibre coverage to reach 30% in 2019. As the latest DESI Report shows, Italy's FTTH coverage increased by 6 percentage points between June 2018 and June 2019, which represents one of the highest growth rates in Europe, and is facilitating Italy's catch up with the EU average (34%) after lagging behind for many years. The wholesale only business model has also provided the prospect for significant payback to Open Fiber's initial investors, with a recent offer from Macquarie Capital implying a valuation between 7 and 8 bln for the company.

At the same time, the wholesale only model has supported choice in Gigabit broadband services, with agreements to provide access to around 130 operators in various sectors. WIK studies[15] indicate that markets which can support a diverse range of service providers, through the decision not to operate in retail markets, can better serve the diverse interests of different customer groups as well as supporting competition in future mobile networks, and facilitating the development of smart public services and industrial applications.

Evidence from the Open Fiber case and other wholesale only developments in Europe, coupled with the clear interest from financial investors in a "neutral" infrastructure business model, provide strong signals that this model could support Italy's goals to achieve a Gigabit society in these challenging times, and beyond.

15 See for example WIK (2018) The role of wholesale only models in future networks and applications https://www.stokab.se/en/stokab/this-is-stokab/reports-and-studies.html.

Contents

Figures

Tables

1 What is the wholesale only business model?

In this chapter, we describe what is meant by a "wholesale only" model in the telecom sector, compare the wholesale only model with other structural models that have been used by incumbents and alternative operators to deploy broadband infrastructure, and highlight how this business model has been reflected in EU legislation and Guidelines.

Highlights

"Wholesale only" refers to a business model in which a telecoms network operator focuses its activities at the wholesale level, and does not sell broadband services directly to the mass-market.

Wholesale only has been pursued primarily by non-telecom operators such as utility companies and municipalities. The entry of new investors such as these has been a key driver of FTTH deployment in Europe.

The EU Electronic communications Code recognises the role that wholesale only business models may play in supporting investment in very high capacity networks and retail competition through provisions which allow lighter touch regulation when wholesale only providers are found to have significant market power. More strigent obligations may be imposed only where competition problems to the detriment of end-users have been found or considered likely.

Wholesale only models are required in in the context of the Broadband State Aid Guidelines when state aid is granted to support infrastructure improvements in so-called "black" areas, as a means of demonstrating that the new network will provide significant improvements in openness as well as quality, compared with the existing networks.

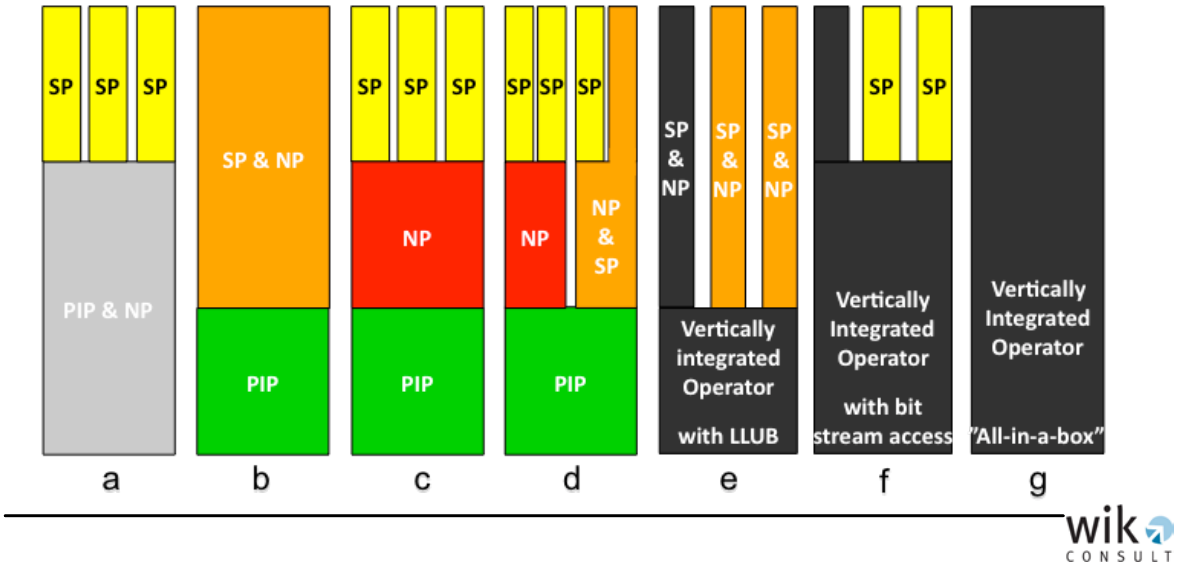
1.1 What does a wholesale only model involve?

A "wholesale only" model refers to a business model in which a telecoms network operator focuses its activities at the wholesale level, and does not sell broadband services directly to the mass-market. According to the schematic diagram developed by Forzati and Mattsson (see below),[16] wholesale only providers may focus on Passive Infrastructure only i.e. dark fibre (PIP), as shown in scenarios b-d, or may additionally offer network services including active equipment (scenario a).[17]

16 Forzati & Mattsson in Lemstra & Melody (2015) The dynamics of broadband markets in Europe – Realizing the 2020 Digital Agenda." Cambridge University Press.

17 Passive access is typically offered at a local connection point. Active access may also be offered at a local connection point e.g. in the form of virtual unbundling or locally accessed leased lines, or at a higher level of aggregation e.g. in the form of regional bitstream or leased lines.

Figure 1-1: NGA deployment models by degree of openness



Legend: LLUB – Local Loop Unbundling; NP – Network Provider; PIP - Passive Infrastructure Provider; SP – Service Provider.

Source: Forzati & Mattsson in Lemstra & Melody (2015) The dynamics of broadband markets in Europe – Realizing the 2020 Digital Agenda." Cambridge University Press.

Wholesale only operators do not act in the retail market, and – in order to meet the definition set out in the EU Electronic Communications Code[18] – should also not have exclusive ties with specific retail providers, or discriminate in favour of specific retail players. Rather a wholesale only operator acts as a neutral network provider offering services to a range of service or application providers, large and small. Under the terms of the Code, wholesale only providers may nonetheless provide services directly to large businesses.[19]

The wholesale only business model is a model that has been favoured by many non-telecoms investors in telecoms infrastructure, including utility companies (such as the ESB in Ireland, Enel Italy and Fluvius in Belgium), municipalities (including municipalities in Sweden, and formerly the Netherlands), and building companies such as Reggeborgh.[20]

This model tends to be attractive for such investors because they do not have a legacy copper or cable network, and are thus focused on constructing a new (fibre) network from scratch. At the same time, they do not have an existing retail customer base or

18 See EU (2018): Directive 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code, 17.12.18, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972&from=en.

19 See recital 208 EECC.

20 See discussion in WIK, IDATE, Deloitte (2016): Regulatory, in particular, access regimes for network investment in Europe, available at: https://op.europa.eu/en/publication-detail/-/publication/c0da75d9-9a8c-11e6-9bca-01aa75ed71a1.

established brand in the telecom sector and therefore have an interest in attracting the widest set of customers on their network to maximise take-up and support the business case.

As they are not active in providing any retail services, wholesale only companies are typically open to providing connectivity to third parties for a variety of purposes, extending beyond consumer broadband to business connectivity, backhaul and connectivity for "smart" applications and IOT.[21]

If appropriately standardised, connections from different wholesale only companies could also in principle be used to deliver services which span multiple sites or countries.

1.2 What other models have been used to deploy fibre networks?

As shown in Figure 1-1, next generation access networks can also be deployed by operators which are vertically integrated and provide their own services to retail customers. Vertically integrated operators may choose and/or be required (as is typically the case for incumbent operators which have been found to have "significant market power") to offer wholesale access services such as unbundled loops, bitstream and/or leased lines in addition to serving their retail business.

Incumbent operators are typically vertically integrated. However, as a result of concerns about the potential for vertically integrated SMP operators to discriminate in favour of their own retail operations, there has been pressure from regulatory authorities in a number of countries, including the UK, Ireland and Italy, for SMP operators to introduce functional or structural measures to distance their wholesale divisions from the provision of retail services. Some private investors in incumbent telecom operators (e.g. Czech Republic and Denmark) have also voluntarily sought to separate the wholesale and retail functions as a means of simplying the business and increasing shareholder value, while maintaining the two divisions under common ownership.[22]

The separation of an operator can have varying degrees, ranging from a separation only for accounting purposes, to complete ownership separation, with several possibilities in between (see **Fehler! Verweisquelle konnte nicht gefunden**

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21 See for example the Stokab business model described in the WIK (2018) study The role of wholesale only models in future networks and applications, available at: https://www.stokab.se/Documents/Nyheter%20bilagor/The%20role%20of%20wholesale%20only_WIK.pdf.

22 See for Czech Republic: PPF (2016): Telefónica O2 Czech Republic and its unique voluntary division, available at: https://www.ppf.eu/en/case-studies/telefonica-o2-czech-republic-and-its-uniquevoluntary-division. and for Denmark: Wood, N. (2019): TDC ramps up DSP push with legal split into OpCo, NetCo, 11.06.19., available at: https://www.telecomtv.com/content/open-service-provider/tdc-ramps-up-dsp-push-with-legal-split-into-opco-netco-35443/.

werden.).[23] In Denmark and the Czech Republic, the business model is based on legal separation under the same ownership (degree 6).

Table 1-1: Degrees of Separation

Ownership separation (in whole or part)
6-Legal separation (separate legal entities under the same ownership)
5-Business separation with separate governance arrangements
4-Business separation with localised incentives
3-Business separation (BS)
2-Virtual separation
1-Creation of a wholesale division
Accounting separation

Source: WIK based on Cave (2006).

As noted in the EU Electronic Communications Code,[24] functional separation may have the capacity to improve competition by reducing the incentive for discrimination. Furthermore, the Code observes that binding commitments associated with voluntary (legal) separation by a vertically integrated operator that has been found to have SMP in one or more markets can "add predictability and transparency to the process" [of separation].[25] However, it should be noted that, as discussed in the WIK (2016) study[26], separation of an incumbent or other operator which owns legacy infrastructure does not give rise to the same incentives as apply for operators without legacy infrastructure, as ownership of legacy infrastructure may impede operators' incentives to deploy upgraded networks[27]. Even if separated, if under common ownership, the existence of a pre-existing telecoms customer base can also pre-dispose the wholesale division of an operator towards favouring retail customers of the business which is under common ownership at the expense of potential rivals in the retail market. Thus while it may address some concerns, it should be noted that discrimination and competition problems can still arise in the event of legal separation which falls short of the definition of a "wholesale only" business. This is evidenced by the fact that significant market power obligations including provisions aimed at addressing potential

23 See Cave, M. (2006): Six Degrees of Separation: Operational Separation as a Remedy in European Telecommunications Regulation. In: Communications & Strategies, No. 64, 4th quarter 2006, pp. 89-103.
24 See EECC recital 202.
25 See EECC recital 206.
26 See WIK, IDATE, Deloitte (2016): Regulatory, in particular, access regimes for network investment in Europe, available at: https://op.europa.eu/en/publication-detail/-/publication/c0da75d9-9a8c-11e6-9bca-01aa75ed71a1.
27 See Cawley, R. A. (2014): The influence of European Union policies and regulation. In: W. Lemstra & W. H. Melody (Eds). The dynamics of broadband markets in Europe: Realizing the 2020 Digital Agenda. Cambridge: Cambridge University Press.

discrimination are still applied on legally separated incumbent operators such as BT in the UK. Moreover, there have also been cases in which separated incumbents have nonetheless been found to have breached competition law, including a 2020 case whereby the Italian incumbent TIM was found by the Competition Authority to have engaged in conduct which aimed to hinder the deployment of alternative ulfrafast broadband infrastructures and to lock in service providers and retail customers to its own FTTC/VDSL network ahead of the launch of a rival network deployed by Open Fiber.[28]

Alternative telecoms operators are also typically vertically integrated, and in many cases have built their businesses on the basis of building a retail brand and attracting retail customers, while gradually investing in the underlying network infrastructure. Indeed, the principles of broadband regulation in Europe were founded on the basis of a notional "ladder of investment" under which alternative operators could progress from reselling broadband services towards unbundling access infrastructure and eventually construct their own access infrastructure.[29]

Some alternative operators have climbed the ladder of investment to deploy FTTH. When they do so, they have maintained their vertically integrated business model, but in order to expand the reach of their network, they have in several cases sought to engage in co-investment schemes with other operators. For example, network "swap" arrangements have been reached by operators in Spain and Portugal (and are mandated in France).In Ireland, one of the alternative operators entered a joint venture arrangement with a utility company to form a wholesale only network, while in Italy a Joint Venture agreement has been reached between Fastweb and the incumbent Telecom Italia.[30] However, it should be noted that these are private voluntary arrangements, which do not meet the criteria established in the EECC under which co-

28 On 25 February 2020, following a 2 and a half year investigation, the Italian Competition Authority, AGCM found that TIM, the Italian incumbent, had abused its dominant power by implementing a complex anti-competitive strategy aimed at hindering the development of alternative ultrabroadband (UBB) infrastructures in Italy. The Authority concluded that TIM's behaviour had been harmful to Open Fiber, which had entered the market to deploy an FTTH infrastructure in both black and white areas. Specifically, in the white areas, TIM is held to have approved an unprofitable change in its coverage plans in the course of the public tendering process launched by the Italian government for the award of State Aid for the deployment of ultrafast broadband infrastructure and then launched litigation which was intended to hinder or delay the award of the contracts in favour of Open Fiber. TIM is alleged to have diverted its FTTC investments from more profitable areas to areas that had been identified as susceptible to State Aid, which hindered deployment of FTTH on the basis of State Aid and reduced the viability of the FTTH deployment through installing an intermediate and suboptimal technology, which could affect demand for higher bandwidths. AGCM also found that throughout the entire country, TIM had implemented predatory strategies such as repricing its wholesale offers for both FTTC and FTTH services below cost and launching promotions to end-users and service providers that were aimed at locking in its customer base and facilitating the migration of the customer base of alternative operators to its upgraded FTTC/VDSL own network to the detriment of Open Fiber. TIM was required to immediately cease this behaviour, refrain from adopting it in future and pay a penalty of 116 million euros. The evaluation of TIM's compliance with AGCM's decision is still pending.

29 See Cave, M. (2006): Encouraging infrastructure competition via the ladder of investment. In: Telecommunications Policy Vol. 30, Issues 3-4, pp. 223-237.

30 See https://www.morningstar.com/news/dow-jones/20200901933/telecom-italia-kkr-fastweb-reach-agreement-on-italian-national-network.

investment schemes can be considered sufficiently open and pro-competitive as to warrant forebearance from ex ante access regulation.

Moreover, even in cases where the criteria of the EECC for a pro-competitive co-investment scheme warranting deregulation are met, there are questions around whether the market dynamics associated with such schemes deliver the same degree of benefit as might be achieved through the availability of a wholesale only infrastructure, especially when focused on passive (dark fibre) access. For example, as observed in a 2017 WIK study,[31] the dynamics of retail competition in an area where the business model is based on vertically integrated co-investors can differ from that in areas where a wholesale only infrastructure is present. Specifically, WIK found that in the areas with vertically integrated players, there were fewer retail service providers and a greater prevalence of bundled offers. Conversely in the urban area served by the wholesale only company (in this case Stokab), there was a wide variety of service providers targeting different market segments, bundling was less common, and customers could pick and choose from where they procured different aspects of their fixed and mobile services and content. In France, which pursues wholesale only models for many of its public initiative projects with co-investment amongst vertically integrated players predominating elsewhere, there can be a wider diversity of offers in the wholesale only zones.[32]

WIK has observed in a number of studies[33], that the role of *new* investors in FTTH, whether those be wholesale only operators or alternative operators, investing or co-investing with others, has been a crucial driver in the deployment of Gigabit networks. In addition to deploying FTTH themselves, such new investors also typically stimulate a response from the incumbent, which is then compelled to invest or co-invest in FTTH in order to compete, driving a positive cycle of infrastructure competition.

1.3 Wholesale only models in the EU Electronic Communications Code and Broadband State Aid Guidelines

The new EU electronic communications Code contains specific provisions concerning wholesale operators.

Specifically, the Code provides that:

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31 WIK 2017 A tale of 5 cities https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf

32 See case study in the WIK (2019) study Competition and investment in the Danish broadband market https://ens.dk/sites/ens.dk/files/Tele/bilag_2_-_wiks_report_on_competition_and_investment_in_the_danish_broadband_market_non-confidential.pdf.

33 See e.g. Godlovitch, I.; Henseler-Unger, I.; Stumpf, U. (2015): Competition & investment: An analysis of the drivers of superfast broadband. Available at: https://www.wik.org/fileadmin/Studien/2015/Competition_and_investment_superfast_broadband.pdf and Wernick, C. et al. (2016): Gigabitnetze für Deutschland, available (in German) at: https://www.wik.org/fileadmin/Studien/2017/Gigabitnetze_Deutschland.pdf.

- Wholesale only operators which meet certain conditions and which are found to have significant market power (SMP) may be subject only to a subset of access obligations and these should be justified on the basis of a market analysis which includes a prospective assessment of their likely behaviour. Further obligations may be imposed only if the NRA concludes that competition problems have arisen or are likely to arise to the detriment of end-users;[34] and

- Wholesale only operators which meet certain conditions are exempted from symmetric access obligations if they make available an alternative means of access to very high capacity networks on fair, non-discriminatory and reasonable terms and conditions.[35]

These limitations are justified in the Code on the basis that, although the presence of wholesale only undertakings do not necessarily lead to effectively competitive retail markets, the wholesale only business model "can be beneficial to the creation of a thriving wholesale market, with positive effects on retail competition downstream. Furthermore, their business model can be attractive to potential financial investors in less volatile infrastructure assets and with longer term perspectives on deployment of very high capacity networks." The preamble to the Code also observes that "Certain competition risks arising from the behaviour of undertakings following wholesale-only business models might be lower than for vertically integrated undertakings, provided the wholesale-only model is genuine and no incentives to discriminate between downstream providers exist."[36]

The 2013 Guidelines applying to broadband state aid[37] also make reference to the wholesale only business model. For example, state aid may be granted in NGA black areas only in specific circumstances, and under the condition that the subsidized network should be based on an open architecture operated as a wholesale only network.[38] The Guidelines also note that, when a public authority decides to deploy and manage a network directly in conjunction with state aid, in order to safeguard competition in the retail broadband market, the public authority should limit its activity to maintain the passive infrastructure and grant access, but not engage in competition at the retail level with commercial operators.[39]

34 Article 80 of the Code.
35 Article 61(3) of the Code.
36 Recital 208 of the Code.
37 See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013XC0126%2801%29.
38 Paragraph 83.
39 See Footnote 96.

2 Examples of wholesale only models in Europe

The number of wholesale only initiatives has been expanding in Europe. In this chapter we describe the drivers of wholesale only investments and highlight examples from around Europe.

Highlights

Wholesale only models are expanding across Europe. Swedish municipalities were amongst the first to pursue this model to deploy FTTH in the late 1990s. Since 2015/16 there has been a resurgence in wholesale only deployments. Utility-backed new entrants within this period include Open Fiber in Italy, SIRO in Ireland and Fluvius in Flanders, Belgium. This period has also seen the expansion of Cityfibre in the UK. It is also notable that in recent years, incumbents in the UK, Denmark and the Czech Republic have moved towards full structural separation between their wholesale and retail divisions.

Although France, Spain and Portugal are considered to be countries which have pursued a vertically integrated co-investment model, the wholesale model is widespread in rural areas of France and Portugal and the wholesale only model has been introduced in Spain, via the acquisition of the MasMovil fibre network by Macquarie; Wholesale only models have also been used in various countries outside Europe, such as New Zealand and Singapore, as a means of supporting fibre deployments.

The wholesale only operator Open Fiber has been responsible for the majority of FTTH deployments in Italy. It is one of the largest operators of FTTH infrastructure in Europe alongside Telefonica and Orange. As of September 2020, Open Fiber had reached more than 9,5m premises, including more than 3m households in rural areas.

Open Fiber has signed agreements with a large number of telecommunication operators including the largest alternative operators in Italy: Vodafone, Fastweb and Wind.

2.1 Wholesale only: an expanding business model

The first examples of wholesale only business models date from the 1990s. At that time, Swedish municipalities were amongst the first in Europe to highlight the importance of fast broadband for economic growth and regional development, and became trailblazers for the installation of fibre as an “infrastructure”. As of 2018, around 175 out of 290 municipalities in Sweden had deployed fibre optics, representing more than 50% of the

nation's fibre coverage.[40] Fibre deployment by municipalities also served to trigger a change in strategy by the incumbent Telia, which switched its focus to FTTH/B investments rather than than the FTTC investments that now prevail in some other European countries.[41]

Municipalities and private actors in other countries such as the Netherlands followed with their own fibre projects. In 2004, the municipality of Amsterdam approved the creation of a public-private-partnership to invest in passive fibre infrastructure (Amsterdam Citynet). In 2005, the city of Amsterdam together with five housing corporations and two financial investors (ING and Reggefiber) agreed to invest in a FTTH network. The municipality of Amsterdam invested € 6 million, ING and Reggefiber each invested € 3 million, three social housing corporations invested each € 1.5 million and two housing corporations each invested € 750,000. The total equity investment amounted to € 18 million. Another €12 million in funding was provided as debt financing. The total budget of € 30 million enabled the first phase of implementation, 40,000 connections, to start in 2006.[42]

In its defence of the business model before the European Commission (DG Competition), the Dutch authorities noted that large-scale fibre deployments were taking place in the US and Asia and that projects such as this would be in line with the Lisbon agenda [for growth and jobs].[43] The authorities also emphasised the pro-competitive nature of the business model, which they noted provided - contrary to the closed model of cable operators - open and non-discriminatory access to all retail operators. They argued that the new business model, inter alia, promotes service competition, boosts innovation and helps to reduce the risk of service providers by allowing them to use funding which matches the characteristics of each individual layer.[44]

Fibre deployments by non-traditional players continued after this point including significant deployments by Reggefiber in the Netherlands, which passed 1 million homes by 2012, 2 million homes by the end of 2014 and 2.3 million homes by the beginning of 2019[45], and by utilities in Denmark, which invested €1.3bln in fibre between 2005-12.

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40 See WIK (2018) for Stokab: The role of wholesale only models in networks and applications.

41 See for example https://www.telegeography.com/products/commsupdate/articles/2014/10/08/telia-investing-usd1-25bn-in-swedish-fibre-over-three-years/.

42 EU-Commission (2007), C (2007) 6072 final, Decision of 11.XII.2007 on THE STATE AID case C 53/2006 (ex N 262/2005, ex CP 127/2004).

43 Communication from the Commission to the Council and the European Parliament. Common Actions for Growth and Employment: The Community Lisbon Programme, COM(2005) of 20 July 2005.

44 Paragraph 49 EU-Commission (2007), C (2007) 6072 final, Decision of 11.XII.2007 on THE STATE AID case C 53/2006 (ex N 262/2005, ex CP 127/2004).

45 Reggefiber is by now a subsidiary of KPN and by May 1st 2019 operating together with KPNs network branch under the name KPNNetwerkNL (https://www.eindelijkglasvezel.nl/). Together they pass 2.3 million homes with their FTTH network in 2019, see Hardy, S. (2019): KPN launches 1 million home FTTH initiative in the Netherlands. Available at: https://www.lightwaveonline.com/fttx/ftth-b/article/16667885/kpn-launches-1-million-home-ftth-initiative-in-the-netherlands.

However, the role of independent fibre networks was challenged by acquisitions e.g. of Reggefiber by KPN and of Dong by TDC, which had a negative impact on expansion of fibre in the areas concerned. For example, following the acquision of Reggefiber, KPN slowed down the expansion of its FTTH footprint. In 2016, the number of homes passed in the Netherlands grew by 137,000, a sharp decrease compared to the 200,000 new fibre lines in 2015.[46] KPN announced that it would scale down its investment in new fibre lines and instead focus on vectoring technology, which could reduce costs as it requires only partial fibre installation.[47, 48]

Moreover, as incumbents began upgrading networks towards FTTC/VDSL, attention in several countries shifted towards questions of how to adapt SMP regulation to support competition on the incumbent network in an NGA environment, rather than focusing on fostering new entry in fibre infrastructure.[49]

More recently, and especially in countries where the pace of NGA deployment by existing operators proved disappointing, attention has shifted back towards new investors and wholesale only networks as a means of triggering investments in very high capacity infrastructure.

Since 2015/16 there has been a resurgence in wholesale only deployments. Utility-backed new entrants within this period include Open Fiber in Italy, SIRO in Ireland and Fluvius in Flanders, Belgium. This period has also seen the expansion of Cityfibre in the UK, and the emergence of wholesale only rural network operators in Austria and France, which are targeting areas subject to state aid.[50]

The map below shows a selection of the wholesale only networks operating in Europe today. It is clear that this business model has been pursued in commercial settings as well as in the context of state aid, and by private and public operators as well as those operating under a public private partnership model (PPP).

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46 See https://www.telecompaper.com/nieuws/ruim-3-miljoen-ftth-aansluitingen-in-nederland-in-2021-2--1201165, retrieved on 2018-1-18.

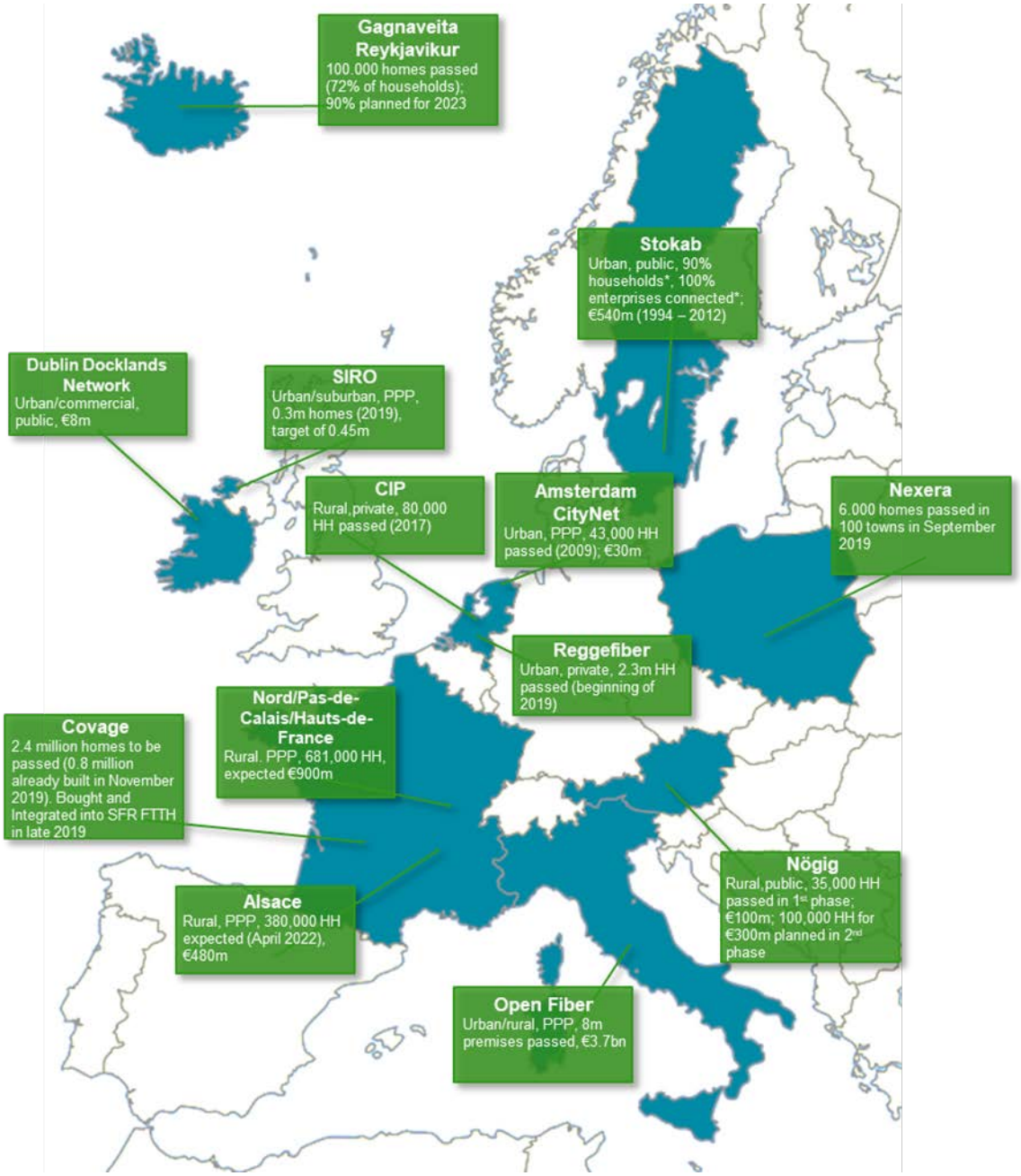
47 See https://www.telecompaper.com/nieuws/ruim-3-miljoen-ftth-aansluitingen-in-nederland-in-2021-2--1201165, retrieved on 2018-1-18.

48 Mölleryd, B. (2015), Development of high speed networks and the role of municipal networks, p. 41.

49 See Godlovitch, I.; Henseler-Unger, I.; Stumpf, U. (2015): Competition & investment: An analysis of the drivers of superfast broadband. Available at: https://www.wik.org/fileadmin/Studien/2015/Competition_and_investment_superfast_broadband.pdf.

50 See Godlovitch, I.; Gantumur, T. (2018): The role of wholesale only models in future networks and applications, available at: https://www.stokab.se/Documents/Nyheter%20bilagor/The%20role%20of%20wholesale%20only_WIK.pdf.

Figure 2-1: Wholesale only initiatives – past, present and future



Source: WIK-Consult.

* in the greater Stockholm area

The scope of deployments by wholesale only players is or is expected to be particularly significant in Sweden and Italy, with widespread deployment also expected in the UK,

Ireland and rural areas of France. Open Fiber has passed 8 million households with its fibre network at the end of 2019.[51] SIRO, an Irish joint venture between the state-owned electricity company ESB Group and Vodafone, had a coverage of about 300,000 premises with its FTTH network in 2019, more than 15% of the total households in Ireland.[52] In mid-2020 they reached a fibre footprint of two thirds of that of the incumbent Eir. 40% of the customers subscribe to speeds of 100Mbit/s or more.[53] For private households, services can be booked through 10 retailers (9 for business customers).[54]

The UK wholesale only operator CityFibre accounced in 2017 that it planned to build a fibre network covering one million premises by the end of 2021 and up to five million premises by 2025, with Vodafone as an exclusive sales partner for a certain period of time.[55] Following Cityfibre's acquisition of FibreNation in early 2020, CityFiber expanded its deployment goal to 8 million premises.[56]

Wholesale only networks are also playing a significant role in France, Portugal, Spain, and are planned in Switzerland – countries which are better known for their focus on infrastructure-based competition and co-investment. The French Public Initiative Networks (PIN)[57] planned to achieve a fibre coverage of three million households by the end of 2019 with the incumbent, Orange, as one of the access seekers.[58] Wholesale only providers in France include Altitude, Covage and TDF,[59] which expanded its business from the provision of broadcast infrastructure into fibre deployment in rural areas. Provision of fibre-based broadband in rural areas of Portugal has largely been driven by DSTelecom,[60] a wholesale only company established to meet the tendering requirements for State Aid in Portugal.[61] In November 2019, the

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51 See commsupdate.com (2019): Open Fiber hits five million milestone, 21.03.19., available at: https://www.commsupdate.com/articles/2019/03/21/open-fiber-hits-five-million-milestone/.

52 See Siro (2020): SIRO Gigabit hubs, available at: https://siro.ie/about-us/gigabit-hubs/ and Burke-Kennedy, E. (2019): Siro now a serious challenger to Eir in fibre arms race, in: irishtimes.com, 26.07.19., available at: https://www.irishtimes.com/business/technology/siro-now-a-serious-challenger-to-eir-in-fibre-arms-race-1.3967160.

53 See Burke-Kennedy (2020): Third of Irish homes, businesses now connectable to fibre broadband, in: irishtimes.com, 16.06.2020, available at: https://www.irishtimes.com/business/technology/third-of-irish-homes-businesses-now-connectable-to-fibre-broadband-1.4279744.

54 See https://siro.ie/.

55 See cityfibre.com (2017): Vodafone and CityFibre bring gigabit-speed fibre to the UK, 09.11.17, available at: https://www.cityfibre.com/news/vodafone-cityfibre-bring-gigabit-speed-fibre-uk/

56 See Jackson, M. (2020): Cityfibre Buy FibreNation and Set 8 Million UK FTTH Homes Goal, in: ispreview.co.uk, 21.01.2020, available at: https://www.ispreview.co.uk/index.php/2020/01/cityfibre-buy-fibrenation-and-set-8-million-uk-ftth-homes-goal.html.

57 Known in France as Reseaux d'Initiative Publique (RIP).

58 See commsupdate.com (2019): Orange to offer FTTH services over all PINs in France, 14.03.19, available at: https://www.commsupdate.com/articles/2019/03/14/orange-to-offer-ftth-services-over-all-pins-in-france/

59 See https://www.tdf-infrastructure.com/.

60 See https://www.dstelecom.pt/?locale=en_US.

61 ANACOM, which managed the tendering process, had indicated that wholesale-only business models were to be offered, adopting the view that wholesale models provide greater incentive to reach the

investment company Macquarie Capital acquired, together with Aberdeen Standard Investments, the FTTH network of the Spanish operator MasMovil, covering almost 1 million households. The network will be an open wholesale network with MasMovil as one longterm renter with a minimum volume commitment.[62] In 2020, the two Swiss network operators Salt and Sunrise established the joint venture "Swiss Open Fiber". This company plans to build an open fibre network to 1.5 million Swiss households over the next 5-7 years, focussed on undersupplied sub-urban regions and with a planned capital investment of up to 3 billion CHF (~2.8bn EUR).[63] It remains to be seen however, whether these plans will be maintained following the announcement in August 2020 that the cable operator Liberty Global will acquire Sunrise Communications.[64]

A wholesaling model is also providing of increasing interest for incumbents. It is notable that in recent years, incumbents in the UK, Denmark and the Czech Republic have moved towards full structural separation between their wholesale and retail divisions (although the divisions remain under common owernship and therefore these examples fall short of being "wholesale only" models). With the exception of the UK, the decision to do so was based on commercial considerations, highlighting the advantages of separated business models for investors.

Outside Europe, one of the largest fibre wholesale only operators is Chorus, which was separated from Telecom New Zealand in December 2011 after winning the government contracts for a majority of the fibre network, for which such a separation was the requirement.[65] The expansion of the network started promptly. The fibre network in NZ was accessible for 82% of the population in early 2020 with a government target of 87% coverage by the end of 2022.[66] The take-up also grew steadily, with fibre take-up of over 50% of the served households, overtaking copper connections in absolute numbers in 2019.[67] Chorus itself has passed more than 900,000 premises, and is targeting more than 1 million by the end of 2022, more than half of all NZ premises.[68]

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maximum number of customers, since the wholesale provider does not have an incentive to market foreclosure in favour of its retail arm.

62 See https://www.macquarie.com/au/en/about/news/2019/maccap-to-acquire-fibre-broadband-network-in-move-to-create-spains-first-independent-wholesale-bitstream-operator.html.

63 See Salt & Sunrise (2020): Swiss Open Fiber – Strategic Partnership of Sunrise and Salt for FTTH Roll-Out in Switzerland, available at: https://www.salt.ch/media/press/files/2020/5/19/cc8f1e75-0b9d-4b61-a6f7-3440df89f2f6/447/20200519_Media%20Presentation_EN.PDF.

64 See https://www.libertyglobal.com/liberty-global-to-acquire-100-of-sunrise-communications-group-by-tender-offer/.

65 See Commerce Commission New Zealand (2013): Annual Telecommunications Monitoring Report 2012, available at: https://comcom.govt.nz/__data/assets/pdf_file/0020/63830/2012-Annual-Telecommunications-Report-3-May-2013.pdf.

66 See Crown Infrastructure Partners (2020): Quarterly connectivity update – Q1: to 31 March 2020, available at: https://www.mbie.govt.nz/assets/quarterly-connectivity-update-q1-31-march-2020.pdf.

67 See Commerce Commission New Zealand (2020): Annual Telecommunications Monitoring Report – 2019 Key facts, available at:

2.2 The case of Open Fiber

A notable example on the contribution of utilities to driving fibre deployment is the wholesale-only network operator Open Fiber in Italy.

Open Fiber was founded in December 2015 with the objective of installing, supplying and operating FTTH communications networks across Italy. The company operates as a joint venture between the energy utility Enel, and the equity arm of the national investment bank Cassa Depositi e Prestiti (CDP).[69]

Open Fiber represents Enel's second foray into the telecom market, as during the telecoms liberalisation phase, Enel was engaged together with France Telecom and Deutsche Telekom in founding the telecommunications operator Wind. Enel subsequently sold Wind and focused on expanding its core energy business internationally.

However, in December 2015, Enel Group returned to the telecom business with the creation of Enel OpEn Fiber S.p.A (EOF). The aim of the initiative is to create a national high-speed fibre network leveraging the knowledge of the Group as well as its existing infrastructure. In 2016, EOF initially announced a plan to roll out FTTH networks in 224 cities, as part of its project to install smart meters across Italy,[70] Although the two plans were separated following the energy regulator's concerns about cross-subsidization.[71] OEF estimated that leveraging its own infrastructure as well as that of other utilities could reduce build costs by as much as 25%. (see Figure 2–2).[72]

https://comcom.govt.nz/__data/assets/pdf_file/0021/212763/2019-Annual-Telecommunications-Monitoring-Report-Revised-version-12-March-2020.pdf.

68 See Chorus (2020): H1 FY20 Result Presentation, available at: https://company.chorus.co.nz/reports.

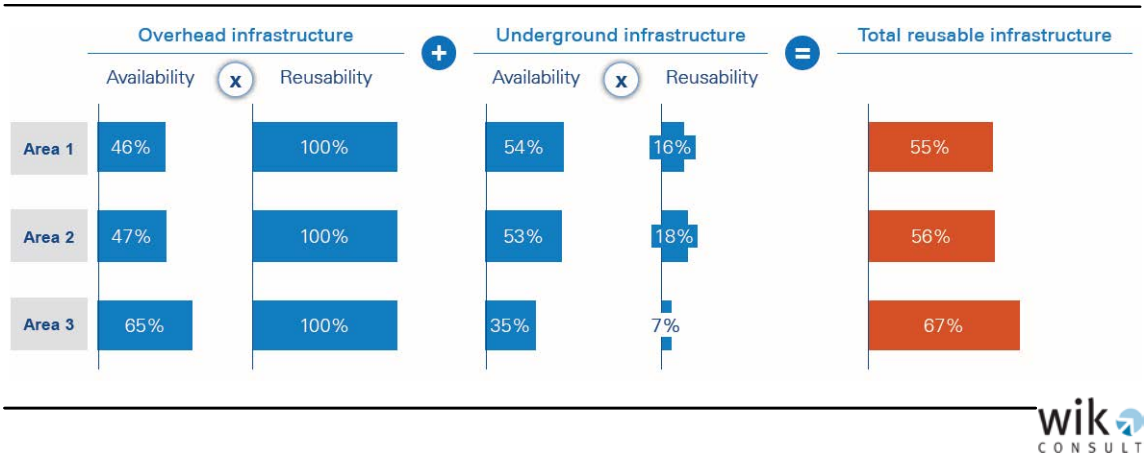
69 Cassa Depositi e Prestiti is a company under the control of the Italian government active in the acquisition and management of shareholdings in Italian companies.

70 Enel (2016), Enel Open Fiber strategic plan presented to Enel Board of Directors, Press release from March 23rd 2016, downoadable at: https://www.enel.com/content/dam/enel-com/pressrelease/porting_pressrelease/1665521-1_PDF-1.pdf.

71 Gerli, P., Van der Wee, M., Verbrugge, S. and J. Whalley (2017),The involvement of utilities in the development of broadband infrastructure: A comparison of EU case studies, p. 7.

72 Arthur D Little (2017), Utilities' contribution to national fibre development, p. 8.

Figure 2-2: Synergies by reusing electrical network announced by Enel (Italy)



Source: Gerli et al. (2017) based on Enel's presentation to the Italian Senate of the Republic.

In December 2016, Enel OpEn Fiber and Metroweb Italia merged, creating a structure in which the company was equally held by Enel and the publicly controlled investment vehicle Cassa Depositi e Prestiti (CDP).[73] Open Fiber then updated its strategic plan in June 2016, expanding the scope of its deployments to 271 cities in economically viable zones, including the largest Italian cities. Open Fiber's updated 2016 - 2030 strategic plan aims at providing:[74]

- coverage with high-speed fibre optics of about 10.6 million homes (compared with 7.5 million homes in the previous plan in 2016) in black areas in the period from 2016 to 2024;
- progressive increase in investment from around € 2.5 billion to € 3.7 billion, of which about 85% in 2016 - 2022. Overall investment of over 7 billion euro is envisaged with expectations of investments of €1bln annually in the coming years.

In addition to its coverage of commercially viable areas, Open Fiber has been awarded contracts under Italy's broadband state aid programme, the "National Ultra-Broadband Scheme",[75] and is committed to deploying around 8,8 million households in approximately 7.000 municipalities by 2023.

73 Enel (2016), Enel signs agreement for the acquisition of Metroweb", Press release from October 10 2016, available at: https://www.enel.com/media/press/d/2016/10/enel-signs-agreement-for-the-acquisition-of-metroweb.

74 Ibid.

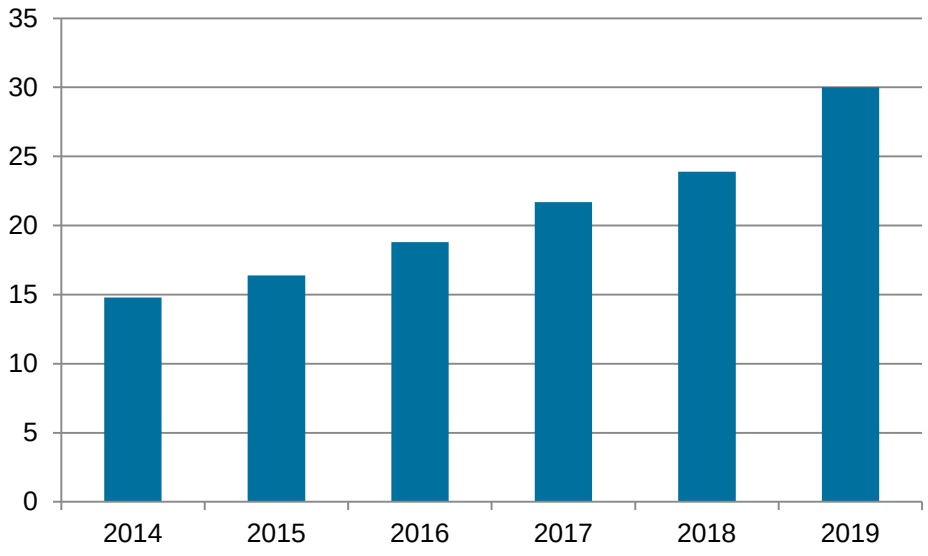
75 Banda ultralarga - Enel Open Fiber firma contratto su seconda gara Infratel, Press release from December 27 2018, available at: https://www.corrierecomunicazioni.it/telco/banda-ultralarga/banda-ultralarga-a-open-fiber-la-seconda-gara-infratel/; http://openfiber.it/fibra-ottica/area-infratel.

By 2024, it is envisaged that Open Fiber will cover a total of 19,5 m households in all regions of Italy, both in urban and rural areas.

As of September 2020, Open Fiber had reached more than 9,5m premises, including more than 3m households in rural areas.[76]

Since 2014, the year before Open Fiber started its fibre network, the fibre penetration progressively increased in Italy, more than doubling in five years to 30%. The network expansion was especially large from 2018 to 2019, reflecting an increase in the speed of Open Fiber's network build.

Figure 2-3: Coverage of FTTB/H networks in Italy in % of households



Source: European Commission 2015-2020 – Digital Economy and Society Index (DESI).

Open Fiber's access network is based on GPON (Gigabit Passive Optical Network) FTTH technology, in which part of the connection is shared between operators, while the final connection is based on a single dedicated fibre. Open Fiber plans to upgrade its network towards NG-PON and NG-PON2, which will provide additional capacity as user needs expand.[77] Open Fiber is also developing a terabit capable national transport infrastructure, which enables handover at regional and national connection points for operators which prefer not to deploy their own backbone networks.

76 See https://openfiber.it/mondo-open-fiber/comunicati-stampa/open-fiber-estensione-finanziamento/.

77 While GPON is designed for capacities of 2.5Gbit/s downstream and 1.25Gbit/s up, subsequent generations can increase capacities to 10Gbit/s symmetric (XGS-PON) and 4x10Gbit/s download with 2.5Gbit/s upload for NG-PON2.

Open Fiber offers passive access to its fibre network, as a condition of its concession agreement to provide very high capacity connectivity in white areas.[78] In addition, Open Fiber offers a range of active services including Open Stream (a service equivalent to virtual local unbundled access VULA), Open Internet (which allows operators without their own networks to offer Internet access, in essence allowing the existence of FVNO, Fixed Virtual Network Operators), as well as Ethernet and wavelength services aimed at business connectivity.[79]

Open Fiber has signed agreements with approximately 130 operators including the largest alternative telecommunication operators in Italy Vodafone, Fastweb and Wind[80], media players such as Sky and multi-utilities, which make use of Open Fiber's FTTH solutions to provide high-speed connectivity services and innovate in fields such as Smart Grids, Edge Computing and Small Cells.

In addition to offering alternative options for established broadband providers, the availability of a new fibre wholesale network has supported the entry and expansion of service providers, whose main focus lies beyond telecoms.

In an interview for this study, Pietro Maranzana, Chief Broadband Officer at Sky Italia, noted that video streaming and gaming are likely to be the main applications for consumers. "We are hosting services such as Netflix, Amazon etc on our network and as a result of a combination of Open Fiber technologies and our own network, we can offer guaranteed service and response times to customers," he said. Although Sky also offers broadband services based on FTTC/VDSL from the incumbent, they prioritise FTTH wherever possible, "because it offers faster speeds, more stability and low latency".

Sky Italia started offering its fibre-based services commercially on 16 June 2020. Prior to that, Sky Italia had been trialling the service. Maranzana noted that: "Within our trial, we observe that customers download more because of the higher speeds available. Whereas previously they may only have downloaded one movie, they now download three or four at a time. Fibre allows more devices to be used simultaneously by different people. So, for example, people might be watching Netflix while someone else is listening to Spotify and another is using gaming online. This capability is especially relevant for families."

Meanwhile, companies such as Sorgenia, which specializes in gas and renewable energy plants, are using the Open Fiber network to offer broadband services alongside electricity and gas services to consumers and businesses, thus providing a "multi-utility" service. In an interview conducted for this study, Andrea Casalgrandi, responsible for

78 Services available in the white areas are described at: https://openfiber.it/contents/wp-content/uploads/2019/07/Descrizione-Sintetica-Servizi-CD-250719.pdf.
79 See https://openfiber.it/en/operators/operators-services/.
80 See https://openfiber.it/servizi-operatori/operatori-partner/.

marketing and communications at Sorgenia noted that Open Fiber was the only provider that could enable them to offer broadband services without needing to operate their own infrastructure. Casalgrandi also observed that: “From a business perspective, a wholesale only partner is beneficial as it means that Sorgenia is not competing with retail offers from the network operator”. Fibre is used by the company to deepen the relationship with energy and gas customers, and Casalgrandi notes that a customer that takes multiple services may also be more likely to turn to the company e.g. for the installation of photovoltaics.

An important implication of the Open Fiber deployment is that the incumbent Telecom Italia, which had previously, together with Fastweb, committed to only a more modest investment in FTTC/VDSL, announced that they would expand their ambitions, reaching agreement in mid 2016 to build an FTTH network through a joint venture Flash Fiber. The fibre network built by the joint venture provides ultra-broadband access services on a wholesale-basis, but is not wholesale only. The goal of Telecom Italia and Fastweb is to connect 3 million homes in 29 major Italian cities already covered by FTTC by 2020 for a total investment of €1.2 billion, financed part in equity and part in debt.[81]

At the start of 2018, Flash Fiber had connected 430,000 addresses, and by mid-2018, the company reported that it had completed half its planned network development.[82] Areas covered by Flash Fiber are shown in the map below.

81 See https://advanced-television.com/2016/07/28/fastweb-telecom-italia-partner-on-ftth-network/.
82 See https://www.flashfiber.it/en/2018/07/19/coverage-progress/.

Figure 2-4: Areas covered by Flash Fiber

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

Estimates from Intermonte however, show that Telecom Italia's FTTH coverage is rather limited compared to that of Open Fiber, leaving most of TI's customer-base served with FTTC/VDSL technology.

Table 2-1: FTTH homes passed by operator, Intermonte estimates

FTTH Households (k)	FY17A	FY18A	FY19E	FY20E	FY21E	FY22E	target
TIM+FF HHs passed	**2,186**	**3,236**	**3,836**	**4,336**	**4,836**		
TIM+FF HHs passed (w/o Milan)	**1,386**	**2,436**	**3,036**	**3,536**	**4,036**		
coverage (based on c.25mn italian HH)	***9%***	***13%***	***15%***	***17%***	***19%***		
FlashFiber (Eu1.2bn Capex)	500	1,500	2,000	2,500	3,000		
TIM standalone	50	100	200	200	200		
lines bought from Fastweb	650	650	650	650	650		
Lines rent from OF in Milan (IRU)	800	800	800	800	800		
Eurosud Project	186	186	186	186	186		
Open Fiber HHs passed	**2,400**	**5,100**	**7,900**	**10,600**	**14,400**	**17,800**	**19,100**
coverage (based on 25mn italian HH)	***10%***	***20%***	***32%***	***42%***	***58%***	***71%***	
A+B HHs	**2,400**	**4,000**	**5,700**	**7,100**	**8,400**	**9,200**	**9,500**
new HHs	***+1,300***	***+1,600***	***+1,700***	***+1,400***	***+1,300***	***+800***	
A+B (MWB)	1,100						
C+D HHs	**0**	**1,100**	**2,200**	**3,500**	**6,000**	**8,600**	**9,600**
new HHs	***+1,300***	***+1,100***	***+1,100***	***+1,300***	***+2,500***	***+2,600***	

Source: Company (A), Intermonte Estimates (E)

3 The role of open fibre in fixed and mobile applications of the future

WIK-Consult has examined future applications and services and the implications for bandwidth demand in studies for the European Commission as well as for regulatory authorities and regional administrations in Germany, the UK, Denmark and Belgium. In this chapter, we examine trends in demand from consumers, businesses and IOT, as well as discussing how 5G developments are likely to impact requirements for fibre connectivity.

Highlights

Demand models developed by WIK and applied in countries such as the UK, Germany and Belgium suggest that, if demand is not constrained by the lack of high bandwidth infrastructure, by 2025 a high proportion of consumers and small businesses are likely to require downstream bandwidths of 1Gbit/s or more and upstream bandwidths of 600Mbit/s or more, along with lower latencies. Demand is likely to be driven not only by higher quality video, but by growing reliance on cloud services, the proliferation of devices, eEducation and eHealth, and the evolution of applications using augmented or virtual reality. These requirements are likely to necessitate fibre in or very close to the building.

As of 2018, only around 20% of enterprises in Italy were making use of cloud computing services, and only 7% of enterprises were analyzing “big data”. One of the factors (although not the only factor) contributing to Italy’s lagging performance in business ICT use may be the very low levels of Italian businesses which had a fast fixed broadband connection of more than 30Mbit/s (only 37% in 2019).

Fibre is needed not only for fixed connections to households and businesses, but to provide the backbone for the 5G mobile networks of the future. WIK research suggests that an increasing proportion of mobile base stations will need to be connected to fibre (up to 90%), and further fibre connectivity will be required when small cells are deployed.

Trials and early use cases in Italy show how fibre could support digitisation of industry and public services:

In Bari, Open Fiber’s network will be used to provide connectivity for traffic lights, video surveillance and street lighting, as well as to increase the speed and effectiveness of repairs. In total, 15.000 lights will be connected to the network

Under Turin’s “Smart Road” project, autonomous and remote control vehicles will be tested, using 5G and fibre connectivity. This “Smart Road” project also includes traffic detection systems, smart cameras and digitized road signs, to facilitate the capabilities of autonomous driving.

A field experiment in Sardinia involving an audiovisual connection from a rural clinic to a bigger hospital enabled rural patients to benefit from the expert opinion of a heart specialist

A trial for “5G cities” is being conducted from 2017 to 2020 by Open Fiber and Wind Tre in Prato and L’Aquila. A multitude of use cases are set to be trialled in these cities, including constant smart monitoring of buildings for earthquake prevention. being one of them.

Remotely provided healthcare and education, supported by high bandwidth connections, may play a vital role in supporting Italy’s society and economy though the period of turmoil and uncertainty created by the Coronavirus crisis.

Open fibre networks can permit a variety of service providers to innovate in smart applications on top of the infrastructure and could help to address concerns over lock-in.

3.1 Applications for consumers and small businesses

The main driver of bandwidth demand for consumers has thus far been the growth in online video and the proliferation in connected devices used in the home, and in some cases, beyond. Going forward, Cisco[83] projects that the number of connected devices per individual in Italy will grow from 5.0 in 2018 to 8.5 in 2023. Cisco projects that an increase in the number of Internet users, alongside greater utilization of online applications and services will drive average Internet traffic per capita from 30.3GB in 2017 to 61.8GB in 2022. By 2022, 82% of Internet traffic in Italy is expected to be driven by devices other than PCs, including connected TVs, tablets and smartphones.

Looking forward to the years to come, 8K TV is expected to further drive demand for download bandwidths, while increased utilization of the cloud and video conferencing, for both personal and business use is expected to increase demand for upload speeds. Applications such as alternative reality (AR) and virtual reality (VR) also require low latencies. Although the best-known VR applications are linked to gaming today, AR and VR applications are also expected to emerge in the context of education, training and healthcare, as discussed in the following sections.

In the context of a 2018 study for the UK regulatory authority Ofcom,[84] WIK identified the expected bandwidth and quality requirements of various future applications. These are shown below:

83 Cisco VNI highlights.
84 WIK (2018) The benefits of ultrafast broadband.

Table 3-1: Application categories with their capacity and quality requirements 2025, based on WIK for Ofcom (2018)

Application category	2015 Downstream bandwidth (Mbit/s)	Assumed CAGR in%	Downstream (Mbit/s) in 2025	Upstream (Mbit/s) in 2025	Packet loss	Latency
Basic Internet	2	25	≈20	≈16	o	o
Homeoffice/VPN	16	30	≈250	≈250	+	+
Cloud Computing	16	30	≈250	≈250	+	++
State of the Art Media and Entertainment (4k, 3D, UHD)…	14	20	≈90	≈20	++	+
Progressive Media and Entertainment (8k, Virtual Reality)	25	30	≈300	≈60	++	+
Communication	1,5	20	≈8	≈8	++	+
Videocommunication (HD)	8	15	≈25	≈25	++	++
Gaming	25	30	≈300	≈150	++	++
E-Health	2,5	30	≈50	≈50	++	+
E-Home/E-Facility	2,5	30	≈50	≈50	o	o
Mobile Offloading	2	30	≈15	≈12	o	o

Source: WIK.

We then estimated bandwidth demand per household on the basis of expectations around the prevalence of multiple devices and the usage of applications by different user types (see below), and matched the resulting bandwidth and quality demand against an assessment of the capabilities of different technologies.

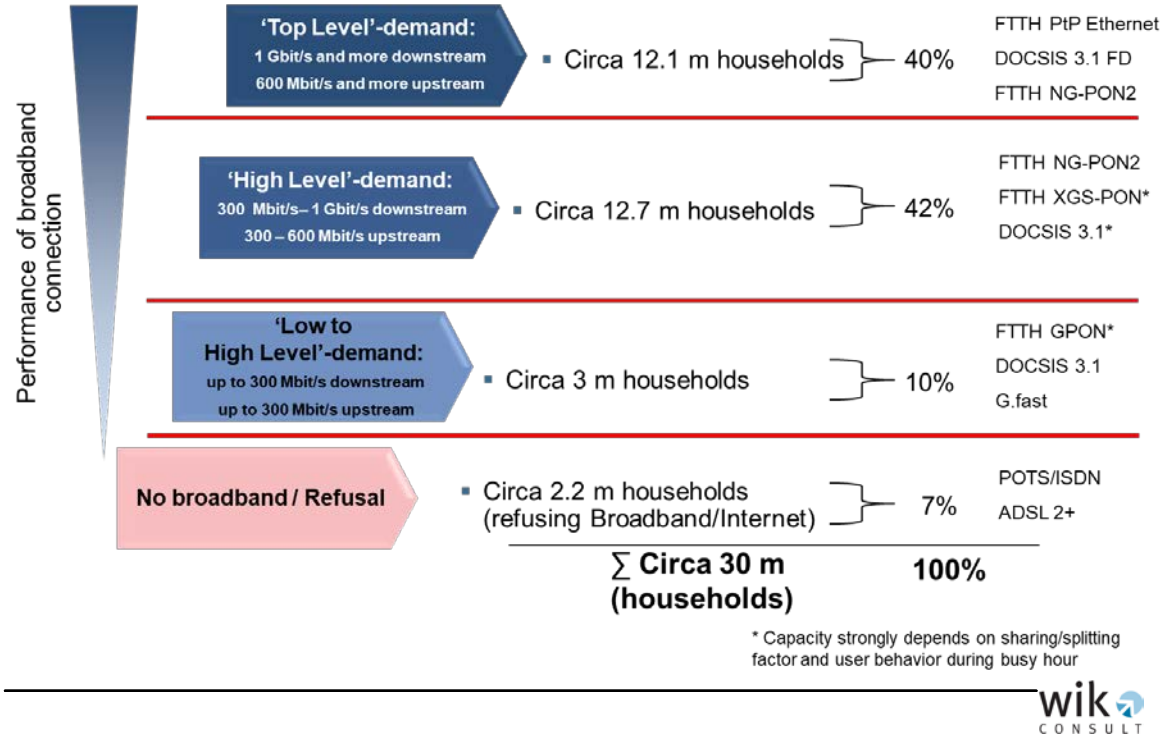
Table 3-2: Overview of digital applications and user types, based on WIK for Ofcom (2018)

Categories / User Types	Occasional	Sceptical Outsider	Home office User	Trend User	Avantgardist	Professional
Basic Internet	✓	✓	✓	✓	✓	✓
Homeoffice/VPN			✓			
Cloud Computing				✓	✓	✓
State of the Art Media and Entertainment (4k, 3D, UHD)…				✓		
Progressive Media and Entertainment (8k, Virtual Reality)						✓
Communication	✓					
Videocommunication (HD)			✓	✓		
Gaming					✓	
E-Health	✓			✓		
E-Home/E-Facility					✓	✓
Mobile-Offloading	✓	✓	✓	✓	✓	✓

Source: WIK.

We concluded that in a timeframe towards 2025, if availability and price were not a constraining factor, that around 40% of UK households would require downstream bandwidths of at least 1Gbit/s fibre with upstream bandwidths of around 600Mbit/s. This “top-level” demand would require the use of FTTH or Docsis 3.1 Full Duplex.

Figure 3-1: Bandwidth, Quality of Service and technologies for the UK in 2025, based on WIK for Ofcom (2018)



Source: WIK (2017).

Although the usage of bandwidth-hungry digital applications in Italy is less intensive than in the UK,[85] it could reasonably be expected that a significant portion of Italian consumers will require bandwidths of between 300-1Gbit/s in the period to 2025, and that this may expand in the years to follow. In the absence of cable infrastructure in Italy, this demand will need to be met by the expansion of full fibre networks.

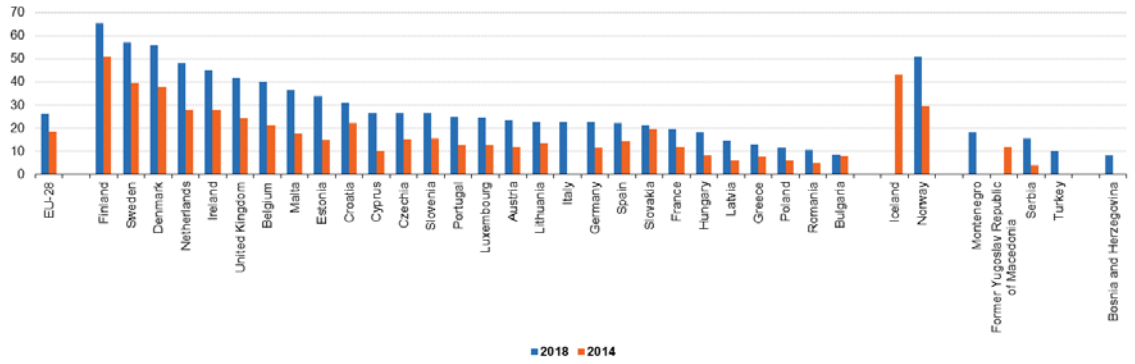
The importance of high and symmetric bandwidths for small businesses and home workers is also worth highlighting. Data from Eurostat[86] show that as of 2018, only around 20% of enterprises in Italy were making use of cloud computing services, and only 7% of enterprises were analyzing "big data".[87]

85 Cisco reports that average traffic per capita in the UK in 2017 was 79.6GB – more than double that in Italy.

86 See https://ec.europa.eu/eurostat/statisticsexplained/images/8/8d/Use_of_cloud_computing__services%2C_2014_and_2018_%28%25_of_enterprises%29.png.

87 EC Digital Agenda Scoreboard.

Figure 3-2: Use of cloud computing services, 2014 and 2018 (% of enterprises)

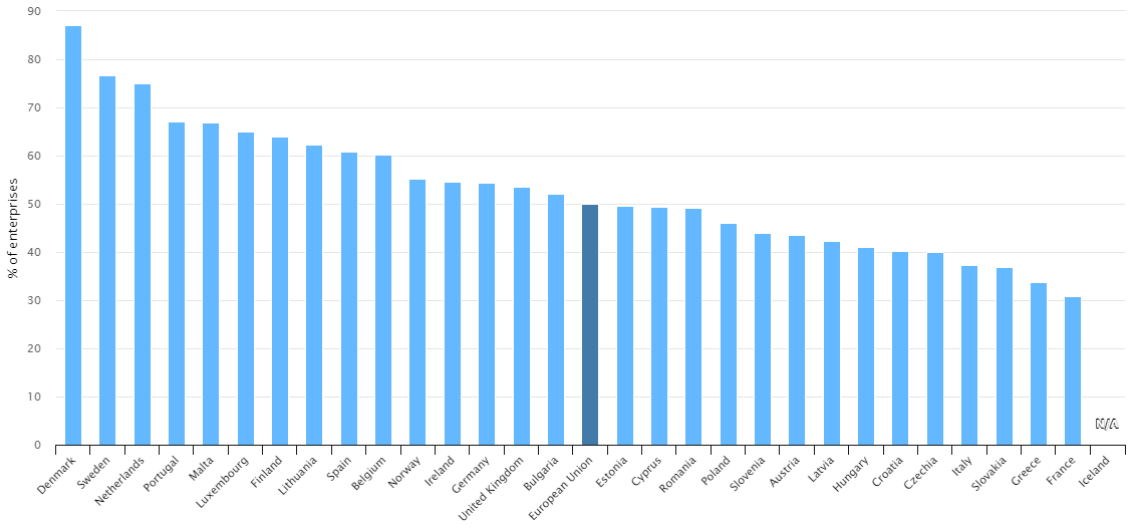


Note : Italy: Break in series. Iceland and The Former Yugoslav Republic of Macedonia: 2018 not available. Montenegro, Turkey and Bosnia and Herzegovina: 2014 not available.

Source: Eurostat (online data code: isoc_cicce_use).

One of the factors contributing to Italy's lagging performance in business ICT use may be the very low levels of Italian businesses which had a fast fixed broadband connection of more than 30Mbit/s (only 37% in 2019).

Figure 3-3: Enterprises having a fast fixed broadband connection



Source: European Commission (2019).

The widespread deployment of fibre offering the capability for high bandwidth symmetric connectivity, could help to enable small Italian businesses to make better use of digital opportunities.

Indeed, research by WIK suggests that the presence of fibre can provide an important stimulus to increase the use of digital services and applications. For example, both download and especially upload bandwidth usage increased significantly in the context of a copper switch-off trial conducted by Orange in the Palaiseau region.[88] A 2018 study by WIK for the FTTH Council also found, based on a representative survey among Swedish consumers, that FTTH users were 11% more active online by and used more services across several possible dimensions (e.g. information, entertainment).[89]

3.2 IOT, M2M and the digitization of industry and public services[90]

Another development for which fibre deployment is likely to be important, is the digitization of industry and public services alongside the proliferation of the connected devices (the Internet of Things). Examples include smart energy and agriculture, eHealth and education and intelligent transport.

3.2.1 Smart energy

Smart energy including smart grids and meters, offers the prospect of enabling more efficient energy use, with associated environmental benefits and reduced costs. Smart energy involves connecting devices and developing applications to measure and control the generation and use of energy.

For example, ICT can be used by grid operators to monitor processes in the grid and boost the efficiency of energy transmission. This is crucial in a system with a high feed-in from intermittent energy sources such as wind and photovoltaic generation and will become increasingly important as demand for electricity increases as a result of the growing use of electric vehicles and heat pumps.

ICT can also be used by electricity generators to monitor faults and tailor power generation to meet the prevailing requirements.

On the consumer side, smart meters offer the potential for new customer services and products. They allow the introduction of time or load dependent tariffs and provide

88 See discussion in WIK (2016) for the EC Regulatory, in particular access, regimes for network investment in Europe.

89 See Arnold, R.; Kroon, P.; Tas, S.; Tenbrock, S. (2018): The socio-economic impact of FTTH, study by WIK-Consult for the FTTH Council, available at: https://www.ftthcouncil.eu/documents/FTTH_Council_report__FINAL_and_proofread-update-20180214.pdf.

90 Some content derived or adapted from WIK (2019) Analysis of the Danish Telecommunication Market in 2030, available at: https://ens.dk/sites/ens.dk/files/Tele/wik_consult_final_report.pdf.

consumers with (real-time) information on their energy consumption. Smart meters can also be connected to wider "home automation" systems.

Although some smart energy applications including smart meters do not require the capacities available over fibre, other critical applications in the grid such as applications to monitor and addressing critical events, require very low latency and high reliability.

Supported by the efforts of Enel, Italy is one of the frontrunners in smart metre technology. Electromechanical devices were implemented as early as 2001. Newer versions for 32 million homes and businesses were introduced in 2016.[91]

In an interview given in 2020, Enel further highlighted how fibre connections can support smart energy. Nicola Lanzetta, Head of market Italy at Enel, noted that:[92] "A high-speed internet connection enables customers to fully benefit from innovations in smart home technology and the digitisation of the energy sector."

3.2.2 Smart cities

Smart city applications offer the prospect of using technology to control energy use for public lighting and buildings, as well as guiding traffic flows and supporting more sustainable mobility solutions including public transport, car and bicycle sharing schemes, as well as automated driving. Smart city applications can also be used to enforce environmental schemes such as congestion charging, and support efficiency in public services such as waste management. Fibre to public buildings and street furniture is a key enabler of smart city services.

One of the pioneers in this space has been the City of Stockholm. In collaboration with the wholesale only fibre network operator Stokab, the City has plans to connect 500 city cabinets at all major street crossings with fibre over a period of 3 years. In an interview conducted with WIK,[93] Stokab noted that dynamic capacity in traffic lights could be used to prevent traffic jams in urban areas, and can have a positive impact on the environment and energy consumption by reducing waiting times for cars and making buses more attractive. Stokab observed that in the first week of trials of dynamic traffic light controls in the Stockholm area, buses experienced 25% faster driving times. In a simulation conducted for the city as a whole – buses were able to drive as if there were no rush hour.

Another important application of cameras at the street level is to enforce rules over when or which vehicles can drive (e.g. in the context of bans on certain types of fuel for

91 See https://www.enel.com/media/press/d/2016/06/enel-presents-enel-open-meter-the-new-electronic-meter.

92 See https://www.digitaltveurope.com/2020/01/06/enel-unit-teams-up-with-melita-for-italian-fibre-offering/.

93 See WIK (2019) Telecommunications markets in 2030.

environmental purposes), or which charges might be applicable (e.g. in the context of congestion charging). Assessments could also be made concerning the length of vehicles and whether they comply with any restrictions applicable.

Within Italy, Milan has been cited as a leading example of a "smart city". With the benefit of a long-standing fibre infrastructure, Milan has supported the development of fablabs, incubators and co-working spaces, supporting innovation and economic development in the city.[94] The city has also been a leader in developing smart mobility and digital local Government services, as well as providing access to its extensive datasets.[95]

Infrastructure deployed by Open Fiber has also been used to support smart city applications elsewhere. For example, in the city of Bari, Open Fiber struck a partnership to provide connectivity for 100 backbone access points, which would be used for smart city applications. The city plans to use it for traffic lights, video surveillance and street lighting, as well as to increase the speed and effectiveness of repairs. In total, 15.000 lights will be connected to the network.[96]

Another example of a smart city fueled by Open Fiber's network is Gemona del Friuli, a municipality in the north-east of Italy with about 11,000 inhabitants. The fibre network will be used to enable smart environmental sensors as well as smart applications such as cloud computing, teleworking and health and digital education. To further facilitate smart city policies, 50 buildings owned by the municipality will also be connected to the network.[97]

A fibre "backbone" is also essential for local city WiFi initiatives. One example is the "smart square" project initiated in 2016 at the Piazza Risorgimento in Turin. A focus for the initiative was to avoid energy waste, by using smart lighting and watering systems.[98] Free WiFi is also available for public use. The Piazza was visited by 27.000 different people within six months, the free WiFi was used 10.000 times, with 1.300 Gigabyte of downloaded data.[99]

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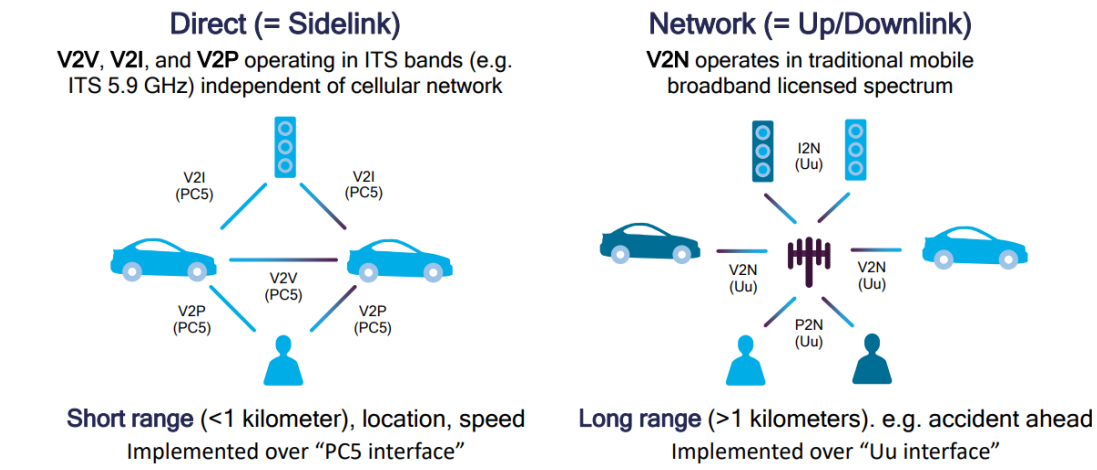
94 See https://labgov.city/theurbanmedialab/smart-city-development-the-milan-mode/.
95 See https://www.enelx.com/it/en/resources/stories/2019/06/smart-city-cities-italian-virtuous.
96 See Corrierecomunicazioni.it (2019): Smart city, Bari accelera: completata da rete di Open Fiber, 16.09.19., electronically available in Italian at: https://www.corrierecomunicazioni.it/telco/smart-city-bari-accelera-completata-da-rete-di-open-fiber/.
97 See https://openfiber.it/mondo-open-fiber/comunicati-stampa/gemona/.
98 See Ertico (2016): Italy's first smart square is born in Torino, 02.11.16, electronically available at: https://erticonetwork.com/italys-first-smart-square-born-torino/.
99 See Planet Smart City (2017): Success stories from the first smart square in Italy, 24.03.17., electronically available at: https://www.planetsmartcity.com/success-stories-from-the-first-smart-square-in-italy/.

3.2.3 Smart transportation

The development of connected automotive mobility is another application that will depend on the widespread deployment of fibre.

A basis for the implementation of this application is the Cellular Vehicle-to-Everything (C-V2X) standard that interconnects vehicles with other vehicles, the infrastructure, pedestrians and the network. The following diagram shows the different communications models V2V, V2I, V2P (direct link) and V2N (Up/Downlink).

Figure 3-4: C-V2X communication models



Source: 5GAA.

Requirements for autonomous driving are quite strict. Autonomous vehicles may drive very close to each other and at higher speeds (up to 200 km/h). Therefore an autonomous vehicle requires full road network coverage to work driverless in all geographies.[100]

For this reason, fibre backhaul alongside roads is one of the main prerequisites for autonomous driving. Moreover, the power supply infrastructure may also need to be redesigned to ensure power supply for base stations.

There are a number of 5G CAM iniatives active in Italy, including 5G CARMEN, a project to build a 5G-enabled corridor and conduct trials using a mixture of 5G micro and macro cells for ubiquitous C-V2X connectivity.[101]

100 Campolo et al. (2017): 5G Network Slicing for Vehicle-to-Everything Services, in IEEE Wireless Communications, Volume: 24, Issue: 6.

101 See https://trimis.ec.europa.eu/project/5g-connected-and-automated-road-mobility-european-union.

Another flagship project in Italy is the “Smart Road” project in Turin, where not only autonomous vehicles will be tested, but also remote control vehicles, requiring 5G and fibre connectivity.[102] This “Smart Road” project also includes traffic detection systems, smart cameras and digitized road signs, to facilitate the capabilities of autonomous driving.[103]

The related field of smart logistics is a key driver in the field of IoT. IoT devices in the field of logistics are mainly used for tracking packages and increasing efficiency in supply chains. These devices can also be used to track vehicles in a large company fleet. IoT solutions for logistics in Italy had achieved a total market volume of 360 million Euro by 2016.[104] Although the bandwidths required for each of these sensors today may be limited, the proliferation of devices and quantity of data is likely to require fibre connections in the backbone (linked to wireless technologies) and in centres which are involved in processing this data.

3.2.4 E-Health

E-Health or smart health refers to ICT in healthcare. E-Health can involve networking amongst healthcare practioners, the consolidated collection and processing of medical data as well as remote monitoring and interventions for patients in a home or hospital setting.

Demographic change is an important driver for applications in telemonitoring and telecare. Key drivers are that the life expectancy is on the rise and senior citizens and other vulnerable segments of the population expect to lead an independent life without being overly dependent on their families and medical facilities. Meanwhile, the ready availability and exchange of medical records, coupled with connectivity amongst specialists and the application of AI can support more efficient and accurate diagnoses and treatment for all patients.

Today data volumes associated with many telemedecine and telecare solutions are not very high, and can mostly be satisfied through standard fixed, mobile and wireless broadband connections. However, upcoming e-Health applications are likely to require more advanced forms of connectivity involving increased bandwidths quality of service

102 Giarda, R. (2018): Smart Roads Decree: autonomous vehicles, made in Italy , electronically available at: http://www.bakerinform.com/home/2018/11/13/smart-roads-decree-autonomous-vehicles-made-in-italy.

103 See http://www.comune.torino.it/consiglio/documenti3/documentazione/000/0/H201900637_01.pdf.

104 Atzori, E. (2018): La Smart Logistics perno dell’Internet of Things in Italia, 06.06.18., electronically available in Italian at: https://blog.tuttocarrellielevatori.it/13603/smart-logistics-iot/.

and/or reliability[105]. Specifically, going forwards, digital healthcare solutions may increasingly involve:

- Augmented and virtual reality e.g. in the treatment of phobias[106] and dementia,[107] as well in surgery. [108]
- Big data processing e.g. to record, store and exchange patient data including scans.[109] The aggregation of data can then provide scope for the use of AI to analyse patterns and develop algorithms to detect specific medical conditions.
- Robotics: Currently, robotics is used in the fields of assisted living technology and with certain medical conditions. In future robotics is increasingly expected to play a role in surgical procedures.

As these examples illustrate, fibre and advanced mobile technology (LTE and future 5G) can be regarded as prerequisite for the next evolutions in innovative medical services and applications. These technologies enable very high bandwidths transmitting of large volumes of data with a very low latency. In the study conducted by Ecorys, WIK, IDATE and CBO for the European Commission on CEF Digital, the study team recommended that all medical (as well as educational) facilities should ideally be equipped with point to point fibre connections, in order to enable them to realise their digital potential. Very high capacity connections will also be required for end-users to be able to interact and benefit from remotely provided consultations and monitoring.

Health care policy in Italy is handled separately by the 20 regions which means that there is no unified policy on the health services that are available digitally. However, encouraged by the Government's digital agenda, many regions have taken the first steps to introduce services such as electronic patient records or to discontinue paper-based prescriptions.[110]

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105 Quality of service metrics can be particularly important for the use of Health IT. Latency, reliability, packet loss and jitter can be even more important than bandwidth in the specific solutions, available at: https://transition.fcc.gov/national-broadband-plan/health-care-broadband-in-america-paper.pdf.

106 See https://www.npr.org/sections/13.7/2016/09/01/491991386/can-cute-virtual-reality-spiders-help-reduce-arachnophobia.

107 See https://www.healthline.com/health-news/heres-how-vr-can-help-people-with-dementia#What-the-study-found.

108 See See https://healthcare-in-europe.com/en/news/augmented-reality-is-the-future-of-surgery.html.

109 See preliminary findings from the study for the European Commission "Smart investments for smart communities", available at: https://ec.europa.eu/digital-single-market/en/news/cef2-study-workshop-smart-investments-smart-communities.

110 empirica & Bertelsmann-Stiftung (2018): #SmartHealthSystemsInternational comparison of digital strategies, electronically available at: https://www.bertelsmann-stiftung.de/fileadmin/files/Projekte/Der_digitale_Patient/VV_SHS-Studie_EN.pdf.

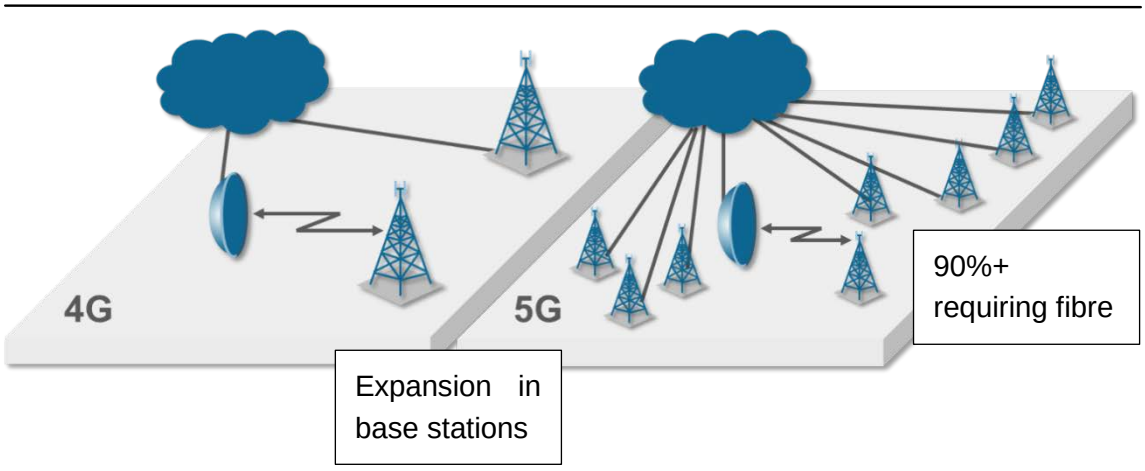
For general practicioners, the use of telemedicine is possible and allowed in the same way as personal visits to the doctor.[111] Connections between larger hospitals and remote clinics can also serve to distribute expertise and maintain the lifelines needed for rural communities to thrive. A field experiment in Sardinia with an audiovisual connection from a rural clinic to a bigger hospital to instantaneously receive the expert opinion of a heart specialist was well received.[112]

3.3 Fibre as the backbone of 5G

Several of the future use cases described above, including connected automotive mobility and potentially robotic surgery, will require some very low latency wireless connectivity. This is one of the key characteristics that should be provided by upcoming 5G technology.

However, the availability of fibre will become even more critical for mobile operators as they upgrade to 5G technologies which use higher frequencies with a lower range and therefore require build-out of additional base stations over time especially in densely populated areas. Interviews conducted by WIK with a number of mobile operators across Europe suggest that 5G is likely to require fibre to the vast majority of base stations (more than 90%), in comparison with today's networks, which still make use of microwave radio links for a significant proportion of connections.

Figure 3-5: Fibre requirements in a 5G environment



Source: WIK based on operator interviews.

111 See http://www.salute.gov.it/imgs/C_17_pubblicazioni_2129_allegato.pdf.
112 See Pinna, R.; Carrus, P. P.; Musso, M. (2016): Excellence in healthcare: Telemedicine project in an Italian region, electronically available at: http://sites.les.univr.it/eisic/wp-content/uploads/2018/07/Pinna-Carrus-Musso.pdf.

Significant synergies between FTTH and 5G deployment have been confirmed in a number of studies.

In a 2019 study by Comsof for the FTTH Council Europe, which modelled the cost of 5G deployment in isolation and in conjunction with FTTH, the authors concluded that between 65-96% of the fibre costs for 5G front and backhaul could be eliminated by rolling out an optimized and future proof converged fibre network. In the presence of an existing FTTH network, the cost for fibre to deploy 5G could be virtually eliminated, potentially decreasing the total cost of 5G by 50%.[113]

In a study by Ecorys, WIK, IDATE and CBO for the European Commission on CEF Digital, WIK concluded that access to 5G for most or all households in very remote areas could be provided at limited additional cost if full fibre connections to socio-economic drivers such as schools and hospitals were installed alongside an additional fibre backhaul connection for 5G.[114] The authors concluded that 5G connections would not substitute for FTTH, but could be used to reach households in very remote areas where the costs of FTTH are too high to support the business case, even in the presence of public subsidies.

3.4 The role of neutral networks in supporting new applications and 5G

The previous sections underline the importance of achieving a more widescale coverage of very high capacity networks than is the case today in Italy, and within many other European markets.

However, as elaborated by WIK in a number of studies[115], it is unlikely to be economically viable to duplicate VHC networks multiple times across the whole territory. This means that it is important, at least in zones which cannot be competitively served through end-to-end infrastructure competition, to support business models that allow infrastructure to be shared, either through wholesale only models or via co-investment (as outlined in the EU electronic communications Code).

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113 See https://www.ftthcouncil.eu/documents/COM-190313-FibreFor5G-ConvergenceStudy-Presentation-RafMeersman%20-%20v4%20-%20publish.pdf.

114 See interim study presentation downloadable at: https://ec.europa.eu/information_society/newsroom/image/document/2019-40/cef2_workshop_presentation_30092019_final_143907AA-A46C-EFC6-A6203D68B1512B1D_61982.pptx.

115 See e.g. WIK-Consult, Ecorys and VVA (2015): Support for the preparation oft he impact assessment accompanying the review of the regulatory framework for e-communications, available at: http://publications.europa.eu/resource/cellar/2984b37b-9aa6-11e6-868c-01aa75ed71a1.0001.01/DOC_1 and Braun, M.; Wernick, C.; Plückebaum, T.; Ockenfels, M. (2019): Parallele Glasfaserausbauten auf Basis von Mitverlegung und Mitnutzung gemäß DigiNetzG als Möglichkeiten zur Schaffung von Infrastrukturwettbewerb, available (in German with a summary in English) downloadable at: https://www.wik.org/index.php?id=diskussionsbeitraegedetails&id=diskussionsbeitraegedetails&tx_ttnews%5Bcat%5D=4&tx_ttnews%5Byear%5D=2019&tx_ttnews%5BbackPid%5D=93&tx_ttnews%5Btt_news%5D=2276&cHash=f17be22933684953bbcbfaebc86db865&L=1.

WIK and others have highlighted in various studies the role that wholesale only (or neutral) networks can play in this context.

A 2015 report for the UK Department of Digital, Culture, Media and Sport[116] observes that "with the advent of small cells and 5G, a neutral wholesale-only shared infrastructure is likely to become more prominent. The neutral wholesale-only infrastructure could be owned by network operators wishing to co-invest to share the risk, or independent wireless infrastructure providers, or fibre network providers who may choose to diversify into the provision of sites for small cells, or local authorities (e.g. the local council, or road/highways agency) who wish to utilize their assets such as street lights and ducts."

The importance of neutral infrastructure hosts and/or network sharing to support the business case for 5G CAM was also highlighted in a study by Ecorys, WIK, IDATE and CBO for the European Commission.[117]

In a 2018 study[118] WIK noted that neutral fibre networks deployed in Sweden may have supported competition in the deployment of 4G mobile networks, and were likely to put Sweden in a good position to rapidly deploy 5G in a manner which fosters competition.

Meanwhile in a 2019 study[119] in an interview with WIK, Stokab noted that it considers that a neutral fibre infrastructure lowers the threshold for the City to establish new services created by private actors. This network could also be used by private actors for e g IoT,and as a backbone for the 5G networks.

In the same study, WIK observed that, as the value chain evolves towards increasingly complex bundles of digital services (for industry and the public sector) and towards OTT services for consumers, telecoms operators face a choice between going down the value chain in competition with systems integrators and OTT players, or moving up the value chain and favouring a strategy based on operating a "dumb pipe", which could be used by multiple players to develop innovative applications and services.[120]

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116 Department for Digital, Culture, Media & Sport (2015), 5G Network Deployment Pilots: Call for Views, UK Government, p. 10.

117 See presentation at the CEF2 study workshop: smart investments for smart communities https://ec.europa.eu/digital-single-market/en/news/cef2-study-workshop-smart-investments-smart-communities.

118 WIK (2018): The role of wholesale only models in future networks and applications https://www.stokab.se/Documents/Nyheter%20bilagor/The%20role%20of%20wholesale%20only_WIK.pdf.

119 WIK (2019): Analysis of the Danish Telecommunication market in 2030, https://ens.dk/sites/ens.dk/files/Tele/wik_consult_final_report.pdf; OECD (2019): The Operators and their Future: The State of Play and Emerging Business Models, available at: https://www.oecd-ilibrary.org/science-and-technology/the-operators-and-their-future_60c93aa7-en and De Luca, S. (2018): BITS seminar on wholesale-only operators, summary of a seminar by Cullen International, December 2018, available at: https://www.cullen-international.com/events/conferences/2018/12/BITS-Seminar-on-wholesale-only-operators.html.

120 p91 and following Ibid.

Within Italy, a trial for “5G cities” is being conducted from 2017 to 2020 by Open Fiber and Wind Tre in Prato and L’Aquila, in which Open Fiber will focus on delivering 5G services powered by its fibre network in Prato.[121] A multitude of use cases are set to be trialled in these cities, including constant smart monitoring of buildings for earthquake prevention.

121 See https://openfiber.it/en/technologies/5g/5g-city/.

4 The investment case for wholesale only

One of the main drivers for the expansion in wholesale only businesses – and particularly those operating with commercial investors – are the opportunities that this model brings for long term returns on investment. In this chapter, we highlight why the business case for wholesale access may differ from that of downstream services, and provide insights from investors on what attracted them to this model.

Highlights

Theoretical business models developed by WIK-Consult illustrate how wholesale only business models can improve the business case for FTTH deployment, compared with vertically integrated approaches.

A number of investors have also highlighted the attractions of wholesale only fibre infrastructure businesses in offering an essential service with predictable cashflows. For example, in a 2018 Research note, Barclays Capital observed that: “Open Fiber has momentum (and financial backing) and in our view it will be very tough for TI to out-invest and compete.”

In April 2018, Berenberg announced the launch of a “Digital Infrastructure Debt Fund” with the aim of targeting the “substantial backlog of necessary investment in Germany and other countries of Europe”. The fund will focus on expanding fibre-optic networks, 5G masts and data centres in leading industrialised nations. Berenberg notes that fibre-optic projects are noteworthy for having technical and economic lifetimes of up to 50 years, and “as a result, stable cash flows and predictable returns are generated”.

Steffen Leiwesmeier, Head of Financing for Digital Infrastructure at the Hamburg Commercial Bank, noted in an interview for this study that: “A concern with integrated models is that penetration can be limited, while providing access to third parties significantly reduces the investment risk.” According to Leiwesmeier, the solution for the future is for everyone to focus on what they do best. “There is a need to implement a new ecosystem where at every level of the value chain, different parties may play a role.”

The ability of the wholesale only model to provide shareholder value has been demonstrated through investor interest in Open Fiber. On 16 September 2020, ENEL received a binding offer from Macquarie Infrastructure & Real Assets, for the acquisition of the 50% stake held by ENEL in Open Fiber.[122] The offer assumes an implicit Enterprise Value of Open Fiber of between 7 and 8 billion euro, significantly more than the investments made by CDP and ENEL, which each originally contributed around 1 billion euro to the venture.

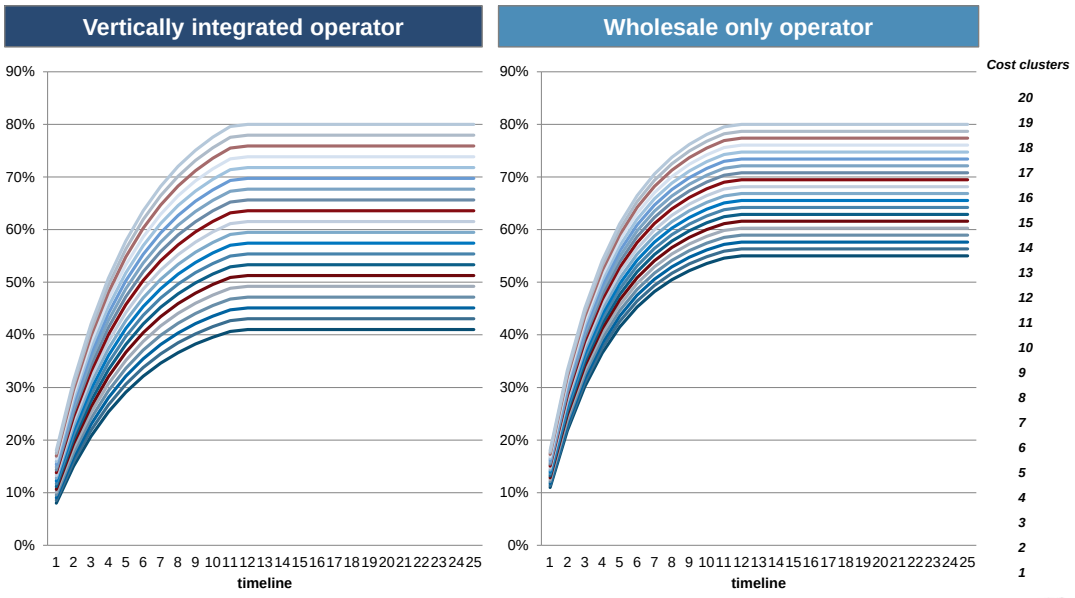
122 See https://www.reuters.com/article/us-open-fiber-m-a-macquarie-enel-idUSKBN2682HH.

4.1 The implications of wholesale only on the business case for FTTH deployment

Business models developed by WIK-Consult illustrate how wholesale only business models can improve the business case for FTTH deployment, compared with vertically integrated approaches.

For example in a 2017 study[123], WIK found that investment periods for fibre optic utilities on the basis of wholesale only networks showed shorter payback periods in comparison to vertically integrated operators. It concluded that the wholesale only model could be used to expand the number of areas accessible for commercial rollout and reduce the overall need for subsidies. Although costs faced by the two types of providers were similar (or even higher for the wholesale only provider, when taking into account its numerous wholesale contractual relationships), a key difference was the higher take-up on the wholesale only network. Wholesale only providers were also found to have a lower risk profile in their business activities as the infrastructure market segment is less competitive than the retail market.

Figure 4-1: Take-up over time compared

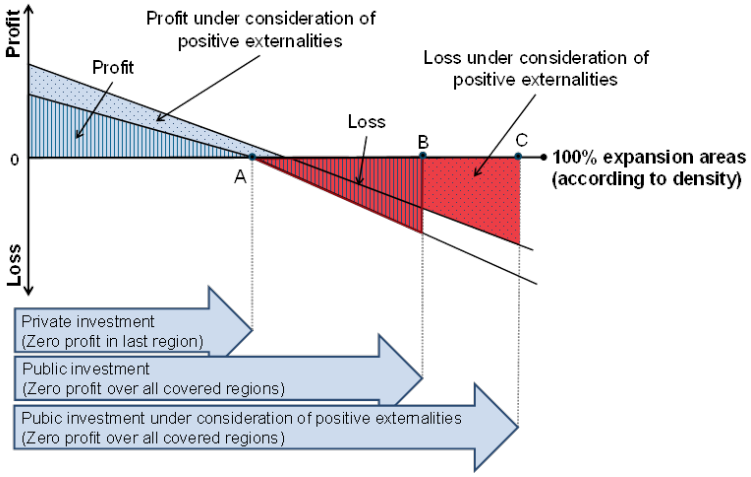


Source: WIK.

123 See Wernick, C. et al. (2017): Ansätze zur Glasfaser-Erschließung unterversorgter Gebiete, available at: https://www.wik.org/fileadmin/Studien/2017/2017_DIHK_Studie.pdf.

In another study,[124] WIK found that the ownership model could also influence the business case for fibre deployment. Specifically, WIK concluded that public policy actors are likely to make significantly different investment decisions than private sector actors, which is illustrated in a stylized way in the figure below. Specifically, while a profit-maximising firm would focus only on areas in which it could achieve maximum profitability, a firm which also takes into account public interest (total welfare), might expand its investment beyond that point, making use of cross-subsidisation to cover a wider area than would be implied under the profit-maximising scenario.

Figure 4-2: Investment decision for broadband deployment



Source: WIK based on Inderst et al. (2011).[125]

The study also observed that public actors such as municipalities and communities, may also take into account positive externalities such as the benefits to be gained by serving more remote communities. This is illustrated by an outward shift of the profit function in Figure 4-2, which illustrates that broadband is deployed even in regions with a lower population density (Point C). Public actors might also take into account other factors such as the "sustainability" of infrastructure, and take a more long-term view of investments than would be typical of the private sector.

Similar observations on the implications for the business case of the involvement of public investors are made in a presentation given in 2004[126] by Rabobank, an investor

124 Wernick, C.; Bender, C. (2017): The Role of Municipalities for Broadband Deployment in Rural Areas in Germany: An Economic Perspective, in: Digiworld Economic Journal, No. 105, 1st Q 2017.

125 See Inderst et al. (2011): "Ökonomische und rechtliche Rahmenbedingungen zum Ausbau und zur Finanzierung von Breitband-Hochleistungs-infrastrukturen in dünn besiedelten Gebieten", Study for the Federal Ministry of Economics and Technology (BMWi), downloadable at: https://docplayer.org/17189424-Oekonomische-und-rechtliche-rahmenbedingungen-zum-ausbau-und-zur-finanzierung-von-breitband-hochleistungsinfrastrukturen.html.

126 Joop de Besten, Henk Doorenspleet - Rabobank presentation: FTTH from a banker's perspective, Delft 14 March 2004.

in regional fibre projects, which showed that the business case for FTTH is positive only under high penetration scenarios and is sensitive to increases in the WACC (weighted average cost of capital). The Rabobank presentation also observes that the acceptable WACC levels could be influenced by the nature of the investors, with municipalities and housing corporations accepting considerably lower levels of return. This could mean that certain types of investors are more likely to consider fibre as commercially viable than others, which expect market-based levels of return.[127]

It is possible that these findings about the impact on the fibre business case of investment by actors which are not solely profit-maximising, may also be relevant for other publicly owned investors in telecoms infrastructure, although more research would be needed to confirm this hypothesis.

4.2 The views of investors on wholesale only models

Wholesale only models for fibre deployment have attracted attention and interest from private as well as public investors in Europe since the early days in the development of this business model. The Amsterdam Citynet project was funded with the aid of private investors, including ING and Reggefiber.[128] The private investment company Reggeborgh was also the investor behind the widescale wholesale only FTTH deployment in the Netherlands by Reggefiber,[129] which was later acquired by the Dutch incumbent KPN.[130] It should be noted however that, following its acquisition by KPN, Reggefiber's FTTH rollout stalled.

The French national investment bank Caisse des Depots and infrastructure investment fund Margueritte played a significant role in providng finance for French Public Initiative Networks, which focused on wholesale only fibre deployments in rural areas of France.[131] Indeed, it is notable that the amounts of state aid required to fund French rural deployments have been in decline, in part due to the availability of long-term financing, which reduced the need for State Aid in this area.

More recently, private investors have taken note of the potential for wholesale only businesses to disrupt telecoms markets in circumstances where the conditions are right.

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127 See discussion in WIK, Deloitte, IDATE (2016) Regulatory, in particular access regimes for network investment in Europe.

128 In 2005, the city of Amsterdam together with five housing corporations and two financial investors (ING and Reggefiber) agreed to invest in a FTTH network. The municipality of Amsterdam invested € 6 million, ING and Reggefiber each invested € 3 million, three social housing corporations invested each € 1.5 million and two housing corporations each invested € 750,000. The total equity investment amounted to € 18 million. Another €12 million in funding was provided as debt financing.

129 The Reggefiber network was financed through shareholder equity as well as debt from third parties including the European Investment Bank (EIB). Schrijver, T. (2015), Off-Balance Financing of the fiber network at Reggefiber: a case study, p. 3.

130 See https://overons.kpn/en/news/2014/kpn-acquires-remaining-40-stake-in-reggefiber.

131 See interviews in chapter 3 WIK (2018) The role of wholesale only models in future networks and applications.

In a May 2018 research note on "European Telecoms Services",[132] Barclays took a positive view of Open Fiber, and noted that in addition to the threat to TI from Open Fiber, it sees a risk to Deutsche Telekom and BT from alternative infrastructure deployments, which could be mitigated only if the incumbents themselves accelerate their FTTH deployments. Barclays observe that BT and DT had struggled to make the FTTH business case work, largely because they assess the FTTH investment against the value of the copper revenue annuity in a way that wholesale only companies do not have to. However, it concludes that not investing presents risks that incumbents will lose market share in the medium term, confirming that infrastructure competition from new fibre entrants presents a significant (and perhaps the only) incentive for incumbents to deploy FTTH.

The risks to investors in incumbent operators are mirrored by opportunities for potential investors in wholesale only projects, in countries or regions where there is a space in the market, due to the absence of cable or other significant infrastructure competitors to the incumbent.

For example, in April 2018, Berenberg announced the launch of a "Digital Infrastructure Debt Fund"[133] with the aim of targeting the "substantial backlog of necessary investment in Germany and other countries of Europe". The fund will focus on expanding fibre-optic networks, 5G masts and data centres in leading industrialised nations. Berenberg notes that fibre-optic projects are noteworthy for having technical and economic lifetimes of up to 50 years, and "as a result, stable cash flows and predictable returns are generated".

Private equity firms such as Antin Infrastructure Partners have also taken significant stakes in telecoms infrastructure projects, including wholesale and business fibre specialists in their portfolio such as UK-based Cityfibre and NL-based Eurofiber alongside tower and mast companies such as Axion (Spain) and FPS Towers (France).[134] Antin notes that when screening for investment opportunities they aim to identify "companies that provide an essential service with high barriers to entry, generating predictable and stable cashflows".

The Hamburg Commercial Bank has provided debt financing for a range of fibre infrastructure projects in Germany as well as the Netherlands, Spain, Portugal and Austria. In an interview for this study, Steffen Leiwesmeier, Head of Financing for Digital Infrastructure noted that they have invested in regional companies which provide retail services, but that for them the integrated model should be seen only as a bridge towards focusing on the main purpose of the business, which is infrastructure. A

132 See http://www.astrid-online.it/static/upload/ee15/ee15dd20387f716c39d4823e71773e7c1.pdf.
133 See https://www.berenberg.de/en/press/berenberg-digital-infrastructure-debt-fund-i-invests-in-the-expansion-of-fibre-optic-networks-3911.html.
134 See https://www.antin-ip.com/portfolio/investments.

concern with integrated models is that penetration can be limited, while providing access to third parties significant reduces the investment risk.

Leiwesmeier agrees that wholesale only business models present a significant threat to incumbents, some of which had "slept" through a time during which they should have been making significant investments in fibre upgrades. According to Leiwesmeier, the solution for the future is for everyone to focus on what they do best. "There is a need to implement a new ecosystem where at every level of the value chain, different parties may play a role."

The preference from long-term investors (both public and private) for utility-style business models for telecoms was also highlighted in the 2016 study conducted by WIK with IDATE and Deloitte for the European Commission on "Access and Investment", in interviews with Delibor Vavruska from Citigroup and Harald Gruber of the European Investment Bank.[135]

In this context, Vavruska noted that there is a large pool of infrastructure funds offering long term and cheap capital. "Long-term utility-type assets are unlikely to be subject to innovation and therefore can be subject to a longer payback period and different competition and different regulatory approach compared with shorter term assets," he said.

Meanwhile Gruber noted that "The optimum would be a regulatory environment which enables a single independent basic infrastructure, typically an open access network, which can be accessed on equal terms by service providers. Financing of passive infrastructure allows risks to be identified more easily."

The logic of separating infrastructure from services, is also increasingly being pursued by private investors in incumbent operators,[136] on the basis that there is a fundamental difference between the "access" business (which is more akin to a utility) and the "retail services" business.

For example, when the Czech incumbent O2 was acquired by the private equity firm PPF, the company was split between an infrastructure wholesaler (Cetin) and service provider. PPF noted in the context of a 2017 investor presentation[137] that the infrastructure business entailed "longer packback" reflecting the longer lifecycle of the underlying network technologies, while the service business was "asset light" and associated with short payback on products with a short lifecycle, recouped over the term of the customer contract.

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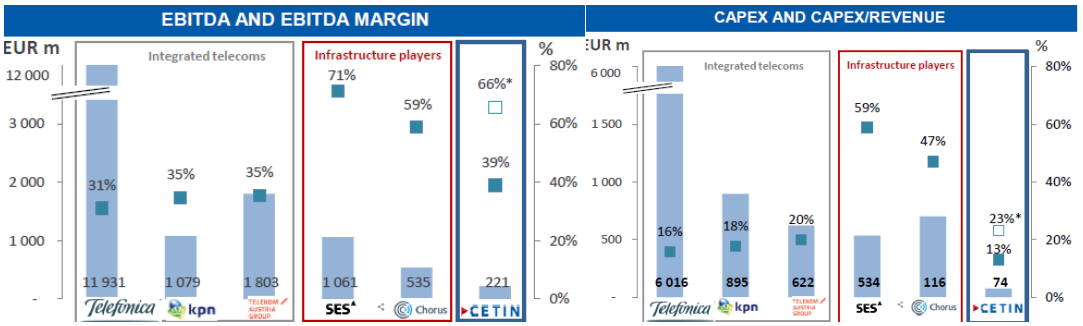
135 See Chapter 6 WIK, Deloitte, IDATE (2016) Regulatory, in particular access, regimes, for network investment in Europe.

136 Including CETIN/O2, TDC.

137 See https://www.cetin.cz/documents/10182/124348/20170102+CETIN+Company+overview.pdf/ac291d02-0990-45dd-8219-5ea7c51191be.

Benchmarks of selected operators presented by Cetin show that pure "infrastructure players" tended to have higher EBITDA margins, and also higher CAPEX/revenue ratios than the vertically integrated telecoms operators, highlighting the effects of combining two distinct businesses (infrastructure vs services) in one.

Figure 4-3: Information on EBITDA and CAPEX for different operators



Source: Cetin.

However, as noted in section 1.2 and as highlighted in the Barclay Capital research note, the investment incentives for separate infrastructure divisions of incumbent operators differ from those of greenfield wholesale only providers, because incumbent operators must trade off short-term cashflows and profits from existing copper infrastructure against the longer-term payback that may be achieved by investing in fibre. It is noteworthy in this context that CETIN's capex/revenue profile is lower than the "infrastructure players" identified in its benchmark.

Positive attitudes to telecom network infrastructure investments mirror those for investment in other infrastructures used to support telecom network deployment. One prominent model in the telecommunications market is the one of mobile tower companies independent from mobile network operators (so called TowerCos). A report by EY estimated in 2019, that a wider spread of these models[138] could lead to economic savings of €31bn in Europe by 2029. They also notice an increased investor interest in European mobile towers in recent years, e.g. by the investment firm KKR, which nowadays owns shares in TowerCos active in various European countries.[139]

A study by PwC and Global Infrastructure Facility argues, that cities should establish the preconditions to make it possible for private investors to invest into city

138 Meaning in this case an increase in the share of mobile towers owned by TowerCos from 17% to 50%.

139 See EY (2019): The economic contribution of the European tower sector, available at: https://www.eylaw.com.hk/Publication/vwLUAssets/ey-the-economic-contribution-of-the-european-tower-sector/$FILE/ey-the-economic-contribution-of-the-european-tower-sector.pdf.

infrastructure.[140] These investments appear to be profitable: Investments by private investors into public infrastructure yielded double digit annual returns in 2016.[141]

More generally, the case to deploy private capital to invest in telecom infrastructure is made in a study by United Europe and Roland Berger, which notes that opportunities arise from the high liquidity in the capital markets accompanied by public underinvestment in infrastructure. The authors note that one problem is that large initial investments and long building times are needed in infrastructure projects, before the cashflow starts.[142] However, investments into companies that have already built fibre infrastructure, which yields returns, could address the perceived risk for the capital markets, opening the gate for additional investment from private capital to support VHC goals in Italy and beyond.

4.3 Investors' view of Open Fiber

In its 2018 Research note,[143] Barclays observed that "Open Fiber has momentum (and financial backing) and in our view it will be very tough for TI to out-invest and compete. Key success factors are 1) no cable/incumbent FTTH, 2) Enel (utility provider) a key infrastructure partner, 3) fertile competitive retail environment with broad support for alternative infrastructure." Barclays sees the potential for a "double-digit" internal rate of return (IRR) for greenfield FTTH investments in Italy. They highlight the low capex per home passed (€300 for the horizontal part with potential decline to €250 over time) as a key benefit arising from the re-use of existing infrastructure in Italy. The research note indicates growing EBITDA expectations alongside an increasing customer-base, which Barclays identifies as a key driver of the business case.

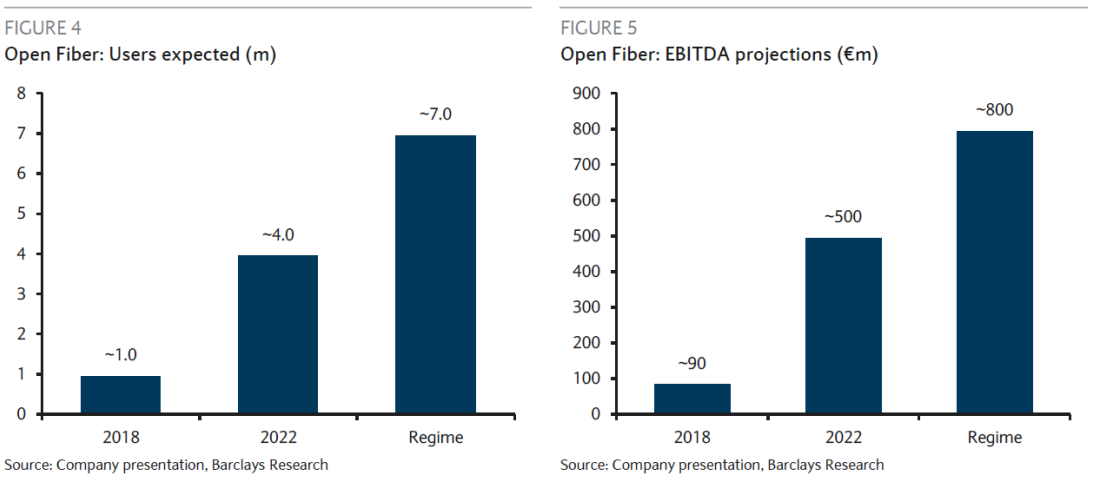
140 See PwC and Global Infrastructure Facility (2020): Increasing private sector investment into sustainable city infrastructure, available at: https://www.pwc.com/gx/en/industries/assets/pwc-increasing-private-sector-investment-into-sustainable-city-infrastructure.pdf.

141 See PwC and GIIA (2017): Global infrastructure investment – The role of private capital in the delivery of essential assets and services, available at: https://www.pwc.com/gx/en/industries/assets/pwc-giia-global-infrastructure-investment-2017-web.pdf.

142 See Ammermann, H. (2015): Squaring the circle – Improving European infrastructure financing, available at: https://www.rolandberger.com/en/Publications/Squaring-the-circle-improving-European-infrastructure-financing.html.

143 See http://www.astrid-online.it/static/upload/ee15/ee15dd20387f716c39d4823e71773e7c1.pdf.

Figure 4-4: Open Fiber: Expected users and EBITDA projections



Source: Company presentation, Barclay Research.

These positive expectations have been borne out by Open Fiber's financial performance in practice. Open Fiber's revenues grew to almost 200 million euro in 2019, due to the progressive expansion of its customer base. This revenue growth was achieved despite the fact that Open Fiber's coverage is still relatively limited, and confirms that there is demand for fibre-based solutions in Italy. Open Fiber also reports that it achieved positive EBITDA in 2019 through a combination of cost control and increased revenues.

As a result, Open Fiber has attracted interest from major infrastructure investors. On 16 September 2020, ENEL received a binding offer from Macquarie Infrastructure & Real Assets, for the acquisition of the 50% stake held by ENEL in Open Fiber.[144] The offer provides for a consideration of approximately 2,65 billion euro, net of debt with adjustments and earn out mechanisms, and assumes an implicit Enterprise Value of Open Fiber of between 7 and 8 billion euro. This offer confirms the potential of wholesale only business models to add value, noting that CDP and ENEL each originally contributed around 1 billion euro to the venture.

144 See https://www.reuters.com/article/us-open-fiber-m-a-macquarie-enel-idUSKBN2682HH.

5 Environmental impact of fibre

Considerable focus has been given to the economic benefits of increased bandwidth. These are illustrated inter alia in the 2016 study prepared by WIK-Consult, Ecorys and VVA for the European Commission in the context of the Impact Assessment accompanying the review of the EU Framework for electronic communications,[145] and in the 2018 study prepared by WIK for Ofcom on the "Benefits of ultrafast broadband".[146] Recent academic literature also provides evidence of a positive impact on EU GDP from ultrafast broadband[147] that exceed the benefits achieved through basic broadband.[148]

With the introduction of a strategy for a "European Green Deal",[149] attention is increasingly also being given to the environmental advantages of FTTH. In this chapter, we summarise available literature on this subject.

Highlights

A number of studies confirm that fibre access networks are significantly more energy efficient than legacy copper or coax networks, and thus produce less carbon dioxide in proportion to the data transmitted. For example, a 2014 study by Aleksic and Lovric found that deployment of all FTTH/B infrastructure could lead to 88% less greenhouse gas emission per bit in Europe than using copper and coax infrastructure.

A 2018 study by Carbon Smart also assessed the environmental implications of deploying fibre, thereby assessing the environmental impact over the full lifecycle of the network. The authors noted that extracting the 2kg copper ore needed to produce a 200-foot length of copper wire would produce around 1,000 kgCO2e, while creating the equivalent length of fibre optic cabling would produce just 0.06 kgCO2e.

The study also concluded that the adoption of data dependent ICT-enabled solutions has the potential to reduce global emissions by 16.5% per annum by 2020. Examples cited include the potential for increased teleworking to reduce traffic, energy efficiency through smart metre use, the use of telemedicine to replace physical appointments and reductions in congestion due to autonomous cars.

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145 WIK, Ecorys, VVA (2016) Support for the preparation of the impact assessment accompanying the review of the regulatory framework for e-communications http://publications.europa.eu/resource/cellar/2984b37b-9aa6-11e6-868c-01aa75ed71a1.0001.01/DOC_1.

146 WIK (2018) Benefits of ultrafast broadband deployment https://www.ofcom.org.uk/__data/assets/pdf_file/0016/111481/WIK-Consult-report-The-Benefits-of-Ultrafast-Broadband-Deployment.pdf.

147 Ultrafast broadband in the EU is defined as at least 100Mbit/s download speed, i.e. not only possible by building FTTH-networks, but often achieved through it.

148 See Briglauer, W.; Gugler, K. (2018): Go for Gigabit? First Evidence on Economic Benefits of (Ultra-) Fast Broadband Technologies in Europe. Available at: http://ftp.zew.de/pub/zew-docs/dp/dp18020.pdf.

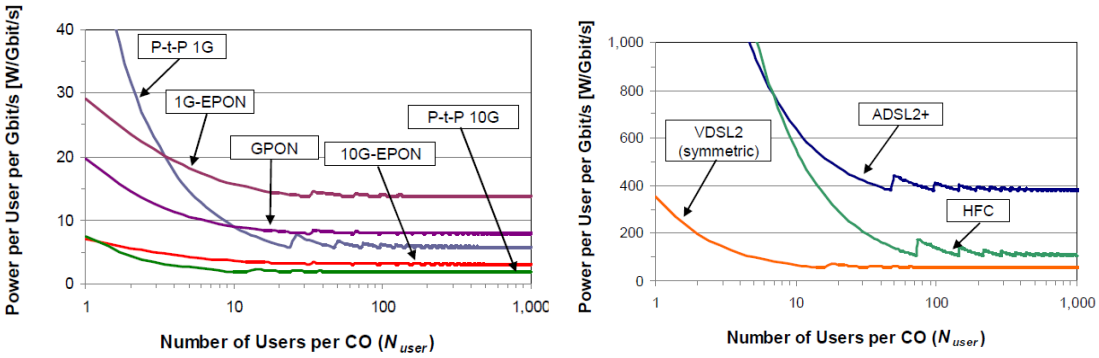
149 See https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

5.1 Environmental benefits associated with FTTH

In a 2014 study, Aleksic and Lovric[150] investigated the implications of wired access networks on energy consumption and environment. They found that deployment of all FTTH/B infrastructure could lead to 88% less greenhouse gas emission per bit in Europe than using copper and coax infrastructure.

The power per user per megabit for different FTTH architectures, cable and xDSL architectures is shown in the figures below. It can be clearly seen that ADSL is the most inefficient technology. However, HFC cable and VDSL2 are clearly shown to be considerably less energy efficient than the FTTH technologies assessed. In the scenario where there is an unlimited uplink to the metropolitan area network, 10Gibt/s point to point is seen to be the most energy efficient technology. However, in a (more realistic) scenario where the uplink capacity is limited to 320Gbit/s, 1Gbit/s point to point and PON options are shown to be the most power efficient.

Figure 5-1: Power efficiency of FTTN and FTTH access options when assuming an unlimited available capacity in CO



Source: Aleksic and Lovric.[151]

The high level conclusions of this study are similar to those reached in a 2011 study by Baliga, Ayre et al,[152] which also found that optical access networks are the most energy efficient of the available access technologies. In a study which also considered wireless technologies, the authors found that the most energy efficient network architecture was a PON network, followed by point to point fibre for high bandwidths. UMTS and WIMAX

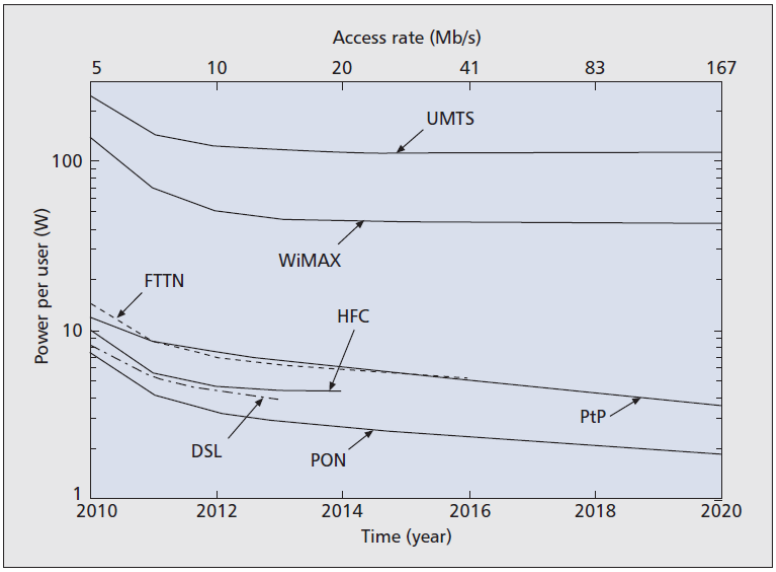
150 See Aleksic, S & A.Lovric (2014). Energy Consumption and Environment Implications of Wired Access Networks. American Journal of Engineering and Applied Sciences 4 (4), 531-539.

151 See https://www.researchgate.net/publication/224176081_Power_consumption_of_wired_access_network_technologies.

152 Energy consumption in wired and wireless access networks https://people.eng.unimelb.edu.au/rtucker/publications/files/energy-wired-wireless.pdf.

were found to be considerably less energy efficient for the bandwidths considered. The bandwidths achievable via HFC, FTTN and DSL at that time fell short of those possible with fibre optics and the energy efficiency was lower for those technologies than for FTTH PON.

Figure 5-2: Expected power consumption of latest generation DSL, HFC, PON, FTTN, P2P, Wimax and UMTS equipment as a function of the calender year



Source: Baliga, Ayre et al.[153]

A 2018 study by Carbon Smart[154] also assessed the environmental implications of deploying fibre, thereby assessing the environmental impact over the full lifecycle of the network. The authors noted that extracting the 2kg copper ore needed to produce a 200-foot length of copper wire would produce around 1,000 kgCO2e, while creating the equivalent length of fibre optic cabling would produce just 0.06 kgCO2e. The study also notes that due to the limited thickness of fibre, it can be deployed using alternative trenching techniques such as microtrenching, which it noted are cheaper, quicker and more environmentally friendly.

Further underlining positive effects of an expansion of fibre networks, the European Telecommunications Network Operators' Association (ETNO) found through a survey of their members, that albeit a traffic increase of 1,100% from 2010 to 2018, carbon

153 Energy consumption in wired and wireless access networks https://people.eng.unimelb.edu.au/rtucker/publications/files/energy-wired-wireless.pdf.

154 See https://www.carbonsmart.co.uk/wp-content/uploads/2018/04/Digital-Infrastructure-WhitePaper.pdf.

emissions of the operators reduced by 40% and electricity consumption increased only by 10%. This supports the findings that the switch to fibre networks significantly improves energy efficiency of telecommunication infrastructure.[155]

5.2 Environmental benefits from digitisation

While it is clear that fibre-based technologies require less power and are associated with fewer emissions per Gigabit than legacy copper and cable-based technologies, this efficiency may be counteracted by the expanding usage of bandwidth. Moreover, increased digitisation is associated with a greater role for datacentres, which have been shown to be energy intensive.[156]

However, various studies highlight that significant energy savings can be made across industry and the public sector, as well as by individuals as a result of digitisation.

A recent study by WIK[157] highlights that several technologies facilitated by FTTH networks, such as smart citiy applications, smart building systems and better possibilities for teleworking also reduce energy consumption.

Likewise, in its 2018 study,[158] Carbon Smart concluded that the adoption of data dependent ICT-enabled solutions has the potential to reduce global emissions by 16.5% per annum by 2020. Examples cited in the study include the potential for increased teleworking to reduce traffic, energy efficiency through smart metre use, the use of telemedicine to replace physical appointments and reductions in congestion due to autonomous cars.

Similarly, in a study of the UK market, SQW (2013)[159] estimated that achieving faster broadband by 2024 could lead to a reduction of 2.3 billion km in annual commuting distance, resulting in annual net carbon dioxide equivalent savings of around 0.24 million tonnes.

Although significant attention has been given to the impact of transport on CO2 emissions, another important contributor to greenhouse gases is heating, ventilation and air conditioning systems within buildings. Indeed, one study suggests that buildings are responsible for around 40% of all energy consumption in the EU as well as 36% of

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155 ETNO (2020): European Commission's public consultation on EU climate ambition for 2030 and for the design of certain climate and energy policies of the European Green Deal, ETNO position paper, available at: https://etno.eu/library/positionpapers/409-etno-green-deal.html.

156 Energy efficiency in data centres, available at: https://www.comsoc.org/publications/tcn/2019-nov/energy-efficiency-data-centers.

157 See WIK (2019) Analysis of the Danish Telecommunication market in 2030, https://ens.dk/sites/ens.dk/files/Tele/wik_consult_final_report.pdf.

158 See https://www.carbonsmart.co.uk/wp-content/uploads/2018/04/Digital-Infrastructure-WhitePaper.pdf.

159 See SQW (2013). UK Broadband Impact Study. Study conducted for the European Commission.

CO2 emissions.[160] According to the ACEEE (American Council for an Energy-Efficient Economy) smart technologies can reduce the energy consumption of buildings by about 20%. This may be achieved by interconnected technologies, occupancy sensors or complex energy management systems. The estimated average energy savings range between 18% for offices, 14% for retail stores and hospitals and 8% for hotels.[161]

160 See EC (2019). Energy performance of buildings, available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings/overview.

161 See ACEEE (2017). Smart buildings save energy and improve occupant comfort, available at: https://aceee.org/blog/2017/12/smart-buildings-save-energy-and.

6 Implications of the Coronavirus

On 31 January 2020, the Coronavirus was confirmed to have reached Italy. On 9 March 2020, as the virus continued to spread, the Italian Government imposed a nationwide lockdown, which lasted until 18 May. The Coronavirus has brought untold suffering. At the same time, it has shone a spotlight on services and infrastructure which are truly essential to the economy and society.

In this section, we consider how enforced distancing shaped users' interaction with broadband networks, and how the experience could support a lasting shift towards digitisation, reducing pollution and energy consumption, in the years to come.

Highlights

Use of video conferencing and online gaming increased significantly during the lock-down period in Italy, with increased bandwidth demands of up to 70%, with peaks in terms of upload bandwidths of up to 300%.

eHealth and eLearning solutions have been pursued and promoted by the Government during this period.

Companies report a significant increase in remote working, which was previously uncommon in Italy. One ISP interviewed for this study, suggested that it could adapt its practices following the outbreak to allow for increased reliance on remote working as part of a balanced solution.

Despite the increased demand for bandwidth, there has been no significant acceleration in fibre take-up. This could be due to the closure of shops, but financial challenges and uncertainty may also deter switching.

After the country went into lockdown on 9 March, nitrogen dioxide (NO2) levels in Milan and other parts of northern Italy fell by about 40%. Columbia University also identified a 5-10 per cent decline in emission of the greenhouse has CO2 in Northern Italy, as traffic levels fell by 35%.

6.1 The role of broadband in connecting communities and maintaining morale

Italy has a culture of close contacts amongst friends and colleagues and between the generations. These traditions were brought to an abrupt end in March, when the Government quaranteened first areas in Northern Italy and later the country as a whole.

During this difficult period, daily interactions moved online. Facebook reported a 10 fold increase in group calls,[162] while messaging traffic across all its platforms had increased by 50% across those countries hardest hit by the virus. Use of Facebook's social media applications expanded by 70%.

Use of online video and gaming also expanded during the period, as families and individuals sought stimulation and information in times of isolation. Installations of Netflix in Italy increased by more than three quarters from February to March,[163] while games such as Fortnite contributed to increased bandwidth demands of up to 70%.[164]

Increased reliance on digital services in Italy has been reflected in national trends in broadband usage. During the Coronavirus pandemic, Open Fiber reported a 300% increase in upload traffic, showing that legacy technologies and historic patterns of asymmetric bandwidth demand (associated with the passive consumption of content) may be challenged in a more digitised many-to-many environment.

Indeed, to avoid the risk of overwhelming existing capacity, service providers such as Netflix and Youtube were called upon by the European Commission to reduce video quality to reduce the pressure on broadband networks.[165] Netflix responded by reducing traffic on its European networks by 25% through reducing the bitrate and with that the quality of their videos.[166]

6.2 Broadband in Italy's schools and hospitals

Prior to the Coronavirus, online courses were not mainstream in Italy. 9% of Internet users undertook an online course in 2019, but this was below the (still limited) European average of 11%. European digitisation indices also show Italians lagging behind in communicating online with public authorities and in the adoption of smart healthcare solutions.

Italian schools and universities responded by using video conferencing software to conduct lessons online,[167] as well as emailing tasks for students to complete at home.

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162 See https://www.bbc.com/news/business-52029737.
163 See https://www.businessinsider.com/netflix-downloads-surging-in-countries-affected-most-by-coronavirus-2020-3?r=US&IR=T.
164 See https://www.ccn.com/italy-plays-shocking-amount-of-fortnite-to-fight-coronavrius-lockdown-blues/. Similar figures have been reported by Open Fiber.
165 See https://9to5mac.com/2020/03/20/limit-streaming-quality/.
166 See https://www.reuters.com/article/us-health-coronavirus-netflix/netflix-to-cut-european-traffic-by-25-due-to-coronavirus-idUSKBN2163I4.
167 See https://www.forbes.com/sites/federicoguerrini/2020/03/14/how-the-coronavirus-is-forcing-italy-to-become-a-digital-country-at-last/#5607c1b46f75.

Via its Digital Solidarity initiative, the Government also supported the availability of eLearning solutions for free.[168]

Remote consultations replaced doctor's visits, and telehealth providers have accelerated their expansion to offer telehealth platforms.[169]

Developments in China during this period also show how technology can help relieve pressure on front line workers and improve healthcare outcomes. According to the UN industrial development organisation,[170] in March 2020, a field hospital staffed by robots opened in Wuhan in China where the pandemic began. The "Smart Field Hospital" is a trial aimed at relieving health care working, and is based on a joint venture between Wuhan Wuchang Hospital, China Mobile and CloudMinds, a maker of cloud robotics systems.

All medical services in the facility were carried out by robots and other IoT devices. Patients entering were screened by connected 5G thermometers to alert staff for anyone feverish. Patients wore smart bracelets and rings that synced with CloudMinds' AI platform so their vital signs, including temperature, heart rate and blood oxygen levels, could be monitored. Doctors and nurses also wore the devices to catch any early signs of infection. Other robots provided patients with food, drinks, medicine and information, while others sprayed disinfectant and cleaned floors.

6.3 Broadband as a driver of economic recovery

Italy has not traditionally been at the forefront of digitisation in the workplace. As of 2018, only around 20% of enterprises in Italy were making use of cloud computing services, and only 7% of enterprises were analyzing "big data". Just 5% of the population made any significant use of homeworking, one of the lowest levels across the EU. A report on smart working by Milan's Politecnico University in October 2019 suggested that more than half of Italian SMEs were not interested in smart working.

However, these traditions were abruptly changed as a result of the Coronavirus. Italy's biggest IT services group Engineering said it was supporting 250,000 workers remotely at 400 firms it supplies.[171] Microsoft recorded 100% growth in usage of the messaging application Teams in Italy.[172] Encouraged by the Italian Government's Digital Solidarity

168 See https://www.weforum.org/agenda/2020/03/italy-covid19-coronavirus-lockdown-digital-solidarity/.
169 See https://techcrunch.com/2020/03/25/kry-launches-free-service-for-doctors-to-do-video-consultations-during-covid-19-crisis/.
170 See https://www.unido.org/stories/china-robot-delivery-vehicles-deployed-help-covid-19-emergency.
171 See https://www.reuters.com/article/us-health-coronavirus-italy-work/smart-move-coronavirus-converts-home-working-laggard-italy-idUSKBN210211.
172 See https://www.euractiv.com/section/digital/news/under-lockdown-italys-social-and-family-life-goes-virtual/.

initiative, Amazon Web Services gave access to their cloud computing platforms to companies, non-profit organisations and government agencies.[173]

In an interview for this study Pietro Maranzana, Chief Broadband Officer for Sky Italia, reported that 95% of its employees were now engaged in smart working and 2,600 people were being connected every day via the company's digital communications systems. Mr. Maranzana found that standardised activities were not negatively impacted, although there was a negative effect for activities which required personal engagement. Mr. Maranzana observed that the process had been a huge learning experience for employees, requiring adaptations that could remain beyond the spread of the virus. For example, the company could consider increasing the number of days spent per week on smart working from 1 to 2, thereby adopting a mixed approach making the best of both worlds.

At the same time, companies and organisations that had invested in digitisation prior to the pandemic have found that these investments shielded them from some of its economic effects. Energy company Enel reported that its deployment of a digital network to support energy generation and delivery, had meant that it could remotely manage its generation activites. Half of its worldwide workforce also work remotely.[174]

6.4 Supporting the environment

One of the few positive effects of the Coronavirus has been to illustrate the benefits that remote working, healthcare and education can bring to the environment, by reducing traffic and cutting pollution.

Since the country went into lockdown on 9 March, nitrogen dioxide (NO2) levels in Milan and other parts of northern Italy fell by about 40%.[175] One cause could be the reduction in road traffic, which accounts for the largest share of NO2 emissions in Europe. Scientists at Columbia University also identified a 5-10 per cent decline in emission of the greenhouse has CO2 in Northern Italy, as traffic levels fell by 35%.[176]

Air pollution presents not only a threat for global warming, but also for global health. Research by academics at Aarhus University has suggested that higher mortality rates

173 See https://www.weforum.org/agenda/2020/03/italy-covid19-coronavirus-lockdown-digital-solidarity/.
174 See https://www.euractiv.com/section/electricity/news/enel-says-digital-drive-has-given-it-hedge-on-coronavirus-threat/.
175 See https://www.theguardian.com/environment/2020/mar/23/coronavirus-pandemic-leading-to-huge-drop-in-air-pollution.
176 See https://www.france24.com/en/20200320-clearer-water-cleaner-air-the-environmental-effects-of-coronavirus.

from Coronavirus in North Italy may in part have been affected by higher pollution levels in the region.[177]

6.5 Implications for fibre take-up

Although the restrictions associated with the Coronavirus lockdown highlighted potential demand for bandwidth, including the symmetric bandwidths offered through fibre connections, in interviews conducted for this study, switching to fibre connections was limited during the lockdown period. This could reflect the fact that shops were closed and advertising campaigns were in many cases suspended. However, Sorgenia, an energy company relying on Open Fiber's network to offer broadband services, also observes that it could reflect payment difficulties amongst smaller firms and consumers, and a reluctance to switch during such an unsettled period.

However, it seems like that the behavioural differences triggered by the Coronavirus distancing measures could translate to a greater necessity for and appreciation of the advantages of full fibre in the years to come, increasing the imperative to support business models which are conducive to fibre investment in Italy.

177 See https://www.sciencedaily.com/releases/2020/04/200406100824.htm.

7 Conclusions

For all its devastation, the Coronavirus has shone a spotlight on how we could work and live in a more environmentally sensitive, more flexible and less pressurised society. However, it is clear from the experience of recent months that, to benefit from the positive aspects of digitisation, Europe needs a broadband infrastructure fit for the post-Coronavirus age.

Even before the Coronavirus hit, Cisco was predicting that the number of devices per person in Italy would increase by 70% from 2018-2023, while IP traffic is predicted to increase by around 25% per year.[178] These levels could (and should) increase as consumers and businesses take the positive lessons from their experience and respond by making permanent adjustments to their working experience (e.g. through increased reliance on home working) and use of public services, including remote healthcare and education.

Ensuring fibre connectivity to hospitals, schools and other so-called "socio-economic drivers" will be vital in supporting these societal and economic adjustments. Fibre will also be needed to provide the backbone for 5G connectivity that supports reliable delivery of critical services.

As bandwidth demand increases, the importance of energy efficiency in the telecom sector will also come to the fore, again supporting the case for transitioning to modern networks.

However, businesses and consumers which have been scarred with the high costs of the Coronavirus, may have fewer funds available to pay for very high capacity connections. Government financing may also be constrained.

This means that it will be more important than ever to pursue market structures and business models which contribute to maximising the coverage of fibre while mininising the cost, and requirement for public investments.

The increasing prevalence and success of wholesale only business models in supporting fibre deployment across Europe, coupled with the clear interest from financial investors in a "neutral" infrastructure business model (not only for alternative investors, but also increasingly incumbents), provide strong signals that this model could support Italy's goals to achieve a Gigabit society in the face of constraints imposed by the Coronavirus pandemic.

Specifically, Open Fiber's market entry and wholesale only approach has stimulated broadband deployment and competition in the Italian market, by introducing infrastructure-based competition to the incumbent and making a range of FTTH-based

178 Cisco Visual networking Index.

offers available to service providers. With its focus on FTTH deployment, and absence of legacy infrastructure, Open Fiber's entry has supported the rapid deployment of fibre to homes, businesses and schools in Italy, contributing to the doubling of fibre coverage to reach 30% in 2019 and reaching a current coverage of more than 9,5m premises, including more than 3m in rural areas.

The wholesale only business model pursued by Open Fiber has also provided the prospect for significant payback to its initial investors, with a recent offer from Macquarie Capital implying a valuation of between €7 and €8 bln for the company.

At the same time, the wholesale only model has supported choice in Gigabit broadband services, as Open Fiber has reached agreements to provide access to around 130 operators including the largest alternative telecommunication providers as well as media providers and multi-utilities. WIK studies[179] indicate that markets which can support a diverse range of service providers, through the decision not to operate in retail markets, can better serve the diverse interests of different customer groups as well as supporting competition in future mobile networks, and facilitating the development of smart public services and industrial applications.

In turn, smart building /office, smart city, energy, eHealth and education and industrial applications, should support the digital renewal of the economy as well as more energy efficient solutions, which can contribute to Italy's environmental goals.

The case study of Italy, alongside developments in several other countries demonstrate that wholesale only models, such as that pursued by Open Fiber, have the potential to support investment and competition across a wide range of digital services, and confirm that this model may have an important role to play in achieving a Gigabit society in Italy as well as more widely across the EU.

179 See for example WIK (2018) The role of wholesale only models in future networks and applications https://www.stokab.se/en/stokab/this-is-stokab/reports-and-studies.html.