BETTER POLICIES FOR BETTER LIVES

Promoting high-quality broadband networks in G20 countries

OECD Report for the G20 Infrastructure Working Group

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Introduction

1. Connectivity is an essential pillar of ensuring an inclusive digital transformation. The COVID-19 health emergency has further accentuated the awareness of how the quality, capability and resilience of broadband networks are becoming even more critical to ensure an inclusive society as more and more activities, such as work and education, are conducted in a remote manner. Teleworking and online education applications, for instance, require good upload speeds, which are not always supported by copper networks. The same applies to video conferences that have replaced physical meetings and business travel. Those with Internet connections of adequate quality could nearly seamlessly transition to a more virtual and distance economy. Those with slow connections or no connectivity at all, have been struggling during the pandemic. Overall, disparities remain in the G20 – between and within countries-, in terms of access to high-quality communication networks and services.

2. Analysing the performance of networks is crucial to inform policy makers and regulators to identify quality gaps and design the right policies and regulation towards closing those gaps. However, measuring broadband quality is not an easy task, and it includes several quality measures. One important measure is the speed of the connection. Other quality measures, that will become more important with the next evolution of mobile and fixed broadband networks (i.e. 5G and high-capacity fixed networks), are improved network response (i.e. latency) and fewer network errors (i.e. fewer packet losses).

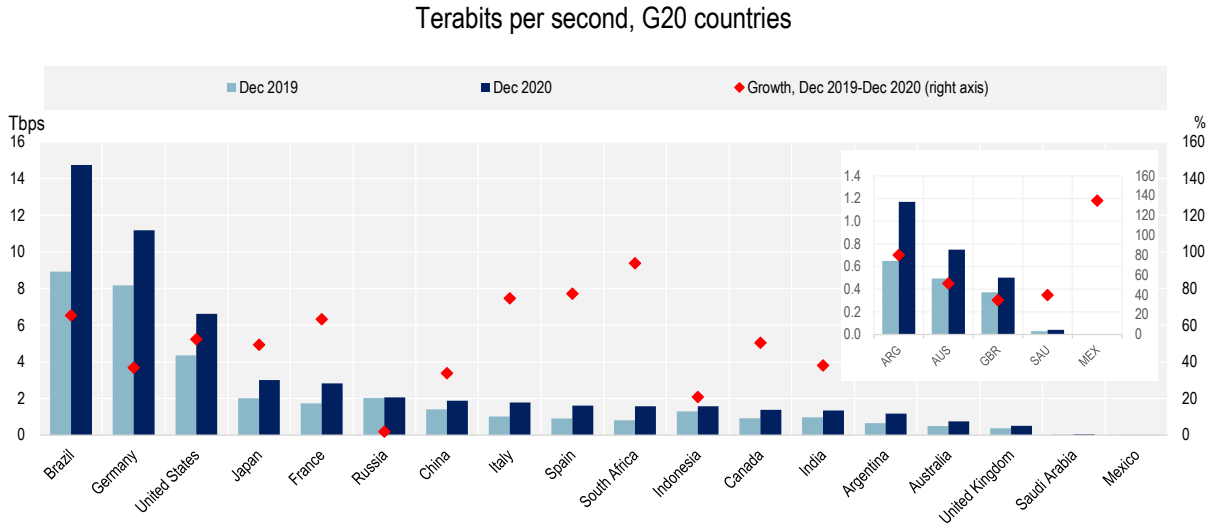
3. This report focuses on state of broadband speed quality across the G20 and how to upgrade the speeds of networks further to spur the economic recovery. It identifies existing gaps and puts forward policies and regulation towards extending high-quality networks and upgrading the quality of networks.

The importance of ensuring high-quality connectivity

Increased demand for high-quality connectivity

4. The COVID-19 health emergency has further accentuated the awareness of how quality, capability and resilience of broadband networks are becoming even more critical to ensure an inclusive society as more and more activities such as work and education are conducted in a remote manner. It has fuelled more demand for high-quality connectivity. Internet Exchange Points (IXPs), bulk-traffic exchange crossroads where multiple networks connect to exchange traffic, are one critical element of this infrastructure. From December 2019 to December 2020, IXPs have reported record net increases of up to 55.5% in total bandwidth handled across the G20 (Figure 1). Traffic not only grew significantly at historically large IXPs in Brazil, or Germany, but even more so in other G20 countries with smaller IXPs, such as South Africa (with a 94% growth). Fixed and mobile network operators reported the same trend. Telecom Italia, for example, saw traffic increases of 70-90% in its fixed broadband network. Overall, operators and content providers have, to date, managed to maintain services and keep the Internet, a network of networks, up and running.

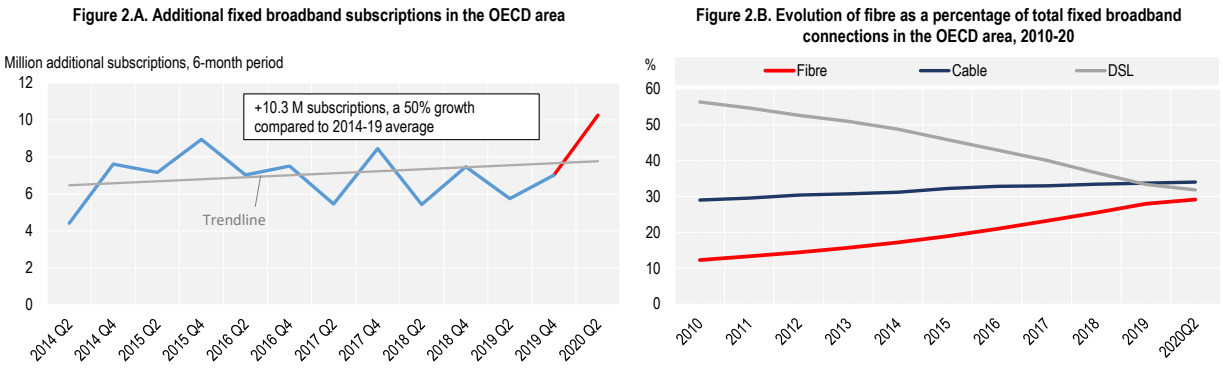
Figure 1. Bandwidth produced at Internet Exchange Points rose sharply



Note: China: Data from Hong Kong exchange HKIX. Korea: Data will soon be available.
Source: OECD, based on Packet Clearing House (2021)

5. Taking a more granular view, data from the [OECD Broadband Portal] reveals that the pandemic has also spurred the uptake of high-speed broadband subscriptions. From 2014 until 2019, every six months around 6.8 million new fixed broadband subscriptions were added in the OECD area. However, in the first half of 2020, and thus the first phase of the pandemic, the number of new fixed broadband subscriptions increased sharply to 10.3 million, representing a 50% growth compared to the average of additional subscriptions observed in the past five years (Figure 2.A). In addition, users have been upgrading their connections during the pandemic, reflecting the need for symmetrical upload and download speeds to work and study from home. Fibre has been the fastest growing technology in OECD countries over the past decade and the share of fibre in all fixed broadband subscriptions in OECD countries rose to 29.2% by June 2020 (Figure 2.B).

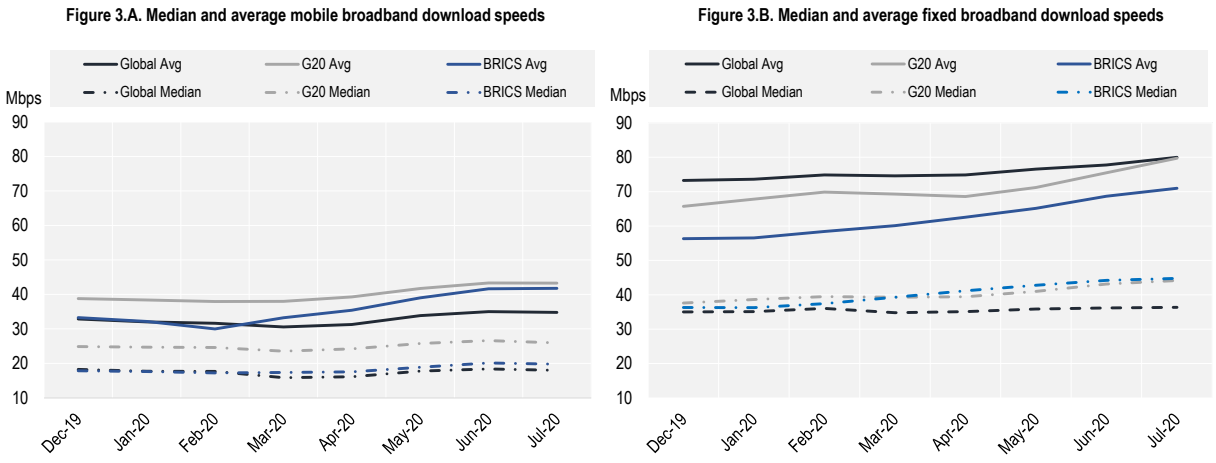
Figure 2. During the first phase of the pandemic, new fixed broadband subscriptions jumped to over 10 million



Source: OECD Broadband Portal (2021), https://www.oecd.org/sti/broadband/broadband-statistics/

6. While demand on networks has increased drastically, networks have, so far, managed to accommodate changes in utilisation patterns, respond to overall increased demand and avoid congestion. Actual measured speeds reflect this: For example, broadband performance measures by download speeds has remained stable in times of COVID-19 for fixed networks and have increased slightly for mobile networks (Figure 3).

Figure 3. Evolution of fixed and mobile broadband speeds, Ookla, 4Q2019-3Q 2020



Note: The G20 Average and Median for mobile and fixed broadband download speed exclude data from South Korea.
Source: Ookla (2020[11]), "Tracking COVID-19's Impact on Global Internet Performance", https://www.speedtest.net/insights/blog/tracking-covid-19-impact-global-internet-performance/#/

7. While fibre penetration has increased and networks coped with existing demand, there is still a need to extend the coverage of broadband networks, especially to underserved areas, to increase the overall quality of broadband connections and to move towards symmetrical up- and download speeds. During the economic recovery phase and with the increasing digital transformation of economies and societies, demand for high-quality connectivity will only grow. Deploying fibre deeper into networks and bringing it closer to businesses and homes will be essential to upgrade networks.

Boosting the deployment of high-quality networks for economic recovery and development

8. The important question at the heart of the policy agenda in G20 countries today is how to expand access to higher quality connectivity. Moreover, policy makers are interested in how to achieve this goal in the most cost-effective way given budgetary constraints across many G20 finance ministries as the world economy tries to recover from the present crisis. Best practices show that a sound regulatory and policy framework of the communication sector, taking into account country differences and needs, is an important, if not the most important, lever for investments in communication infrastructure, which are largely been made by the private sector. Policies and regulations fostering competition, for example, have led to market entry, more investment in networks and price declines for communication services. Policies directed at facilitating infrastructure deployment reduce overall investment costs and allow for a faster deployment of networks. Another important lever are innovative technologies to connect areas that are harder to reach, for instance through fixed-wireless services. Finally, in areas where there is no viable business case for the private sector, efficient mechanisms allocating public funds might be needed to bridge connectivity gaps.

9. G20 countries are increasingly concerned with bridging the connectivity divide by ensuring high quality and affordable broadband for all citizens. Many countries have programmes or measures in place to reduce digital divides and expand broadband access through reforms to universal access provisions or national broadband plans. Some governments have moved towards the objective of ensuring high-quality connectivity for all by allocating funds to enhance the deployment of high-capacity fixed networks (e.g. fibre).[1]

10. The COVID-19 pandemic has raised awareness of the crucial role that connectivity plays in all aspects of our everyday lives. Given that access to high-quality broadband by all segments of the population is critical for economic recovery in an increasingly "distance economy", several G20 countries have included connectivity as a fundamental element in their economic recovery packages (Box 1).

Box 1. Recovery plans including connectivity features, selected examples

The European Union

The EU Recovery and Resilience Facility (as part of the NextGeneration EU programme, a EUR 750 billion [USD 856 billion] temporary recovery instrument) makes available EUR 672.5 billion (USD 768 billion) in grants and loans for public investment and reforms in the 27 member states. The aim is to help them address the impact of the Covid-19 pandemic, to foster the green and digital transitions and to build resilient and inclusive societies (European Council, 2021[2]). Those grants and loans can be used for reforms and investments for communication infrastructure such as fibre and 5G technology (European Commission, 2021[3]). [2]

France

"France Relance" or "Relaunch France", is the economic stimulus plan presented by the French government in September 2020, as part of France's response to the Covid-19 crisis. The plan started its implementation in 2020 and will run through 2022. With a budget of EUR 100 billion (USD 114 billion), of which 40% are financed by the EU Recovery and Resilience Facility, "France Relance" has the objective of "rebuilding the French economy". A key aspect of this recovery plan is the goal to extend the coverage of high-capacity fibre networks in the entire French territory by 2025 ("Poursuite du plan France Très Haut Débit (Gouvernement de France, 2020, p. 267[4]). In January 2021, the government announced a EUR 570 million (USD 650 million) fund to boost fibre deployment, out of which EUR 240 million (USD 274 million) had already been invested to achieve this aim in 2020 (Gouvernement de France, 2021[5]).[3]

Indonesia

Indonesia has allocated a budget of Rp 417.8 trillion (USD 28.7 billion[4]) for infrastructure development in 2021. The budget is targeted to boost the sustainable post-COVID development of the country. Respective policies will support industrial and tourism areas, the development of public health facilities and basic needs such as water, sanitation, and housing, to strengthen the national health system. In addition, the budget is specifically earmarked to strengthen the country's communication infrastructure. For example, Base Transceiver Stations (BTS) are planned to be built in 5 053 locations in underdeveloped, frontier and outermost areas (Republic of Indonesia, Ministry of Finance, 2020[6]).

The United States

In the United States, President Biden announced on 31 March 2021 the proposal of the "American Jobs Plan", which would allocate USD 100 billion (of a total USD 2 trillion) to expand broadband access to every American, if passed (White House, 2021[7]). This proposal follows the Recovery Plan announced by President Biden, the "American Rescue Plan Act of 2021", which allocates USD 7.1 billion out of USD 1.9 trillion, for broadband connectivity and infrastructure funding. This recovery plan has been

approved by Congress, and includes the provision of emergency funding to upgrade federal information technology infrastructure and address the recent breaches of federal government data systems (The White House, 2021[8]). Furthermore, on 25 February, the communication regulator in the United States, the FCC, adopted a Report and Order that established the Emergency Broadband Benefit Programme, a USD 3.2 billion federal initiative to help lower the cost of high-speed Internet for eligible households during the on-going COVID-19 pandemic. The Emergency Broadband Benefit Program was developed by Congress in the Consolidated Appropriations Act of 2021 (FCC, 2021[9]).

The United Kingdom

The United Kingdom aims to provide GBP 900 million (USD 1.154 billion) for a range of 'shovel ready' local growth projects in England over the course of 2020 and 2021. These investments aim to enable local areas to invest in priority infrastructure projects to drive local growth and jobs and may include communication infrastructure projects (GOV.UK, 2020[10]).[5]

Source: (European Council, 2021[2]) (European Commission, 2021[3]) (Mobile Europe, 2020[11]) (GOV.UK, 2020[10]) (FCC, 2021[9]) (The White House, 2021[8])

Addressing the "Financing Gap" to boost high-quality connectivity

11. While most of the investment in broadband deployment usually comes from market participants, including private as well as publicly owned networks (e.g. municipal networks or national wholesale networks), investment in the communication sector has been complemented by public funding in many G20 countries in the form of state aid. Often, the financing derives from national broadband plans and digital strategies. The vast majority of OECD and G20 countries have established connectivity targets through national broadband plans or digital strategies, which set goals for coverage and speeds. Many plans increasingly aim for higher speeds (e.g. "Gigabit" and even 10 Gbps broadband connections).

12. Estimating the amount of public financing required to reach connectivity targets, as well as which geographical areas should be subject to state-aid (i.e. the "financing gap") is crucial both to make the best use of public funds, as well as to avoid crowding-out investment by private players.

13. Policy makers need to be cautious of the possibility of state aid hindering incentives by the private sector to deploy networks. Sweden, for example, conducts prior market analysis to identify the areas that are not commercially attractive, and once the areas are detected, public consultations of the planned financed expansions are held where private operators can identify if these plans clash with a planned commercial development (Government Offices of Sweden, 2017[12]; OECD, 2018[13]).

14. Broadband deployment costs vary with differences in choice of access technology (e.g. fibre, copper, mobile, etc.), geographical situation of a country, historical market structure, and current market conditions in the country, which are, in turn, shaped by the institutional framework of the country. Therefore, the exercise of estimating the investment needs in an aggregate manner for a group of countries is a very complex task. First, it would require very detailed knowledge of the cost of deploying broadband to achieve a certain connectivity target within each domestic context, to be then aggregated. Secondly, the cost of the deployment depends on the connectivity targets established by each country (i.e. in terms of the population covered, broadband speeds and period). To calculate the financing gap, understood as state aid (or public funding), at a national level, it requires obtaining granular information on current network deployment to determine the geographical areas that are non-competitive in order to avoid crowding out of private investment.

15. Country and regional examples assessing the financing gap to reach connectivity targets in National Broadband plans can be found in Box 2.

Box.2. Assessing the financing gap to reach connectivity targets in National Broadband Plans, country and regional examples

The European Union

The European Investment Bank (EIB) estimated the magnitude of the funding gap to achieve the fixed and mobile broadband objectives, as expressed in the Digital Agenda for Europe together and the European Gigabit Strategy (EGS). The DAE requires full coverage of the European Union with basic broadband (already achieved), and seeks to further ensure that "by 2020, (i) everyone in the European Union has access to much higher Internet speeds of above 30 Mbps and (ii) 50% or more of households in the European Union subscribe to Internet connections above 100 Mbps." The EGS goes much further, establishing strategic objectives by 2020 of (i) achieving availability of 5G connectivity as a fully-fledged commercial service in at least one major city in each Member State; by 2025 of achieving (ii) "Gigabit connectivity for all main socio-economic drivers such as schools, transport hubs and main providers of public services as well as digitally intensive enterprises;" (iii) uninterrupted 5G coverage for all urban areas and all major terrestrial transport paths; and (iv) providing access to Internet connectivity offering a downlink of at least 100 Mbps, upgradable to Gigabit speed, to all households in the European Union, rural or urban.

The European Investment Bank (EIB) found that a total investment of USD 453 billion (EUR 384 billion) would be required by 2025 under the most likely assumptions. Of this, USD 149 billion (EUR 126), that is 33%, would be required to complete achievement of the 2010 DAE; USD 77 billion (EUR 65 billion), that is 17%, would be needed to meet the 5G connectivity goals; USD 111 billion (EUR 94 billion), that is 24%, would be required for rural connectivity, and USD 116 billion (EUR 98 billion), that is 26%, would be required for gigabit connectivity to companies and institutions ("socio-economic drivers").

Under more ambitious goals and assumptions, the total investment to 2025 would need to amount to USD 505 billion (EUR 428 billion) instead of the USD 453 billion (EUR 384 billion) associated with the most likely scenario. Conversely, under more modest goals and assumptions, with greater reliance on wireless for rural coverage and a much smaller number of companies and institutions to be provided with gigabit connectivity, the total investment need to 2025 would be just USD 227 billion (EUR 192 billion), or roughly half of the cost of the most likely scenario.

The EIB further estimated that USD 153 billion (EUR 130 billion, that is 33% of that funding, could be expected to come from private investments, and that the remaining USD 300 billion (EUR 254 billion) represented an investment gap that would somehow have to be addressed by some combination of public policy interventions (European Investment Bank, 2018[14]).

France

The National Broadband Plan in France named "Plan France Très Haut Débit" (France's Plan for Ultra-Fast Broadband) established that all French households and businesses should be covered by broadband speeds of 30 Mbps and above by 2022. The French government estimated that the investment needed to achieve a reach a 95% coverage target amounted to EUR 20 billion (USD 22.8 billion)[6], including private sector investment as well as public funding, with EUR 3.3 billion (USD 3.8 billion)[7] of state aid targeted to compensate for the lack of private investment in rural areas (Gouvernement de France, 2020[15]; European Commission, 2021[16]). Furthermore, in 2020, as part of the economic stimulus plan ("France Relance") in response to the COVID-19 crisis, the French Government allocated additional EUR 570 billion (USD 651 billion)[8] in funds to achieve coverage of fibre in 100% the French territory by 2025 (Gouvernement de France, 2021[17]).

Germany

The German government has set an ambitious goal for high-speed connectivity in its coalition agreement: nationwide gigabit Internet coverage by 2025 (CDU, CSU, and SPD, 2018[18]). In 2011, WIK Consult estimated that in a greenfield environment, the nationwide roll-out of a fibre access network (43 million customers) and the operation at 70 % penetration require investments of EUR 70 to 80 billion (USD 97 billion to USD 111 billion)[9] (WIK Consult, 2011[19]). To achieve the goal of full gigabit Internet coverage, the German federal government has put in place a number of public broadband subsidies. Between 2016 and 2030, around EUR 11 billion (USD 12.55 billion)[10] has been or will be made available by the Federal Government's state aid programme for broadband deployment. This includes 70% of special assets ("Sondervermögen Digitale Infrastruktur"), financed mostly by the EUR 6.6 billion (USD 7.39 billion)[11] in revenue generated by the 2019 spectrum auction (to be paid in instalments until 2030), which are channelled into Gigabit network deployment. Additional funds of approximately EUR 11 billion are provided by the federal states (*Bundesländer*) (OECD, 2020[20]).

The United Kingdom

The United Kingdom had set an ambitious target for 15 million premises to be connected to full fibre by 2025, with nationwide coverage by 2033 (UK Government, 2018[21]). In 2020, as part of the National Infrastructure Strategy, the UK Government further underlined that by 2025, at least 85% of UK premises should have access to gigabit broadband (UK Government, 2020[22]). The UK Government plans that this high-capacity fixed broadband infrastructure will be mostly built using private investment, where the government and Ofcom, the communication regulator, have committed to policy and regulatory measures that will lower the cost of deploying infrastructure and promote competition. For areas not reached by the commercial market (i.e. mostly rural areas accounting for around 20% of the territory), the government has allocated GBP 5 billion (USD 6.4 billion) in public funding (UK Parliament, 2021[23]).

Sweden

The Swedish Post and Telecom Authority (PTS) used a sophisticated cost model to estimate the investment needed to fulfil Sweden's National Broadband Plan "A Completely Connected Sweden by 2025 − a Broadband Strategy", which aims to achieve "access to high-speed broadband in all of Sweden" by 2025 (Government Offices of Sweden, 2016[24]).[12]

PTS estimated the feasibility of this goal and found that, under the assumption that the private sector would invest in addition to their current commercial plans, USD 2.32 billion (SEK 22 billion) during 2020-25 (including SEK 7 billion in 2020), and with substantial additional public investments amounting to USD 68.7 million (SEK 650 million), 97.5-98.5% of all households will have access to or in the form of homes passed of 1 Gbps by 2025. [13]

Major players and financing sources for communication infrastructure

16. Historically, communication services were financed and provided by a single, often public network operator. In the absence of effective competition, these network operators had limited incentive to provide innovative services or attractive prices to their customers. Over the past twenty years, many G20 countries transformed their communication environments and liberalised markets to enable competition for communication services. As a consequence, communication networks are mainly deployed and funded by the private sector in G20 countries. Network operator companies generate revenue and profit from investments in communication infrastructure. Due to the capital-intensive nature of the communication industry, profit margins have to be sufficiently high in order to generate a reasonable return on investment.

17. The communication services market is composed of different network operators that invest in network deployment. Many of the bigger network operators are listed on the stock exchange and shares in their ownership are publicly traded. While network operators still represent the major source of financing for broadband deployment, there is not "the" network operator. What is referred to as a network operator in fact may mean a variety of business models. The different operators can be roughly categorised into four types (OECD, 2019[25]):

- Traditional (vertically integrated) mobile and fixed broadband providers
- Vertically integrated cable operators
- Wholesale (vertically separated) operators (e.g. municipality networks providing access to dark fibre)
- (Terminal) equipment and online service providers

18. These four categories of network operators continue to further develop their business models. Traditional vertically integrated communication operators are for example starting to move into other parts of their value chains with new services or leveraging their data for analytical services (i.e. big data). Vertically integrated cable network operators, on the other hand, are facing increased pressure on their traditional business lines around television. Wholesale (vertically separated) operators have grown in importance over recent years. They range from backbone wholesalers in the fixed market, to tower companies in the mobile market, to integrated wholesale networks in both the fixed and mobile communication market. This category of operators may significantly change the dynamics of communication markets. It could be a more cost-effective model for investment in broadband networks if these operators can generate attractive propositions for others to use their infrastructure.

19. A recent development in the communication sector is that online content service providers, have been expanding their own communication infrastructures and creating new sources of content (e.g. Apple, Alphabet [Google], Microsoft, Amazon, Facebook, etc.). They are now among the largest providers of backbone fibre networks. For example, over the past years, Google has invested USD 30 billion to expand its communication infrastructure, including submarine fibre cables and data centres (OECD, 2019[25]).

20. A further development is the entry of private equity companies in the field of communication infrastructure as well as institutional investors,[14] such as pension funds. Some of them fund smaller specialised firms that operate fibre connections; some invest in wholesalers such as tower companies. However, their overall share in market investments is still low compared to network operators (Box 3).

Box 3. Growing interest of institutional investors in communication infrastructure

Institutional investors are increasingly considering investments in communication infrastructure, including backbone fibre networks, with some making dedicated allocations to broadband infrastructure investment funds, as opposed to a bundling with other infrastructure assets.

Communication infrastructure is seen as a growth sector given of its foundational role for the digital transformation of our economies and societies, including the development of smart cities. Given this growing demand, different elements of communication infrastructure are attracting investor interest, from the fibre backbone through to communication towers and data centres, as well as related digital services.

Access to communication infrastructure assets is being enabled by several operators models, including vertically integrated operators moving to rationalise their operations in order to focus on strategic, customer-facing business, and seeking to tap alternative sources of capital. This has involved in many instances, the voluntary partial or full sale of certain assets, including wholesale elements of their

networks. Institutional investors have sought to acquire such assets, and make the necessary large investments, given the long-term stable cash flows that can match their long-term liabilities.

Institutional investors have in the past, and until recently, considered communication infrastructure investment to be "core plus", meaning that the sector was perceived to have somewhat riskier qualities than traditional infrastructure investments and requiring higher returns. However, developments in the sector and the current health emergency have been leading to a shift in perceptions among institutional investors, as broadband services are now seen as essential (a utility much like electricity).[15]

Institutional investors have been accessing communication infrastructure projects through direct investments, unlisted digital infrastructure funds, broader mixed infrastructure funds, and listed fund vehicles, such as real estate investment trusts (REITS).

Sources: Infrastructure Investor, "How digital infrastructure became mission-critical", 11 May 2020; Pere News, "Deep Dive: Why digital is the next frontier of private capital; Macquarie, "Digital infrastructure: an essential backbone", 24 September 2020; Infrastructure Investor, "Keynote Interview: The future is digital", March 2021, with Morgan Stanley Infrastructure Partners; White & Case (2020) , "Funding Europe's broadband ambitions"; Societé Générale, "FTTH Sector Provides Infra Boost", Project Finance International, Global Infrastructure Report, June 2020; Forbes, "Crisis Catalyzes Demand For Digital Infrastructure", 17 June 2020.

21. Moreover, a number of established communication operators have been looking to restructure their operations, with a view to optimising their business model, securing new investments, and strengthening their balance sheet,[16] while expanding their fibre services into new, underserved areas (Box 4).

Box 4. Evolving operator business models and financial partnerships to enhance infrastructure deployment in underserved areas

Altice Europe and transactions in France and Portugal to support fibre deployment

In 2018, Altice Europe, which controls the major French telecom operator SFR, announced that it would cede 49.99% of its fibre network outside of the main French cities to an OMERS Infrastructure majority-led consortium, including Allianz Capital Partners and AXA IM - Real Assets, for EUR 1.8 billion (USD 2.12 billion)[17]. This transaction involved the creation of a joint venture, a neutral infrastructure wholesaler called SFR FTTH (now known as Xp Fibre), housing a fibre network covering 5 million FTTH homes in medium and low density areas, but expected to grow by 5 million new customers by 2022. The customer base was awarded to Altice by the French government as part of a commitment by Altice to expand the fibre network. EUR 1.9 billion (USD 2.24 billion) [18] in non-recourse debt was issued to finance the expansion of the fibre network, arranged by five banks and involving seven-year bullet term loans with project finance protections, designed to attract bank and institutional investor interest. The debt transaction was considered a "jumbo" deal compared with financing arrangements undertaken through concession deals in France (typically less than EUR 200 million, i.e. USD 236 million) [19].

This cession was expected to lower Altice's debt burden and enhance its infrastructure deployment at a lower cost, while maintaining revenues gained by the provision of construction and technical services to the wholesaler. From the perspective of the institutional investors, the transaction enabled the acquisition of a high-quality infrastructure business providing essential services, and capable of generating steady cash flows over the long term, suitable for pension funds such as OMERS.

In 2019, Altice Europe executed a similar transaction in Portugal with Morgan Stanley Infrastructure Partners, in which its fibre business in that country was ceded to a new joint entity, Altice Portugal

FTTH, creating the largest nationwide fibre wholesaler, with roughly 4 million FTTH homes by the end 2019. The 49.99% stake in the joint entity was acquired at a cost of EUR 1.6 billion (USD 1.8 billion) [20].

Institutional investment in Deutsche Glasfaser, a German fibre company present in the regions

In 2020, KKR, a United States-based asset management firm, announced the sale of Deutsche Glasfaser, a fibre Internet company, in which it had invested in 2015 through its Infrastructure Fund II, to OMERS and EQT Infrastructure, a Swedish private equity fund. Under the ownership of KKR, and with its investment of EUR 450 million (USD 513.7 million)[21], Deutsche Glasfaser has reportedly become one of the fastest growing FTTH services company in Germany, with a focus on deployment fibre networks in rural areas that often do not even dispose of cable TV connections. The company was initially established by a Dutch investment company, Reggeborgh, in 2011. OMERS has indicated that its investment will yield stable cash flows in the future, protected by entry barriers. Relative to other European countries, Germany has a significantly lower fibre penetration rate, providing a potential growth opportunity for investors.

Sources: Altice Europe Annual Report 2018; Altice Press Releases, 30 November 2018 and 13 December 2019, Les Echos, «Altice cède une partie de son réseau de fibre optique », 30 November 2018; OMERS Press Release, 30 November 2018; Societé Générale, "FTTH Sector Provides Infra Boost", Project Finance International, Global Infrastructure Report, June 2020; Business Wire, "KKR Sells Deustche Glasfaser to EQT and OMERS", 10 February 2020; Pitchbook, "KKR Takes Majority Stake in Deutsche Glasfaser", 21 July 2015; Financial Times, "KKR to sell ultrafast German internet business in EUR 2.8 deal", 10 February 2020; EQT Press Release, "EQT Acquires Inexio, a leading provider of fiber-optic internet access in Germany", 28 September 2019

22. In addition to private actors, public actors have a role in financing communication infrastructure through direct and indirect actions, as well as alternative financing options, where pure market-based approaches are not sufficient. Public funding may also be important in emerging economies where capital markets are less developed. While big international communication companies that often operate in emerging countries have easy access to international capital markets, this is less the case for regional players that might want to enter these markets. In addition, there may be cases where the costs of deploying high-speed fixed broadband are greater than the price the market is willing to pay, for example, in areas that would require very important investments to connect companies and citizens and/or areas with a high share of low-income households. In particular, the cost of deploying networks in rural areas can be high, and in some cases, generating positive business cases will be difficult. In this case, the public sector has a role to play to ensure that networks are deployed so that people can obtain equal access. The correct identification of which sparsely populated areas require public funding is crucial to avoid the possibility of state aid hindering incentives by the private sector to deploy networks.

23. Public financing for high-quality connectivity may derive from national broadband plans. For example, in 2016, Brazil launched a second phase of the National Broadband Plan (Programa Brasil Inteligente). It sought to cover at least 75% of municipalities with fibre optic infrastructure backhaul. It also aimed to connect 30 000 schools with broadband connection speeds of 72 Mbps. In addition, it would promote investments in the next generation of wireless networks, 5G and the Internet of Things (IoT) (OECD, 2020[26]).

24. Therefore, even if in the majority of G20 countries private investment is the largest source of investment in communication infrastructures, notably in the advanced economies, in some instances governments may complement investments in taking a longer-term and broader view of returns. For example, governments may choose to invest alongside private actors through public-private partnerships (PPPs) to share the risks associated with the creation, development and operation of an infrastructure asset, especially in areas where positive business cases are hard to achieve (Box 5).

Box 5. Selected PPP arrangements in Europe for expanding broadband to underserved areas

France

France's strategy to building out its national fibre network has involved a hybrid approach, in which operators are invited, in medium-populated regions, to provide sole coverage for a dedicated region, yet allowing third party access to their network, while in rural to lower-density regions, funding is provided for the development of local wholesale fibre networks.

France's high-speed broadband development strategy aimed at connecting 100% of households and companies by fibre optic cable in low-density regions by 2022 – *Plan France Très Haut Débit* – was launched in 2013 and was funded by EUR 20 billion (USD 26.56 billion)[22] public investment from the French government and the European Union.

The focus was to enable local authorities and private players to develop new fibre infrastructure, especially in remote and hard-to-reach locations.

Drawing on public funding from the Plan and other sources but involving private sector financing, a number of local authorities have put in place public-private partnership (PPP) projects under concession contracts with private partners (construction companies, network operators, and infrastructure investment funds) to build out and operate fibre infrastructure in remote regions. The private partner is responsible for the design, construction, financing, maintenance and operation of the network (including marketing to retail telecom operators), and its return to the local authority at the end of the concession agreement (between 20 years and 35 years). When seeking State funding for the construction of the network, the local government authority must provide a business plan demonstrating that, after construction, the network will be economically and financially viable without the need for any further state subsidies.

At the end of 2018, 12% of the network in the rural areas were deployed through these PPP contracts. According to France, the Plan will help France in becoming one of the first European countries to achieve a 100% coverage of its territory.

Greece

In Greece, a major effort to expand broadband network development was made in a Rural Broadband Project using PPPs. Based on a Design-Build-Operate-Transfer model (DBOT), and signed in 2014, concessions were granted to three special purpose operators ("special purpose vehicles", SPVs) to build and maintain fibre networks (complemented by broadband wireless where needed) for designated non-served rural areas (roughly 5% of the population), each operator having a defined territory. The project was supported by EU funds and financing from a major Greek bank. The SPVs are to provide wholesale access to third-party retail service providers, thus promoting retail-level competition.

The scheme provided for a two-year construction period (with key milestones), followed by an operating period of fifteen years, after which network assets and related rights are to be transferred back to the authorities.

Key lessons learned from the scheme, which earned an EU Broadband Award in 2017, include the crucial need for cooperation of all stakeholders (national and local authorities, telecom sector, construction companies), a clear division of responsibilities between the public and private sectors, active support from regional and local authorities, a common licensing regime, and the need to address other aspects of the digital divide, beyond connectivity.

The scheme is being followed by an ultra-fast broadband scheme (UFBB) aimed at providing wholesale-only ultra-high-speed fibre infrastructure to roughly 18 percent of the population.

Sources: GI Hub Case Study; Ashurst, "The French Broadband Programme: a network of opportunities'"; PPT, "Broadband network development in white rural areas of Greece on PPP basis"; Information Society S.A., "Broadband Network Development in White Rural Areas of Greece"; EU project webpage, Broadband Network Development in White Rural Areas and good practice in EU Broadband Good Practices database.

Assessing the quality of broadband networks to tailor policies and regulation

25. A pre-requisite to tailor policies and regulatory measures aimed at maximising the benefits of access to and use of high-quality broadband services, is to measure the availability of broadband and the performance (i.e. quality) of the broadband connection within and across countries. Drawing on both elements of availability and quality enables countries to set appropriate broadband objectives and expand access in underserved areas. This policy area ranks high on current policy agendas of G20 member countries.

26. The OECD has worked systematically on broadband performance and laid the foundation for a harmonised measurement approach in 2012 for one dimension of broadband quality: download speeds. It has since then published a number of reports related to this work (OECD, 2013[27]; OECD, 2014[28]). The OECD Broadband Portal provides data on broadband penetration by speed tiers and broadband coverage, besides a range of other key parameters.

27. While bandwidth speed is one metric to gauge overall performance, other measures of quality become increasingly important. The need for improved response times (i.e. latency) between devices and compute nodes will grow, supporting many applications across different sectors (e.g. fully automated vehicles, remote surgery, etc.) and networks will increasingly be measured by assurance of delivery. Latency can be defined as the round trip time for information between two devices across the network. It is often referred to as delay or ping rate, and in general terms, it is the lag that a user or connected device may experience while waiting for content to load (OECD, 2019[25]).

28. A growing relevance of speed, latency and resilience of networks for current and future digital applications and tools, however, leads to more complexity in providing transparency to end-users on the actual performance of their communication services. This is in particular the case with the development of 5G as it enables operators to differentiate products and services in more complex ways due to network slicing which allows for tailor-made services for specific user groups. Regulators will need to work on indicators on coverage and QoS of 5G networks to enable informed choices both in the business-to-business (B2B) segment, but also for consumers. Information of the availability and quality of a service (e.g. geographically or in a roaming situation) will become crucial.

29. Services spanning multiple countries (e.g. connected mobility) will also require continuous QoS and seamless handover, both within a country and between different countries. This could imply a need for increased QoS provisioning for interconnection and roaming (BEREC, 2019[29]).

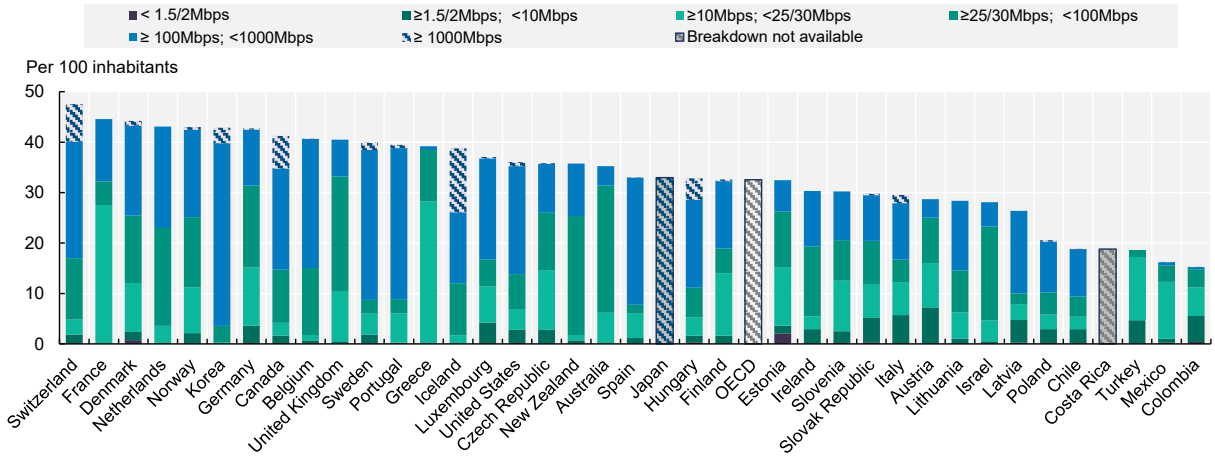
Measuring advertised download speeds

30. One way to obtain information on the speed of broadband connections is by measuring download speeds by different speed tiers (OECD, 2013[30]). Regulators collect information on the advertised download speed of subscriptions, which are compiled to show subscriptions broken down by speed tiers – a view of the "theoretical" speed of subscriptions, offered by network operators. Figure 4 provides an overview of fixed broadband subscriptions by speed tiers.

31. The share of broadband subscriptions, relative to broadband penetration, in higher advertised speed tier categories (advertised data as provided by countries) are becoming more common in OECD countries. For example, fourteen OECD countries had more than 50% of their subscriptions above 100 Mbps in June 2020 (e.g. Korea, Sweden, Portugal, Spain Iceland, Hungary, Canada, Switzerland, Belgium, Latvia, the United States, Luxembourg, Poland and Chile). In addition, 1 Gbps offers have been introduced in OECD countries and first 10 Gbps offers are emerging. In June 2020, six OECD countries had at least 5% of their overall fixed broadband subscriptions with advertised speeds above 1 Gbps (e.g. Iceland, Switzerland, Canada, Hungary, Korea, and Italy) (Figure 4).

Figure 4. Fixed broadband subscriptions per 100 inhabitants, per speed tiers, June 2020

In megabits per second (Mbps)



Note: Based on December 2019 speed tiers. Australia: Data reported for December 2018 and onwards is being collected by a new entity using a different methodology. Figures reported from December 2018 comprise a series break and are incomparable with previous data for any broadband measures Australia reports to the OECD. Speed tier data are only for services purchased over the National Broadband Network (NBN), which comprise the majority of fixed broadband services in operation. There is no public data available for the speed of non-NBN services. Data for Switzerland and United States are preliminary. New Zealand: Speed tiers are for 2018 instead of 2019
Source: OECD Broadband Portal (2021)

32. While overall broadband speeds have been uniformly increasing across countries, important disparities still exist between countries. These disparities often reflect the technology mix in countries. Countries with a high share of fibre-to-the home connections, for example, such as Korea and Japan, display a higher number of high-quality connections than countries that still rely on an important share of copper (xDSL) networks. The growing share of fibre in fixed broadband[1] allows for much higher speeds for high-bandwidth online activities such as video streaming services, multiple screens services and home-connected devices (OECD, 2020[31]). Besides differences across countries, speeds also vary between urban and rural areas within countries, as explored in the accompanying G20 report titled “Synthesis report on existing digital divides”.

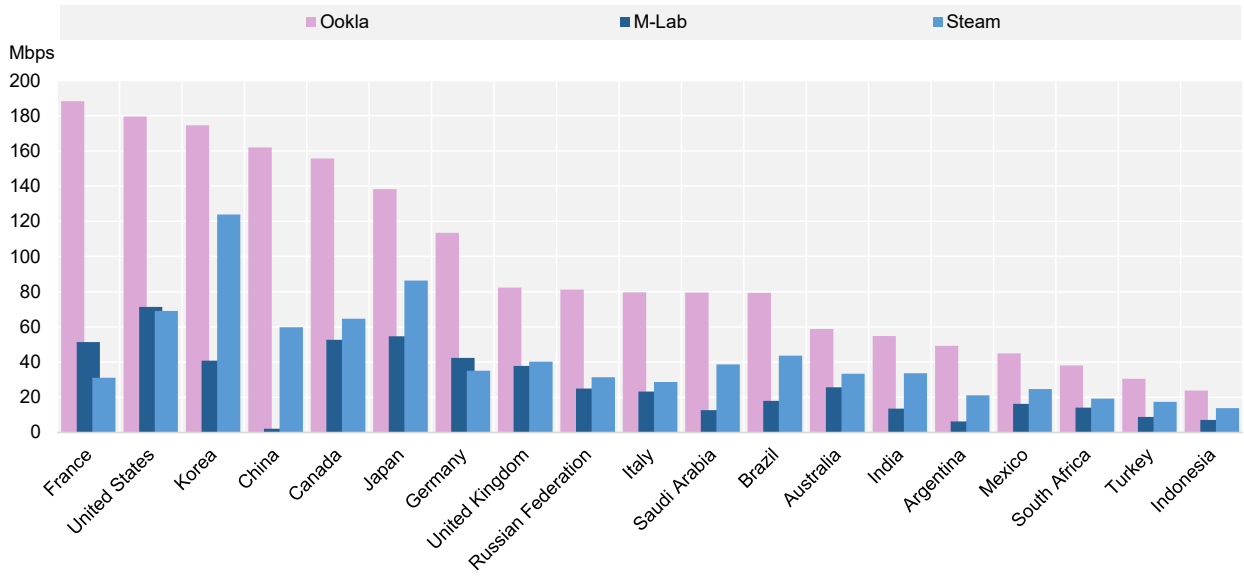
Broadband performance: Measuring actual download and upload speeds

33. Advertised speeds may differ from actual speeds experienced by users. Regulatory authorities have increasingly paid attention to the significant gaps between “advertised” and actual speeds experienced in several countries. In particular, the transparency generated by data on network quality provides incentives for operators to “self-regulate” and invest in network improvements.

34. Different entities measure the speed of broadband connections from their perspective of the Internet. Therefore, to look at "actual" broadband speeds, it is useful to observe data from different sources measuring actual speeds, as each source has a different methodology, and does not have a complete perspective on the Internet. It is worth noting the features of the different tools used for measuring download (upload) speeds when drawing conclusions from these data. M-Lab and Ookla, for example, compile results from speed tests by users who actively measure their actual speed between their device and the test provider to access the Internet.

35. M-Lab provides a broad view on broadband speeds due to the large amount of speed tests it compiles. For the average connection speed measured by M-Lab for fixed broadband networks, the average download speed in G20 countries was 27.5 Mbps during the period of July 2019 to June 2020. Data from Steam is a further way to consider download speeds across countries, which reflects the speeds of users using one of the most Internet Protocol (IP) intensive applications: online games. It collects data on the speeds experienced by gamers over fixed and mobile networks, representing one of the most demanding user groups on the Internet that seek higher performance levels. As such, average speeds reported on this website are usually higher than the M-Lab data as only gamer subscriptions are being considered. The average download speeds as reported by Steam for G20 countries was 43 Mbps in March 2021 (Figure 5).

Figure 5. Actual average fixed broadband download speeds in G20 countries measured by Ookla, M-Lab and Steam, 2021 (2020)*



Notes: *Speedtest (Ookla) data are for January 2021; M-Lab (Worldwide Broadband Speed League) speeds were measured from 1 July 2019 to 30 June 2020; and Steam data are for March 2021. The data for average fixed and mobile broadband download speed tests reported by Ookla measures the sustained peak throughput achieved by users of the network. In practice, when a user asks for a Speedtest, the device pings nearby dedicated testing servers, saturates the network connection, and measures the sustained peak speed achieved by the device during the test window. Therefore, the measured indicator does not reflect the day-to-day speeds experienced by users, but rather the actual maximal speeds attainable by the network connection when a users' device sends the maximum amount of data to one of 14 000 testing servers.
Source: Ookla (2021), "Speedtest Global Index", www.speedtest.net/global-index; M-Lab (2021), "Worldwide Broadband Speed League", www.cable.co.uk/broadband/speed/worldwide-speed-league; Steam (2021) "Steam Global Traffic Map", https://store.steampowered.com/stats/content.

Policies and regulatory measures to foster investment in high-quality connectivity

36. As more people and things go online, continued investment in communication networks is needed to ensure that connections and transfers of data between connected devices can take place quickly, both in fixed and mobile communication markets. In particular, investing in future proof technologies, such as fibre, and taking it closer to the user, helps support increases in speed and capacity across all next-generation technologies, regardless if the final connection is wireless or fixed. G20 countries have worked on policies and regulation directed at extending access and promoting the deployment of the next generations of fixed and mobile networks, which translate into higher speeds. This section provides an overview of policies followed by G20 countries to increase the quality of broadband networks.

37. One key objective among G20 countries consists in removing barriers to infrastructure deployment and getting the regulatory measures "right". This becomes even more crucial with the next generation of both fixed and broadband networks as the deployment of next evolution of broadband networks (e.g. 5G and fixed Gigabit networks) entail significant costs for operators and as wireless and fixed broadband networks become more complementary.

38. Policy and regulatory measures that reduce network deployment costs increase incentives to invest in network rollout and upgrades. These measures include promoting infrastructure sharing and co-investment initiatives, implementing "dig-once" policies that leverage on non-broadband infrastructure projects (e.g. highway/ road construction, railways, utilities, and street light providers), and easing infrastructure deployment. Easing infrastructure deployment can be achieved by the reduction of approval and construction times to deploy networks that many times depend on municipal authorities (i.e. streamlining access to rights of way), and by making information available for operators on public assets where infrastructure can be deployed. All these measures can increase deployment efficiency and reduce network deployment costs, influencing directly the incentives to expand high-quality connectivity.

39. The accompanying G20 report titled "Synthesis report on existing digital divides" looks at policies and regulatory measures to expand connectivity to bride digital divides such as the importance of a sound regulatory and policy framework of the communication, and presents policies and regulations to foster competition that have led to market entry, more investment in networks and price declines for communication services. It also presents complementary tailored approaches to extend broadband coverage in rural and remote areas.

40. Complementing the accompanying report, the present report on Promoting High-Quality Networks focuses on selected examples of policies directed at facilitating infrastructure deployment and reducing overall investment costs to boost investment in high capacity networks. It also presents examples on "data driven regulation" on broadband performance that has led to network upgrades. These policies are discussed in the following section.

Examples of policies and regulatory measures aiming to boost high-capacity networks

Monitoring the quality of broadband connections: The importance of evidence-based policy making and ensuring transparency for users

41. Broadband users across G20 countries require information on the availability, quality and prices of communication services to make informed choices. The publication of coverage and network quality data not only contributes to increased transparency, but also competitive pressure to increase the quality of broadband networks.

42. Policy makers have an important role to play in increasing the transparency of broadband offers for users. This is particularly relevant as we move towards a "distance economy" where most of the

economic activities are increasingly happening in a remote manner (i.e. from home) in 2020-21. Granular data of the available fixed broadband offers and their advertised and actual speeds may be required for a household to make an informed choice.

43. In addition, major obstacle to broadband uptake in many countries is affordability. Prices of communication services are a measure of affordability and an important factor in understanding the competitive dynamics of communication markets. While broadband price plans are inherently complex (e.g. as regards bundles, usage patterns, promotional discounts), defining usage baskets (i.e. low, medium and high usage) are a way to then measure and compare prices of communication services.

44. Furthermore, information on broadband coverage (maps) within a country is another key element for policy makers designing financing schemes for network deployment. In order to know where the public funding for broadband deployment is directed, such that it does not crowd out private investment, detailed information on broadband availability within countries is warranted to inform policy makers and ensure efficient use of public spending. Therefore, broadband mapping is a critical tool for policy makers.

45. G20 countries increasingly make use of data-driven regulation to complement traditional regulatory tools, by relying on the power of disclosing information to steer communication markets in the right direction (e.g. France, Korea and Germany) for operators to "self-regulate" and make network improvements. These type of measures may become increasingly important with the next evolution of fixed and wireless networks.

46. For example, Arcep, the communication regulator in France, is seeking to provide users with precise and personalised information, whether it comes from the users (crowdsourcing) or is collected by the regulator from operators (Arcep, 2019[32]). Arcep's priority is to make data on coverage and quality of communication networks available to users, so that competition is not limited to prices, but also network quality. Given that the "crowd-sourced" quality measures of broadband depend on the user's connection at home, France made a move to the use of more complex techniques in December 2018, such as Application Programming Interfaces (API) to be implemented in operators' set-top boxes to measure the quality of networks more accurately.

47. In a similar fashion, the Korean government, through the National Information Society Agency (NIA), monitors the quality of broadband providers and renders the results publicly available. The NIA has gone to great lengths to measure the quality of both fixed and wireless broadband in order to contrast the advertised speeds with actual speeds experienced by users. The first communication service quality evaluations by the NIA started in 1999 for wired telephones, 2G, and fixed broadband. It now encompasses various services including LTE services and Gigabit wired Internet, with the aim of covering 5G networks in the future. Network quality measurement is rather a complex endeavour in Korea, as it involves "in the field" measurement of quality with a vehicle, and requires a precise sampling technique across the country. According to the NIA, the service quality evaluation has significantly contributed to broadband development, as operators increased network quality each publication of the results. Furthermore, it has helped increase competition by providing users with objective quality information on communication services, so that they can choose providers accordingly.

48. Another example of broadband quality measurements conducted by regulatory authorities are those done in Germany. The German communication regulator, Bundesnetzagentur (BNetzA), operates a broadband measurement tool since October 2015. Users can measure the download and upload speeds of their fixed and mobile broadband connections. Moreover, by way of an installable version of the broadband measurement tool, users can measure the speeds of their fixed broadband connections and use the results in order to prove contractual mal-performance vis-à-vis their provider or in court proceedings. Since 2018, the so-called "Funkloch-App" ("dead spot" app) can be downloaded for Android and iOS smartphones. With this app, users can measure network coverage in a given area. Measurements taken by users of the Funkloch-App are displayed in an interactive online map accessible by the public.

Infrastructure sharing as a means to reduce network deployment costs and foster investment

49. With the increasing need for high-quality networks, new partnerships and infrastructure sharing agreements among operators can be a mean to significantly reduce network. At present, many G20 countries have witnessed network sharing, either in the form of passive infrastructure sharing or active mobile infrastructure sharing agreements. Most G20 countries encourage infrastructure sharing, provided that the advantages outweigh the drawbacks, i.e. that sharing is not detrimental to competition.

50. Passive infrastructure sharing refers to common use by two or more operators of their passive elements of their respective networks (e.g. masts, towers, sites, etc.). Active infrastructure sharing is common use of active elements of the network such as backhaul and even spectrum resources allocated individually to each operator (e.g. radio access network [RAN] sharing, roaming, software elements, etc.)

51. Passive infrastructure sharing has been common in G20 countries. For example, in Korea, passive fixed and mobile infrastructure sharing currently takes place and all three major operators need to consult with each other regarding potential joint installations when deploying telecommunication equipment and facilities.

52. There are also increasing examples of active infrastructure sharing for mobile networks in G20 countries, such as radio access network (RAN) sharing agreements RAN sharing, which includes antenna, mast and backhaul equipment may help reduce deployment costs.[23] For example, the German spectrum license decision for the 2.1 GHz and 3.6 GHz bands in 2018 included an obligation for licensees to engage in non-discriminatory negotiations on the shared use of existing nationwide mobile networks (roaming) and on mobile nationwide infrastructure sharing for MNOs (BNetza, 2018[33]). In France, there is a national roaming agreement between Orange and Iliad for the 2G and 3G networks, and a RAN sharing agreement between Bouygues Telecom and SFR.

Implementing "dig-once" policies to reduce network deployment costs

53. A number of G20 and OECD countries have focused on "dig-once" policies to leverage non-broadband infrastructure projects (e.g. utilities, street light providers, and highway/ road construction) and reduce the costs of broadband network deployment. For example, countries belonging to the European Union have transposed into national legislation the European Union Broadband Cost Reduction Directive (2014/61/EU) by January 2016, which includes provisions that allow communication network operators to access other utility networks. In Germany, the fifth action to amend the German Telecommunications Act, enforced by the end of 2019, contains additional provisions regarding transparency of mobile network coverage and coordination of civil works regarding the deployment of high-speed telecommunication infrastructure in areas of public funding. In Switzerland, through commercial agreements in the past decade, Swisscom has signed several contracts of cooperation with municipal utilities to deploy the FTTH network on communal territories (OECD, 2020[31]).

Streamlining rights of way to facilitate network roll-out

54. Several G20 countries have been making efforts in streamlining rights of way to facilitate "network densification" (i.e. bringing smaller cells closer to connected devices). Often, communication operators need approval from several levels of governments which are not necessarily coordinated and can thus be lengthy. Harmonised procedures to get all necessary permissions are needed for the development of high-quality networks, where municipalities play a key role. As such, many G20 countries are working to reduce approval and construction times for network rollout. Other than reducing the costs of small cell deployment, other public interests at a municipal level may exist, such as landscape protection and environmental considerations, which should also be considered (OECD, 2019[34]).

55. In the United States, an example of regulatory action to streamline rights of way is the FCC Order, "*Accelerating Wireless and Wireline Broadband Deployment by Removing Barriers to Infrastructure*

Investment," adopted on September 2018 (FCC, 2018[35]). It specifies the amount that municipalities may reasonably charge for small cell deployment given the importance of 5G to the United States (OECD, 2019[34]). The United Kingdom reformed its Electronic Communications Code (ECC) in 2017, and reduced the cost for operators to deploy communication infrastructure. In Europe, the European Electronic Communications Code (EECC) establishes provisions to facilitate network deployment, and in particular, its Article 57 aims to minimise authorisation requirements and costs of the deployment of small cells (European Commission, 2018[36]).

Co-investment initiatives

56. In recent years, co-investment initiatives to deploy fibre to the home (FTTH) networks have also been on the rise, where regulators have had to evaluate the effects to competition. An increasing number of G20 countries have adopted policies to reduce the costs of broadband deployment through measures of co-investment, or joint-deployment of broadband networks. For example, in European Union, the EECC envisages creating incentives to co-investment in new networks consisting of fibre by providing for regulatory relief to operators entering in such agreements.[24]

Wholesale access remedies with the aim of providing incentives to upgrade networks

57. With the aim of fostering fibre deployment, regulators are both looking to safeguard competition while incentivising investments in networks. Some G20 members are promoting infrastructure-based competition, including through physical infrastructure access, to boost fibre deployment. Some implement this through asymmetric wholesale access remedies to provide smaller operators access to the network of the incumbent, while others have worked towards open access fibre networks based on geographical segmentation.

58. For example, in the European Union, countries such as Spain and Portugal, have been highly successful in promoting fibre-to-the-home (FTTH) deployment in recent years. Portugal focused initially only on regulating access to ducts, poles and in-building wiring, to consider in a later phase potential asymmetric access regulation to fibre for those holding significant market power (SMP). Spain in 2016, after seven years of the initial phase, applied fibre wholesale access regulation based on geographical segmentation of competitive versus non-competitive areas (Godlovitch et al., 2019[37]). France took a slightly different approach, and from the onset (2008) applied symmetric regulation for fibre wholesale products based on geographical segmentation. Symmetric regulation on fibre in France imposes that the firm exploiting a fibre cable must provide reasonable open access to other firms in non-discriminatory terms.[25] In the United Kingdom, Ofcom aims to boost fibre expansion by supporting Openreach in retiring its old copper network, and by considering keeping wholesale remedies on fibre on in some areas while deregulating areas where there is efficient competition of fibre-to-the-premises (FTTP) networks (Ofcom, 2020[38]).

Adapting the regulatory framework when phasing out legacy networks

59. A number of G20 countries have started to see the transition of legacy networks and services, such as copper fixed networks, and regulatory frameworks have had to adapt to the evolving nature of networks. With numerous players and stakeholders involved in the communication sector, meeting the needs for high-quality connectivity networks requires collaboration among all key actors. This is particularly relevant when it comes to phasing out legacy networks (e.g. 2G or 3G networks for 4G and 5G, or copper transition to fibre) which has become more relevant with newer generations of network technologies. When taking a decision of phasing out a legacy network, the needs among operators, the users of these networks and the government need to be considered (Box 6).

Box 6. Examples of countries adapting their regulatory framework to phase out legacy networks

The European Union

In the European Union, the European Electronic Communications Code (EECC) (Article 81) establishes that operators with significant market power in one or several markets should notify in a timely manner their plan to migrate from legacy infrastructure (including copper networks), and the regulator should ensure that this transition occurs in a timely and transparent manner. In addition, the regulator should ensure the availability of alternative products to access an upgraded network in the areas concerned with the migration of legacy networks to safeguard competition and end-users' rights (European Commission, 2018[36]).

Italy

In Italy, during the last market analysis for wholesale access services, AGCOM adopted a regulatory framework for the migration from legacy copper network to a Next Generation Access (NGA) network by a decommissioning plan of the incumbent operator (Decision no. 348/19/CONS).[26]

Mexico

In Mexico, asymmetric regulation has been imposed to the "preponderant" economic agent in the communication sector (i.e. a similar notion to the player with significant market power), which requires this agent to transition its legacy network to fibre, and to provide non-discriminatory access to wholesale services to rival operators.

The United Kingdom

In the United Kingdom, the communication regulator, Ofcom, has noted the need for regulatory approaches that encourage investment in fibre to the premises (FTTP) deployment, or what the United Kingdom calls "full-fibre broadband". Some of the changes announced on January 2020 include that wherever FTTP is deployed, regulation will be removed for copper products. The aim is to incentivise stakeholders to invest more in FTTP solutions (Ofcom, 2020[39]).

Concluding remarks

60. Reliable connectivity is fundamental for the digital transformation in facilitating interactions between people, organisations and machines. The COVID-19 health emergency has further accentuated the awareness of how the resilience and quality of broadband networks are becoming even more critical. As we move more and more towards "a distance" economy (e.g. remote learning, remote health, automated driving, etc.), ensuring high-quality connectivity, becomes essential. However, disparities remain in the G20 – between and within countries-, in terms of access to high-quality communication networks and services.

61. As such, an important question at the heart of the policy agenda in G20 countries today is how to expand access to higher quality connectivity. Moreover, how to achieve this goal in the most cost-effective way given budgetary constraints across many G20 finance ministries as the world economy tries to recover from the present crisis. The present report attempts to answer this question: how to promote high-quality networks in G20 countries in a cost effective way.

62. To boost high-quality connectivity, private investment and access to financing are crucial. In addition, public measures may be necessary where private investment is not sufficient. The domestic environment is critical to the objective of providing incentives to invest in upgrading networks and extending their coverage.

63. Policy makers in G20 countries have an important role to play to provide incentives to market players to increase investments to promote high-quality networks. Namely, measures that reduce network deployment costs increase incentives to invest in network rollout and upgrades. In addition, increasing the transparency of broadband offers for users is key to improve the quality of networks. Experiences in G20 countries show that publishing actual broadband performance indicators to inform consumers has led to network upgrades by operators in terms of speeds experienced by users.

64. While most of the investment in broadband deployment in G20 countries usually comes from market participants, public actors can also play a role in financing communication infrastructure through direct and indirect actions where pure market-based approaches are not sufficient, such as in rural and remote areas. The correct identification of which sparsely populated areas require public funding is crucial to avoid the possibility of state aid hindering incentives by the private sector to deploy networks. Often, public financing derives from national broadband plans and digital strategies. Governments may also choose to invest alongside private actors through public-private partnerships (PPPs) to share the risks associated with deploying an infrastructure asset, especially in areas where positive business cases are hard to achieve.

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Notes

[1] More details on overarching and tailored policies to bridge digital divides can be found in the accompanying G20 report "Synthesis report on existing digital divides".

[2] An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[3] An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[4] An exchange rate of 14 582.203 Rp/USD for the year 2020 from the OECD has been used.

[5]An exchange rate of 0.780 GBP/USD for the year 2020 from the OECD has been used.

[6]An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[7]An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[8]An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[9]An exchange rate of 0.718 EUR/USD for the year 2011 from the OECD has been used.

[10] An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[11]An exchange rate of 0.893 EUR/USD for the year 2019 from the OECD has been used.

[12] An exchange rate of 9.456 SEK/USD for the year 2019 from the OECD has been used.

[13] The Swedish Broadband Strategy included the three following milestones. First, to achieve 95% of connected households and businesses by 2020 with broadband of at least 100 Mbps. Second, by 2023, all of Sweden should have access to reliable high-quality mobile services; and third, by 2025, 98% of the population should have access to 1 Gbps broadband in their residences and work places, the remaining 1.9% with 100 Mbps, and 0.01% with 30 Mbps.

[14] Previous work by Celik and Isaksson (2014[40]) from the Directorate of Financial Affairs (DAF) of the OECD noted the following: "There is no simple definition of an "institutional investor". The closest we get to a common characteristic is that institutional investors are not physical persons. Instead they are organised as legal entities. The exact legal form, however, varies widely among institutional investors and covers everything from straightforward profit maximising joint stock companies (for example, closed-end investment companies) to limited liability partnerships (like private equity firms) and incorporation by special statute (for example, in the case of some sovereign wealth funds). Institutional investors may act independently or be part of a larger company group or conglomerate. This is, for example, the case for mutual funds who are often subsidiaries of banks and insurance companies." (Çelik and Isaksson, 2014[40])

[15] See: Macquarie, "Digital infrastructure: an essential backbone", 24 September 2020; Infrastructure Investor, "Keynote Interview: The future is digital", March 2021, with Morgan Stanley Infrastructure Partners; White & Case (2020) , "Funding Europe's broadband ambitions"; Societé Générale, "FTTH Sector Provides Infra Boost", Project Finance International, Global Infrastructure Report, June 2020

[16] See OECD (2019), The Operators and their Future: the State of Play and Emerging Business Models.

[17] An exchange rate of 0.847 EUR/USD for the year 2018 from the OECD has been used.

[18] An exchange rate of 0.847 EUR/USD for the year 2018 from the OECD has been used.

[19] An exchange rate of 0.847 EUR/USD for the year 2018 from the OECD has been used.

[20] An exchange rate of 0.893 EUR/USD for the year 2019 from the OECD has been used.

[21] An exchange rate of 0.876 EUR/USD for the year 2020 from the OECD has been used.

[22] An exchange rate of 0.753 EUR/USD for the year 2013 from the OECD has been used.

[23] However, some challenges faced by operators in implementing these type of agreements are the inherent differences in network architecture, equipment purchased from different vendors and differences in network management procedures.

[24] Namely, the EECC establishes that an operator with significant market power (SMP) will be able to propose commitments on offers for co-investment in new networks that consist of optical fibre elements up to the end-user premises or base station. Under the EECC, not all "Very High Capacity Networks" (VHCNs) are eligible for co-investments. To be eligible, they must consist of fibre up to the end-user premises or to the base station.

[25] See article L.34-8-3 of the CPCE (Code des postes et des communications électroniques).

[26] There are two conditions to be met before announcing the decommissioning of a given local exchange: i) the coverage to be reached and ii) the percentage of accesses already migrated to NGA from the given local exchange. As regards the coverage, 100% of NGA coverage needs to be reached. To this purpose, also Fixed Wireless Networks are included in the coverage, but only to a limited extent. As regards the take up of NGA it has to be at least the 60% of activated accesses on the given local exchange, both by SMP operator and alternative operators.