# Enhancing Access and Connectivity to Harness Digital Transformation

Digital transformation can only be fully realised if high quality access to communication networks and services is made available at affordable prices for all people and firms no matter who they are or where they live. This involves investing in significantly upgrading communication infrastructures to address the increasing demand for data generated by the billions of devices coming online in the near future. Increasing competition and making it easier to roll out the needed infrastructure will encourage this investment. At the same time, efforts need to be made to allow all parts of society to take part in digital transformation, including rural populations currently experiencing significantly worse broadband access in many OECD countries.

### Key recommendations

- Meeting the fast-growing demand for greater mobile connectivity requires investment in fixed communication networks, including fibre. The Internet of Things (IoT) means an estimated three devices per person will be online by 2022.
- Encouraging competition between network operators will drive investment and boost connectivity. Enhancing infrastructure sharing, whilst also reducing administrative barriers to investment, could also help expand coverage.
- To expand coverage in rural areas, one option is to encourage private investment through a variety of incentives, such as competitive tendering for partial tax exemption, lower spectrum fees, or loans at a reduced interest rate. Otherwise, governments could invest directly where it is not commercially viable.

## Prepare for more people and things going online than ever before

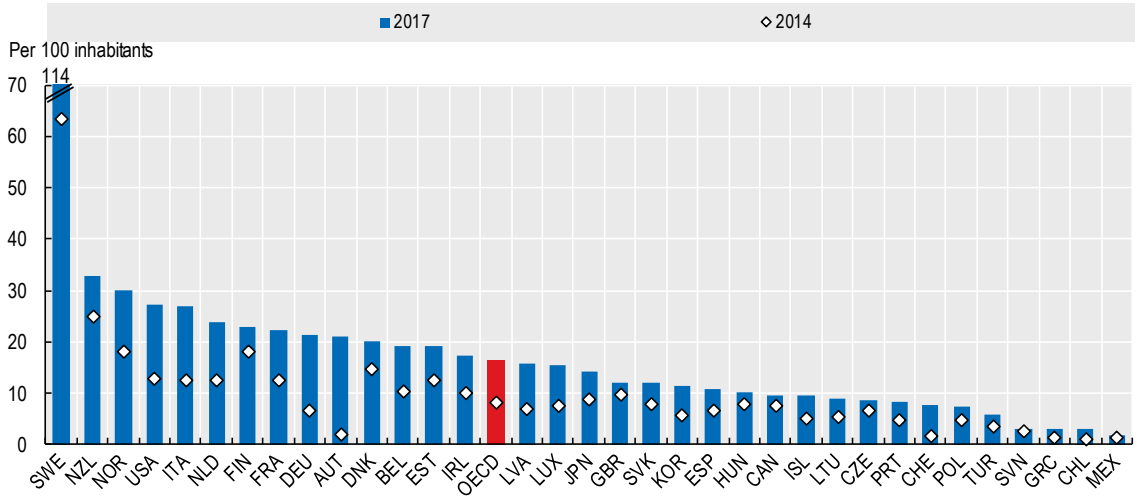
As demands for reliable and fast connections are expected to continue to increase, policy makers should encourage investment in high quality and affordable communication infrastructures and services. In December 2017, mobile broadband subscriptions in the OECD area rose to over 100 subscriptions per 100 inhabitants for the first time. This represents an increase of 79 million mobile broadband subscriptions since December 2016. The use of the IoT – i.e. connected devices – and their demands on communication networks also grew dramatically over the same period. Between 2015 and 2017, mobile data usage more than doubled in two-thirds of the countries for which data were available, with the OECD average in 2017 being 3 GB of data use per mobile subscription.

The IoT will be a key element of the digital future. It will increasingly enable digital technologies to embed themselves in all aspects of our economies and societies. One estimate suggests that the IoT will be made up of 20 billion devices worldwide by 2022 (more than three objects per person), representing global growth of more than 400% over five years (CISCO, 2018). Out of the many types of the IoT, machine-to-machine (M2M) subscriptions alone almost doubled across the OECD between 2014 and 2017 (Figure 1).

As more people and things connect, greater demand will be placed on networks. Many connected devices, including those that are powered by emerging digital technologies like artificial intelligence (AI), will require the transmission of huge amounts of data. Similarly, as connected devices become widespread in critical sectors such as health or energy, the safe and reliable functioning of related systems will depend on the reliability of communication networks. In particular, these applications may require the time-sensitive upload and download of data, with rapid transmission of data between two devices in the network.

**Figure 1.** Connected devices are on the rise

M2M SIM cards, per 100 inhabitants, 2017

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*Note*: See Statlink for figure notes.

*Source*: OECD (2019a), *Measuring the Digital Transformation: A Roadmap for the Future*, https://dx.doi.org/10.1787/9789264311992-en, based on OECD, *Broadband Portal*, www.oecd.org/sti/broadband/broadband-statistics (accessed September 2018).

## Invest in broadband to empower future technologies

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. The use of fibre in fixed networks must be extended to support increases in speed and capacity across all next-generation technologies. As of December 2017, on average only 23% of fixed broadband subscriptions in OECD countries were fibre, compared to 41% of subscriptions that use xDSL cables. 5G, the fifth generation of wireless communication technology, the fifth generation of wireless communication technology, holds many promises, including download speeds that are 200 times faster and one tenth of the data transmission round-trip time (i.e. latency) compared to current 4G networks, enabling higher processing speeds and more devices to go online wirelessly (OECD, forthcoming).

The continued expansion of the digital transformations relies on the increased expansion of fixed networks with sufficient capacity. This is because fixed networks take on the 'heavy lifting' of the increasing demands on wireless networks especially where radio spectrum is a scarce resource. Therefore, investment in next generation communication networks such as fibre is critical. By bringing fibre physically closer to the end user, whether a business or a residence, Internet speed increases across all technologies, even when the final connections are made using co-axial cable or copper.

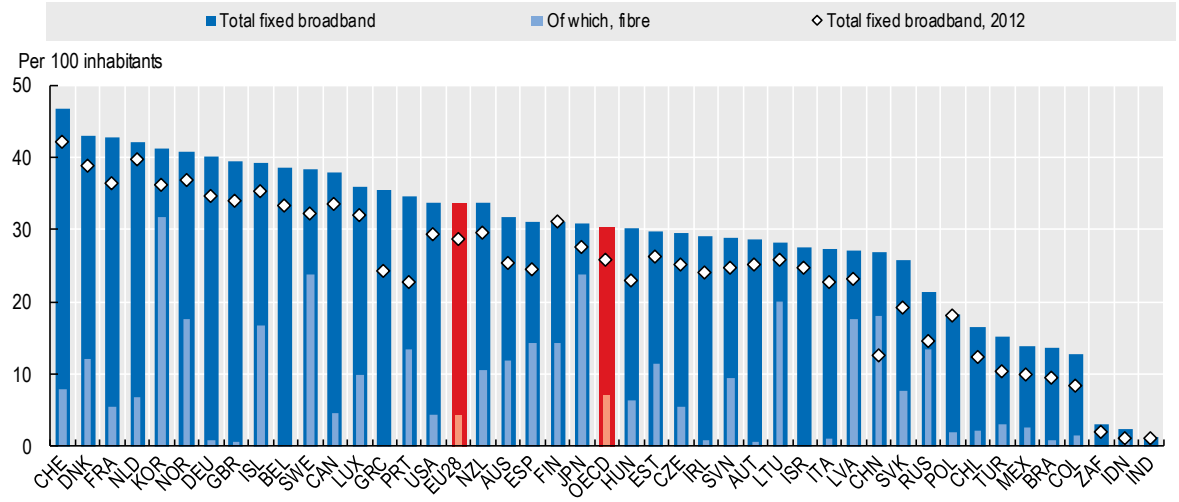
At the end of 2017, there were on average only seven fibre subscriptions per 100 people across the OECD (Figure 2). Japan and Korea are the only OECD countries where fibre subscriptions account for more than 75% of total fixed broadband subscriptions. They are also two of the few OECD countries with operators that offered 10 GB download speeds for residential services in 2018.

The emergence of 5G networks will require the rollout of a number of smaller cell sites that will complement traditional large cell towers, underlining the need for increased investment in next-generation communication infrastructures. Japan and Korea will start to offer commercial mobile 5G services by 2019. Some countries have also implemented dedicated plans and strategies associated with the rollout of 5G networks (OECD, forthcoming).

It is likely that some of the traditional telecommunication regulatory issues will become even more relevant for the successful rollout of this new generation of wireless technologies. For example, streamlining "rights of way" for telecommunication operators become increasingly important to deploy massive numbers of small cells for 5G and backhaul to connect the cells. Similarly, all wireless connections depend on the use of spectrum, efficient spectrum management, effective access to backhaul and backbone facilities, and new forms of infrastructure sharing, and so these will be essential for the development of 5G mobile networks (OECD, forthcoming).

**Figure 2.** Investing in fibre backhaul can increase speeds across all technologies

Fixed broadband subscriptions, per 100 inhabitants, by technology, December 2017




StatLink http://dx.doi.org/10.1787/888933915012

*Source*: OECD (2019a), *Measuring the Digital Transformation: A Roadmap for the Future*, https://dx.doi.org/10.1787/9789264311992-en, based on OECD, *Broadband Portal*, www.oecd.org/sti/broadband/broadband-statistics; ITU, *World Telecommunication ICT Indicators Database*, http://handle.itu.int/11.1002/pub_series/dataset/64cb0e71-en; European Union, *Digital Scoreboard*, https://ec.europa.eu/digital-single-market/en/digital-scoreboard (accessed September 2018).

## Promote competition and remove barriers to investment to boost connectivity

Greater convergence in communication markets means policy makers must promote competition to ensure that users benefit from greater choice from network service providers, either through bundled or simple voice, data and video offers. Fixed, wireless and broadcasting network services are increasingly being delivered on Internet protocol (IP)-based networks. This means that market players are able to offer combinations of telephony, broadband Internet access, wireless services and television. Promoting competition can increase investment, lower prices and drive up the overall quality and speed of broadband offers, including to underserved populations.

Broadband has become a general-purpose technology that supports a variety of traffic types, applications and devices, including transformative technologies like cloud computing and the IoT. This could lead over-the-top applications such as voice and video services to directly compete with the service offerings of network operators. There is a changing relationship between innovation, competition and investment in this converging market which will require policy makers to promote frameworks that foster investment in broadband networks, protect consumers, promote competition and enable opportunities for all (OECD, 2016).

As markets transform, policy makers should exercise caution with potential mergers that would reduce the number of mobile network operators (MNOs) and consider analysis on both price and non-price effects of such mergers. Experience in OECD countries has shown that countries with a larger number of MNOs, for example those going from three to four operators, are likely to offer more competitive and innovative services (OECD, 2014), although local conditions vary. Further, proposed remedies should be assessed in terms of whether they effectively ensure competition. Some countries have opted for behavioural remedies such as obtaining commitments from merging parties and others have facilitated the presence of mobile virtual network operators or have applied structural remedies (e.g. divestment). Policy makers should also promote sufficient competition in international mobile roaming (Bourassa et al., 2016).

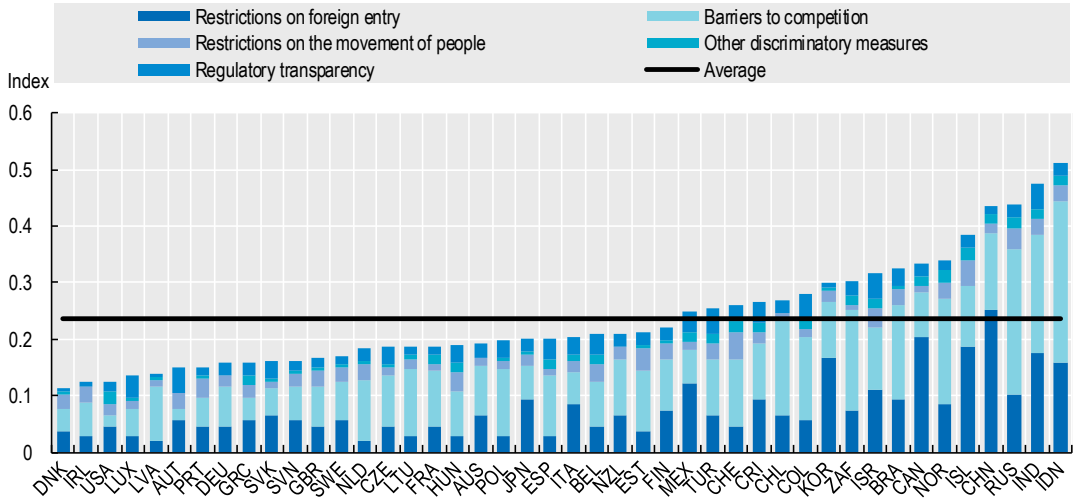
Sharing network components can also reduce costs. It is a critical decision for each country to determine the balance between end-to-end infrastructure competition and the joint provisioning of facilities by rivals to support greater retail competition. Infrastructure sharing can promote competition, particularly where markets are characterised by a dominant player, and could reduce costs for network and services providers while enabling the development of new and innovative services for end users (OECD, 2017a). As 5G networks are rolled out, many expect that infrastructure sharing will become increasingly important to reduce the costs (OECD, forthcoming).

Co-investment arrangements, whereby two or more operators co-invest in network deployment, could, in some circumstances, spur coverage and increase competition. Such arrangements have emerged in countries like the Netherlands, Portugal, Spain and Switzerland as a means of sharing risk and overcoming financing constraints. However, it is too early to ascertain what the ideal conditions and overall effect of this approach are at this stage (Godlovitch and Neumann, 2017).

Other barriers to investment should also be addressed, including developing more internet exchange points to enhance local traffic exchange, efficiently allocating spectrum to handle growing wireless data transmission, and fostering the adoption of the new generation of IP addresses (IPv6), given the exhaustion of the pool of the previous IP generation (IPv4).

**Figure 3.** Barriers to entry and competition are the most common telecommunication services trade restrictions

OECD Telecommunication Services Trade Restrictiveness Index, 2017

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*Note:* See Statlink for figure notes.

*Source*: OECD (2019a), *Measuring the Digital Transformation: A Roadmap for the Future*, https://dx.doi.org/10.1787/9789264311992-en, based on OECD, *Services Trade Restrictiveness Index*, https://oe.cd/stri-db (accessed September 2018).

International services trade barriers also reduce investment in the telecommunications sector, with restrictions on foreign entry and barriers to competition being the most prevalent (Figure 3). Pro-competitive reforms in the telecommunication sector are associated with a substantial reduction in trade costs for business services. In 2017, however, the largest overall increase in services restrictiveness for the 22 sectors analysed was in the telecommunication sector (OECD, 2018a). This was primarily due to increased restrictions on foreign investment and operation in the sector. The pro-competitiveness reforms in Mexico drove increased connectivity, lower prices and better quality services, including an increase of over 50 million mobile broadband subscriptions (OECD, 2017b).

## Expanding access for an inclusive digital transformation

Ensuring adequate access to communication infrastructures for all citizens is essential for the realisation of the opportunities of digital transformation. A number of divides exist in society including differences in access to broadband between rural and urban areas, and divides along gender and age, among others. Bridging the gaps is needed to ensure an inclusive digital transformation so that the opportunities are harnessed by all.

Entrenched divides in broadband connection persist across the OECD. The rural-urban divide not only includes differences in access to broadband services, but also unequal access to broadband of sufficient quality. Across a majority of OECD countries, the share of households with broadband connections in rural areas is less than the share in urban and other areas, although encouragingly this gap has been narrowing. All OECD countries have set national targets for broadband availability. In 2017, the majority of OECD countries aimed for around 90% of the population to have access to broadband services at download rates of more than 20 Mbps (OECD, 2018b).

Indeed, variations in access become even more significant when connection speed is taken into account. In 2016, just 56% of rural households in the OECD area had access to fixed broadband with a minimum speed of 30 Mbps, in comparison to over 85% of households in other areas (Figure 4). Measures of fixed broadband coverage with a minimum speed of 30 Mbps in rural areas can contrast sharply with overall broadband access data measured by surveys that do not take into account minimum speeds or technology categories.

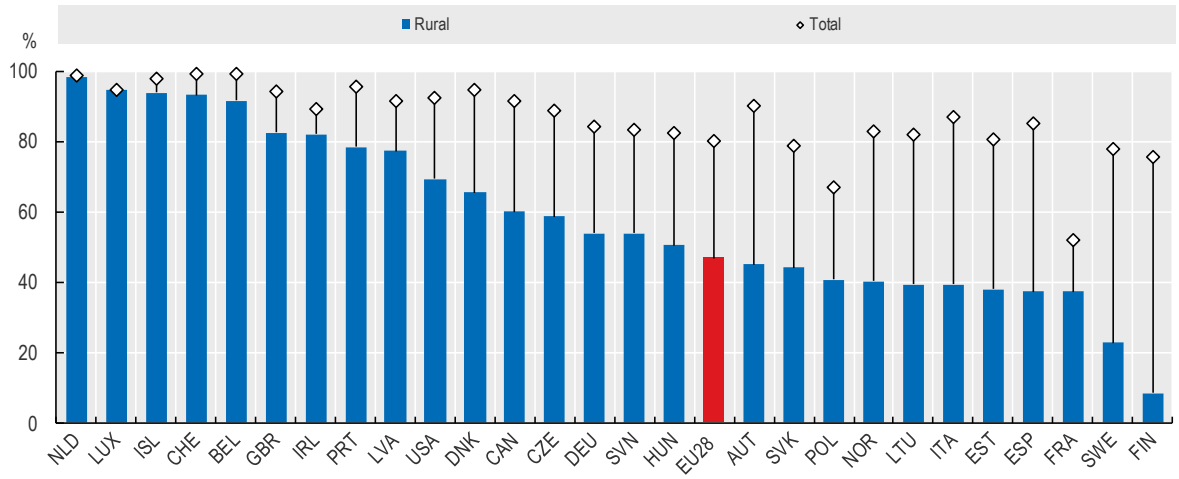
Addressing geographical digital divides is challenging because backbone networks are typically located closer to densely populated areas. Areas with low population density may be prone to natural monopolies, as commercial operators may assess that there is insufficient demand to invest. In some countries, a lack of basic infrastructure, including electricity, roads and ports, can present further challenges to high-speed infrastructure development in rural and remote areas.

In the majority of OECD countries, private investment is the largest source of investment in communication infrastructures. However, in some instances, governments may be better placed to take a longer-term and broader view of returns, and may choose to invest alongside private actors through public-private partnerships to share the risks associated with the creation, development and operation of an infrastructure asset.

Often, such investment takes place through national broadband plans. The majority of OECD countries have included specific components in their plans related to the expansion of broadband in rural and remote areas (OECD, 2018b). Such national broadband strategies should address all of the key barriers to the expansion of high-speed networks and services, and should be revisited and reviewed regularly.

**Figure 4.** Rural areas lag behind urban and other areas in broadband access at sufficient speeds

Households in areas where fixed broadband with a contracted speed of 30 Mbps or more is available, as a percentage of households in the total and rural categories, June

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*Note:* See Statlink for figure notes.

*Source*: OECD (2019a), *Measuring the Digital Transformation: A Roadmap for the Future*, https://dx.doi.org/10.1787/9789264311992-en, based on OECD calculations based on CRTC, *Communications Monitoring Report, 2017* (Canada); EC, *Study on Broadband Coverage in Europe 2017* (European Union); FCC, *2018 Broadband Deployment Report* (United States).

Governments may choose to solve critical bottlenecks to private operation in rural areas by investing in high-speed backbones or backhaul infrastructure (OECD, 2017c), albeit often with the provision of implementing open access policies so as to not encourage monopoly power in underserved areas (OECD, 2017d). Another option is to promote private investment through a variety of incentives to reduce the cost of investment and network deployment in rural areas. These can include competitive tendering for partial tax exemption, changes to spectrum license arrangements, or loans at a reduced interest rate (OECD, 2018b), although competing objectives should be considered before policy changes are made.

Divides do not exist only as a result of physical infrastructure. Further to the divides between rural and urban populations, divides exist along a range of dimensions, including gender, age, income and education. While across the OECD, women access the Internet in similar numbers to men, in some countries the gap can be large (OECD, 2019b). For example, in Turkey there was a gap of 18 percentage points between men and women and one of over 66 percentage

points between young and elderly Internet users. Across the European Union twice as many young men know how to code compared with young women, while women are also less likely to study STEM subjects. At the age of 15, only an average of 0.5% of girls across the OECD wish to become ICT professionals, compared to 5% of boys (OECD, 2017e).

With ageing populations and the delivery of public services increasingly conducted over the Internet, the gaps in Internet use between different ages may emerge as a policy concern. Those aged 55 to 75 were less likely than 16-24 year-olds to use the Internet in all OECD countries (OECD, 2019b), while 32% of 55-65 year-olds failed ICT skills tests, compared with only 5% of 16-24 year-olds (OECD, 2017f). Similar divides are seen among lower educated groups who consistently have lower access rates than more educated people (OECD, 2017e).

## Further reading


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Digital technologies and large-scale data flows are fundamentally changing how people live and work, interact with one another, participate in the economy, and engage with the government. The OECD's ***Going Digital*** project examines how government policy can help ensure this digital transformation benefits all by increasing growth and improving well-being. Going Digital Policy Notes provide insights into key trends, opportunities and challenges, and the policy directions needed for making the most of digital transformation.

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