Digital Economy and Society Index (DESI) 2020

Connectivity

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Connectivity

The connectivity dimension of the Digital Economy and Society Index (DESI) looks at both the demand and the supply side of fixed and mobile broadband. Under *fixed broadband*, it assesses the take-up of overall and ultrafast broadband (at least 100 Mbps), the availability of fast broadband (next generation access (NGA) providing at least 30 Mbps) and of fixed very high capacity networks (VHCNs)[(1)], and also considers the prices of retail offers. *Mobile broadband* includes 4G coverage, the take-up of mobile broadband (3G and 4G) and the indicator on 5G readiness[(2)]. Digital connectivity is considered a social right in the EU[(3)].

In connectivity, Denmark had the highest score, followed by Sweden, Luxembourg, Latvia and Spain. Greece, Cyprus and Bulgaria had the weakest performance for this dimension of the DESI.

As for the mobile broadband sub-dimension (including indicators 1c1, 1c2 and 1c3), Finland, Germany, Italy, Hungary and Denmark lead Europe, while Bulgaria and Slovenia registered the lowest scores.

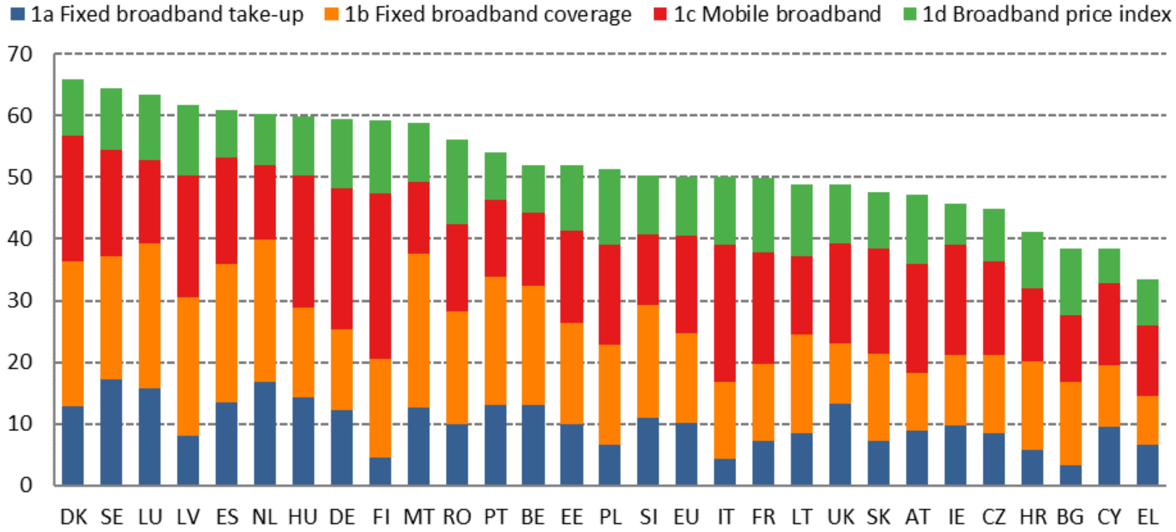
Table 1 Connectivity indicators in DESI

	EU	
	DESI 2018	**DESI 2020**
1a1 Overall fixed broadband take-up % households	**75%** 2017	**78%** 2019
1a2 At least 100 Mbps fixed broadband take-up % households	**15%** 2017	**26%** 2019
1b1 Fast broadband (NGA) coverage % households	**79%** 2017	**86%** 2019
1b2 Fixed Very High Capacity Network (VHCN) coverage % households	**26%** 2017	**44%** 2019
1c1 4G coverage % households (average of operators)	**91%** 2017	**96%** 2019
1c2 Mobile broadband take-up Subscriptions per 100 people	**90** 2017	**100** 2019
1c3 5G readiness Assigned spectrum as a % of total harmonised 5G spectrum	**NA**	**21%** 2020
1d1 Broadband price index Score (0 to 100)	**NA**	**64** 2019

Source: DESI 2020, European Commission.

(1) Fixed VHCN coverage includes FTTP and DOCSIS 3.1 coverage.
(2) The 5G readiness indicator was introduced in the DESI in 2019.
(3) https://composite-indicators.jrc.ec.europa.eu/social-scoreboard/

Figure 1 Digital Economy and Society Index 2020, Connectivity



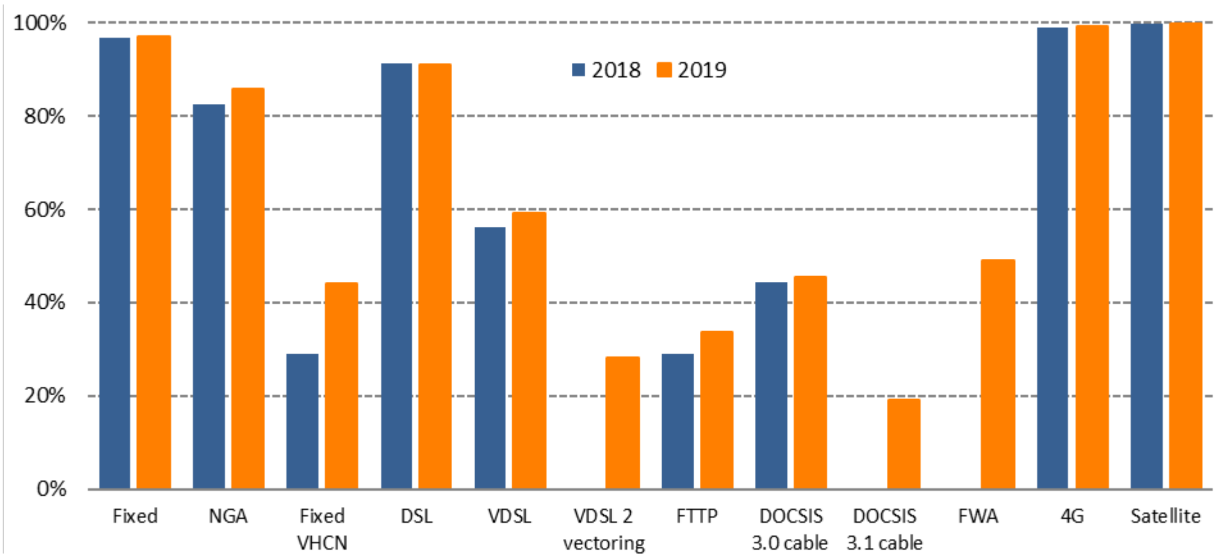
Source: DESI 2020, European Commission.

1. Broadband coverage

Broadband is available to all households in the EU, when considering all major technologies (xDSL, cable, fibre to the premises (FTTP), FWA, LTE and satellite). Primary internet access at home is provided mainly by fixed technologies, which remained stable at 97%. Among these technologies, xDSL has the largest footprint (91%) followed by DOCSIS 3.0 cable (46%) and FTTP (34%).

Coverage of NGA technologies (VDSL, VDSL2 vectoring, FTTP, DOCSIS 3.0, DOCSIS 3.1) capable of delivering download speeds of at least 30 Mbps reached 86%, up from 83% a year ago, thanks to an increase of 3 percentage points in VDSL and 4.5 percentage points in FTTP coverage last year. Coverage of DOCSIS 3.1 networks was 19%. DSL coverage remained stable. 44% of households already benefit from very high capacity network (VHCN) coverage with gigabit connectivity on FTTP and DOCSIS 3.1 networks, up from 29% last year. 4G mobile coverage is almost universal at 99.4%.

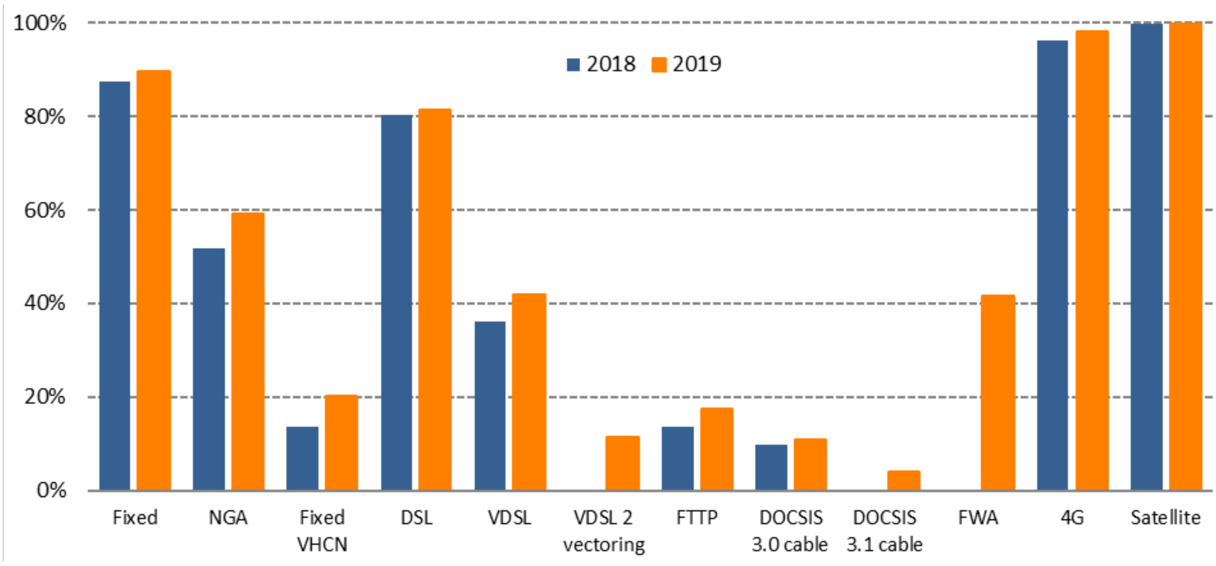
Figure 2 Total coverage by technology at EU level (% of households), 2018-2019



Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

Broadband coverage of rural areas[4] remains challenging as 10% of households are not covered by any fixed network and 41% are not covered by any NGA technology. Rural fixed coverage increased marginally from 88% to 90%. Rural coverage improved in VDSL (from 36% to 42%), DOCSIS 3.0 (from 10% to 11%) FTTP (from 14% to 18%) and VHCN (from 14% to 20%). Mobile broadband availability went up by 2 percentage points last year, although mobile is still mainly used as a complementary technology rather than a substitute for fixed technologies.

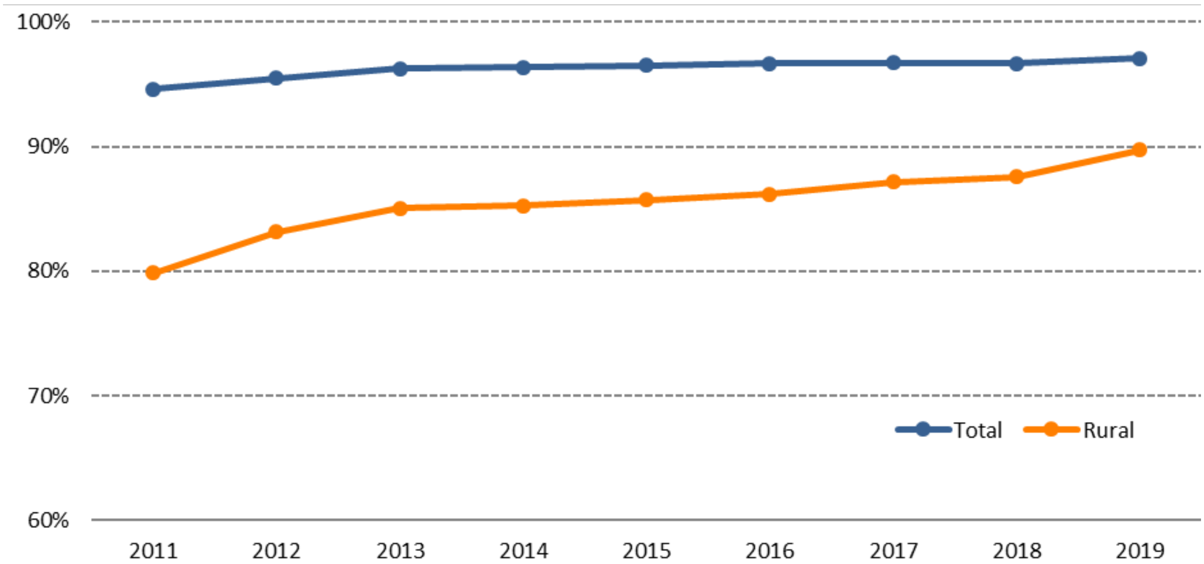
Figure 3 Rural coverage by technology at EU level (% of households), 2018 – 2019



Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

Overall coverage of fixed broadband has only marginally increased since 2011 from 95% to 97%. Rural coverage improved from 80% in 2011 to 90% in 2019.

Figure 4 Fixed broadband coverage in the EU (% of households), 2011 - 2019

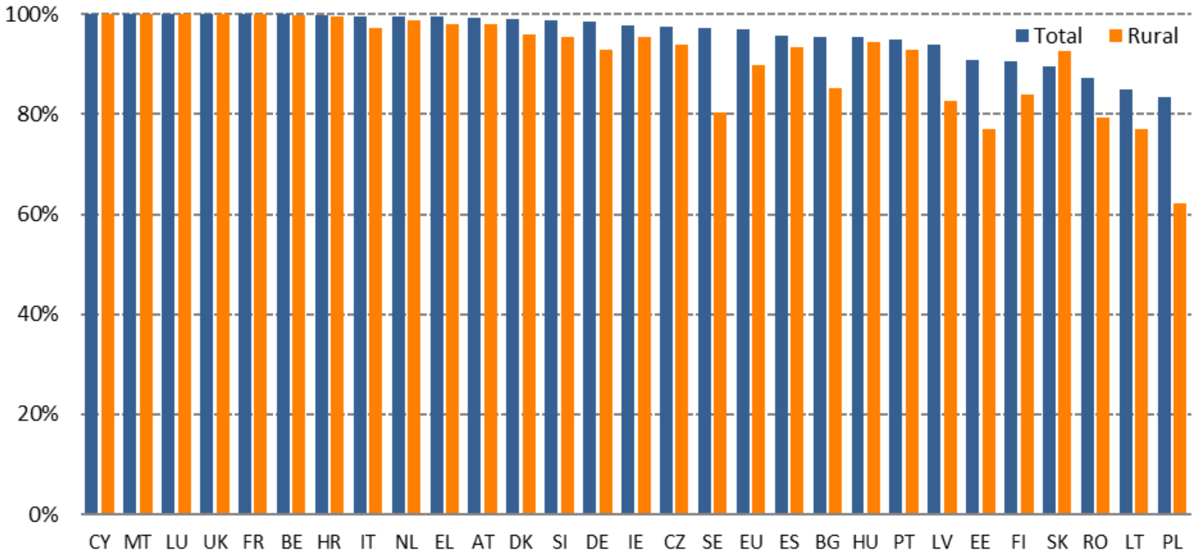


Source: IHS Markit, Omdia, Point Topic and VVA, Broadband coverage in Europe studies.

[4] For the definition of rural areas see sub-chapter “3.2 Defining households and rural areas” in the methodology of the study “Broadband Coverage in Europe 2018”, page 16, by IHS Markit and Point Topic (https://ec.europa.eu/digital-single-market/en/news/study-broadband-coverage-europe-2018).

Fixed coverage is highest in the Member States with well-developed DSL infrastructures. In 12 Member States, more than 99% of households are covered. Poland, Lithuania, Romania and Slovakia are lagging behind with less than 90% of households covered.

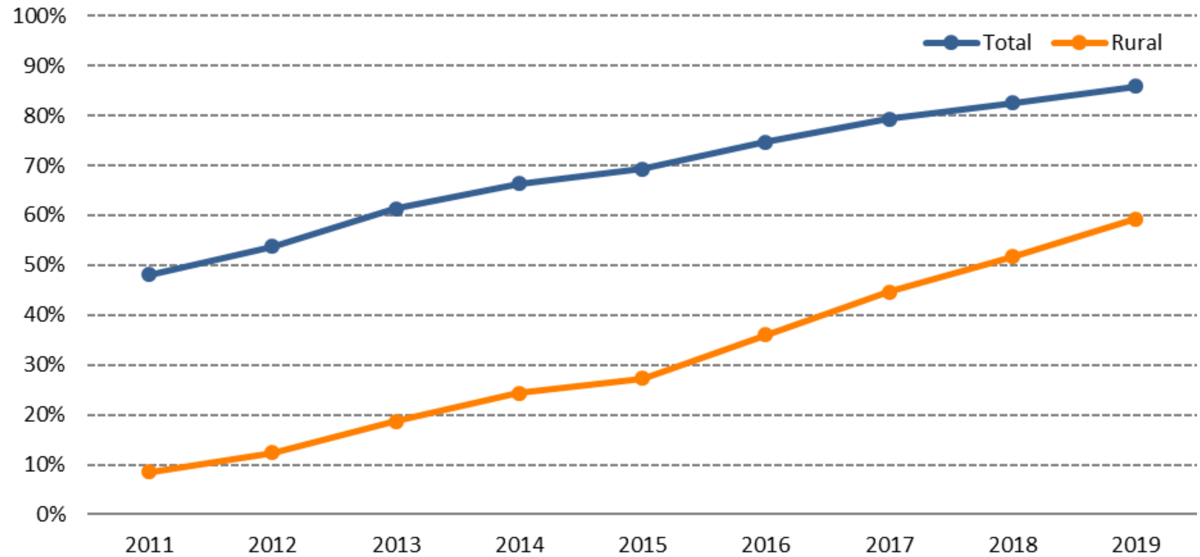
Figure 5 Fixed broadband coverage (% of households), mid-2019



Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

Coverage of next generation access (NGA) technologies continued to increase, reaching 86% in 2019 up from 48% in 2011. By mid-2019, VDSL had the largest coverage among NGA technologies at 59%, followed by cable (46%) and FTTP (34%). NGA coverage improved significantly in rural areas, with an increase of 50 percentage points in 8 years: in 2011, it stood at 9% of households, while in 2019 at 59%.

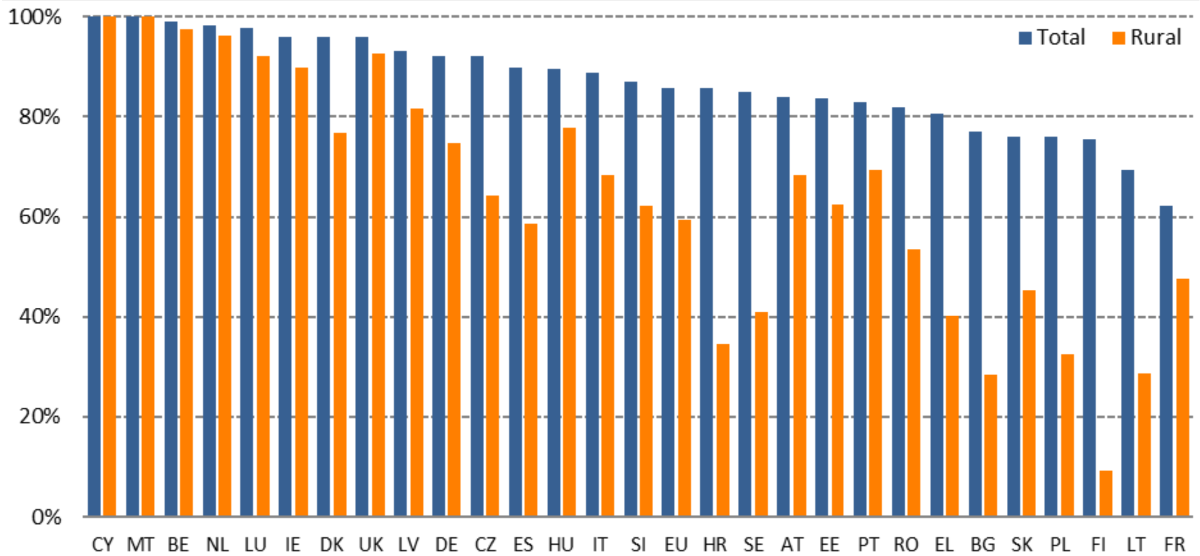
Figure 6 Next generation access (NGA) broadband coverage in the EU (% of households), 2011-2019



Source: IHS Markit, Omdia, Point Topic and VVA, Broadband coverage in Europe studies.

Cyprus, Malta and Belgium are the leaders in NGA. In 13 Member States, fast broadband is available to at least 90% of households, whereas in France and Lithuania less than 70% of households have access to such networks.

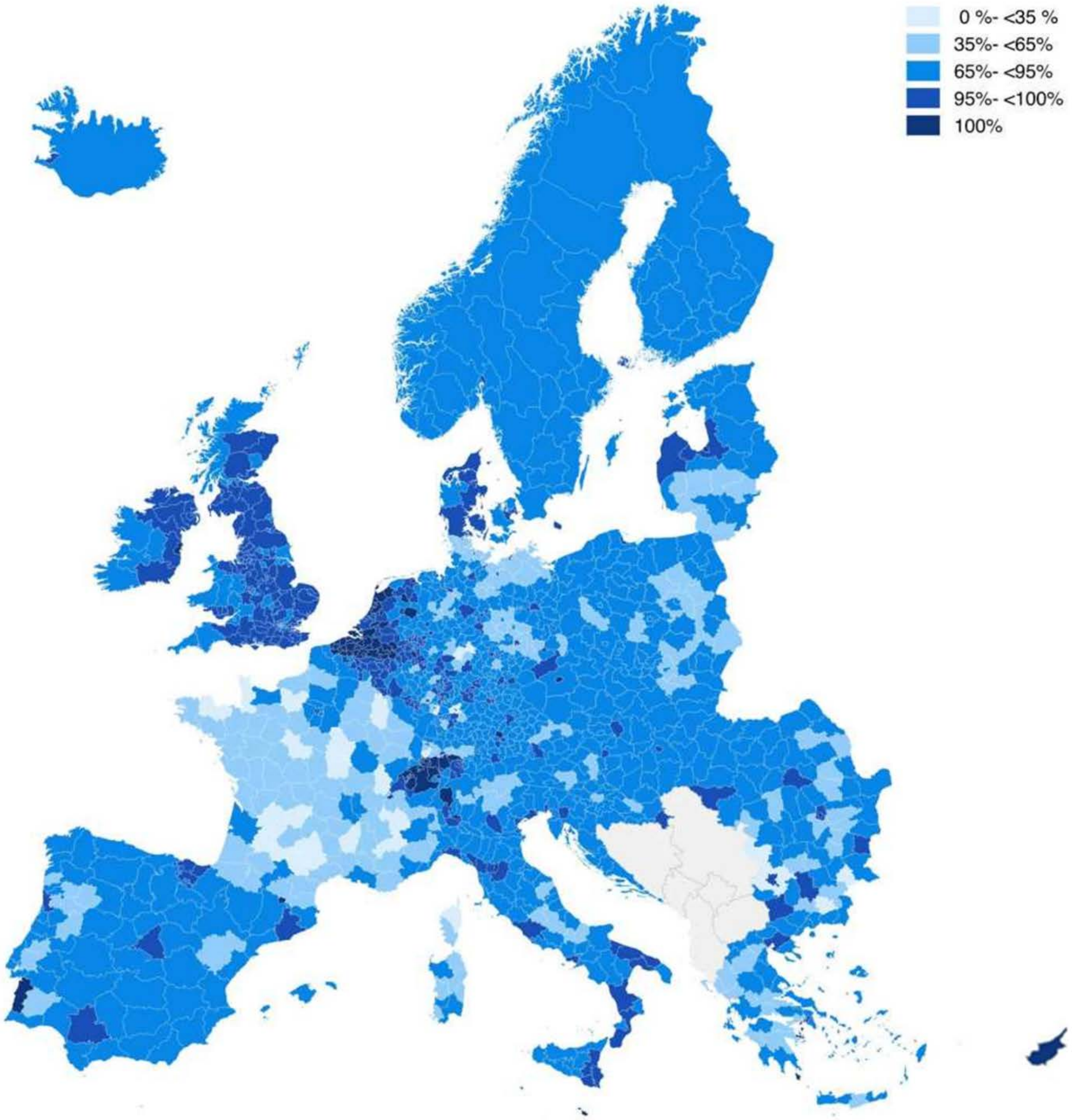
Figure 7 Next generation access (NGA) broadband coverage in the EU (% of households), mid-2019



Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

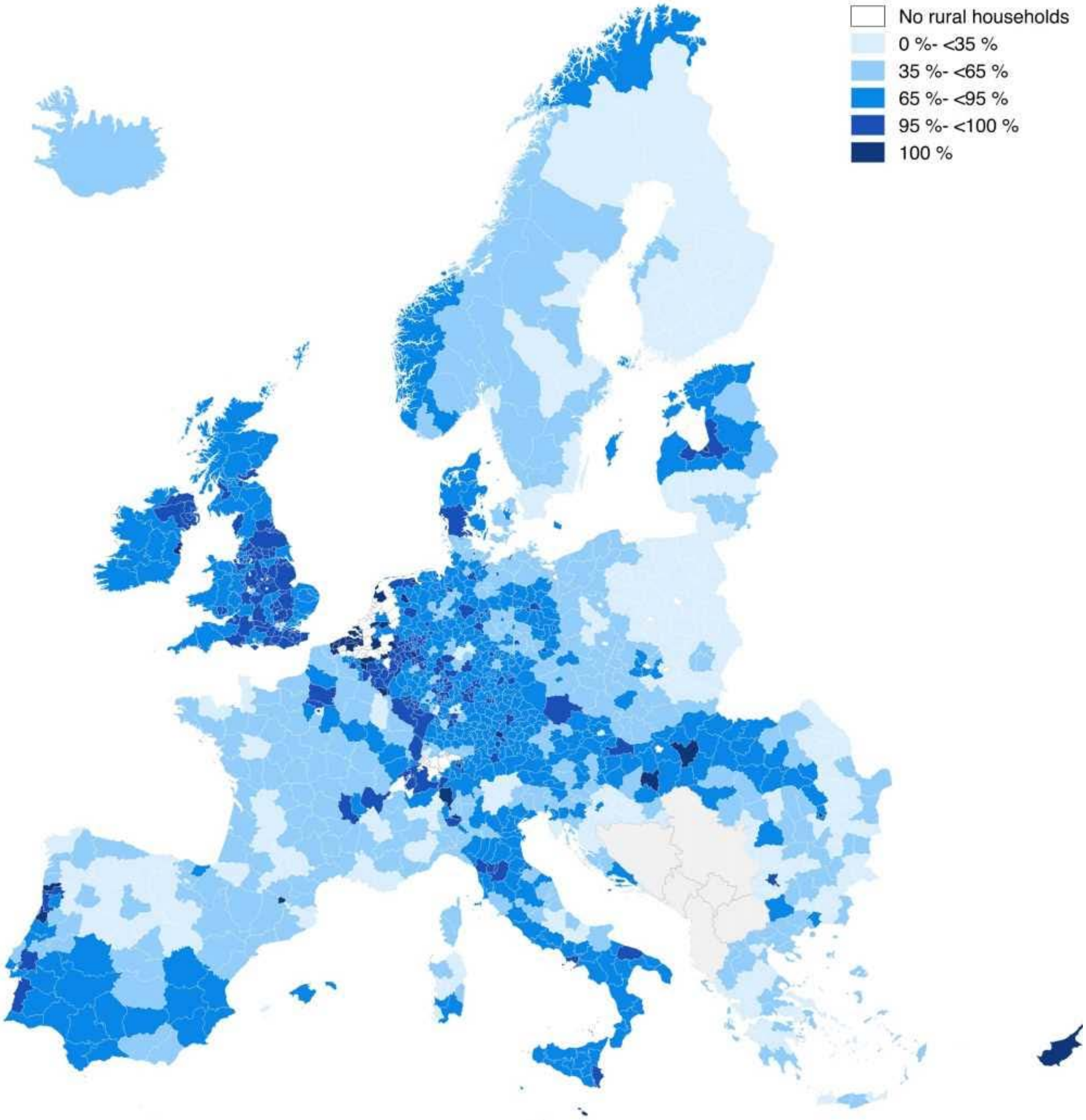
The discrepancy in overall and rural NGA broadband coverage is well illustrated by the two maps below.

Figure 8 Overall Next generation access (NGA) broadband coverage in the EU (% of households), mid-2019



Source: Broadband Coverage in Europe 2019, a study by IHS Markit, Omdia and Point Topic.

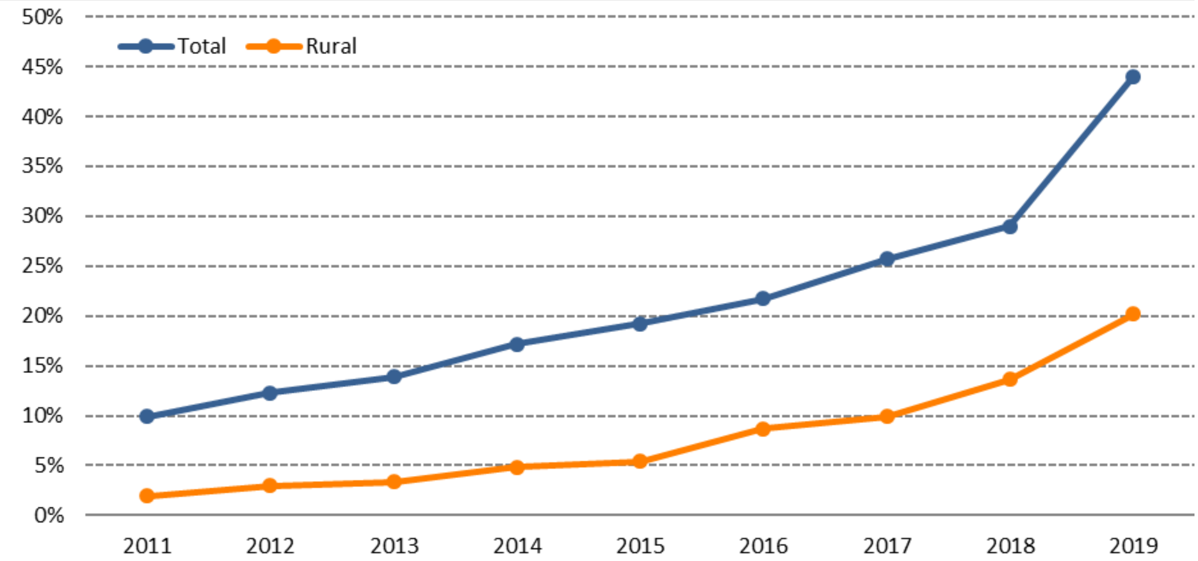
Figure 9 Rural Next generation access (NGA) broadband coverage in the EU (% of households), mid-2019



Source: Broadband Coverage in Europe 2019, a study by IHS Markit, Omdia and Point Topic

Overall very high capacity network (VHCN) coverage shows a spectacular increase between 2011 and 2019 from 10% to 44%, an increase of 34 percentage points in 8 years. In rural areas, growth was lower, but still significant, from 2% to 20% within the same time period. The significant gap between total and rural VHCN coverage shows the regional disparities in digital opportunities and confirms that more investment is needed in rural areas in order to catch up.

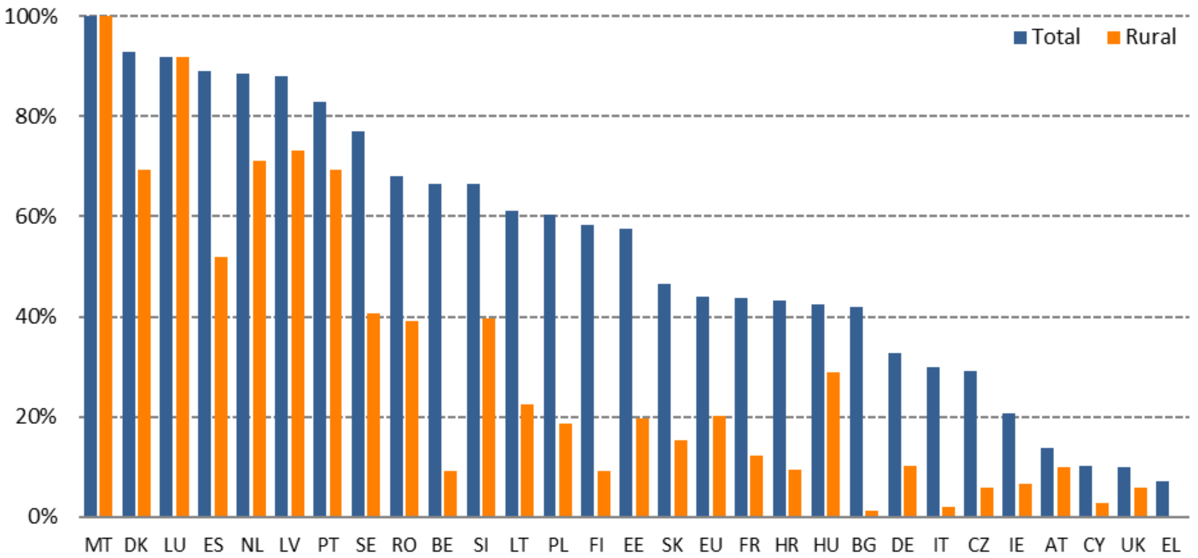
Figure 10 Fixed very high capacity network (VHCN) coverage (% of households) in the EU, 2011-2019



Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

On VHCN coverage, Malta is leading with 100% coverage, followed by Denmark and Luxembourg with above 90% coverage. The poorest performers in this respect are Greece (7%), the UK and Cyprus (both at 10%). Austria, Ireland and Czechia are below 30%, while Italy is at 30%. VHCN coverage in Germany stands at a mere 33%.

Figure 11 Fixed very high capacity network (VHCN) coverage (% of households), mid-2019



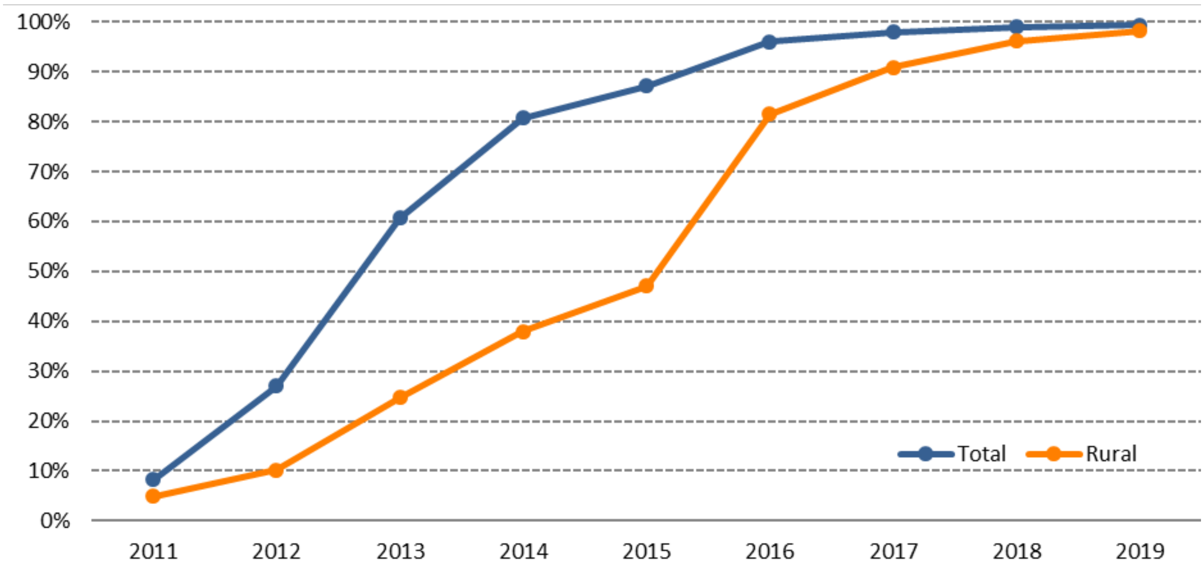
Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

4G (LTE) is almost ubiquitous with 99.4% of households covered by at least one operator in Europe (overall 4G coverage), and it is now even more widely available than fixed broadband (97.1%). 4G coverage increased mainly in Ireland, Romania, Cyprus and Croatia from 2018 to 2019.

Looking at the 5 year trend, overall 4G coverage increased from 81% in 2014 by 18 percentage points to 99.4% in 2019. Rural 4G coverage went up from 38% in 2014 to 98% in 2019, an increase of 60 percentage points in 5 years.

Average 4G availability[5] is 96%, up from 85% in 2016. In comparison, overall 4G coverage increased only 3 percentage points since 2016.

Figure 12 4G mobile coverage in the EU (% of households), 2011-2019



Source: IHS Markit, Omdia, Point Topic and VVA, Broadband coverage in Europe studies.

Figure 13 4G mobile coverage (% of households), mid-2019

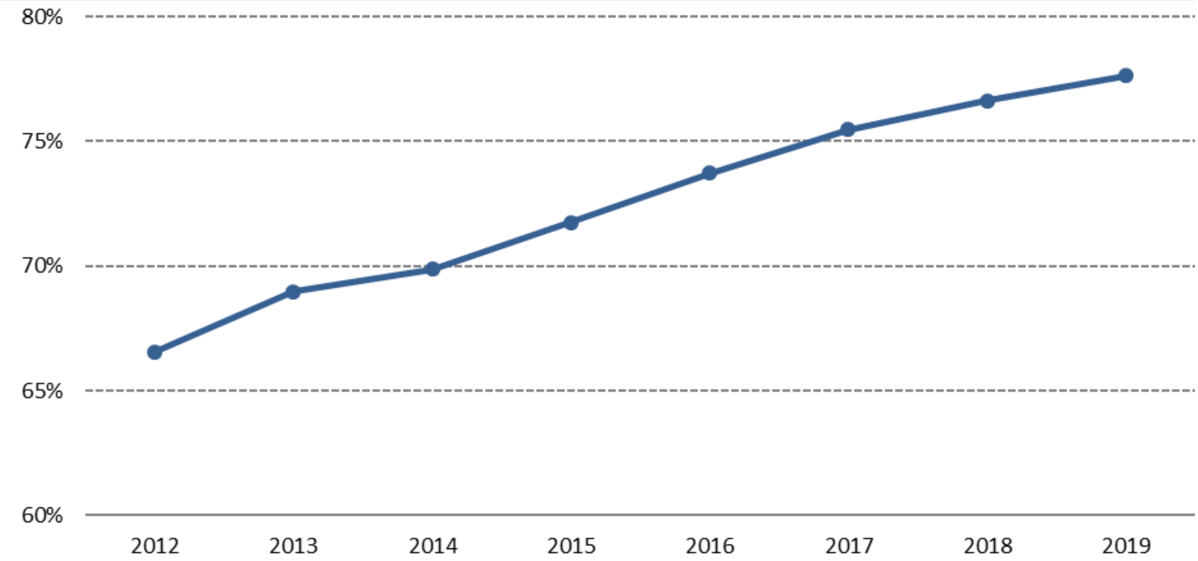
Source: IHS Markit, Omdia and Point Topic, Broadband coverage in Europe studies.

2. Fixed broadband take-up

Although fixed broadband is available to 97% of EU households, 22% of households do not have such a subscription. Growth in take-up has been steady over the last 6 years, up from 67% to 78%.

[5] This indicator measures the average of mobile telecom operators' coverage within each country.

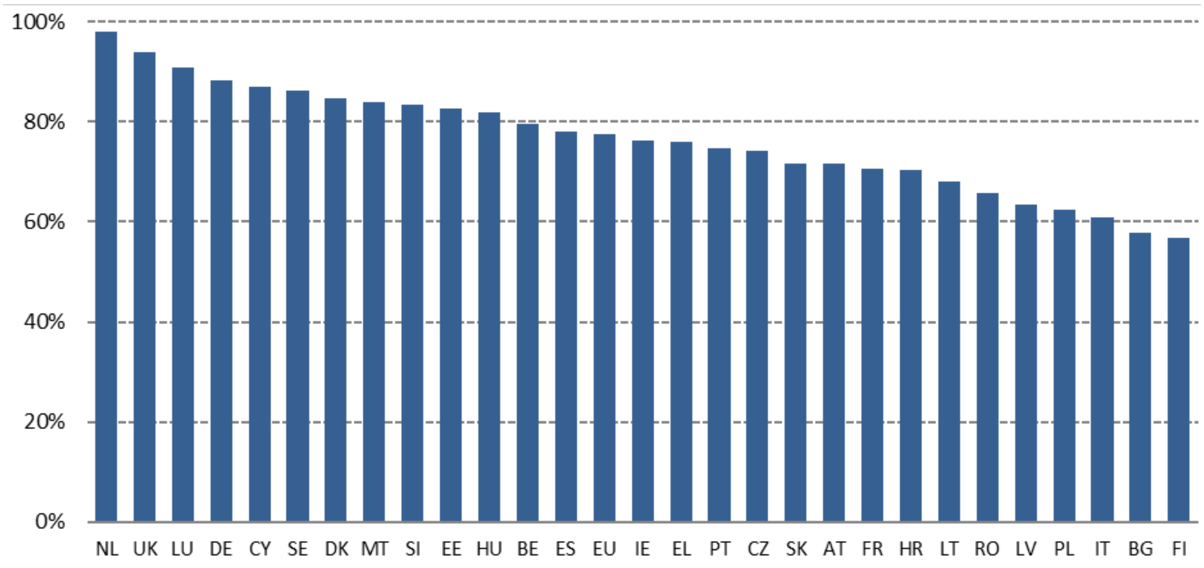
Figure 14 Households with a fixed broadband subscription in the EU (% of households), 2012-2019



Source: Eurostat, Community survey on ICT usage in Households and by Individuals.

Take-up rates ranged from only 57% to 98%. The Netherlands, the UK, Luxembourg and Germany registered the highest take-up rates, while Finland, Bulgaria, Italy, Poland and Latvia had the lowest. The relatively low take-up rates in Finland, Italy, Poland and Latvia may partly be due to fixed-mobile substitution[(6)].

Figure 15 Households with a fixed broadband subscription (% of households), 2019



Source: Eurostat, Community survey on ICT usage in Households and by Individuals.

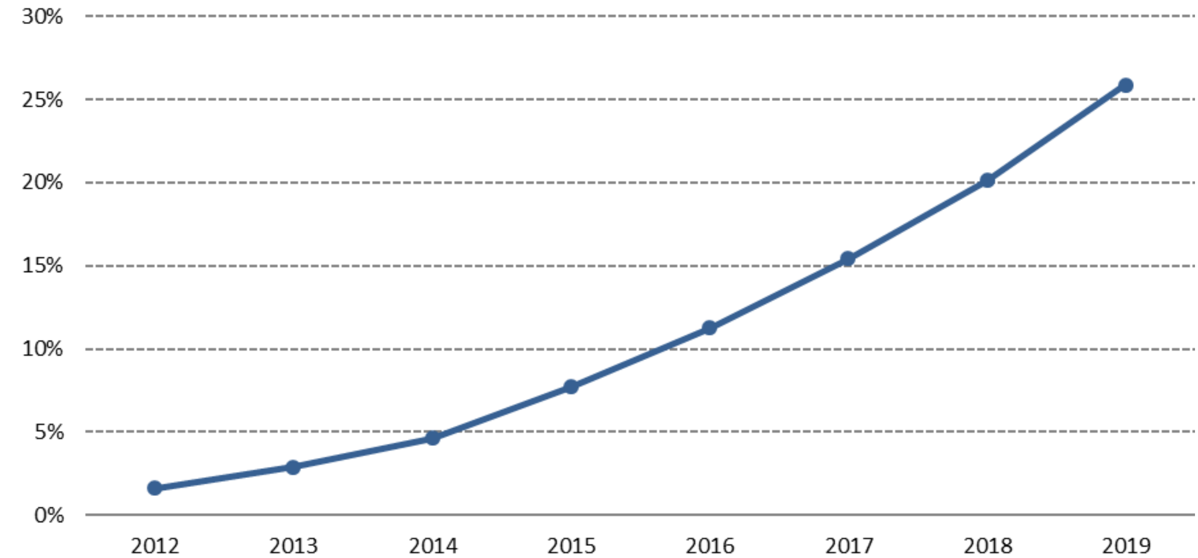
There is a substantial gap between urban and rural fixed broadband penetration rates. This gap remained almost the same in 9 years, standing at 16 percentage points in 2010 and at 14.6 percentage points in 2019. 68% of rural households in the EU had a fixed broadband subscription in 2019. The Netherlands, the UK and Luxembourg registered the highest figures, while in Bulgaria and Finland less than half of rural households subscribed.

[(6)] See in sub-chapter "3.3. Mobile broadband take-up" below "Figure **Error! Main Document Only.** Households using only mobile broadband at home (% of households), 2019" and related description.

In the Netherlands, the UK, Luxembourg, Germany, Denmark, Sweden and Belgium, urban and rural penetration rates are identical or almost identical.

However, in a large group of Member States (Bulgaria, Finland, Latvia, Romania, Italy, Poland, Lithuania, Malta, Portugal, Greece, France and Spain), fixed rural take-up is relatively low (below 63%) and there are significant gaps of 12-30 percentage points between urban and rural take-up.

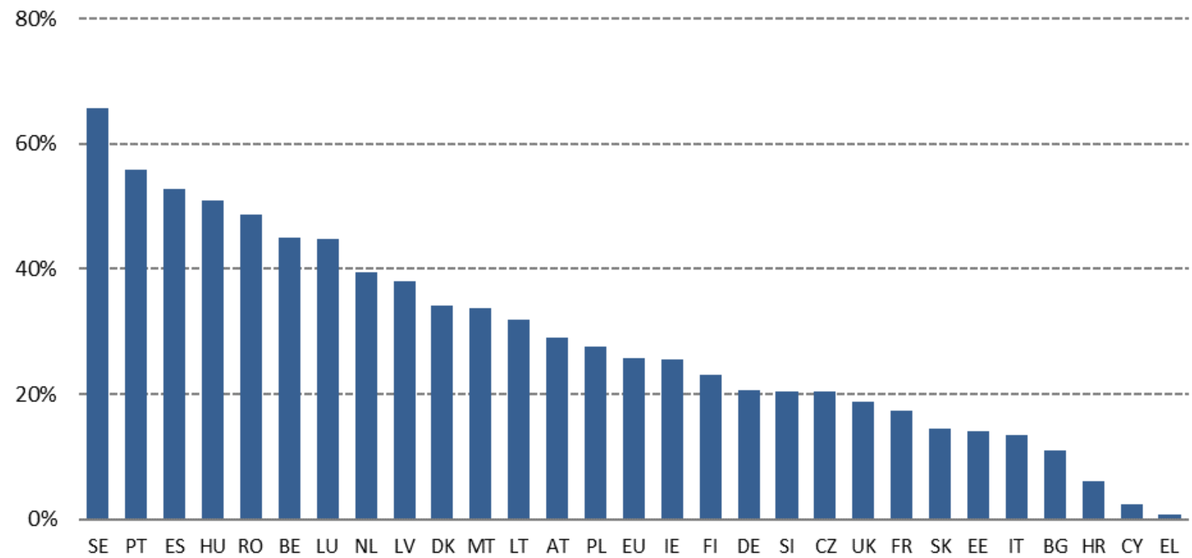
Figure 16 Households with a fixed broadband subscription of at least 100 Mbps (% of households) 2012 – 2019



Source: Estimated based on Eurostat's "Community survey on ICT usage in Households and by Individuals" and data from the Communications Committee (COCOM).

The Digital Agenda for Europe set the objective of at least 50% of households subscribing to ultrafast broadband by the end of 2020. In June 2019, 66.5% of households were covered by networks capable of providing at least 100 Mbps. As new service offers emerge, take-up is growing sharply. 26% of European households currently subscribe to ultrafast broadband (at least 100 Mbps), a marked improvement from 2% 7 years ago. Penetration is highest in Sweden, Portugal, Spain and Hungary with over 50% of households subscribing to at least 100 Mbps. In Greece, Cyprus and Croatia, by contrast, take-up is very low (less than 10%).

Figure 17 Households with a fixed broadband subscription of at least 100 Mbps (% of households), 2019

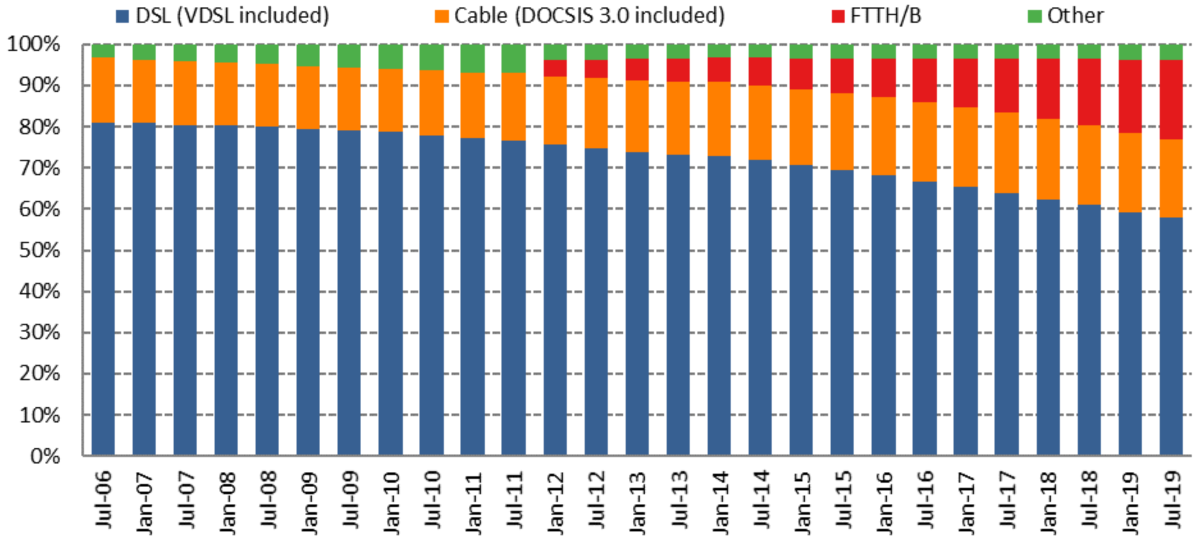


Source: Estimated based on Eurostat's "Community survey on ICT usage in Households and by Individuals" and data from the Communications Committee (COCOM).

Although DSL is still the most widely used fixed broadband technology, its market share declined from 79% in 2009 to 58% in 2019 – more than 20 percentage points in 10 years. Its main challenger - cable - increased its share slightly (15% versus 19%) during the same period.

However, the most spectacular growth was achieved by FTTH/B, which has acquired 19% of the market in just 8 years. Nevertheless, DSL is still dominant, and its market share could be maintained for some years thanks to increasing VDSL coverage.

Figure 18 Fixed broadband subscriptions – technology market shares in the EU (% of subscriptions), July 2006-July 2019



Source: Communications Committee (COCOM).

The market share of xDSL varies from 8% to 97% and is generally lower in Eastern Europe, where FTTH/B is more widely used. Cable is present in all but two Member States (Greece and Italy).

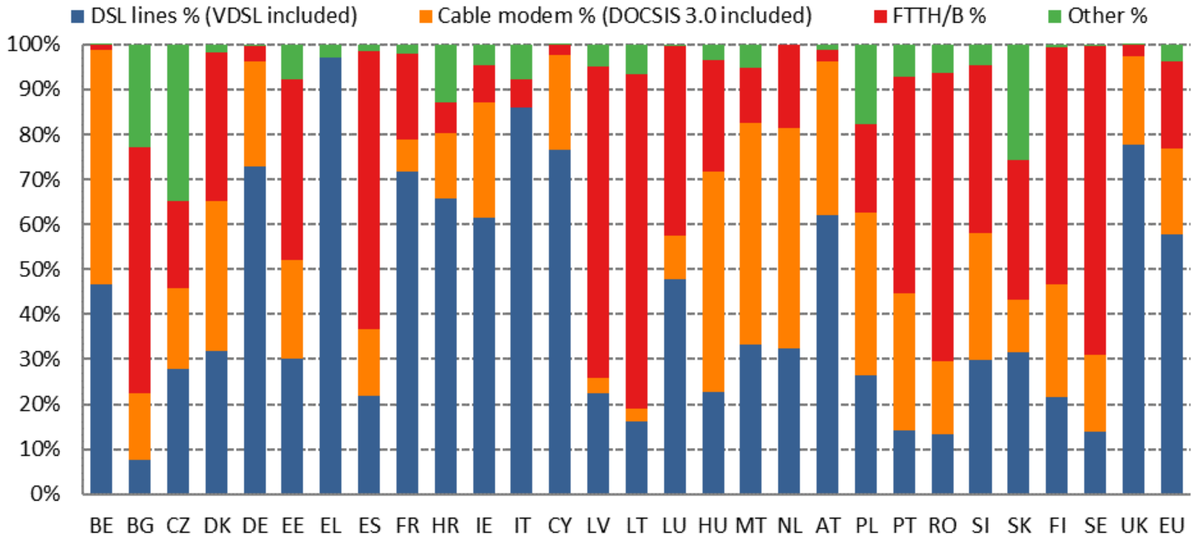
DSL technologies are particularly prevalent in Greece and Italy, and have the lowest market share in Bulgaria, Romania, Portugal and Sweden.

Looking at alternative technologies, cable is the main rival to xDSL in the majority of Member States. Cable has a very high market share in Belgium, Hungary, Malta and the Netherlands.

FTTH and FTTB together represent 19% of EU broadband subscriptions. FTTH/B is the most widely used technology in Lithuania, Latvia, Sweden, Romania, Spain, Bulgaria and Finland.

However, compared to global frontrunners such as South Korea and Japan, Europe as a whole continues to lag behind in the deployment of these technologies.

Figure 19 Fixed broadband subscriptions – technology market shares in the EU (% of subscriptions), July 2019



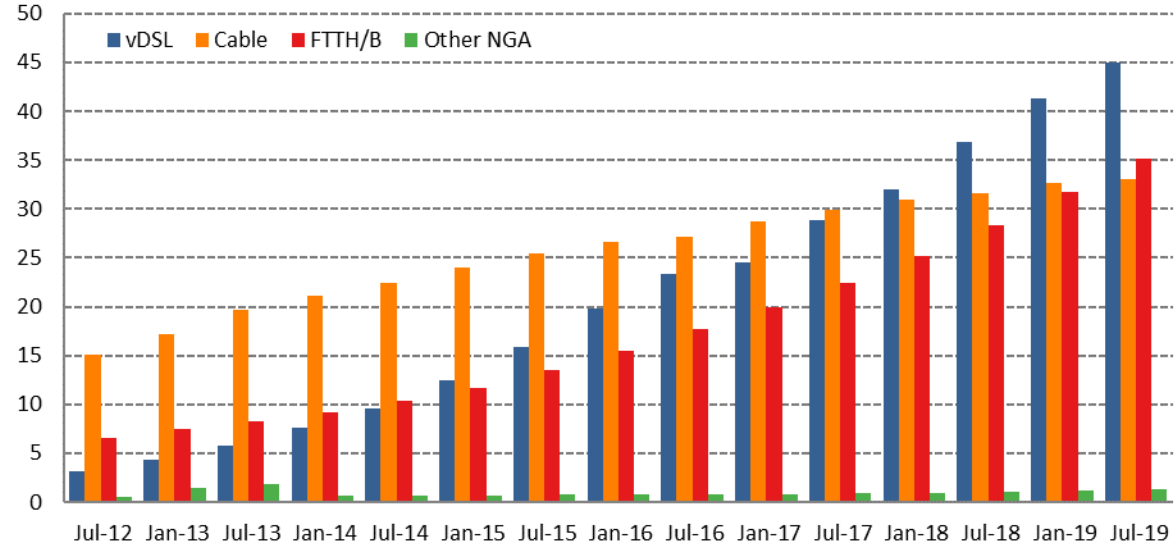
Source: Communications Committee (COCOM).

NGA subscriptions have been steadily increasing in the EU since 2012, and the last 2 years have seen a sharp increase of 32.5 million. NGA currently accounts for 63% of all broadband subscriptions, while in 16 Member States, its market share is greater than 75%. By contrast, NGA take-up remains lower than 50% in Greece, Cyprus, France, Austria and Italy.

Belgium and the Netherlands are ahead of other Member States in NGA take-up, with both VDSL and DOCSIS 3.0 cable being widely available. The highest growth in the last 12 months could be observed in Italy (13 percentage points), the UK and Germany (10 percentage points each). VDSL is currently the most widespread NGA technology in the EU in terms of take-up.

29% of NGA subscriptions are DOCSIS 3.0 and DOCSIS 3.1 cable, a relatively high figure given that cable broadband in total represents only 19% of all EU fixed broadband subscriptions. While almost all cable networks have been upgraded to NGA, only 65% of the xDSL network is VDSL-enabled. Nevertheless, VDSL coverage has increased by 11 percentage points in the last 3 years and the number of subscriptions has more than doubled. VDSL now represents 39% of all NGA subscriptions, being the most widespread NGA technology. FTTH/B has a 31% share of total NGA subscriptions.

Figure 20 NGA subscriptions (millions) by technology in the EU, July 2012-July 2019



Source: Communications Committee (COCOM).

While new entrant operators are gaining more and more market share (61% by mid-2019), incumbents still control 39% of subscriptions. The market share of incumbents is the highest in Luxembourg (63%), while in Austria, Cyprus, Latvia, Estonia, Lithuania and Denmark it is still above 50%. Incumbents have the lowest market shares in Romania (20%) and Czechia (21%).

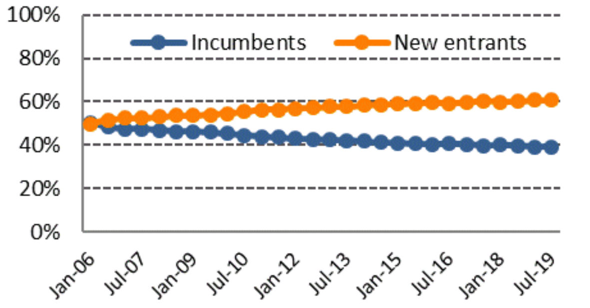
Market shares are calculated at national level for incumbents and new entrants. However, broadband markets are geographically fragmented, suggesting that a large number of households are served by only one provider (most likely the incumbent operator in this case).

Incumbent operators are market leaders in almost all Member States. Overall, the market share of incumbents in the EU decreased by 10 percentage points between 2006 and 2015. Since then, however, there have been no significant changes.

In the DSL market, unbundling has reduced the dominance of incumbents. However, in VDSL, incumbents still hold 58% of subscriptions (down 5 percentage points since July 2018). Nevertheless, NGA is provided primarily by new entrants.

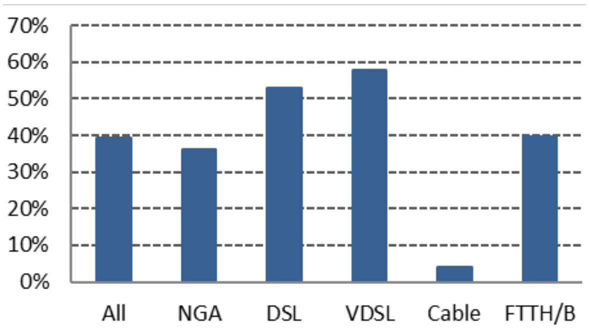
New entrant operators can compete with incumbents by using either the incumbent's network or their own network to offer internet access. In Greece, competition is almost entirely based on regulated access to the incumbent's access network. There is also a high share (over 70%) of DSL subscriptions in Italy, the UK, Cyprus, Germany and France, meaning that new entrants are not exclusively using the incumbents' networks but are also building their own networks. In Eastern European Member States, competition is based rather on competing infrastructures. This also goes for Belgium, Malta, Portugal and the Netherlands.

Figure 21 Fixed broadband subscriptions – operator market shares in the EU (% of subscriptions), January 2006-July 2019



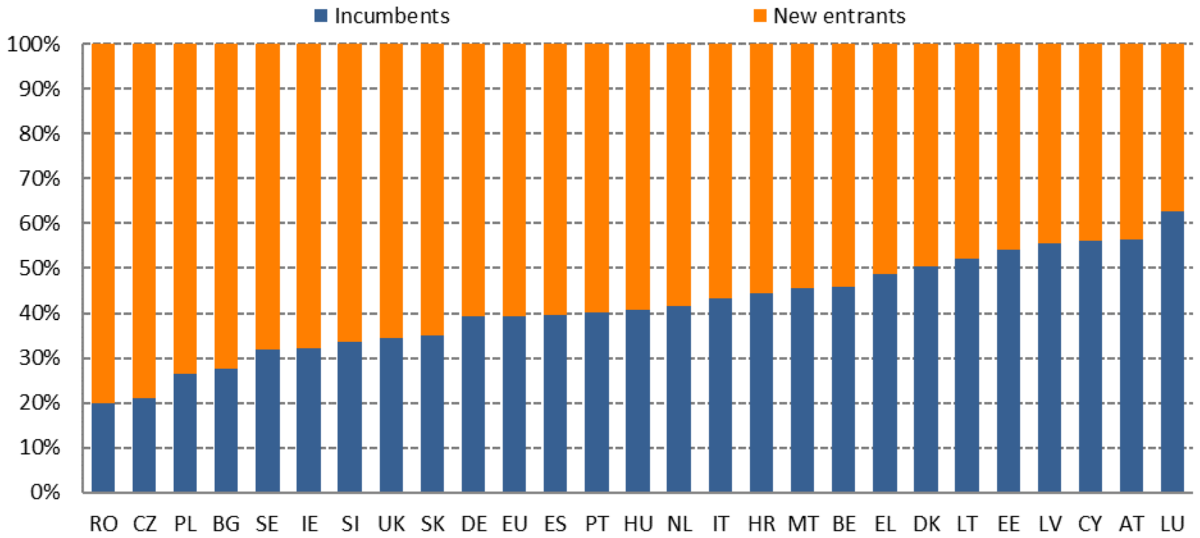
Source: Communications Committee (COCOM).

Figure 22 Incumbent operator market share by technology in the EU (% of subscriptions), July 2019



Source: Communications Committee (COCOM).

Figure 23 Fixed broadband subscriptions – operator market shares in the EU (% of subscriptions), July 2019



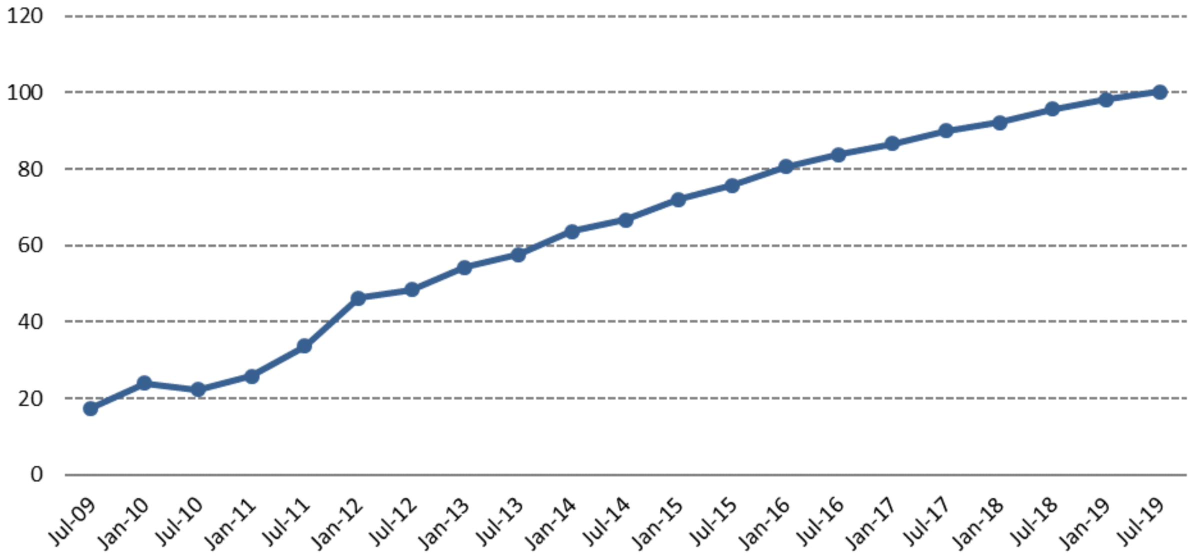
Source: Communications Committee (COCOM).

3. Mobile broadband take-up

Mobile broadband represents a fast-growing segment of the broadband market. There are 100.2 active mobile broadband SIM cards per 100 people in the EU. The penetration rate more than doubled over the last 7 years (from 48% in mid-2012).

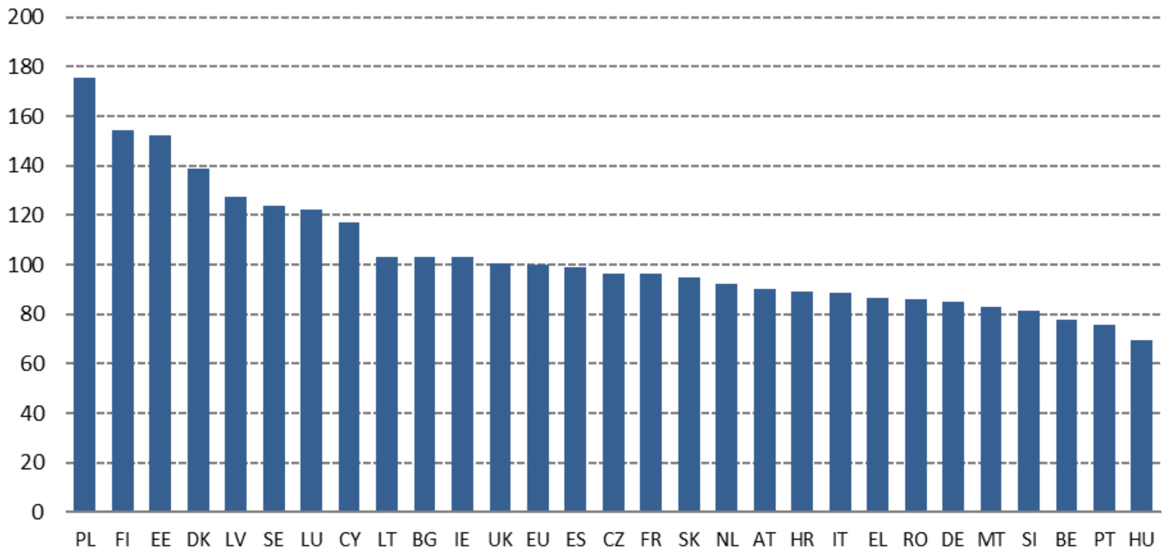
In Poland, the Nordic countries, Estonia, Latvia and Luxembourg there are already more than 120 subscriptions per 100 people, while in Hungary the take-up rate is the lowest, with 70 subscriptions per 100 people. Most mobile broadband subscriptions are used on smartphones rather than on tablets or notebooks.

Figure 24 Mobile broadband penetration in the EU (subscriptions per 100 people), July 2009-July 2019



Source: Communications Committee (COCOM).

Figure 25 Mobile broadband penetration (subscriptions per 100 people), July 2019



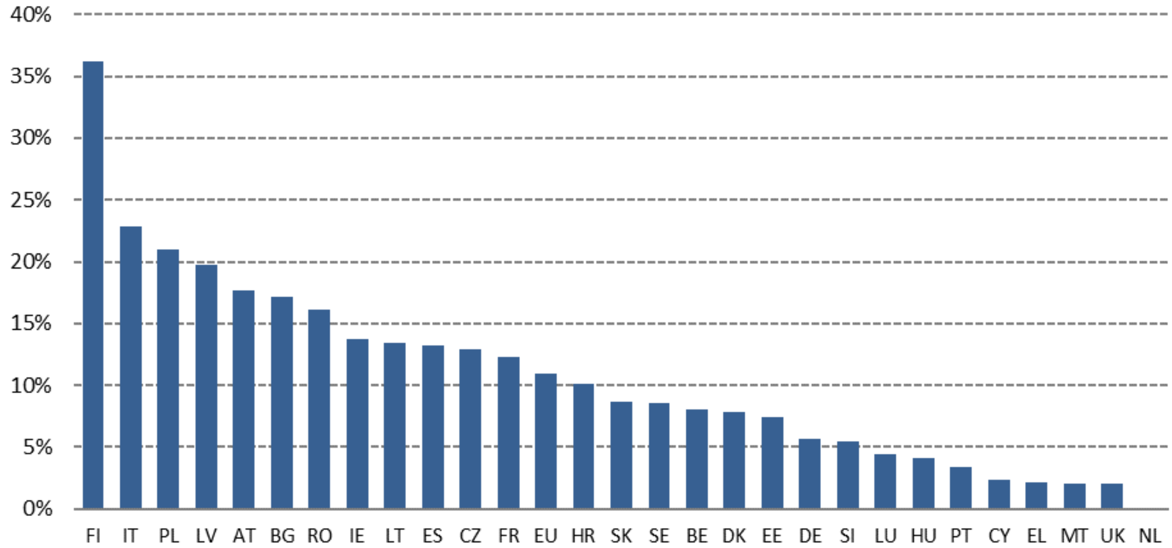
Source: Communications Committee (COCOM).

Mobile broadband is still mainly complementary to fixed broadband. Europeans primarily use fixed technologies at home to access the internet. However, there is a growing number of households which rely only on mobile internet. In 2019, 11% of EU households accessed the internet only through mobile technologies, up from 4.1% in 2010. Finland and Italy were the leaders in mobile-only access, with 36% and 23% of households respectively.

The Netherlands had the lowest mobile-only access rate at less than 0.04% of households, which correlates with the fact that it has the highest take-up rate of fixed broadband in the EU (98%).

By contrast, in Finland, Italy, and Poland, where fixed broadband take-up is comparatively low, more than 20% of households rely purely on mobile technologies at home.

Figure 26 Households using only mobile broadband at home (% of households), 2019



Source: Eurostat, Community survey on ICT usage in Households and by Individuals.

The 5G readiness indicator in the DESI shows the portion of spectrum assigned for 5G purposes in each Member State in the 5G pioneer bands. The percentage score of the 5G readiness indicator is based on the amount of spectrum assigned in a specific Member State and ready for 5G use by the end of 2020 within the 5G pioneer bands identified in Europe.

This score is calculated based on the portion of spectrum assigned in each 5G pioneer band in comparison with the maximum feasible amounts, which are as follows:

- 700 MHz band: 60 MHz (703-733 & 758-788 MHz)
- 3.6 GHz band: 400 MHz (3 400-3 800 MHz)
- 26 GHz band: 1000 MHz within 24 250-27 500 MHz.

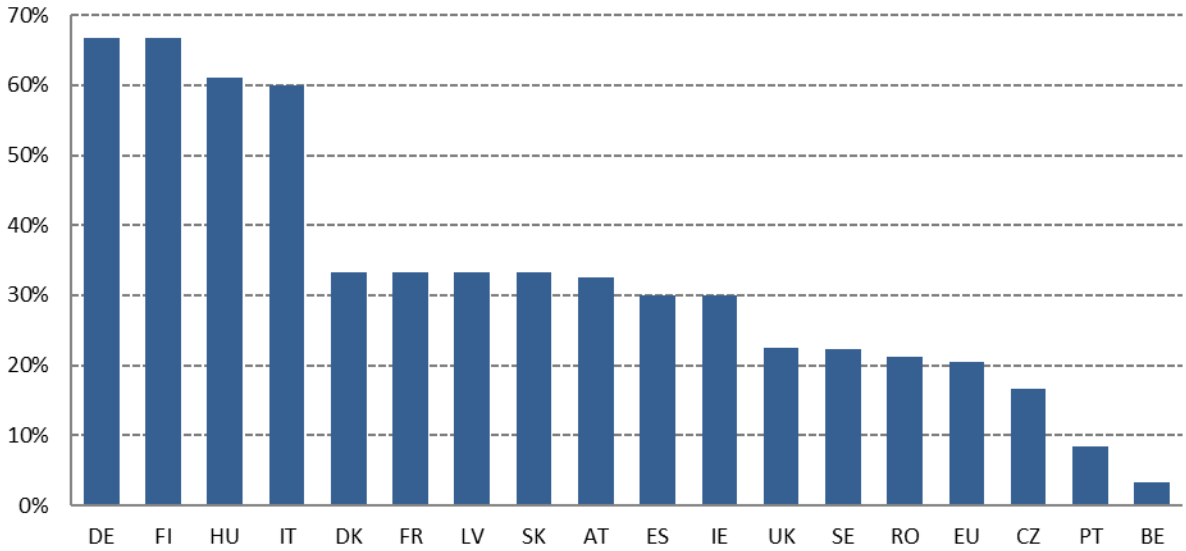
All three spectrum bands have an equal weight, so having the maximum feasible amount assigned – and ready for 5G use – in the range of one of these bands will result in a score of 33.3%, i.e. one third of the total maximum score.

Remarks:

1. For the 700 MHz band, there are a number of derogations allowing for a delay until 2022; however, the 5G readiness indicator is about factual reporting, not a judgement on legal compliance.
2. For the 3 400-3 800 MHz band, only licences aligned with the new technical conditions (according to Commission Decision (EU)2019/235) were considered ready for 5G use.
3. For the 26 GHz band, at least a portion of 1000 MHz within the band must be assigned and ready for 5G use by the end of 2020, as required by the European Communications Code.

Until the end of March 2020, 17 Member States assigned spectrum in the 5G pioneer bands. Germany, Finland, Hungary and Italy assigned at least 60% of the 5G spectrum already. The following countries have not assigned yet any 5G spectrum (according to the above conditions): Bulgaria, Croatia, Cyprus, Estonia, Greece, Lithuania, Luxembourg, Malta, the Netherlands, Poland and Slovenia.

Figure 27 5G readiness (assigned spectrum as a % of total harmonised 5G spectrum), 2020

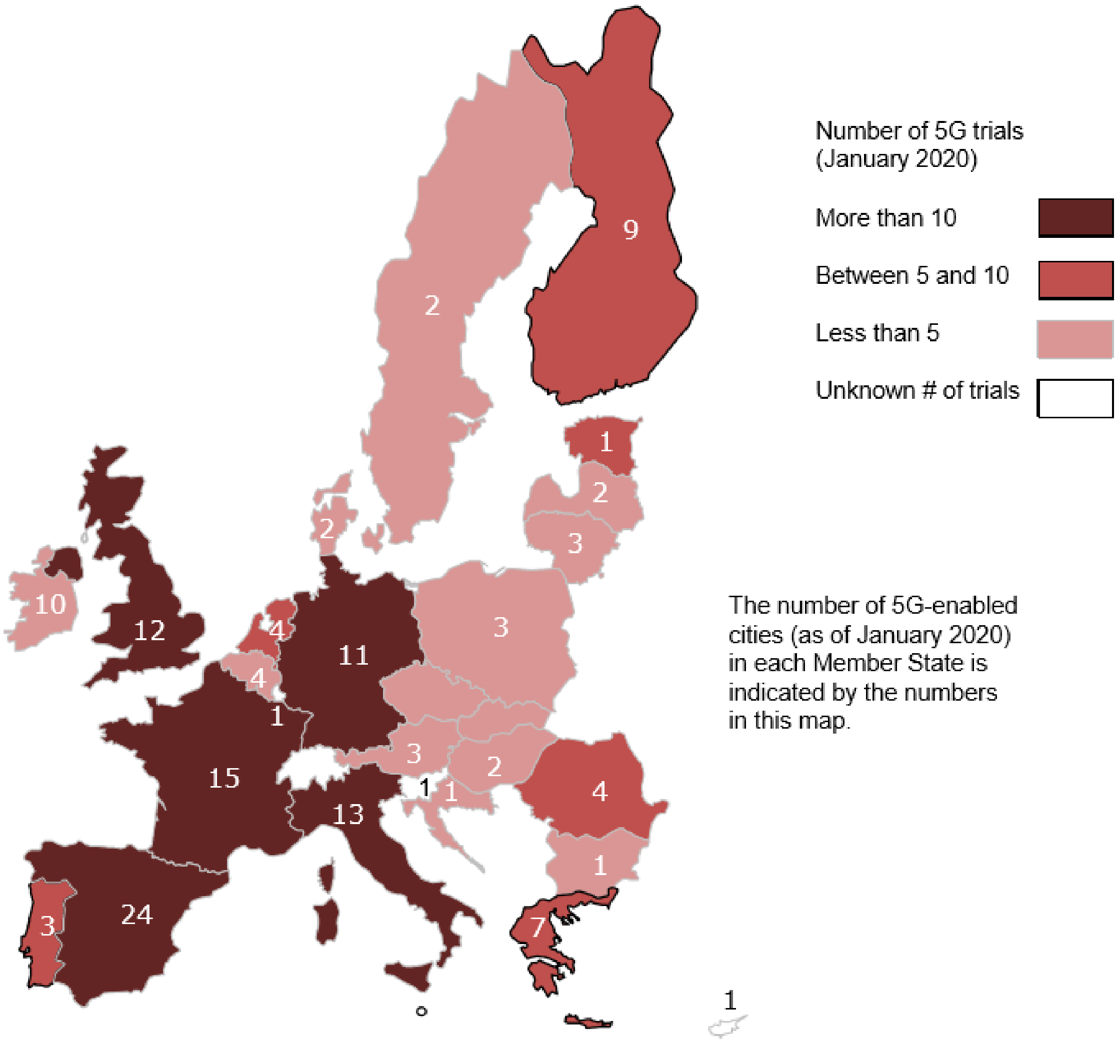


Source: Communications Committee (COCOM) based on iDATE.

5G cities are European cities where commercial 5G services have been announced as having been launched by operators, or where major 5G city pilots are taking place with a view of a commercial service launch. The numbers indicated in the map in Figure 28 are based on the information provided by the members of the Communication Committee.

The number of 5G trials being monitored in Europe and shown in Figure 28 is based on the publicly available information on pre-commercial 5G trials and pilots launched in Member States as part of the industry's 5G trial roadmap.

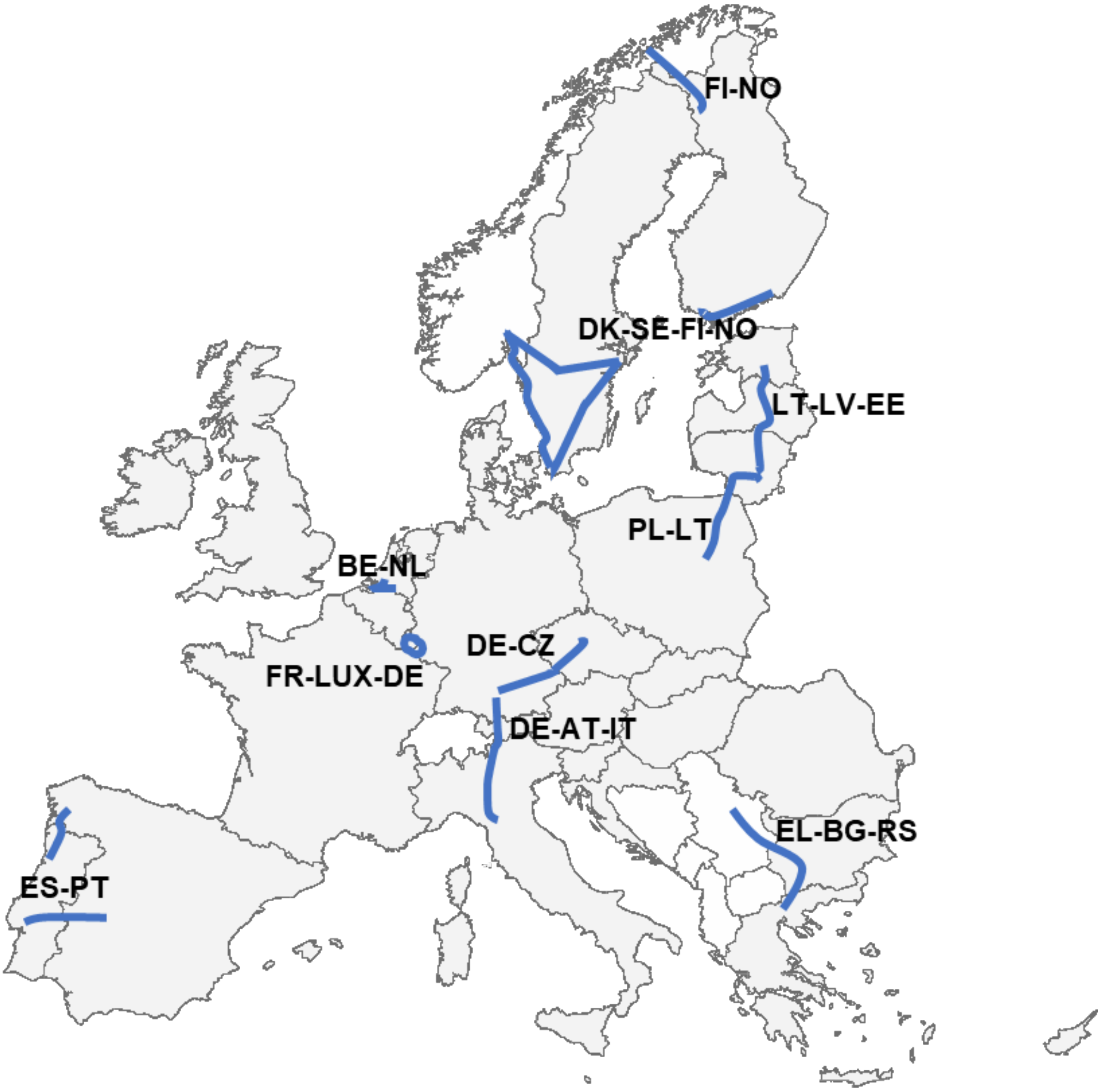
Figure 28 Numbers of 5G cities and reported 5G trials in EU Member States, January 2020



Source: iDATE.

The ‘5G digital cross-border corridors’ shown in Figure 29 are large-scale segments of highways running across two or more national borders where 5G connectivity systems applied to connected and automated mobility solutions and use cases are tested. Such corridors are either based on bilateral agreements for enhanced cross-border cooperation that Member States have signed and/or included in Horizon 2020 research and innovation projects.

Figure 29 A map of 5G digital cross-border corridors in the EU Member States, January 2020



Source: iDATE.

At the end of March 2020, 5G commercial services had been deployed in 9 Member States (AT, FI, DE, HU, IE, IT, LV, RO, ES) and in the UK.

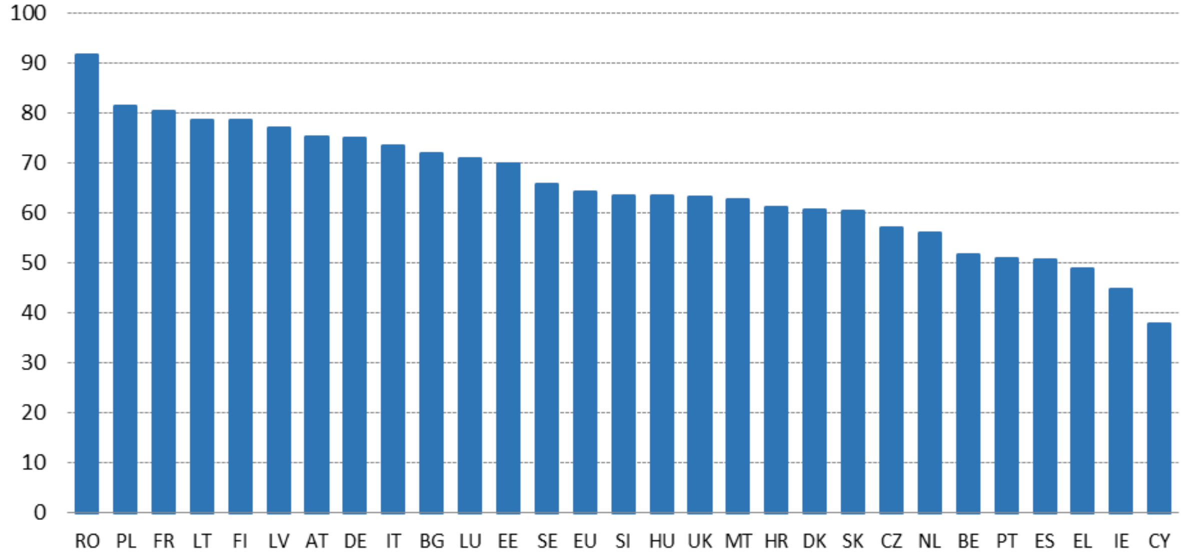
4. Broadband prices

The Broadband Price Index measures the prices of representative baskets of fixed, mobile and converged broadband offers.

The Broadband Price Index is a score[7] that measures the prices of over 30 representative broadband consumption baskets of different speeds and different products (standalone internet, double play, triple play and quadruple play).

[7] 0 to 100, 100 being the best.

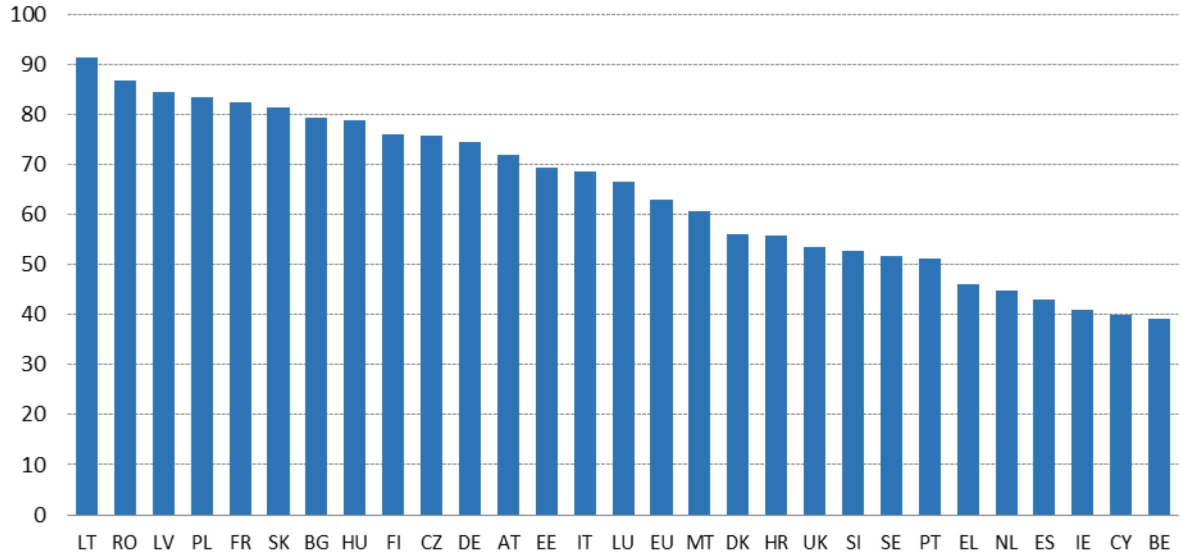
Figure 30 Broadband price index – all baskets (score 0-100, 100 being the best) 2020



Source: Commission, based on Empirica (Retail broadband prices studies).

On fixed broadband only, Lithuania, Romania, Latvia, Poland, France and Slovakia are the leaders with scores above 80. Belgium, Cyprus, Ireland and Spain are the most expensive countries in this category.

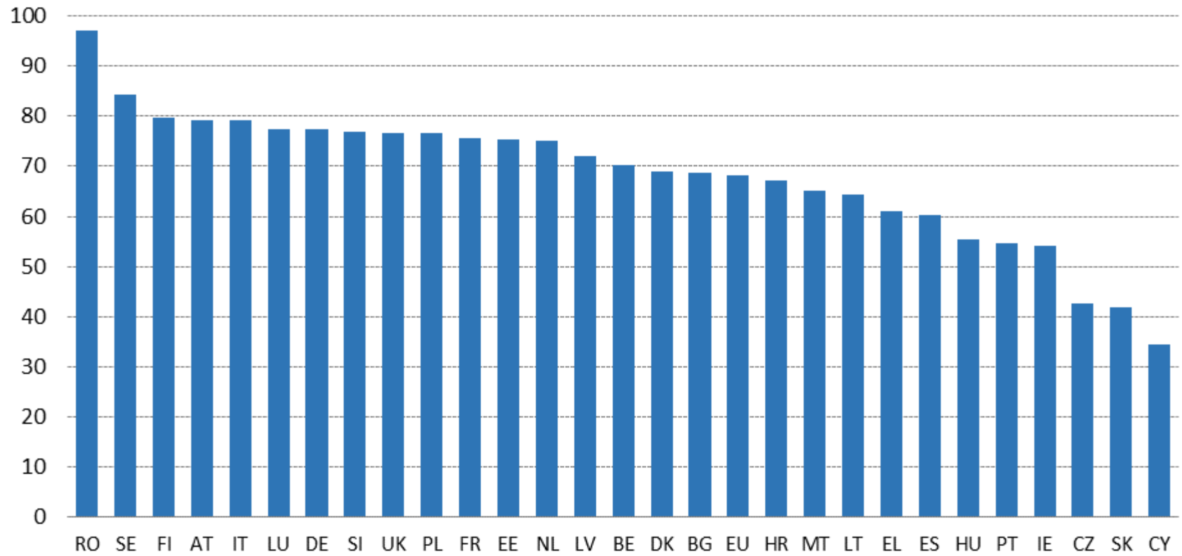
Figure 31 Broadband price index – baskets with fixed offers only (score 0-100, 100 being the best) 2020



Source: Commission, based on Empirica (Retail broadband prices studies).

Considering baskets with mobile offers only, Romania scores best regarding prices in this category, followed by Sweden and Finland. In Cyprus, Slovakia and Czechia, mobile operators are offering the most expensive mobile broadband products.

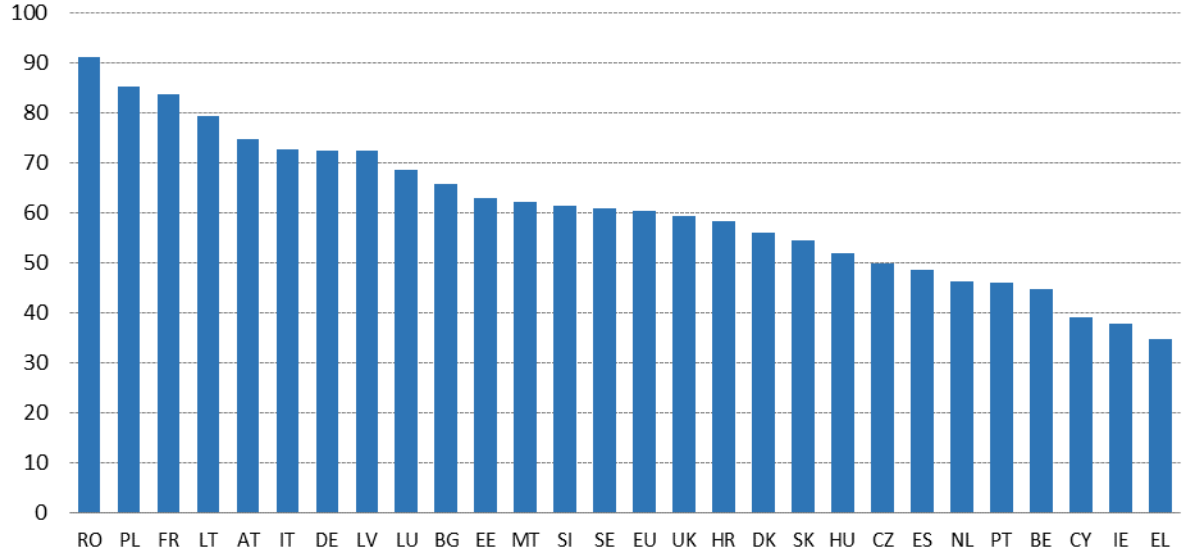
Figure 32 Broadband price index – baskets with mobile offers only (score 0-100, 100 being the best), 2020



Source: Commission, based on Empirica (Retail broadband prices studies).

Looking at baskets with converged fixed & mobile offers only, we see that Romania is again leading with the most affordable prices in this category, followed by Poland, France and Lithuania. The most expensive prices are offered in Greece, Ireland, Cyprus and Belgium.

Figure 33 Broadband price index – baskets with converged fixed & mobile offers only (score 0-100, 100 being the best), 2020



Source: Commission, based on Empirica (Retail broadband prices studies).

5. Progress towards a Gigabit society

As outlined above, Member States have made progress towards achieving the connectivity objectives of the Gigabit society. New network deployment is mainly, if not exclusively, in fibre. Commercial deployment focuses on urban areas, and slows down as providers move to less densely populated areas; public intervention focuses on rural areas. At the same time, providers are completing the upgrade of their legacy networks to VDSL vectoring and have started upgrading their cable networks to DOCSIS 3.1.

The penetration of broadband services of at least 30 and at least 100 Mbps is constantly increasing, but still stands at 50% and 25% of subscriptions respectively.

Almost all Member States have launched their 5G strategies focusing on spectrum availability, 5G testing and designating 5G cities. The first deployments of 5G networks have started in few Member States and operators have started marketing 5G offers. A number of regional agreements for 5G corridors have been signed for automated driving. The COVID-19 crisis forced a number of Member States to postpone a number of 5G assignment procedures scheduled in Q2 2020.

6. EU support for National Broadband Plan (NBP) implementation

The European Investment and Structural Funds (ESIF) supported EU countries' implementation of their national broadband plans (NBPs) by providing almost €6 billion in grants in 2014-2020. 56% of the planned projects have been signed. The Commission proposed that this support continues in 2021-2027, with the focus on very high capacity networks.

Telecoms infrastructure projects are also supported by European Fund for Strategic Investment (EFSI) guarantees and European Investment Bank (EIB) lending: as of 12 December 2019, approximately €12.3 billion in investments are estimated to have been mobilised thanks to a total EIB financing of €3.47 billion, of which €3.01 billion was approved for a budgetary guarantee from EFSI. To date, total EFSI financing has been signed for €2.45 billion, and disbursed for €1.73 billion. The Commission proposes to continue support for telecom infrastructure projects beyond 2021 through the InvestEU programme.

The Connecting Europe Broadband Fund (CEBF) was launched in June 2018 and is expected to unlock total investments of between €1.0 billion and €1.7 billion. The CEBF can invest in all EU Member States, as well as EEA Member States participating in the Telecom Connecting Europe Facility (Iceland and Norway). The project pipeline shows solid geographical diversification, as do the projects already signed by the Fund to date.

The CEBF signed its maiden project in Croatia on 25 January 2019 for an expected contribution of €30 million (equity capital). The project aims to deploy high-quality fibre-to-the-home (FTTH) open-access network for residential, business and public administration in the rural areas of the Primorje-Gorski Kotar and Istria regions – Croatia's two north-western counties in – and to cover over 135,000 locations.

The Commission's proposal for the digital part of the Connecting Europe Facility 2021-2027 earmarks €3 billion in grants to co-fund different digital infrastructure investments including: 5G corridors along transport routes; very high capacity networks, including 5G systems, for socio-economic drivers and households; backbone networks of strategic importance, and very high quality wireless connectivity in local communities.

The Commission continues to support the development of administrative capacity to design and implement NBPs through the Broadband Competence Offices Network launched in 2017 (with currently 115 members). The network brings together national and regional authorities active in this field, and is supported by a permanent secretariat based in Brussels. An updated version of the *Broadband Investment Guide* is being developed by experts in the field and is expected to be published end-2020.

Work to improve the mapping of broadband also continued with the review of existing national initiatives. An EU Broadband Mapping Portal was launched in spring 2019 and is expected to be updated taking into account BEREC guidelines on geographic surveys. BEREC is expected to finalise the guidelines by the end of 2020.

7. Municipalities need more connectivity – WiFi4EU

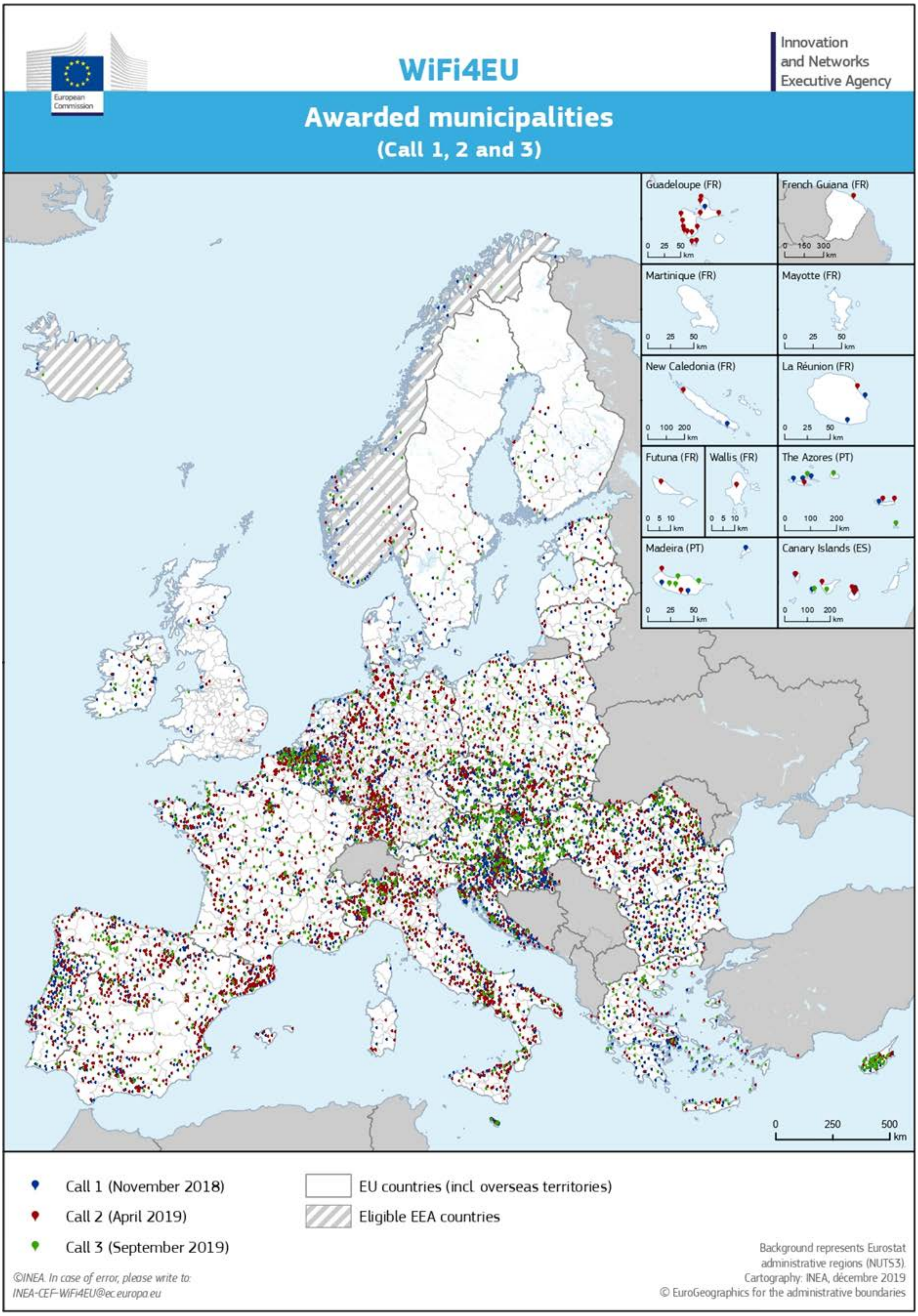
The WiFi4EU initiative promotes free Wi-Fi access in public spaces including schools, parks, squares, public buildings, libraries, health centres and museums in municipalities throughout Europe. Three calls have been run, for a total of almost 8,000 vouchers distributed to winning municipalities.

The first WiFi4EU call, which took place in November 2018, awarded 2,800 vouchers to more than 13,000 municipalities from every EU Member State, Norway and Iceland. The second call in April 2019 saw more than 10,000 applications for 3,400 vouchers. Last September, the third call distributed 1,780 vouchers in the first 2 seconds. More than 27,000 municipalities registered; over a quarter of all European municipalities.

Each voucher entitles the winning municipality to install a WiFi4EU network, which covers the costs for €15,000 as a fixed amount. The fourth and last call, scheduled for 2020, includes 947 vouchers equivalent to an additional €14.2 million, for a total budget of the initiative amounting to €150 million.

The vouchers are allocated on a first-come-first-served basis while ensuring geographical balance.

Figure 34 WiFi4EU - Country allocation



Source: European Commission.

8. EU harmonised radio spectrum underpins future wireless digital services within the EU

The EU harmonised radio spectrum for wireless broadband use amounts to 4340 MHz, including the 26 GHz frequency band (24.25-27.5 GHz), while 2090 MHz thereof are subject to authorisation in accordance with the provisions of Directive (EU) 2018/1972 (European Electronic Communications Code, EECC). The 700 MHz frequency band (703-733 MHz and 758-788 MHz) shall be awarded and available for use by 30 June 2020 under Decision (EU) 2017/899[(8)]. In addition, the 3.6 GHz frequency band (3400-3800 MHz) and at least 1 GHz of the 26 GHz frequency band (subject to market demand) shall be allowed for use by 31 December 2020 pursuant to Article 54 of the EECC.

In April 2020, 39% of the EU harmonised radio spectrum for wireless broadband was awarded across Member States. Less than 2 months before the expiration of the deadline, and while some Member States have announced the postponement of spectrum awards due to the COVID-19 crisis or are in the process of resolving other issues (e.g. pending cross-border coordination), only seven Member States have assigned the 700 MHz band (and two not in full). Bands above 1 GHz provide additional capacity. These remain partly unassigned in many Member States, but will play a significant role in the deployment of 5G services, in particular the 3.6 GHz band, which has been identified as the primary 5G band in Europe.

Taking into account the above timeframes as well as the information gathered by the Commission, with relation to the administrative measures taken so far by Member States towards the fulfilment of the above timeframe obligations, there is some concern about the timely implementation of EU law regarding the authorisation of radio spectrum for 5G.

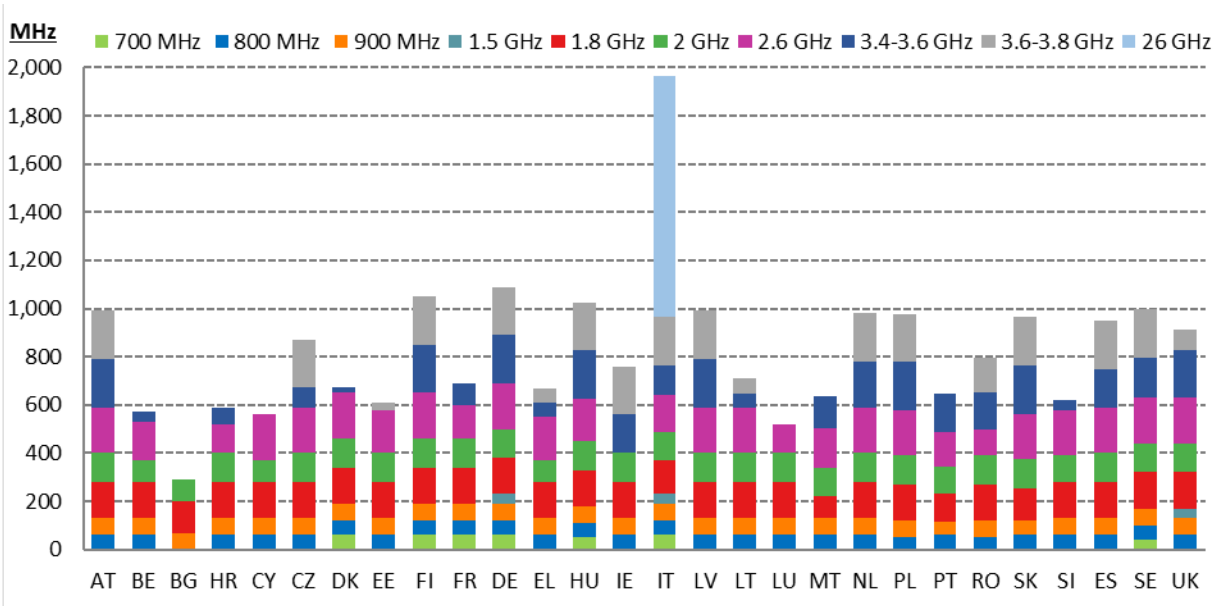
Lack of radio spectrum assignment may be due to different reasons depending on the circumstances in each Member State, such as cross-border coordination issues or use of radio spectrum for defence purposes. In this context, and given the different regulatory conditions applicable to each band, lack of assignment does not necessarily mean non-compliance with EU law.

Exceptional circumstances resulting from the COVID-19 pandemic have forced some Member States to postpone 5G auctions initially scheduled for the first months of 2020. So far, seven Member States (AT, CY, EE, FR, PL, PT and ES) have postponed spectrum auctions for 5G due to reasons related to the pandemic.

Hungary was the latest country to assign radio spectrum for 5G, in the context of a multiband auction that was carried out on 26 March 2020 (700 MHz, 2.1 GHz, 3.6 GHz), just one day before the national restriction measures, due to the COVID-19 pandemic, were put in place.

[(8)] Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 2017 on the use of the 470-790 MHz frequency band in the Union (OJ L.138 of 25.05.2017, p.131.

Figure 35 Assigned radio spectrum for wireless broadband in harmonised EU bands (April 2020)



Source: European Commission.

9. Convergent radio spectrum management approaches are essential to support 5G investment

700 MHz band

Assigned in seven Member States (DE, DK, FI, FR, IT[9], SE, HU) so far. Other countries are expected to authorise the band by 30 June 2020, unless there are justified reasons for a delay until mid-2022 at the latest[10] or short delays due to COVID-19. Currently, five Member States (BG, HR, CY, EL, IT) are still in the process of resolving cross-border issues (with EU and/or non-EU countries) or in general freeing up the band from incumbent users, which will eventually cause delays.

This band has generated lower sale prices than the 800 MHz band in most Member States (except for France, where four mobile network operators were competing, and Sweden, where only 40 MHz of radio spectrum out of a total of 60 MHz were made available). Initial licences last slightly longer, with an average of 16.9 years.

3.6 GHz band

Assigned (at least partially) in 25 Member States. Current uses vary, 13 Member States have assigned the band (at least partially) based on '5G conditions' in accordance with Commission Implementing Decision (EU) 2019/235 of 24 January 2019. The IT auction provided two blocks of 80 MHz and two blocks of 20 MHz, and the price paid was significantly higher than in other countries. In the recent HU auction, 310 MHz (31 lots of 10 MHz each) were awarded to three operators in blocks of 50 MHz, 140 MHz and 120 MHz respectively.

26 GHz band

Currently only assigned for 5G use in Italy, broken down into 5 lots of 200 MHz.

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[9] The 700 MHz frequency band will be available for use in Italy from July 2022 as the authorities have obtained an exception as provided for in Decision of the European Parliament and the Council on the use of the 470-790 MHz band in the Union

[10] A limited list of justified reasons is contained in the annex to the Decision of the European Parliament and the Council on the use of the 470-790 MHz band in the Union.

The 800 MHz band (the 'digital dividend I') is currently assigned in all Member States (in two cases only partially) except for Bulgaria, which has been exempted due to incumbent military use under Article 1(3) of the Radio Spectrum Policy Programme.

Implementing Decisions

Since 2018 the Commission has adopted the following Decisions, pertinent to wireless broadband:

- Commission Implementing Decision (EU) 2018/661 (amending Decision (EU) 2015/750) as regards the extension of the 1.5 GHz band to provide 50 MHz of additional download capacity for 5G services.
- Commission Implementing Decision (EU) 2019/235 (amending Decision 2008/411/EC) to update the relevant technical conditions applicable to the 3.6 GHz band to make the band 5G-ready as it has been identified as the primary pioneer band for 5G in the EU.
- Commission Implementing Decision (EU) 2019/784 to harmonise the technical conditions applicable to the 26 GHz band. This band will be essential for some of the envisaged 5G use cases such as enhanced mobile broadband, specific vertical services that require short response times and extremely high data rates and fixed wireless access for the provision of high-speed internet to households and businesses in areas with limited availability of fixed broadband technology.

Moreover, the Commission further delivered on its 5G spectrum roadmap by recently adopting three Decisions regarding the 26 GHz, the paired terrestrial 2 GHz and the 2.6 GHz frequency bands:

- Commission Implementing Decision (EU) 2020/590 of 24 April 2020 amending the harmonised technical conditions of Decision (EU) 2019/784 for use of the 26 GHz band, taking due account of the international agreement reached at the last World Radiocommunication Conference in 2019. It adapts the technical conditions for the protection of the passive satellite services below 24 GHz, which are used for earth monitoring and climate observation (e.g. for the European Copernicus programme). This amendment strikes a sensitive balance in promoting Union policies on 5G deployment and climate change.
- Commission Implementing Decision (EU) 2020/667 of 6 May 2020 amending the harmonised technical conditions of Decision 2012/688/EC, in order to make the paired terrestrial 2 GHz band fit for 5G use, under the principle of technology neutrality.
- Commission Implementing Decision (EU) 2020/636 of 8 May 2020 amending the harmonised technical conditions of Decision 2008/477/EC, in order to make the 2.6 GHz band fit for 5G use, under the principle of technology neutrality.

It is an established EU policy, enshrined also in the European Electronic Communications Code, that authorisation conditions conducive to investment in 5G deployment should avoid extracting excessive capital from the market and should promote ambitious infrastructure roll-out targets (including along rail and roads). The conditions should also enable innovative services, create opportunities for vertical services to access radio spectrum and not artificially limit or apportion radio spectrum supply, in particular in the 3.6 GHz band where large blocks of contiguous spectrum should be made available to operators to unleash the full 5G potential.

10. Ex ante market regulation: state of play

With the exception of the termination markets (covered in the future by a delegated act), *ex ante* market regulation is largely concentrated in the broadband markets.

Nevertheless, *ex ante* market regulation is still maintained in a few Member States for markets included in the 2003 and the 2007 recommendations on relevant markets.

Figure 36 Article 7 cases as at 19/05/2020

Effective competition - no ex ante regulation
No effective competition - ex ante regulation
Partial competition - partial ex ante regulation

n number of rounds of market analysis

2014 RECOMMENDATION					2007 REC.		2003 RECOMMENDATION								
Call term. on fixed network	Voice call term. on mobile networks	Wholesale local access	Wholesale central access	Wholesale high-quality access	Access to PSTN for res & non-res.	Call orig. on fixed network	Local/nat. Call for res.	Internat. call for res.	Local/nat. call for non-res.	Internat. call for non-res.	Retail LL	Transit on fixed network	Trunk segments LL	Access & call orig. on mobile network	Broadcast Transmis.
Market 1	Market 2	Market 3a	Market 3b	Market 4	ex-Mkt 1	ex-Mkt 2	ex-Mkt 3	ex-Mkt 4	ex-Mkt 5	ex-Mkt 6	ex-Mkt 7	ex-Mkt 10	ex-Mkt 14	ex-Mkt 15	ex-Mkt 18
3	4	5	5	5	4	4	3	2	4	3	4	1	2	1	4
3	3	3	3	2	3	2	3	1	3	1	1	2	1	1	1
3	3	3	2	2	3	3	2	2	2	2	1	1	1		
2	2	2	2	1	2	2	1		1		1		1		
3	4	4	4	3	3	3	3	2	3	2	2	3	3	4	4
4	4	4	4	3	4	4	2	2	2	1	2	1	1	2	2
4	4	4	4	4	4	4	2	2	1	1	2	1	1	1	1
4	5	4	4	3	3	3	1	1	1	1	1	1	2	1	3
2	1	4	4	1	2	3	2	1	2	1	2	2	1	V	3
5	5	5	5	3	5	5	1	1	1	1	2	1	2	W	4
5	5	4	3	2	4	3	2	1	2	1	2	2	1	1	5
3	4	4	4	3	3	2	3	1	3	1	3	3	3	1	1
4	5	4	4	4	6	4	3	3	3	3	3	2	2	2	2
4	3	3	3	3	3	3	2	2	2	2	2	2	2	1	2
3	5	4	4	2	3	2	2	2	2	2	2	3	2	2	2
5	5	4	4	4	2	3	4	3	4	3	3	2	1	1	1
5	3	4	4	2	1	3	3	2	3	2	1	2	2	1	6
3	4	3	3	2	3	3	2	2	2	2	2	1	1	1	
4	4	2	2	3	3	3	2	2	2	2	3	2	2	2	1
5	5	6	4	3	4	3	2	2	2	2	2	2	2	1	2
3	3	3	4	1	3	4	2	2	2	2	2	1	1	2	3
3	3	3	3	3	2	2	2	2	2	2	1	1	3		2
3	3	2	1	2	2	2	1	1	1	1		3			2
4	5	3	3	4	4	4	2	2	2	2	2	2	1	1	2
2	5	4	4	2	3	3	2	1	1	1	2	3	1	3	3
4	4	3	3	3	4	3	2	2	2	2	2	2	4	2	4
5	5	3	4	3	3	3	1	1	1	1	2	2	1	1	5
3	5	3	5	5	5	4	2	2	2	2	4	2	4	1	2

Source: European Commission.

11. Open internet rules

Under the EU open internet rules, in Regulation (EU) 2015/2120 (the TSM Regulation), EU citizens are entitled to distribute and have access to information and content, to use and provide applications and services, and use terminal equipment of their choice, regardless of the location of the end user or provider or the location of the information, content, application or service. These rights are established by the directly applicable EU Regulation, which is binding in its entirety. Specific BEREC net neutrality guidelines[11], issued in close cooperation with the Commission, and cooperation between national regulatory authorities within the BEREC Open Internet Working Group, contribute to the rules' consistent application throughout the EU/EEA.

Regulatory developments

In 2019 several regulatory developments occurred. The Commission prepared a report on the open internet provisions of the TSM Regulation, which was submitted to the Council and the Parliament on 30 April 2019. The Report concludes that the Regulation protects end users' rights and promotes an open and innovative internet. The Commission will continue to monitor the openness of the internet with the evolution of services and technologies.

On 6 December 2018 BEREC issued its opinion on the evaluation of how the TSM Regulation and the BEREC net neutrality guidelines are applied. Stakeholders agreed that the TSM Regulation should not be reopened at this stage, but that some further clarifications are needed in the guidelines. BEREC

[11] BEREC Guidelines on the Implementation by National Regulators of European Net Neutrality Rules BoR (16) 127.

started the review of the guidelines in 2019, and adoption is envisaged in the second quarter of 2020.

In 2019, three Member States (BG, SI and EL) adopted separate acts specifying the application of a provision in the TSM Regulation, mainly giving guidance on transparency provisions, quality of service and traffic management. Finally, in 2019 Ireland's national regulatory authority was empowered to enforce the open internet rules.

Following the introduction of social distancing measures to fight the Coronavirus pandemic, the demand for internet capacity has increased, be it for teleworking, e-learning or entertainment purposes. To respond to this intensified flow of internet traffic, the Commission called upon the cooperation of major platforms, BEREC, telecom operators and the public to ensure connectivity and an open internet across Europe. Streaming platforms are advised to offer standard rather than high definition and to cooperate with telecom operators. Telecom operators should take preventive and mitigating measures. Users can apply settings that reduce data consumption, including the use of Wi-Fi or lower resolution content. As a precautionary measure, the Commission and BEREC set up a special reporting mechanism to monitor the internet traffic situation in each Member State to be able to respond to capacity issues.

Open internet annual reports

The TSM-Regulation obliges national regulatory authorities to publish annual reports on their monitoring and findings and to share these reports with the Commission and BEREC. The latest annual country reports (covering 1 May 2018 to 30 April 2019) are available here.

In addition, BEREC publishes an annual report on the implementation of the TSM-Regulation and the net neutrality guidelines.

Open internet issues

In 2019, national regulatory authorities continued their analysis of individual commercial offers emerging on the market on a case-by-case basis. Some Member States (including BE, ES, CY and AT) carried out formal investigations of commercial practices, e.g. zero-rated offers, while several Member States (including BG, DE, EL, CY, LU, HU, NL, AT, and PT) carried out procedures on traffic management practices. Some Member States (including LT, PT and RO) carried out formal investigations on transparency.

In addition, two Member States (DE and HU) reported issues with restrictions for end users preventing them from using the terminal equipment of their choice.

As regards legal proceedings, two national court cases (in DE and IT) were concluded in 2019. In the German case, the court rejected a request for an interim decision, thus enforcing the decision of the Bundesnetzagentur (BNetzA), the national regulatory authority, prohibiting unequal treatment of traffic through video throttling. In the Italian case, the court upheld the decision of AGCOM, the national regulator, from 2017, prohibiting a zero-rated offer which enabled continued use of the zero-rated music app even after the data bundle was consumed, while all other traffic was blocked.

In addition to these cases, a Hungarian case was referred to the Court of Justice of the European Union (joint cases C-39/19 and C-807/18). This is the first preliminary ruling request in this field, and will be a landmark ruling on zero-rating[12]. The dispute concerns additional services offered by

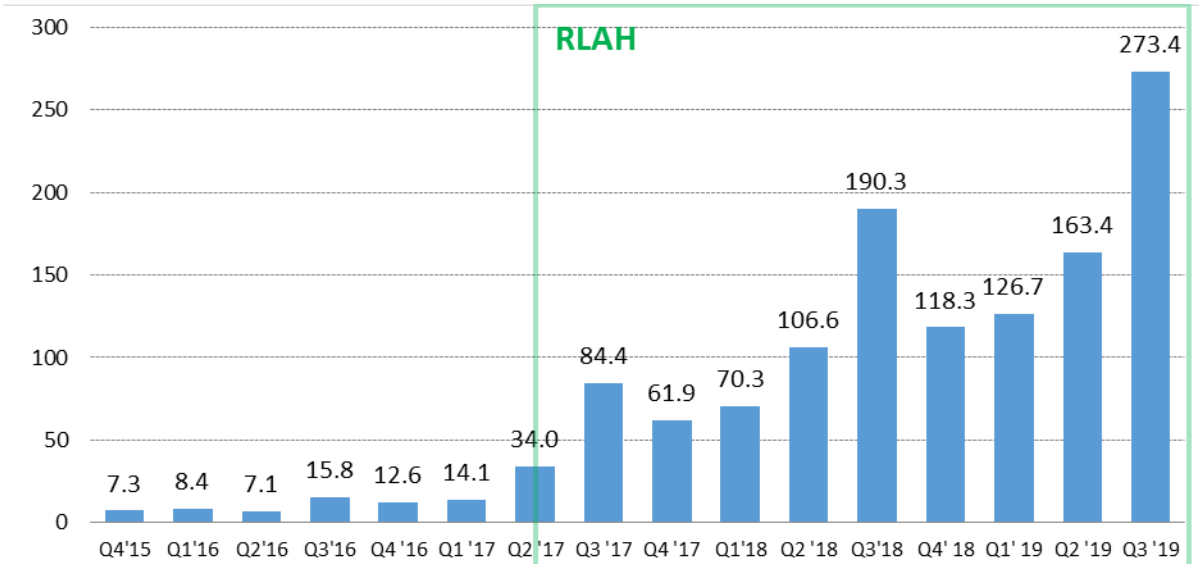
[12] The opinion of the Advocate General was published on the 4 March 2020. The opinion states that the prohibition in Article 3(3) is general, unconditional and objective in that it prohibits any traffic management measure which would not be reasonable (within the meaning of paragraph 3) and would not contribute to equal treatment and not discriminatory of this traffic. The Advocate General agrees with the Commission that when an infringement of Article 3(3) of the TSM-Regulation EU (2015/2120) is found, it is not essential to

Telenor Magyarország Zrt. relating to social media (chat) applications and music streaming and online radio applications. The issues at stake are: *(i)* the enabling of continued usage of the zero-rated services even after exhaustion of the data volume, while all other traffic is blocked; and *(ii)* the relationship between Article 3(2) (commercial agreements) and (3) (traffic management).

12. Widespread use of roam-like-at-Home (RLAH) & multiplication of roaming traffic under RLAH

Since 15 June 2017, mobile operators are not allowed to impose charges other than domestic ones when they provide (retail) roaming services to customers periodically travelling in the EU/EEA. There are two main exceptions to this rule. To prevent abusive or anomalous use of roaming at domestic prices, mobile operators may apply a fair use policy. Furthermore, when mobile operators are able to demonstrate that RLAH is objectively not sustainable without detrimental effects on the domestic markets, they may obtain an authorisation from their national regulator to impose a small surcharge for providing roaming services (sustainability derogation surcharge). As underlined in the Commission roaming review report of 29 November 2019[(13)], the rapid and massive increase in roaming traffic since June 2017 has shown that the RLAH reform has met its objective to unleash the untapped demand for mobile consumption by travellers in the EU. Between summer 2016 and summer 2018, retail roaming traffic increased 3-fold for voice and 12-fold for data. Between summer 2018 and summer 2019, roaming traffic remained stable for voice, while it increased further, by more than 40%, for data. Despite such increases, roaming traffic remains a small fraction of domestic traffic. Overall, there is high consumer satisfaction with increased benefits linked to higher roaming consumptions.

Figure 37 EEA retail roaming data traffic (millions GB)



Source: Based on the 24th BEREC Benchmark Data Report, April 2019-October 2019[(14)].

Overall, mobile operators are complying with the roaming rules and despite initial concerns, waterbed effects[(15)] have not been observed following the introduction of RLAH. The general trend

further assess whether paragraph 2 of Article 3 has been infringed (which would entail a detailed analysis of the market and the impact of the measure in question). This was also the view of the majority of national regulatory authorities in the BEREC Open Internet Working Group.

[(13)] Report on the review of the roaming market, COM(2019)616 final and accompanying Commission staff working document SWD(2019)416 final, both available here.

[(14)] International Roaming BEREC benchmark data report April 2019 - September 2019, available here.

in domestic prices and in retail roaming prices to the rest of the world is decreasing. Domestic-only tariffs remain limited and around 96% of consumers are roaming enabled.

Fair use policies and sustainability derogations served their purpose in ensuring the sustainability of the RLAH regime, although their use remains marginal. In summer 2019, voice or data roaming traffic subject to a surcharge due to a fair use policy or a sustainability derogation did not exceed 6% of total roaming traffic in the EU. Apart from mobile virtual network operators, derogations are mainly used in some countries where data prices are very low, revenues per user are low and/or roaming imbalances are high (e.g. Estonia, Finland, Lithuania and Poland).

For the roaming consumer, quality of service is an essential element of the roaming service provided. The BEREC Opinion on the roaming market(16) observes a lack of transparency regarding data speeds provided while roaming. Furthermore, 14 out of 30 NRAs have reported consumer complaints on quality of service while roaming.

The Roaming Regulation expires on 30 June 2022. The Commission roaming review report of November 2019 concluded that despite signs of some competition dynamics on both the retail and wholesale roaming markets, the underlying basic competition conditions have not changed and are not likely to change in the foreseeable future to such an extent that retail or wholesale regulation of the roaming market could be lifted after the expiry of the Regulation. In this light, the Commission has included in its work programme for 2020 a legislative proposal for extending the Roaming Regulation to ensure continuation of 'roam like at home' and maintain its benefits for consumers beyond 2022.

13. Emergency Communications and the single European emergency number 112(17)

The share of emergency calls to the 112 single European emergency number is rising, showing Europeans' increasing preference for using this number in cases of emergency. Calls to 112 increased 12% year on year, while the total number of emergency calls rose 6%. Calls to 112 represented 51% of calls placed in case of an emergency. By extrapolating data reported by 8 countries, 2,300,000 emergency calls were placed by roaming end users in the reporting period.

Accuracy of caller location continued to improve in the reporting period. Advanced mobile location (AML), a handset-based caller location solution that relies on GNSS and Wi-Fi signals, took off in the Netherlands. Currently AML is fully deployed in Belgium, Estonia, Finland, Ireland, Lithuania, Malta, Slovenia, the Netherlands and the UK. The Commission is contributing to this development by financing AML deployment in Germany, Denmark, France, Croatia, Hungary, Portugal and Sweden, raising the number of AML countries to 16 in the near future.

The share of emergency calls placed from mobile phones is more than double that of the calls placed from fixed networks. In the reporting period, 72% of emergency calls were placed from a mobile phone. This confirms that a growing number of European citizens could benefit from handset-derived caller location, as mandated by the European Electronic Communications Code in Article 109(6).

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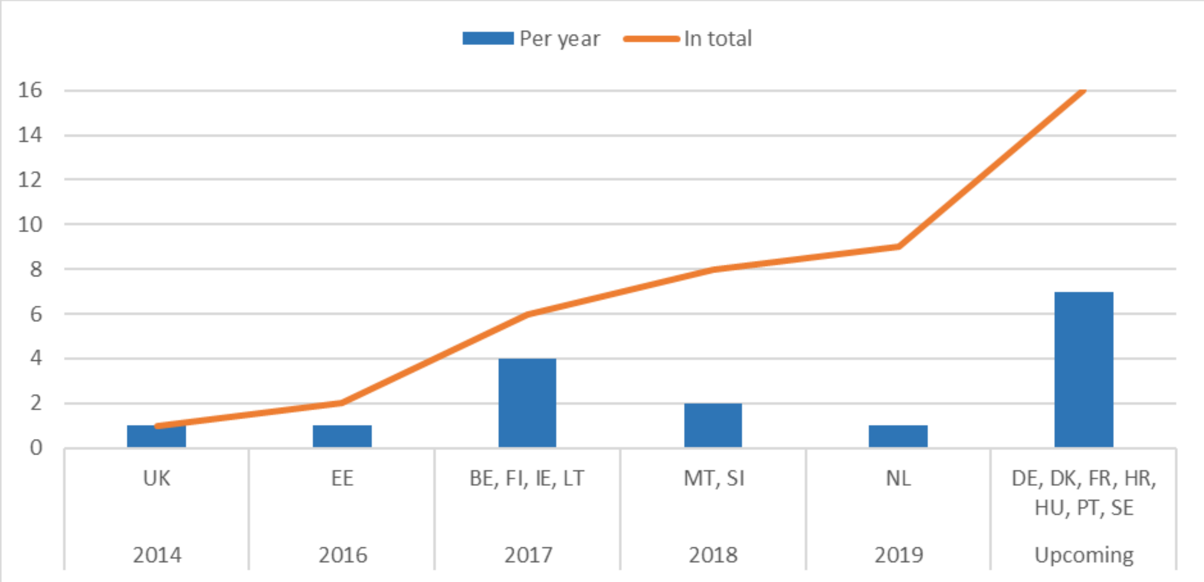
(15) Waterbed effect: When pressing down prices in one part of firms' operations causes another set of prices to rise.

(16) BEREC Opinion on the functioning of the roaming market as input to EC evaluation, BoR(19)101, 19 June 2019, available here.

(17) The main findings based on the Communications Committee's (COCOM) 112 implementation report, available here.

Figure 38 Deployment of advanced mobile location



Source: COCOM 20-05 working document.

23 Member States plus Iceland and Norway reported that the average answer time for contacting the emergency services was less than 10 seconds. Of 27 Member States which reported the time needed to receive the caller location, the longest periods were reported in Austria, where the time taken ran to minutes. A number of countries reported the time needed to receive handset-based location: Estonia (10s), Finland (5s), France (30s), Ireland (10s), Lithuania (25s), Latvia (20s), Malta (8s), the Netherlands (20s), Slovenia (6s), Romania (8.6s), UK (15s), Iceland (10s) and Norway (4s).

Some 24 Member States reported the implementation of alternative access to emergency services for end users with disabilities through SMS. Meanwhile, some applications deployed can provide much better location information and additional features. However, in the case of roaming end users, there is room for improvement for cross-border use of these means of access to emergency services. SMS to short numbers are not routed to the host country public safety answering point, while awareness of app-based or web-based solutions is insufficient due to a wide variety of these solutions across Member States. This state of affairs is in contrast with the availability of calls to the 112 single European emergency number for other end users.

Member States reported that in the next 2 years they are considering deploying various public warning systems: location-based SMS (in 8 countries), cell broadcast (in 7 countries) and mobile application (in 1 country). Currently the technologies deployed are: sirens in 16 Member States; TV, radio or social media alerts in 14 Member States; specific applications in 5 Member States; SMS alerts in 6 Member States and cell broadcasts in 4 Member States.

The Commission regularly monitors Member States' compliance with obligations on the functioning of 112. As a result of this monitoring, the Commission initiated infringement proceedings in July 2019 against several Member States and continues working towards full compliance to ensure that EU citizens can fully benefit from the service.

ANNEX I Abbreviations

Abbreviation	Explanation
4G / 5G	Fourth/Fifth generation technology standard for cellular networks
AI	Artificial Intelligence
BCO	Broadband competence office
BERD	Business expenditure on R&D
CAGR	Compound annual growth rate
CEF	Connecting Europe Facility
CRM	Customer Relationship Management
CSA	Coordination and Support Actions
DIH	Digital Innovation Hubs
DII	Digital Intensity Index
DOCSIS	Data over cable service interface specification
DSL	Digital subscriber line
DTT	Digital terrestrial television
EBP	European Blockchain Partnership
EBSI	European Blockchain Services Infrastructure
eForm	Electronic Form
EFSI	European Fund for Strategic Investments
eID	Electronic Identification
eider's	Electronic Identification, Authentication and Trust Services
EIF	European Investment Fund
ERA-NET	European Research Area
ERM	Enterprise Risk Management
ERP	Enterprise Resource Planning
Euro HPC JU	Euro High Performance Computing Joint Undertaking
FET	Future & Emerging Technologies
FTTB	Fibre-to-the-building
FTTH	Fibre-to-the-home
FTTP	Fibre-to-the-premises
FWA	Fixed wireless access
GBARD	Government Budget Allocations for R&D
GDP	Gross Domestic Product
GHz	Gigahertz
HES	Secondary and Higher Education Establishments
HPC	High Performance Computing
IA	Innovation Action
IaaS	Infrastructure as a service
ICOs	Initial Coin Offerings
ICT	Information and communication technology
IMSI	International mobile subscriber identity
IoT	Internet of Things
JRC	Joint Research Centre
LEIT	Leadership in Enabling and Industrial Technologies
LTE	Long-term evolution
Mbps	Megabits per second
MHz	Megahertz
MNO	Mobile network operator
MVNO	Mobile virtual network operator

NACE	Statistical Classification of Economic Activities in the European Community
NBP	National broadband plan
NGA	Next generation access
NRA	National regulatory authority
OTT	Over-the-top
PaaS	Platform as a Service
PCP	Pre-Commercial Procurement
PERD	R&D personnel
PPI	Public Procurement for Innovation
PPS	Purchasing Power Standards
PRC	Private for-Profit Companies
PSAP	Public safety answering point
QCI	Quantum Communication Infrastructure
R&D	Research and Development
R&I	Research and Innovation
REC	Research Organisations
SaaS	Software as a Service
SMEs	Small and Medium Enterprises
USO	Universal service obligation
VDSL	Very-high-bit-rate digital subscriber line
VHCN	Very high capacity network