Research and Innovation: ICT projects in Horizon 2020

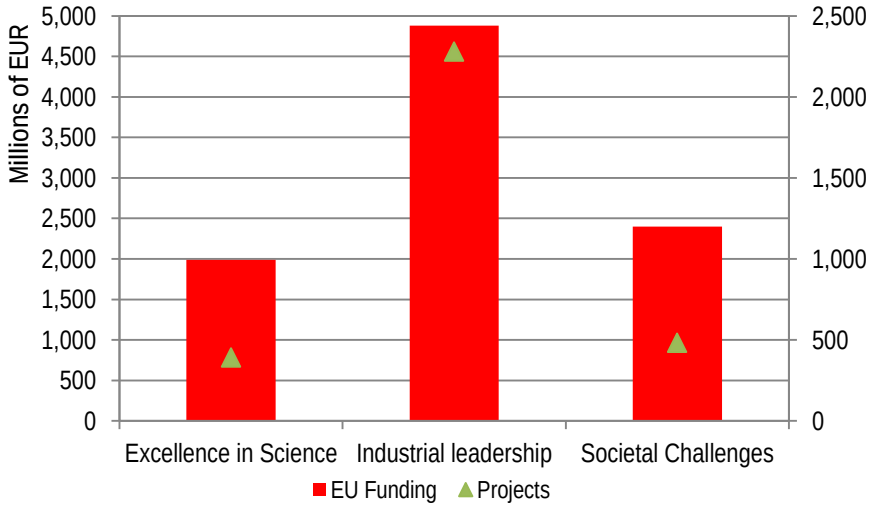
Digital Economy and Society Index Report 2019
Research and Innovation

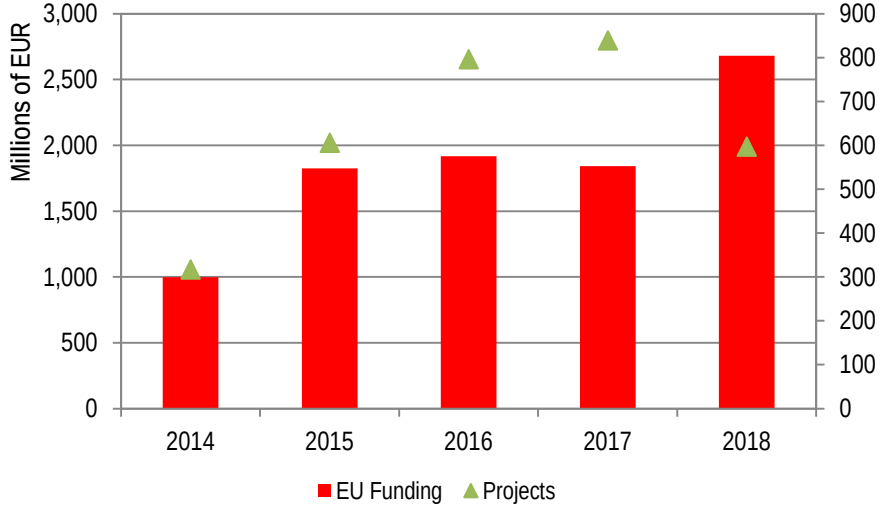
After five years of implementation, Horizon 2020 has allocated approximately EUR 9.3 billion in EU funding to more than 3,000 projects in ICT-related areas.

The *Industrial Leadership* pillar covers R&I activities on generic ICT technologies driven by either industrial roadmaps or bottom-up processes. It accounts for about EUR 4.9 billion, or more than half of all funding for ICT-related projects. EUR 4.2 billion (86 % of the total) correspond to its LEIT ICT component. Industrial Leadership also accounts for about 2,280 projects (or 72 % of the total), of which more than half from LEIT ICT.

The *Excellent Science* pillar (e-infrastructures and Future & Emerging Technologies, or FET) supports research to uncover radically new technological possibilities and ICT contributions. Areas covered include high performance computing, quantum technologies and brain science. It accounts for about 20% of both funding (EUR 2 billion) and participations and 12 % of projects (483).

The *Societal Challenges* pillar addresses application-driven R&I from a multi-disciplinary perspective. Projects to some extent involving ICT are financed in all of the seven societal challenges, particularly health and wellbeing, clean and efficient energy, smart transport, inclusive and innovative societies and security and freedom. This pillar accounts for about 26 % of funding (EUR 2.4 billion), 15 % of projects and 28 % of participations.





More than 10,500 organisations, including an increasing number of private-sector companies, have participated in ICT-related projects in Horizon 2020 between 2014 and 2018.

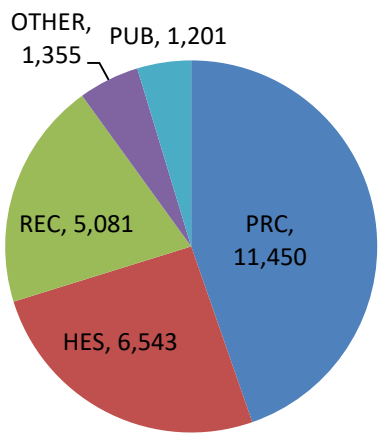
About 10,500 organisations have participated in ICT-related projects during the first five years of H2020. Business involvement has continued to rise, with private for-profit companies (PRC) accounting for about 40 % of the budget and 45 % of participations (compared with 35 % and 33 %, respectively, under FP7).

Secondary and higher education establishments (HES) and research organisations (REC), taken together, account for about 46 % and more than half of total funding. This represents a lower share than in FP7, which is partly explained by the higher involvement of the private sector.

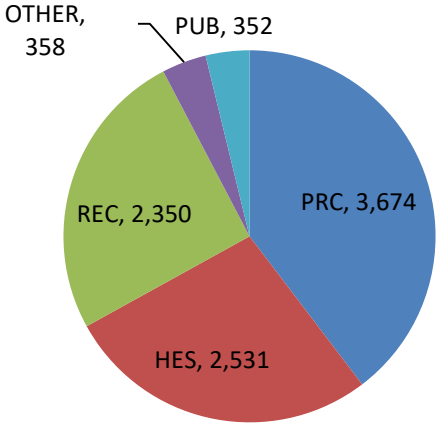
Public organisations other than those involved in research and education account for a relatively small share of both funding and participations (about 5 % and 4 % respectively), similar to the 'other' organisations category.

HES and REC are much more likely to be involved in a number of projects (roughly 5 to 6 participations on average) than their private sector counterparts (fewer than 2). This is partly explained by the fact that there are fewer education establishments or research organisations than companies. (which in turn affects the likelihood of engaging in multiple projects).

Participations, by type of organisation, cumulated values 2014-2018



EU funding, by type of organisation, cumulated values 2014-2018 (in EUR m)



European Commission

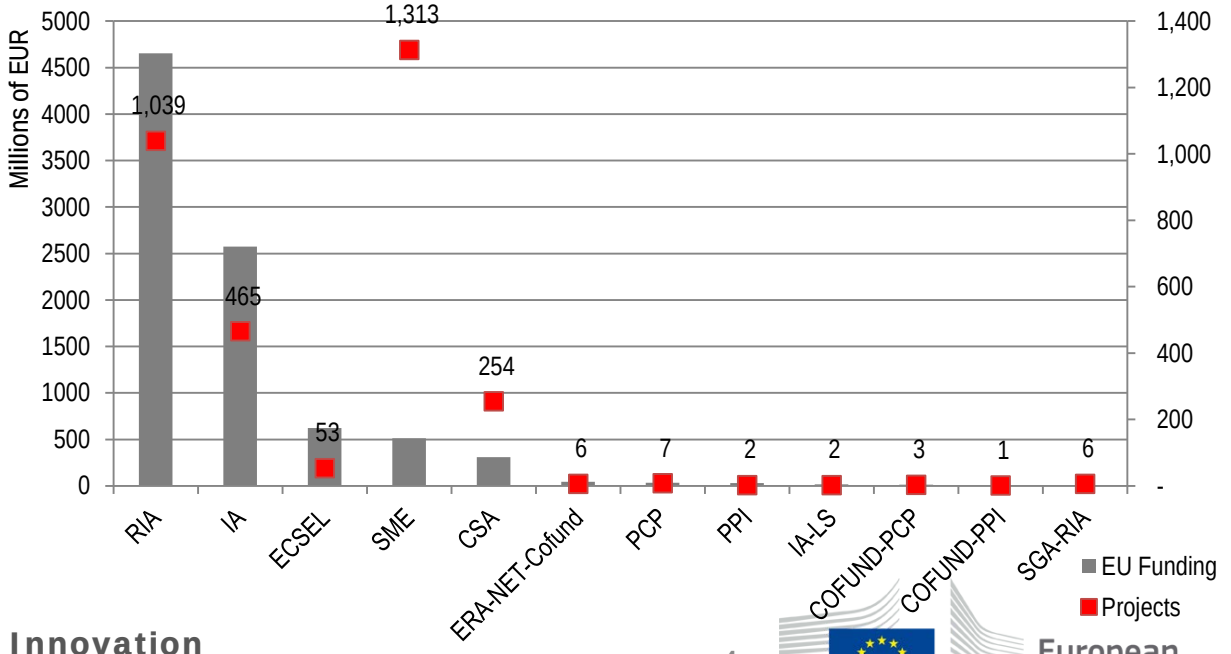
Research and innovation actions account for the bulk of funding in ICT-related topics in Horizon 2020. The SME instrument accounts for the largest number of projects, although these typically receive smaller amounts.

Research and innovation actions (RIA) aim to uncover new knowledge and/or explore the feasibility of a new or improved technology, products, processes, services or solutions. They account for the largest share of funding overall as well as in the Industrial Leadership and Excellent Science pillars. They have received approximately EUR 4.6 billion between 2014 and 2018. Innovation actions (IA) are the second most important instrument in terms of funding (EUR 2.6 billion) and the preferred action type under the Societal Challenges pillar. They aim to produce plans and arrangements or designs, and may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication. SME instrument projects account for a large share of projects but, given their relatively small size, a much smaller share of funding.

Coordination and support actions (CSA) involve accompanying measures such as standardisation, dissemination, awareness-raising and communication. They received EUR 310 million and accounted for over 250 projects between 2014 and 2018.

Other action types, such as pre-commercial procurement (PCP) actions, public procurement for innovation (PPI) actions and European research area (ERA-NET) actions have a more limited scope of application. They therefore account for a relatively small share of both projects and funding.

EU Funding and projects by type of action, cumulated values 2014-2018



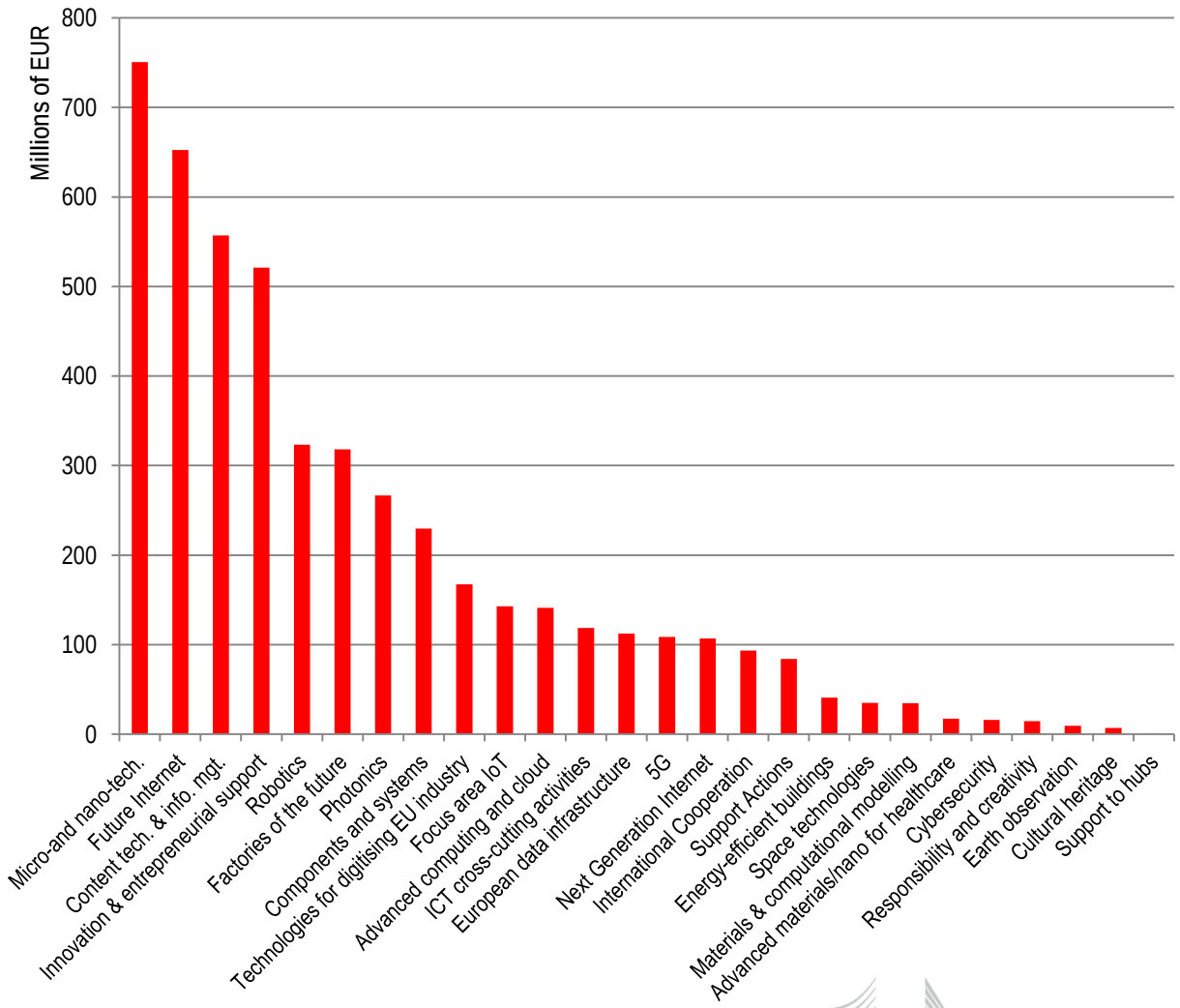
Micro- and nano-electronics, future networks and internet and content technologies continue to attract a sizeable share of both funding and participants, as do e-Infrastructures and FET. Many ICT-relevant projects are also financed within the Societal Challenges pillar.

Within *Industrial Leadership*, projects in the areas of micro- and nano-electronic technologies (including the ECSEL joint undertaking on electronic components and systems) and future/next generation internet and 5G (taken together, including the 5G cPPP) have received the largest funding amounts (nearly EUR 800 million each). Content technologies and information management area (including funding for the Big Data cPPP) received nearly EUR 560 million.

Within *Excellent Science*, e-Infrastructures are a major area of work (EUR 520 million), as are the different components of Future and Emerging Technologies (FET): FET Open and the FET flagships received approximately EUR 530 million each; FET proactive, nearly EUR 400 million.

Many ICT-relevant projects are also financed under *Societal Challenges*, notably in the areas of smart transport, health and wellbeing and secure societies, which encompasses a number of relevant cybersecurity projects.

EU funding, Industrial Leadership pillar, by area, cumulated values 2014-2018

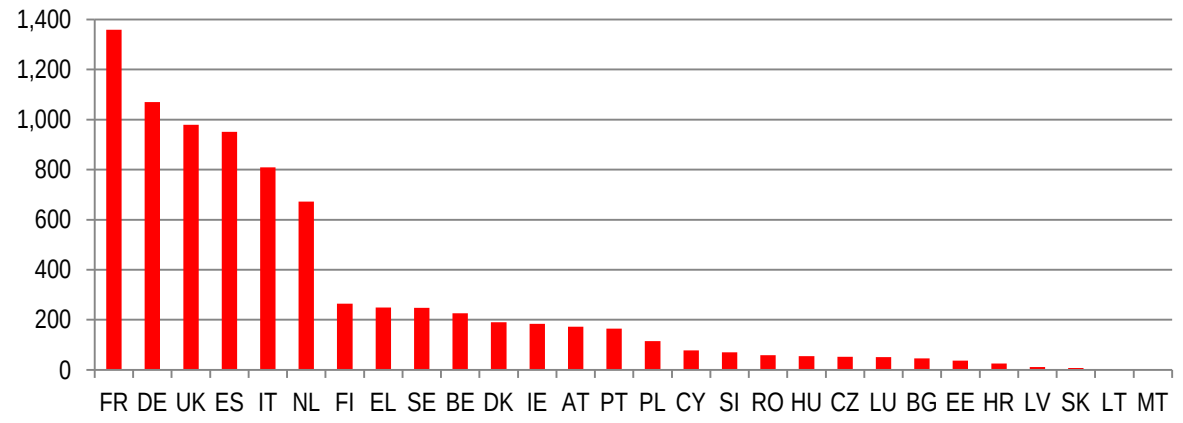


In absolute terms, France, Germany and the United Kingdom are the biggest recipients of EU funding. Cyprus, Greece and Slovenia receive the highest levels of funding relative to the size of their ICT sector.

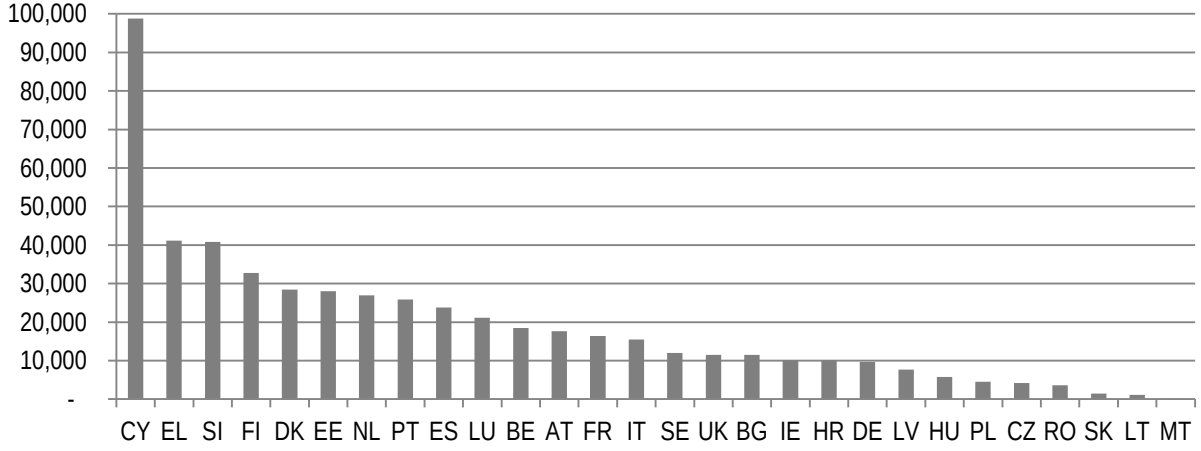
In absolute terms, the EU's largest economies are the main recipients of EU funding for ICT-related projects under Horizon 2020. France, Germany, the United Kingdom, Spain and Italy alone accounted for about 63 % of total EU funding and a similar share of participations in the first five years of implementation. These countries also lead in terms of the number of projects coordinated. When considering the recipient countries' ICT sector value added, Cyprus, Greece and Slovenia are among the Member States having received the highest amounts of funding in proportional terms.

In all Member States, the largest share of funding has gone to projects from the Industrial Leadership pillar, particularly LEIT ICT. There are relatively large variations across Member States with regard to the amount of funding having come from the other parts of the programme.

EU funding by Member State, cumulated values, 2014-2018, in EUR million



EU funding by Member State, cumulated values, 2014-2018
in EUR per million ICT VA



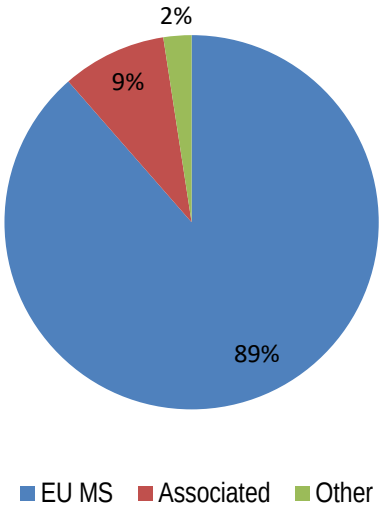
There is significant involvement of international participants in ICT-related projects in Horizon 2020: between 2014 and 2018, 11 % of funding went to non-EU countries, primarily associated countries with a strong R&I sector.

Although beneficiaries from the EU Member States account for the vast majority of funding and projects, Horizon 2020 projects (including ICT-related) are becoming increasingly attractive for international participants, who contribute valuable knowledge and expertise in return.

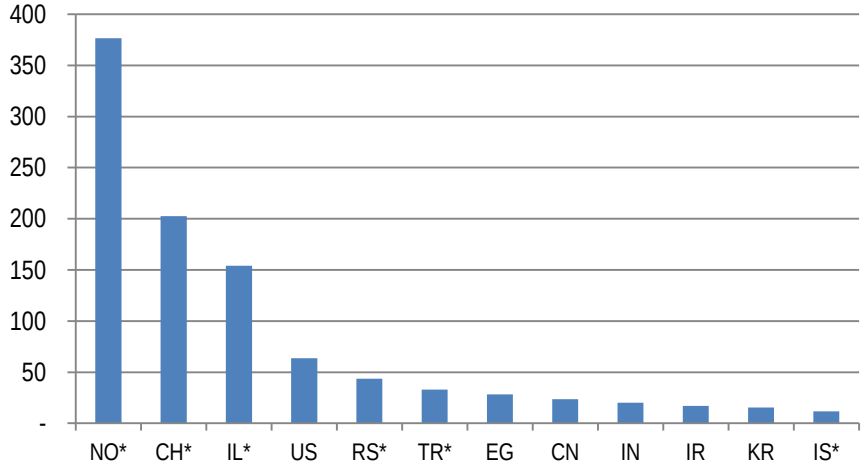
This is illustrated by the fact that, between 2014 and 2018, organisations from non-EU countries received approximately EUR 1 billion in funding (about 11 % of the total). These figures do not capture EU affiliates of non-EU companies.

Close to 80 % of funding for non-EU beneficiaries went to associated countries. Research-oriented players such as Norway, Switzerland and Israel are the largest recipients within this group. The remainder of the budget went to other non-EU countries.

EU funding of Horizon 2020 ICT-related projects 2014-2018, by country type (in % of total)



EU funding to selected non-EU countries (having received at least EUR 10 million), in EUR million , 2014-2018



* = Associated country

Notes

Coverage:

- This report considers projects supported through Horizon 2020 funding in ICT-related topics, as defined in the Commission's "Guide to ICT-related activities"*.
- To ensure full consistency with the Guide, the criteria for the inclusion of projects for analytical purposes have been slightly updated compared with previous editions. As this has broadened the scope of the analysis, the results presented here are not fully comparable with those from previous years. In the same vein, the categories and structure used correspond to those in the Guide (i.e. for the sake of clarity, SMEInst topics are included under Industrial Leadership).
- The Fast Track to innovation pilot and parts of the European Innovation Council pilot are excluded from the analysis.
- The report considers projects signed as of 31 December 2018. Only projects for which the signature year was known at the time of writing are taken into account.

Acronyms for types of organisations:

- PRC: Private for profit companies
- SME: small and medium-sized enterprises
- PUB: public bodies (excluding research and education)
- REC: research organisations
- HES: secondary and higher education establishments
- OTH: other entities

The following country groupings are used for the chart on international participation:

- Associated countries (art. 7 of the H2020 Regulation): Iceland, Norway, Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey, Israel, Moldova, Switzerland (partial association: Excellent Science Pillar only), Faroe Islands.
- Other: all other non-EU countries.

Source: the report is based on the Commission's "Guide to ICT-related activities" as well as on CORDA data elaborated by DG CONNECT. The source of data for ICT Value Added is PREDICT.

*For further details: https://ec.europa.eu/digital-single-market/en/news/guide-ict-related-activities-horizon-2020; https://ec.europa.eu/digital-single-market/en/news/guide-ict-related-activities-horizon-2020-work-programme-2018-20

Connectivity

Broadband market developments in the EU

Digital Economy and Society Index Report 2019
Connectivity

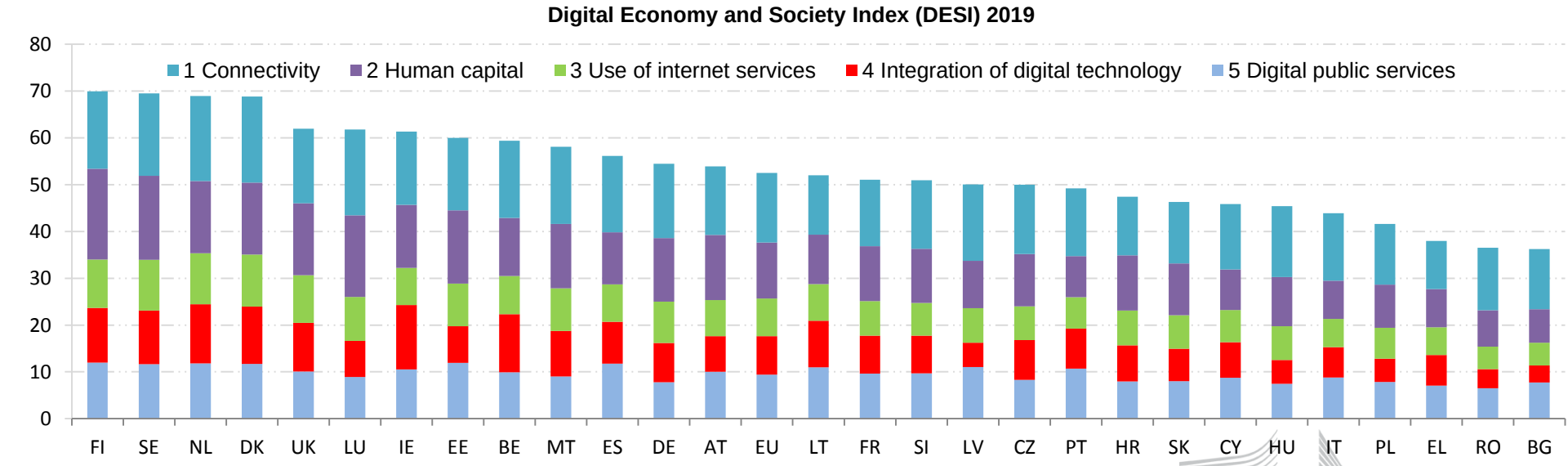
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the progress of EU Member States in digital competitiveness.

Finland, Sweden, the Netherlands and Denmark, have the most advanced digital economies in the EU followed by the UK, Luxembourg, Ireland and Estonia.

Bulgaria, Romania, Greece and Poland have the lowest scores on the index.

The five dimensions of the DESI

1 Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2 Human capital	Internet user skills and advanced skills
3 Use of internet	Citizens' use of internet services and online transactions
4 Integration of digital technology	Business digitisation and e-commerce
5 Digital public services	e-Government and e-health



Source: DESI 2019, European Commission

In Connectivity, Denmark had the highest score, followed by Luxembourg, the Netherlands, Sweden and Finland. Greece, Croatia and Lithuania had the weakest performance in this dimension of the DESI.

The connectivity dimension looks at both the demand and the supply side of fixed and mobile broadband. Under fixed broadband, it assesses the availability as well as the take-up of basic, fast (Next Generation Access – NGA providing of at least 30 Mbps) and ultrafast broadband (at least 100 Mbps) and also considers the prices of retail offers. Mobile broadband includes the availability of 4G, the take-up of mobile broadband and a new indicator on 5G readiness. Digital connectivity is considered a social right in the EU.*

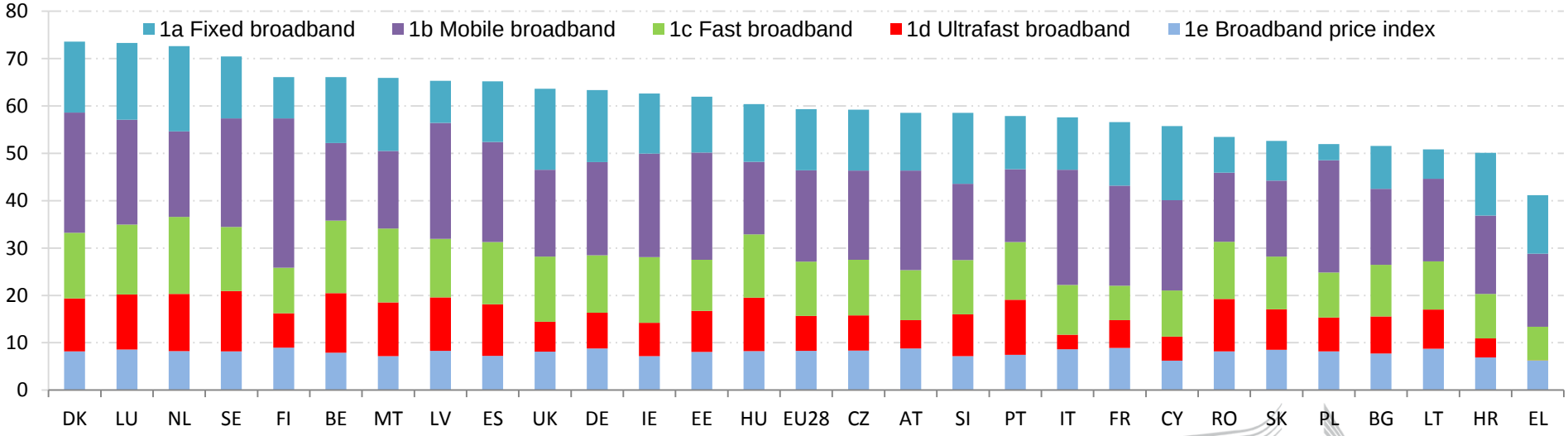
A comparative assessment of fixed broadband (basic, fast and ultrafast) shows the Netherlands and Luxembourg as the best performers. In contrast, Greece, Poland and Croatia are shown to be among the worst performers.

As for mobile broadband, Finland, Denmark, Latvia and Italy lead Europe, while Romania and Hungary registered the lowest scores. https://composite-indicators.jrc.ec.europa.eu/social-scoreboard/

* https://composite-indicators.jrc.ec.europa.eu/social-scoreboard/

Connectivity indicators in DESI 2019	EU
1a1 Fixed broadband coverage	**97%**
% households	2018
1a2 Fixed broadband take-up	**77%**
% households	2018
1b1 4G coverage	**94%**
% households (average of operators)	2018
1b2 Mobile broadband take-up	**96**
Subscriptions per 100 people	2018
1b3 5G readiness	**14%**
Assigned spectrum as a % of total harmonised 5G spectrum	2018
1c1 Fast broadband (NGA) coverage	**83%**
% households	2018
1c2 Fast broadband take-up	**41%**
% households	2018
1d1 Ultrafast broadband coverage	**60%**
% households	2018
1d2 Ultrafast broadband take-up	**20%**
% households	2017
1e1 Broadband price index	**87**
Score (0 to 100)	2017

Digital Economy and Society Index (DESI) 2019, Connectivity



Source: DESI 2019, European Commission

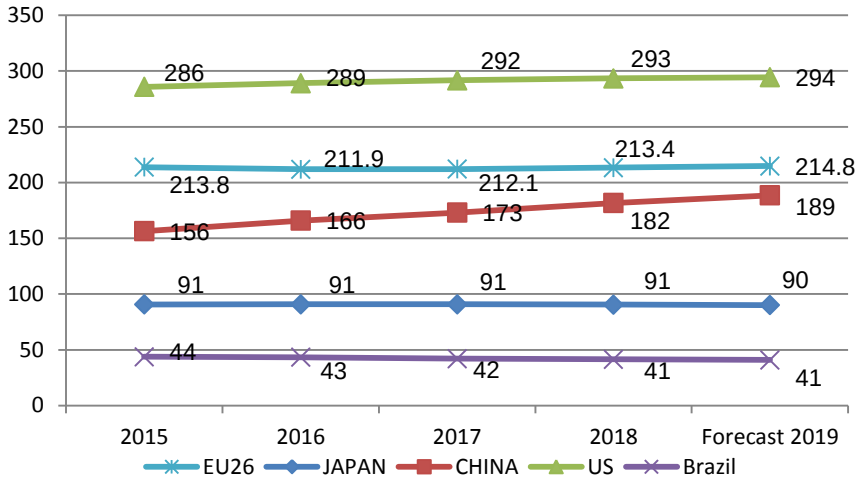
Total telecoms services revenues have stagnated in Europe since 2015. Mobile and fixed voice revenues have fallen by 16 % since 2014. An increase in mobile data and internet services was accompanied by a decline in voice services (fixed and mobile).

Telecoms operators in Europe generated less revenue than the US operators. Revenues fell from EUR 213.8 billion in 2015 to EUR 213.4 billion in 2018 in Europe. At the same time, the US revenues increased by 2.7 % from EUR 286 billion to EUR 293 billion, despite its smaller population.

China saw its revenues increased by 16 %, rising from EUR 156 billion in 2015 to EUR 182 billion in 2018.

Note: This analysis is based on detailed figures from 26 EU Member States, which covered around 98% of the total EU market (total telecom carrier services). Data is not available for Malta and Cyprus.

Total Telecommunication revenues per region, billion EUR, 2015-2019 (forecast)

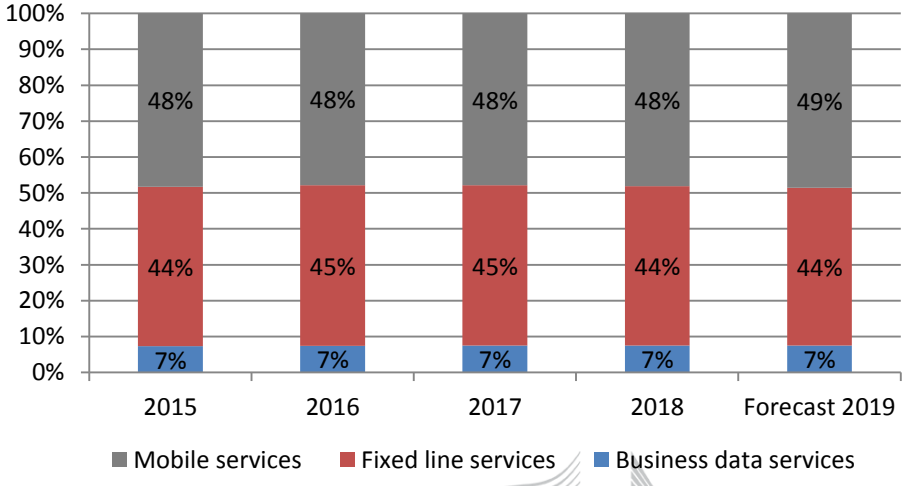


The analysis of telecoms revenues (carrier services) by segment shows a decline in voice services (both fixed and mobile) revenues. Fixed voice service revenues have fallen by 11.4 % since 2015, compared to 11.6 % for mobile services over the same period (2015 – 2018). Together, fixed and mobile voice services represented 43 % of total telecoms revenues in 2018, compared with 49 % in 2015.

Mobile data services represented 28 % of total revenues in 2018, up from 25 % in 2015. The growth in mobile data services was accompanied by a decline in voice services.

**Note:* This analysis is based on detailed figures from 26 EU Member States, which covered around 98% of the total EU market (total telecom carrier services). Data is not available for Malta and Cyprus.

Telecoms services revenues by segment, % of total, 2015 - 2019 (forecast)



Source: 2019 European IT Observatory (EITO) in collaboration with IDC.

Broadband coverage: Fast broadband (Next generation access - NGA) covers 83 % of homes, up from 79 % a year ago, while Ultrafast broadband (Fibre to the Premises and Docsis 3.0 cable) is available in 60 %, up from 57 % a year ago. 4G mobile is almost universal at 99 %. Rural coverage improved substantially in 4G, VDSL and FTTP.

Basic broadband is available to all homes in the EU, when considering all major technologies (xDSL, cable, fibre to the premises - FTTP, WiMax, HSPA, LTE and satellite). Fixed and fixed-wireless technologies cover 97 % of EU homes.

Coverage of NGA technologies (VDSL, cable Docsis 3.0 and FTTP) capable of delivering download speeds of at least 30 Mbps reached 83 %, thanks to an increase of 3 percentage points in VDSL and FTTP last year.

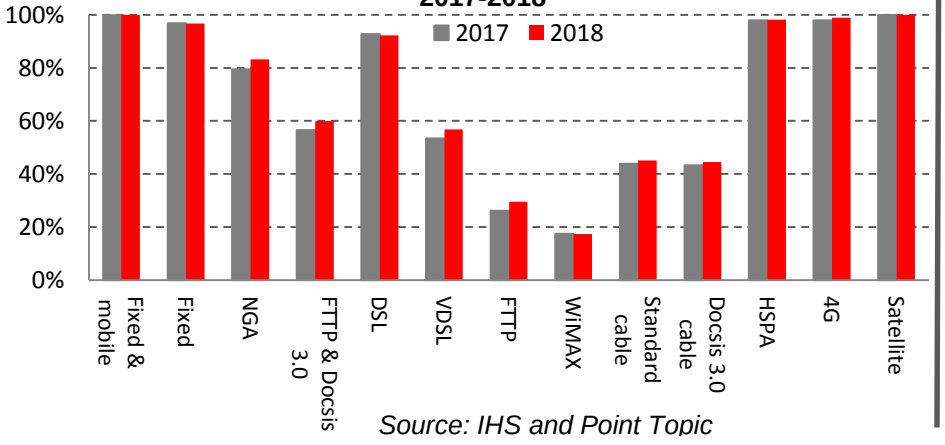
DSL coverage has somewhat declined, as DSL is being replaced by FTTP or mobile.

30 % of homes already benefit from very high capacity broadband with gigabit connectivity on FTTP networks.

Rural areas remain challenging, as 13 % of homes are not covered by any fixed network and 48 % by any NGA technology. Rural fixed coverage is stable at 87%. Mobile broadband availability went up slightly last year, although mobile is still mainly used as a complementary technology rather than a substite to fixed technologies.

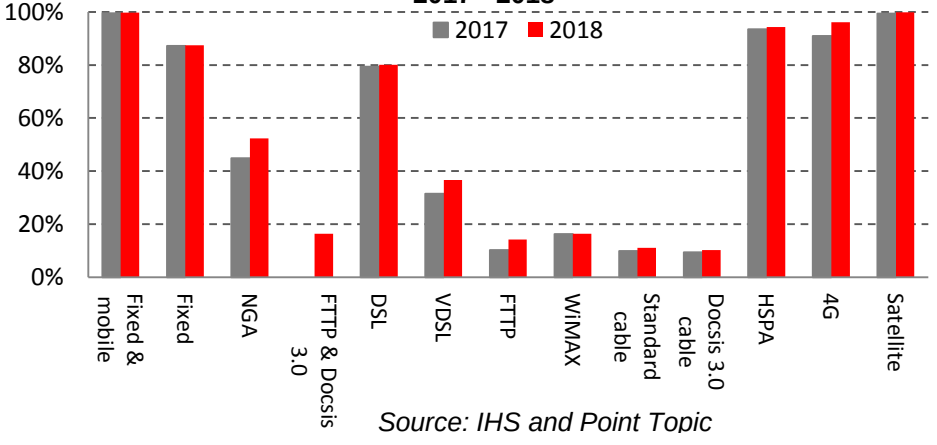
Note: Substantial revisions have been made in the dataset concerning in particular the rural indicators.

Total coverage by technology at EU level (% of homes), 2017-2018



Source: IHS and Point Topic

Rural coverage by technology at EU level (% of homes), 2017 - 2018

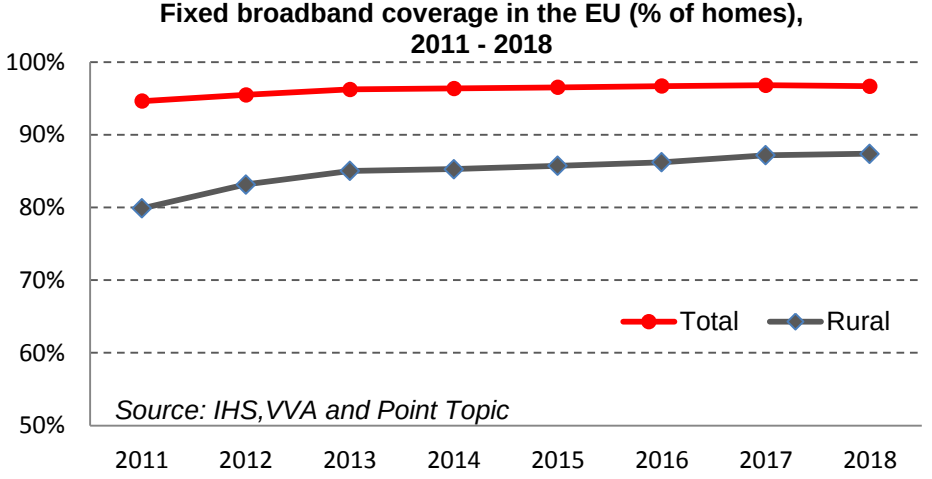


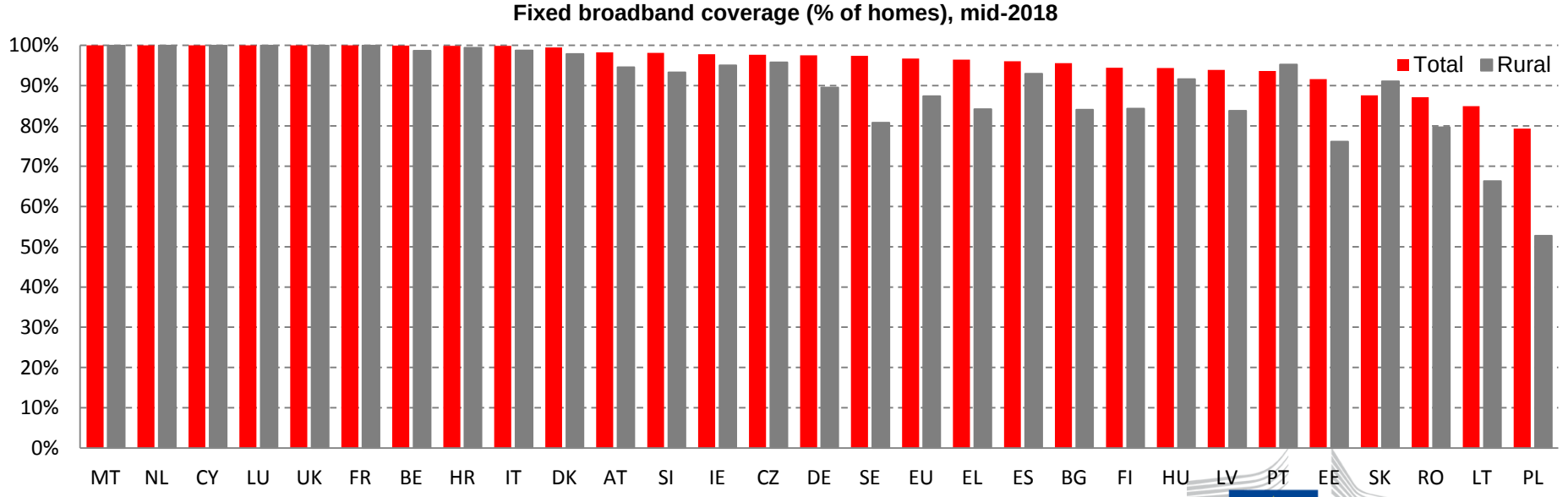
Source: IHS and Point Topic

Fixed broadband coverage remained at 97 %. In 10 Member States more than 99 % of homes are covered. Poland, Lithuania, Romania and Slovakia are lagging behind with less than 90 % of homes covered.

Primary internet access at home is provided mainly by fixed technologies. Among these technologies, xDSL has the largest footprint (92 %) followed by cable (45 %) and WiMAX (17 %). Fixed coverage is the highest in the Member States with well-developed DSL infrastructures.

Overall coverage of fixed broadband has only marginally increased since 2011. Rural coverage improved from 80 % in 2011 to 87 % in 2018.



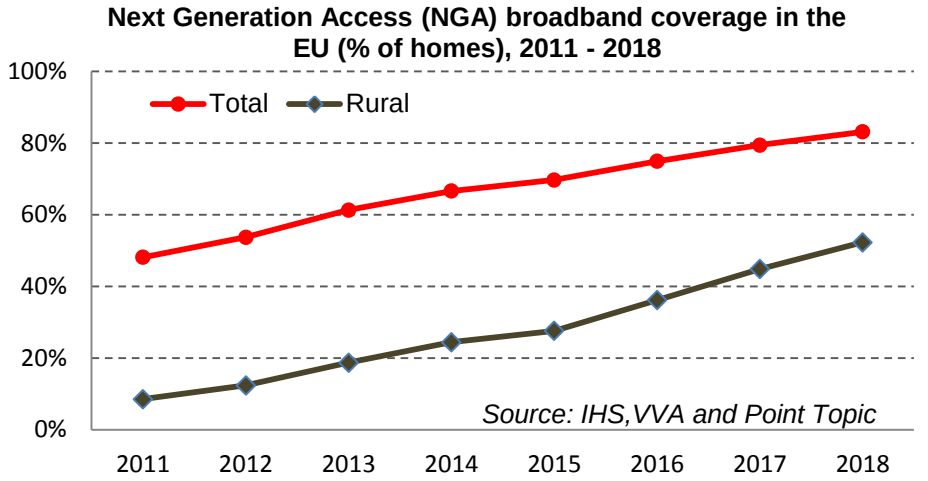


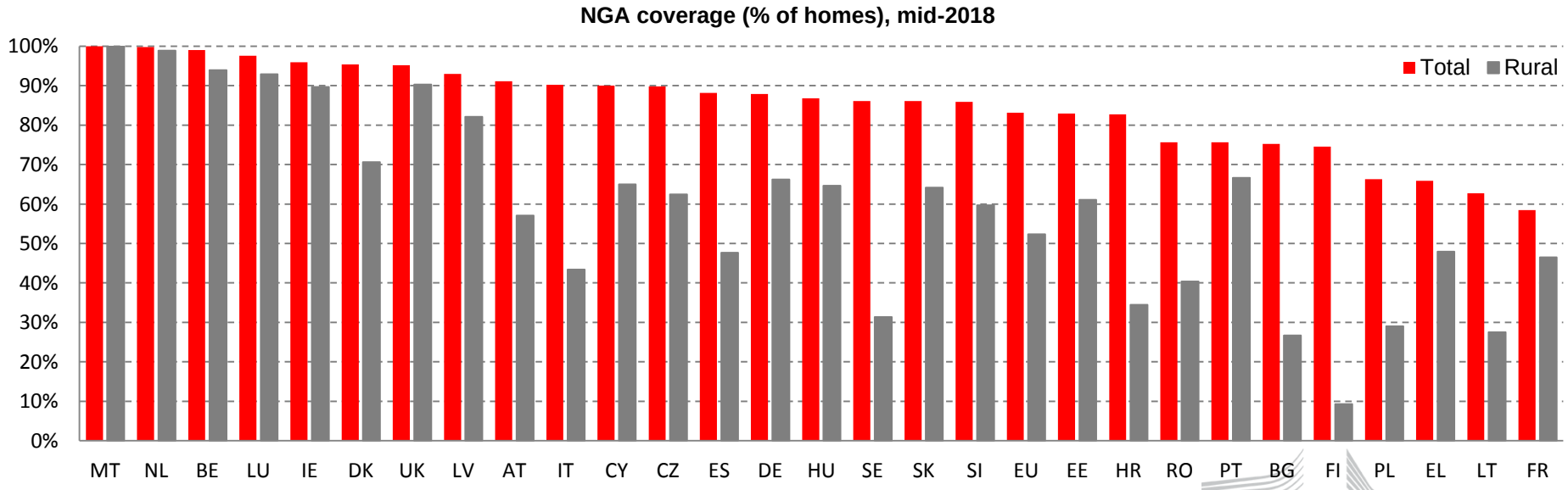
Source: IHS and Point Topic

Coverage of Next Generation Access (NGA) technologies continued to increase and reached 83 %. NGA improved significantly in rural areas, from 45 % to 52 % of homes compared to last year.

By mid-2018, VDSL had the largest NGA coverage at 57 %, followed by cable (44 %) and FTTP (30 %). While cable coverage only marginally increased last year, VDSL and FTTP went up by 3 percentage points.

Malta, the Netherlands and Belgium are the leaders in NGA. In 11 Member States fast broadband is available to at least 90 % of homes. On the other hand, in France, Lithuania, Greece and Poland less than two thirds of homes can have access to such networks.





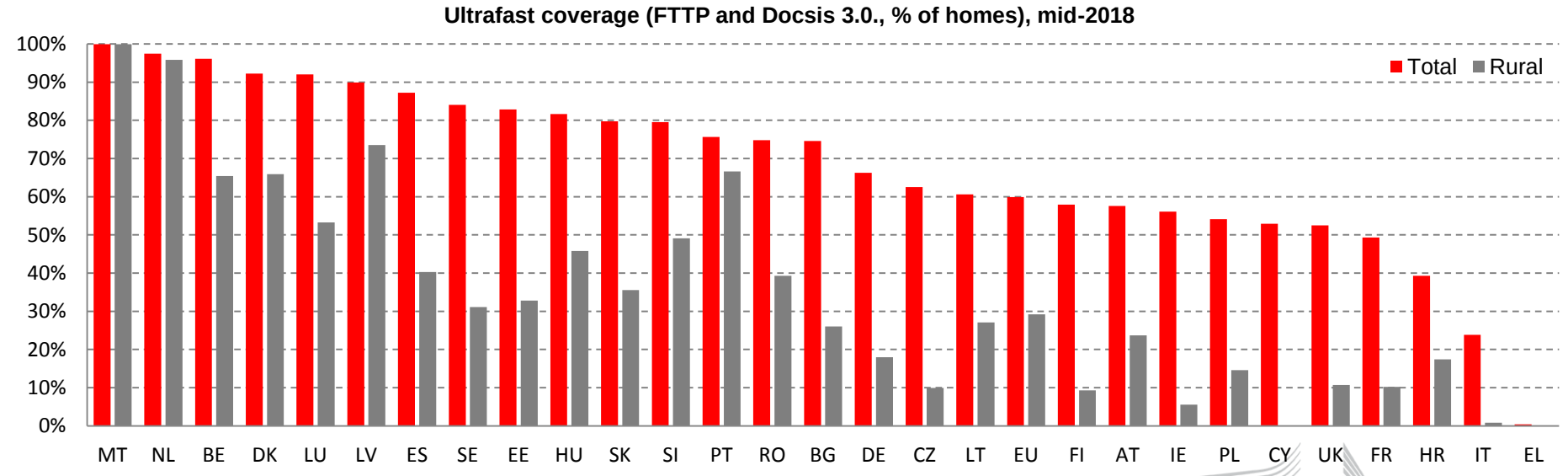
Source: IHS and Point Topic

Ultrafast broadband (FTTP & Cable Docsis 3.0) is available in 60 % of European homes. In Malta, the Netherlands, Belgium, Denmark and Luxembourg at least 90 % of homes have access, while in Greece it is less than 1 %.

Ultrafast broadband capable of providing at least 100 Mbps connectivity is currently measured as the combined coverage of cable Docsis 3.0 and FTTP networks. Cable covers 44 %, while FTTP covers 30 % of homes. Cable and FTTP networks overlap, and mainly cover urban areas. 60 % of homes in total have access to at least one of the ultrafast technologies, up from 57 % a year ago.

The rural coverage of ultrafast technologies stands at 16 % of homes.

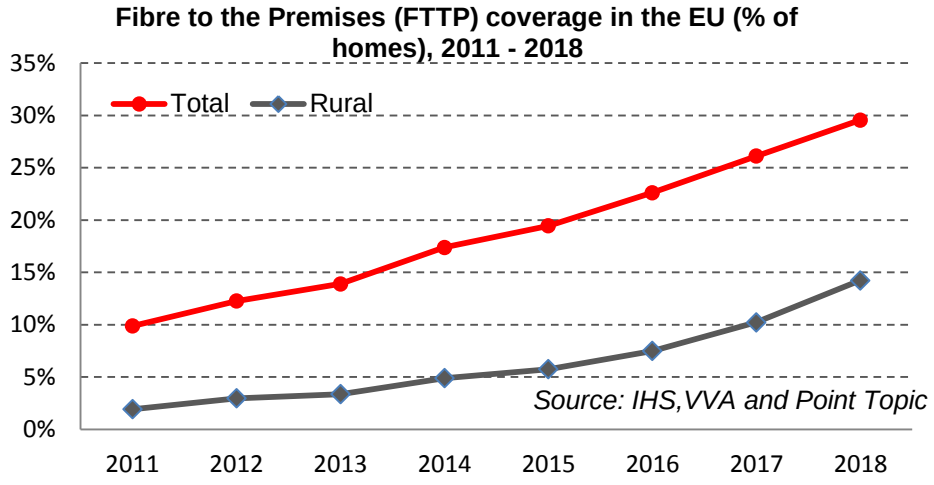
The top three countries (Malta, the Netherlands and Belgium) provide ultrafast connectivity mainly through cable, while FTTP is the more widespread ultrafast technology in Latvia and Spain. At the bottom of the list, Greece has no cable and only a marginal availability of FTTP, while Italy only has FTTP available in some cities.

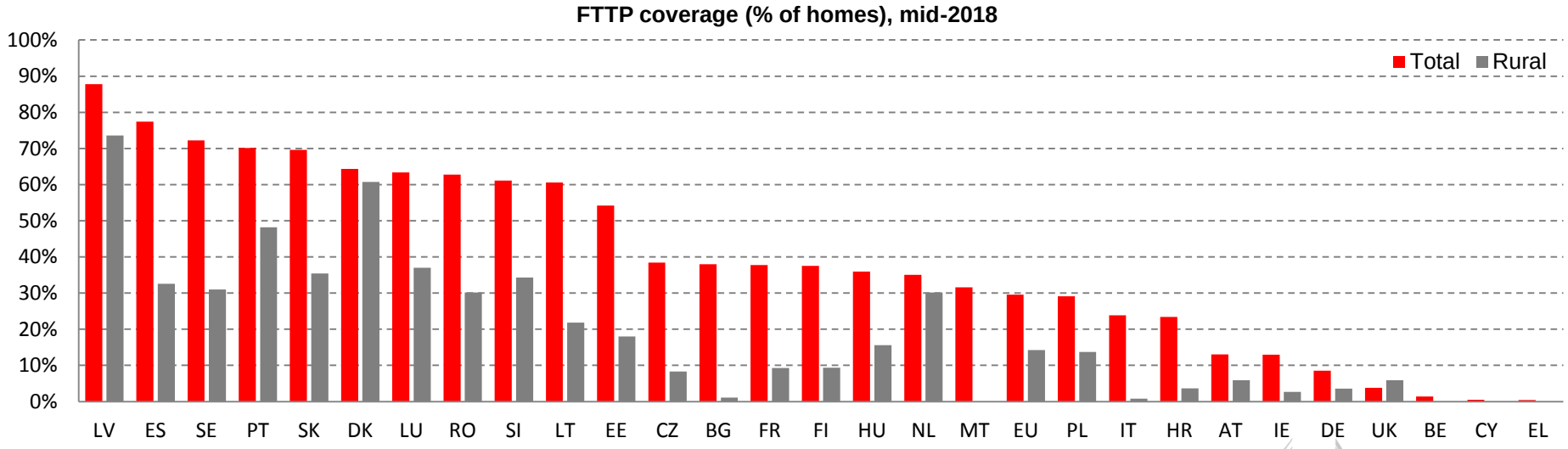


Source: IHS and Point Topic

Coverage of Fibre to the Premises (FTTP) grew from 10 % in 2011 to 30 % in 2018, although it remains a primarily urban technology. Latvia, Spain, Sweden, Portugal and Slovakia are the leaders in FTTP in Europe.

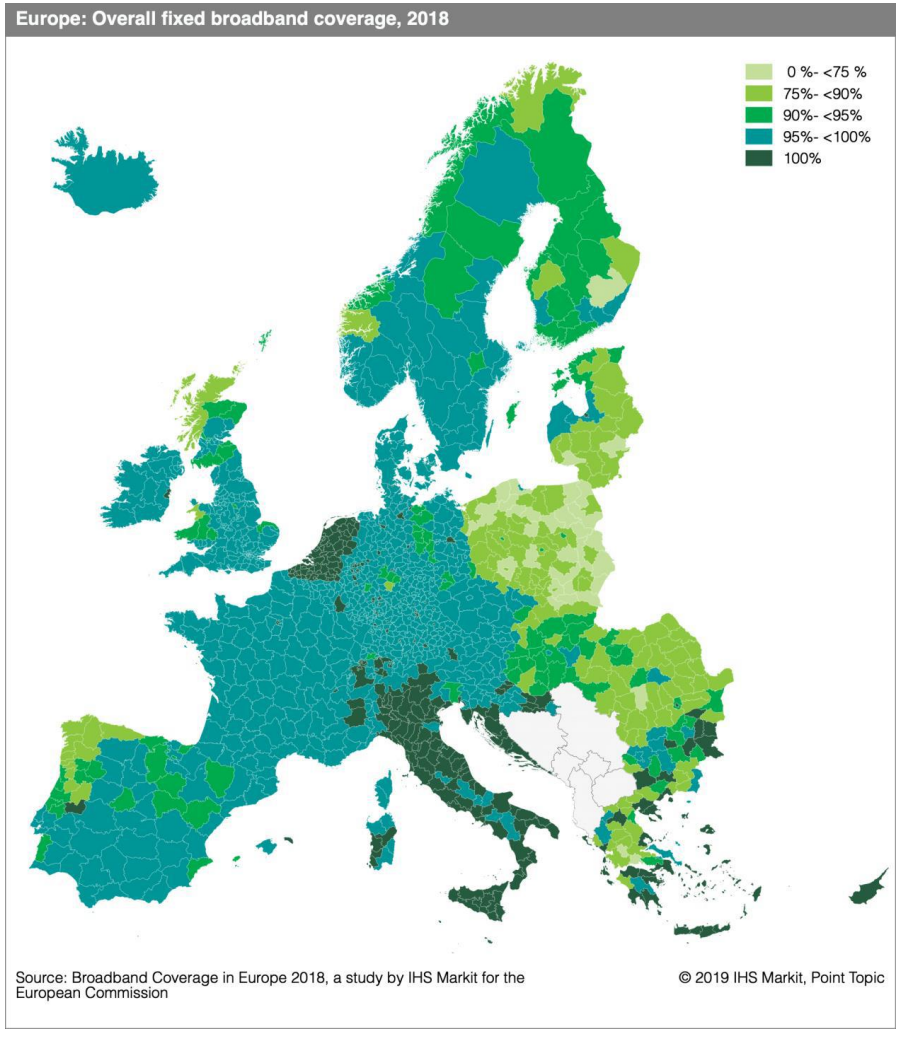
FTTP is catching up in Europe, as coverage of homes has tripled since 2011. However, the FTTP footprint is still significantly lower than that of cable Docsis 3.0 and VDSL. In Latvia, Spain and Sweden more than 70 % of homes can already subscribe to FTTP services, while in Greece, Cyprus, Belgium, the UK and Germany less than 10 % can do so. FTTP increased the most in Slovakia (13 percentage points) and in France (10 percentage points). FTTP services are available mainly in urban areas with the exception of Latvia and Denmark, where more than 50 % of rural homes also have access to it.

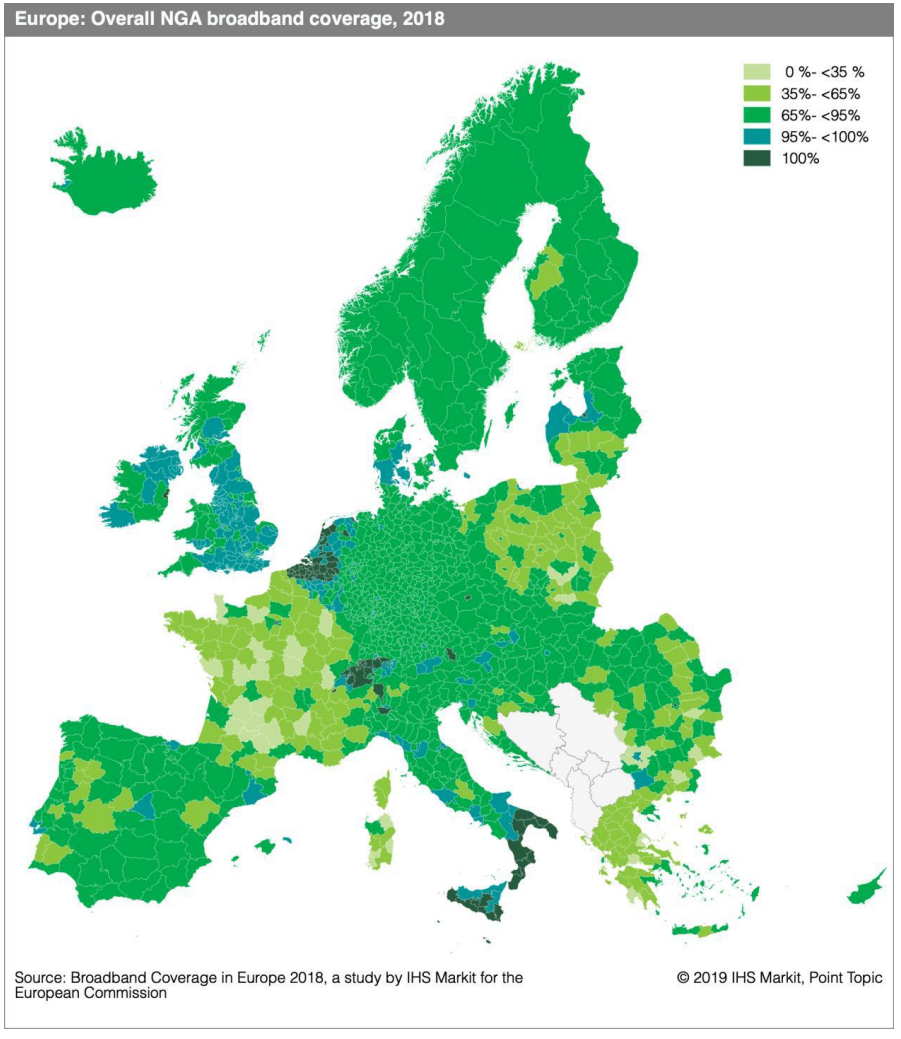




Source: IHS and Point Topic

Overall fixed broadband and NGA broadband coverage by region.

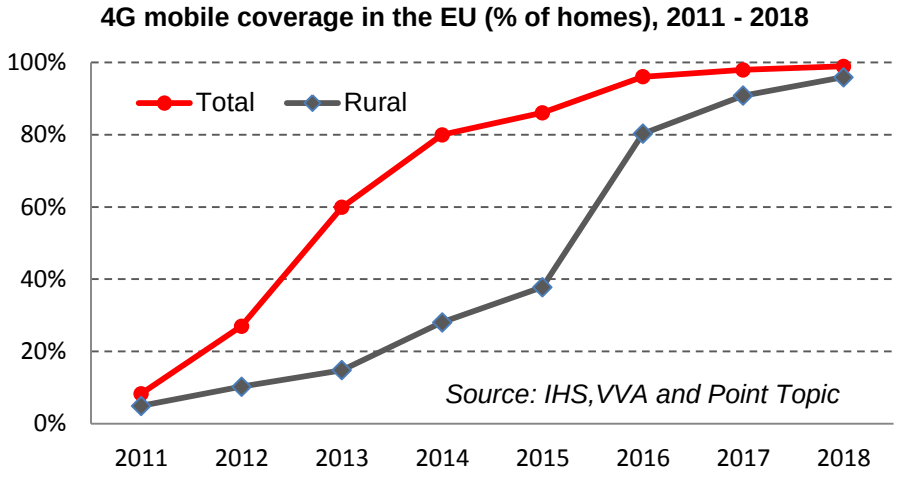


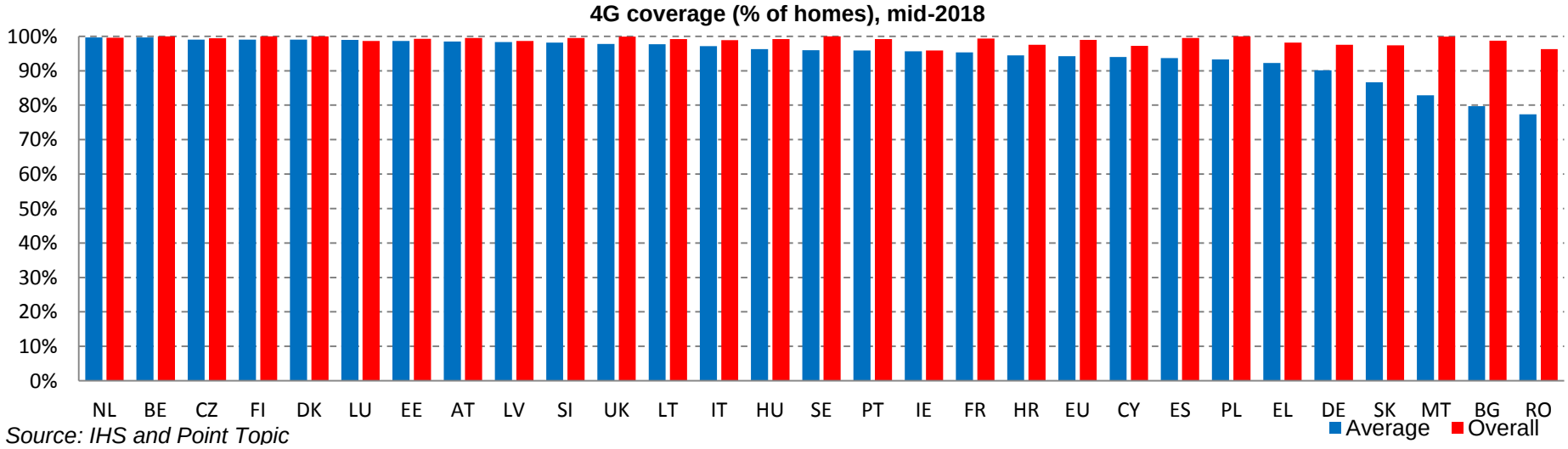


4G coverage: 99 % of homes are covered by at least one operator in Europe (overall coverage). Rural coverage went up from 38 % in 2014 to 96 % in 2018. Average 4G availability* is 94 %, up from 85 % two years ago.

4G (LTE) is now almost as widely available as advanced 3G (HSPA) and fixed broadband. 4G expanded mainly in Croatia and Cyprus last year.

Average 4G availability (calculated as the average of each operator's coverage) is somewhat below the overall coverage and stands at 94 %.





Source: IHS and Point Topic

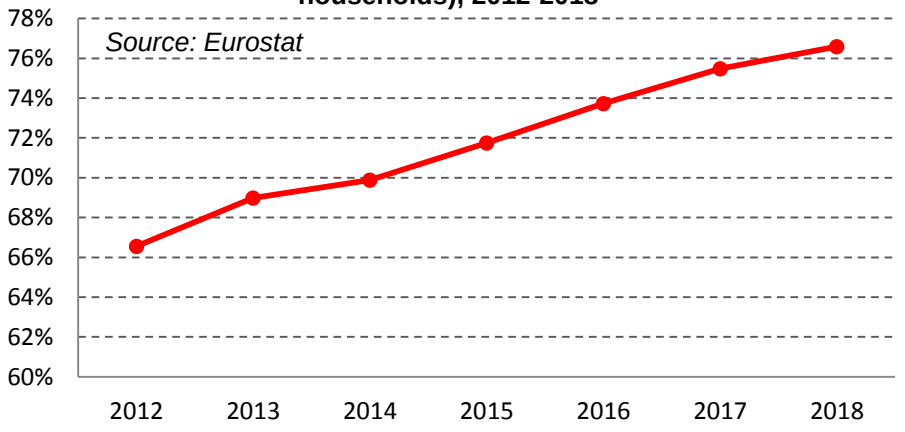
** This indicator measures the average of mobile telecom operators' coverage within each country.*

77 % of EU homes had a fixed broadband subscription in 2018. The Netherlands, the UK, Luxembourg and Germany registered the highest figures, while Bulgaria, Finland, Poland, Latvia and Italy had the lowest take-up rates.

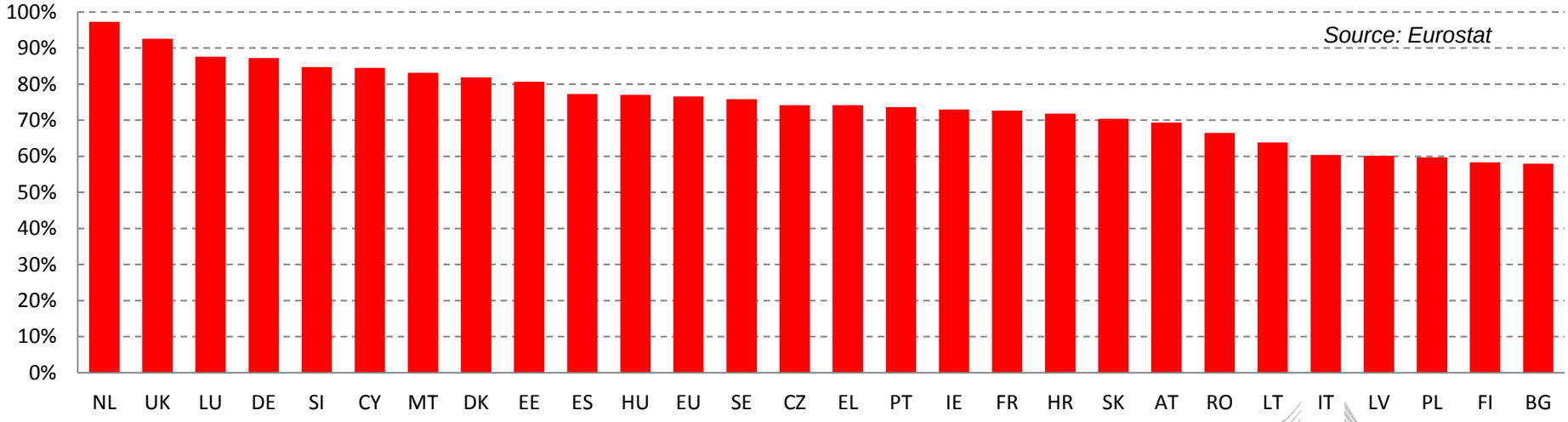
Although fixed broadband is available to 97 % of EU homes, 23 % of homes do not have such a subscription. Growth in take-up has been steady over the last 6 years, up from 67 % to 77 %.

Take-up rates ranged from only 58 % in Finland and Bulgaria to 97 % in the Netherlands. The relatively low take-up rates in Finland, Poland, Latvia and Italy may partly be due to fixed-mobile substitution.

Households with a fixed broadband subscription (% of households), 2012-2018



Households with a fixed broadband subscription (% of households), 2018*



*The figures for Belgium were removed due to low data reliability.

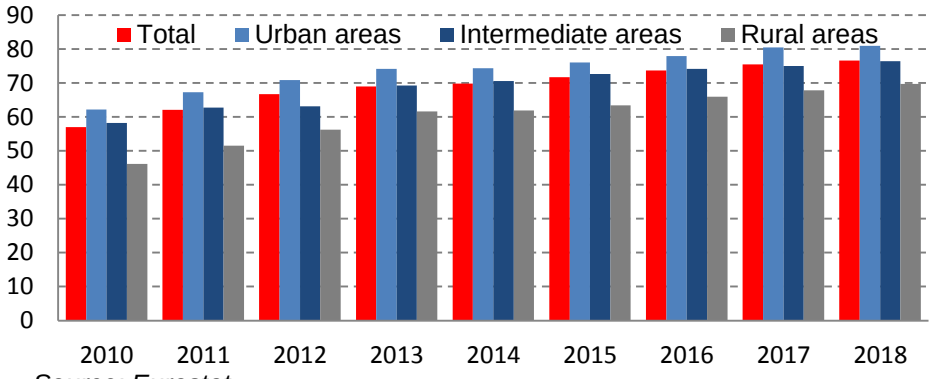
70 % of rural homes in the EU had a fixed broadband subscription in 2018. The Netherlands, the UK and Luxembourg registered the highest figures, while in Bulgaria and Latvia, less than half of rural homes subscribed.

There is a substantial gap between rural and national penetration rates. However, this gap slightly decreased from 11 percentage points in 2010 to 7 percentage points in 2018.

In the Netherlands, the UK, Luxembourg, Germany, Denmark, Belgium, Czechia and Austria, rural and national penetration rates are identical or almost identical.

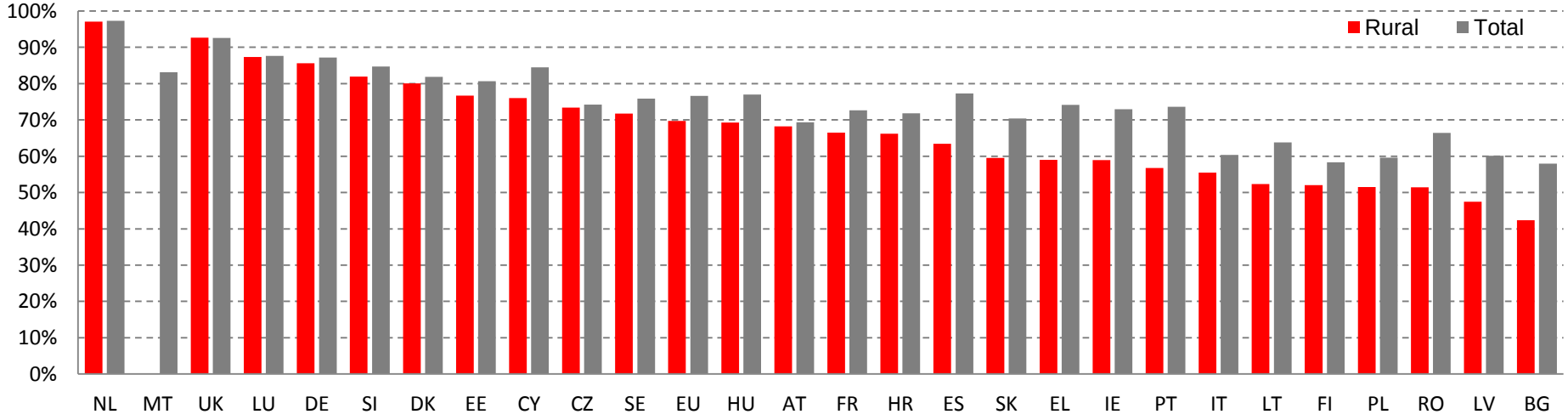
However, in Bulgaria, Latvia, Romania, Lithuania, Portugal, Ireland, Greece, Slovakia and Spain, where fixed rural take-up is relatively low (63 % and below), there are significant gaps of 11-17 percentage points between rural and national take-up.

EU households with a fixed broadband connection by degree of urbanisation (% of households), 2010-2018



Source: Eurostat

Household fixed broadband penetration, rural vs total (% of households), 2018*

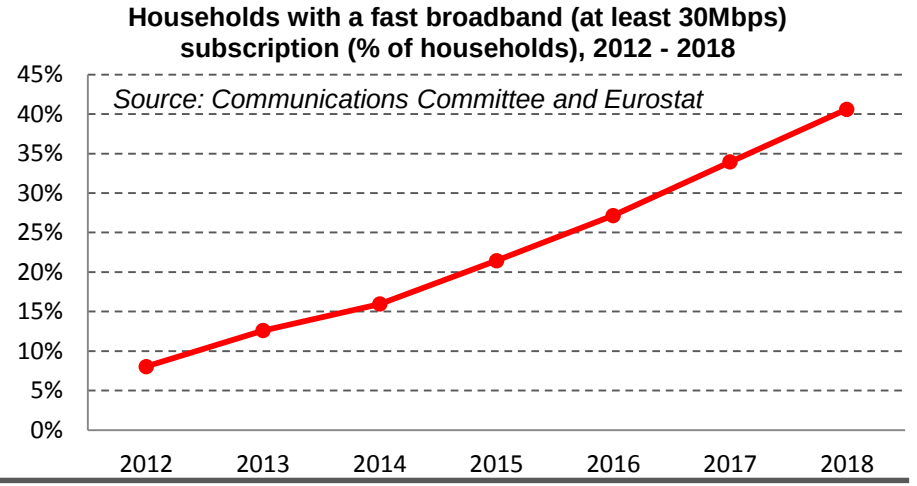


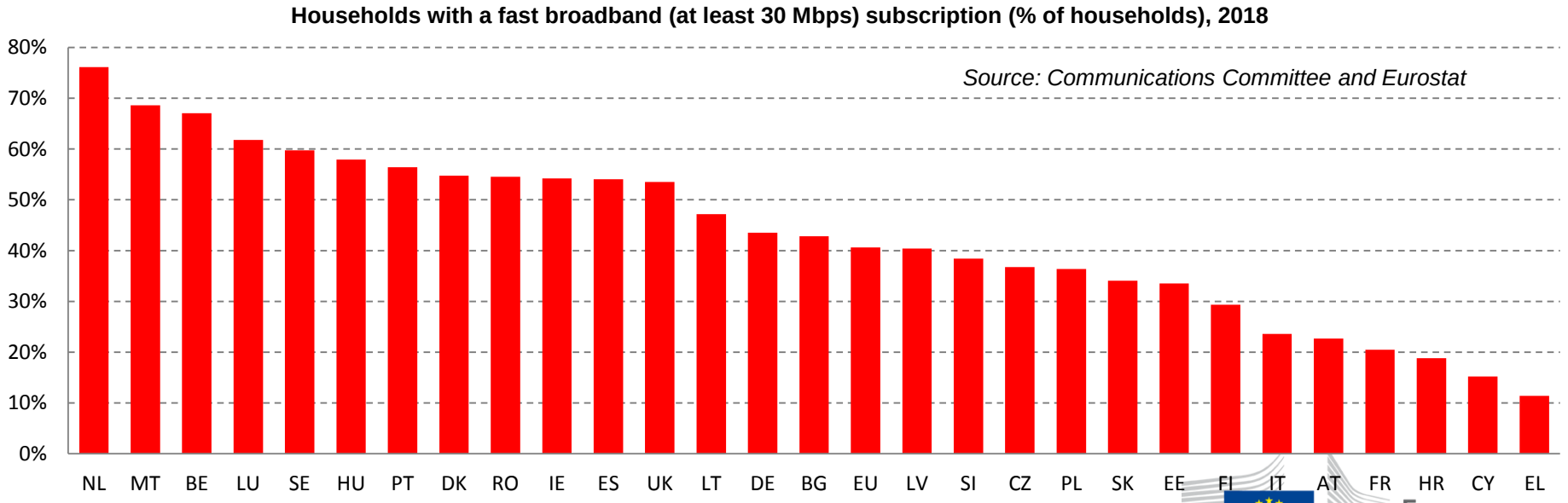
Source: Eurostat

*The figure for rural fixed broadband household penetration in Malta was removed due to low data reliability. The figures for Belgium were removed due to low data reliability.

The take-up of fast broadband access has doubled in the last 3 years. In July 2018, 41% of homes had a subscription of at least 30 Mbps. The Netherlands, Malta and Belgium are the leaders in fast broadband take-up in Europe.

There has been a sharp upward trend in the take-up of fast broadband in the EU since 2010, triggered also by the continuous deployment of infrastructure. Almost all cable subscriptions and around one third of DSL subscriptions have been migrated to high-speed plans. Fibre services are also catching up. In the Netherlands, Malta and Belgium more than two thirds of homes already subscribe to fast broadband, while in Greece, Cyprus and Croatia take-up remains below 20 %.

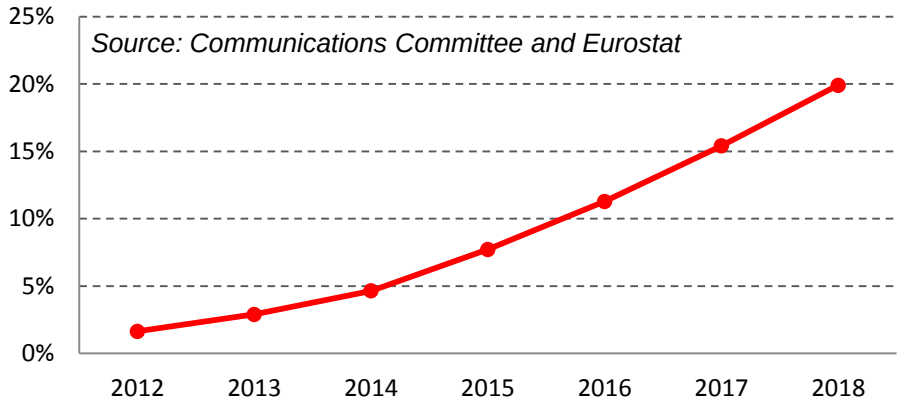




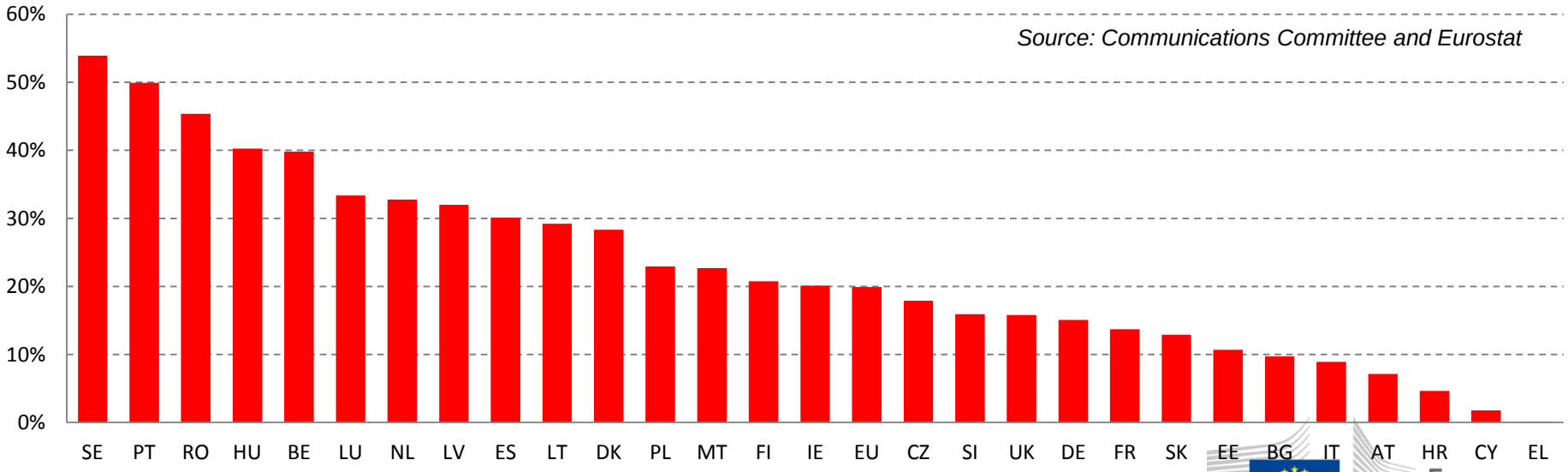
20 % of European homes currently subscribe to ultrafast broadband (at least 100 Mbps), a marked improvement from 2 % 6 years ago. Sweden, Portugal, Romania, Hungary and Belgium are the most advanced in ultrafast broadband adoption.

The Digital Agenda for Europe set the objective of at least 50 % of homes subscribing to ultrafast broadband by 2020. In June 2018, 60 % of homes were covered by networks capable of providing 100 Mbps. As service offers emerge, take-up is growing sharply. Penetration is highest in Sweden, Portugal, Romania and Hungary with over 40% of homes subscribing to at least 100 Mbps. In Greece, Cyprus and Croatia take-up is very low.

Households with an ultrafast broadband (at least 100Mbps) subscription (% of households), 2012 - 2018



Households with an ultrafast broadband (at least 100 Mbps) subscription (% of households), 2018



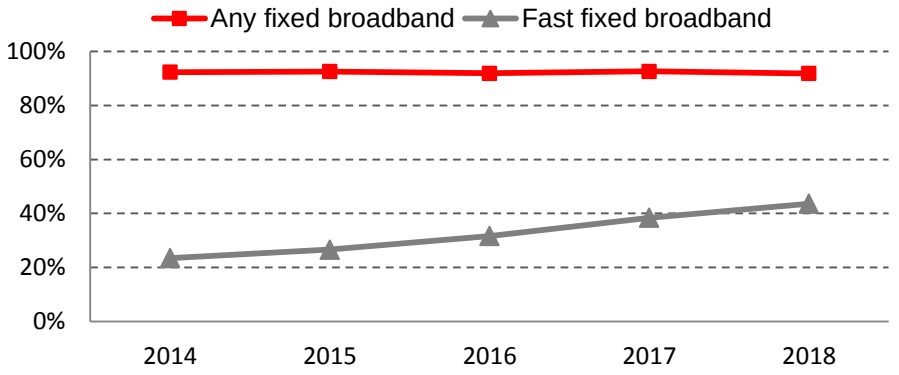
In the EU, 92 % of companies have a fixed broadband subscription. However, only 44 % have fast broadband (at least 30Mbps). While almost all large companies use broadband, 9 % of small enterprises are not yet connected.

While the vast majority of European businesses use broadband, only 44 % of companies and 41 % of private homes subscribed to fast broadband in 2018.

Nevertheless, there has been a significant improvement in fast broadband penetration, which increased by more than 20 percentage points (from 23 % to 44 %) for all enterprises in the last 4 years.

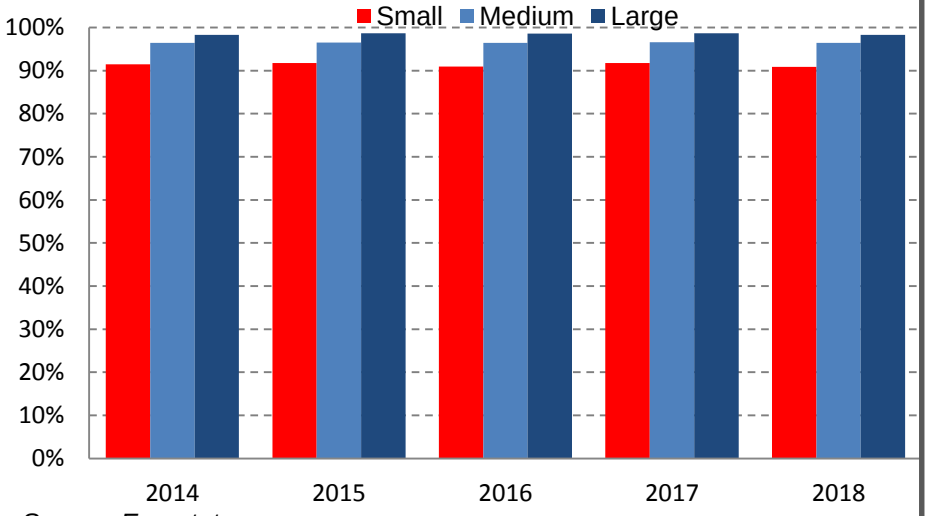
The take-up rate of fast broadband varies greatly between companies of different sizes. While 75 % of large companies benefit from broadband speeds of at least 30 Mbps, only 40 % of small enterprises do so.

Percentage of enterprises in the EU with fixed broadband connection, 2014-2018



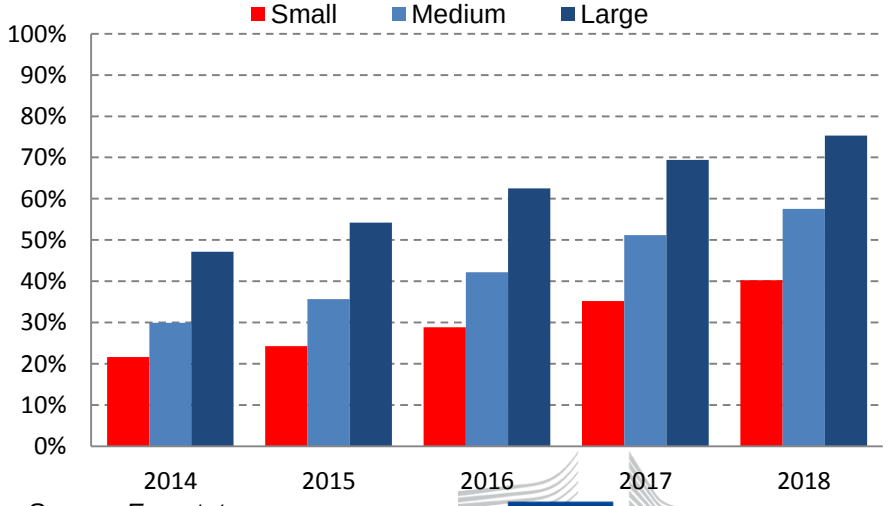
Source: Eurostat

Percentage of enterprises in the EU with any fixed broadband connection, by enterprise size, 2014-2018



Source: Eurostat

Percentage of enterprises in the EU with a fast fixed broadband connection, by enterprise size, 2014-2018



Source: Eurostat

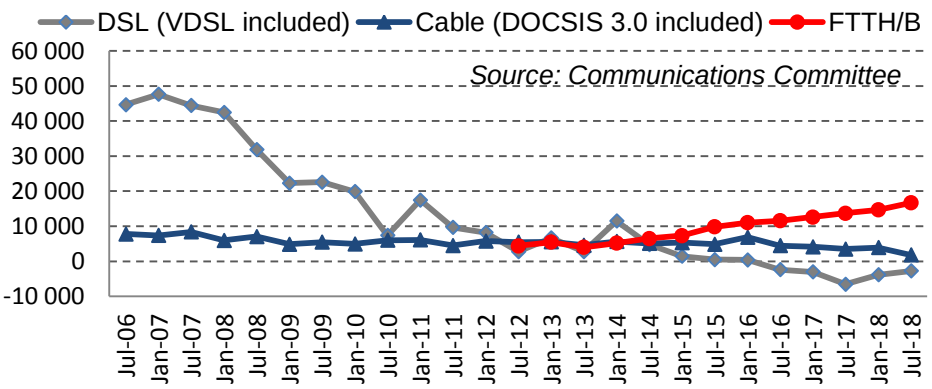
While 61 % of subscriptions are still xDSL, this technology is steadily losing market share. Cable is second with 19 % of the market. Fibre to the home/building (FTTH/B), as the fastest-growing technology, has already aqcuired a 16 % market share.

Although DSL is still the most widely used fixed broadband technology, its market share declined from 80 % in 2008 to 61 % in 2018 – almost 20 percentage points in 10 years. Its main challenger — cable — increased its share slightly (15 % versus 19 %) during the same period.

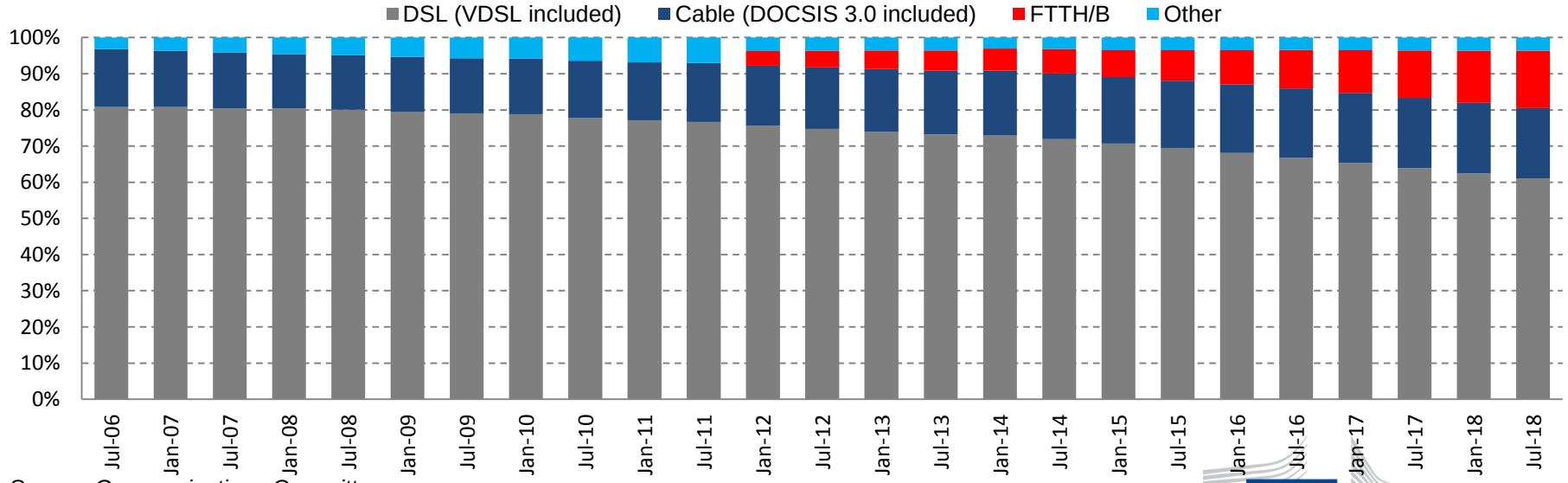
However, the most spectacular growth was achieved by FTTH/B, which has acquired 16 % of the market in just 7 years.

Nevertheless, DSL is still dominant, and its market share could be maintained for some years thanks to increasing VDSL coverage.

Fixed broadband net adds in the EU by technology, July 2006 – July 2018



Fixed broadband subscriptions, technology market shares in the EU, July 2006 – July 2018



Source: Communications Committee

The market share of xDSL varies from 11 % to 100 % and is generally lower in eastern Europe, where FTTH/B is more widely used. Cable is present in all but two Member States.

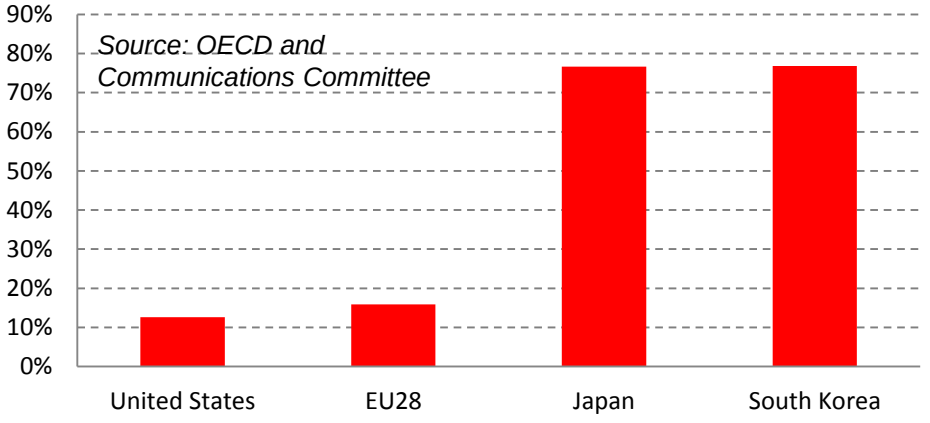
xDSL is particularly important in Greece and Italy, and has the lowest market share in Bulgaria, Lithuania and Romania.

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

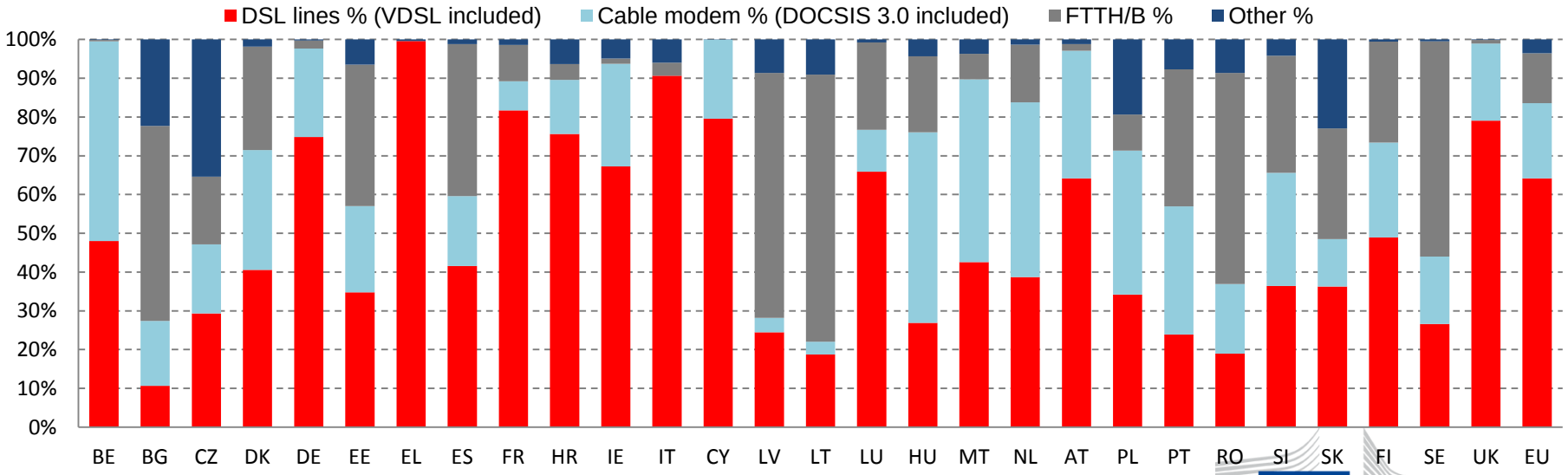
FTTH and FTTB together represent 16 % of EU broadband subscriptions. FTTH/B is the most widely used technology in Lithuania, Latvia, Romania, Bulgaria, Portugal, Estonia and Sweden.

In these technologies, Europe continues to lag behind global leaders such as South Korea and Japan.

Share of fibre connections in total fixed broadband, July 2018



Fixed broadband subscriptions - technology market shares, July 2018



Source: Communications Committee

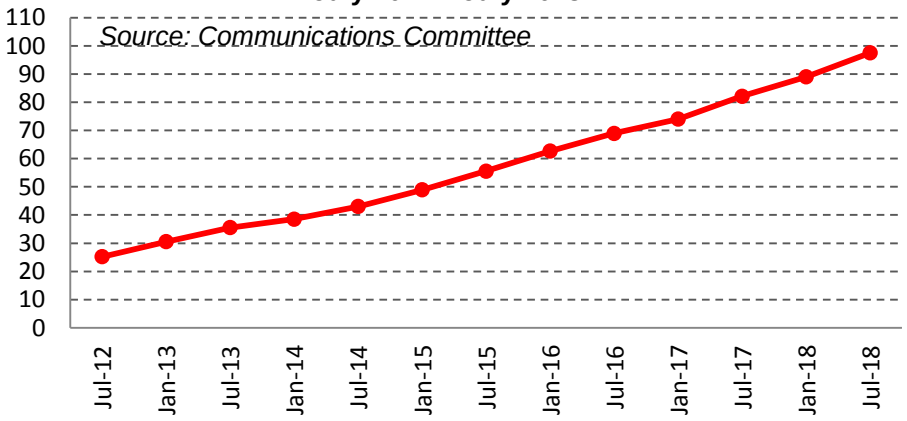
NGA subscriptions have increased sharply by 28.5 million in the last 2 years, and 55 % of all subscriptions are NGA. In 12 Member States, the market share of NGA is greater than 75%. By contrast, its take-up remains low in Greece, Cyprus, France, Austria and Italy.

NGA subscriptions have been steadily increasing in the EU since 2012 and currently account for 55 % of all EU fixed broadband subscriptions.

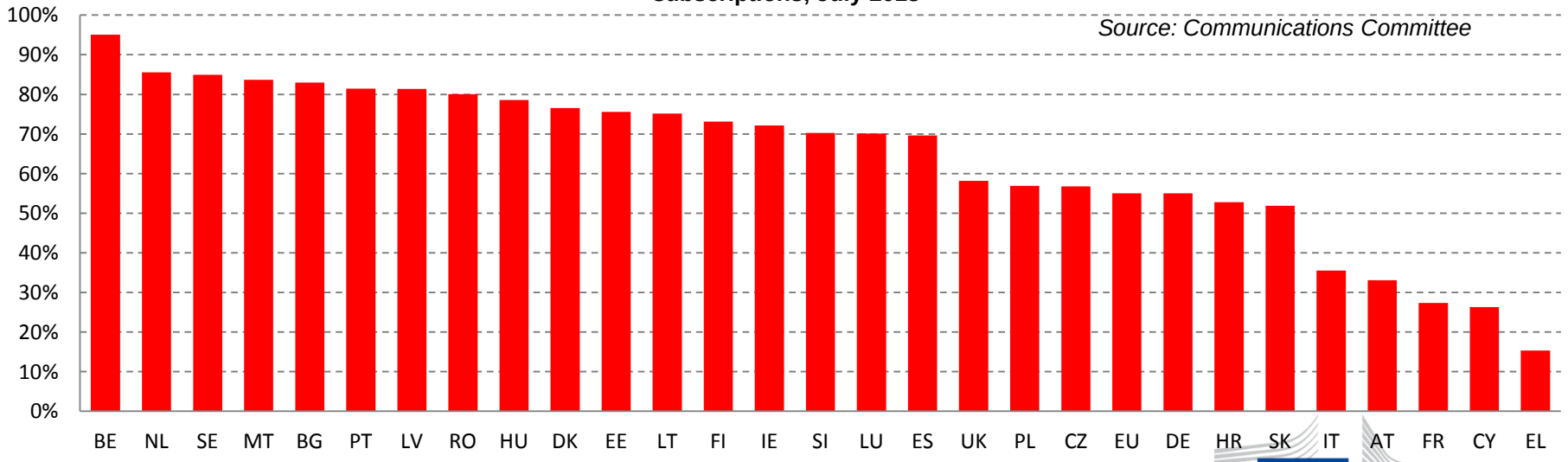
Belgium and the Netherlands lead ahead of other Member States in NGA take-up, with both VDSL and DOCSIS 3.0 cable widely available.

The highest growth in the last 12 months was in Malta (17 percentage points), Cyprus, Luxembourg and Italy (all 14 percentage points).

Total NGA subscriptions in the EU (in millions), July 2012 – July 2018



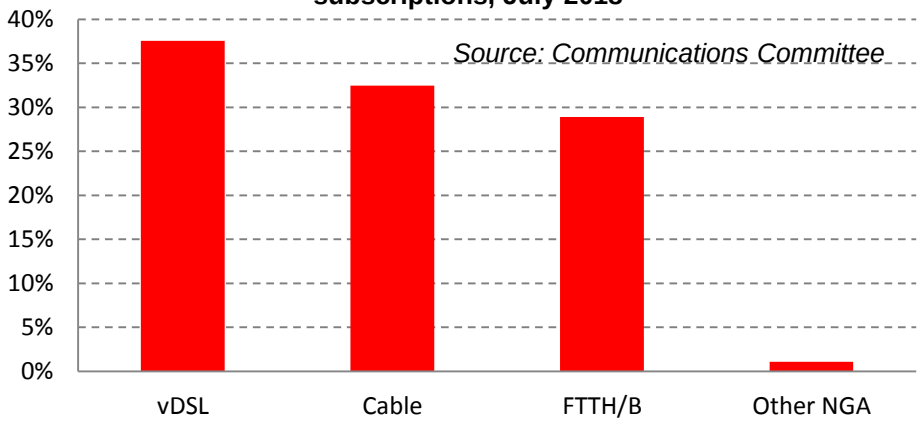
NGA (FTTH, FTTB, VDSL, DOCSIS 3.0 cable and other NGA) subscriptions as a % of total fixed broadband subscriptions, July 2018



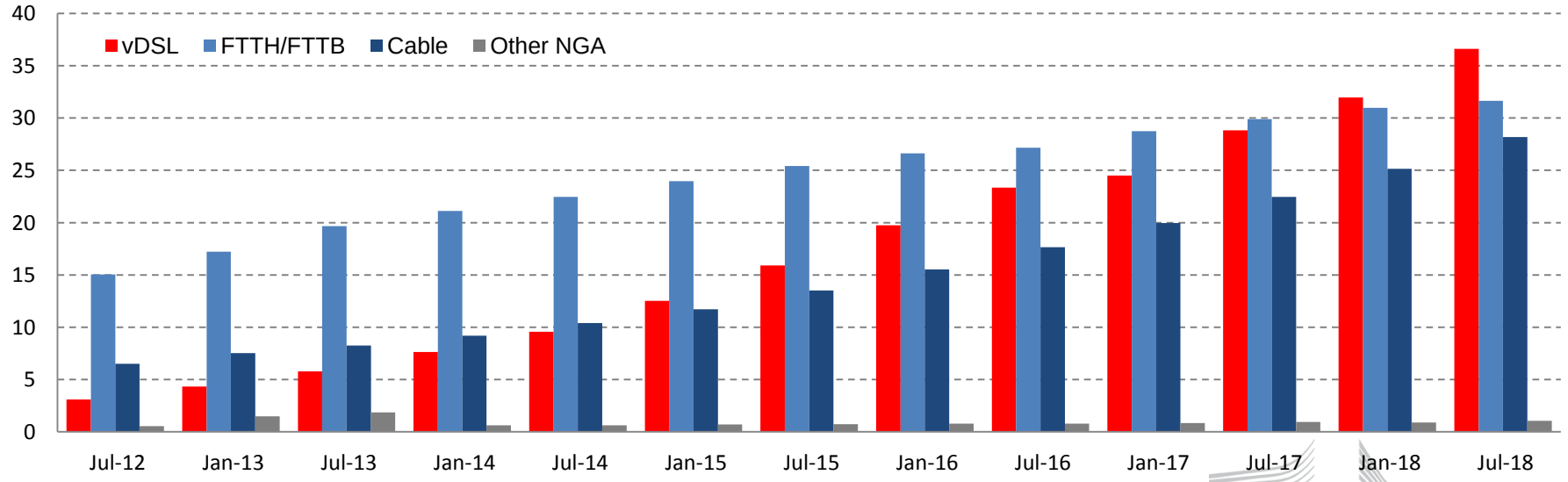
VDSL is currently the most widespread NGA technology in the EU in terms of take-up, followed by DOCSIS 3.0 cable. FTTH/B is catching up.

32 % of NGA subscriptions are DOCSIS 3.0, which is 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 61 % of the xDSL network is VDSL-enabled. Nevertheless, VDSL coverage increased by 15 percentage points in the last 3 years and the number of subscriptions more than doubled. VDSL now represents 38 % of all NGA subscriptions, being the most widespread NGA technology. FTTH/B has a 29 % share in total NGA subscriptions.

Share of different NGA technologies in total NGA subscriptions, July 2018



NGA subscriptions in the EU (millions) by technology, July 2012 – July 2018

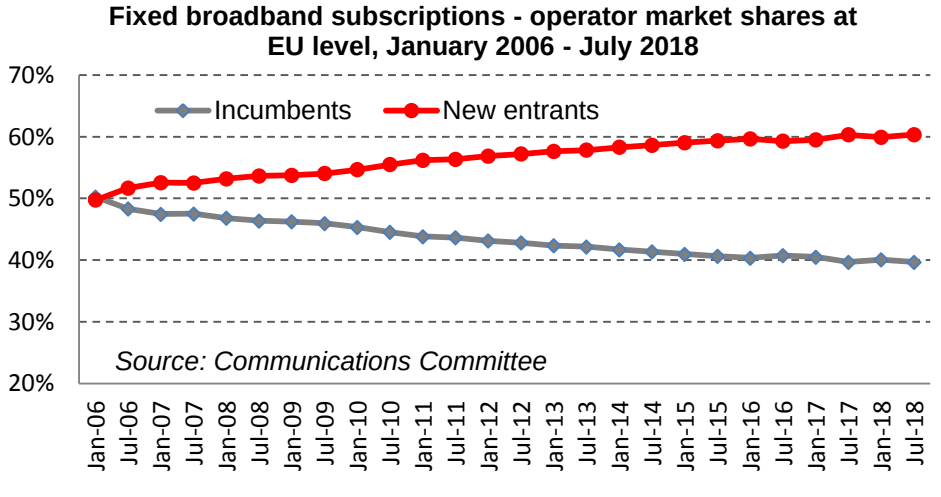


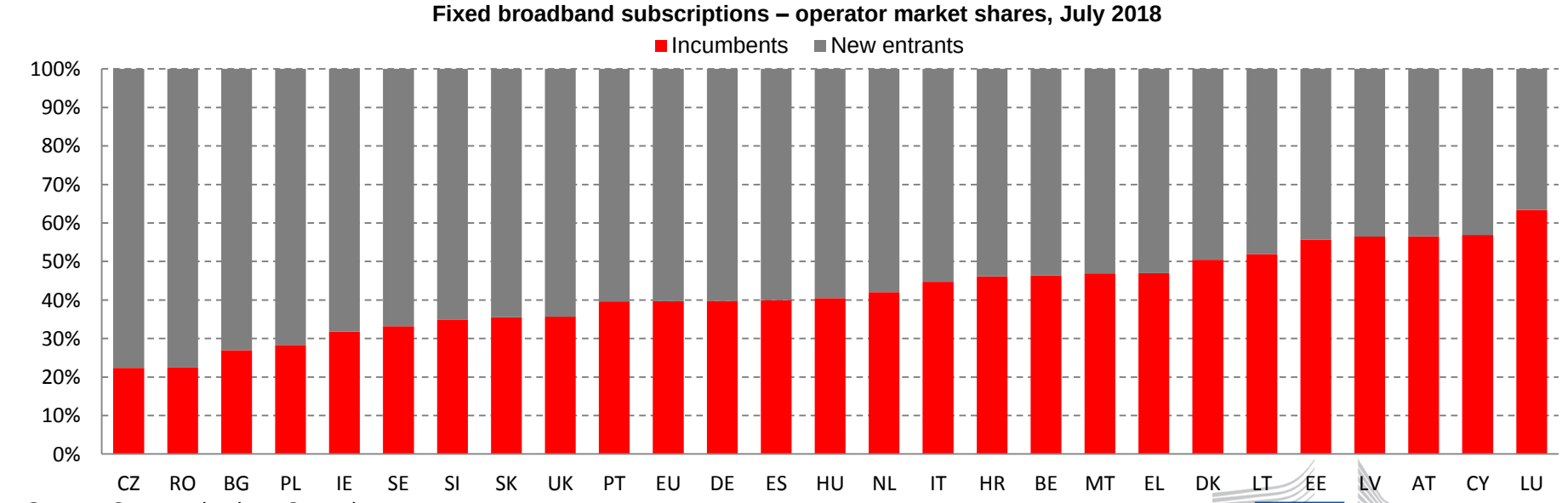
Source: Communications Committee

Competition in the fixed broadband market: while new entrant operators are gaining more and more market share, incumbents still control 40 % of subscriptions. The market share of incumbents is the highest in Luxembourg and Cyprus and the lowest in Czechia and Romania.

Market shares are calculated at national level for incumbents and new entrants. However, broadband markets are geographically fragmented suggesting that a large number of homes 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 has decreased by 10 percentage points since 2006. However, there have been no significant changes since 2015.

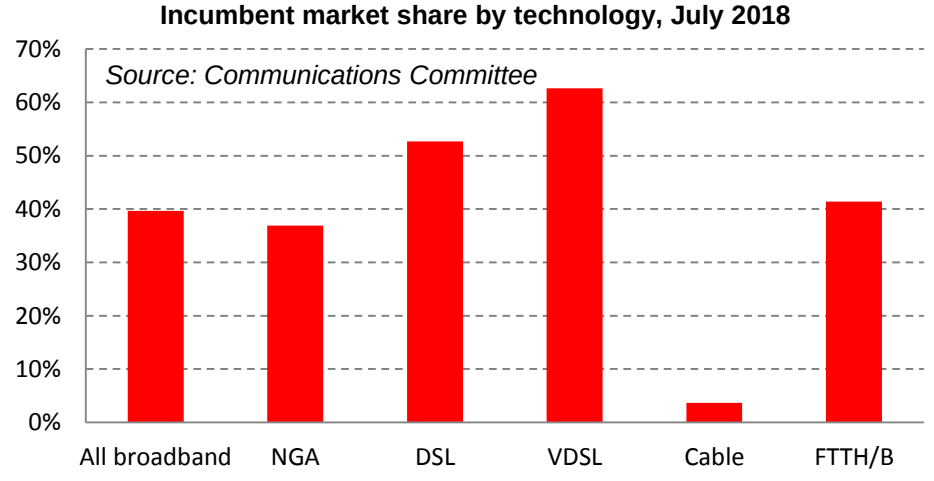


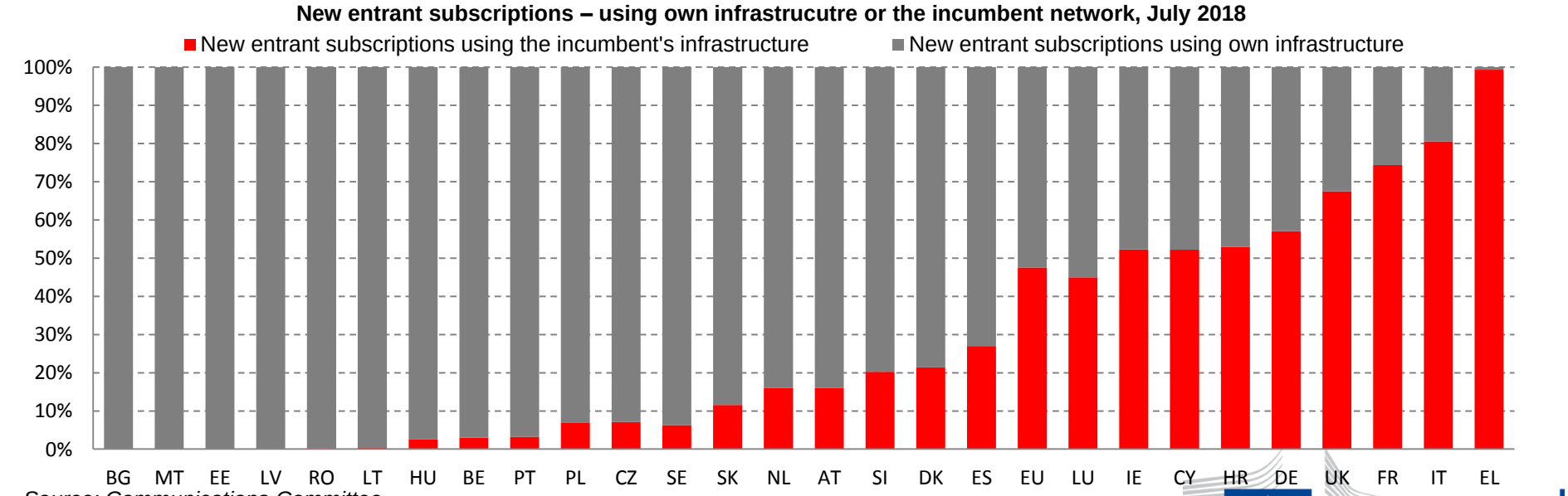


Source: Communications Committee

In the DSL market, unbundling has reduced the dominance of incumbents. However, in VDSL incumbents still hold 63 % of subscriptions. Nevertheless, NGA is provided primarily by new entrants mainly because of the high share of cable.

New entrant operators can compete with incumbents by using either the incumbent's network or their own network to offer internet access. In the EU, 48 % of new entrant subscriptions are based on incumbent networks. In Greece, competition is almost entirely based on regulated access to the incumbents access network, while in Italy and France over 80 % of subscriptions are DSL. In eastern European Member States, competition is based rather on competing infrastructures. This also goeas for Belgium, Malta, Portugal and the Netherlands.





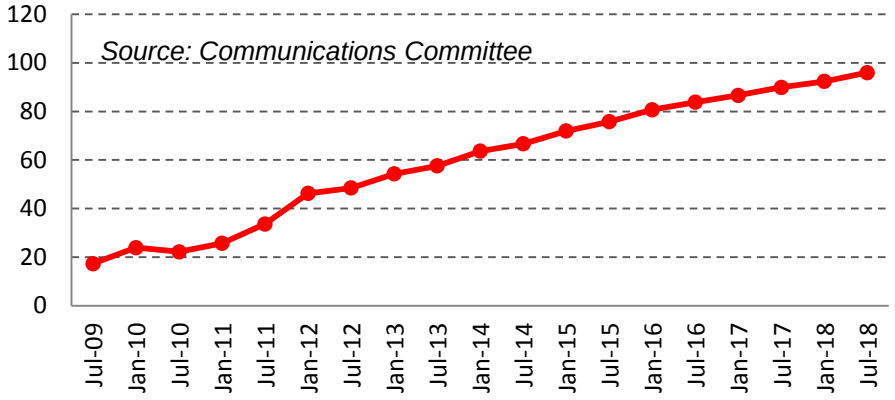
Source: Communications Committee

Mobile broadband represents a fast-growing segment of the broadband market. More than 70 % of all active mobile SIM cards use mobile broadband.

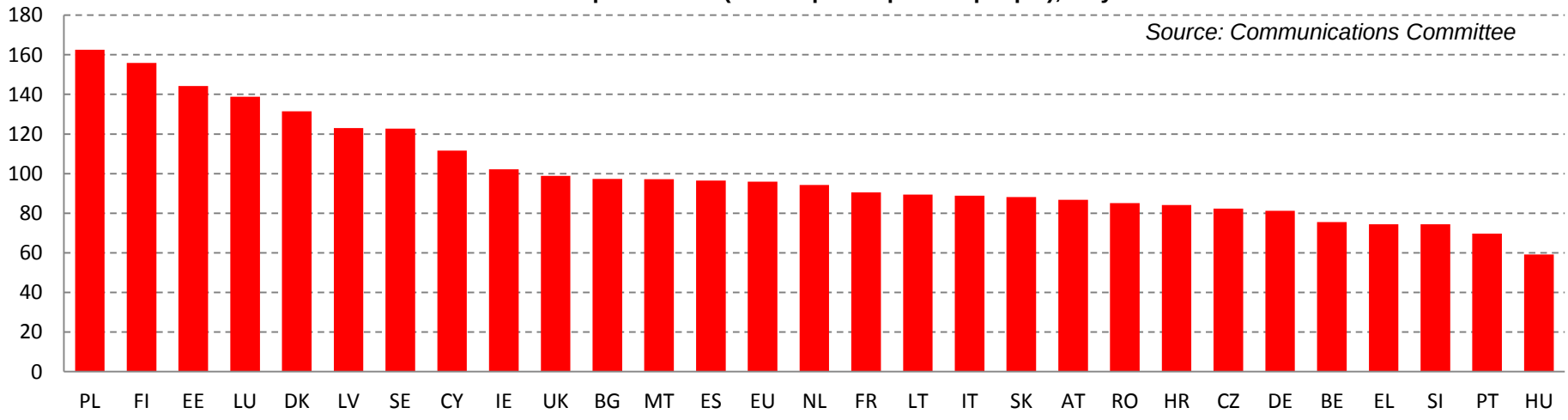
There are 96 active mobile broadband SIM cards per 100 people in the EU. The penetration rate doubled over the last 6 years.

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

Mobile broadband penetration at EU level (subscriptions per 100 people), July 2009 – July 2018



Mobile broadband penetration (subscriptions per 100 people), July 2018

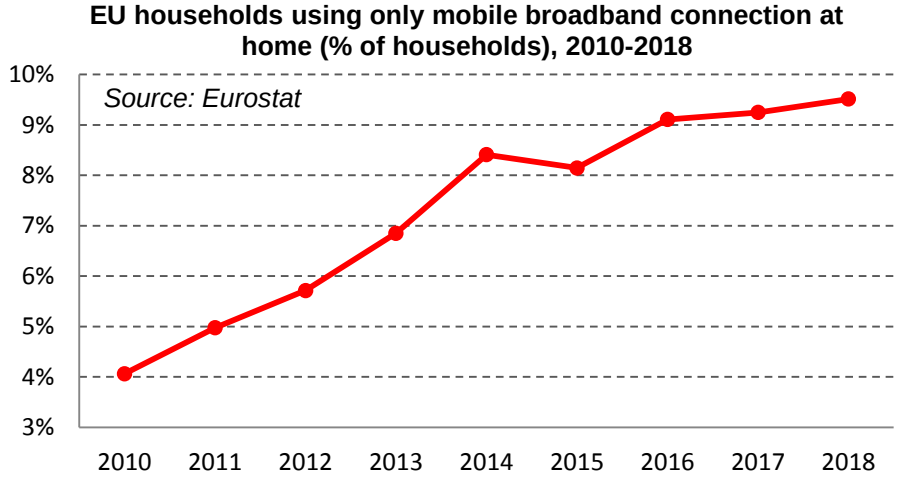


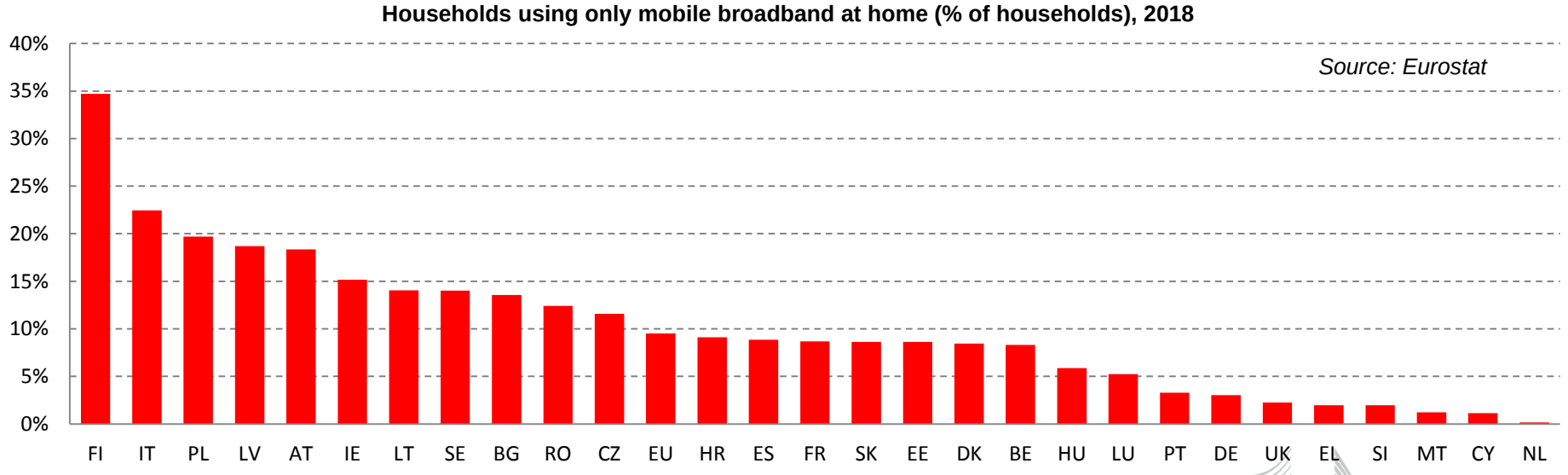
Mobile broadband is still mainly complementary to fixed broadband. In 2018, 9.5 % of EU homes accessed the internet only through mobile technologies. Finland and Italy were leaders in mobile–only access with 35 % and 22 % of homes respectively.

Europeans primarily use fixed technologies at home to access the internet. However, there is a growing number of homes with only mobile internet use. The percentage of homes with purely mobile broadband access grew from 4.1 % in 2010 to 9.5 % in 2018.

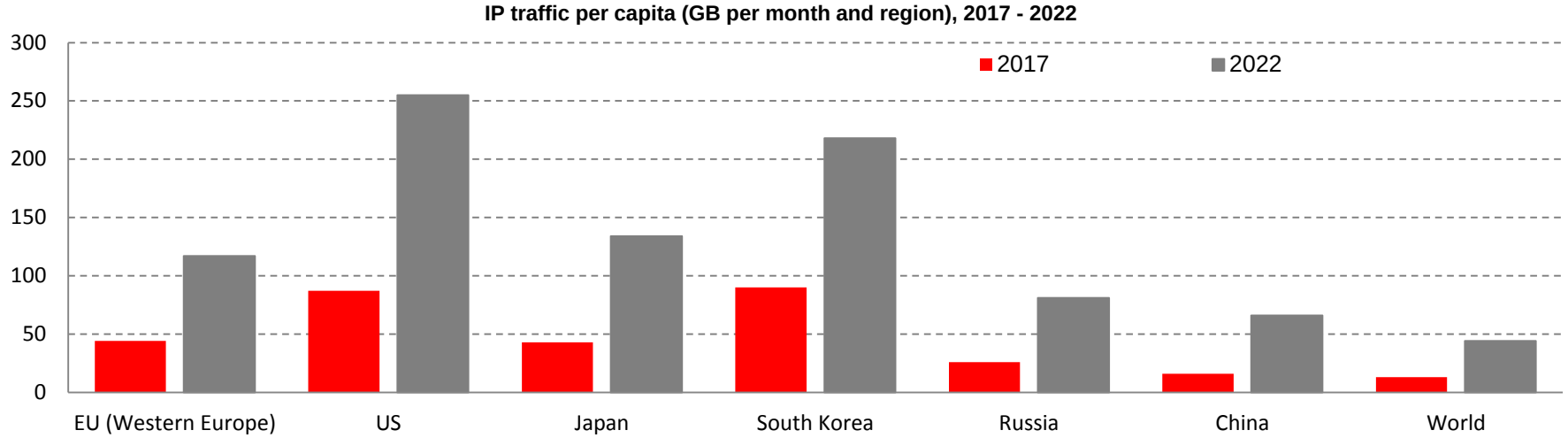
The Netherlands had the lowest mobile-only access rate at less than 0.2 % of homes, which correlates with the fact that it has the highest take-up rate of fixed broadband in the EU (97 %).

By contrast, in Finland, Italy, Poland, Latvia and Austria, where fixed broadband take-up is comparatively low, more than 15 % of homes rely purely on mobile technologies at home.





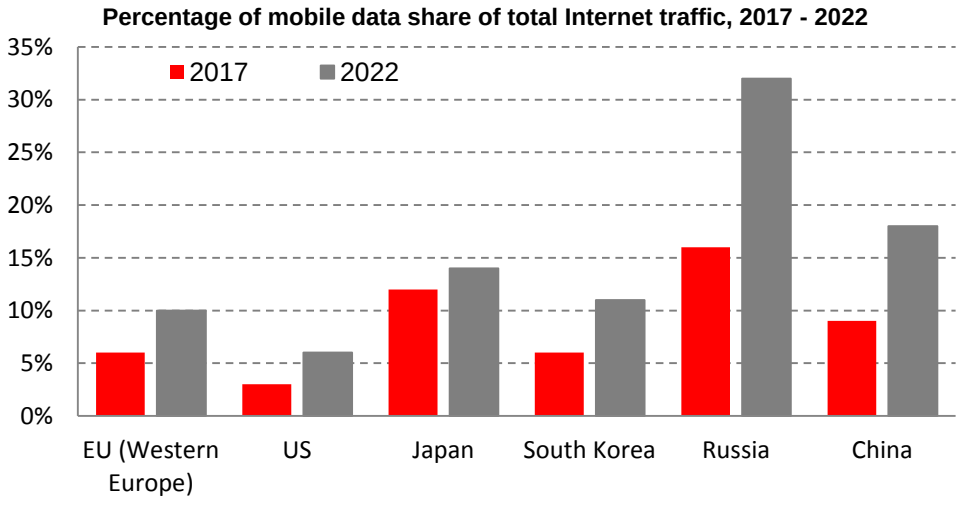
Internet traffic per capita in western Europe* is currently 44 GB per month. By 2022, this figure is forecast to go up to 117 GB, while in the USA it will be 255 GB, followed by South Korea with 218 GB. Internet traffic will continue to be mainly fixed in all world regions.



Source: Cisco, VNI Forecast Highlights

Internet traffic per capita in western Europe* is well below the figures for the US and South Korea.

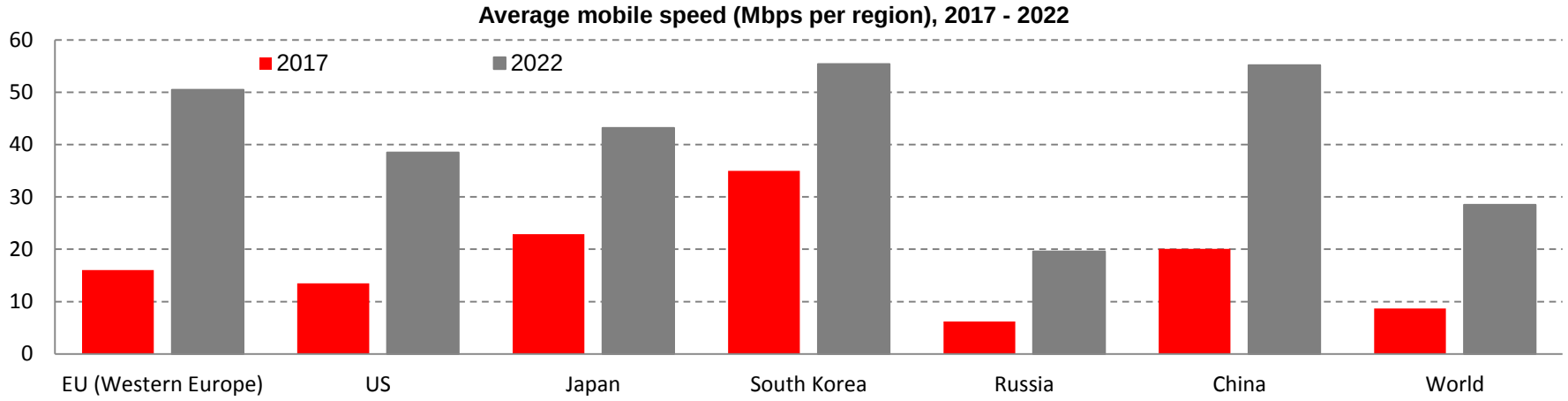
Mobile data traffic is a fraction of total IP traffic, and this will remain so despite the increase forecasted by Cisco. Mobile data currently represents 6 % of European internet traffic, and this ratio is forecast to reach 10 % by 2022. Nevertheless, the share of mobile traffic will be significantly higher in Japan (14 %), China (18 %) and Russia (32 %). By contrast, only 6 % of US's traffic will go through mobile networks by 2022.



Source: Cisco, VNI Forecast Highlights

* France, Germany, Italy, Spain, Sweden, the United Kingdom, Denmark, Netherlands, Belgium, Ireland, Norway and Iceland.

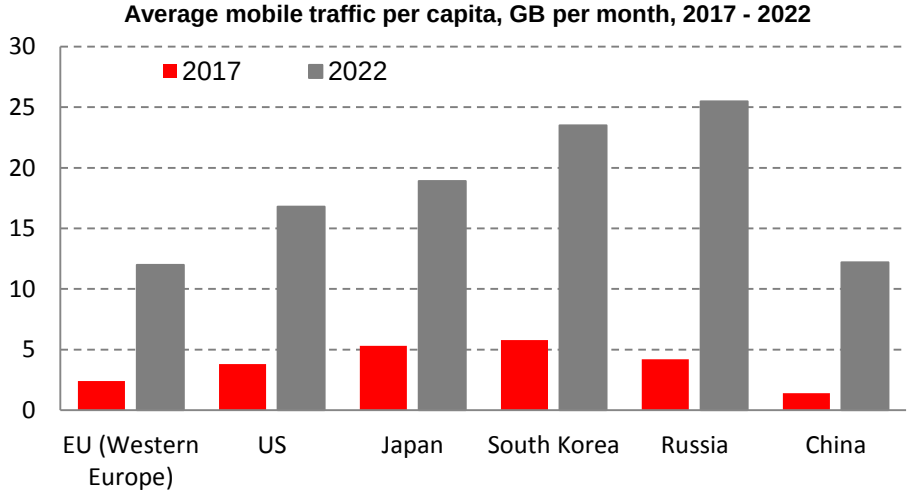
Mobile traffic per capita in western Europe* is currently 2.4 GB per month. By 2022, this figure is forecast to reach equally 12 GB in both western Europe and in China, while in the USA it will be 17 GB. The average mobile speed in western Europe is currently 16 Mbps, ahead of the USA, with 13.5 Mbps.



Source: Cisco, VNI Forecast Highlights

Average mobile traffic per capita in in western Europe is well below the figures for the USA, Japan, South Korea and Russia. Mobile traffic per capita is forecasted to skyrocket by 2022. It is currently 2.4 GB per capita in the EU and it is forecast to reached 12 GB per capita by 2022. Nevertheless, the traffic per capita is significantly higher in the USA (3.8 GB), Japan (5.3 GB), South Korea (5.8 GB) and Russia (4.2 GB). Only China, with 1.4 GB per capita, is currently below European levels. By 2022, Russia will have taken the lead with 25.5 GB of mobile traffic per capita, followed by South Korea with 23.5 GB.

* France, Germany, Italy, Spain, Sweden, the United Kingdom, Denmark, Netherlands, Belgium, Ireland, Norway and Iceland.



Source: Cisco, VNI Forecast Highlights

67 % of EU households subscribe to bundled services. Double play and triple play bundles are available in all Member States, with an EU average of 31 % and 25 % respectively. Quadruple play is the least used with 11 %.

Bundled services are most widely used in Malta, France, Portugal, the Netherlands and Greece (>80 %), while the lowest take-up is in Czechia, Lithuania and Sweden (<30 %).

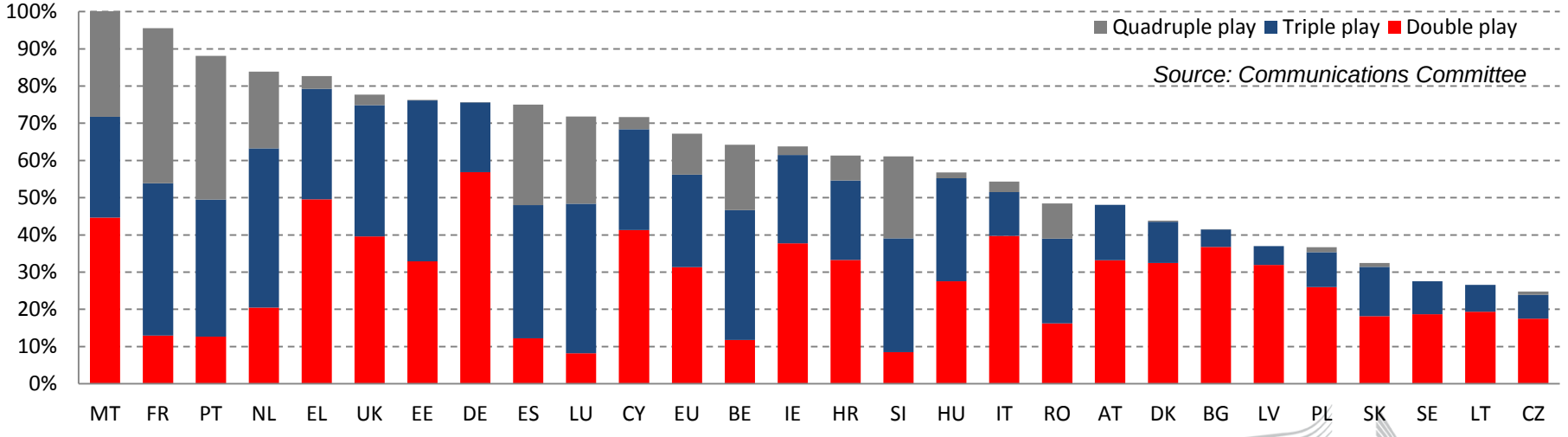
Double play bundles are most popular in Germany (57 %), Greece, Malta and Cyprus, but in almost half of the countries more than 30 % of the households subscribe to such services.

Regarding triple play bundles, Estonia, the Netherlands, France and Luxembourg lead ahead of other Member States. The penetration rate is higher than 30 % in 10 countries. There was less than 10 % take-up in Bulgaria, Latvia, Czechia, Lithuania, Sweden and Poland.

When it comes to quadruple play, the picture is more polarised. While the EU average is 11 %, there are 17 Member States, where take-up is less than 3 %. Penetration is above 18 % in eight countries (France, Portugal, Malta, Spain, Luxembourg, Slovenia, the Netherlands and Belgium).

The prevalence of bundled services is linked to the regulatory environment. More and more national regulatory authorities are considering bundles or multiple-services in their market analysis, especially in connection with the replicability of bundles. Some of them impose obligations to communicate retail offers before their commercial launch.

Double/triple/quadruple play (subscriptions/households), July 2017*



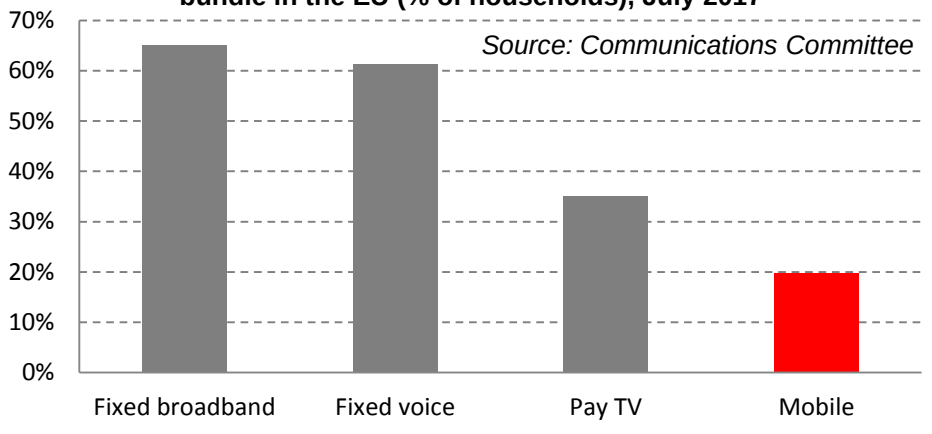
*Data for Finland is not available.

20 % of EU households subscribe to converged bundles (including both fixed and mobile services). However their popularity varies widely among Member States, ranging from 0 % to 61 %.

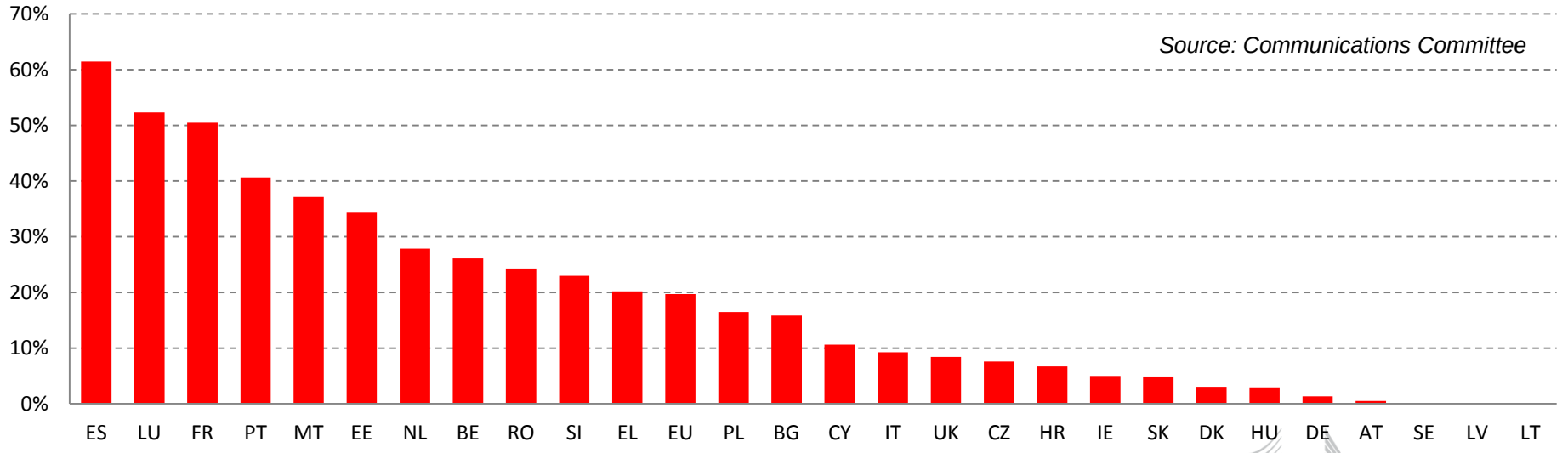
While 65 % of homes subscribe to bundles including fixed broadband, only 20 % of households chose bundles with mobile services.

Spain, Luxembourg and France lead in the take-up of converged bundles (>50 %). However, converged bundles have a penetration rate of less than 20 % in 16 Member States.

Households subscribing to telecoms services as part of a bundle in the EU (% of households), July 2017



Households subscribing to converged bundles (% of households), July 2017*



*Data for Finland is not available.

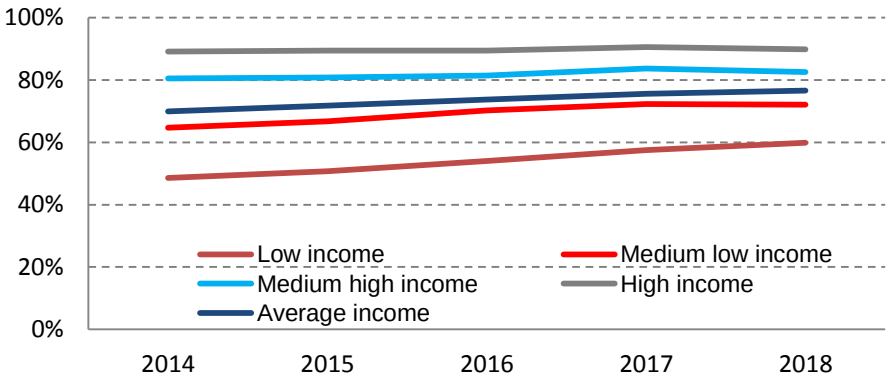
Broadband take-up tends to be lower in Member States where the cost of broadband access accounts for a higher share of income, but this correlation is not strong. Based on the Broadband Price Index, fixed broadband is most affordable in Finland, France, Germany and Austria.

Income plays an important role in broadband take-up. The lowest income quartile has a take-up rate for fixed broadband of just 60 % as opposed to 90 % in the highest income quartile. The take-up in the EU for average income is 76.6 %.

The **Broadband Price Index** is a score* that measures the prices of twelve representative broadband baskets as a percentage of household income. The baskets include three speed categories (12-30 Mbps, 30-100 Mbps and at least 100 Mbps) and four types of products (standalone internet, internet + TV, internet + fixed telephony and internet + TV + fixed telephony).

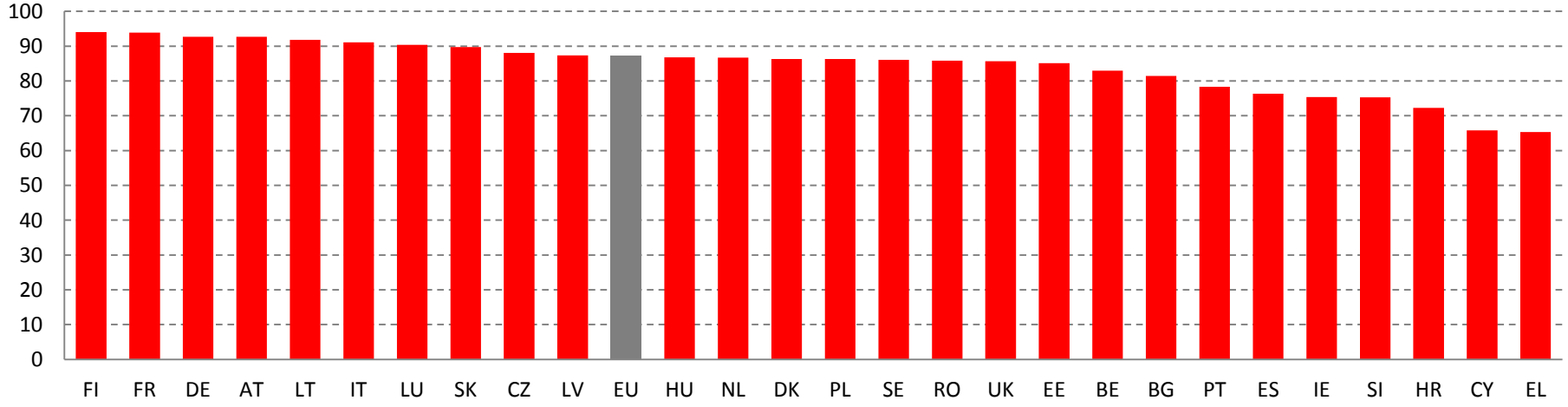
** 0 to 100, 100 being the best*

Fixed broadband household penetration by income quartiles, 2014-2018



Source: Eurostat

Broadband Price Index (0-100), DESI 2019*



** No income data available for MT, therefore Broadband Price Index not calculated.*
Source: European Commission based on Empirica and Eurostat

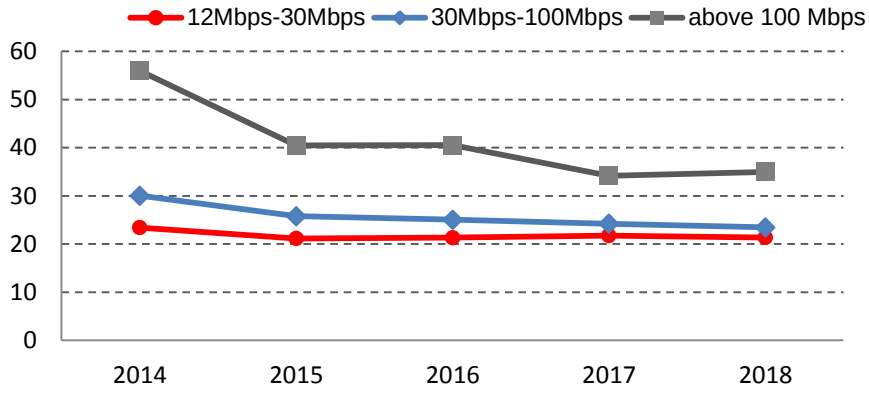
Prices* of fast broadband access tend to decrease over time but vary widely between Member States.

Broadband retail prices (minimum prices, based on Purchasing Power Parity/PPP) vary between EUR 10 and EUR 38 for a standalone offers with a minimum download speed of 12 Mbps. The minimum prices were the lowest in Bulgaria (EUR 10), Hungary (EUR 11) and Romania (EUR 13), and the highest in Ireland (EUR 38), Spain (EUR 33), Slovenia (EUR 31) and Cyprus (EUR 30).

As for offers of at least 100 Mbps, the EU average is EUR 35 with a substantial decrease from 2014, where the average was EUR 60.

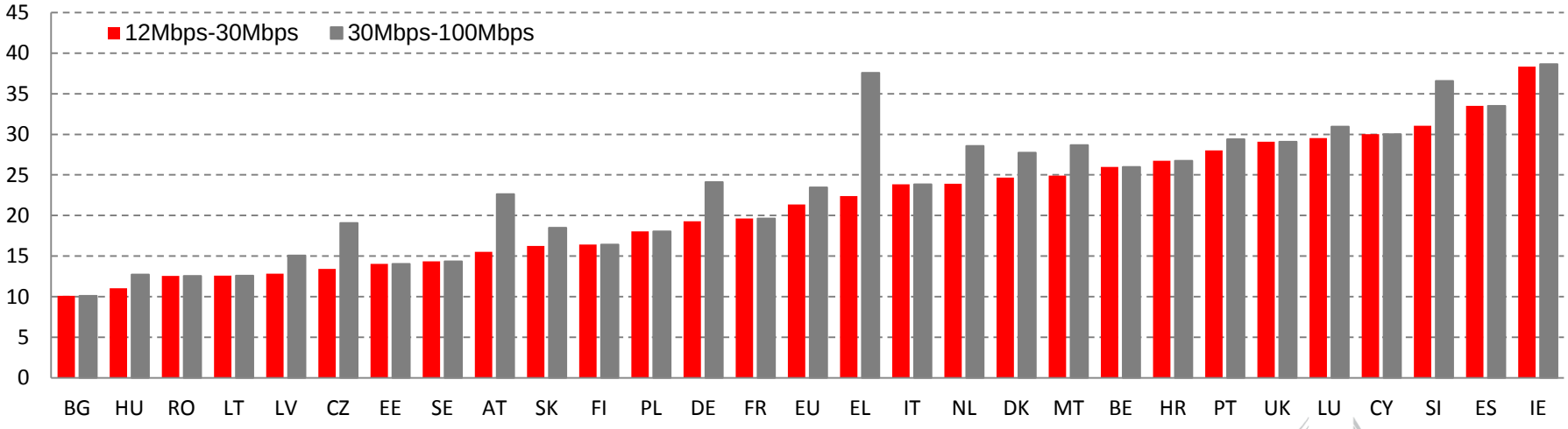
* Based on the least expensive monthly prices available and expressed in euros, adjusted for purchasing power parity, VAT included.

Broadband retail prices (EUR PPP) – standalone offers, 2014 - 2018



Source: European Commission Services based on Empirica and Van Dijk, Fixed Broadband Prices in Europe, annual report. 2014-2018.

Fixed broadband retail prices (EUR PPP) - standalone offers, October 2018



Source: European Commission services based on Empirica, Fixed Broadband Prices study, 2018

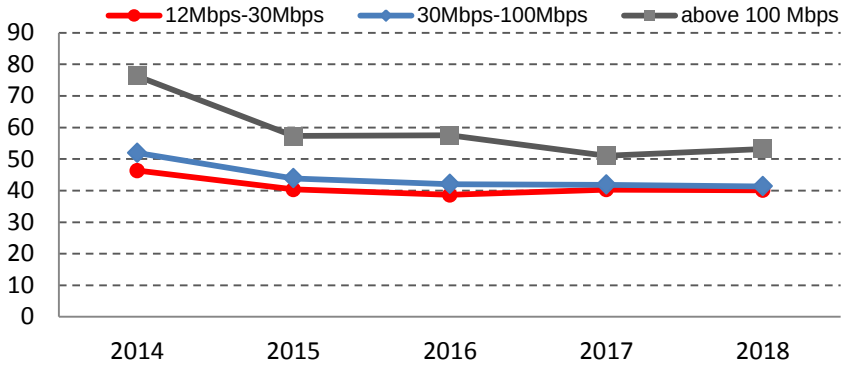
Prices* of triple play bundles which include fast broadband access, fixed telephony and television have fallen by 21 %, on average, since 2014. The largest decrease has been in higher speeds, with a 30 % price decrease between 2014 and 2018.**

The minimum prices for triple play bundles that include broadband access (with a download speed between 12 and 30 Mbps), fixed telephony and television vary between EUR 26 and EUR 65 in the EU. The lowest prices were recorded in Slovakia (EUR 26), Lithuania (EUR 26.5) and Latvia (EUR 27), while the highest were in Sweden (EUR 65), Belgium (EUR 63), Spain (EUR 57), Ireland (EUR 55), and Malta (EUR 54).

The EU average prices for at least 100 Mbps offers is EUR 53 with a decrease of 30 % from 2014.

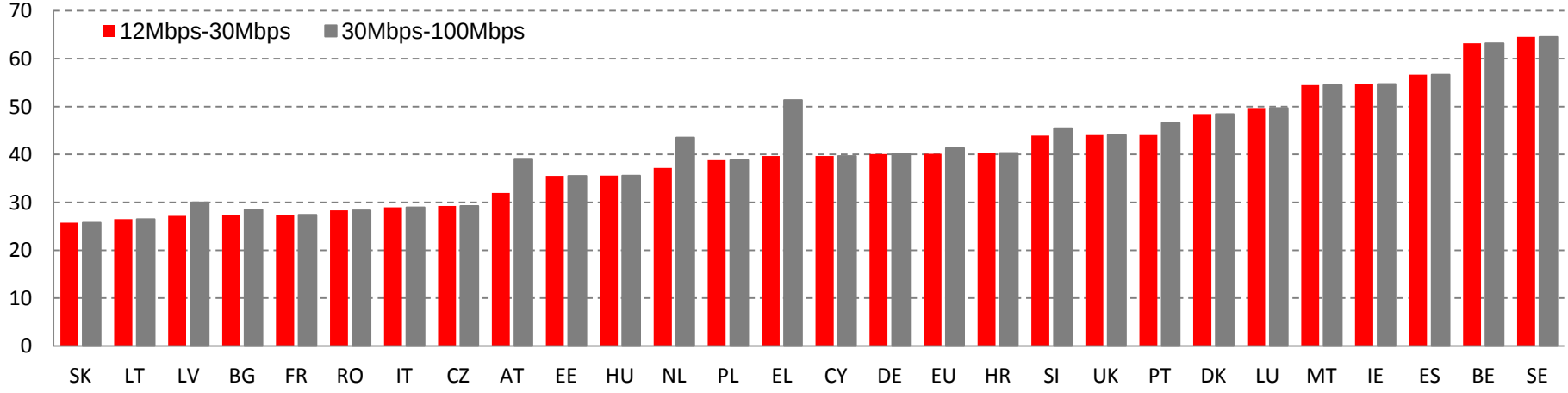
*Based on the least expensive prices available and expressed in euros, adjusted for purchasing power parity, VAT included. **No data available for Finland.

Broadband retail prices (EUR PPP) – bundles including broadband, fixed telephony and television, 2014-2018



Source: European Commission Services based on Empirica and Van Dijk, Fixed Broadband Prices in Europe, annual report. 2014-2018.

Fixed broadband retail prices (EUR PPP) - bundles including broadband, fixed telephony and television, October 2018



Source: European Commission services based on Empirica, Fixed Broadband Prices study, 2018

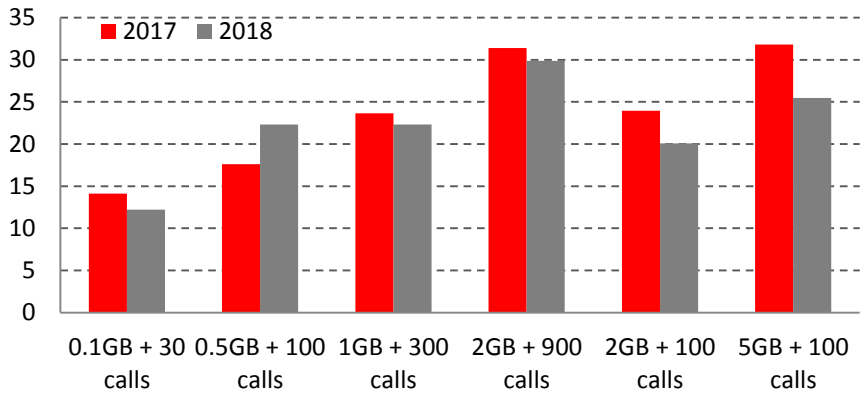
Prices of mobile voice and data plans vary greatly across Europe. Prices have fallen in all but one consumption basket (500 MB + 100 calls). The largest price drop is in the most data-intensive basket (5 GB + 100 calls) which has fallen by 20 % since 2017.

Looking at the usage basket of 300 voice calls and 1GB data, minimum prices range between EUR 8 and EUR 59 with an EU average of EUR 22 (EUR 2 cheaper than a year ago).

The cheapest countries are Luxembourg, Italy, Slovenia, Austria and France, with minimum prices below EUR 10.

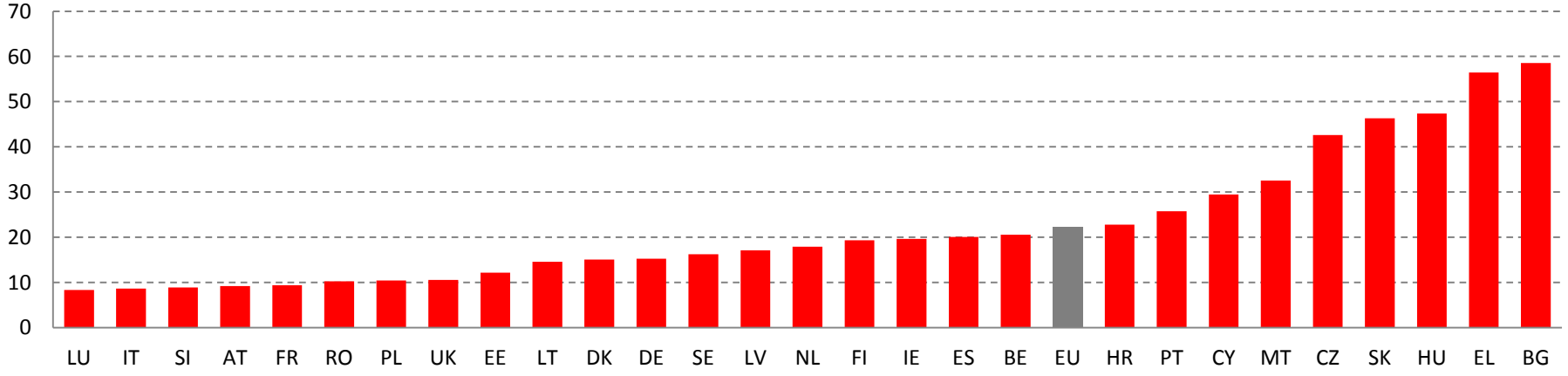
By contrast, prices are high in Bulgaria (EUR 59), Greece (EUR 56), Hungary (EUR 47), Slovakia (EUR 46) and Czechia Bulgaria (EUR 43).

Mobile broadband prices (EUR PPP) - handset use in the EU, 2017 - 2018



Source: Commission services based on Empirica, Mobile Broadband Prices study, 2017- 2018

Mobile broadband prices (EUR PPP) - handset use, 1GB + 300 calls, 2018



Source: Commission services based on Empirica, Mobile Broadband Prices study, 2018

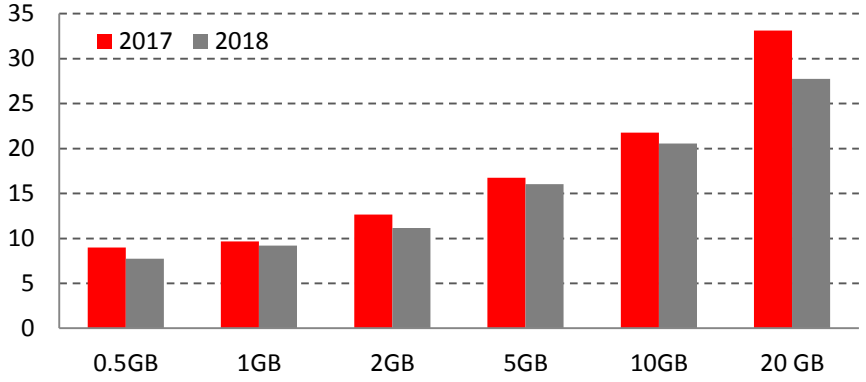
Prices of mobile broadband plans for laptops and tablets show large differences across Europe. On average, prices have decreased for all types of consumption baskets since 2016, ranging from 5 % to 16 %.

Looking at 5 GB data-only plans for laptops, minimum prices range from EUR 3.7 to EUR 42. The EU average (EUR 17) is below the price of fixed standalone offers of 12-30 Mbps.

The cheapest countries are Italy, Poland, Sweden, Latvia and Austria, with prices below EUR 10. At the same time, prices are very high in Cyprus (EUR 43).

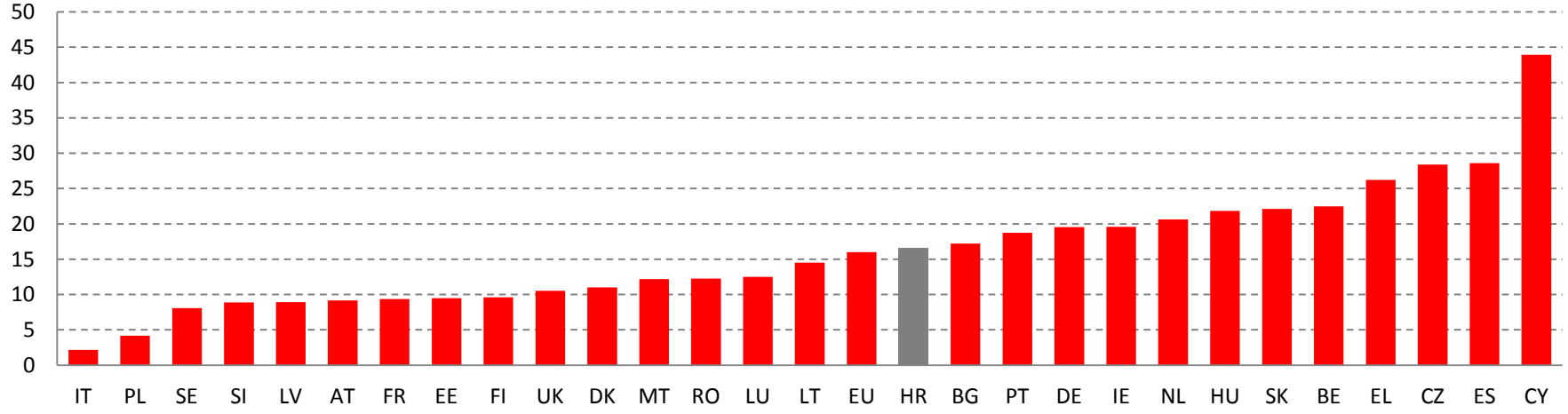
Prices from laptops have decreased for all types of consumption baskets since 2016. The largest price drop is in the highest consumption basket (20 GB), with a 21 % decrease.

Mobile broadband prices (EUR PPP) - laptop/tablet use in the EU, 2017 - 2018



Source: European Commission services based on Empirica, Mobile Broadband Prices study, 2017-2018

Mobile broadband prices (EUR PPP) - laptop/tablet use, 5GB, 2018



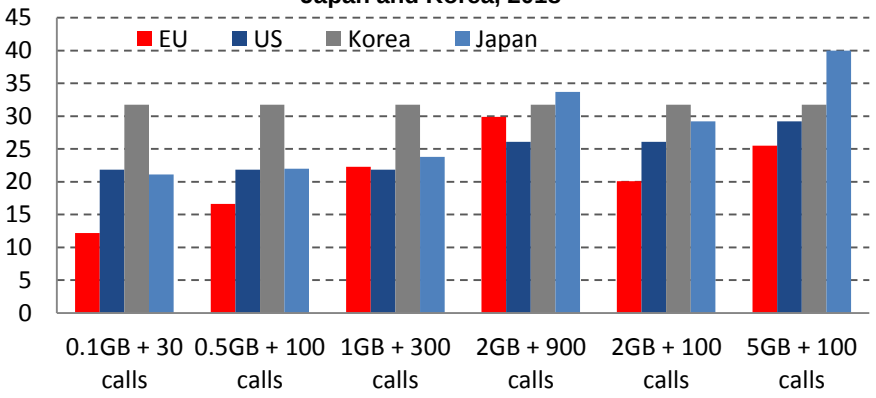
Source: European Commission services based on Empirica, Mobile Broadband Prices study, 2018

Mobile prices worldwide: compared with the USA, Japan and South Korea, the EU is cheaper for data-intensive handset usage baskets. Compared with the USA, the EU is cheaper for all data-only (laptop/tablets) packages.

On average, the EU performs well in all data consumption baskets, with much lower prices than South Korea and Japan, even in high-consumption baskets (5 GB). When comparing EU and US prices, prices are lower for all baskets in the EU, except for the basket with 1 GB data and high intensity of voice calls (2GB + 900 calls).

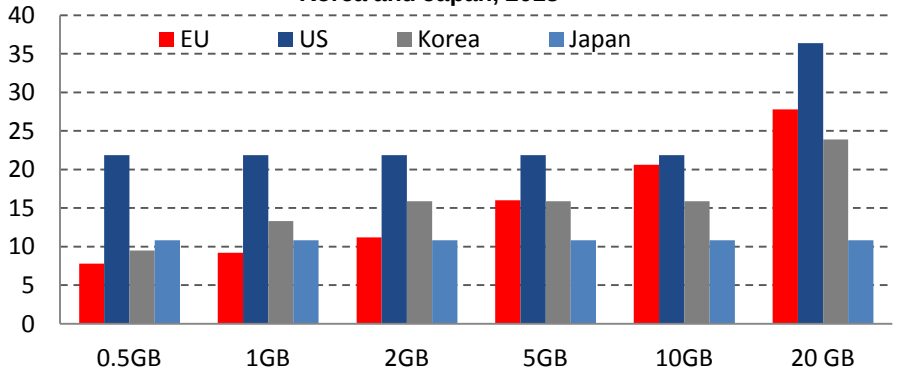
Regarding the handset use baskets with less than 2 GB data usage, the USA offered flat rates for calls and text messages for EUR 26.7 in 2018, while in South Korea 5 GB is included in all data consumption baskets.

Mobile broadband prices (EUR PPP) - handset use in the EU and the US, Japan and Korea, 2018



Source: European Commission services based on Empirica, Mobile Broadband Prices study, 2018

Mobile broadband prices (EUR PPP) - laptop/tablet use in the EU, the US, Korea and Japan, 2018



Source: European Commission services based on Empirica, Mobile Broadband Prices study, 2018

Regarding laptop/tablet baskets, the USA is more expensive than the EU for all baskets. The least expensive data-only offer in the USA allows up to 10 GB of data for EUR 22.

In the case of Japan, prices have substantially dropped from previous years, and baskets of up to 20 GB can be found for EUR 10.8 on average. This is what makes Japan the best performer in this category.

On average, the EU performs well in lower baskets, but prices are higher than South Korea and Japan for high-end baskets (especially 10 GB and 20 GB).

Telecoms markets: general trends

Member States have actively been pursuing the connectivity objectives of the gigabit society.

While a few of them will not achieve the 30 Mbps ubiquitous coverage target by 2020, the focus has now shifted to achieving the 2025 target for all EU households to have access to at least 100 Mbps connectivity (upgradable to Gbps). https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access

Ultra-fast broadband coverage is constantly improving. While this is driven by new fibre roll-outs in many Member States, in others it can be attributed to the wide availability of updated legacy networks (e.g. Germany, Belgium). Take-up of ultra-fast networks is steadily increasing and seems to broadly correlate with the affordability of prices. Only a few Member States have not yet updated their national broadband plans to reflect the gigabit objectives.

Almost all Member States have launched their 5G strategies focusing on the availability of spectrum, 5G testing and designating 5G cities.

A number of regional agreements for 5G corridors have been signed for automated driving.

A few Member States have earmarked investments to help develop 5G. Many operators have started or announced 5G trials and are exploring partnerships and network sharing agreements.

The pioneer band is 3.4 – 3.8 GHz, followed by the 700 MHz band. The first auctions have already taken place, and the voluntary peer review under the Radio Spectrum Policy Group also seems to have generated interest among administrations. Most auctions in the 3.4 – 3.8 GHz band were designed to enable large blocks to be acquired, facilitating the provision of 5G services. They also yielded a reasonable price (around €0.05/pop./MHz).

In the 700 MHz band, the plans of some Member States to reserve spectrum for public protection and disaster relief raise concerns about avoidable spectrum scarcity.

In terms of market developments, content drives competition and the increasing take-up of quad-play bundled offers drives a consolidation trend between fixed and mobile operators in markets where the two businesses were distinct up to now.

Development of national broadband plans (NBPs)

Since the adoption of the Digital Agenda for Europe 2020 targets — i.e. coverage of 30 Mbps download for all Europeans and take-up of 100 Mbps subscriptions by at least 50 % of EU households **— all Member States have gradually adopted NBPs and started to implement them**, **albeit with various time lines ranging from 2017 to 2022.** Some NBPs are integrated into broader strategic approaches, while others are documents specifically dedicated to broadband deployment.

Content-wise, nearly all Member States' NBPs focus on achieving minimum download speeds — in most cases in terms of coverage (availability of commercial offers in a given territory) and sometimes also penetration (actual take-up in the form of internet subscriptions). In contrast, emphasis on upload data rates is rather exceptional (e.g. Denmark, Luxembourg or Ireland; see also Table next slide). In addition, operational measures to foster demand for digital applications and high-speed internet access are relatively infrequent.

Declared broadband targets in NBPs are, first and foremost, guideposts, whose practical feasibility and actual success will depend on the utilisation of appropriate means, including legal measures and financial resources.

It is therefore important that Member States have the necessary resources and tools in place, rather than merely policy targets, to facilitate the effective rollout of broadband infrastructure on their territories.

Some Member States (e.g. Sweden, Finland, and the Netherlands) **have already adapted their NBP targets to the new EU broadband targets for 2025** proposed by the Commission in its September 2016 **Communication** 'Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society' (see Table next slide).

To facilitate the exchange of best practice between Member States on **developing their 5G Road Maps and adapting their NBP's to the gigabit targets for 2025**, the Commission set up the **COCOM Working Group 5G** in 2017. It finished its work in October 2018 and published a final report (see https://ec.europa.eu/digital-single-market/en/news/5g-observatory-reports-important-progress-5g-roadmaps). **This working group also identified common elements, which can become part of the revised NBPs.**

Broadband Targets of NBPs

MS	NBP-Targets	MS	NBP-Targets
Austria	99% coverage with 100 Mbps by 2020	Italy	100 % coverage with 30 Mbps by 2020 85 % coverage with 100 Mbps by 2020
Belgium	50% household (HH) penetration with 1 Gbps by 2020	Latvia	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020
Bulgaria	100% coverage with 30 Mbps by 2020 50% of households and 80% of businesses subscribing >100 Mbps by 2020	Lithuania	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020
Croatia	100% coverage with 30 Mbps by 2020. 50% HH penetration with 100 Mbps by 2020	Luxembourg	100% coverage with 1 Gbps downstream and 500 Mbps upstream by 2020
Cyprus	100% coverage with 30 Mbps by 2020. 50% HH penetration with 100 Mbps by 2020	Malta	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020
Czechia	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020	Netherlands	100% coverage with 100 Mbps by 2023 (updated 2018) Vast majority should take advantage of 1 Gbps by 2023
Denmark	100% coverage with 100 Mbps download and 30 Mbps upload by 2020	Poland	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020
Estonia	100% coverage with 30 Mbps by 2020 60% HH penetration with 100 Mbps by 2020	Portugal	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020
Finland	100% coverage with at least 100 Mbps by 2025 (updated 2018)	Romania	100% coverage with 30 Mbps and 80% coverage with over 30 Mbps by 2020 (updated 2018 to 2020 targets) 45% HH penetration with 100 Mbps by 2020
France	100% coverage with 30 Mbps by 2022	Slovakia	100% coverage with 30 Mbps by 2020
Greece	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020	Slovenia	96% coverage with 100 Mbps, 4% coverage with 30 Mbps by 2020
Germany	100% coverage with 50 Mbps by 2018	Spain	100 % coverage with 30 Mbps by 2020 50 % HH penetration with 100 Mbps by 2020
Hungary	100% coverage with 30 Mbps by 2018 50% HH penetration with 100 Mbps by 2020	Sweden	95% coverage with 100 Mbps by 2020. 98% coverage with 1 Gbps, by 2025. 50% HH penetration with 100 Mbps by 2020 (updated 2018)
Ireland	100% coverage with 30 Mbps by 2020 50% HH penetration with 100 Mbps by 2020, expected upstream bandwidth of 17-21 Mbps	United Kingdom	Full fibre rollout to 15 million premises by 2025 (updated 2017) and 100% fibre coverage by 2033

Source: atene KOM: Study on National Broadband Plans in the EU (SMART 2014/0077), Commission services

EU support for NBP implementation

The **European Investment and Structural Funds (ESIF)** support the NBP implementation by providing **almost € 6bn in grants in 2014-20**. **56% of the planned projects have already been signed.** The Commission proposed that this support continues in 2021-2027 with the focus on very high capacity networks (VHCNs).

The **European Fund for Strategic Investment (EFSI)** guarantees and the European Investment Bank (EIB) lending activity also support telecoms infrastructure projects: **as of February 2019, more than € 11,7bn had been mobilised, with € 3,1bn from EFSI and the EIB**. The Commission proposes to continue this support beyond 2021 with the InvestEU programme.

The **Connecting Europe Broadband Fund** was launched in 2018 and is expected **to unlock additional investments of between € 1bn and € 1.7bn**. A initial project for an open access network to cover 135.000 households in some rural areas of Croatia has already been signed.

The Commission has also tabled a **proposal for a Connecting Europe Facility 2021-2027 with € 3bn in grants** to different digital infrastructure investments (e.g. 5G corridors, VHCN for socio-economic drivers, backbone networks and local wireless network access connectivity to municipalities that builds on the WiFi4EU initiative).

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). It **brings together national and regional authorities** active in this field with the support of a permanent secretariat (Brussels based Support Facility). **An updated version of the Broadband investment Guide of the Commission will be published in 2019.**

Work to improve the **mapping of broadband** has also continued with the review of existing national initiatives. **An EU Broadband Mapping Portal was launched in spring 2019.** The Commission has commissioned a study to develop an EU broadband coverage methodology and will contribute to the work of the Body of European Regulators for Electronic Communications (BEREC) to provide guidelines on the geographical surveys and forecasts of network deployments set out in the European Electronic Communications Code (Directive (EU) 2018/1972).

The Commission has also shared with the Member States a "rural proofing questionnaire", aiming to ensure that the connectivity needs of rural areas are given the necessary attention in case of modification requests concerning broadband programmes financed under ESIF.

A first decision on authorising S**tate aid to deploy gigabit networks in areas, where an NGA network is already present,** was approved in December 2018 (SA. 48 418, Bavarian gigabit pilot project), as well as a decision on **take-up support through a voucher scheme** (SA.49 935, Superfast Broadband Project – Greece).

Municipalities need more connectivity – WiFi4EU

The WiFi4EU initiative promotes free Wi-Fi access in public spaces including parks, squares, public buildings, libraries, health centres and museums in municipalities throughout Europe.

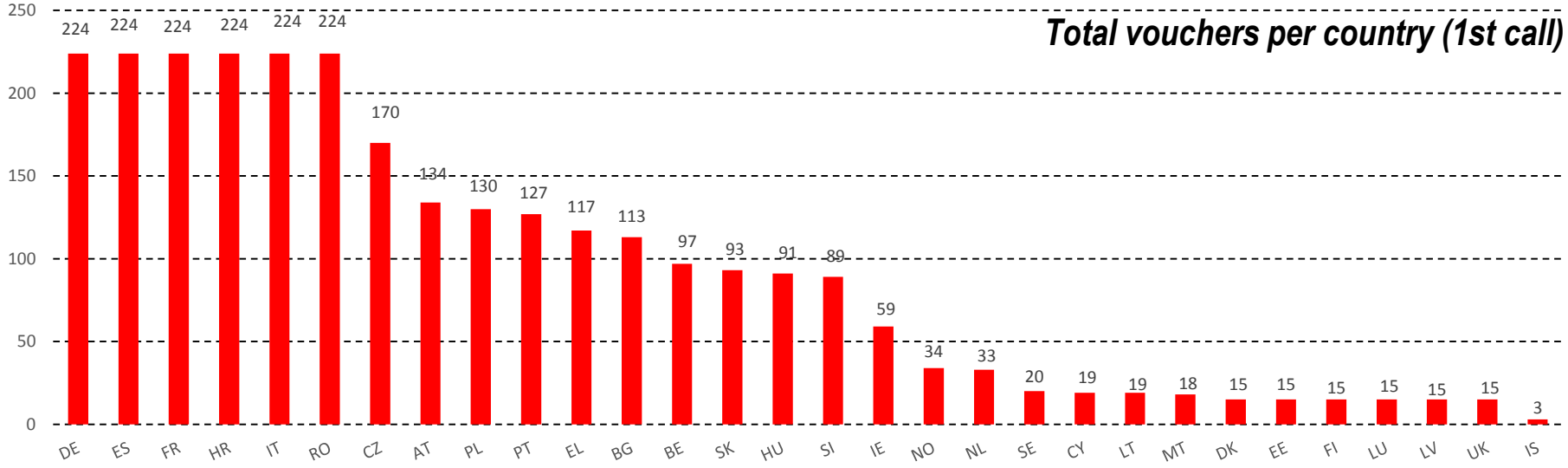
The first and second call for proposals were launched respectively between the 7 and 9 November 2018, and between the 4 and 5 April 2019. Municipalities participated on a large scale, showing a genuine need for more connectivity. 21. 500 municipalities registered; over a fifth of all European municipalities. 13,200 municipalities applied for a WiFi4EU voucher in the first call, and a bit more than 10,000 again in the second call.

Each voucher entitles the winning municipality to install a WiFi4EU network, which covers costs of up to € 15,000.

In December 2018, the Commission awarded 2,800 vouchers for a total of €42 million. The second call is ongoing with 3,400 vouchers equivalent to an additional € 51 million.

The vouchers were allocated on a first come, first served basis. To ensure geographical balance, a minimum of 15 and a maximum of 224 vouchers (for the first call) have been allocated to each country.

Other calls are planned in 2019 and 2020 for a total budget of the initiative amounting to EUR 120 million.



Source: European Commission

EU harmonised spectrum underpins future wireless digital services within the EU

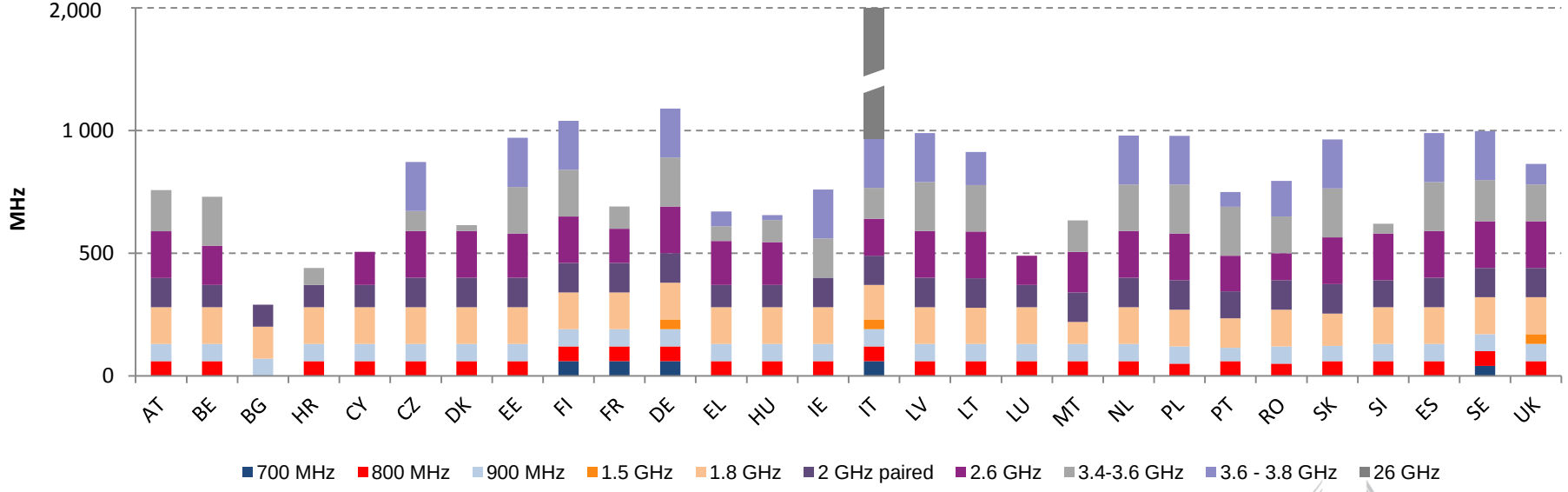
The EU harmonised spectrum for wireless broadband use amounts to 2090 MHz with a major increase coming from the harmonisation of the 26 GHz band. 41% of this spectrum was assigned for wireless broadband use across Member States at the end of 2018 (68% if the 26 GHz is excluded). While only six Member States have assigned the 700 MHz band so far (one not in full), activity is expected to increase in 2019 as many Member States are preparing the necessary assignment procedures.

Bands above 1 GHz provide additional capacity. They remain partly unassigned in many Member States, but will play an even more relevant role in the deployment of 5G services, in particular the 3.4-3.8 GHz band, which has been identified as the primary 5G band in Europe.

Lack of assignment may be due to different reasons depending on the circumstances in each Member State, such as cross-border coordination or use for defence purposes.

In this context, and in view of different regulatory conditions applicable to different bands, lack of assignment does not necessarily mean non-compliance with EU law as there may be legitimate reasons under EU law.

Assigned spectrum for wireless broadband in harmonised EU bands (April 2019)



Source: Commission Services

Note: Assigned spectrum includes guard bands

European Commission

Convergent spectrum management approaches are essential to support 5G investment

700 MHz band:

Assigned in six Member States (DE, DK, FI, FR, IT*, SE). 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.**

The 700 MHz band has generated lower sale prices than the 800 MHz band in most Member States (except in France, where four mobile network operators were competing, and Sweden, where only 40 MHz was made available). Initial licences last slightly longer, with an average of 17.4 years.

3.4-3.8 GHz band:

Assigned (at least partially) in 25 Member States. Current uses vary, six Member States have assigned the band (at least partially) based on '5G conditions' in accordance with Decision (EU) 2019/235. The IT auction provided 2 blocks of 80 MHz and 2 blocks of 20 MHz, and the price paid was significantly higher than in other countries.

26 GHz band:

Currently only assigned for 5G use in Italy with 5 lots of 200 MHz.

The European Electronic Communications Code provides for a common deadline to authorise and ensure that the 3.6 GHz and 26 GHz bands can be used by the end of 2020; 700 MHz will be for wide coverage, 26 GHz for high local capacity and speed, and 3.6 GHz as the primary and universal spectrum band.

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

The Commission adopted Implementing Decision (EU) 2018/661 on the extension of the 1.5 GHz band to provide 50 MHz of additional download capacity for 5G services.

The Commission adopted Implementing Decision (EU)2019/235 to update the relevant technical conditions applicable to the 3.4-3.8 GHz band to make the band 5G-ready as it has been identified as the primary pioneer band for 5G in the EU.

The Commission adopted Implementing Decision (EU)2019/784 to harmonise the technical conditions applicable to the 26 GHz band (24250-27500 MHz). 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.

It is an established Union policy, enshrined inter alia in a number of recitals (e.g. 99, 134, 135) and Articles (e.g. 53, 54) of the EECC that authorisation conditions conducive to investment in 5G deployment should avoid extracting excessive capital from the market, promote ambitious infrastructure roll-out targets (including along rail and roads), enable innovative services, create opportunities for vertical services to access spectrum, not artificially limit or apportion spectrum supply, in particular in the 3.4-3.8 GHz band where large blocks of spectrum should be made available to operators to unleash the full 5G potential.

* The 700 MHz spectrum will be available for use in Italy from July 2022 as the authorities have invoked an exception as provided in Decision of the European Parliament and the Council on the use of the 470-790 MHz band in the Union.

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

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, it is still maintained in a few Member States for markets included in the 2003 and the 2007 recommendations on relevant markets.

The infringement proceedings launched in 2017 against seven Member States for delays of more than 5 years in conducting the periodic reviews are still ongoing against Ireland and Poland.

Article 7 cases as at 30/06/2019

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

1	1st round-competition/regulation
2	2nd round-competition/regulation
3	3rd round-competition/regulation
4	4th round-competition/regulation

	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	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 7	ex-Mkt 10	ex-Mkt 14	ex-Mkt 15	ex-Mkt 18
Austria	3	4	5	5	5	4	4	4	1	2	1	4
Belgium	3	3	3	3	1	3	2	1	2	1	1	1
Bulgaria	3	3	3	2	2	3	3	1	1	1		
Croatia	2	2	2	2	1	2	2	1		1		
Cyprus	2	3	4	4	3	3	3	2	3	3	3	3
Czech Republic	4	4	4	4	3	4	4	2	1	1	1	2
Denmark	4	4	4	4	4	4	4	2	1	1	1	1
Estonia	4	5	4	4	3	3	3	1	1	2	1	3
Finland	2	1	4	4	1	2	3	2	2	1	V	3
France	5	5	5	5	3	5	5	2	1	2	W	4
Germany	5	5	3	3	2	3	3	2	2	1	1	4
Greece	3	4	4	4	2	3	2	2	3	2	1	1
Hungary	4	5	4	4	4	6	4	3	2	2	2	2
Ireland	4	3	3	3	2	3	2	2	2	2	1	2
Italy	3	5	3	3	2	3	2	2	3	2	2	2
Latvia	5	5	4	4	3	2	3	3	2	1	1	1
Lithuania	5	3	3	3	2	1	3	1	2	2	1	6
Luxemburg	3	4	3	3	2	3	3	2	1	1	1	
Malta	4	4	2	2	3	3	3	3	2	2	2	1
Netherlands	5	5	6	4	3	4	3	2	2	2	1	2
Poland	3	3	3	4	1	3	3	2	1	1	2	3
Portugal	3	3	3	3	3	2	2	1	1	3		2
Romania	3	3	2	1	2	2	2		3			2
Slovakia	4	5	3	3	3	4	4	2	2	1	1	2
Slovenia	2	5	4	4	2	3	3	2	3	1	3	3
Spain	3	4	3	3	3	4	3	2	2	4	2	4
Sweden	4	4	3	3	3	3	3	2	2	1	1	4
United Kingdom	3	5	3	5	5	5	4	4	2	4	1	2

Member States' implementation of the net neutrality rules (Regulation (EU) 2015/2120) 1/2

Net neutrality rules

Under the EU net neutrality rules, Europeans are entitled to have access to the online content and services they wish, regardless of where this content originates from or is stored. These rights are established by directly applicable EU legislation and cannot be changed by a mere administrative decision. Specific BEREC guidelines and close cooperation between national regulatory authorities, BEREC and the Commission help consistently apply the rules throughout the EU.

Regulatory developments

The Commission prepared the report on Articles 3, 4, 5 and 6 of the Regulation which was submitted to the co-legislators on 30 April 2019. To this end, the Commission ordered a study on the implementation of the net neutrality provisions of the Telecoms Single Market Regulation (SMART 2017/0011) in 2018 and organised a stakeholder workshop. BEREC issued its opinion on the evaluation of the application of the Regulation and the BEREC net neutrality guidelines. All stakeholders agree that the Regulation should not be reopened at this stage and that some further clarifications are needed in the BEREC guidelines.

Net neutrality annual reports

Under Article 5 of Regulation (EU) 2015/2120, national regulatory authorities are required to publish annual reports on their monitoring and findings and to share these reports with the Commission. The latest annual country reports on open internet from national regulators covering the period 1 May 2017 to 30 April 2018 are available at: https://ec.europa.eu/digital-single-market/en/news/annual-country-reports-open-internet-national-regulators

Member States' implementation of the net neutrality rules (Regulation (EU) 2015/2120) 2/2

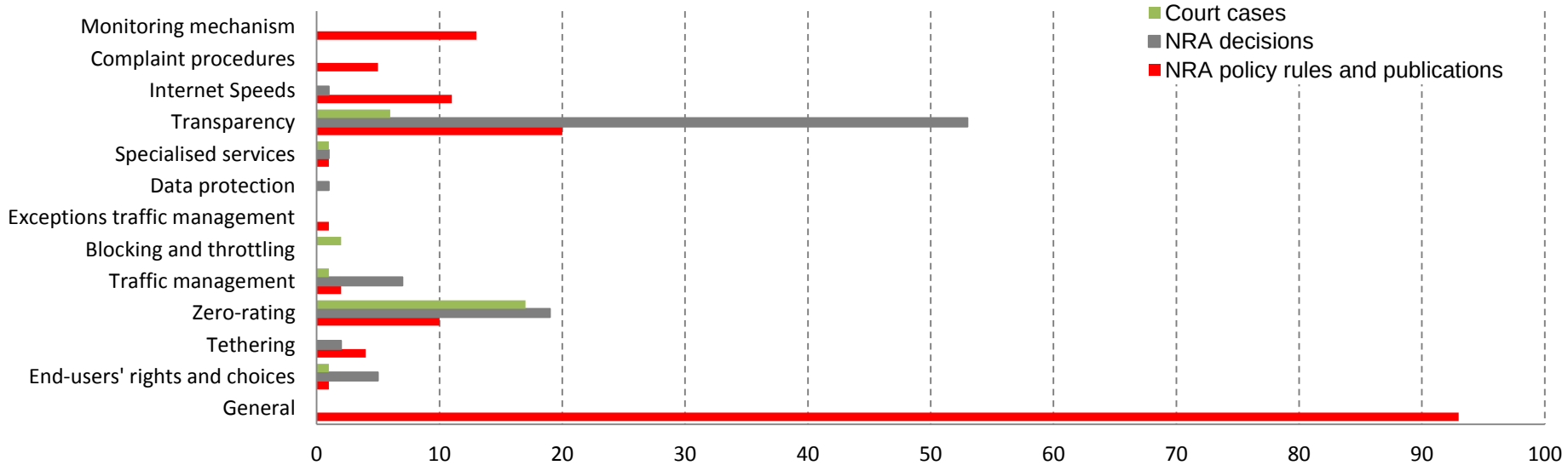
Net neutrality issues

In 2018, national regulatory authorities continued their analysis of individual commercial offers emerging on the market on a case-by-case basis. In many Member States (including CY, EL, LT, PT, BG, AT, IT, DE, RO, SI, SE, HR, CZ), they concluded formal investigations/intervened in the existing market practices.

In 2018, the first cases were decided by the national courts: BG (transparency), DE (limitation of video traffic speed as well as unequal treatment of zero-rated data usage in roaming), SE (free use of zero-rated content when end-users have used their data volume).

In NL, in a judicial dispute between a non-governmental organisation and the national regulatory authority over a specific zero-rating offer on the market, the national regulatory authority decision not to find non-compliance was upheld. In HU, a first case was referred to the Court of Justice of the European Union (throttling of content that is not zero-rated while offering full access to zero-rated applications). In BG, the first financial penalties were imposed (infringement of transparency rules).

Court cases, national regulatory authority decisions and policy rules and publications by subject



Bird & Bird, Smart 2017/0011

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

Since 15 June 2017, except in a few cases duly authorised by national regulators to avoid any increase in domestic prices, mobile operators in the EU/EEA are not allowed to levy any roaming surcharges for any fair usage of roaming services by their customers.

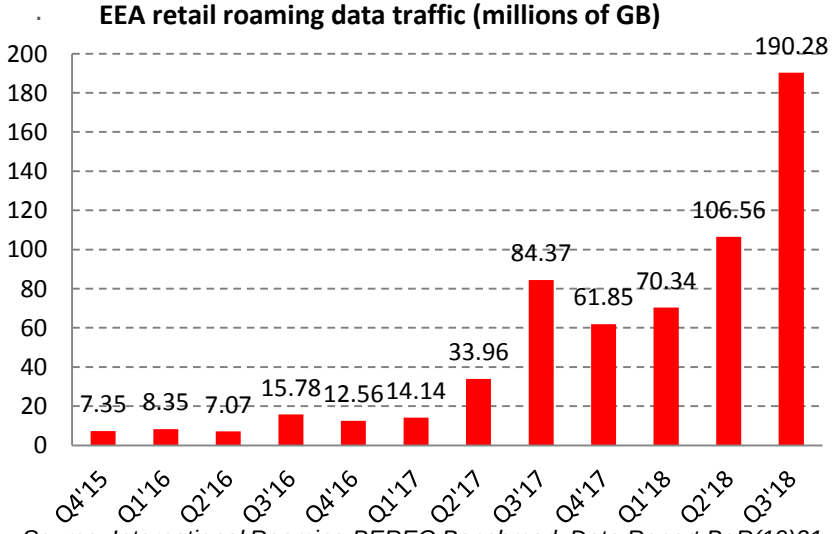
We have seen broadly successful implementation of the new roaming rules, overall consumer satisfaction, and a significant increase in travelers' roaming data consumption as well as substantial increases in roaming voice calls since 15 June 2017. According to the latest BEREC International Roaming Benchmark Report, the average retail revenue per user has increased slightly overall in the EU/EEA since June 2017.

National regulatory authorities are responsible for monitoring and enforcing EU roaming rules in the Member States. It is therefore necessary that they are conferred in all Member States with the appropriate sanctioning powers in case of non-compliance with those rules.

According to the report, more than 96% of EU/EEA subscribers are roaming-enabled. About 90% of the roaming traffic in the EU/EEA is 'roam-like-at-home'. Sustainability derogations have been granted by national regulators to operators falling into categories that were meant to be likely candidates for the derogation, i.e. some mobile virtual network operators in several countries and some mobile network operators in some of the very low data price countries with high roaming imbalances and/or low revenue per user (EE, LT, FI, PL).

Even in the latter countries, roaming traffic subject to the small surcharge makes up less than 30% of roaming traffic (except for LT). In total, less than 1% of EU/EEA roaming data traffic (less than 4% for voice) is subject to a small roaming surcharge due to a derogation (RLAH+).

According to the report, in summer 2018 roaming data traffic was multiplied by 12 in the EU/EEA compared to summer 2016 (last summer before RLAH, see below figure). For voice, the increase in roaming traffic was by a factor 3. The increase in outbound roaming traffic has been particularly high for PL, RO, LV, BG, HR and ES operators.



Source: International Roaming BEREC Benchmark Data Report BoR(19)21, April 2018-October 2018

Emergency Communications and the single European emergency number 112

The main findings based on the COCOM 112 implementation report:

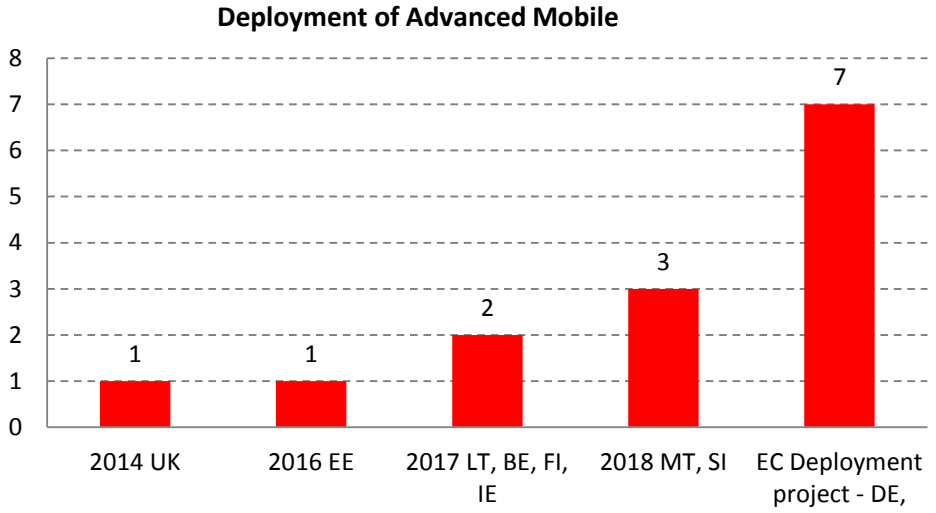
The share of emergency calls to the Single European emergency number 112 is rising, which shows the increasing preference of Europeans to use this number for emergencies. 112 calls increased 5% in one year, while the total number of emergency calls dropped 2.5%. 112 calls represented 48% of emergency calls.

Accuracy of caller location continued to improve in the reporting period. Advanced Mobile Location (AML) handset-based caller location solution took off in Malta and Slovenia. AML is currently deployed in Belgium, Estonia, Finland, Ireland, Lithuania, Malta, Slovenia and the UK. The Commission helps develop it by financing AML deployment in Germany, Denmark, France, Croatia, Hungary, Portugal and Sweden, increasing the number of AML countries to 15.

23 Member States reported that calls to emergency services were answered within 10 seconds.

26 Member States reported that they already have a public warning system in place. The technologies deployed include: sirens in 16 Member States; TV, radio or social media alerts in 10 Member States; specific applications in 5 Member States; SMS alerts in 5 Member States, and cell broadcast in 4 Member States.

23 Member States reported the implementation of alternative access to emergency services for users with disabilities through SMS. Meanwhile, some emergency applications deployed can provide much better location information and additional features. The information received from Member States reveals a number of potential implementation issues with equivalent disabled access to emergency services. In addition to the basic problem of the lack of an appropriate service to ensure two-way interactive communication, there are Member States where solutions that meet minimum requirements are not deployed throughout the whole territory or are not available at all times of the day. User location information for disabled users is also not available in 14 Member States.



Source: COCOM 19-04 working document

The 5G scoreboard shows overall progress on implementation of the 5G Action Plan in Europe.

Situation as of April 2019
Sources: Idate Digiworld, Communications Committee

5G roadmaps and national plans

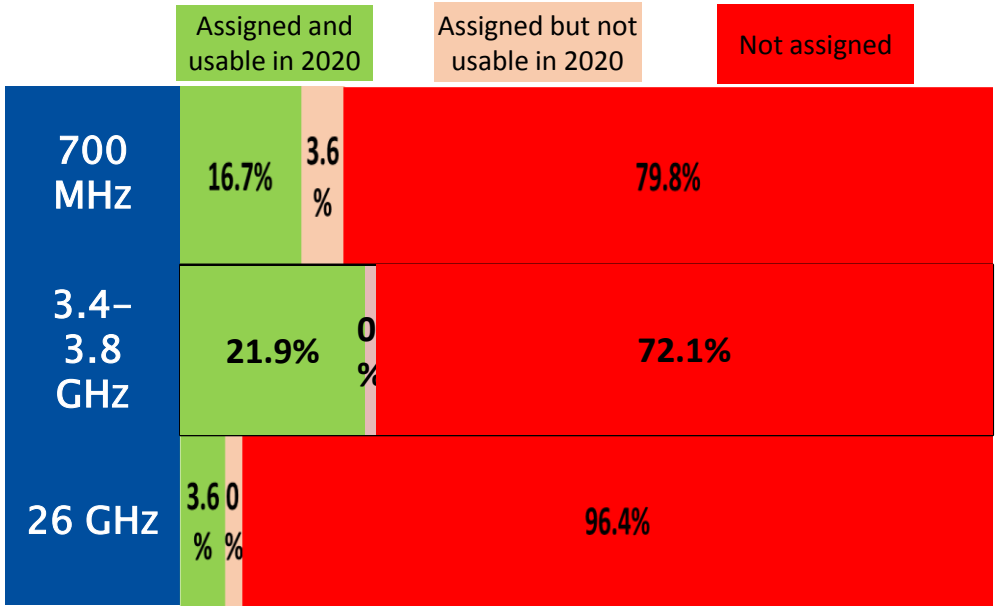
10

Ten Member States have published national 5G roadmaps:

- Austria
- Estonia
- Finland
- France
- Germany
- Luxembourg
- Netherlands
- Spain
- Sweden
- UK

5G PIONNER SPECTRUM

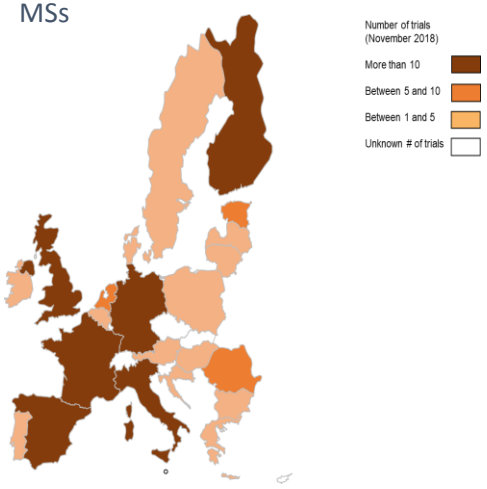
14.1%



5G TRIALS

147

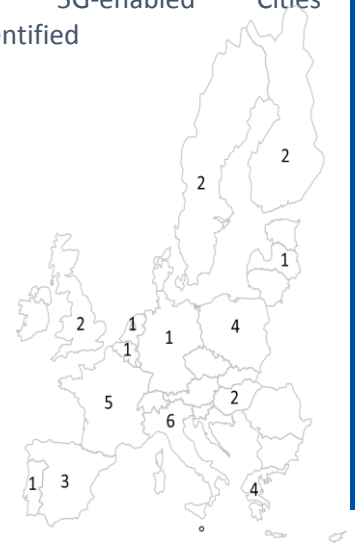
147 5G trials in the 28 MSs



5G CITIES

35

35 5G-enabled Cities identified

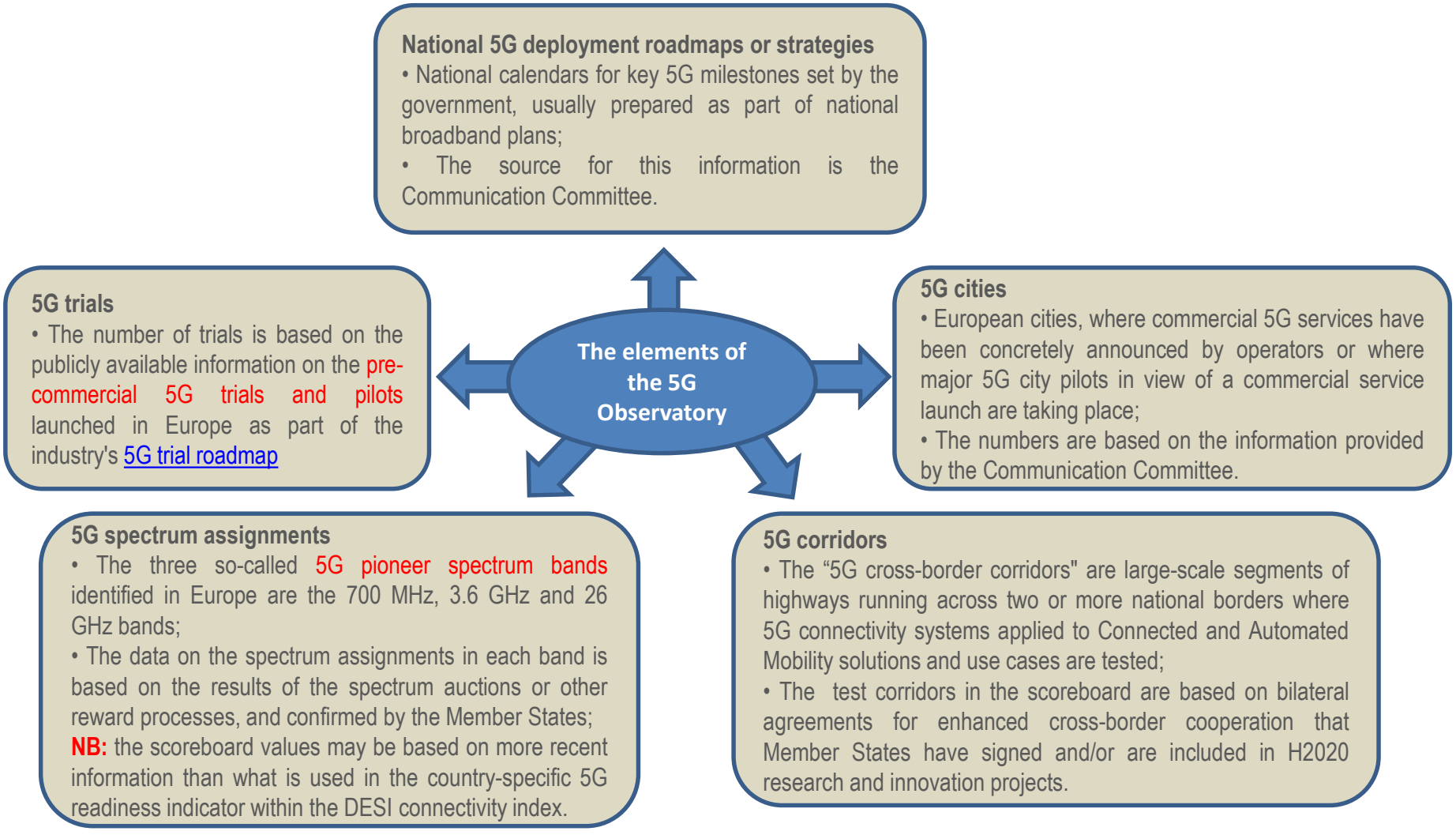


5G CORRIDORS

10

10 "digital cross-border corridors" established

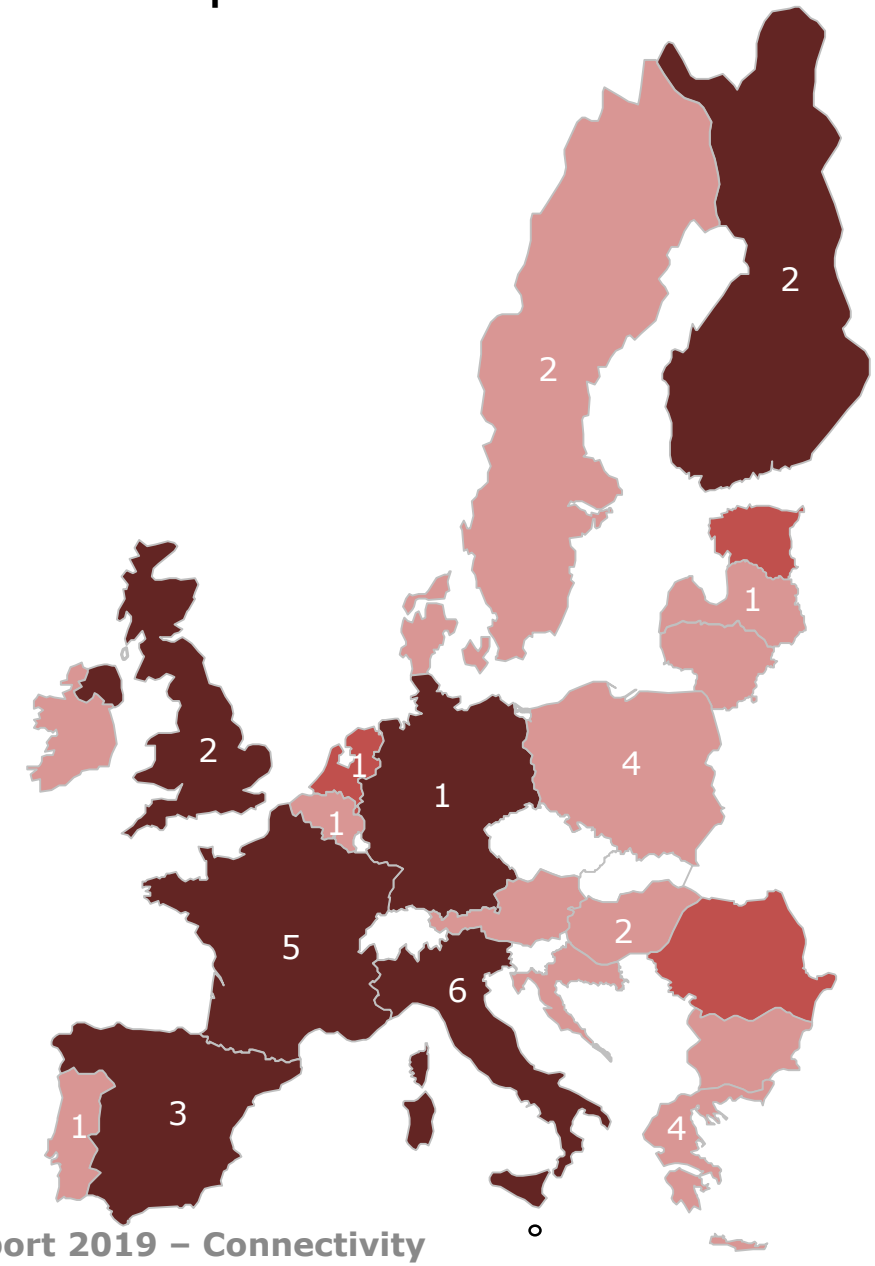
The 5G scoreboard is made up of five different elements relevant for the deployment of 5G in Europe based on the 5G Action Plan.



More information on the current state of play is available on the European 5G Observatory.

The map of 5G digital cross-border corridors shows the test corridors identified by the Member States and included in Horizon 2020 research and innovation actions.

The number of reported 5G trials in the EU and 5G cities identified by the Member States are shown in this map.



Number of 5G trials (March 2019)

- More than 10
- Between 5 and 10
- Between 1 and 5
- Unknown # of trials

The number of 5G-enabled cities (as of January 2019) in each Member State is indicated by the numbers in this map.

The 5G readiness indicator in the DESI shows the portion of spectrum that has been assigned for 5G purposes in each Member State in the so-called pioneer bands.

The percentage score of the 5G readiness indicator is based on the amount of spectrum that has been assigned in a specific Member State and ready for 5G use by the end of 2020 within the so-called 5G pioneer bands identified in Europe;

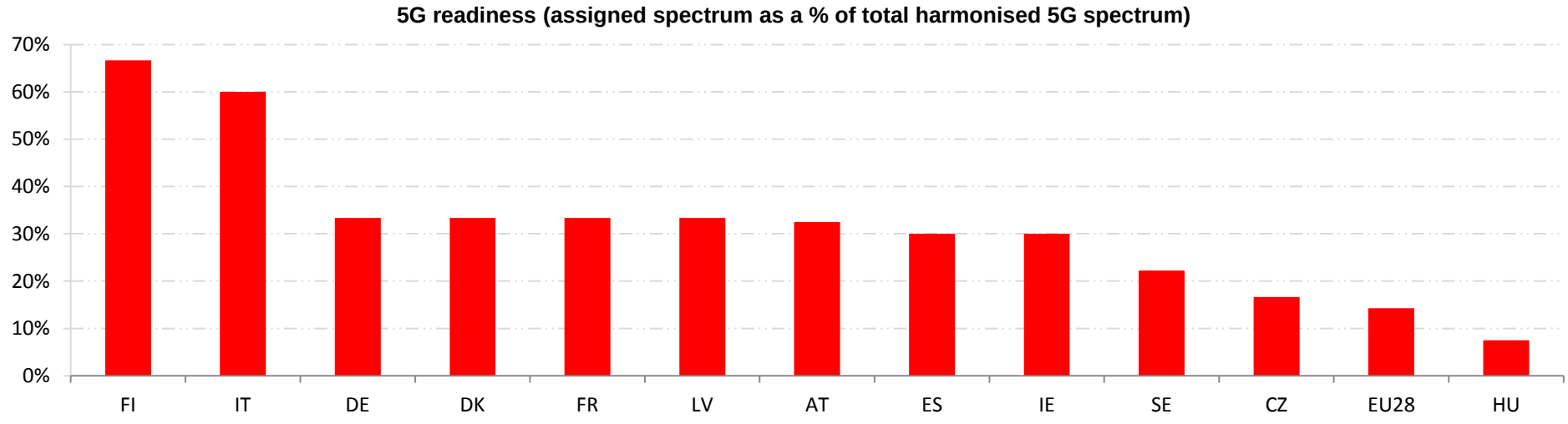
The percentage is calculated based on the amount of spectrum assigned in each 5G pioneer band in comparison with the maximum feasible amounts, which are as follows:

- 700 MHz band: 60 MHz (703-733 & 758-788 MHz)
- 3.6 GHz band: 400 MHz (3400-3800 MHz)
- 26 GHz band: 1000 MHz within 24250-27500 MHz

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

Remarks

1. For the 700 MHz band, there are a number of derogations allowing for a delay until 2022; however, 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 shall be assigned and ready for 5G use by the end of 2020, as required by the European Communications Code.



Source: Idate Digiworld, Communications Committee

Digital Public Services

Digital Economy and Society Index Report 2019
Digital Public Services

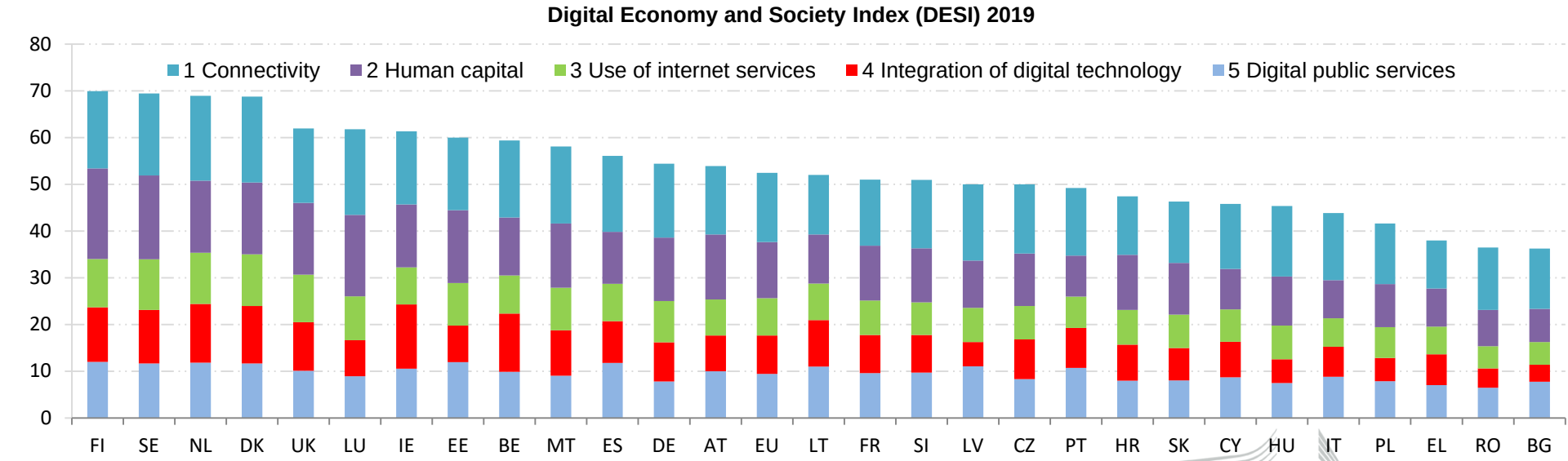
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the progress of EU Member States in digital competitiveness.

Finland, Sweden, the Netherlands and Denmark, have the most advanced digital economies in the EU followed by the UK, Luxembourg, Ireland and Estonia.

Bulgaria, Romania, Greece and Poland have the lowest scores on the index.

The five dimensions of the DESI

1 Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2 Human capital	Internet user skills and advanced skills
3 Use of internet	Citizens' use of internet services and online transactions
4 Integration of digital technology	Business digitisation and e-commerce
5 Digital public services	e-Government and e-health



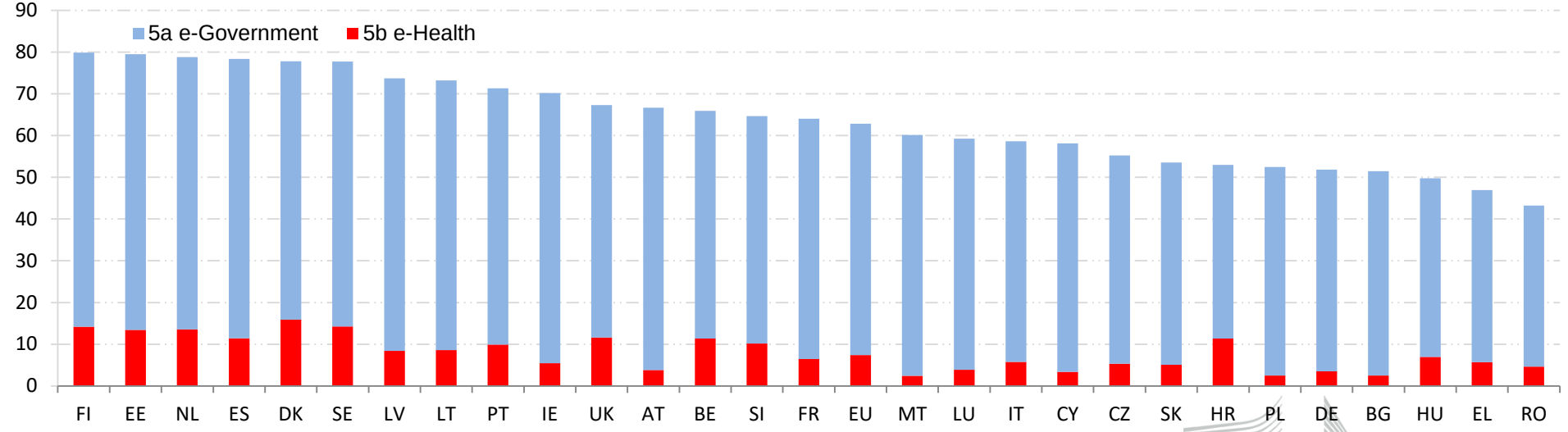
Source: DESI 2019, European Commission

In digital public services, Finland has the highest score, followed by Estonia, the Netherlands and Spain. Romania, Greece and Hungary and have the lowest scores.

The digital public services dimension consists of eight indicators: the eGovernment users measured as a percentage of those internet users who need to submit forms to the public administration (the e-government users indicator); the extent to which data that is already known to the public administration is pre-filled in forms presented to the user (the pre-filled forms indicator); the extent to which the various steps in dealing with the public administration can be carried out completely online (the online service completion indicator); the degree to which public services for businesses are interoperable and cross-border (the digital public services for businesses indicator); the government's commitment to open data (the open data indicator); the percentage of people who used online health and care services without having to go to a hospital or doctors surgery (the e-health services indicator); the extent to which general practitioners are using electronic networks to exchange medical data with other healthcare providers and professionals (the medical data exchange indicator); and the extent to which general practitioners are using electronic networks to transfer prescriptions to pharmacists (the e-prescription indicator).

Digital Public Services indicators in DESI 2019	EU
5a1 e-Government users	**64%**
% internet users needing to submit forms	2018
5a2 Pre-filled forms	**58**
Score (0 to 100)	2018
5a3 Online service completion	**87**
Score (0 to 100)	2018
5a4 Digital public services for businesses	**85**
Score (0 to 100) - including domestic and cross-border	2018
5a5 Open data	**64%**
% of maximum score	2018
5b1 e-Health services	**18%**
% individuals	2017
5b2 Medical data exchange	**43%**
% of general practitioners	2018
5b3 e-Prescription	**50%**
% of general practitioners	2018

Digital Economy and Society Index (DESI) 2019, Digital Public Services



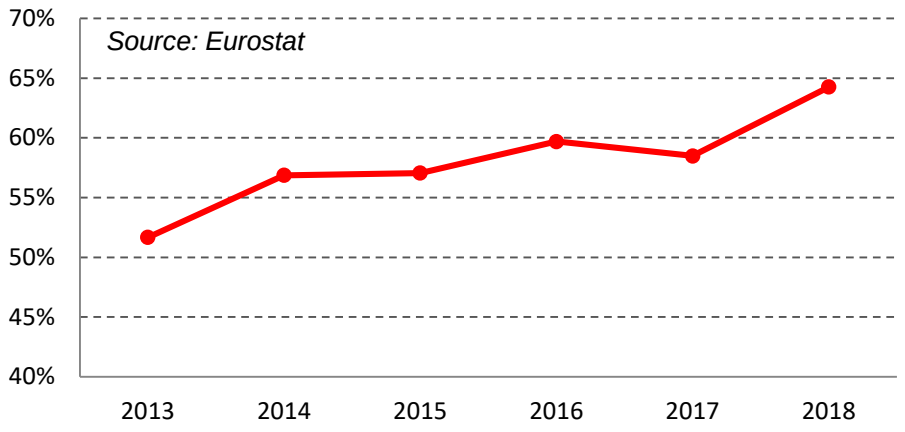
Source: DESI 2019, European Commission

The demand side of digital public services is progressing, as 64 % of EU citizens used public services online.

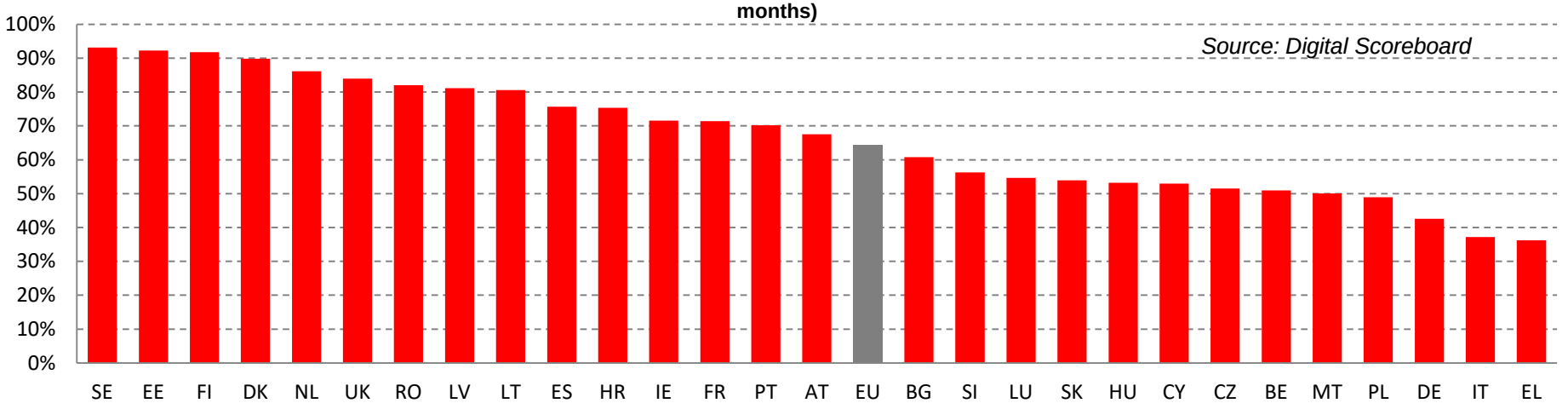
e-Services reduce the time spent in public administrations and this encourages people to use them. Sweden, Estonia, Finland and Denmark performed very well, with more than 90 % of internet users (aged 16-74), who need to submit filled forms to the public administration, choosing governmental portals. Only Italy and Greece perform below 40 %.

24 countries performed better in 2018 than in 2017, with Portugal and Czechia making the biggest improvement with 18 and 15 percentage points respectively. In 2018, the number of e-government users increased by 10 %, which is the greatest recorded change since the DESI started. Compared to recent years, the upward trend from 2015 to 2017 stopped in 2017 with a fall of 1 percentage point.

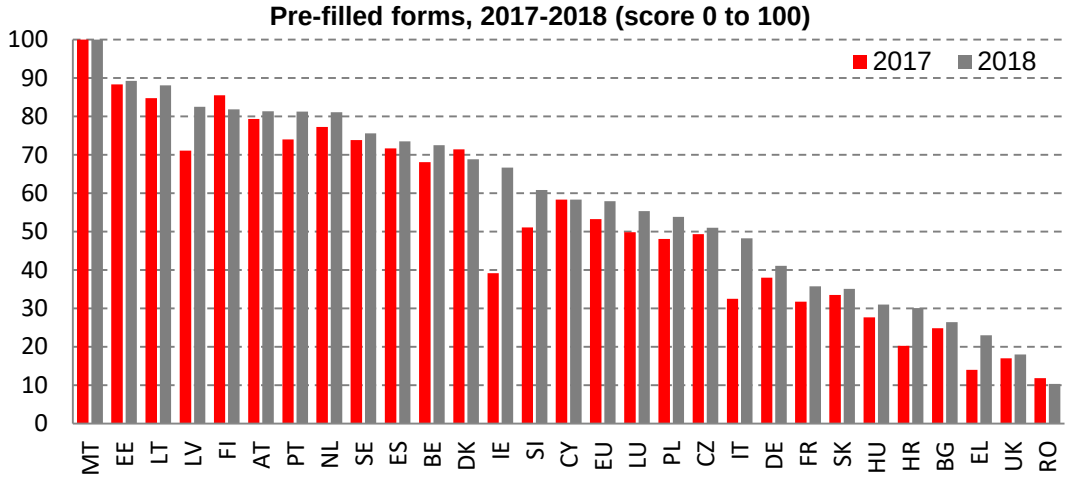
e-Government users between 2013 and 2018



e-Government users, 2018 (% of internet users needed to submit filled forms to public authorities over the Internet in the last 12 months)



The provision of government services online is progressing, with several Member States recording big improvements.



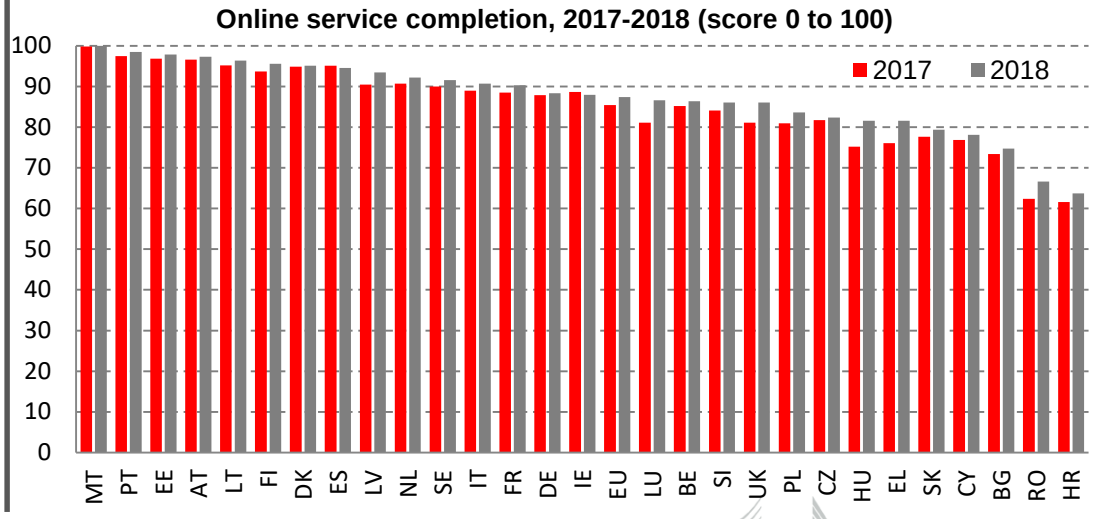
Source: eGovernment Benchmark Report

The use of inter-connected registers is key to assure that users do not have to resubmit data to the public administration.

Although all the countries improved compared to 2017, the amount of data available in public services' online forms (pre-filled forms) is still not satisfactory. Only four countries (i.e. Romania, Cyprus, Denmark and Finland) recorded lower scores compared to 2017. Ireland (+27.5 points), Italy (+15.75 points) and Latvia (+11.38 points) made the most progress. The three best performing countries were Malta, Estonia, and Latvia with scores above 82 points. However, the worst performing countries (i.e. Romania, the UK, Greece and Bulgaria) scored below 30 points.

Online service completion refers to the extent to which the various steps needed in dealing with the public administration can be done completely online.

Malta, Portugal, Estonia, Austria, and Lithuania performed the best, retaining the same ranking they achieved in 2017. Altogether 13 countries (Malta, Portugal, Estonia, Austria, Lithuania, Finland, Denmark, Spain, Latvia, the Netherlands, Sweden, Italy, and France) scored above 90 points. Croatia, Romania and Bulgaria had low scores, while only two Member States (Spain and Ireland) had slightly declined compared to 2017. Hungary is the country with the greatest increase compared to 2017, followed by Luxembourg and Greece.

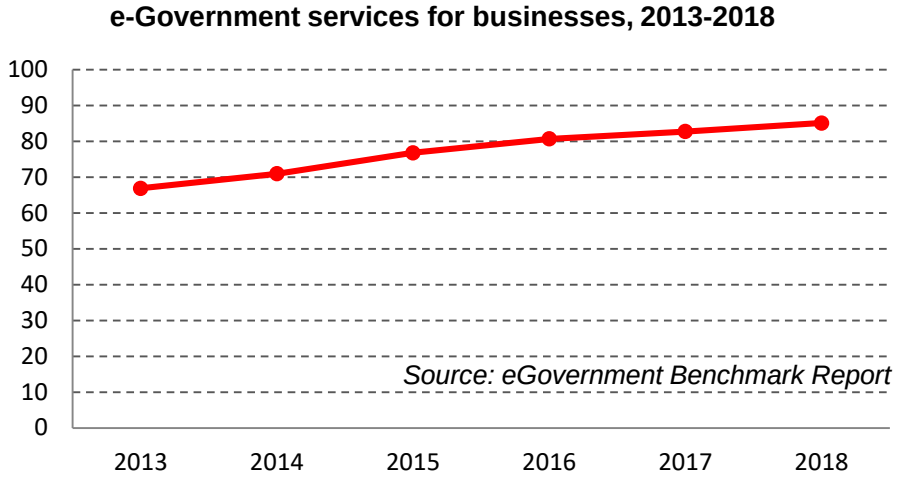


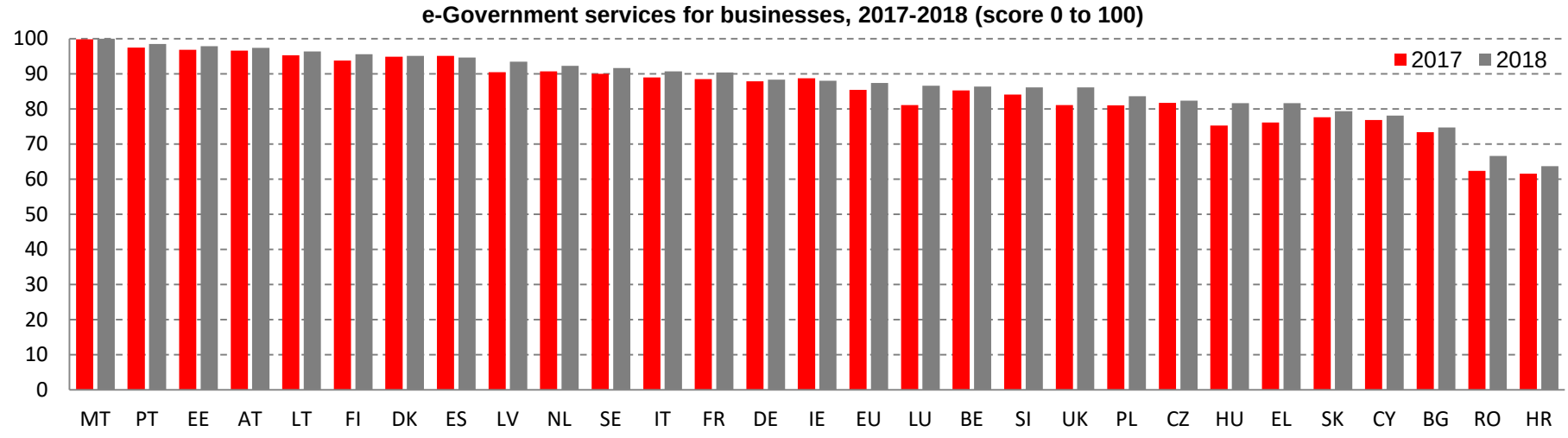
Source: eGovernment Benchmark Report

The provision of digital public services for businesses is improving, having increased by more than 25 % in the last 5 years.

This indicator measures the degree to which basic public services for businesses, when starting a business and conducting regular business operations, are available online and cross borders to other EU Member States. Services provided through a portal receive a higher score, while services that only provide information online but the operations of which have to be done offline receive a lower score.

Altogether 11 countries (Denmark, Ireland, the UK, Lithuania, Bulgaria, Malta Spain, Estonia, Sweden, Latvia and Cyprus) scored more than 90 points (out of 100). Bulgaria and the UK recorded the greatest improvement compared to 2017. On the other hand, Croatia, Romania and Bulgaria scored below 75, while Germany recorded a drop of more than 4 points.





Source: eGovernment Benchmark Report

Open data: The overall results across the EU show the variety in the speed of transformation and the priorities that countries have set.

As from 2018, the level of maturity of open data is based on the four following indicators:

I. Open data policy: the presence at national level of specific policies on open data, licensing norms, and the extent of coordination at national level to provide guidelines to national, local and regional administrations, and set up coordinated approaches towards data publication.

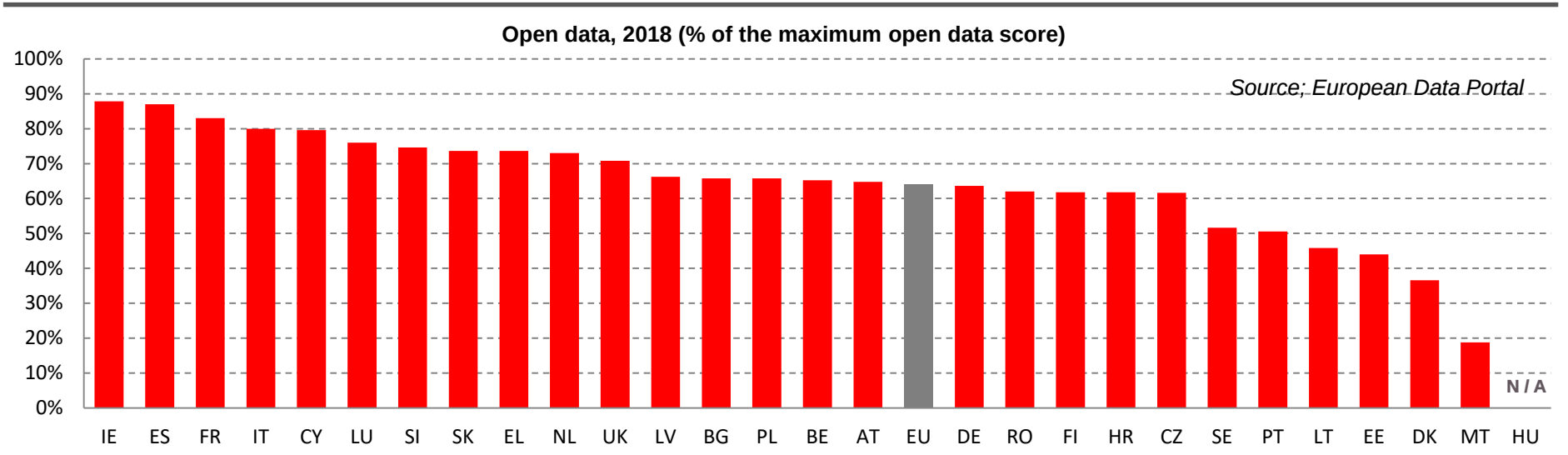
II. Open data portals: the development of national portals and their level of sophistication to feature available open data.

III. Open data impact: the impact of open data at country level on four dimensions: political, social, environmental and economic.

IV. Open data quality: the extent to which national portals have a systematic and automated approach to harvesting and the compliance level in terms of the metadata standard DCAT-AP (specification for metadata records).

The less advanced open data countries choose to take what they deem to be the natural next step and invest in modernising their national portals so they become the main gateways to open data available throughout the country. The more 'mature' open data countries have now shifted to boosting the quality of data publication. The top performing countries are now prioritising the impact derived from open data and carry out activities to monitor and capture this impact.

Ireland, Spain and France performed well, having scored more than 80 %. On the other hand, Malta, Denmark, Estonia and Lithuania underperformed, having scored less than 50 %.



** The methodology was updated to enforce the metadata quality and impact, therefore there is a break in the series compared to past years.*

*** Hungary did not participate in the exercise for 2018*

Can businesses and the public quickly and easily access public information and services? Public administrations score 84 (out of 100) points in user centricity.

This indicator includes three key elements of online service provision:

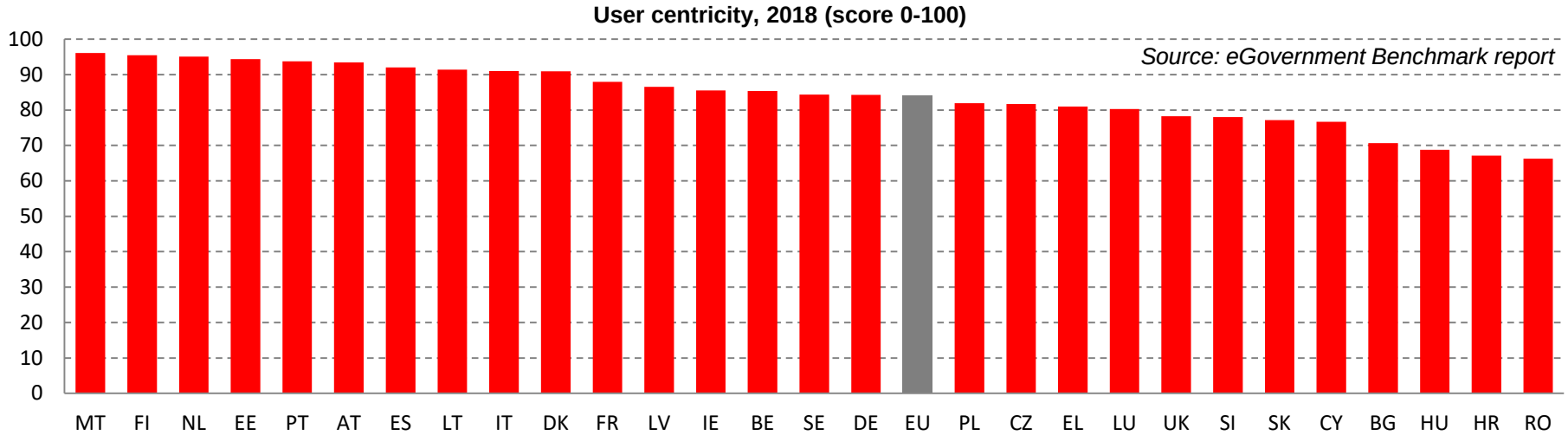
I. Online availability: this illustrates how services are made available (automated; service available online through a portal or directly; information on the service is available either through a portal or online; the service or any information about the service is not online available).

II. Usability: this measures the availability of support channels and feedback mechanisms, such as online chats.

III. Mobile friendliness: this captures the extent to which government services are available through mobile devices, providing seamless and convenient mobile experience to the public and businesses.

Member States are improving, having an overall score of 84 (out of 100) which keeps growing. Over the last five years, online availability has risen by 15 points, broadening the online scope of public services. Moreover, an initial gap of 64 points between the top and bottom five performing countries of 64 points has decreased by 12 points over the last five years. Encouragingly, public sector services are also increasingly mobile-friendly, allowing users to find information and obtain services anytime and anywhere.

Malta, Finland and the Netherlands are leading in the EU, scoring more than 90 points, while Romania, Croatia and Hungary are lagging behind, scoring less than 70 points.



In the last 5 years, Member States increased the use of key enablers by 10 %

The key enabler indicator includes the following four key elements of online service provision and availability:

I. Electronic Identification (eID) is a government-issued document for online identification and authentication.

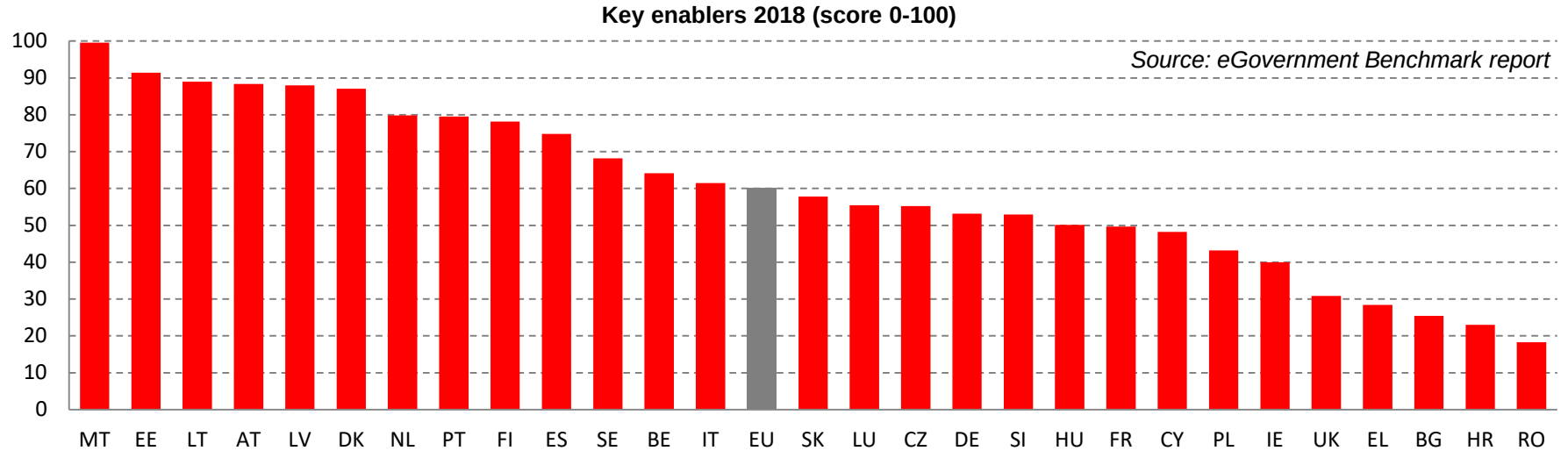
II. eDocuments: a document that has been authenticated by its issuer using any means recognised under applicable national law, specifically through the use of electronic signatures, i.e. not a regular pdf or word doc.

III. Authentic sources: base registries used by governments to automatically validate or fetch data related to individuals or businesses.

IV. Digital post: assesses whether public authorities allow people to receive communications digitally only, and hence reducing paper mailings. Digital post refers to the possibility for governments to communicate by electronic means only with people or entrepreneurs, such as through personal mailboxes.

Member States have ample room to improve the implementation of key enablers in their service provisions. For example, public administrations could optimise the reuse of (personal) information already provided by users. In effect, the authentic source indicator stands at 56 (out of 100). However, countries substantially differ; eID stands at 55, while digital post options are available in 65 out of 100 institutions. eDocuments stands at 65 (out of 100) as well.

Malta, Estonia, Lithuania, Austria, Latvia and Denmark are leading, scoring more than 80 points, while Romania, Croatia and Bulgaria and Greece are lagging behind, scoring less than 30 points.

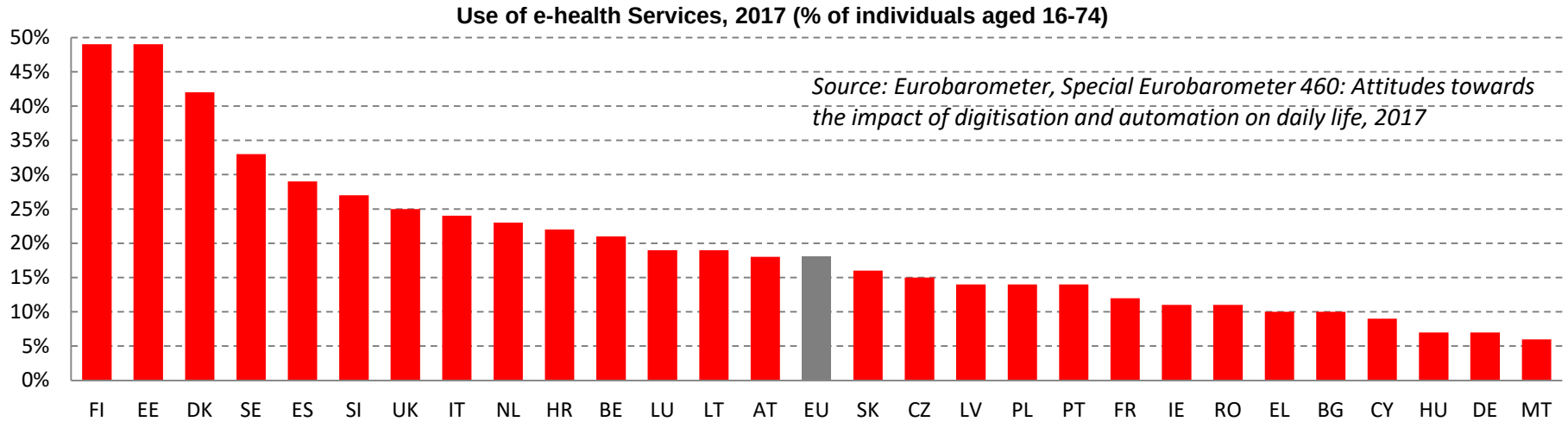


Digital health and care: more than half of the people in the EU want online access to their medical records.

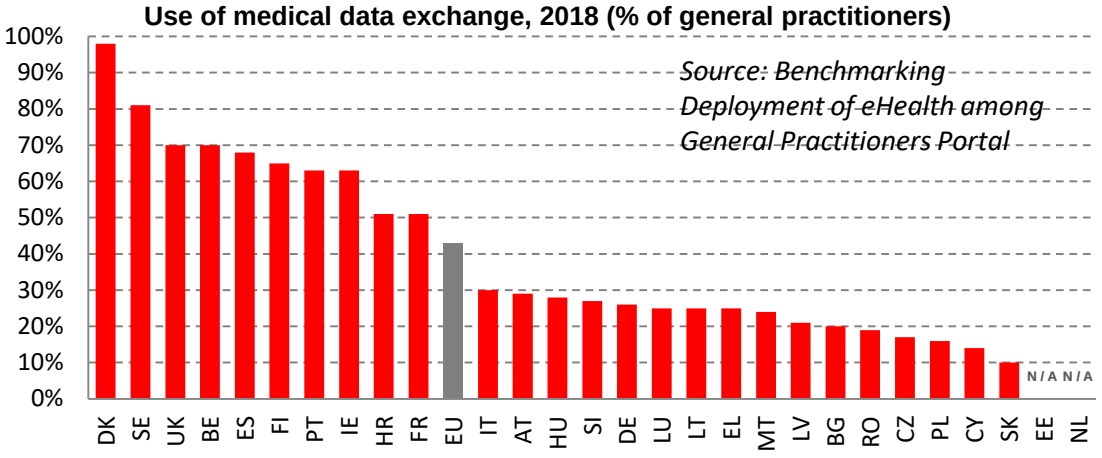
Only 18 % of people in the EU have used online health and care services without having to go to a hospital or a doctors surgery (for example, by getting a prescription or a consultation online). 5% have used these "once", 6 % "twice" and 7 % "three times or more". The majority (81 %) have "never" used these services.

According to Eurobarometer, 52 % of all people in the EU would like online access to their medical and health records. People in the EU are much more willing to share data on their health and wellbeing with doctors and healthcare professionals (65 %) than with companies (14 %) or with public authorities even if anonymised and for research purposes (21 %). One in twenty (5 %) would be willing to give their anonymised data to private sector companies for commercial purposes. Less than one in five people in the EU have used health and care services provided online (18 %). Overall, seven in ten (70 %) would be willing to give their health and personal wellbeing data to others. Most likely they are willing to do this for their doctor or health care professional (65 %).

Almost 50 % of people in Finland and Estonia used e-health services, while in Denmark the percentage is slightly lower (42 %). On the other hand, Malta Hungary, Germany and Cyprus underperformed, having scored less than 10 %.



Almost half of general practitioners used electronic means to exchange medical data and prescribe medicines.



** The Netherlands did not participate in the exercise for 2018*
*** For Estonia the data was removed, because of low reliability*

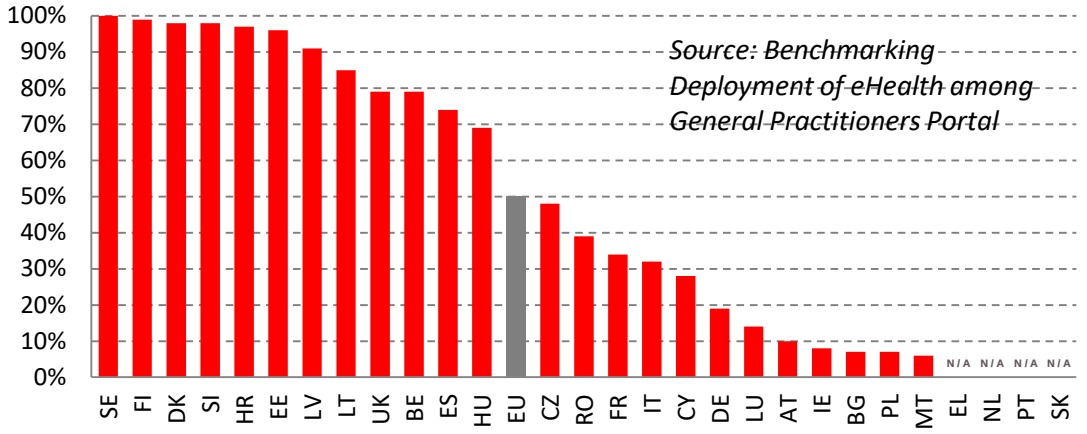
More than 40 % of general practitioners used electronic networks to exchange medical data with other healthcare providers and professionals.

One of the bottlenecks that prevents general practitioners from exchanging patients' data are the compatibility problems that might be encountered with the systems.

Denmark ranked first, having scored 98 %, with Sweden following (81 %). Altogether 10 countries scored over 43 %. The rest had a much worse performance, with Slovakia, Cyprus, Poland, Czechia and Romania having scored below 20 %.

The use of electronic prescriptions has been introduced to improve health care in the EU. So far, half of general practitioners have used electronic networks to transfer prescriptions to pharmacists.

Sweden scored 100 %, while Finland, Denmark, Slovenia, Croatia Estonia and Latvia perform very well (above 90 %). However, 7 countries (i.e. Malta, Poland, Bulgaria, Ireland, Austria, Luxembourg and Germany) have a lot of room for improvement. In general, there is a big gap between the countries that performed above the EU average and those that performed below it.



** The Netherlands did not participate in the exercise for 2018*
*** For Greece, Portugal and Slovakia the data was removed, because of low reliability*

Human Capital
Digital Inclusion and Skills

Digital Economy and Society Index Report 2019
Human capital

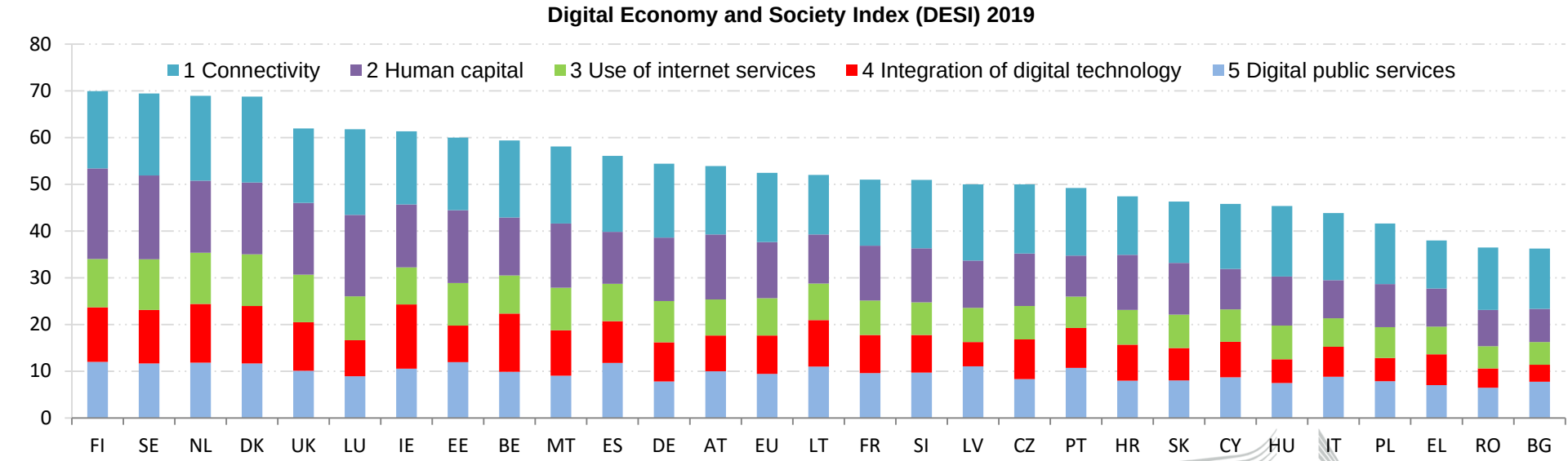
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the progress of EU Member States in digital competitiveness.

Finland, Sweden, the Netherlands and Denmark, have the most advanced digital economies in the EU followed by the UK, Luxembourg, Ireland and Estonia.

Bulgaria, Romania, Greece and Poland have the lowest scores on the index.

The five dimensions of the DESI

1 Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2 Human capital	Internet user skills and advanced skills
3 Use of internet	Citizens' use of internet services and online transactions
4 Integration of digital technology	Business digitisation and e-commerce
5 Digital public services	e-Government and e-health



Source: DESI 2019, European Commission

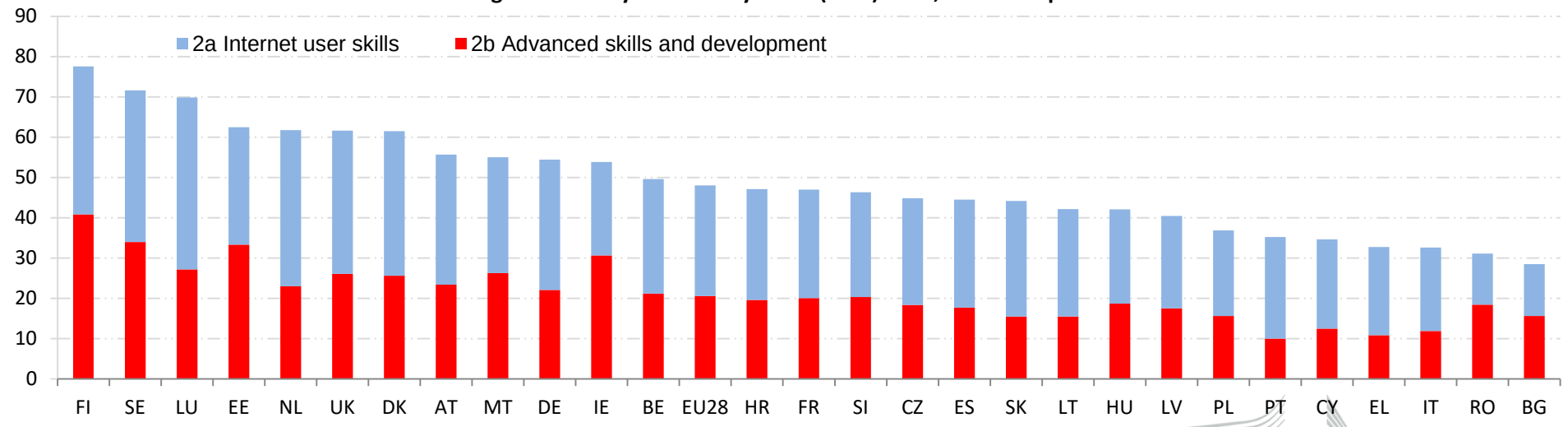
In the Human capital dimension of DESI 2019, Finland, Sweden, Luxembourg and Estonia obtained the highest scores. Bulgaria, Romania, Italy and Greece had the lowest ones.

The Human capital dimension of DESI has two sub-dimensions covering 'internet user skills' and 'advanced skills and development'. The former draws on the European Commission's Digital Skills Indicator, which is computed based on the number and complexity of activities involving the use of digital devices and/or the internet. The latter includes indicators on ICT specialist employment and ICT graduates. According to the latest data, Luxembourg, the Netherlands and Sweden are the top performers in terms of internet user skills, whereas Finland, Sweden and Estonia have the highest scores in advanced skills and development. Bulgaria, Romania, Italy and Greece rank the lowest overall on DESI's Human Capital dimension.

Human Capital indicators in DESI 2019	EU
2a1 At least basic digital skills % individuals	**57%** 2017
2a2 Above basic digital skills % individuals	**31%** 2017
2a3 At least basic software skills % individuals	**60%** 2017
2b1 ICT specialists % total employment	**3.7%** 2017
2b2 Female ICT specialists % female employment	**1.4%** 2017
2b3 ICT graduates % graduates	**3.5%** 2015

Digital Economy and Society Index (DESI) 2019, Human Capital

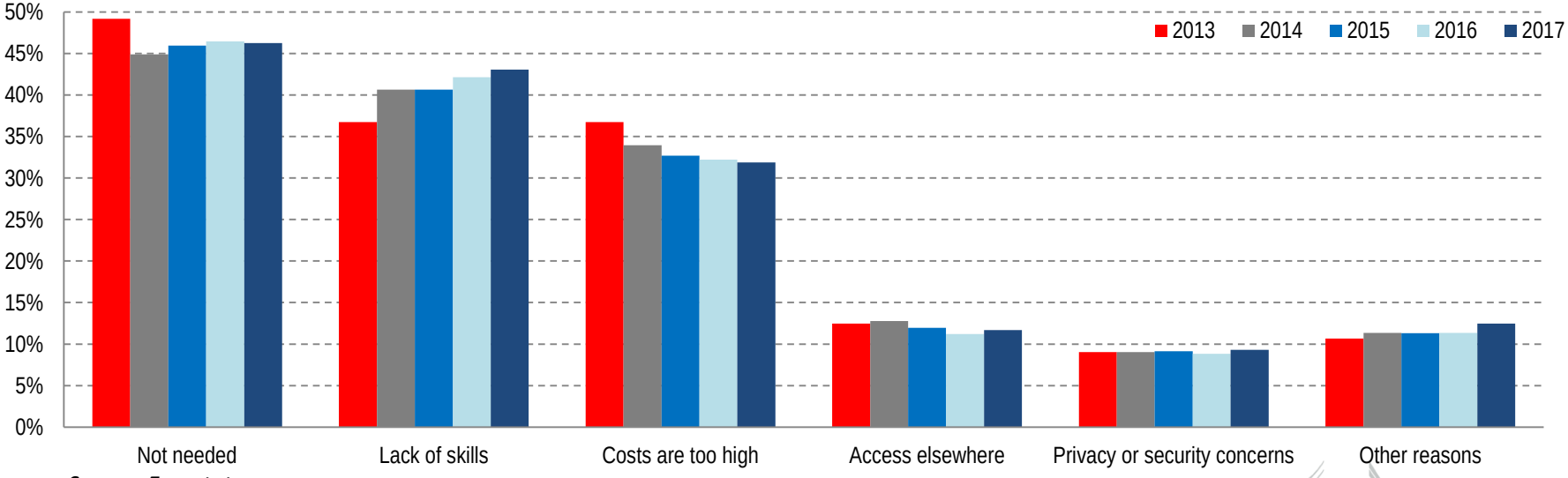
Source: DESI 2019, European Commission



Lack of need or interest, insufficient skills and cost-related barriers are the most common reasons for not having internet access at home. Digital skills are key to combat digital exclusion.

The three main reasons given for not having internet access at home remain, respectively, the lack of need or interest (46 % of households without internet access in 2017), insufficient skills (43 %) and high access and equipment costs (32 %). The deterring effect of each of these factors varies significantly in strength across Member States. For example, only 8 % of Danish households without internet access mentioned costs as a barrier but as many as 57 % did so in Croatia and Hungary. Lack of relevant skills remains by far the fastest-growing factor deterring households from having internet access at home. Moreover, given that this factor limits awareness of potential benefits from digitisation, it may also be among the reasons behind the large numbers of EU households that still claim not to have internet access at home because they do not need it.

Barriers to internet access at home in the EU, 2013-2017 (% households without internet access)



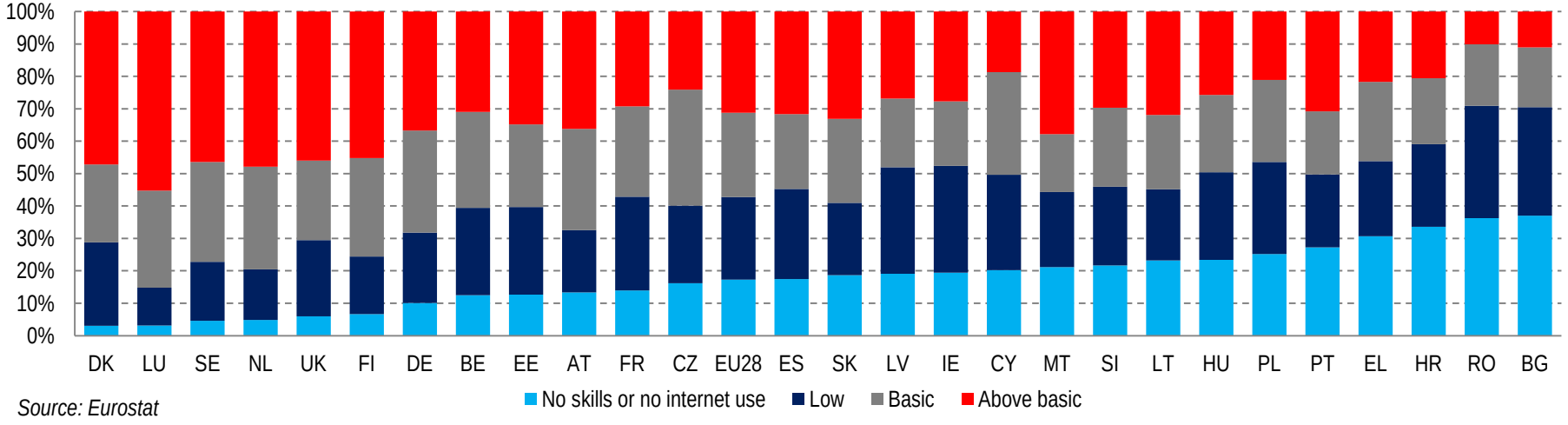
Source: Eurostat

In 2017, 43 % of the EU population had an insufficient level of digital skills. 17 % had none at all, as they either did not use the internet or barely did so.

According to the digital skills indicator, a composite indicator based on the digital competence framework for citizens*, 17 % of the EU population had no digital skills in 2017, the main reason being that they did not use the internet or only seldom did so. This represents an improvement (i.e. decrease) of 2 percentage points compared to 2016. The share of EU citizens without basic digital skills, in turn, went down by 1 percentage point (to 43 %). However, these figures imply serious risks of digital exclusion in a context of rapid digitisation. There are proportionally more men than women with at least basic digital skills (respectively, 60 % and 55 %). In addition, only about 31 % of people with low education levels or no education have at least basic digital skills. 49 % of those living in rural areas have basic digital skills compared with 63 % in urban areas.

There are still major disparities across Member States. The share of people with at least basic digital skills ranges from 29 % in Bulgaria and Romania (despite noticeable progress in both these countries in 2017) to 85 % in Luxembourg and 79 % in the Netherlands.

Digital skills of the EU population, 2017 (% of individuals, by skills level)**



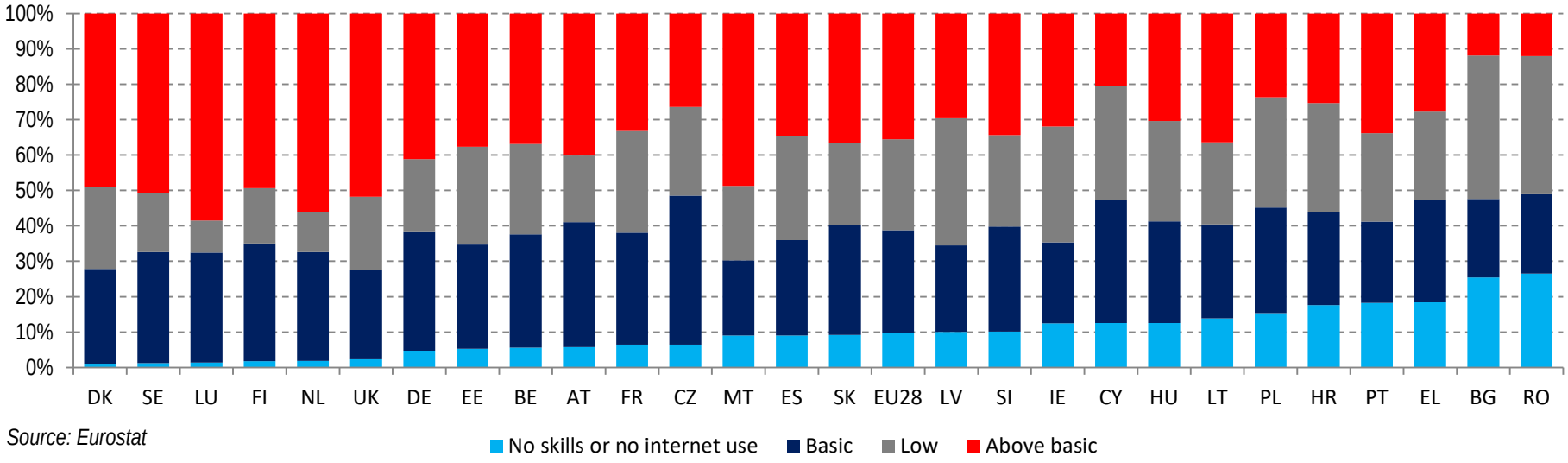
Source: Eurostat

*More details at: https://ec.europa.eu/jrc/digcomp. **To be classified as *low skilled*, an individual has to have carried out activities from only one of the four Digital Competence dimensions considered (information, communication, content-creation and problem-solving). Ba*sic skills* means that an individual has *basic skills* in at least one dimension, but *no skills* in none. To be classified as *above basic*, the individual has to score *above basic* in all dimensions. The latest data available on digital skills are for 2017. Data not available for Italy.

About 10 % of the EU labour force has no digital skills, mostly because they do not use the internet. 35 % does not have at least basic digital skills, which are now required in most jobs.

The share of the EU's active labour force (employed and unemployed) that can be considered to have no digital skills (essentially because they do not use the internet or do so only seldom) fell from 11 % in 2016 to 10 % in 2017. This share is much higher in Member States like Romania (26 %), Bulgaria (25 %) and Portugal (18 %), although they are among those showing the largest improvements in this respect. Conversely, a very large proportion of the labour force (between 82 % and 89 %) in Member States such as Luxembourg, the Netherlands, Finland and Sweden has at least basic digital skills. In addition, at least half of the labour force in each of these countries have above basic skills. Digital skills are critically important not only for accessing the labour market but also for harnessing the benefits of the digital transformation that is currently underway. Making sure the EU labour force has the necessary digital skills, including by addressing digital skills deficits in certain groups, such as older cohorts or blue-collar workers, will thus be essential to bring about an inclusive digital economy and society.

Digital skills of the EU labour force, 2017 (% individuals, by skills level)*



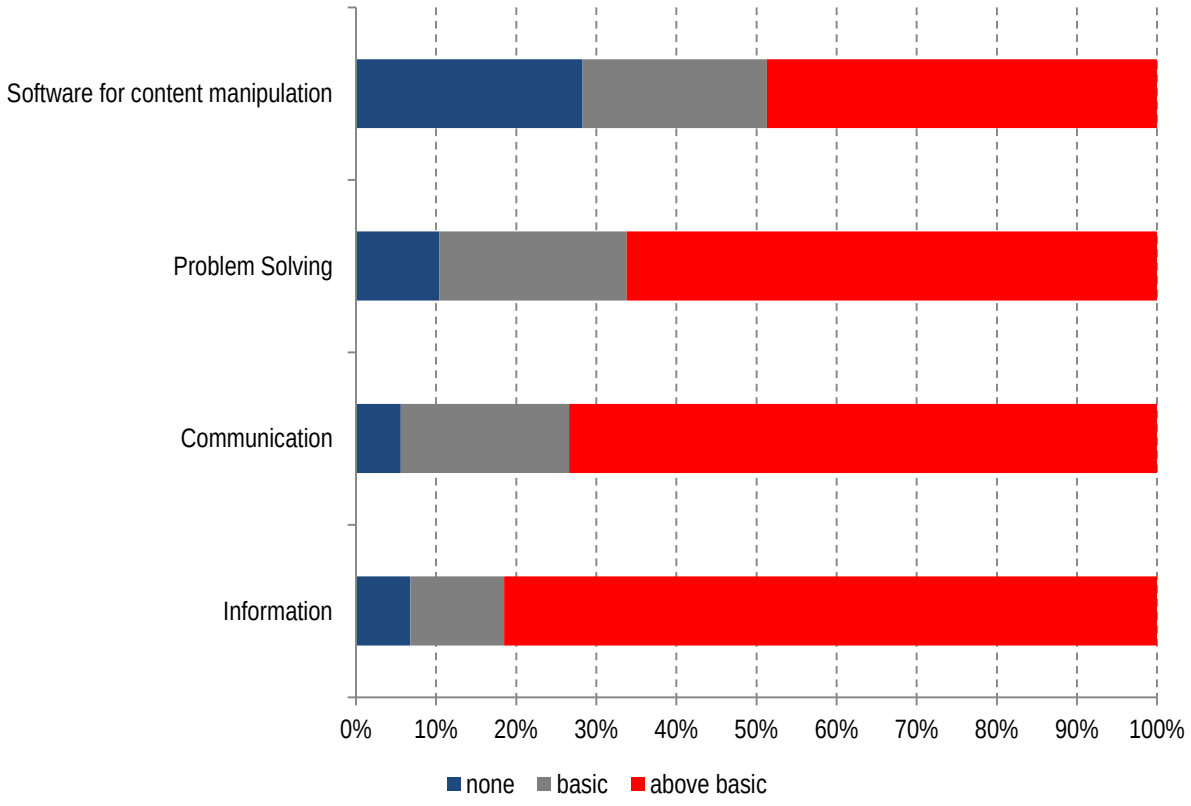
Source: Eurostat

* Data not available for Italy

Approximately 28 % of the EU's internet users have no software-related skills.

Advanced digital skills are becoming a prerequisite for entry into many jobs and have a wide range of applications, even beyond domains where they are needed for core tasks. Across competence dimensions, the largest skills deficit, both among the active labour force and the population at large, relates to the use of software for content manipulation. Almost one in three internet users in the EU has no skills in this area (i.e. they claimed not to have carried out any of the activities considered under this dimension, which range from relatively basic text treatment and spreadsheet-based work to video editing and coding). This share is particularly large in Member States like Bulgaria, Romania (about 51 % of internet users) as well as Latvia (40 %) and Ireland (39 %). Conversely, in others like Luxembourg, Portugal, the UK and the Netherlands, a large majority of internet users has above basic software skills (69 %, 58 % - both- and 57 % respectively). By type of activity, only about 7 % and 30 % of EU internet users had, respectively, written code and used advanced spreadsheet functions. In contrast, 82 % and 73 % can be considered to have above basic skills in the information and communication dimensions respectively.

Digital skills, by competence dimension and level, 2017
(% of internet users)



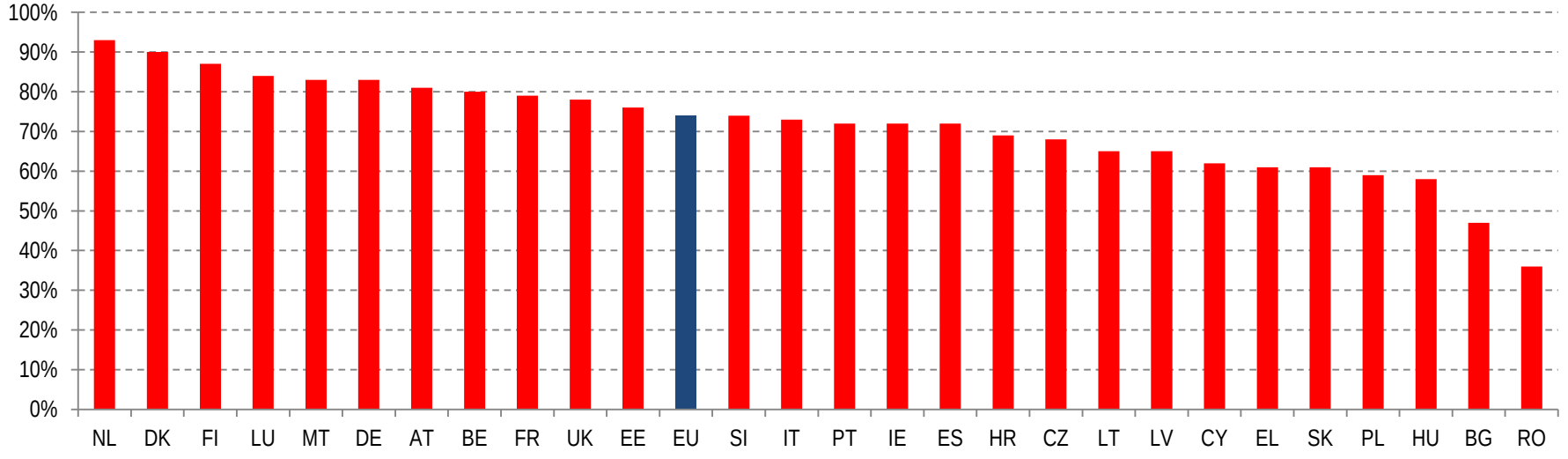
Source: Eurostat

European Commission

74 % of internet users who were employed in the EU used computers or computerised equipment at work in 2018, with large disparities across countries.

In 2018, 71 % of EU internet users in employment reported to use computers, laptops, smartphones, tablets or other portable devices at work; 19 % of these workers used computerised equipment or machinery, such as those used in production lines, warehouses or delivery services. 74 % used ICT devices or equipment from at least one of those categories. The Netherlands had the highest rate of ICT usage by workers in the EU, as 93 % of its internet users in employment declared that they used computers or computerised equipment at work. It is followed by Denmark (90 %) and Finland (87 %). Conversely, the lowest ICT usage rates amongst the internet users in employment were observed in Romania (36 %) and Bulgaria (47 %), which is partly explained by these countries' low shares of ICT specialists in total employment.

Use of computers or computerised equipment at work, 2018*
(% of employed having used the internet in previous 12 months)



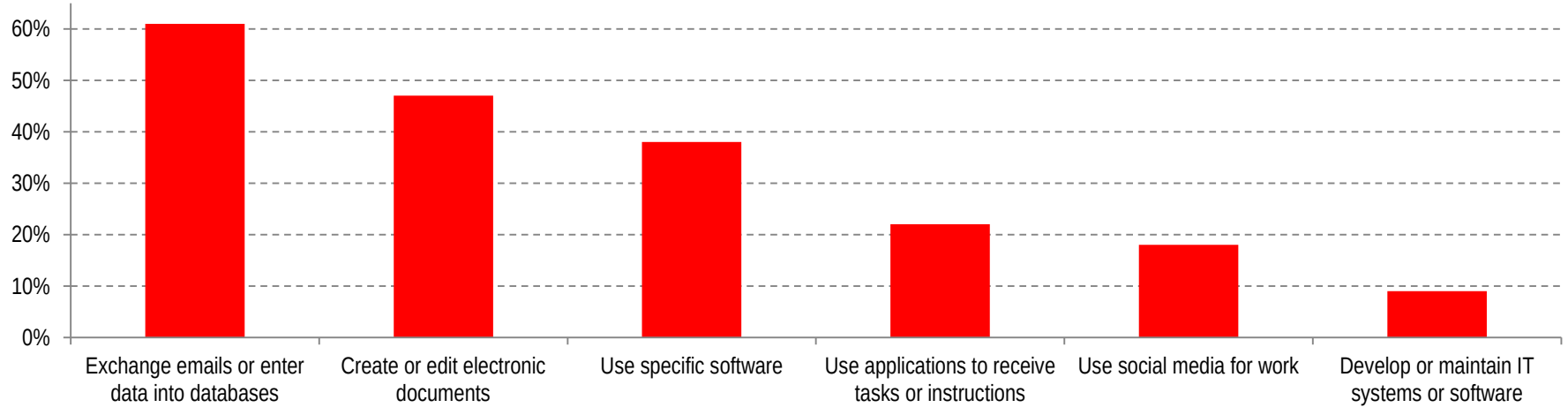
* Data not available for Sweden

Source: Eurostat

61 % of internet users in employment used email or entered data into databases and 47 % worked with electronic documents in 2018, but less than 10 % developed or maintained IT systems.

The most common activities involving the use of computers, laptops, smartphones, tablets or other portable devices or computerised equipment at work were exchanging emails or entering data into databases (61 % of internet users in employment), creating or editing electronic documents (47 %) and using specific occupational software; e.g. for design, data analysis, processing, etc. (38 %). 22 % of internet users in employment worked with applications to receive tasks or instructions (excluding emails), and 18 % used social media for their work. Only about 9 % of internet users in employment were involved in developing or maintaining IT systems or software, although significant variations exist across Member States: from only 2 % in Romania, Bulgaria and Slovakia to 14 % and 15 % in Denmark and Finland respectively.

ICT-related activities at work carried out at least once a week, 2018*
(% of employed people having used the internet in previous 12 months)



* Activities not mutually excluding.

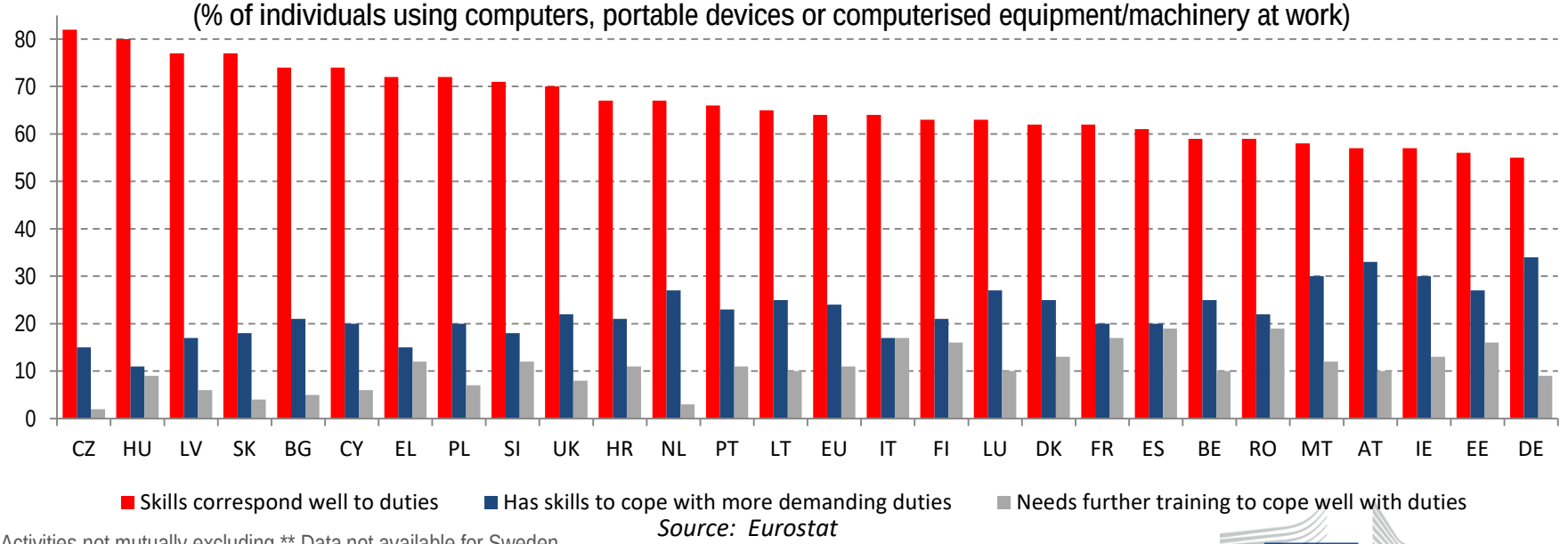
Source: Eurostat

New software or computerised equipment entailed changes in the main job tasks of 16 % of European internet users in employment in 2018.

In 2018, 39 % of EU workers using some sort of ICT device or equipment declared that they had to learn how to use new software or computerised equipment for their job over the previous year. 21 % reported changes in their main professional tasks as a result of new software or equipment being introduced during same period, and 20 % said they were involved in choosing, modifying or testing the software or computerised equipment used at their work. The highest shares of ICT-using workers whose main job tasks changed due to new software or computerised equipment were registered in Denmark, Luxembourg and Portugal (all 30 %). Cyprus (5 %), Latvia (11 %) and Bulgaria (12 %) had the lowest shares.

About 64 % of the EU's workers using ICT devices or equipment deemed their skills relating to the use of computers, software or applications at work corresponded well to their duties, whereas 24 % said they had the skills to cope with more demanding duties and 11 % admitted that they needed further training. Approximately 12 % of the EU's internet users (regardless of employment status), in turn, relied on on-the-job training to improve their digital-related skills; 11 % on free online training or self-study and 9 % on training provided by their employer*.

Skills relating to use of use of computers, software or applications at work (self-assessed), 2018**
(% of individuals using computers, portable devices or computerised equipment/machinery at work)



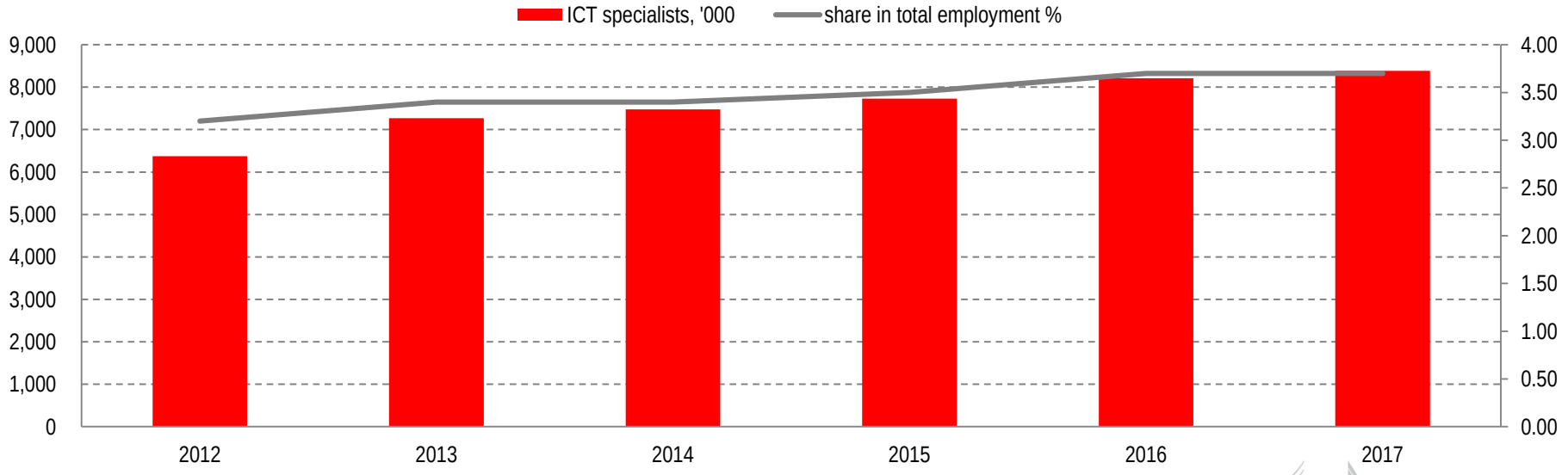
Source: Eurostat

* Activities not mutually excluding.** Data not available for Sweden

The number of ICT specialists employed in the EU reached nearly 8.4 million in 2017, but the employment potential of people with specialised ICT skills remains underexploited.

In 2017, nearly 8.4 million people were employed as information and communication technologies (ICT) specialists in the EU. This amounts to about 3.7 % of total employment. These figures represent a slight increase compared with a year earlier. Although the progression is less strong than in 2016, it remains significant from a long-term perspective: between 2007 and 2017, the number of ICT specialists employed in the EU grew by 36 %, compared with a 3.2 % increase in overall employment. Nearly 83% of all ICT specialists employed in the EU in 2017 were men, and about 62 % had at least tertiary education. The Member States employing the most ICT specialists were the UK (1.6 million), Germany (1.5 million) and France (1 million). The highest shares of ICT specialists in total employment were recorded in Finland (6.8 %), Sweden (6.6 %) and Estonia (5.6 %); the lowest in Greece (1.6 %), Romania (2.1 %) and Portugal (2.2 %). In 2018, 1 in 5 companies in the EU employed ICT specialists and nearly 1 in 10 recruited or tried to recruit ICT specialists. However, 53 % of companies that recruited or tried to recruit ICT specialists in 2018 reported difficulties in filling vacancies, compared to 41 % a year earlier. This situation, combined with evidence on the growing number of ICT vacancies, suggests that the gap between demand and supply of ICT specialists may be widening in the EU, and that the employment potential of people with specialised ICT skills remains underexploited.

Employment of ICT specialists in the EU, 2012-2017



Source: Eurostat

Through its Digital Skills and Jobs Coalition, the Commission seeks to further reduce digital skills gaps by fostering the sharing, replication and upscaling of best practices in areas such as training and matching for digital jobs, certification and awareness raising.

The Digital Skills and Jobs Coalition is one of the 10 key actions under the New Skills Agenda for Europe. It has been operational since 2016 and brings together Member States and stakeholders from the private and public sectors to develop a large digital talent pool and ensure that Europe's citizens and labour force are equipped with adequate digital skills.

As of mid-2018, more than 100 companies, education providers and NGOs have made pledges to reduce digital skills gaps by providing measures such as training courses, matching for digital jobs, certification and awareness raising. 23 National Coalitions for Digital Skills and Jobs have also been created in the EU Member States.

members of the Digital Skills and Jobs Coalition have so far offered 10.9 million people in the EU a chance to improve their digital skills. In total, 7.4 million digital skills training courses were provided, 1.9 million certifications were delivered and 1.6 million people were reached through awareness-raising campaigns.

Furthermore, the Digital Opportunity Traineeship, which was launched in 2018, will provide cross-border traineeships for up to 6,000 students until 2020. The aim is to provide students of all disciplines with hands-on experience in digital-related fields demanded by the market. Trainees will strengthen their ICT specific skills, in fields like digital marketing, software development, cybersecurity and big data. More than 3,000 traineeships have already taken place throughout the EU and in partner countries during the first year of implementation.

The EU ICT Sector and its R&D Performance

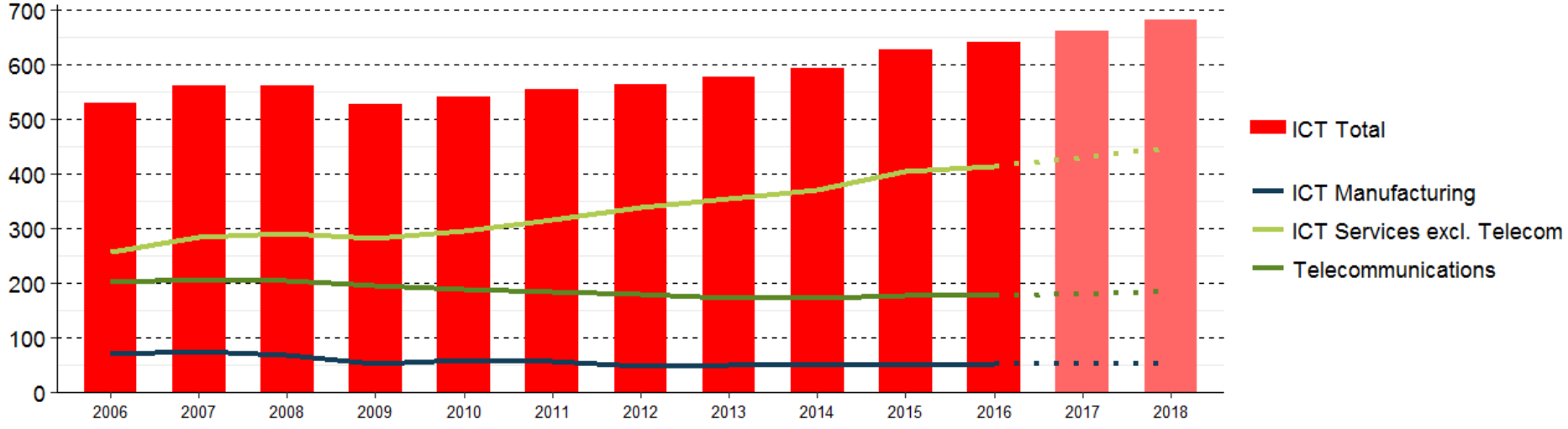
Digital Economy and Society Index Report 2019
The EU ICT sector and its R&D performance

The value added of the ICT sector was EUR 642 billion in 2016. ICT services made up 92 % of total ICT sector value added. ICT services (excluding telecommunications) were the dominant sub-sector and the only one expanding in the medium to long term.

The value added of the EU ICT sector was EUR 642 billion in 2016, and it is expected it will have continued to grow in the two years following that. A breakdown by sub-sector shows the predominance of ICT services (EUR 590 billion and 92 % of total ICT sector value added in 2016) over ICT manufacturing.

The ICT services sub-sector (excluding telecommunications) is the only one that saw an increase in value added over the medium term (2006-2016), up to EUR 414 billion. Both the telecommunications and ICT manufacturing sub-sectors experienced a decline in the same period, only slightly recovering in the last two years.

ICT sector Value Added, EUR billion, 2006-2018



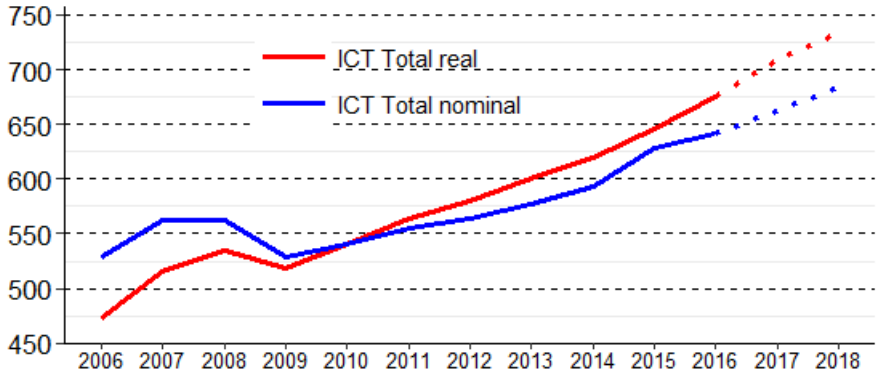
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

The value added of the ICT sector grew much faster in real terms than the rest of the economy. At global level, the ICT sector's share of value added in EU GDP lags behind that of main competitors (Japan, the United States and China).

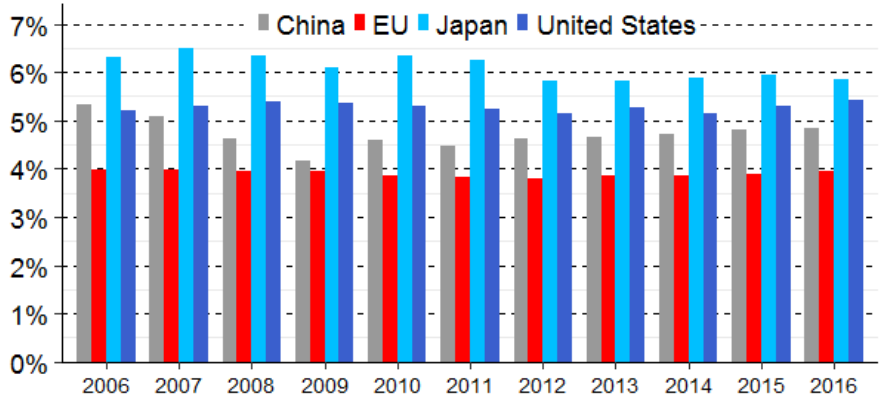
Although the value added of the ICT sector increased by 21 % in nominal terms (in line with GDP: + 22 %), it increased by 44 % in real terms over 2006-2016 (well above GDP: + 9 %). These trends are explained by the decline in prices in the ICT sector over 2006-2016 (see slide 5).

ICT sector Value Added, nominal and deflated, EUR billion, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

ICT sector share of GDP, percentage, 2006-2016



The value added of the ICT sector accounted for 4.3 % of EU GDP in 2016 (comprehensive definition*). According to the operational definition*, which enables world comparisons, the value added of the ICT sector in the EU (4 %) was lower than that of Japan (5.8 %), the US (5.4 %), and China (4.9 %) in 2016. The EU's ICT sector grew marginally as a percentage of GDP from the previous year, but so did that of most of its competitors, except Japan which, however, had the highest percentage.

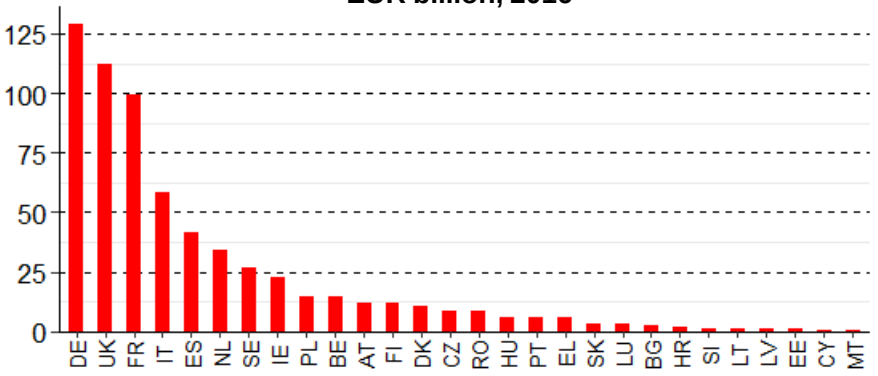
** See methodological note.*

Source: Commission services' calculations and estimates based on PREDICT project

The EU's five largest economies (Germany, the United Kingdom, France, Italy, and Spain) were the five biggest contributors to ICT sector value added in 2016. However, Ireland, a medium-sized country, has by far the highest ICT sector share of GDP (11.6 % in 2014, latest data available).

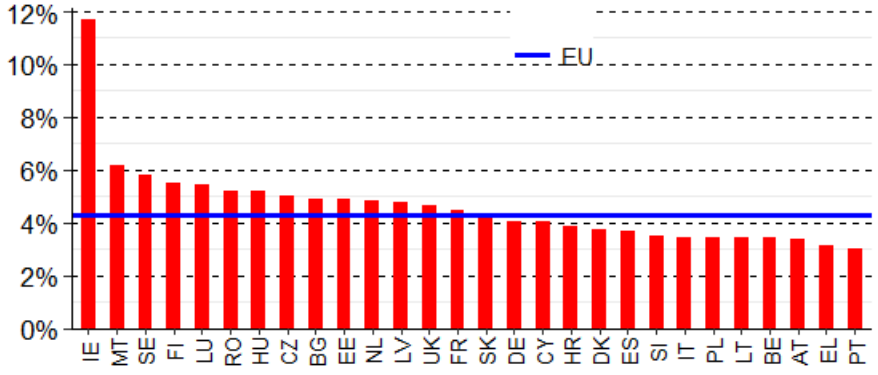
Unsurprisingly, the EU's five biggest economies were also the five biggest contributors to ICT sector value added in 2016; Germany (EUR 129 billion or 20 % in terms of shares), the United Kingdom (EUR 112 billion or 18 %), France (EUR 99 billion or 15 %), Italy (EUR 58 billion or 9 %), and Spain (EUR 41 billion or 6 %). Together, these five countries accounted for 69 % of total EU ICT sector value added in 2016.

ICT sector Value Added, EUR billion, 2016



Note: Data for Ireland refers to 2014.

ICT sector share of GDP, percentage, 2016



Note: Data for Ireland refers to 2014.

Ireland had by far the highest ICT sector share of GDP, 11.6 % in 2014 (latest data available), while Portugal lagged behind at 3 %. After Ireland, the countries with the highest share of ICT sector included Malta (6.2 %), Sweden (5.8 %), Finland (5.5 %) and Luxembourg (5.4 %).

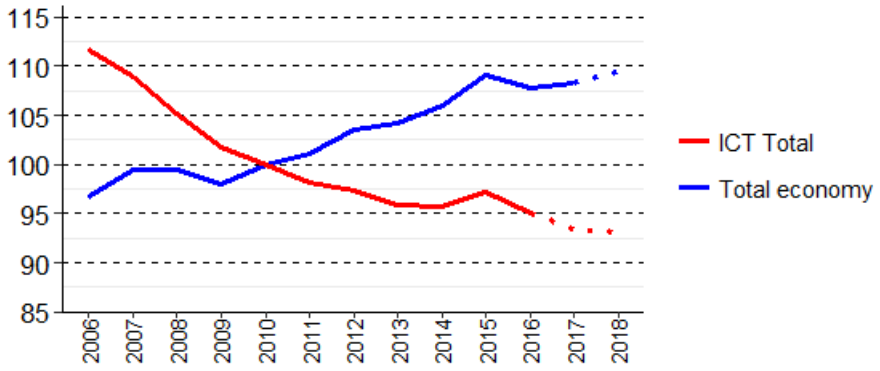
Romania, Hungary and Czechia also had a high ICT sector share of GDP (5 % or higher). The biggest changes in ICT as a proportion of GDP over the medium term (2006-2016) were in Ireland, where it grew by 3.5 percentage points (due to the process of relocation of European operations of many non-EU ICT multinationals) and in Finland, where it fell by 3.1 percentage points (due mainly to the crisis at Nokia, the Finnish ICT manufacturer).

Source: Commission services' calculations and estimates based on PREDICT project

ICT prices continued to go down in 2016-2017 after a spike in 2015, but the decline in prices is forecast to slow in 2018. The telecommunications sub-sector experienced the largest decline.

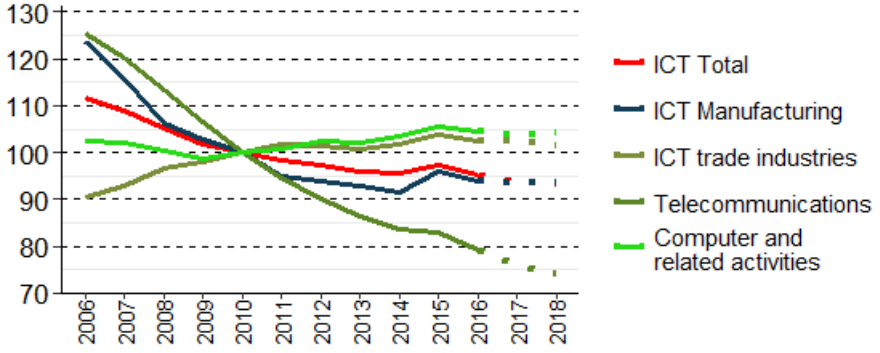
Prices in the ICT sector fell by 16 % over the medium term (2006-2017), while prices in general grew by 12 % over the same period. This highlights the particular nature of product prices in the ICT sector, which also incorporates improvements in the quality of products (e.g. CPUs' speed). This different price evolution of the ICT sector with respect to the overall economy explains the fact that, in the EU, the share of the ICT sector in total GDP remained stable (around 4%) between 2006 and 2016 (see slide 3).

Price Index, ICT sector and oveall economy, Index base 2010=100, 2006-2018



Note: Values for the year 2018 and ICT sector in 2017 are nowcasted data.

Price Index, ICT by sub-sector, Index base 2010=100, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

An analysis by sub-sector shows a contrasting situation: while some sub-sectors experienced a dramatic drop in prices (telecommunications: - 39 %, ICT manufacturing: - 24 %), other saw moderate growth (the ICT trade industry: + 13 %) or stagnation (computers and related activities: + 1 %) over the medium term (2006-2017). In addition, prices in the ICT sector stabilised somewhat towards the end of 2013-2017.

Source: Commission services' calculations and estimates based on PREDICT project

The ICT sector employed 6.6 million people in 2016. The main employer was the ICT services sub-sector (excluding telecommunications), with 4.9 million people in 2016. The share of employment in the ICT sector relative to total employment was 2.8 % in the EU in 2016.

The ICT sector employed 6.6 million people in 2016, continuing on an upward trend since 2010.

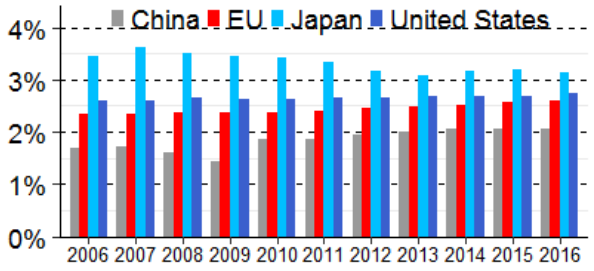
The ICT services sub-sector (excluding telecommunications) employed 4.9 million people, accounting for 74 % of total ICT employment in 2016. This is the only sub-sector that recorded growth (of 31 %) over the medium term (2006-2016). The telecommunications sub-sector employed 1.1 million people in 2016, a number which fell over the medium term by 9 %. The ICT manufacturing sub-sector employed 625,000 people in 2016, a drop of 32 % since 2006.

Employment in the ICT sector accounted for 2.8 % of total EU employment in 2016 (comprehensive definition*), an increase of 8 % over the medium term.

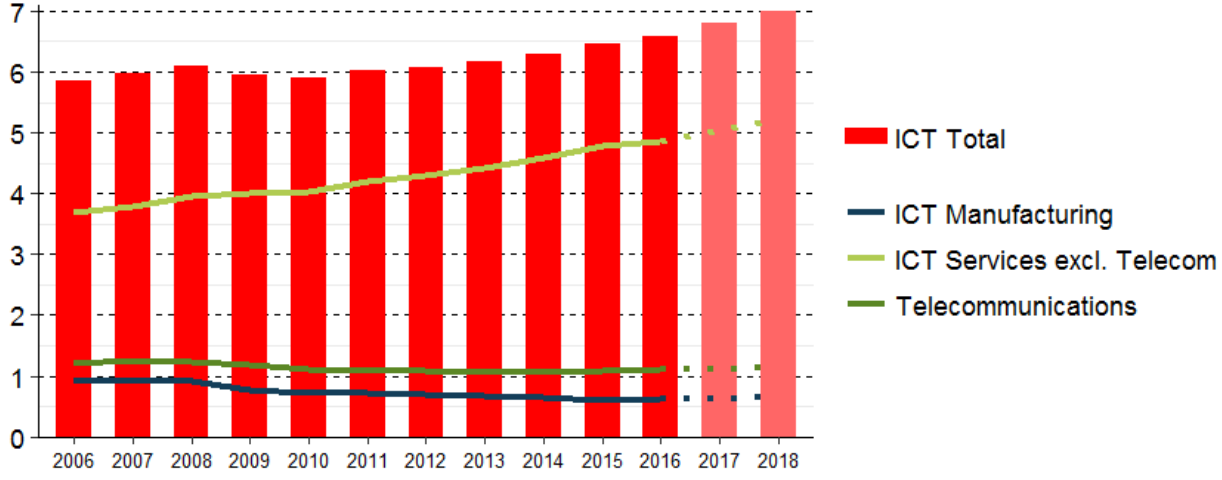
In the operational definition* which enables world comparisons, the US (2.7 %) was slightly ahead of the EU (2.6 %), which in turn was ahead of China (2.1 %). All three lagged well behind Japan (3.1 %) in 2016, however.

** See methodological note.*

ICT sector share of total employment, percentage, 2006-2016



Employment in the ICT sector, million people, 2006-2018



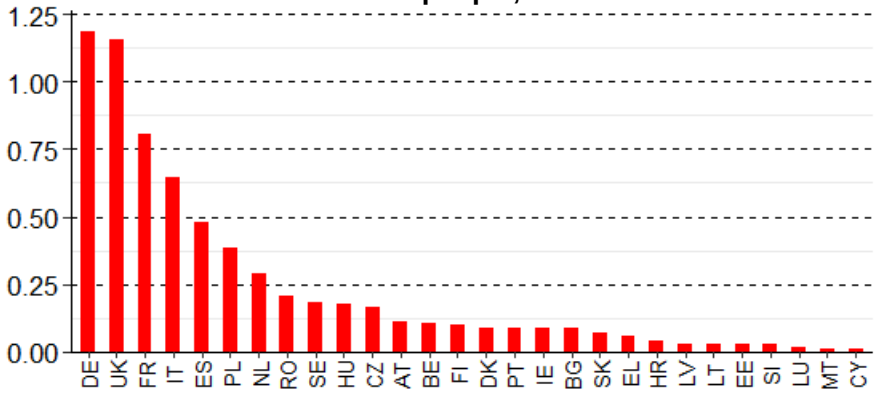
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

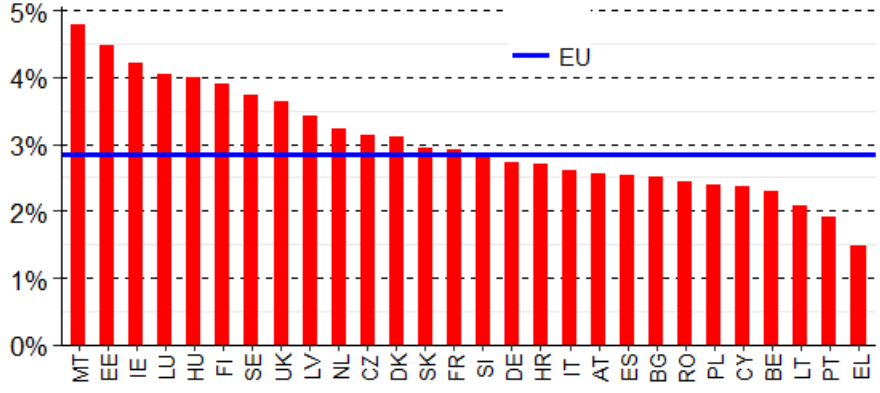
The five biggest EU economies (Germany, the United Kingdom, France, Italy, and Spain) were the five biggest employers in the EU ICT sector in 2016. However, small countries like Malta and Estonia had the highest rate of ICT sector employment as a share of total employment in 2016.

As was the case for value added, the EU's five largest economies were also the five largest employers in the EU ICT sector in 2016: Germany (over 1.2 million people or 18 % of total EU ICT sector employment), the United Kingdom (1.1 million people or 18 %), France (803,000 people or 12 %), Italy (646,000 people or 10 %), and Spain (480,000 people or 7 %). Together, the five largest employers accounted for 65 % of total ICT sector employment in 2016.

Employment in the ICT sector, million people, 2016



ICT sector share of total employment, percentage, 2016



In 2016, Malta had the highest share of ICT sector employment in total employment (4.8 %) and Greece the lowest (1.5 %). Other countries that performed well in 2016 included Estonia (4.5 %) and Ireland (4.2 %). Luxembourg and Hungary were close behind with rates around 4 %. Over the medium term (2006-2016), ICT sector employment as a share of total employment remained stable in most countries; small countries like Estonia and Latvia made significant progress, showing growth of almost 2 percentage points.

Source: Commission services' calculations and estimates based on PREDICT project

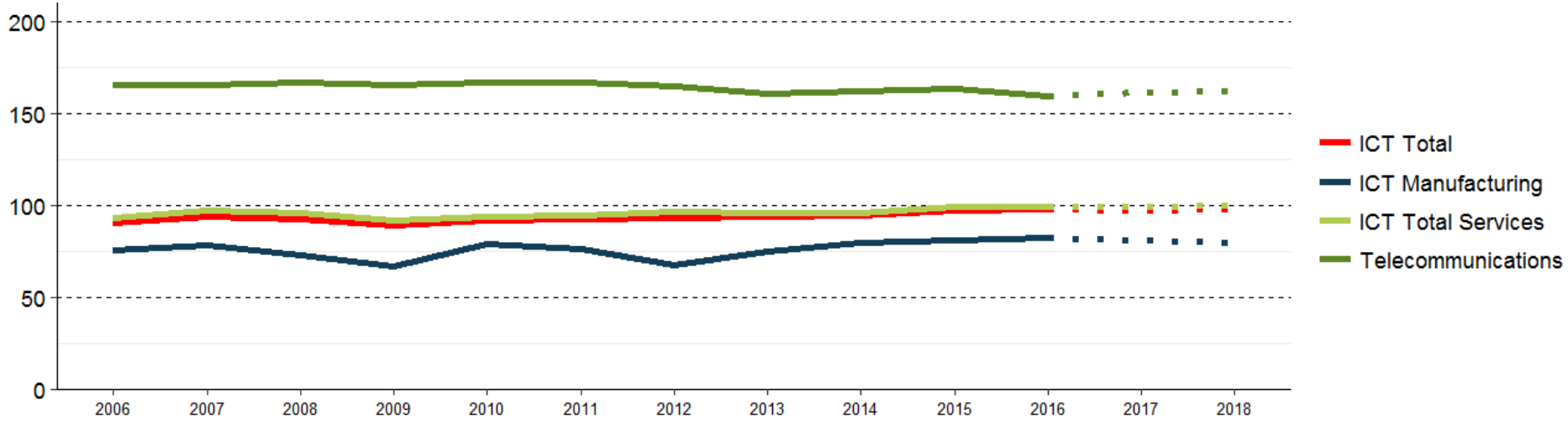
Labour productivity in the ICT sector was EUR 97,000 per person employed in 2016. Labour productivity in the telecommunications sub-sector was by far the highest.

Labour productivity in the ICT sector (comprehensive definition*) was EUR 97,000 per person employed in 2016, a slight increase over the medium term (2006-2016). Labour productivity in the ICT manufacturing sub-sector (EUR 82,000 per person employed in 2016) was below the average of the total ICT sector, and volatile.

** See methodological note.*

Labour productivity in the ICT services (i.e. services and trade), which was EUR 99,000 per person employed in 2016, is less sensitive to business cycles and was closer to the total ICT sector average than that of the ICT manufacturing. Labour productivity in the telecommunications sub-sector was by far the highest (at EUR 160,000 per person employed in 2016).

Productivity in the ICT sub-sector, thousand EUR per person employed, 2006-2018



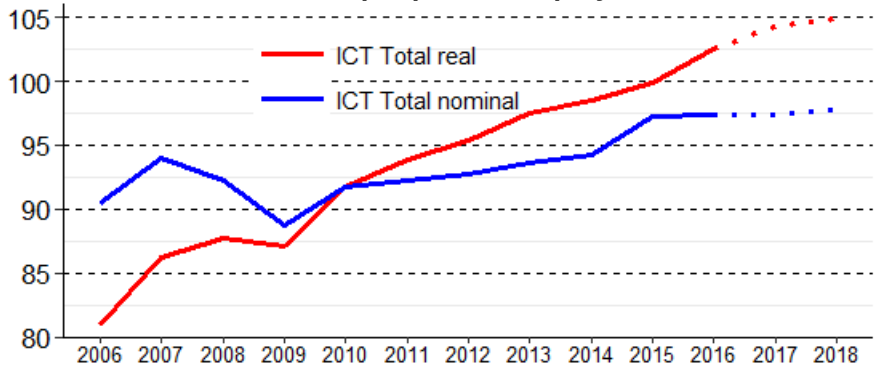
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

The ICT sector had higher labour productivity (in nominal terms) and grew faster (in real terms) over the period 2006-2016 than the overall economy. At global level, the EU ICT sector labour productivity was comparable with that of Japan but lagged markedly behind the US.

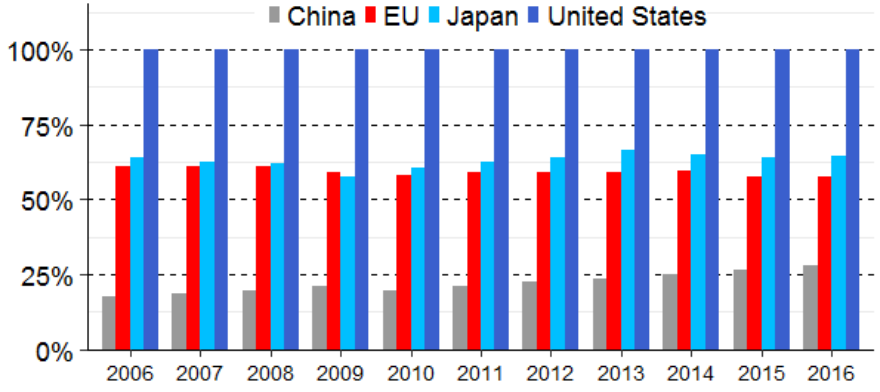
Labour productivity in the ICT sector was higher than in the rest of the economy (EUR 97,000 per person employed versus EUR 64,000 per person employed in 2016). Although it grew less quickly in nominal terms (+ 7 % versus + 16 % over 2006-2016), labour productivity in the ICT sector grew faster than that of the general economy in real terms (+ 23 % versus + 6 % over 2006-2016).

Productivity, nominal and deflated, thousand EUR per person employed, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

ICT sector Productivity, thousand EUR PPS per person employed, Index US=100, 2006-2016



According to the operational definition* which enables world comparisons, labour productivity in the EU ICT sector is considerably below that of the US (index: 57.8; index US=100) and also lower than Japan's (index: 64.6), but is far ahead of China (index: 28.0), which is however rapidly catching up.

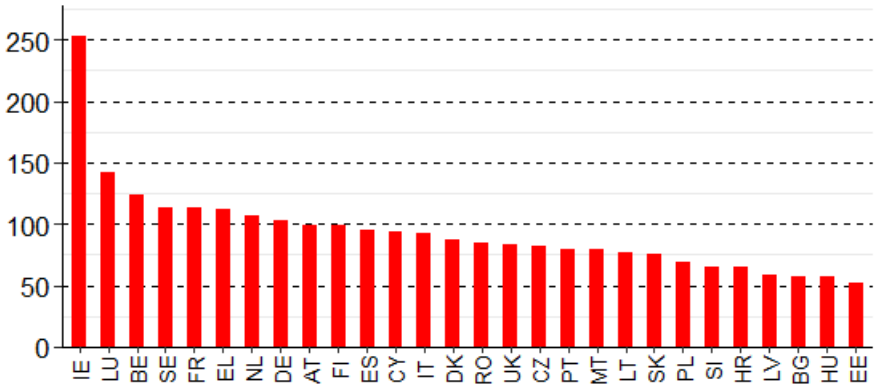
** See methodological note.*

Source: Commission services' calculations and estimates based on PREDICT project

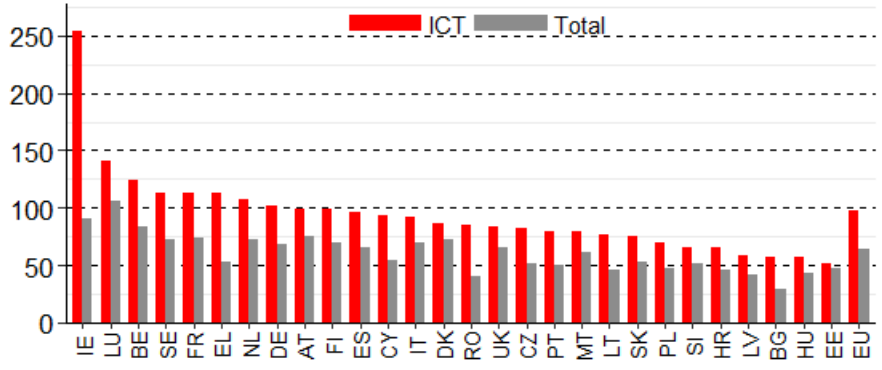
Labour productivity was highest in Ireland followed by Luxembourg and Belgium. Estonia, Hungary, and Bulgaria had the weakest performance.

In terms of labour productivity in the ICT sector, Ireland (EUR PPS 252,000 per person employed) by far led the way in 2014 (latest data available), but Luxembourg (EUR PPS 141,000 per person employed) and Belgium (EUR PPS 124,000 per person employed) also fared well in 2016. At the opposite end of the scale were Estonia (EUR PPS 52,000 per person employed), Hungary (EUR PPS 57,000 per person employed), and Bulgaria (EUR PPS 57,000 per person employed).

Productivity in the ICT sector, thousand EUR PPS per person employed, 2016



Productivity, ICT sector and total, thousand EUR PPS per person employed, 2016



Note: Data for Ireland refers to 2014.

The picture for labour productivity in the economy as a whole was broadly similar. Luxembourg (EUR PPS 105,000 per person employed) and Ireland (EUR PPS 93,000 per person employed) were the best-performing countries, while Bulgaria (EUR PPS 29,000 per person employed) and Romania (EUR PPS 40,000 per person employed) were at the bottom of the scale.

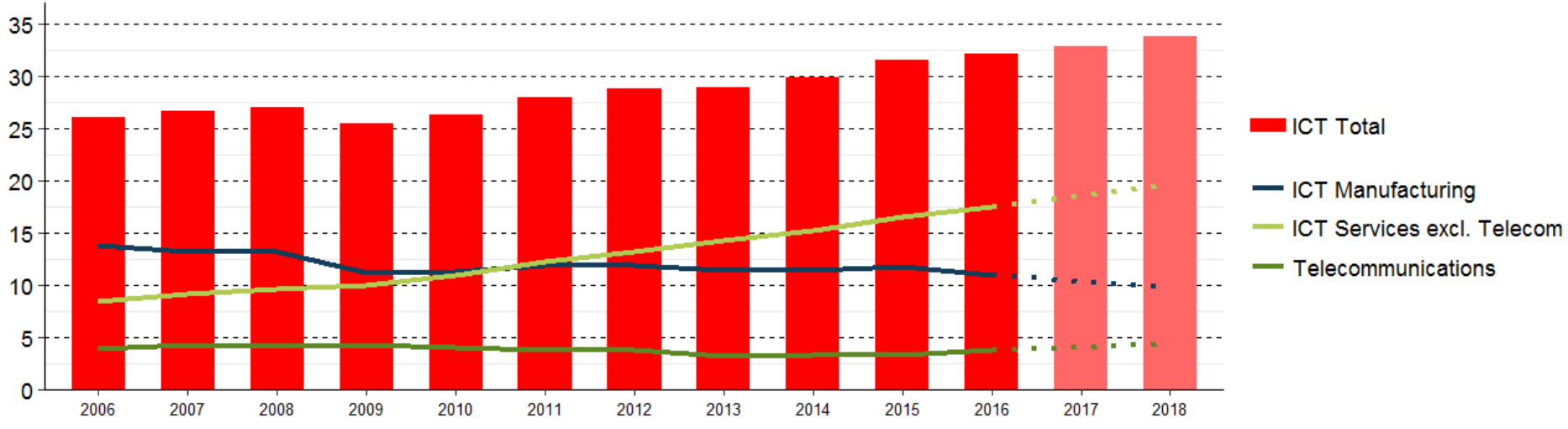
Source: Commission services' calculations and estimates based on PREDICT project

R&D expenditure by business enterprises (BERD) in the ICT sector was EUR 32 billion in 2016. The ICT services sector was responsible for 66 % (EUR 21 billion) of ICT BERD in 2016.

R&D expenditure by business enterprises (BERD) in the ICT sector amounted to EUR 32 billion in 2016, its highest value over the medium term (2006-2016) and far from its low point of EUR 25 billion in 2009. A breakdown by sub-sector reveals a more balanced situation for BERD than for value added – despite accounting for only 8 % of ICT sector value added, the ICT manufacturing sub-sector was responsible for 34 % of total ICT BERD (EUR 11 billion) while the ICT services sub-sector was responsible for 63 % (EUR 21 billion) of ICT BERD in 2016.

Over the medium term (2006-2016), the situation was quite different. The ICT manufacturing sub-sector experienced structural decline (falling by 21 % in 2006-2016), whereas the ICT services saw a structural increase (rising by 72 % in 2006-2016), particularly the ICT services sub-sector excluding telecommunications, which saw an increase of 106 % in 2006-2016.

R&D expenditure by business enterprises (BERD) in the ICT sector, EUR billion, 2006-2018



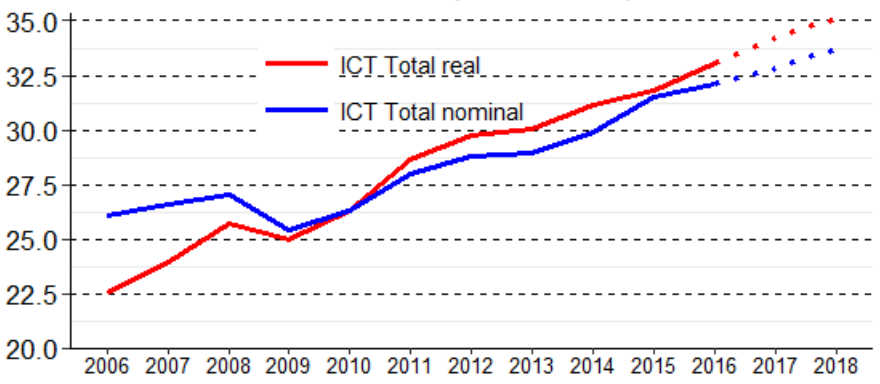
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

R&D expenditure by business enterprises grew faster in the ICT sector than in the general economy in real terms. ICT R&D intensity was 5 % in 2016 in the EU, far behind the US and Japan.

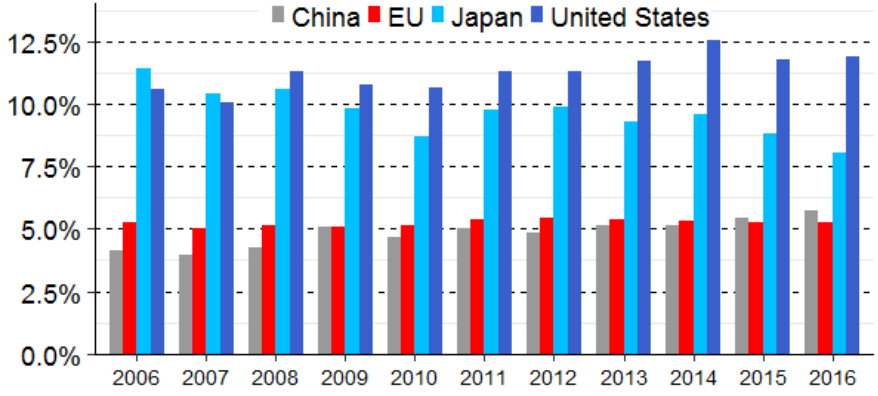
In real terms, R&D expenditure by business enterprises in the ICT sector grew faster than in the general economy (+ 38 % versus + 26 % in 2006-2015).

R&D expenditure by business enterprises (BERD) in the ICT sector, nominal and deflated, EUR billion, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

ICT sector R&D Intensity (BERD/VA), percentage, 2006-2016



R&D intensity (BERD/VA) in the ICT sector (comprehensive definition*) amounted to 5.0 % in 2016. According to the operational definition* which enables world comparisons, China (5.5 %) surpassed the EU (5.2 %) for the second time, and both the EU and China lagged behind the US (12.0 %) and Japan (8.0 %) in 2016.

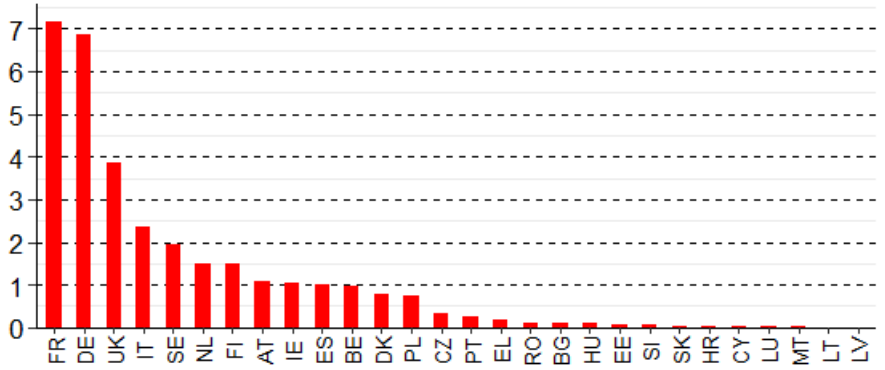
** See methodological note.*

Source: Commission services' calculations and estimates based on PREDICT project

The EU's six main contributors in terms of R&D expenditure by business enterprises in the ICT sector in 2016 were the EU's four biggest economies (France, Germany, the United Kingdom, and Italy) together with Sweden and the Netherlands..

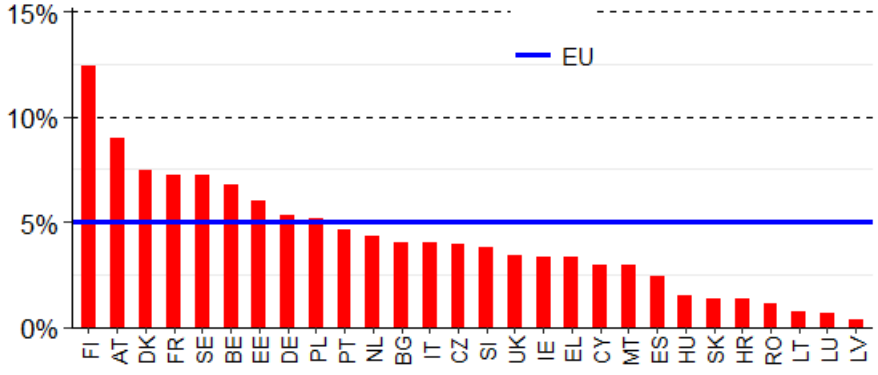
The EU's six main contributors in terms of R&D expenditure by business enterprises in the ICT sector in 2016 were the four largest economies in the EU (France, Germany, the United Kingdom and Italy), followed by Sweden and the Netherlands: France (EUR 7.2 billion or 22 %), Germany (EUR 6.9 billion or 21 %), the United Kingdom (EUR 3.8 billion or 12 %), Italy (EUR 2.3 billion or 7 %), Sweden (EUR 1.9 billion or 6 %) and the Netherlands (EUR 1.5 billion or 5 %). Together, these six accounted for 74 % of total R&D expenditure by business enterprises in the ICT sector.

R&D expenditure by business enterprises (BERD) in the ICT sector, EUR billion, 2016



Note: Data for Ireland refers to 2014.

ICT sector R&D Intensity (BERD/VA), percentage, 2016



Note: Data for Ireland refers to 2014.

Source: Commission services' calculations and estimates based on PREDICT project

Finland led the EU with 12.4 % ICT R&D intensity rate (BERD/VA) in 2016; Denmark had a rate of 7.5 % and Sweden 7.2 %. Other strong performers include Austria (8.9 %), France (7.2 %), and Belgium (6.7 %). Over the medium term (2006-2016), ICT R&D intensity remained broadly stable, but some countries, such as Poland and Bulgaria, made significant progress.

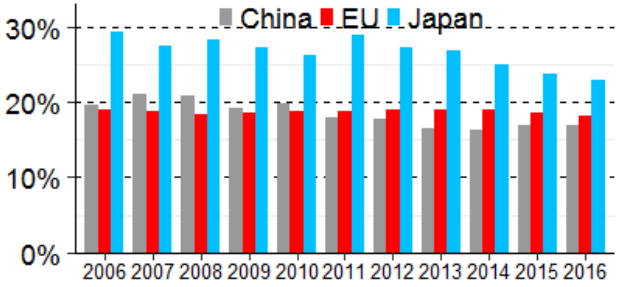
R&D personnel in the ICT sector included 313,000 full-time equivalents (FTEs) in 2016. The top employer was the ICT services sub-sector (excluding telecommunications), employing 205,000 FTEs in 2016 (65 % of ICT R&D personnel). R&D personnel in the ICT sector made up 19 % of total R&D personnel in 2016.

R&D personnel in the ICT sector included 313,000 full-time equivalents (FTEs) in 2016, a figure which rose over the medium term (2006-2016), growing faster after 2009. The ICT services sub-sector (excluding telecommunications) employed 205,000 FTEs in 2016 (65 % of R&D personnel in the ICT sector, making it the top employer), with a rising trend. The ICT manufacturing sub-sector employed 78,000 FTEs in 2016, with a downward trend in the medium term (2006-2016) despite an uptick in 2015. The telecommunications sub-sector employed 31,000 FTEs in 2016 (10 % of R&D personnel in the ICT sector), down by about 29 % from a peak of 39,000 FTEs in 2010.

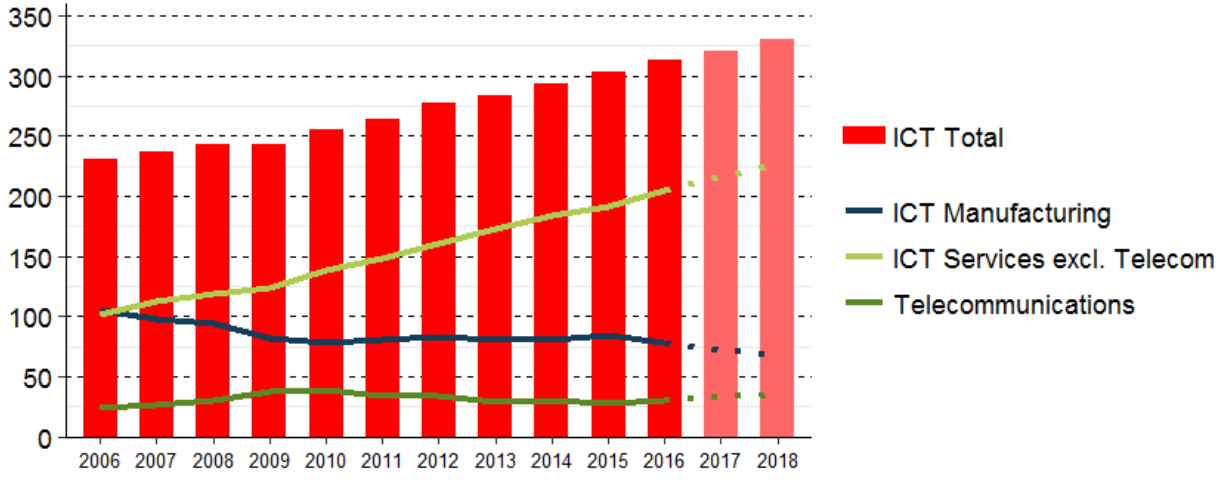
** See methodological note*

R&D personnel in the ICT sector (comprehensive definition*) made up 19 % of total R&D personnel in 2016, a figure which remained stable over the medium term. However, according to the operational definition* which enables world comparisons, the EU (18 %) and China (17 %) were behind Japan (23 %) in 2016 and in the medium term (no data available for the US).

ICT sector share of total R&D Personnel, percentage, 2006-2016



R&D Personnel (PERD) in the ICT sector, thousand FTEs, 2006-2018



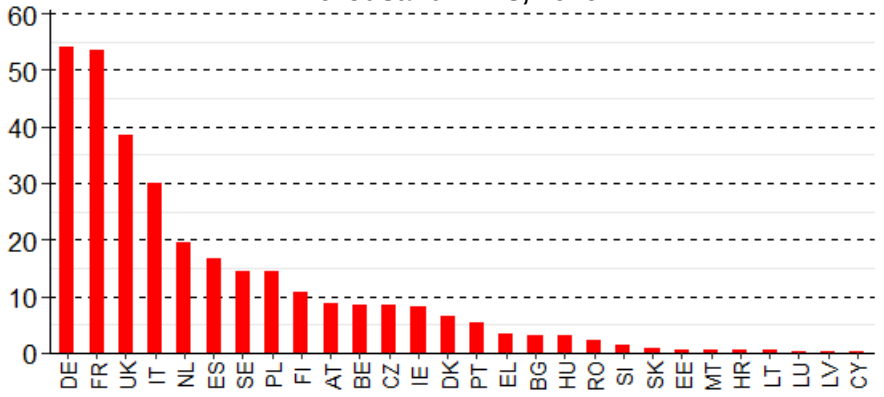
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

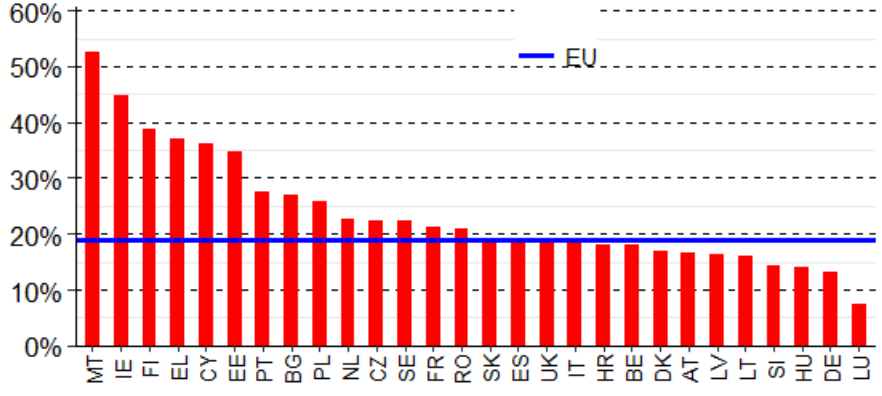
The EU's four biggest economies were also the four biggest employers of R&D personnel in the ICT sector in 2016: France, Germany, the United Kingdom, and Italy. Malta and Ireland were the two countries with the highest concentration of R&D personnel in the ICT sector in 2016.

The EU's four biggest economies were also the four biggest employers of R&D personnel in the ICT sector in 2016. These were Germany (54,000 FTEs or 17 %), France (53,000 FTEs or 17 %), the United Kingdom (38,000 FTEs or 12 %), and Italy (30,000 FTEs or 10 %). Together, the four biggest employers represented 56 % of total R&D personnel in the ICT sector in 2016.

R&D Personnel (PERD) in the ICT sector, thousand FTEs, 2016



ICT sector share of total R&D Personnel (PERD), percentage, 2016



Malta (53 %) and Ireland (45 %) were the two countries with the highest concentration of R&D personnel in the ICT sector in 2016. Luxembourg had the lowest concentration (7 %).

Other strong performers were Finland (39 %), Greece (37 %) and Cyprus (36 %).

Source: Commission services' calculations and estimates based on PREDICT project

Estimated publicly funded expenditure on ICT R&D in the EU grew to EUR 6.7 billion in 2017. This was more than 26 % below the necessary trend line for doubling publicly funded ICT R&D between 2007 and 2020.

The estimated level of publicly funded expenditure on ICT R&D (in any sector of the economy) in the EU was on an increasing trend in the medium term (2006-2017), interrupted only by a fall in 2012, and reached EUR 6.7 billion in 2017.

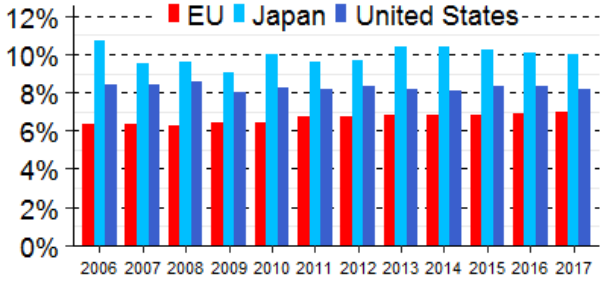
The Digital Agenda target of doubling publicly funded ICT R&D between 2007 and 2020 requires an annual growth rate of 5.5 % (assuming a constant annual growth rate). Estimated public ICT R&D expenditure was below the necessary trend line in 2017, with a gap of more than 26 %.

In 2017, public funding of ICT R&D represented 7.0 % of EU total 'government budget allocations for R&D' (GBARD), a figure which remained broadly stable over the medium term.

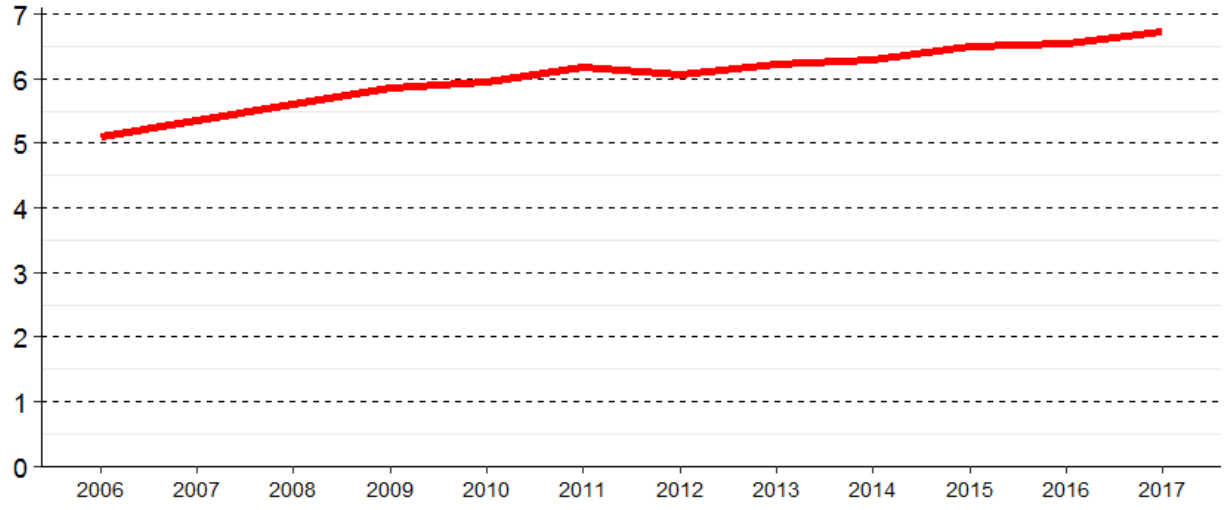
The EU lagged behind the US (8.2 %) and Japan (10.0 %), a position that remained stable over the medium term (no data available for China).

** Official statistics on public expenditure are available one year before business statistics.*

ICT GBARD share of total GBARD, percentage, 2006-2017



Public funding of ICT R&D (ICT GBARD), EUR billion, 2006-2017



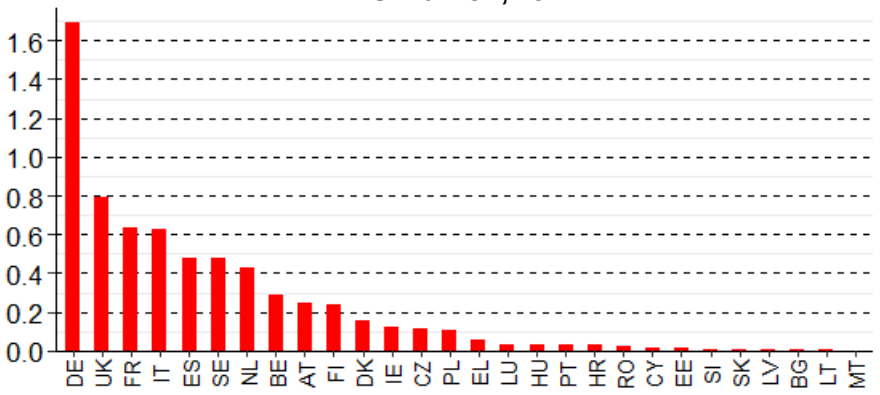
Source: Commission services' calculations and estimates based on PREDICT project

The EU's five biggest public funders of ICT R&D in 2017 were Germany, the United Kingdom, France, Italy and Spain. As in previous years, Cyprus had the highest rate of ICT GBARD as a share of total GBARD in 2017.

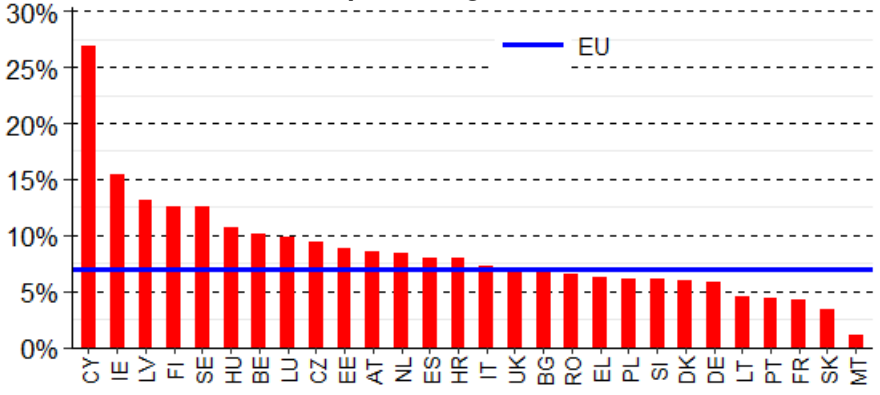
The EU's five biggest public funders of ICT R&D in 2016 were Germany (EUR 1.7 billion or 25 %), followed by the United Kingdom (EUR 793 million or 12 %), France (EUR 636 million or 9 %), Italy (EUR 623 million or 9 %) and Spain (EUR 477 million or 7 %).

Together, those five countries accounted for 63 % of total public funding for ICT R&D.

Public funding of ICT R&D (ICT GBARD), EUR billion, 2017



ICT GBARD as share of total GBARD, percentage, 2017



As in previous years, Cyprus was leading the way in the EU with the highest rate (27 %) of ICT GBARD as a proportion of total GBARD in 2016. The ranking in 2016 again reveals strong performances by Ireland (15.5 %), Sweden and Finland (both 12.5 %).

However, some other countries also pay special attention to ICT in their public spending on R&D, such as Latvia (at 13.1 %) and Hungary (at 10.7 %).

Source: Commission services' calculations and estimates based on PREDICT project

METHODOLOGICAL NOTE

Definition of the ICT sector

In this section, the ICT sector is defined according to the definition provided by the OECD and based on the NACE (Statistical Classification of Economic Activities in the European Community) Rev.2 (2008) nomenclature. The ICT sector has 12 industries:

ICT manufacturing

C261	Manufacture of electronic components and boards
C262	Manufacture of computers and peripheral equipment
C263	Manufacture of communication equipment
C264	Manufacture of consumer electronics
C268	Manufacture of magnetic and optical media

ICT services

G4651	Wholesale of computers, computer peripheral equipment and software
G4652	Wholesale of electronic and telecommunications equipment and parts
J5820	Software publishing
J61	Telecommunications
J62	Computer programming, consultancy and related activities
J631	Data processing, hosting and related activities; web portals
S951	Repair of computers and communication equipment

METHODOLOGICAL NOTE

Comprehensive versus operational definition

The comprehensive definition of the ICT sector applies to EU Member States for the period 2008-2016. It corresponds to the definition provided by the OECD in 2007.

The operational definition of the ICT sector enables the EU to be compared with non-EU countries over a longer period (2006-2016), as some of these countries do not have the necessary disaggregated information to estimate all the ICT industries included in the comprehensive definition. The operational definition does not include the following industries: manufacture of magnetic and optical media (268) and ICT trade industries (465).

Sector analysis

In the previous section, an analysis by ICT sub-sectors is made for each indicator. The 12 industries are aggregated into three sub-sectors: ICT manufacturing, ICT services (excluding telecommunications), and Telecommunications.

Source

Joint Research Centre – Dir. B Growth and Innovation (JRC – Dir. B) calculations and estimates, based on Eurostat, the OECD's structural analysis database (STAN), EU-KLEMS data and other national sources, from the JRC's PREDICT project.

All data contained in these databases come from official sources (e.g. Eurostat, OECD, national statistical institutes). However, there may be some discrepancies with the original sources, e.g. due to updates of the original data or the use of multiple auxiliary sources and variables.

Integration of Digital Technology

Digital Economy and Society Index Report 2019
Integration of Digital Technology

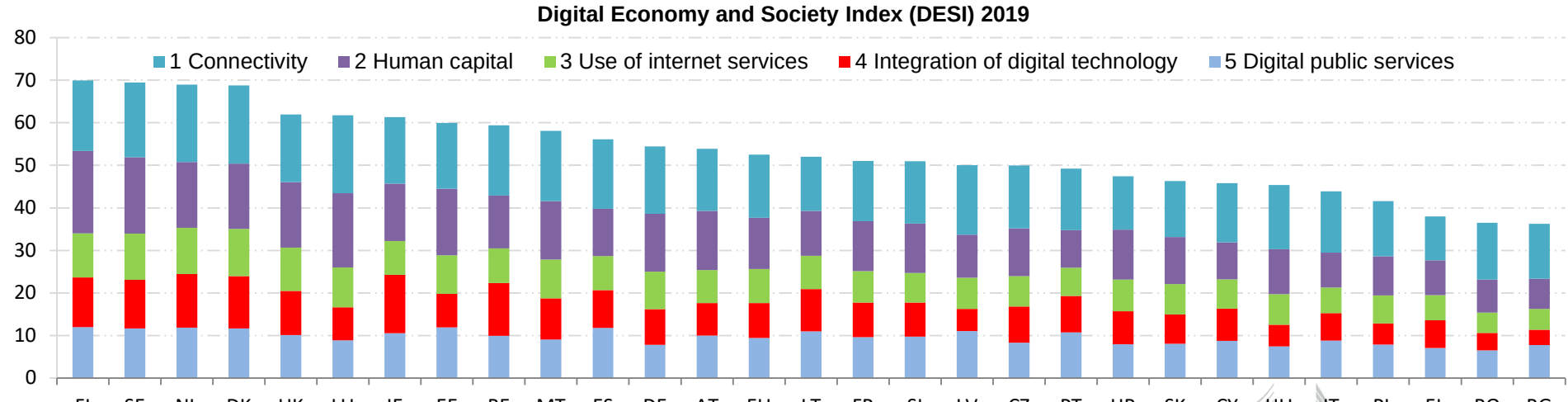
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the progress of EU Member States in digital competitiveness.

Finland, Sweden, the Netherlands and Denmark, have the most advanced digital economies in the EU followed by the UK, Luxembourg, Ireland and Estonia.

Bulgaria, Romania, Greece and Poland have the lowest scores on the index.

The five dimensions of the DESI

1 Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2 Human capital	Internet user skills and advanced skills
3 Use of internet	Citizens' use of internet services and online transactions
4 Integration of digital technology	Business digitisation and e-commerce
5 Digital public services	e-Government and e-health



Source: DESI 2019, European Commission

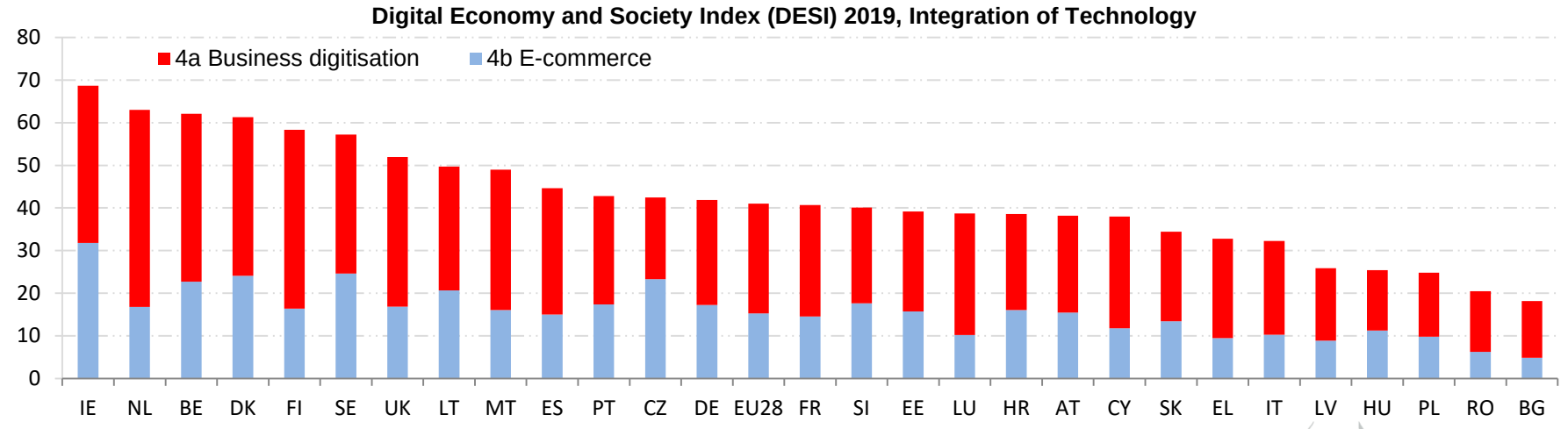
On Integration of digital technology, Ireland scored highest, followed by the Netherlands, Belgium and Denmark. Bulgaria, Romania, Poland and Hungary scored lowest.

Integration of digital technology covers (a) 'business digitisation' and (b) 'e-commerce'.

'Business digitisation' has four indicators (as the % of enterprises using): electronic information sharing, social media, big data analysis and cloud solutions.

e-Commerce includes three indicators: the percentage of small and medium-sized enterprises (SMEs) selling online, e-commerce turnover as a percentage of total turnover of SMEs, and the percentage of SMEs selling online cross-border.

Integration of Digital Technologies indicators in DESI 2019	EU
4a1 Electronic information sharing	**34%**
% enterprises	2017
4a2 Social media	**21%**
% enterprises	2017
4a3 Big data	**12%**
% enterprises	2018
4a4 Cloud	**18%**
% enterprises	2018
4b1 SMEs selling online	**17%**
% SMEs	2018
4b2 e-Commerce turnover	**10%**
% SME turnover	2018
4b3 Selling online cross-border	**8%**
% SMEs	2017



Source: European Commission services based on Eurostat data

The EU Member States that have exploited e-commerce opportunities the most are Ireland, Sweden and Denmark, whereas the Netherlands and Finland are leading in the adoption of e-business technologies.

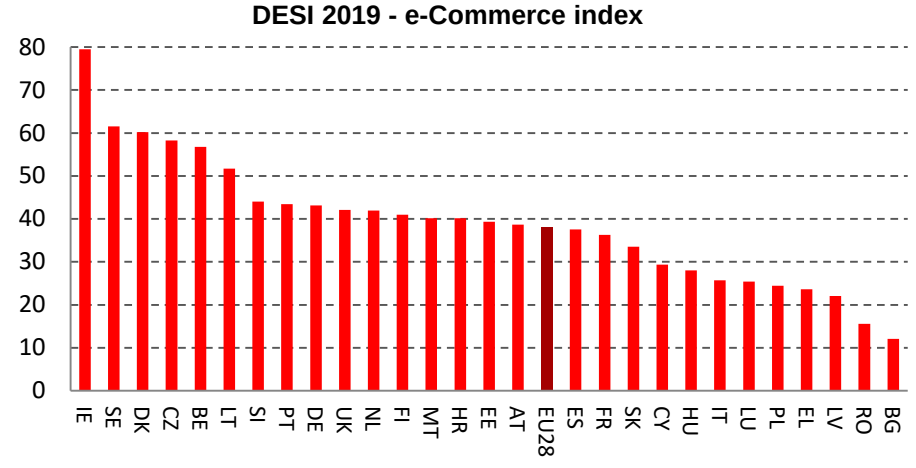
Enterprises are implementing both e-business and e-commerce solutions.

Regarding e-commerce, Ireland, Belgium and Czechia are among the top five countries in all the three indicators mentioned previously. Denmark is leading regarding the share of enterprises selling online, whereas Sweden ranks 3rd. Sweden is positioned 4th and Denmark 5th concerning the share of e-commerce turnover in total turnover.

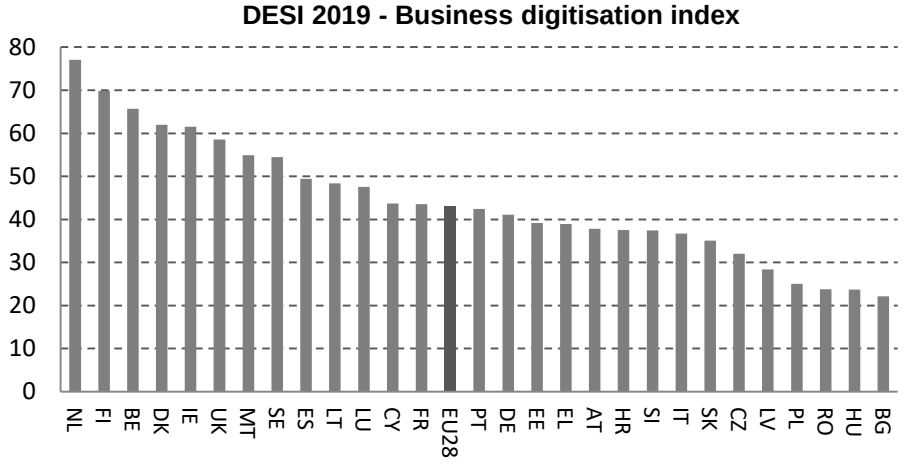
In Bulgaria, Romania and Latvia, SMEs are yet to exploit the many opportunities in e-commerce.

When it comes to e-business technologies, the leading countries are the Netherlands (2nd among EU Member States in three indicators: electronic information sharing, social media and big data analysis; 3rd in cloud solutions), Finland (forerunner in the use of cloud solutions) and Belgium (first in electronic information sharing).

Bulgaria, Hungary, Romania, Poland and Latvia are lagging behind in the adoption of e-business technologies.



Source: European Commission services based on Eurostat data



Source: European Commission services based on Eurostat data

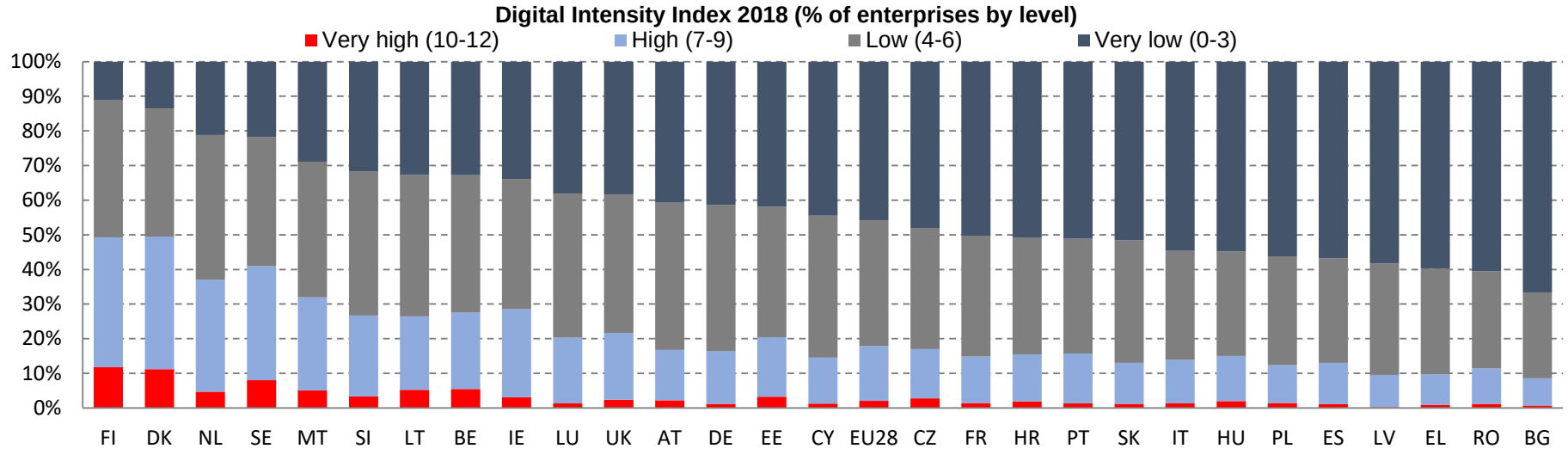
Less than a fifth of companies in the EU-28 are highly digitised, but the situation across countries is varied, ranging from 50 % of companies in Finland and Denmark to only 10 % in Bulgaria, Greece and Latvia.

The Digital Intensity Index (DII) measures the availability at firm level of 12 different digital technologies: internet for at least 50 % of people employed; recourse to ICT specialists; fast broadband (30 Mbps or above); mobile internet devices for at least 20 % of people employed; a website or homepage; a website with sophisticated functions; social media, paying to advertise on internet; buying medium-high cloud computing services, sending e-invoices suitable for automated processing; e-commerce web sales accounting for at least 1 % of total turnover; and business-to-consumer (B2C) web sales of over 10 % of total web sales.

The value for the index therefore ranges from 0 to 12.

Finland and Denmark are the only countries in the EU where the percentage of firms with a very high DII (i.e. possessing at least 10 out of the 12 monitored digital technologies) is above 10 %, followed by Sweden with 8 %.

By contrast, in some countries such as Bulgaria, Romania, Greece, Latvia, Spain, Poland Hungary and Italy the majority of businesses (over 55 %) have had low investments in digital technologies (i.e. have a very low DII), often having just a simple website and a few computers.



Source: Eurostat

Digital transformation of European businesses is driven by fast broadband connections, social media and mobile applications.

The table below shows the degree of penetration and speed of adoption of the different technologies monitored by the DII. Large companies are more digitised than SMEs. While some dimensions seem to be reaching saturation (e.g. having a simple website), at least for large companies, for most dimensions there is still room for improvement.

Key indicators tracking digitisation processes	Year	% of EU28 enterprises			Variation 2018 on 2017 or 2016	
		Large	SMEs		Large	SMEs
Enterprises having **a web site** or homepage	2018	94%	77%		0%	0%
Access to **ICT specialist** skills	2018	90%	65%	(a)	1%	1%
Website has some **interactive functionalities**	2018	74%	57%		0%	-1%
Website has references to the enterprise's **social media profiles**	2018	63%	37%		3%	3%
>50% of the persons employed **use computers** & Internet	2018	52%	43%		2%	3%
Fastest **broadband** connection is at least 30 Mb/s	2018	75%	43%		6%	5%
>20% of workers with **portable devices** for business use	2018	42%	34%		3%	2%
Pay to **advertise** on the internet	2018	38%	26%	(a)	4%	1%
Selling online (at least 1% of turnover)	2018	38%	17%		-1%	-1%
Sending **eInvoices** suitable for automated processing	2018	47%	23%	Not comparable with 2017 or 2016		
Buy medium-high **Cloud Computing** services	2018	39%	17%	(a)	9%	4%
Exploit **B2C eCommerce**	2018	9%	8%	(b)	1%	0%

(a) Variation on 2016

(b) Enterprises where web sales are more than 1% of total turnover and B2C web sales more than 10% of the web sales

Source: European Commission services based on Eurostat data

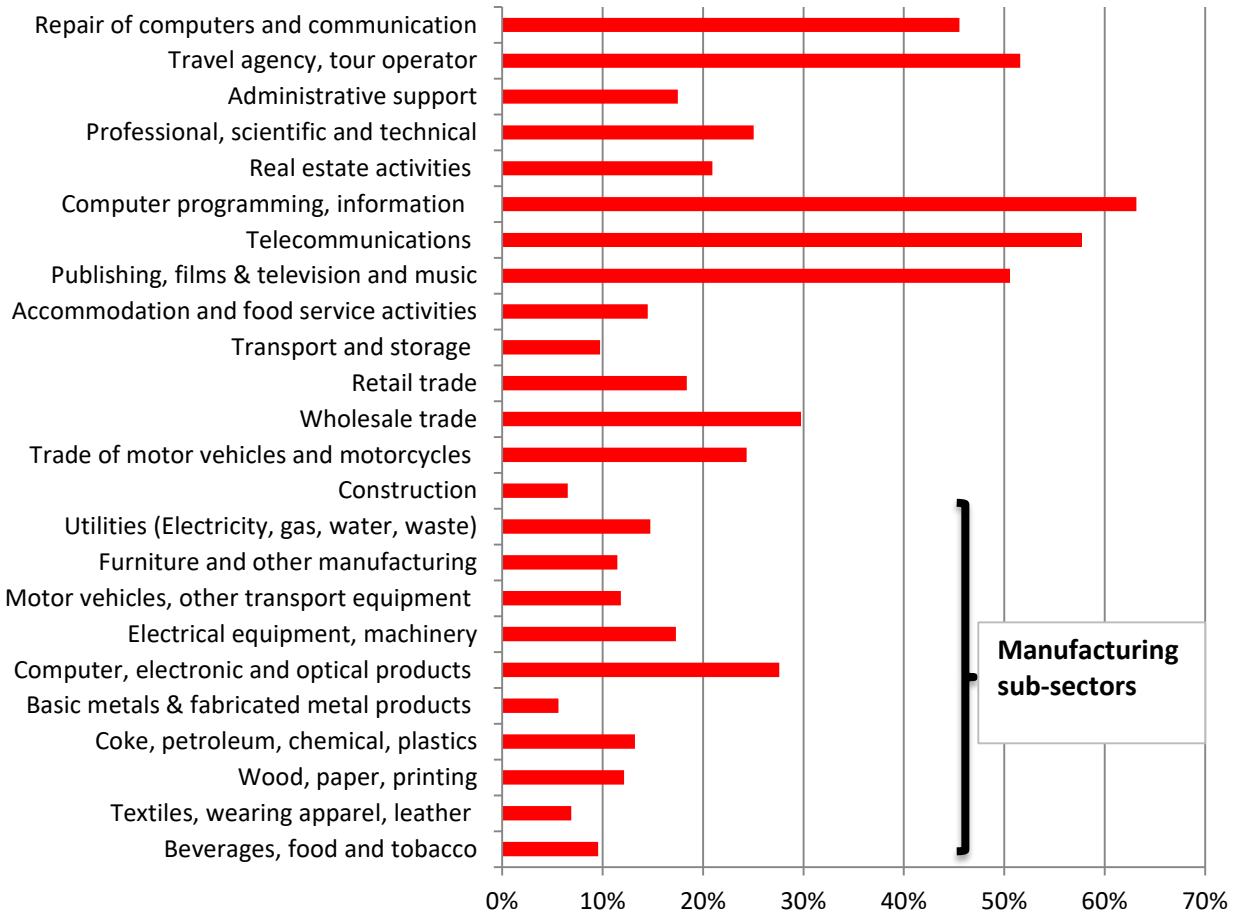
The digitisation of economic sectors is progressing at different pace, according to their own specific needs and starting points.

The different segments of the ICT sector (from telecoms to the manufacture of computers) tend to be the most digitised sectors of the economy. However, other sectors such as travel agencies and the media sectors are also highly digitised.

Some sectors are still impervious to digital changes: for example, in the construction sector only 6.5 % of the enterprises have a high or very high DII, while for transport and storage almost 10 % of enterprises have high or very high DII.

The distribution of the DII by economic activity is similar across EU countries. Denmark, Finland and Sweden are over performing in many of the sectors. Some positive exceptions of higher digitisation exist in the following sectors: "travel agency; tour operator reservation service and related activities" (Slovenia, Lithuania, Romania, Hungary, Estonia, the Netherlands and Czechia), "professional scientific and technical activities" (Finland, Slovenia and Lithuania), "real estate activities" (Finland, the Netherlands and Ireland) and "transport and storage" (Malta).

Enterprises with high or very high digital intensity index by economic activity, EU, 2018
(% of enterprises)

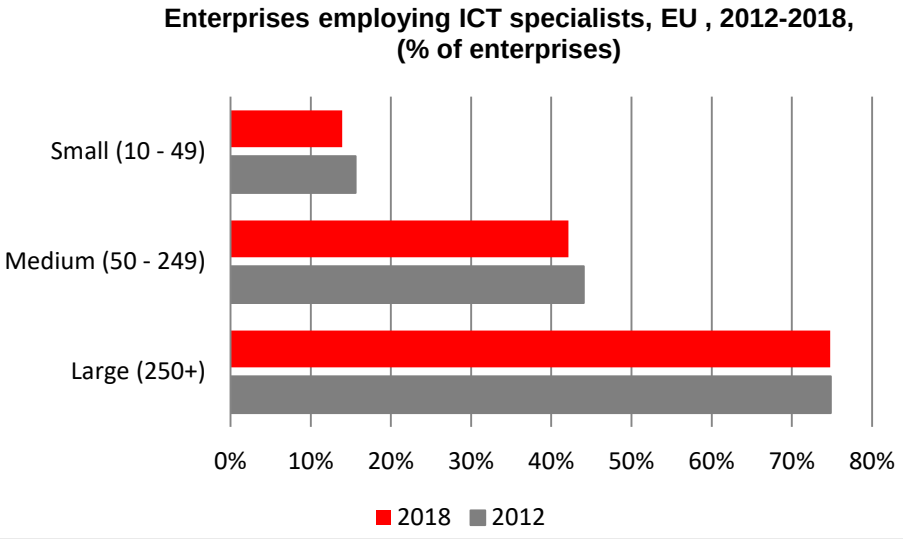


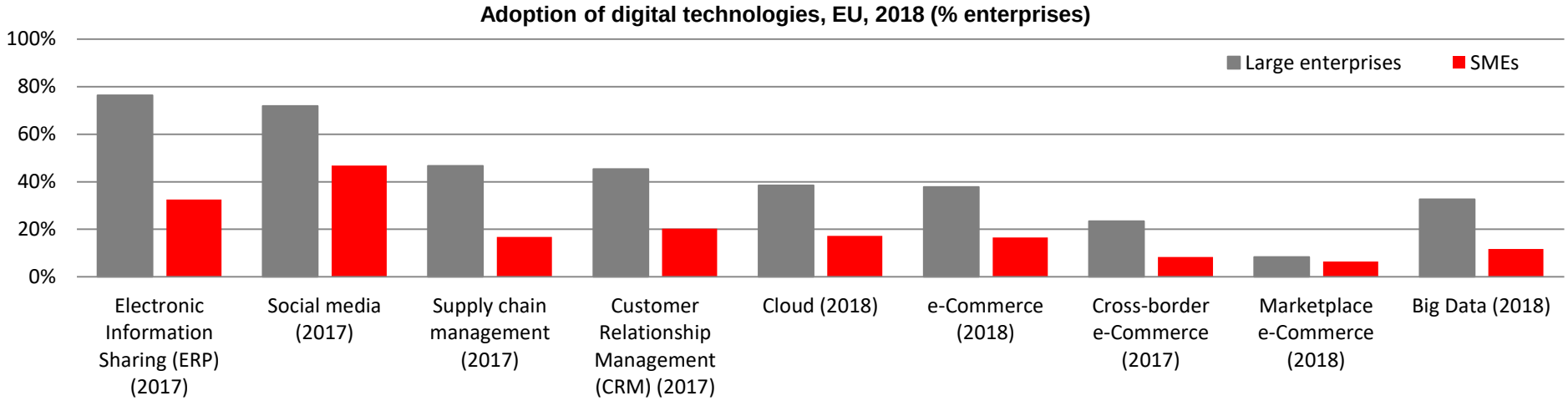
Source: European Commission services based on Eurostat data

The adoption of digital technologies varies strongly according to company size. There are still many areas for SMEs, where opportunities for digitisation can be exploited.

Large enterprises have a scale advantage, thus 75 % of them employ internal ICT specialists. The share of SMEs employing ICT specialists decreased slightly (1.6 percentage points) during the last six years, however the share of SMEs where ICT tasks were carried out by external personnel increased since 2015 (1.7 percentage points)

Electronic information sharing through Enterprise Resource Planning (ERP) software is much more common in large companies. SMEs are active on social media (47 % use any type of social media, 2017) and, to a limited extent, they try to exploit e-commerce opportunities by selling through online marketplaces (6.5 % of SMEs versus 8.3 % of large enterprises). Nevertheless, there are many technological opportunities yet to be exploited by SMEs such as cross-border e-commerce, cloud services and customer relationship management.





Source: Eurostat

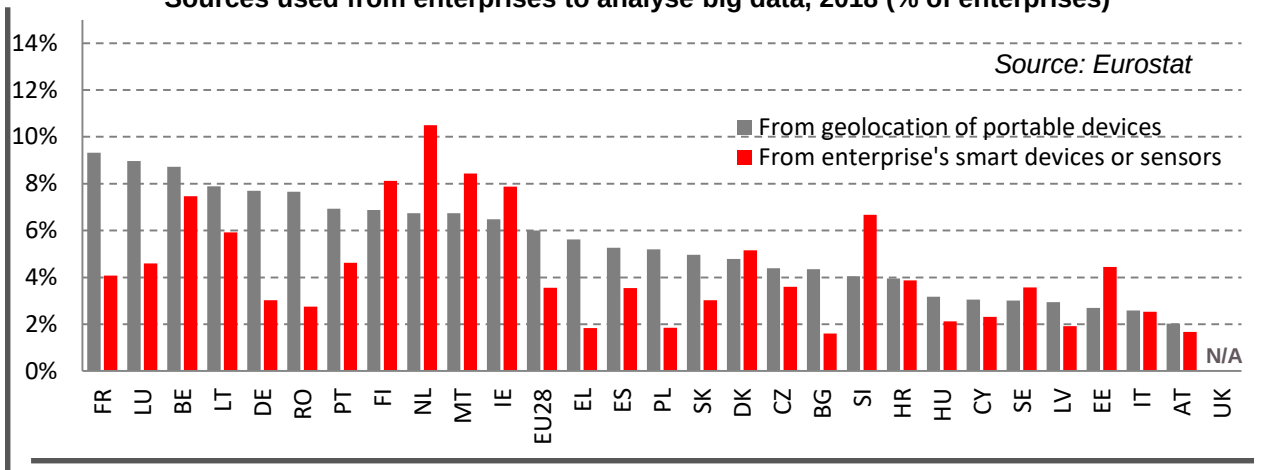
More than 12 % of enterprises analyse big data. Malta performs the best, with almost 25 % of Maltese enterprises analysing big data.

Enterprises all around the EU are constantly evolving and aligning with the trends and technologies for collecting, storing and analysing data. Companies use big data for analysing in large volumes, producing near or real time results from data that comes in different format types. Large companies have the lion's share in big data processing (33 %), while SMEs have still room for improvement (12 %) to take advantage of the benefits that big data can bring.

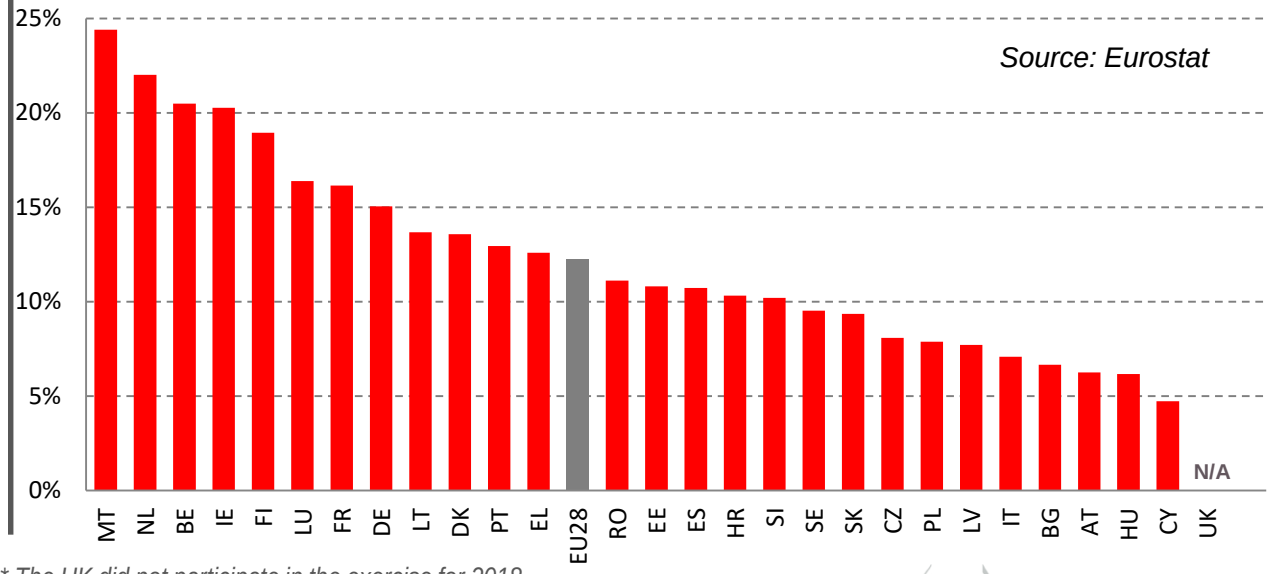
Nearly 6 % of enterprises analyse big data from geolocation of portable devices, while almost 4 % analyse data from their smart devices or sensors.

In Malta, almost one fourth of enterprises use big data. The Netherlands, Belgium and Ireland follow closely, with more than 20 % of enterprises taking advantage of big data. On the other hand, enterprises in Cyprus, Hungary, Austria and Bulgaria barely use big data.

Sources used from enterprises to analyse big data, 2018 (% of enterprises)



Enterprises analysing big data from any data source, 2018 (% of enterprises)



** The UK did not participate in the exercise for 2018*

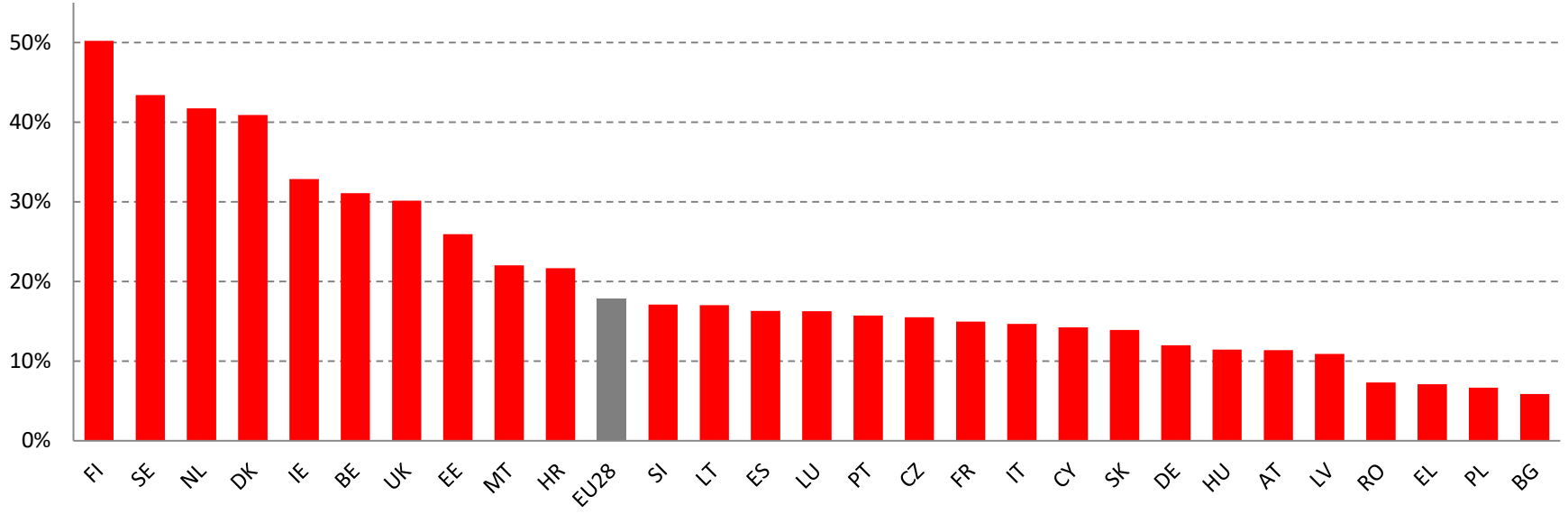
26.2 % enterprises invest in cloud computing services, with 17.8 % investing in cloud computing services of medium-high sophistication.

26.2 % of European enterprises purchase cloud computing services and incorporate cloud technologies for improving operations while reducing costs, representing an increase of 25 % compared to 2016. The cloud uptake of larger companies (55.6 %) is higher than SMEs (25.3 %) in 2018.

17.8 % of companies use medium-high sophisticated services (i.e. hosting of the enterprise's database, accounting software applications, Customer Relationship Management (CRM) software and computing power). There is a bigger proportion of larger enterprises following this trend (38.5 %) than SMEs (17.2 %).

Finnish enterprises are leaders in incorporating cloud services of medium-high sophistication. 50 % of Finnish enterprises buy such services, having recorded a 50 % increase between 2014 and 2018. Sweden, the Netherlands and Denmark follow with more than 40 % of enterprises using these services. However, the gap between top and low performers remain large, with Bulgaria, Poland, Greece and Romania performing below 10 %.

Cloud computing services of medium-high sophistication, 2018 (% of enterprises)



Source: European Commission services based on Eurostat

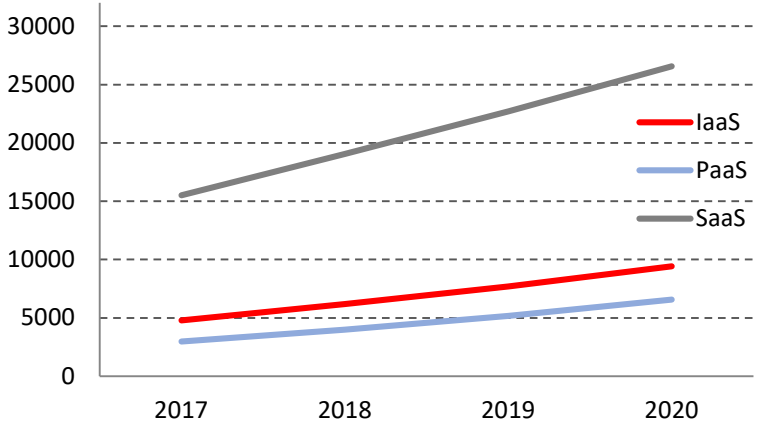
Revenues generated from public cloud services within the EU market increased by 25 % compared to 2017. They are expected to grow by 45 % in average between 2018 and 2020.

Total revenues generated by public cloud services, i.e. Infrastructure as a service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS), across the EU market increased by 25 % between 2017 and 2018. They are expected to continue to grow by 45 % between 2018 and 2020.

In 2018, SaaS represented almost two thirds of total public cloud revenues generated within the EU market. It is forecasted to continue until at least until 2020. In 2018, IaaS and PaaS represented 21 % and 13 % of total public cloud revenues generated within the EU market.

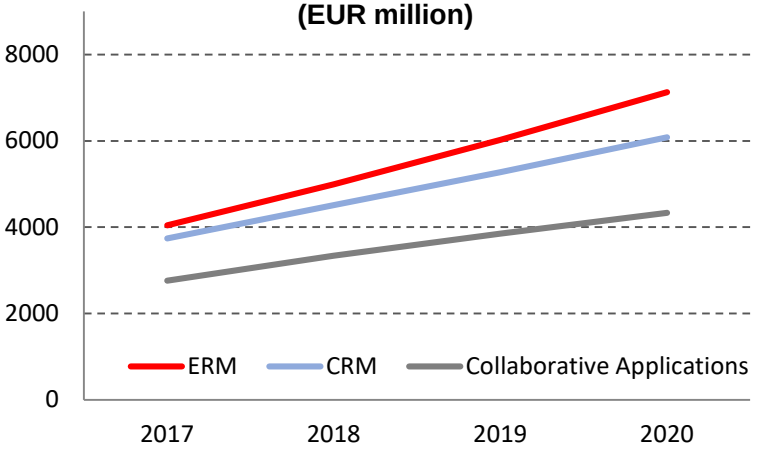
Between 2018 and 2020, it is forecasted that IaaS and PaaS will respectively grow at 52 % and 64 % both at a higher rate than SaaS over the same period (39 %).

EU public cloud service revenues per category, 2017 - 2020 (EUR million)



Source: European Commission services based on IDC

Revenue of the top 3 SaaS Applications in share of total SaaS EU revenues, 2017 - 2020 (EUR million)



Source: European Commission services based on IDC

Between 2017 and 2018, of the three applications contributing the most to SaaS revenues across the EU market, the revenue rates for each increased by the following percentages:

23 % for Enterprise Risk Management (ERM); 20 % for Customer Relationship Management (CRM) and; 21 % for Collaborative Applications.

They are expected to remain the most prominent ones applications that contribute to total SaaS revenues until at least 2020 with respective revenue growth rates of 43 %; 35 % and; 30 % between 2018 and 2020.

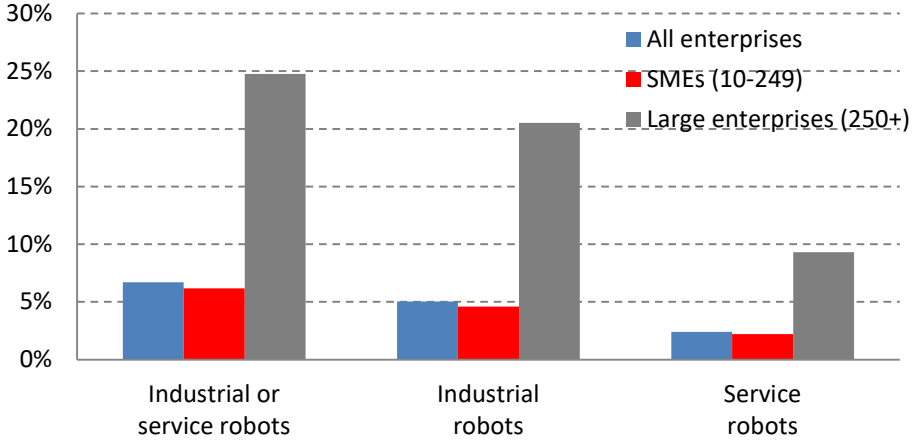
In 2018, software security, as a SaaS application, contributed EUR 1169.8 million to total SaaS revenues within the EU market. The revenue growth rate is expected to be at 37 % and therefore growing faster than CRM and collaborative applications but still slower than ERM over the 2018 to 2020 period.

Use of robots is low on an EU level, with 6.7 % of all enterprises using industrial or service robots. The share of large enterprises that use robots is four times higher than the share of SMEs.

The adoption of robotics is quite low in all EU Member States for which data are available (Belgium, Croatia, Ireland, Latvia, Luxembourg and the UK did not cover this optional module in 2018), with a take-up rate in all enterprises ranging from 10.8 % in Spain to 1.2 % in Cyprus. Only Western European countries are above the EU average of 6.7 %. The share of enterprises using robots is below 4 % in Estonia, Hungary, Lithuania, Greece, Romania and Cyprus.

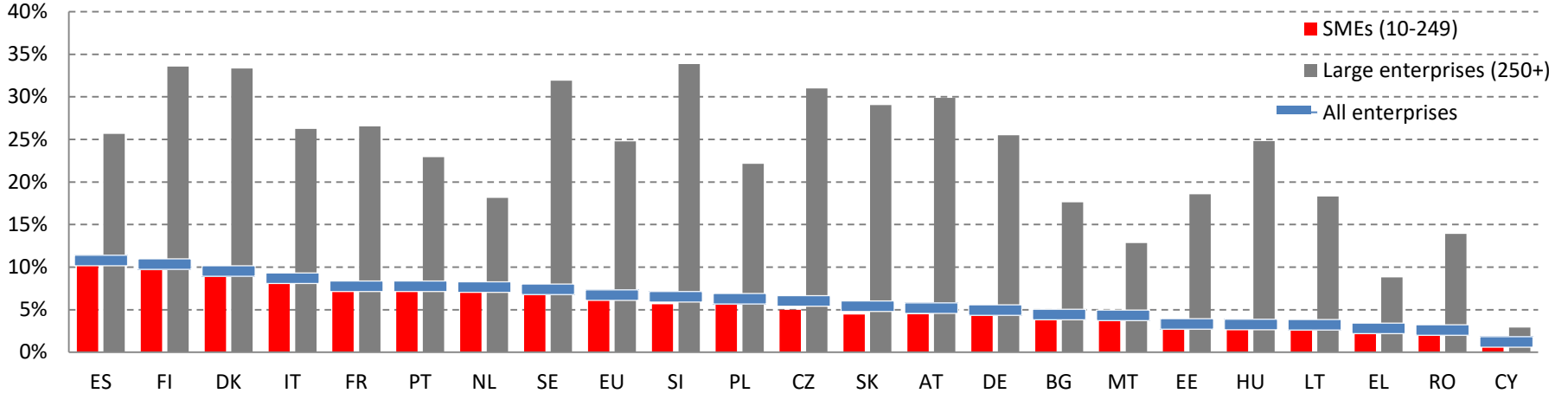
The use of robots varies strongly according to company size. Almost 25 % of large enterprises use both industrial and service robots, while the take-up rate for SMEs is four times less at only 6.2 %. More than 30 % of large enterprises use robots in Slovenia, Finland, Denmark, Sweden and Czechia. The use of industrial robots is more than twice that of service robots both in large enterprises and in SMEs.

Use of robots, EU, 2018 (% of enterprises)*



Source: Eurostat

Use of robots, 2018 (% enterprises using industrial or service robots)*



** Data not available in six EU Member States*

Source: Eurostat

More than 4 % of enterprises use 3D printing services for internal use or for products for sale.

3D printing evolves and its use extends beyond the manufacturing sub-sectors. Enterprises invest in 3D printing technologies and services for improving production and product sales.

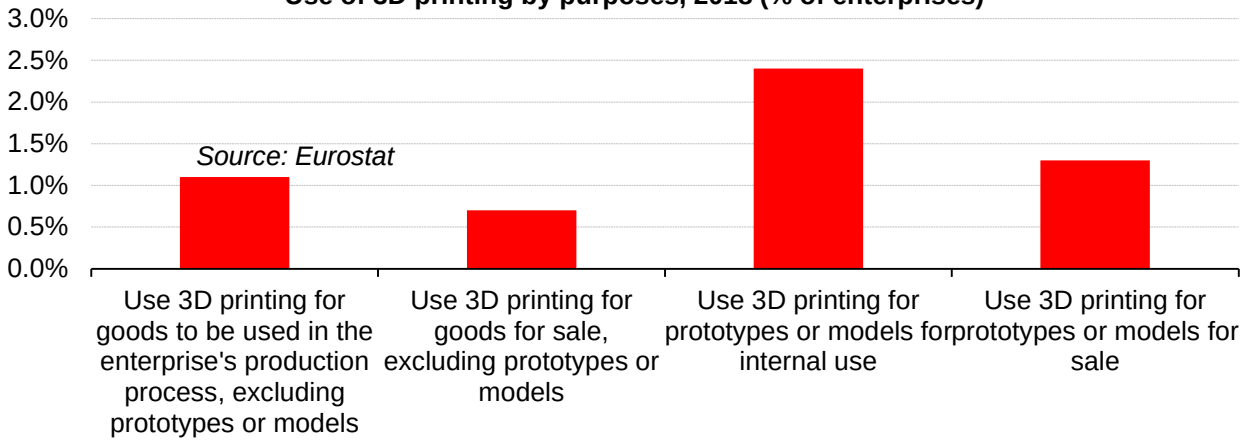
During 2018, 1.1 % of enterprises used 3D printing services for producing goods to be used in the enterprises' production process, while 0.7 % used them for printing goods for sale. 2.4 % of enterprises used 3D printing for producing prototypes or models for internal use, while 1.3 % used them for printing prototypes or models for sale purposes.

3D printing is a new technology that is not commonly used by all the enterprises. Almost 4 % of SMEs used 3D printing. Larger enterprises make greater use of 3D services (13.4 %).

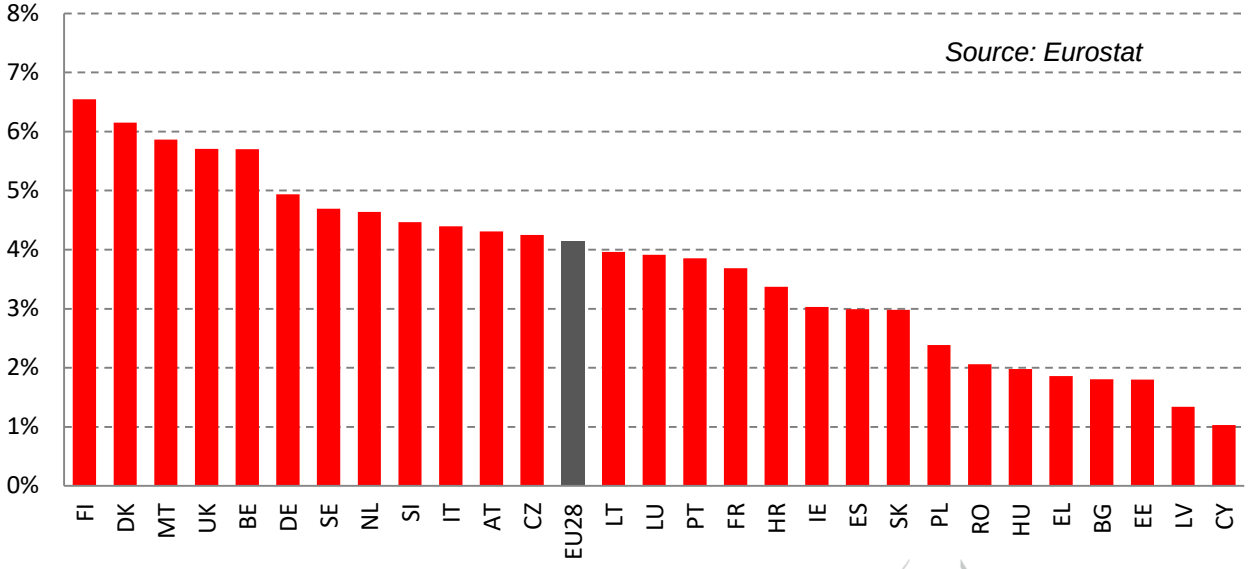
More than 6 % of Finnish and Danish enterprises use 3D printing services, while less than

1.5 % of Latvian and Cypriot enterprises use these services.

Use of 3D printing by purposes, 2018 (% of enterprises)



Enterprises using 3D printing services, 2017 (% of enterprises)



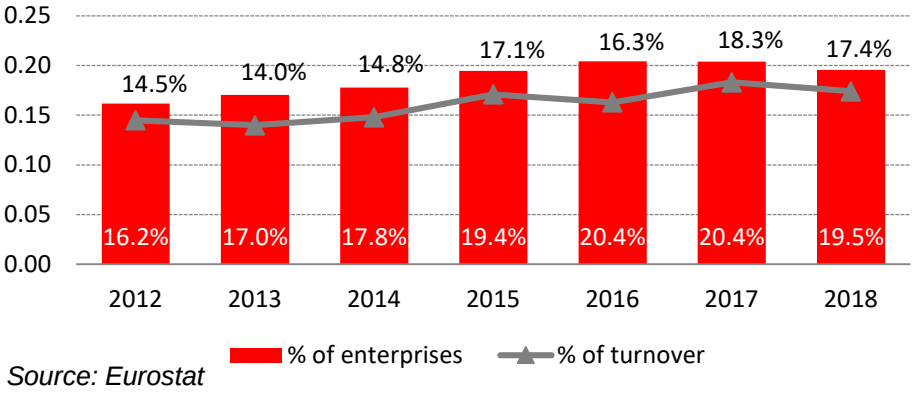
e-Commerce: only 20 % of companies make electronic sales, representing slow progress in this area. Larger enterprises are better at exploiting e-commerce possibilities.

One out of five enterprises in the EU-28 made electronic sales in 2017. The percentage of turnover on e-sales amounted to 17.4 % of the total turnover of companies with 10 or more persons employed.

In the EU-28, between 2012 and 2018, the percentage of companies selling online increased by 4.2 percentage points and the companies' turnover realised from e-sales increased by 2.8 percentage points.

** This indicator is slightly different from the 'enterprises selling online' indicator, which concerns businesses that received orders via computer mediated networks with the sales representing at least 1% of the total turnover..*

Trends in e-commerce, EU (% of enterprises, % of turnover)



Source: Eurostat

e-Sales and turnover from e-sales , by firm size, between 2012 and 2018 (% of enterprises, %of turnover)

	Enterprises with e-sales (turnover >1%) (%)			Turnover from e-commerce (%)		
	2012	2015	2018	2012	2015	2018
All enterprises	16.2%	19.4%	19.5%	14.5%	17.1%	17.4%
Large (250+)	39.3%	42.8%	42.5%	20.7%	23.7%	24.1%
SMEs (10-249)	15.5%	18.8%	18.9%	7.8%	9.4%	10.1%

Source: Eurostat

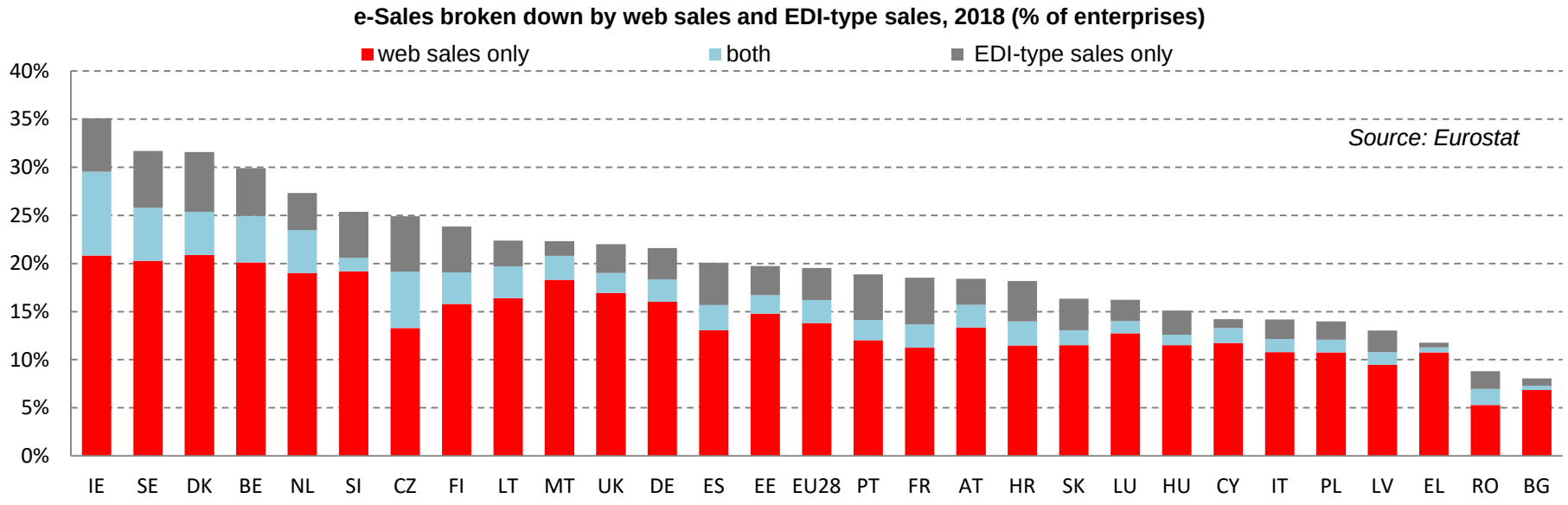
The share of companies conducting e-sales and the turnover from e-sales varies significantly according to size.

The share of SMEs making e-sales (18.9 %) is less than half compared to the share of large enterprises (42.5 %). Similarly, the share of the e-sales' turnover on the total turnover by SMEs (10.1 %) is less than the half of the share generated by the large ones (24.1 %).

Different types of e-commerce: Web and EDI-type.

e-Commerce can be broadly divided into two types: web sales and Electronic Data Interchange (EDI-type) sales, referring to the way customers place orders for products. The EDI type is the exchange of data between information systems, through a dedicated channel and according to a defined standard. It does not require human intervention except in exceptional cases.

The percentage of enterprises selling online (web or EDI type) ranged from 8 % in Bulgaria to 35 % in Ireland, followed by Sweden (32 %). Web sales, made through the enterprise own website or through third parties one (including marketplace), is the most common option for
e-sales. Around 14 % of the enterprises sell through a website, 2 % exploit both channels, while slightly more than 3 % make use of EDI-type sales.



Enterprises selling online are slowly increasing their share of sales to consumers (B2C).

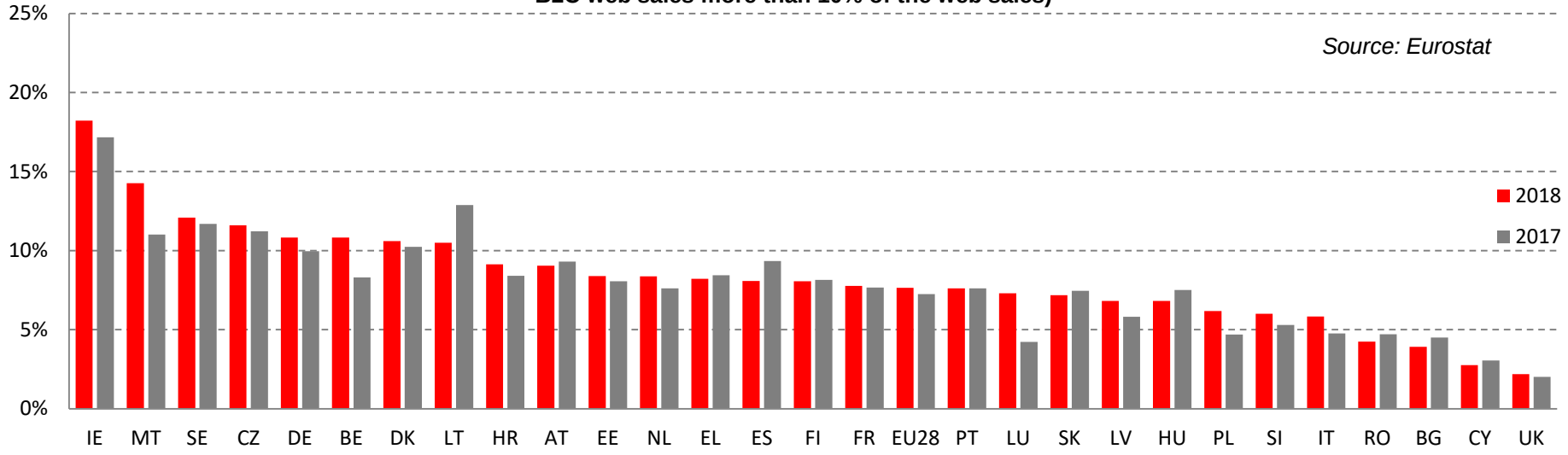
Among the EU-28, the percentage of enterprises exploiting the opportunities of e-sales to consumers (with web sales more than 1% of total turnover and B2C web sales more than 10 % of their web sales) ranged from 2.2 % in the UK to 18.2 % in Ireland. Most of the Member States increased their B2C e-sales compared to 2017. Belgium and Malta improved the most.

Large enterprises and SMEs increased their B2C share of e-sales by 21 % and 20 % respectively compared to 2015.

Enterprises exploiting the "Business to Consumers" opportunities of web sales, between 2015 and 2018 (% of enterprises)

	2015	2016	2017	2018
All enterprises	9.6%	10.5%	11.3%	11.5%
Large (250+)	13.3%	13.6%	15.8%	16.1%
SMEs (10-249)	9.5%	10.4%	11.1%	11.4%

Enterprises exploiting the "Business to Consumers" opportunities of web sales, 2017-2018 (% of enterprises with B2C web sales more than 10% of the web sales)



Source: Eurostat

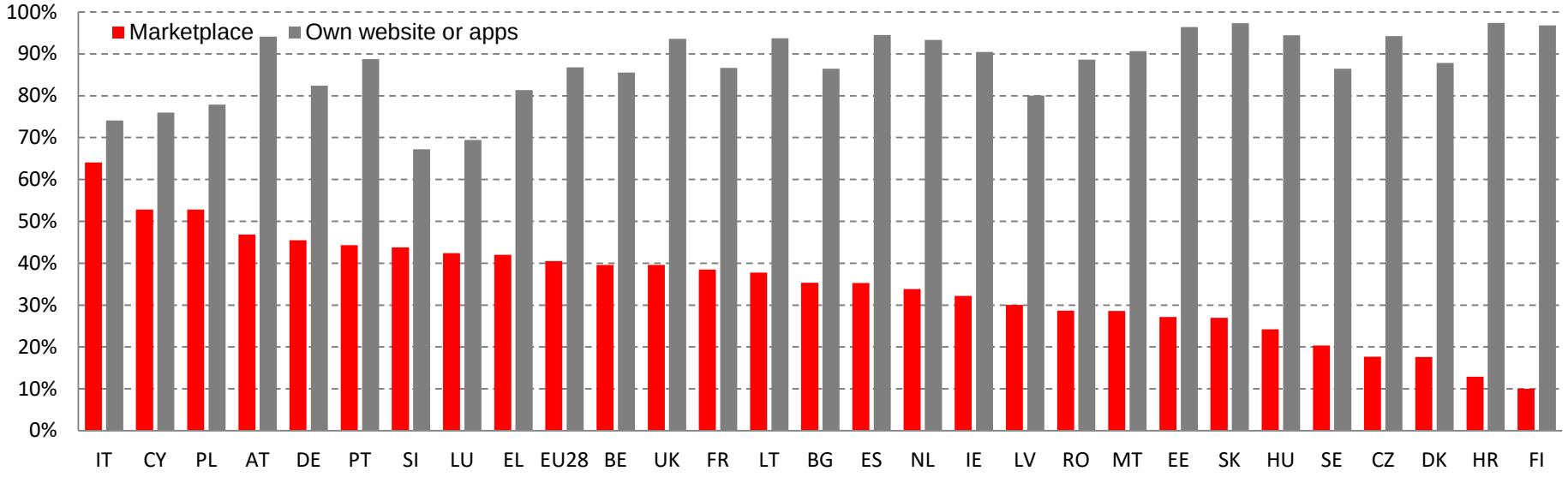
Businesses are starting to become active on online marketplaces. More than twice as many companies with web sales sell on their own website or apps than in marketplaces.

As regards web sales, it is necessary for an enterprise to disentangle its web sales made through a marketplace, available on external websites, from those done through its own website. e-commerce marketplaces and general online platforms may facilitate economic growth by enabling sellers to access new markets and reach new customers at lower cost. This option has been exploited at EU level by 40 % of enterprises with web sales against 87 % using their own website or apps.

Altogether 13 EU Member States reported that over 90 % share of enterprises with web sales via own sites, with Croatia, Slovakia, Finland and Estonia are leading in this group of countries.

Companies in Finland, Croatia, Denmark and Czechia have the lowest percentages of web sales via marketplaces (below 20 %). Selling online via marketplaces was the most common option in Italy (64 %), Cyprus and Poland (both 53 % of enterprises with web sales).

Web sales broken down by own website or apps and marketplace, 2018 (% enterprises with web sales)



Source: Eurostat

The share of turnover from web sales via companies' own website or apps is greater than that from web sales via marketplaces.

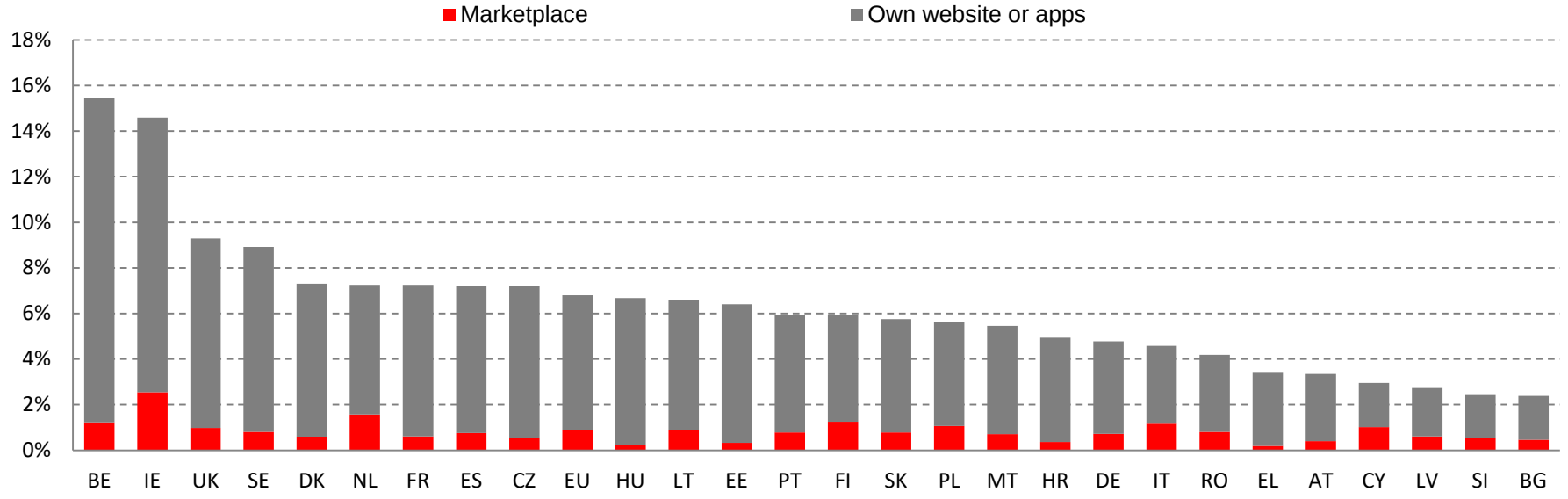
In the EU-28, companies gained 7 % of their total turnover from web sales. 87 % of it (equal to 6 % of total turnover) was gained from web sales via own website or apps and only 13 % (equal to 1 % of total turnover) from sales via online marketplaces.

Turnover from sales on own websites or apps had the highest share in total turnover in Belgium (14.2 %), Ireland (12 %), the UK (8.3 %) and Sweden (8.1 %).

The highest share of turnover from selling via the marketplace (from the total turnover of the firm) was gained in Ireland (2.5 %) and the Netherlands (1.6 %).

When looking at the composition of the web sales turnover, companies in Cyprus gained 35 % of their web sales turnover through sales on marketplaces, while companies in Italy gained 25 %.

Turnover from web sales broken down by own website or apps and marketplace, 2018 (% total turnover)



Source: Eurostat

Use of Internet Services

Digital Economy and Society Index Report 2019
Use of internet services

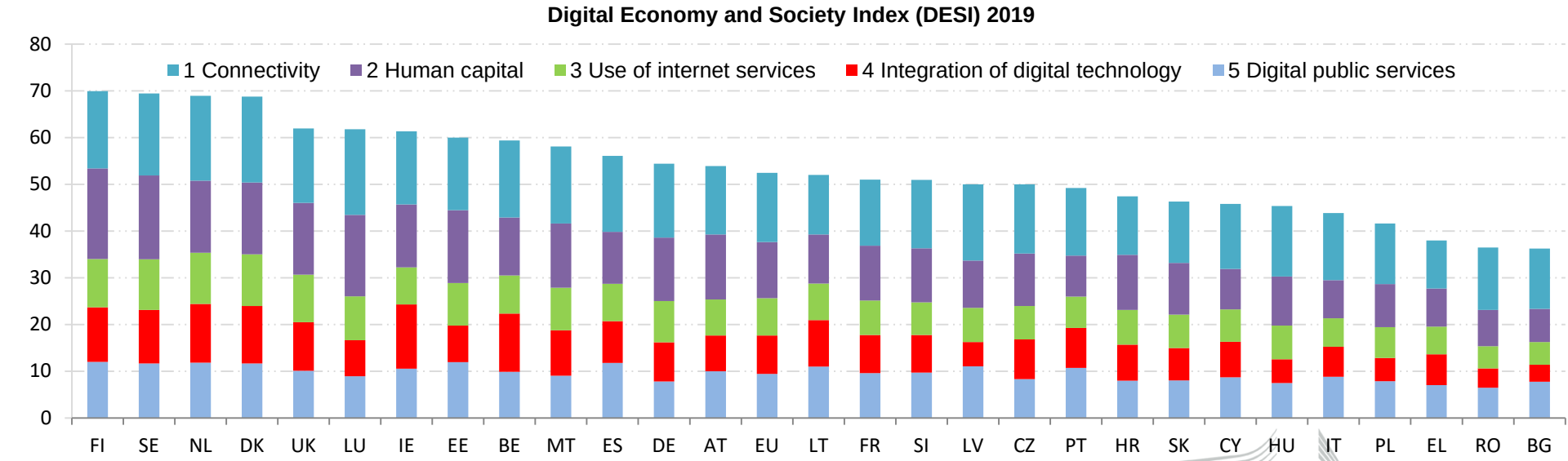
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the progress of EU Member States in digital competitiveness.

Finland, Sweden, the Netherlands and Denmark, have the most advanced digital economies in the EU followed by the UK, Luxembourg, Ireland and Estonia.

Bulgaria, Romania, Greece and Poland have the lowest scores on the index.

The five dimensions of the DESI

1 Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2 Human capital	Internet user skills and advanced skills
3 Use of internet	Citizens' use of internet services and online transactions
4 Integration of digital technology	Business digitisation and e-commerce
5 Digital public services	e-Government and e-health

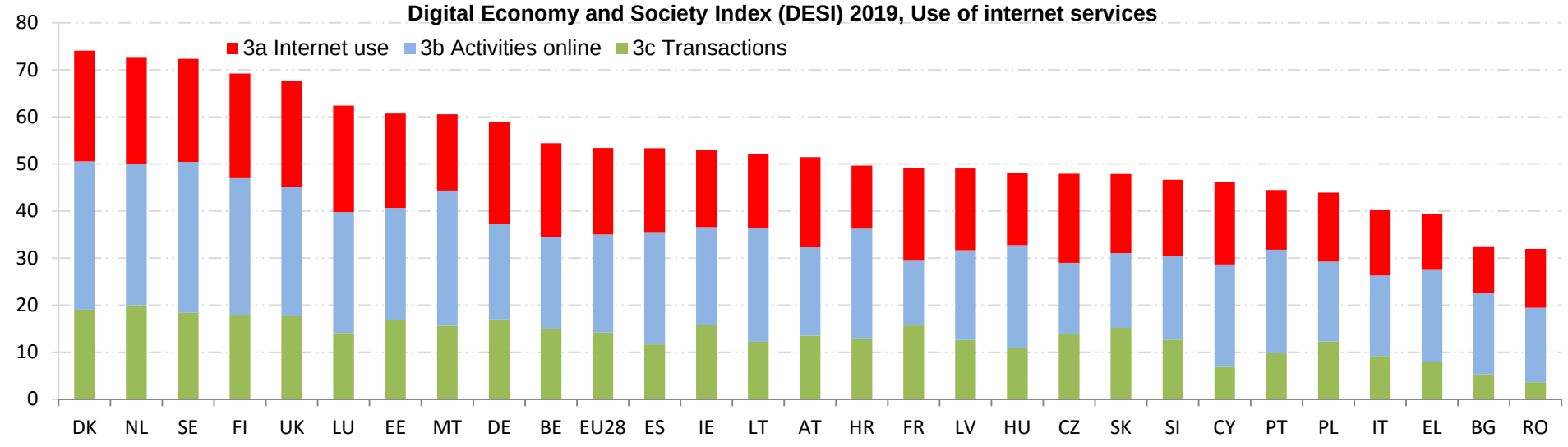


Source: DESI 2019, European Commission

There are still large disparities across EU Member States regarding the use of internet services.

People in the EU engage in a range of online activities — they actively use the internet to get news, browse social networks, communicate, shop, use online banking services and much more. Such activities are captured in DESI's Use of internet services dimension. Denmark, the Netherlands, Sweden and Finland have the most active internet users, followed by the UK, Luxembourg, Estonia and Malta. Romania, Bulgaria and Greece are, by comparison, the least active.

Ireland and Lithuania are the Member States that have registered the largest improvement in this dimension compared with the previous edition (4 percentage points) closely followed by the UK, Italy, Croatia and Greece, also making significant progress in comparison to results of DESI 2018.



Source: DESI 2019, European Commission

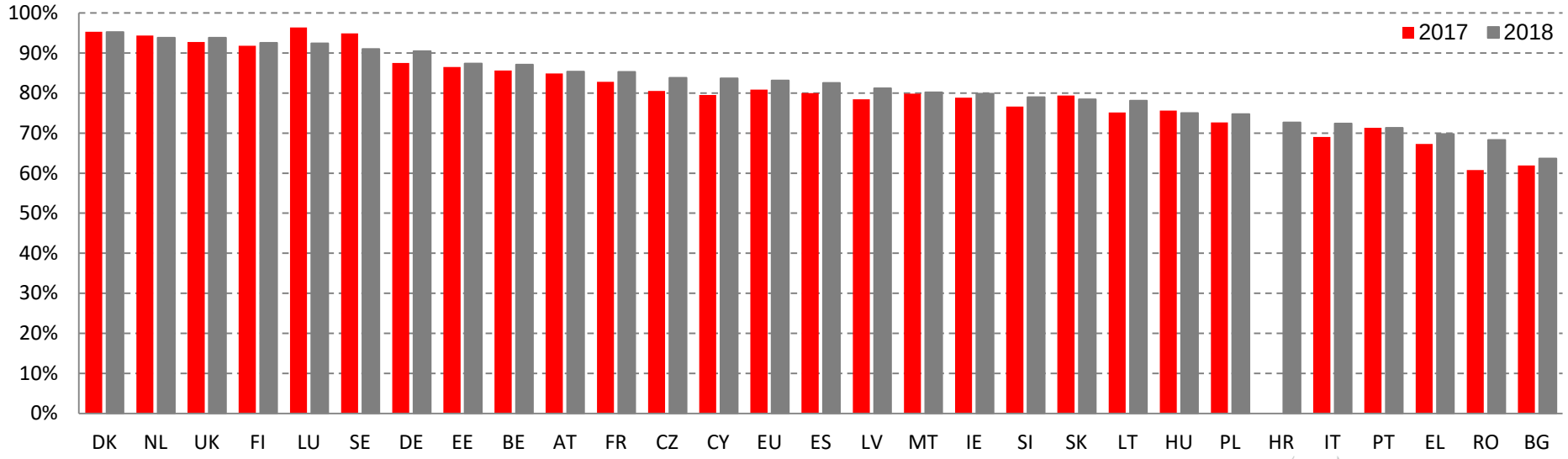
The differences in regular internet use shrank further in 2018. However, in some Member States, over a third of the population still does not regularly go online.

In Member States such as Denmark, the Netherlands, the UK and Finland, the vast majority of the population uses the internet at least once a week. The countries in the process of catching up with these top-performing Member States, such as Germany, Estonia, Belgium and Austria saw further improvements in this respect in 2018.

Spain, Latvia and Malta also made significant progress and now stand very close to the EU average. Noteworthy increases were also recorded in both Romania (+ 8 percentage points compared with 2017) and Cyprus (+ 4 percentage points).

31 % of Romanians and 36 % of Bulgarians still do not go regularly online. The largest number of internet users are young individuals (97 % for 16-24 year olds) and those who have a high-level of formal education (97 %).

Regular internet use in the EU, 2017-2018 (% of individuals)

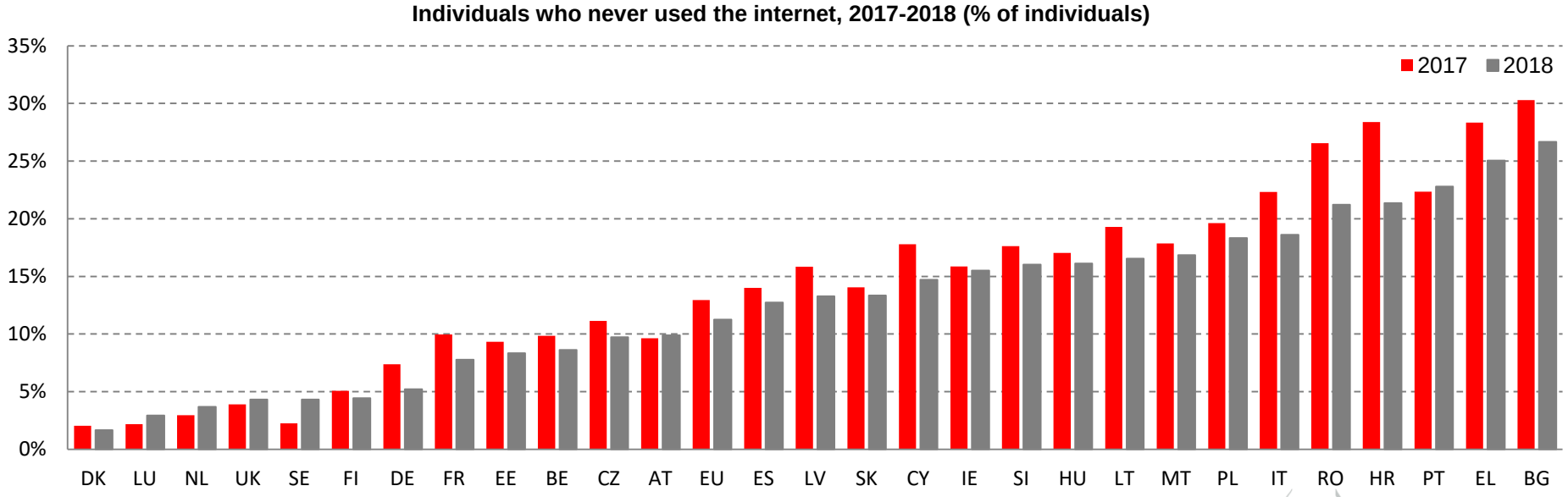


Source: Eurostat

The share of people in the EU who have never gone online decreased again in 2018, although the current share of 11 % warrants further actions. Despite convergent trends, large disparities remain across Member States.

The share of people in the EU not using the internet fell in nearly all Member States in 2018. Still every 10th European has never used the internet. Denmark, Luxembourg, the Netherlands, the UK, Sweden and Finland are countries where the share is even below 5 %. The share is still significantly large in Bulgaria (27 %), Greece (25 %), Portugal (23 %), Croatia and Romania (both 21 %).

The Members States with the largest reductions were Croatia with a drop of 7 percentage points, Romania with a drop of 5 percentage points, and Italy and Bulgaria, both with a drop of 4 percentage points. People with low education levels or on low incomes, as well as the elderly, the retired or the inactive tend to use the internet comparatively less.



Source: Eurostat

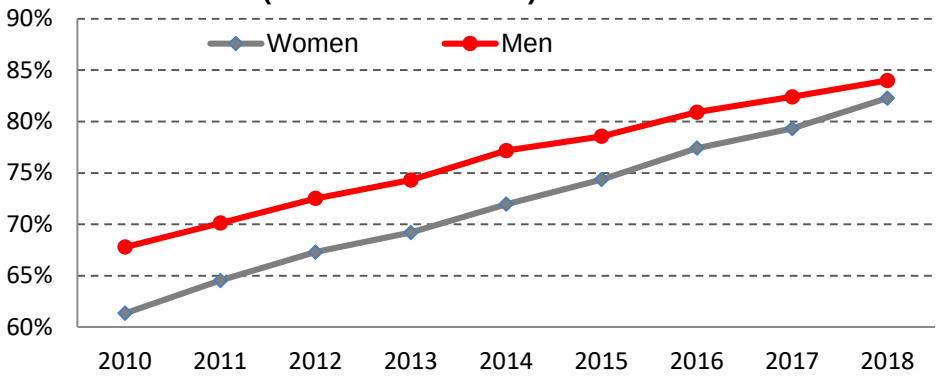
83 % of people in the EU go online at least weekly. A gender gap persists but it is narrowing. The elderly and those with low education levels or on low incomes continue to be at risk of digital exclusion.

In 2018, 83 % of Europeans used the internet at least weekly and about 76 % daily or almost every day, compared with 81 % and 72 % respectively a year earlier.

Proportionately, men use the internet more than women do (at least weekly: 84 % against 82 %; daily or almost: 75 % against 77 %), although the difference is narrowing.

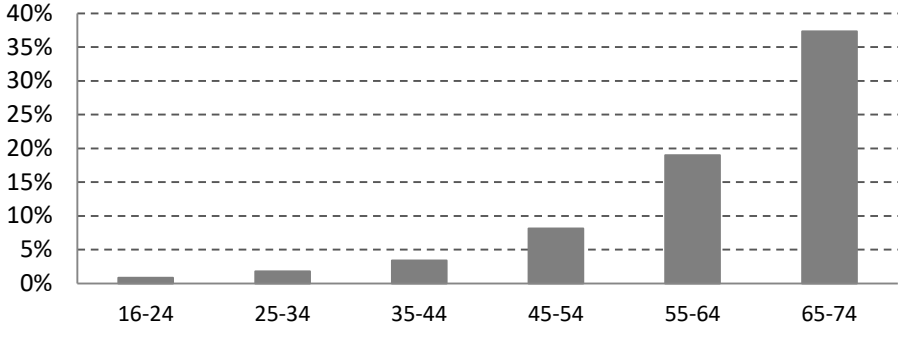
The gender gap persists but continues to narrow, reaching 1.7 % in 2018 against 6.4 % in 2010.

Gender gap between individuals who are regular internet users (at least once a week) between 2010-2018



Source: Eurostat

Individuals who have never used the internet by age, 2018



Source: Eurostat

89 % of households in the EU have internet access but the share of individuals who have never used the internet is still significant. It is the highest among 65-74 year olds (37 %), while among 16-24 it is less than 1 %.

Similar proportions are seen based on the education level – 27 % of individuals with no or a low-level of education and 1 % of individuals with a high-level of formal education. People from these groups continue to be at a high risk of digital exclusion.

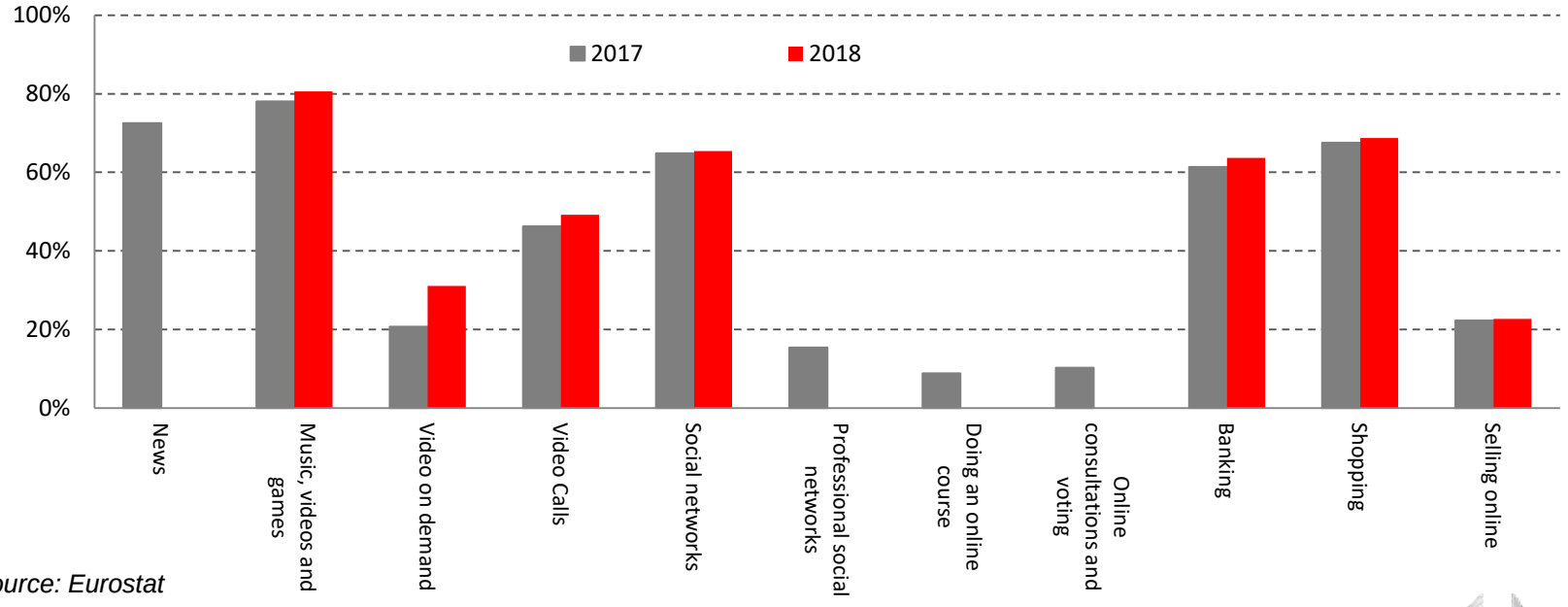
Growth in the use of online services is generally slow, although use of the internet for video on demand picked up significantly in 2018.

As in the previous edition of DESI, annual variation in the different activities considered in the Use of internet services dimension has been limited. The percentage of people using the internet for video calls, banking, music videos and games increased moderately (about 3 percentage points in each). The largest increase was in use of the internet for video on demand, where the share of users went from 21 % in 2016 to 31 % in 2018.

Reading news online is second the most popular activity performed by internet users. Shopping and participating on social networks are also very popular. While doing an online course is among the least popular activities online, it is relatively widespread in Sweden and Finland with 18 % and 17 % of internet users participating in these in 2017.

It is also not that common for users to participate in professional social networks, create professional profiles, or create content and post it online.

Use of internet services in the EU, 2017-2018, selected indicators (% of internet users)



Source: Eurostat

Almost every third internet user (31 %) watched video on demand in 2018.

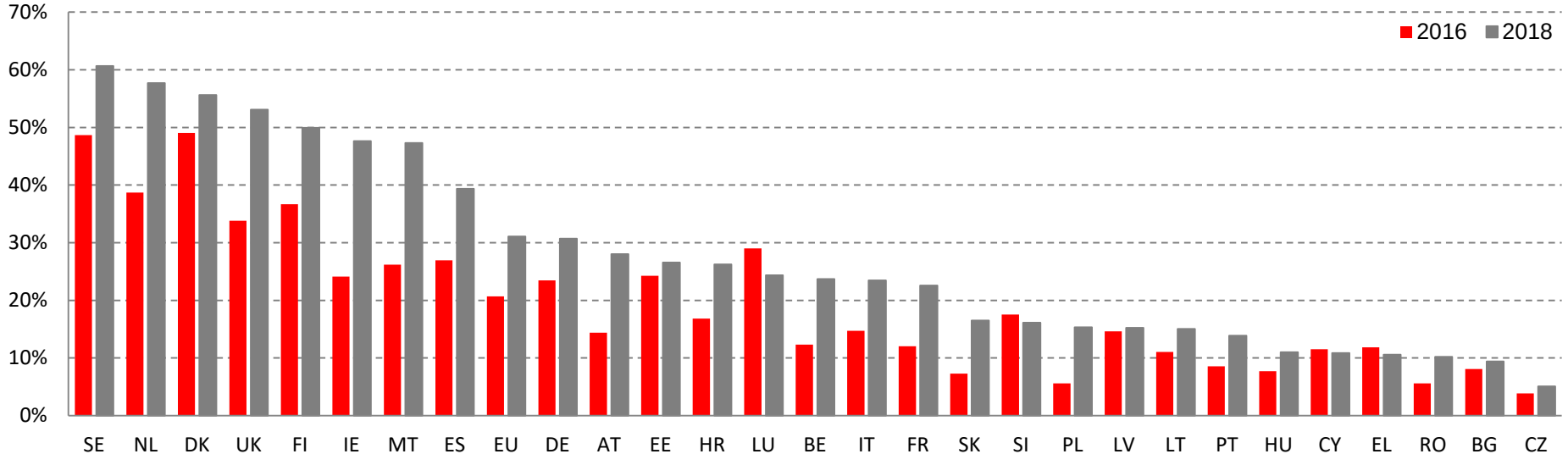
In 2018, 31 % of internet users watched video on demand (21 % in 2016). Among 16-24 year olds, the share of users watching video on demand reached 51 %, whereas this figure was 25 % for the 45-54 year olds, 17% for the 55-64 year olds and 11 % for 65-74 year olds.

The countries with the largest proportion of internet users who watched video on demand (above 50%) were Sweden (61 %), the Netherlands (58%), Denmark (56 %) and the UK (53 %). Czechia (5 %), Bulgaria (9 %), Romania (10%), Greece, Hungary and Cyprus (11 % each) had the lowest proportion.

Among female internet users there was an increase of 11 percentage points between 2016 (18 %) and 2018 (29 %). A similar trend was observed for male internet users with an increase of 10 percentage points from 23 % in 2016 to 33 % in 2018.

The largest increases in the proportion of internet users watching video on demand were registered in Ireland (24 percentage points) followed by Malta (21 percentage points).

Individuals watching video on demand, 2016-2018 (% of internet users)



Source: Eurostat

Participation in online social networks increased moderately in the EU in 2018, reaching 65 % of internet users.

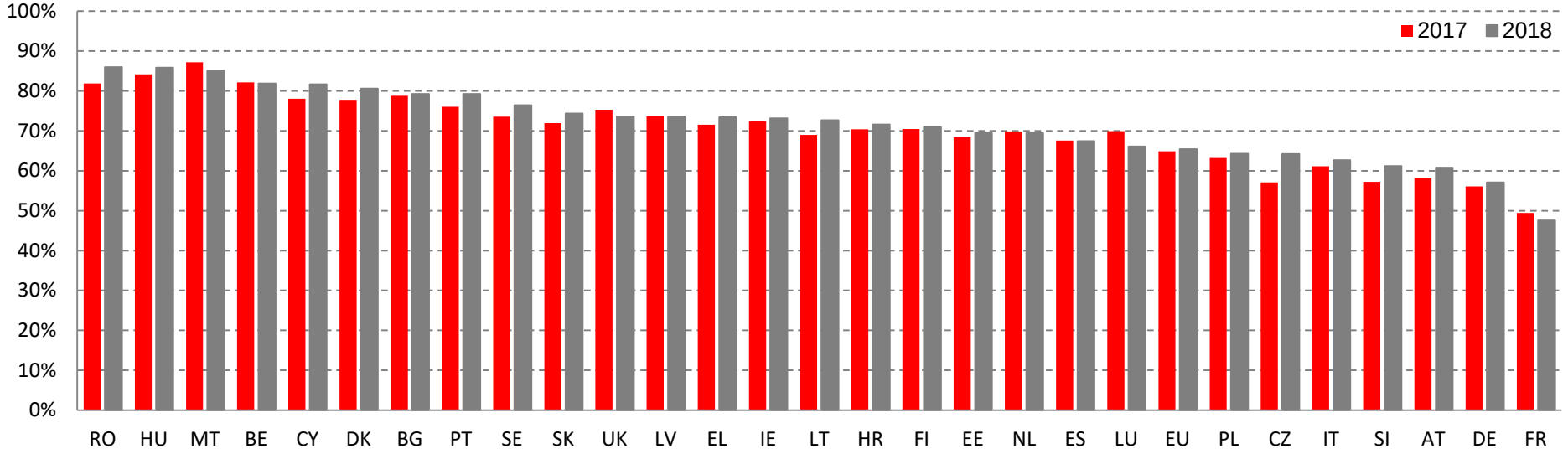
In 2018, 65 % of internet users participated in social networks. Among 16-24-year olds, the proportion of users participating in social networks reached close to 90 %, whereas this figure was 57 % for 45-54 year olds.

The countries with the largest proportion of internet users participating in social networks were Romania and Hungary (86 %), followed by Malta (85 %), and Belgium and Cyprus (both 82 %).

The largest increases in the proportion of internet users participating in social networks between 2017 and 2018 were registered in Czechia (7 percentage points) followed by Romania and Slovenia (4 percentage points each).

France had the lowest proportion of users (48 %), followed by Germany (57 %), and Austria and Slovenia (both 61 %).

Participation in social networks, 2017-2018 (% of internet users)



Source: Eurostat

Participation in online professional social networks is still very low in the EU, oscillating at around 15 % of internet users in 2017.

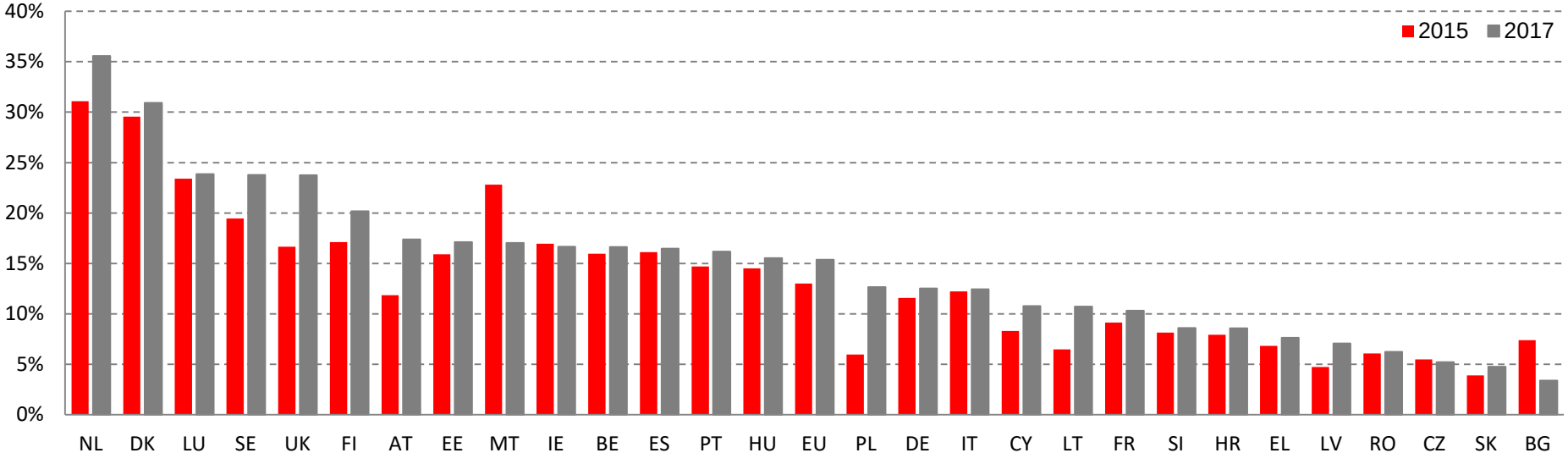
In 2017, 15 % of internet users participated in professional social networks, a small increase (2 percentage points) from 2015.

The countries with the largest proportion of internet users using professional social networks were the Netherlands and Denmark (36 % and 31 %), followed by Luxembourg, Sweden and the UK (reaching 24 %).

Bulgaria had the lowest proportion of users (3 %), followed by Slovakia (5 %).

The largest increases in the proportion of internet users participating in professional social networks between 2015 and 2017 were registered in the UK (7 percentage points) followed by Poland (7 %) and Austria (6 %).

Participation in professional social networks, 2015-2017 (% of internet users)



Source: Eurostat

The upward trend in e-commerce continued in 2018, with around 69 % of EU internet users now shopping online.

In 2018, 69 % of internet users ordered goods and services online and 23 % of individuals sold goods or services online, using, among other means, online auctions.

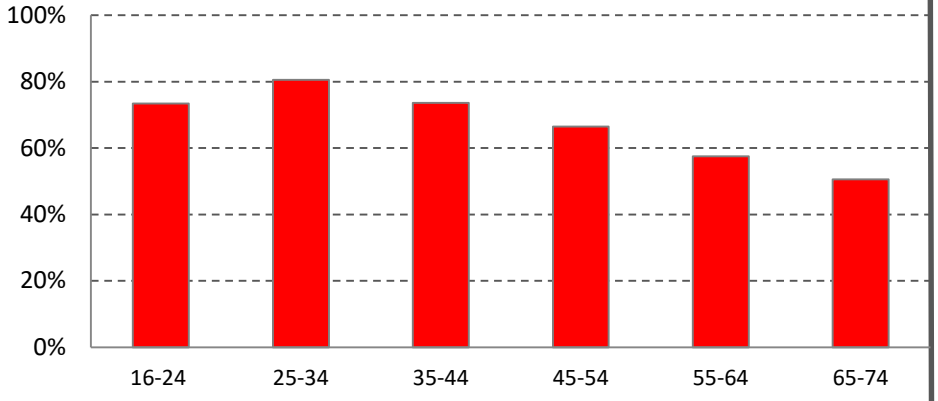
e-Commerce varies considerably across EU Member States. In 2018, 87 % of internet users in the UK shopped online compared to only 26 % in Romania.

The largest annual increase in the proportion of internet users engaging in e-commerce was in Ireland (5 percentage points).

e-Commerce is affected by age, level of education and employment situation. There was a slightly higher share of men shopping online than women (69 % and 68 % respectively).

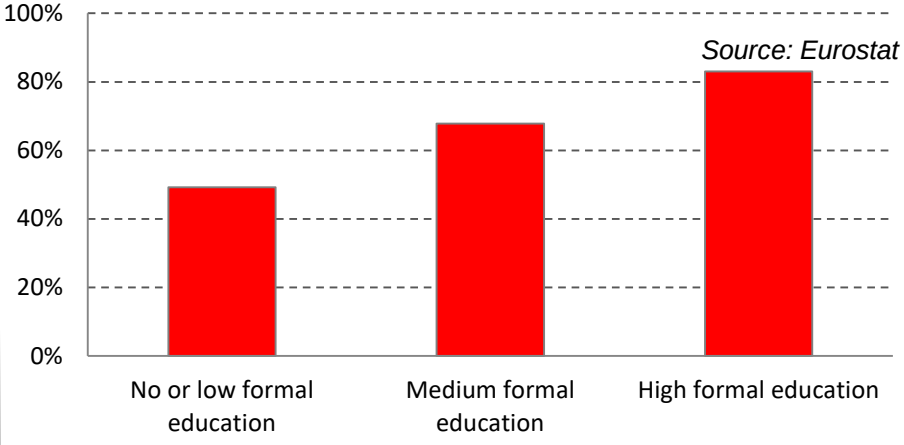
Young people make up the most active age group of online shoppers is (81 % of 25-34-year-olds); while the proportion of internet users with a higher level of education shopping online (83 %) is 34 percentage points higher than those with lower-level formal education. Employees and the self-employed (75 %) together with the students (70 %) are very active online shoppers.

Individuals buying online by age groups, 2018



Source: Eurostat

Individuals buying online by education levels, 2018



Source: Eurostat

The most popular goods and services purchased in 2018 were clothes and sport goods, followed by travel accommodation services and household goods.

In 2018, the most popular categories of goods and services purchased online in the EU were clothes and sport goods (64 % of online buyers), travel and holiday accommodation (53 %), household goods (45 %), tickets for events (39 %), and books, magazines and newspapers (32 %).

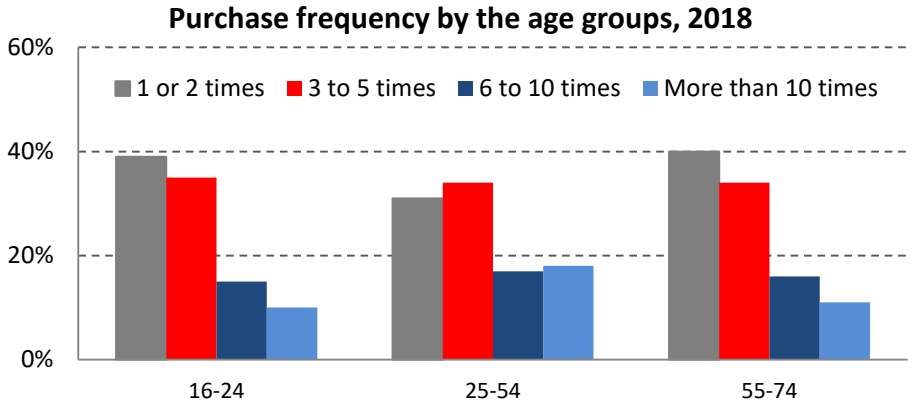
Fewer than one in five purchases were for telecommunication services (20 %), computer hardware (17 %), medicines (14 %) and e-learning material (7 %).

Online shoppers aged 16-24 and 25-54 favoured clothes and sports goods in their online purchases (72 % and 67 % respectively).

Among people aged 16-24 almost every third purchase was either computer software (31 %), films and music (29 %) or electronic equipment (26 %)

People aged 25-54 were the most frequent buyers of household goods (50 %), tickets for events (41 %), food or groceries (28 %) and telecommunication services (20 %).

The older (55-74) age group took the lead in buying books, magazines and newspapers (34 %), medicines (19 %), and travel and holiday accommodation (55 %), which was also popular among those aged 25-54 (55 %).



Source: Eurostat

41 % of online shoppers claimed to have spent between EUR 100 and EUR 499 on online purchases over the previous three-month period. Every 10th person aged 25-54 spent more than EUR 1000. Among 16-24 year-olds the small value purchases (between EUR 50 and EUR 100) are the most common (27 %).

People aged 25-54, in turn, tend to make more frequent purchases: every third person purchased between 3 to 5 times (34 %), 17 % of online shoppers in this group bought online 6-10 times and 18 % even more than 10 times in 2018.

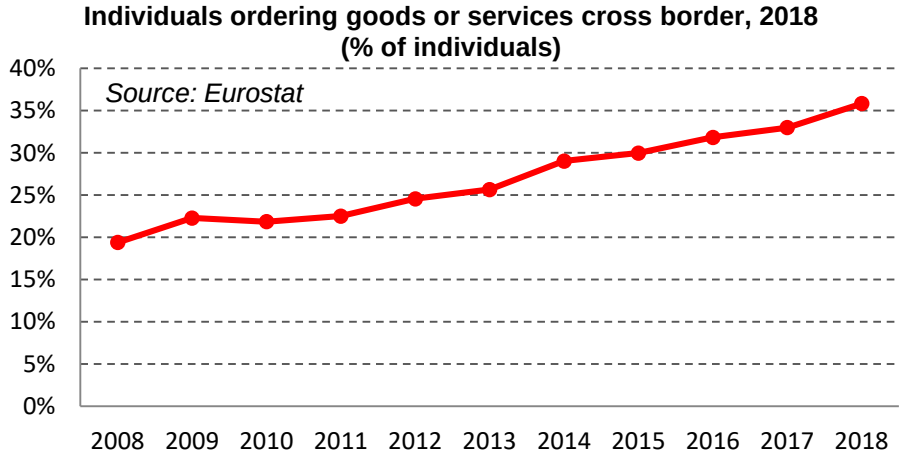
Only 36 % of online shoppers ordered cross-border goods and services from other EU countries in 2018.

In 2018, although 69 % of internet users in the EU shopped online, cross-border online shopping is advancing more slowly. Among online shoppers, 36 % made online purchases from sellers in other EU countries and 26 % from sellers in non-EU countries in 2018, compared with 25 % and 13 % respectively in 2012.

Among online shoppers, who made purchases over 2018, 88 % bough goods or services from national sellers. There was an increase in purchases from sellers in other EU countries (from 30 % in 2015 to 36 % in 2018) and from sellers outside the EU (from 37 % in 2015 to 46 % in 2018).

The extent of cross-border e-commerce differs substantially between Member States, as it ranges from 3 % of internet users in Romania and 7 % in Poland to 61 % in Luxembourg and 59 % in Malta.

A number of factors including country size and language influence buying goods and services from other EU Member States. For example, Luxembourg, Malta and Austria, which have relatively small home markets and have strong language connections with other large European countries, have higher shares of cross-border e-commerce.



Among internet users who made cross border purchases in 2017, 80 % bought or ordered tangible goods such as: electronics, clothes, toys, food, groceries, books, and CDs/DVDs.

Lower proportions of internet users booked online travel, accommodation or made holiday arrangements (34 %).

Only 16 % bought or ordered other services, such as e-tickets for events (sport events, concerts or other entertainment events) or telecommunication services (subscription of telephone services, SIM cards).

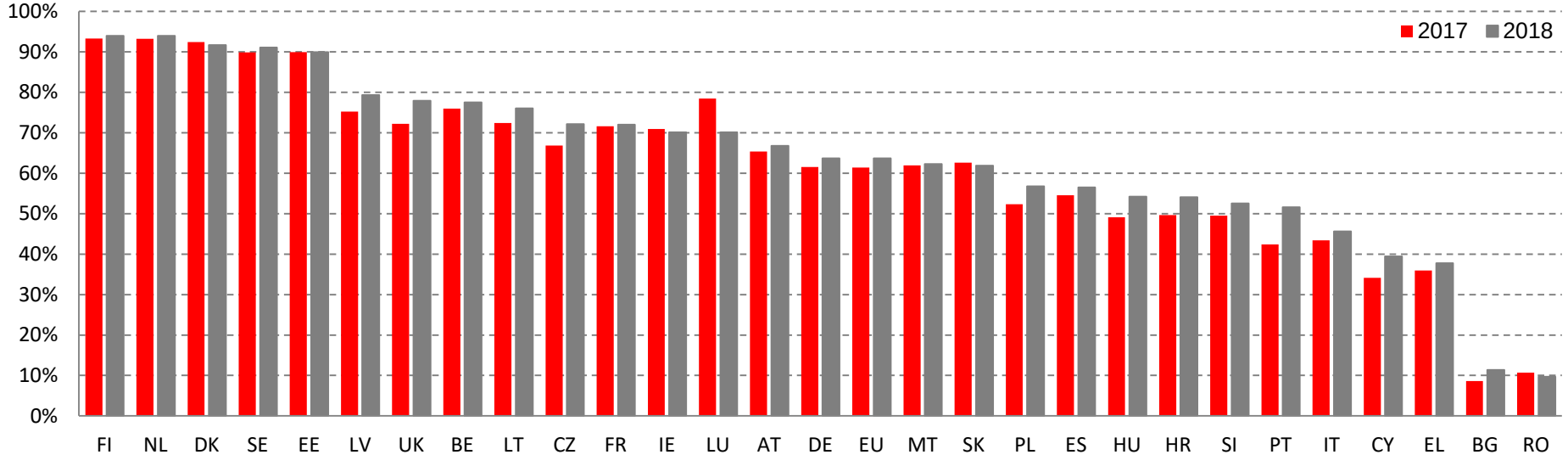
64 % of EU internet users used online banking in 2018, although a large majority of them still do not in a number of Member States.

Online banking is a relatively common activity among internet users in the EU. 64 % used internet banking in 2018, a 3 percentage points annual increase from 2017.

In 2018, high shares of internet users doing online banking were recorded in the Netherlands and Finland (both 94 %), Denmark (92 %) and Sweden (91 %) in 2018. Large differences remain across Member States, with Romania (10 %) and Bulgaria (11 %) having the lowest shares. The highest increase in 2018 was observed in Portugal.

Among individuals with a high-level of formal education the share reached 80 %, while it was half of that for individuals with no or low formal education (41 %). Among 25-34 year olds, the share reached 75 %, and 70 % for 35-44 year olds.

Individuals who used internet banking in previous 3 months (% of internet users), 2017-2018



Source: Eurostat

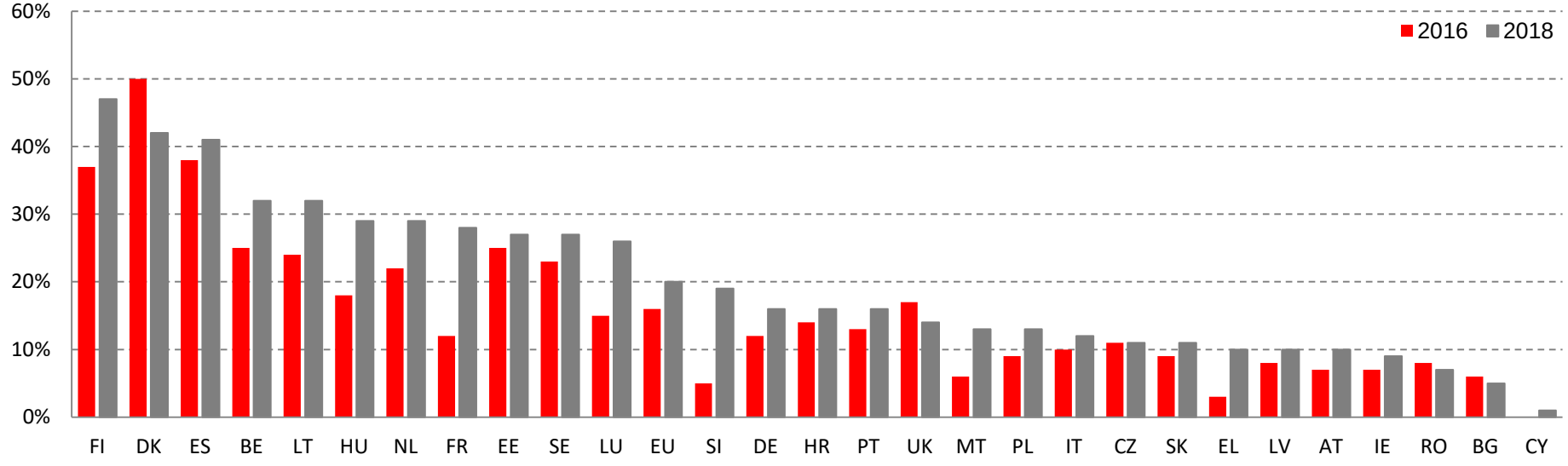
Seeking health information on the internet is widespread, but only one-fifth of EU internet users made an online appointment with practitioner in 2018.

Using the internet to seek health-related information is widespread across the EU. 60 % of EU internet users, sought out health-related information online in 2018, with the Netherlands (76 %), Hungary and Finland (both 74 %) having the highest share.

On average, only 20 % of EU internet users went online to make an appointment with a practitioner in 2018. Across the EU Member States, this figure ranges from over 47 % in Finland and 42 % in Denmark to 1 % in Cyprus and 5 % in Bulgaria.

From 2016, the biggest increase was observed in France (16 percentage points) and Slovenia (14 percentage points). Denmark and the UK were two countries where the highest drop between 2016 and 2018 was observed (8 percentage points drop for Denmark and 3 percentage points drop for UK).

Making an appointment with a practitioner via website, 2016-2018 (% of internet users)



Source: Eurostat