European Commission

Broadband Coverage in Europe 2016

Mapping progress towards the coverage objectives of the Digital Agenda

FINAL REPORT

A study prepared for the European Commission
DG Communications Networks, Content and Technology
by:

IHS Markit™ POINT topic

Digital Single Market

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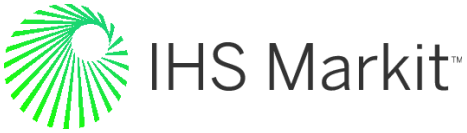

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Executive Summary

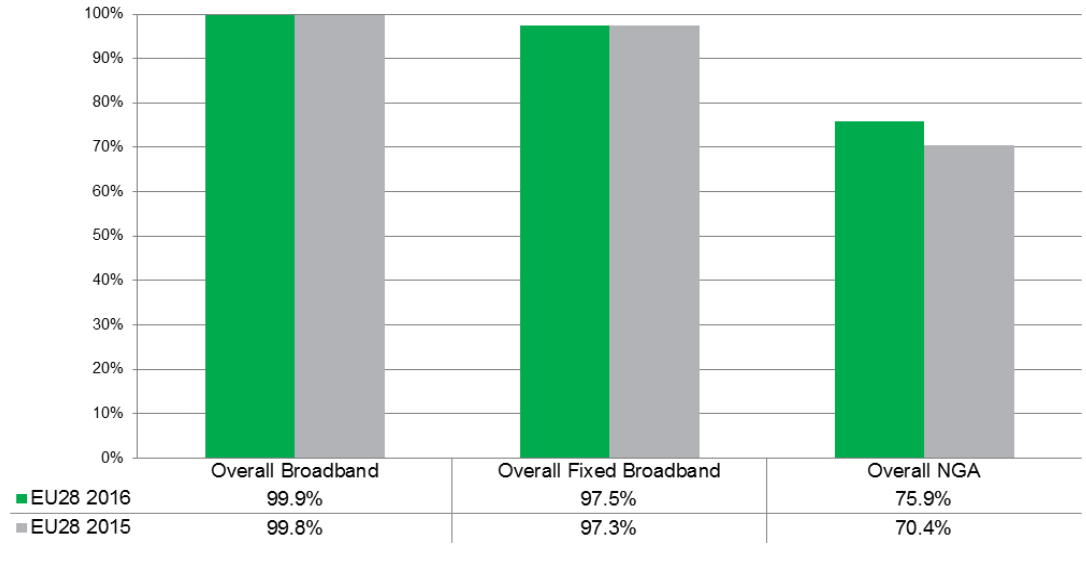
- The Broadband Coverage in Europe study is designed to monitor the progress of EU Member States toward their specific broadband coverage objectives – namely: 'Universal Broadband Coverage with speeds at least 30 Mbps by 2020' and 'Broadband Coverage of 50% of households with speeds at least 100 Mbps by 2020'.

- In 2016, DG Connect selected the IHS Markit in partnership with Point Topic to run the project. The research team surveyed NRAs and telecommunications groups across each participating state to compile the requisite information. Both IHS Markit as well as Point Topic have previously conducted the broadband coverage research. Point Topic was the incumbent provider introducing the original research methodology in the period 2010-2012. IHS Markit (in cooperation with VVA) delivered the study from 2013-2015 and adopted similar data collection and analysis methods to those implemented by Point Topic in order to ensure comparability of datasets for the purposes of time-series assessment.

- The collected data reflects the situation at the end of June 2016 compared to the situation at the end of June 2015. In editions of the study prior to 2015, the collected data reflected the situation at the end-of-year (i.e. end of December). The timeline of the data collection for the 2015 edition of the BCE study was moved forward in order to align reporting of the broadband coverage data with the publications of the Digital Economy and Society Index and the European Semester related country assessments.

- This report covers 31 countries across Europe – the EU28, plus Norway, Iceland and Switzerland, and analyses the availability of nine broadband technologies (DSL, VDSL, cable modem, DOCSIS 3.0, FTTP, WiMAX, HSPA, LTE and satellite) across each market, at national and rural levels. In addition, three combination categories indicating the availability of one or more forms of broadband coverage are also published. These cover overall fixed and mobile broadband availability, fixed broadband availability and next generation access (NGA) availability.

EU28: Coverage by technology combination, 2016



	Overall Broadband	Overall Fixed Broadband	Overall NGA
EU28 2016	99.9%	97.5%	75.9%
EU28 2015	99.8%	97.3%	70.4%

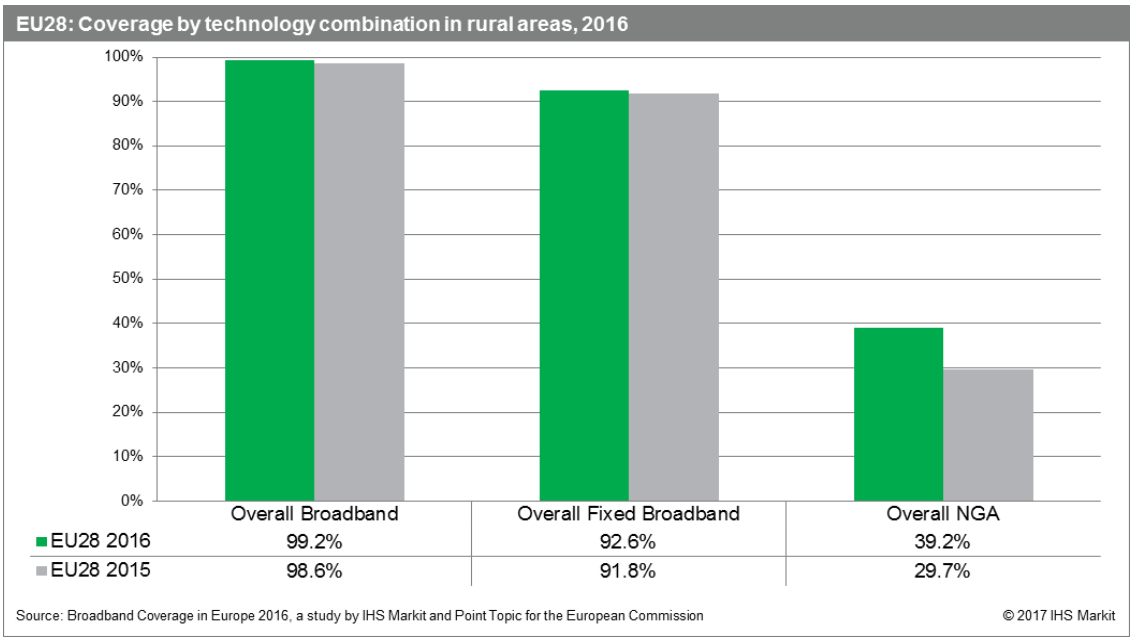
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

- The collected data shows that over 218 million EU households (99.9%) had access to at least one of the main fixed or mobile broadband access technologies at the end of June 2016 (excluding satellite). This equates to a 0.1 percentage point increase, or 1.4 million additional households, compared to the end of June 2015.

- Overall fixed broadband coverage increased by 0.2 percentage points, reaching 97.5% of households by mid-2016, an equivalent of an additional 1.5 million households and 213 million EU households in total being passed by fixed broadband access technologies.

- Next generation access services (VDSL, DOCSIS 3.0 and FTTP) continued to increase at a similar rate to the previous edition of the study, rising by 5.5 percentage points to cover 75.9% of households across the EU Member States by mid-2016. This translates to 12.8 million new households, meaning that over 166 million households in the EU had access to next generation broadband by the end of June 2016.

- Rural broadband coverage remains considerably lower than national coverage across EU Member States. While 92.6% of rural EU households were covered by at least one broadband technology in mid-2016, less than 40% (39.2%) had access to next generation services.

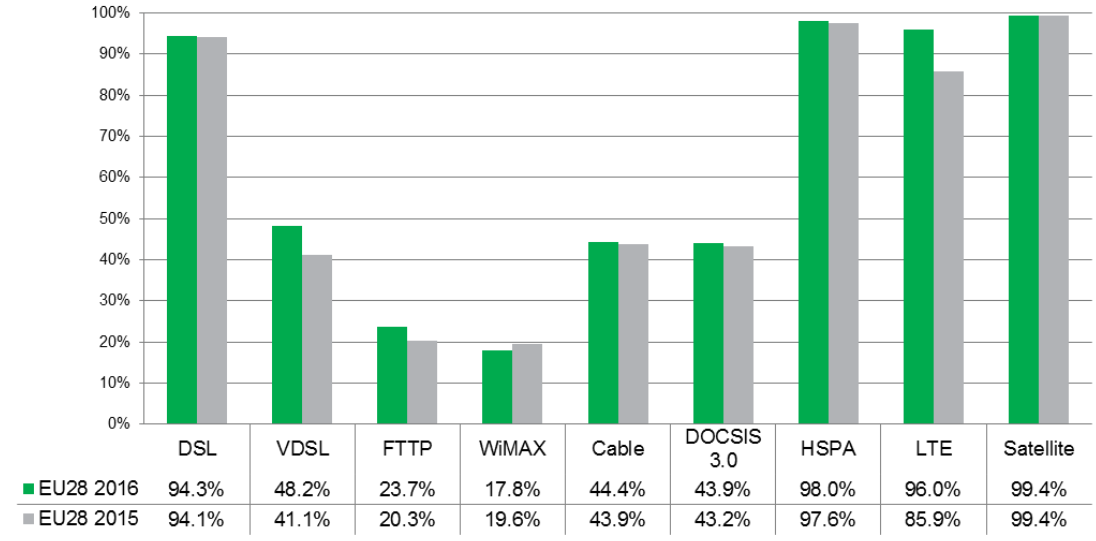


- Satellite broadband remained the most pervasive technology in Europe in terms of overall coverage. However, satellite coverage is still limited in the Baltic countries and is absent in Iceland.

- DSL continued to be the most widespread fixed access technology, reaching 94.3% of EU households by mid-2016, an improvement of 0.2 percentage points. Cable networks were the second most prevalent fixed access technology, covering 44.4% of EU homes (up from 43.9% at the end of June 2015). WiMAX was the only broadband technology to record a reduction in coverage, decreasing by 1.8 percentage points to 17.8%. This is a consequence of many operators discontinuing their WiMAX networks in order to redistribute the spectrum for LTE services.

- VDSL maintained its lead among NGA technologies with a 7.1 percentage point coverage increase in the twelve-month period to mid-2016, making it the fastest growing fixed broadband technology for the fifth consecutive year. At the end of June 2016, VDSL services were available to nearly a half (48.2%) of EU households and as such VDSL continues to be the key driver of NGA coverage growth across the EU.

EU28: Coverage by technology, total



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
EU28 2016	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%
EU28 2015	94.1%	41.1%	20.3%	19.6%	43.9%	43.2%	97.6%	85.9%	99.4%

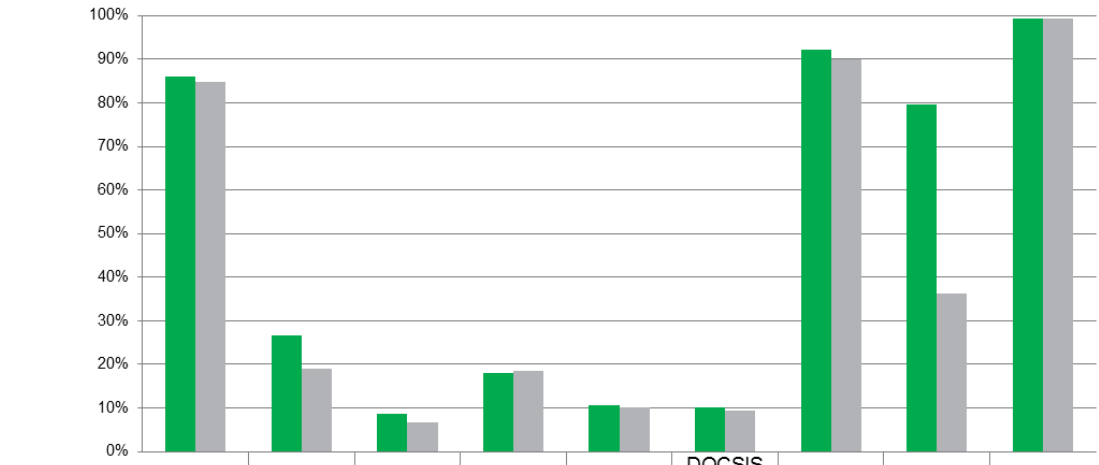
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

- The number of EU households passed by FTTP networks increased by 3.4 percentage points to reach 23.7% of EU households at the end of June 2016. Whilst this represented slower growth than for VDSL services, it was notably faster than increase in DOCSIS 3.0 coverage, which grew by only 0.7 percentage points to reach 43.9% of EU households.

- Examining mobile broadband technologies, availability of LTE services continued to expand at a fast pace and following a 10.1 percentage point increase, LTE networks covered 96.0% of EU homes at the end of June 2016. A considerable growth making LTE networks nearly as widespread as HSPA networks, which passed 98.0% of EU households by mid-2016.

- Limitations remain in terms of rural broadband coverage. By mid-2016, fixed broadband services were available to 92.7% of rural households across the EU. This is nearly 5 percentage points less than total fixed coverage. The difference was much greater for NGA technologies with rural NGA coverage reaching 39.2% rural homes compared to 75.9% at a national level. Nevertheless, the gap between rural and national coverage, for both fixed and NGA technologies, is declining compared to previous editions of the study suggesting increasing investment in rural broadband.

EU28: Coverage by technology, rural areas



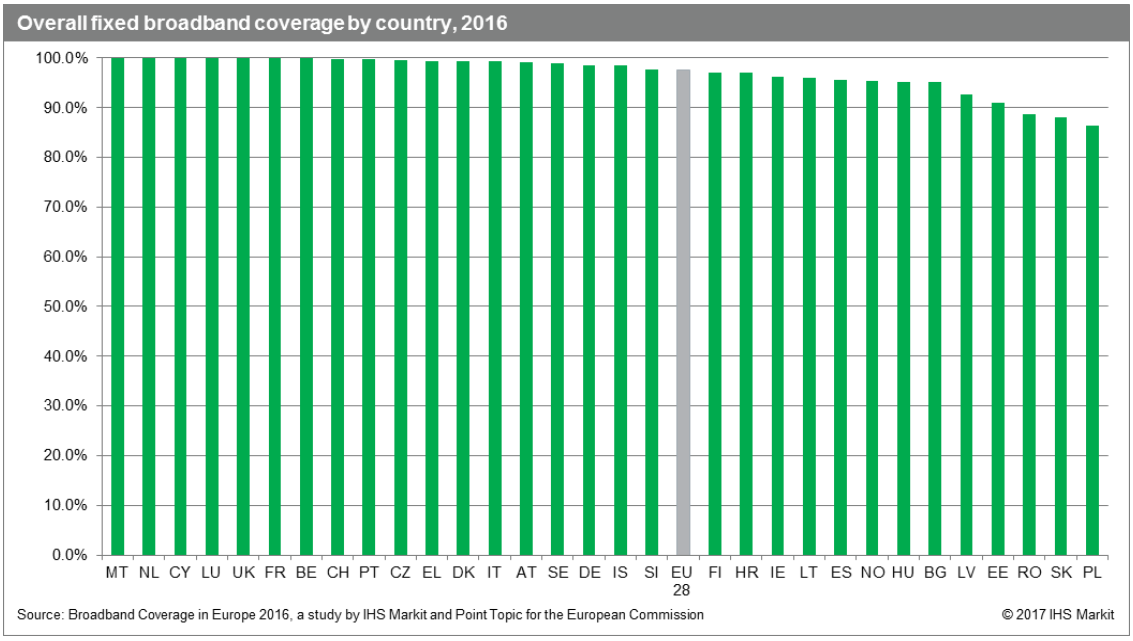
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
EU28 2016	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%
EU28 2015	84.8%	18.9%	6.7%	18.6%	10.1%	9.4%	89.9%	36.3%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

- As in previous years, the highest growth in rural fixed broadband coverage was reported for VDSL. What is more, rural VDSL coverage grew at a faster rate than in previous years, rising by 8.2 percentage points, to reach 26.6% of rural EU homes by mid-2016. This improvement reflects the continued investment of predominantly incumbent operators to upgrade existing DSL networks in rural areas.

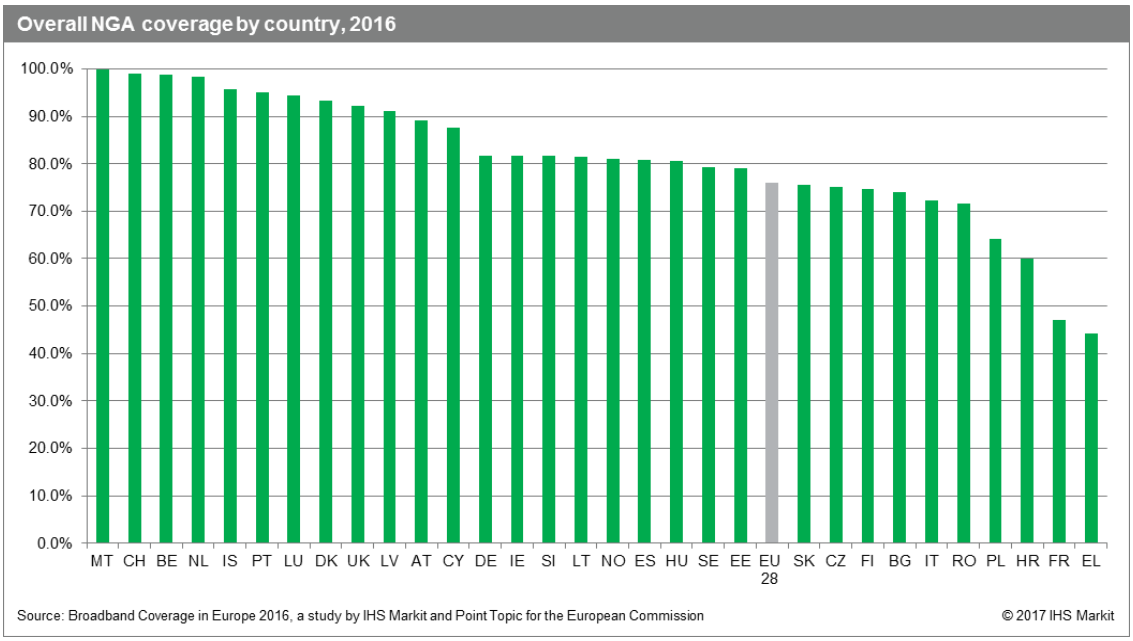
- By mid-2016, HSPA coverage reached 92.2% of rural households compared to 89.9% in mid-2015. Growth in rural LTE coverage was considerably faster in the twelve-month period to mid-2016, increasing by a staggering 43.4 percentage points to 79.7%.

- Out of the 31 study countries, 26 countries reported fixed broadband coverage of above 95.0%, while 19 countries had fixed broadband coverage above the EU28 average (97.5%). A number of countries registered complete, or near-complete, fixed broadband coverage including Malta, Luxembourg, Cyprus, the Netherlands and the United Kingdom. Three countries, Romania, Slovakia and Poland, recorded fixed coverage of less than 90% of households by mid-2016.



- Malta remained the only country to report complete coverage for NGA technologies, while Switzerland, Belgium, the Netherlands, Iceland and Portugal all reported coverage levels at or above 95%.

- Out of the 31 study countries, 21 countries reported NGA coverage above the EU28 average (76.0%). As in the previous edition of the study, Greece reported the lowest proportion of homes passed by NGA networks. In addition to Greece, France was the only other country to report NGA availability of below 50.0% of households in mid-2016.



- Looking at mobile broadband technologies, all of the study countries reported HSPA coverage levels above 95%, with the exception of Germany (92.1%) and Slovakia (90.7%). During the twelve months to mid-2016, LTE technology has become near-universal in many study countries, with LTE coverage reaching 99% of households in eleven study countries. In addition, LTE coverage now reaches similar levels to those of HSPA networks.

1.0 Introduction

In order to foster the development of network-based knowledge economy and stimulate growth the European Commission has been promoting strategies to encourage digital opportunities and enhance Europe's leading position in digital economy. In May 2015, the Digital Single Market (DSM) strategy was adopted to eliminate online barriers, which hamper free movement of goods and services online and mean that businesses, governments and individuals cannot fully benefit from digital tools that would be available to them but that are currently locked in 28 different regulatory environments.

The European Commission estimates that once completed, a DSM could create up to €415 billion per year and generate hundreds of thousands new jobs. The DSM strategy is based on three pillars:

1. Access: better access for consumers and businesses to digital goods and services across Europe;
2. Environment: creating the right conditions and a level playing field for digital networks and innovative services to flourish;
3. Economy & Society: maximising the growth potential of the digital economy.

However, in order for the consumers, businesses and governments to fully benefit from the provisions of the DSM, it is essential that access to digital infrastructure is ensured by facilitating roll out of reliable high-speed broadband networks across Europe.

In 2010, the Digital Agenda for Europe (DAE) was drawn as one of the flagship initiatives of the Europe 2020 strategy and included specific broadband coverage targets stretching to 2020:

- Universal broadband coverage of speeds above 30 Mbps by 2020
- 50% broadband coverage of speeds above 100 Mbps by 2020.

The Digital Scoreboard serves as a tool for assessing progress towards these targets. Broadband availability metrics are also a component of the Digital Economy and Society Index (DESI) that summarises indicators on Europe's digital performance and Member States digital competitiveness. One of DESI's five dimension measures focuses on connectivity and measures the deployment and quality of broadband infrastructure.

In order to monitor the progress of the broadband networks deployment across the Member States, DG Connect (the European Commission Directorate General for Communications Networks, Content and Technology) has commissioned the Broadband Coverage in Europe (BCE) project to measure the household coverage of all the main fixed and wireless broadband technologies with a specific focus on Next Generation Access (NGA) technologies. In 2013, DG Connect selected the consortium of IHS Markit & VVA to run the three-year project. In 2016, IHS Markit partnered with the previous research provider of the BCE study, Point Topic, and was subsequently chosen to continue to deliver the broadband coverage research for the period 2016-2018.

The European Commission publishes and analyses the data in the Digital Scoreboard. A number of broadband coverage indicators are also included in the Digital Economy and Society Index (DESI) and the European Semester related country assessments. In order to align reporting of the broadband coverage data with the publications of the DESI, the broadband coverage data collection has been scheduled to reflect the situation at the end of June (i.e. half-year data rather than year-end data points are collected). This change was first implemented in the 2015 edition of the BCE study and has been carried on going forward.

As in previous years, the study is primarily based on a survey of broadband network operators and National Regulatory Agencies (NRAs) to obtain a Europe-wide picture of the coverage of the nine main broadband technologies. The study was to cover thirty countries including the EU28, Norway, and Iceland. A separate study was commissioned by Glasfasernetz Schweiz to conduct identical research of broadband coverage in Switzerland. Results of the study are also included in this report increasing the total number of study countries to 31.

The nine broadband technologies analysed in this study are:

- DSL (including VDSL)
- VDSL
- Cable modem (including DOCSIS 3.0)
- DOCSIS 3.0
- FTTP (Fibre-to-the-property)
- WiMAX
- HSPA
- LTE
- Satellite

Coverage of these technologies is reported on national and rural level based on the number of homes passed by each individual technology.

The study also aims, as requested by DG Connect, to estimate the overall coverage of "combination" of technologies accounting for the overlap of the different technologies capable of delivering a comparable level of performance. The combination categories included in this study, and similar to previous years, are:

- Overall broadband coverage
    - Includes all the main broadband technologies, both fixed and mobile, but excludes satellite
    - Combination of DSL (including VDSL), cable modem (including DOCSIS 3.0), FTTP, WiMAX, HSPA and LTE

- Overall fixed broadband coverage
    - Includes all the main fixed-line broadband access technologies, but excludes satellite
    - Combination of DSL (including VDSL), cable modem (including DOCSIS 3.0), FTTP, and WiMAX

- Next Generation Access (NGA) coverage
    - Includes fixed-line broadband access technologies capable of achieving download speeds meeting the Digital Agenda objective of at least 30 Mbps coverage
    - Combination of VDSL, DOCSIS 3.0, and FTTP

Due to the fact that multiple operators may deploy their networks in the same or similar areas, particularly in urban and more densely populated locations, it is necessary to take into account the possibility of overlapping coverage when determining the technology combinations.

The methodology used in this report mirrors the approach developed by Point Topic in 2012, adopting regional approach to measuring overlapping and complementary coverage. Coverage data was collected on a regional level using NUTS 3 statistical units as a research basis. The NUTS (Nomenclature of Units for Territorial Statistics) areas are geographical subdivisions generally based on existing national regional divisions of EU countries and associated countries (such as Norway, Iceland and Switzerland). More specifically, NUTS 3 level areas are smaller regional units of 150,000 to 800,000 inhabitants. There are 1,357 NUTS 3 areas in the 31 study countries. With general statistical data (such as population, household, and area size) readily available on NUTS 3 level, using this regional approach provides a comprehensive and detailed view of broadband coverage across Europe and allows for a year-to-year comparison with the BCE 2012-2015 data.

In addition to individual technology coverage and combination technology coverage, DG Connect required coverage by download speed to be included in the study. The following speed categories were thus included among the research metrics:

- Coverage by broadband network/s capable of at least 2 Mbps download speed

- Coverage by broadband network/s capable of at least 30 Mbps download speed

- Coverage by broadband network/s capable of at least 100 Mbps download speed

Coverage by speed categories was first estimated by IHS Markit in the 2013 edition of the BCE study. By including this additional metric, it is possible to obtain an additional analytical layer to evaluate the study countries' progress towards the Digital Agenda goals and determine the actual speeds consumers will be able to receive on the particular networks available to them.

In the Tender Specifications for SMART 2016/0043, DG Connect also requested additional mobile coverage data to be collected in order to better reflect availability of mobile broadband services for European consumers as well as to take into account the mobility aspect connected with mobile networks accessibility.

Therefore, in addition to the standard coverage metrics, the research team provided DG Connect with data on average LTE coverage in each study country. This measurement took into account coverage of all LTE network operators, calculating average household/population coverage level in order to better represent an actual user experience, as a typical user will only be able to use one mobile network at a time. This indicator was included as one of the components of the DESI Connectivity dimension.[1]

To address the mobility aspect of mobile networks coverage, the research team introduced a new metric looking at coverage of transportation networks in each study country. As this was a completely new metric with untested methodology, the research team applied varied approach to estimating the transportation coverage consisting of information provided by the mobile networks operators, NRAs, desk research. In addition, we have compared household and landmass coverage and used Point Topic's European Kilometre Grid database and the Corine landmass database to determine population settlements within sparsely populated and/or geographically challenging regions in order to provide fair assessment of availability of mobile services.

Given the varying level of available information, the research team decided to take the 2016 transportation coverage data collection as a testing ground for this metric with the aim to further evolve the methodological approach in the next iterations of the study. Therefore, following discussions with DG Connect, a decision has been made to keep the 2016 transportation coverage results for internal purposes. The research team will continue to develop a more robust methodology with further help from NRAs and operators.

Furthermore, the Tender Specifications also asked for the research team to provide additional insight into the Machine-to-Machine (M2M) communications needs. M2M connectivity is increasingly important in terms of M2M applications' reliance on availability of universal and uninterrupted broadband connectivity. The research team has included a short chapter in the Appendix of this report outlining the existing M2M applications currently deployed in the Member States and their connectivity needs.

[1] DESI Indicator 1b2: 4G coverage (DESI 2017).

The following table details the scope of the Broadband Coverage in Europe 2016 study.

Scope	Description of Broadband Coverage Metrics
Geographical coverage	• EU28 + Iceland, Norway and Switzerland • Rural and national coverage
Technologies	The following technologies are included: • DSL (excluding VDSL) • Cable modem (excluding DOCSIS 3.0) • HSPA • FTTP (Fibre to the Home and Fibre to the Building) • VDSL • Cable modem DOCSIS 3.0 • LTE • WiMAX • Satellite The study also covers the following technology combinations: • Overall broadband coverage (including DSL, VDSL, FTTP, Cable modem, Cable modem DOCSIS 3.0, WiMAX, HSPA and LTE) • Overall fixed broadband coverage (including DSL, VDSL, FTTP, Cable modem, Cable modem DOCSIS 3.0 and WiMAX) • NGA coverage (including VDSL, FTTP and cable modem DOCSIS 3.0)
Speeds	The study covers the following speed categories: • At least 2 Mbps download • At least 30 Mbps download • At least 100 Mbps download
Mobile coverage	Additional mobile metrics are included in the 2016 edition of the study: • Average LTE coverage (average of operators in each study country) • HSPA and LTE coverage of transportation infrastructure

Acknowledgements

It would not be possible to deliver the results of this project without the support of all involved parties. First and foremost, the IHS Markit and Point Topic team would like to thank all survey respondents, both regulators and operators, who took the time to fill in the BCE questionnaire and provide us with the fundamental information and data that form the core of this study. We are very grateful for their involved and responsible approach in addressing the demanding request for information and data. While the figures in our deliverables might not always be exactly the same as those provided by respondents (due to a number of complex factors, such as different statistical bases or definitions), the research team always attempted to prioritise data received directly from respondents and reflect this information in our estimates as much as possible.

The research team is also grateful to the FTTH Council Europe and IDATE, for kindly sharing information from their research of FTTx coverage across Europe. While in most cases the team relied on data collected though the survey, IDATE's data proved to be an important additional source of information.

Last but certainly not least, we would like to thank DG Connect for their active involvement throughout all stages of the project.

2.0 Project Objectives

The specific objectives of the study can be set out as below:

- Collect coverage data on a country, regional, and rural level for different technologies through:
  - a survey of operators (ISPs) and National Regulatory Authorities (NRAs);
  - a review of alternative sources (e.g. operator websites, white papers, consultant reports);

- Estimate coverage for different technology and speed combinations; and

- Write up a final report on the findings on EU and country-level and prepare a database with statistical data.

3.0 Methodological approach in detail

The methodological approach used in the 2016 edition of the Broadband Coverage in Europe study mirrors the approach used in the 2013-2015 studies, which was in turn based on a methodology first implemented by Point Topic in 2012. Applying the same methodological approach allows the research team to ensure both consistency and year-on-year comparability of the data.

As in previous years of the project, a survey of NRAs and broadband network operators forms the core of this study. The survey results were validated and cross-checked against additional information gathered from other sources (including public announcements by telecoms groups) in parallel with the survey data collection. The additional research also helped to fill in any gaps, which resulted from incomplete information from NRAs or operators. Lastly, survey data and additional information were combined and used to calculate national coverage by individual technologies as well as the combination coverage categories and speed coverage categories for all study countries.

The timeline of the data collection for the 2016 edition of the BCE study follows an amended schedule first implemented for the 2015 edition of the study. This means that the collected information reflects the situation at the end of June (i.e. half-year data rather than year-end data points were collected).

The following chapters of this report provide a detailed description of the project's methodology.

3.1 Survey design and data collection

For the sake of consistency, the research team used similar wording and formatting of the survey questionnaire as in 2012-2015. Using near-identical question wording enables the research team to deliver findings which can be compared with research undertaken in previous years.

Where possible, the research team contacted survey participants that were approached for the 2012-2015 data collection. During the previous data collection the IHS Markit research team updated and expanded the list to include new contacts in already surveyed companies and organisations as well as those companies that were not previously approached. The fact that the BCE project is a long-running project means that most respondents are familiar with the study as well as the survey questionnaire, making it easier for them to fill in the by-now familiar information.

The survey questionnaire was focused on one central question, which asked about the absolute number of homes passed by broadband networks, and was applied to the following key metrics of the research:

- Technology coverage – for each of the technologies (with the exception of satellite) a question was included asking NRAs to supply the number of homes passed by each individual technology in the country.

- Regional coverage – NRAs and operators were also asked to supply homes-passed information for each of the NUTS 3 regions in all study countries for each of the technologies.

- Rural coverage – the same questions were asked of respondents for homes passed in rural areas of each NUTS 3 region as well as for the total number of rural homes passed country-wide.

- Speed coverage - the 2013-2015 survey questionnaires were extended to include questions asking participants about the numbers of homes passed by networks able to achieve speeds of at least 2 Mbps, 30 Mbps and 100 Mbps. This metric and corresponding questions were retained in the 2016 study.

In a number of cases, coverage data was delivered on a more detailed geographical level than the requested NUTS 3 areas. In these cases, the research team aggregated the provided data to match the NUTS 3 regions.

In addition to the coverage questions, the survey questionnaire also provided space for additional comments and explanations of the various technologies and speed specifications in cases in which

respondents' definitions differed from those outlined in the survey (detailed definitions of the individual broadband technologies are included in the Appendices of this report). These comments provided further insight and were reflected in the final analysis of the data.

Given the nature of satellite broadband coverage, questions regarding satellite coverage were not included in the survey questionnaire. The satellite coverage across Europe was determined based on conversations with leading satellite providers such as Eutelsat, a KA-SAT broadband provider and other smaller satellite operators.

Furthermore, in order to determine the additional mobile coverage metric focused on HSPA and LTE coverage of transportation links, the research team included questions regarding mobile network coverage of key road and railway infrastructure in the 2016 questionnaire. The research team provided the length of road and rail networks (in km) in each study country and asked the NRAs and mobile network operators to provide information on percentage coverage of both individual road and rail coverage as well as combined coverage of transportation infrastructure provided by HSPA and LTE networks. In cases, where specific transportation coverage information was not available, the respondents were asked to provide more general information on landmass/geographic coverage of the HSPA and LTE networks, represented in terms of percentage of landmass/geographic area covered by the specific networks.

The research team has been from the onset of this project aware of the sensitivity of the requested data provided by operators, as much of the coverage data (especially on such a granular level) could be regarded as commercially sensitive by operators. Therefore, confidentiality of the information gathered from both NRAs as well as individual operators was assured at all stages of the survey data collection and subsequent analysis.

In order to protect the confidentiality of the data, study results for individual coverage technologies are published only on a total country level. On the regional NUTS 3 level, reported data is limited to coverage by technology combinations. As these technology combinations include multiple technologies, coverage by individual technologies or companies is concealed within the combined total coverage.

All of the collected data was treated as commercially confidential and was used solely for the purposes of this study.

3.2 Defining households and rural areas

The central question posed by the survey questionnaire asks about the number of homes passed by individual operator and/or technology networks, depending on the respondent. In order to make determining the numbers of homes passed in each NUTS 3 region easier for respondents, the research team provided guidance by including total number of households in each area in the survey questionnaire.

As it is not possible to obtain annually updated household figures by NUTS3 regions for all of the BCE study countries, IHS & VVA team (as well as Point Topic) calculated the number of households in each NUTS 3 region using NUTS 3 level population data published annually by Eurostat and average household size figures also published by Eurostat annually for each country. This approach allowed the research team to maintain a unified methodology across all of the study countries using one data source.

One of the key dimensions of the study was centred around gaining information on broadband coverage in rural areas. In order for the rural data collected in the period 2013-2015 to be comparable to the 2012 dataset, the IHS & VVA research team adopted a similar approach to determine rural households to the one used by Point Topic.

In 2012, Point Topic developed a new methodology to defining rural areas using the Corine land cover database and creating a database of population and land type in every square kilometre across Europe. Households in square kilometres with population less than one hundred were classified as rural. This granular approach based on population density enabled Point Topic to identify the truly rural areas likely to be unserved or underserved by broadband operators.

Beginning with the 2016 edition of the study, IHS Markit has partnered with Point Topic and an updated estimation of rural population in individual NUTS 3 regions was produced by Point Topic. According to the updated data, in 2016 approx. 14% of households in the study countries were rural. Combining this information with updated population and household data from Eurostat, the EU statistical office, allowed the research team to create new estimates for the numbers of rural households across each market and NUTS 3 area.

3.3 Additional research conducted in parallel to the survey

In addition to data gathered through the NRAs and ISPs survey, the research team carried out supplemental research to check the validity of survey data as well as to fill in any missing pieces of information.

The additional research was built on the IHS Markit and Point Topic team's extensive in-house knowledge of the European broadband sector and was complemented with country and regional-level data collected from publicly available NRAs and ISPs reports and details on broadband strategies and development plans of individual companies and governments.

This desk-based research provided basic estimates on country-level coverage for each technology. In many cases, information on regional deployments of next generation access technologies was also available, or it was possible to infer such detail from company communications.

The individual elements of the additional research were determined on a country-by-country basis and included (but were not limited to) desk research of the following publicly available sources:

- NRAs market reports
- ISPs financial reports and press releases
- Industry organisations white papers, special reports and analysis
- Industry news

3.4 Validation and integration of data

In this phase of the study, data collected through the survey and via additional research were brought together to obtain the actual coverage figures for all of the study countries.

The data integration was conducted on a country-by-country basis. Information gathered from additional research was cross-checked with results of the survey. In cases for which data points were missing, for example some of the NUTS 3 regions or rural coverage, a modelling methodology was applied to fill in the gaps. Models used varied on a case-by-case basis, and relied on a range of inputs, which included national coverage and regional presence data as well as the research team's knowledge of individual markets, companies' deployment strategies and ancillary data, such as population density.

Each country's data was integrated for each technology individually. This allowed the research team to first obtain estimates for individual technologies at a NUTS 3 level, which were then used to calculate estimates for technology combinations – again at a NUTS 3 level. Regional data was finally summed to obtain national-level coverage information. When integrating data on individual technologies, special attention was paid to areas for which coverage of the same technology was provided by multiple operators, in order to rule out possible overlap.

At the end of the data validation and aggregation process, the research team was able to provide estimates for each of the nine broadband technologies in all NUTS 3 areas both on total and rural level.

3.5 Estimating coverage for different technology combinations

After reaching the broadband coverage figures by individual technologies in each country and NUTS3 regions, the research team calculated estimates for the following three technology combinations, taking into account the overlaps of different technologies:

- Overall broadband coverage (including DSL, VDSL, FTTP, Standard cable modem, DOCSIS 3.0, WiMAX, HSPA and LTE)

- Overall fixed broadband coverage (including DSL, VDSL, FTTP, Standard cable modem, DOCSIS 3.0 and WiMAX)

- Overall NGA coverage (including VDSL, FTTP and DOCSIS 3.0)

For the sake of consistency, the research applied similar methodology in the 2016 study to the approach used in the 2012-2015 editions of the study. Unless information provided by NRAs or telecoms groups suggested otherwise, a standardised default formula was used taking the average of:

1. The minimum possible coverage; equal to the coverage of the most widespread technology or operator in the area; and

2. The maximum possible coverage; equal to the sum of the coverage of all the technologies or operators being considered, or to 100%, whichever was the greater.

As in the previous studies, a varied formula was used in cases where some technologies' coverage was more complementary than overlapping. In these cases, the minimum coverage was taken as equal to the sum of the complementary technologies, if this was greater than the most-widely available single technology.

Additionally, the estimates for combination coverage on a national level were made by summing the estimates for the NUTS 3 areas rather than applying this formula on a country level. This approach provides a more accurate data output than simply taking the country-level average.

Once the research team completed the final country level dataset, it was passed on to DG Connect and to the NRAs of all of the study countries for their feedback and comments before the finalised data was used as components of the Digital Society & Economy Index (Connectivity Dimension) and published as part of the individual country assessment reports.

In a number of cases, new and more accurate data was provided to the research team reflecting the 2015 data and thus justifying restatement of the figures published in the Broadband Coverage in Europe 2015 study. During the 2016 data collection, the research team has also introduced new checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households. When these checks were applied to rural coverage values reported in previous years, they identified underestimation of rural coverage in a number of countries leading to restatements of previously reported rural coverage data. Restatements are indicated in the data tables sections of individual country chapters.

3.6 Estimating coverage for speed categories

The speed categories were first included as broadband coverage metrics in 2013 in order to provide additional analytical layer to evaluate the study countries' progress towards the Digital Agenda goals and to estimate the download speeds available to households across the EU Member States. This additional component of the broadband coverage research was retained in the 2016 edition of the study with following speed categories included among the metrics:

- Coverage by broadband network/s capable of at least 2 Mbps download speed

- Coverage by broadband network/s capable of at least 30 Mbps download speed

- Coverage by broadband network/s capable of at least 100 Mbps download speed

Including this metric allows for a comparison of the technology coverage, which might be reported as relatively high, to the actual speeds consumers will be able to receive on the particular networks available to them.

In previous years, the speed coverage metrics and analysis were included in a separate chapter in the Appendix of the BCE final report as the quality of the received data varied quite substantially across respondents. However, given the fact that speed coverage metrics have been collected and estimated for the past three years and as such have become a standard component of the study, the research team has decided to include the speed coverage analysis in the main sections of the final report for the 2016 edition of the report.

The following methodological approach was first implemented in 2013 and carried over in the subsequent iterations of the study. In order to estimate the coverage by the speed categories, the research team needed to develop a suitable methodology and clear definition to determine coverage by realistically achievable speeds as required by DG Connect. Thus, the following speed categories were added among the research metrics and questions regarding these categories were included in the survey questionnaire:

- Coverage by broadband network/s capable of realistically achieving actual download speeds of at least 2 Mbps. This category encompassed DSL (including VDSL), FTTP, WiMAX, standard cable (including DOCSIS 3.0 cable), HSPA and LTE broadband access technologies. However, as not all DSL connections are capable of download speeds of 2Mbps and higher, respondents were asked to exclude those connections which did not meet the criteria from their answers.

- Coverage by broadband network/s capable of realistically achieving actual download speeds of at least 30 Mbps. This category encompassed VDSL, FTTP, DOCSIS 3.0 cable, and LTE broadband access technologies. However, as not all connections utilizing these technologies can achieve 30 Mbps and higher actual download speeds (for example, VDSL connections with distance from the exchange point higher than 500m see radical decrease in actual speeds), respondents were asked to exclude those connections which did not meet the criteria from their answers.

- Coverage by broadband network/s capable of realistically achieving actual download speeds of at least 100 Mbps. This category encompassed FTTP, DOCSIS 3.0 cable, and LTE broadband access technologies. In cases where vectoring is applied to VDSL2 technology and speeds reach 100 Mbps and higher download speeds, VDSL with vectoring was asked to be included in this category. However, as not all connections utilizing these technologies can achieve 100 Mbps actual download speeds (for example, in the case of FTTB – fibre-to-the-building – connections included in the FTTP category in-building wiring can pose significant constraints on achievable end-user broadband speeds), respondents were asked to exclude those connections from their answers.

The coverage of these speed categories was then defined as a household having technical access to one or more networks supporting at least 2, 30, or 100 Mbps download speed connections if the connection's broadband speed was capable of achieving a minimum of 2, 30, or 100 Mbps download speed (respectively) for the majority of the time. 'Majority of time' is understood to mean actual download speeds achieved by a household for at least 75% of the time.

As speed information can be generally hard to decode, even for the NRAs and ISPs themselves, the research team, in addition to the collected survey data, also relied on sector knowledge regarding deployments to make informed estimates of achievable speeds to gain complete picture of coverage by the speed categories.

The research team also gave an option to the respondents to also include information on achievable speeds on LTE networks in the at least 30 Mbps and at least 100 Mbps download speed categories. With the technological improvements in terms of speed and connection quality attainable over LTE mobile networks, 2016 was the first year LTE speeds were recorded within these categories.

Note that unlike the technology coverage, the speed metric categories have been determined on a country level only, as gathering information on rural and regional NUTS 3 level would not have been feasible within the scope of the study – although we hope that NRAs and ISPs will consider collecting and making such information available at a future point in time.

3.7 Estimating additional mobile coverage metrics

As required in the Tender Specifications for SMART 2016/0043 and following the discussions with DG Connect at the inception meeting, the research team has introduced two new mobile metrics as part of the 2016 Broadband Coverage in Europe study. These metrics are aimed to better reflect availability of mobile broadband services for European consumers as well as to take into account the mobility aspect connected with mobile networks accessibility. In order to comply with the Tender Specifications, the research team introduced the following additional mobile metrics:

- Average LTE coverage
- HSPA and LTE networks coverage of transportation infrastructure

The first additional metric took into account LTE household/population coverage provided by individual operators in each study country. This data was provided either by the operators themselves, by the NRAs or collected from publicly available sources, such as information accessible from operators' websites, quarterly reports, press releases, etc. The research team then provided DG Connect with overall average LTE coverage value, calculated as a simple average of operators' LTE networks coverage in each study country.

This indicator was requested by DG Connect to serve as a better measurement of actual user experience (as a typical user will only be able to use one network at a time) and was included as one of the components of the DESI's Connectivity dimension (1b2 – 4G Coverage).

The second additional mobile coverage metric aimed to estimate HSPA and LTE mobile networks coverage of transportation infrastructure in the study countries. As this was a completely new metric with untested methodology, the research team applied varied approach to estimating the transportation coverage consisting of information provided by the mobile networks operators, NRAs, desk research as well as comparing household and landmass coverage and using it to determine overlay of geographical coverage and key transportation links in order to provide fair assessment of the availability of mobile services.

The research team included questions regarding mobile network coverage of key road and railway infrastructure in the 2016 questionnaire, providing the length of road and rail networks (in km) in each study country. NRAs and mobile network operators were asked to provide information on percentage coverage of both individual road and rail coverage as well as combined coverage of transportation infrastructure provided by HSPA and LTE networks. In cases, where specific transportation coverage information was not available, the respondents were asked to provide more general information on landmass/geographic coverage of the HSPA and LTE networks, represented in terms of percentage of the total country landmass area covered by the specific networks.

In parallel, the research team collected information from additional sources such as NRA reports and other operator reported and publicly available information to complement the survey data. In cases where only landmass coverage information was available, coverage of transportation infrastructure was determined by comparing landmass and population/household coverage values and overlaid with Point Topic's European Kilometre Grid database and the Corine landmass database.

Given the varying level of available information, the research team decided to take the 2016 transportation coverage data collection as a testing ground for this metric with the aim to further evolve the methodological approach in the next iterations of the study. Therefore, following discussions with DG Connect, a decision has been made to keep the 2016 transportation coverage results for internal purposes. The research team will continue to develop a more robust methodology with further help from NRAs and operators.

4.0 European Overview

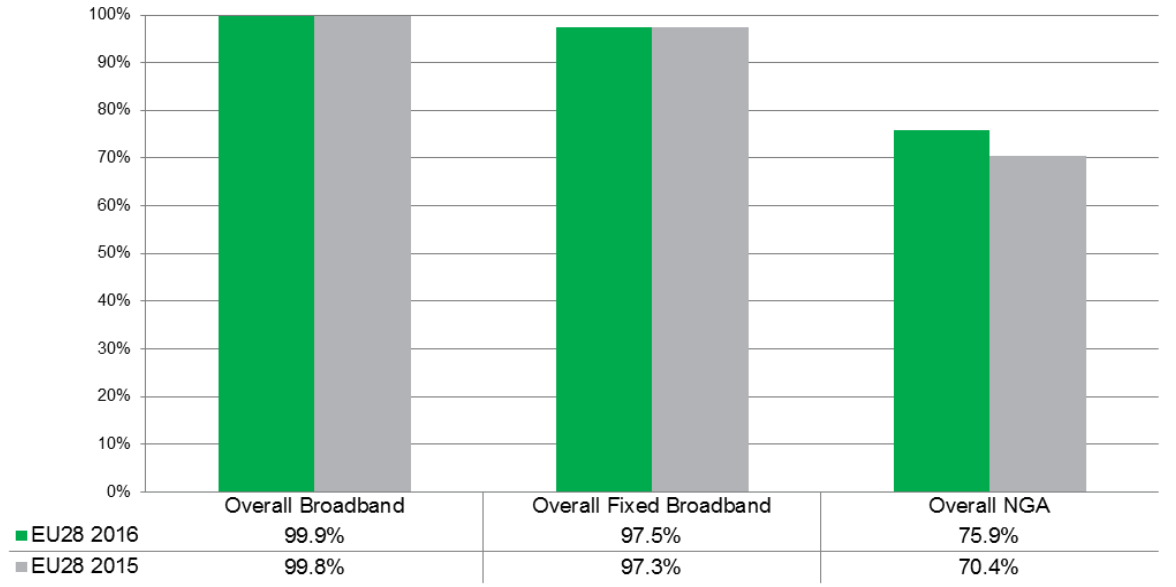
4.1 Europe-wide coverage by technology combinations

The main objective of the 2016 Broadband Coverage in Europe study was to assess the availability of broadband services across the EU, with additional information provided for Norway, Iceland and Switzerland.

As in the previous editions of the study, nine broadband technologies (DSL, VDSL, FTTP, WiMAX, cable, DOCSIS 3.0, HSPA, LTE, satellite) were analysed to ensure comparability and to evaluate progress in broadband roll-out across Europe.

The collected data show that over 218 million EU households (99.9%) had access to at least one of the main fixed or mobile broadband access technologies in mid-2016 (excluding satellite). This represents a 0.1 percentage point increase, or 1.4 million additional households, compared to the end of June 2015. When satellite coverage is included, basic broadband services are now offered to every household in the EU.

EU28: Coverage by technology combination, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In absolute terms, the number of homes passed by fixed broadband networks (DSL, cable, FTTP or WiMAX) increased by 1.6 million in the twelve-month period to mid-2016, translating to 97.5% homes passed in the EU28 by mid-2016, up from 97.3% in mid-2015.

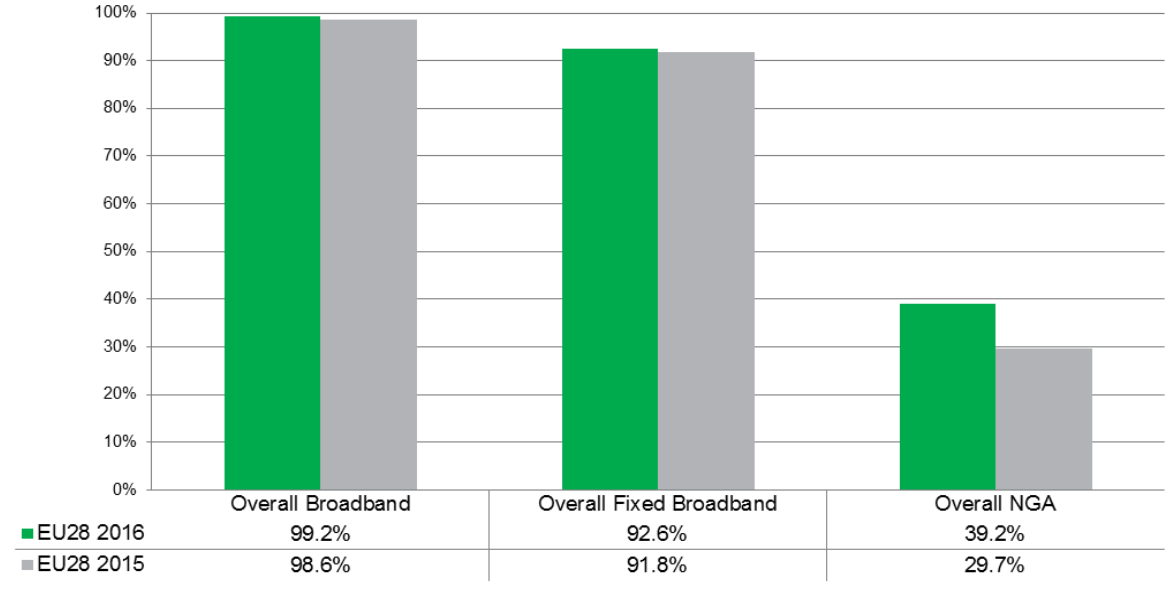
As in previous years, the largest growth among the combination categories was witnessed in coverage of Next Generation Access (NGA) networks, which reported a 5.5 percentage point increase in the twelve-month period to mid-2016. This is equivalent to 12.8 million new households gaining access to next generation broadband services. By mid-2016, 75.9% of households across the EU Member States were passed by at least one NGA technology (VDSL, FTTP or Cable DOCSIS 3.0), compared to 70.4% in mid-2015.[2]

Access to fast broadband services in rural areas remains a key priority for the EU. At the end of June 2016, 99.2% of rural households across the EU28 had access to at least one broadband technology. However, only 39.2% (12.0 million rural households) could benefit from NGA broadband.

[2] During the 2016 data collection, new and more accurate NGA technologies coverage data became available for a number of study countries (Estonia, Italy, Lithuania, Romania, Slovenia, and Switzerland) reflecting the 2015 NGA coverage levels. This new data justified restatements of the 2015 data for the individual countries and impacted the EU28 2015 total NGA coverage, which was previously reported to be 70.9% and has been restated to 70.4% EU households having access to NGA broadband in mid-2015. All restatements are highlighted in the data tables included in the individual country chapters.

Nevertheless, rural NGA coverage growth is increasing at a faster rate than in the first half of 2015, suggesting NGA deployment is shifting towards rural areas. Rural NGA coverage increased by 9.5 percentage points in the last year compared with 2.7 percentage points in the six-month period to mid-2015. In total 2.9 million additional rural households gained access to next generation broadband services between the end of June 2015 and 2016.

EU28: Coverage by technology combination in rural areas, 2016



	Overall Broadband	Overall Fixed Broadband	Overall NGA
EU28 2016	99.2%	92.6%	39.2%
EU28 2015	98.6%	91.8%	29.7%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

4.2 Europe-wide coverage by individual technologies

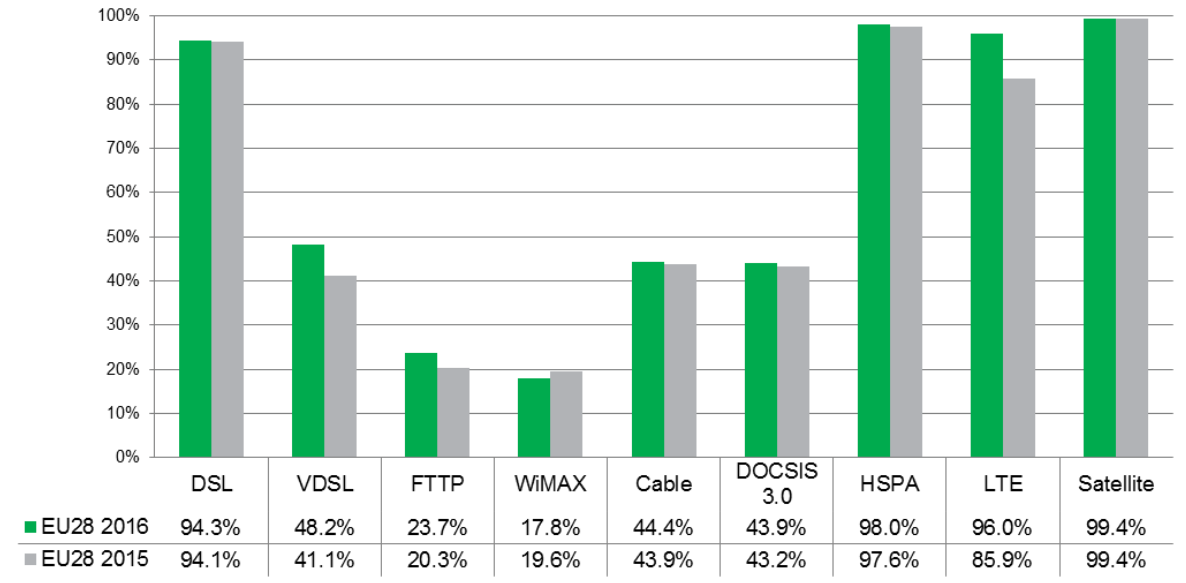
4.2.1 Coverage by technology in total

The breakdown by technology shows that satellite remained the most pervasive technology in Europe in terms of overall coverage. By mid-2016, satellite broadband was available to 99.4% of EU households. Based on our research, this indicates there has been no change in satellite broadband coverage compared to 2015. In the Baltic countries, there remained a low coverage of the KA-band satellites with satellite broadband reaching only certain parts of Estonia, Latvia and Lithuania. As in previous years, there continued to be no satellite broadband services available in Iceland.

Looking at fixed broadband coverage technologies, DSL technology continued to be the most widespread. DSL networks reached 94.3% of EU households by mid-2016, an improvement of 0.2 percentage points. Meanwhile, cable broadband coverage increased 0.5 percentage points to 44.4%. While these appear to be negligible coverage increases, when taking into account the increasing number of households, they represent considerable growth in absolute coverage. For instance, in the twelve-month period to June 2016, cable networks passed an additional 1.6 million EU households.

WiMAX was the only broadband technology to witness a reduction in coverage, decreasing by 1.8 percentage points to 17.8%. This is a result of many operators discontinuing their WiMAX networks in order to reallocate the spectrum for LTE transmission.

EU28: Coverage by technology, total



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
EU28 2016	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%
EU28 2015	94.1%	41.1%	20.3%	19.6%	43.9%	43.2%	97.6%	85.9%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Growth in VDSL coverage remained the key driver of the increase in overall NGA coverage. VDSL coverage continued to grow at a similar rate to the previous years, increasing by 7.1 percentage points in the twelve-month period to mid-2016. Consequently, VDSL carried on being the fastest growing fixed broadband technology for the fifth consecutive year. There was also considerable growth in the availability of FTTP technology, as coverage increased by 3.4 percentage points to reach nearly a quarter (23.7%) of EU households.

Compared to VDSL and FTTP, growth in DOCSIS 3.0 was considerably lower, expanding by only 0.7 percentage points to reach 43.9% of households. DOCSIS 3.0 growth was limited by the lack of new cable networks being deployed, while the majority of existing cable technology has already been upgraded to DOCSIS 3.0. By mid-2016, 98.9% of homes passed by cable networks had access to DOCSIS 3.0 cable broadband services indicating that the upgrade of cable networks to DOCSIS 3.0 is mostly complete across the EU.

Examining mobile broadband technologies, HSPA continued to provide nearly universal coverage, reaching 98.0% of EU households by mid-2016. LTE is now also close to providing close to universal coverage, following a steep 10.1 percentage point increase in the twelve-month period to June 2016. This increase translates to almost 23 million additional households across the EU, as LTE coverage reached 96.0% of EU households. By mid-2016, the difference in coverage between HSPA and LTE equalled only 2 percentage points, compared to 11.7 percentage points at the end of June 2015.

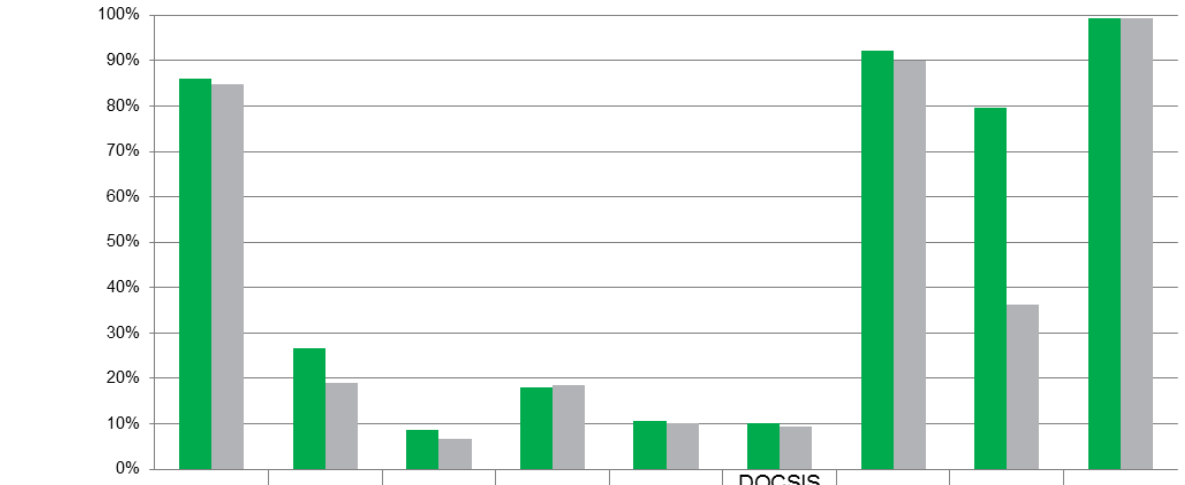
4.2.2 Coverage by technology in rural areas

Historically, it has been hard for operators to justify investments in rural areas. As a result of low population density in these areas, investments can be viewed as economically less profitable. Consequently, achieving the Digital Agenda's goal of universal 30 Mbps coverage by 2020 continues to represent a considerable challenge in EU's rural regions.

Broadband coverage levels in rural regions remain notably lower than total national coverage, with fixed broadband networks passing 92.6% of rural EU households compared to 97.5% of total households. The gap between rural and total NGA coverage in previous years had remained the same at around 40 percentage points. However, in the past year, there has been an evidence of the gap between rural and total NGA coverage narrowing as the difference reduced to 36.7 percentage points by mid-2016, with 39.2% coverage at rural level versus 75.9% for all EU households. This development suggests that NGA networks deployments are beginning to shift towards rural areas.

Rural VDSL coverage increased by 7.7 percentage points in the twelve-month period to mid-2016, compared with only 1.8 percentage points in the first half of 2015. By the end of June 2016, over a quarter (26.6%) of rural households across the EU has access to VDSL services. However, as was the case in previous years, the additional VDSL coverage relates mainly to areas already covered by DSL networks, which are being gradually upgraded to VDSL. Consequently, this increase would not account for newly deployed networks to previously underserviced areas.

EU28: Coverage by technology, rural areas



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
EU28 2016	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%
EU28 2015	84.8%	18.9%	6.7%	18.6%	10.1%	9.4%	89.9%	36.3%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL remained the most important fixed technology for rural coverage, increasing by 1.3 percentage points to reach 86.0% of rural EU households by mid-2016. With regards to other fixed technologies, the number of rural households reached by WiMAX decreased 1.8 percentage points to 17.8% by mid-2016. This was due to the decision of many operators across the EU to shut down their WiMAX operations in order to redistribute the spectrum for LTE.

The number of rural households passed by cable broadband services remained limited with 10.7% of rural homes reached by the end of June 2016. The low rural coverage of cable networks can be attributed to the considerable cost of deploying cable networks. For this reason, operators continue to

focus on deploying new cable networks in urban areas, where the higher population densities help ensure return on investment. Where rural cable networks are available, they have been largely upgraded to DOCSIS 3.0 due to the relatively low cost of upgrading cable networks to DOCSIS 3.0 versus the cost of the initial deployment. High-speed cable broadband services passed 10.1% of rural households by mid-2016. FTTP remained the least widespread rural NGA technology, however, the number of rural homes reached by FTTP networks increased by 2.1 percentage points over the course of the year. Consequently, at current trajectories, rural FTTP coverage can be expected to overtake rural DOCSIS 3.0 availability in 2017.

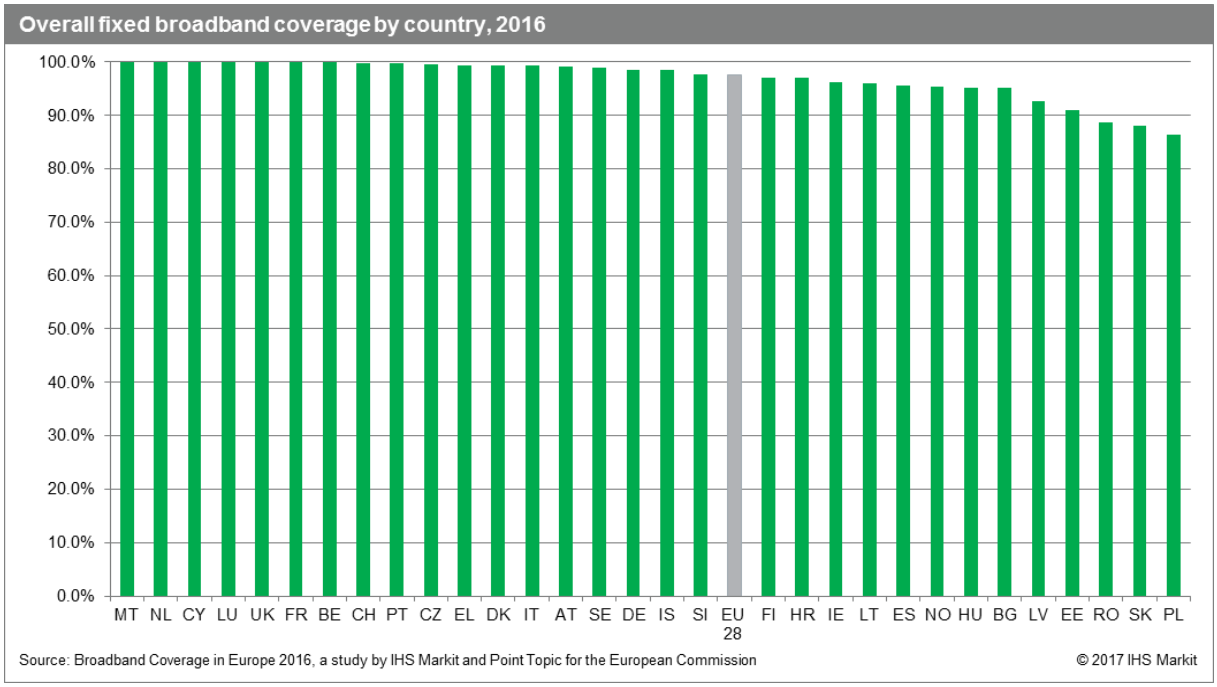
In terms of mobile broadband, the number of homes reached by HSPA networks increased at a similar pace to the previous year. By mid-2016, 92.2% of rural homes had been covered, a 2.3 percentage point increase over the course of the twelve-month period. Given its much lower starting coverage, unsurprisingly, LTE coverage improved at a considerably faster rate than HSPA. The number of rural EU homes reached by LTE increased to 79.7% from 36.3%, an increase of 43.4 percentage points. As in the previous year, LTE was the fastest growing broadband technology in rural areas in terms of coverage. This remains an important development, as the rollout of LTE networks in rural areas has the potential to improve rural coverage in regions where fixed network deployment is more difficult or not feasible.

Due to the nature of satellite technology, satellite reached roughly the same level of coverage in rural areas as across the EU as a whole (99.4%). In the most sparsely populated and hard-to-reach areas, satellite continues to be the only option for receiving broadband access.

4.3 Country comparison by total technology coverage

4.3.1 Total overall fixed broadband by country

The overall fixed broadband coverage category has been designed to provide a measure of progress in deployment of fixed broadband access technologies which are capable of providing households with broadband services of at least 2 Mbps download speed. Four technologies make up the overall fixed broadband coverage figures: DSL (including VDSL), cable (including DOCSIS 3.0), FTTP, and WiMAX. Note that FTTP coverage trends are discussed in more detail in the following chapter on NGA coverage by country.

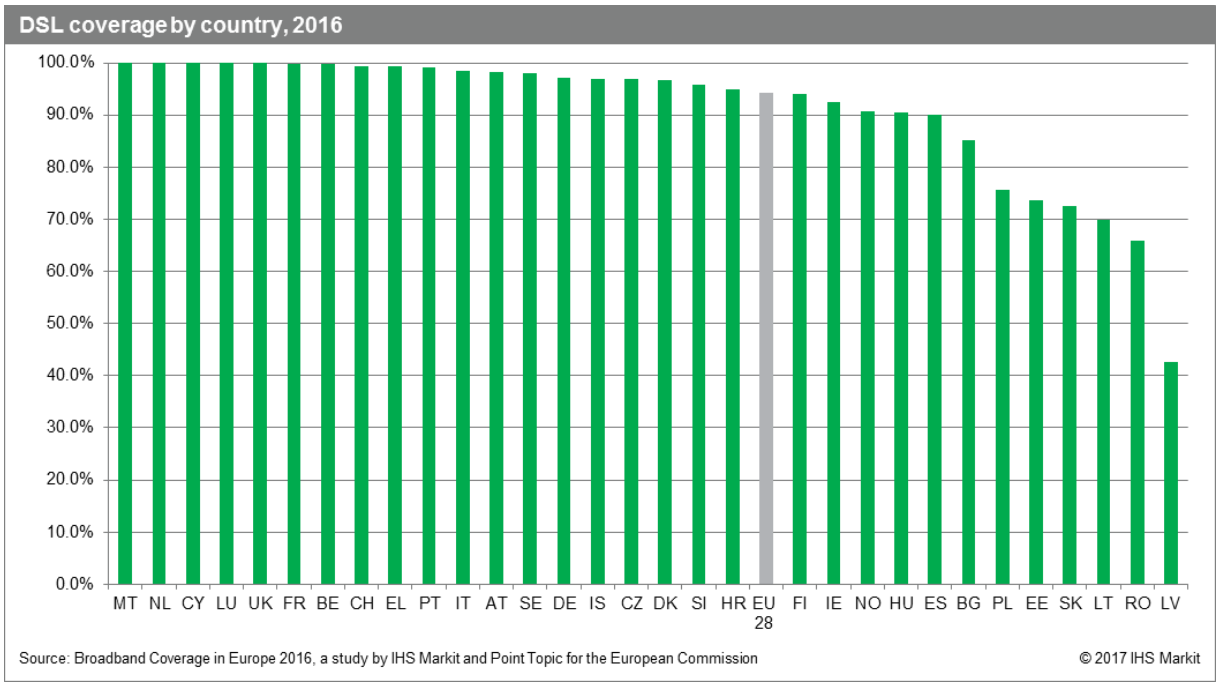


Out of the 31 study countries, 26 countries registered fixed broadband coverage of above 95%, indicating the breadth of fixed broadband coverage in most nations. Compared to the previous year, more countries are above the European average for overall fixed broadband coverage with 19 countries reporting fixed broadband coverage levels at or above the EU average of 97.5% at the end of June 2016. Several countries recorded complete, or near-complete, fixed broadband coverage including Cyprus, Luxembourg, Malta, the Netherlands and the United Kingdom. Only three countries (Romania, Slovakia and Poland) reported coverage below 90% in mid-2016. These countries face fixed broadband coverage challenges due to their sparsely populated and underserviced rural areas.

4.3.1.1 Total DSL coverage by country

DSL remained the most widespread fixed broadband technology in terms of coverage in the twelve-month period to the end of June 2016, with 18 study countries recording DSL coverage of at least 95%. As in the previous year, Malta, the Netherlands, Cyprus, Luxembourg and the United Kingdom reported complete coverage by DSL networks. However, it is important to note that while a universal DSL coverage was registered for these countries, this is generally considered to be accurate to one decimal place to account for the possibility of a negligible number of remote homes failing to receive DSL coverage.

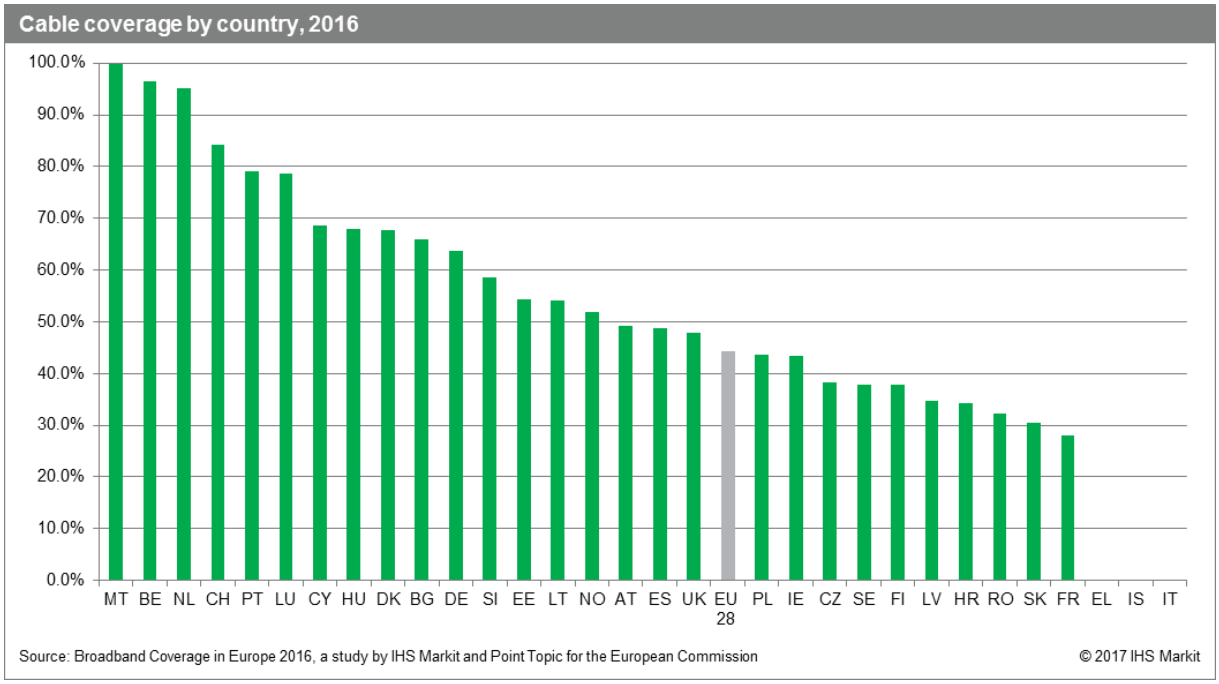
The universal or near-universal DSL coverage (i.e. very close to 100% of households) was observed in countries with the most developed traditional telephone networks, as DSL technology utilizes fixed line twisted-pair copper network infrastructure.



Only six Member States recorded DSL coverage levels below 80%: Poland, Estonia, Slovakia, Lithuania, Romania and Latvia. In a number of these countries DSL coverage has begun to give way to NGA technologies such as FTTP, which is discussed in more detail in the individual country chapters.

4.3.1.2 Total cable coverage by country

Compared to DSL coverage, there is considerable variation in cable coverage by country. Traditionally, cable operators have concentrated deploying their networks in urban and semi-urban areas, as higher population densities in these areas helped to ensure return on investment. Cable networks are also likely to have greater coverage in countries with a tradition of cable TV. Conversely, in countries where cable companies entered the market at a later stage or their operations failed (such as in Italy), cable coverage tends to be considerably lower.

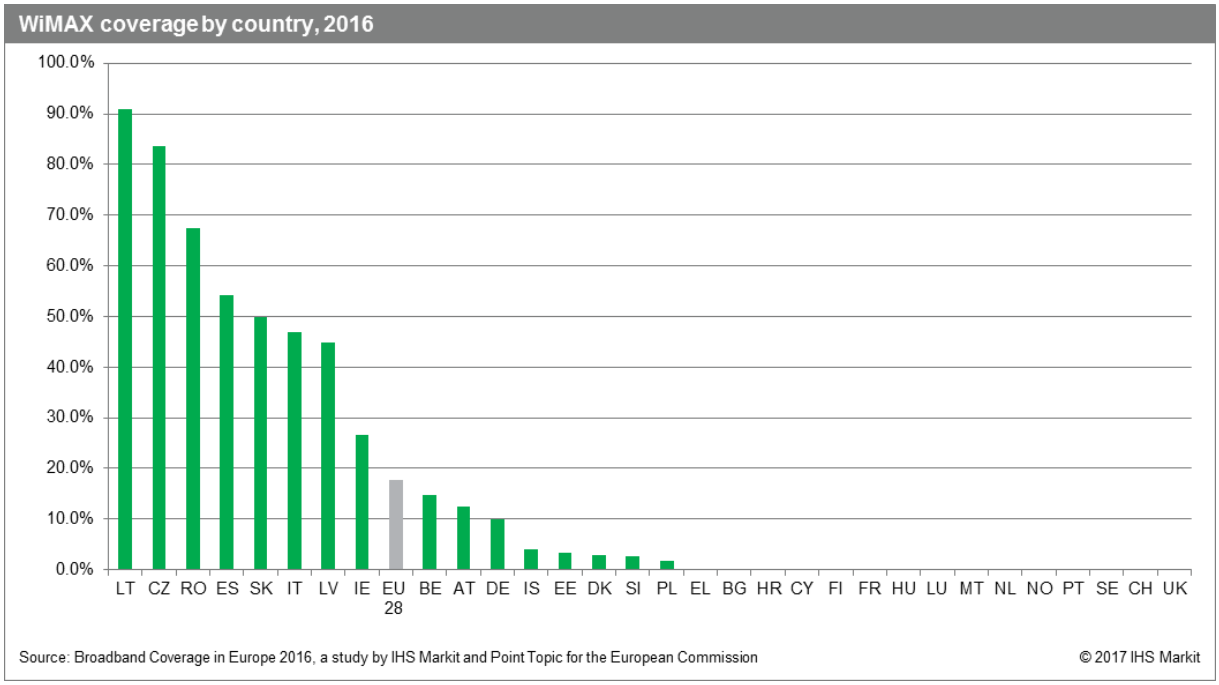


As cable deployments are generally centred on urban areas, there tends to be low levels of extra coverage provided by cable technology due to overlap with DSL in these urban areas. However, DOCSIS 3.0 cable services continue to contribute considerably to NGA broadband availability across the EU as described in the following chapter.

By mid-2016, three countries recorded cable coverage above 95%: Malta, Belgium and the Netherlands. However, Malta was still the only country with complete cable coverage. Fifteen other countries recorded coverage rates above the European average of 44.4%, although all these countries reported coverage levels well below the three leaders. The highest coverage increase was reported in Cyprus, where cable coverage increased by 11.7 percentage points to reach 68.7% of homes across Cyprus. Cable networks remained completely absent in Greece, Iceland and Italy.

4.3.1.3 Total WiMAX coverage by country

When determining WiMAX coverage, it is important to keep in mind the limitations of WiMAX signals. WiMAX can technically offer quite extensive geographic reach, yet the number of customers that the network can realistically support may be much smaller than a fixed wireline technology. Another challenging factor is the great fragmentation of the European WiMAX market, which features many small providers operating across Europe. On the other hand, WiMAX technology generally provides a viable broadband solution for less-densely populated and harder-to-reach areas.



By mid-2016, WiMAX remained a rather marginal broadband technology in the majority of study countries. This is reflected by WiMAX coverage exceeding 70% in only two study countries, Lithuania and Czech Republic. Fourteen countries reported no WiMAX availability, compared to nine countries in mid-2015, driven by the decision of several operators to discontinue WiMAX in order to redistribute the spectrum for LTE. For instance, WiMAX coverage reduced by 65 percentage points in Bulgaria following the decision of the wireless operator, Max Telekom, to discontinue its WiMAX network and migrate all of its WiMAX subscribers to its LTE network[3].

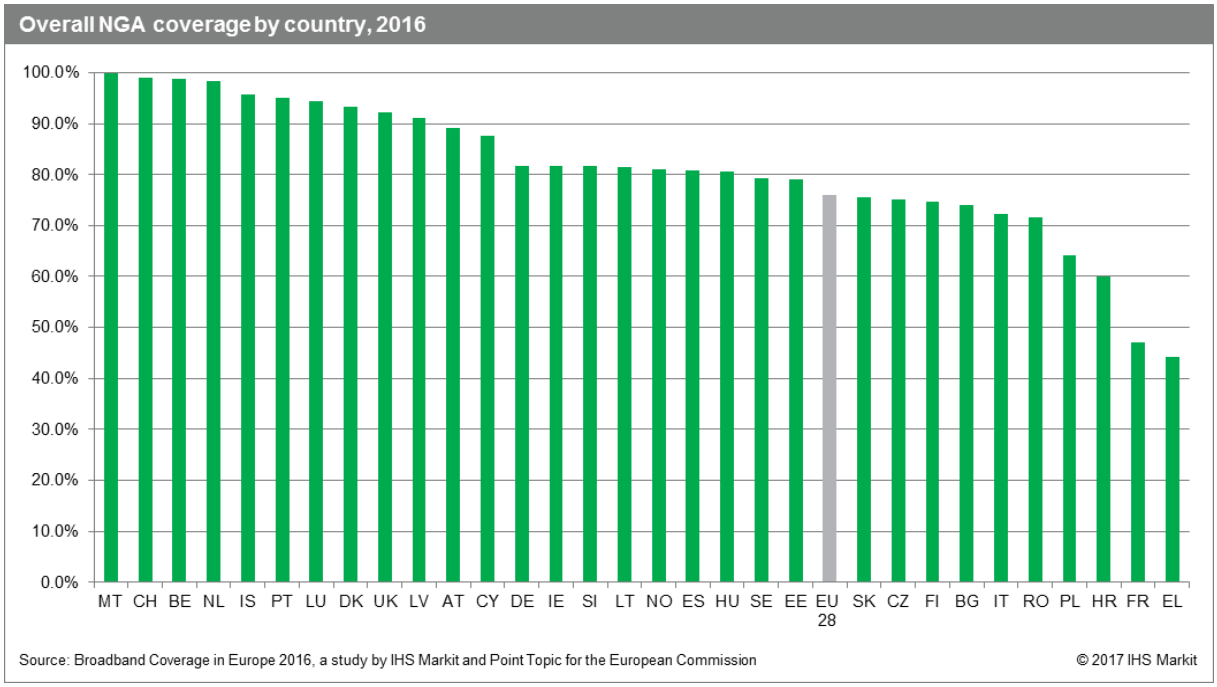
4.3.2 Total overall NGA coverage by country

The NGA combination category comprises VDSL, FTTP and DOCSIS 3.0 technologies, all typically capable of delivering a service speed of at least 30 Mbps (although VDSL local loop lengths mean that actual speeds do vary[4]). The main objective of the Digital Agenda for Europe is to have complete

[3] https://www.telegeography.com/products/commsupdate/articles/2015/11/03/max-to-discontinue-wimax-services-in-november/

[4] Please see Chapter 4.5 for more information on actual download speed coverage.

coverage of European households at this speed by 2020. The analysis of the combination therefore constitutes an evaluation of the roll-out of the relevant technologies and progress towards this goal.



As was the case with cable coverage, the most urbanised countries recorded the highest NGA coverage. Malta remained the only country to report complete coverage for the NGA technology category, while Switzerland, Belgium, the Netherlands, Iceland and Portugal reported coverage levels above 95%. There continued to be considerable differences in NGA coverage across the study countries, reflecting the various strategies and approaches to high-speed broadband deployment adopted across Europe. Of the 31 study countries, ten countries reported coverage levels below the European average (75.9%). Even though it remains below the EU average, Italy recorded a staggering 31.3 percentage point growth in NGA coverage and NGA networks passed nearly three-quarters (72.3%) of Italian homes at the end of June 2016. Nevertheless, coverage levels in some countries remain very low compared to the top performers. For instance, NGA services in France and Greece are available only to around 45% of households.

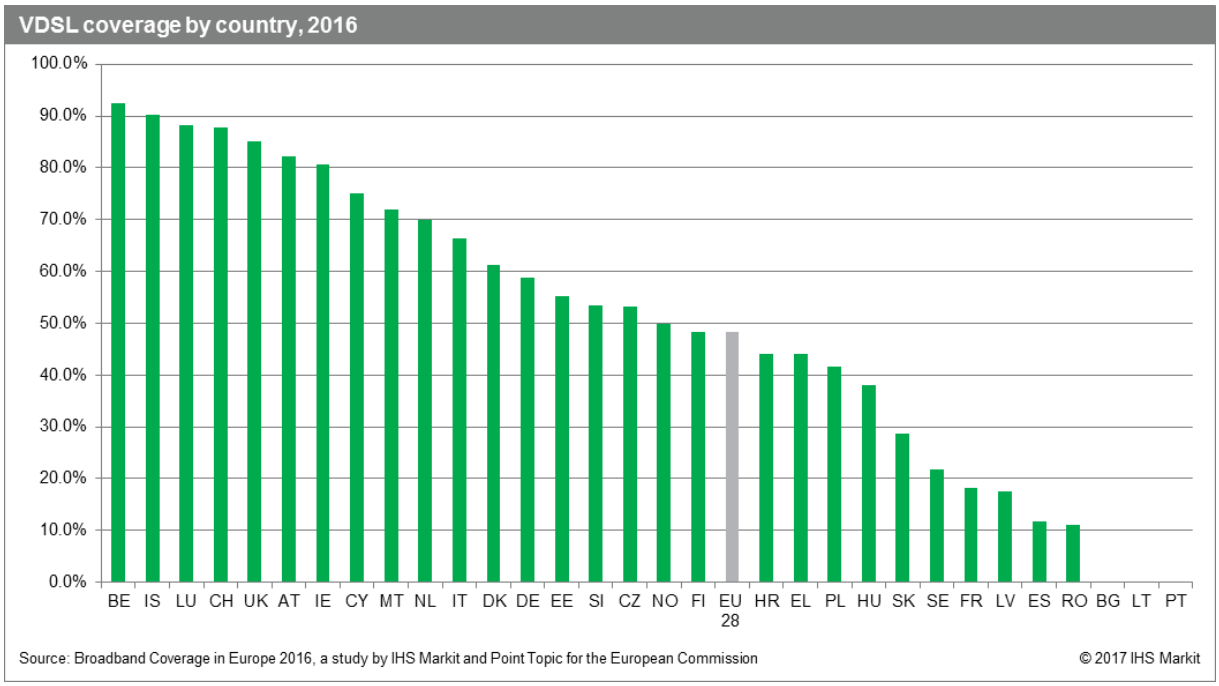
4.3.2.1 Total VDSL coverage by country

VDSL remained the fastest growing NGA technology during the study period. At the end of June 2016, VDSL networks passed nearly a half (48.2%) of EU homes compared to 41.1% in mid-2015. This shows that coverage growth is continuing at a similar rate to the first six months of 2015, when total VDSL coverage improved by 3.5 percentage points. Operators continue to focus their deployment strategies on upgrading existing copper networks instead of investing in the typically more expensive deployments of fibre optic networks all the way to customers' property.

It is important to note that broadband performance on VDSL lines varies depending on the length of the copper loop from the VDSL enabled cabinet connected to the optical fibre backhaul. Typically, households with a VDSL connection and a distance of about 500 metres from a VDSL enabled street cabinet or exchange reach download connection speeds of around 25 Mbps.[5]

Belgium and Iceland were the only two study countries to report VDSL coverage exceeding 90%, although five other countries reported coverage levels of over 80% (Luxembourg, Switzerland, the UK, Austria and Ireland). Eighteen study countries achieved VDSL coverage exceeding the EU average, however, VDSL remains far from widespread in most markets.

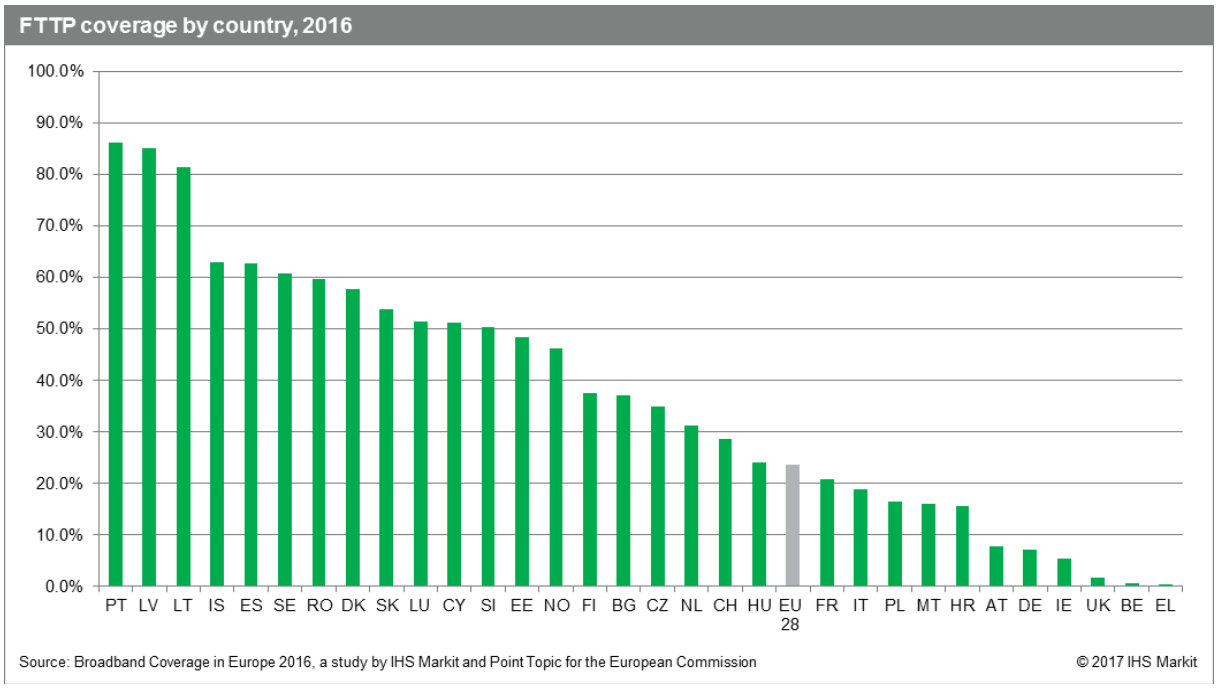
[5] For further analysis of actual download speed coverage please see Chapter 4.5.



At the end of June 2016, VDSL was not available in Bulgaria, Lithuania and Portugal, while four countries had less than 20% coverage (France, Latvia, Spain and Romania). Traditionally, many of these countries prefer other NGA technologies over VDSL. However, in other countries, there was a substantial increase in NGA coverage. For instance, VDSL coverage in Italy more than doubled during the twelve-month period to mid-2016, as coverage increased by 33.6 percentage points. Iceland, Germany, Hungary and Slovakia also witnessed double-digit growth in VDSL coverage during the twelve-month period to mid-2016.

4.3.2.2 Total FTTP coverage by country

In 2016, FTTP coverage continued to grow in Portugal, improving by 10.7 percentage points during the twelve-month period to mid-2016. As a consequence of this growth, Portugal with 86.1% FTTP coverage has now surpassed Latvia (85.2%) and Lithuania (81.4%) to rank first in terms of FTTP coverage among all study countries.



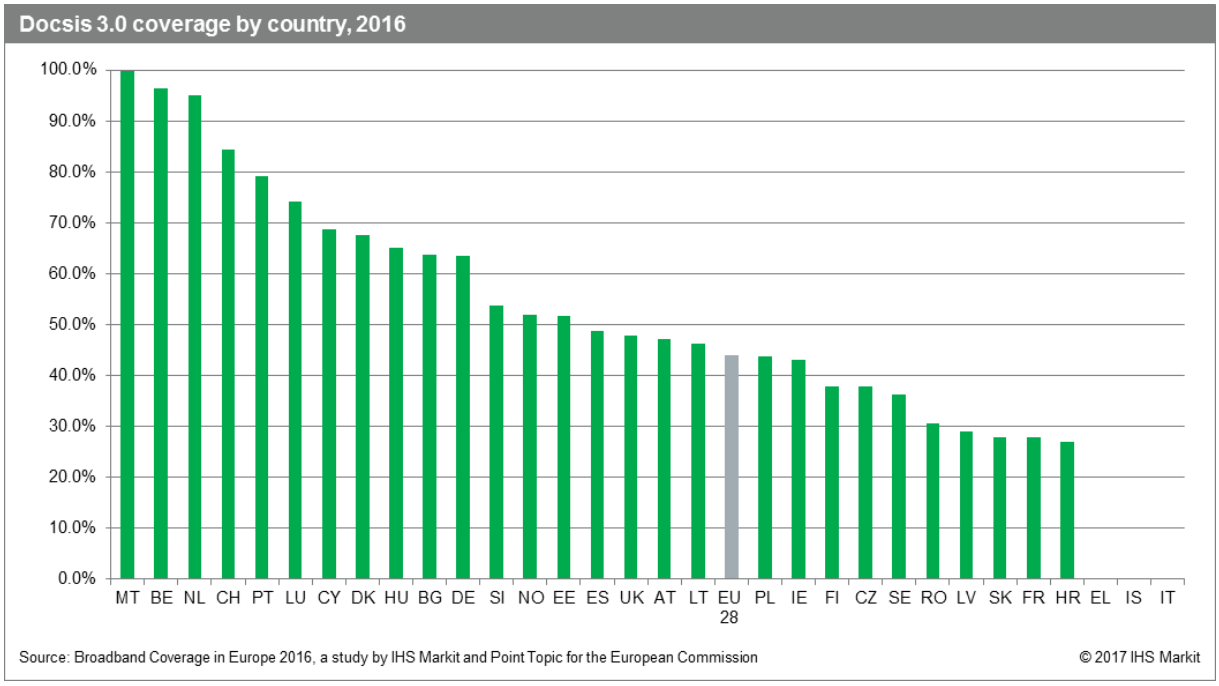
The strongest growth in FTTP coverage, however, was recorded in Czech Republic, where availability of FTTP services increased by 17.7 percentage points during the twelve-month period to mid-2016 with more than a third (35%) of Czech homes passed by FTTP networks, driven primarily by small and local deployments. In the same period, Spain also saw a substantial 10.0 percentage point FTTP coverage increase, rising by 10.0 percentage points to reach 62.8% of Spanish households. One of the major contributors to the rise of FTTP coverage in both Portugal and Spain is the strategic business model of Portuguese and Spanish network operators, which is based on network sharing and cooperation on joint roll-out of FTTP networks all the way to customers' premises.

Eleven countries reported coverage levels below the EU average. While FTTP access is on offer in all study countries, in some of the countries FTTP services are available only on a very limited basis. As in previous years, Greece and Belgium reported the lowest levels of FTTP coverage, at 0.6% and 0.4%. In the UK, FTTP coverage was only slightly higher at 1.8%. This reflects the preference of operators in these countries to prioritise their deployment strategies on upgrading existing VDSL networks, rather than investing in the typically more expensive FTTP technology. These operators view the speeds associated with VDSL technologies as sufficient to satisfy current demand. And some operators have also begun to trial solutions such as G.fast in selected areas to further increase speeds to up to gigabit levels with a view of wider scale implementation in the future as consumer demand grows.

4.3.2.3 Total DOCSIS 3.0 coverage by country

In mid-2016, European cable network operators continued to upgrade their cable networks to the DOCSIS 3.0 standard, although a large part of the work has already been done in previous years. The percentage of cable networks across Europe upgraded to DOCSIS 3.0 technology increased to 99.0%, an increase of 0.5 percentage points in the twelve-month period to mid-2016.

A further 4 countries fully upgraded their cable networks to DOCSIS 3.0 by mid-2016, meaning that cable networks in 15 study countries were fully upgraded. DOCSIS 3.0 comprised over 80% of cable networks in all countries with cable broadband coverage, with the exception of Croatia. However, even in Croatia the pace of DOCSIS 3.0 upgrades seems to have picked up with 78.6% of cable homes passed being upgraded to the DOCSIS 3.0 standard compared to only 70% in mid-2015.



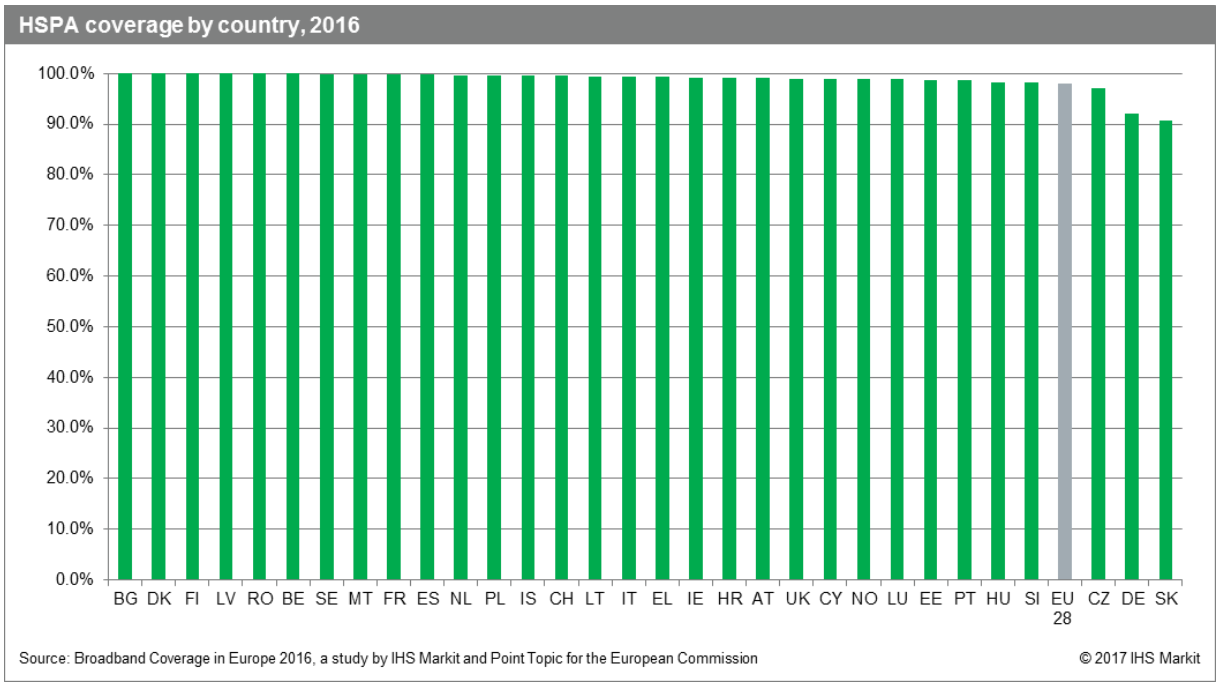
Malta was the only country to record 100% DOCSIS 3.0 coverage, while Belgium and the Netherlands remained the other countries to report DOCSIS 3.0 coverage levels above 95%. Beyond this, all other study countries recorded DOCSIS 3.0 coverage levels below 85%. Eighteen of the study countries performed better than the EU average (43.9%). The biggest improvement in terms of the number of

homes passed by DOCSIS 3.0 was recorded in Cyprus, where coverage increased by 11.2 percentage points. As in previous years, Greece, Iceland and Italy remained the three study countries without a cable broadband network and therefore reported no DOCSIS 3.0 coverage.

4.3.3 Mobile broadband technologies coverage by country

4.3.3.1 Total HSPA coverage by country

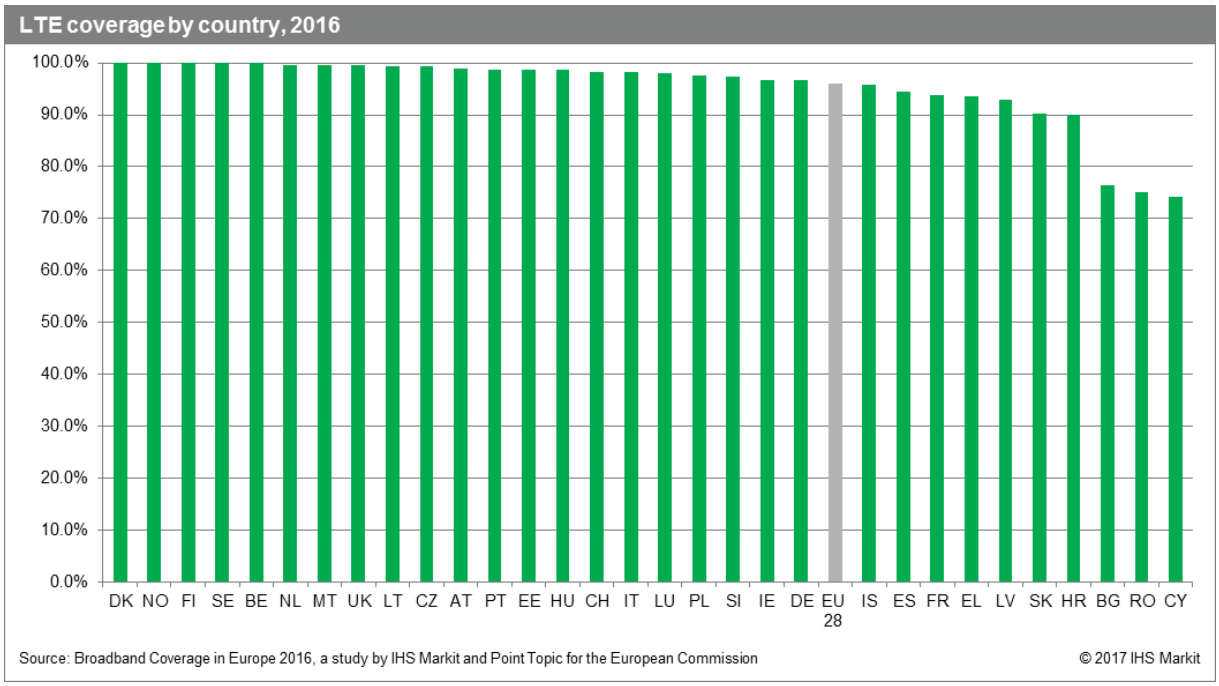
As in previous years, HSPA provided near-universal coverage. By mid-2016, HSPA networks covered 98.0% of EU households, an increase of 0.4 percentage points compared to mid-2015. The limited coverage growth highlights that HSPA coverage has approached saturation levels. The biggest improvement in HSPA coverage was witnessed in Ireland, where coverage improved by 4.6 percentage points to 99.2%. With coverage improvements in Ireland, Slovakia and Germany were the only two countries to report HSPA coverage levels below 95% (at 92.1% and 90.7%, respectively).



However, it is important to note that the actual performance and user experience of HSPA broadband varies greatly due to varying standards of individual operators as well as actual conditions in each coverage area. CDMA-based mobile networks (such as HSPA) are also subject to changes in the range of the geographical area covered by a cellular telephone transmitter based on the amount of traffic using that transmitter in any given moment – so called cell breathing. Thus, the quality of mobile broadband connection can vary significantly, within an area as a consequence of geographic or building features, and temporally as a consequence of cell breathing. There can also be significant differences between indoors and outdoors coverage with respect to mobile broadband performance. For the purpose of this study the research team defined HSPA coverage based on outdoors coverage of premises.

4.3.3.2 Total LTE coverage by country

LTE remained the fastest growing broadband technology in terms of coverage, increasing by 10.1 percentage points in the twelve-month period to mid-2016, reaching 96.0% of EU households. Yet, even though LTE retained its title, the pace of the coverage growth is slowing compared to previous years. This is to be expected, as the availability of LTE networks has become near-universal in several study countries. By mid-2016, 21 study countries reported coverage levels exceeding the EU average (96.0%) and LTE coverage reached 99% of households in 11 study countries. It is also worth to note that in a number of countries, such as the Czech Republic, Germany, Hungary, and the UK, LTE coverage reached higher levels than that of HSPA networks.



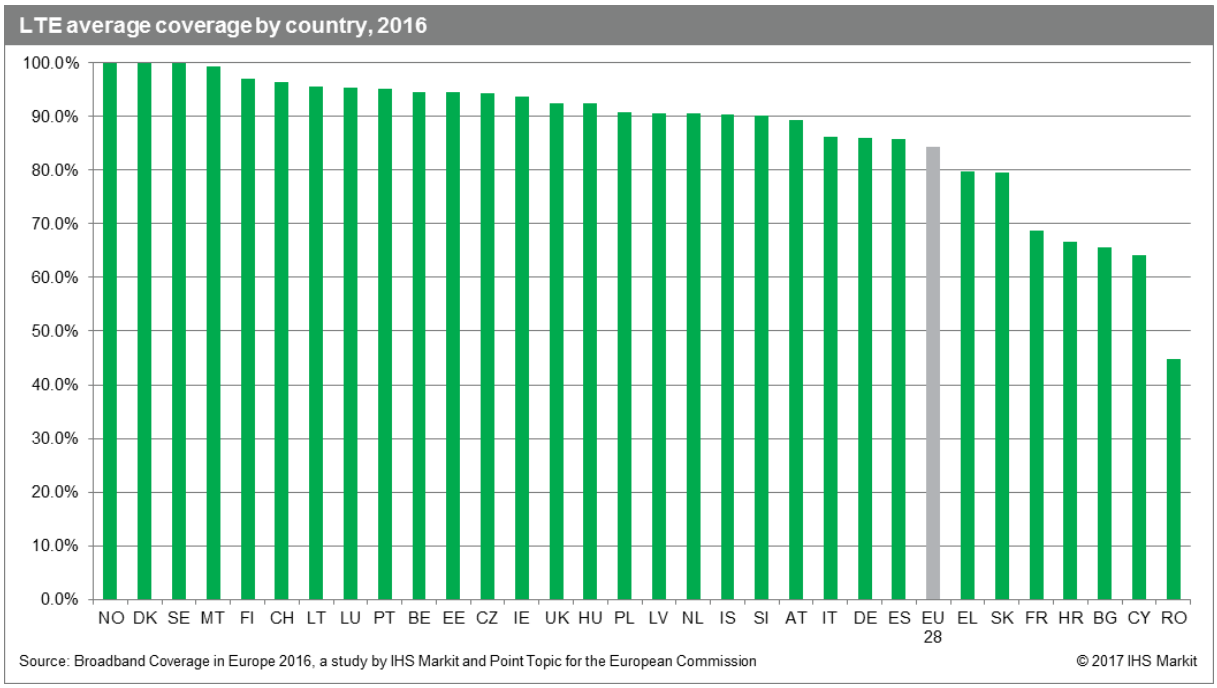
Several countries recorded significant growth in LTE coverage during the twelve-month period to the end of June 2016, including Malta where LTE coverage increased by 27.5 percentage points to make it one of the leaders in terms of availability of LTE services. However, the largest increase was reported in Slovakia where LTE coverage increased by 29.0 percentage points to 90.3%. Bulgaria also witnessed a rapid growth in the proportion of households covered by LTE, as coverage increased by 28.4 percentage points. Despite this, Bulgaria continued to lag behind the vast majority of study countries. Along with Romania and Cyprus, LTE coverage in Bulgaria was at around 75% of households in mid-2016.

4.3.3.3 Average LTE coverage by country

In addition to the standard measurement of LTE broadband coverage analysing the highest possible coverage after taking into account overlapping network coverage of operators providing LTE services over their networks in the same area, DG Connect has also asked the research team to provide them with a new metric looking at average coverage of all LTE operators. This indicator aims to serve as a better measurement of actual user experience, as a typical user will only be able to connect to one LTE network at a time. The average LTE coverage metric has been also included as one of the components of the Connectivity dimension of the Digital Economy & Society Index published in March 2017.

Looking at the average LTE coverage values, it is possible to see that all operators in Denmark, Norway, and Sweden provide universal coverage meaning that no matter which particular operator a consumer decides to use, the operator's LTE network will be available ubiquitously. In Malta, LTE services are available to be provided on average to 99.3% of consumers and in Finland, Switzerland, Lithuania, Luxembourg, and Portugal the average LTE coverage was higher than 95.0%.

In seven countries (Greece, Slovakia, France, Croatia, Bulgaria, Cyprus, and Romania) average LTE coverage levels were recorded lower than the overall EU average total of 84.4%. In these countries, operators provide only partial LTE coverage and thus the user experience of these networks is also limited.



4.3.3.4 Total mobile coverage of transportation links

As per the Tender Specifications and DG Connect's specification during the inception meeting, the research team has aimed to provide information on availability of mobile broadband connectivity not limited to household coverage, which would better reflect the mobility aspect of mobile connectivity.

The 2016 data collection and analysis provided best-effort estimates based on data obtained from NRAs, mobile network operators, as well information attained from various official NRA-backed reports assessing national mobile networks connectivity and publicly available operator published information, such as operator coverage maps. The research team also collected data on landmass/geographic coverage of mobile networks, which was used to help guide the estimates in cases where transportation coverage information was not available. In addition, Point Topic's European Kilometre Grid database and the Corine landmass database were also used to compare operator published coverage maps with the geographic location of key transportation links.

As such the research team considered transportation infrastructure in terms of motorways and roads as well as railway networks. The following data thus represents a composite estimation of road and railway coverage provided by HSPA and LTE networks, taking into account operator networks overlap.

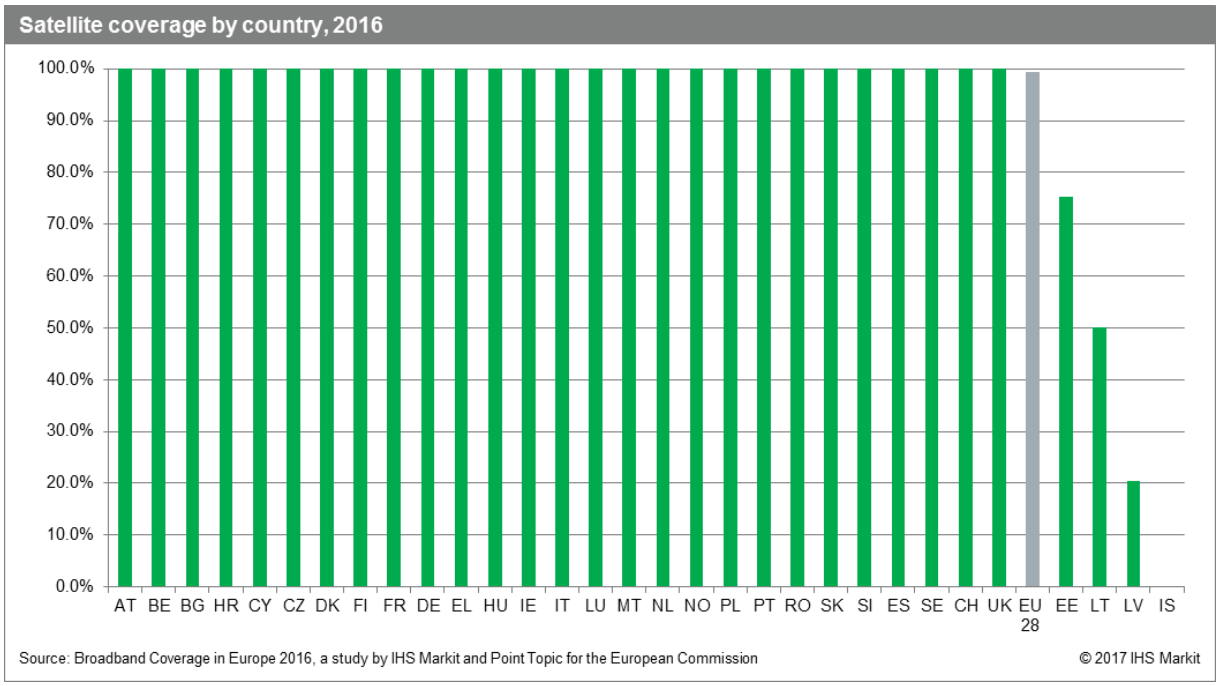
However, it is outside of the scope of this evaluation to take into account the quality of service components associated for example with lost connectivity due to road and rail tunnels, tower signal handover when travelling in high-speed on a motorway or with restricted signal strength inside train carriages caused by the thickness of the carriage walls. Therefore, these and other factors influencing mobile broadband connectivity and user experience were not evaluated.

Given the varying level of available information, the research team decided to take the 2016 transportation coverage data collection as a testing ground for this metric with the aim to further evolve the methodological approach in the next iterations of the study. Therefore, following discussions with DG Connect, a decision has been made to keep the 2016 transportation coverage results for internal purposes. The research team will continue to develop a more robust methodology with further help from NRAs and operators.

4.3.3.5 Total satellite coverage by country

At the end of June 2016, all of the study countries, with the exception of Iceland, were covered by KA-band satellite capable of delivering 2 Mbps broadband services. However, there continued to be only partial satellite coverage in Estonia, Lithuania and Latvia. As in 2015, satellite beams are still capable of reaching about 75% of Estonian households, approx. 50% of Lithuanian households and just over

20% of Latvian homes. In addition, satellite dishes with 1.2m diameter are required to receive satellite broadband services in these areas, thus making the widespread use of satellite broadband in these three countries more challenging.



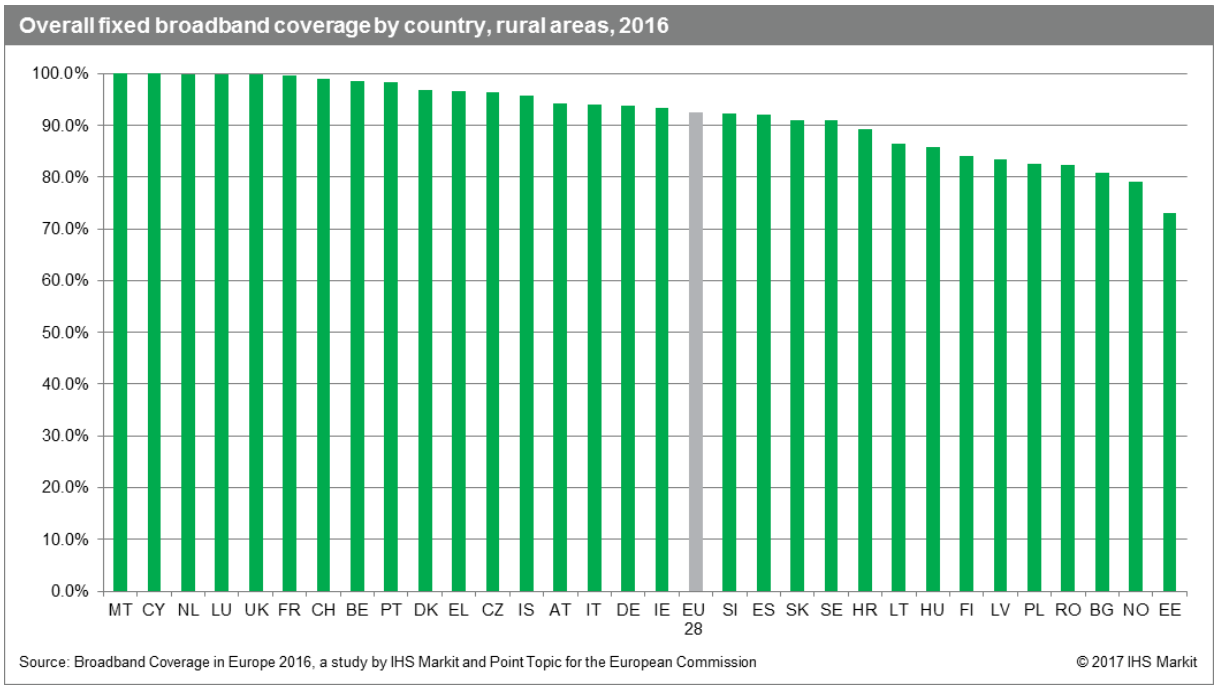
Moreover, it is important to note that while satellites are technically able to cover all households in the reach of a particular beam, the actual number of users that can be serviced by a single beam is limited by the peak average bandwidth usage, thus restricting number of serviceable homes in a particular area.

As in the previous year, the research team estimated the total EU coverage of satellite broadband as reaching over 99% of EU households. Satellite coverage in rural areas was assumed to be identical to the total satellite coverage and satellite coverage for overseas administrative areas was assumed to be the same as coverage of the respective countries they belong to (France, Portugal and Spain).

4.4 Country comparison by rural technology coverage

4.4.1 Rural overall fixed broadband coverage by country

As in previous years, rural fixed coverage in most study countries is lower than national fixed coverage. By mid-2016, rural fixed broadband coverage reached 92.7% of rural households compared to national coverage of 97.5%. However, the gap between total fixed coverage and rural fixed coverage continues to reduce. Standing at 4.8 percentage points in mid-2016, this is 0.8 percentage points lower than the gap in mid-2015, and 7.5 percentage points lower than at the end of 2012.



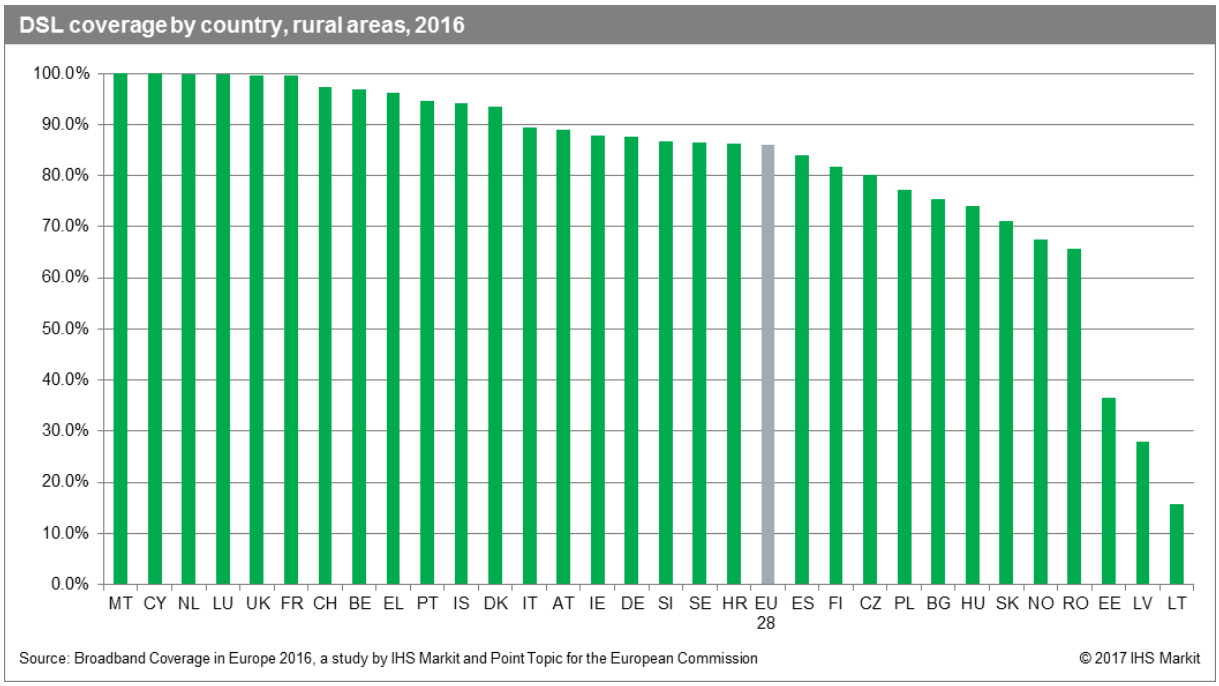
Seventeen study countries reported rural fixed broadband coverage above the EU average (92.6%). Moreover, seven countries reported that more than 99% of rural households were covered by at least one fixed broadband technology. Predominantly, these are countries with relatively high levels of urbanisation. For instance, in 2016 just 1% of households in Malta were classified as rural, 8% in the Netherlands, and 11% in Cyprus.

It should be noted that data on rural coverage collected from NRAs and individual operators was not always as comprehensive as total market-level data. In cases when information on rural coverage was incomplete, the research team estimated rural coverage using similar approach applied by Point Topic in previous years of the study. These estimations assume that a technology will typically cover a particular rural area only when urban or non-rural areas within the same region reach 100% coverage.

During the 2016 data collection, the research team has also introduced new checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households. When these checks were applied to rural coverage values reported in previous years, they identified underestimation of rural coverage in a number of countries leading to restatements of previously reported rural coverage data. These restatements have been reflected in the year-on-year rural comparisons analysed throughout this report.

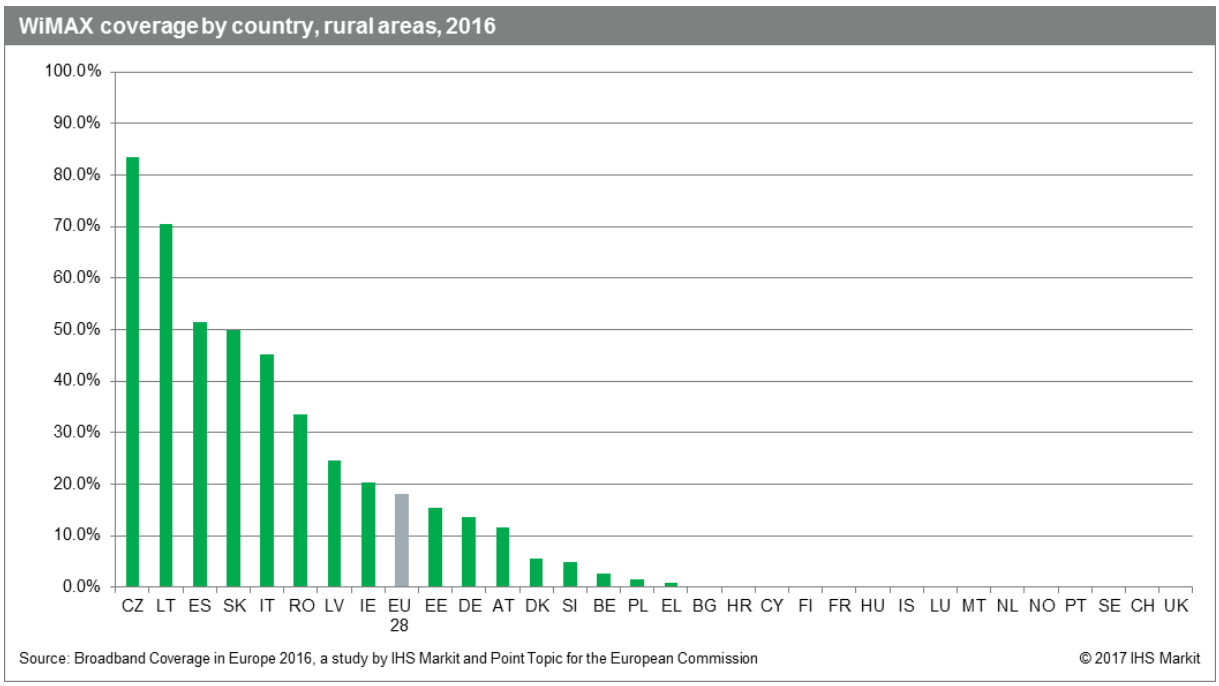
4.4.1.1 Rural DSL, WiMAX and cable coverage by country

In mid-2016, DSL remained the most widespread fixed broadband technology in terms of the number of rural homes passed. On average, rural DSL networks covered 86.0% of rural EU households. This represents an 8 percentage point gap when compared to the total EU average for DSL networks (94.3%). Moreover, the difference between total and rural coverage was far greater in several study countries such as Lithuania (54 percentage points) and Estonia (37 percentage points).



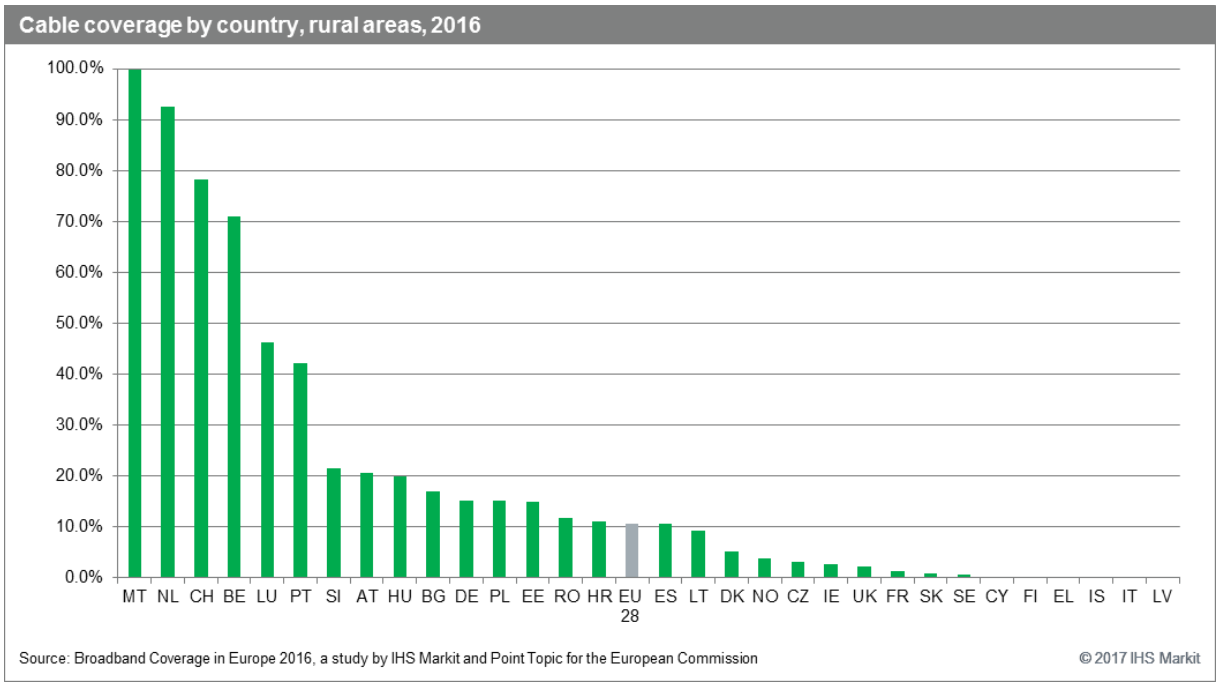
By mid-2016, nineteen countries reported rural DSL coverage levels exceeding the European average. DSL coverage improvements in Croatia and Sweden meant these countries were above the European average for rural DSL coverage, unlike in the 2015 edition of the study. Rural DSL coverage in Estonia, Latvia and Lithuania remained at below 40% in mid-2016, considerably below the other study countries.

However, other technologies can serve as a partial substitute for DSL in rural areas meaning that countries with low-DSL coverage in rural areas are often among the leaders in terms of rural WiMAX coverage.



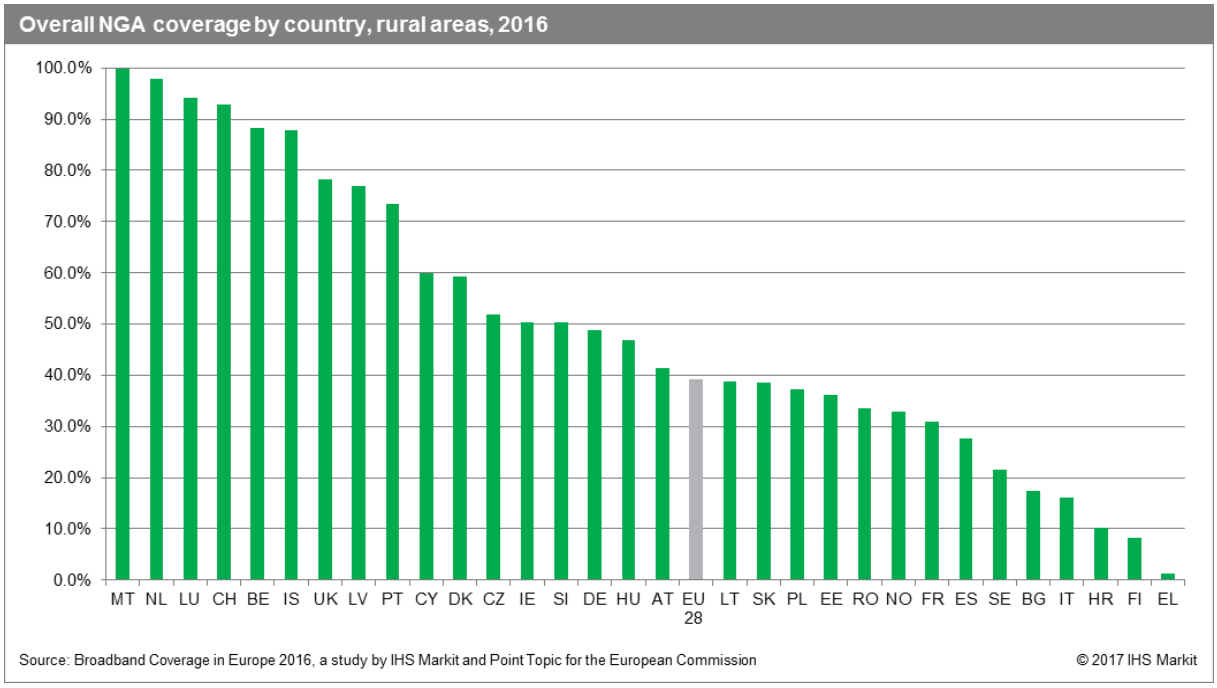
Compared to mid-2015, a further six countries (Bulgaria, Croatia, Finland, Iceland, Malta and the UK) reported that WiMAX was not available to households in rural areas in mid-2016. As noted previously, this reflects the decision of several operators to discontinue WiMAX in order to redistribute the spectrum for LTE.

With regards to cable technologies in rural areas, the nature of cable network deployment, and its primary focus on urban and semi-urban areas, results in limited coverage for rural households. At the end of June 2016, only 10.7% of rural EU households had access to cable broadband. This equates to a 0.5 percentage point increase, a similar growth rate to previous editions of the study.



4.4.2 Rural NGA coverage by country

Ensuring access to high speed broadband services for rural households is one of the main challenges that European countries face in implementing their national strategies for achieving the targets set out in the Digital Agenda for Europe.



Malta continued to lead the study in terms of rural NGA coverage, with near-complete NGA coverage of rural households. The rural EU average for NGA technologies, at 39.2%, continued to be considerably lower than total NGA coverage (76.0%). However, in contrast to previous years, the gap between rural NGA and total NGA coverage reduced. By mid-2016, the difference was 36.7

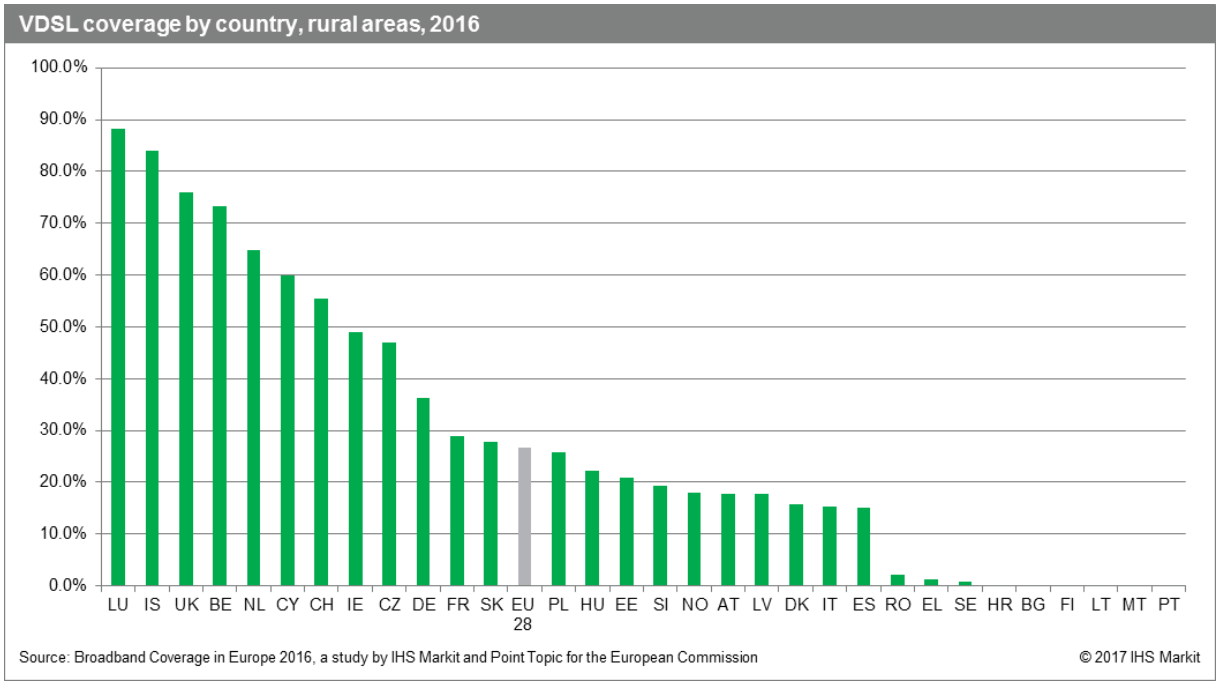
percentage points in comparison to over 40 percentage points in mid-2015. This suggests that deployment is shifting towards rural areas, as urban areas start to reach saturation for NGA coverage.

Seventeen countries performed better than the EU average, and four countries recorded rural NGA coverage exceeding 90% - Malta, the Netherlands, Luxembourg, and Switzerland. As of mid-2016, Croatia, Finland and Greece recorded rural NGA coverage below 10%. In all three of these countries, the availability of DSL connections in rural areas is rather high and an upgrade of such networks to VDSL could potentially lead to increased rural NGA coverage in the future. For instance, rural NGA coverage in Italy improved by 16 percentage points in the twelve-month period to mid-2016, driven by the deployment of VDSL networks. Previously, at the end of June 2015, only 3.1% of rural homes had access to NGA broadband and in 2014, there was no rural NGA coverage recorded in Italy.

4.4.2.1 Rural VDSL, FTTP and DOCSIS 3.0 coverage by country

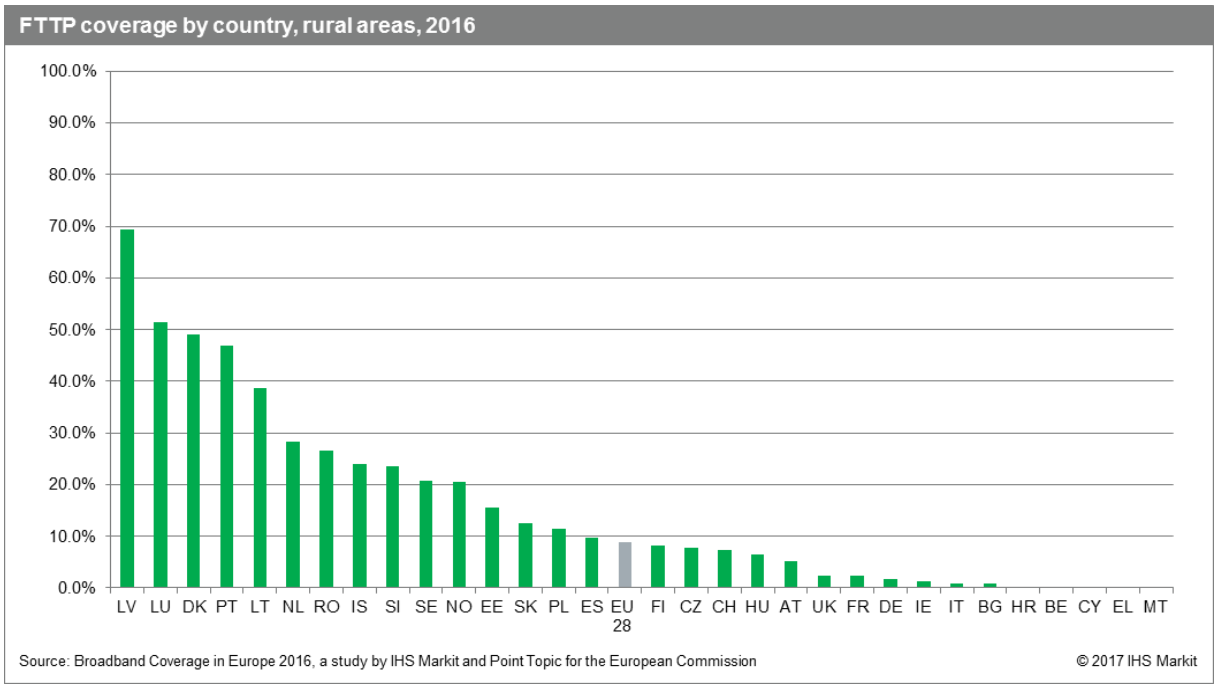
VDSL remained the leading rural NGA technology. Rural VDSL coverage improved by 7.7 percentage points, with VDSL networks passing 26.6% of rural homes in the EU by mid-2016. This constitutes a considerably faster rate of rural growth, compared to previous editions of the study.

Luxembourg continued to lead in terms of rural VDSL coverage, with almost 90% of rural households reached. Iceland, the UK and Belgium were the only three other countries to record rural coverage levels of more than 60%.

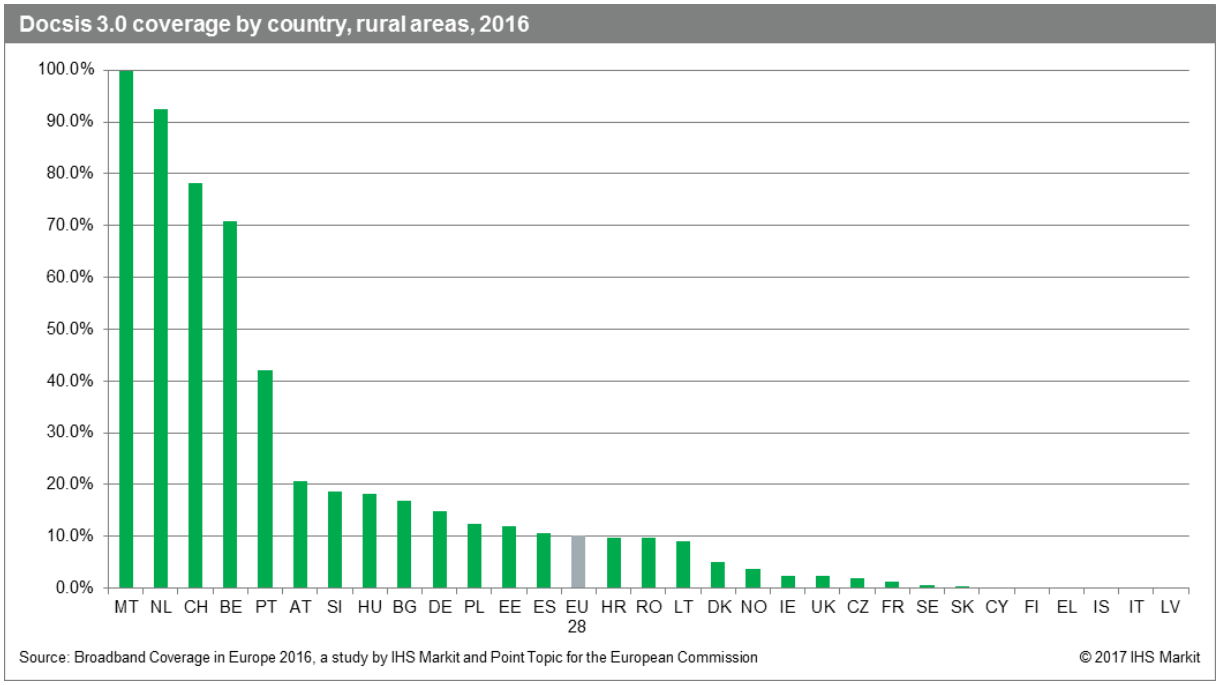


With regards to rural FTTP coverage, Latvia was the leader with nearly 70% of rural households reached by FTTP by mid-2016. Luxembourg and Denmark were the only two other countries to have around 50% rural FTTP coverage, reaching 51.5% and 49.0% of households, respectively. Fifteen other countries recorded above-average FTTP availability; although in many of these countries FTTP coverage was still less than 30%. Rural households in four countries (Belgium, Cyprus, Greece and Malta) had no access to FTTP services.

In the previous editions of the BCE study, rural FTTP coverage in Lithuania was estimated to reach around 90% of rural households. However, results of a detailed mapping study conducted by the Lithuanian Ministry of Transport and Communications suggest that a much smaller proportion of rural households in Lithuania (around 40%) have access to FTTP broadband. In light of this new data, historical data has been restated accordingly.



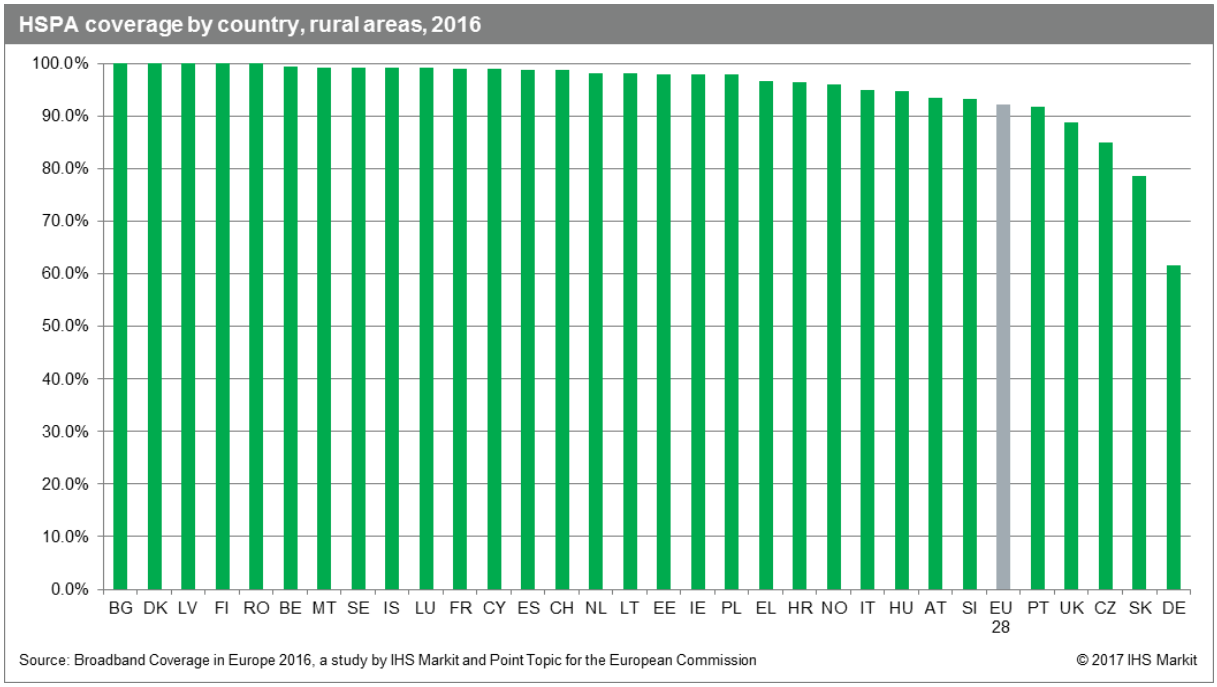
Developments in rural DOCSIS 3.0 coverage continued to broadly reflect the availability of standard cable broadband services. By mid-2016, rural DOCSIS 3.0 coverage increased by 0.7 percentage points to 10.1%. Malta was the only country with near-complete rural DOCSIS 3.0 coverage, followed by the Netherlands with 92.5% of rural homes passed by the high-speed cable networks. Switzerland and Belgium were the only other countries with more than 50% rural DOCSIS 3.0 coverage.



4.4.3 Rural Mobile coverage by country

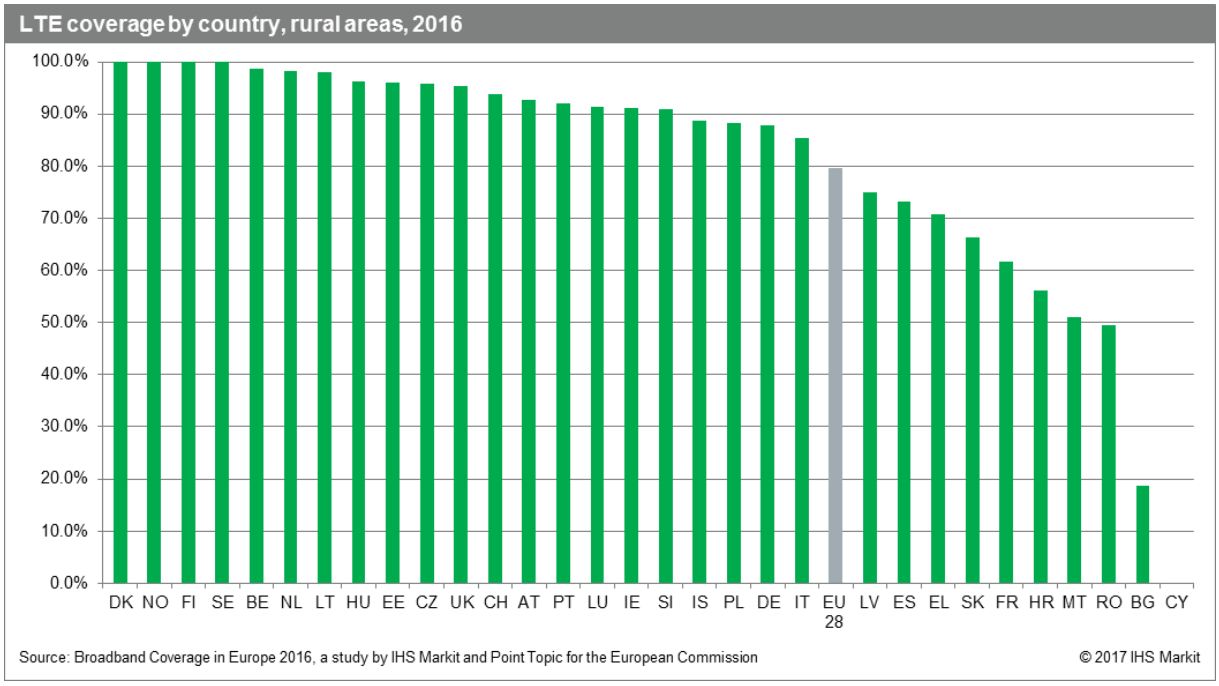
4.4.3.1 Rural HSPA coverage by country

HSPA continued to offer the second widest rural broadband coverage in the EU after satellite broadband. Five countries (Bulgaria, Denmark, Latvia, Finland and Romania) reported complete coverage, with several others recording near-complete coverage levels. All countries, with the exception of the UK, Czech Republic, Slovakia and Germany, recorded HSPA coverage of more than 90%.



4.4.3.2 Rural LTE coverage by country

Rural LTE coverage registered a substantial increase in the twelve-month period to mid-2016, rising by 43.4 percentage points to 79.7%. Conversely, in the six-month period to mid-2015, total rural LTE coverage increased by only 9.3 percentage points.



In total, 21 countries reported coverage levels above the EU average. However, there are still considerable differences compared to HSPA coverage. Three countries recorded rural LTE coverage of below 50% (Romania, Bulgaria and Cyprus). Cyprus was the only country with no rural LTE coverage, following the initiation of rural LTE deployments in Malta and Bulgaria.

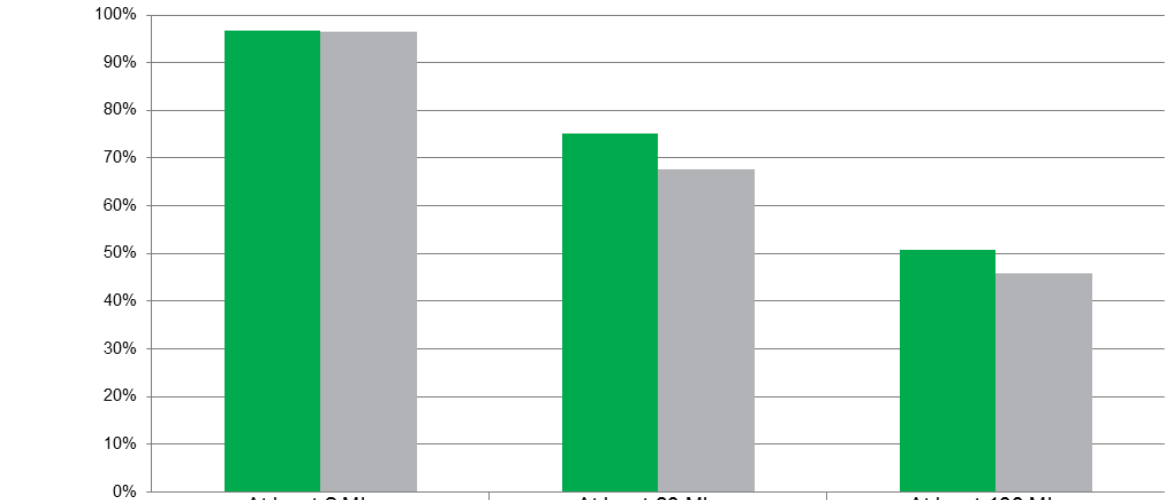
By mid-2016, sixteen study countries reported rural LTE coverage above 90% compared to six countries (Denmark, the Netherlands, Sweden, Slovenia, Norway and Luxembourg) in mid-2015. The highest coverage increases were reported in the UK and Poland, where rural LTE coverage increased by 85.2 and 82.6 percentage points, respectively. By mid-2016, rural LTE covered 95.3% of rural UK households and 88.4% of rural Polish households.

4.5 Coverage by speed categories

4.5.1 Europe-wide coverage by speed categories

Looking at coverage levels by the individual speed categories, it is possible to see that at the end of June 2016, 96.7% of EU households were reached by networks providing them with actual download speeds of at least 2 Mbps, a constant trend compared to mid-2015.

EU28: Coverage by download speed categories, 2016



	At least 2 Mbps	At least 30 Mbps	At least 100 Mbps
EU28 2016	96.7%	75.1%	50.8%
EU28 2015	96.4%	67.6%	46.0%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

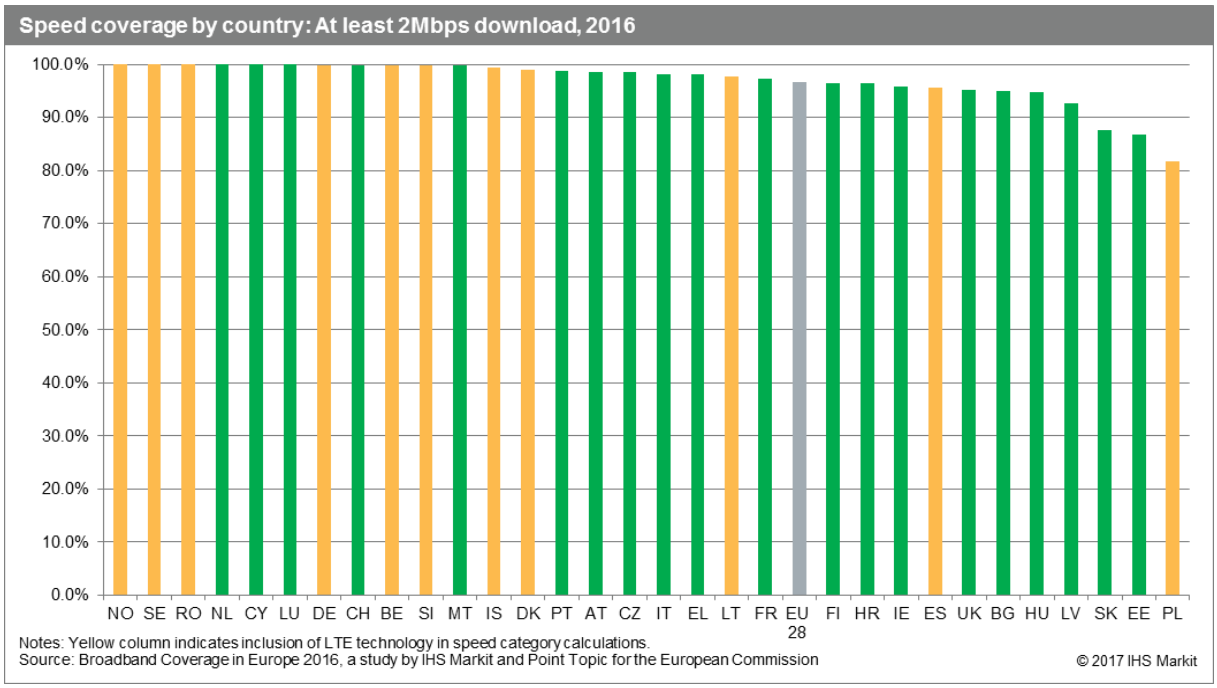
As for availability of connections with at least 30 Mbps actual download speed, three-quarters (75.1%) of EU homes had access to such services in mid-2016. This speed category registered the highest increase, growing by 7.5 percentage points compared to the end of June 2016. The increase can be attributed to overall growth in fixed NGA coverage, but also to technological advancements meaning that higher number of VDSL networks is capable of supporting 30 Mbps download speeds and LTE networks are capable of supporting such speeds in a consistent manner, a fact that has been reflected in the speed coverage estimates for the first time in 2016.

The research team estimates that over a half (50.9%) of EU households had access to broadband services capable of providing at least 100 Mbps actual download speeds at the end of June 2016 meaning that EU as whole has reached the Digital Agenda goal of 50% of households having access to 100 Mbps broadband services by 2020. However, as is explained in the following sections, big differences remain among individual countries.

4.5.2 Country comparison of coverage by speed categories

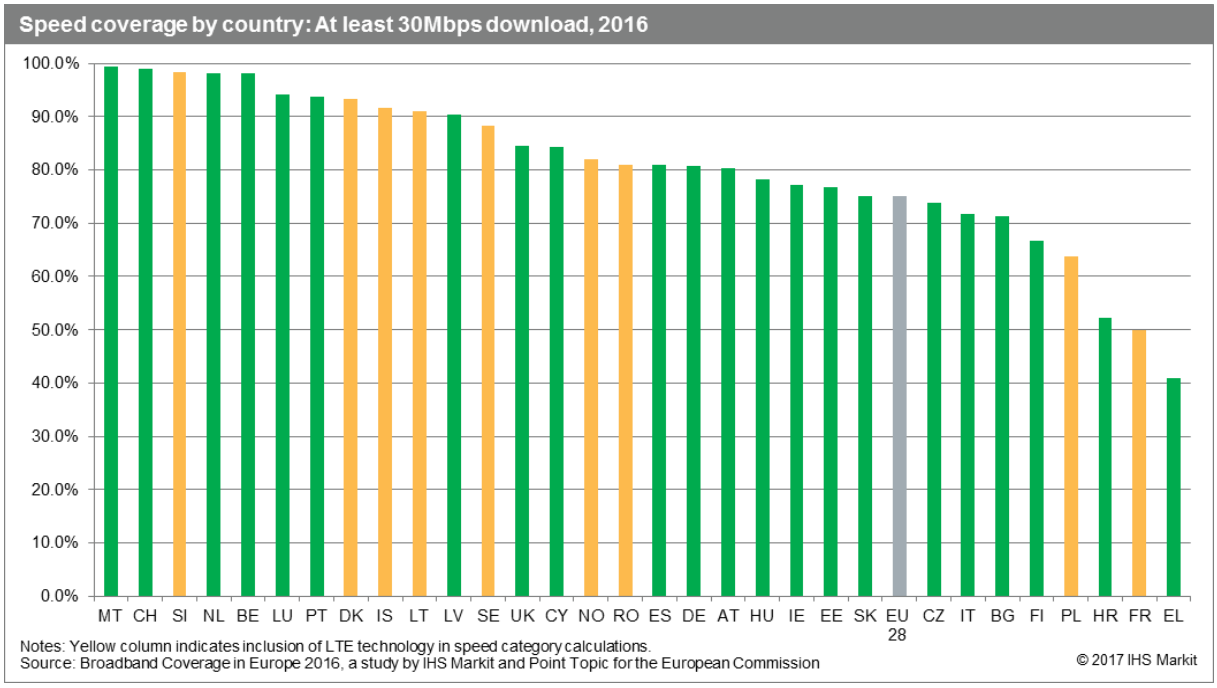
The information gathered on actual download speed of at least 2 Mbps shows that in most countries, vast majority of households had access to connections with at least 2 Mbps actual download speeds at the end of June 2016. In 11 countries, at least 2 Mbps actual download speeds were available to all or nearly-all (over 99.8%) households.

Lower availability of at least 2 Mbps broadband connections was recorded for countries with higher proportion of DSL or WiMAX networks in the make-up of fixed broadband coverage, as traditionally DSL (and WiMAX) networks tend to be less reliable in sustaining actual speeds at peak times compared to cable and FTTP networks. In Slovakia, Estonia, and Poland fewer than 90.0% of homes were passed by networks capable of delivering at least 2 Mbps actual download speeds.



In a number of countries, availability of at least 2 Mbps broadband connections reached higher levels than that of fixed broadband coverage. In Germany, Iceland, Norway, Romania, Slovenia, and Sweden, mobile networks and LTE networks in particular were reported to provide sustainable actual downloads speeds of at least 2 Mbps and thus contributed to boosting the coverage by at least 2 Mbps speed category to surpass coverage provided by fixed broadband networks.

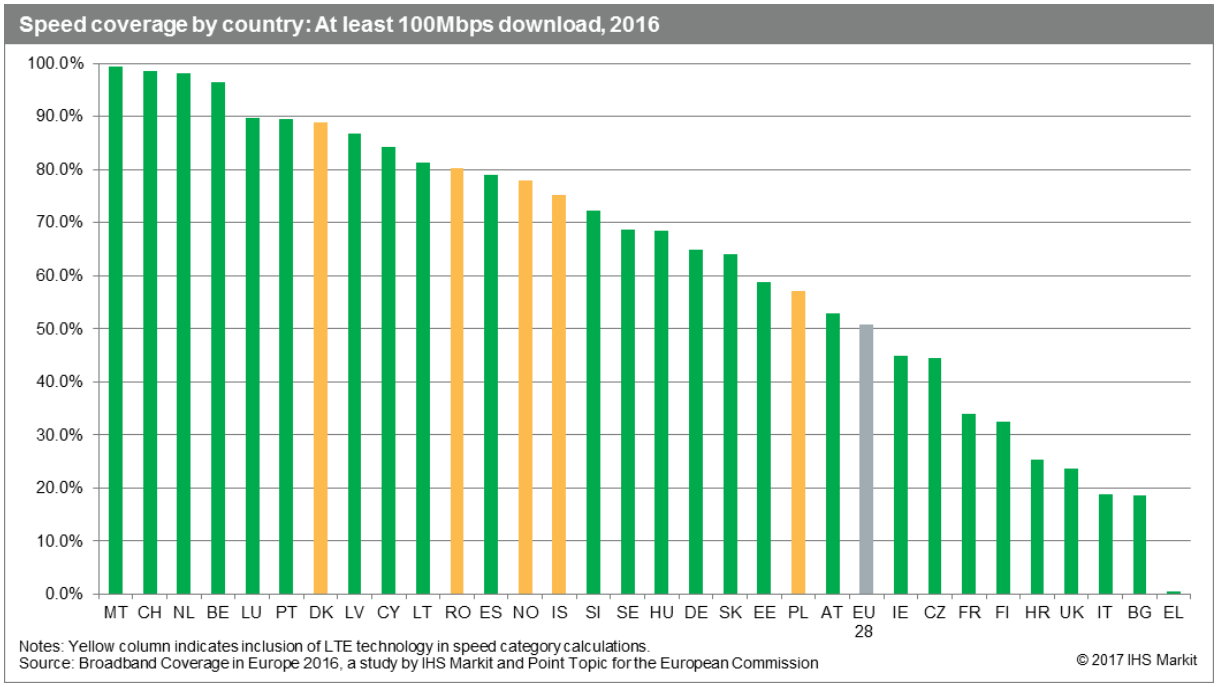
Similar trend was also observed when looking at the NGA coverage figures in comparison with data on at least 30 Mbps actual download speeds. In France, Lithuania, Norway, Romania, Slovenia, and Sweden more households were able to access broadband services providing them with at least 30 Mbps actual download speeds than there were homes passed by fixed NGA networks. This development shows the potential and technological improvement of the LTE networks, which in these countries were considered to be able to partially support the at least 30 Mbps speeds for the required majority (75%) of time at the end of June 2016.



In addition, many countries experienced a substantial growth in availability of connections supporting at least 30 Mbps actual download speeds in the twelve-month period to the end of June 2016. The highest growth was recorded in Italy, where at least 30 Mbps coverage grew by 28.2 percentage points and at the end of June 2016, more than 7 in 10 Italian households (71.8%) had access to services providing these speeds. The main reason for this growth was a steep increase in VDSL coverage witnessed in Italy over the same period, with information provided by the main VDSL networks operators suggesting that most connections over the newly deployed VDSL networks were capable of supporting the at least 30 Mbps actual speeds.

However, this was not a case for many other countries, which have seen large increases in VDSL coverage in recent years, resulting in high levels of VDSL coverage compared to other NGA technologies. As the quality of VDSL connection speeds relies on a number of factors, such as distance from the street cabinet or presence of crosstalk, VDSL networks tend to be impacted the most in terms of inconsistencies in actual speeds achieved at peak times.

Countries, with the largest gaps between the two categories (NGA coverage and At least 30 Mbps coverage) include Austria, Finland, the UK, and Croatia, for which differences of more than 8 percentage points were recorded.



As mentioned previously, by mid-2016, the EU as whole reached the Digital Agenda goal of 50% of households having access to 100 Mbps broadband services by 2020. However, big differences remain among individual countries, with levels of 100 Mbps availability ranging from 99.4% in Malta to virtually no connections being able to support at least 100 Mbps speeds in Greece.

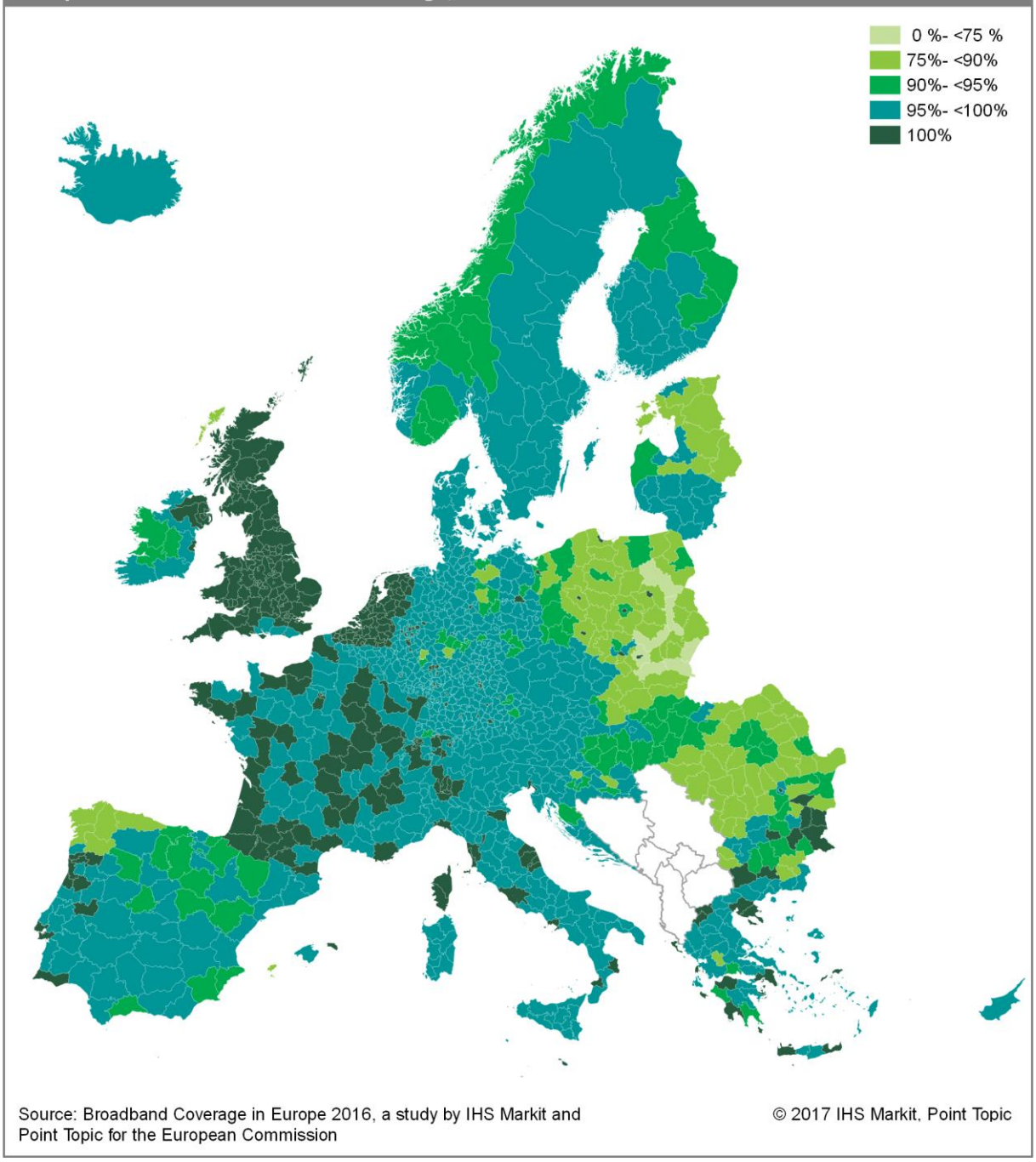
Biggest increases in terms of availability of at least 100 Mbps actual download speeds, were recorded for Norway and Poland, which witnessed a 39.0 and 35.2 percentage points increases, respectively. As was the case with the “At least 2 Mbps” and “At least 30 Mbps” speed categories, the main contributor to this increase was the inclusion of LTE in this category as reported by the NRAs.

When comparing NGA coverage levels to the availability of 100 Mbps actual download speeds, it is possible to conclude that high NGA coverage does not necessarily mean high levels of availability of at least 100 Mbps speeds. Countries such as the UK, Italy, Austria and Ireland, where VDSL networks make up significant portion of the overall NGA coverage show some of the biggest differences. For example, in the case of the UK, while 92.3% of homes are passed by NGA networks, services supporting actual download speeds of 100 Mbps and higher are available to less than a quarter (23.6%) of UK households.

4.6 NUTS 3 level total coverage

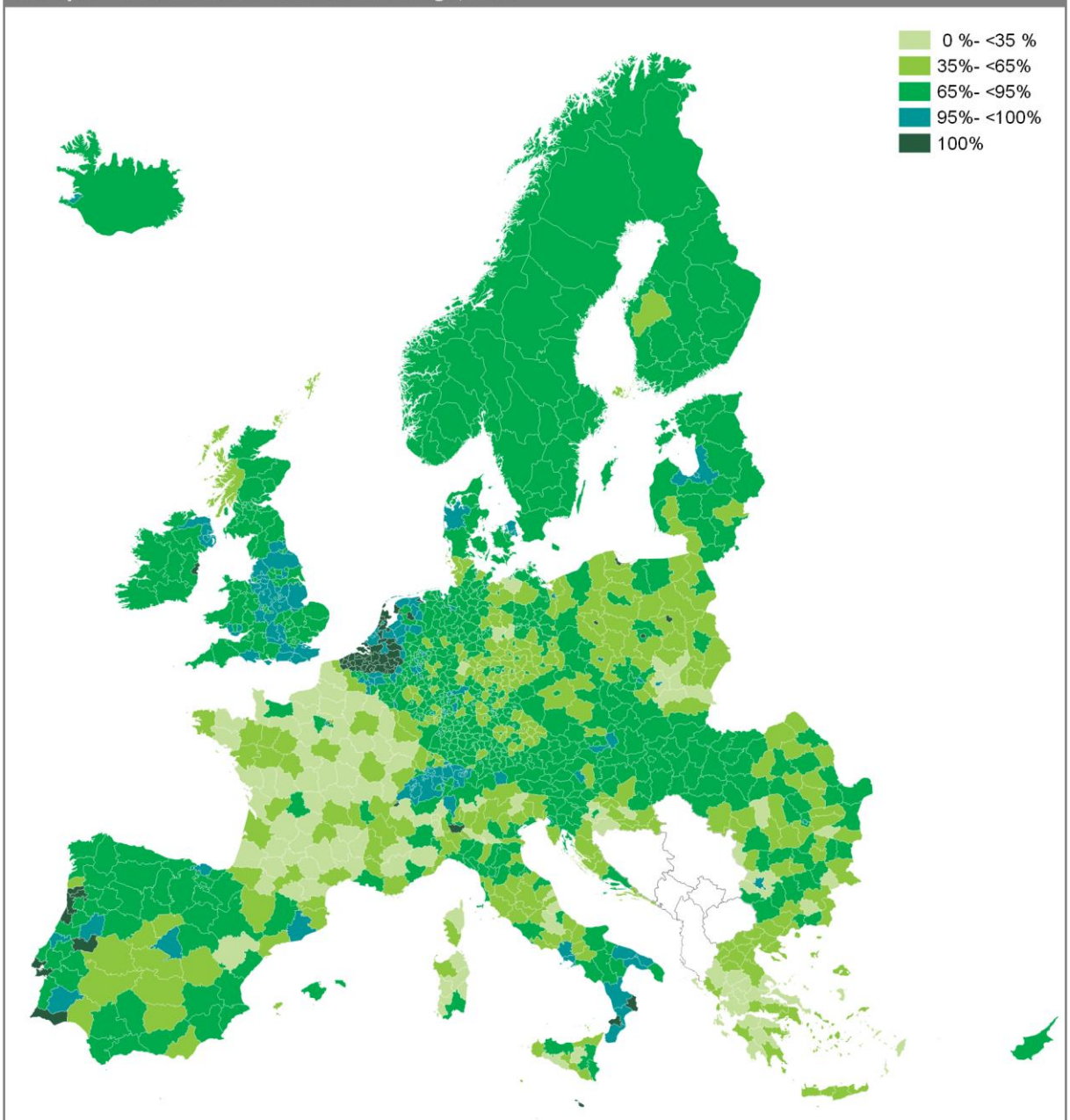
The maps included in this chapter indicate the distribution of fixed and NGA broadband coverage across Europe's regions and demonstrate the study results discussed in the previous chapters of this report.

Europe: Overall fixed broadband coverage, 2016



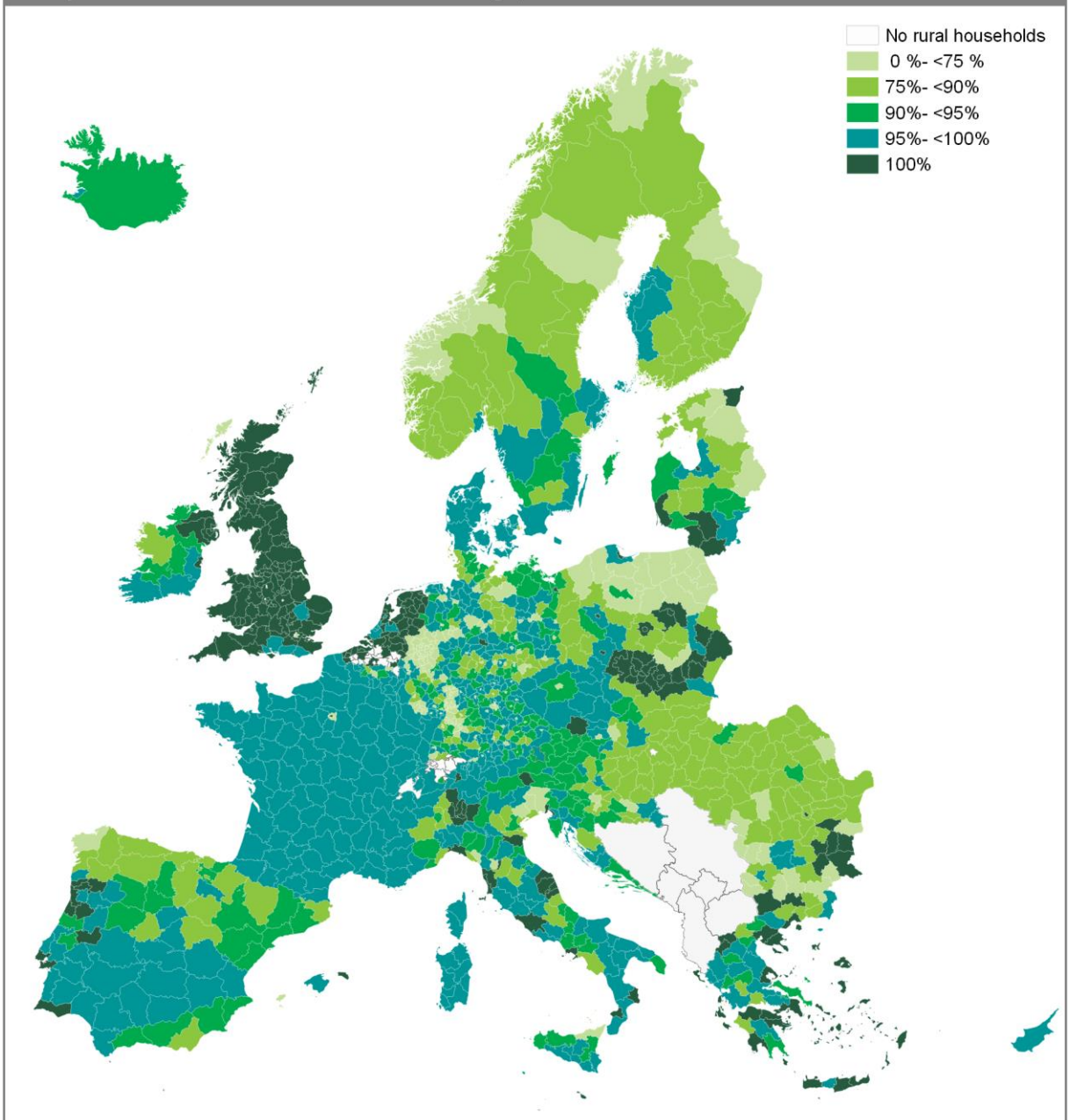
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Europe: Overall NGA broadband coverage, 2016



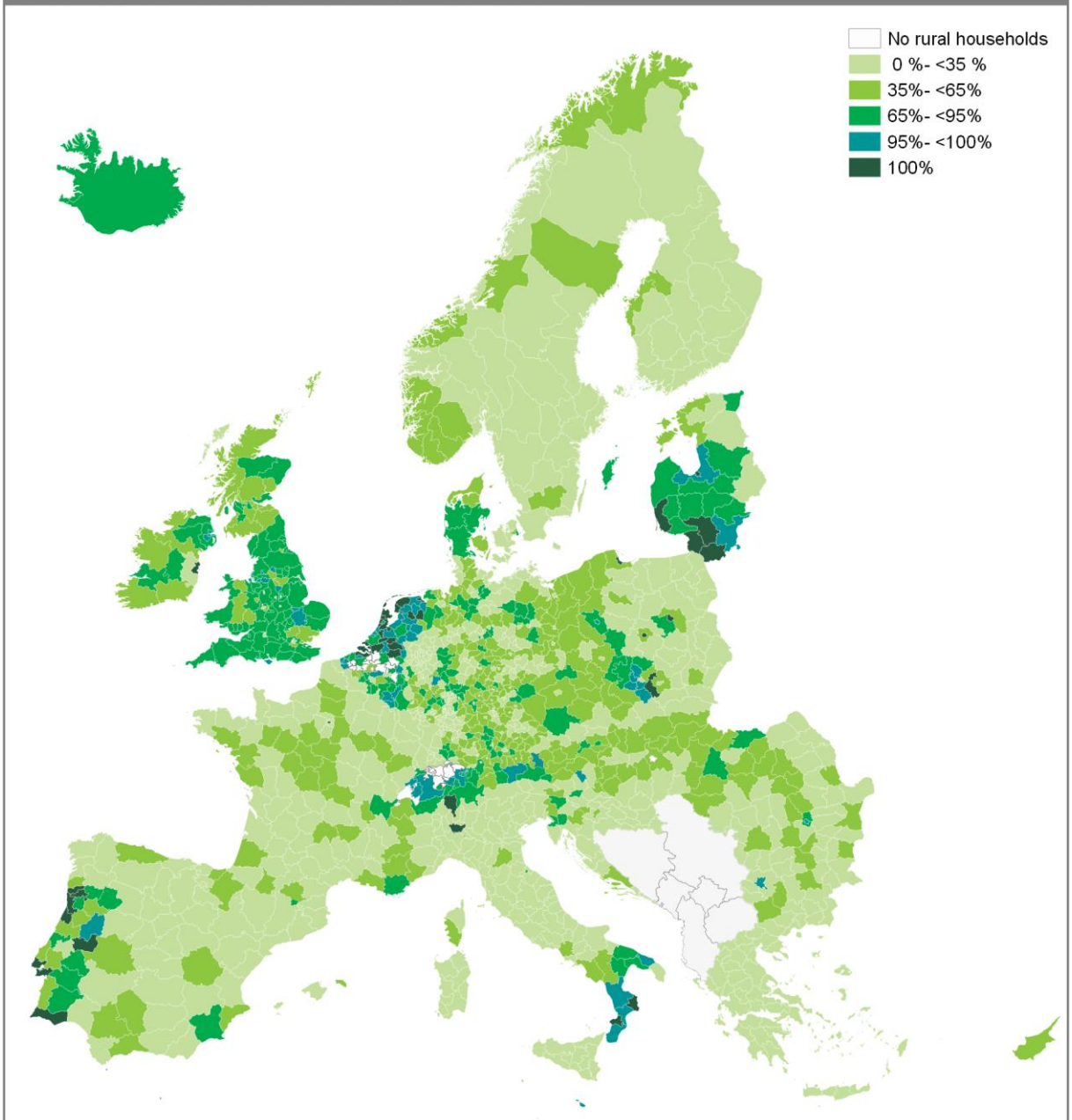
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Europe: Overall rural fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Europe: Overall rural NGA broadband coverage, 2016



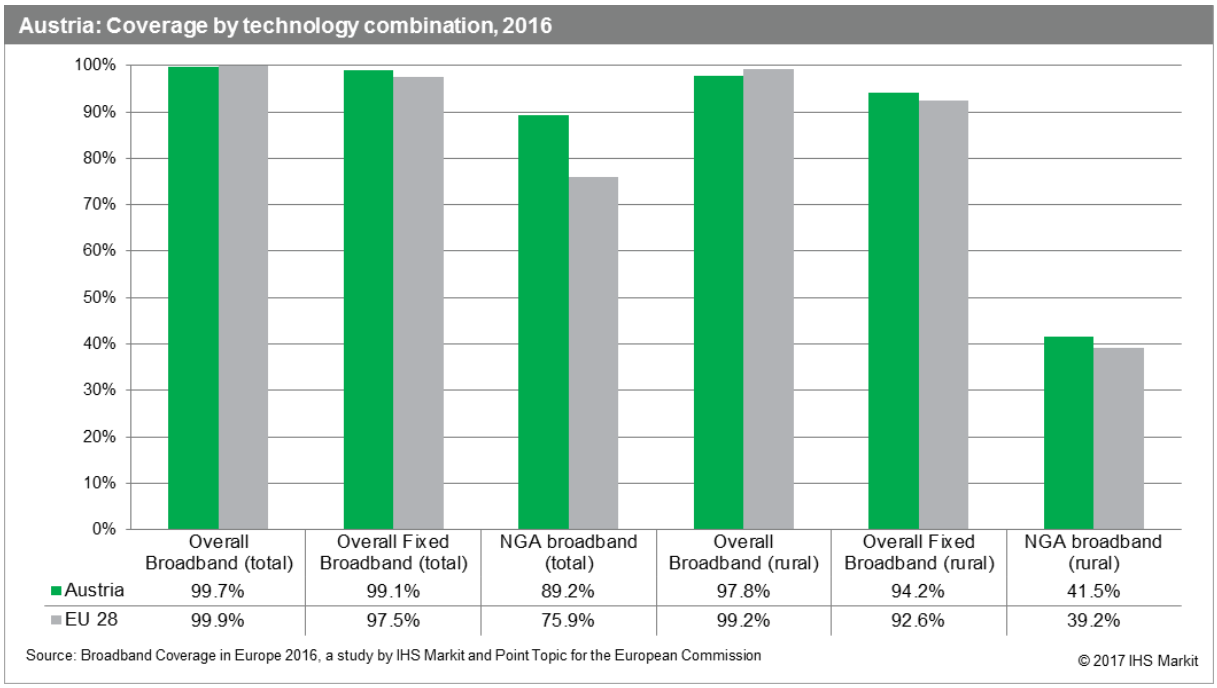
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.0 Coverage by Country

5.1 Austria

5.1.1 National coverage by broadband technology

In the twelve months to June 2016, overall broadband coverage in Austria remained slightly below the EU average, both nationally and in rural areas. Fixed broadband coverage was relatively unchanged during the period and continued to be above the EU average by nearly 2 percentage points at a both national and rural level. NGA coverage remained stable, rising less than 0.5 percentage points, as Austria continued to outperform the EU average for total NGA coverage and nearly 9 in 10 (89.2%) Austrian households had access to NGA services. In terms of rural NGA coverage, there was an increase of around 16 percentage points in the year to mid-2016 as Austria moved above the EU average. By mid-2016, 41.5% rural homes in Austria were passed by NGA networks and rural NGA coverage can be expected to continue to grow, helped by a funding programme put in place by the Austrian Government to close the urban-rural gap.[6]



By mid-2016, DSL networks reached around 98% of Austrian households, unchanged from the previous year. During the twelve months to mid-2016, Austrian cable coverage moved above the EU average (44.4%), increasing by 8.5 percentage points to 49.1% of homes. Cable coverage in Austria can be expected to continue to grow, with the leading cable company, UPC, set to deploy cable networks to an additional 250,000 households across Austria and Switzerland over the next five years.[7]

Looking at NGA broadband, VDSL remained the key NGA technology in Austria. The proportion of homes reached by VDSL networks (82.1%) was unchanged from previous years, remaining above the EU average (48.2%). Moreover, DOCSIS 3.0 coverage (47.2%) moved above the EU average (43.9%), due to the aforementioned increase in cable coverage. There was minimal change in the reach of FTTP networks in the twelve-month period to the end of June 2016, although in August 2016 the incumbent (A1 Telekom Austria) revealed it plans to deploy FTTP networks to an additional 30,000 households[8].

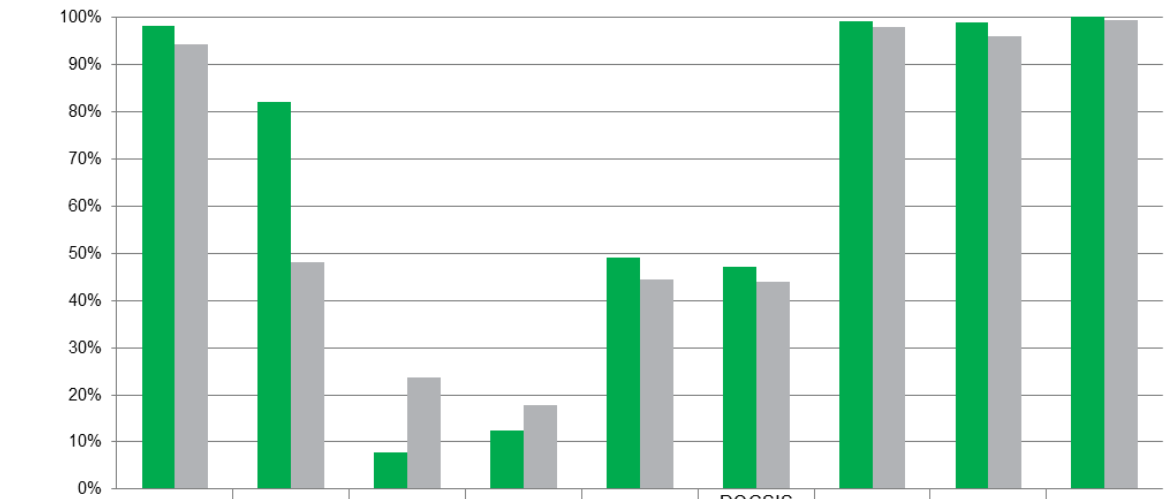
[6] https://www.telegeography.com/products/commsupdate/articles/2016/10/17/austria-allocates-eur110m-for-broadband-development-in-2017/

[7] https://www.upc.at/ueber-upc/presse/pressearchiv/upc-startet-millionen-investitionsprogramm-autostrada/

[8] http://www.a1.net/newsroom/2016/08/a1-erweitert-breitband-internet-in-grazer-innenstadt-mit-neuer-ausbauvariante/

Examining mobile broadband technologies, the proportion of Austrian households covered by LTE networks increased by 9.5 percentage points to reach 99.0% of households, thus remaining above the EU average of 96.0%. Moreover, when average coverage of LTE networks of all mobile network operators is considered, on average LTE services were available to 89.3% of Austrians. With near-universal LTE coverage, Austrian operators such as T-Mobile are trialling 4.5G as a precursor to the development of 5G technology.[9]

Austria: Coverage by technology, total, 2016

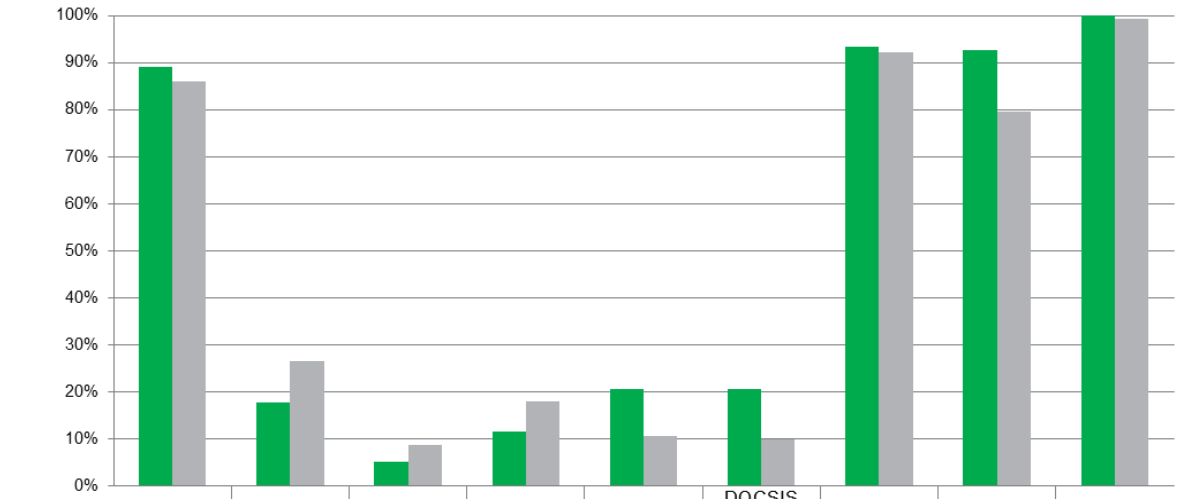


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Austria	98.3%	82.1%	7.8%	12.5%	49.1%	47.2%	99.1%	99.0%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL remained the primary broadband technology in rural areas, reaching 89.0% of households, unchanged from the previous year. The number of rural households passed by cable networks increased 3.3 percentage points to 20.7%, considerably higher than the EU average (10.7%). There was a reduction in WiMAX coverage, leading to a slight drop in the rural fixed broadband combination category.

Austria: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Austria	89.0%	17.9%	5.3%	11.7%	20.7%	20.7%	93.4%	92.6%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[9] https://www.telegeography.com/products/commsupdate/articles/2016/10/24/t-mobile-austria-huawei-demo-speeds-of-almost-2gbps/

Examining rural NGA coverage, rural VDSL availability increased by 10.8 percentage points during the period, but the difference between rural VDSL coverage (17.9%) and total VDSL coverage (82.1%) remained substantial and rural VDSL coverage in Austria continued to be below the EU average. At 20.7%, DOCSIS 3.0 was key NGA access technology in rural areas, increasing 3.3 percentage points in the twelve months to the end of June 2016.

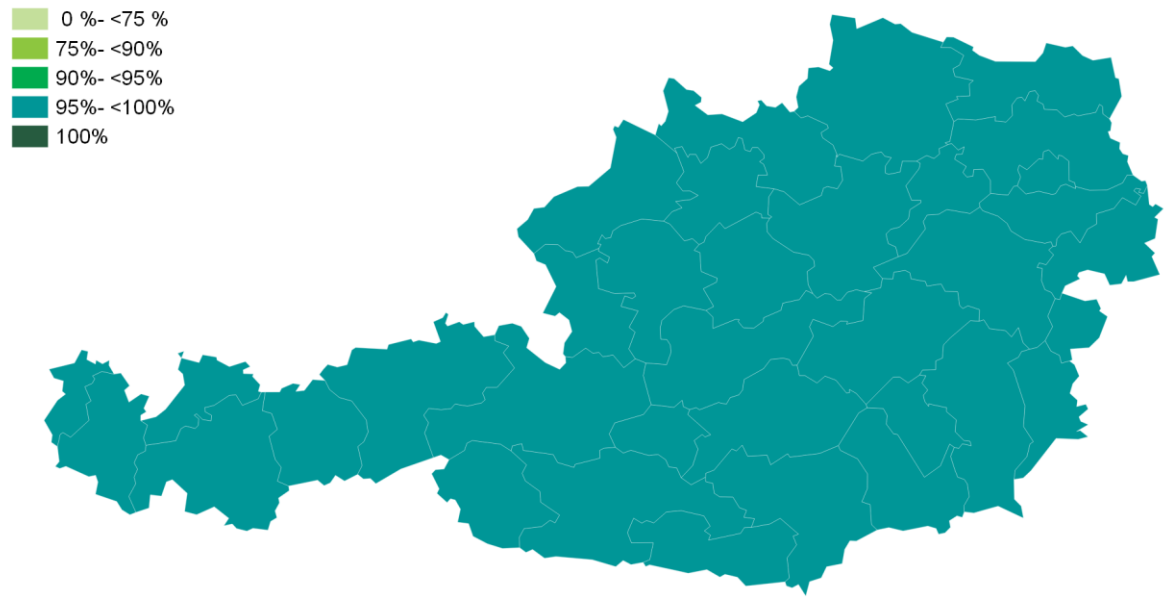
With regards to mobile broadband technology in rural areas, LTE coverage increased to 92.6% of rural households, rising 67 percentage points. Given the extent of LTE coverage in rural areas, A1 Telekom Austria is evaluating fixed-mobile solutions to deliver high-speed broadband in rural areas.[10] On average, LTE services provided by all Austrian mobile network operators were available to 89.3% of Austrians at the end of June 2016. This is higher than the average EU value

[10] https://www.telekomaustria.com/en/newsroom/2016-7-15-telekom-austria-group-austrian-subsidiary-a1-presents-the-internet-of-the-next-generation

5.1.2 Regional coverage by broadband technology

Examining individual regions, fixed broadband coverage did not vary significantly across regions, with all regions reporting coverage in the 98%-100% range. Universal fixed broadband coverage was recorded in the Salzburg und Umgebung region.

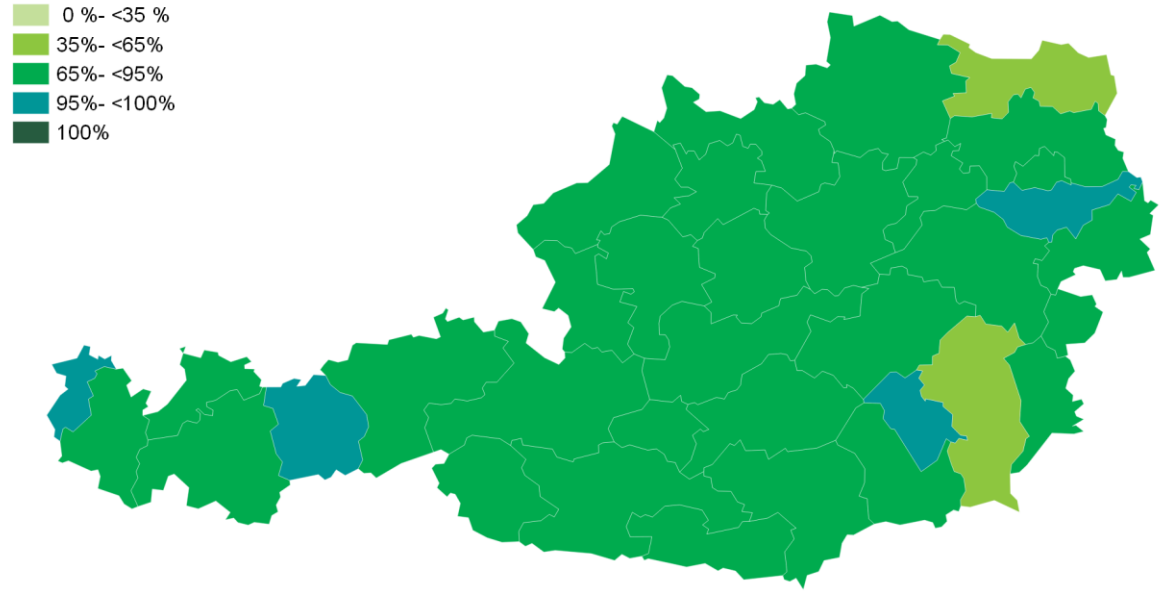
Austria: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

With regards to NGA coverage, the situation was more varied, with coverage levels ranging from close to 65% in Weinviertel and Oststeiermark to 100% in the Salzburg region.

Austria: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.1.3 Data tables for Austria

Statistic	National
Population	8,576,261
Persons per household	2.2
Rural proportion	13.7%

	Austria 2016		Austria 2015		Austria 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	98.3%	89.0%	98.4%	*89.1%*	98.4%	88.9%	94.3%	86.0%
VDSL	82.1%	17.9%	82.1%	*7.1%*	81.6%	*5.4%*	48.2%	26.6%
FTTP	7.8%	5.3%	7.1%	2.1%	7.1%	2.1%	23.7%	8.8%
WiMAX	12.5%	11.7%	16.1%	18.0%	16.5%	18.0%	17.8%	18.0%
Cable	49.1%	20.7%	40.6%	17.4%	39.1%	17.2%	44.4%	10.7%
DOCSIS 3.0	47.2%	20.7%	40.6%	17.4%	39.1%	17.2%	43.9%	10.1%
HSPA	99.1%	93.4%	98.0%	85.2%	98.0%	85.0%	98.0%	92.2%
LTE	99.0%	92.6%	89.5%	25.6%	60.1%	4.6%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	89.3%	-	-	-	-	-	84.4%	-
Satellite	100%	100%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.7%	97.8%	99.3%	94.8%	99.3%	94.8%	99.9%	99.2%
Overall fixed broadband	99.1%	94.2%	99.2%	*94.7%*	99.2%	*94.7%*	97.5%	92.6%
NGA broadband	89.2%	41.5%	88.8%	*25.9%*	88.2%	*22.4%*	75.9%	39.2%
At least 2 Mbps	98.6%	-	98.5%	-	98.4%	-	96.7%	-
At least 30 Mbps	80.3%	-	76.9%	-	75.9%	-	75.1%	-
At least 100 Mbps	52.9%	-	42.3%	-	40.8%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

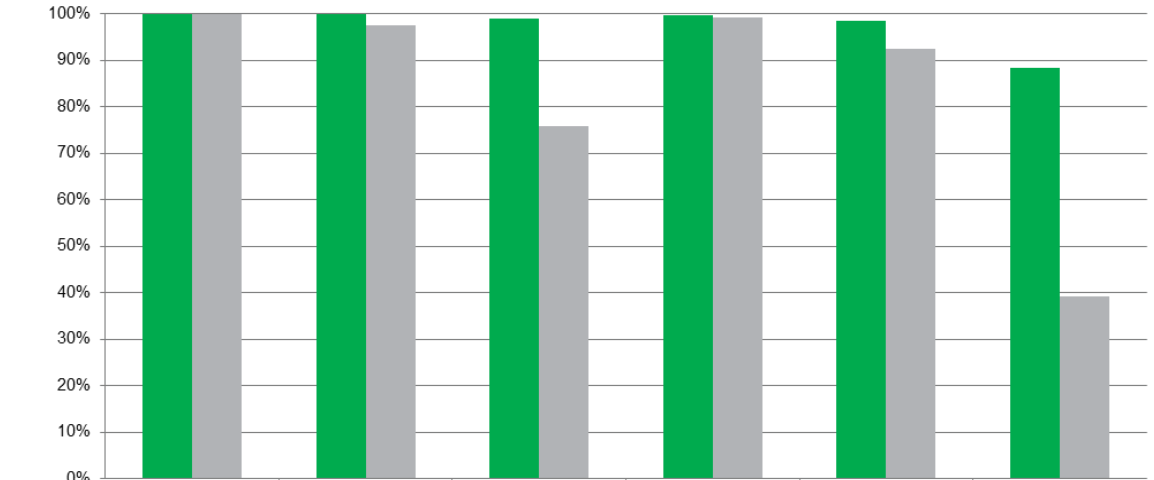
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL and VDSL coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.2 Belgium

5.2.1 National coverage by broadband technology

As in previous years, Belgium outperformed the EU average in terms of broadband coverage for all technology combination categories. Given the high broadband coverage levels achieved in previous years, it is unsurprising that there were no substantial changes in broadband coverage levels during the twelve months to the end of June 2016. The only notable change was a 1.9 percentage point increase in rural NGA coverage, which reached 88.3% of rural homes.

Belgium: Coverage by technology combination, 2016

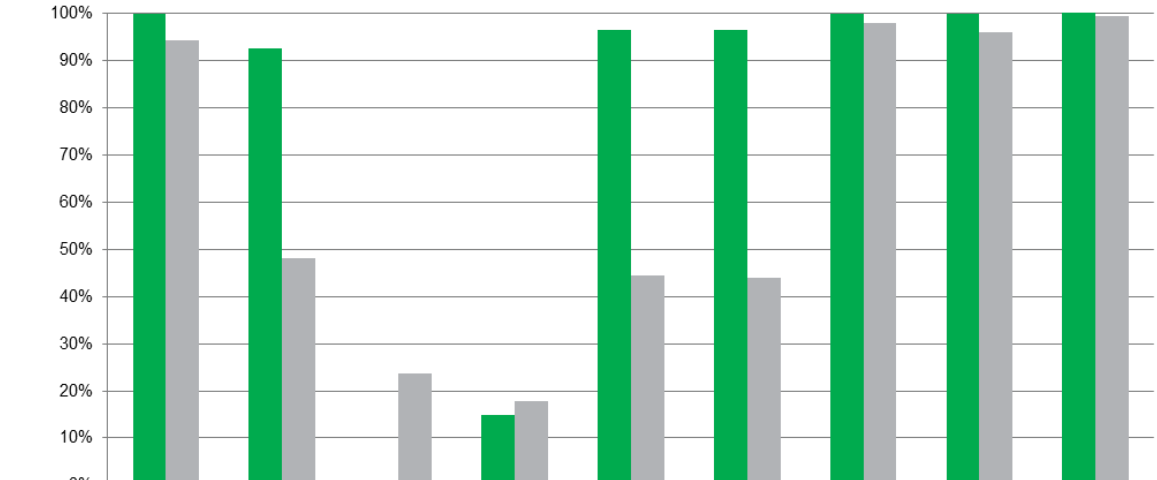


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Belgium	100.0%	99.9%	98.9%	99.8%	98.5%	88.3%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

With regards to fixed broadband access at a national level, there were no substantial coverage increases reported in the twelve-month period to mid-2016. VDSL coverage increased 2.1 percentage points, while DSL, cable and DOCSIS 3.0 coverage remained relatively unchanged.

Belgium: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Belgium	99.9%	92.5%	0.6%	14.8%	96.4%	96.4%	100.0%	99.9%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

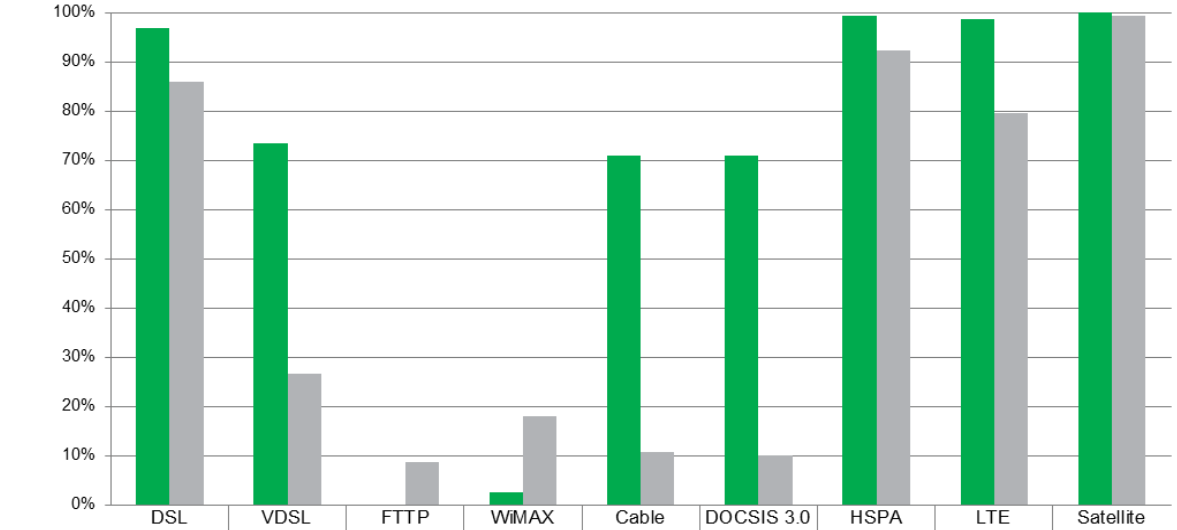
DOCSIS 3.0 continued to be the key NGA technology in Belgium, although Belgium was also the European leader in terms of VDSL coverage, with 92.5% homes passed compared to the EU average of 48.2%. As in previous years, the proportion of homes passed by FTTP technology remained low. However, this is set to change due to substantial investment from the incumbent. In December 2016, Proximus revealed plans to invest EUR 3 billion in the next 10 years, in order to cover more than 85% of enterprises and more than 50% of all households in Belgium with FTTP networks.[11]

Looking at mobile broadband technologies in Belgium, HSPA coverage reached universal levels. LTE coverage increased 14.3 percentage points to reach 99.0% of households by mid-2016. Network investments look set to continue with the leading cable operator, Telenet, committing to spend EUR 250 million on the mobile network it acquired from Base.[12] Meanwhile, with near-universal LTE coverage, mobile operators such as Orange (previously Mobistar) and Proximus looked towards technologies such as 4.5G[13] and LTE-A[14] to provide network differentiation.

Due to these high-level investments in LTE networks, average coverage of all LTE networks operators reached 94.5% of Belgians by mid-2016.

DSL remained the main broadband access technology in rural areas, reaching 96.9% of rural households. Rural cable coverage increased at a faster rate, rising by 6.3 percentage points. As a result, Belgium continued to be characterised by relatively high rural cable coverage, with 70.9% of rural homes passed compared to the EU average of 10.7%. Consolidation of regional cable companies continues, with Telenet's acquisition of regional operator, Coditel.[15] In terms of mobile broadband access in rural areas, LTE coverage increased by around 61 percentage points to cover 98.6% of rural households.

Belgium: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Belgium	96.9%	73.4%	0.0%	2.6%	70.9%	70.9%	99.4%	98.6%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

When comparing rural coverage in Belgium with other countries, it is important to note that Belgium is the second most urbanised country included in the study (after Malta). 4.1% of households in Belgium are classified as rural, compared to the EU average of 14.0%.

[11] https://www.proximus.com/en/news/20161216_Fiber

[12] https://press.telenet.be/telenet-versnelt-modernisering-van-zijn-mobiel-netwerk

[13] https://www.proximus.com/en/news/proximus-launches-45g-technology-first-belgium

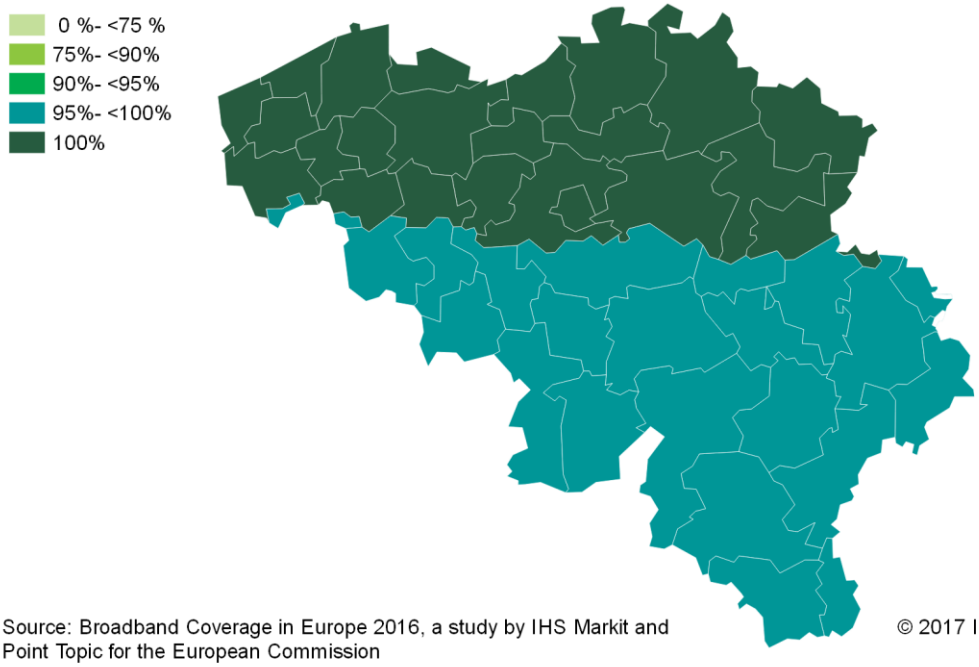
[14] https://www.telegeography.com/products/commsupdate/articles/2017/03/08/orange-extends-4g-coverage-to-brussels-metro/

[15] https://press.telenet.be/telenet-breidt-haar-kabelaanwezigheid-uit-in-brussel-een-deel-van-wallonie-en-delen-van-het-groothertogdom-luxemburg-door-de-overname-van-sfr-belux

5.2.2 Regional coverage by broadband technology

Fixed broadband coverage in all Belgian regions exceeded 99% with no substantial changes in fixed coverage recorded in any of the regions.

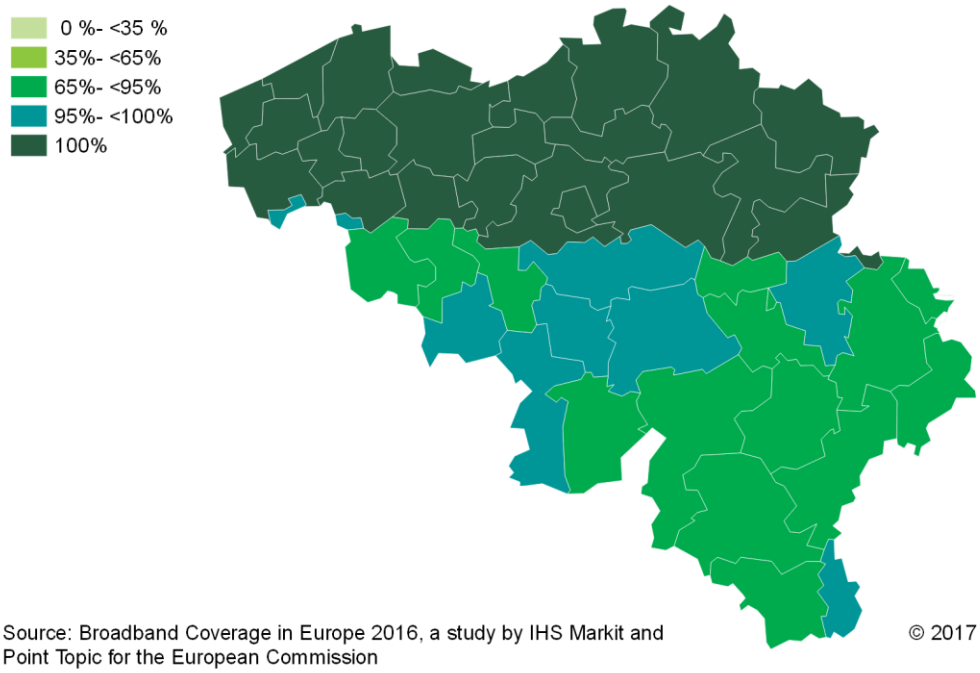
Belgium: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

With regards to NGA technologies, a clear pattern can be observed when comparing the Flemish and the Walloon regions. While the former regions reported complete NGA coverage, coverage rates in the Walloon regions varied between 94% and nearly 100%.

Belgium: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.2.3 Data tables for Belgium

Statistic	National
Population	11,258,434
Persons per household	2.3
Rural proportion	4.1%

	Belgium 2016		Belgium 2015		Belgium 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	99.9%	96.9%	99.9%	98.8%	99.9%	98.8%	94.3%	86.0%
VDSL	92.5%	73.4%	90.4%	71.9%	90.0%	69.2%	48.2%	26.6%
FTTP	0.6%	0.0%	0.4%	0.0%	0.4%	0.0%	23.7%	8.8%
WiMAX	14.8%	2.6%	15.0%	3.3%	15.1%	3.3%	17.8%	18.0%
Cable	96.4%	70.9%	96.3%	64.6%	96.2%	60.1%	44.4%	10.7%
DOCSIS 3.0	96.4%	70.9%	96.3%	64.6%	96.2%	60.1%	43.9%	10.1%
HSPA	100.0%	99.4%	97.9%	81.0%	97.8%	77.4%	98.0%	92.2%
LTE	99.9%	98.6%	85.6%	38.0%	67.8%	28.2%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	94.5%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	99.8%	99.9%	99.4%	99.9%	99.5%	99.9%	99.2%
Overall fixed broadband	99.9%	98.5%	99.9%	99.4%	99.9%	99.4%	97.5%	92.6%
NGA broadband	98.9%	88.3%	98.9%	86.4%	98.8%	84.0%	75.9%	39.2%
At least 2 Mbps	99.8%	-	99.8%	-	99.8%	-	96.7%	-
At least 30 Mbps	98.2%	-	98.1%	-	98.0%	-	75.1%	-
At least 100 Mbps	96.5%	-	96.4%	-	96.2%	-	50.8%	-

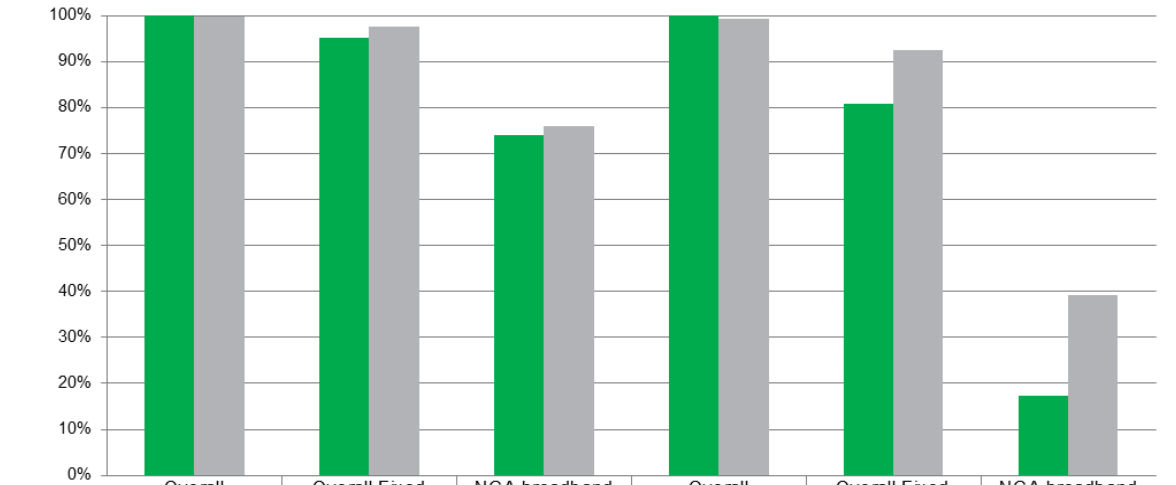
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.3 Bulgaria

5.3.1 National coverage by broadband technology

Overall broadband and fixed broadband coverage remained relatively unchanged during the twelve months to mid-2016. Overall broadband coverage was universal at a both national and rural level, while fixed broadband coverage was below the EU average. Bulgaria did witness improvements in NGA availability, which increased by 2.3 percentage points at a national level and 0.6 percentage points at a rural level. Despite these improvements, NGA coverage in Bulgaria remained below the EU average, both nationally and in rural areas. Nationally, little less than three-quarters (74.1%) of Bulgarian households had access to NGA broadband services, yet only 17.3% of rural homes were passed by NGA networks at the end of June 2016.

Bulgaria: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Bulgaria	100.0%	95.2%	74.1%	100.0%	80.8%	17.3%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Examining individual technologies, DSL remained the most widespread fixed broadband technology but, at 85.2%, remained below the EU average of 94.3%. On the other hand, Bulgarian cable coverage was above the EU average of 44.4%, passing 65.9% of households. Moreover, in previous years, Bulgaria was characterised by high levels of WiMAX coverage. This is no longer the case due to operators discontinuing the service, in order to reallocate the spectrum to LTE networks. Most notable, in November 2015, Max Telecom shut down its WiMAX service and moved customers to its LTE network.[16]

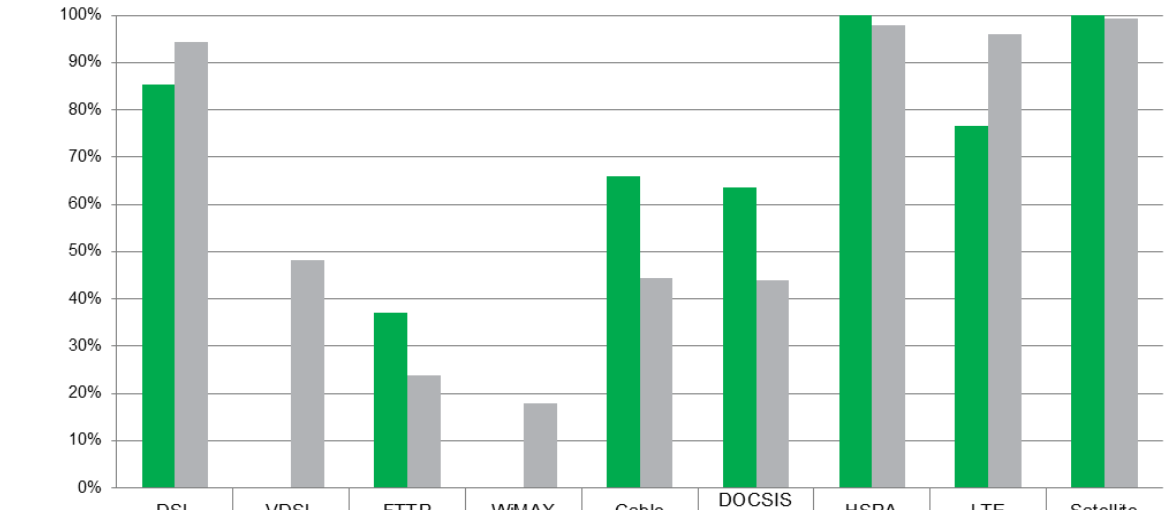
In relation to NGA technologies, VDSL services continued to be absent in Bulgaria. DOCSIS 3.0 passed 63.6% of households, making it the most prevalent NGA technology in Bulgaria. FTTP networks reached 37.1% of homes, an increase of 4.9 percentage points when compared to the previous year. The incumbent, Vivacom (brand name of Bulgarian Telecommunications Company), passed 1.1m homes with its FTTP network as of June 2016[17], while other providers such as Bulsatcom and MTel (MobilTel) have also invested in fibre networks in recent years.

Looking at FTTP coverage, it is important to note one specific aspect of the Bulgarian broadband market: In many areas, fibre optic cable is rolled out very near to individual properties or blocks of flats, with coaxial cable used in the distance from the last amplifier to the customers' homes. While this FTTLA (fibre-to-the-last-amplifier) architecture is sometimes described as FTTB, in the case of Bulgaria this coverage was classified as DOCSIS 3.0 rather than FTTP. This classification was applied by Point Topic in 2012 and maintained in subsequent analysis. Given that both FTTP and DOCSIS 3.0

[16] https://www.telegeography.com/products/commsupdate/articles/2015/11/03/max-to-discontinue-wimax-services-in-november/

technologies are combined in the NGA broadband coverage category, this classification does not impact the total NGA coverage levels.

Bulgaria: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Bulgaria	85.2%	0.0%	37.1%	0.0%	65.9%	63.6%	100.0%	76.5%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Bulgaria was late to launch LTE services, with the first LTE network deployed by Max Telecom in May 2014.[18] Bulsatcom followed in early 2015, while Telenor Bulgaria introduced their LTE service in December 2015.[19] Network operators proceeded with their LTE deployment, as LTE coverage continued to increase, rising by 28.4 percentage points in the twelve months to the end of June 2016. However, despite this considerable increase, LTE coverage in Bulgaria at 76.5% remained below the EU average of 96.0%.

The fact that Bulgarian mobile network operators have begun to deploy LTE networks relatively late, also has an impact in the comparatively low levels of average LTE operator coverage which reached only 65.7% at the end of June 2016.

In rural areas, DSL services remained the most widespread in terms of coverage, reaching 75.3% of rural homes. Cable networks passed 16.9% of rural households, an increase of 0.7 percentage points. As mentioned, WiMAX coverage considerably reduced during the twelve months to mid-2016 due to operators discontinuing the service.

Rural DOCSIS 3.0 and FTTP continued to be the only NGA technologies available to rural households, though the latter was available to only 0.7% of rural homes. All cable networks in rural areas were upgraded to DOCSIS 3.0, meaning the technology passed 16.9% of homes, which was above the EU average of 10.7%.

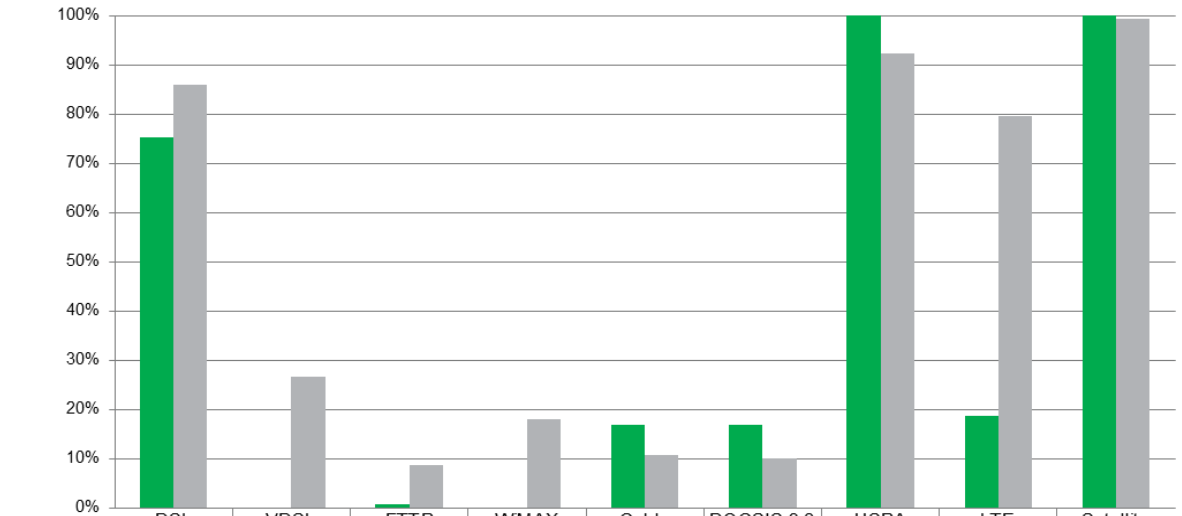
This edition of the study marked the first time that LTE services were available in rural Bulgaria, as LTE networks reached 18.7% of rural households. HSPA coverage increased 0.4 percentage points, becoming universal in rural areas.

[17] https://s2.vivacom.bg/files/financial_reports/74/document/Vivacom_results_presentation_Q2_2016_v1.pdf

[18] https://www.maxtelecom.bg/en/about/news/max-telecom-announces-the-commercial-launch-of-the-first-4g-lte-network-in-bulgaria

[19] https://www.telegeography.com/products/commsupdate/articles/2015/11/27/telenor-bulgaria-poised-to-launch-lte-on-1-december/

Bulgaria: Coverage by technology, rural areas, 2016



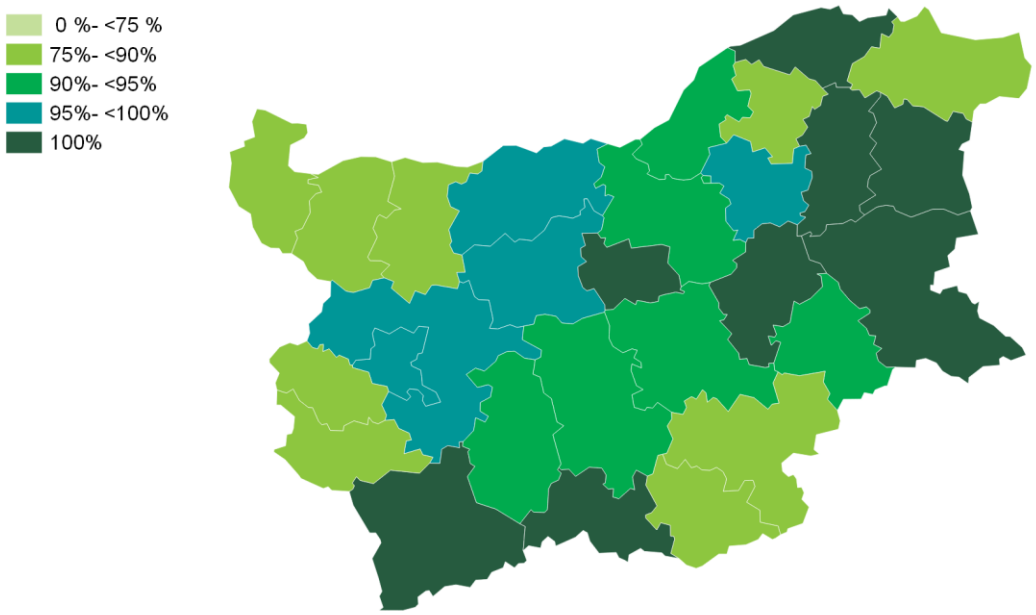
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Bulgaria	75.3%	0.0%	0.8%	0.0%	16.9%	16.9%	100.0%	18.7%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.3.2 Regional coverage by broadband technology

Fixed broadband coverage in Bulgaria ranged between 81% and 100% across individual regions, with eight regions (Gabrovo, Silistra, Varna, Shumen, Burgas, Sliven, Blagoevgrad, and Smolyan) recording complete coverage.

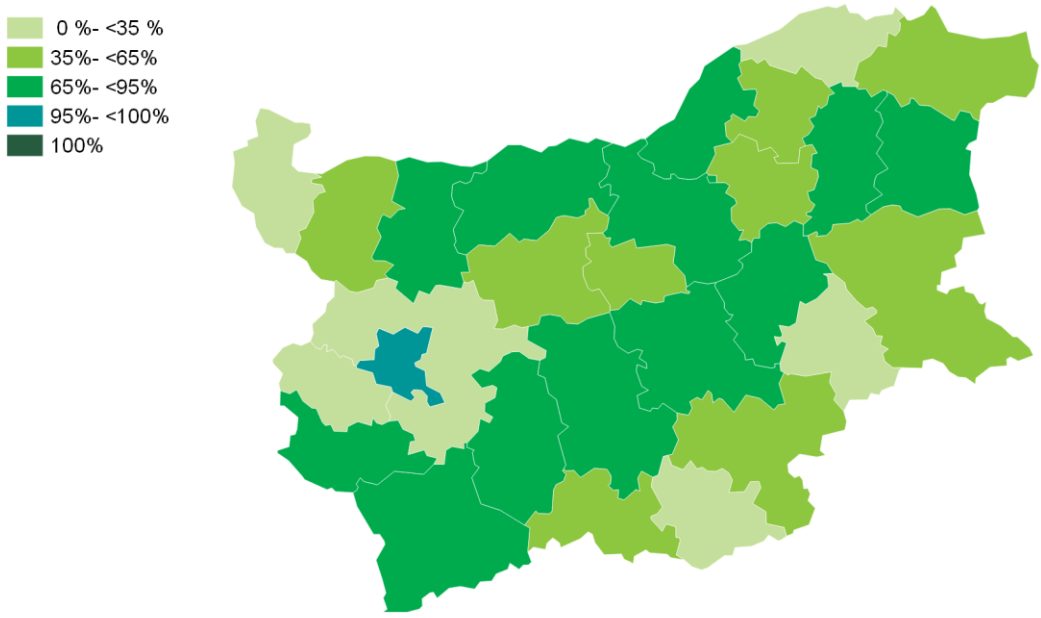
Bulgaria: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In mid-2016, NGA coverage in Bulgaria remained very varied, with coverage levels ranging from only 12% coverage in Vidin to nearly complete NGA coverage in the capital Sofia.

Bulgaria: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.3.3 Data tables for Bulgaria

Statistic	National
Population	7,202,198
Persons per household	2.4
Rural proportion	19.5%

	Bulgaria 2016		Bulgaria 2015		Bulgaria 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	85.2%	75.3%	85.1%	76.0%	85.1%	*69.4%*	94.3%	86.0%
VDSL	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	48.2%	26.6%
FTTP	37.1%	0.8%	32.2%	0.7%	28.3%	0.2%	23.7%	8.8%
WiMAX	0.0%	0.0%	64.6%	12.3%	64.6%	12.3%	17.8%	18.0%
Cable	65.9%	16.9%	64.9%	*16.2%*	64.5%	*15.1%*	44.4%	10.7%
DOCSIS 3.0	63.6%	16.9%	62.9%	*16.2%*	61.4%	*15.1%*	43.9%	10.1%
HSPA	100.0%	100.0%	99.9%	99.6%	99.6%	97.9%	98.0%	92.2%
LTE	76.5%	18.7%	48.1%	0.0%	36.1%	0.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	65.7%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	99.9%	99.9%	99.3%	99.9%	99.2%
Overall fixed broadband	95.2%	80.8%	95.2%	*81.2%*	95.1%	*80.0%*	97.5%	92.6%
NGA broadband	74.1%	17.3%	71.8%	*16.7%*	69.4%	*15.1%*	75.9%	39.2%
At least 2 Mbps	94.9%	-	94.9%	-	94.8%	-	96.7%	-
At least 30 Mbps	71.3%	-	68.4%	-	66.5%	-	75.1%	-
At least 100 Mbps	18.6%	-	15.7%	-	15.1%	-	50.8%	-

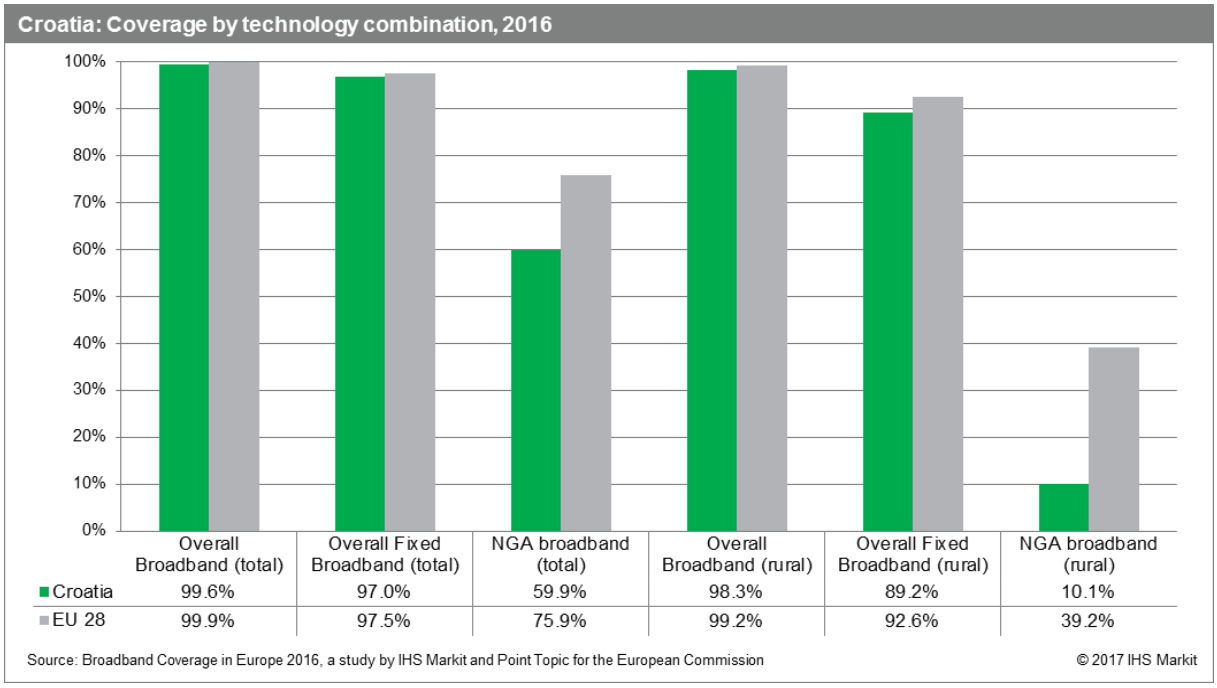
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural cable and DOCSIS 3.0 coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.4 Croatia

5.4.1 National coverage by broadband technology

At the end of June 2016, Croatia continued to lag behind the EU average in all coverage combination categories on both national and rural levels. The difference in Croatian coverage compared to the EU average was negligible in terms of the overall broadband and fixed broadband combinations, but more notable when NGA broadband availability was examined. By mid-2016, 59.9% of all Croatian households and 10.1% of rural Croatian households had access to NGA broadband services. While this represented a considerable improvement at a total level, equivalent to around 8 percentage points, rural NGA coverage remained relatively unchanged when compared to the previous edition of this study.



Looking at individual technologies, DSL was the most widespread fixed broadband technology, reaching 94.9% of Croatian homes. While Croatian DSL coverage was slightly above the EU average of 94.3%, cable network coverage in the country was below the EU average of 44.4%. At 34.3%, the availability of cable networks in Croatia increased 1.6 percentage points during the twelve months to the end of June 2016.

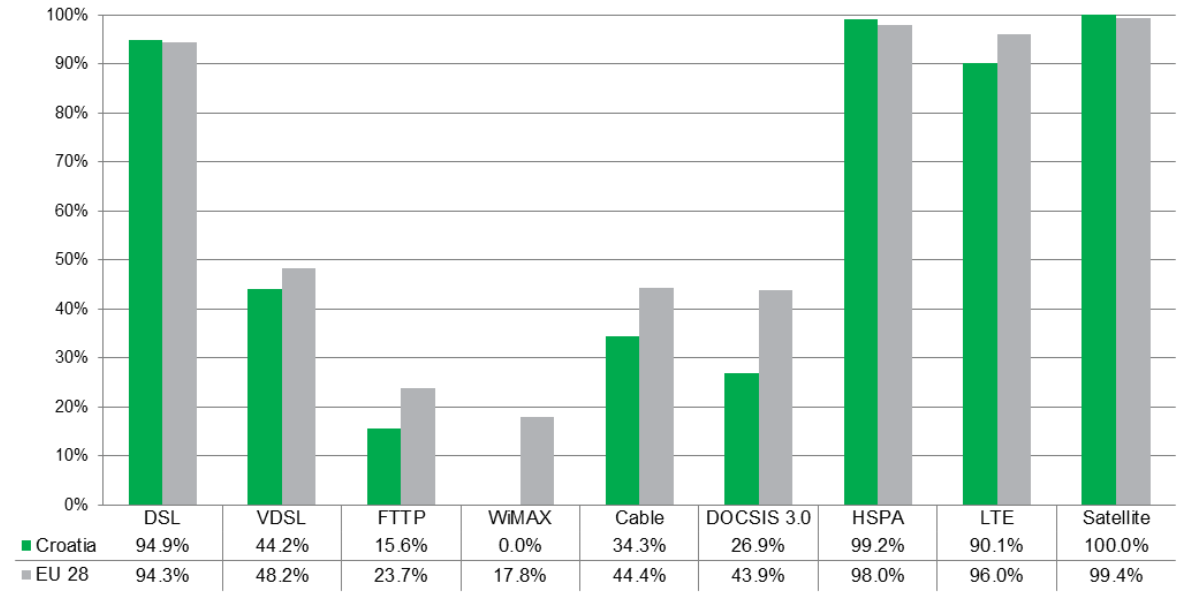
In terms of NGA broadband access, VDSL services witnessed the biggest improvement with regards to total coverage. VDSL networks passed 44.2% of households, increasing by 8.3 percentage points, as the incumbent T-Hrvatski Telekom continued to upgrade its copper network. T-Hrvatski Telekom is also exploring other ways to increase the speeds of its existing infrastructure, including G.fast.[20] The other two NGA technologies examined in this study, DOCSIS 3.0 and FTTP, also recorded increases in their respective coverage levels. FTTP coverage reached 15.6% of households at the end of June 2016, a 5.5 percentage point improvement, while DOCSIS 3.0 networks passed 26.9% of Croatian homes, a 3.9 percentage point increase. Despite this increase in DOCSIS 3.0 coverage, the proportion of cable networks upgraded to DOCSIS 3.0 remained lower than all other study countries.

As was the case in the previous edition of this study, Croatian mobile operators T-Hrvatski Telekom and VIPNet continued to deploy their LTE networks throughout the period. In addition, Tele2 launched their nationwide 4G network in February 2016.[21] As a consequence of these investments, total LTE coverage increased by 21.2 percentage points, reaching 90.1% of homes, but remained below the EU average of 96.0%.

[20] http://www.t.ht.hr/en/Press/press-releases/3379/Hrvatski-Telekom-paves-the-way-to-digital-future-amongst-the-first-in-Europe-to-present-superfast-Internet-technologies-LTE-A-Pr.html
[21] http://www.tele2.com/media/press-releases/2016/tele2-croatia-launches-4g/

Due to the fact that Croatian mobile network operators are still in the process of deploying their LTE networks, the average LTE operator coverage was recorded to be relatively low at 66.7% at the end of June 2016.

Croatia: Coverage by technology, total, 2016



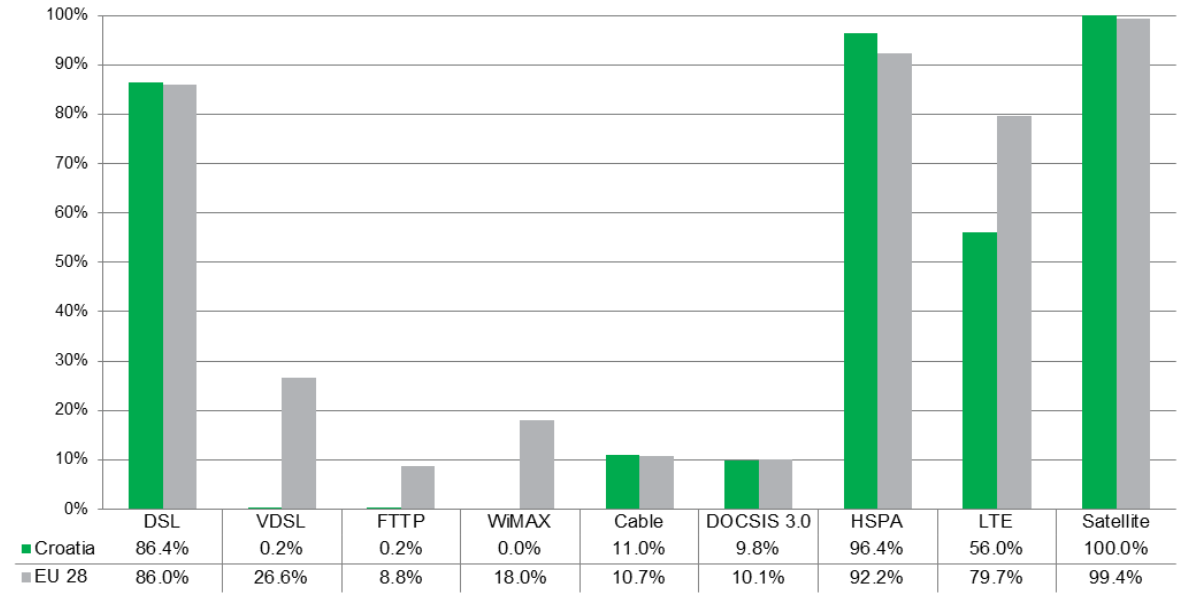
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Croatia	94.9%	44.2%	15.6%	0.0%	34.3%	26.9%	99.2%	90.1%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In rural areas, DSL was the most prevalent broadband access technology, passing 86.4% of rural homes at the end of June 2016. As in the previous edition of the study, the availability of cable and DOCSIS 3.0 networks remained stable in rural areas. Standard cable networks passed 11.0% of rural households, while DOCSIS 3.0 networks covered 9.8% of rural homes. As a consequence, rural cable coverage was slightly above the EU average (10.7%) and rural DOCSIS 3.0 coverage was slightly below the EU average (10.1%). DOCSIS 3.0 continued to be the key NGA broadband technology in rural areas, with minimal FTTP and VDSL coverage in rural Croatia.

There was considerable growth in the coverage of LTE networks in rural Croatia during the twelve months to the end of June 2016. At 56.0%, rural LTE availability increased by 45.3 percentage points, but remained below the EU average (79.7%). Coverage of HSPA networks also continued to grow, increasing 5.4 percentage points to 96.4% of rural homes.

Croatia: Coverage by technology, rural areas, 2016



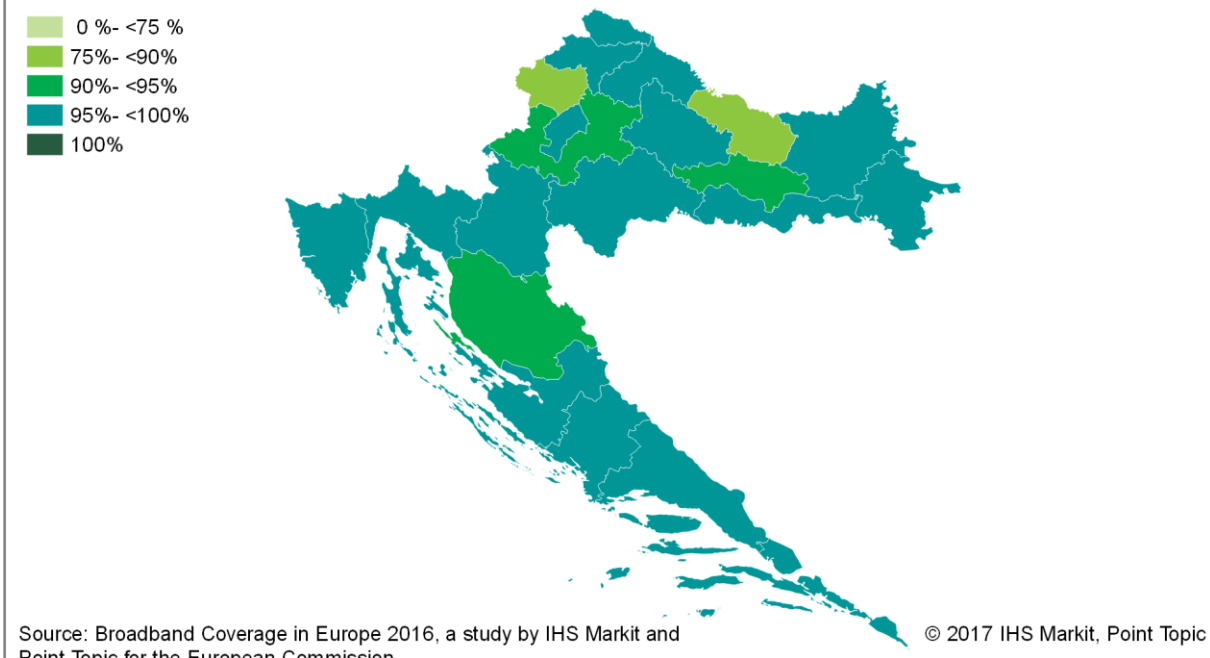
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Croatia	86.4%	0.2%	0.2%	0.0%	11.0%	9.8%	96.4%	56.0%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.4.2 Regional coverage by broadband technology

Looking at regional coverage patterns, all regions reported fixed broadband coverage levels exceeding 90% with the exception of the Krapinsko-zagorska region (84.0%) and the Virovitičko-podravska region (83.3%).

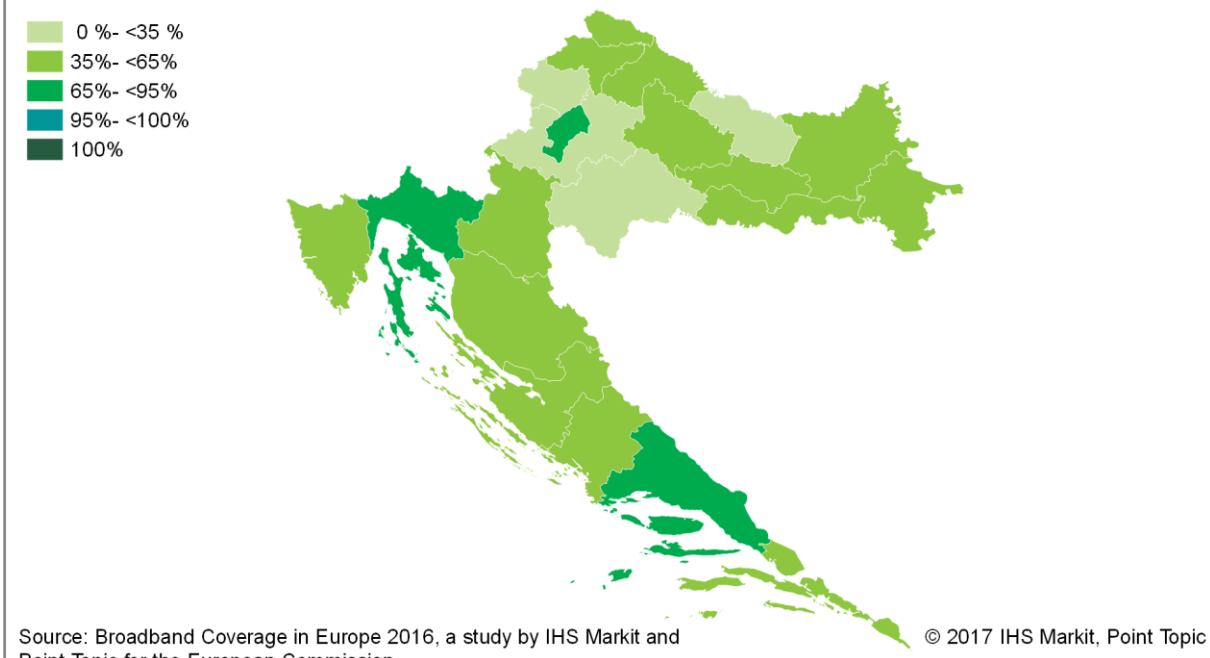
Croatia: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA coverage remained very varied, ranging from less than 23.7% in Krapinsko-zagorska region to over nearly 87% in Zagreb.

Croatia: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.4.3 Data tables for Croatia

Statistic	National
Population	4,246,809
Persons per household	2.8
Rural proportion	22.1%

	Croatia 2016		Croatia 2015		Croatia 2014		EU28 2016	
Technology	Total	Rural	Total	Total	Total	Rural	Total	Rural
DSL	94.9%	86.4%	94.7%	*86.1%*	94.6%	*84.9%*	94.3%	86.0%
VDSL	44.2%	0.2%	35.9%	0.0%	31.4%	0.0%	48.2%	26.6%
FTTP	15.6%	0.2%	10.1%	0.0%	8.8%	0.0%	23.7%	8.8%
WiMAX	0.0%	0.0%	2.0%	3.2%	2.0%	3.2%	17.8%	18.0%
Cable	34.3%	11.0%	32.7%	10.9%	31.0%	10.2%	44.4%	10.7%
DOCSIS 3.0	26.9%	9.8%	23.0%	9.8%	21.8%	9.7%	43.9%	10.1%
HSPA	99.2%	96.4%	98.0%	91.0%	97.7%	89.9%	98.0%	92.2%
LTE	90.1%	56.0%	68.9%	10.7%	58.1%	7.5%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	66.7%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.6%	98.3%	99.1%	95.9%	99.0%	95.4%	99.9%	99.2%
Overall fixed broadband	97.0%	89.2%	96.9%	*89.2%*	96.6%	*88.0%*	97.5%	92.6%
NGA broadband	59.9%	10.1%	52.0%	9.8%	47.5%	10.2%	75.9%	39.2%
At least 2 Mbps	96.4%	-	96.1%	-	95.8%	-	96.7%	-
At least 30 Mbps	52.3%	-	49.1%	-	54.3%	-	75.1%	-
At least 100 Mbps	25.3%	-	22.0%	-	21.8%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

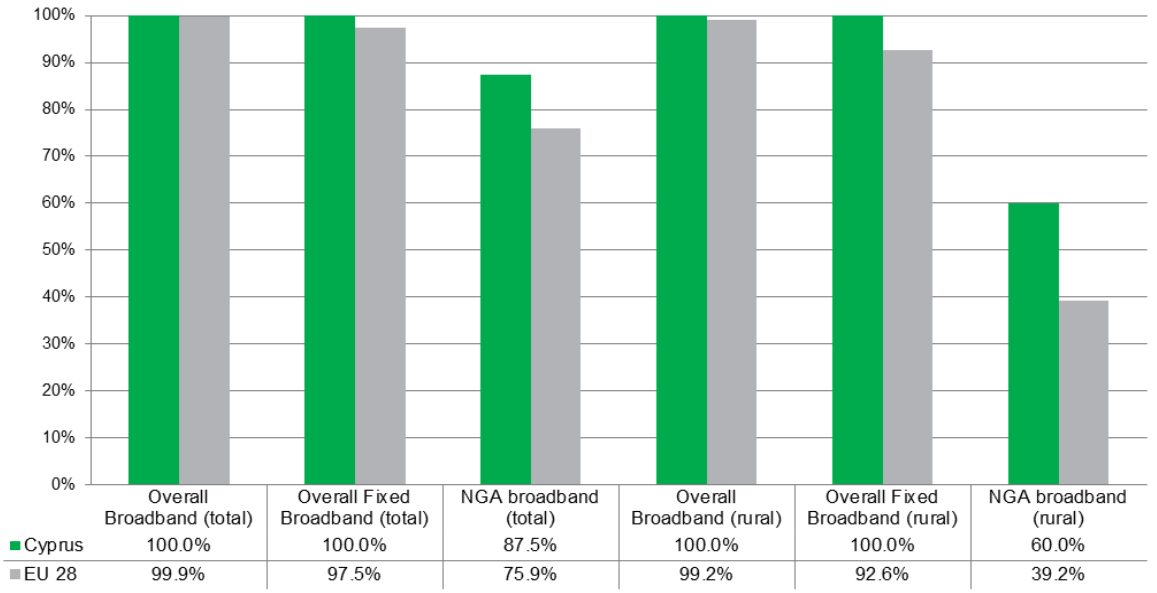
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.5 Cyprus

5.5.1 National coverage by broadband technology

Since 2012, Cyprus has attained complete overall and fixed broadband coverage at a national and rural level. Therefore the focus in terms of broadband coverage improvement is to increase the availability of NGA technologies across Cyprus. By mid-2016, NGA broadband coverage in Cyprus was above the EU average at both a national and rural level, as both measurements increased by around 3.5 percentage points during the twelve-month period to the end of June 2016 to reach 87.5% of households nationally and 60.0% of household in rural areas.

Cyprus: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Cyprus	100.0%	100.0%	87.5%	100.0%	100.0%	60.0%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Looking at individual broadband technologies, DSL services were available to all homes in Cyprus, while cable networks passed 68.7% of households by mid-2016, an 11 percentage point increase compared to the previous year. Cable networks continued to compete on speed, demonstrated by the main cable operator (Cablenet) increasing its download speeds to 120Mbps[22], and all cable networks being upgraded to DOCSIS 3.0. Despite this, VDSL services were the most prevalent with regards to NGA broadband access, as the incumbent CYTA continued to upgrade its copper infrastructure.[23] VDSL networks increased by 7.0 percentage points during the twelve-month period to mid-2016, reaching 75% of households. FTTP coverage increased at a slower pace, at 2 percentage points in the year to the end of June 2016, passing over a half (51.2%) of Cypriot households.

Examining mobile broadband technologies, there is near-universal coverage of HSPA networks in Cyprus. This is in contrast to LTE networks, which reached 74.3% of households by mid-2016, and remained below all study countries in terms of coverage. This is because Cyprus was late to launch LTE services, with the first LTE networks in Cyprus not deployed until March 2015.[24] Therefore, despite considerable growth in the last two years, Cyprus remained behind in this area.

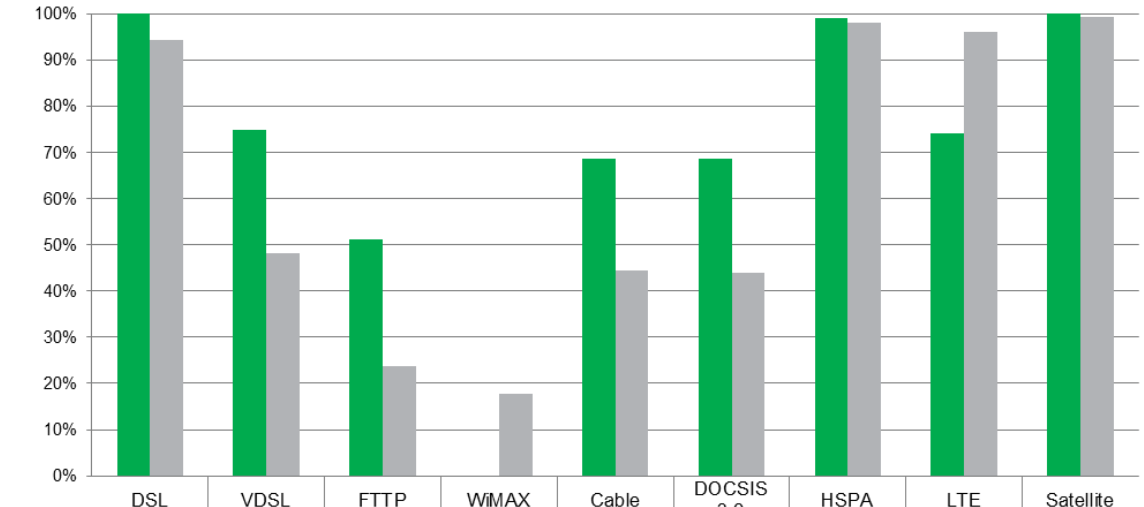
The lower availability of LTE services is also confirmed when looking at the average LTE operator coverage, which reached only 64.2% at the end of June 2016.

[22] http://cablenet.com.cy/home-services-2/cable-triple-play/3play-premium-120m/

[23] https://www.telegeography.com/products/commsupdate/articles/2015/10/19/cyta-nearing-completion-of-network-modernisation-project/

[24] http://in-cyprus.com/mtn-primetel-launch-4g-networks/

Cyprus: Coverage by technology, total, 2016



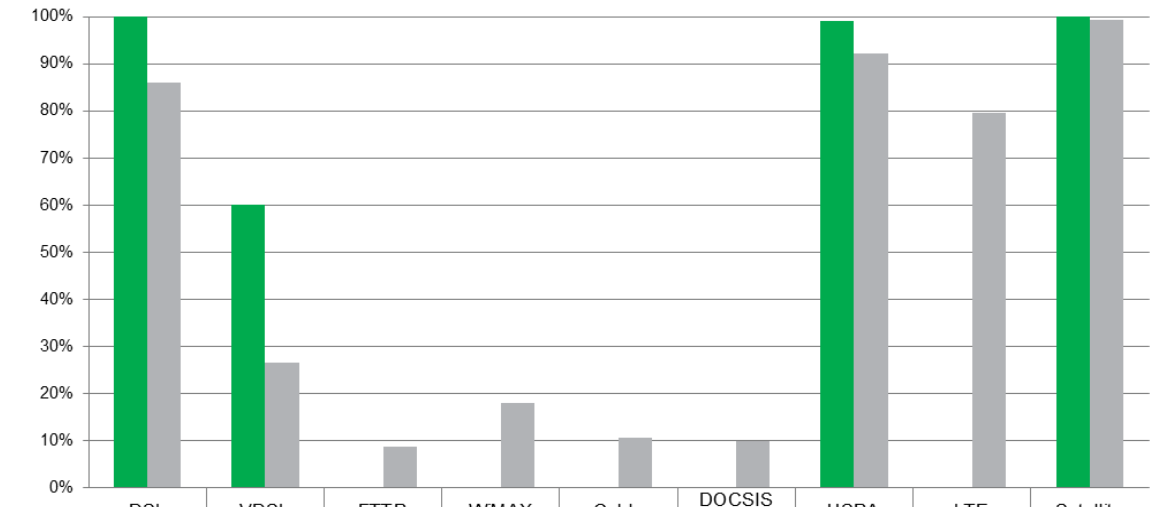
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Cyprus	100.0%	75.0%	51.2%	0.0%	68.7%	68.7%	99.0%	74.3%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

By mid-2016, DSL broadband provided complete rural coverage in Cyprus. Given that neither FTTP nor DOCSIS 3.0 networks were present in rural areas, VDSL was the only NGA access technology available to rural households. Rural VDSL coverage grew by 3.4 percentage points during the twelve-month period to mid-2016, reaching 60.0% of rural households.

In terms of mobile broadband availability, Cyprus continued to be the only study country without rural LTE coverage. Yet, rural HSPA coverage, at 99.0%, remained above the EU average.

Cyprus: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Cyprus	100.0%	60.0%	0.0%	0.0%	0.0%	0.0%	99.0%	0.0%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.5.2 Regional coverage by broadband technology[25]

Cyprus: Overall fixed broadband coverage, 2016

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Cyprus: NGA broadband coverage, 2016

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[25] Please note that even though the map depicts the area of the whole island, the data on broadband coverage concern only the areas under the effective control of the Republic of Cyprus.

5.5.3 Data tables for Cyprus

Statistic	National
Population	847,008
Persons per household	2.8
Rural proportion	11.6%

	Cyprus 2016		Cyprus 2015		Cyprus 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	94.3%	86.0%
VDSL	75.0%	60.0%	68.0%	56.6%	60.2%	51.0%	48.2%	26.6%
FTTP	51.2%	0.0%	49.3%	0.0%	48.8%	0.0%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	68.7%	0.0%	57.5%	0.0%	56.3%	0.0%	44.4%	10.7%
DOCSIS 3.0	68.7%	0.0%	57.5%	0.0%	56.3%	0.0%	43.9%	10.1%
HSPA	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	98.0%	92.2%
LTE	74.3%	0.0%	60.2%	0.0%	0.0%	0.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	64.2%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.2%
Overall fixed broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	97.5%	92.6%
NGA broadband	87.5%	60.0%	84.0%	56.6%	80.1%	51.0%	75.9%	39.2%
At least 2 Mbps	100.0%	-	100.0%	-	100.0%	-	96.7%	-
At least 30 Mbps	84.3%	-	78.7%	-	78.1%	-	75.1%	-
At least 100 Mbps	84.3%	-	78.7%	-	78.1%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

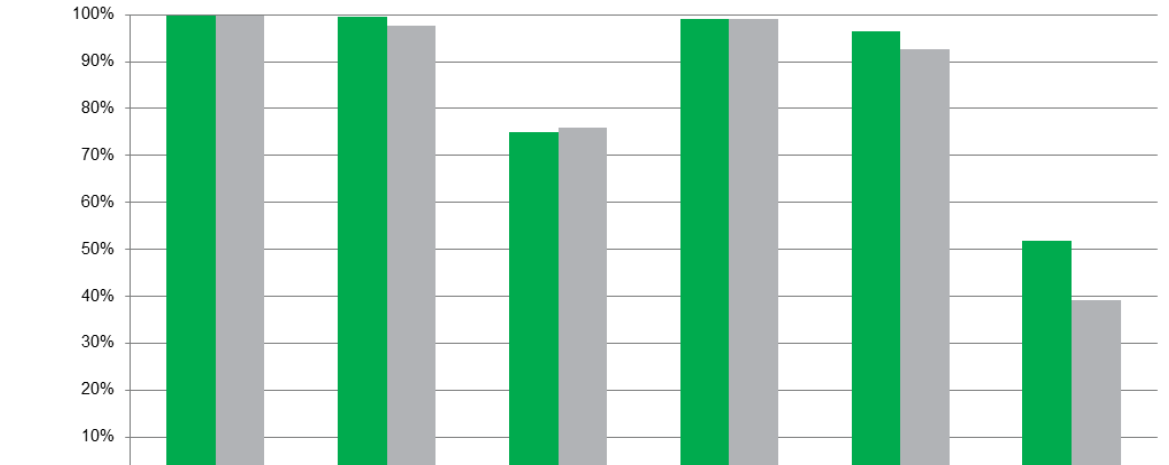
5.6 Czech Republic

5.6.1 National coverage by broadband technology

As of mid-2016, 99.5% of Czech homes were passed by at least one fixed broadband technology, slightly above the EU average of 97.5%. In rural areas, 96.5% rural households had access to fixed broadband services. With regards to NGA technologies, on a national level three-quarters (75.1%) of Czech households were able to connect to high-speed broadband at the end of June 2016, yet despite a 2.2 percentage point increase, total NGA coverage was slightly below the EU average of 75.9%.

On the other hand, rural NGA coverage experienced a significant growth over the twelve months to mid-2016. Increasing by 25.2 percentage points, rural NGA coverage reached over a half (51.9%) of rural households at the end of June 2016, above the EU average of 39.2%.

Czech Republic: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Czech Rep	99.8%	99.5%	75.1%	99.2%	96.5%	51.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL and WiMAX were the two dominant fixed broadband technologies in the Czech Republic, with DSL and WiMAX networks passing 97% and 83.7% of Czech homes, respectively. The Czech broadband market is characterised by a large number of small local fixed wireless providers, which is reflected in the relatively high total WiMAX coverage figure based on the combined coverage offered by these providers (some of which also offer services within both licenced and unlicensed bands).

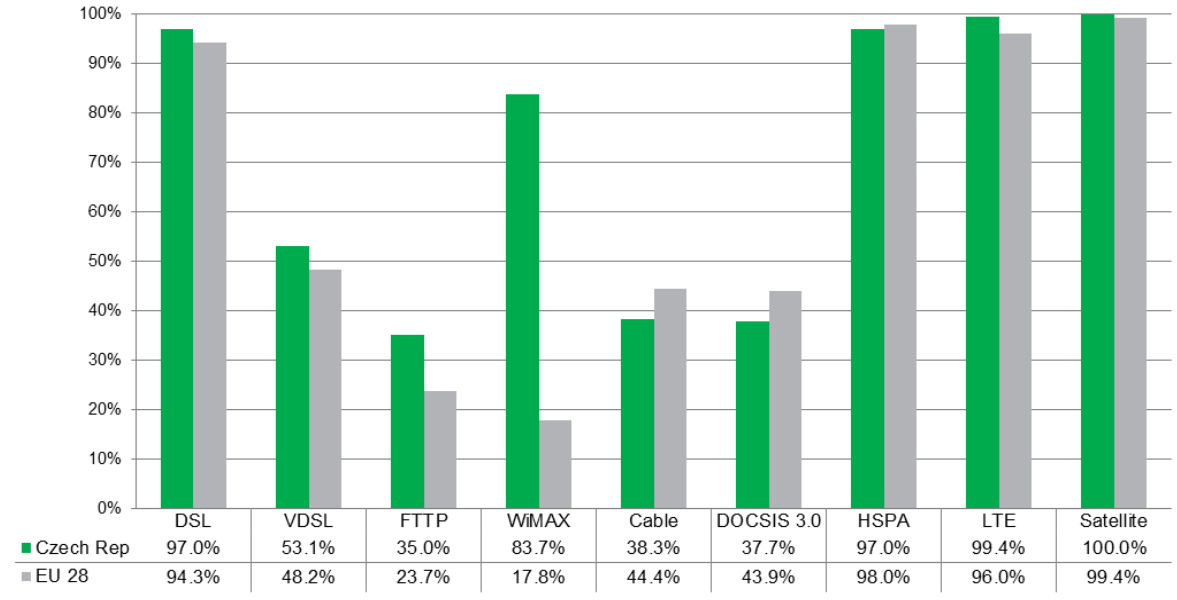
Cable coverage increased by 4.6 percentage points compared to mid-2015 with cable broadband services being available to 38.3% of Czech households. As cable companies have traditionally limited their presence to big cities across the Czech Republic, vast majority of the households covered by cable networks were located in urban areas.

The most significant developments were recorded in terms of NGA coverage. Following the structural separation of the incumbent O2 Czech Republic in 2015, the now independent infrastructure incumbent, CETIN, continued roll-out of VDSL, albeit at a slightly slower pace than in the previous years. Nationally, VDSL coverage increased by 1.1 percentage points, with 53.1% of Czech households having access to VDSL services by mid-2016. Cable companies, such as UPC or Nej.cz, also continued with improvement works on their networks resulting near complete upgrade of all cable networks in the Czech Republic to the DOCSIS 3.0 standard in a 4.5 percentage year-on-year increase to a total of 37.7% of households having access to high-speed cable broadband services.

At the end of June 2016, FTTP networks were estimated to pass about a third (35.0%) of Czech households following a 17.7 percentage point increase compared to mid-2015. Most of this increase can be attributed to smaller and local operators rolling out these networks.

By mid-2016 LTE coverage increased by 4.5 percentage points to a near universal coverage level with 99.4% of homes passed by at least one LTE network, above the EU average of 96.0%. When average coverage of all LTE network operators is considered, on average 94.3% of Czechs had access to LTE services at the end of June 2016.

Czech Republic: Coverage by technology, total, 2016



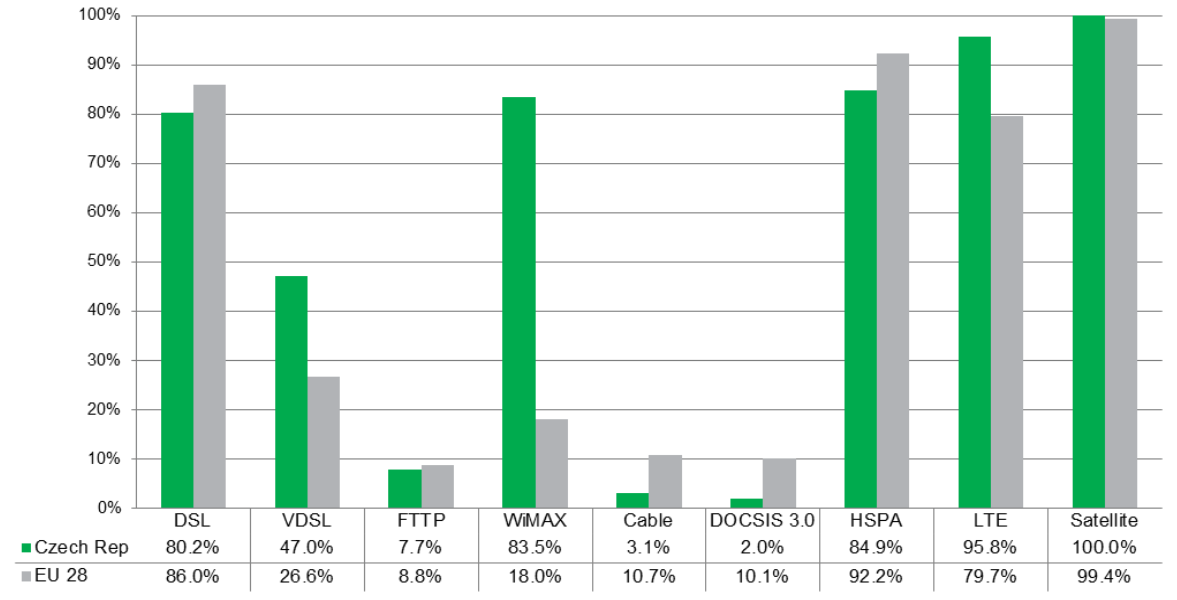
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Czech Rep	97.0%	53.1%	35.0%	83.7%	38.3%	37.7%	97.0%	99.4%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

While VDSL coverage growth remained limited on a national level, availability of rural VDSL services increased significantly since June 2015 with 47.0% of rural homes being passed by VDSL networks by mid-2016, an estimated 23.5 percentage point growth.

Yet the biggest coverage increase in rural areas was recorded for LTE technology, which grew by 39.5 percentage points and at the end of June 2016, LTE services were available to 95.8% of rural households across the Czech Republic.

Czech Republic: Coverage by technology, rural areas, 2016



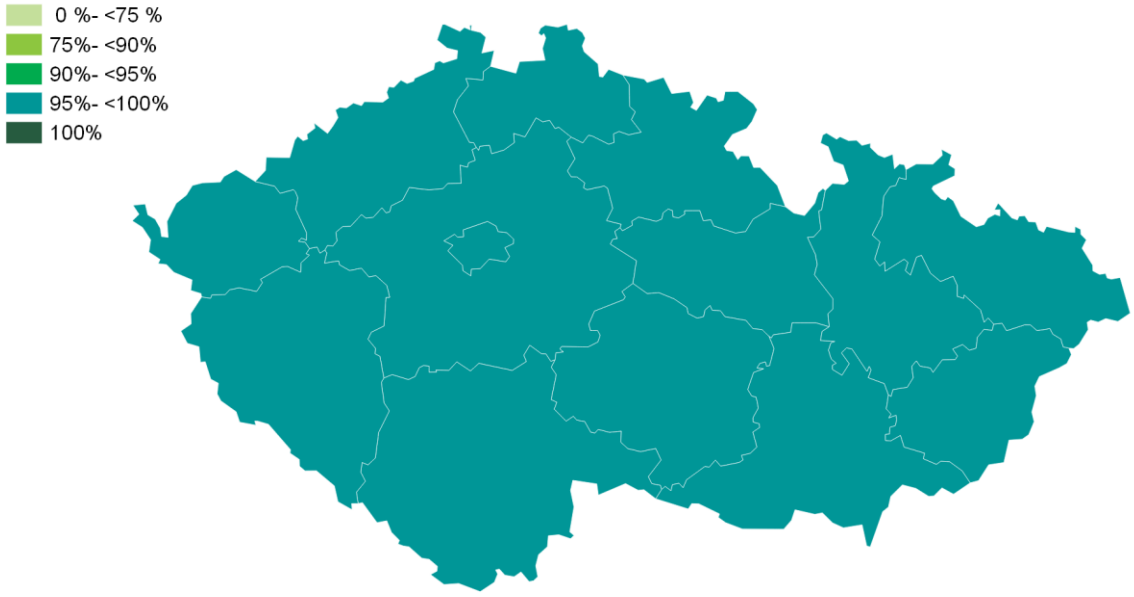
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Czech Rep	80.2%	47.0%	7.7%	83.5%	3.1%	2.0%	84.9%	95.8%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.6.2 Regional coverage by broadband technology

Fixed broadband coverage levels in all regions of the Czech Republic exceeded 98% although no region reported complete coverage.

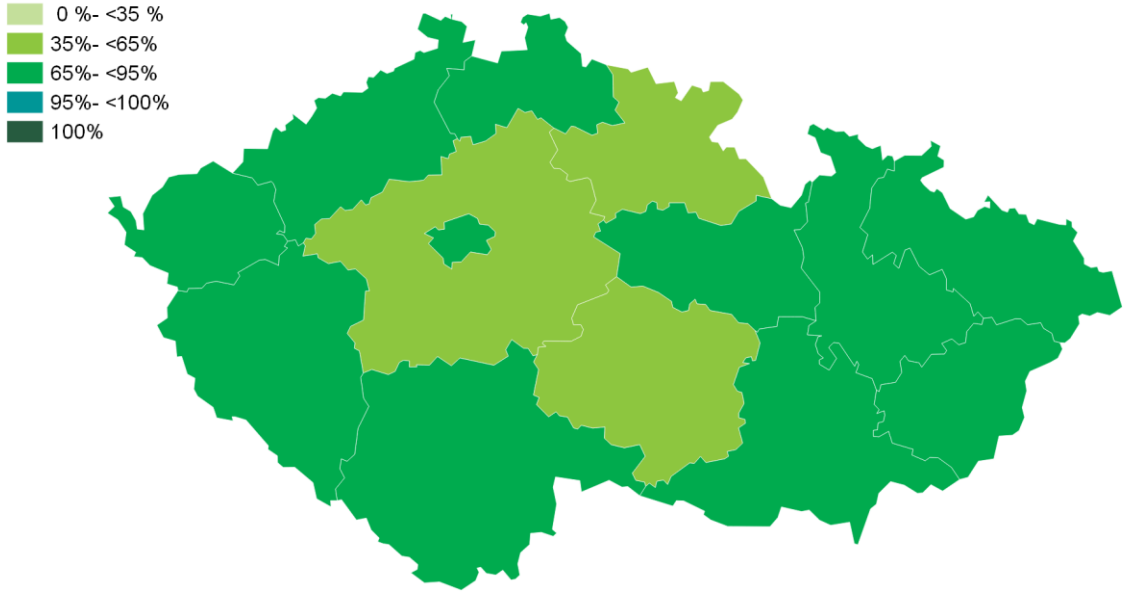
Czech Republic: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage recorded more varied levels ranging from around 59% in the Vysočina and Středočeský regions to more than 94% in the capital, Prague.

Czech Republic: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.6.3 Data tables for Czech Republic

Statistic	National
Population	10,538,275
Persons per household	2.4
Rural proportion	14.3%

	Czech Rep. 2016		Czech Rep. 2015		Czech Rep. 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	97.0%	80.2%	97.0%	80.8%	97.0%	*80.8%*	94.3%	86.0%
VDSL	53.1%	47.0%	52.0%	*23.6%*	45.7%	0.0%	48.2%	26.6%
FTTP	35.0%	7.7%	17.3%	5.7%	13.9%	4.0%	23.7%	8.8%
WiMAX	83.7%	83.5%	70.6%	69.9%	70.6%	70.0%	17.8%	18.0%
Cable	38.3%	3.1%	33.7%	1.5%	33.4%	1.4%	44.4%	10.7%
DOCSIS 3.0	37.7%	2.0%	33.3%	0.6%	31.9%	0.6%	43.9%	10.1%
HSPA	97.0%	84.9%	97.0%	*79.2%*	97.0%	*79.2%*	98.0%	92.2%
LTE	99.4%	95.8%	93.8%	*56.3%*	91.9%	*43.4%*	96.0%	79.7%
LTE average operator coverage (DESI indicator)	94.3%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.8%	99.2%	99.2%	*94.4%*	99.2%	*94.4%*	99.9%	99.2%
Overall fixed broadband	99.5%	96.5%	98.5%	*90.4%*	98.5%	*90.3%*	97.5%	92.6%
NGA broadband	75.1%	51.9%	72.9%	*26.7%*	67.3%	4.5%	75.9%	39.2%
At least 2 Mbps	98.5%	-	98.0%	-	98.0%	-	96.7%	-
At least 30 Mbps	73.9%	-	72.7%	-	60.4%	-	75.1%	-
At least 100 Mbps	44.5%	-	43.3%	-	39.4%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

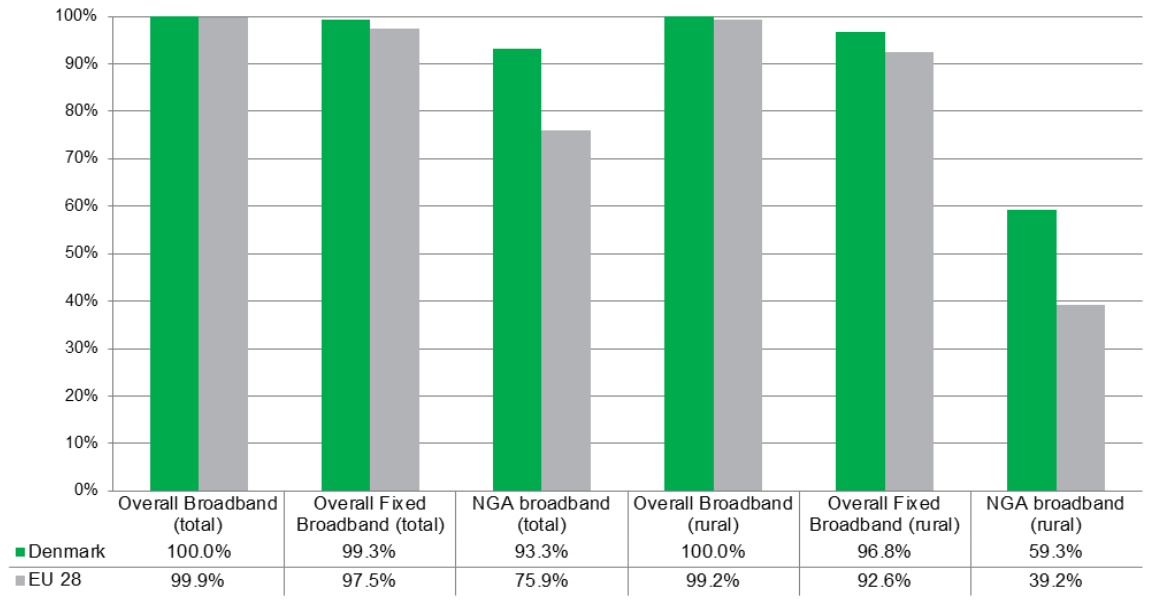
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural cable and DOCSIS 3.0 coverage levels leading to restatements of data reported in previous year. Moreover, new data available from CETIN led to a restatement of 2015 rural VDSL coverage. All restatements are highlighted in italics.

5.7 Denmark

5.7.1 National coverage by broadband technology

By mid-2016, Denmark reported above-average coverage levels for all broadband combination categories. With high coverage recorded already in previous years, the coverage levels for all combination categories remained relatively unchanged in the twelve-month period to mid-2016. This was with the exception of the rural NGA combination category, which increased by 4.6 percentage points to reach 59.3% of rural homes.

Denmark: Coverage by technology combination, 2016

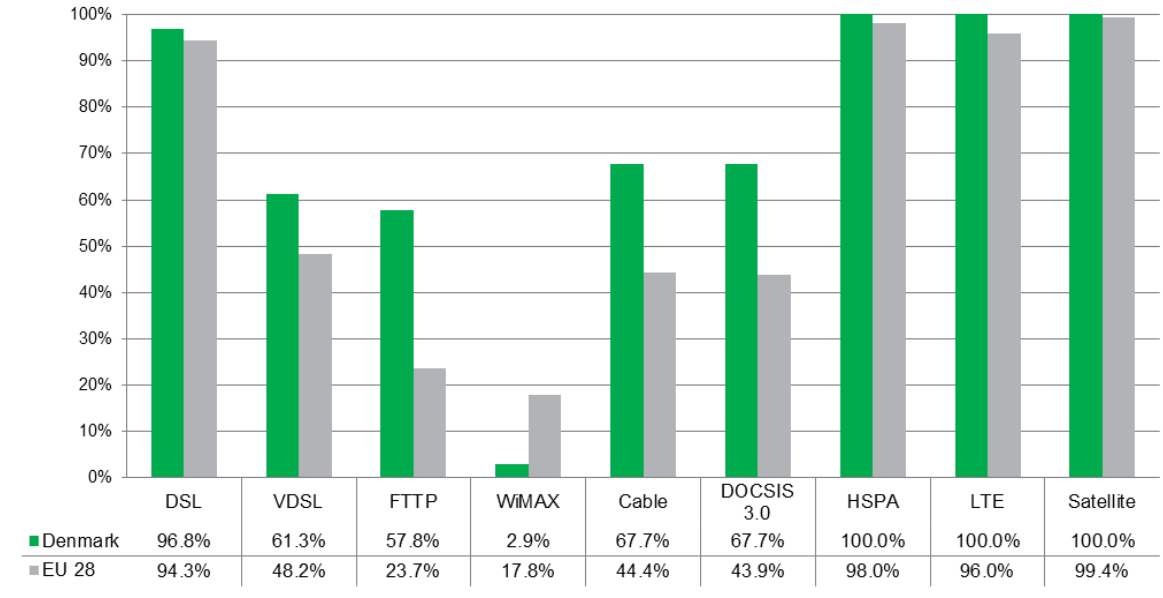


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Denmark	100.0%	99.3%	93.3%	100.0%	96.8%	59.3%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

With regards to fixed broadband technologies, DSL remained the dominant access technology. DSL networks reached 96.8% of homes, exceeding the EU average of 94.3%. With the exception of WiMAX, all broadband technologies outperformed the EU average in terms of coverage levels.

Denmark: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Denmark	96.8%	61.3%	57.8%	2.9%	67.7%	67.7%	100.0%	100.0%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

VDSL services passed 61.3% of Danish households by mid-2016, while FTTP networks were available to 57.8% of homes. The biggest coverage increase in the twelve-month period was in DOCSIS 3.0 coverage, which increased 2.7 percentage points to cover 67.7% of households. Since the majority of cable networks in Denmark have been upgraded to DOCSIS 3.0, the incumbent operator (TDC) has started to deploy DOCSIS 3.1 technology via its subsidiary YouSee. DOCSIS 3.1 enables 1Gbps downloads speeds, and TDC intends to deploy the technology to 1.4 million households by the end of 2017.[26]

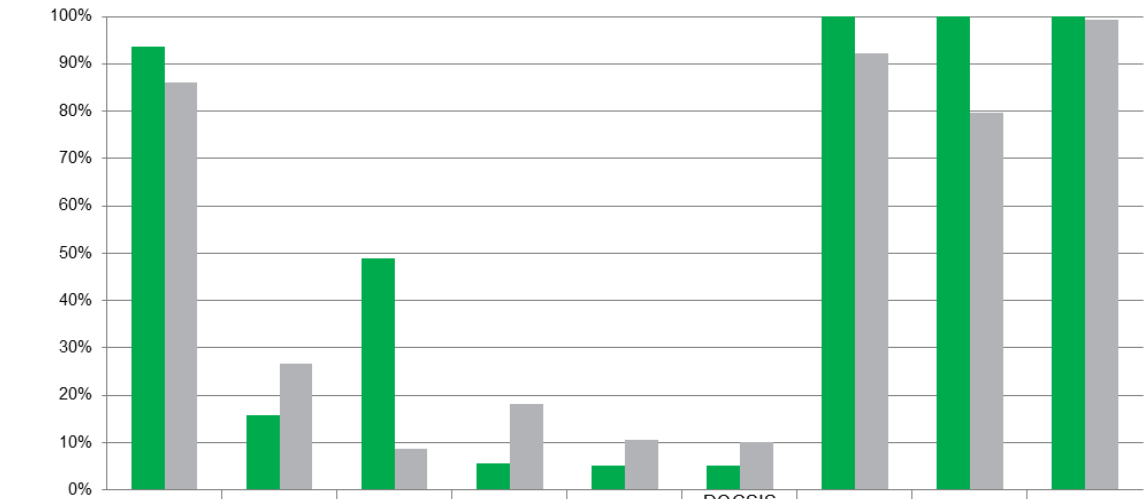
Denmark was an early adopter of LTE, with the first commercial network launched as early as 2010, and remains one of the leaders in Europe with regards to mobile broadband technologies. In 2015, Denmark had already reached near-universal LTE coverage (99.0%). In the twelve-month period to mid-2016, coverage increased by a percentage point to reach 100% of households. Given the universal reach of HSPA and LTE coverage in Denmark, in 2015 advanced LTE-A services were launched by TDC[27], Telenor[28], and Telia[29].

In addition, a ubiquitous LTE network coverage is provided by all mobile network operators meaning that average LTE operator coverage also reaches 100%.

Examining rural coverage in Denmark, DSL was the most widespread fixed broadband technology, reaching 93.5% of rural households. The proportion of DSL networks upgraded to VDSL in rural areas remained low. Rural VDSL coverage reached 15.8%, below the EU average of 26.6%. As a means to improve VDSL speeds in rural areas, TDC intends to deploy VPlus technology to its existing VDSL2 vectoring network.[30] In terms of other NGA technologies, DOCSIS 3.0 coverage remained limited in rural areas. FTTP remained the key NGA technology for rural areas, passing 49.0% of rural homes, a 3.0 percentage point increase.

Denmark remained the leading study country in terms of rural access to mobile broadband, with 100% coverage of both HSPA and LTE technologies in rural areas.

Denmark: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Denmark	93.5%	15.8%	49.0%	5.6%	5.1%	5.1%	100.0%	100.0%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

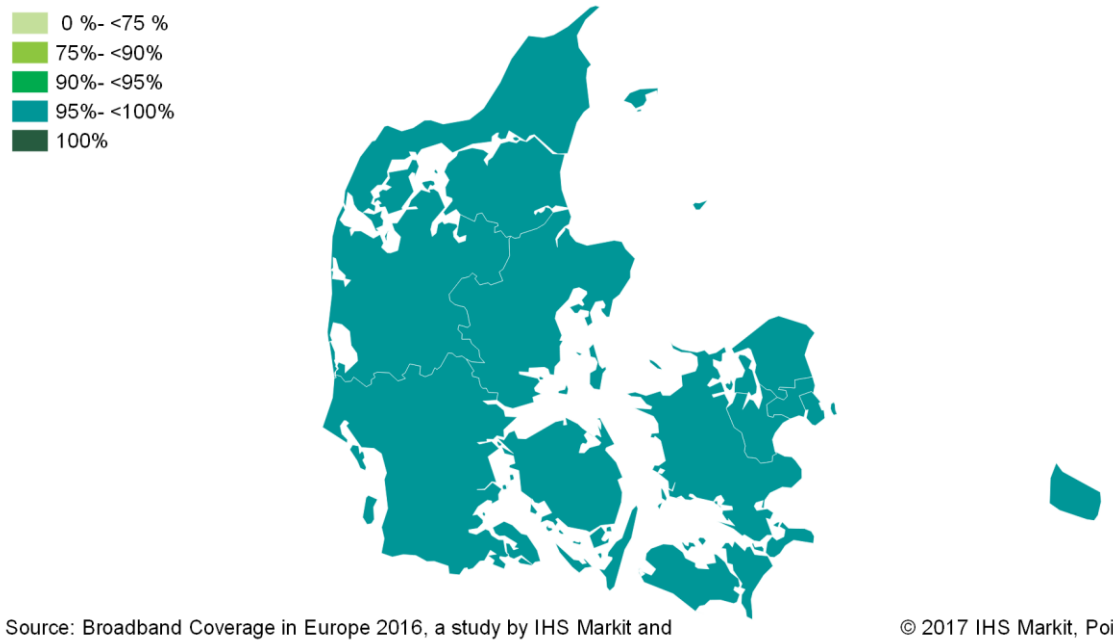
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[26] https://www.telegeography.com/products/commsupdate/articles/2016/05/20/tdc-begins-docsis-3-1-rollout-to-offer-1gbps-speeds/
[27] https://www.telegeography.com/products/commsupdate/articles/2015/07/06/tdc-starts-4g-network-deployment/
[28] http://www.telenor.com/media/articles/2015/a-string-of-network-innovations-in-denmark/
[29] https://www.telegeography.com/products/commsupdate/articles/2015/08/10/telia-embarks-on-lte-a-deployment/
[30] http://www.nokia.com/en_int/news/releases/2016/11/28/tdc-group-and-nokia-increase-danish-broadband-speeds-to-deliver-better-customer-experience

5.7.2 Regional coverage by broadband technology

All regions in Denmark reached similarly high fixed broadband coverage levels with more than 99% of households having access to at least one fixed broadband service in each region.

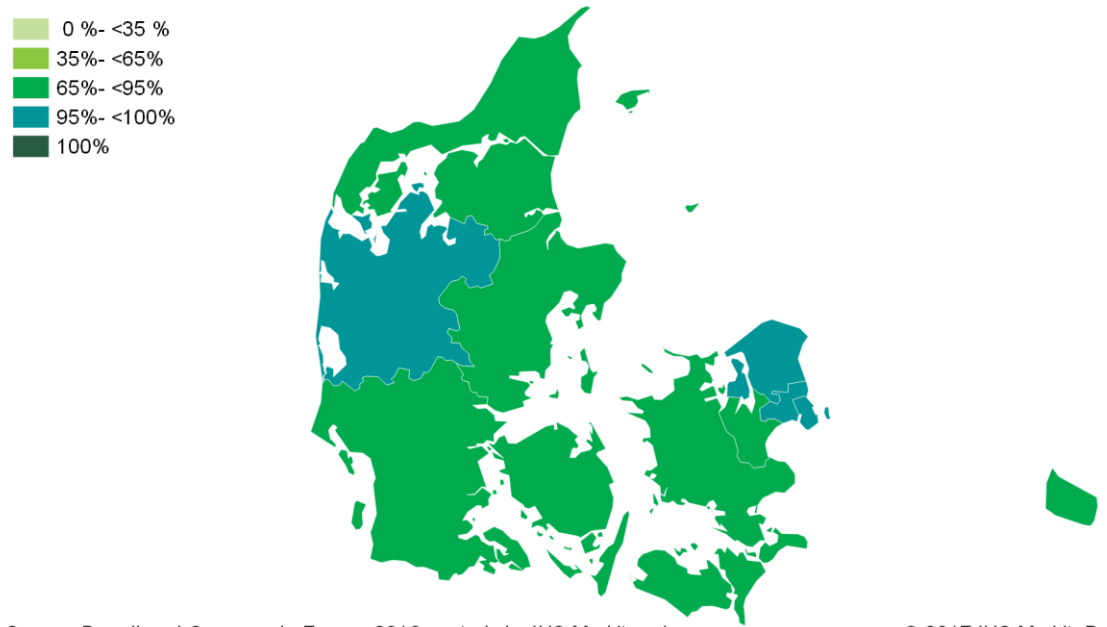
Denmark: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage was more varied with two regions (Fyn and Vest-og Sydsjælland in central Denmark) recording NGA coverage between 84% and 85% of households and four regions reaching NGA coverage levels higher than 95%. Nearly all homes in Copenhagen were passed by NGA networks.

Denmark: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.7.3 Data tables for Denmark

Statistic	National
Population	5,659,715
Persons per household	2.1
Rural proportion	10.9%

	Denmark 2016		Denmark 2015		Denmark 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	96.8%	95.3%	98.0%	94.0%	98.2%	95.0%	94.3%	86.0%
VDSL	61.3%	15.8%	63.0%	16.0%	65.8%	20.6%	48.2%	26.6%
FTTP	57.8%	49.0%	57.0%	46.0%	51.6%	42.0%	23.7%	8.8%
WiMAX	2.9%	5.6%	3.0%	4.0%	0.0%	0.0%	17.8%	18.0%
Cable	67.7%	5.1%	65.0%	6.0%	63.1%	6.5%	44.4%	10.7%
DOCSIS 3.0	67.7%	5.1%	65.0%	6.0%	63.1%	6.5%	43.9%	10.1%
HSPA	100.0%	100.0%	99.0%	99.0%	99.0%	99.0%	98.0%	92.2%
LTE	100.0%	100.0%	99.0%	99.0%	99.0%	99.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	100.0%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	99.5%	99.5%	99.5%	99.5%	99.9%	99.2%
Overall fixed broadband	99.3%	96.8%	99.0%	97.0%	99.1%	97.5%	97.5%	92.6%
NGA broadband	93.3%	59.3%	91.7%	54.7%	91.7%	53.7%	75.9%	39.2%
At least 2 Mbps	98.9%	-	99.0%	-	99.0%	-	96.7%	-
At least 30 Mbps	93.3%	-	92.0%	-	92.0%	-	75.1%	-
At least 100 Mbps	88.9%	-	87.0%	-	85.0%	-	50.8%	-

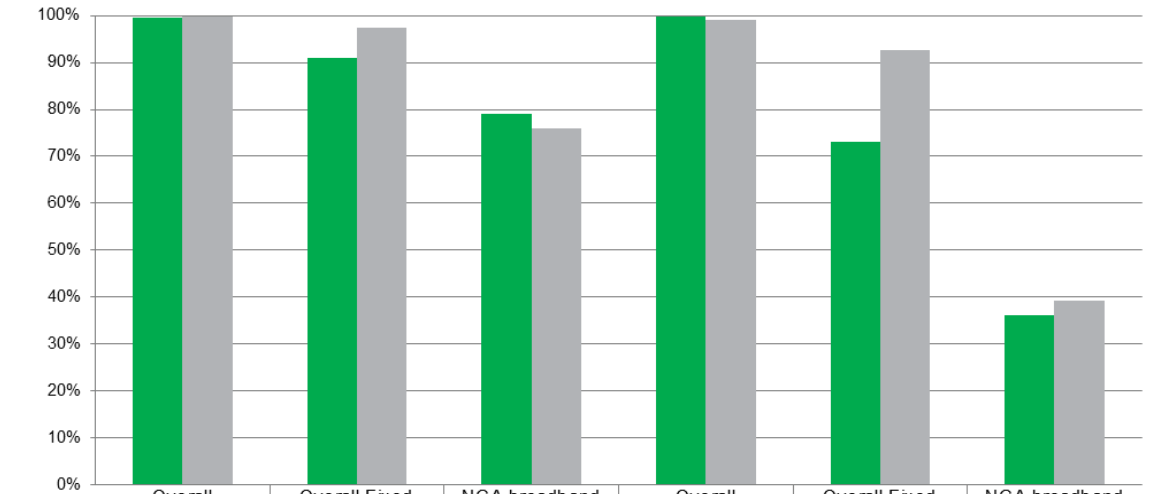
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.8 Estonia

5.8.1 National coverage by broadband technology

Estonian broadband coverage levels have been restated for 2015 and 2014 due to more accurate data now being collected by the NRA. Therefore, coverage levels in this study are different to those reported in previous editions the BCE study report. By mid-2016, overall broadband coverage was slightly behind the EU average, but above EU average levels in rural areas was. Fixed broadband coverage was also lower than the EU average, both on a national and rural level, despite a 4.1 percentage point improvement in national coverage. There was also progress in terms of NGA coverage. By mid-2016, NGA coverage in Estonia reached 79.1% of total households and 36.0% of rural homes.

Estonia: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Estonia	99.5%	90.9%	79.1%	99.9%	73.0%	36.0%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

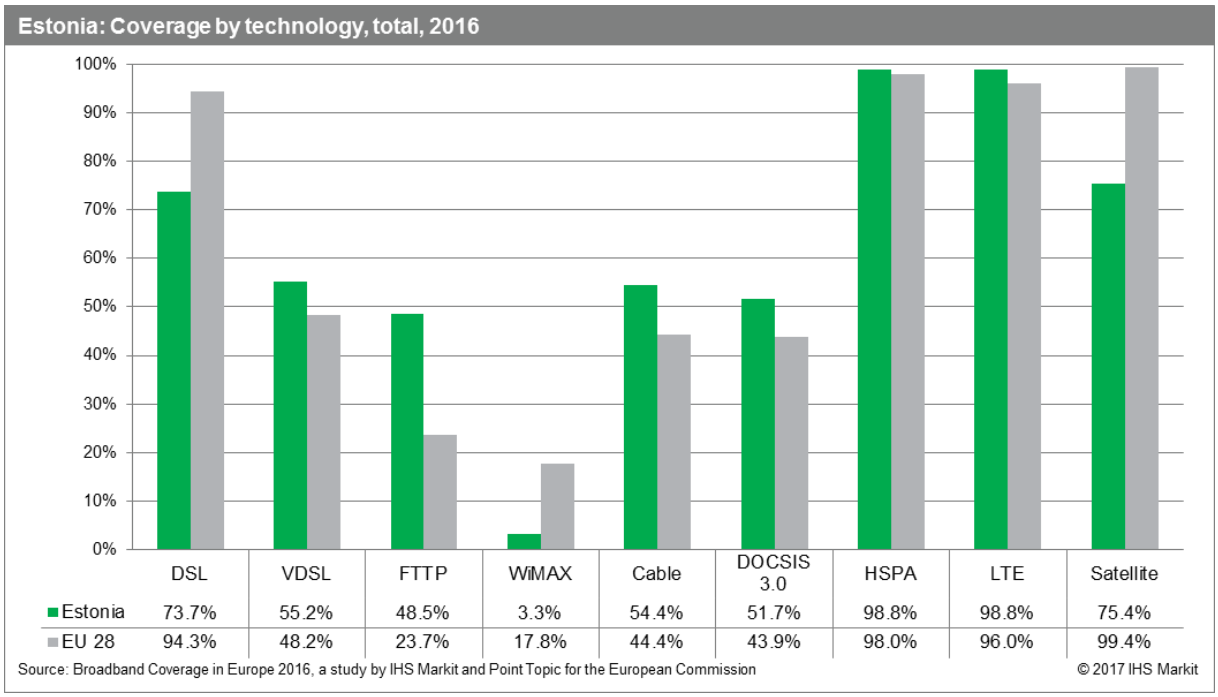
Looking at the coverage of individual technologies, at 73.7%, Estonia reported one of the lowest levels of DSL coverage among the study countries. In comparison, cable coverage was above the EU average with cable networks passing 54.4% of homes at the end of June 2016. The majority of these cable networks were upgraded to DOCSIS 3.0, which covered 51.7% of households. DOCSIS 3.0 was the second most widespread NGA technology after VDSL networks. VDSL coverage reached 55.2% of homes increasing by 2.6 percentage points during the twelve months to mid-2016, while FTTP networks passed 48.5% of households.

During the twelve months to June 2016, LTE coverage in Estonia increased by 14.5 percentage points, reaching near-universal levels. This is unsurprising given that Estonia was one of the early adopters of LTE, launching LTE services already in 2010. Mobile operators have moved onto providing LTE-Advanced services, with Tele2 deploying the technology in 2015.[31]

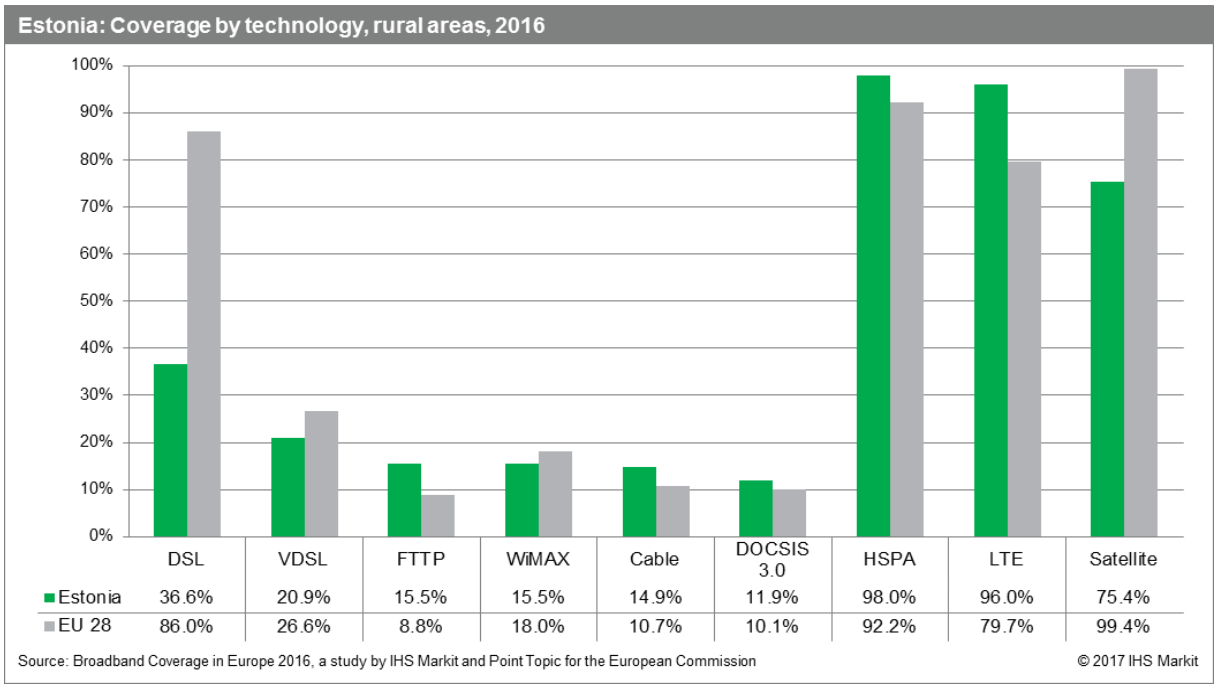
In terms of average LTE operator coverage, it reached 94.5% by mid-2016, confirming the general trend of LTE coverage saturation.

Estonia, along with Latvia and Lithuania, remained only partially covered by satellite broadband services – with significant limitations on addressable market in a number of areas due to the orbital slots of the relevant satellites and the subsequent local requirements for larger dishes to receive the satellite signals.

[31] https://www.telegeography.com/products/commsupdate/articles/2015/11/26/tele2-eesti-prepares-375mbps-lte-a-launch/



In rural areas, at 36.6% DSL coverage remained well below the EU average. WiMAX availability was also lower than the EU average, as coverage reduced by 27.6 percentage points during the year to mid-2016 as a result of operators redistributing spectrum for LTE services. Cable coverage in rural areas was above EU average levels, with cable broadband networks passing 14.9% or rural homes.



Examining NGA technologies, by mid-2016, rural VDSL networks had the highest reach, passing 20.9% of rural homes. FTTP and DOCSIS 3.0 networks covered 15.5% and 11.9% of rural Estonian households, respectively.

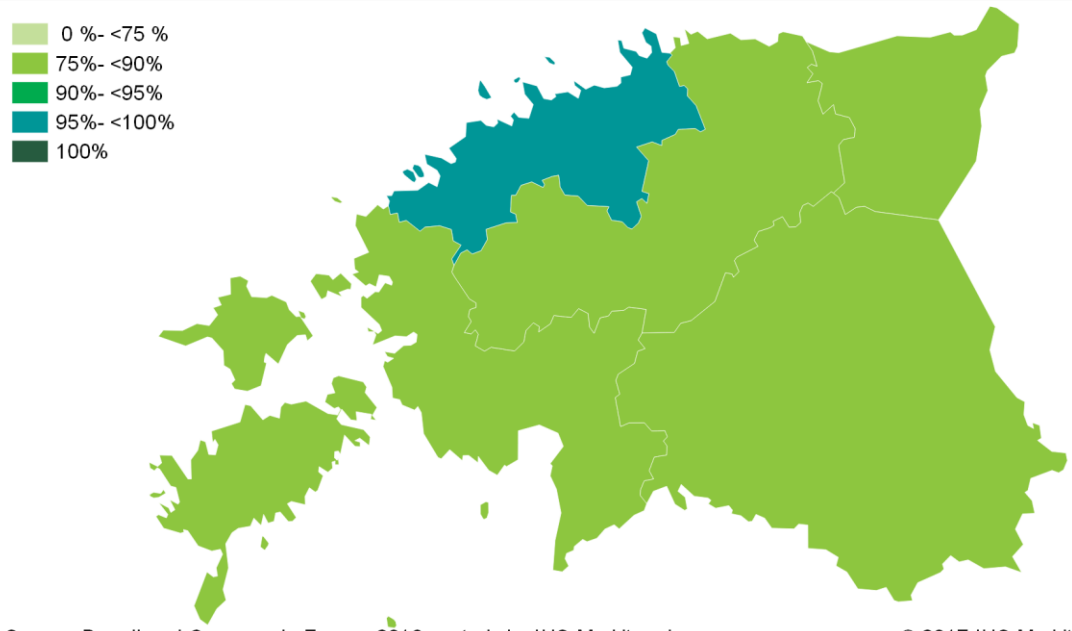
Rural LTE coverage increased by 15.4 percentage points during the twelve months to mid-2016, and reached 96.0% of rural homes. During 2016, Telia Estonia (formerly TeliaSonera) installed 399 new mobile base stations, offering a fixed-mobile solution[32] to exploit the near-universal LTE coverage in rural areas.

[32] http://www.teliacompany.com/en/news/news-articles/2017/estonia-port/

5.8.2 Regional coverage by broadband technology

There were considerable differences in fixed broadband coverage in Estonia's five regions, with coverage in the Põhja-Eesti region exceeding 99.9%, while coverage in the Kesk-Eesti region being lower than 80%.

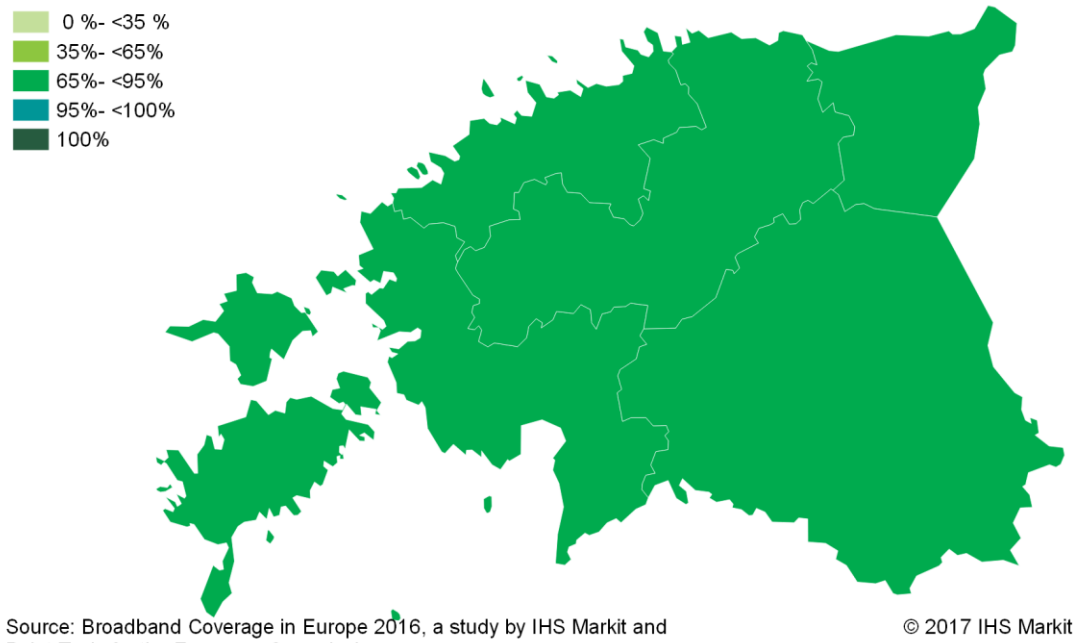
Estonia: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage patterns reflected those for fixed broadband, with three regions reporting coverage under 80% and only in the Põhja-Eesti NGA coverage reached nearly 87% of households.

Estonia: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.8.3 Data tables for Estonia

Statistic	National
Population	1,313,271
Persons per household	2.2
Rural proportion	21.3%

	Estonia 2016		Estonia 2015		Estonia 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	73.7%	36.6%	*73.6%*	*35.9%*	*72.1%*	*35.8%*	94.3%	86.0%
VDSL	55.2%	20.9%	*49.6%*	*18.8%*	*44.6%*	*16.9%*	48.2%	26.6%
FTTP	48.5%	15.5%	*47.5%*	*15.2%*	*44.6%*	*13.7%*	23.7%	8.8%
WiMAX	3.3%	15.5%	*9.4%*	43.1%	*8.7%*	40.0%	17.8%	18.0%
Cable	54.4%	14.9%	*54.0%*	*14.5%*	*51.7%*	*13.8%*	44.4%	10.7%
DOCSIS 3.0	51.7%	11.9%	*51.7%*	*11.6%*	*46.5%*	*11.0%*	43.9%	10.1%
HSPA	98.8%	98.0%	*98.9%*	*98.0%*	99.0%	98.0%	98.0%	92.2%
LTE	98.8%	96.0%	84.3%	*80.6%*	79.2%	74.7%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	94.5%	-	-	-	-	-	84.4%	-
Satellite	75.4%	75.4%	75.4%	75.4%	75.4%	75.4%	99.4%	99.4%
Overall broadband	99.5%	99.9%	*99.5%*	*99.4%*	*99.7%*	99.1%	99.9%	99.2%
Overall fixed broadband	90.9%	73.0%	*86.8%*	*73.0%*	*86.0%*	*70.0%*	97.5%	92.6%
NGA broadband	79.1%	36.0%	*78.1%*	*33.8%*	*75.1%*	*30.7%*	75.9%	39.2%
At least 2 Mbps	86.8%	-	86.8%	-	86.0%	-	96.7%	-
At least 30 Mbps	76.9%	-	76.3%	-	72.0%	-	75.1%	-
At least 100 Mbps	58.7%	-	58.3%	-	54.1%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

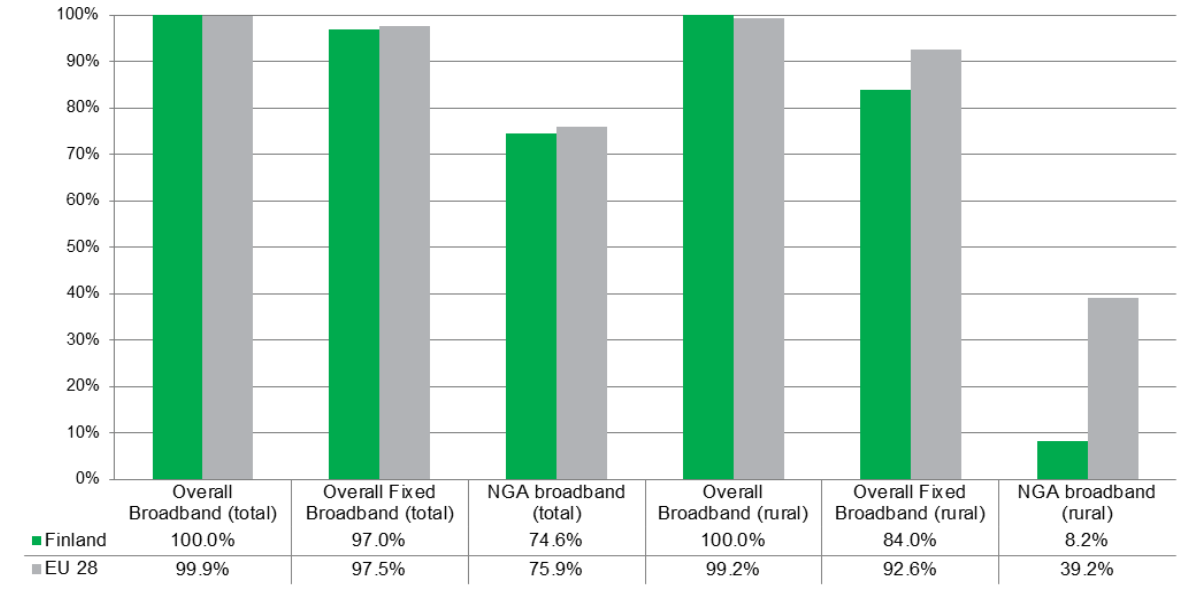
As mentioned, previously reported coverage trends and values reported for Estonia have been restated in light of new and more accurate data shared by the NRA. All restatements are highlighted in italics.

5.9 Finland

5.9.1 National coverage by broadband technology

As in the previous year, Finland recorded complete broadband coverage at a national and rural level while fixed broadband coverage was slightly below the EU average, both nationally and in rural areas. With regards to NGA broadband, total NGA coverage was at 74.6% also slightly below the EU average of 75.9%. In rural areas, NGA services were available to only 8.2% of rural homes, a coverage level considerably below the EU average of 39.2%.

Finland: Coverage by technology combination, 2016

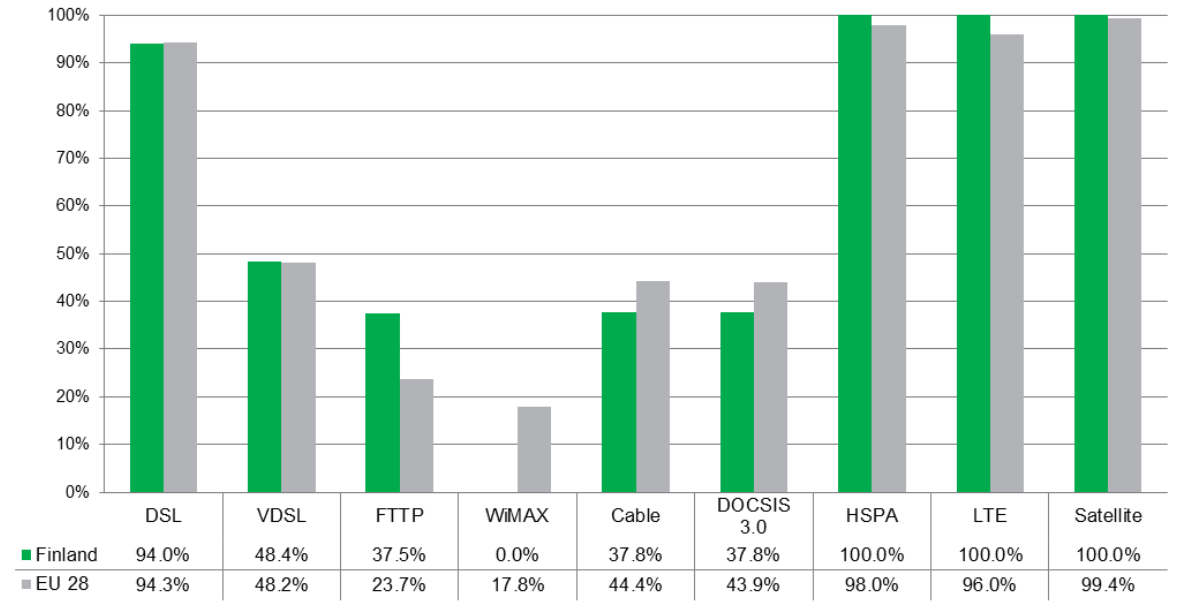


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Finland	100.0%	97.0%	74.6%	100.0%	84.0%	8.2%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Coverage levels for the majority of individual technologies remained largely unchanged compared to 2015. DSL remained the most widespread fixed broadband technology, covering 94.0% of Finnish households, while cable networks passed 37.8% of homes. In mid-2016, no WiMAX coverage was recorded in Finland, as a consequence of WiMAX spectrum being reallocated towards LTE networks.

Finland: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Finland	94.0%	48.4%	37.5%	0.0%	37.8%	37.8%	100.0%	100.0%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

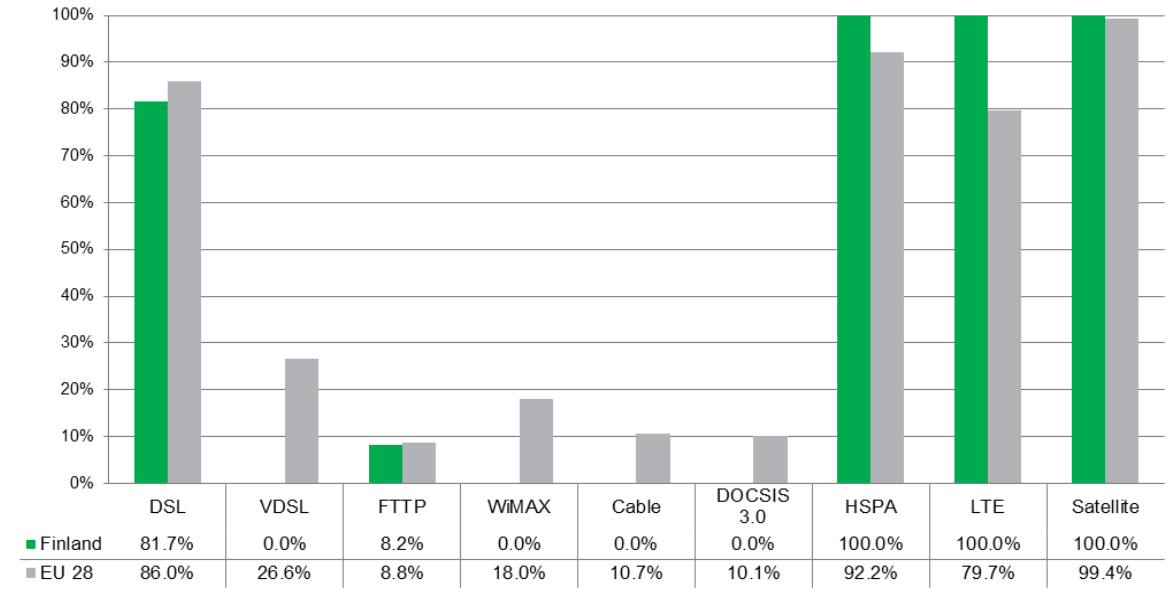
Examining NGA broadband technologies, VDSL services continued to have the widest coverage in Finland and were available to 48.4% of homes. Telia Company (formerly TeliaSonera), Elisa and DNA have all invested considerably in FTTP deployment in recent years. As such, FTTP networks passed 37.5% of households by mid-2016. DNA has also launched a 1Gbps fibre-optic broadband service, which at launch was available to half of the 600,000 households covered by its existing HFC broadband network.[33] As of mid-2016, Finnish cable networks were fully upgraded to DOCSIS 3.0 with DOCSIS 3.0 services passing 37.8% of households.

As was the case in the previous edition of the study, HSPA networks were available to 100% of households. Similarly, LTE networks across Finland reached universal coverage, as a result of a 7.9 percentage point increase during the twelve-month period to the end of June 2016.

When considering an average coverage of all LTE network operators, on average LTE services were available to 97.0% of Finns at mid-2016.

Improving rural broadband coverage is an important part of the Finnish Government's "Broadband 2015" project, which provides state aid for the construction of high speed broadband networks in areas deemed less attractive by the operators.[34] By mid-2016, rural DSL coverage increased by 1.5 percentage points to 81.7%, but remained below the EU average (86.0%). As in previous years, there was an absence of DOCSIS 3.0 and VDSL networks in rural areas. Therefore, FTTP was the sole contributor to rural NGA access, passing 8.2% of rural households.

Finland: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Finland	81.7%	0.0%	8.2%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

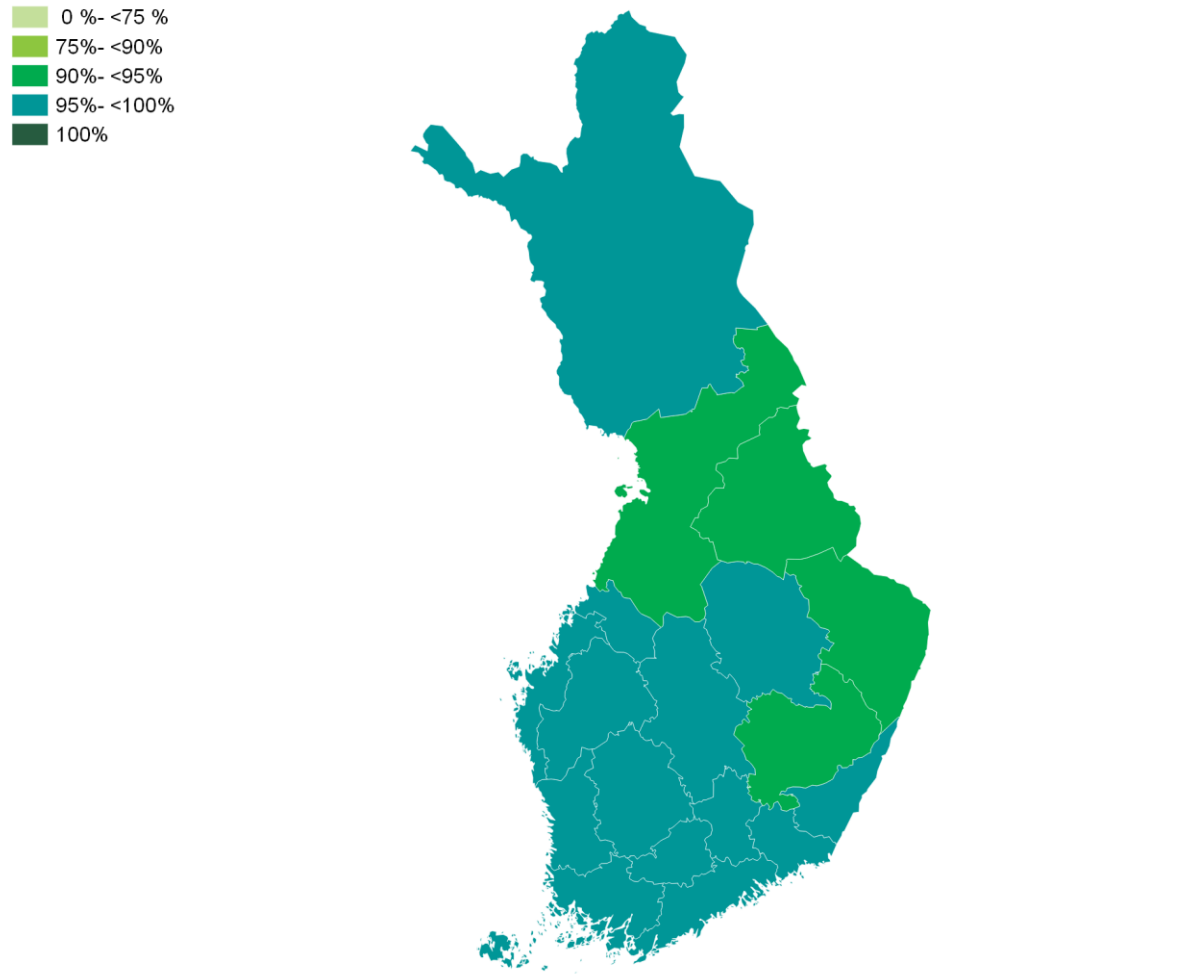
Since 2015, mobile network operators Telia Company and DNA have deployed a shared network in order to improve mobile broadband coverage in the north-eastern areas of Finland[35]. Finland reported a considerable increase in LTE coverage in rural areas during the twelve-month period to mid-2016, increasing 39.9 percentage points, as Finland recorded universal rural coverage for both LTE and HSPA services.

[33] https://www.telegeography.com/products/commsupdate/articles/2016/05/10/dna-finland-launches-gigabit-broadband/
[34] https://www.viestintavirasto.fi/en/steeringandsupervision/broadband2015subsidies.html
[35] http://telecoms.com/278851/teliasonera-dna-to-share-network-in-rural-finland/

5.9.2 Regional coverage by broadband technology

As in the previous year, in most regions in Finland fixed broadband coverage reached levels above 95%, with only four (Etelä-Savo, Pohjois-Karjala, Kainuu, and Pohjois-Pohjanmaa regions) of the nineteen regions falling below this threshold. Lowest fixed broadband coverage was recorded in the Kainuu region at 90.8%, while near universal (99.9%) coverage was registered for the Pohjanmaa region.

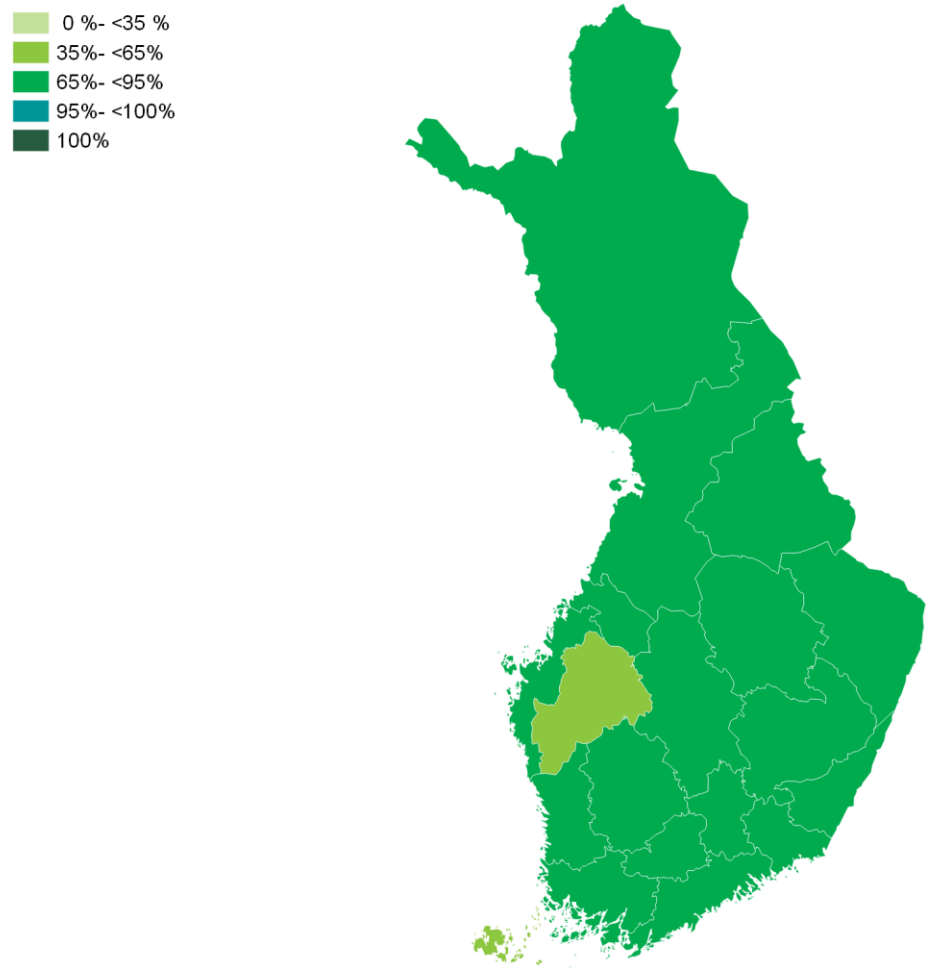
Finland: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA coverage varied more considerably, with the lowest coverage level reported in the Åland region (46%) and highest in the Pohjanmaa region (82.6%) and Helsinki (over 80%). Most regions reported no significant coverage changes in the twelve months to the end of June 2016.

Finland: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.9.3 Data tables for Finland

Statistic	National
Population	5,451,753
Persons per household	2.1
Rural proportion	18.7%

	Finland 2016		Finland 2015		Finland 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	94.0%	81.7%	94.0%	*80.2%*	94.0%	*79.4%*	94.3%	86.0%
VDSL	48.4%	0.0%	48.4%	0.0%	48.4%	0.0%	48.2%	26.6%
FTTP	37.5%	8.2%	37.4%	*8.2%*	37.7%	*8.1%*	23.7%	8.8%
WiMAX	0.0%	0.0%	2.3%	1.1%	2.3%	1.1%	17.8%	18.0%
Cable	37.8%	0.0%	44.4%	0.0%	44.3%	0.0%	44.4%	10.7%
DOCSIS 3.0	37.8%	0.0%	44.4%	0.0%	44.3%	0.0%	43.9%	10.1%
HSPA	100.0%	100.0%	100.0%	100.0%	99.5%	97.2%	98.0%	92.2%
LTE	100.0%	100.0%	92.1%	60.1%	92.1%	56.3%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	97.0%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	100.0%	99.8%	98.6%	99.9%	99.2%
Overall fixed broadband	97.0%	84.0%	97.0%	*83.9%*	97.0%	*83.2%*	97.5%	92.6%
NGA broadband	74.6%	8.2%	75.1%	*8.2%*	75.1%	*8.1%*	75.9%	39.2%
At least 2 Mbps	96.5%	-	96.5%	-	96.5%	-	96.7%	-
At least 30 Mbps	66.7%	-	66.8%	-	66.8%	-	75.1%	-
At least 100 Mbps	32.5%	-	33.7%	-	33.7%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

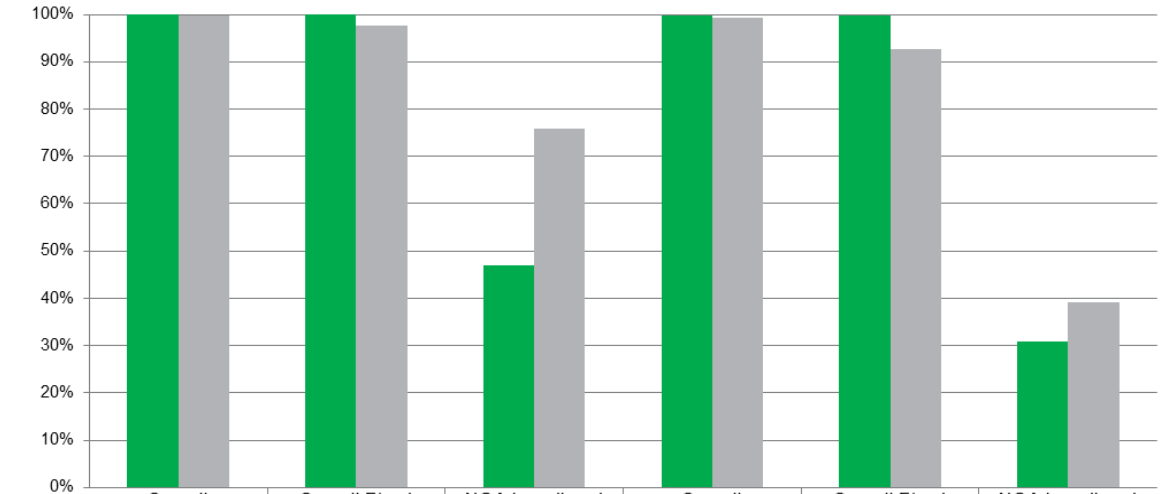
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL and FTTP coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.10 France

5.10.1 National coverage by broadband technology

By mid-2016, France recorded complete coverage for overall broadband and fixed broadband, with near-complete coverage for these technology combinations at a rural level. However, the proportion of total households passed by NGA technologies remained one of the lowest among the study countries, reaching 47.0% of households and remaining considerably below the EU average (75.9%). NGA availability in rural areas was also below the EU average, despite increasing from 23.0% to 30.9% by mid-2016.

France: Coverage by technology combination, 2016

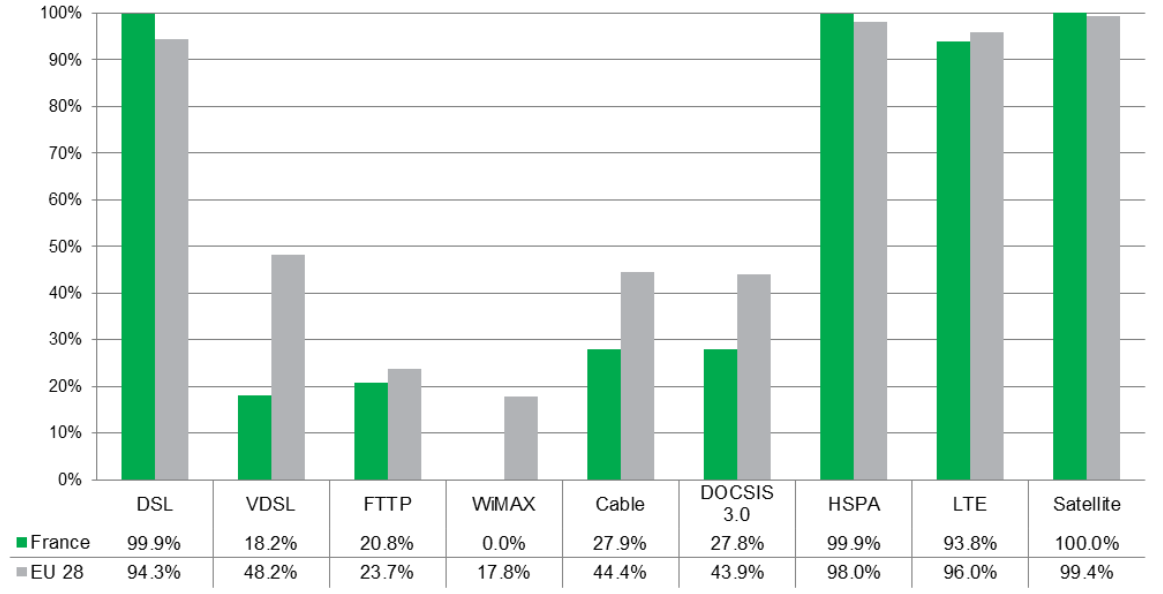


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
France	100.0%	100.0%	47.0%	99.9%	99.7%	30.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL continued to be the most widespread fixed broadband technology in terms of coverage of French households, increasing 0.4 percentage points, to reach 99.9% of households. Despite this, VDSL was the least widespread NGA technology in France, as the proportion of DSL networks upgraded to VDSL remained low. By mid-2016, 18.2% of French homes had access to VDSL services, an uplift of 1.5 percentage points in the twelve-month period to mid-2016.

France: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
France	99.9%	18.2%	20.8%	0.0%	27.9%	27.8%	99.9%	93.8%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

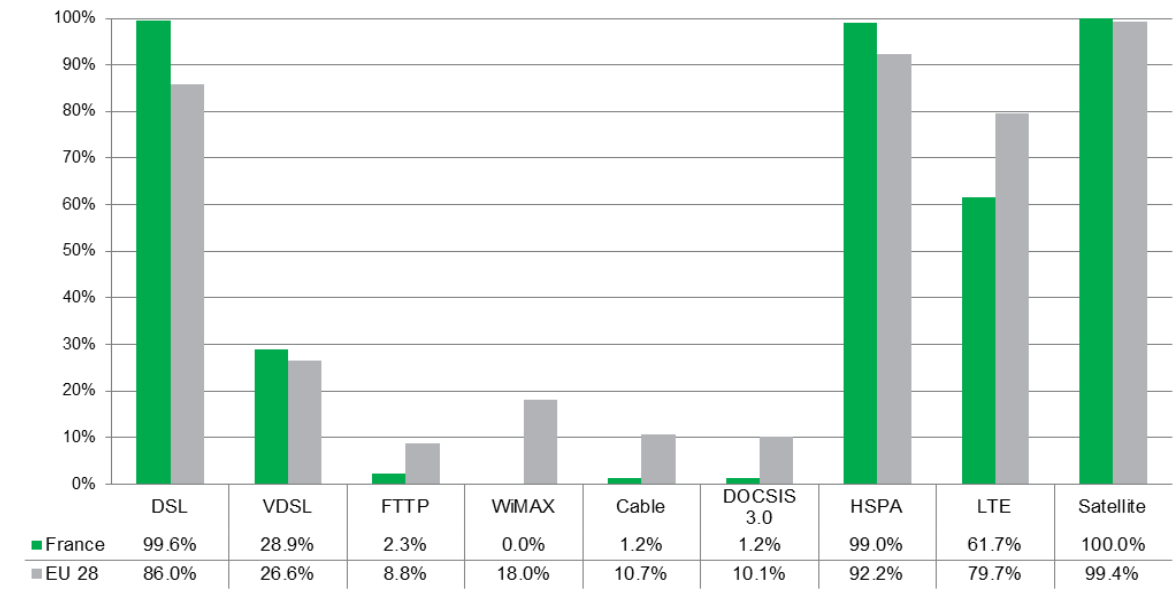
Meanwhile, DOCSIS 3.0 remained the most dominant NGA technology in terms of coverage, although the proportion of homes passed by the technology reminded stable at around 28 percentage points for the fourth consecutive year. The biggest growth in terms of NGA coverage during the year to mid-2016 was from FTTP networks, which increased by 5.3 percentage points to cover 20.8% of French households. This growth is underpinned by the "Plan France Très Haut Débit", France's national broadband plan, which focuses on deploying FTTP in urban and highly-populated areas.[36]

Looking at mobile broadband technologies, the availability of LTE networks recorded a 16.3 percentage point increase in the year to mid-2016 to cover 93.8% of households. Despite this improvement, LTE coverage in France remained below the EU average of 96.0%. When average of availability of LTE services of all mobile network operators is considered, 78.3% of French households on average had access to LTE networks.

By mid-2016, rural DSL coverage in France was near-universal after a 1.1 percentage point increase in the year to June 2016. Conversely, the percentage of rural homes passed by cable remained very limited at 1.2%, meaning rural DOCSIS 3.0 coverage was also minimal.

The availability of FTTP networks in rural areas was, at 2.3%, also limited. Nevertheless, rural FTTP coverage can be expected to increase, given the incumbent's deployment target of 22 million households reached by FTTP by 2022.[37] In the meantime, VDSL services remain the key NGA technology in rural areas in France. Rural VDSL increased by 7.8 percentage points in the twelve-month period to mid-2016, reaching 28.9% of rural households.

France: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
France	99.6%	28.9%	2.3%	0.0%	1.2%	1.2%	99.0%	61.7%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Improving mobile broadband coverage in rural areas was an important aspect of the economic reforms passed in France in February 2015, known as the "Loi Macron". It required mobile operators to deploy 2G networks in unserved areas by 2016 and 3G/4G networks by 2017.[38] As such, there have been improvements in terms of rural coverage for both HSPA and LTE technologies in the twelve-month period to mid-2016. Rural HSPA networks reached 99.0% of rural households, above the EU average of 92.2%. Meanwhile, deployment of LTE networks in rural areas of France increased dramatically during the year to mid-2016, increasing 56.4 percentage points to reach 61.7% of rural homes. Yet, despite this staggering increase, French rural LTE coverage remained below the EU average (79.7%).

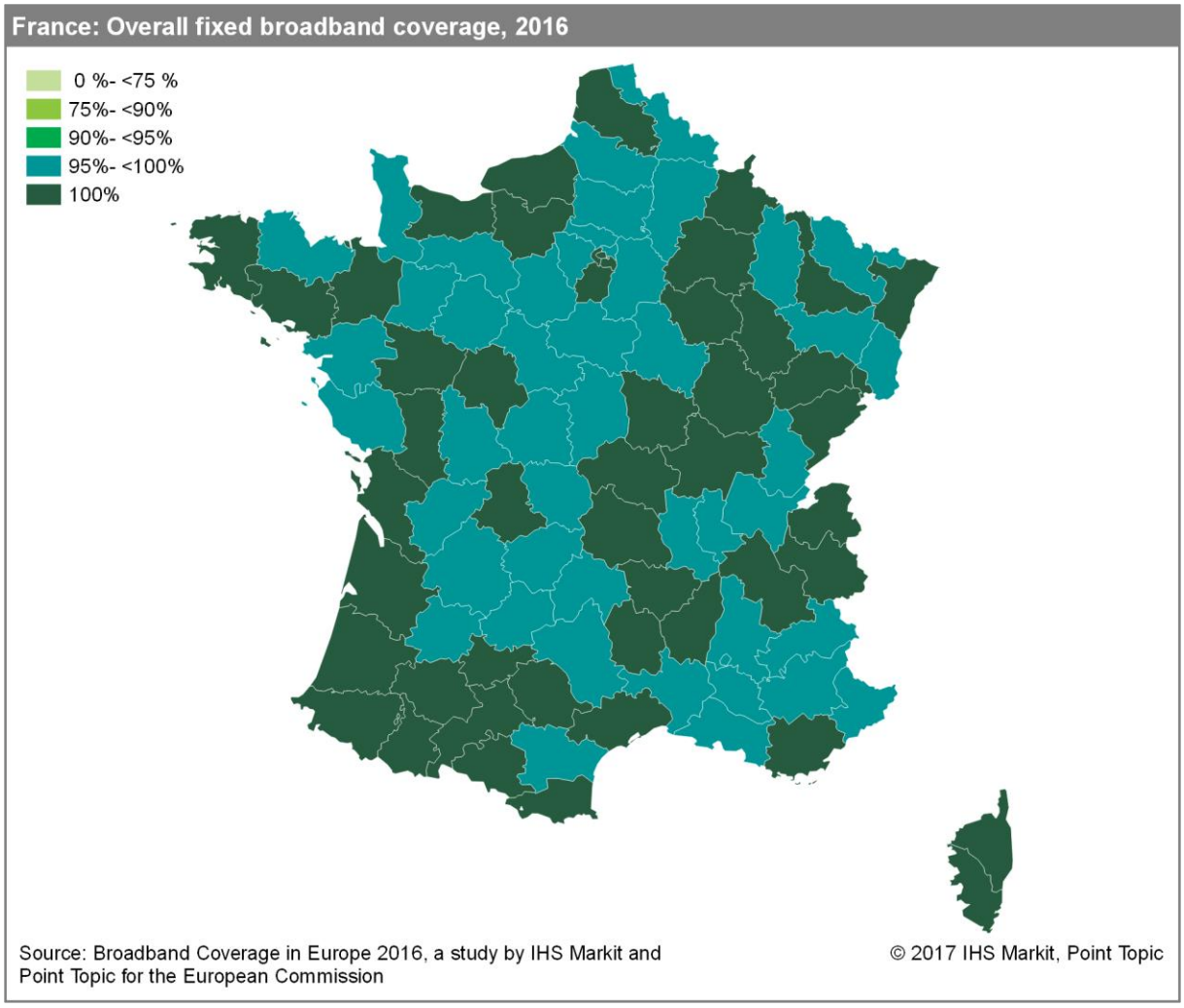
[36] http://www.francethd.fr/le-plan-france-tres-haut-debit/qu-est-ce-que-le-plan-france-tres-haut-debit.html

[37] https://www.orange.com/en/Press-Room/press-releases-2017/press-releases-2015/Orange-picks-up-speed-with-100-Fibre-Orange

[38] https://www.telegeography.com/products/commsupdate/articles/2015/04/20/french-government-approves-amendment-mandating-rural-mobile-expansion/

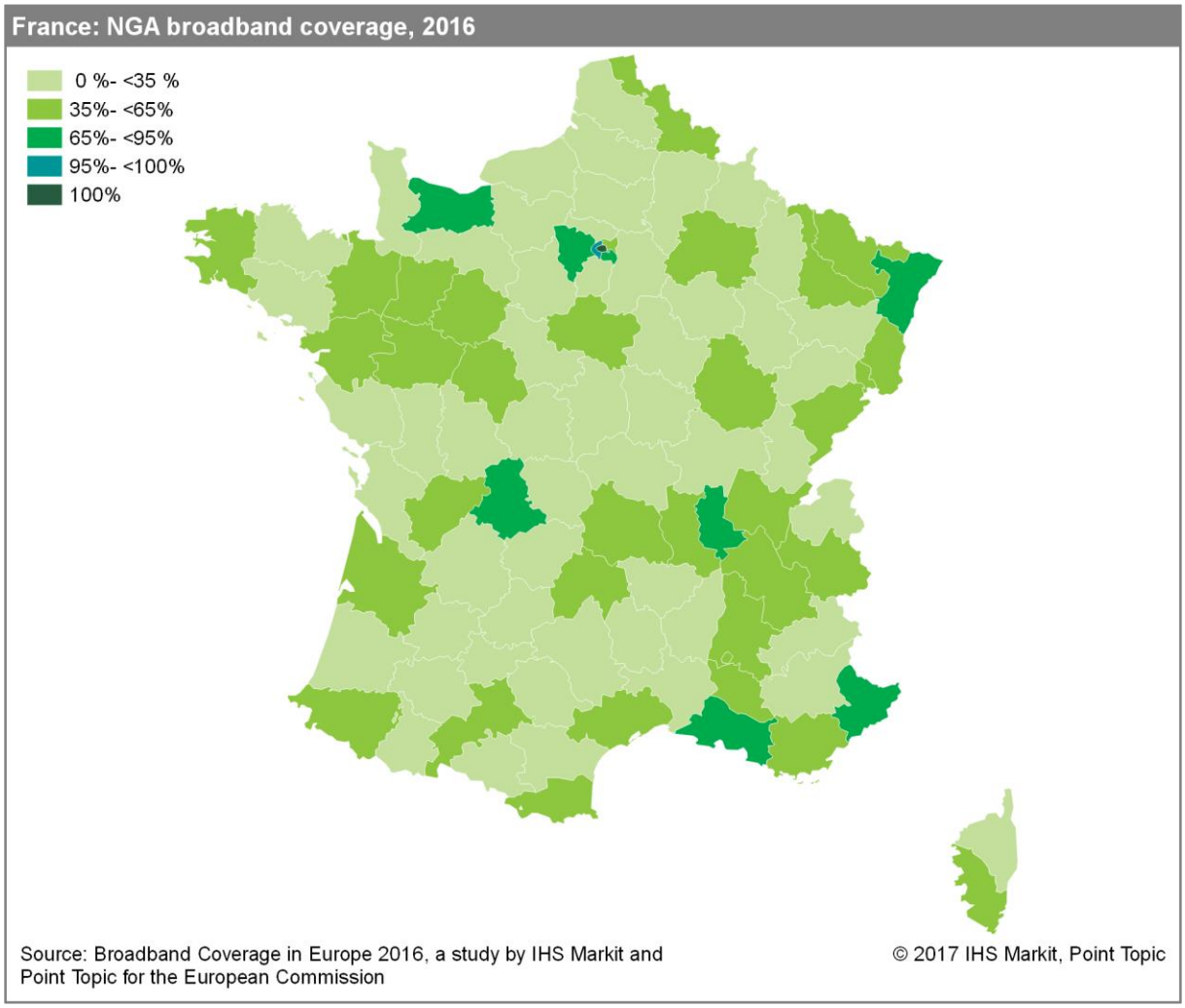
5.10.2 Regional coverage by broadband technology

All French regions reported fixed broadband coverage rates of 100% or very close to 100% with no region recording fixed broadband coverage levels lower than 99.9%. This is an improvement compared to mid-2015, when the Rhône region and overseas territories of Guadeloupe and Martinique reported coverage rates below 98%.



However, substantial variations remain in terms of NGA coverage. Although by mid-2016, all French regions reported that NGA networks were available, coverage ranged from 9.0% in Guyane to 100% in Paris. The only other region to report NGA coverage exceeding 95% was the Hauts-de-Seine region, which constitutes the broader Paris metropolitan area. This shows the considerable disparity in NGA coverage between the capital and other regions.

Only seven other regions recorded NGA coverage levels in the 65%-95% category - Haute-Vienne, Calvados, Bouches-du-Rhône, Yvelines, Alpes-Maritimes, Seine-Saint-Denis, Bas-Rhin, and the Rhône region. The Calvados region also registered the highest increase in NGA coverage over the twelve-month period to the end of June 2016. Due to newly reported FTTP networks deployment, NGA coverage in the region grew by 20.8 percentage pointst to reach 67.2% of households.



The following broadband coverage levels were recorded in French regions outside mainland Europe:

Coverage data for French NUTS 3 areas outside mainland Europe			
NUTS 3	**Description**	**Overall fixed broadband coverage**	**NGA broadband coverage**
FR910	**Guadeloupe**	99.9%	54.6%
FR920	**Martinique**	100.0%	42.8%
FR930	**Guyane**	100.0%	9.0%
FR940	**Réunion**	99.9%	22.9%

5.10.3 Data tables for France

Statistic	National
Population	66,192,574
Persons per household	2.2
Rural proportion	15.6%

	France 2016		France 2015		France 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	99.9%	99.6%	99.5%	*98.6%*	99.5%	*98.4%*	94.3%	86.0%
VDSL	18.2%	28.9%	16.7%	21.1%	15.5%	17.7%	48.2%	26.6%
FTTP	20.8%	2.3%	15.5%	2.0%	13.6%	1.7%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	27.9%	1.2%	29.5%	0.7%	29.2%	1.3%	44.4%	10.7%
DOCSIS 3.0	27.8%	1.2%	29.5%	0.7%	29.2%	1.3%	43.9%	10.1%
HSPA	99.9%	99.0%	99.8%	*98.7%*	99.8%	*98.6%*	98.0%	92.2%
LTE	93.8%	61.7%	77.5%	5.3%	75.4%	*3.9%*	96.0%	79.7%
LTE average operator coverage (DESI indicator)	78.3%*	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	99.9%	100.0%	*99.8%*	100.0%	*99.8%*	99.9%	99.2%
Overall fixed broadband	100.0%	99.7%	99.8%	*99.0%*	99.7%	*99.0%*	97.5%	92.6%
NGA broadband	47.0%	30.9%	44.8%	23.0%	42.6%	20.0%	75.9%	39.2%
At least 2 Mbps	97.4%	-	97.1%	-	97.0%	-	96.7%	-
At least 30 Mbps	50.0%	-	41.3%	-	40.0%	-	75.1%	-
At least 100 Mbps	33.9%	-	28.4%	-	26.9%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA. The data includes both overseas territories as well as mainland France.

During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL and FTTP coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

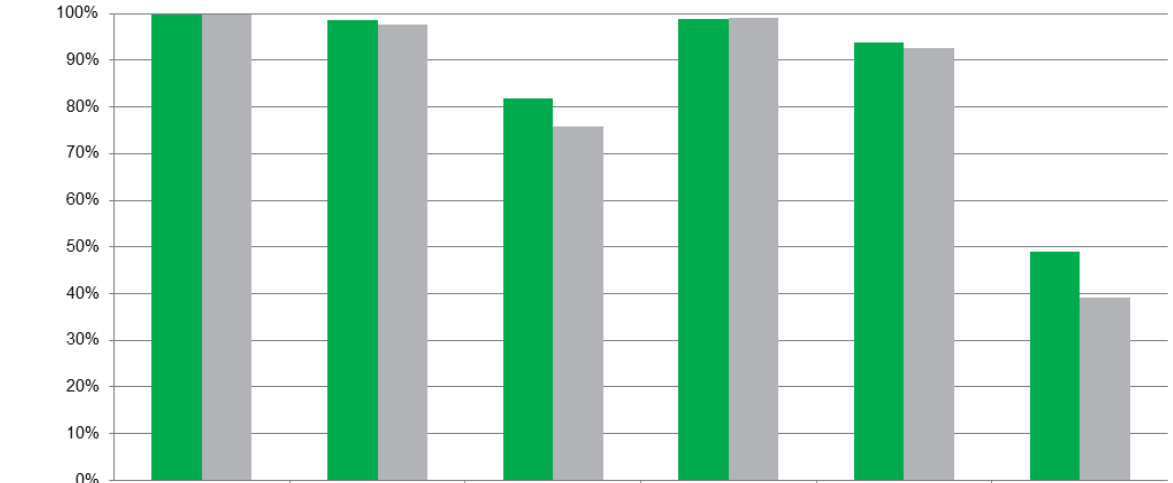
* An updated value for average LTE operator coverage is reported compared to the DESI (data for 2015 was published).

5.11 Germany

5.11.1 National coverage by broadband technology

As in previous years, Germany reported above-average coverage levels for all broadband combination categories. While on a national level there were only limited increases in fixed broadband and NGA broadband coverage (0.3 and 0.4 percentage points, respectively), rural NGA coverage increased by 12.5 percentage points to reach 48.9% of households at the end of June 2016.

Germany: Coverage by technology combination, 2016

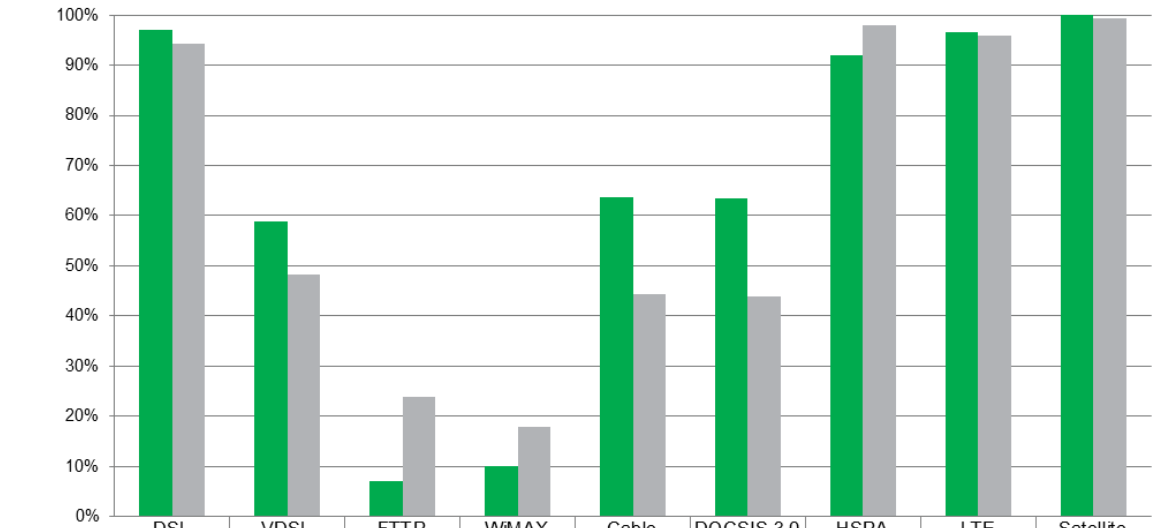


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Germany	99.9%	98.6%	81.8%	98.8%	93.8%	48.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL was the dominant broadband access technology in terms of coverage, passing 97.1% of German homes. Standard cable coverage was lower, at 63.7%, although it still exceeded the EU average.

Germany: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Germany	97.1%	58.8%	7.1%	10.0%	63.7%	63.5%	92.1%	96.6%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

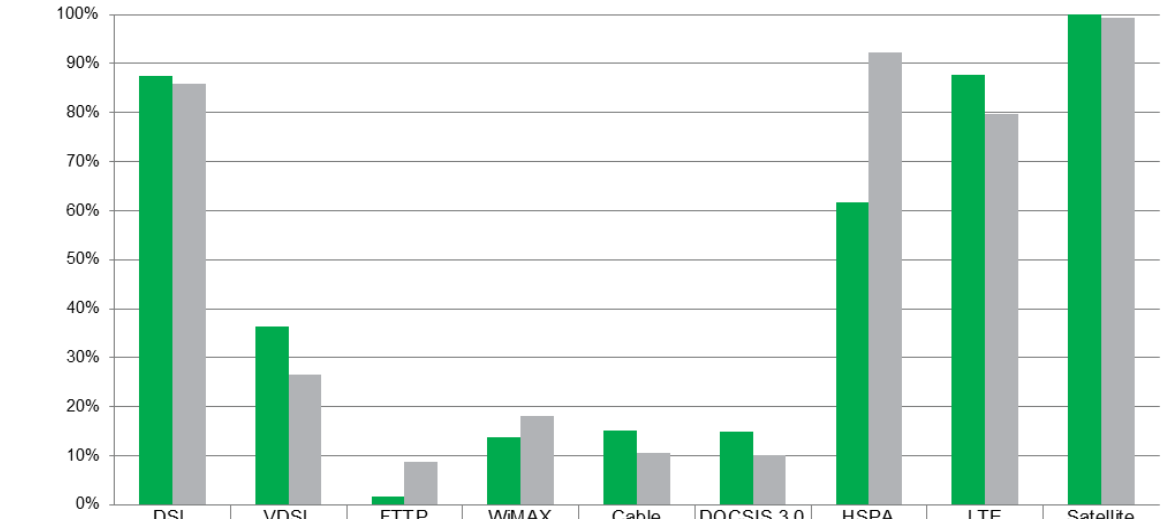
In terms of high-speed cable broadband, DOCSIS 3.0 was available to 63.5% of households as it remained the key NGA technology in Germany. With the majority of cable networks upgraded to DOCSIS 3.0, Liberty Global's Unitymedia plans to start deploying DOCSIS 3.1 technology in parts of Germany in early 2018, enabling download speeds of up to 1Gbps.[39] Meanwhile, Vodafone revealed that it had reached 5 million households with download speeds of up to 400Mbps using the cable networks it acquired from Kabel Deutschland, reflecting the speed advantages of cable networks versus copper alternatives.[40]

Examining other NGA technologies, the most substantial coverage gains were reported for VDSL networks, coverage of which increased by 10.3 percentage points during the twelve-month period and at the end of June 2016 VDSL services have been available to nearly 6 in 10 (58.8%) of German households. In an attempt to increase the speeds attainable over their legacy copper networks, both the incumbent Deutsche Telekom[41] and Vodafone[42] have previously announced plans to deploy VDSL vectoring. The focus on upgrading existing copper networks partly contributed to the limited availability of FTTP services. At the end of June 2016, FTTP networks were available to only 7.1% of German households, a negligible 0.5 percentage point increase.

By mid-2016, Germany was one of two countries with HSPA coverage of below 95%, with coverage of the technology increasing 0.6 percentage points to cover 92.1% of households. In terms of LTE coverage, Germany witnessed growth of 2.6 percentage points in the twelve months to the end of June 2016, as coverage reached 96.6% of homes. In terms of average LTE operator coverage, by mid-2016 LTE networks of all operators were on average available to 86.0% of Germans.

In rural areas, DSL continued to be an important driver of broadband coverage, with 87.6% of rural homes having access to DSL services. Rural cable coverage was, at 15.2%, higher than the EU average but considerably lower than DSL coverage. Examining NGA technologies, VDSL remained the most prevalent technology in rural areas. During the twelve-month period to mid-2016, rural VDSL coverage increased 7.8 percentage points, passing 36.3% of rural homes. The reach of other NGA technologies was far lower, however, as both DOCSIS 3.0 and FTTP increased by less than a percentage point to cover 14.9% and 1.7% of rural households, respectively.

Germany: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Germany	87.6%	36.3%	1.7%	13.7%	15.2%	14.9%	61.6%	87.8%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[39] http://www.broadbandtvnews.com/2017/03/20/liberty-global-starts-docsis-3-1-rollout-in-germany/

[40] http://www.vodafone.com/content/dam/vodafone/investors/financial_results_feeds/tradingupdate_31december2016/170102_AI_Conference_Call_Transcript_FINAL.pdf

[41] http://www.lightreading.com/gigabit/dsl-vectoring-gfast/dt-expands-its-vectoring-commitments/a/d-id/713968

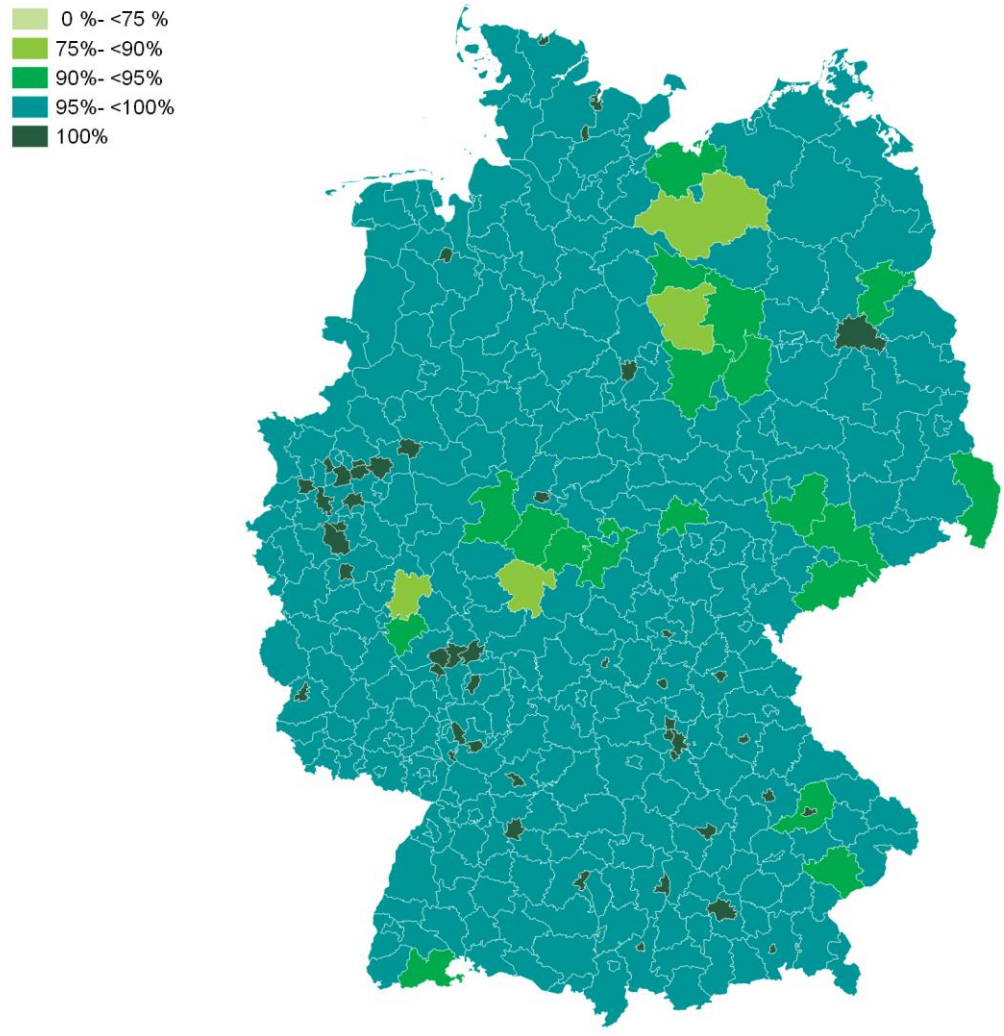
[42] https://www.telegeography.com/products/commsupdate/articles/2014/08/05/vodafone-launches-vdsl-vectoring-offer/

By mid-2016, LTE networks were available to 87.8% of rural households, an increase of 5.3 percentage points on the previous year. As rural LTE coverage increases, Deutsche Telekom is using its mobile network to complement its fixed broadband services, offering hybrid LTE-DSL access connections aimed at rural households.[43] Meanwhile, Vodafone launched "LTE Zuhause" in 2015, which aims to provide broadband access in rural areas without DSL and cable infrastructure.[44] Meanwhile, Germany's HSPA networks were available to only 61.6% of rural homes in mid-2016. This is the lowest out of all of the study countries and reflects the focus of German mobile operators' on deploying LTE networks in previously underserved rural areas, rather than rolling out HSPA networks in these areas.

5.11.2 Regional coverage by broadband technology

Examining regional patterns in fixed broadband coverage, some significant differences could be observed, with fixed broadband coverage ranging from just over 88% in Vogelsbergkreis to 100% in most metropolitan areas. In total, four regions (Vogelsbergkreis, Altmarkkreis Salzwedel, Ludwigslust-Parchim, and Westerwaldkreis) recorded fixed coverage levels lower than 90%.

Germany: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

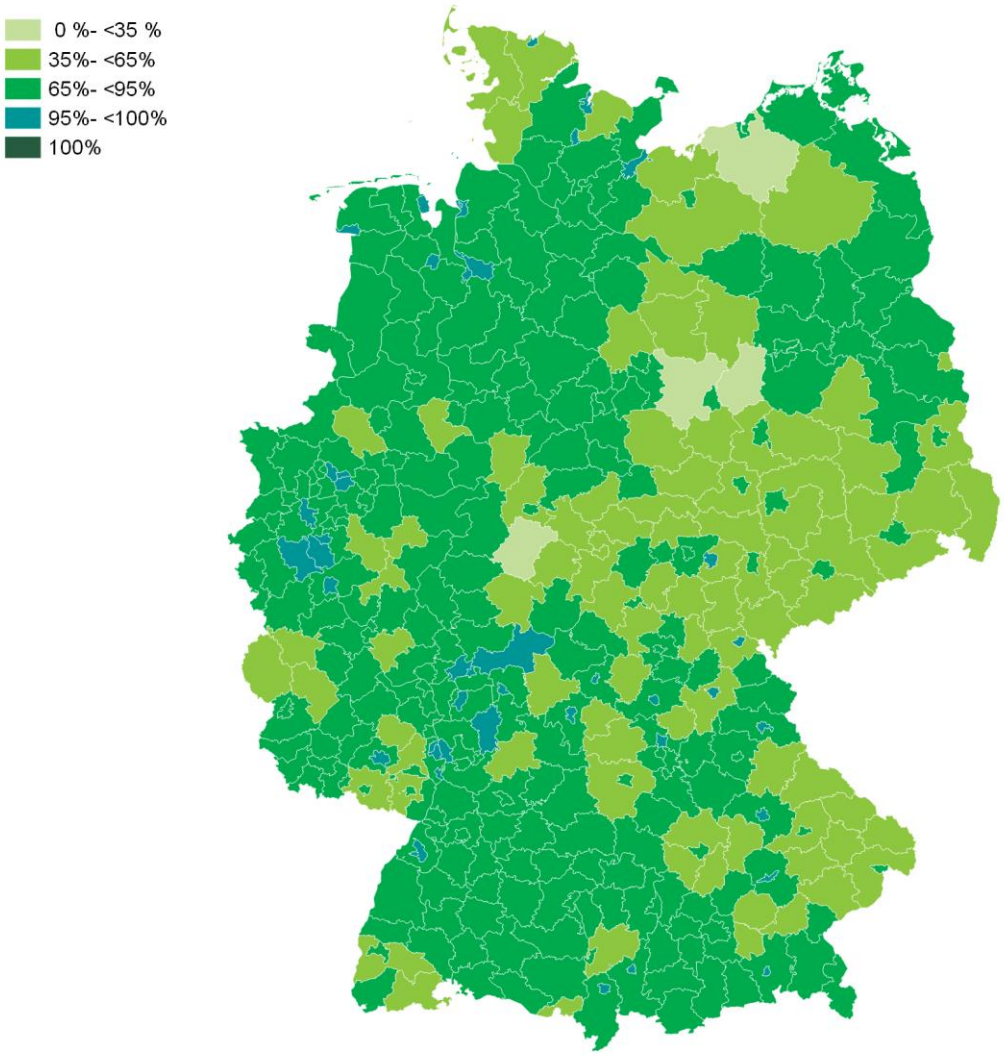
[43] http://www.telecompaper.com/news/deutsche-telekom-unveils-hybrid-dsl-lte-home-router--1035238

[44] https://www.vodafone.de/unternehmen/presse/pressearchiv2015-302422.html

In the twelve months to the end of June 2016, many regions across Germany witnessed significant improvements in terms of NGA coverage. For instance, the Elbe-Elster and Prignitz regions registered coverage increases of more than 35 percentage points each, and in Weimarer Land, Neumarkt i.d. OPf., and Limburg-Weilburg, NGA coverage grew by approx. 30 percentage points. Notably, the Elbe-Elster region recorded the lowest coverage in mid-2013 when only 13.6% of local households had access to NGA service, yet by mid-2015 over a half of homes in the region were passed by NGA networks.

At the end of June 2016, the lowest reported NGA coverage was 28.6% in the Jerichower Land region. By comparison, most urban areas recorded NGA coverage levels exceeding 90%. The city of Rosenheim was closest to reaching universal NGA coverage with 99.3% homes passed by NGA networks.

Germany: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.11.3 Data tables for Germany

Statistic	National
Population	81,196,195
Persons per household	2.0
Rural proportion	8.6%

	Germany 2016		Germany 2015		Germany 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	97.1%	87.6%	96.6%	86.0%	95.8%	84.7%	94.3%	86.0%
VDSL	58.8%	36.3%	48.5%	28.5%	43.0%	26.0%	48.2%	26.6%
FTTP	7.1%	1.7%	6.6%	1.4%	4.4%	0.8%	23.7%	8.8%
WiMAX	10.0%	13.7%	10.4%	14.2%	10.1%	13.3%	17.8%	18.0%
Cable	63.7%	15.2%	63.2%	14.8%	62.4%	14.0%	44.4%	10.7%
DOCSIS 3.0	63.5%	14.9%	62.7%	14.4%	61.6%	13.4%	43.9%	10.1%
HSPA	92.1%	61.6%	91.5%	59.6%	92.5%	62.5%	98.0%	92.2%
LTE	96.6%	87.8%	94.0%	82.5%	92.1%	78.8%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	86.0%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.9%	98.8%	99.9%	*98.8%*	99.8%	*97.7%*	99.9%	99.2%
Overall fixed broadband	98.6%	93.8%	98.3%	93.0%	97.9%	92.4%	97.5%	92.6%
NGA broadband	81.8%	48.9%	81.4%	36.4%	80.8%	33.1%	75.9%	39.2%
At least 2 Mbps	99.9%	-	99.9%	-	99.8%	-	96.7%	-
At least 30 Mbps	80.7%	-	76.7%	-	74.6%	-	75.1%	-
At least 100 Mbps	64.9%	-	63.5%	-	62.1%	-	50.8%	-

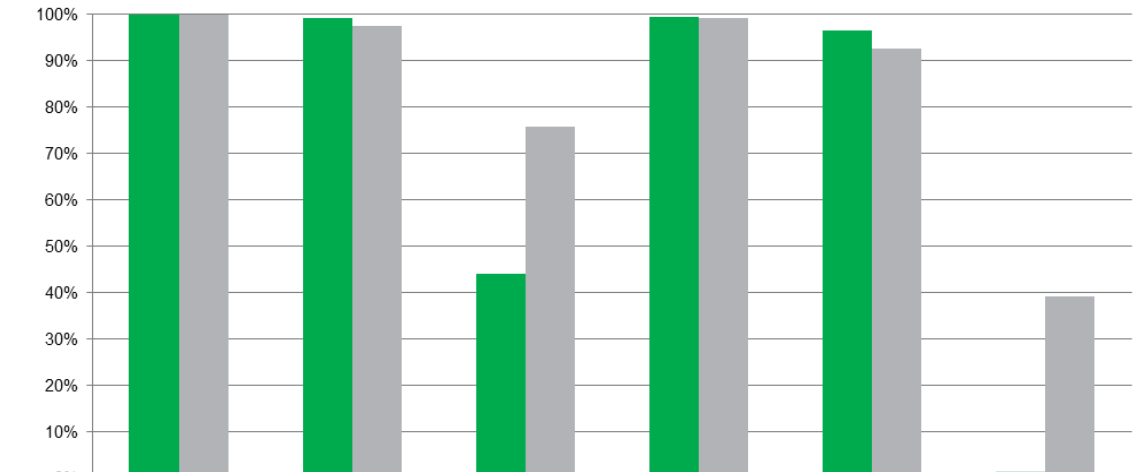
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.12 Greece

5.12.1 National coverage by broadband technology

In mid-2016, Greece maintained stable overall and fixed broadband coverage levels that exceeded the EU average. However, despite a 7.9 percentage point increase in NGA coverage, high-speed broadband services were available to only 44.2% of Greek households compared to the EU average of 75.9%. Only a marginal progress was recorded in rural NGA coverage, and with just 1.3% of rural homes passed by NGA networks at the end of June 2016, the lowest level among all study countries.

Greece: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Greece	99.9%	99.3%	44.2%	99.4%	96.5%	1.3%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

At the end of June 2016, Greece remained as one of the three study countries (along with Iceland and Italy) with no cable networks presence. Coupled with very low FTTP and WiMAX coverage (0.4% and 0.2% respectively), the entire fixed broadband coverage still relies on a single technology, namely DSL, with VDSL serving as the only source of high-speed NGA access.

Coverage of DSL networks remained at a near-universal level (99.3%), unchanged from previous years. The incumbent, OTE, as well as the other alterative broadband operators have been heavily investing in upgrading its DSL network, contributing to a 7.9 percentage point year-on-year growth in VDSL coverage, with VDSL services being available to 44% of Greek households. Yet, despite these efforts, VDSL coverage remained below the EU average of 48%.

Nevertheless, all of Greece's main broadband providers OTE, Vodafone Greece and Wind have begun to take steps to boost both VDSL upgrades as well as substantial FTTP deployments over the next couple of years.[45] Additionally, in July 2016 Vodafone Greece and Wind entered into an agreement to cooperate on investments for the deployment of fibre-optic networks (similar to Vodafone's agreements with other operators in Spain, Portugal, Ireland and Italy).[46] By sharing the cost of network deployment, the operators hope to increase FTTP and overall NGA coverage in Greece to the EU levels in the near future.

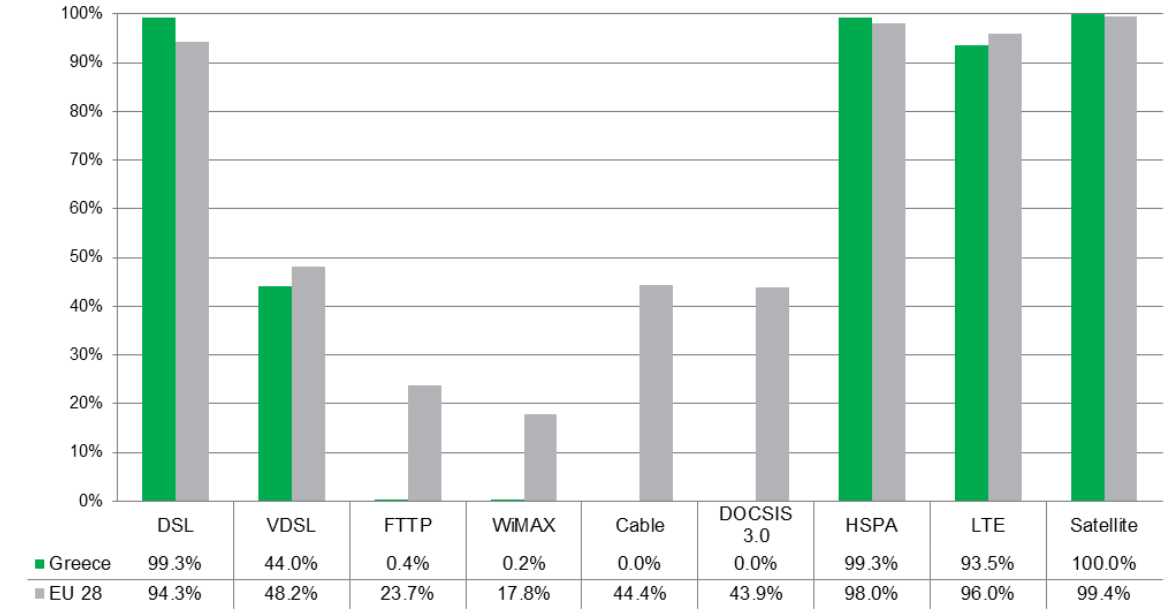
Examining mobile networks coverage, HSPA networks maintained a near universal coverage level of 99.3%, a level reached already in 2013. On the other hand, LTE recorded significant coverage growth

[45] https://www.telegeography.com/products/commsupdate/articles/2017/02/17/greek-operators-to-spend-on-fibre-and-supervectoring/

[46] http://www.vodafone.gr/portal/client/news/pressReleaseClient!pressReleaseDetails.action?pressReleaseId=40424&dateFrom=&dateUntil=

of 13.7 percentage points to 93.6% of homes passed in mid-2016. During the period of the study, Cosmote[47] (OTE's mobile branch), Vodafone Greece and Wind Hellas[48] continued their LTE network roll-outs as well as upgrades to LTE-Advanced which contributed to growth of LTE coverage. Yet, on average after taking into account coverage of all LTE operators, 79.8% of Greeks were able to use LTE services.

Greece: Coverage by technology, total, 2016

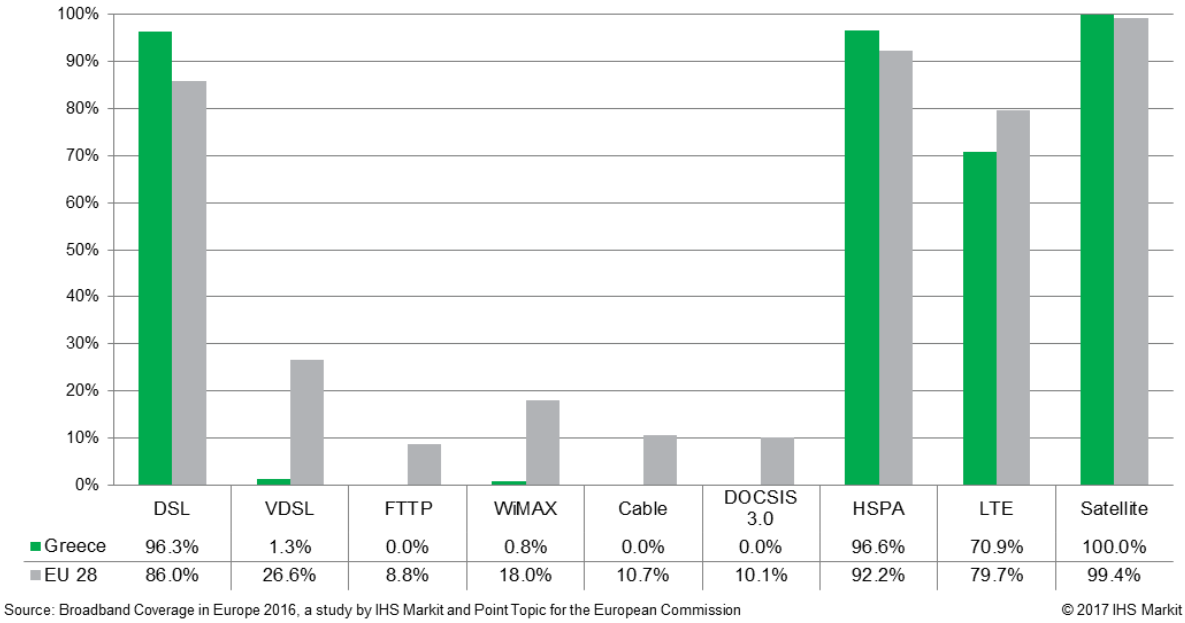


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Greece	99.3%	44.0%	0.4%	0.2%	0.0%	0.0%	99.3%	93.5%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL remained the sole fixed broadband access technology available to rural households across Greece, which provided broadband access to 99.3% of rural households at the end of June 2016. Despite high rural DSL coverage, VDSL upgrades in rural areas continued to be extremely limited achieving only 1.3% rural coverage. Thus, rural NGA availability remains very challenging in Greece.

Greece: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Greece	96.3%	1.3%	0.0%	0.8%	0.0%	0.0%	96.6%	70.9%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[47] https://www.telegeography.com/products/commsupdate/articles/2015/03/03/cosmote-greece-rolls-out-300mbps-lte-a-in-athens-and-thessaloniki/

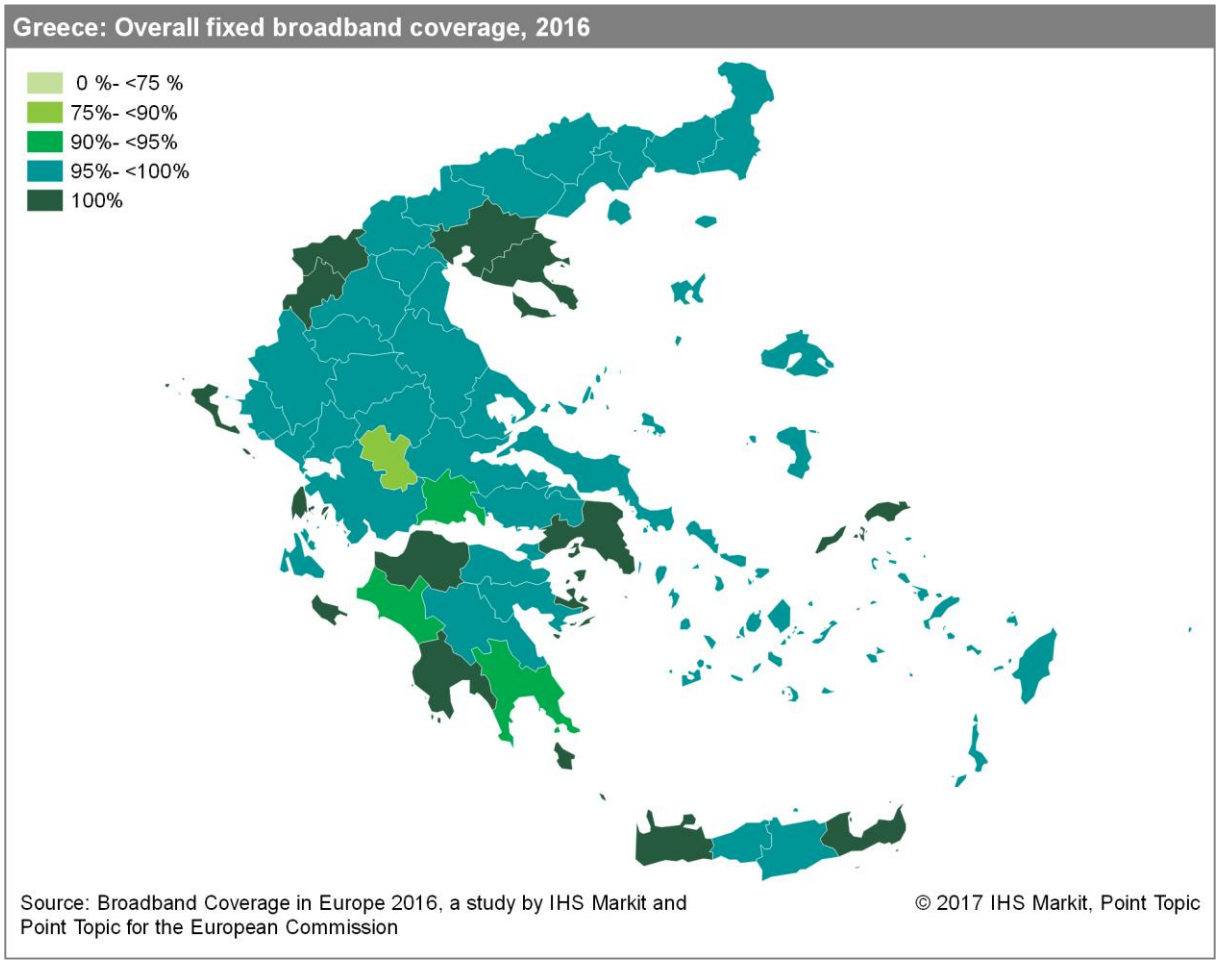
[48] https://www.wind.gr/en/wind/gia-tin-etaireia/newsroom/deltia-tupou/deltio-tupou/?prid=656

In terms of rural mobile technologies, HSPA coverage remained unchanged (99.3%) from mid-2015. On the other hand, LTE coverage increased by 34.8 percentage point increase compared to mid-2015, with 70.9% rural homes passed by LTE networks at the end of June 2016.

5.12.2 Regional coverage by broadband technology

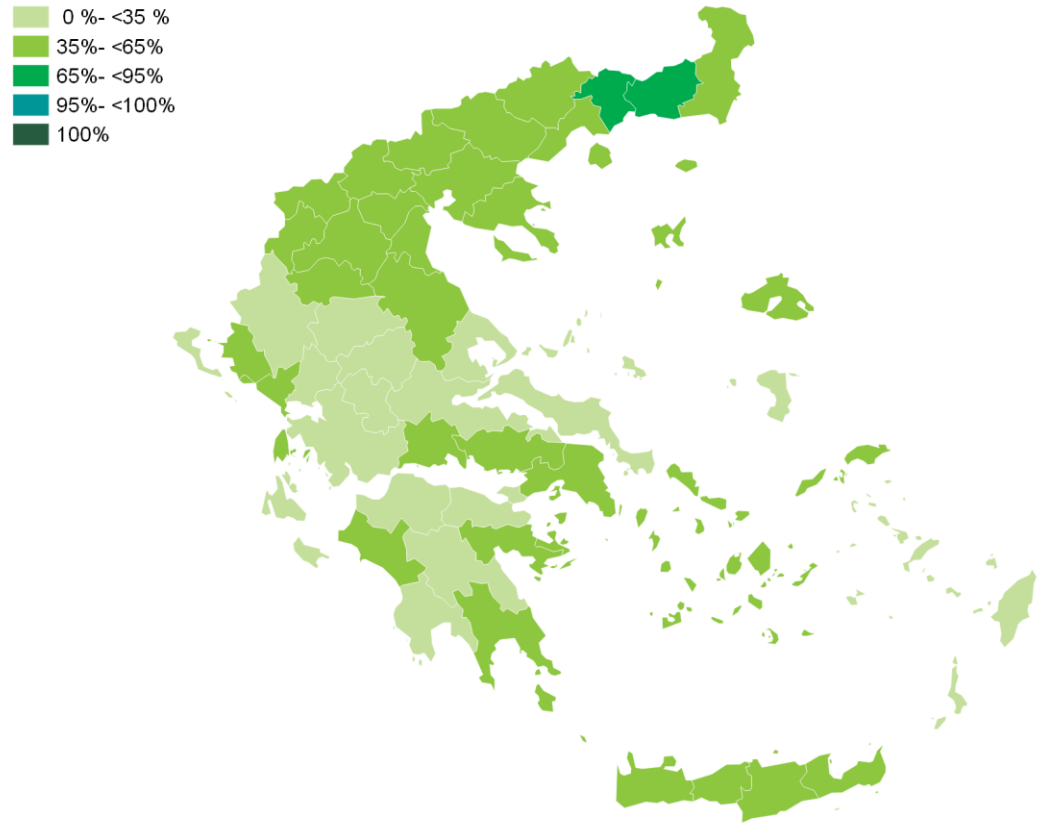
Most regions recorded fixed broadband coverage rates exceeding 98%. One exception was Evrytania, which was the only region with fixed coverage rate lower than 90%. Three other regions with coverage levels lower than 95% were Ileia, Fokida, and Lakonia.

It is also worth noting that the Greek island regions (such as Zakynthos, Lefkada, or Kerkyra) tended to report complete or almost complete fixed broadband coverage, while more variation was observed in mainland regions.



NGA coverage was more varied, with most regions recording coverage levels between 19% and 71%. At the end of June 2016, NGA coverage exceeded 50% in only six regions (Evros, Xanthi, Rodopi, Serres, Grevena, and Attiki). The highest NGA coverage continued to be reported in the north-east regions of Xanthi and Rodopi with the most substantial year-on-year increase in NGA broadband coverage (18 percentage points) registered in Kyklades and Rethymni.

Greece: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.12.3 Data tables for Greece

Statistic	National
Population	10,926,608
Persons per household	2.5
Rural proportion	20.2%

	Greece 2016		Greece 2015		Greece 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	99.3%	96.3%	99.3%	96.3%	99.3%	96.3%	94.3%	86.0%
VDSL	44.0%	1.3%	36.1%	0.5%	33.8%	0.5%	48.2%	26.6%
FTTP	0.4%	0.0%	0.4%	0.0%	0.4%	0.0%	23.7%	8.8%
WiMAX	0.2%	0.8%	0.1%	0.5%	0.1%	0.4%	17.8%	18.0%
Cable	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	44.4%	10.7%
DOCSIS 3.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	43.9%	10.1%
HSPA	99.3%	96.6%	99.3%	96.7%	99.3%	96.6%	98.0%	92.2%
LTE	93.5%	70.9%	*79.7%*	*36.1%*	70.2%	23.1%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	79.8%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.9%	99.4	99.9%	99.3%	99.9%	99.3%	99.9%	99.2%
Overall fixed broadband	99.3%	96.5%	99.3%	96.5%	99.3%	96.4%	97.5%	92.6%
NGA broadband	44.2%	1.3%	36.3%	0.5%	34.0%	0.5%	75.9%	39.2%
At least 2 Mbps	99.9%	-	99.9%	-	99.8%	-	96.7%	-
At least 30 Mbps	80.7%	-	76.7%	-	74.6%	-	75.1%	-
At least 100 Mbps	64.9%	-	63.5%	-	62.1%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

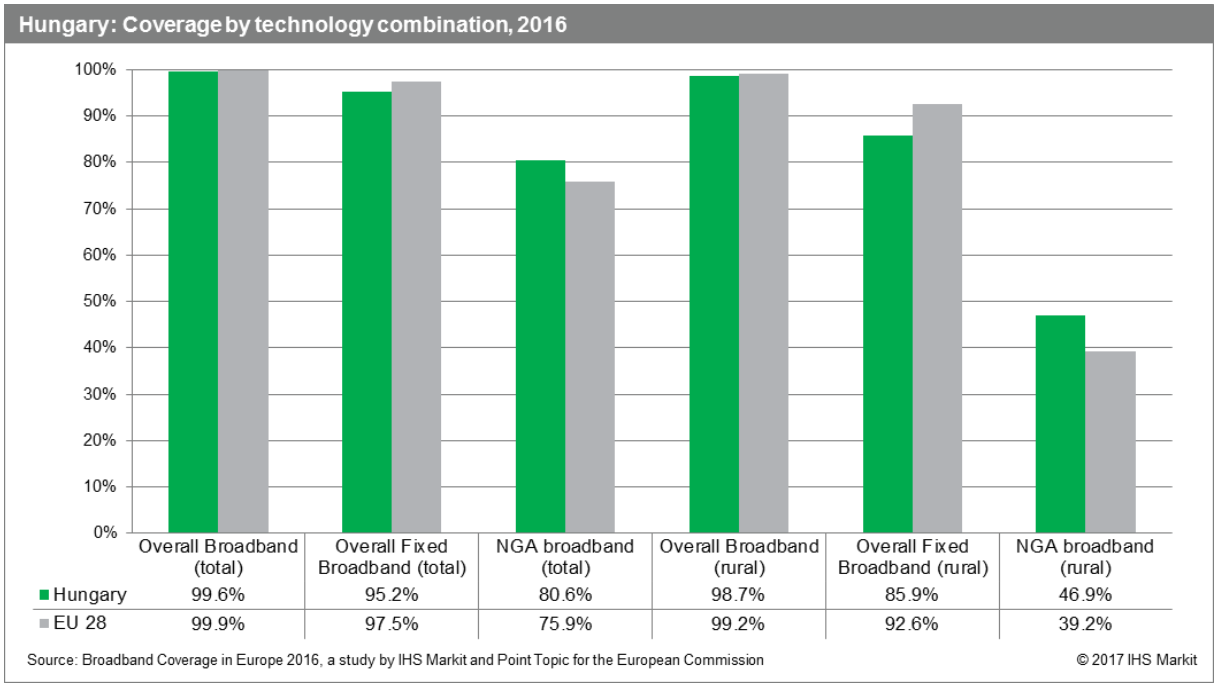
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural LTE coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.13 Hungary

5.13.1 National coverage by broadband technology

During the twelve months to mid-2016, overall broadband availability in Hungary increased by 0.5 percentage points, reaching 99.6% of homes, while fixed broadband availability remained stable at 95.2%. Examining rural broadband coverage, 98.7% of rural Hungarian households had access to broadband, an increase of 1.4 percentage points. There was also a minimal 0.4 percentage point increase in rural fixed broadband coverage, passing 85.9% of rural homes. As a consequence, at the end of June 2016, Hungary was below the EU average for overall broadband coverage and fixed coverage, both nationally and in rural areas.

By mid-2016, 80.6% of Hungarian households had access to high-speed NGA broadband, following a 2.4 percentage point growth. A considerably higher increase in coverage was observed for rural NGA coverage, which grew by 9.8 percentage points, reaching 46.9% of rural homes. Consequently, Hungary was above the EU average for NGA coverage, both nationally and in rural areas.



Looking at the individual technologies, DSL continued to be the most widespread fixed broadband technology, available to 90.5% of households. As of mid-2016, Hungarian DSL coverage was below the EU average of 94.3%. Meanwhile, cable networks passed 68.0% of homes at the end of June 2016, which was considerably above the EU average.

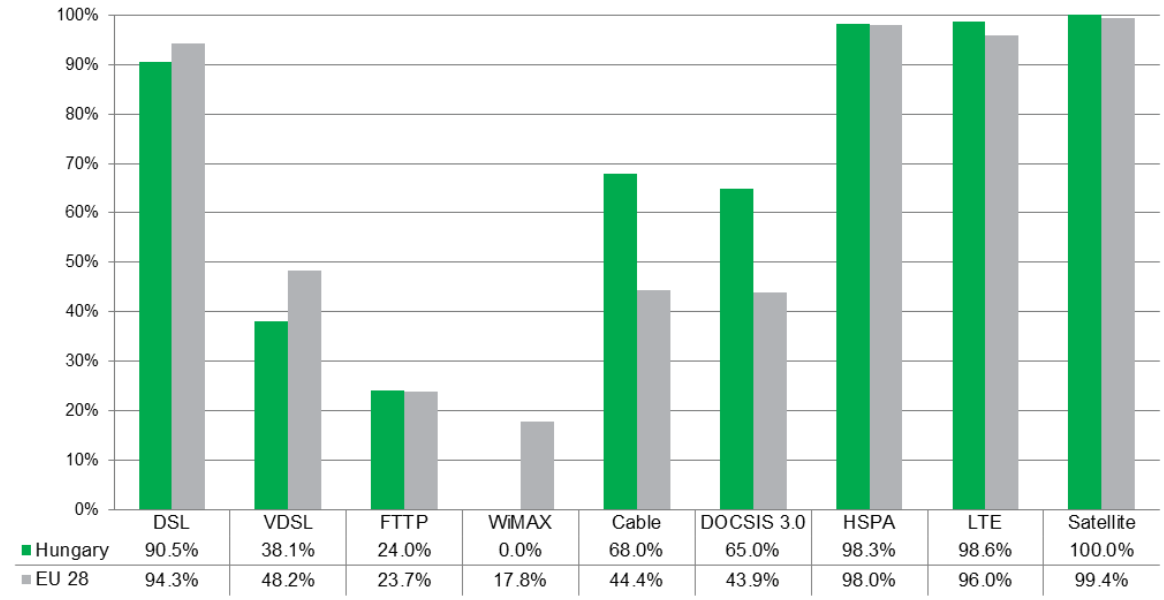
With regards to NGA technologies, VDSL networks witnessed the biggest increase in coverage during the period, increasing by 10.1 percentage points during the year. It has been the incumbent telecoms provider, Magyar Telekom's focus to expand its VDSL networks with an aim of its broadband services being available to all households by 2018.[49] However, given there was only a 2.4 percentage point increase in total NGA coverage in Hungary, it appears that VDSL services were deployed in areas that already had a DOCSIS 3.0 or FTTP presence. Therefore, DOCSIS 3.0 remained the main driver of NGA availability in Hungary, reaching 65.0% of households, while FTTP networks increased by 2.5 percentage points to pass 24.0% of homes at the end of June 2016.

Evaluating mobile broadband coverage, LTE coverage increased by 3.6 percentage points during the twelve months to mid-2016. At 98.6%, LTE coverage in Hungary remained slightly above the EU average (96.0%). Similarly, Hungarian HSPA coverage, which remained stable at 98.3% during the

[49] http://www.telekom.hu/about_us/press_room/press_releases/2014/february_21

period, was also slightly higher than the EU average (98.0%). With near-universal HSPA and LTE coverage, the leading mobile network operators have begun to focus on LTE-Advanced networks deployment in selected areas of Hungary.[50] Moreover, when average coverage of all LTE networks operators is considered, on average 92.4% of Hungarians had access to LTE services at the end of June 2016.

Hungary: Coverage by technology, total, 2016

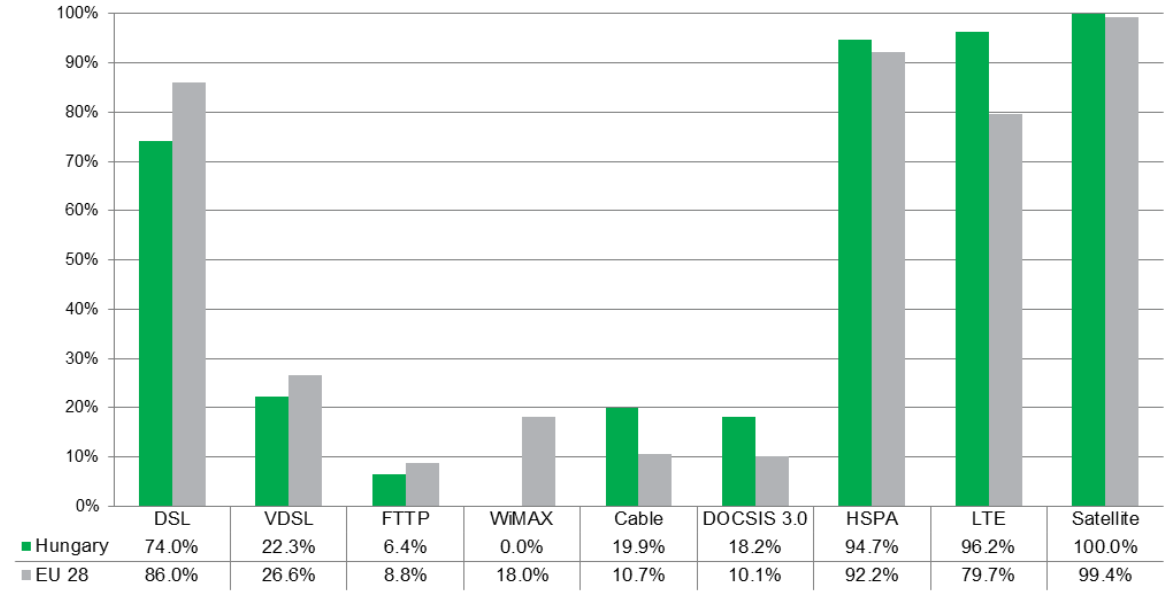


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Hungary	90.5%	38.1%	24.0%	0.0%	68.0%	65.0%	98.3%	98.6%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In rural areas, DSL remained the most widespread fixed broadband technology due to the limited deployment of cable networks in these areas.

Hungary: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Hungary	74.0%	22.3%	6.4%	0.0%	19.9%	18.2%	94.7%	96.2%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

VDSL services increased 7.6 percentage points in the twelve months to the end of June 2016, covering 22.3% of rural households. In addition to the incumbent's investments, DSL and cable

[50] https://www.telegeography.com/products/commsupdate/articles/2017/02/06/vodafone-hungary-switches-on-lte-a-in-budapest-environs/

provider Invitel is also investing in network deployments across Hungary, with the aim of increasing coverage to 500 thousand households in 98 cities[51], supported by EU funding.[52]

Examining other broadband technologies, the growth of FTTP technologies in rural areas was limited, increasing by 2.2 percentage points during the period, while rural DOCSIS 3.0 coverage remained stable at 18.2% of rural homes. Meanwhile, mobile operators continued to expand their LTE networks across Hungary. At 96.2%, rural LTE services increased by 12.1 percentage points during the twelve-month period, overtaking HSPA networks in terms of rural coverage. Moreover, given the limited availability of NGA technologies in rural Hungary, mobile network operator, such as Telenor Hungary, continued to deploy LTE solutions as an alternative to fixed broadband technologies in rural areas.[53]

[51] http://www.telecompaper.com/news/invitel-starts-eur-30-mln-network-development-programme--1081287

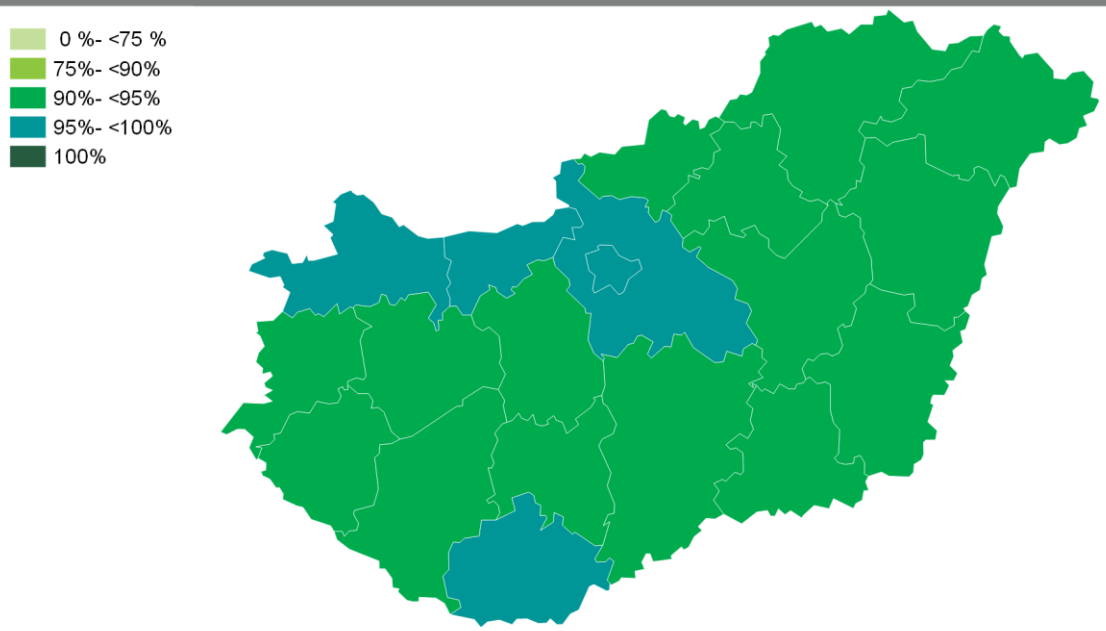
[52] http://www.broadbandtvnews.com/2016/09/28/invitel-secures-european-funding/

[53] https://www.telegeography.com/products/commsupdate/articles/2017/02/20/telenor-hungary-expands-150mbps-lte-to-small-villages

5.13.2 Regional coverage by broadband technology

On a regional level, fixed broadband coverage was lowest in the Somogy region (92.5%) and highest in Budapest (nearly 99%). In addition, five regions out of twenty recorded fixed coverage rates higher than 95%, compared to only three at the end of 2014.

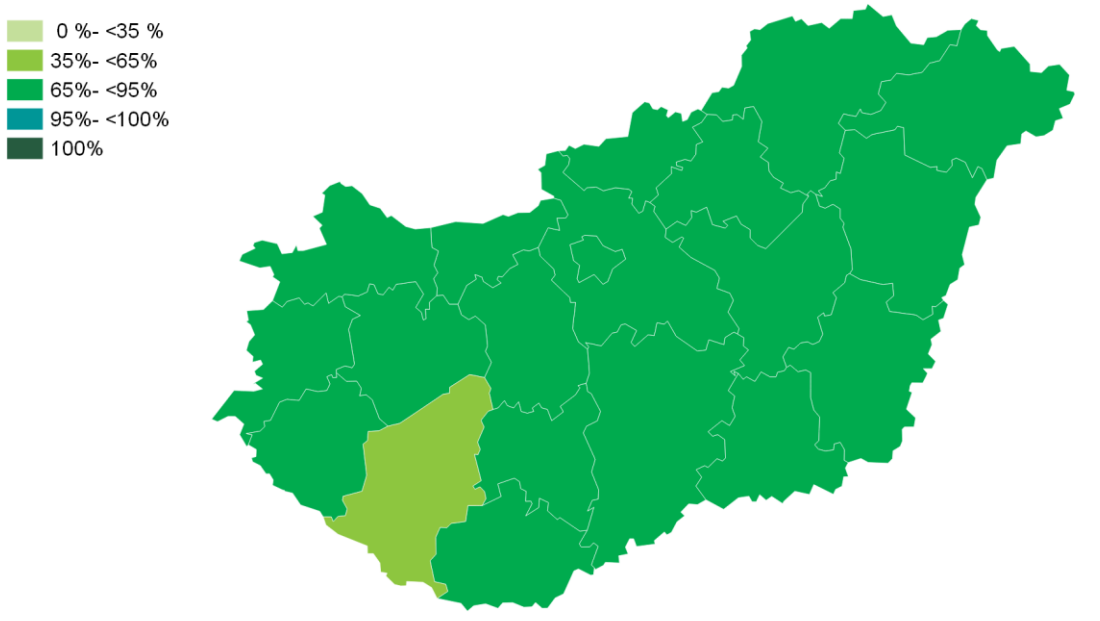
Hungary: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage continued to vary greatly in 2016 and ranged between nearly 63% in Somogy and close to 93% in Budapest.

Hungary: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.13.4 Data tables for Hungary

Statistic	National
Population	9,830,485
Persons per household	2.2
Rural proportion	31.8%

	Hungary 2016		Hungary 2015		Hungary 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	90.5%	74.0%	90.5%	*73.8%*	88.7%	*71.9%*	94.3%	86.0%
VDSL	38.1%	22.3%	28.0%	*14.7%*	26.1%	*9.4%*	48.2%	26.6%
FTTP	24.0%	6.4%	21.5%	4.2%	20.8%	4.0%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	68.0%	19.9%	66.1%	19.8%	64.3%	19.2%	44.4%	10.7%
DOCSIS 3.0	65.0%	18.2%	63.2%	18.2%	60.4%	17.4%	43.9%	10.1%
HSPA	98.3%	94.7%	98.3%	94.6%	98.2%	94.2%	98.0%	92.2%
LTE	98.6%	96.2%	95.0%	84.1%	73.0%	14.9%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	92.4%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.6%	98.7%	99.1%	97.3%	99.1%	97.1%	99.9%	99.2%
Overall fixed broadband	95.2%	85.9%	95.2%	*85.5%*	94.4%	*83.3%*	97.5%	92.6%
NGA broadband	80.6%	46.9%	78.2%	*37.1%*	*75.6%*	*30.8%*	75.9%	39.2%
At least 2 Mbps	94.8%	-	94.8%	-	93.9%	-	96.7%	-
At least 30 Mbps	78.2%	-	76.9%	-	74.8%	-	75.1%	-
At least 100 Mbps	68.4%	-	67.7%	-	65.4%	-	50.8%	-

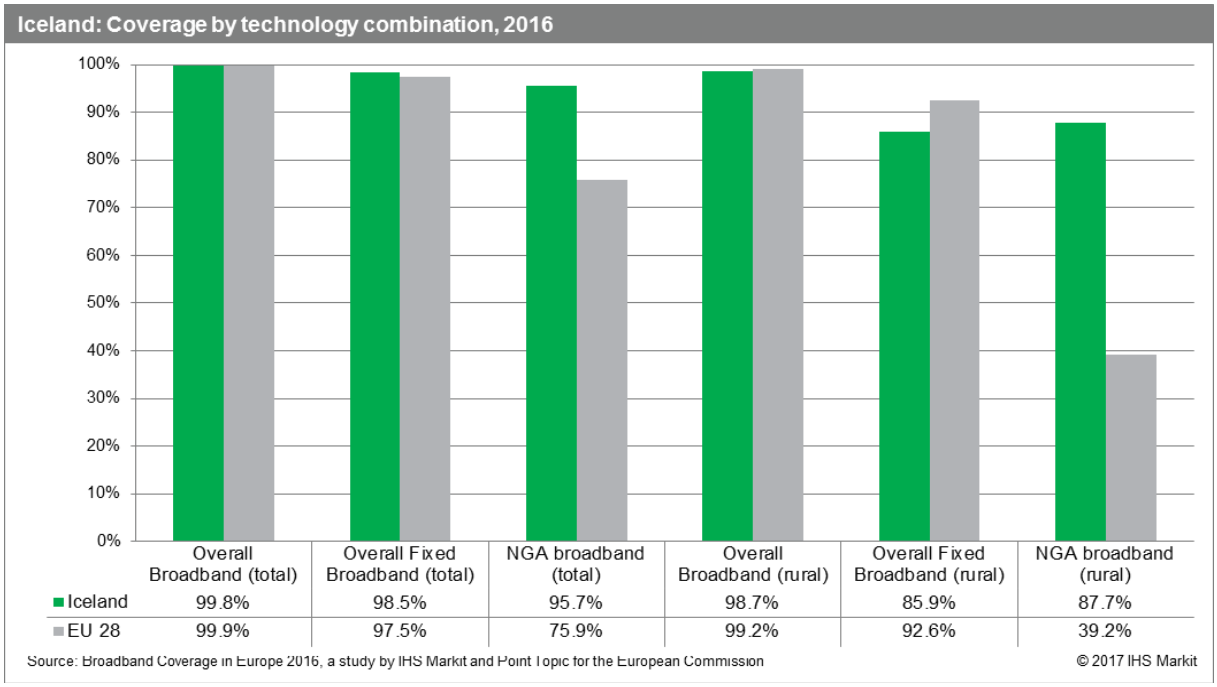
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural VDSL coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

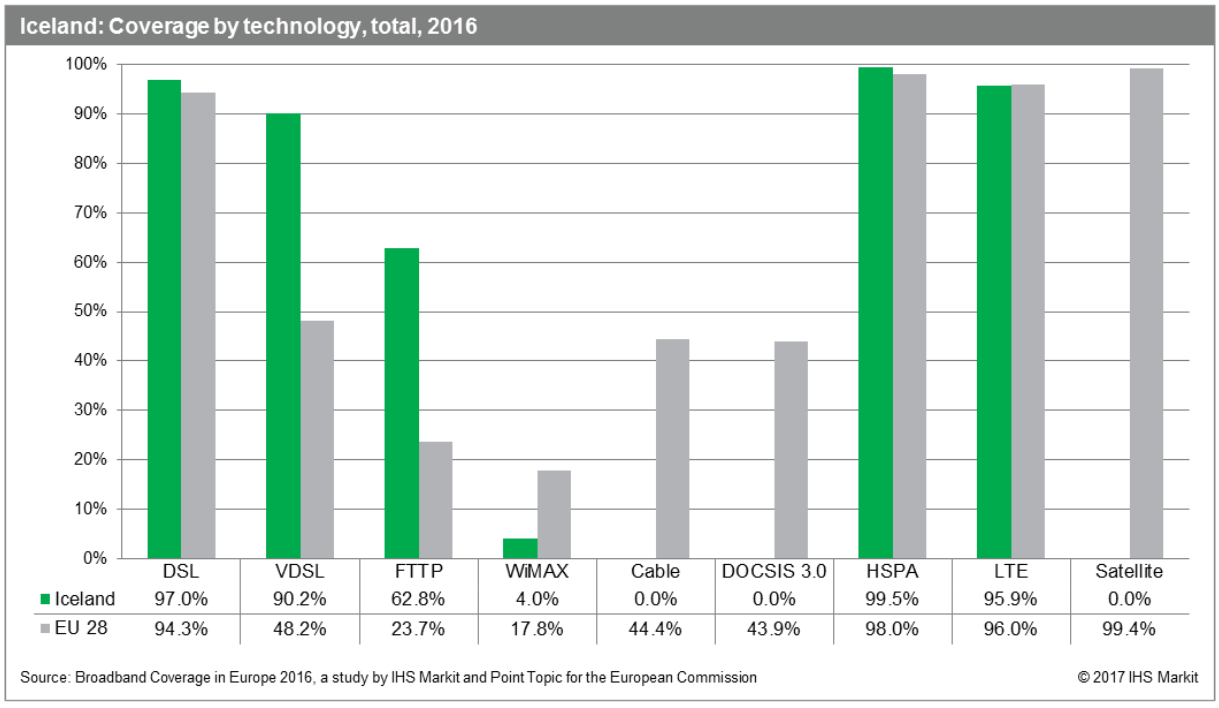
5.14 Iceland

5.14.1 National coverage by broadband technology

Iceland continued on its path towards universal overall and fixed broadband coverage in 2016, overall and fixed broadband both increased by 0.4 percentage points, with 99.8% homes being passed by at least one fixed or mobile network and 98.5% households having access to fixed broadband services. NGA coverage experienced a 4.9 percentage point increase by mid-2016 with NGA broadband being available to 95.7% of Icelandic homes, a coverage level significantly above the EU average of 75.9%. In rural areas, following a 13.4 percentage point increase, NGA coverage reached 87.7% of rural households, more than twice the EU average (39.2%).



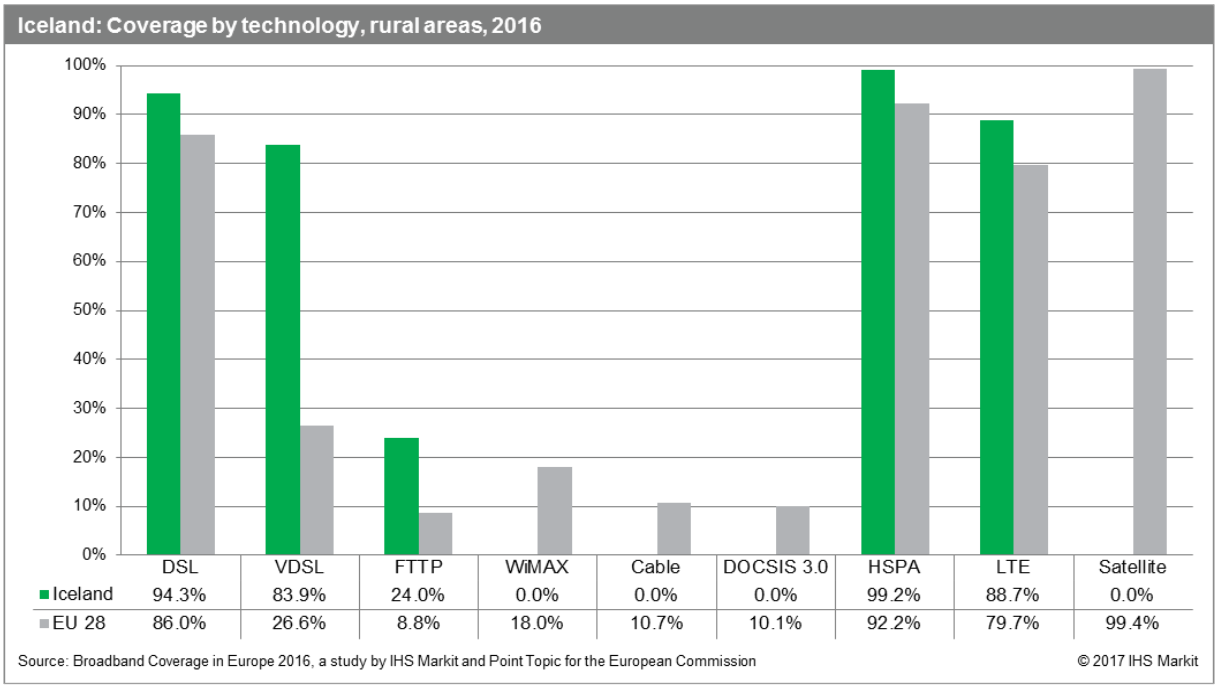
With cable connections absent in Iceland and WiMAX coverage limited, at just 4%, DSL and FTTP are the two technologies driving fixed broadband coverage in the country.



In the twelve month period to the end of June 2016, VDSL and FTTP coverage experienced growth, which contributed to the substantial increases in NGA coverage. VDSL registered a 6.3 percentage point increase to 90.2% whilst, FTTP increased by 9.4 percentage points to reach 62.8% of Icelandic households. This growth can be largely attributed to the continued investment of the incumbent operator, Siminn, as well as Reykjavik Energy's subsidiary GR (Gagnaveita Reykjavikur) in the expansion of their fibre optic networks. [54][55]

In terms of availability of mobile broadband technologies, nearly all Icelandic households (98.6%) had access to at least one HSPA network. Availability of LTE grew substantially during the first half of 2016, recording an 11.0 percentage point increase with LTE networks passing 95.9% of homes. In terms of the average LTE operator coverage, LTE services were available on average to 93.2% of Icelanders.

In terms of rural technologies, VDSL coverage increased by 10.7 percentage points to 83.9%, over three times the EU average (26.6%). As a result, Iceland ranked as the second-highest country in terms of rural VDSL coverage behind Luxembourg. The pace of rural FTTP deployment also picked up by mid-216 as coverage experienced a substantial increase of 21.7 percentage points to 24%, whilst provision of rural WiMAX services ceased during the same period.



Rural HSPA coverage increased by 3.1 percentage points, with HSPA networks providing near universal coverage to 99.2% of rural households at the end of 2016. In addition, rural LTE coverage recorded a substantial growth of 31.1 percentage points with nearly 9 in 10 (88.7%) of rural homes across Iceland being passed by at least one LTE network by mid-2916.

[54] https://www.siminn.is/servlet/file/Siminnkynning2016.pdf?ITEM_ENT_ID=17743&COLLSPEC_ENT_ID=3 (Siminn 2016 Investor Presentation)
[55] http://www.visir.is/g/2016161009436/tuttugufalt-hradari-tengingar-fra-2007

5.14.2 Regional coverage by broadband technology

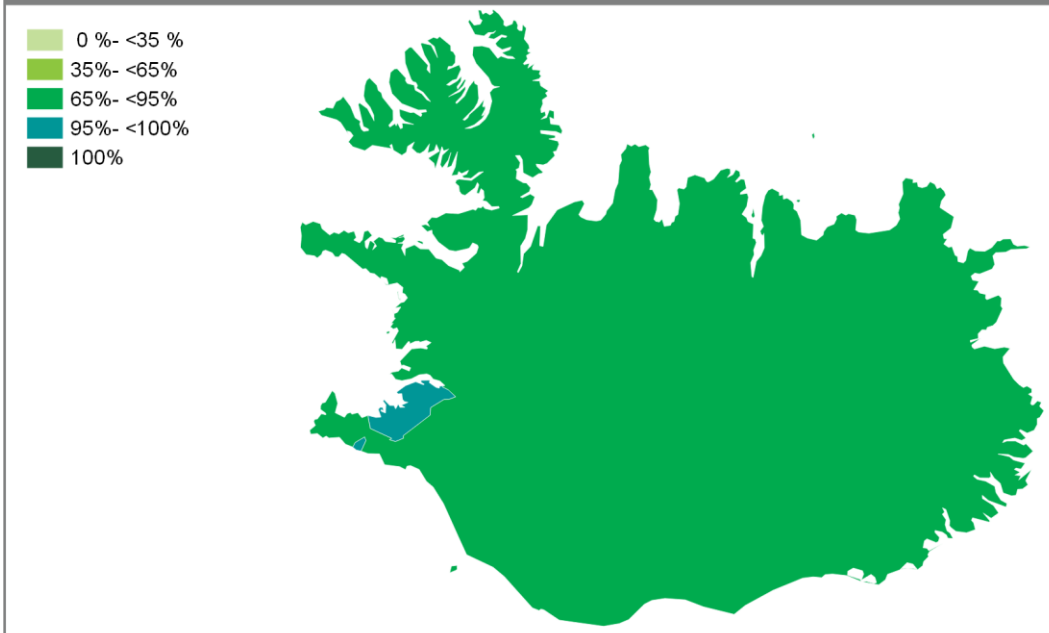
Overall fixed broadband coverage differed by nearly 4 percentage points between the two Icelandic regions, with near-complete coverage recorded in the more densely populated Höfudborgarsvædi region surrounding the capital Reykjavik.

Iceland: Overall fixed broadband coverage, 2016

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

There was quite a large gap in NGA coverage between the two regions as the Höfudborgarsvædi region (i.e. the area around Reykjavik) recorded an NGA coverage level of more than 98%, while in the Landsbyggd region NGA services were available to 90.5% of households.

Iceland: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.14.3 Data tables for Iceland

Statistic	National
Population	329,100
Persons per household	2.5
Rural proportion	35.3%

	Iceland 2016		Iceland 2015		Iceland 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	97.0%	94.3%	96.2%	*90.2%*	96.1%	89.0%	94.3%	86.0%
VDSL	90.2%	83.9%	85.8%	73.2%	84.3%	69.1%	48.2%	26.6%
FTTP	62.8%	24.0%	53.4%	2.3%	52.9%	2.3%	23.7%	8.8%
WiMAX	4.0%	0.0%	4.0%	7.0%	4.0%	7.0%	17.8%	18.0%
Cable	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	44.4%	10.7%
DOCSIS 3.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	43.9%	10.1%
HSPA	99.5%	99.2%	98.6%	96.1%	97.5%	93.2%	98.0%	92.2%
LTE	95.9%	88.7%	85.0%	57.5%	72.3%	46.9%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	93.2%	-	-	-	-	-	84.4%	-
Satellite	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	99.4%	99.4%
Overall broadband	99.8%	99.6%	99.3%	98.0%	98.7%	97.6%	99.9%	99.2%
Overall fixed broadband	98.5%	95.8%	98.1%	93.5%	98.0%	93.5%	97.5%	92.6%
NGA broadband	95.7%	87.7%	90.8%	71.3%	89.6%	70.2%	75.9%	39.2%
At least 2 Mbps	99.28%	-	98.0%	-	98.0%	-	96.7%	-
At least 30 Mbps	91.68%	-	89.9%	-	89.6%	-	75.1%	-
At least 100 Mbps	75.17%	-	53.4%	-	52.9%	-	50.8%	-

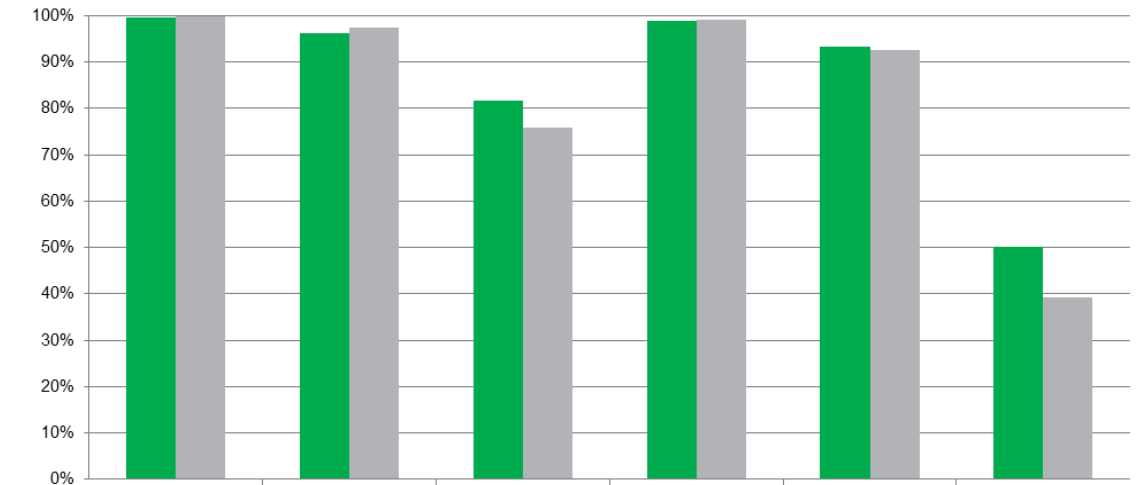
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural VDSL coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.15 Ireland

5.15.1 National coverage by broadband technology

Overall broadband coverage in Ireland improved during the twelve-month period to mid-2016, but remained slightly below the EU average on both national and rural level. Fixed broadband coverage in Ireland was stable throughout the period, both nationally and in rural areas, and continued to be lower than the EU average. On the other hand, Ireland was above the EU average for NGA broadband availability on both at a national and rural level. By mid-2016, NGA coverage increased by 1.9 percentage points, with 81.6% of Irish households having access to NGA services. Meanwhile, rural NGA coverage reached 50.3% of rural homes following a 5.4 percentage increase in the twelve months to the end of June 2016.

Ireland: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Ireland	99.6%	96.3%	81.6%	99.0%	93.3%	50.3%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As in the previous edition of the study, DSL coverage reached 92.5% of households. The incumbent, Eircom, continued to upgrade its DSL networks to VDSL technology throughout the year. As a result, at the end of June 2016, VDSL networks covered 80.6% of households, an increase of 10.0 percentage points. VDSL remained the key NGA technology in Ireland, with limited improvements in FTTP and DOCSIS 3.0 coverage.

FTTP networks increased by a percentage point during the period, passing 5.5% of homes at the end of June 2016. FTTP coverage can be expected to increase in the next couple of years as Vodafone (in partnership with the Electricity Supply Board) and Eircom continue to deploy FTTP networks.[56] Meanwhile, cable and DOCSIS 3.0 coverage witnessed modest improvements in coverage, both reaching 43% of households, as Ireland remained slightly below the EU average for both technologies.

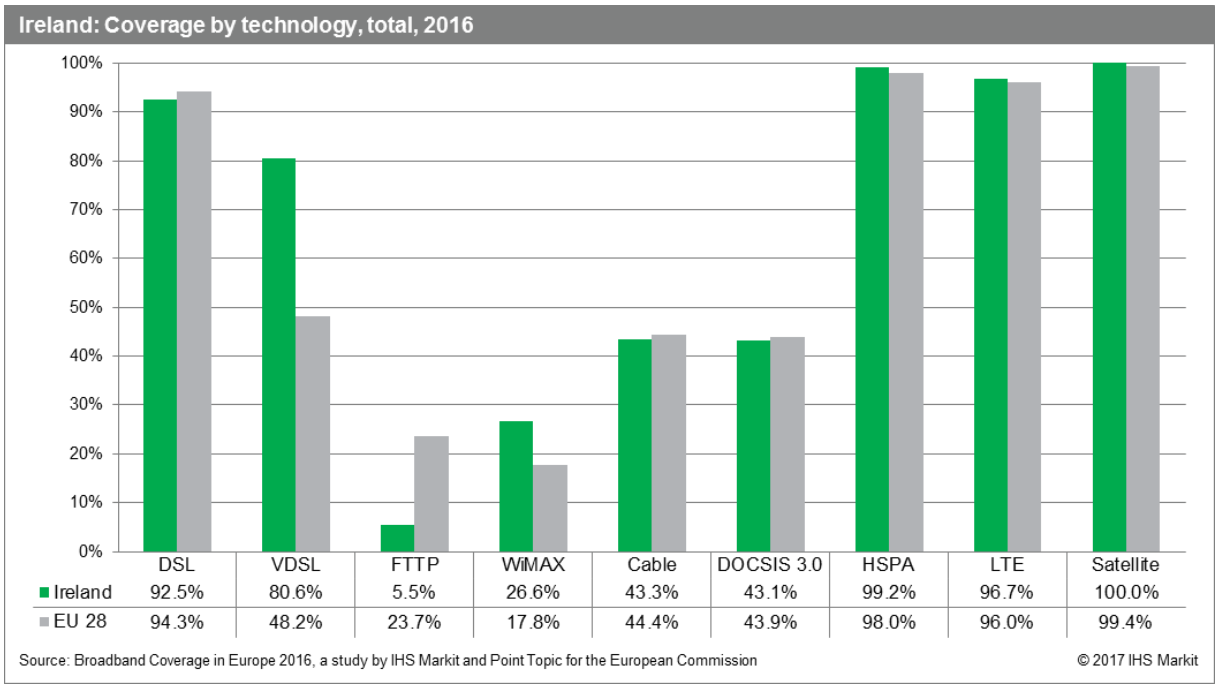
Examining mobile broadband technologies, LTE networks continued to be deployed with LTE coverage increasing by 6.6 percentage points during the period and covering 96.7% of homes as of mid-2016. The average LTE operator coverage reached 93.7% in the same period.

In addition, over the last year, mobile operators, Vodafone and Hutchinson Three, have launched LTE-Advanced services in parts of Ireland to provide network differentiation.[57][58]

[56] https://www.eir.ie/opencms/export/sites/default/.content/pdf/IR/presentations/2016_2017/quarter1/eir_1st_quarter_results_presentation_FY1617_1.pdf

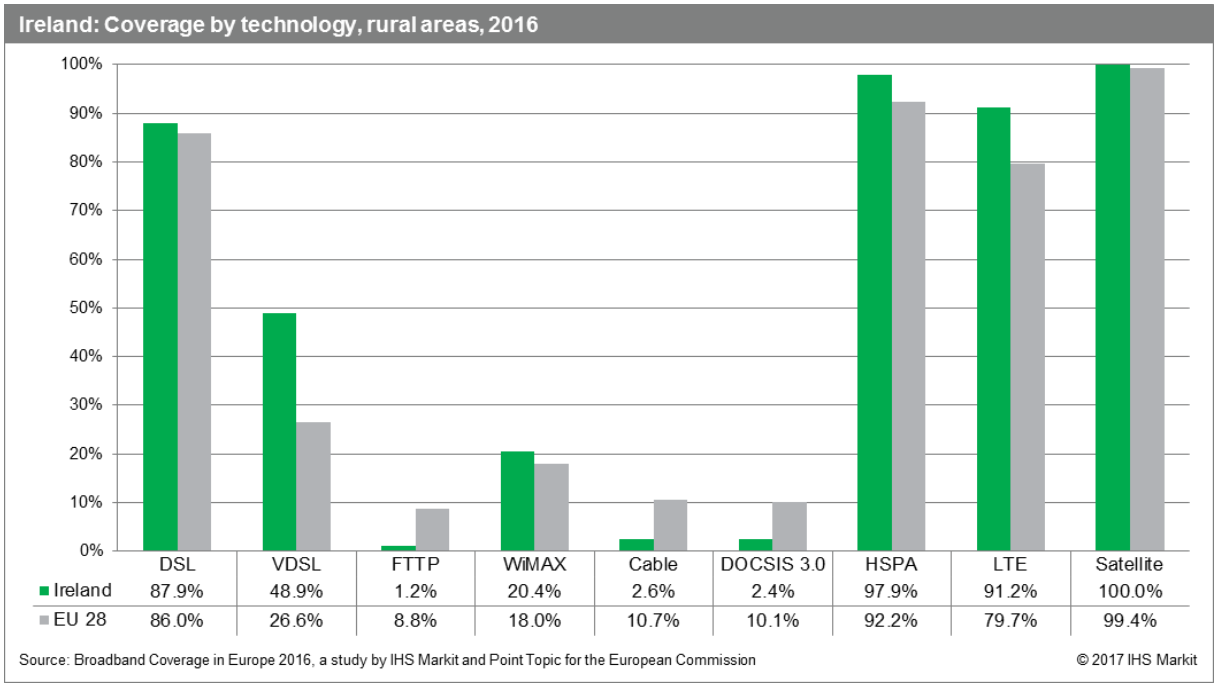
[57] http://www.independent.ie/business/vodafone-ireland-announces-1000mbs-phone-speeds-in-45g-dublin-network-trials-35500174.html

[58] http://press.three.ie/press_releases/three-irelands-leading-mobile-data-network-introduces-free-4g-for-life/



As of mid-2016, DSL continued to be the most widespread fixed broadband technology in rural areas, while VDSL remained the most prominent NGA technology. Availability of rural VDSL services increased by 4.7 percentage points during the period and reached nearly a half (48.9%) of rural households across Ireland. This improvement is an indication of Eircom's pledge to support Ireland's digital agenda by providing high-speed internet access to 0.3m households in rural Ireland.[59] Examining other NGA technologies, FTTP networks were deployed in rural areas for the first time, as coverage reached 1.2% of rural households.

There was a considerable increase in the coverage of mobile broadband technologies during the year to the end of June 2016. LTE availability increased 18.2 percentage points, reaching 91.2% of rural households, while HSPA networks grew by 12.5 percentage points to reach 98.0% of rural homes. Consequently, coverage in Ireland was above the EU average for HSPA and LTE coverage.

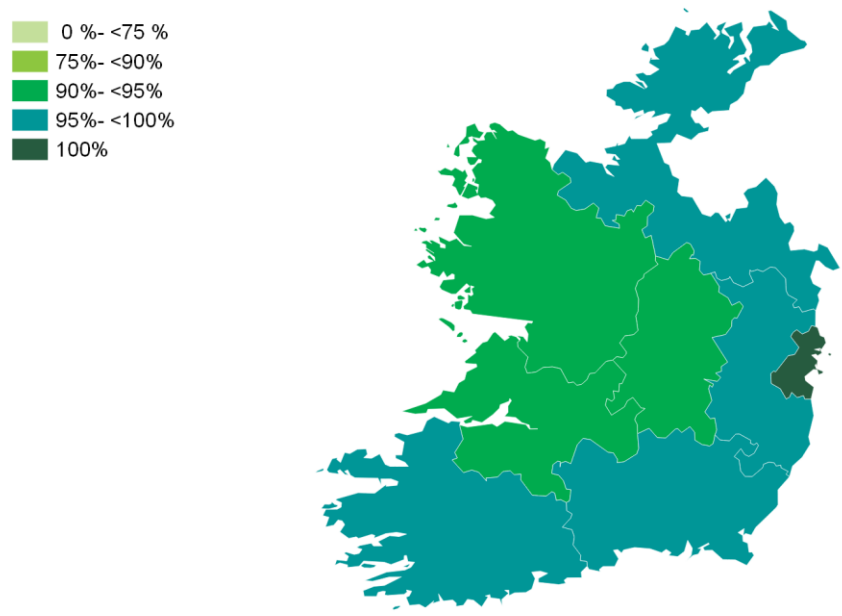


[59] https://www.eir.ie/opencms/export/sites/default/.content/pdf/IR/presentations/2016_2017/quarter1/eir_1st_quarter_results_presentation_FY1617_1.pdf

5.15.2 Regional coverage by broadband technology

Regional fixed broadband coverage in Ireland remained quite varied at the end of June 2016, with all households in Dublin having fixed broadband access but 92.1% of households in West Ireland being covered by fixed networks.

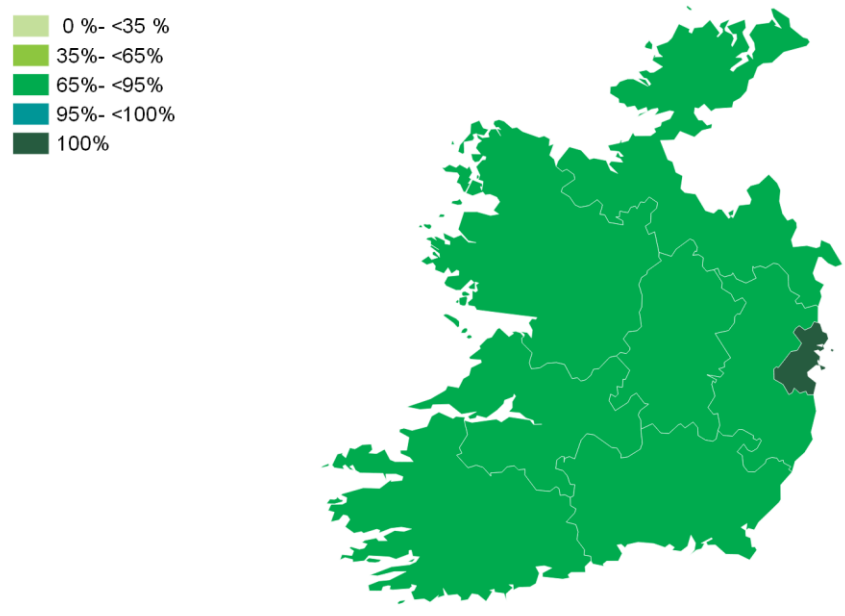
Ireland: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA broadband services were available to all households in Dublin at the end of June 2016, unchanged from the previous year. Outside of Dublin, NGA coverage ranged from little less than 70% in West Ireland to 86.1% in the Mid-West.

Ireland: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.15.3 Data tables for Ireland

Statistic	National
Population	4,605,501
Persons per household	2.6
Rural proportion	36.8%

	Ireland 2016		Ireland 2015		Ireland 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	92.5%	87.9%	92.5%	*86.8%*	92.5%	*86.8%*	94.3%	86.0%
VDSL	80.6%	48.9%	70.6%	*44.2%*	60.8%	*21.6%*	48.2%	26.6%
FTTP	5.5%	1.2%	4.5%	0.0%	1.7%	0.0%	23.7%	8.8%
WiMAX	26.6%	20.4%	26.6%	20.4%	26.6%	20.4%	17.8%	18.0%
Cable	43.3%	2.6%	42.7%	2.6%	42.4%	1.8%	44.4%	10.7%
DOCSIS 3	43.1%	2.4%	42.0%	2.4%	40.7%	1.7%	43.9%	10.1%
HSPA	99.2%	97.9%	94.6%	85.4%	94.6%	85.3%	98.0%	92.2%
LTE	96.7%	91.2%	90.1%	73.0%	87.0%	64.6%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	93.7%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.6%	99.0%	97.6%	95.0%	97.6%	95.0%	99.9%	99.2%
Overall fixed broadband	96.3%	93.3%	96.3%	*93.3%*	96.3%	*93.3%*	97.5%	92.6%
NGA broadband	81.6%	50.3%	79.7%	*44.9%*	70.7%	*22.1%*	75.9%	39.2%
At least 2 Mbps	95.9%	-	95.9%	-	95.9%	-	96.7%	-
At least 30 Mbps	77.2%	-	69.5%	-	54.3%	-	75.1%	-
At least 100 Mbps	44.9%	-	43.3%	-	40.6%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

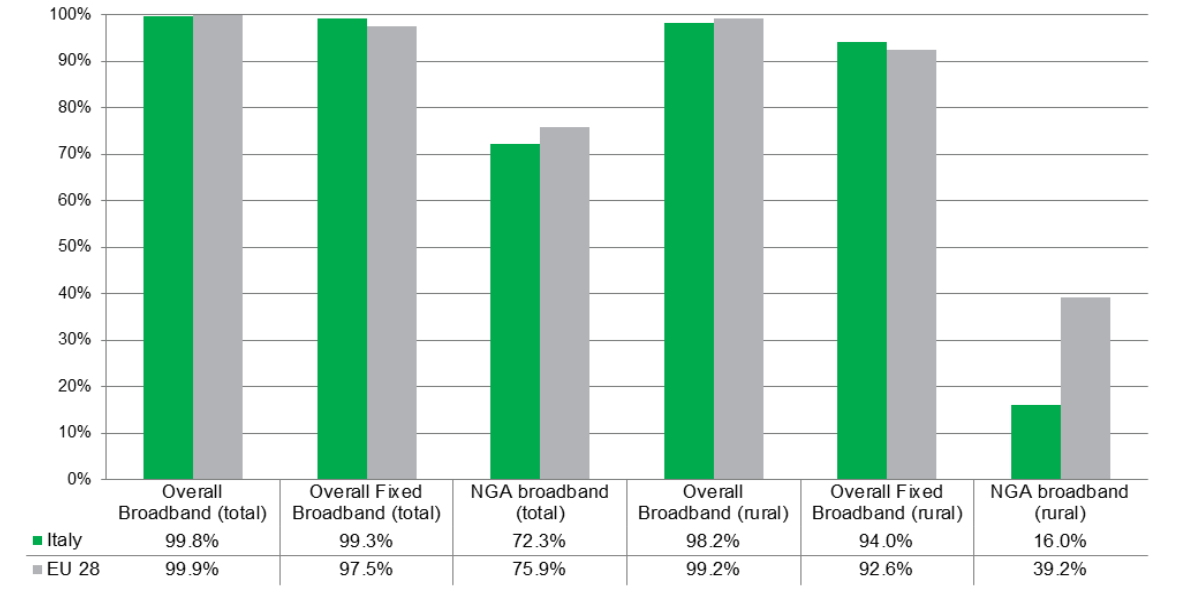
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL and VDSL coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.16 Italy

5.16.1 National coverage by broadband technology

At the end of June 2016, overall broadband and fixed broadband coverage remained relatively unchanged at a total level. In rural areas, overall broadband coverage increased by 1.5 percentage points, but no increase in rural fixed broadband coverage was registered in the same period. NGA broadband coverage increased considerably, both nationally and in rural areas, rising by 31.3 and 12.9 percentage points, respectively. Yet, despite this significant growth, Italy remained below the EU average for NGA broadband coverage, both nationally and in rural areas.

Italy: Coverage by technology combination, 2016

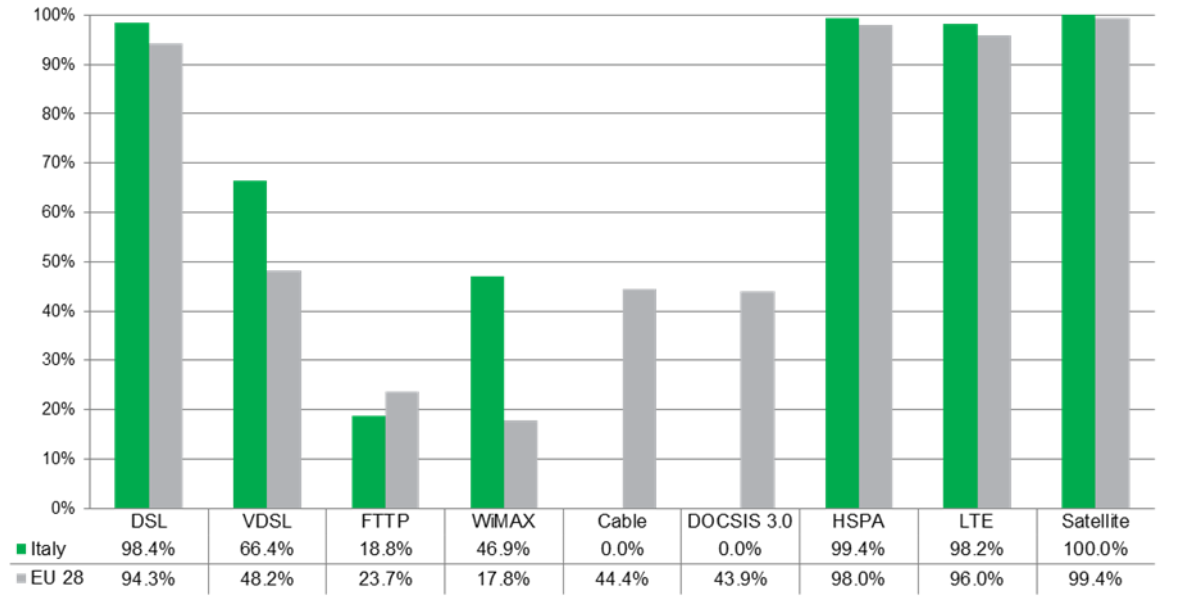


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Italy	99.8%	99.3%	72.3%	98.2%	94.0%	16.0%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Examining individual technologies, Italy witnessed considerable growth in VDSL coverage during the twelve months to mid-2016. Availability of VDSL services increased from 32.8% to 66.4% of households, as Telecom Italia and an alternative broadband operator, Fastweb, continued their investments in the technology.

Italy: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Italy	98.4%	66.4%	18.8%	46.9%	0.0%	0.0%	99.4%	98.2%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

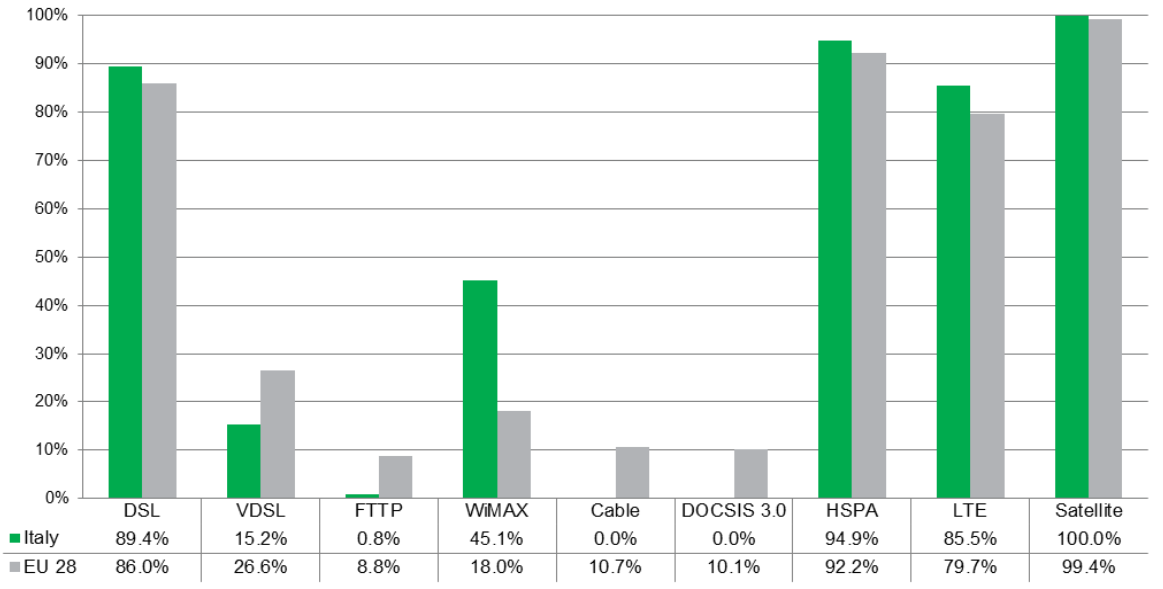
As cable networks are absent in Italy, FTTP is the only other NGA technology available to Italian households. FTTP networks coverage increased by 2.4 percentage points, reaching 18.8% of households. FTTP services can be expected to continue to grow, with continued investments from a number of companies. Enel, an Italian utility firm, aims to pass 9.5 million households by 2021 with its wholesale FTTP network.[60] Meanwhile, Telecom Italia and Fastweb plan to form a joint venture, subject to regulatory approval, and plan to invest EUR 1 billion to bring FTTP networks to 29 Italian cities.[61]

LTE coverage increased by 8.6 percentage points, reaching 98.2% of homes by mid-2016. Following the merger of Three and Wind Italia, the French operator Iliad plans to enter the Italian market in 2017 as the fourth mobile network operator. It has signed a national roaming agreement with the merged entity and will receive spectrum and macro sites before deploying its own network.[62] In the meantime, LTE services of all Italian LTE network operators were available on average to 86.2% of Italians.

DSL continued to be the main technology providing fixed broadband access in rural areas, covering 89.4% of rural homes across Italy. WiMAX coverage remained relatively high and was available to nearly a half (45.1%) of rural households.

Examining NGA coverage in rural areas, VDSL networks increased by around 12 percentage points during the twelve months to the end of June 2016. At 15.2%, VDSL networks covered a substantially higher proportion of rural households than FTTP services (0.8%), which remained primarily available in North Italian cities, such as Milan, Bologna and Turin.

Italy: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Italy	89.4%	15.2%	0.8%	45.1%	0.0%	0.0%	94.9%	85.5%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

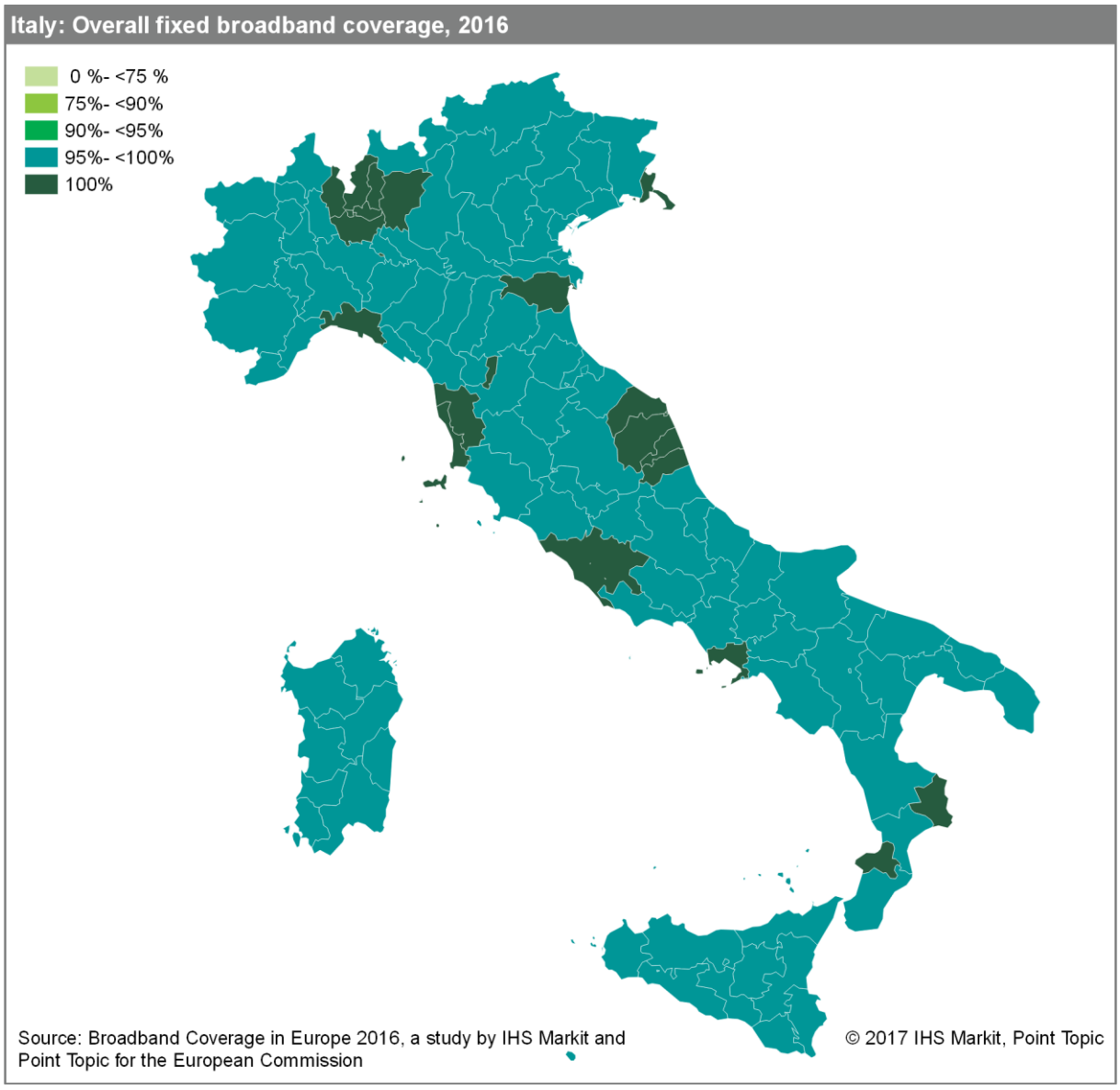
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Rural LTE coverage improved considerably, increasing by 58.7 percentage points. By mid-2016, 85.5% of rural homes were able to connect to the high-speed mobile broadband network. HSPA coverage in rural areas also increased, rising from 86.3% to 94.9% of rural homes.

[60] https://www.telegeography.com/products/commsupdate/articles/2016/07/29/enel-completes-metroweb-buy/
[61] http://www.eurocomms.com/industry-news/12107-tim-fastweb-ftth-joint-venture-comes-under-regulatory-scrutiny
[62] https://www.iliad.fr/presse/2016/CP_050716_Eng_.pdf

5.16.2 Regional coverage by broadband technology

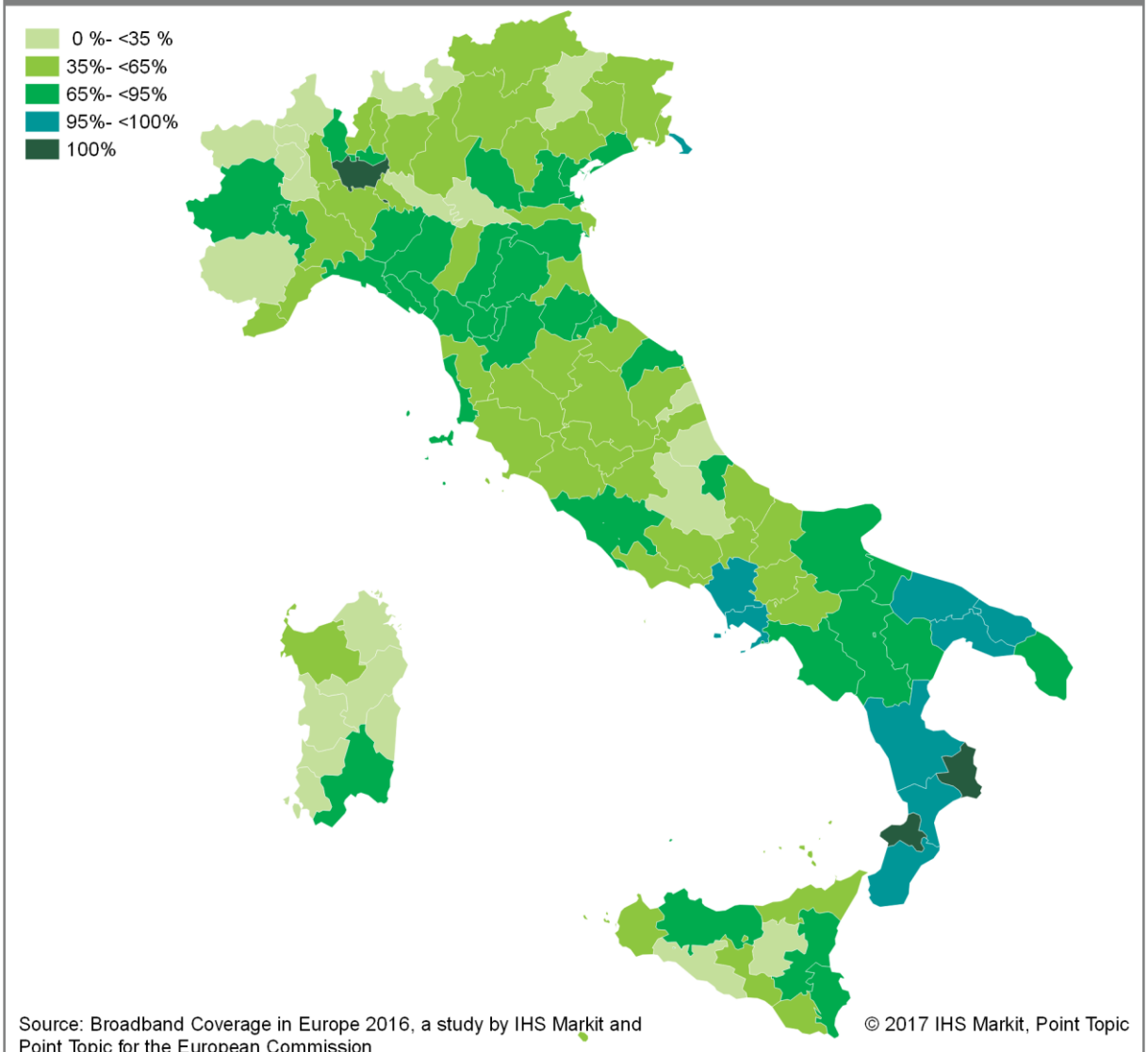
There was relatively little regional variation in terms of fixed broadband coverage in mid-2015 with vast majority of regions registering coverage levels higher than 97% (only four out of 110 regions recorded lower coverage – Treviso, Pordedone, Udine, and Massa-Carrara).



NGA coverage in the individual regions continued to vary greatly with NGA networks absent in two regions (Ogliastra and Medio Campidano) and one region (Enna) recording less than 10% NGA coverage. However, this is a considerable improvement compared to mid-2015, when eight regions were lacking any NGA coverage and another 18 regions had recorded NGA coverage levels lower than 10%.

On the other hand, in regions such as Milan, Crotone, and Vibo Valentia NGA services were available all households, and in additional six regions, NGA broadband coverage was higher than 99%. Other major urban areas such as Bologna, Genoa, Rome or Naples, also enjoyed much higher NGA availability levels (between 80%-90%).

Italy: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.16.3 Data tables for Italy

Statistic	National
Population	60,795,612
Persons per household	2.4
Rural proportion	12.2%

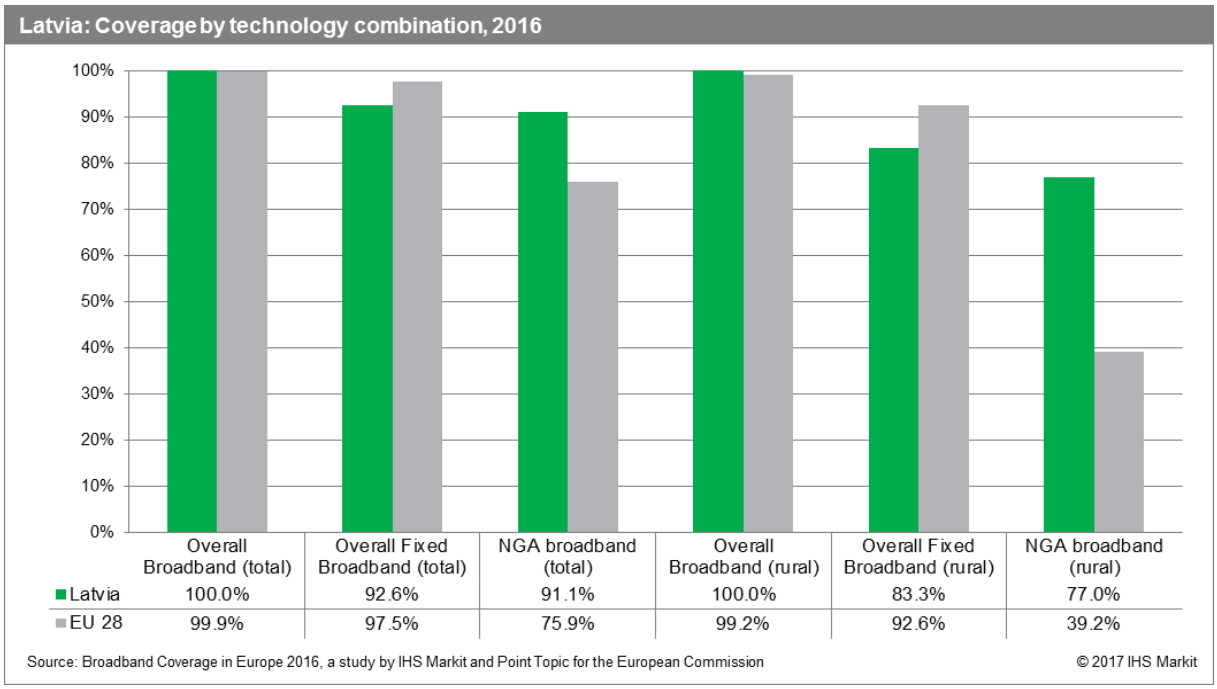
	Italy 2016		Italy 2015		Italy 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	98.4%	89.4%	98.4%	*89.4%*	98.2%	*88.3%*	94.3%	86.0%
VDSL	66.4%	15.2%	32.8%	*3.1%*	24.3%	0.0%	48.2%	26.6%
FTTP	18.8%	0.8%	*16.4%*	0.0%	*14.8%*	0.0%	23.7%	8.8%
WiMAX	46.9%	45.1%	47.0%	47.1%	47.2%	47.2%	17.8%	18.0%
Cable	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	44.4%	10.7%
DOCSIS 3.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	43.9%	10.1%
HSPA	99.4%	94.9%	98.3%	86.3%	97.7%	81.5%	98.0%	92.2%
LTE	98.2%	85.5%	89.7%	26.8%	77.0%	16.1%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	86.2%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.8%	98.2%	99.6%	*96.7%*	99.4%	*95.7%*	99.9%	99.2%
Overall fixed broadband	99.3%	94.0%	99.3%	*94.0%*	99.1%	*93.1%*	97.5%	92.6%
NGA broadband	72.3%	16.0%	*41.0%*	*3.1%*	*31.7%*	0.0%	75.9%	39.2%
At least 2 Mbps	98.2%	-	98.1%	-	97.8%	-	96.7%	-
At least 30 Mbps	71.8%	-	43.6%	-	27.2%	-	75.1%	-
At least 100 Mbps	18.8%	-	16.4%	-	14.8%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.
During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural DSL and VDSL coverage levels leading to restatements of data reported in previous year. In addition, more accurate data regarding total FTTP coverage became available during the 2016 data collection leading to a restatement of 2015 and 2014 FTTP coverage. All restatements are highlighted in italics.

5.17 Latvia

5.17.1 National coverage by broadband technology

Latvia recorded slight improvements in terms of overall, fixed and NGA broadband availability at a national level. Coverage improved 0.4% for both overall broadband and NGA broadband, but only 0.1% for fixed broadband. This meant that Latvia was above the EU average for overall broadband and NGA broadband coverage, but below in terms of fixed broadband coverage. In rural areas, Latvia recorded complete coverage for the overall broadband category following a 1.3 percentage point increase. The fixed broadband and NGA broadband categories reported more substantial coverage increases, at 5.5 and 9.7 percentage points, respectively. Despite this increase, rural fixed broadband coverage (83.3%) remained below the EU average (92.6%). Rural NGA broadband coverage, at 77.0%, remained well-above the EU average of 39.2%.



Examining individual technologies, FTTP was the most widespread fixed broadband access technology in Latvia. This reflects Latvia's long-term preference for fibre-optic technology in broadband infrastructure exemplified by the incumbent operator, Lattelecom, deploying FTTP networks since 2009[63].

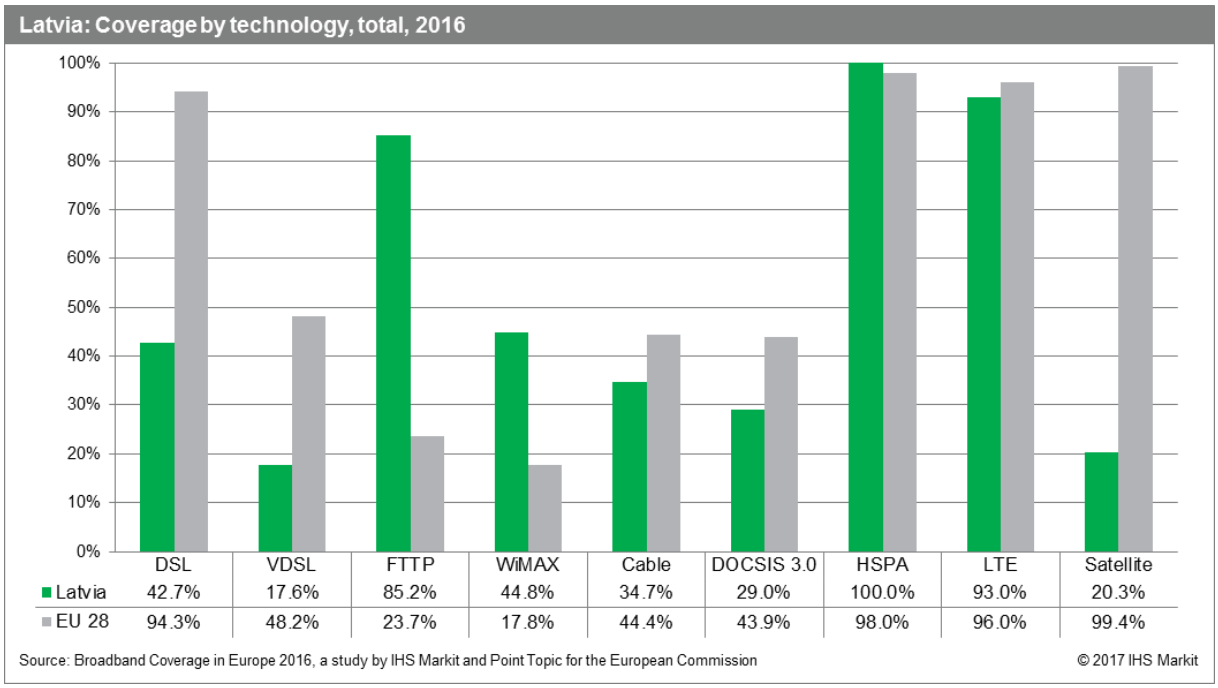
Consequently, Latvia is one of only two study countries where FTTP coverage greatly exceeds that of DSL. At the end of June 2016, DSL coverage reached 42.7% of households compared to 85.2% homes passed by FTTP networks. In terms of other NGA technologies, VDSL and DOCSIS 3.0 networks passed 17.6% and 29.0% of homes, respectively.

While HSPA services were universal in Latvia, LTE networks reached 93.0% of households, an increase of 4.0 percentage points in the twelve months to mid-2016. LTE coverage can be expected to grow in the future, helped by Tele2's plan to invest EUR 3 million in its mobile network to construct 60 new base stations[64].

Moreover, when average of availability of LTE services provided by all mobile network operators is considered, on average 90.7% of Latvians had access to LTE networks at the end of June 2016.

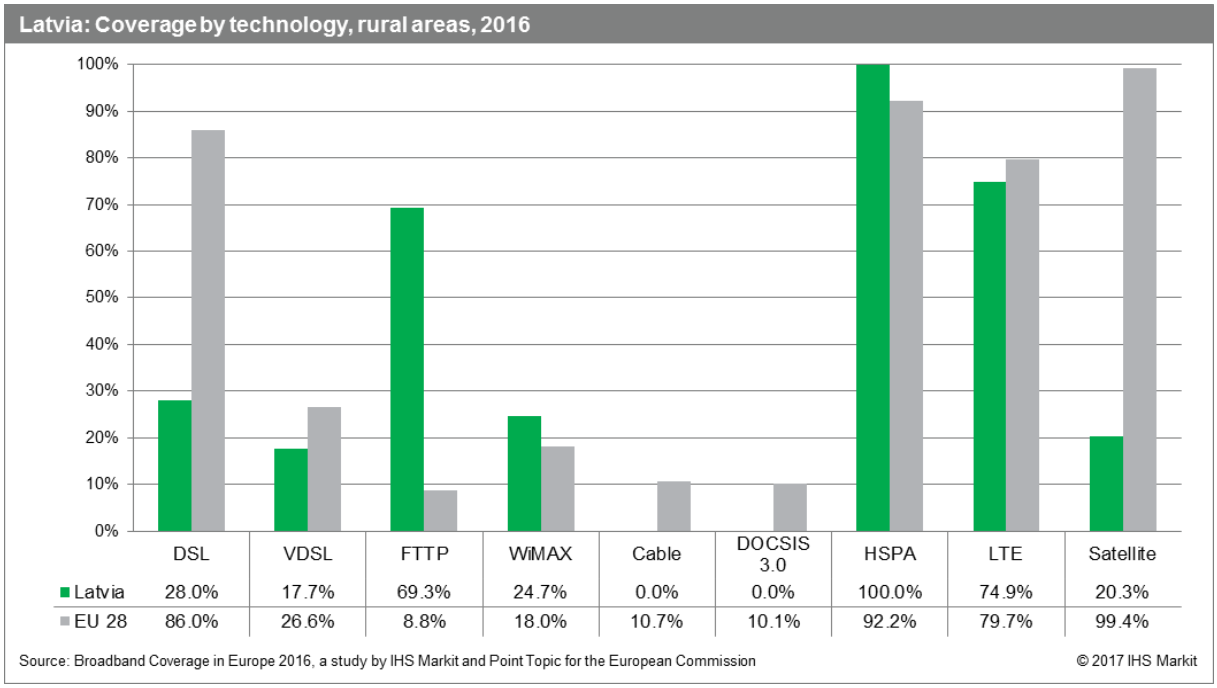
[63] http://www.csimagazine.com/news-30-01-2009-lattelcom.php

[64] https://www.telegeography.com/products/commsupdate/articles/2017/03/31/tele2-continues-network-expansion/



In rural areas, DSL networks passed 28.0% of homes, while WiMAX broadband was available to less than a quarter (24.7%) of rural households. As in previous years, cable networks were absent from rural Latvia. Examining NGA technologies, FTTP services were the most widespread, reaching 69.3% of households, well-above the EU average (8.8%). However, the biggest increase in rural NGA broadband coverage was witnessed in VDSL networks, which increased by 17.7 percentage points during the period as a result of Lattelecom's VDSL rollout programme. This programme aims to deploy VDSL networks to around 180,000 households in areas, where FTTP networks deployment is not feasible.[65]

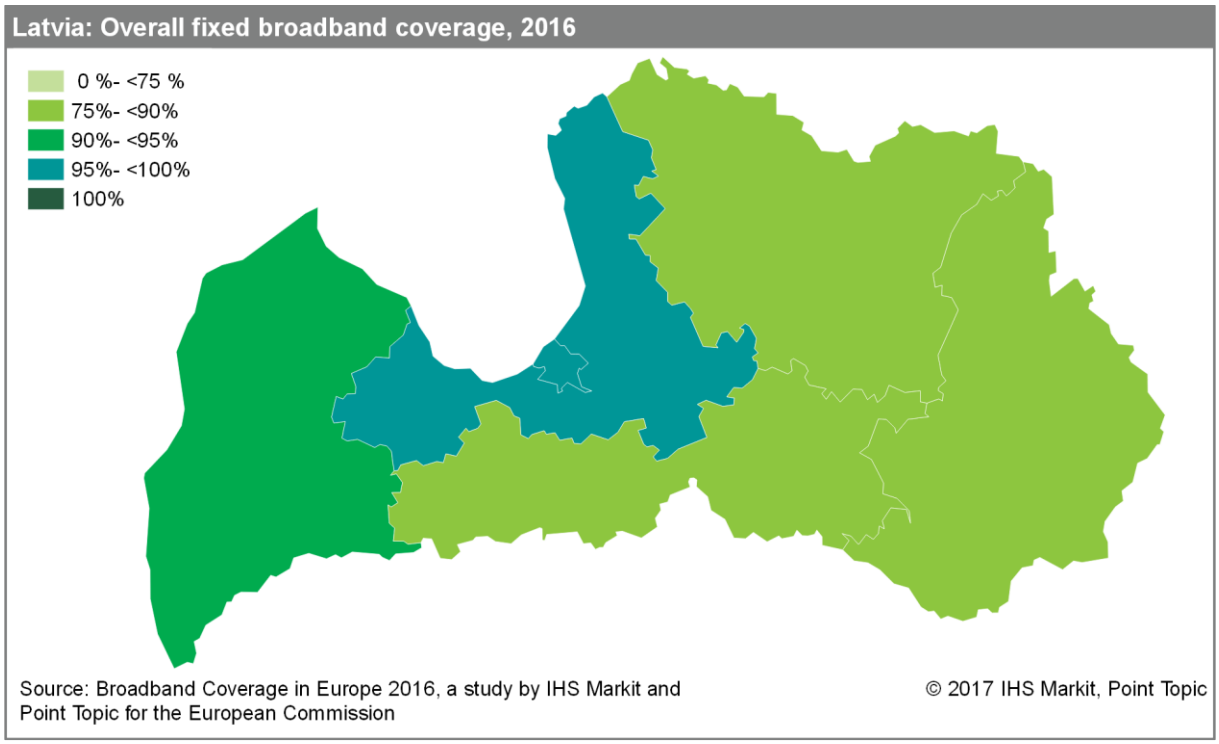
Rural LTE coverage increased by 13.5 percentage points in the year to June 2016, reaching 74.9% of rural households.



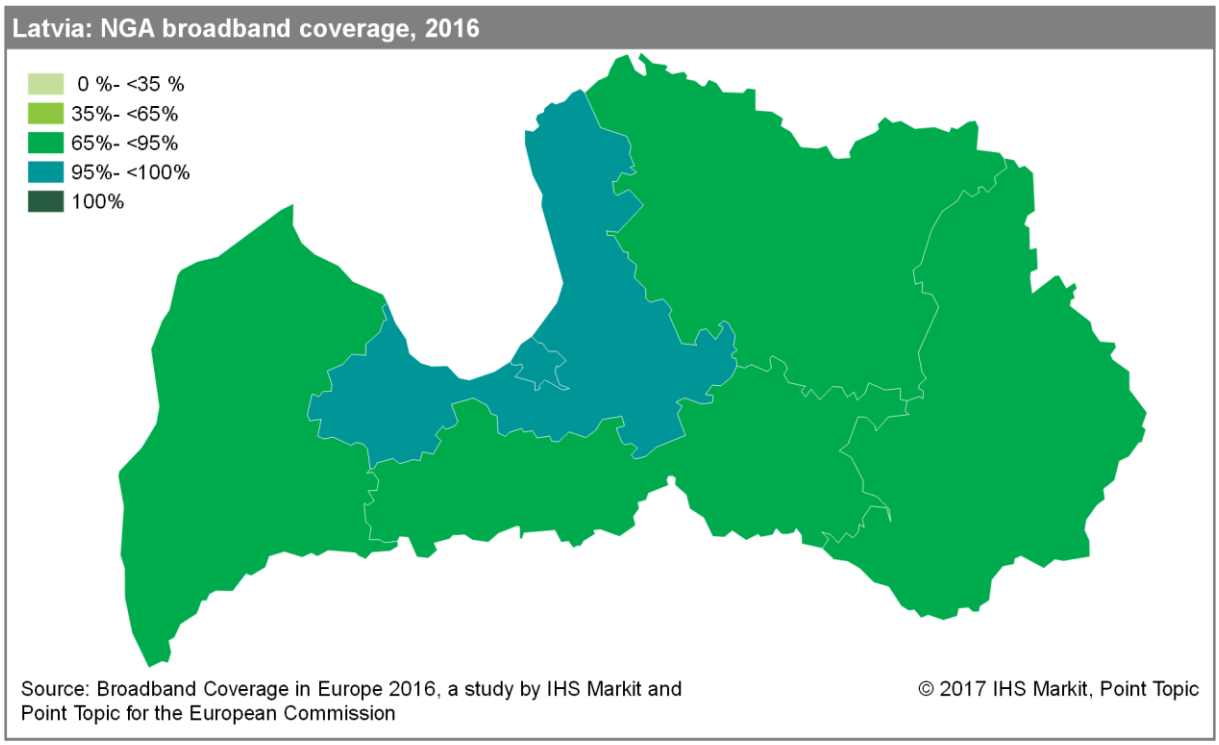
[65] https://www.lattelecom.lv/par-lattelecom/jaunumi/lattelecom-uzsak-verienigu-interneta-tikla-modernizaciju-lai-palielinatu-atrumu

5.17.2 Regional coverage by broadband technology

There is quite a lot of regional variation in terms of fixed broadband coverage ranging from little over 80% in the Eastern region of Latgale to near-complete coverage recorded in the capital Riga,



Riga was also the only region with NGA networks available to more than 99% of households, while in the most Eastern region of Latgale high-speed NGA broadband was available to little more than 70% of households.



5.17.3 Data tables for Latvia

Statistic	National
Population	1,986,096
Persons per household	2.6
Rural proportion	28.0%

	Latvia 2016		Latvia 2015		Latvia 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	42.7%	28.0%	42.3%	9.0%	42.3%	8.2%	94.3%	86.0%
VDSL	17.6%	17.7%	14.8%	0.0%	12.7%	0.0%	48.2%	26.6%
FTTP	85.2%	69.3%	85.0%	*67.3%*	83.9%	*63.6%*	23.7%	8.8%
WiMAX	44.8%	24.7%	44.9%	*24.1%*	44.6%	*28.6%*	17.8%	18.0%
Cable	34.7%	0.0%	34.5%	0.0%	34.3%	0.0%	44.4%	10.7%
DOCSIS 3.0	29.0%	0.0%	28.8%	0.0%	28.6%	0.0%	43.9%	10.1%
HSPA	100.0%	100.0%	99.2%	97.3%	99.2%	97.3%	98.0%	92.2%
LTE	93.0%	74.9%	89.0%	61.4%	65.0%	4.2%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	90.7%	-	-	-	-	-	84.4%	-
Satellite	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%	99.4%	99.4%
Overall broadband	100.0%	100.0%	99.6%	98.7%	99.6%	98.7%	99.9%	99.2%
Overall fixed broadband	92.6%	83.3%	92.5%	*77.8%*	91.9%	*75.9%*	97.5%	92.6%
NGA broadband	91.1%	77.0%	90.7%	*67.3%*	89.6%	*63.6%*	75.9%	39.2%
At least 2 Mbps	92.6%	-	92.5%	-	91.9%	-	96.7%	-
At least 30 Mbps	90.4%	-	89.8%	-	88.8%	-	75.1%	-
At least 100 Mbps	86.8%	-	86.4%	-	85.5%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural WiMAX coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

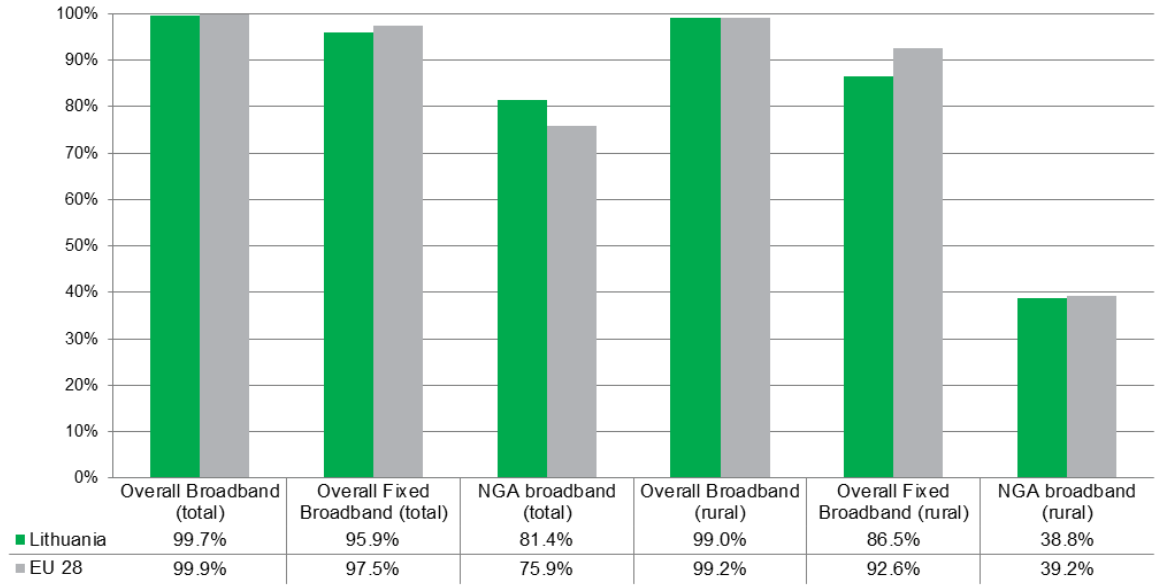
5.18 Lithuania

5.18.1 National coverage by broadband technology

During the 2016 data collection, more accurate data became available after the Ministry of Transport and Communications conducted an extensive mapping study of NGA networks in Lithuania. This new data suggest that coverage of fibre optic networks has been overestimated in previous iterations of the BCE study, leading to restatements of both FTTP and NGA coverage.

At the end of June 2016, 95.9% of Lithuanian households had access to fixed broadband services. In rural areas, fixed broadband was available to 86.5% of rural households. On both national and rural level fixed broadband coverage was below the EU average. Fixed NGA networks passed 81.4% of all homes across Lithuania with NGA services being available to 38.8% of rural homes.

Lithuania: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Lithuania	99.7%	95.9%	81.4%	99.0%	86.5%	38.8%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As in the other Baltic countries, Lithuanian telecoms operators have been traditionally focused on FTTP deployments rather than upgrades to VDSL, which is absent in the country. As a result, in terms of individual technologies, Lithuania is characterised by relatively low DSL coverage, with 69.8% homes passed by DSL networks compared with an average of 94.3% in the EU as a whole.

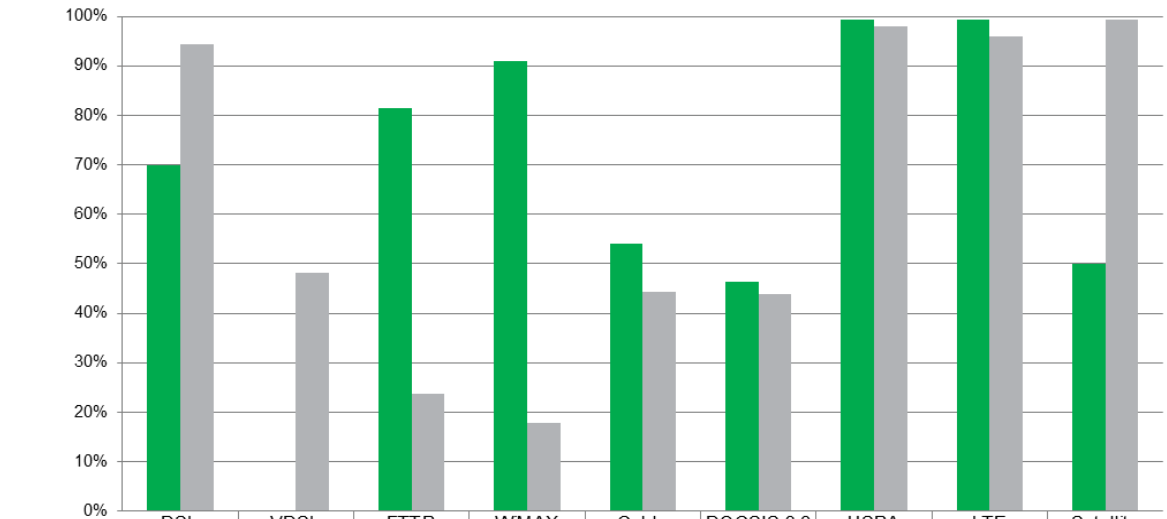
Therefore, FTTP is one of the two key fixed broadband technologies providing fixed and NGA broadband access to 81.4% of Lithuanian households by mid-2016, along with WiMAX, which was available to 9 in 10 (91.0%) households across the country.

More than a half of households (54.0%) had access to cable broadband services and 46.3% of homes were passed by high-speed cable DOCSIS 3.0 networks at the end of June 2016. However, there is a significant overlap of DOCSIS 3.0 and FTTP networks, meaning that overall NGA coverage level was that of FTTP coverage.

Both HSPA and LTE mobile networks reached near universal coverage (99.4% for both technologies) at the end of June 2016. Moreover, when average availability of LTE services provided by all mobile network operators is considered, on average 95.7% of Lithuanians had access to LTE networks by mid-2016. With near-universal HSPA and LTE coverage, the leading mobile network operators have begun to focus on LTE-Advanced networks deployment in selected areas of Lithuania with Tele2 expanding its LTE-A network to around 50% of the population and 33 cities by mid-2016, in addition to the LTE-A services being first offered by Telia Sonera's Omnitel since 2014.[66]

[66] http://tele2.lt/privatiems/naujienos/cat/naujienos/post/Tele2-4GPlius-pletra-50proc-gyventoju-gali-naudoti-dar-greitesniu-internetu/

Lithuania: Coverage by technology, total, 2015

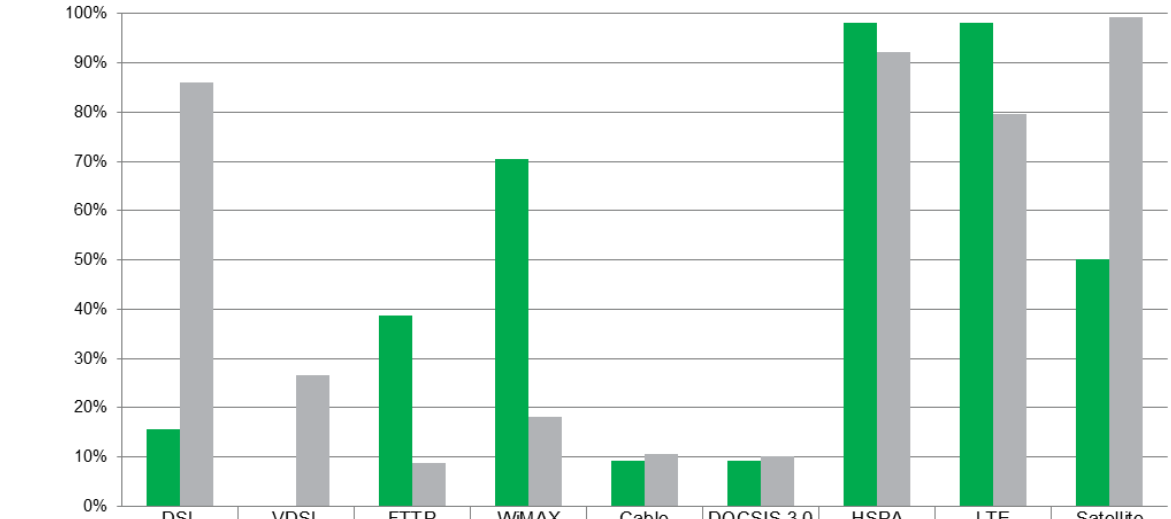


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Lithuania	69.8%	0.0%	81.4%	91.0%	54.0%	46.3%	99.4%	99.4%	50.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

WiMAX was the key technology for rural broadband access with 70.5% of rural households having access to WiMAX services at the end of June 2016. Given the absence of cable networks and limited availability of DSL, which passed only 15.7% of rural households, FTTP was the only fixed NGA technology available in rural areas. By mid-2016, 38.8% of rural homes were passed by FTTP networks.

Lithuania: Coverage by technology, rural areas, 2016



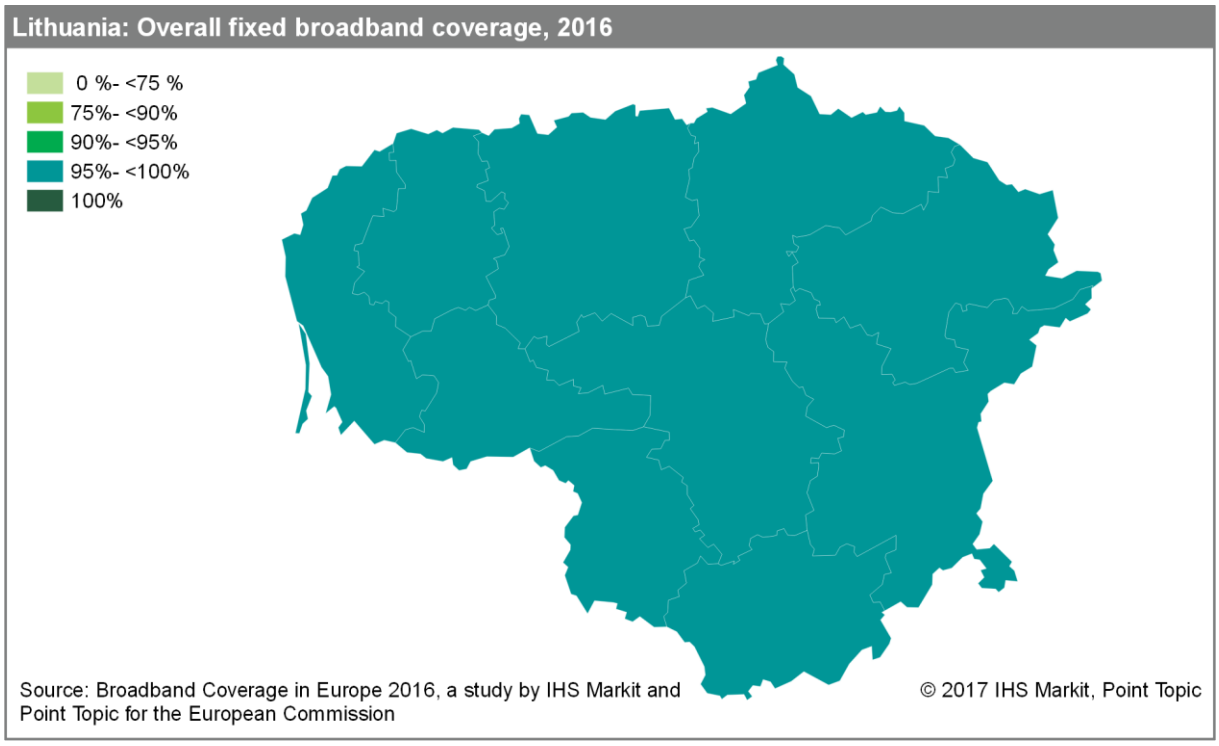
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Lithuania	15.7%	0.0%	38.8%	70.5%	9.2%	9.2%	98.1%	98.1%	50.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

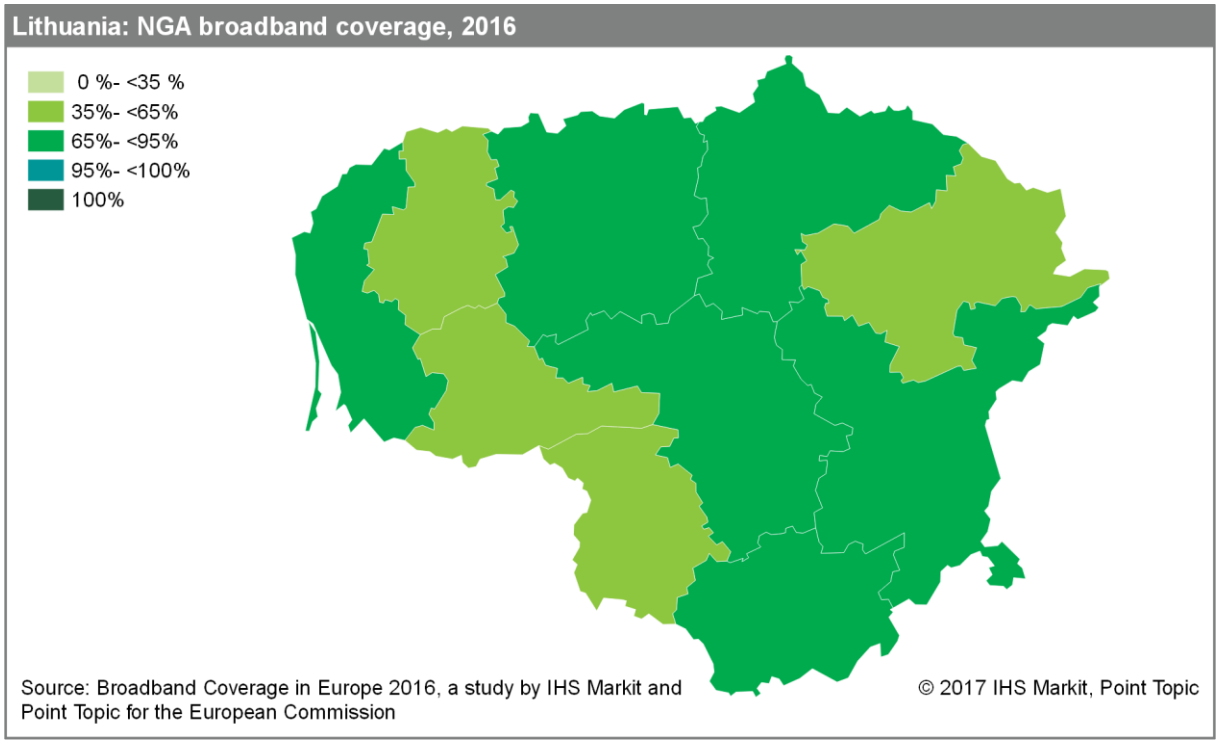
After first becoming available in 2014, rural LTE coverage reached 98.1% of rural households by mid-2016, increasing by 29.2 percentage points year-on-year.

5.18.2 Regional coverage by broadband technology

Fixed broadband coverage was higher than 95% in all of the ten regions, with little regional difference and fixed broadband coverage ranging from 95% in the most rural region of Utenos to 97% of households covered in the Kaunas region.



There was more differentiation in terms of regional NGA coverage with highest coverage levels recorded in the Kaunas region and the Vilnius region.



5.18.3 Data tables for Lithuania

Statistic	National
Population	2,921,262
Persons per household	2.3
Rural proportion	30.4%

	Lithuania 2016		Lithuania 2015		Lithuania 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	69.8%	15.7%	69.3%	15.2%	69.2%	*16.1%*	94.3%	86.0%
VDSL	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	48.2%	26.6%
FTTP	81.4%	38.8%	*80.8%*	*38.7%*	*80.5%*	*37.9%*	23.7%	8.8%
WiMAX	91.0%	70.5%	90.3%	*69.1%*	90.3%	*69.2%*	17.8%	18.0%
Cable	54.0%	9.2%	53.6%	0.0%	53.4%	0.0%	44.4%	10.7%
DOCSIS 3.0	46.3%	9.2%	45.9%	0.0%	42.9%	0.0%	43.9%	10.1%
HSPA	99.4%	98.1%	98.9%	96.4%	98.6%	95.6%	98.0%	92.2%
LTE	99.4%	98.1%	90.2%	68.8%	79.9%	36.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	95.7%	-	-	-	-	-	84.4%	-
Satellite	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	99.4%	99.4%
Overall broadband	99.7%	99.0%	99.5%	98.4%	99.4%	98.1%	99.9%	99.2%
Overall fixed broadband	95.9%	86.5%	*95.7%*	*86.3%*	*95.4%*	*85.4%*	97.5%	92.6%
NGA broadband	81.4%	38.8%	*80.8%*	*38.7%*	*80.5%*	*37.9%*	75.9%	39.2%
At least 2 Mbps	97.7%	-	97.5%	-	97.4%	-	96.7%	-
At least 30 Mbps	91.0%	-	85.4%	-	82.3%	-	75.1%	-
At least 100 Mbps	81.4%	-	80.8%	-	80.5%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

As mentioned, previously reported coverage trends and values reported for Lithuania have been restated in light of new and more accurate data stemming from the new NGA mapping study conducted by the Ministry of Transportation and Communications. All restatements are highlighted in italics.

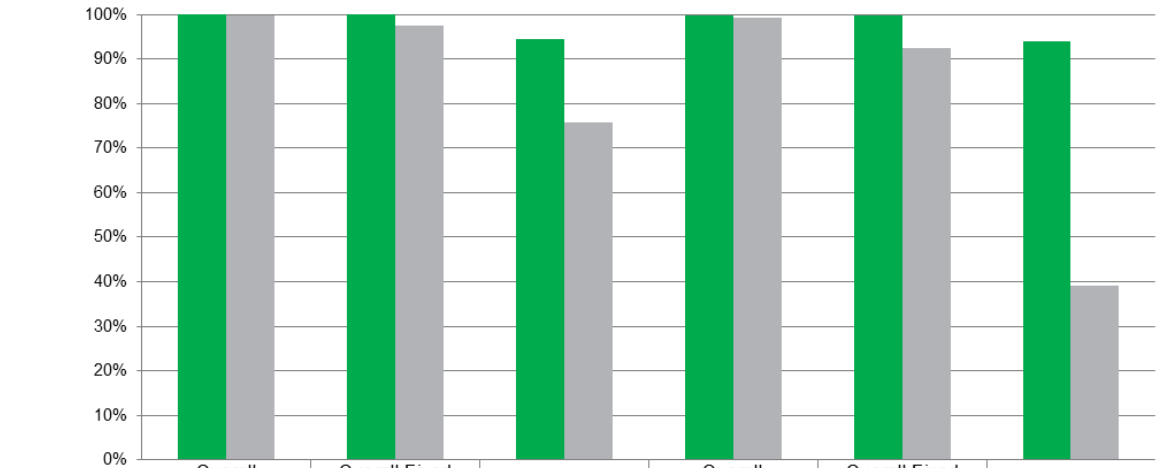
5.19 Luxembourg

5.19.1 National coverage by broadband technology

Luxembourg maintained high levels of broadband coverage during the twelve-month period to the end of June 2016, reporting complete coverage for overall broadband and fixed broadband on both national and rural level. Furthermore, NGA networks remained stable with 94.4% of all households and 94.1% of rural households covered, exceeding both total (75.9%) and rural (39.2%) EU average coverage levels.

Generally, the country benefits from the fact that it covers a geographically small area in comparison to its neighbours. Therefore, extending NGA technologies such as FTTP and DOCSIS 3.0 has been somewhat easier in Luxembourg than in other European countries.

Luxembourg: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Luxembourg	100.0%	100.0%	94.4%	99.9%	99.9%	94.1%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Looking at the individual technologies, Luxembourg continues to outperform the EU average levels for coverage of all technologies with the exception of WiMAX, which is not present in the country. Universal fixed broadband availability is a result of complete DSL coverage, with ongoing upgrades to VDSL. Luxembourg ranked third in terms of VDSL coverage after Belgium and Iceland, with 88.8% of households having access to VDSL services in mid-2016.

Cable coverage experienced a slight increase of 3.4 percentage points, bringing availability of cable broadband services to 78.6% of households. Further increase in cable coverage in Luxembourg can be expected in the future as Telenet announced an extension of their cable network, following their acquisition of SFR BeLux. [67] Most cable networks in Luxembourg have been already upgraded to the DOCSIS 3.0 standard with high-speed cable broadband being available to 74.3% households.

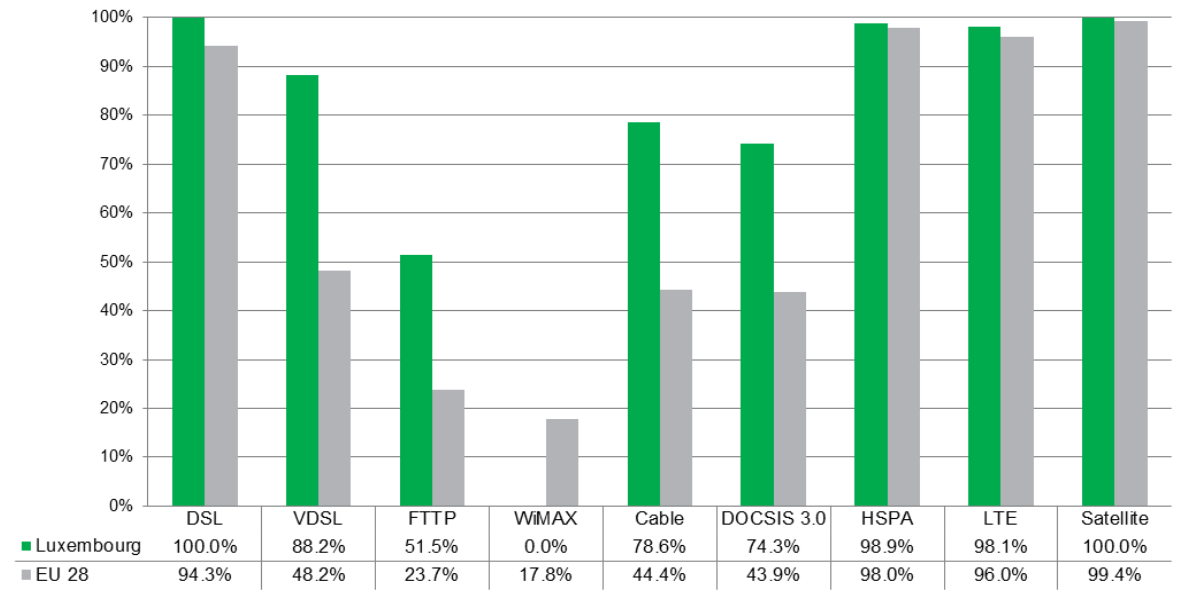
By mid-2016, gains were also observed in terms of FTTP coverage, which increased by 4.4 percentage points to 51.5%, which is more than twice the EU average (23.7%). The high availability of FTTP services can be attributed to the activities of both the incumbent operator, P&T, as well as the alternative operator Tango heavily investing in FTTP rollouts already since 2011.

LTE coverage registered a 1.9 percentage point increase by mid-2016 with LTE networks passing 98.1% of homes. In terms of average LTE services availability, when average coverage of all LTE network operators is considered, LTE services were available to 95.4% of Luxembourg. Moreover, the overall bandwidth available over the networks will grow as mobile operators continue to shift their

[67] http://uk.reuters.com/article/uk-altice-m-a-telenet-idUKKBN14B0MW

focus towards deployment of LTE-Advanced technology over their networks with Tango [68] and Orange[69] upgrading to LTE-A networks during the twelve-month period of this study.

Luxembourg: Coverage by technology, total, 2016



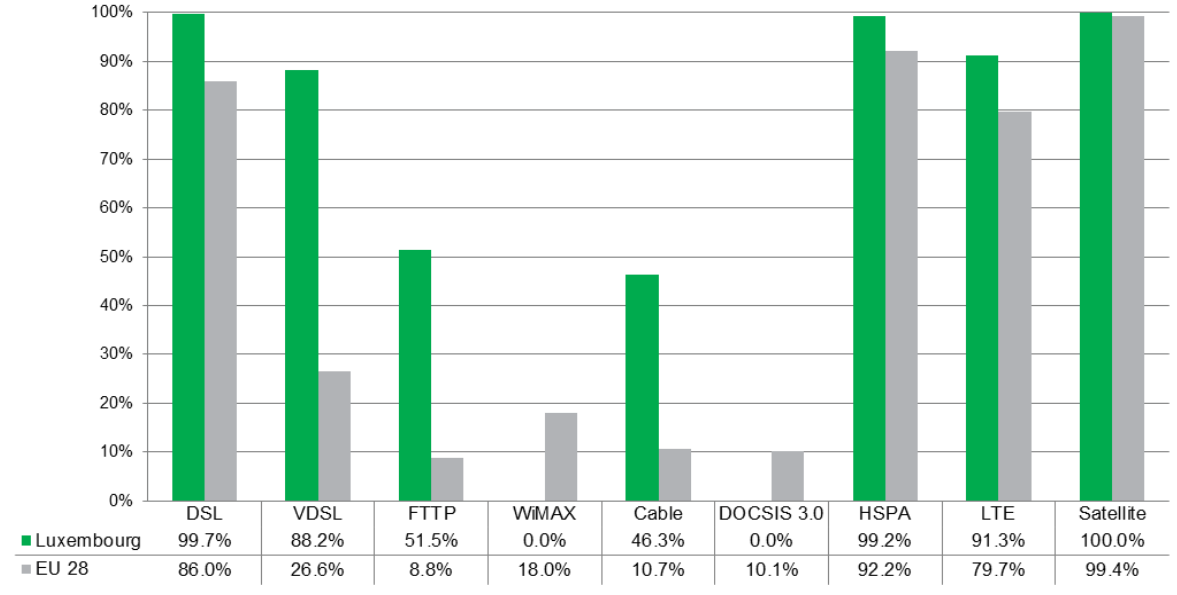
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Luxembourg	100.0%	88.2%	51.5%	0.0%	78.6%	74.3%	98.9%	98.1%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As in previous years, rural areas in Luxembourg continue to benefit from above EU average coverage levels for all technologies except for WiMAX and DOCSIS 3.0, which remained unavailable to rural households. Rural FTTP coverage recorded a 5.5 percentage point growth by mid-2016 with FTTP networks passing 51.5% of rural homes, well above the EU average of 23.7%.

Rural LTE coverage remained stable with 91.3% rural households across Luxembourg having access to mobile LTE broadband services by mid-2016.

Luxembourg: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Luxembourg	99.7%	88.2%	51.5%	0.0%	46.3%	0.0%	99.2%	91.3%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

[68] http://www.wort.lu/en/lifestyle/first-quarter-2015-faster-4g-network-for-luxembourg-next-year-says-tango-548efa080c88b46a8ce48144

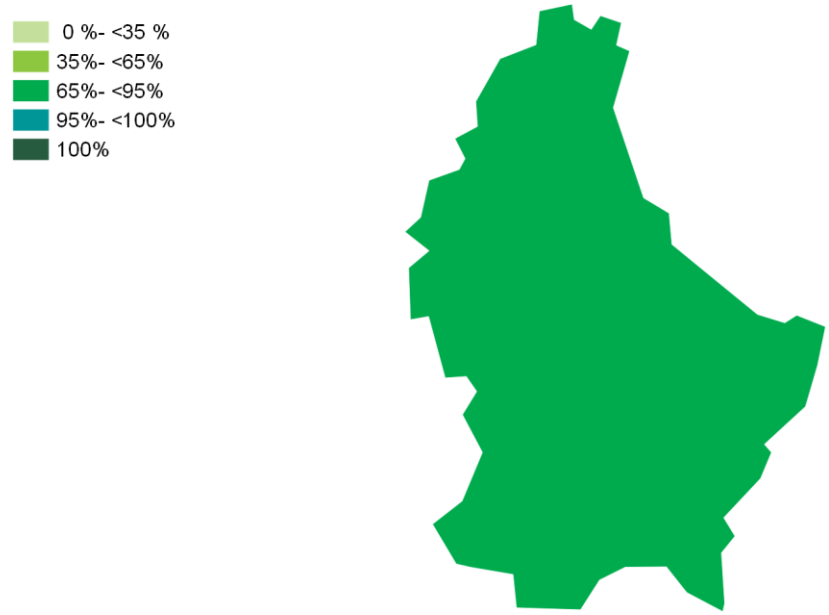
[69] https://corporate.orange.lu/en/page/our-network

5.19.2 Regional coverage by broadband technology

Luxembourg: Overall fixed broadband coverage, 2016

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Luxembourg: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.19.3 Data tables for Luxembourg

Statistic	National
Population	562,958
Persons per household	2.5
Rural proportion	11.5%

	Luxembourg 2016		Luxembourg 2015		Luxembourg 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	100.0%	99.7%	100.0%	99.9%	100.0%	99.9%	94.3%	86.0%
VDSL	88.2%	88.2%	88.6%	88.3%	88.8%	88.1%	48.2%	26.6%
FTTP	51.5%	51.5%	47.1%	46.0%	42.8%	35.7%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	78.6%	46.3%	80.5%	42.1%	70.5%	52.8%	44.4%	10.7%
DOCSIS 3.0	78.6%	0.0%	75.2%	0.0%	65.0%	0.0%	43.9%	10.1%
HSPA	98.9%	99.2%	99.6%	99.6%	99.6%	99.6%	98.0%	92.2%
LTE	98.1%	91.3%	96.2%	91.2%	96.0%	89.5%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	95.4%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.2%
Overall fixed broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	97.5%	92.6%
NGA broadband	94.4%	94.1%	94.4%	94.1%	94.4%	94.0%	75.9%	39.2%
At least 2 Mbps	100.0%	-	100.0%	-	100.0%	-	96.7%	-
At least 30 Mbps	94.1%	-	94.4%	-	94.4%	-	75.1%	-
At least 100 Mbps	89.7%	-	87.6%	-	82.5%	-	50.8%	-

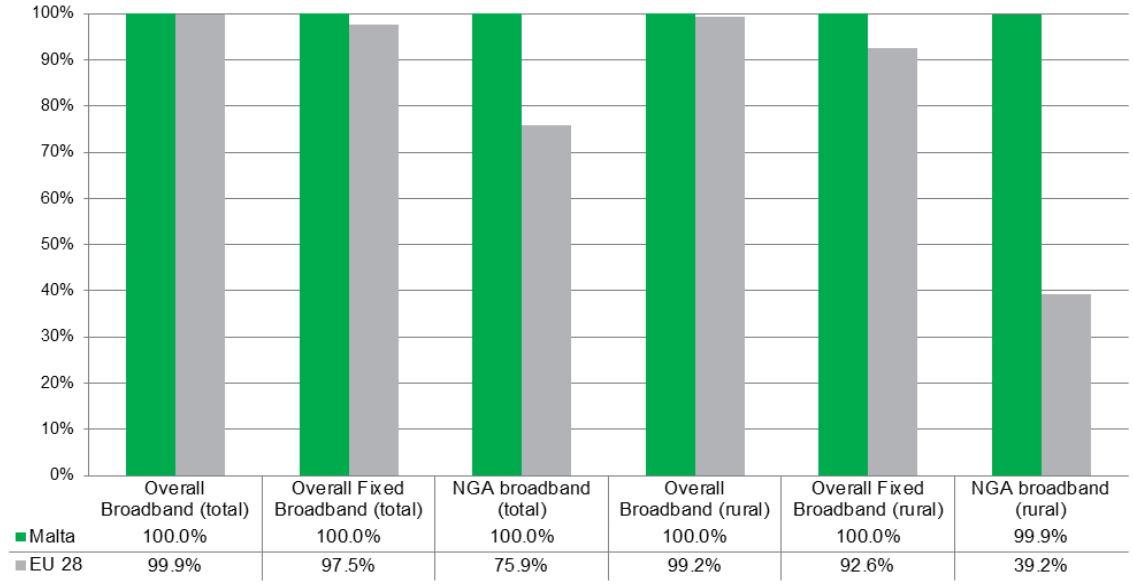
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.20 Malta

5.20.1 National coverage by broadband technology

Malta continued to be the only country with virtually complete broadband coverage across all three coverage combination categories on both national and rural levels, as was the case in previous years.

Malta: Coverage by technology combination, 2016

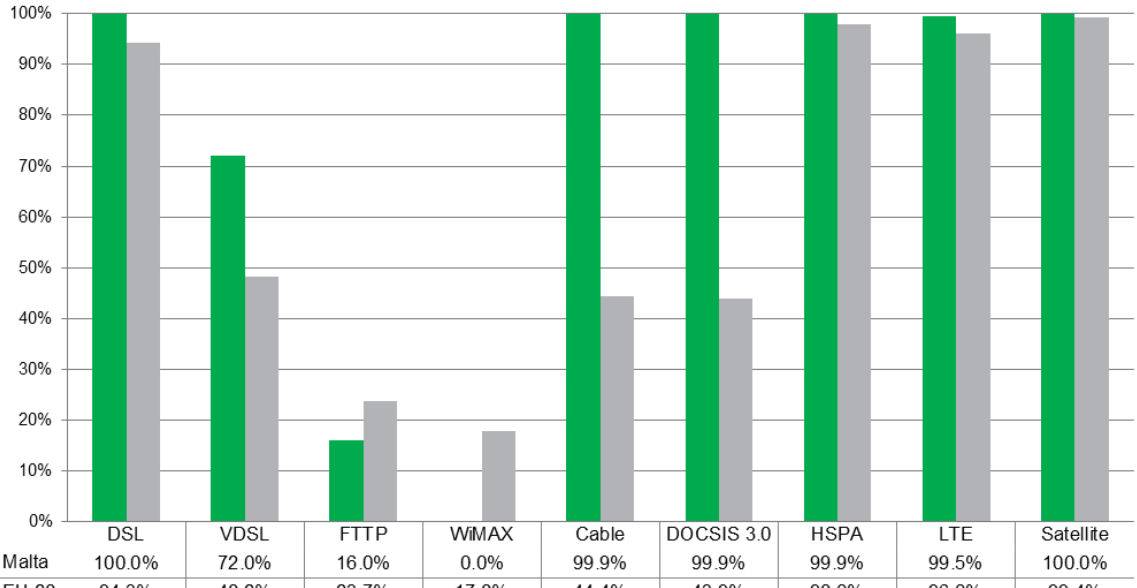


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Malta	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As noted in previous iterations of this study, the fact that Malta is a small, very densely populated island with small rural population (only 1% of households were identified as rural) presents an undisputable geographical advantage to reaching universal broadband coverage above the EU average.

Malta: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Malta	100.0%	72.0%	16.0%	0.0%	99.9%	99.9%	99.9%	99.5%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

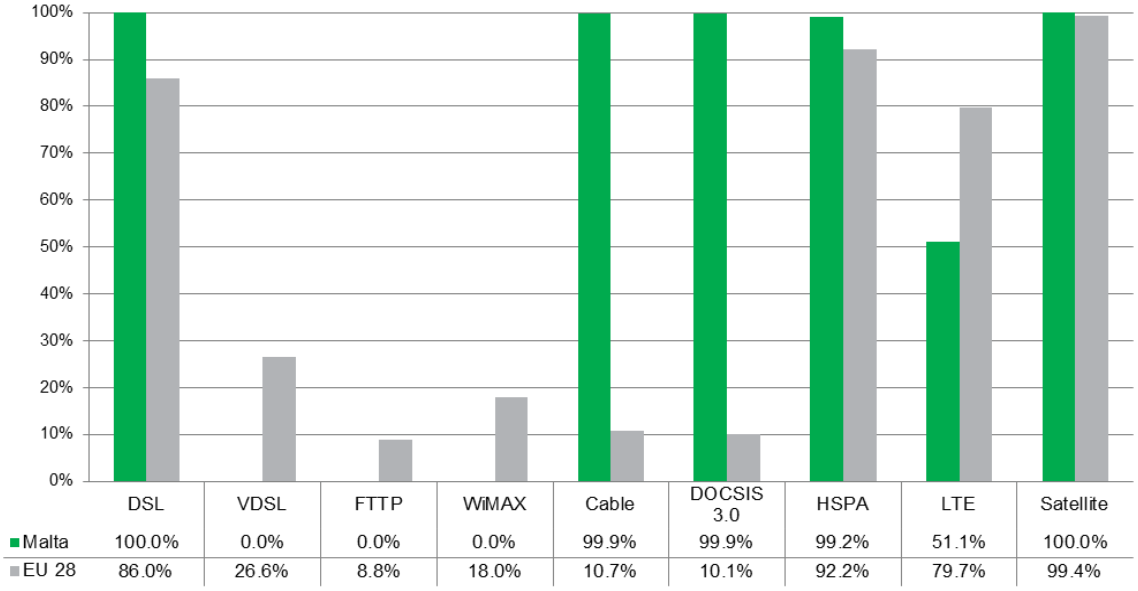
Looking at the individual technologies, Malta is also the only country to report complete coverage across a range of key technologies, namely DSL and cable as was the case in 2015. Provision of

WiMAX services ceased during the twelve months leading up to June 2016, as Vodafone Malta the sole provider of WiMAX technology turned off its WiMAX service and migrated existing customers to fixed broadband services.[70]

NGA coverage remained ensured through complete DOCSIS 3.0 coverage, whilst FTTP coverage continued to increase at a steady pace. By mid-2016, availability of FTTP services grew by 5.4 percentage points, passing 16% of homes across the island. Future expansion of FTTP networks can be expected with the telco operator GO investing extensively in the fibre optic network.[71] In addition, VDSL networks passed 72% of households, unchanged from mid-2015.

LTE coverage in Malta continued to see substantial growth, recording 27.5-percentage point growth to pass 99.5% of Maltese households. This brought Malta in line with the EU average for LTE coverage, whilst HSPA maintained near universal coverage. By mid-2016, 99.3% of Maltese people on average had access to LTE services from all operators.[72]

Malta: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Malta	100.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.2%	51.1%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

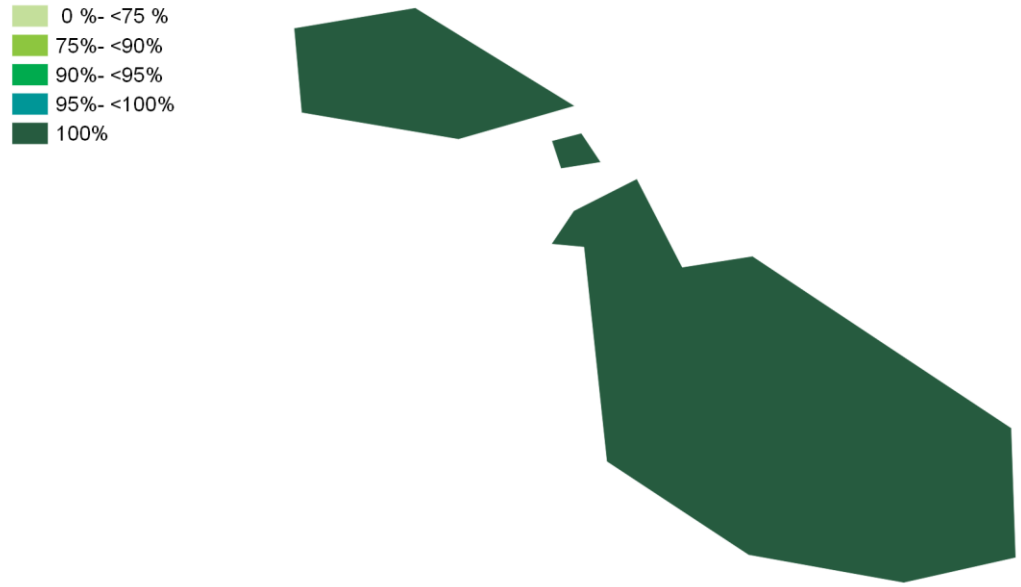
When examining rural broadband coverage in Malta, it is important to keep in mind the generally small number (less than 1%) of Maltese households considered to be rural. With this perspective, complete rural coverage was observed for DSL, cable, and satellite technologies in rural areas, unchanged from 2015. Given the absence of VDSL and FTTP networks in rural areas, DOSCIS 3.0 remained the only NGA access technology available to rural households, with 99.9% of rural households accessible via the technology.

Vodafone Malta[73] and GO continued LTE roll out to rural areas in the twelve months leading up to June 2016, with rural LTE coverage rising to 51.5%, from no coverage in mid-2015.

[70] https://www.vodafone.com.mt/file.aspx?f=11685
[71] https://www.go.com.mt/-/go-investing-over-50-million-euros-to-launch-internet-of-the-future#.WNjx1VXyuUk
[72] In the DESI, a figure for end 2015 was published.
[73] https://www.telegeography.com/products/commsupdate/articles/2015/11/10/vodafone-malta-hits-99-4g-coverage/

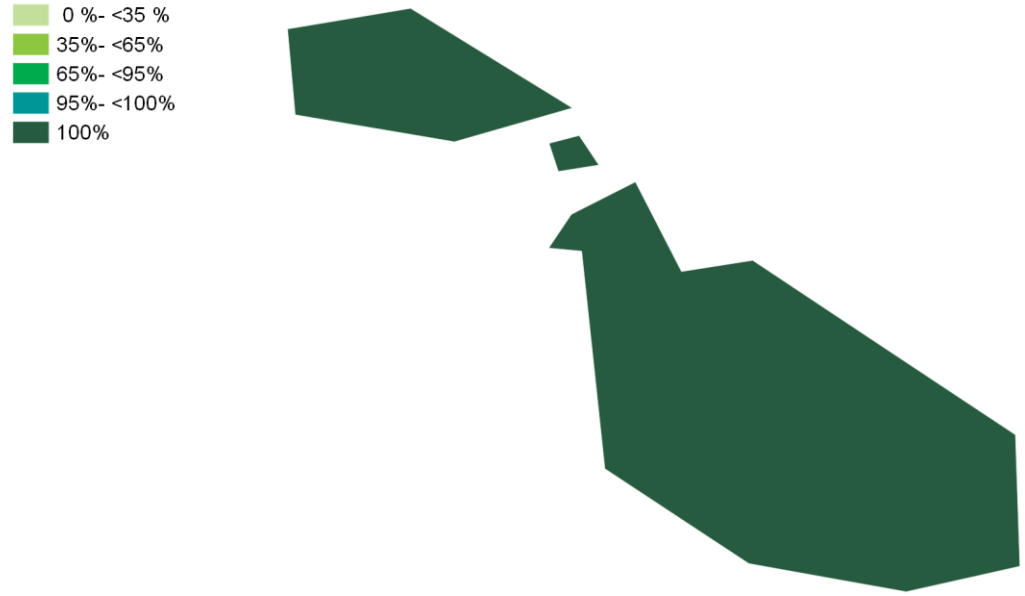
5.20.2 Regional coverage by broadband technology

Malta: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Malta: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.20.3 Data tables for Malta

Statistic	National
Population	429,344
Persons per household	2.6
Rural proportion	1.02%

	Malta 2016		Malta 2015		Malta 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	94.3%	86.0%
VDSL	72.0%	0.0%	*72.0%*	0.0%	75.0%	0.0%	48.2%	26.6%
FTTP	16.0%	0.0%	10.4%	0.0%	8.4%	0.0%	23.7%	8.8%
WiMAX	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%	17.8%	18.0%
Cable	99.9%	99.9%	100.0%	100.0%	100.0%	100.0%	44.4%	10.7%
DOCSIS 3.0	99.9%	99.9%	100.0%	99.9%	100.0%	100.0%	43.9%	10.1%
HSPA	99.9%	99.2%	99.0%	99.0%	99.0%	95.7%	98.0%	92.2%
LTE	99.5%	51.1%	72.0%	0.0%	67.0%	0.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	99.3%*	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.2%
Overall fixed broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	97.5%	92.6%
NGA broadband	100.0%	99.9%	100.0%	99.9%	100.0%	100.0%	75.9%	39.2%
At least 2 Mbps	99.78%	-	99.8%	-	99.8%	-	96.7%	-
At least 30 Mbps	99.43%	-	99.5%	-	99.5%	-	75.1%	-
At least 100 Mbps	99.39%	-	99.4%	-	99.4%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

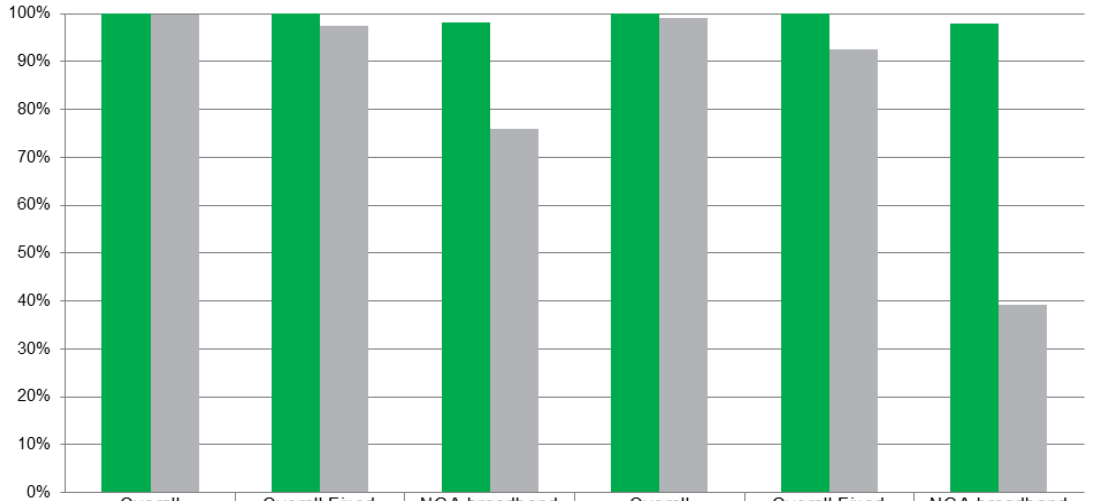
* In the DESI, a figure for end 2015 was published.

5.21 Netherlands

5.21.1 National coverage by broadband technology

Broadband coverage levels for all combination categories in the Netherlands remained unchanged in the twelve months to the end of June 2016. By mid-2016, the Netherlands reported complete coverage in relation to overall broadband and fixed broadband at a national and rural level. Meanwhile, NGA coverage was near-complete with regards to national and rural coverage, at 98.3% and 97.9%, respectively. This ensured that the Netherlands remained one of the leaders among the study countries in terms of NGA coverage, behind only Malta at a rural level and Malta, Switzerland and Belgium at a national level.

Netherlands: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Netherlands	100.0%	100.0%	98.3%	100.0%	100.0%	97.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

The Netherlands exceeded the EU average for all individual broadband technologies, except for WiMAX, which is not present in the Netherlands. DSL remained the most widespread broadband technology, achieving universal coverage. While VDSL coverage remained stable at 69.9% of households, the incumbent KPN has increased the speed of connections over its copper network via a range of technologies, including VDSL vectoring and VPlus.[74][75] KPN is also the sole owner of the wholesale fibre operator Reggefiber, which is deploying FTTP networks across the Netherlands. During the twelve-month period to mid-2016, Netherlands witnessed a 1.2 percentage point increase in the proportion of households passed by FTTP, reaching 31.2% of households. However, this made no difference to the proportion of homes passed by NGA technologies suggesting that FTTP networks were deployed in areas that already had a VDSL or DOCSIS 3.0 presence.

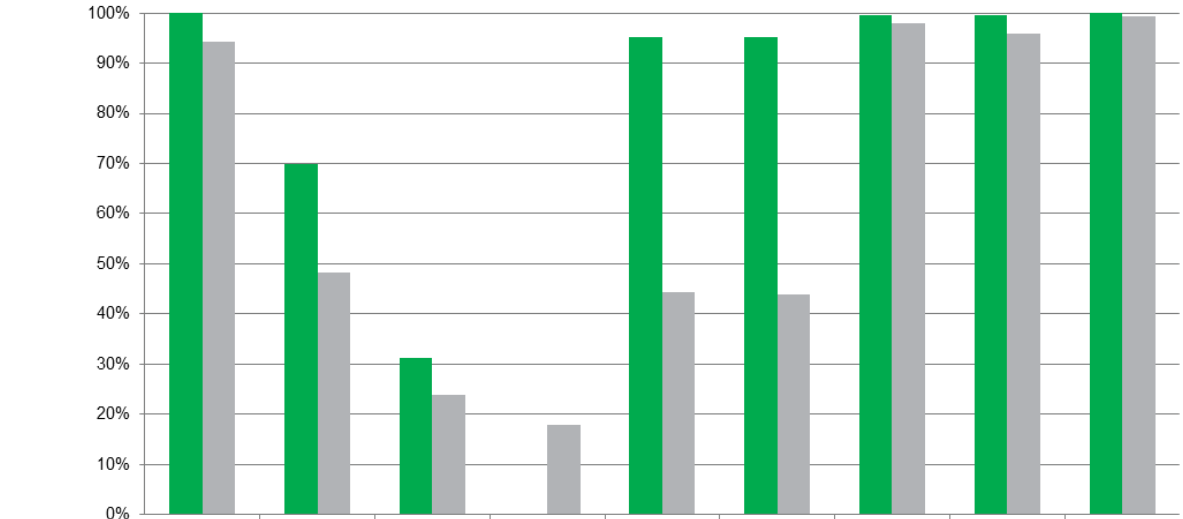
In terms of cable technologies, the availability of cable networks and DOCSIS 3.0 remained unchanged, at 95.1% of households. With near-universal coverage of DOCSIS3.0, the leading cable operator VodafoneZiggo (formerly Ziggo) plans to implement DOCSIS 3.1 standards in the next few years, enabling download speeds of 1Gbps.[76]

At the end of June 2016, the Netherlands continued to lead the study countries in terms of mobile coverage. This is unsurprising given the high availability levels reached already in 2014 and 2015. In previous years, all major mobile networks operators including KPN, T-Mobile Netherlands and Vodafone launched their LTE networks. By the end of 2014, the Netherlands reached nearly universal

[74] https://www.providers.nl/392/kpn-investeert-in-vdsl-vectoring-techniek/
[75] https://www.providers.nl/3104/kpn-begint-levering-vplus-verbinding-tot-200mbits/
[76] http://www.digitaltveurope.net/205622/upc-netherlands-doubles-upload-speeds-for-broadband/

LTE coverage with 99.6% of homes being passed by the high-speed mobile networks. Yet looking at the average coverage of all LTE network operators, LTE services were available on average to 90.6%.

Netherlands: Coverage by technology, total, 2016



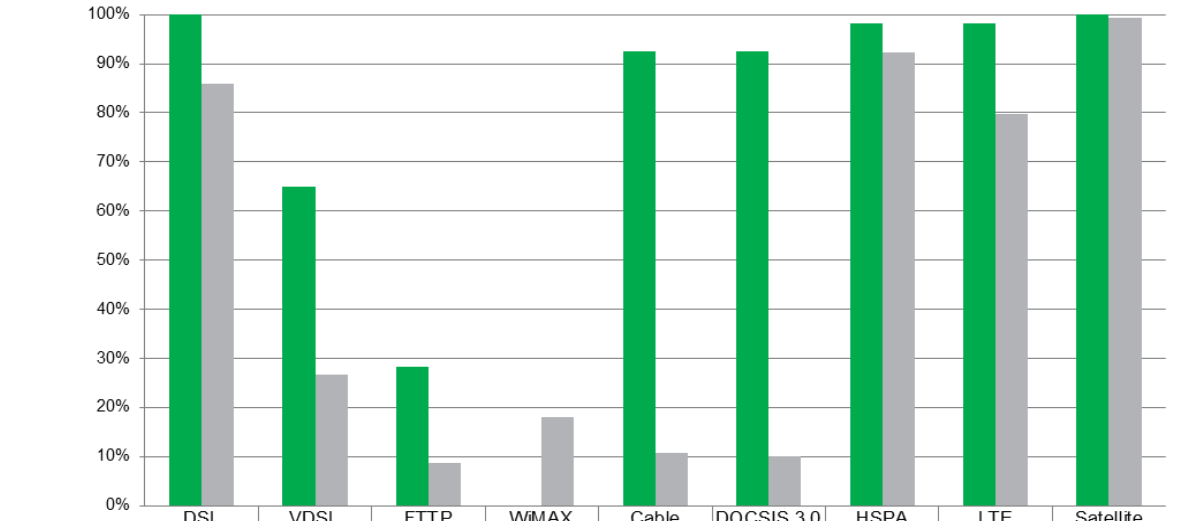
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Netherlands	100.0%	69.9%	31.2%	0.0%	95.1%	95.1%	99.6%	99.6%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Broadband coverage in rural areas was relatively unchanged, when compared with the previous year. As was the case in mid-2015, 99.9% of rural homes had access to DSL broadband services, while 92.5% of rural homes were passed by cable networks. In terms of NGA technologies, there were minimal increases in VDSL and DOCSIS 3.0 coverage. VDSL coverage increased by 0.2 percentage points to reach 64.9% of rural households, while DOCSIS 3.0 improved 0.1 percentage points to pass 92.5% of rural homes. The most substantial increase during the twelve-month period was in terms of rural FTTP availability, which grew by 1.3 percentage points, reaching 28.4% of rural households.

Mobile broadband coverage in rural areas was unchanged in the twelve months to the end of June 2016. Given the high levels of coverage reached in the previous year, at 98.2%, both HSPA and LTE rural coverage in the Netherlands remained above the EU average.

Netherlands: Coverage by technology, rural areas, 2016



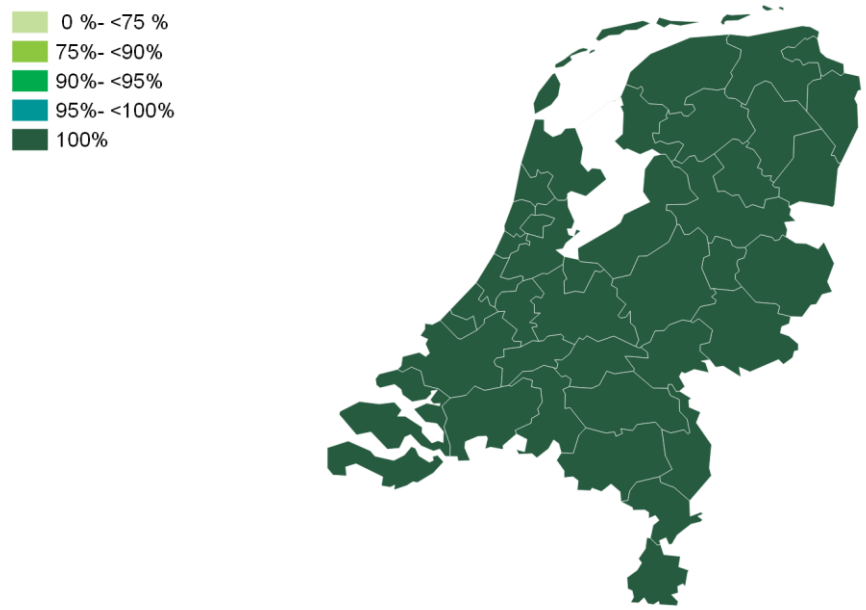
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Netherlands	99.9%	64.9%	28.4%	0.0%	92.5%	92.5%	98.2%	98.2%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.21.2 Regional coverage by broadband technology

Fixed broadband coverage remained unchanged across the individual regions with all households being able to access fixed broadband services at the end of June 2016.

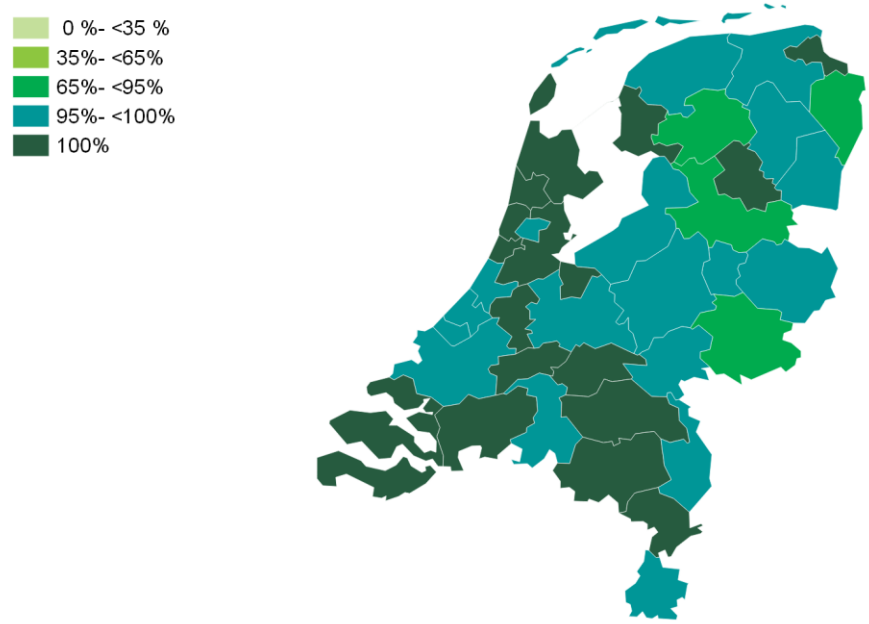
Netherlands: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA coverage was slightly more varied in the individual regions. Eighteen regions recorded complete NGA availability, while the lowest NGA coverage continued to be in Oost-Groningen region, where nearly 90% of households had access to high-speed broadband.

Netherlands: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.21.3 Data tables for Netherlands

Statistic	National
Population	16,900,726
Persons per household	2.2
Rural proportion	8.2%

	Netherlands 2016		Netherlands 2015		Netherlands 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	100.0%	99.9%	100.0%	99.9%	100.0%	99.9%	94.3%	86.0%
VDSL	69.9%	64.9%	69.9%	64.7%	68.9%	51.1%	48.2%	26.6%
FTTP	31.2%	28.4%	29.7%	27.1%	28.2%	20.5%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	95.1%	92.5%	95.1%	92.4%	96.8%	93.2%	44.4%	10.7%
DOCSIS 3.0	95.1%	92.5%	95.1%	92.4%	96.8%	93.2%	43.9%	10.1%
HSPA	99.6%	98.2%	99.6%	98.3%	99.6%	95.5%	98.0%	92.2%
LTE	99.6%	98.2%	99.6%	98.3%	99.6%	95.5%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	90.6%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.2%
Overall fixed broadband	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	97.5%	92.6%
NGA broadband	98.3%	97.9%	98.3%	97.8%	98.4%	97.7%	75.9%	39.2%
At least 2 Mbps	100.0%	-	100.0%	-	100.0%	-	96.7%	-
At least 30 Mbps	98.2%	-	98.2%	-	98.4%	-	75.1%	-
At least 100 Mbps	98.2%	-	98.1%	-	98.2%	-	50.8%	-

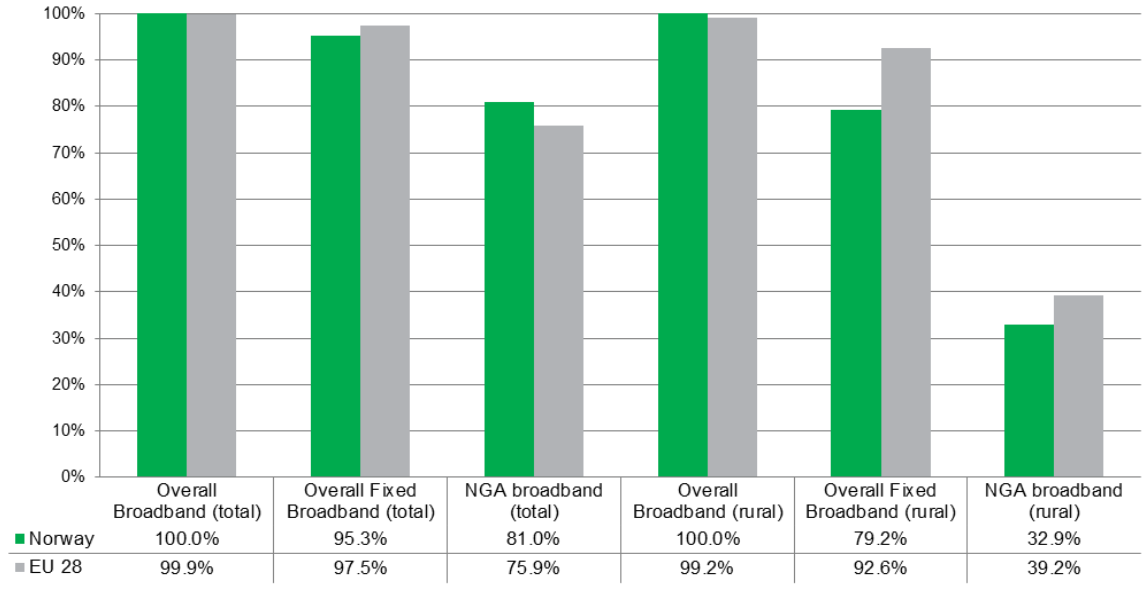
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.22 Norway

5.22.1 National coverage by broadband technology

As of the end of June 2016, Norway was above the EU average for overall broadband coverage, both nationally and in rural areas. On the other hand, Norway remained slightly below the EU average in terms of fixed broadband coverage at a total and rural level. Examining NGA broadband availability, Norway was above the EU average at a total level, as 81% of households were passed by at least one NGA technology. However, Norway was below the EU average for rural NGA coverage, with less than one-third (32.9%) of rural homes able to access NGA broadband.

Norway: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Norway	100.0%	95.3%	81.0%	100.0%	79.2%	32.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Looking at the coverage levels of individual broadband technologies, DSL coverage improved by 1.1 percentage points during the year to reach 90.6% of households by mid-2016, but remained below the EU average. VDSL coverage also witnessed an improvement during the period, rising by 2.6 percentage points, with a half (49.9%) of Norwegian household covered and above the EU average of 48.2%. There was also growth in the reach of cable networks, up to 51.9% from 50.6%, which was higher than the EU average (44.4%). DOCSIS 3.0 coverage improved by 1.6 percentage points to 51.9%, meaning that all cable networks were upgraded to DOCSIS 3.0 as of mid-2016.

The biggest improvement in terms of fixed broadband technologies concerned FTTP coverage, which increased by 5.2 percentage points. This trend can be expected to continue, with Telenor aiming to deploy the technology to a further 800k homes by 2020.[77] By mid-2016, nearly a half (46.3%) of Norwegian households was covered by FTTP technology, therefore exceeding the EU average of 23.7%.

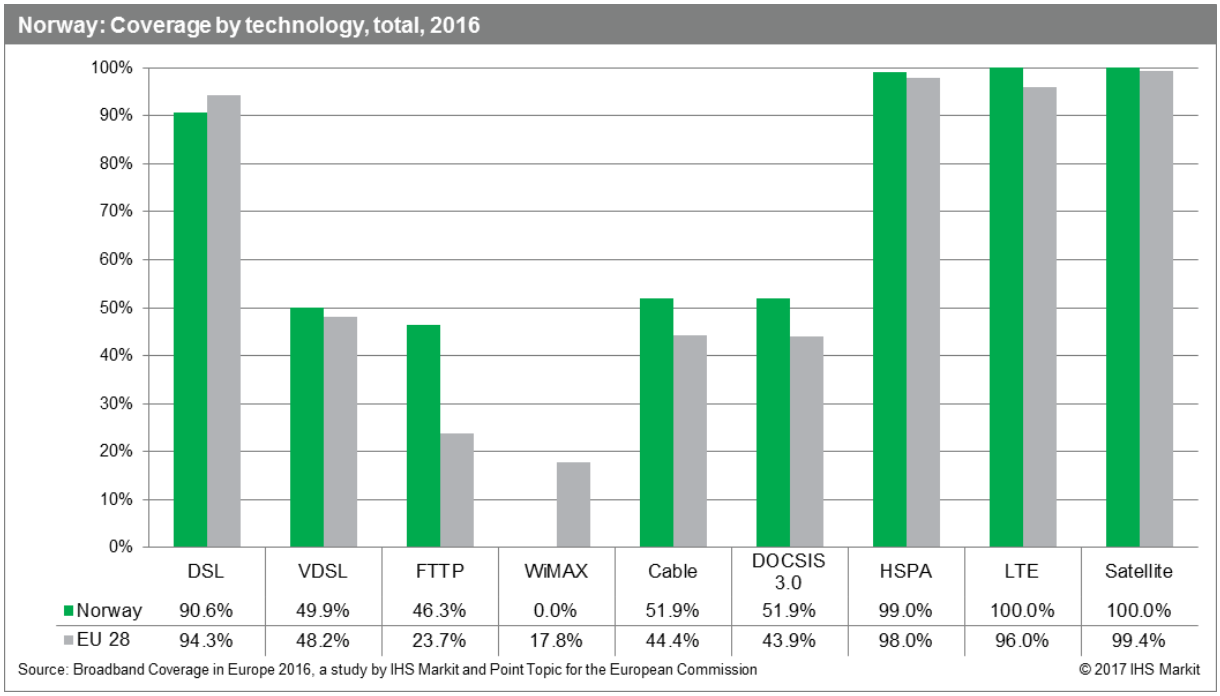
Examining mobile broadband technologies, HSPA networks continued to cover 99.0% of Norwegian homes. LTE networks increased 0.4 percentage points during the twelve-month period, reaching universal coverage level. In addition, a ubiquitous LTE network coverage is provided by all mobile network operators meaning that average LTE operator coverage also reached 100%.

With complete LTE coverage provided by all operators, mobile network operators have begun to look towards new technologies to provide further innovation and greater speeds. Telenor[78] and Telia

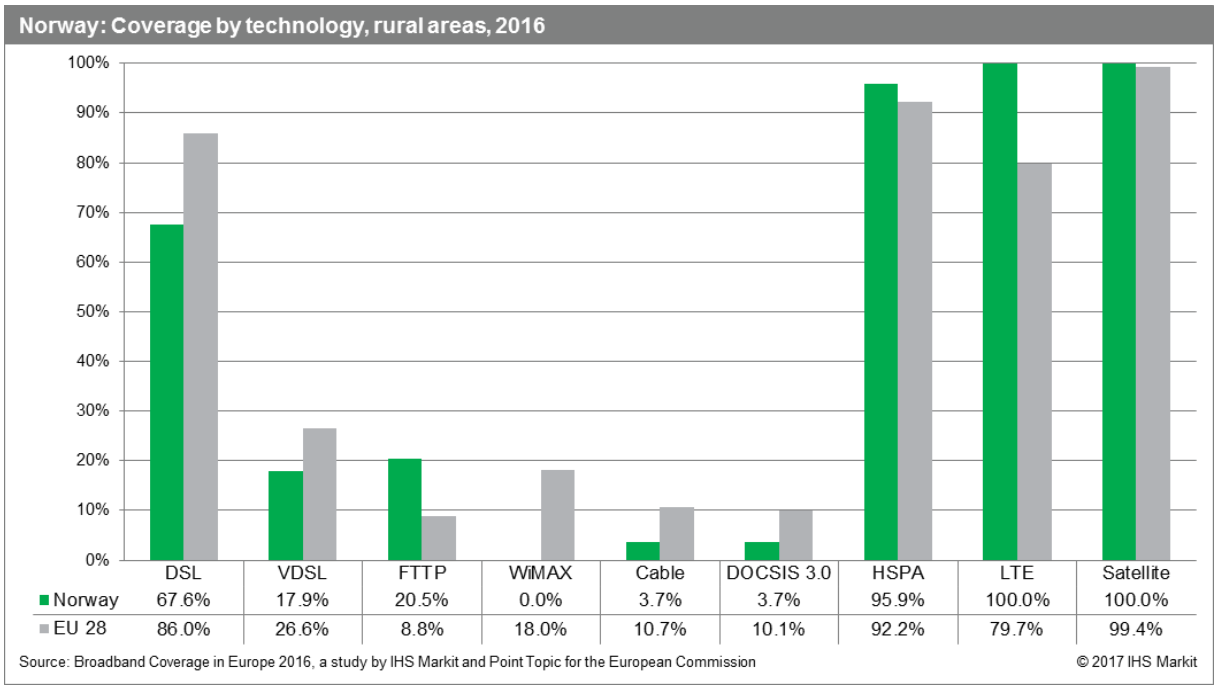
[77] https://www.telenor.com/wp-content/uploads/2017/02/Telenor-CMD-2017-Telenor-Norway.pdf

[78] http://telecomist.com/2015/04/telenor-introducing-lte-a-in-more-than-200-municipalities/

Company[79] (formerly NetCom) launched their LTE-Advanced networks in 2015, with the former's LTE-A network covering 91.4% of the Norwegian population as of October 2016. [80]



Although significantly below the EU average (86.0%), DSL remained the most prevalent technology in rural areas. DSL networks passed 67.6% of rural homes at the end of June 2016, while the next most widespread fixed broadband technology, FTTP, passed 20.5% of rural homes. VDSL networks were the fastest-growing broadband technology in rural areas in the year to mid-2016, rising by 2.3 percentage points to 17.9%. At 3.7%, rural DOCSIS 3.0 networks continued to have a marginal impact on rural NGA coverage across Norway.



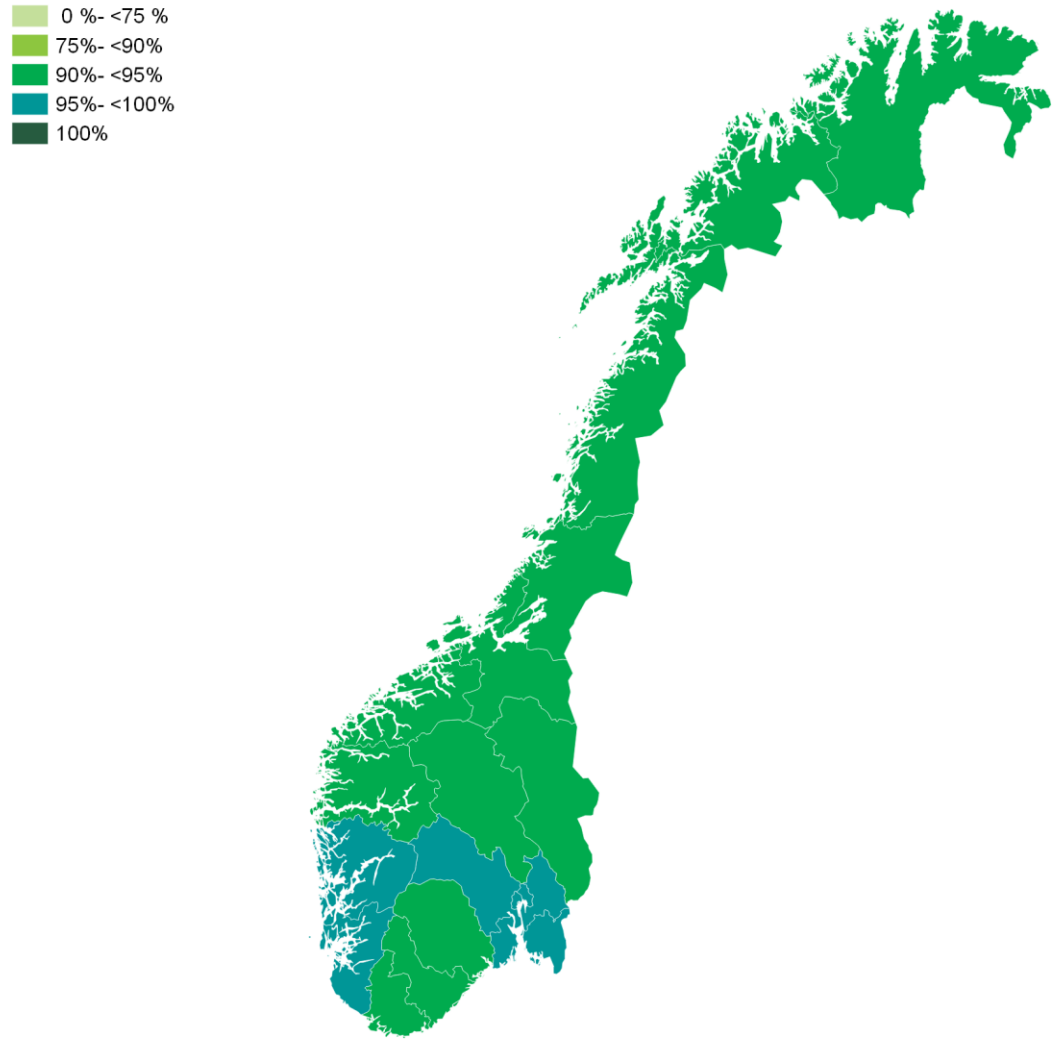
[79] https://www.telegeography.com/products/commsupdate/articles/2015/03/06/netcom-launches-limited-lte-a-offering/
[80] https://www.telenor.com/wp-content/uploads/2017/02/Telenor-CMD-2017-Telenor-Norway.pdf

Norway continued to be one of the leaders in terms of rural mobile broadband coverage, with HSPA and LTE coverage considerably above the EU average. HSPA networks reached 95.9% of homes as of mid-2016, while LTE coverage improved 1.7 percentage points during the twelve month-period to achieve universal coverage.

5.22.2 Regional coverage by broadband technology

Given the country's size and population distribution, there is a degree of regional variation with regards to fixed broadband coverage. While nearly complete coverage was reported for the capital Oslo, in three regions (Finnmark, Sogn og Fjordane, and Nord-Trøndelag) fixed broadband coverage remained between 90% and 91%.

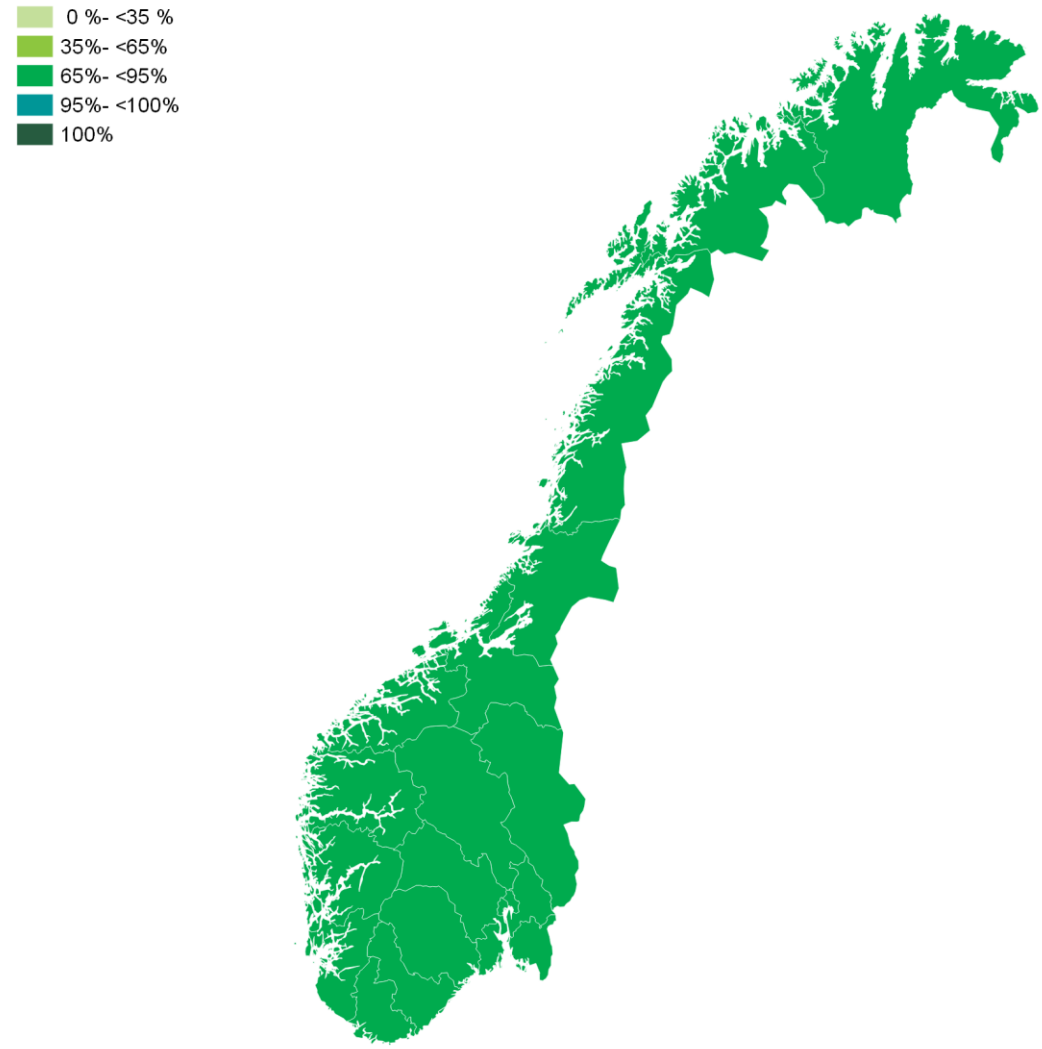
Norway: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

There were even greater differences between regions in terms of NGA coverage, which ranged from 67.7% in Sogn og Fjordane and 68.5% Oppland to around 95% in Oslo. There weren't any significant increases in regional NGA coverage over the twelve months to the end of June 2016.

Norway: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.22.3 Data tables for Norway

Statistic	National
Population	5,166,493
Persons per household	2.0
Rural proportion	21.4%

	Norway 2016		Norway 2015		Norway 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	90.6%	67.6%	89.5%	67.4%	90.4%	70.2%	94.3%	86.0%
VDSL	49.9%	17.9%	47.3%	15.6%	36.5%	13.4%	48.2%	26.6%
FTTP	46.3%	20.5%	41.1%	18.4%	40.0%	22.3%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	51.9%	3.7%	50.6%	2.7%	49.5%	2.9%	44.4%	10.7%
DOCSIS 3.0	51.9%	3.7%	50.3%	2.4%	49.5%	2.9%	43.9%	10.1%
HSPA	99.0%	95.9%	99.0%	*95.6%*	98.6%	95.0%	98.0%	92.2%
LTE	100.0%	100.0%	99.6%	*98.3%*	83.0%	31.7%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	100.0%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	99.5%	*97.8%*	99.3%	97.5%	99.9%	99.2%
Overall fixed broadband	95.3%	79.2%	94.7%	77.4%	95.2%	81.7%	97.5%	92.6%
NGA broadband	81.0%	32.9%	79.6%	32.2%	78.0%	31.2%	75.9%	39.2%
At least 2 Mbps	100.0%	-	95.3%	-	95.2%	-	96.7%	-
At least 30 Mbps	82.0%	-	78.6%	-	75.0%	-	75.1%	-
At least 100 Mbps	78.0%	-	39.0%	-	28.0%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

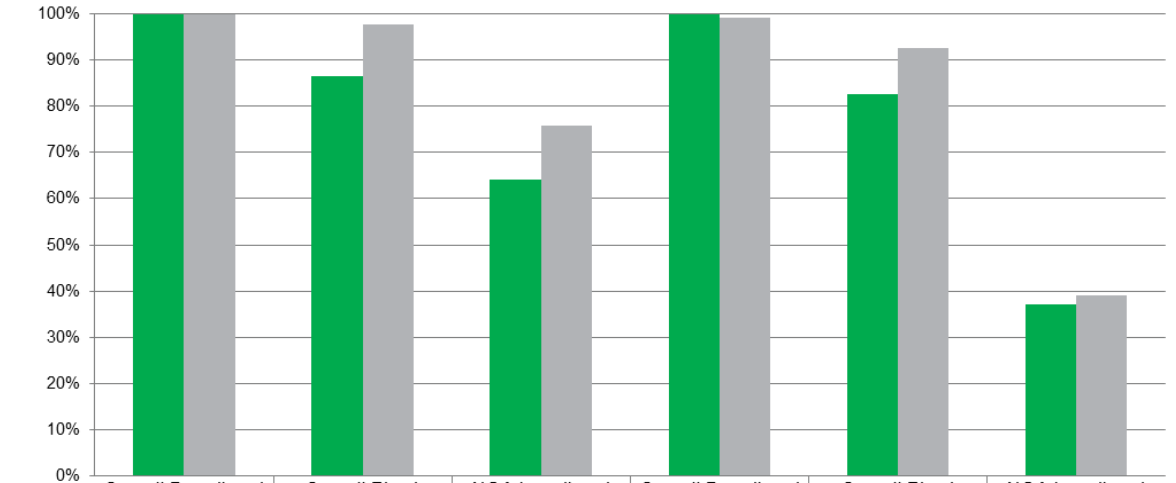
5.23 Poland

5.23.1 National coverage by broadband technology

While Poland achieved near-universal overall broadband coverage, its fixed broadband coverage remained below the EU average on both a national and rural level. By mid-2016, 86.4% of Polish households had access to at least one fixed broadband technology, a 0.2 percentage point increase. This was considerably lower than the EU average of 97.5%. Fixed broadband coverage in rural areas was 15 percentage points lower than the EU average, covering 82.5% of rural households.

NGA coverage in Poland was also below the EU average, both nationally and in rural areas. At a national level, Poland witnessed a 3.4 percentage point increase in NGA coverage. Yet, with 64.1% of households covered, it was still lower than the 75.9% average for EU households. On a rural level, NGA coverage increased by a similar amount, passing 37.2% of rural homes compared to the EU average of 39.2%.

Poland: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Poland	99.9%	86.4%	64.1%	99.8%	82.5%	37.2%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

A detailed look at coverage levels of the individual technologies explains Poland's shortcomings in fixed broadband availability. As of mid-2016, Poland was one of six study countries with DSL coverage of less than 80% of households with DSL networks reaching 75.7% of Polish households. Cable networks covered 43.6% of homes, around one percentage point below the EU average, while all cable networks in Poland were upgraded to DOCSIS 3.0 by mid-2016.

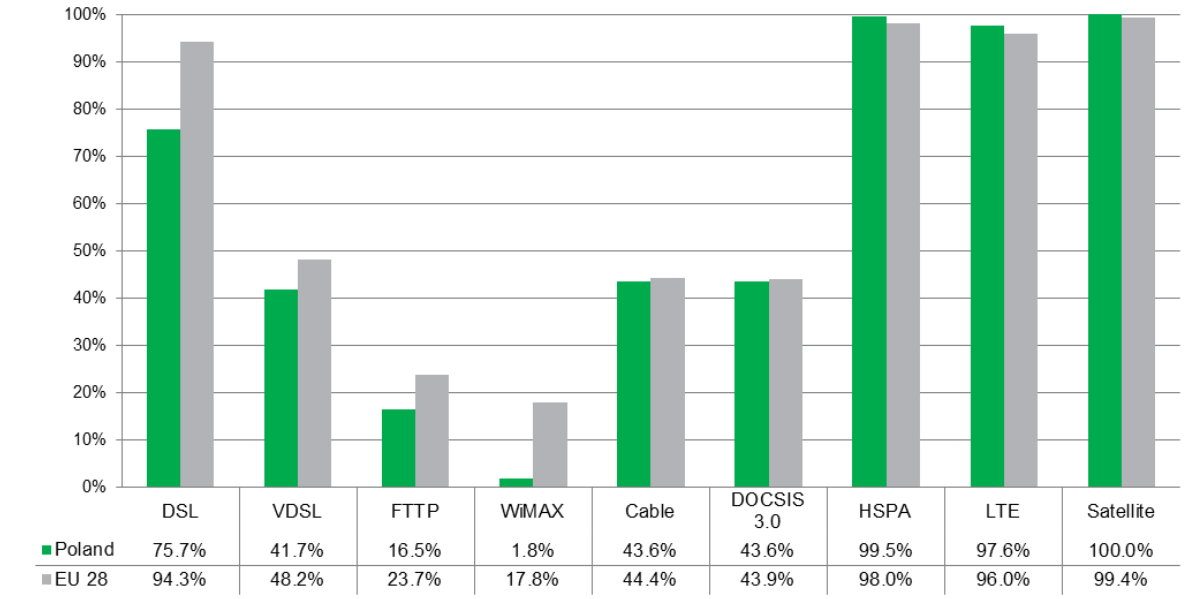
In terms of other NGA technologies, availability of VDSL services remained stable at 41.7%. In contrast, there was a 7.5 percentage point growth in FTTP networks, reaching 16.5% of Polish households. This was due to the incumbent Orange Polska's deployment of FTTP services, with the operator planning to reach 3.5 million homes by 2018.[81]

LTE coverage increased considerably during the twelve months to the end of June 2016, recording a 21.7 percentage point growth. At 97.6%, LTE coverage was above the EU average of 96.0%. This improvement coincided with mobile operators Orange and T-Mobile deploying the 800MHz and 2600MHz frequencies that they won in the October 2015 spectrum auction[82]. Moreover, average LTE coverage of all operators reached 90.7% by mid-2016.

[81] https://www.orange.com/en/news/2016/mai/In-Poland-Orange-extends-its-fiber-optic-network

[82] https://www.telegeography.com/products/commsupdate/articles/2016/02/09/orange-t-mobile-poland-using-new-lte-bands/

Poland: Coverage by technology, total, 2016



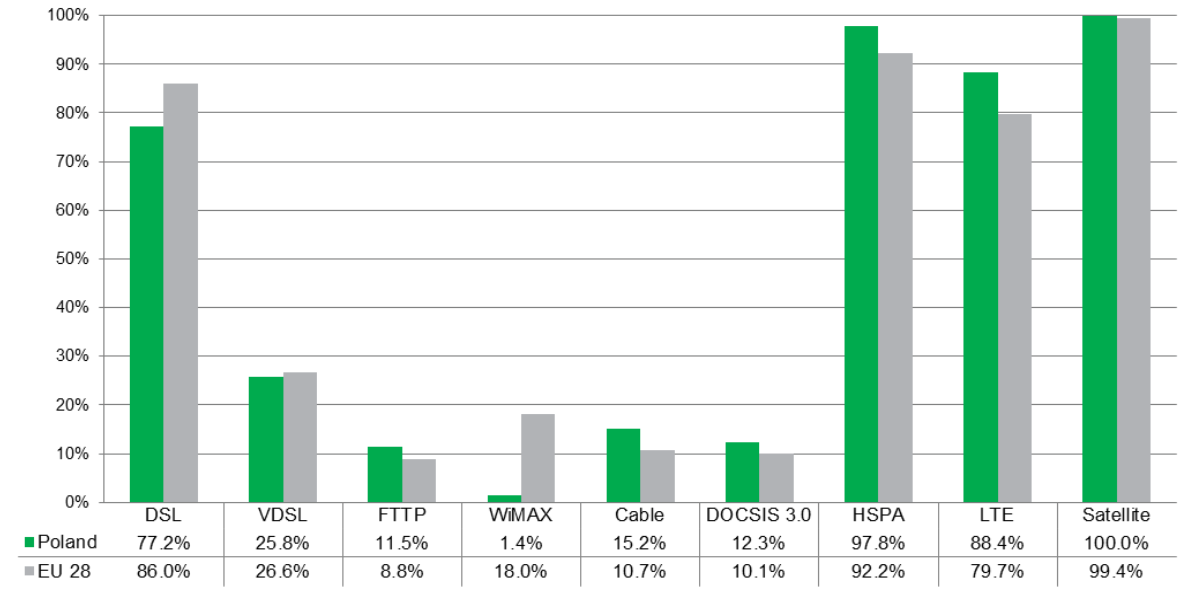
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Poland	75.7%	41.7%	16.5%	1.8%	43.6%	43.6%	99.5%	97.6%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Rural DSL coverage, similar to rural cable availability, remained stable in the twelve months to the end of June 2016. In rural areas, there was growth in the availability of FTTP networks as coverage increased 5.7 percentage points during the period. By mid-2016, FTTP services reached 11.5% of rural homes in Poland compared to the EU average of 9.4%. Nevertheless, VDSL remained the primary NGA technology available in rural areas. It passed a quarter (25.8%) of rural homes, unchanged from the previous year. Rural DOCSIS 3.0 coverage increased slightly, growing 1.2 percentage points and covering 12.3% of rural households by mid-2016.

There was a substantial increase in the availability of LTE services in rural areas during the year to mid-2016. Rural LTE coverage improved 82.7 percentage points to reach 88.4% of households, which was above the EU average (79.7%).

Poland: Coverage by technology, rural areas, 2016



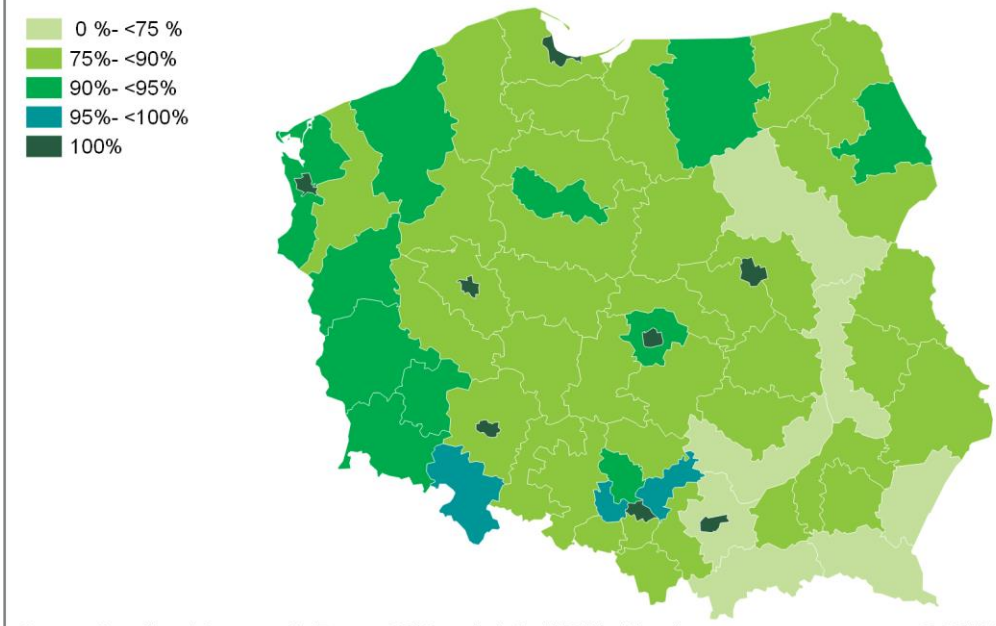
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Poland	77.2%	25.8%	11.5%	1.4%	15.2%	12.3%	97.8%	88.4%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.23.2 Regional coverage by broadband technology

There were considerable regional differences in terms of fixed broadband coverage in Poland. Urban centres, such as Warsaw, Lodz, Krakow, Gdansk, Szczecin, Wroclaw, or Poznan recorded complete fixed broadband coverage. But in a number of regions, such as in the Krakowski and Sandomiersko-jedrzejowski regions, fixed broadband was available to less than 65% of households.

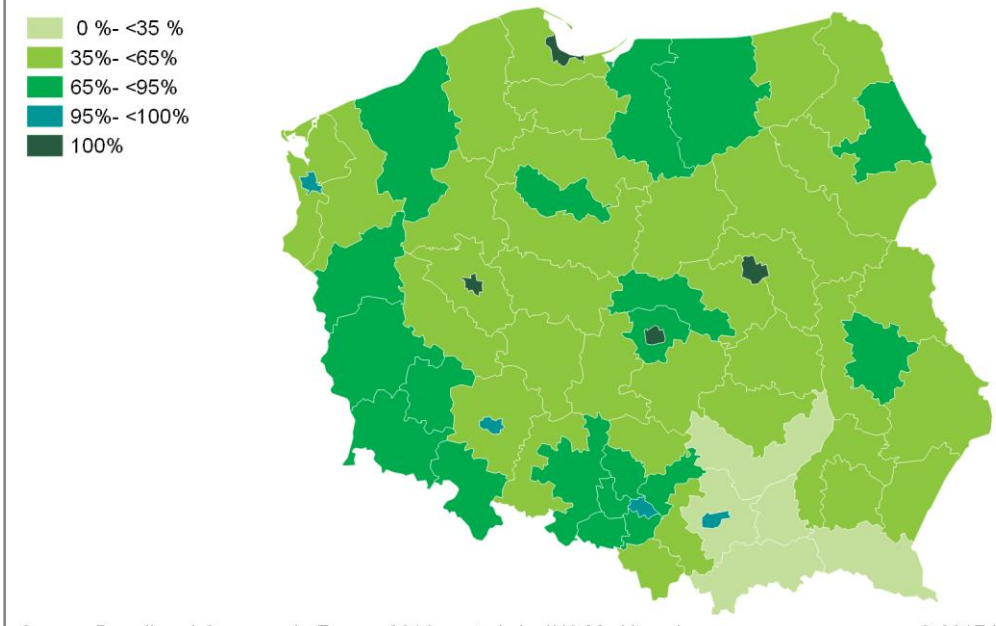
Poland: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Large differences were also recorded for NGA coverage. Complete coverage was observed in the capital Warsaw, city of Lódz, Poznan, and in the Trojmiejski urban regions, whereas coverage levels did not exceed 30% of households in three regions (Krakowski, Nowosadecki, and Sandomiersko-jedrzejowski).

Poland: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.23.3 Data tables for Poland

Statistic	National
Population	38,017,059
Persons per household	2.8
Rural proportion	20.7%

	Poland 2016		Poland 2015		Poland 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	75.7%	77.2%	76.2%	77.0%	75.6%	75.3%	94.3%	86.0%
VDSL	41.7%	25.8%	42.7%	25.8%	28.5%	25.1%	48.2%	26.6%
FTTP	16.5%	11.5%	9.0%	5.8%	7.3%	4.3%	23.7%	8.8%
WiMAX	1.8%	1.4%	2.4%	1.8%	2.5%	1.4%	17.8%	18.0%
Cable	43.6%	15.2%	42.0%	14.9%	40.5%	14.7%	44.4%	10.7%
DOCSIS 3.0	43.6%	12.3%	40.0%	11.1%	39.5%	10.8%	43.9%	10.1%
HSPA	99.5%	97.8%	99.5%	97.8%	99.5%	97.8%	98.0%	92.2%
LTE	97.6%	88.4%	75.9%	5.7%	66.7%	3.4%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	90.7%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.9%	99.8%	99.8%	99.5%	99.8%	99.3%	99.9%	99.2%
Overall fixed broadband	86.4%	82.5%	86.2%	81.5%	85.4%	79.9%	97.5%	92.6%
NGA broadband	64.1%	37.2%	60.7%	33.8%	53.4%	31.1%	75.9%	39.2%
At least 2 Mbps	81.8%	-	81.0%	-	80.2%	-	96.7%	-
At least 30 Mbps	63.7%	-	53.5%	-	42.2%	-	75.1%	-
At least 100 Mbps	57.2%	-	22.0%	-	13.5%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

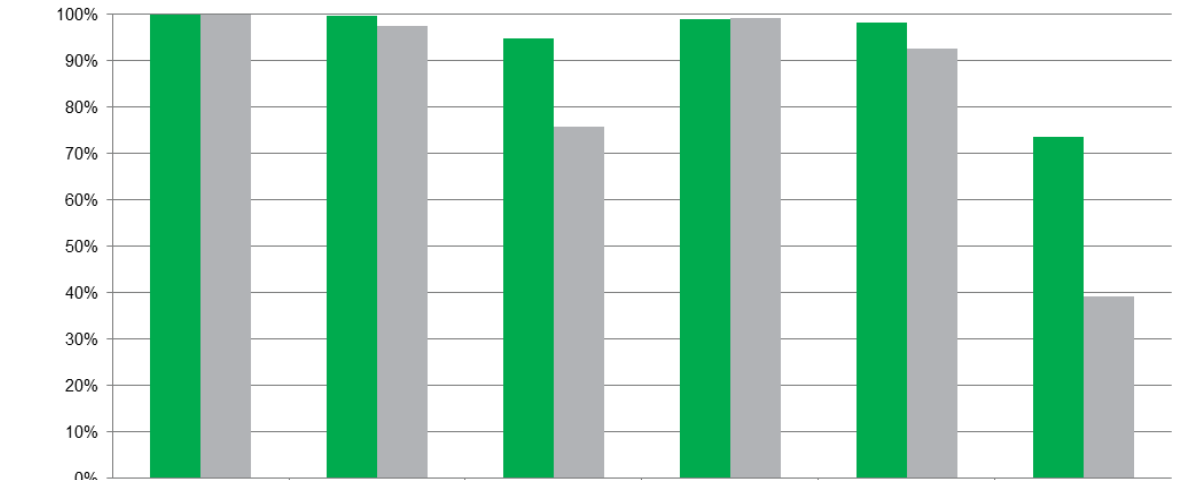
5.24 Portugal

5.24.1 National coverage by broadband technology

As was the case in 2015, Portugal remained above the EU average in all combination categories. Overall broadband and fixed broadband recorded almost complete fixed broadband coverage, with 99.8% of all Portuguese households being passed by at least one fixed network and 99.1% of rural households having access to fixed broadband services in mid-2016.

With fixed broadband technologies recording near universal coverage, it means that progress in broadband coverage is limited to availability of NGA technologies. Over the twelve months to mid-2016, NGA coverage increased by 4.1 percentage points and with 95.0% of households having access to high-speed broadband services exceeded the EU average of 75.9% by a significant margin. In addition, rural NGA coverage grew by 9.4 percentage points, leading to nearly three-quarters (73.5%) of rural households being able to connect to a NGA broadband by the end of June 2016.

Portugal: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Portugal	99.9%	99.8%	95.0%	99.1%	98.4%	73.5%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Looking at the coverage of individual technologies, it is possible to see that while DSL coverage is nearly universal, DSL networks have not been upgraded to VDSL. This is due to the long-term preference of Portuguese network operators to deploy FTTP networks across the country rather than rolling out VDSL upgrades. FTTP coverage already increased dramatically since 2014 and this trend continued into the first half of 2016. By mid-2016, FTTP coverage grew by 10.7 percentage points, resulting in 86.1% of households having access to FTTP services and Portugal being the leader in FTTP coverage among the study countries and jumping ahead of the traditionally strong Baltic States for the first time in the history of the BCE study.

Portugal has been able to benefit from lower labour costs and an underground duct system installed over 30 years ago, which both contribute to lowering the costs of FTTP deployment. It has thus been feasible for the incumbent Portugal Telecom and other network operators to prioritise FTTP deployment. Additionally, Portugal is one of few countries (along with Spain and to a lesser degree France), which have seen fruitful cooperation among leading ISPs (Vodafone/Portugal Telecom[83] and Vodafone/Sonaecom [84]) with network sharing and joint deployment agreements contributing to expedited rollout and reduced costs of fibre-optic network deployment.

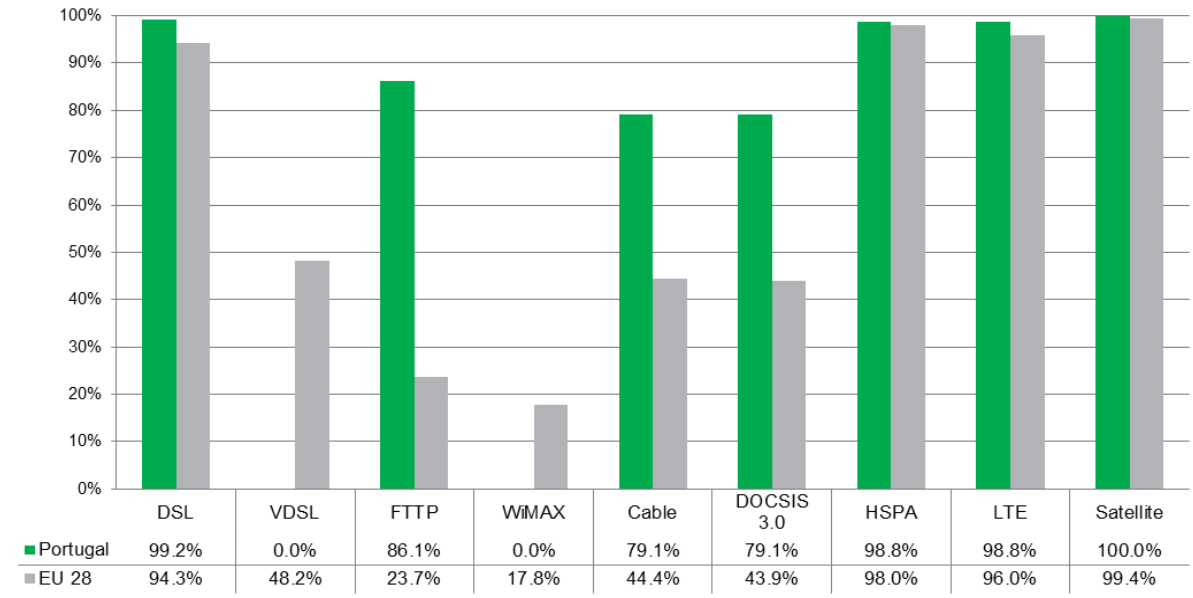
In relation to mobile technologies, LTE coverage experienced a 4.5 percentage point increase to 98.8% of households passed by the technology. HSPA coverage rose by 1.7 percentage point to 98.8%, bringing both mobile broadband technologies in line with the EU average. When average

[83] http://www.vodafone.com/content/index/media/vodafone-group-releases/2014/vodafone-portugal-fibre-sharing.html

[84] http://press.vodafone.pt/en/2009/12/21/sonaecom-and-vodafone-sign-cooperation-agreement-on-ngn/

coverage of LTE networks of all mobile network operators is considered, on average 95.3% of Portuguese had access to LTE services at the end of June 2016.

Portugal: Coverage by technology, total, 2016

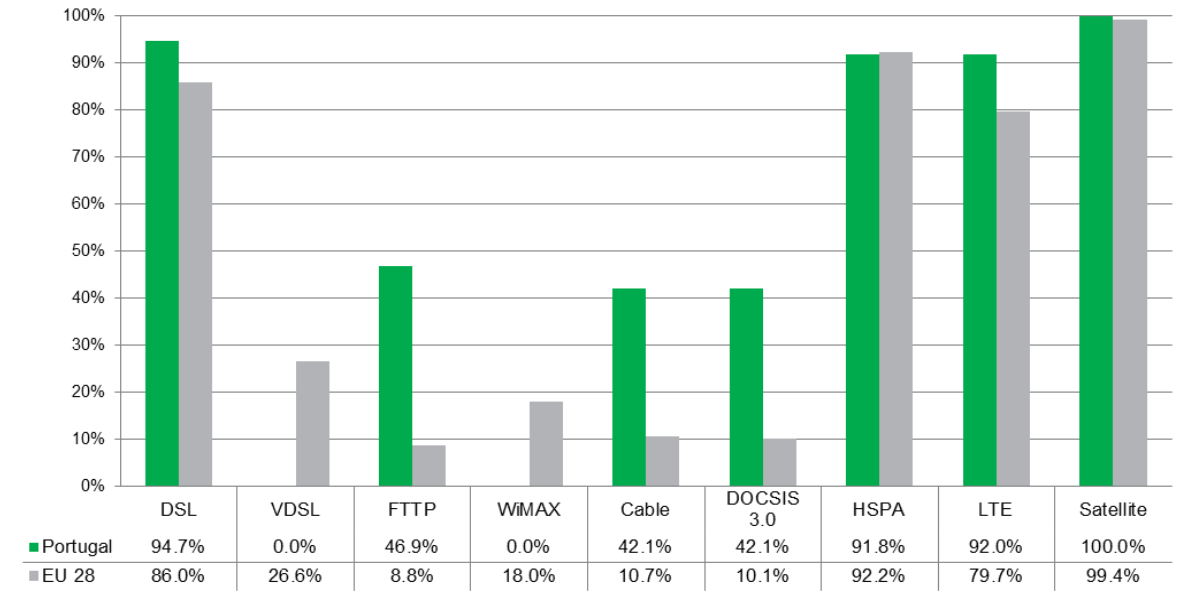


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Portugal	99.2%	0.0%	86.1%	0.0%	79.1%	79.1%	98.8%	98.8%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In terms of coverage in rural areas, while DOCSIS 3.0 remained unchanged, rural FTTP coverage experienced a substantial 16.7 percentage point growth, making it the key NGA technology in rural areas, with 46.9% of rural homes passed by FTTP networks (five times the EU average). This is a result of continued rural FTTP deployment by regional indirect access providers, dstelecomand Fibroglobal.[85]

Portugal: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Portugal	94.7%	0.0%	46.9%	0.0%	42.1%	42.1%	91.8%	92.0%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

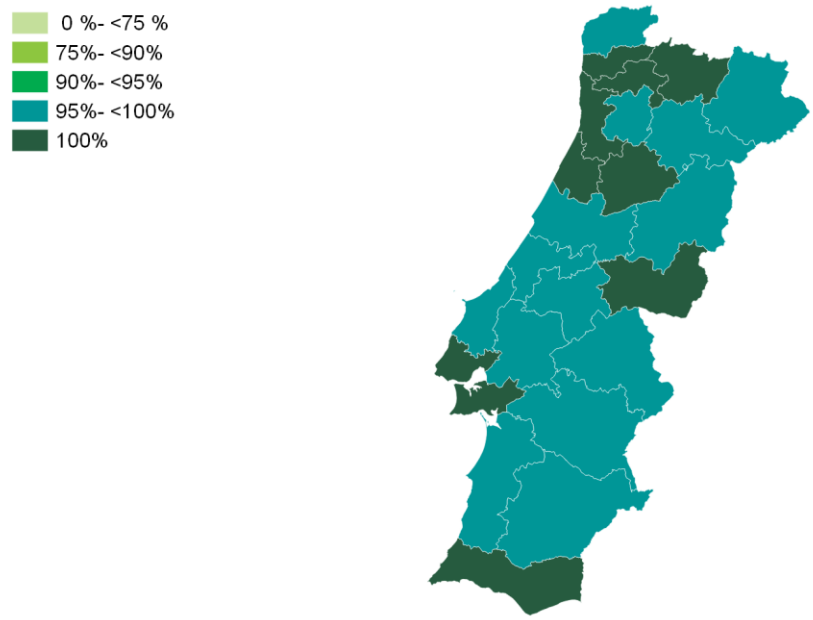
Rural LTE networks also observed significant growth, increasing by 25 percentage points to pass 92% of rural homes by mid-2016. In addition, rural HSPA availability increased by 7.3 percentage points to cover 91.8% of rural households.

[85] http://www.norte.dstelecom.pt/noticias/dstelecom-distinguida-como-operador-europeu-que-melhor-contribuiu-para-reforco-de-fibra-otica/?year=&start=

5.24.2 Regional coverage by broadband technology

In terms of fixed broadband coverage there were not any substantial differences between the individual regions. Nine regions recorded complete fixed broadband coverage while in the remaining 15 regions between 98% and 99% of households had access to fixed broadband services.

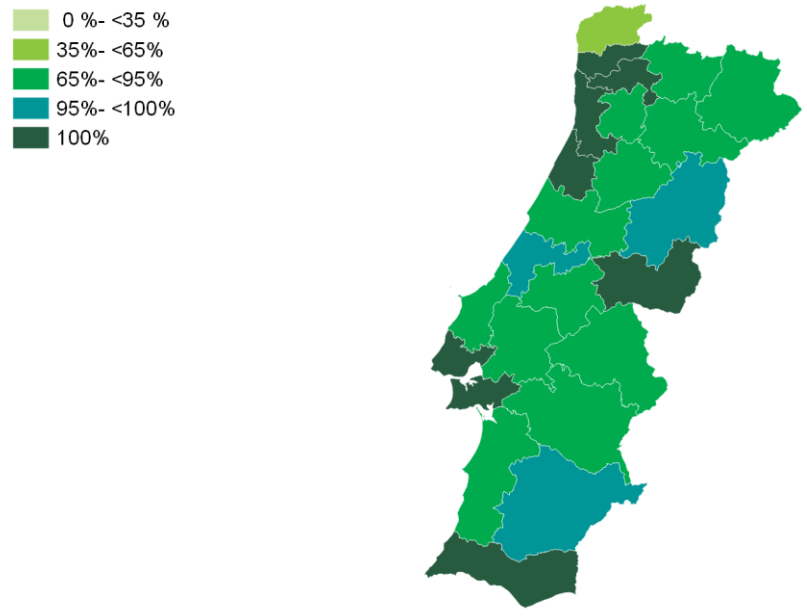
Portugal: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

There was much more regional variation in terms of NGA coverage. Complete coverage was observed in six regions (the Lisbon and Porto metropolitan areas, Algarve, Cávado, Ave, and the Beira Baixa region), while only in Alto Minho less than 65% of households had access to NGA services and in other two regions (Médio Tejo and Alentejo Litoral) was NGA coverage lower than 80%.

Portugal: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

The following broadband coverage levels were recorded in Portuguese regions outside mainland Europe:

Coverage data for Portuguese NUTS 3 areas outside mainland Europe			
NUTS 3	Description	Overall fixed broadband coverage	NGA broadband coverage
P200	Região Autónoma dos Açores	99.98%	99.8%
P300	Região Autónoma da Madeira	99.98%	86.3%

5.24.3 Data tables for Portugal

Statistic	National
Population	10,472,159
Persons per household	2.6
Rural proportion	15.1%

	Portugal 2016		Portugal 2015		Portugal 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	99.2%	94.7%	99.1%	97.3%	99.1%	97.1%	94.3%	86.0%
VDSL	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	48.2%	26.6%
FTTP	86.1%	46.9%	75.4%	*30.2%*	65.8%	*23.0%*	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	79.1%	42.1%	79.4%	*43.9%*	80.1%	*40.4%*	44.4%	10.7%
DOCSIS 3.0	79.1%	42.1%	79.4%	*43.9%*	80.0%	*40.4%*	43.9%	10.1%
HSPA	98.8%	91.8%	96.8%	*84.5%*	96.7%	*78.0%*	98.0%	92.2%
LTE	98.8%	92.0%	94.3%	67.0%	94.2%	*63.8%*	96.0%	79.7%
LTE average operator coverage (DESI indicator)	95.3%	-	-	-	-	-	84.4%	-
Satellite	100%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.9%	99.1%	99.8%	*98.9%*	99.8%	*99.0%*	99.9%	99.2%
Overall fixed broadband	99.8%	98.4%	99.8%	*98.8%*	99.8%	*98.6%*	97.5%	92.6%
NGA broadband	95.0%	73.5%	90.9%	*64.1%*	89.1%	*57.4%*	75.9%	39.2%
At least 2 Mbps	98.85%	-	98.1%	-	99.1%	-	96.7%	-
At least 30 Mbps	93.75%	-	90.9%	-	86.6%	-	75.1%	-
At least 100 Mbps	89.48%	-	88.0%	-	86.1%	-	50.8%	-

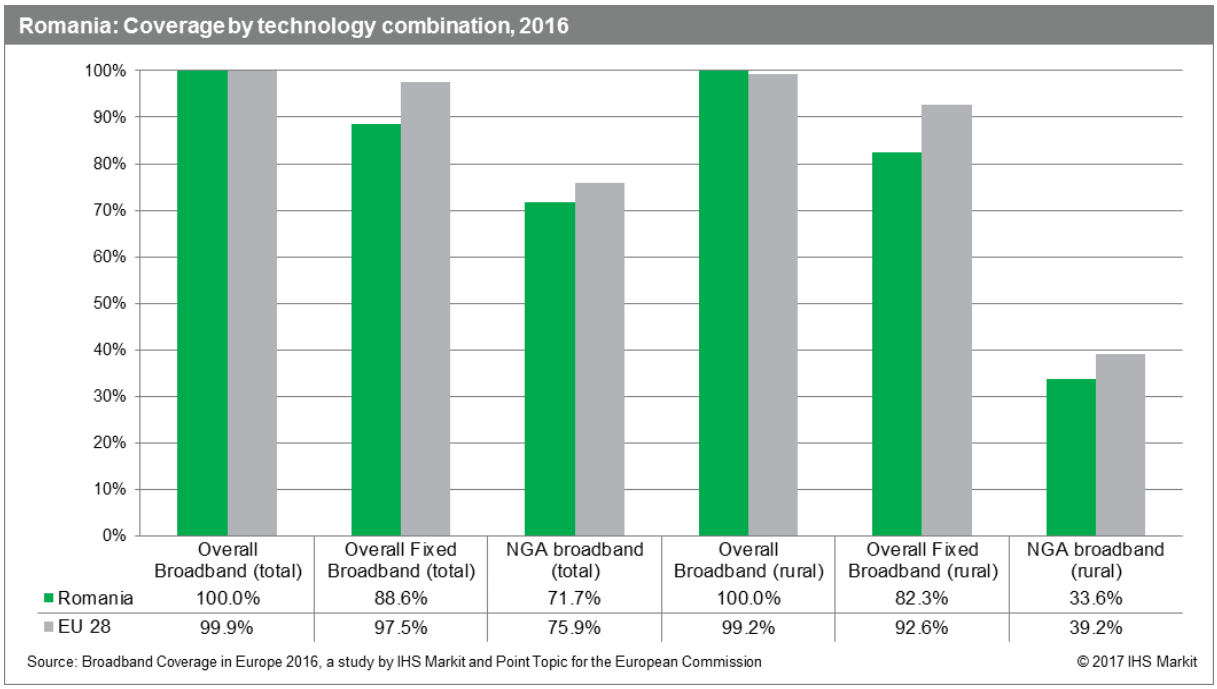
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

During the 2016 data collection, newly introduced checks of rural coverage estimates, comparing the number of uncovered households on a total level to the number of uncovered rural households identified previously underestimated rural FTTP, Cable, DOCSIS 3.0 and HSPA coverage levels leading to restatements of data reported in previous year. All restatements are highlighted in italics.

5.25 Romania

5.25.1 National coverage by broadband technology

In mid-2016, Romania continued to lag behind the EU average in terms of fixed broadband coverage on both national and rural level, but it once again performed better than the European average with regards to NGA availability. At the end of June 2016, 88.6% of Romanian households had access to fixed broadband services compared to the EU average of 97.5%. In rural areas, fixed broadband networks passed 82.3% of rural homes, while in the EU as a whole 92.7% of rural households were able to connect to fixed broadband. NGA broadband coverage increased by 1.1 percentage points during the twelve months to the end of June 2016 and reached 71.7% of all Romanian households. Furthermore, NGA broadband services were available to a third (33.6%) of rural households, following a 4.1 percentage point increase.



Romania's below-average fixed broadband coverage can be explained with a closer look at coverage levels of the individual technologies, which shows limited availability of both DSL and cable technologies. DSL services were available to 65.9% of homes, which was below the EU average of 94.3%. Meanwhile, cable networks passed 32.3% of households, a 1.5 percentage point increase compared to the previous study, but still considerably behind the EU average of 44.4%.

Examining NGA availability, both the incumbent Telekom Romania and RCS&RDS continued to invest in FTTP services[86] and by the end of June 2016, FTTP networks in Romania passed 59.7% of households, making it the key driver of NGA technologies in Romania. Elsewhere, VDSL services remained relatively stable at 11.0% of households, while DOCSIS 3.0 coverage reported a 1.7 percentage point increase to reach 30.6% of households. UPC Romania and RCS&RDS remained the two largest cable operators in Romania.

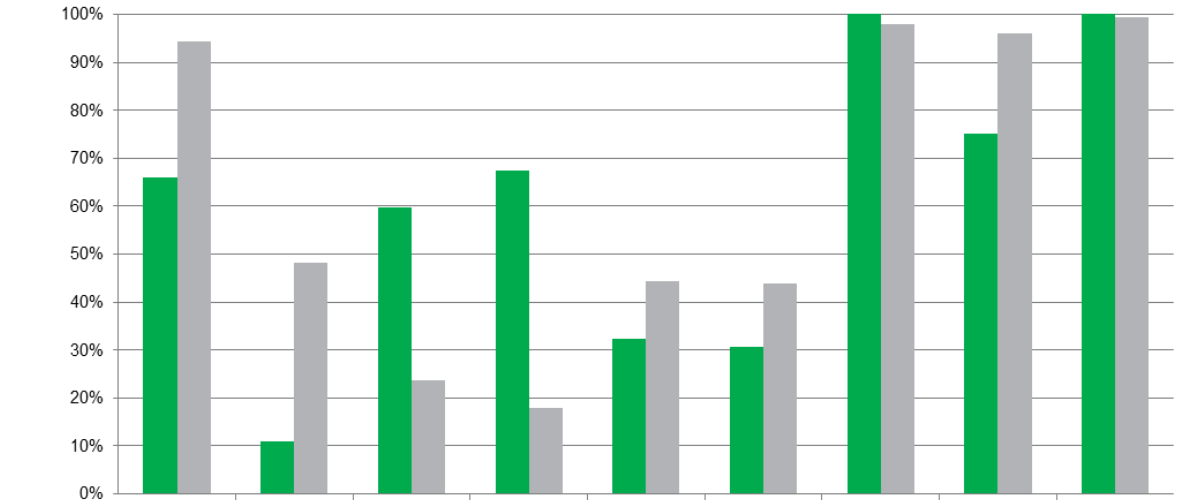
Although LTE coverage continued to improve during the twelve months to mid-2016, growing by 9.1 percentage points to cover 75.2% of homes, it remained below the EU average of 96.0%. Coverage is expected to continue to improve, partly due to continued investment from Orange Romania, who announced a three year network investment plan, worth EUR 500 million, in 2015.[87] Orange Romania, along with Vodafone Romania, are deploying LTE-Advanced networks, enabling greater speeds to be

[86] https://www.telekom.ro/about-us/media/news/telekom-romania-announces-financial-indicators-for-q2-2016/article93323

[87] https://www.telegeography.com/products/commsupdate/articles/2015/03/20/orange-romania-investing-half-a-billion-euros-in-three-years/

achieved over LTE networks[88]. At the end of June 2016, average LTE coverage of all network operators was limited with LTE services being available on average to 44.7% of Romanians.

Romania: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Romania	65.9%	11.0%	59.7%	67.4%	32.3%	30.6%	100.0%	75.2%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

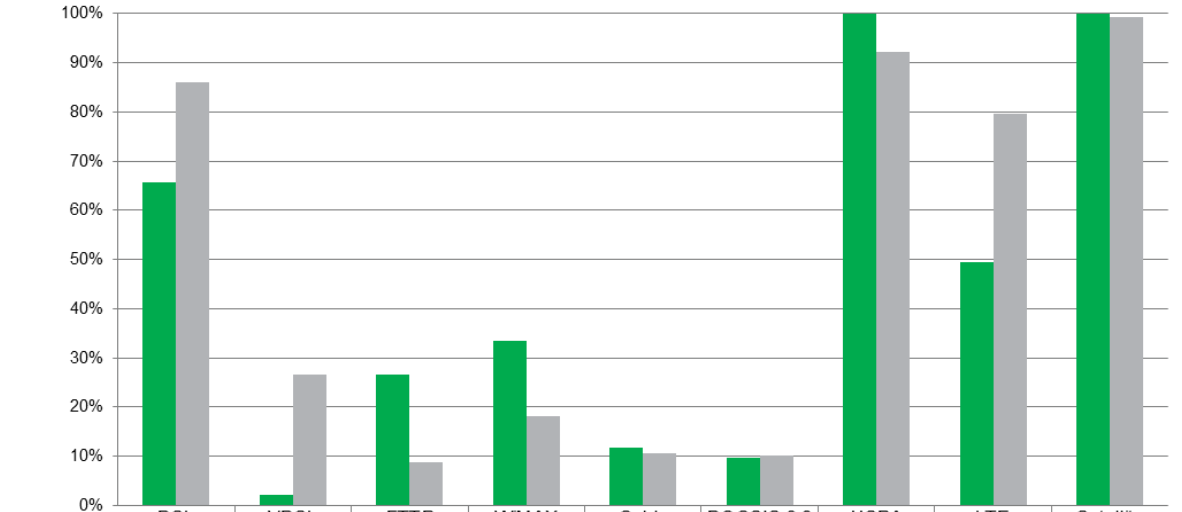
In rural areas, DSL remained the most prevalent broadband technology, passing 65.7% of rural homes, followed by WiMAX broadband, which passed a third (33.5%) of households. The next most widespread broadband technology was FTTP, which increased by 1.7 percentage points to 26.7% of rural homes. This growth was supported by the RO-Net project which, supported by EU funds, deployed fibre in over 200 localities, mostly in rural parts of Romania.[89] In terms of other NGA technologies, rural VDSL coverage remained limited (2.1%) while DOCSIS 3.0 passed 9.7% of rural households. This was slightly lower than the overall reach of cable networks in rural areas, which equalled 11.7% of rural homes.

While rural HSPA coverage was near-universal, LTE networks reached less than a half (49.5%) of rural households. Even though, there was a substantial increase in LTE availability of around 16 percentage points during the twelve months to mid-2016, rural LTE coverage continued to be lower than the EU average (79.7%).

[88] https://www.telegeography.com/products/commsupdate/articles/2016/09/06/vodafone-romania-launches-dual-carrier-lte-a-in-372-localities-orange-expands-quad-play-packages-nationwide/

[89] http://www.business-review.eu/news/ro-net-internet-broadband-project-completed-in-over-200-white-areas-111478

Romania: Coverage by technology, rural areas, 2016



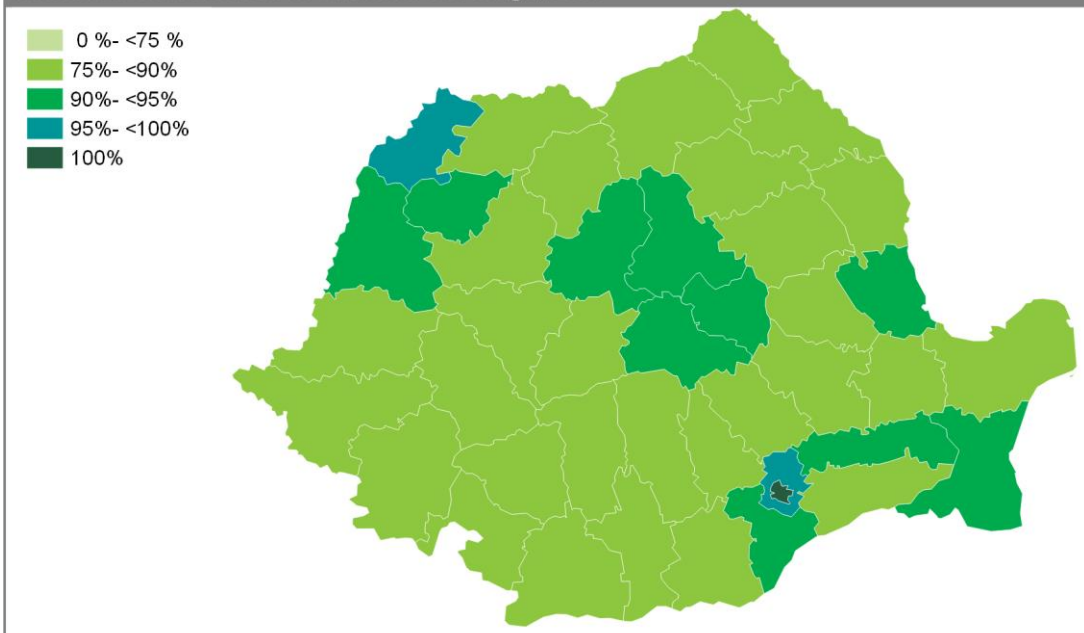
	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Romania	65.7%	2.1%	26.7%	33.5%	11.7%	9.7%	100.0%	49.5%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.25.2 Regional coverage by broadband technology

Fixed broadband coverage across the Romanian regions ranged from less than 80% in Vaslui and Vâlcea to complete coverage in the capital Bucharest.

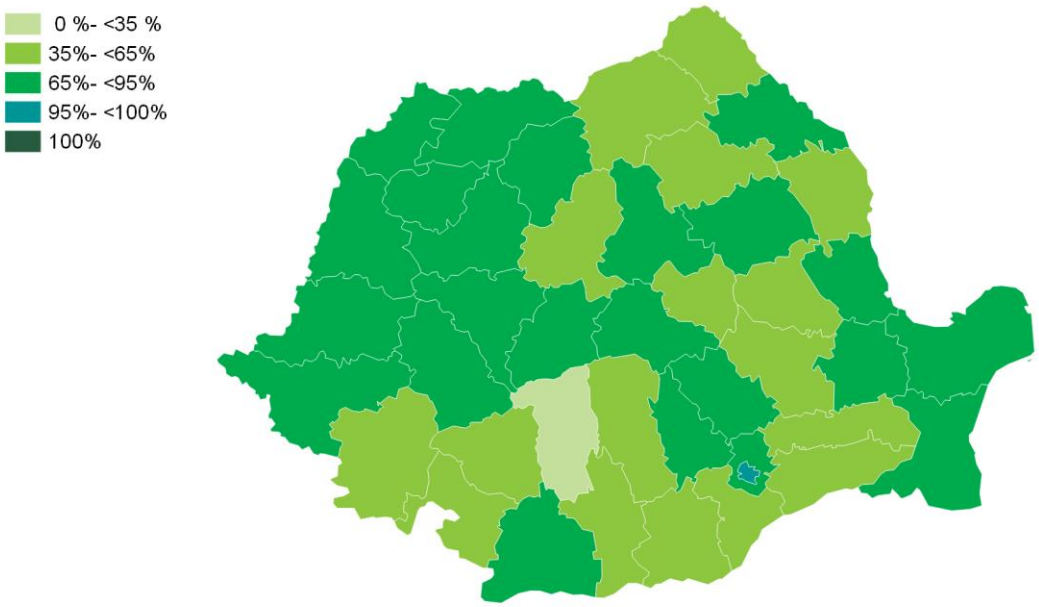
Romania: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage also remained very varied as it ranged from little less than 35% in the Vâlcea region to nearly 98% in Bucharest. Bucharest also continued to be the only region to record NGA coverage levels higher than 96%.

Romania: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.25.3 Data tables for Romania

Statistic	National
Population	19,870,647
Persons per household	2.7
Rural proportion	21.0%

	Romania 2016		Romania 2015		Romania 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	65.9%	65.7%	68.3%	63.7%	71.4%	63.3%	94.3%	86.0%
VDSL	11.0%	2.1%	11.8%	1.8%	13.7%	1.8%	48.2%	26.6%
FTTP	59.7%	26.7%	*58.2%*	*25.0%*	58.0%	22.7%	23.7%	8.8%
WiMAX	67.4%	33.5%	65.5%	31.2%	67.4%	33.2%	17.8%	18.0%
Cable	32.3%	11.7%	30.9%	9.3%	32.7%	10.4%	44.4%	10.7%
DOCSIS 3.0	30.6%	9.7%	28.9%	7.3%	29.3%	7.4%	43.9%	10.1%
HSPA	100.0%	100.0%	99.8%	99.5%	99.7%	99.3%	98.0%	92.2%
LTE	75.2%	49.5%	66.1%	33.8%	55.8%	17.8%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	44.7%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	99.9%	99.7%	99.8%	99.6%	99.9%	99.2%
Overall fixed broadband	88.6%	82.3%	88.8%	80.5%	89.4%	80.2%	97.5%	92.6%
NGA broadband	71.7%	33.6%	*70.4%*	*29.5%*	69.2%	27.4%	75.9%	39.2%
At least 2 Mbps	100.0%	-	99.9%	-	89.3%	-	96.7%	-
At least 30 Mbps	80.9%	-	73.0%	-	64.8%	-	75.1%	-
At least 100 Mbps	80.1%	-	72.2%	-	60.2%	-	50.8%	-

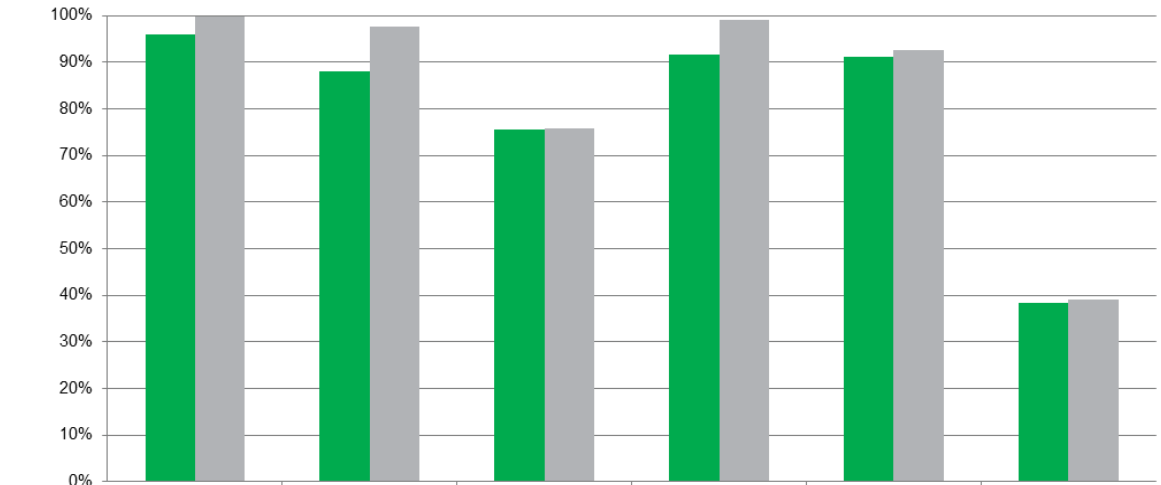
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.26 Slovakia

5.26.1 National coverage by broadband technology

At the end of June 2016, Slovakia continued to lag behind the EU average in all coverage combination categories on both national and rural levels. As in the previous edition of the study, NGA coverage levels increased considerably, growing by 8.4 percentage points on a national level and by 14.9 percentage points in rural areas. By mid-2016, 75.5% of all Slovakian households and 38.4% of rural households had access to high-speed broadband services.

Slovakia: Coverage by technology combination, 2016

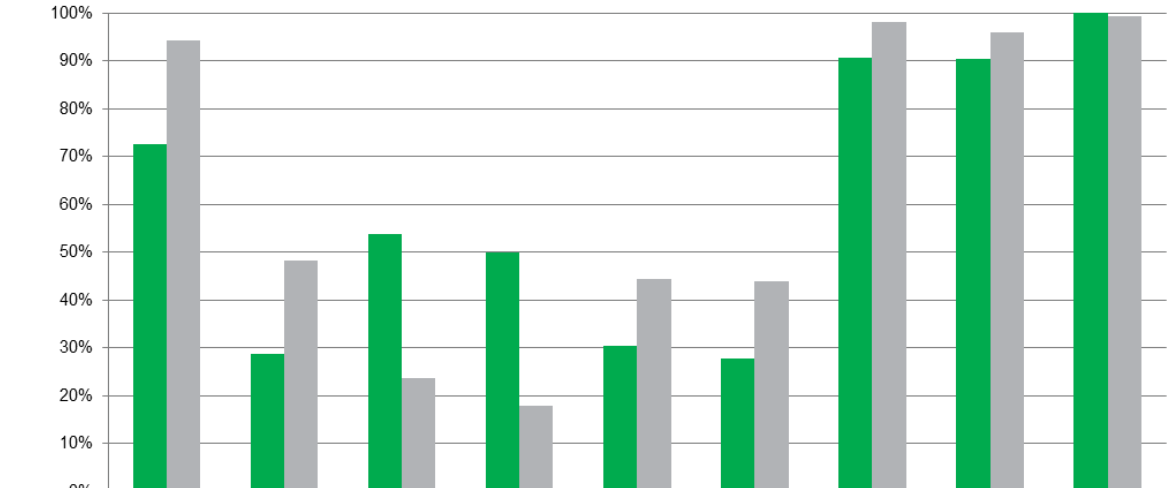


	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Slovakia	95.9%	88.0%	75.5%	91.6%	91.1%	38.4%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As was the case in previous years, DSL and cable availability in Slovakia were considerably below their respective EU averages. DSL networks passed 72.5% of homes, compared with the EU average of 94.3%, while cable broadband services were available to 30.4% of households in Slovakia compared to 44.4% of households across the EU. Meanwhile, Slovakia was one of only five countries to report WiMAX availability equal to or above 50%.

Slovakia: Coverage by technology, total, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Slovakia	72.5%	28.7%	53.7%	50.0%	30.4%	27.9%	90.7%	90.3%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

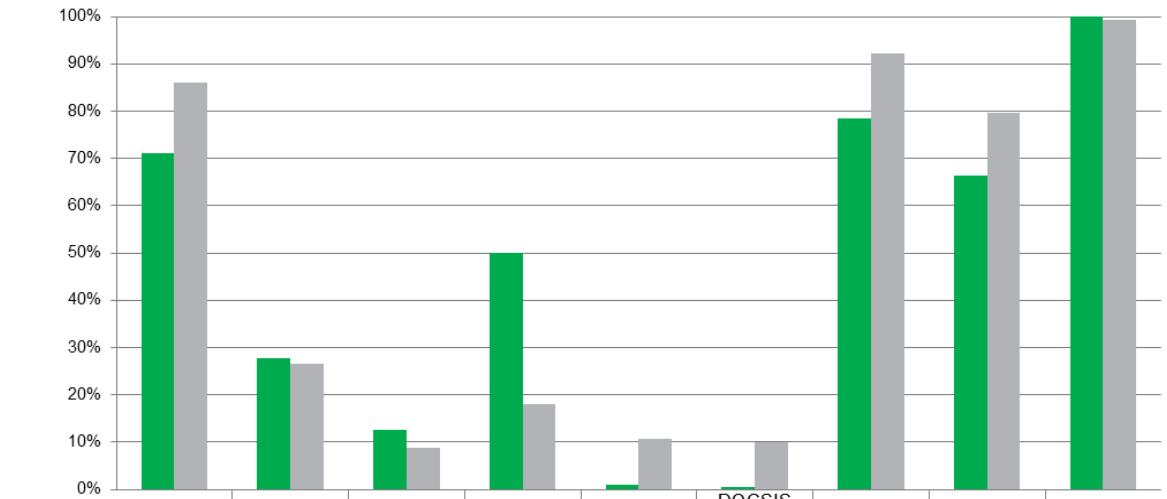
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Examining NGA technologies, VDSL networks passed 28.7% of Slovakian households, increasing 11.8 percentage points during the year to mid-2016 as a result of the incumbent Slovak Telekom's decision to invest in upgrades of its legacy copper network. Slovak Telekom is also investing in FTTP networks, along with Orange Slovakia. Overall, FTTP networks reached 53.7% of Slovakian homes by mid-2016, making it the most widespread NGA technology in Slovakia. DOCSIS 3.0 coverage also increased during the period, rising by 2.6 percentage points to 27.9% of households. In mid-2016 the main cable operator in Slovakia, UPC, was offering download speeds of up to 500 Mbps in order to compete with Slovak Telekom's and Oranges FTTP offerings.[90]

LTE networks were not launched on a large scale in Slovakia until 2014. Consequently, despite a 29.1 percentage point increase in LTE coverage during the period, Slovakia remained at 90.3% slightly below the EU average of 96.0%. Improved coverage was as a result of continued investment from all of the mobile network operators, including O2 Slovakia's launch of LTE services during the study period.[9192] The lower availability of LTE services is also confirmed when looking at the average LTE operator coverage, which reached only 79.5% at the end of June 2016. HSPA availability, at 90.7%, was also below the EU average (98.0%).

In rural areas, DSL and WiMAX remained the two most widespread fixed broadband technologies. At the end of June 2016, 71.2% of rural homes were passed by DSL networks, an increase of 5.2 percentage points. The incumbent continued to upgrade these networks to VDSL throughout the period, with the technology reaching 27.7% of rural homes by mid-2016. WiMAX coverage was stable at 50.0%, considerably above the EU average, while FTTP coverage in rural areas remained unchanged at 12.5% of households. The availability of cable services and DOCSIS 3.0 continued to be negligible in rural areas.

Slovakia: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Slovakia	71.2%	27.7%	12.5%	50.0%	0.8%	0.4%	78.5%	66.4%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

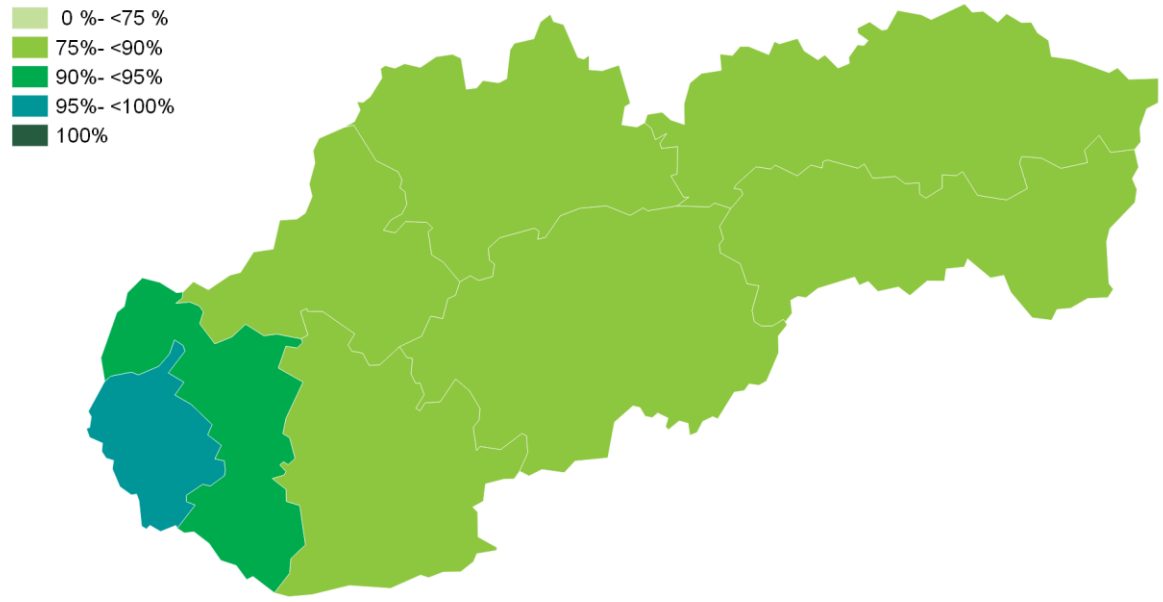
As mentioned, mobile network operators continued to deploy LTE networks across Slovakia during the twelve-month period to mid-2016. The coverage of LTE services in rural areas increased considerably, rising by 57.9 percentage points to 66.4% of rural households. Moreover, there was also a slight rise in the coverage of HSPA networks in rural areas, growing 6.8 percentage points to reach 78.5% of rural homes.

[90] http://www.libertyglobal.com/pdf/press-release/LG-Earnings-Release-Q2-16-FINAL.pdf
[91] http://www.gtigroup.org/news/ind/2015-05-12/6247.html
[92] https://www.telegeography.com/products/commsupdate/articles/2016/01/20/o2-slovakia-outlines-2016-plans/

5.26.2 Regional coverage by broadband technology

Besides the area surrounding the capital Bratislava, fixed broadband coverage in individual regions remained between 80% and 94%. In the capital Bratislava, fixed broadband services were available to more than 98% of households. Lowest coverage was registered in the Presovsky region, where a little over 8 in 10 homes were passed at the end of June 2016.

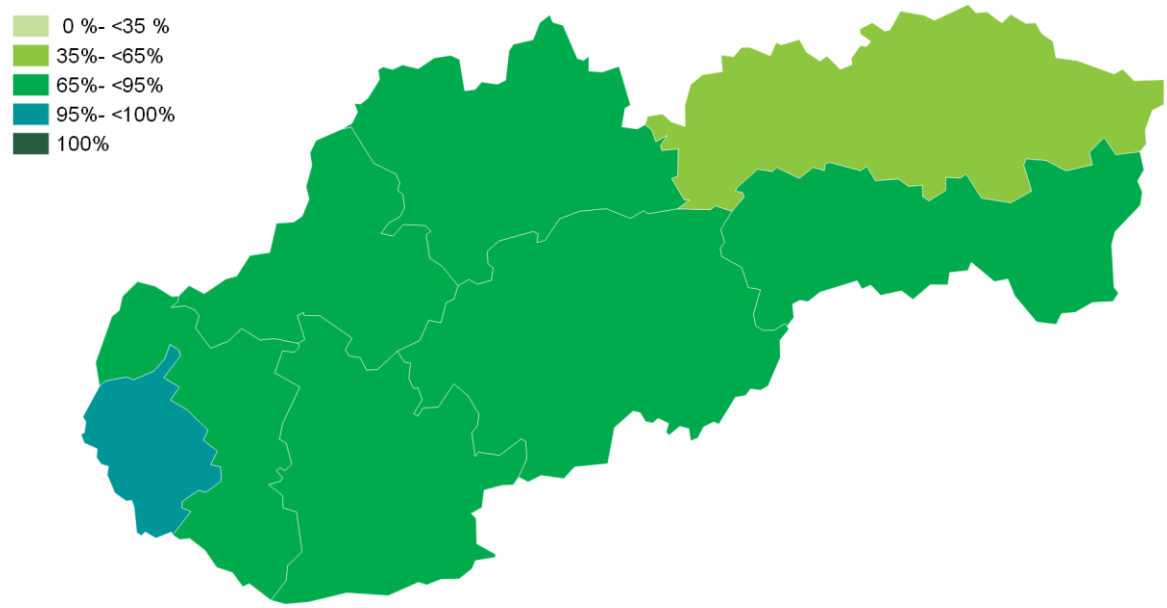
Slovakia: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA coverage across the Slovak regions ranged from little less than 65% in Presovsky region to over 95% in Bratislava and 83% in Kosicky region. In addition, in Trenciansky region, which recorded the lowest NGA coverage in the previous year, availability of NGA services increased by more than 16 percentage points to 66.1% home passed by NGA networks at the end of June 2016.

Slovakia: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.26.3 Data tables for Slovakia

Statistic	National
Population	5,421,349
Persons per household	2.8
Rural proportion	28.8%

	Slovakia 2016		Slovakia 2015		Slovakia 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	72.5%	71.2%	71.2%	66.0%	70.9%	50.1%	94.3%	86.0%
VDSL	28.7%	27.7%	16.9%	11.9%	11.7%	0.0%	48.2%	26.6%
FTTP	53.7%	12.5%	50.4%	*12.2%*	48.0%	4.3%	23.7%	8.8%
WiMAX	50.0%	50.0%	50.0%	50.0%	50.1%	50.4%	17.8%	18.0%
Cable	30.4%	0.8%	28.8%	0.6%	28.4%	0.4%	44.4%	10.7%
DOCSIS 3.0	27.9%	0.4%	25.3%	0.0%	25.4%	0.0%	43.9%	10.1%
HSPA	90.7%	78.5%	91.8%	71.7%	91.1%	69.3%	98.0%	92.2%
LTE	90.3%	66.4%	61.2%	8.5%	52.2%	0.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	79.5%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	95.9%	91.6%	95.9%	91.6%	95.9%	89.1%	99.9%	99.2%
Overall fixed broadband	88.0%	91.1%	86.3%	83.0%	86.8%	76.6%	97.5%	92.6%
NGA broadband	75.5%	38.4%	67.1%	*23.5%*	62.5%	4.3%	75.9%	39.2%
At least 2 Mbps	87.6%	-	86.3%	-	86.5%	-	96.7%	-
At least 30 Mbps	75.1%	-	66.1%	-	61.5%	-	75.1%	-
At least 100 Mbps	64.1%	-	57.0%	-	54.5%	-	50.8%	-

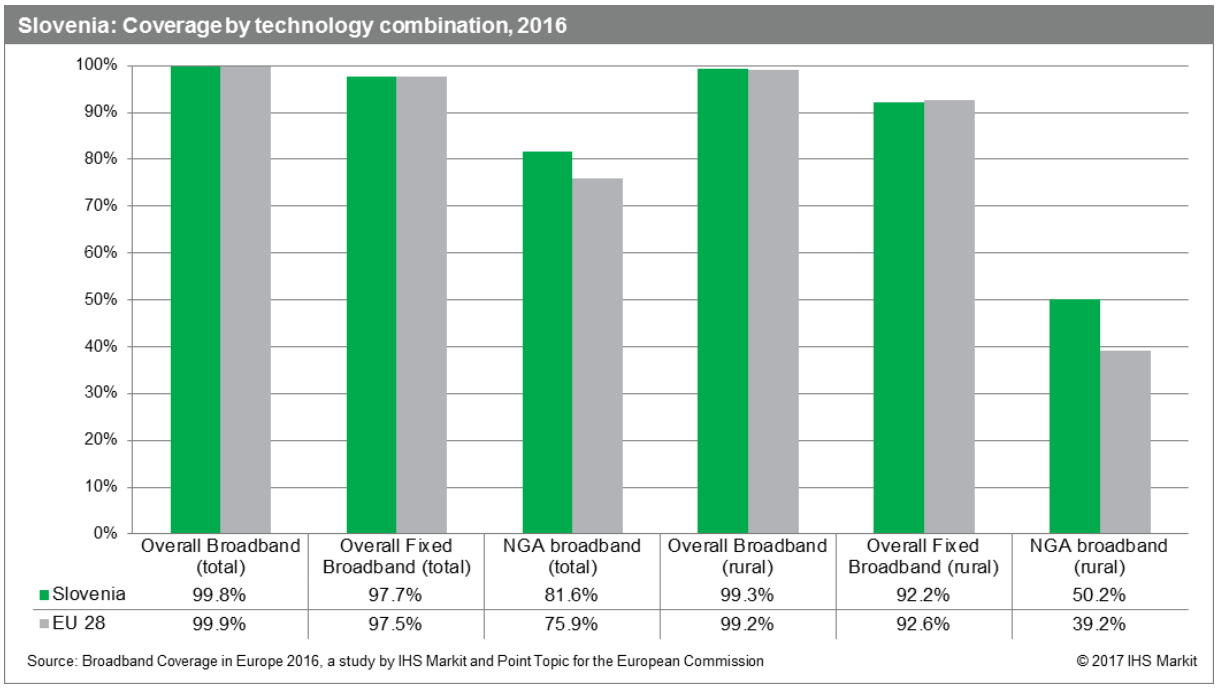
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.27 Slovenia

5.27.1 National coverage by broadband technology

Slovenian broadband coverage levels have been restated for 2015 and 2014 due to more accurate data now being collected by the NRA. Therefore, coverage levels in this study are different to those reported in previous editions the BCE study report.

In mid-2016, Slovenia was slightly below the EU average in terms of overall broadband coverage but above the EU average for fixed broadband and NGA broadband coverage. The proportion of households covered by at least one fixed broadband technology increased by 2.2 percentage points during the twelve months to reach 97.7% of households the end of June 2016, while NGA broadband coverage increased by 0.8 percentage points during the same period with 81.6% of Slovenian homes passed by NGA networks.



When rural broadband availability is considered, Slovenia was above the EU average with regards to overall broadband coverage and NGA broadband coverage in rural areas, which reached over a half (50.2%) of households. However, Slovenia was slightly below the EU average for fixed rural broadband availability despite a 2.1 percentage point increase to 92.2% in the twelve-month period.

At the end of June 2016, DSL was the most widespread fixed broadband technology with DSL networks covering 95.9% of households. Meanwhile, cable broadband services were available to of Slovenian homes.

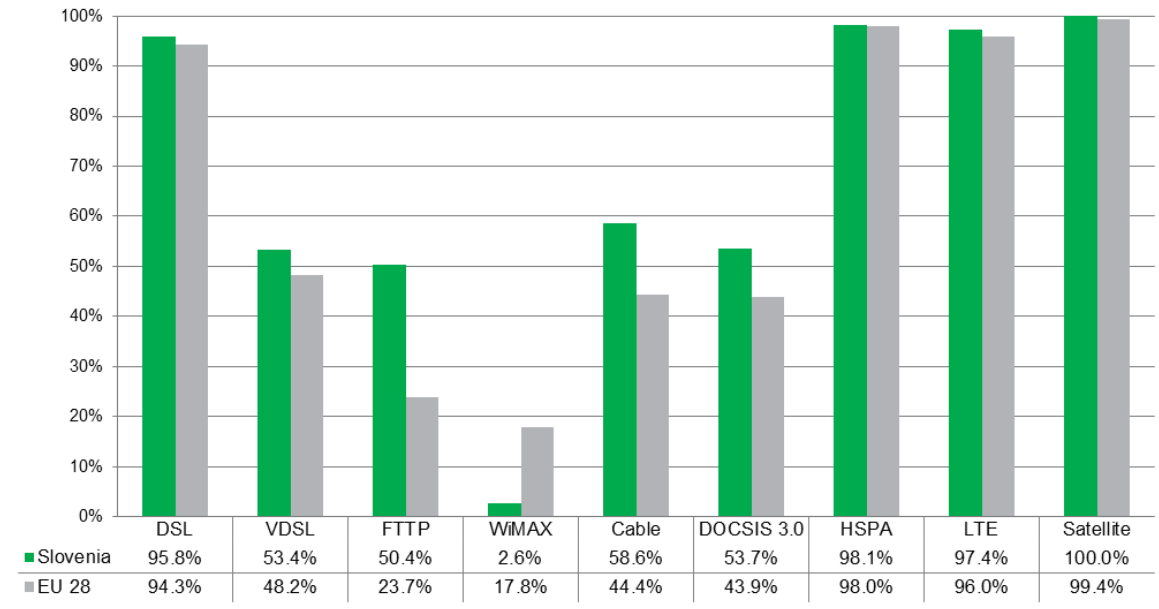
Examining NGA technologies, the Slovenian Government's Digital Slovenia 2020 strategy aims to cover 96% of households with download speeds of at least 100 Mbps by 2020[93] and network operators have been investing in a mix of technologies to achieve this goal. FTTP services recorded the highest growth in coverage from July 2015 to the end of June 2016, expanding by 5.4 percentage points and reaching 50.4% of households. In terms of other NGA technologies, VDSL networks covered 53.4% of households. DOCSIS 3.0 had a similar reach, passing 53.7% of homes, as the majority of Slovenia's cable infrastructure was upgraded to the technology.

LTE coverage remained above the EU average, increasing by 1.7 percentage points and reaching 97.4% of households. In addition, by mid-2016, 90.1% of Slovenians on average had access to LTE services from all operators.[94]

[93] http://www.mju.gov.si/fileadmin/mju.gov.si/pageuploads/DID/Informacijska_druzba/pdf/DSI_2020_3-2016_pic1.pdf

[94] This is an updated figure compared to the value originally reported in the DESI.

Slovenia: Coverage by technology, total, 2016

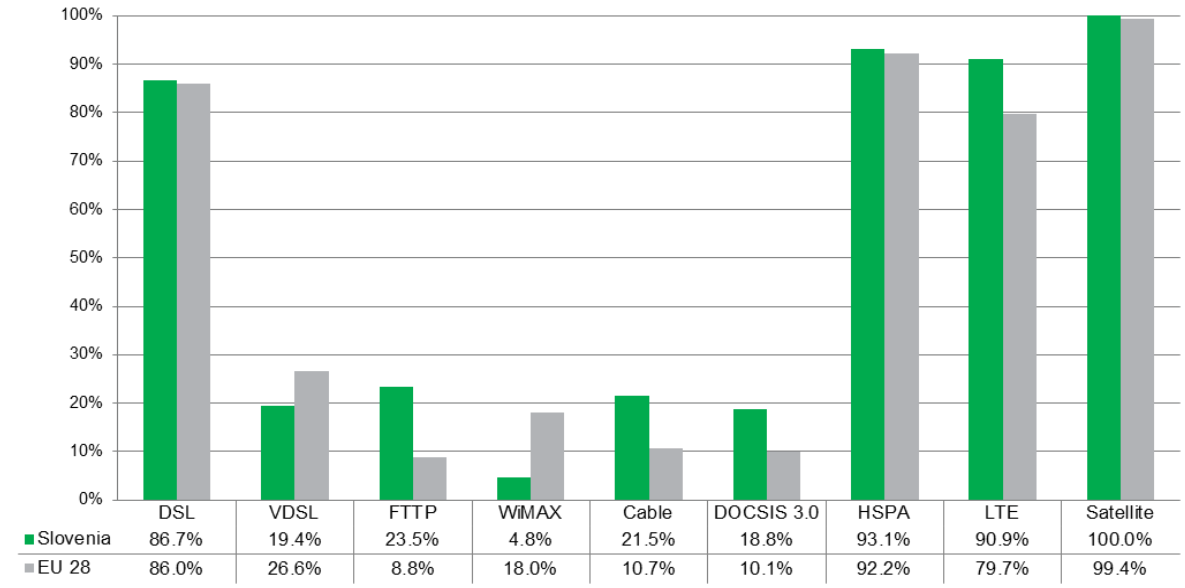


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Slovenia	95.8%	53.4%	50.4%	2.6%	58.6%	53.7%	98.1%	97.4%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In rural areas, DSL coverage reached 86.7% of rural households and at 21.5%, the reach of cable networks in rural areas remained considerably above the EU average (10.7%). Although DOCSIS 3.0 coverage was also high, at 18.8%, FTTP networks were the most widespread NGA technology in rural Slovenia. FTTP services passed 23.5% of households, an increase of 3.3 percentage points. Rural VDSL coverage increased by a similar amount, 3.1 percentage points, and reached 19.4% of rural homes.

Slovenia: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Slovenia	86.7%	19.4%	23.5%	4.8%	21.5%	18.8%	93.1%	90.9%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

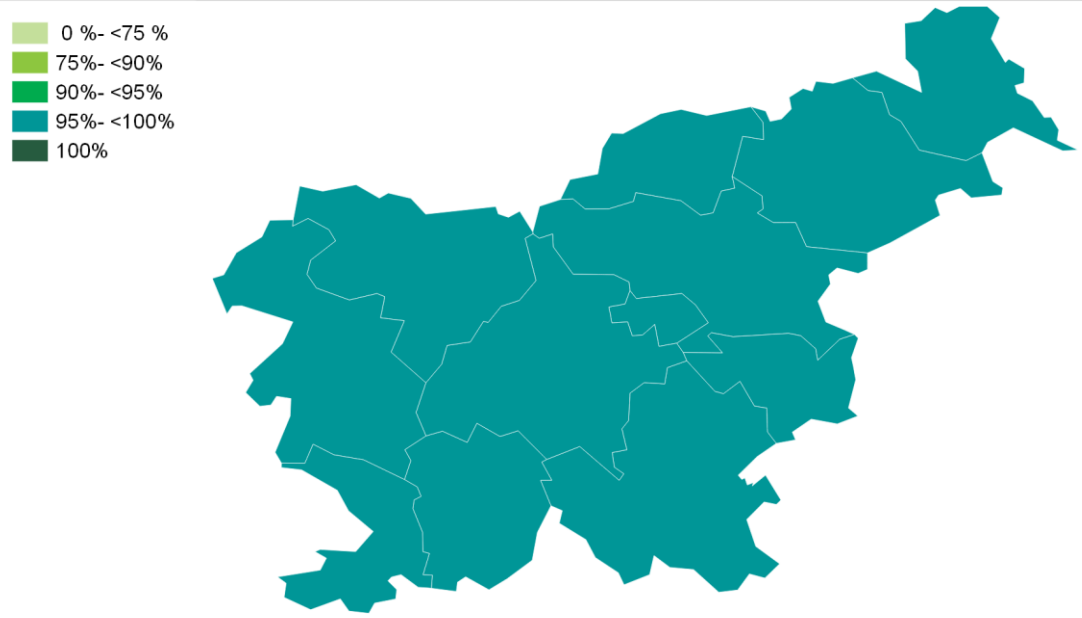
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Rural LTE coverage recorded a 9.7 percentage point increase, covering 90.9% of rural homes, remaining well-above the EU average of 81.2%. Meanwhile, HSPA networks passed 93.1% of rural homes, following a 1.6 percentage point increase from mid-2015.

5.27.2 Regional coverage by broadband technology

Fixed broadband coverage in Slovenia remained relatively stable across the twelve regions, ranging from a little over 95% in the Spodnjeposavska region to over 99% in the Gorenjska region.

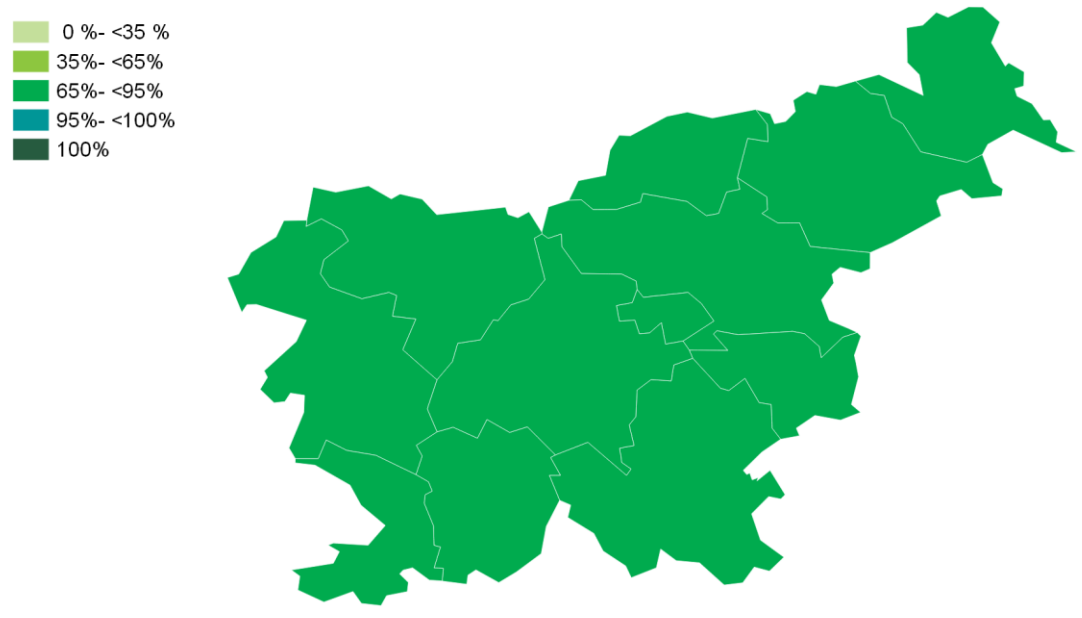
Slovenia: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

NGA coverage ranged from 73.6% in the Jugovzhodna Slovenija region to nearly 86% in the Osrednjeslovenska region. In ten out of twelve regions NGA coverage recorded NGA coverage levels higher than 75%.

Slovenia: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.27.3 Data tables for Slovenia

Statistic	National
Population	2,061,292
Persons per household	2.5
Rural proportion	23.1%

	Slovenia 2016		Slovenia 2015		Slovenia 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	95.9%	86.7%	90.9%	*82.3%*	90.8%	*81.9%*	94.3%	86.0%
VDSL	53.4%	19.4%	*52.8%*	16.3%	*52.5%*	15.2%	48.2%	26.6%
FTTP	50.4%	23.5%	45.0%	20.2%	42.2%	18.3%	23.7%	8.8%
WiMAX**	2.6%	4.8%	0.3%	1.1%	0.3%	1.1%	17.8%	18.0%
Cable	58.6%	21.5%	*58.4%*	*21.5%*	*58.3%*	*21.4%*	44.4%	10.7%
DOCSIS 3.0	53.7%	18.8%	*52.4%*	*18.3%*	*51.1%*	*17.9%*	43.9%	10.1%
HSPA	98.1%	93.1%	*98.0%*	*91.5%*	*97.9%*	*91.1%*	98.0%	92.2%
LTE	97.4%	90.9%	*95.7%*	*81.2%*	*87.7%*	*72.4%*	96.0%	79.7%
LTE average operator coverage (DESI indicator)	90.1%*	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.8%	99.3%	*99.7%*	*99.1%*	99.6%	*98.5%*	99.9%	99.2%
Overall fixed broadband	97.7%	92.2%	95.5%	*90.1%*	95.4%	*88.2%*	97.5%	92.6%
NGA broadband	81.6%	50.2%	*80.8%*	*49.8%*	*80.2%*	*45.8%*	75.9%	39.2%
At least 2 Mbps	99.8%	-	99.3%	-	98.3%	-	96.7%	-
At least 30 Mbps	98.4%	-	92.7%	-	83.5%	-	75.1%	-
At least 100 Mbps	72.2%	-	68.7%	-	67.3%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. As mentioned, previously reported coverage trends and values reported for Slovenia have been restated in light of new and more accurate data shared by the NRA. All restatements are highlighted in italics.

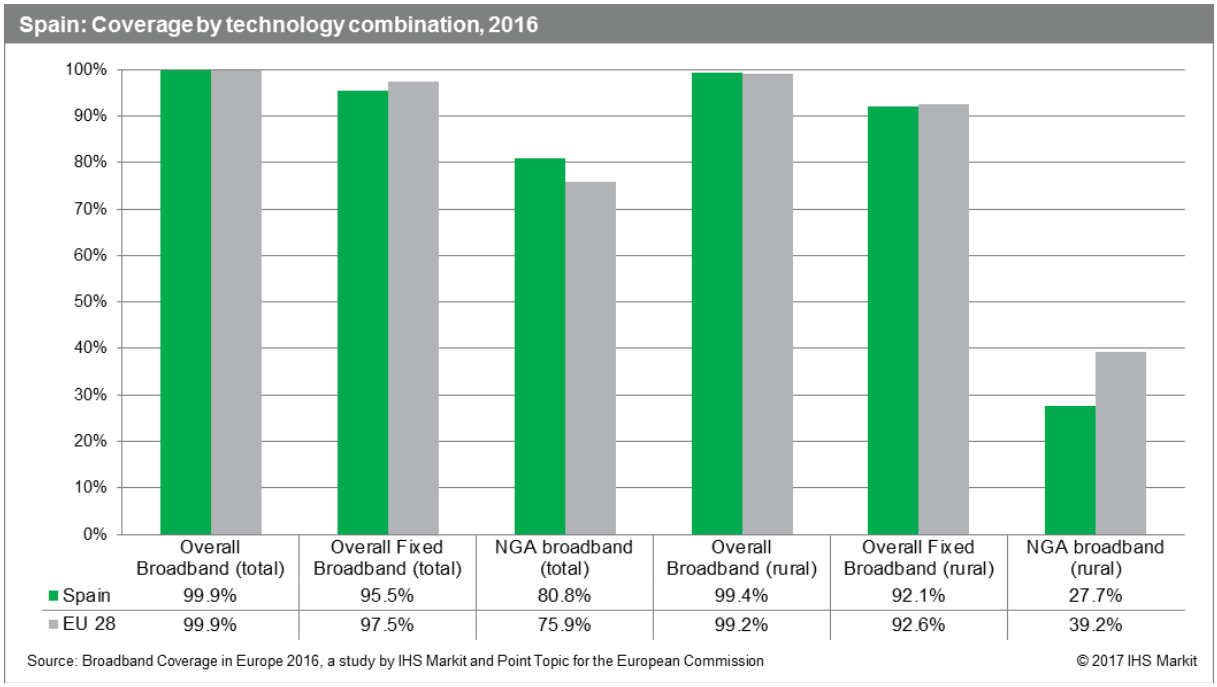
*An updated value for average LTE operator coverage is reported compared to the DESI.

**There is no national WiMAX provider present in Slovenia and WiMAX technology is only used in small, mostly rural areas as part of an Open Access Network initiative aimed at increasing coverage of white spot areas.

5.28 Spain

5.28.1 National coverage by broadband technology

At the end of June 2016, overall broadband and fixed broadband coverage in Spain remained relatively unchanged, on both national and rural levels, compared to mid-2015. NGA coverage grew by 4.2 percentage points passing 80.8% of households, thus exceeding the EU average by nearly 5 percentage points. On the other hand, rural NGA coverage continued to fall behind the EU average due to slower pace of NGA deployment in rural areas. Rural NGA coverage increased by 3.8 percentage points passing 27.7% of rural households, 12.1 percentage points behind the EU average of 39.2%.



Examining coverage of the individual technologies, all technologies with the exception of FTTP experienced marginal change or remained the same in comparison to mid-2015 coverage levels. DSL remained as the main fixed broadband technology in Spain, although at 90.1% it falls behind the EU average of 94.3%. However, FTTP continued to be the technology of choice in terms of increasing broadband availability across Spain. Over the twelve month period to the end of June 2016, FTTP coverage grew by 10.0 percentage points and by mid-2016, 62.8% of Spanish households had access to FTTP services. Moreover, the increasing availability of FTTP services also impacts the speeds available to Spanish households and results in Spain being ahead by nearly 30 percentage points in terms of availability of services capable of achieving at least 100 Mbps download broadband speeds (79.1% vs. the EU average of 50.8%).

This reflects the strategy of major Spanish operators, such as the incumbent Telefonica España, Vodafone Spain, Orange Spain and Jazztel, to prioritise FTTP networks deployment over upgrades of their legacy networks to VDSL. Moreover, in the last couple of years the operators have also entered into a number of network sharing agreements in order to reduce cost and expedite the rollout. Most recently, Orange Spain entered into joint network rollout agreement with Grupo MASMOVIL and Telefonica entered into a wholesale agreement with Vodafone Spain. [95][96]

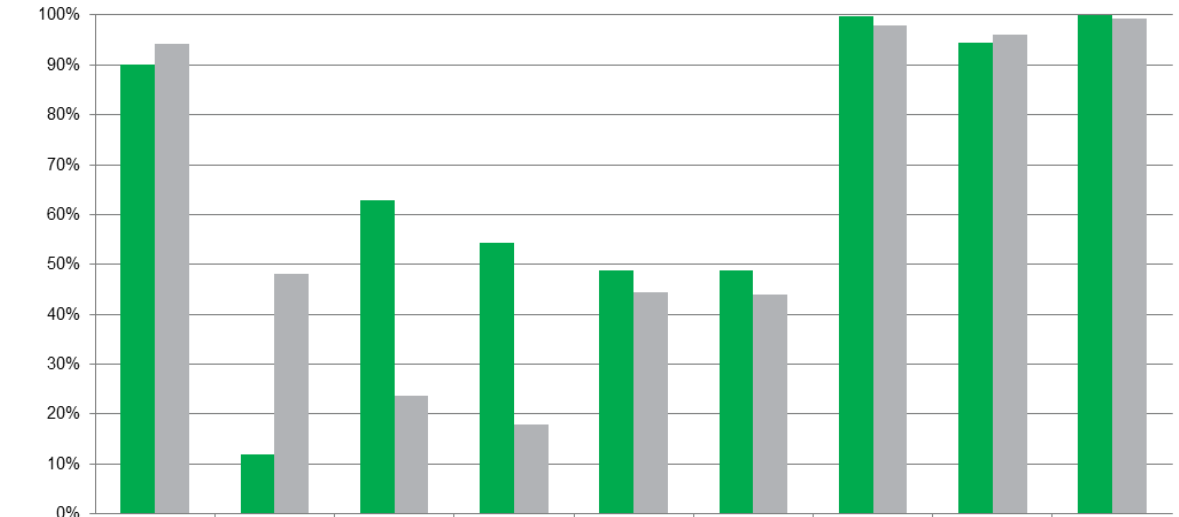
With no plans to upgrade existing copper infrastructure to VDSL or VDSL2 vectoring, in favour of FTTP, VDSL covered only 11.8% of households. Availability of DOCSIS 3.0 services also remained at

[95] https://www.telegeography.com/products/commsupdate/articles/2016/07/25/orange-espana-and-grupo-masmovil-ink-ftth-rollout-deal/

[96] https://www.telefonica.com/en/web/press-office/-/telefonica-and-vodafone-sign-a-commercial-agreement-for-wholesale-access-to-fibre-optics

its previous levels with high-speed cable broadband networks passing about a half (48.8%) of Spanish households at the end of June 2016.

Spain: Coverage by technology, total, 2016

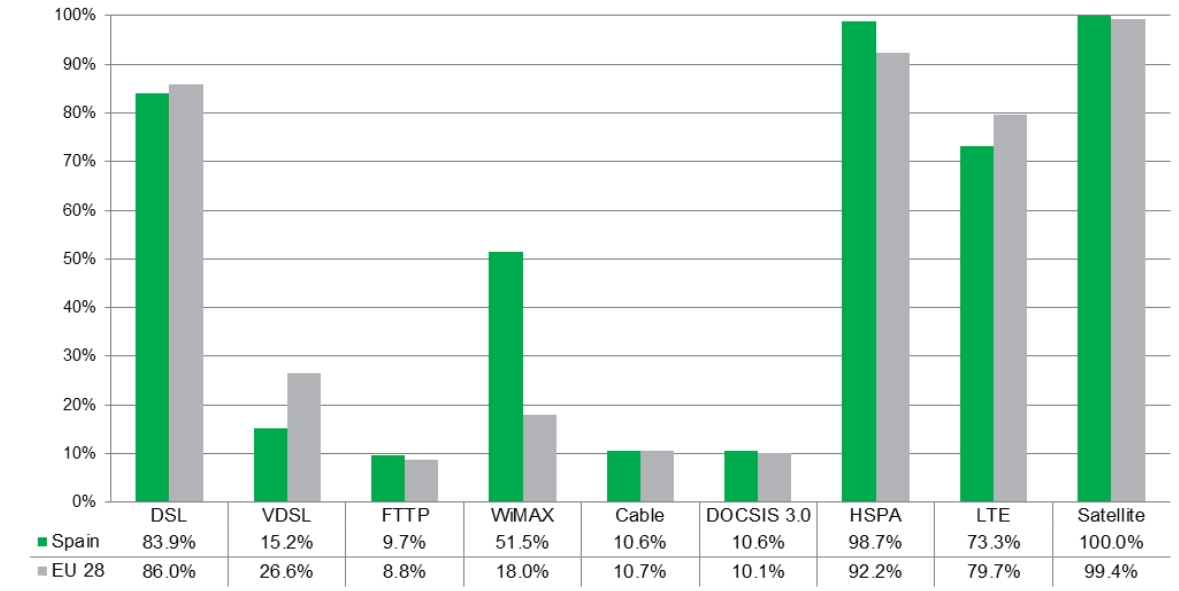


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Spain	90.1%	11.8%	62.8%	54.2%	48.8%	48.8%	99.7%	94.4%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In terms of mobile technologies, HSPA coverage remained stable at near-universal coverage level. Over the twelve months to mid-2016, LTE coverage experienced a considerable growth of 15.3 percentage points, with 94.4% of homes passed by LTE networks at the end of June. Yet despite this increase, Spain's LTE coverage remained below the EU average by 1.6 percentage points. Moreover, when average coverage of LTE networks of all mobile network operators is considered, on average 85.9% of people in Spain had access to LTE services at the end of June 2016.

Spain: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Spain	83.9%	15.2%	9.7%	51.5%	10.6%	10.6%	98.7%	73.3%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

As in 2015, DSL remained as the key fixed broadband technology available to rural households with 83.9% of rural homes passed by DSL networks. WiMAX also remained considerably high reaching over half (51.5%) of rural households, above the EU average (18%).

By mid-2016, only 15.2% of rural households had access to VDSL. Whilst only 10.6% of rural households had access to DOCSIS 3.0 cable broadband services. Similarly, due to FTTP network deployment having been limited to mainly urban areas, FTTP services have reached little less than 1 in 10 (9.7%) of rural households. This left VDSL as the most wide-spread NGA technology in rural Spain, despite a deployment freeze in the last years.

This is due to change, as the regulator CNMC seeks to introduce competition in rural areas affected by low coverage.[97] By regulating wholesale pricing of Movistar's fibre optic networks and allowing alternative operators to build-out FTTP networks in areas, which CNMC classes as non-competitive, the regulator hopes to boost rural NGA coverage in the country. As a result, Orange Spain has now begun a series of investments and FTTP network deployment in several rural areas.[9899]

Rural LTE coverage increased considerably by 46.5 percentage points, reaching 73.3% of rural households by the end of June 2016, yet still remained below the EU average of 79.7%.

[97] https://www.telegeography.com/products/commsupdate/articles/2017/01/19/cnmc-approves-wholesale-fibre-offer-revises-wholesale-broadband-pricing/

[98] http://acercadeorange.orange.es/UpImages/files/2295/.._ftth_arcos_de_la_frontera_9638336e3778948b65edbb5e7.pdf

[99] http://acercadeorange.orange.es/UpImages/files/2252/.._ftth_cunit_e1ce3dd241b107bb921f400ce.pdf

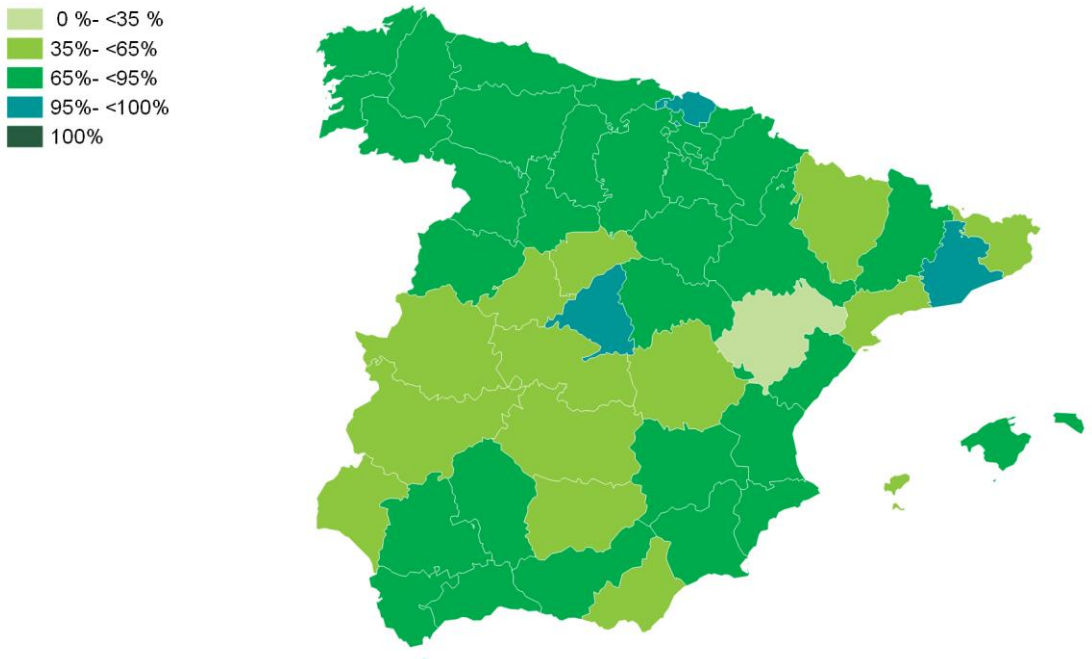
5.28.2 Regional coverage by broadband technology

Fixed broadband coverage levels continued to vary quite significantly between the individual regions, ranging from around 53% in El Hierro to complete coverage in Menorca (due to 100% WiMAX coverage across the island).

Spain: Overall fixed broadband coverage, 2016

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Spain: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

In terms of NGA coverage, the northern regions continue to lead along with the coastal regions. Three regions recorded NGA coverage higher than 95% - Bizkaya, Barcelona, and Madrid. On the other hand, in Teruel, only a third of households had access to NGA services. In addition, the overseas provinces and the Mediterranean Islands also recorded lower availability of NGA services.

The following broadband coverage levels were recorded in Spanish regions outside mainland Europe:

Coverage data for Spanish NUTS 3 areas outside mainland Europe			
NUTS 3	Description	Overall fixed broadband coverage	NGA broadband coverage
ES630	Ceuta (ES)	98.5%	92.4%
ES640	Melilla (ES)	100.00%	100.0%
ES703	El Hierro	53.4%	6.0%
ES704	Fuerteventura	95.7%	18.6%
ES705	Gran Canaria	90.8%	86.8%
ES706	La Gomera	63.6%	17.2%
ES707	La Palma	83.6%	10.4%
ES708	Lanzarote	94.0%	65.5%
ES709	Tenerife	93.7%	79.0%

5.28.3 Data tables for Spain

Statistic	National
Population	46,771,341
Persons per household	2.6
Rural proportion	18.5%

	Spain 2016		Spain 2015		Spain 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	90.1%	83.9%	88.5%	80.5%	88.5%	80.5%	94.3%	86.0%
VDSL	11.8%	15.2%	11.0%	14.1%	11.0%	14.1%	48.2%	26.6%
FTTP	62.8%	9.7%	52.8%	5.6%	44.8%	5.0%	23.7%	8.8%
WiMAX	54.2%	51.5%	57.1%	49.8%	57.1%	49.8%	17.8%	18.0%
Cable	48.8%	10.6%	47.8%	9.8%	47.8%	9.8%	44.4%	10.7%
DOCSIS 3.0	48.8%	10.6%	47.8%	9.8%	47.8%	9.8%	43.9%	10.1%
HSPA	99.7%	98.7%	99.7%	98.4%	99.7%	98.4%	98.0%	92.2%
LTE	94.4%	73.3%	79.1%	26.8%	76.3%	20.1%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	85.9%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	99.9%	99.4%	99.8%	99.2%	99.8%	99.2%	99.9%	99.2%
Overall fixed broadband	95.5%	92.1%	95.1%	91.1%	95.1%	91.6%	97.5%	92.6%
NGA broadband	80.8%	27.7%	76.6%	23.9%	73.2%	23.6%	75.9%	39.2%
At least 2 Mbps	95.5%	-	95.1%	-	95.1%	-	96.7%	-
At least 30 Mbps	80.8%	-	76.6%	-	73.2%	-	75.1%	-
At least 100 Mbps	79.1%	-	74.2%	-	70.5%	-	50.8%	-

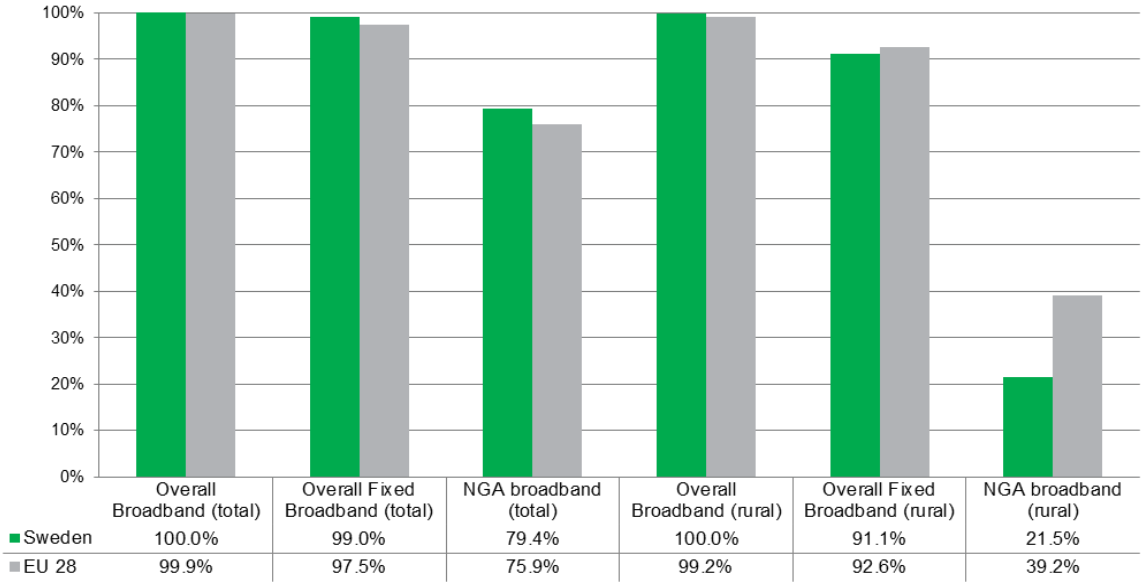
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.29 Sweden

5.29.1 National coverage by broadband technology

As in previous years, Sweden was above the EU average with regards to total broadband coverage across each of the combination categories. However, when rural coverage was examined, Sweden was below the EU average for fixed and NGA broadband access. Despite a 7.5 percentage point increase in rural NGA coverage, at 21.5% availability of NGA services in rural areas remained below the EU average of 39.2%.

Sweden: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Sweden	100.0%	99.0%	79.4%	100.0%	91.1%	21.5%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

DSL continued to be the most widespread fixed broadband technology, reaching 98.0% of households by mid-2016. Examining NGA technologies, FTTP remained the most prevalent in terms of coverage, increasing by 4.4 percentage points in the year to the end of June 2016, to reach 60.8% of households. Swedish network operators, Telia Company and Telenor, remain committed to the technology and the former aims to connect 1.9 million households to its FTTP network by 2018.[100]

With regards to other NGA technologies, DOCSIS 3.0 networks passed over a third (36.2%) of Swedish homes by mid-2016. Overall cable coverage remained stable during the period, meaning that the proportion of cable networks upgraded to DOCSIS 3.0 increased by 8 percentage points to equal 96% in total. VDSL remained the NGA technology with the lowest coverage, passing 21.9% of homes, following an increase of 3.6 percentage points during the twelve-month period to mid-2016.

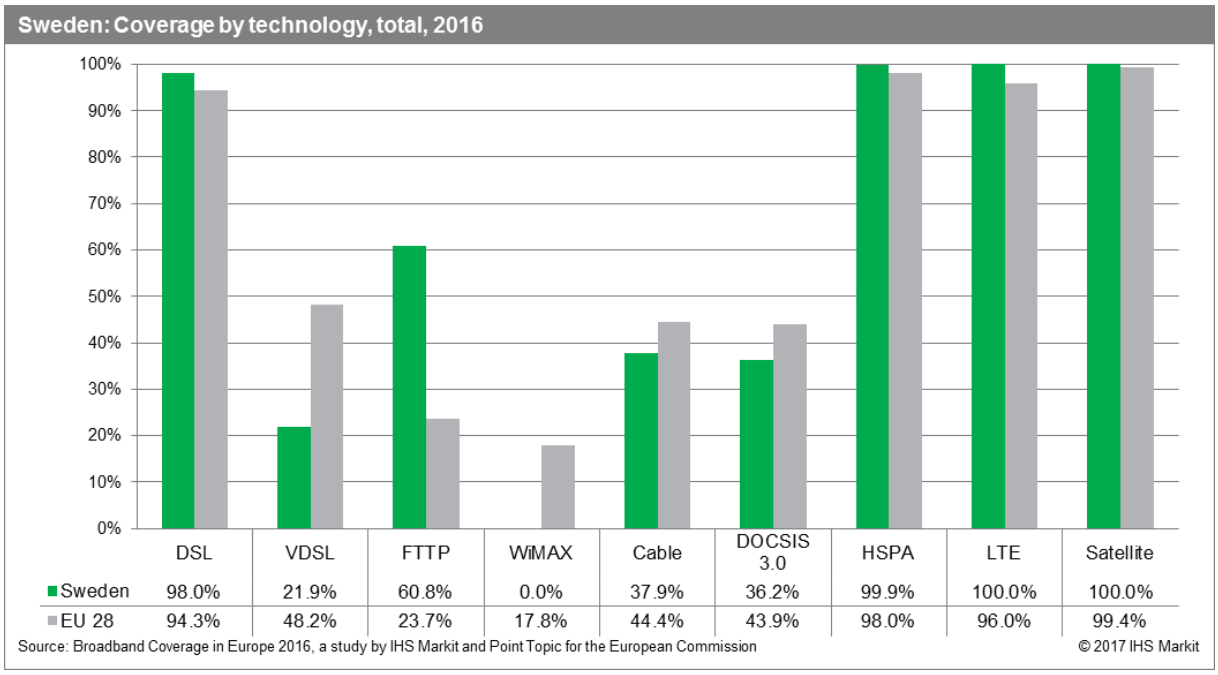
As in the previous edition of the study, HSPA and LTE coverage was near-universal, surpassing 99% coverage for both technologies. In addition, a very nearly ubiquitous LTE network coverage is provided by all mobile network operators meaning that average LTE operator coverage also reached 100%.[101]

Consequently, with complete LTE coverage provided by all mobile network operators, Hutchinson's Three Sweden has started to deploy LTE-Advanced networks in parts of the country[102], in order to differentiate its network from competitors.

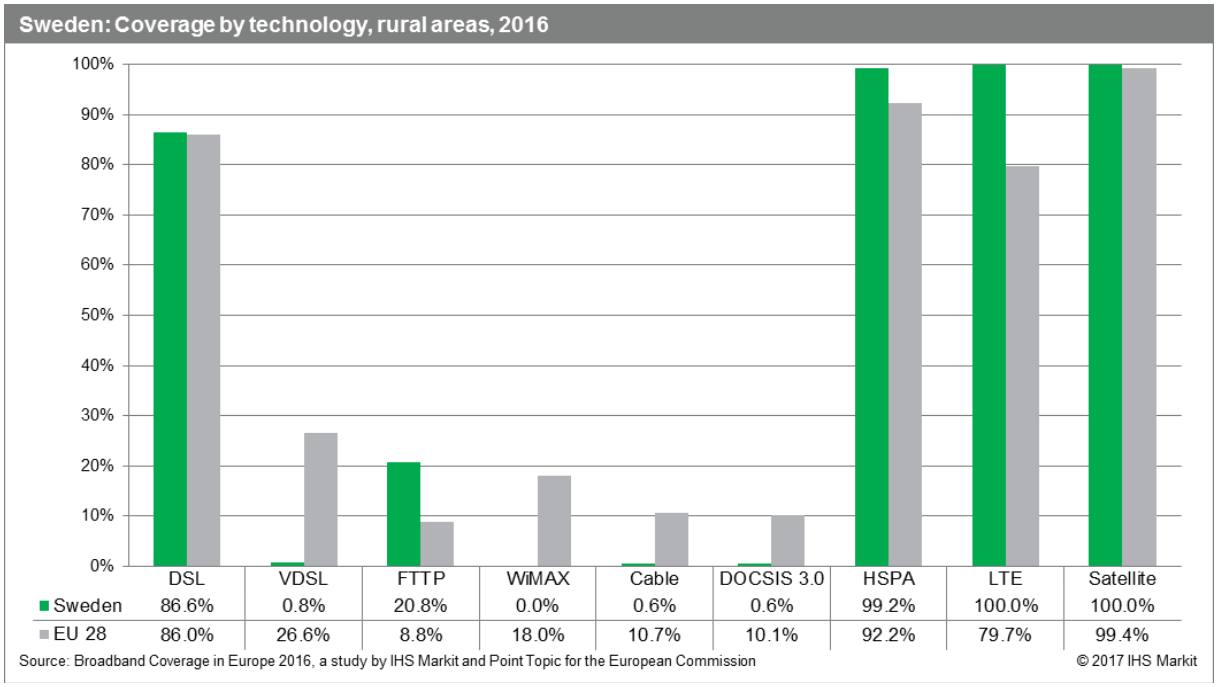
[100] http://www.telia.se/media/2014/10/05/telia-satsar-nio-miljarder-p-fiber/066cb492-9c96-4d31-8eb5-144da57ee8af

[101] It is important to note that a small number of households might be lacking coverage even when data indicates universal LTE availability.

[102] http://www.mobileeurope.co.uk/press-wire/three-debuts-td-lte-advanced-in-sweden



With regards to rural broadband coverage, in June 2015 the European Commission approved Sweden's rural broadband programme for the period 2014-2020. As part of this programme, the government plans to invest EUR 350 million towards high speed internet expansion across underserved regions where the deployment of next-generation networks is not commercially feasible.[103] However, with this programme still in its initial stages, rural NGA coverage in Sweden remained limited at 21.5% of households. Moreover, the reach of VDSL and DOCSIS 3.0 in rural areas continued to be less than 1%.



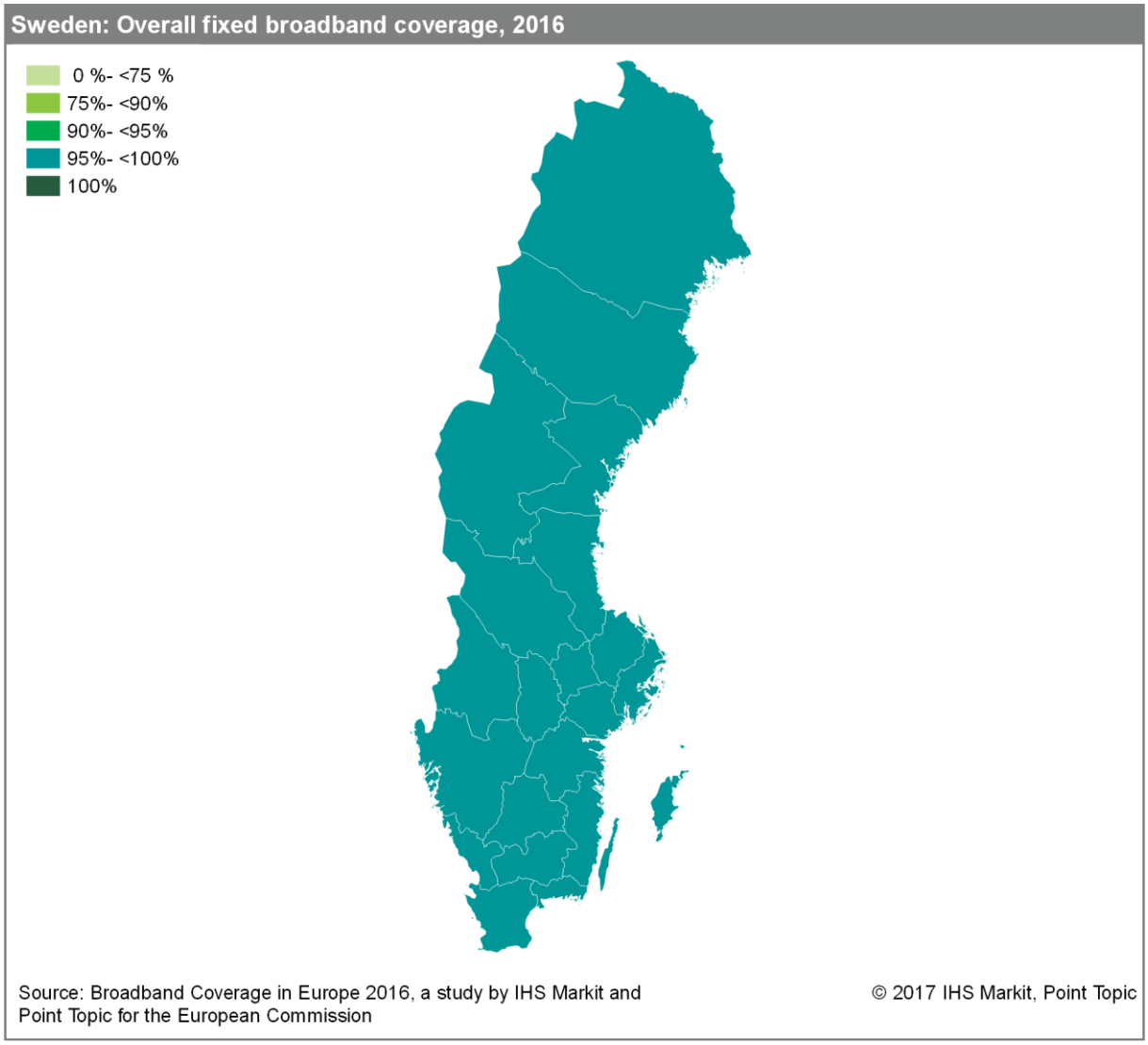
As in the previous year, rural areas across Sweden benefitted from near-universal coverage of LTE networks. LTE networks covered very nearly 100% of rural households, increasing from 98.0% in the previous year. Rural LTE coverage is a focus area for the telecommunications regulator, given the low rural NGA availability in Sweden. In 2015, the regulator ordered a joint venture between Tele2 and

[103] https://www.telegeography.com/products/commsupdate/articles/2015/06/11/usd393m-rural-broadband-strategy-approved-national-secretariat-to-support-regions/

Telenor, named Net4Mobility (N4M), to roll out LTE technology to a list of specific rural locations identified as lacking broadband access.[104]

5.29.2 Regional coverage by broadband technology

Overall fixed broadband coverage in Sweden was high across all regions, ranging from 95.3% in Jämtlands län and Västerbottens län to 99.9% in Örebro län. In Stockholm, 99.7% of households in the Swedish capital had access to fixed broadband services. While no region reported complete coverage, 10 out of the 21 regions recorded fixed broadband coverage levels exceeding 99%.

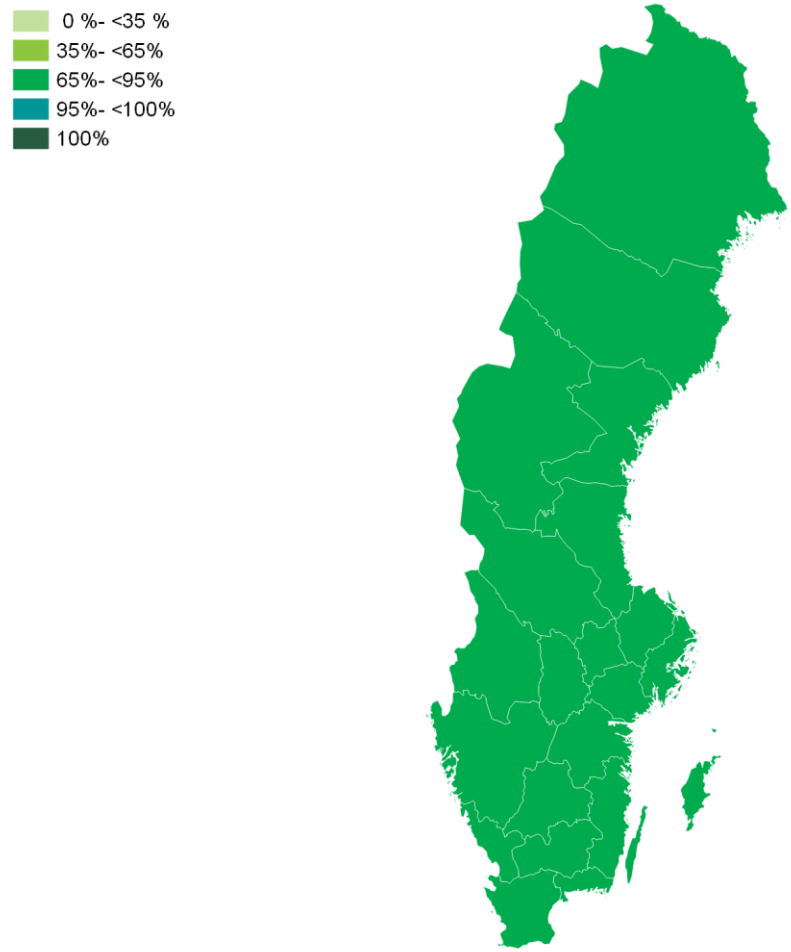


NGA coverage across regions was more varied, with the lowest NGA coverage recorded in Jämtlands län (66.4%) while two regions, Stockholm and Västerbottens reported NGA coverage close to 90%.

The biggest year-on-year increase in NGA coverage compared to mid-2015 was recorded for the Gotlands län region, where availability of NGA services grew by 20.0 percentage points to nearly 87% of households covered by the end of June 2016.

[104] https://www.telegeography.com/products/commsupdate/articles/2015/01/16/pts-reiterates-800mhz-coverage-order-to-tele2-telenor/

Sweden: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.29.3 Data tables for Sweden

Statistic	National
Population	9,747,355
Persons per household	2.1
Rural proportion	9.7%

	Sweden 2016		Sweden 2015		Sweden 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	98.0%	86.6%	97.9%	89.0%	97.9%	89.0%	94.3%	86.0%
VDSL	21.9%	0.8%	18.3%	0.5%	18.3%	0.5%	48.2%	26.6%
FTTP	60.8%	20.8%	56.4%	13.7%	56.4%	13.7%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	37.9%	0.6%	38.8%	0.1%	38.8%	0.1%	44.4%	10.7%
DOCSIS 3.0	36.2%	0.6%	34.0%	0.0%	34.0%	0.0%	43.9%	10.1%
HSPA	99.9%	99.2%	99.1%	96.5%	99.1%	96.5%	98.0%	92.2%
LTE	100.0%	100.0%	99.2%	98.0%	99.2%	98.0%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	100.0%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	100.0%	99.5%	98.2%	99.5%	98.2%	99.9%	99.2%
Overall fixed broadband	99.0%	91.1%	99.0%	93.6%	99.0%	93.6%	97.5%	92.6%
NGA broadband	79.4%	21.5%	76.4%	13.9%	76.4%	13.9%	75.9%	39.2%
At least 2 Mbps	100.0%	-	99.0%	-	99.0%	-	96.7%	-
At least 30 Mbps	88.4%	-	76.4%	-	76.4%	-	75.1%	-
At least 100 Mbps	68.7%	-	57.5%	-	57.5%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

5.30 Switzerland

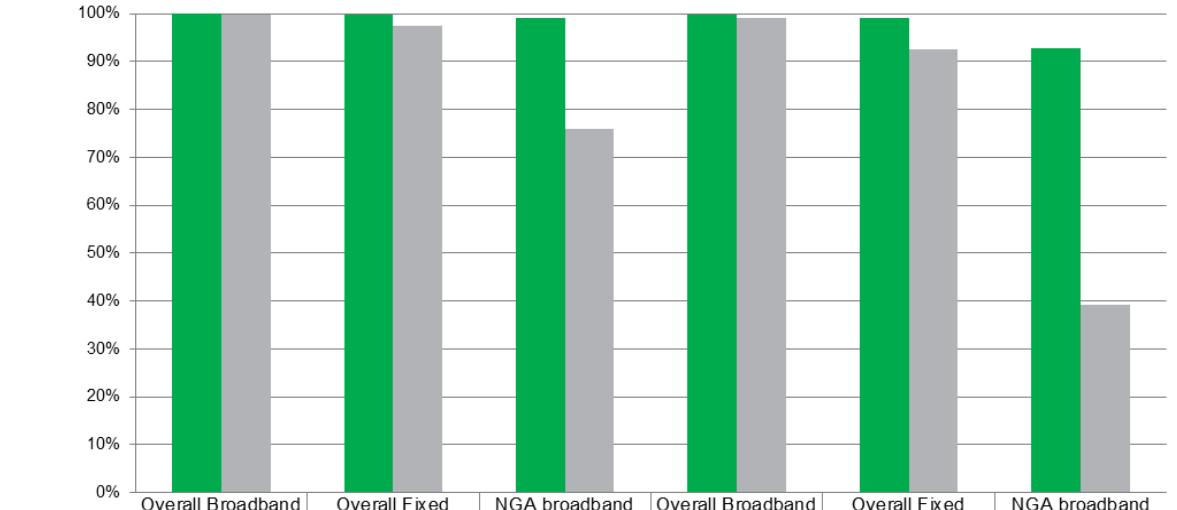
5.30.1 National coverage by broadband technology

As in the previous years, research on broadband coverage in Switzerland was included in the BCE study thanks to additional funding provided by Glasfasernetz Schweiz, a Swiss fibre optic industry association.

Switzerland continued to be one of the leaders in Europe in relation to broadband coverage. As in previous years, Switzerland reported above-average coverage levels for all coverage combination categories. Given the high broadband coverage levels achieved in previous years, it is unsurprising that there were no substantial changes in broadband coverage levels in the twelve-month period to the end of June 2016.

By mid-2016, Switzerland recorded universal, or near-universal, coverage for the overall broadband combination category on a national and rural level (100.0% and 99.8%, respectively), as well as for the fixed broadband combination category (99.8% and 99.0%, respectively). Similarly, NGA broadband availability was near-universal (99.0%) at a national level. At a rural level, NGA broadband services were available to 92.9% of rural households.

Switzerland: Coverage by technology combination, 2016



	Overall Broadband (total)	Overall Fixed Broadband (total)	NGA broadband (total)	Overall Broadband (rural)	Overall Fixed Broadband (rural)	NGA broadband (rural)
Switzerland	100.0%	99.8%	99.0%	99.8%	99.0%	92.9%
EU 28	99.9%	97.5%	75.9%	99.2%	92.6%	39.2%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Switzerland continued to rank ahead of the EU average in terms of total coverage for each broadband technology with the exception of WiMAX, which is absent in the Swiss market. Moreover, Switzerland remained one of four countries with cable coverage above 80% of total households. In previous years, cable operators, led by UPC (formerly Cablecom), have been investing substantially in cable deployment, with this activity set to continue in the next couple of years.[105] By mid-2016, Switzerland's entire cable infrastructure was upgraded to DOCSIS 3.0, meaning that cable networks serve as the key NGA technology in the country.

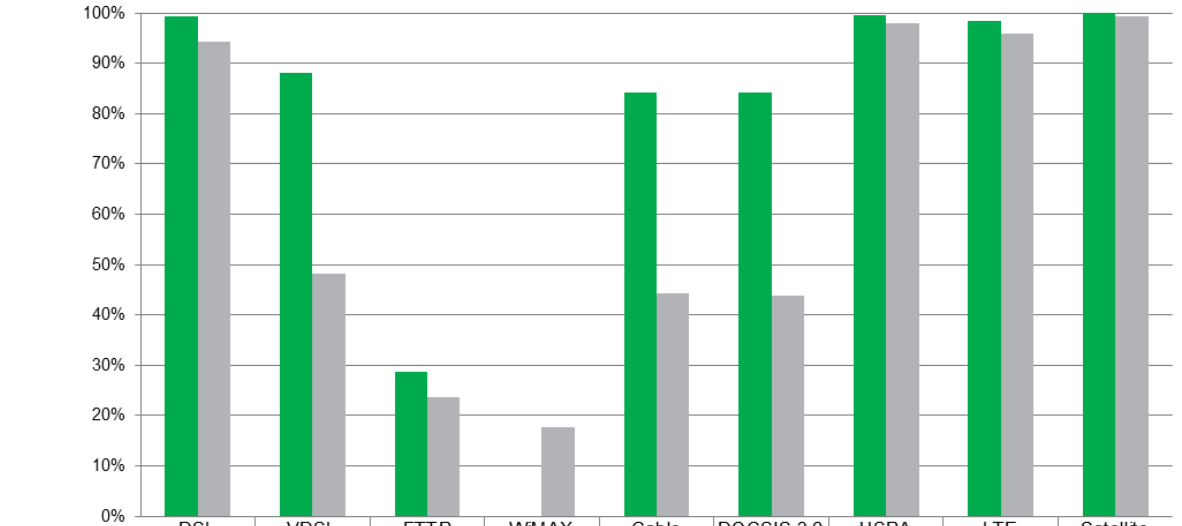
Examining other NGA technologies, Switzerland was one of six countries to record VDSL coverage of above 80%. Over the twelve-month period, VDSL coverage increased by 6.5 percentage points and at the end of June 2016, 88.0% of Swiss households had access to VDSL broadband services.

Growth in FTTP coverage was slower compared to VDSL, nevertheless, following a 1.7 percentage point increase, FTTP networks passed 28.6% of homes by mid-2016 and remained above the EU average (23.7%). These increases can be attributed to the continued large-scale deployment of both VDSL and FTTP technologies by the incumbent operator Swisscom, launched partly in reaction to the

[105] https://www.upc.at/ueber-upc/presse/pressearchiv/upc-startet-millionen-investitionsprogramm-autostrada/

increasing competition from cable providers. In addition, Swisscom was also one of the first European network operators to launch commercial deployment of G.fast technology in September 2016, which will allow the company to offer download speeds to up to 500 Mbps over its copper network.[106]

Switzerland: Coverage by technology, total, 2016

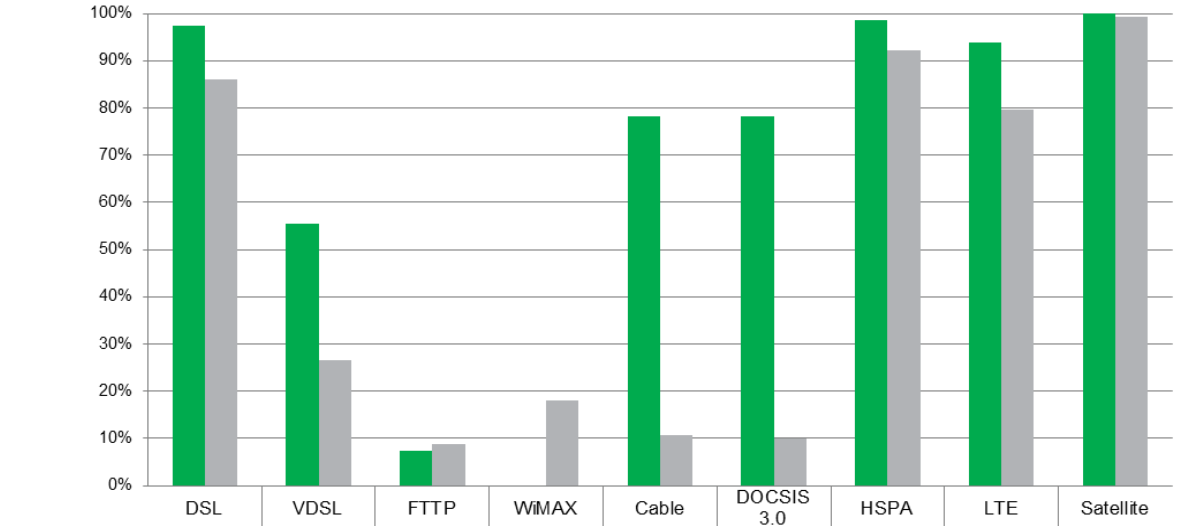


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Switzerland	99.5%	88.0%	28.6%	0.0%	84.3%	84.3%	99.5%	98.3%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

With regards to mobile broadband technologies, 98.3% of Swiss homes were passed by LTE technology, an increase of 6.0 percentage points compared to mid-2015. Following widespread adoption of LTE, Swisscom and Sunrise have both introduced speed-tiered plans that offer customers the chance to upgrade to advanced LTE plans.

Switzerland: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
Switzerland	97.4%	55.5%	7.3%	0.0%	78.2%	78.2%	98.7%	93.8%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

During the twelve-month period to mid-2016, Switzerland remained one of the leaders in Europe in terms of rural cable coverage. Cable networks passed 78.2% of rural households with all of cable networks upgraded to DOCSIS 3.0. Looking at other NGA technologies, at the end of June 2016,

[106] https://www.swisscom.ch/en/about/medien/press-releases/2016/10/20161018-MM-Gfast.html

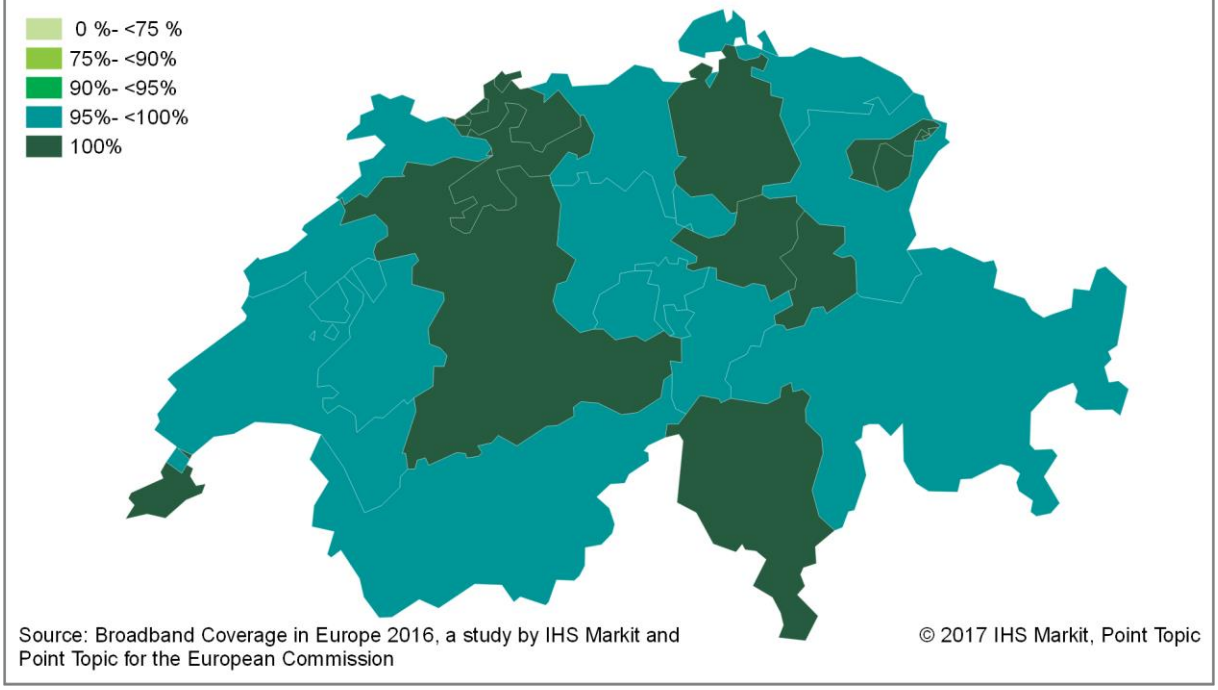
VDSL services were available to 55.5% of rural households in Switzerland. Meanwhile, 7.3% of rural households had access to FTTP broadband.

Examining mobile broadband access in rural areas, Switzerland was above the EU average for HSPA coverage by mid-2016, reaching 98.7% of rural homes. Rural LTE coverage was also above the EU average of 79.7%.

5.30.2 Regional coverage by broadband technology

Eighteen out of the 26 Swiss regions reported virtually complete fixed broadband coverage, with fixed coverage in all of the remaining regions exceeding 96%. Lowest coverage was recorded in the Jura and Uri regions, reaching 96.1% of households.

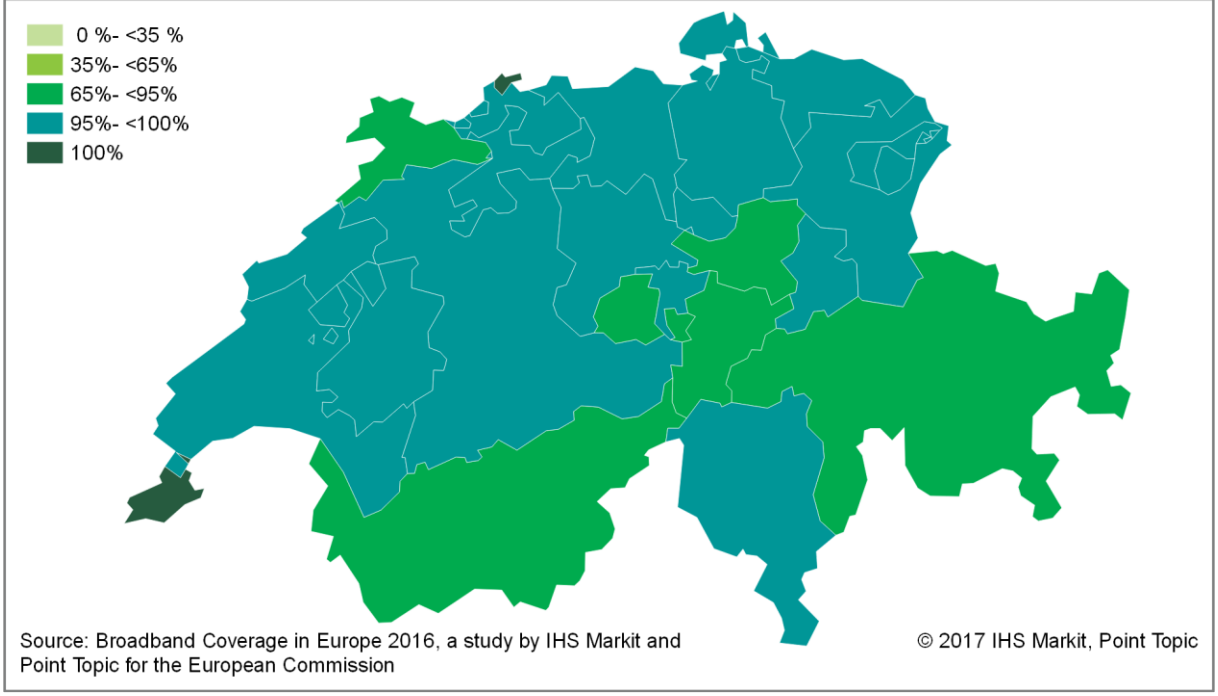
Switzerland: Overall fixed broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Complete NGA coverage was recorded in Geneva and Basel, with over 95% of homes passed by NGA networks in majority of the remaining regions. In five regions - Valais, Jura, Obwalden, Uri, and Graubünden – NGA coverage was lower than 95%, yet no region recorded less than 90% NGA coverage.

Switzerland: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.30.3 Data tables for the Switzerland

Statistic	National
Population	8,233,842
Persons per household	2.3
Rural proportion	12.7%

	Switzerland 2016		Switzerland 2015		Switzerland 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	99.5%	97.4%	99.5%	97.4%	99.4%	97.4%	94.3%	86.0%
VDSL	88.0%	55.5%	81.5%	39.7%	79.7%	38.7%	48.2%	26.6%
FTTP	28.6%	7.3%	27.0%	6.6%	25.9%	6.2%	23.7%	8.8%
WiMAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	18.0%
Cable	84.3%	78.2%	84.1%	*78.0%*	83.9%	77.6%	44.4%	10.7%
DOCSIS 3.0	84.3%	78.2%	84.1%	*78.0%*	83.9%	77.6%	43.9%	10.1%
HSPA	99.5%	98.7%	99.4%	97.6%	99.0%	96.1%	98.0%	92.2%
LTE	98.3%	93.8%	92.3%	72.2%	91.8%	69.9%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	96.3%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	99.8%	99.9%	*99.6%*	99.9%	99.6%	99.9%	99.2%
Overall fixed broadband	99.8%	99.0%	99.8%	*99.0%*	99.8%	99.0%	97.5%	92.6%
NGA broadband	99.0%	92.9%	98.9%	*92.7%*	98.8%	91.6%	75.9%	39.2%
At least 2 Mbps	99.8%	-	99.8%	-	99.8%	-	96.7%	-
At least 30 Mbps	98.9%	-	98.9%	-	98.7%	-	75.1%	-
At least 100 Mbps	98.5%	-	98.4%	-	98.3%	-	50.8%	-

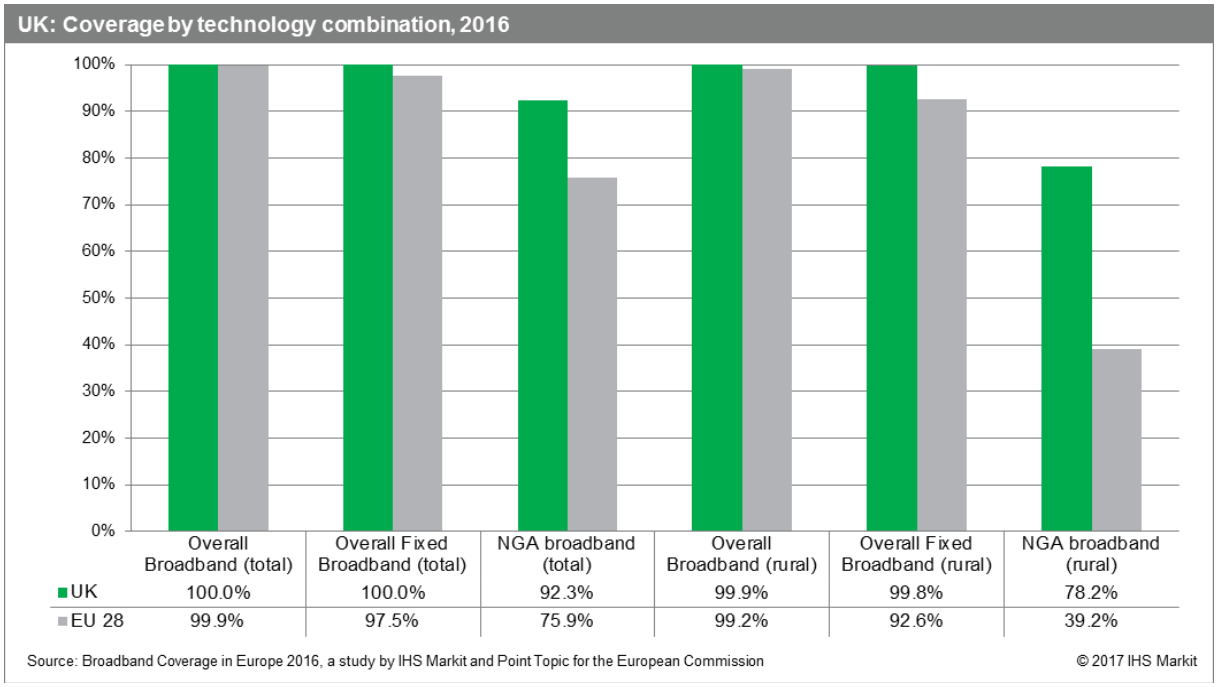
Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

Due to new and more accurate data on cable broadband coverage, previously reported coverage trends and values reported for Switzerland have been restated. All restatements are highlighted in italics.

5.31 United Kingdom

5.31.1 National coverage by broadband technology

As in the previous edition of the study, the United Kingdom recorded universal broadband coverage at a national level and near-universal broadband coverage at a rural level. Moreover, fixed broadband coverage recorded near identical levels as overall broadband. With regards to NGA coverage, the proportion of homes passed by NGA networks increased by 1.8 percentage points to reach 92.3%, substantially higher than the EU average (75.9%). Growth of NGA technologies in rural areas was more dramatic, where coverage increased by 30.8 percentage points, covering 78.2% of rural households at the end of June 2016.



Looking in more detail at coverage levels of the individual technologies, UK broadband coverage continued to be driven by DSL technology, with VDSL maintaining its position as the dominant NGA technology. The UK remained one of the leaders in Europe in terms of VDSL, with coverage levels of nearly double the EU average. As was the case in the previous editions of the study, VDSL was the only fixed broadband technology to register a notable increase in coverage. The number of households covered by VDSL increased by 2.2 percentage points in the twelve-month period to mid-2016, reaching 85.0% of UK households. The continued VDSL coverage increases can be attributed to investments made primarily by the incumbent telecommunications group, BT, which reached over 25 million premises with its VDSL-based next-generation access infrastructure by mid-2016.[107]

With the incumbent maintaining its focus on upgrading its legacy copper-based network, there was limited expansion of FTTP networks in the UK. Consequently, in the twelve-month period to mid-2016, the proportion of homes passed by FTTP increased by only 0.3 percentage points. This had led to the Government pledging over EUR 800 million across the next four years to support the rollout of FTTP networks in the UK.[108]

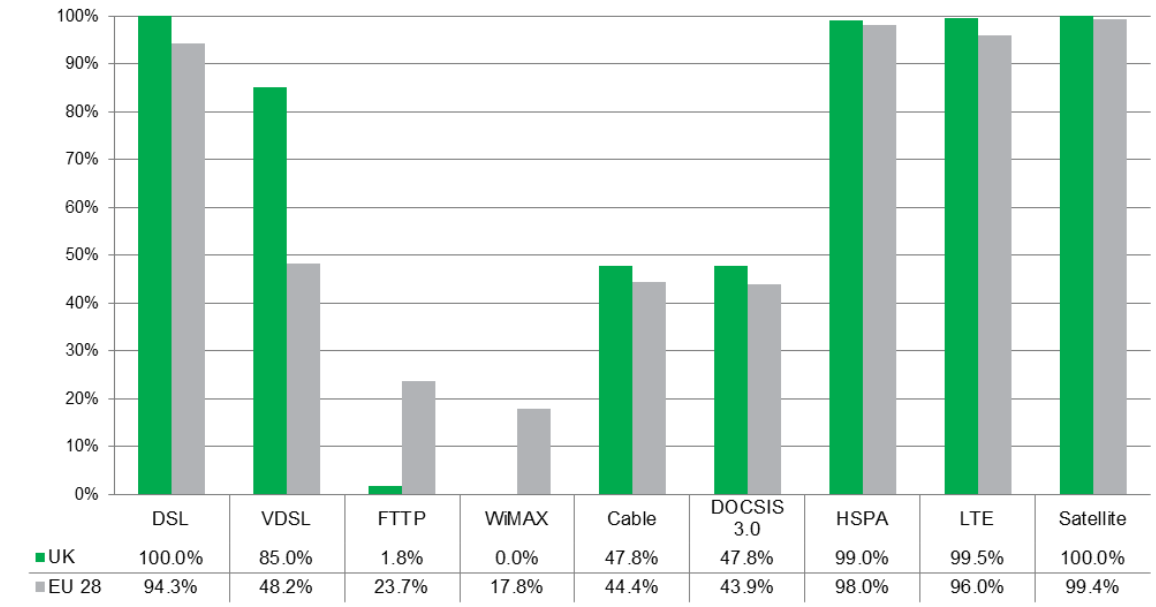
As was the case with FTTP coverage in the UK, DOCSIS 3.0 coverage increased by less than a percentage point by mid-2016, with the planned network expansion of the UK's leading cable company, Virgin Media, still in its early stages.[109]

Examining mobile broadband technologies, LTE technologies continued to expand at a similar rate to the previous edition of the study, increasing by 10 percentage points to 99.5%, above the EU average

[107] http://home.bt.com/tech-gadgets/tech-news/openreach-fibre-network-passes-25-million-uk-premises-11364050797620
[108] https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016
[109] http://www.libertyglobal.com/pdf/presentations/Liberty-Global-Group-Q4-2016-Investor-Call-Presentation-FINAL.pdf

of 96.0%. In terms of average coverage of all LTE network operators, on average LTE services were available to 92.5% of UK premises at the end of June 2016.

UK: Coverage by technology, total, 2016

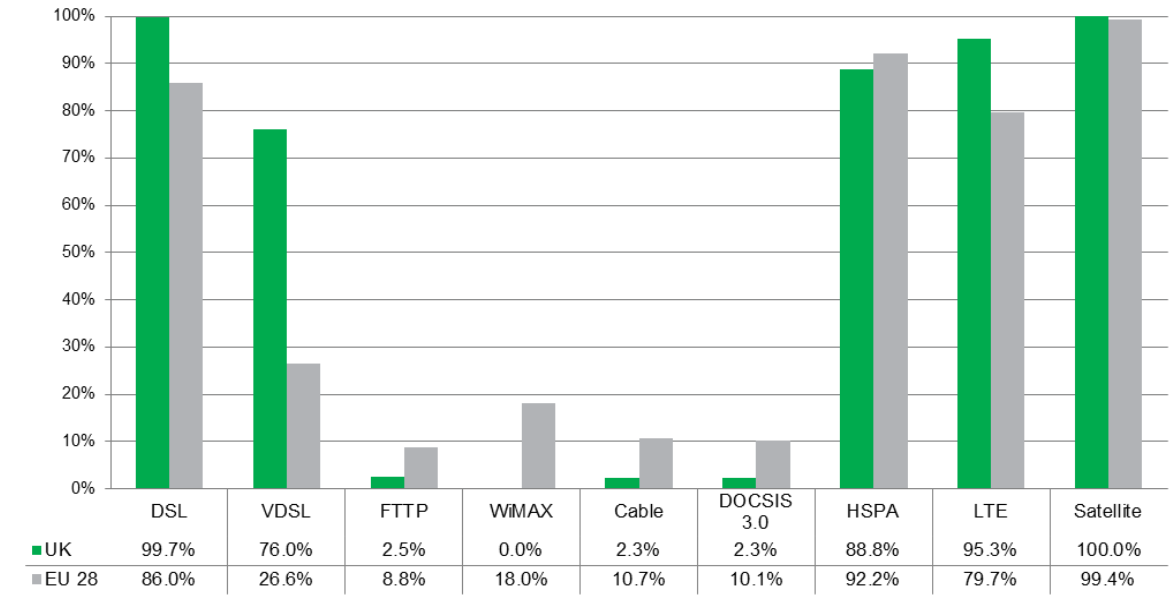


	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
UK	100.0%	85.0%	1.8%	0.0%	47.8%	47.8%	99.0%	99.5%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

At the end of June 2016, rural areas continued to depend on DSL technology to receive broadband access, as rural cable coverage remained negligible, while rural WiMAX coverage was non-existent. With near-universal DSL coverage, as per mid-2015, the twelve-month period to mid-2016 saw a substantial proportion of DSL networks upgraded to VDSL. As a result, rural VDSL coverage increased by around 32 percentage points in the year to mid-2016, reaching 76.0% of rural households. In contrast, rural FTTP coverage remained low at 2.5%. Yet, as the efforts of local companies and initiatives, such as B4RN or Gigaclear continue, rural FTTP availability is expected to slowly begin to improve.

UK: Coverage by technology, rural areas, 2016



	DSL	VDSL	FTTP	WiMAX	Cable	DOCSIS 3.0	HSPA	LTE	Satellite
UK	99.7%	76.0%	2.5%	0.0%	2.3%	2.3%	88.8%	95.3%	100.0%
EU 28	86.0%	26.6%	8.8%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

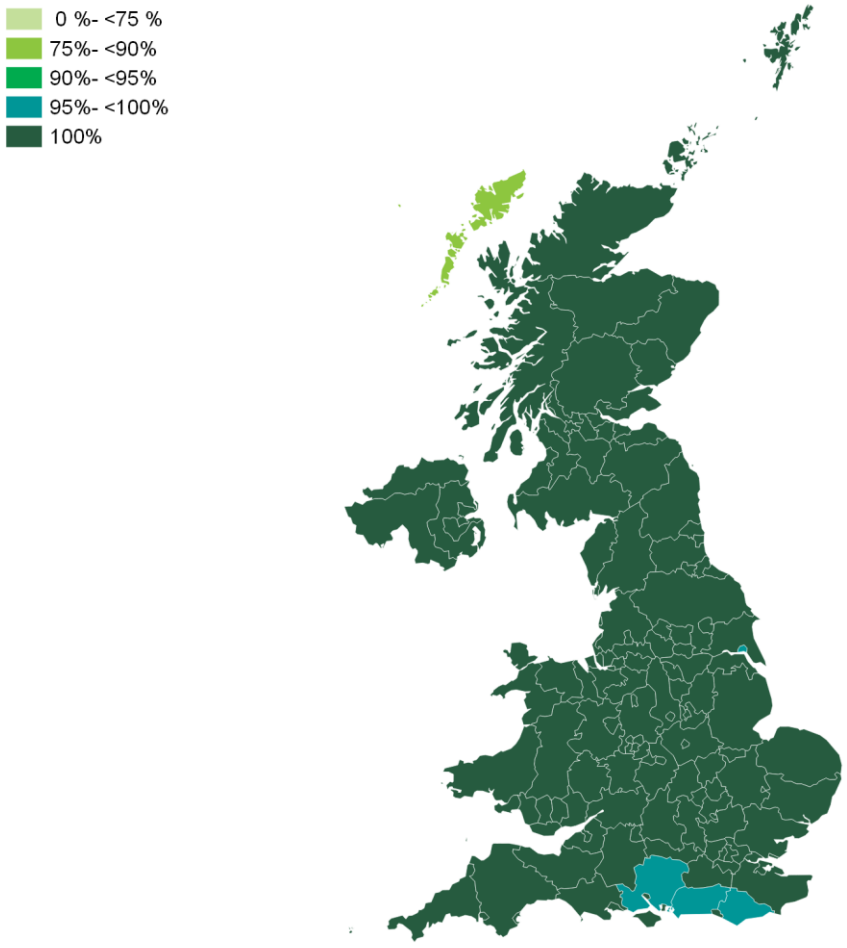
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

The UK witnessed a substantial increase in rural LTE coverage during the twelve-month period to the end of June 2016. The proportion of rural areas covered by the technology increased by around 85 percentage points, reaching 95.3% of rural households, due to the efforts of UK mobile operators to tackle rural blackspots. In particular, mobile operator EE (part of the BT Group) is focussing on rural areas, vowing to report in only geographic coverage from 2017.[110]

5.31.2 Regional coverage by broadband technology

Complete fixed broadband coverage was reported in almost all of the regions in the UK, with only six out of 139 regions having lower coverage. In Kingston upon Hull, East Sussex, West Sussex, Cambridgeshire, and Hampshire, fixed broadband coverage reached between 98% and 99.9% of households. The Western Islands (Eilean Siar) were the only region, where fixed broadband coverage was less than 90%.

United Kingdom: Overall fixed broadband coverage, 2016



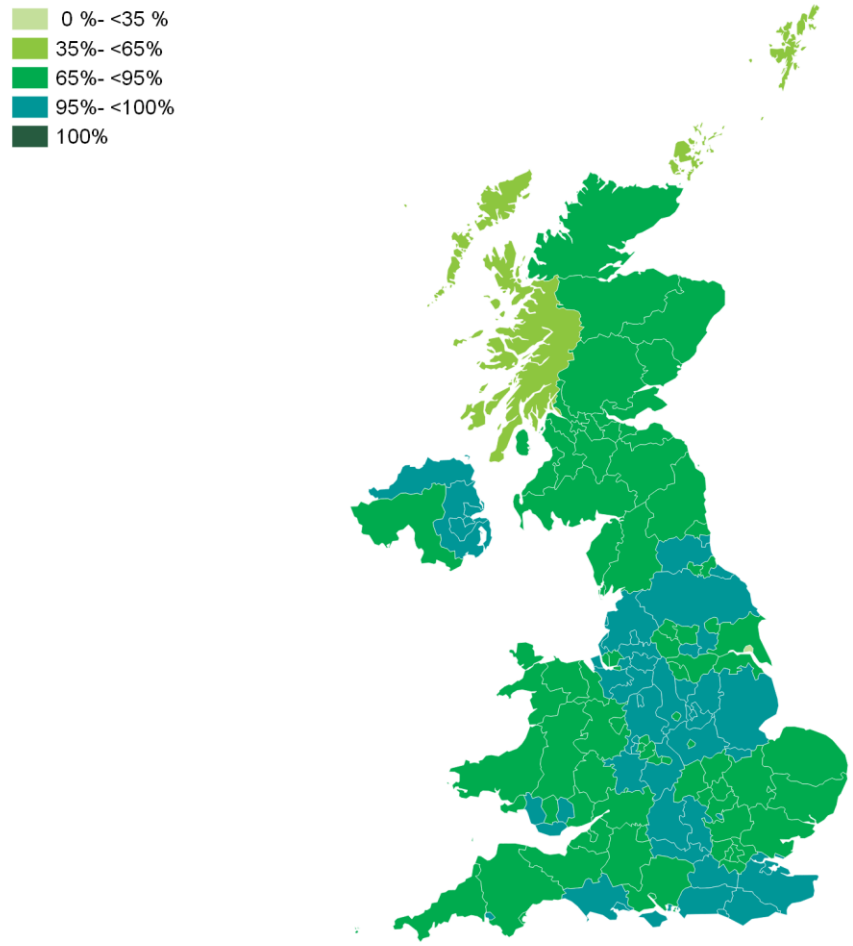
Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

Regional NGA coverage was much more varied and while most regions reached NGA coverage levels above 80%, a number of rural regions in Wales, Yorkshire and Scotland show much lower availability of NGA services. On the other hand, a state-funded infrastructure investment in Northern Ireland has resulted in near-complete coverage of the whole province, despite its vast rural areas.

[110] http://newsroom.ee.co.uk/ee-calls-on-industry-to-get-clear-on-coverage-as-it-covers-5000-square-kilometres-of-4g-not-spots-overnight

Lowest NGA broadband coverage was recorded in Kingston upon Hull (less than 35%) and Eilean Siar (Western Isles), where NGA services were available to approx. 40% of households. In the remote regions of Lochaber, Skye & Lochalsh, Arran & Cumbrae and Argyll & Bute, Orkney Islands, and Shetland Islands between 56%-63% of households had access to NGA broadband at the end of June 2016.

United Kingdom: NGA broadband coverage, 2016



Source: Broadband Coverage in Europe 2016, a study by IHS Markit and Point Topic for the European Commission

5.31.4 Data tables for the United Kingdom

Statistic	National
Population	64,641,461
Persons per household	2.3
Rural proportion	8.7%

	UK 2016		UK 2015		UK 2014		EU28 2016	
Technology	Total	Rural	Total	Rural	Total	Rural	Total	Rural
DSL	100.0%	99.7%	100.0%	99.7%	100.0%	99.7%	94.3%	86.0%
VDSL	85.0%	76.0%	82.8%	43.9%	78.9%	42.4%	48.2%	26.6%
FTTP	1.8%	2.5%	1.4%	0.9%	1.4%	0.8%	23.7%	8.8%
WiMAX	0.0%	0.0%	4.2%	2.7%	4.2%	2.7%	17.8%	18.0%
Cable	47.8%	2.3%	46.9%	*2.4%*	46.8%	*2.4%*	44.4%	10.7%
DOCSIS 3.0	47.8%	2.3%	46.9%	*2.4%*	46.8%	*2.4%*	43.9%	10.1%
HSPA	99.0%	88.9%	99.0%	88.8%	99.0%	88.8%	98.0%	92.2%
LTE	99.5%	96.3%	89.5%	10.1%	84.0%	9.4%	96.0%	79.7%
LTE average operator coverage (DESI indicator)	92.5%	-	-	-	-	-	84.4%	-
Satellite	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.4%	99.4%
Overall broadband	100.0%	99.9%	100.0%	99.9%	100.0%	99.9%	99.9%	99.2%
Overall fixed broadband	100%	99.8%	100.0%	99.8%	100.0%	99.8%	97.5%	92.6%
NGA broadband	92.3%	78.2%	90.5%	47.4%	88.5%	45.9%	75.9%	39.2%
At least 2 Mbps	95.1%	-	95.0%	-	95.0%	-	96.7%	-
At least 30 Mbps	84.4%	-	82.7%	-	81.0%	-	75.1%	-
At least 100 Mbps	23.6%	-	23.0%	-	22.9%	-	50.8%	-

Note: The 2016 figures represent state of broadband coverage as of end of June 2016. The 2015 (end of June) and 2014 (end of year) figures are drawn from the previous studies conducted by IHS and VVA.

6.0 Appendices

6.1 M2M applications

With M2M connectivity becoming increasingly important in terms of M2M applications' reliance on availability of universal and uninterrupted broadband connectivity, the Tender of Specification of SMART 2016/0043 asked for the research team to provide additional insight into the Machine-to-Machine (M2M) communications needs. The analysis below outlines the existing M2M applications currently deployed in the Member States, their connectivity needs and future outlook.

6.1.1 IoT and M2M Definitions

Internet of Things (IoT) is not a specific device or technology – it is a conceptual framework, driven by the idea of embedding connectivity and intelligence in a wide range of devices. IHS Markit defines an IoT device as a device which has some form of embedded connectivity that allows the device to be directly connected to the internet (i.e. IP addressable), or allows the device to connect (tether) to an IP addressable device.

Machine-to-machine (M2M) is communication between machines, devices, and equipment with little or no direct human interaction. The transmission of the data and information between these machines and devices can occur over a wired, wireless, or hybrid network. As such, M2M represents a sub-set of IoT.

In the context of this report, IHS Markit is referring to M2M delivered over a cellular network "cellular IoT", based on standardised technologies. Typically cellular connectivity is enabled through a connectivity module (modem) embedded into a device, such as an electricity meter or a video camera.

6.1.2 M2M Connectivity and Technologies

Like smartphones, M2M modules typically connect to public mobile networks run by mobile network operators (MNOs). IHS Markit segments M2M across the following 9 types of 2G, 3G and 4G/LTE connectivity. Many connectivity modules integrate more than one form of connectivity. This is to enable connectivity in areas where 3G or 4G is not available. "LTE Only" refers to connectivity modules that only support LTE connectivity.

- 2G - GSM/GPRS/EDGE
- 2G - CDMA 1xRTT
- 3G - WCDMA/HSPA
- 3G - CDMA EV-DO
- 4G - Highspeed LTE
- 4G - LTE Only
- 4G - LTE Cat-1
- 4G - LTE Cat-M
- 4G - NB-IoT

The latter two connectivity types (LTE Cat-M and NB-IoT) were standardised in June 2016 with 3GPP Release 13. These address a range of Low Power Wide Area Network (LPWAN) applications that have significantly different requirements from those enabled by legacy cellular networks such as WCDMA or Highspeed LTE. These are:

- Very low data rates and therefore the ability of supported devices to transmit over long distances;
- Long-battery life (5-10 years) for supported devices;
- Very low cost of deployment and ongoing ownership;
- The ability to reach deep into indoor areas such as basements.

These two technologies were developed for a range of reasons. Firstly - to give mobile operators an option to migrate their M2M customers (for instance utility companies) from 2G networks, which are set to be switched off in the next few years. Secondly - to open up new revenue opportunities for

operators. Thirdly - to address the growing competitive threat of unlicensed LPWAN technologies like SIGFOX and LoRaWAN.

Given their immaturity, neither NB-IoT nor Cat-M1 has been deployed widely in Europe, although a range of operators have announced their plans. At Mobile World Congress 2017, nine leading operator groups (including European players KPN, Orange and Telefónica) came out in support for Cat-M and Deutsche Telekom and Vodafone are backing NB-IoT. Deployment of both NB-IoT and Cat-M1 will begin from 2017 onwards.

In October 2016 Vodafone said that it would launch commercial NB-IoT networks in Germany, Ireland, the Netherlands and Spain in the first three months of 2017 and cover the rest of its global footprint by 2020. To date (early April 2017) Vodafone had launched commercial NB-IoT in Spain (in January 2017), but had yet to do so in the other three countries.

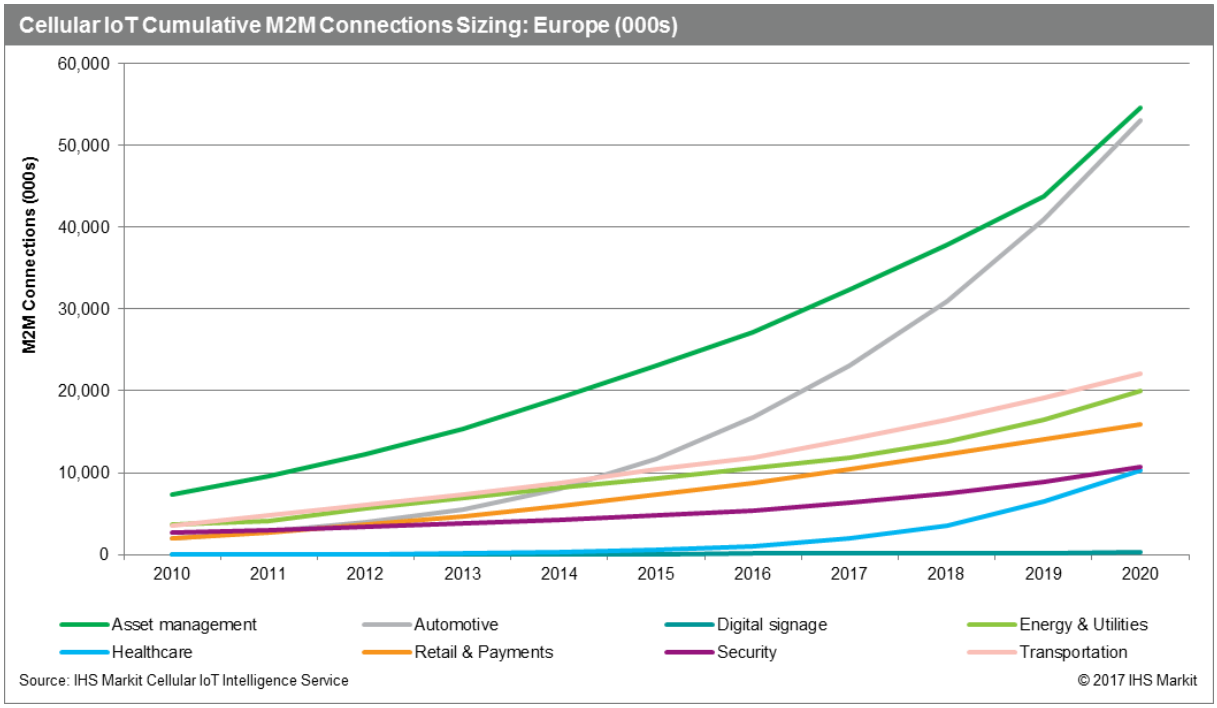
Unlicensed technologies such as SIGFOX and LoRaWAN pose a potential competitive threat to mobile operators in the LPWAN space. Increasingly, mobile operators are choosing to engage with these technologies, which are well placed to compete on price with NB-IoT and Cat-M. Among those mobile operators that have decided to deploy LoRaWAN are: Bouygues Telecom (France), KPN (the Netherlands), Orange (France) and Swisscom (Switzerland). Telefónica (Spain) and Telia (Estonia) are partnering with SIGFOX.

6.1.3 M2M Applications

There are a wide range of M2M use cases and applications. Their requirements, in terms of bandwidth and latency, vary greatly. For instance, video surveillance (**Security**) requires much lower latency than smart metering (**Energy & Utilities**). IHS Market currently puts these into eight application segments (see the table below).

Application Segments	Description
Asset Management	Embedded cellular connectivity for monitoring and/or controlling fixed and mobile non-vehicular assets.
Automotive	OEM and aftermarket embedded cellular connections in cars and light trucks, targeting consumer use-cases.
Digital Signage	Embedded cellular connectivity for providing content to remote digital signage displays.
Energy & Utilities	Embedded cellular connectivity for enabling utility smart grid infrastructure deployments, specifically for electricity, gas, and water services.
Healthcare	Embedded cellular connectivity for healthcare-related services offered remotely as opposed to on-site in a medical facility.
Retail & Payments	Embedded cellular connectivity for enabling for enabling payment processing and self-service retail applications.
Security	Embedded cellular connectivity used as either a primary or secondary connection for home and small business security alarms, managed home automation services, and video surveillance.
Transportation	OEM and aftermarket embedded cellular connections in fleet vehicles, tractor-trailers, and public transportation.

As indicated in the chart below, the largest application areas by number of M2M connections in Europe are: Asset Management; Automotive; Transportation and Energy & Utilities.



Taking the example of one leading M2M operator in Europe, Deutsche Telekom, common use cases across these 4 areas include:

- **Asset management**: providing real-time data on the location of trucks and the condition of containers and goods.
- **Automotive**: enablement of in-car mobile internet access, allowing information on traffic conditions and entertainment to be provided on route.
- **Transportation**: relay of data on the location of a vehicle as well as information on fuel consumption and mileage to fleet managers.
- **Energy & Utilities**: smart meters enabling consumers to monitor and adjust their energy consumption.

6.1.4 Outlook

By lowering the cost of connectivity and expanding its reach into hitherto uncovered areas, NB-IoT and Cat-M1 carry the potential to drive tens of millions of new M2M connections. These will largely be massive IoT: this use case is characterized by a very large number of connected devices typically transmitting a relatively low volume of non-delay-sensitive data.

While NB-IoT and Cat-M1 are nascent technologies, there have been a range of trials and pilots. For instance:

- In December 2016, the Swedish operator Telia launched a smart farming service to monitor irrigation systems. Sprinklers are equipped with sensors that can monitor position via GPS, provide alerts in the case of falling pressure and report status updates on the irrigation systems (which are also equipped with sensors). The sensor unit is connected to the mobile network and onward to the client server via a NB-IoT module.

- In November 2016, Sonera in Finland announced that it had completed a trial during which a pilot NB-IoT network communicate information on temperature, humidity and air pressure over Sonera's commercial 4G network in the Finnish capital, Helsinki.

- In October 2016, Vodafone Spain demonstrated a smart parking space solution powered by NB-IoT. A sensor was buried in a space within the Vodafone Plaza in Madrid. The sensor communicated to a smartphone app whether the space was occupied or free.

The core application opportunities for NB-IoT and Cat-M1 are follows:

- **Logistics and Asset Management** – It includes applications such as asset tracking, asset management, package tracking, material and feedstock management, factory automation, and a variety of other applications.

- **Smart Metering** – Includes gas, water, and electric communicating meters.

- **Infrastructure and Environmental Monitoring** – Includes applications related to smart cities, civil infrastructure, and environmental monitoring. Examples include street lighting, waste management, parking management, traffic monitoring, emergency management, public transportation management, and environmental monitoring, including agriculture applications.
- **Security and Smart Buildings** – Covers applications related to intelligent building automation, including HVAC (heating, ventilation, and air conditioning), energy management, security, lighting, and room automation.

- **Energy Production** – Covers all applications related to energy exploration, production, and distribution; also includes energy segments such as oil and gas, solar, wind, and hydroelectric.

These opportunities will also be targeted by providers using unlicensed LPWAN technologies such as SIGFOX and LoRaWAN. These providers include both existing mobile operators and a range of alternative operators which are rolling out SIGFOX or LoRaWAN networks across Europe. Examples of these alternative operators are Arquiva in the UK (SIGFOX) and Unidata in Italy (LoRaWAN).

Whether enterprises select a standardised cellular technology such as NB-IoT or Cat-M or an unlicensed to support their IoT applications depends on a range of factors such as costs, attitudes towards unlicensed spectrum and the ability to provide over-to-air (OTA) updates to devices in the field. In these respects, the four technologies have different characterises. SIGFOX and LoRaWAN modules are currently cheaper than NB-IoT and Cat-M, but rely on rely on unlicensed rather than dedicated licensed spectrum. Currently, SIGFOX devices in the field cannot be updated over-the-air.

Before choosing which technology to use, customers must also be satisfied that it meets their coverage requirements through extensive testing. For many applications, deep indoor coverage, extending to basements and far into buildings, is required. The current way of measuring mobile coverage (% of population or landmass covered) is insufficient to demonstrate that a specific technology can meet requirements for IoT.

6.2 Broadband coverage definitions

6.2.1 Technology definitions

The table below indicates the definitions of the individual broadband access technologies studied by this project. These definitions were included in the survey questionnaire.

Please note that the definitions are not designed to be rigorous definitions from an engineering point of view, but rather are intended to reflect practical definitions used by NRAs and ISPs.

Technology	Technology definition
DSL	DSL (for Digital Subscriber Line) is the basic technology used to provide broadband over conventional telephone lines. The types of DSL used for standard fixed broadband (mainly ADSL or ADSL2+) deliver download speeds of at least 2 Mbps. Not all DSL connections are capable of download speeds of 2Mbps and higher, these connections should not be reported in the survey, but we ask you to note this fact in STEP 4 - Technology definitions of the survey.
VDSL	VDSL (also called FTTC+VDSL for example) is a "Very-high-speed" version of DSL. VDSL is usually provisioned from a street cabinet which has fibre backhaul or directly from the telephone exchange in areas which are close to the exchange. Actual VDSL download speeds can vary and we ask you to note the typical VDSL connection speeds in STEP 4 - Technology definitions of the survey. This definition does not include implementations where fibre is provisioned to a large building, such as a block of flats, and the final connections are provided by VDSL within the building, which are defined as FTTP.
FTTP	FTTP (fibre-to-the-premises) is broadband provided over fibre optic cables going all the way to the home or business premises. This definition also includes "FTTB", where fibre terminates at a large building and broadband distribution within the building, to different flats for example, is by a different non-fibre technology such as VDSL.
WiMAX	WiMAX is a wireless service using one of the IEEE standards 802.16d, for fixed users and 802.16e for mobile.
Cable Modem	Cable Modem broadband is delivered over a fixed cable TV network using coaxial cable according to the earlier cable broadband standards such as DOCSIS 1, usually providing download speeds up to about 20Mbps.
DOCSIS 3.0	DOCSIS 3.0 broadband is delivered over a fixed cable TV network using coaxial cable according to the DOCSIS 3.0 standard, providing download speeds of 30Mbps and above.
HSPA	HSPA (High Speed Packet Access) is the upgraded version of 3G mobile networks capable of providing mobile broadband at a maximum download speed of at least 21.1Mbps.
LTE	LTE (Long Term Evolution) is the next-generation mobile service standardised by the 3rd Generation Partnership Project which requires separate spectrum from 3G mobile and which supports maximum downstream speeds up to at least 100Mbps.

6.2.2 Coverage definitions

The definitions included in the table below were used to determine whether households are within the coverage reach of the individual broadband technologies. These definitions were included in the survey questionnaire.

Please note that the definitions are not designed to be rigorous definitions from an engineering point of view, but rather are intended to reflect practical definitions used by NRAs and ISPs.

Technology	Coverage definition
DSL	A household has DSL coverage if it is a telephone exchange area fully enabled for DSL.
VDSL	A household has VDSL coverage if it is close enough to a VDSL-enabled cabinet or exchange to get a high-speed broadband signal.
FTTP	A household has FTTP coverage if it can be connected now to a fibre service without requiring the construction of new fibre infrastructure.
WiMAX	A household has WiMAX coverage for broadband if it can receive at least 2Mbps downstream from an existing service without requiring the construction of new WiMAX infrastructure.
Cable Modem	A household has cable modem coverage if it can be connected now to a broadband service without requiring the construction of new cable TV network infrastructure.
DOCSIS 3.0	A household has DOCSIS 3.0 coverage if it can be connected now to a DOCSIS 3.0 service without requiring the construction of new cable TV network infrastructure.
HSPA	A household has HSPA coverage if it is in the stated coverage area for at least one HSPA-upgraded 3G mobile network.
LTE	A household has LTE coverage if it is in the stated coverage area for at least one LTE mobile network.
LTE Average operator coverage	A simple average of LTE coverage of all mobile network operators active in a study country.

6.3 Broadband coverage data tables

6.3.1 Total and rural coverage by combination categories for each country

	TOTAL			RURAL		
	Overall broadband coverage	Overall fixed broadband coverage*	Overall NGA coverage**	Overall broadband coverage	Overall fixed broadband coverage*	Overall NGA coverage**
AT	99.7%	99.1%	89.2%	97.8%	94.2%	41.5%
BE	100.0%	99.9%	98.9%	99.8%	98.5%	88.3%
BG	100.0%	95.2%	74.1%	100.0%	80.8%	17.3%
HR	99.6%	97.0%	59.9%	98.3%	89.2%	10.1%
CY	100.0%	100.0%	87.5%	100.0%	100.0%	60.0%
CZ	99.8%	99.5%	75.1%	99.2%	96.5%	51.9%
DK	100.0%	99.3%	93.3%	100.0%	96.8%	59.3%
EE	99.5%	90.9%	79.1%	99.9%	73.0%	36.0%
FI	100.0%	97.0%	74.6%	100.0%	84.0%	8.2%
FR	100.0%	100.0%	47.0%	99.9%	99.7%	30.9%
DE	99.9%	98.6%	81.8%	98.8%	93.8%	48.9%
EL	99.9%	99.3%	44.2%	99.4%	96.5%	1.3%
HU	99.6%	95.2%	80.6%	98.7%	85.9%	46.9%
IS	99.8%	98.5%	95.7%	99.6%	95.8%	87.7%
IE	99.6%	96.3%	81.6%	99.0%	93.3%	50.3%
IT	99.8%	99.3%	72.3%	98.2%	94.0%	16.0%
LT	99.7%	98.5%	97.7%	99.1%	95.7%	92.4%
LV	100.0%	92.6%	91.1%	100.0%	83.3%	77.0%
LU	100.0%	100.0%	94.4%	99.9%	99.9%	94.1%
MT	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%
NL	100.0%	100.0%	98.3%	100.0%	100.0%	97.9%
NO	100.0%	95.3%	81.0%	100.0%	79.2%	32.9%
PL	99.9%	86.4%	64.1%	99.8%	82.5%	37.2%
PT	99.9%	99.8%	95.0%	99.1%	98.4%	73.5%
RO	100.0%	88.6%	71.7%	100.0%	82.3%	33.6%
SK	95.9%	88.0%	75.5%	91.6%	91.1%	38.4%
SI	99.8%	97.7%	81.6%	99.3%	92.2%	50.2%
ES	99.9%	95.5%	80.8%	99.4%	92.1%	27.7%
SE	100.0%	99.0%	79.4%	100.0%	91.1%	21.5%
CH	100.0%	99.8%	99.0%	99.8%	99.0%	92.9%
UK	100.0%	100.0%	92.3%	99.9%	99.8%	78.2%
EU 28	99.9%	97.5%	76.0%	99.2%	92.7%	39.8%

* Fixed broadband coverage includes DSL, VDSL, FTTP, DOCSIS 1.0/2.0, DOCSIS 3.0, WiMax
** NGA coverage includes VDSL, FTTP, DOCSIS 3.0

6.3.2 Total coverage by technology for each country

	DSL***	VDSL	FTTP	WiMAX	Cable***	DOCSIS 3.0	HSPA	LTE	Satellite
AT	98.3%	82.1%	7.8%	12.5%	49.1%	47.2%	99.1%	99.0%	100.0%
BE	99.9%	92.5%	0.6%	14.8%	96.4%	96.4%	100.0%	99.9%	100.0%
BG	85.2%	0.0%	37.1%	0.0%	65.9%	63.6%	100.0%	76.5%	100.0%
HR	94.9%	44.2%	15.6%	0.0%	34.3%	26.9%	99.2%	90.1%	100.0%
CY	100.0%	75.0%	51.2%	0.0%	68.7%	68.7%	99.0%	74.3%	100.0%
CZ	97.0%	53.1%	35.0%	83.7%	38.3%	37.7%	97.0%	99.4%	100.0%
DK	96.8%	61.3%	57.8%	2.9%	67.7%	67.7%	100.0%	100.0%	100.0%
EE	73.7%	55.2%	48.5%	3.3%	54.4%	51.7%	98.8%	98.8%	75.4%
FI	94.0%	48.4%	37.5%	0.0%	37.8%	37.8%	100.0%	100.0%	100.0%
FR	99.9%	18.2%	20.8%	0.0%	27.9%	27.8%	99.9%	93.8%	100.0%
DE	97.1%	58.8%	7.1%	10.0%	63.7%	63.5%	92.1%	96.6%	100.0%
EL	99.3%	44.0%	0.4%	0.2%	0.0%	0.0%	99.3%	93.5%	100.0%
HU	90.5%	38.1%	24.0%	0.0%	68.0%	65.0%	98.3%	98.6%	100.0%
IS	97.0%	90.2%	62.8%	4.0%	0.0%	0.0%	99.5%	95.9%	0.0%
IE	92.5%	80.6%	5.5%	26.6%	43.3%	43.1%	99.2%	96.7%	100.0%
IT	98.4%	66.4%	18.8%	46.9%	0.0%	0.0%	99.4%	98.2%	100.0%
LT	69.8%	0.0%	95.5%	91.0%	54.0%	46.3%	99.4%	99.4%	50.0%
LV	42.7%	17.6%	85.2%	44.8%	34.7%	29.0%	100.0%	93.0%	20.3%
LU	100.0%	88.2%	51.5%	0.0%	78.6%	74.3%	98.9%	98.1%	100.0%
MT	100.0%	72.0%	16.0%	0.0%	99.9%	99.9%	99.9%	99.5%	100.0%
NL	100.0%	69.9%	31.2%	0.0%	95.1%	95.1%	99.6%	99.6%	100.0%
NO	90.6%	49.9%	46.3%	0.0%	51.9%	51.9%	99.0%	100.0%	100.0%
PL	75.7%	41.7%	16.5%	1.8%	43.6%	43.6%	99.5%	97.6%	100.0%
PT	99.2%	0.0%	86.1%	0.0%	79.1%	79.1%	98.8%	98.8%	100.0%
RO	65.9%	11.0%	59.7%	67.4%	32.3%	30.6%	100.0%	75.2%	100.0%
SK	72.5%	28.7%	53.7%	50.0%	30.4%	27.9%	90.7%	90.3%	100.0%
SI	95.8%	53.4%	50.4%	2.6%	58.6%	53.7%	98.1%	97.4%	100.0%
ES	90.1%	11.8%	62.8%	54.2%	48.8%	48.8%	99.7%	94.4%	100.0%
SE	98.0%	21.9%	60.8%	0.0%	37.9%	36.2%	99.9%	100.0%	100.0%
CH	99.5%	88.0%	28.6%	0.0%	84.3%	84.3%	99.5%	98.3%	100.0%
UK	100.0%	85.0%	1.8%	0.0%	47.8%	47.8%	99.0%	99.5%	100.0%
EU 28	94.3%	48.2%	23.7%	17.8%	44.4%	43.9%	98.0%	96.0%	99.4%

*** DSL figures include VDSL coverage; Cable figures include DOCSIS 3.0 coverage

6.3.3 Rural coverage by technology for each country

	DSL***	VDSL	FTTP	WiMAX	Cable***	DOCSIS 3.0	HSPA	LTE	Satellite
AT	89.0%	17.9%	5.3%	11.7%	20.7%	20.7%	93.4%	92.6%	100.0%
BE	96.9%	73.4%	0.0%	2.6%	70.9%	70.9%	99.4%	98.6%	100.0%
BG	75.3%	0.0%	0.8%	0.0%	16.9%	16.9%	100.0%	18.7%	100.0%
HR	86.4%	0.2%	0.2%	0.0%	11.0%	9.8%	96.4%	56.0%	100.0%
CY	100.0%	60.0%	0.0%	0.0%	0.0%	0.0%	99.0%	0.0%	100.0%
CZ	80.2%	47.0%	7.7%	83.5%	3.1%	2.0%	84.9%	95.8%	100.0%
DK	93.5%	15.8%	49.0%	5.6%	5.1%	5.1%	100.0%	100.0%	100.0%
EE	36.6%	20.9%	15.5%	15.5%	14.9%	11.9%	98.0%	96.0%	75.4%
FI	81.7%	0.0%	8.2%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
FR	99.6%	28.9%	2.3%	0.0%	1.2%	1.2%	99.0%	61.7%	100.0%
DE	87.6%	36.3%	1.7%	13.7%	15.2%	14.9%	61.6%	87.8%	100.0%
EL	96.3%	1.3%	0.0%	0.8%	0.0%	0.0%	96.6%	70.9%	100.0%
HU	74.0%	22.3%	6.4%	0.0%	19.9%	18.2%	94.7%	96.2%	100.0%
IS	94.3%	83.9%	24.0%	0.0%	0.0%	0.0%	99.2%	88.7%	0.0%
IE	87.9%	48.9%	1.2%	20.4%	2.6%	2.4%	97.9%	91.2%	100.0%
IT	89.4%	15.2%	0.8%	45.1%	0.0%	0.0%	94.9%	85.5%	100.0%
LT	15.7%	0.0%	89.8%	70.5%	9.2%	9.2%	98.1%	98.1%	50.0%
LV	28.0%	17.7%	69.3%	24.7%	0.0%	0.0%	100.0%	74.9%	20.3%
LU	99.7%	88.2%	51.5%	0.0%	46.3%	0.0%	99.2%	91.3%	100.0%
MT	100.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.2%	51.1%	100.0%
NL	99.9%	64.9%	28.4%	0.0%	92.5%	92.5%	98.2%	98.2%	100.0%
NO	67.6%	17.9%	20.5%	0.0%	3.7%	3.7%	95.9%	100.0%	100.0%
PL	77.2%	25.8%	11.5%	1.4%	15.2%	12.3%	97.8%	88.4%	100.0%
PT	94.7%	0.0%	46.9%	0.0%	42.1%	42.1%	91.8%	92.0%	100.0%
RO	65.7%	2.1%	26.7%	33.5%	11.7%	9.7%	100.0%	49.5%	100.0%
SK	71.2%	27.7%	12.5%	50.0%	0.8%	0.4%	78.5%	66.4%	100.0%
SI	86.7%	19.4%	23.5%	4.8%	21.5%	18.8%	93.1%	90.9%	100.0%
ES	83.9%	15.2%	9.7%	51.5%	10.6%	10.6%	98.7%	73.3%	100.0%
SE	86.6%	0.8%	20.8%	0.0%	0.6%	0.6%	99.2%	100.0%	100.0%
CH	97.4%	55.5%	7.3%	0.0%	78.2%	78.2%	98.7%	93.8%	100.0%
UK	99.7%	76.0%	2.5%	0.0%	2.3%	2.3%	88.8%	95.3%	100.0%
EU 28	86.0%	26.6%	9.4%	18.0%	10.7%	10.1%	92.2%	79.7%	99.4%

*** DSL figures include VDSL coverage; Cable figures include DOCSIS 3.0 coverage

6.3.4 Broadband coverage by speed category for each country

	Broadband coverage (>2Mbps)	Broadband coverage (>30Mbps)	Broadband coverage (>100Mbps)
AT	98.6%	80.3%	52.9%
BE	99.8%	98.2%	96.5%
BG	94.9%	71.3%	18.6%
HR	96.4%	52.3%	25.3%
CY	100.0%	84.3%	84.3%
CZ	98.5%	73.9%	44.5%
DK	98.9%	93.3%	88.9%
EE	86.8%	76.9%	58.7%
FI	96.5%	66.7%	32.5%
FR	97.4%	50.0%	33.9%
DE	99.9%	80.7%	64.9%
EL	98.1%	40.9%	0.4%
HU	94.8%	78.2%	68.4%
IS	99.3%	91.7%	75.2%
IE	95.9%	77.2%	44.9%
IT	98.2%	71.8%	18.8%
LT	97.7%	97.2%	96.9%
LV	92.6%	90.4%	86.8%
LU	100.0%	94.1%	89.7%
MT	99.8%	99.4%	99.4%
NL	100.0%	98.2%	98.2%
NO	100.0%	82.0%	78.0%
PL	81.8%	63.7%	57.2%
PT	98.8%	93.8%	89.5%
RO	100.0%	80.9%	80.1%
SK	87.6%	75.1%	64.1%
SI	99.8%	98.4%	72.2%
ES	95.5%	80.8%	79.1%
SE	100.0%	88.4%	68.7%
CH	99.8%	98.9%	98.5%
UK	95.1%	84.4%	23.6%
EU 28	96.7%	75.1%	50.9%

Note: Yellow highlight indicates inclusion of LTE technology in speed category calculations.

6.3.4 Average operator LTE coverage for each country

	Average operator LTE coverage
AT	89.3%
BE	94.5%
BG	65.7%
HR	66.7%
CY	64.2%
CZ	94.3%
DK	100.0%
EE	94.5%
FI	97.0%
FR	78.3%
DE	86.0%
EL	79.8%
HU	92.4%
IS	93.2%
IE	93.7%
IT	86.2%
LT	95.7%
LV	90.7%
LU	95.4%
MT	99.3%
NL	90.6%
NO	100.0%
PL	90.7%
PT	95.2%
RO	44.7%
SK	79.5%
SI	90.1%
ES	85.9%
SE	100.0%
CH	96.3%
UK	92.5%
EU 28	84.4%

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