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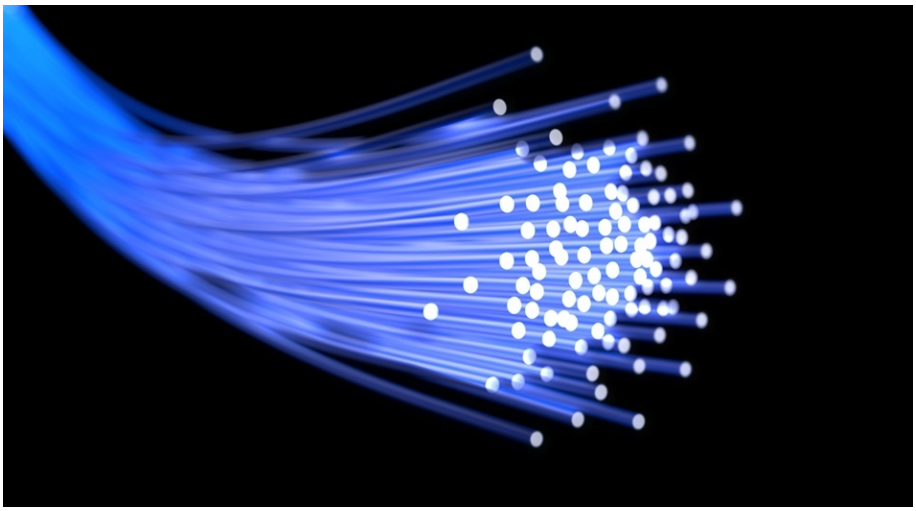
Broadband infrastructure

Supporting the digital economy in the European Union



IN-DEPTH ANALYSIS

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Author: Ron Davies
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This publication provides a brief overview of broadband technology and the benefits that broadband infrastructure can provide in terms of employment and economic growth. It also provides a summary of progress in providing fast network access in the EU and describes the main policies and actions at the European level that affect the deployment of broadband infrastructure.

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eprs@ep.europa.eu
http://www.eprs.ep.parl.union.eu (intranet)
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EXECUTIVE SUMMARY

Broadband is a term used to describe internet access connections with a large data transfer capacity that are therefore capable of delivering information at faster speeds than those possible using a traditional telephone network. Broadband access can be provided over wires (such as copper telephone wires and fibre optic cables) and wireless media (such as mobile or satellite communications).

Fast access to the internet is an important factor in the development of a digital economy. The demands for faster broadband are increasing due to the use of internet technology in providing a range of communication services, rapidly increasing volumes of internet video traffic, increasing numbers of smartphone and other mobile devices, the connection of billions of smart objects through the Internet of Things, and access to applications and data stored remotely in the Cloud. Broadband infrastructure needs to keep pace with these growing demands for broadband internet access.

Economists believe that broadband infrastructure promotes employment. Investments in broadband will increase productivity and so may in the short term reduce employment, but they also lead to the creation of new, high-skill jobs, and so have a net positive effect. Moreover, a wide range of studies have shown that broadband also results in innovation and productivity improvements that stimulate economic growth.

In the European Union (EU), progress has been made on reaching the targets set by the Digital Agenda for Europe, a flagship initiative of the Europe 2020 strategy for smart, sustainable and inclusive growth. Basic broadband is available to all Europeans, but progress still needs to be made by 2020 on reaching the goals for coverage and take-up of fast and ultra-fast broadband. There are still wide differences in the availability of broadband in the different Member States and in different regions. In particular, remote or rural areas, where population density is low, lag behind urban areas in terms of broadband infrastructure, with implications for society in terms of a 'digital divide'.

Policy-makers set goals for broadband availability (such as those in the Digital Agenda for Europe) and seek ways in which investment in broadband can be stimulated, such as providing a regulatory environment that encourages market players to invest in broadband infrastructure. Financial support can also be used to encourage market players to provide broadband, particularly in rural areas where the population density may not be great enough to justify deployment costs.

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List of main acronyms used

3G:	Third-generation mobile network or service.
4G:	Fourth-generation mobile network or service.
ADSL:	Asymmetric Digital Subscriber Line.
DOCSIS:	Data Over Cable System Interface Specification.
DSL:	Digital Subscriber Line.
FTTB:	Fibre to the building.
FTTC:	Fibre to the cabinet.
FTTP:	Fibre to the premises (i.e. to the home or business).
Gbps:	Gigabits per second, i.e. a billion bits per second.
ITU:	International Telecommunications Union.
Kbps:	Kilobits per second, i.e. a thousand bits per second.
LTE:	Long Term Evolution.
Mbps:	Megabits per second, i.e. a million bits per second.
NGA:	Next Generation Access.
NRA:	National Regulatory Authority.
OECD:	Organisation for Economic Co-operation and Development.
PPP:	Public-Private Partnership.
PSTN:	Public Switched Telephone Network.
VDSL:	Very-high-bit-rate Digital Subscriber Line.
WiFi:	A wireless networking technology based on the IEE Standards 802.11x.
WiMAX:	Worldwide Interoperability for Microwave Access.
xDSL:	A family of DSL technologies. The best known variants are ADSL and VDSL.

1. Introduction

Broadband is a telecommunications term used to refer to transmission capacity (i.e. bandwidth) providing faster speeds for transmitting information. It has come to be used principally to describe internet connections providing communications at faster rates than those supported by connections originally used for much internet access, such as dial-up service over a traditional telephone network.

The European Commission categorises download speeds between 144 Kbps and 30 Mbps as *broadband* (even though a very small percentage of current subscriptions in the EU provide downstream speeds of less than 2 Mbps).[1] The Commission considers access at downstream speeds between 30 and 100 Mbps to be *fast broadband* and at rates higher than 100 Mbps to be *ultra-fast broadband*.

As technology has advanced, increased transfer rates have been made possible by upgrading physical infrastructure, by deploying improved technology or a combination of both. On the demand side this constant improvement has been driven by the increasing reliance of citizens and businesses on the internet, as well as their need for new internet services and content and the benefits these can provide. For example:

- Mobile phone subscriptions continue to grow in numbers (worldwide numbers are expected to double between 2014 and 2019) even as applications and other services consume more data. Smartphones now make up more than half of mobile phones sold; monthly data traffic per smartphone is expected to grow from about 1 gigabyte in 2014 to 4.9 gigabytes in 2020.[2]
- Increasingly a wide range of communications are converging on the use of the Internet Protocol, so that operators are able to offer consumers packages that combine internet access, fixed line telephone and television in 'triple play' or (combined with mobile telephone service) 'quadruple play' packages.

What is broadband?

Data transfer rates (often referred to as the 'speed' of a connection) are typically measured by the average number of digital bits that can be transmitted per second, either as thousands of bits per second (kilobits per second or kbps) or millions of bits per second (megabits per second or Mbps). There is, however, no universally agreed lower (or upper) bound to the bit rates that qualify as broadband. Definitions are further complicated since data rates may be different for transmissions from the network to the end point ('downstream') and transmissions from the end point to the network ('upstream').

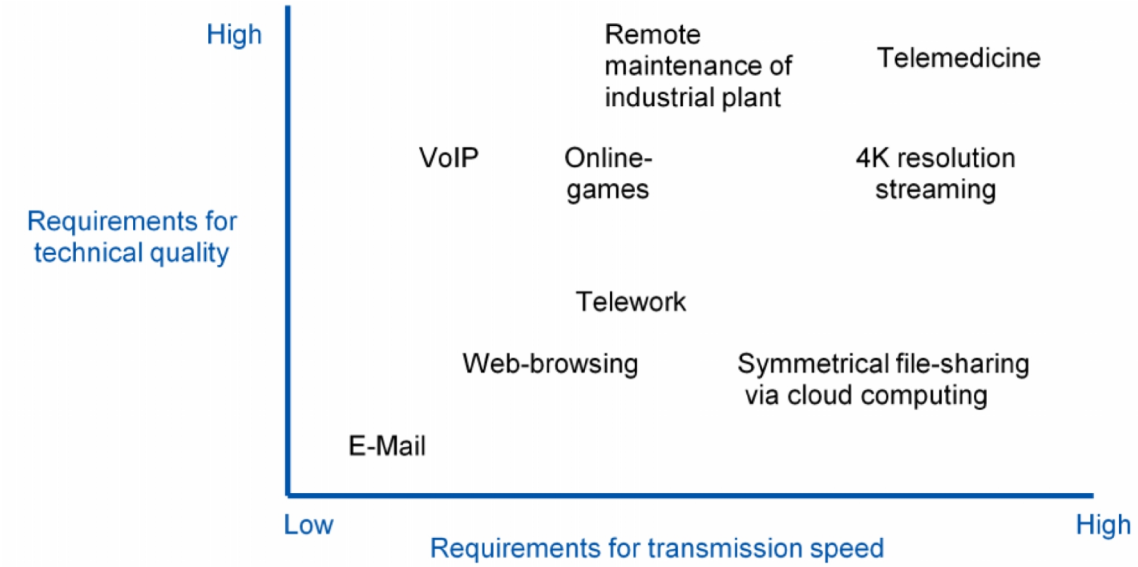
Different organisations define broadband in different terms, and may substantially revise their definitions over time. For example, the official definition of broadband of the Organisation for Economic Co-operation and Development (OECD) specifies a minimum speed of 256 kbps for downstream transmissions, despite the fact that broadband connections are now in general much faster. The US Federal Communications Commission (FCC) previously defined broadband as speeds of at least 4 Mbps downstream and at least 1 Mbps upstream. However as of 2015, the FCC requires that a broadband connection have download and upload speeds of at least 25 and 3 Mbps. Perhaps wisely, the Broadband Commission for Digital Development avoids any explicit mention of speeds, and characterises broadband as 'high-speed Internet access which is always-on and capable of multiple service provision simultaneously'. See Broadband Commission for Digital Development Broadband for all: the state of broadband 2014, ITU/Unesco, 2014.

[1] European Commission, Fast and ultra-fast internet access, Digital Agenda Scoreboard, 2103.

[2] Ericsson's estimate is reported in D. Thomas, S. Bond, Smartphone poised for revolution in media access, Financial Times, 3 June 2015.

- Streaming video is rapidly growing as a percentage of internet traffic, requiring increasingly large amounts of bandwidth and raising requirements for timely packet delivery. Between 2014 and 2019, it is estimated that consumer 'video on demand' traffic will double and Internet protocol television (IPTV) traffic will increase fourfold; all forms of video (including peer-to-peer sharing) will comprise between 80 and 90% of internet traffic by the end of that period.[3]
- Advanced internet-based applications (e.g. telemedicine) can deliver future benefits but will require low latency (delays in delivery) and high quality of service.
- The Internet of Things promises to vastly increase the number of devices communicating via Internet (to an estimated 26 billion devices worldwide by 2020[4]) and hence the amount of data transmitted and number of broadband connections.
- The expected growth in Cloud-based services – whereby data and applications are stored on the internet – will also create greater demand for bandwidth, especially in combination with Big Data applications that capture and process vast quantities of data derived from everyday activities.
- End users are increasingly expecting fast access for traditional internet activities. For example, 36% of UK consumers who shop online will head elsewhere if an online shopping site does not load in 2 to 3 seconds.[5]

Figure 1 - Requirements of online applications for quality and speed of network



Source: Deutsche Bank Research, 2014.

There is substantial evidence that investment in broadband infrastructure, and the availability of broadband access, contributes positively to employment and economic growth.[6] In order to meet the goals of the Europe 2020 strategy for smart and inclusive growth, and the targets of its flagship initiative the Digital Agenda for Europe 2010-15, the European Union (EU) and Member States have an important role to play in encouraging the development of broadband infrastructure in Europe through policy, regulation and funding.

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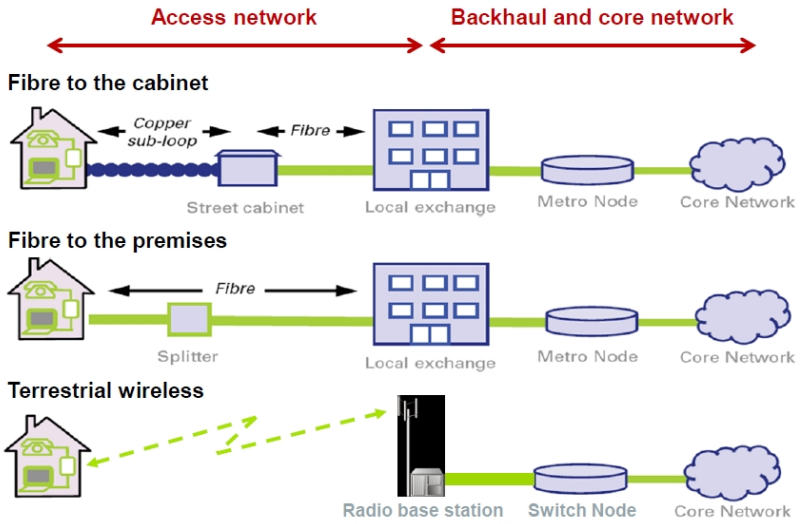
3 Cisco, Visual networking index 2014-2019, 2015.

4 Gartner Group, Forecast: The Internet of Things, 2013.

5 D. Thomas, *op. cit.*

6 R. Wieck, M. Vidal, Investment in telecommunications infrastructure, growth and employment – recent research, 21st regional ITS conference, Copenhagen, 2010.

Figure 2 - Infrastructure components in broadband networks



Source: ITU, Developing successful Public-Private Partnerships to foster investment in universal broadband networks, 2012.

2. Broadband technologies

Broadband access can be provided by a wide range of different technologies, each with its own technical characteristics as well as economic costs and benefits.

2.1. Wireline (fixed) technologies

Wireline or fixed line technologies use a physical wire or cable to transmit information.

Copper telephone lines (typically consisting of 'twisted pairs' of copper wire) have long been used to provide traditional telephone services. In the late 20th century, connections via the circuit-based public switched telephone network (PSTN) could be made to computer networks, but dial-up access was slow and meant that phone calls could not be made at the same time. Newer Digital Subscriber Line (DSL or xDSL) technology using Internet Protocol packet-switching supports faster broadband speeds and means that broadband access can be provided with or alongside regular telephone service. In mid-2014, xDSL technologies (including VDSL or Very-high-bit rate DSL) represented 71% of fixed-line broadband subscriptions in the EU.[7]

Coaxial cable consists of copper wires that are shielded to protect them from interference. They are usually installed and owned by suppliers of cable television services. Standards like DOCSIS 3.0 allow high-bandwidth data transfer over coaxial cable. Contrary to DSL over copper wire, coaxial cable technology is based on shared bandwidth, so the actual speed for an individual user may be affected by the number of subscribers on the network. Also, unlike telephone cabling which is extremely widespread, the deployment of cable-based systems varies widely across the EU: for example, they are available to over 80% of the population in Belgium and the Netherlands but to less than 20% in France, Italy and Spain.[8] Overall in the EU, cable represented 18% of fixed-line broadband subscriptions in 2014.

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[7] European Commission, Broadband access in the EU - Data as of July 2014. Last updated 26 May 2015.

[8] Organisation for Economic Co-operation and Development, The development of fixed broadband networks, OECD, 2014. OECD digital economy papers no. 239.

Optical fibre is a glass strand that uses laser light pulses to transmit signals over distances up to hundreds of kilometres. Optical fibre is impervious to electromagnetic interference, requires less signal boosting and has a much higher capacity (up to 40 gigabits per second) than copper wires transmitting electrical signals. However fibre is costly to deploy.[9] Optical cables are used extensively in the backhaul and core networks of the internet (i.e. the networks that connect local providers to each other). In access networks (i.e. those which link the end user to their service provider), they may reach as far as the user's premises (FTTP or Fibre to the Premises) or to a box located in the street that serves a number of households (FTTC or Fibre to the Cabinet).[10] If run all the way to the end user's house or office, fibre can offer, in a straight-forward fashion, enough bandwidth over the access network for any currently conceivable application (though actual speed will be subject to constraints on other parts of the network); it is therefore sometimes said to be 'future proof'. FTTP accounts for 7% of current fixed broadband subscriptions.

2.2. Wireless technologies

Wireless broadband can be provided by a range of technologies that may extend over short or long distances and that use licensed or unlicensed radio spectrum. WiFi is a short-range technology using unlicensed bands of radio spectrum that is often used to provide privately managed wireless access within a home or office. However, public WiFi 'hotspots' can also provide fast access in public places such as cafés and airports or (increasingly) throughout a city. WiMAX is a wireless technology based on different standards that can provide wireless connections over a wide area, though not all EU Member States have allocated spectrum for its use. However the rapid adoption of mobile phones, smartphones and tablets has meant that the newer generations of **mobile telephone technologies** (third generation '3G' and fourth generation '4G' or Long Term Evolution technologies) are increasingly used for broadband access. Mobile internet access can be bundled with a voice telephone subscription (e.g. using a smartphone) or available as a separate data subscription (e.g. using a separate modem or dongle).

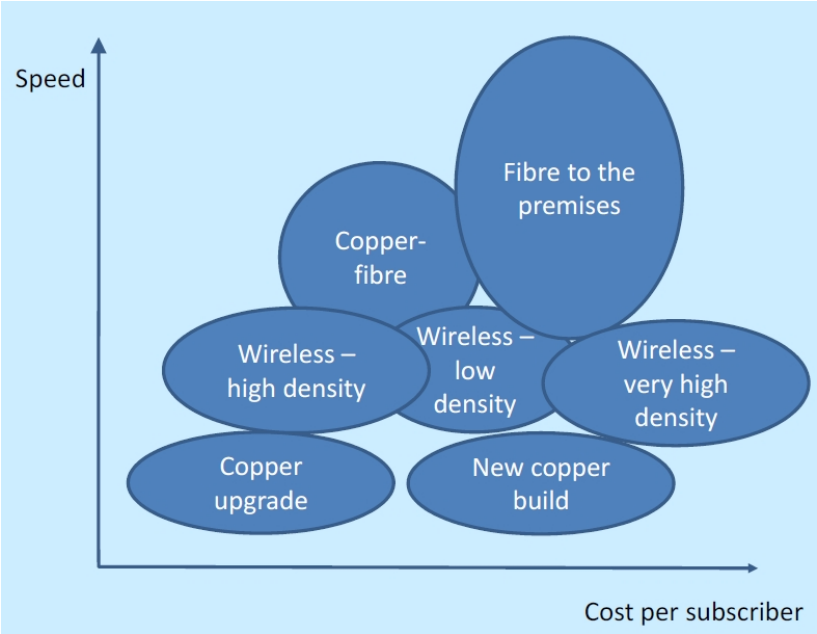
These types of wireless communication are sometimes referred to as **terrestrial wireless** because wireless communication takes place between the end user's device and a station which is earth-bound (e.g. an antenna mounted on a tower or on the top of a building). Their cost and effectiveness can depend on the density of the users in the area served by a particular tower. On the other hand, **satellites** can also send and receive data through high-speed Internet connections directly to end users. However end users of satellite services must install satellite dishes; installation costs and the overall costs of satellite broadband are on average above those of other access

[9] In Germany, investing in broadband rollout using copper-based infrastructure was estimated to cost €20 billion, whereas future-proof fibre optic investments would run to at least €90 billion (S. Heng, Progress needs broadband: private investment requires more government stimuli, Deutsche Bank Research, 2014.). In Europe cost per home passed (i.e. home potentially serviced) in urban areas ranges from €150 to €540 but for rural areas increases to €2 700. See Broadband Commission for Digital Development, Broadband for all: the state of broadband, ITU/Unesco, 2014.

[10] Other terms used in this context include Fibre to the Home (FTTH) where fibre cabling extends to the walls of the end user's home or Fibre to the Building (FTTB) where fibre cable stops at a building such as an apartment block, and other cabling (e.g. coaxial cable) connects the end point to each individual apartment. FTTC is sometimes read as Fibre to the Curb (i.e. kerb) since the cabinet is on the street.

technologies.[11] Satellite broadband products represent only a very small part of the market in the EU (0.5% in 2011), but satellite can be important in areas of low population density. Satellites can also be used in hybrid systems where satellites are used to feed network points that then use terrestrial wireless transmission for the 'last mile' connection to the end user's premises.[12]

Figure 3 - Cost of provision of broadband via different technologies



Source: ITU, Strategies for the deployment of broadband, 2013.

Next Generation Access (NGA) networks

NGA networks are access networks that consist at least in part of optical fibre and that deliver faster internet access than copper-only networks.[13] NGA networks may use also technologies that enhance the transmission of data over short distances of coaxial cable or twisted copper pairs such as DOCSIS (for coaxial cable) or VDSL (copper twisted pair).[14]

Considering only subscriptions in the EU that use NGA networks, 42% use DOCSIS and 32% VDSL.[15] Neither is necessarily the last word in this regard, and newer technologies continue to promise improvements in bandwidth, albeit often over relatively short distances from a fibre cable termination point.[16]

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[11] The EMEA Satellite Operators Association disagrees, arguing that monthly prices (excluding equipment costs) compare with equivalent ADSL offers.

[12] *Ibid.*

[13] European Commission, Next Generation Access Networks (NGA) [web page].

[14] The European Commission sometimes uses the term for any technology (e.g. including 'other NGA' methods such as wireless LTE) that is capable of delivering a download speed of at least 30 Mbps (and hence meets the second broadband target of the Digital Agenda, i.e. making fast broadband available to all in the EU by 2020). See, for example, European Commission, Electronic communications market indicators: Digital Agenda Scoreboard 2013. The ITU has a more detailed and technical definition for what it refers to as Next Generation Networks (NGN). See International Telecommunications Union, ITU-T's definition of NGN. [web page]

[15] European Commission, Broadband markets, Digital Agenda Scoreboard, 2014.

[16] G.fast is one such technology. See Broadband Commission for Digital Development, The state of broadband 2014: broadband for all, ITU/Unesco, 2014.

3. Benefits of broadband

3.1. Employment

One of the important effects of the deployment of broadband can be increases in employment, although the short and long-term effects may be different. The actual building of digital infrastructure creates jobs directly since workers must be hired to lay or install broadband 'pipes'; moreover, jobs are created indirectly through the manufacture of network equipment, and via 'induced' jobs when these workers spend their pay.[17] The effect can be countercyclical if the broadband infrastructure work takes place at low points in the economic cycle.

However the picture becomes more complicated when one considers the longer term impact. Experts believe that increased use of broadband should increase productivity in a wide range of businesses, as transaction and communications costs decrease. This productivity increase will displace some jobs, thereby having a negative effect on employment, at least that of lower-skilled workers.[18] However a large number of economists believe that the increased competitiveness of firms, particularly in the more dynamic sectors of the economy, and the development of new services will outweigh any negative effects of job losses by creating new jobs, and that broadband thus has a net positive effect on employment.[19] This may be particularly true in service industries with high labour intensity.[20]

A report from the International Telecommunications Union (ITU) in 2011 summarised studies by different researchers on different countries, which showed, in all cases, a significant increase in jobs due to network deployment.[21] Despite this significant body of evidence, some economists are concerned that 'network effects' are difficult to estimate and that we know too little about the long-term effects of broadband deployment on employment.[22] Others worry that digital businesses (which depend on broadband access to the internet) require little capital investment and hence create few jobs, and that this could lead to secular stagnation in the economy.[23]

3.2. Economic growth

There is also a broad consensus among economists that broadband infrastructure contributes significantly to economic growth in many sectors of the economy.[24] Broadband facilitates the communication of information and ideas in markets that

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17 R. Atkinson, The economic impacts of declining investment in broadband, Information Technology and Innovation Foundation, 2009.

18 However this negative effect may be spread out over a number of years as job losses through productivity improvements may take some time to occur.

19 R. Wieck, *op. cit.*

20 International Telecommunications Union, Impact of broadband on the economy, 2012.

21 International Telecommunications Union, *op. cit*.

22 S. Hansell, Rural broadband: no job creation machine, New York Times, 20 February 2009.

23 Secular stagnation is a condition of negligible or no economic growth in a market-based economy due to the absence of longer term investments needed to sustain future growth. See C. Frey, How to prevent the end of growth: how the digital economy could lead to secular stagnation, Scientific American, v. 321 n. 1, 2014. Building physical infrastructure for broadband, such as installing fibre optic cable to every home or building, would represent a very significant investment and would create jobs, but presumably this would have only a relatively short-term effect.

24 C. Cambini, *op. cit*.

increasingly are information-based, and helps to reduces transaction costs. Broadband can facilitate the adoption of more efficient business processes. Economic activity may also be stimulated by more competitive firms selling their services abroad.

Moreover broadband facilitates the development and adoption of innovative new products, applications and services, thereby further stimulating growth. A discussion paper prepared for the ITU found that broadband penetration correlated positively with levels of innovation (measured by the number of patents granted) whereas this was not true for other measures related to information and communication technologies (ICTs) such as number of internet users or level of smartphone usage. The study concluded that many economically important innovations such as cloud computing, video-sharing platforms or social networks cannot succeed without 'always on', high-capacity internet connectivity.[25]

While broadband deployment is associated with economic growth, the levels of growth may not be the same in all cases. In general the effect of broadband is found to be more pronounced in countries that have a certain level of infrastructure or developed digital markets. The Organisation for Economic Co-operation and Development (OECD) analysed the situation in the US, three developed and three developing countries and found that those with large internet economies benefitted more from the diffusion of broadband, though all countries benefitted in proportion to their scale of internet use.[26] An economic model shows that though the overall benefits of broadband infrastructure outweigh the costs by 32% for the entire European Union, there is substantial variation across Member States.[27] Another forward-looking study for the EU in 2008 concluded that broadband-related growth reached 0.89% in more advanced countries, but only 0.47% in countries with less developed broadband infrastructure.[28]

In part because of this difference, the degree of increase in GDP due to broadband is not simple to determine. (Other complicating factors may include the absence of time series data, the rapidity of change, workforce change, the range of broadband services and the replacement of other network technologies).[29] Some economists have nevertheless tried to come up with summary figures. Deutsche Bank Research finds that, according to empirical studies, a 10% increase in broadband connections has caused a rise in GDP per capita by over 1% a year.[30] The European Commission has concluded that a 10% increase in broadband penetration increases GDP by a value in the range from 1 to 1.5%.[31]

There are also differing opinions about the effect on the economy of incremental increase in broadband access speeds. Some believe that the economic effects of an additional increase in broadband speed (e.g. from 10 to 50 Mbps in areas with wide

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[25] Global Industry Leaders' Forum, Broadband enabled innovation, ITU, 2011. Discussion paper.

[26] S. Greenstein, R. McDevitt, Measuring the broadband bonus in thirty OECD countries, OECD, 2012. OECD digital economy papers No 197.

[27] H. Gruber, J. Hatonen, P. Koutroumpis, Broadband access in the EU: an assessment of future economic benefits, 2013.

[28] R. Wieck, *op.cit.*

[29] L. Holt, M. Jamison, Broadband and contributions to economic growth: lessons from the US experience. Telecommunications Policy v. 33 p. 575-581; Global Industry Leaders' Forum, Broadband enabled innovation, ITU, 2011.

[30] *Ibid*.

[31] European Commission, Digital Agenda Scoreboard 2012, 2012.

broadband deployment) are simply not well studied; there may be a saturation point after which network effects diminish.[32] On the other hand, one study concluded that, across OECD member countries, raising broadband speeds from 4 Mbps to 8 Mbps resulted in an increase in household income of US$122 per month, and increases to higher speeds produced further rises in income.[33]

3.3. Other effects

Broadband may have other beneficial effects beyond employment and economic growth. For example, some economists conclude that broadband has resulted in a *consumer surplus* i.e. the difference between the amount that consumers are able and willing to pay for a service like broadband, and the (lower) market prices that they actually pay. This consumer surplus is an economic benefit to citizens but is not captured in typical economic measures such as GDP.[34] Other new online applications and services made possible by broadband (e.g. e-Health, e-Government, driverless cars, online finance and online cultural content or leisure applications such as online gaming) may also improve the life of citizens beyond what is easily economically measured.

Broadband is also mentioned as a factor that can increase social inclusion. Broadband access in rural, remote or sparsely populated areas may encourage rural development and allow the population to compete for jobs (particularly high-skilled, knowledge-based jobs) that otherwise might be restricted to high population centres. Better communications, particularly for persons with reduced mobility or living in isolated conditions, can also contribute to the quality of those citizen's lives. On the other hand, those sections of society that do not have the computer skills or easy, affordable access to the internet may find themselves on the wrong side of the 'digital divide', increasingly excluded from society in the absence of programmes to help them make up for those gaps.

3.4. Investment in broadband infrastructure

Given the important effects of broadband on employment and economic growth, experts believe that policy-makers should endeavour to encourage investment in broadband infrastructure and deployment by establishing a predictable legal framework, creating regulatory incentives for investment, and by providing financial incentives or public contributions to infrastructure development.[35] Across the OECD, investment in telecommunications infrastructure fell significantly with the advent of the financial crisis, declining from a high of US$209 billion in 2008 to approximately US$180 to 190 billion annually in the three subsequent years.[36] Since the economic crisis, a range of industrialised countries have implemented programmes for broadband deployment.

However broadband infrastructure represents a challenge for policy-makers. There is no standard blueprint for broadband deployment. The costs for NGA networks are high,

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[32] R. Katz, Broadband stimulus and the economy, Columbia Business School, 2009. See also R. Katz, S. Suter, Estimating the economic impact of the Broadband Stimulus Plan, 2009.

[33] I.K. Rohman, E. Bohlin, The impact of broadband speed on the household income: comparing OECD and BRICS, Chalmers University of Technology, 2013.

[34] S. Greenstein, R. McDevitt, Measuring the broadband bonus in thirty OECD countries, OECD, 2012. OECD digital economy paper no. 197.

[35] R. Wieck, *op. cit.*

[36] OECD, OECD Communications Outlook 2013, 2013.

particularly in terms of the cost to reach a household from the fibre cable end point. The financial risks are also high: failure to recover costs could bankrupt telecommunications operators. Rural areas present a special challenge: lower population densities and hence higher per user costs often make the rollout of fixed-line broadband to these areas unattractive on a commercial basis. Public funding needs to be considered in these areas in order to avoid a digital divide where parts of society remain disadvantaged.[37] At the same time, however, competition in telecommunication services needs to be encouraged and monopolistic solutions avoided. To reduce costs and coordinate deployment, policy-makers can encourage mapping of services, infrastructure, demand and investment.[38]

In addition, investment in broadband infrastructure can take different forms. Extending optical fibre all the way from the core network to the home or the business can be seen as the most 'future-proof' technology since it provides extensive capacity in a straight-forward fashion. However it requires the greatest investment given the costs in physical infrastructure (laying cables, digging up streets, etc.). Extending fibre part way to the user (for example, to a cabinet on the street) can shorten the distance of the final copper cable over which data must travel; this in turn allows speed-enhancing technologies (often limited in the distance over which they are effective) to be used to increase the data transfer rate over the local loop. However many observers warn that policy-makers should not focus on a particular technology or approach, but should stay 'technologically neutral' since more complete coverage rates can result from an approach that allows for a variety of technologies depending on the local situation.

4. Current state of broadband infrastructure in the EU

The Digital Agenda for Europe 2010-2015 established three broadband targets:

- By 2013, broadband (>144 Kbps) should be available to all Europeans.
- By 2020, fast broadband (>30 Mbps) to be available to all.
- By 2020 50% of households should subscribe to ultra-fast broadband (>100 Mbps).

The first goal has been achieved, and progress has been made towards the fast and ultra-fast targets. However whether progress will be sufficient to reach the remaining targets by 2020 remains to be seen. Measuring broadband progress is complex since it involves fixed and wireless connections and different types of networks and technologies, as well as different tiers of access speed. It also often involves both measuring *coverage* (the percentage of the population for which broadband services are available) and *penetration* (the actual take-up of these services as measured by the number of active subscriptions in relation to the population size). However a number of observations can be made based on recent statistics.

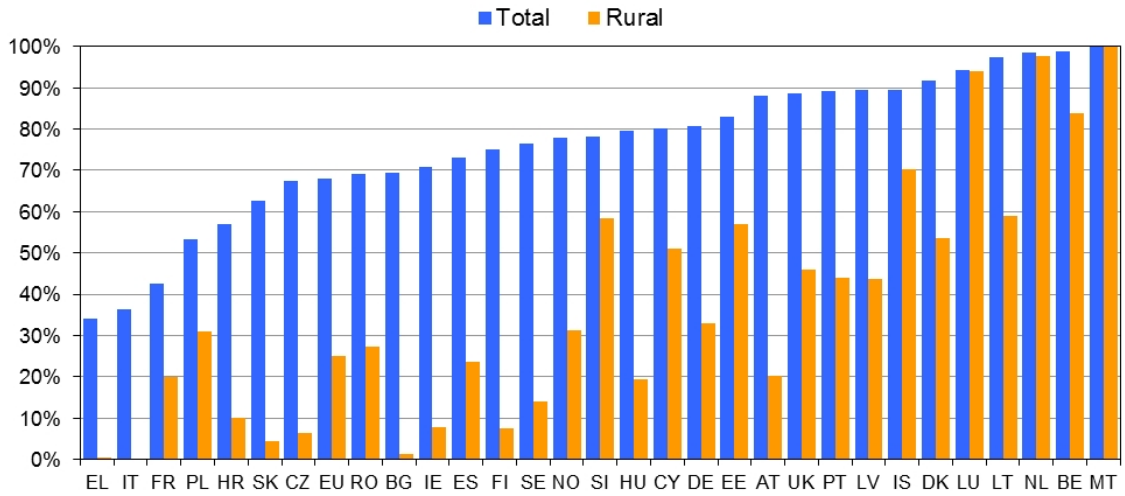
[37] ITU, Strategies for the deployment of NGN and NGA in a broadband environment, 2012.

[38] R. Arnold et al., Study on broadband and infrastructure mapping, European Commission, 2012.

4.1. NGA networks

The coverage of NGA networks across the EU increased by 20 percentage points between 2011 and to 2014 to reach 68% of the population.[39]

Figure 4 - Next Generation Access coverage (percentage of population), 2014



Source: European Commission, Connectivity: broadband market developments in the EU, 2015.Includes FTTP, VDSL and DOCSIS 3.0 coverage)

Broadband deployment in rural areas also lags very significantly behind other areas in the EU; NGA network coverage in rural areas was only 25%, and there are large disparities between different Member States (see Figure 4). Cable and FTTP is not cost-effective outside densely populated areas, but in most Member States rural coverage was significantly lower also in terms of VDSL and mobile 4G/LTE technologies. (At the end of 2014, LTE coverage in the EU overall was 79% overall but on average only 27% in rural areas, and with very wide differences between Member States.)

Considerable investments still need to be made if the EU is to reach 100% coverage at 30 Mbps and 50% take-up at 100 Mbps by 2020: the Commission estimates that an investment of €180 to 270 billion will be required to meet the Digital Agenda broadband targets.[40]

4.2. Mobile and fixed access

Fixed broadband penetration (the number of subscriptions per 100 people) continues to climb in the EU overall, rising from 23.8 in early 2009 to 30.9 in mid-2014. However over the same period, mobile broadband penetration increased more rapidly from 17% to 67%.

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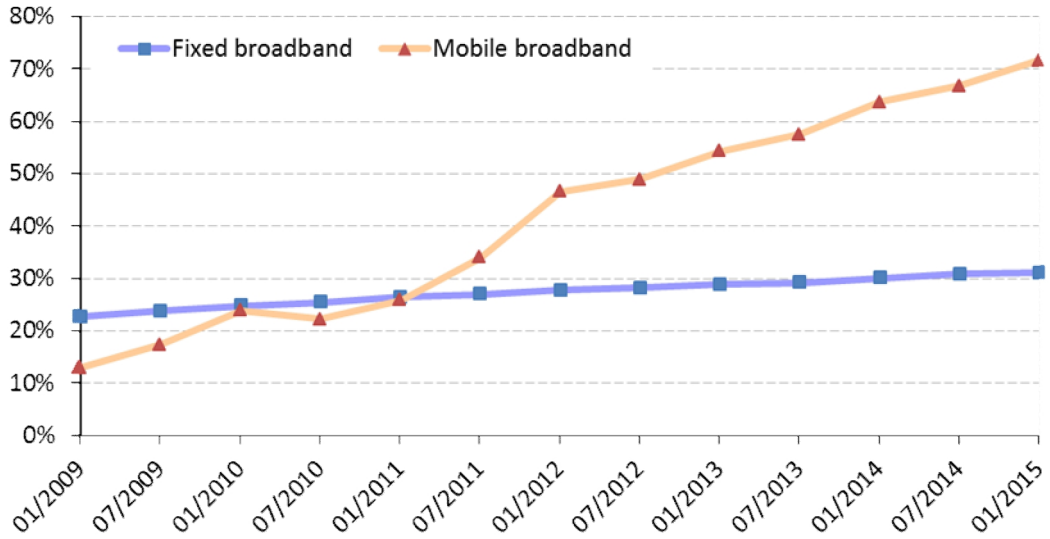
[39] Unless otherwise noted, figures in the following sections are taken from European Commission, Connectivity: broadband market developments in the EU, 2015; European Commission, Digital Agenda targets: progress report, 2015; and European Commission, Implementation of the EU regulatory framework for electronic communications 2015, 2015, SWD(2015)126 final.

[40] Broadband Commission for Digital Development. Broadband for all; the state of broadband, 2014. ITU/Unesco, 2014.

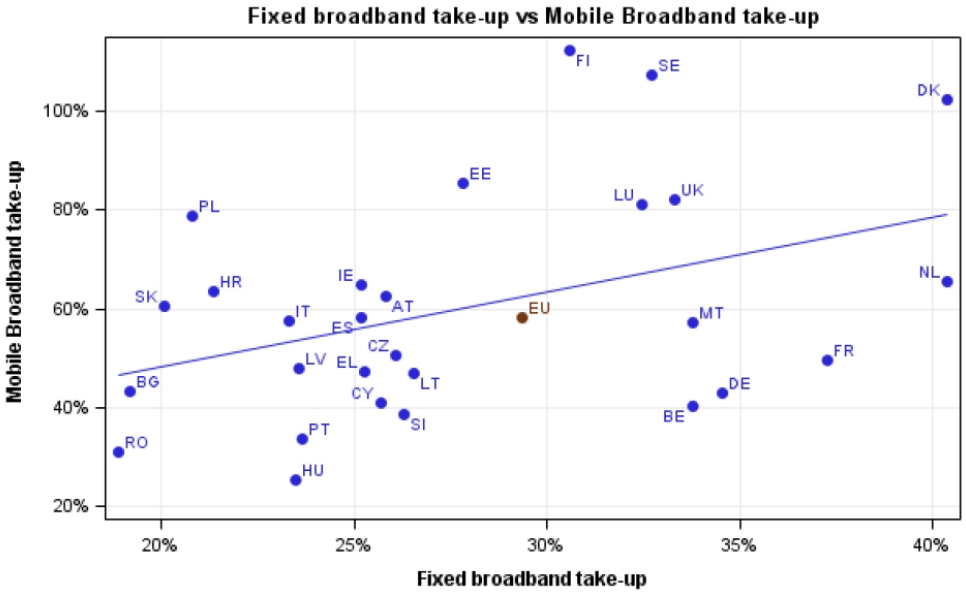
Figure 5 - Fixed and wireless broadband penetration across the EU, 2009-2014 (subscriptions as % of population)



Data source: European Commission, 2015.

The percentage of take-up of mobile and fixed broadband varies considerably across the Member States.

Figure 6 - Fixed and mobile broadband take-up in Member States, 2013

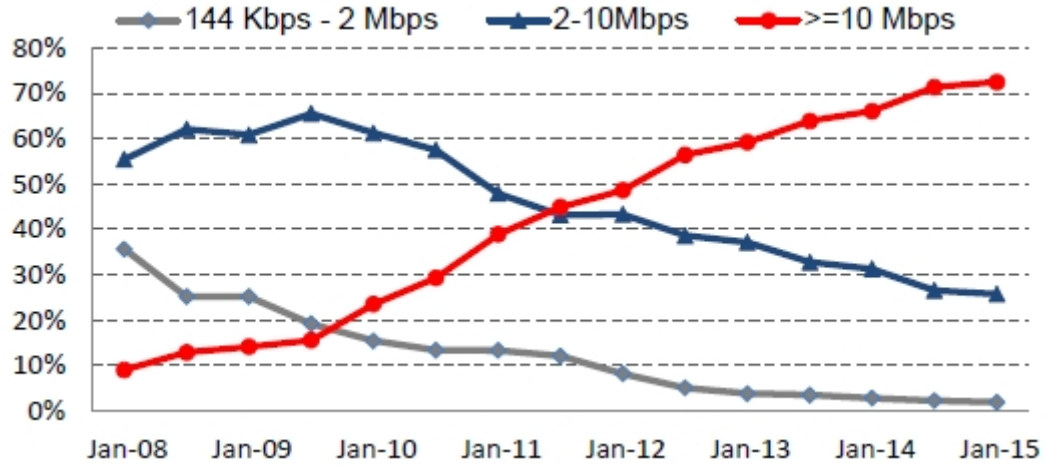


Data source: Communications Committee, 2014.

4.3. Broadband access by speed

Fixed line subscriptions above 10 Mbps are also increasing as a percentage of subscriptions. As of January 2015, there was only a very small percentage (2%) of subscriptions in the EU with the lowest tier of broadband speeds (between 144 Kbps and 2 Mbps) except in a few Member States (e.g. Estonia, 16%; Slovenia, 8%).

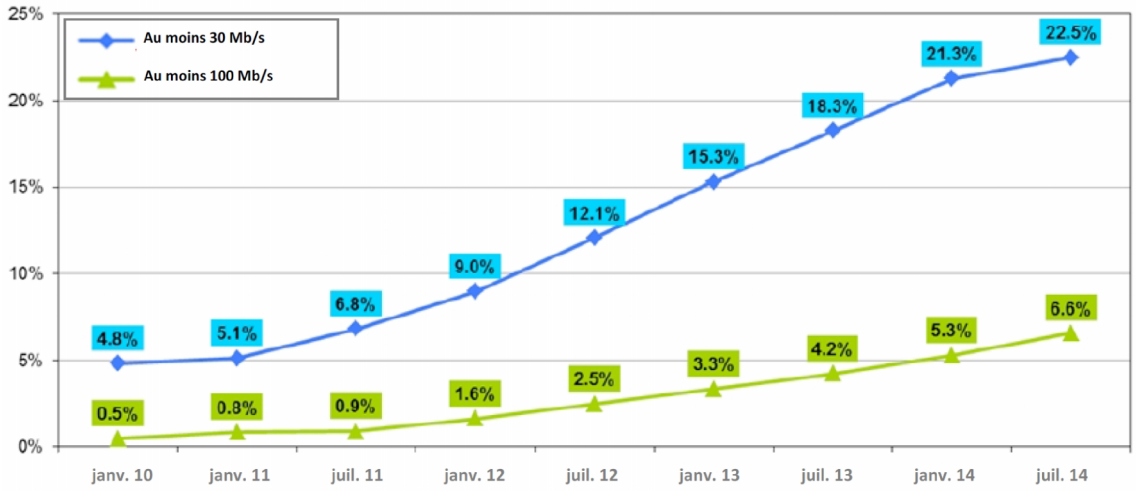
Figure 7 - Fixed broadband subscriptions by headline speed



Source: European Commission, Connectivity: broadband market developments in the EU, 2015.

The penetration of broadband subscriptions over 30 Mbps (fast broadband) is increasing, from 2.5 per 100 people in 2012 to 6.3 per 100 in 2014, and fast and ultra-fast subscriptions represent a growing percentage of the total number of subscriptions in the EU. However the take-up of fast and ultra-fast broadband remains low. Take-up of ultra-fast broadband stood at only 1.6 subscriptions per 100 people at the beginning of 2014 (corresponding to about 3% of households in the EU).

Figure 8 - Fast and ultra-fast broadband subscriptions as % of total subscriptions in the EU



Source: Digital Single Market strategy - Staff working document, 2015.

Fast connections are most widely used in Belgium and the Netherlands (where VDSL and DOCSIS are leading technologies) as well as Latvia, Sweden and Lithuania (where FTTP is the prevailing technology). However some Member States such as Italy, Cyprus and Greece have hardly any fast broadband subscriptions (less than 1 for every 100 people).

4.4. Broadband markets

For some observers, as well as for the Communications Committee (an advisory committee to the Commission), broadband markets in the EU are fragmented.[41] This is partly reflected in the very significant differences across Member States in terms of coverage and take-up of the different types of broadband access networks (see

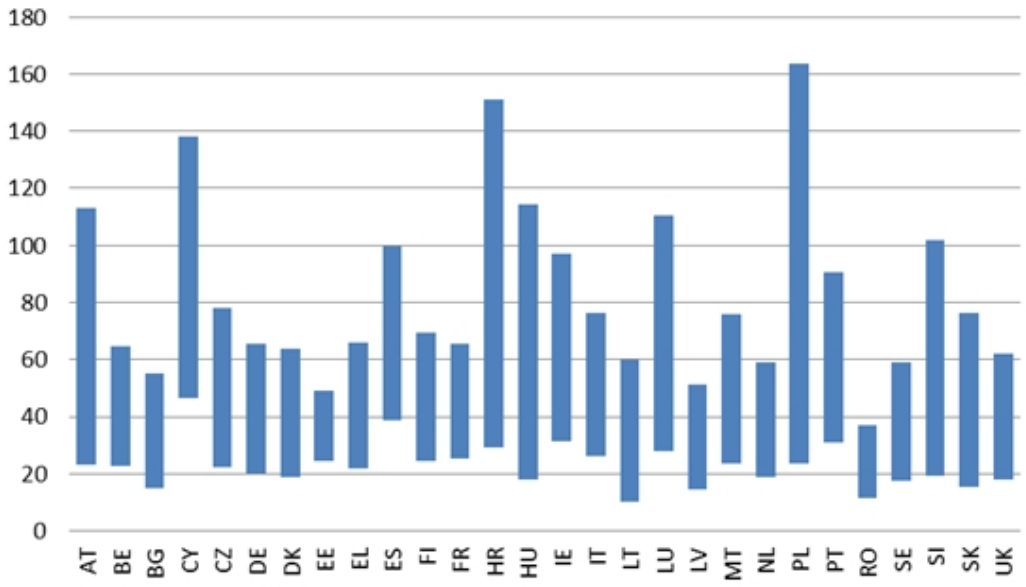
[41] Communications Committee, Broadband in the EU: situation at 1 July 2013, 2014. COCOM 14-03.

Figure 6). For example, the Netherlands and Denmark have more than 40 fixed-line subscriptions for every 100 citizens; in Romania, Bulgaria the values are less than half that. Some countries with low scores (such as Italy, Bulgaria, Poland and Croatia) are not catching up, but are making only slow progress.

Price is another factor in the take-up of broadband. On average across the EU, broadband retail prices have fallen over the years from 2009 to 2014 by amounts ranging from 8.5% to 35% depending on the type of offer, though prices have largely stabilised since 2012.[42] Prices dropped both for fast and ultra-fast subscriptions, and for both standalone offers and 'triple play' bundles including fixed telephone and television services. For example, for speeds between 30 and 100 Mbps, standalone offers declined from a median monthly price of €42 in 2009 to €34 in 2014, and for 'triple play' packages from €92 in 2009 to €62 in 2013.

Prices also varied considerably across Member States with median prices in 2014 for a standalone offer for 30-100 Mbps access varying between €22 (Lithuania) and €102 (Malta) at Purchasing Power Parity, and median prices for a 'triple play' offer running from €38 (France) to over €84 (Malta, Cyprus and Croatia). It should be noted that broadband take-up does tend to be somewhat lower in Member States with lower levels of income.

Figure 9 - Prices in euros for fixed broadband standalone offers, 12-30 Mbps (July 2013)



Source: Communications Committee, 2014.

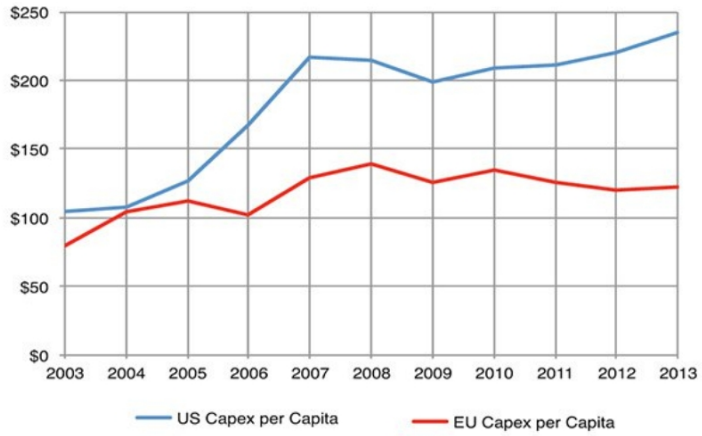
[42] Van Dijk, Broadband internet access cost (BIAC), European Commission, 2014.

US and European broadband deployment

The US and the EU have comparable penetration levels for fixed broadband subscriptions. However differences are visible when it comes to faster NGA networks. In 2011 and 2012, 82% of US households were covered by NGA networks (with speeds of 25 Mbps or better) compared to only 54% in Europe. The difference was even greater in rural areas where coverage was 48% and 12% respectively. The 2014 study[43] that reported these figures attributed this difference to the regulatory approach. In the US, starting in 2003, regulators lifted obligations on incumbents who wanted to invest in high speed DSL and fibre technologies, and encouraged new entrants to construct their own networks. However, according to the study, regulators in the EU focused on increasing competition by 'unbundling the local loop', i.e. allowing new entrants to lease the facilities of incumbent operators at wholesale cost. Unfortunately these new operators did not subsequently build their own networks, while incumbent operators lost incentives to invest in new technologies or networks.

The purported effects of this difference in regulation were striking. In the US, from 2007 to 2012, between US$603 and US$546 per household was invested annually in the telecommunications sector; in Europe, annual investments per household ranged between the equivalent of US$389 and US$244. Some commentators concur that 'the American market-led approach of facilities-based competition has resulted in greater investment in next-generation broadband technologies'.[44] However others argue that broadband availability for Americans and Europeans is similar for next generation speeds, and the US has neither more investment nor better outcomes than the EU.[45]

Figure 10 - Infrastructure investment per capita by private telecom, cable, wireless and satellite providers



Source: American Enterprise Institute.

Comparing the US and Europe is difficult because of different installed infrastructure (e.g. cable television), population density, bundling practices and taxes. The US is more advanced than the EU in the deployment of 4G/LTE mobile technology, so comparisons need to balance fixed and mobile provision and account for factors such as spectrum auctions and mobile data volumes.[46] Arguments about the state of broadband in the US and Europe will continue to be important, however, in terms of evaluating EU *ex ante* broadband regulation.

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[43] C. S. Yoo., US vs. European broadband deployment: what do the data say?, U. of Pennsylvania, [2014].

[44] R. Layton, The European Union's broadband challenge, American Enterprise Institute, 2014.

[45] M. Ammori, Broadband case study: United States and EU,

[46] One study found that US mobile broadband prices were lower than those in the Europe for speeds up to 12 Mbps; although US prices were higher for speeds above this level, this was in part because Americans on average used twice as much mobile bandwidth as Europeans. However in March 2014 prices of a fixed broadband basket of 33 GB at 15 Mbps and above were higher in the US than in any EU Member States surveyed by the OECD except Luxembourg and Spain.

5. EU broadband policy

5.1. Telecommunications regulation

The EU has recognised the strategic importance of broadband, notably in the Digital Agenda for Europe and more recently in the Digital Single Market strategy. However many EU measures relating to broadband apply specifically to the telecommunications sector and are formulated within the context of telecommunications policies and regulation.

Broadband was mentioned as early as 1987 at the beginning of a period in which the principal focus of the EU in terms of telecommunications was on liberalisation and harmonisation of markets that had historically been the purview of monopoly operators. A major legislative package in 1998 was revised in 2002 and further revised by a 2009 package that included measures to increase broadband access and to account for convergence between fixed and mobile. Over this period, under pressure from the EU, National Regulatory Authorities (NRAs) in Member States required incumbent operators that owned network infrastructure to 'unbundle the local loop', i.e. provide access to their fixed networks to other operators. Unbundling increased competition and made broadband more affordable for consumers: this period 'saw the price of calls fall, the range of products increase, efficiency improve, and mobile and broadband growth stabilise'.[47] The effects of increased competition continue today (e.g. retail prices in the EU declined 20% between 2009 and 2014).

However it was also believed that the new 'virtual' operators who would initially provide services using competitors' network facilities would later develop their own infrastructure, following a 'stepping stone' or 'ladder of investment' theory.[48] Ultimately facilities-based competition would allow deregulation. This theory has been criticised by some observers from a theoretical point of view. It has also been difficult to demonstrate empirically that new operators have really progressed to developing any significant infrastructure of their own.[49] Moreover, some researchers have found that NGA rollout can be substantially impeded by the extent and effectiveness of wholesale broadband access regulation imposed on the incumbent operator's first-generation network; they call for greater importance on deregulation.[50] Others find that there is no linkage between regulation and investment levels.[51] Scholars, regulators and stakeholders continue to debate the success or failure of the theory as implemented in the EU.[52]

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[47] A. Savin, How Europe formulates internet policy, Internet policy review v. 3 n. 1 (2014).

[48] The theory, originally proposed by Martin Cave, is explained in M. Bourreau, P. Doan, M. Manant, A critical review of the "ladder investment' approach, Telecommunications policy v. 34, n. 11, pp. 683-696.

[49] C. Cambini, Y. Jiang, Broadband investment and regulation: a literature review, Telecommunications policy v. 33 (2009), p; 559-574.

[50] W. Briglauer, The impact of regulation and competition on the adoption of fibre-based broadband services: recent evidence from the European Union member states, 24th European Regional ITS conference, 2014.

[51] W. Lemstra, N. van Gorp, B. Voogt, Explaining telecommunications performance across the EU, TUDelft, 2014.

[52] For a more detailed description of EU regulatory policy, including the 'ladder of investment' theory, see Section 3.3 in J.S. Marcus et al., How to build a ubiquitous EU digital society, European Parliament, 2013. PE 518.736.

The decision to invest in broadband infrastructure is not a simple or straightforward business decision. Policy-makers can influence broadband investments through telecommunications regulation, which varies widely between different countries worldwide in terms of licensing, price, radio spectrum, universal access and content.[53] In particular, over-regulation or uncertainties about regulated market conditions may be inefficient, and can hamper investment, so the effects of regulation may be negative as well as positive.[54] In recent policy, the European Commission has favoured maintaining the principle of access-based regulation while imposing less intrusive access regulation.

In 2010, the Commission made three proposals concerning broadband. **A recommendation on regulated access to NGA networks** indicated to NRAs how they should ensure a balance between incentivising private investments in new super-fast networks and safeguarding competition with the aim of bringing consistency to Member State regulation. More recent regulation has pursued these dual (if perhaps sometimes competing) goals, as well as addressing specific issues related to fast and ultra-fast broadband. In 2013, the Commission adopted a Recommendation on **costing methodologies and non-discrimination to promote competition and enhance the broadband investment environment.**[55]

Regulation 2014/283 on **guidelines for trans-European networks in the area of telecommunications infrastructure**[56] recognised that the leading role in rolling out broadband networks should be played by the private sector, with public funding limited to programmes which the private sector cannot fully finance due to market failure or sub-optimal investment. This limited public financing should attract additional investment and provide a multiplier effect. Rural and remote areas and other sparsely populated areas should be targeted especially. At least one third of the broadband projects should aim at broadband speeds above 100 Mbps.[57] The projects should be technology neutral, deploying the best technology for the specific purpose.

In 2014, the EU introduced measures to **reduce the cost of physical deployment** of cable for fast broadband access, by coordinating work in public infrastructure.[58] Since much of the cost of network deployment comes in physically installing infrastructure, Member States were required to take measures to ensure reasonable access to existing passive infrastructure such as electricity ducts or poles or sewage transmission facilities; to facilitate the coordination of civil engineering work; and to ensure that new buildings have appropriate high-speed infrastructure in place.

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53 Broadband Commission for Digital Development, *op. cit.*

54 R. Atkinson, The economic impacts of declining investment in broadband, Information technology and innovation foundation, 2009.

55 European Commission. Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment, 11 September 2013, 2013/466/EU.

56 Regulation 283/2014 on guidelines for trans-European networks in the area of telecommunications infrastructure, 2014.

57 It is interesting to note that the Regulation even called for consideration of more ambitious targets for 2020, i.e. that would to aim to make available 100 Mbps access to all EU households and to have 50% of households connected at speeds greater than 100 Mbps.

58 Directive 2014/61/EU, Measures to reduce the cost of deploying high-speed electronic communications networks, 2014.

Despite these measures, there are currently several critical challenges in the area of broadband and telecommunications regulation. First, there appear to be large discrepancies between the investment necessary to meet the Digital Agenda broadband targets and the investment likely to take place. On the basis of one study, the European Commission estimates that there is a gap in the funding to meet the second of these broadband targets (fast broadband) of some €34 billion (of which €21 billion is public funding), and €94 billion of investment is estimated to be required to meet the third, ultra-fast target.[59]

Moreover, some have argued that the fragmented nature of the EU telecommunications market works against investments in broadband. There are some 200 operators in the EU as opposed to a handful in the US market which is roughly the equivalent size. 'Massive' price differences between Member States baffle consumers (prices for the most common broadband connections can be up to four times higher in one country than another).[60] The fact that there are 28 different NRAs responsible for their national markets hinders operators from merging or reaching a size where they can achieve European-level economies of scale. Some argue that without greater scale, operators do not have the resources or the ability to invest as much as they could in broadband.

Moreover, telecommunications operators are increasingly competing with 'over the top' (OTT) internet companies that provide voice and video communications or text messaging services (e.g. Skype, WhatsApp) without owning or leasing any of the broadband infrastructure used to deliver that content. Operators complain that OTT companies are not required to follow the same regulations as telecom operators in terms of data protection and privacy, taxation, competition and quality of service. Declining revenues from their traditional services (at least in the short term) dampens any enthusiasm amongst telecom operators for making large investments in commercial broadband infrastructure.[61]

Universal service and broadband

Universal service is the obligation of an operator to provide all users with a range of basic services of good quality at affordable prices. Services should be essential to the public interest, already in use by a substantial majority of the population, and otherwise not available to the remaining minority. The additional costs of providing a universal service can be met through imposing obligations on operators (cross-subsidising services in one area from services in others), through public funds, or from a fund shared between providers of electronic communications and services. The EU's 2002 Universal Service Directive specifically addressed the provision of a connection to the public telephone network, as well as data communication at 56 Kbps. A 2010 revision specified only data access at speeds sufficient to provide internet access.

[59] European Commission, A Digital Single Market strategy for Europe - Analysis and evidence, 2015. SWD(2015) 100 final.

[60] European Commission, Consumers suffer from geographic lottery for broadband, new studies reveal, 25 March 2014.

[61] P.L.Parcu, V. Silverstri, Electronic communications regulation in Europe: an overview of past and future problems / European University Institute, 2013.

Should broadband access be treated as a Universal Service in the EU? Some observers argue that the different technical means of providing broadband access, as well as competition between operators of traditional telephone, cable, mobile and satellite services, argue against applying Universal Service principles to broadband. Instead other means (including financial incentives, direct public financial support, and a range of policy measures to increase demand) could be used to provide support for broadband access in rural or remote areas. On the other hand, other observers believe that, now that a substantial majority of Europeans uses broadband, a shared Universal Service policy at the European level is needed.[62] As of 2010, broadband access has already been designated as a universal service in Finland, so that a reasonably priced high-quality 1 Mbps connection is considered a basic right.[63] The UK government has promised to make broadband access a basic legal right by requiring telecom companies to provide consumers broadband access at a rate no lower than 5 Mbps.[64] In Germany, the CDU party that forms part of the coalition government, wants to introduce a legal right to fast broadband (connections of at least 50 Mbps) by 2018.[65]

As part of its planned overhaul of telecommunications regulation in the Digital Single Market, the European Commission has promised to review the Universal Services Directive in light of the need to provide high-capacity broadband in the most inaccessible areas in the EU and meet public interest objectives such as access for schools and universities.

5.2. Spectrum management

Demand for radio spectrum is rapidly increasing. Mobile internet traffic in western, central and eastern Europe is predicted to increase by more than ten times between 2014 and 2019.[66] Spectrum harmonisation and standardisation takes place within international and regional bodies, and the EU has increasingly been involved in spectrum issues; however the NRAs in each EU Member State are arguably the most important actors in terms of assigning radio spectrum. The wide variations between Member States in terms of the way in which spectrum in assigned is believed by some observers to introduce inefficiencies, prevent the exploitation of economies of scale, discourage investment in broadband infrastructure and slow down the deployment of new generation technology. The EU has fallen behind the US in the rollout of fourth generation (4G/Long Term Evolution) wireless infrastructure: in 2013, only 26% of EU citizens had access to 4G/LTE mobile coverage; 90% of the US population had this coverage from one provider alone. And there were large divergences between different Member States.

To correct this situation, a number of observers call for greater harmonisation of national policies (or a pan-European policy) that would allow operators to take advantage of economies of scale and scope, to speed up deployment of new wireless broadband infrastructures and to increase investment and innovation. The European Commission took steps in this direction with the introduction of the proposed **Regulation for a single telecommunications market** (the 'Connected Continent'

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[62] M. Falch, A. Henten, Achieving universal access to broadband, Informatica economica, v. 13, n. 2, pp. 166-174, 2009. A. Nucciarelli, B.M. Sadowski, E. Ruhle, Should next generation access networks fall within the scope of universal services? A EU 27 perspective, 23rd European regional ITS conference, 2012.

[63] Finland Ministry of Transport and Communications, 1 Mbit Internet access a universal service in Finland from the beginning of July, 2010.

[64] J. Garside, Broadband to be basic legal right says George Osborne, The Guardian, 18 March 2015.

[65] Rossman, R. CDU will Rechtsanspruch auf schelles Surfen, Süddeutsche Zeitung, 2 July 2015.

[66] Cisco, Visual networking index: Global mobile data traffic forecast, update 2014 - 2019, 2015.

regulation),[67] but the spectrum proposals in this proposal have been rejected by Council. Nevertheless, in its 2015 Digital Single Market Strategy, the Commission plans an ambitious revision of telecom rules, including more effective spectrum coordination and common EU criteria for spectrum management with the aim of creating incentives for investment in high-speed broadband.[68]

5.3. State aid

Member States, regional and local authorities often want to support broadband networks, but such support constitutes state aid, which, if it distorts competition, is incompatible with the Single Market. EU-level rules on state aid ensure that competition is respected in the single market. However the Europe 2020 strategy for growth recognised the role of state aid in contributing to innovation and growth, and the possibility for state aid to contribute to achieving the goals of the Digital Agenda for Europe.

In 2009, the Commission adopted so-called Broadband Guidelines that outlined how public funding could support the building of broadband networks in the light of EU state aid rules. The aim was to provide legal certainty for public and private investors and to facilitate public financial support for projects that would not attract private investment due to high risk or low demand. The guidelines required detailed mapping of the areas being targeted by the support, the use of open tenders, a technologically neutral approach and open wholesale access to the completed network for all operators.

These Broadband Guidelines were revised in 2012.[69] The revision took into account newer technologies for fast broadband and allowed support for ultra-fast broadband projects in urban areas subject to strict conditions. In addition, state aid support was required to create a real step-change in connectivity, and competition was reinforced via the principle of open access for all operators to the completed network.

Furthermore, a 2013 Regulation[70] on state aid rules allowed Member States to provide some types of broadband infrastructure support without being obliged to notify the Commission, as long as there was no infrastructure in place or likely to be developed in the near future. These exemptions covered building basic broadband infrastructure and small measures related to NGA networks as well as broadband civil engineering works and passive infrastructure (e.g. towers, poles or underground ducts). The intention was to speed up investment and encourage public support, particularly in rural areas where passive infrastructure is lacking.[71]

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[67] European single market for electronic communications (Connected continent) Regulation, 2013/0390(COD).

[68] European Commission, A Digital Single Market strategy for Europe, 6 May 2015. COM(2015) 192.

[69] European Commission, EU guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks, 2013. 2013/C 25.01.

[70] Council Regulation 733/2013 on the application of Articles 92 and 93 of the Treaty establishing the European Community to certain categories of horizontal state aid, 22 July 2013.

[71] C. Quigley, The European Commissions' programme for state aid modernization, Maastricht journal of European and comparative law, 2013, no. 1.

The Commission has produced a guide for decision-makers to explain the application of state aid rules to broadband.[72] It also regularly publishes its decisions on state aid for broadband projects.[73]

The European Parliament

The European Parliament has been consistently supportive of efforts to foster development of broadband infrastructure. In a 2011 own initiative resolution in response to the Commission's Communication on European broadband and investing in digitally driven growth,[74] Parliament underlined the contribution of broadband to the competitiveness of European industry as well as to economic growth, employment and social cohesion. Parliament called for incentive measures for the private market, removal of barriers to broadband deployment, and more effective coordination of actions between the EU, Member States, local authorities and private investors.

In a 2012 resolution on completing the Digital Single Market,[75] Parliament emphasised that broadband was an important driver for economic growth, job creation, innovation and European competitiveness. It also stressed that consumers and businesses (especially small and medium-sized enterprises) needed broadband access to take full advantage of the internet. Parliament urged the Commission and Member States to do more to implement fast and ultra-fast broadband, even calling for a strategy aiming at large-scale deployment of optical fibre-based access networks.

Again in 2013, in a resolution on the Digital Agenda,[76] Parliament highlighted the need for broadband and particularly for investment in very fast broadband in order to benefit from the digital economy. Moreover, Parliament regretted that Member States were delaying in assigning spectrum to mobile broadband, and deplored the reduction in the funding that the Commission had originally proposed for ICT investment in the Connecting Europe Facility.

5.4. EU funding support

In countries around the world, broadband infrastructure projects may be supported by public funds for a range of reasons, e.g. they stimulate economic development, they reduce the digital divide by serving rural areas and they support digital services important to the population such as e-Health and e-Learning. The ITU has identified a number of best practices for broadband infrastructure projects, including public consultation, considering different technologies, mandating open access to the networks to foster competition and taking steps to catalyse demand.[77] Public support should only be used where it is unlikely that a private-sector solution will emerge, so that it does not lead to market distortions, crowd out private funding or create disincentives to private investment. It is reasonable to assume that broadband

[72] European Commission, The broadband state aid rules explained, 2013.

[73] European Commission, Commission decisions on state aid to broadband, Updated 15 May 2015.

[74] Commission Communication COM(2010)0472. European Parliament, European broadband: investing in digitally driven growth. Resolution adopted on 6 July 2011, 2010/230(INI).

[75] European Parliament, Completing the digital single market, 11 December 2012. 2012/2030(INI).

[76] European Parliament, Digital agenda for growth, mobility and employment, 12 September 2013. 2013/2593(RSP).

[77] ITU, Developing successful Public-Private Partnerships to foster investment in universal broadband networks, 2012.

deployment in rural areas will not happen on the basis of business calculations alone, but will only succeed with government financial support.[78]

Member States, regional and local authorities will undertake to supply some of the financing necessary to build the broadband infrastructure needed to achieve the Digital Agenda targets. However the EU will continue to contribute. The **European Structural and Investment Funds** are expected to allocate increased amounts for broadband in the 2014-20 programming period (from €2.7 billion in 2007-13 to about €6.4 billion for 2014-20). Of these sums, the **European Agricultural Fund for Rural Development (EAFRD)** is expected to contribute €1.5 billion and the **European Regional Development Fund (ERDF)** about €5 billion.[79]

The **Connecting Europe Facility 2014-20** (CEF) will allocate about €150 million to broadband projects that cannot be financed solely by the private sector. It is hoped that through financial leverage, this will mobilise as much as €1 billion in total investment for the seven-year programming period (though much less than the Commission had originally proposed[80]). The European Investment Bank will also make loans for broadband infrastructure, estimated at €16 billion for the same period.[81]

Broadband infrastructure is also one of the priority investment areas of the new **European Fund for Strategic Investment (EFSI)** originally proposed by Commission President Juncker. Based on a list of possible projects that were identified by a Task Force, it is conceivable that as much as €26 billion could be allocated to broadband infrastructure in the coming years.[82] However critics of EFSI point out that only relatively small public sums from EFSI will be invested; the hope is that these amounts will be leveraged and draw much larger private investments. However sceptics fear that the costs of servicing sparsely populated areas will be too high to interest any private investors, and as a result the areas most in need of assistance will not get it.[83]

6. Stakeholder views

BusinessEurope believes that networks are the backbone of the digital economy and that investments in network infrastructure that allow fast, reliable and affordable connectivity will lead to growth and job creation in the EU. Investments in NGA networks are of key importance, as is simplified access to EU funding and the promotion of PPPs. BusinessEurope also feels that current regulations have hindered

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78 S. Heng, *op. cit.* See also Regulation 1316/2013 of the European Parliament and of the Council establishing the Connecting Europe Facility, 11 December 2013.

79 *Ibid.*

80 The original proposal from the European Commission indicated that the CEF would have about €7 billion available for investment in broadband infrastructure, which was expected to leverage €50-100 billion in private and public money. However the CEF resources were scaled back before the proposal was accepted.

81 See European Commission, A Digital Single Market for Europe - analysis and evidence [Staff working document]. 2015. SWD(2015) 100 final).

82 European Commission, DSM Staff Working Document. SWD.

83 EurActiv, Rural broadband access threatened by Berlin party politics, 30 January 2015.

operators from reaching important economies of scale and that spectrum management needs to be more harmonised to allow for take-up of mobile broadband.[84]

According to **DigitalEurope** (an organisation representing the digital technology industry), a key prerequisite for a successful economy is responsive broadband infrastructure. Mobile broadband can bring benefits to consumers and industry as well as governments.[85] The organisation supported the Commission's proposal for a single telecommunications market, in particular proposals for a single EU telecommunications authorisation and greater harmonisation of spectrum management.[86] Big Data solutions depend on high-capacity networks, and the EU should continue public funding so as to encourage private investment in broadband infrastructure.[87] The organisation also supports greater allocation/assignment of spectrum to support wireless broadband which is becoming 'the default way in which devices connect to the Internet'.[88]

Associations representing different sectors in the telecommunication field have differing views. The **European Telecommunications Network Operators (ETNO)**, which represents incumbent telecommunication operators, believes that if Europe is to remain competitive in terms of advanced digital networks, the EU must adopt a 'lighter touch' pan-European telecommunications regulation that relies primarily on competition law. Allowing mergers between operators would help realise economies of scale and would lead to greater investment in broadband. In addition, ETNO calls for a 'level playing field' in regulations between telecommunications operators and OTT service providers.[89] On the other hand, **the European Competitive Telecommunications Association (ECTA)**, which represents new entrants, believes that the view that there is underinvestment in new broadband infrastructure in Europe is a myth. Rather, regulation-fostered competition has been shown to successfully promote investment. They recognise however that extending broadband coverage to rural areas is likely to need both public and private investment.[90]

Among other industry associations, the **EMEA Satellite Operators Association** believes that satellite broadband provides the only immediately available solution for those who live in areas with slow or non-existent terrestrial or mobile broadband access.[91] The **Fibre to the Home (FTTH) Council Europe** feels that the Digital Agenda broadband targets are now outdated and higher speeds should be the norm. They welcomed the agreement on EFSI, believing that telecommunications networks are a key infrastructure for a competitive Europe and the wide adoption of fibre networks will

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84 BusinessEurope, Recommendations for a flourishing European Digital Economy, 2014. Available on the BusinessEurope website.

85 DigitalEurope, Releasing new radio spectrum bands for mobile broadband in Europe, 2014.

86 DigitalEurope, DigitalEurope views on the proposal for a telecommunications single market regulation, 2013.

87 DigitalEurope, Making Europe fit for the data economy, 2014.

88 DigitalEurope, DigitalEurope views on WRD-15 agenda items 1.1, 1.2 and 10, 2015.

89 European Telecommunications Network Operators Association/Boston Consulting Group, Reforming Europe's telecoms regulation to enable the Digital Single Market, 2013.

90 European Competitive Telecommunications Association (ECTA), What contribution from the Digital Single Market to Europe's global competitiveness? 2015.

91 EMEA Satellite Operators Association, Broadband for all: towards 100% coverage, [no date].

have a positive impact on job creation and economic growth.[92] Representing mobile telecom operators, the **GSM Association** highlights the urgent need for national government and regional regulatory bodies to designate more radio spectrum for mobile uses.[93]

7. Next steps

The Digital Single Market strategy announced by the European Commission in May 2015 will largely replace the Digital Agenda as the EU's main digital strategy for 2015 and beyond.[94] This strategy includes 16 new initiatives of which one is an ambitious overhaul of EU telecommunications rules, including creating incentives for investing in high-speed broadband.

The strategy has highlighted a number of issues that are likely to be addressed in the future. For example, the Commission believes that the current regulatory framework is not steering NRAs towards taking the steps needed to encourage investment in capital-intensive fast broadband networks. The current emphasis on regulated wholesale access to existing networks removes investment incentives such as 'first mover advantage', i.e. the premium in price and profitability that goes to those that accept the risks of providing new and better networks. The time lags in assignment of spectrum, wide differences in assignment conditions and regulations, and different degrees of ambition at the national level in regard to broadband have also affected the rollout of 4G wireless availability which still lags well behind that seen in the US. The Commission plans to present proposals in 2016 that provide a more harmonised approach to spectrum management, tackle regulatory fragmentation, and address incentives for investment in high-speed broadband networks.

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92 Fibre to the Home Council Europe, FTTH Council welcomes the agreement reached on the regulation for the European Fund for Strategic Investments, 2015.

93 GSMA, Spectrum for mobile broadband, 2014.

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Broadband refers to internet connections capable of delivering information at fast speeds, using a variety of different wireline or wireless technologies. Fast access is important to the development of a digital economy in the European Union: economists believe that broadband deployment increases employment and spurs economic growth.

Basic broadband is available to virtually all citizens in the European Union, but progress still needs to be made in coverage and take-up of fast and ultra-fast broadband if the EU's targets are to be met by 2020. Policy-makers can influence broadband deployment through a wide range of policies, including targets and digital policies, telecommunications regulations and state aid rules. Alongside efforts of authorities in Member States, EU public funding can also be provided to support building broadband infrastructure in areas, such as rural communities, where the population density may not be great enough to justify private investment alone.

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