

Chapter A ICT Infrastructure

The key pillar necessary for primary development of the information society and digital economy these days is without a doubt a robust, reliable, and modern infrastructure, enabling the transfer of a huge amount of data necessary to provide services through fixed or mobile electronic networks. Telecommunications and Internet (ICT) infrastructure could be described as the basic building block of most information technologies and information society as a whole.

The Czech Statistical Office is aware of the ICT infrastructure's significance, and, on a regular basis, it processes main data concerning the development and status of this area. This chapter examines trends in the available services provided within fixed and mobile electronic communication networks measured mainly by number of voice (telephone) and internet/broadband (data) subscriptions and connections¹. The initial focus is on telephony; after which it shifts to the internet infrastructure. Data used in this chapter are collected by the Czech Telecommunication Office from the telecommunication or internet service providers and should be distinguished from data based on ICT users' surveys.

A.1 Telecommunication infrastructure

Telecommunication infrastructure is the key pillar according to which the information and technological development of individual states has been evaluated in the past years. In the last millennium it was the fixed-telephone telecommunication service that was mainly used; since 2000 it has been the mobile telecommunication service, which has gradually become more popular.

Today many telecom companies offer service bundles via one single distribution method. This is also known as 'multiplay'. For instance, a company can now use the cable to supply television, internet and telephone services. Sometimes these services are offered in a single package through different distribution methods. Many Czech households nowadays obtain these multiple telecom services from a single provider.

Fixed telephone network penetration – Voice subscriptions via PSTN or VoIP²

Fixed telephone network, with its services, used to be a flagship of the entire communications sector. In the 20th century, fixed telephone line represented the basic infrastructure for the dissemination of speech and also featured the underlying technology platform for the development and spread of other technologies such as the internet. However, traditional fixed-line telephony has been declining in the Czech Republic since 2000, largely due to the rise of mobile service (fixed-mobile substitution) and to the increased use of IP telephony for fixed voice communication (VoIP technology).

- There has been a shift in the type of fixed-telephone connections used in the Czech Republic. The traditional PSTN and ISDN telephone network is losing ground, while the number of telephone connections via the internet (VoIP) was rising. In 2016, the Czech Republic had 917 thousand **VoIP connections**, compared to 462 thousand in 2010. The number of traditional fixed-telephone connections (PSTN lines) in 2016 was 832 thousand. Ten years before it was still 2.8 million. Packages that allow consumers to acquire multiple telecom services, such as TV, the internet and VoIP, in a single subscription have been gaining in popularity for some years.
- The number of **subscribers to voice services** provided by means of **public switched telephone network (PSTN)**³ in the Czech Republic has been decreasing. Since 2001 when their number reached its maximum, the number decreased by 3 million to the above mentioned 832 thousand in 2016. As an

¹ A subscription (subscriber) to publicly accessible services of electronic communications (voice and data services in fixed and mobile communication networks) refers to natural (individual or household) or legal (enterprise, public organisation) person (entity), that has concluded a contract on the use of such services with a provider. Data presented here include solely services provided in the retail segment, i.e. services provided to end users.

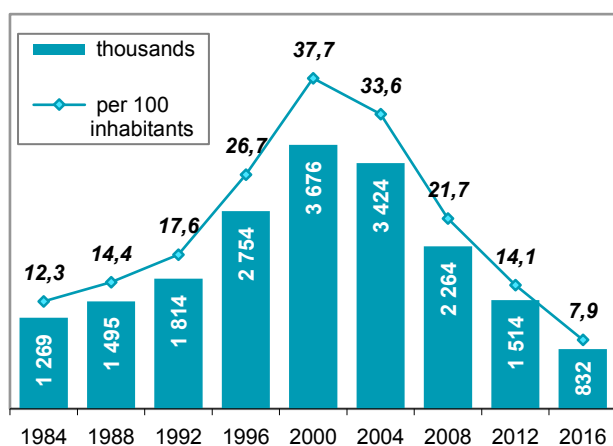
² Number of fixed-telephone voice subscriptions is measured as a number of active fixed traditional telephone lines/connections (PSTN) and number of voice subscriptions using VoIP technology.

³ The PSTN (Public Switched Telephone Network) is a set of technical means defined by an active end point of the public switched telephone network and unambiguously determined by the telephone exchange ending. The number of fixed-voice subscriptions to PSTN lines is measured by number of active PSTN stations – formerly called main telephone stations – and are further classified as residential telephone lines and business telephone lines.

interesting fact can be mentioned that this number of main fixed telephone connections in 2016 is nearly equal to the number which was last recorded in 1972.

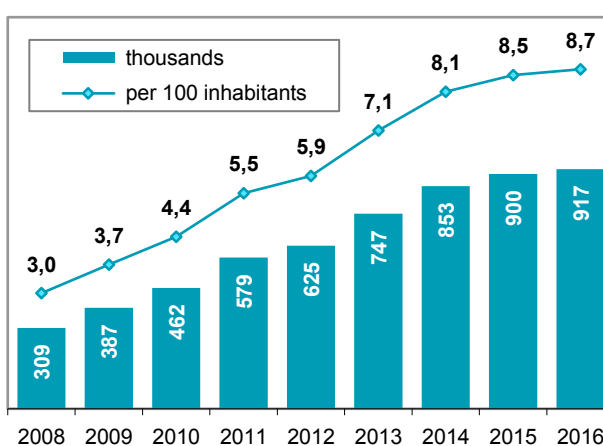
- In particular, the number of “**residential fixed telephone stations – consumer/citizen subscriptions**”, most frequently used at the turn of the millennium, is decreasing. Only in the past 15 years, has the number of subscriptions to the traditional fixed-telephone lines (PSTN) in Czech households decreased 6.5 times from the original 2.6 million in 2001, when mobile telephones started becoming popular with Czech households, to 400 thousand in 2016. In other words, whereas in 2001 a fixed telephone was owned by 75% of households, in 2016, it was only by 14% of them – along with Finland, the lowest share in all EU countries⁴.
- In 2016, the number of “**business fixed telephone stations – business subscriptions**” using “traditional” fixed telephone lines (PSTN) was higher than the number of residential ones. Even in this case, however, there has been a significant decrease in recent years. For instance, in the years 1997 to 2008 their number was around 1 million. In 2016, the number decreased to 429 thousand business subscriptions.

Figure A1 Fixed-telephone voice subscriptions in the Czech Republic (only PSTN)



Source: Czech Telecommunication Office, 2018

Figure A2 Fixed-telephone voice subscriptions in the Czech Republic using VoIP



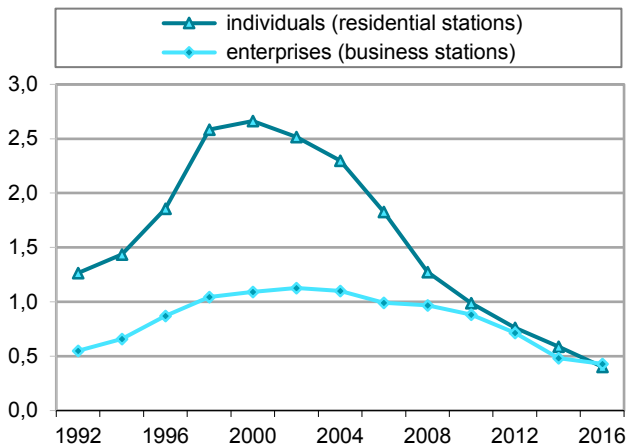
Source: Czech Telecommunication Office, 2018

- The decrease in usage of PSTN lines in the Czech Republic was partially compensated by means of **VoIP technology**⁵. In 2016, the number of subscribers to fixed-voice services by means of this IP technology was 917 thousand compared to 462 thousand in 2010. Over the last 6 years the number has nearly doubled, despite the fact that in recent years their number has not increased significantly.
- The main share in the aforementioned increase of VoIP technology for voice services in recent years, involves subscribers in the form of **enterprises** and other legal entities, whose number continues to grow as opposed to the number of **individuals (households)** using this technology for making telephone calls. In 2016, the number of enterprises that were subscribers to voice services via fixed network by means of VoIP technology already reached 619 thousand, i.e. nearly a fourfold number compared to the year 2010. As opposed to that, since 2013, when the number reached its maximum (383 thousand), the popularity of this technology in Czech households is decreasing. In 2016, this internet technology for access to voice (telephone) services was used by less than 300 thousand Czech households, i.e. the same number as in 2010.

⁴ Further details on the number of households using fixed telephone lines are available in Chapter B.1.

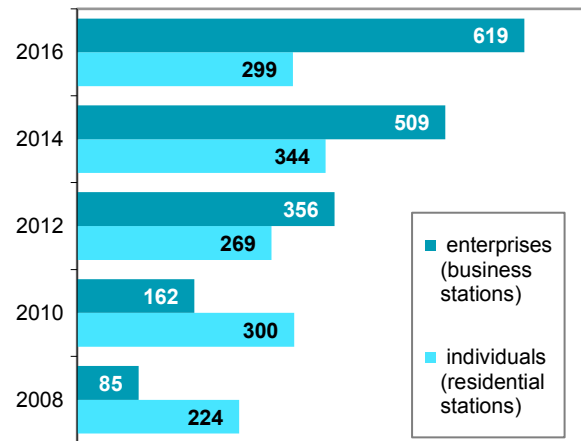
⁵ The VoIP (Voice over Internet Protocol) service, also called IP telephony enables voice transmission over packet-switched data networks and signal transmission by means of Internet Protocol (IP) packets. Voice services by means of the VoIP technology are an alternative to voice services provided by means of the traditional public switched telephone network (PSTN). The number of fixed-voice subscriptions to VoIP corresponds to the number of active telephone numbers used by the subscribers.

Figure A3 Voice-fixed subscriptions using PSTN stations in the Czech Republic (mil.)



Source: Czech Telecommunication Office, 2018

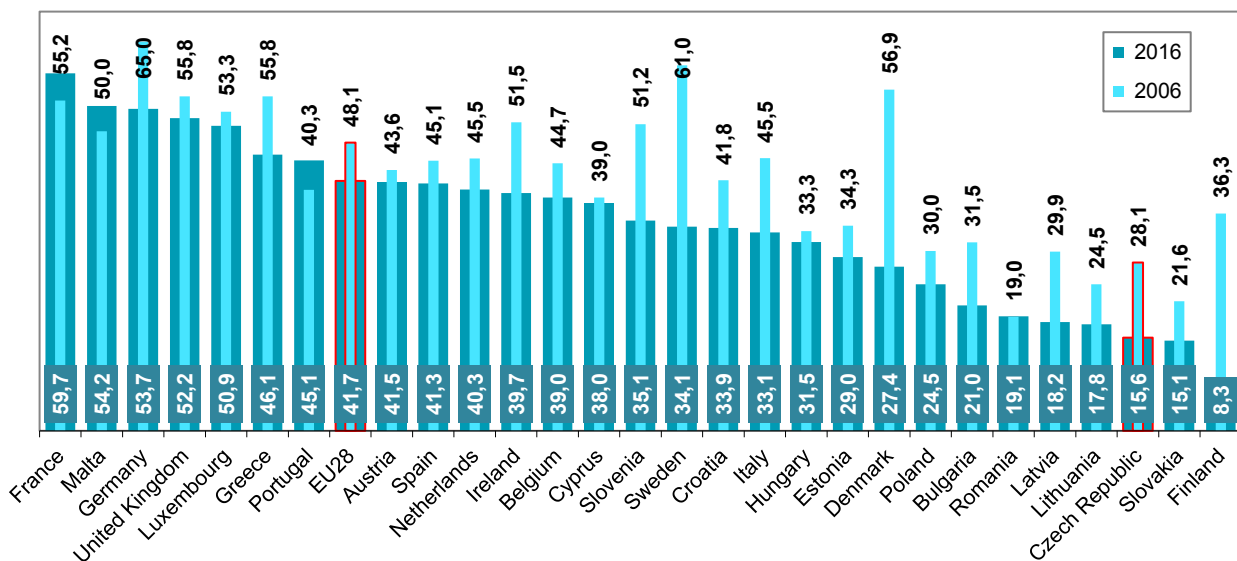
Figure A4 Voice fixed subscriptions using VoIP stations in the Czech Republic (thous.)



Source: Czech Telecommunication Office, 2018

- The growing preponderance of mobile-cellular subscriptions over fixed-telephone subscriptions has been one of the most prominent trends in ICTs since the beginning of the century, with mobile networks establishing themselves as the consumer norm in today's communications markets. Whereas in 2001, a fixed telephone was represented in 75% of Czech households, at the end of 2016 the share was solely 14%. The decrease in usage of fixed telephone lines reflects the increase in mobile telephone ownership. Since 2004 the number of active SIM cards has exceeded the number of inhabitants of the Czech Republic.

Figure A5 Fixed-telephone voice subscriptions (both PSTN and VoIP) per 100 inhabitants in EU countries



Source: CZSO calculations based on International Telecommunication Union data, 2018

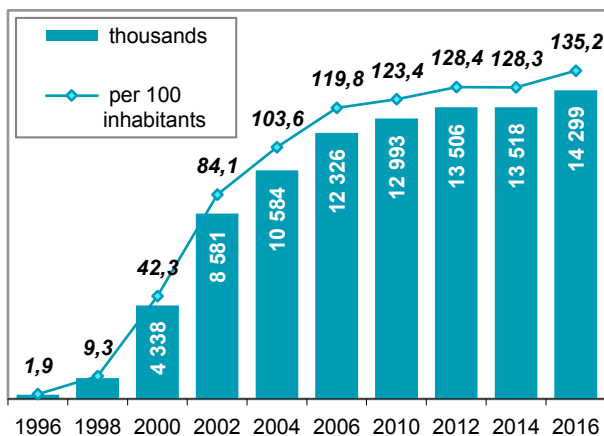
- This rapid increase in mobile telephone usage in the Czech Republic – for more details see the following chapter – did not deviate from the general trend experienced by telecommunication services in developed economies. However, the significant decrease in the number of fixed lines represents a specific issue in the international comparison. In **EU comparison**, the Czech Republic belongs to countries with the lowest number of subscribers to voice services within the fixed telephone network per **100 inhabitants**.
- In 2016, there were in the Czech Republic only 16 subscribers of **voice services per 100 inhabitants** via the fixed telephone network using PSTN lines or VoIP technologies. Lower values were recorded solely in Slovakia or Finland. However, we must add that by the end of the 90s, already before the commencement of mobile GSM networks, the countries of the so called Eastern Bloc lagged behind the countries of Western Europe with respect to equipment with fixed telephone lines.

Mobile telephone network penetration – Voice and M2M subscriptions⁶

A mobile telephone is a technology recording the highest increase in the number of subscribers in recent years. According to the International Telecommunication Union's estimates, at the end of 2016, 35 years after the first mobile network started being operated in Sweden and Norway, the number of mobile telephones used world-wide – the number of active SIM cards – exceeded the number of inhabitants of our planet. Since 2005, their number has increased nearly 3.5 times, i.e. from 2.2 to 7.5 billion in 2016. Whereas in developed countries the mobile telephone market is nearly saturated for several years now, in developing countries we have been still recording a significant increase in the number of users of this technology.

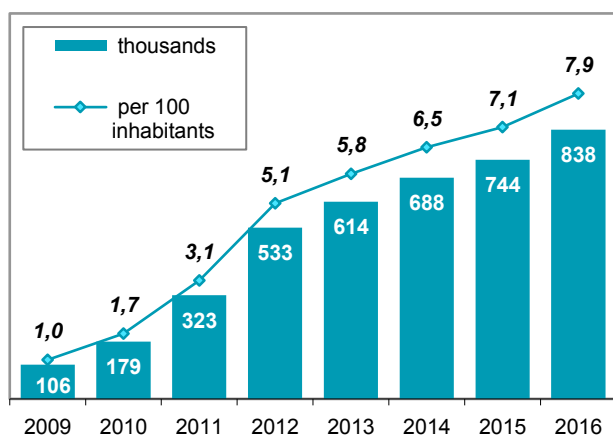
- The appearance of mobile telephones in the Czech Republic was first recorded in 1991 when *Eurotel* launched the first commercial NMT network. At the time, it was a relatively expensive solution with limited coverage. Its services were thus used by quite a low number of customers in the first few years. A real revolution took place five years later, when the first Global System for Mobile Communications (GSM) was launched in the Czech Republic. The later launch of the 3rd mobile operator in the year 2000 led to a decrease in prices and nothing obstructed the fast spread of mobile telephones in the Czech Republic.
- The aforementioned information became evident even in statistical reports. For instance, in 1996 the Czech Republic recorded a year-on-year increase in the **number of active SIM cards**⁷ from 50 thousand to 200 thousand, and between 1999 and 2000 the number even increased from two million to more than four million. In addition, compared to a third in the year 2000, already in 2007 a mobile telephone was owned by 92% of Czech households.

Figure A6 Mobile telephone subscriptions in the Czech Republic – active SIM cards



Source: Czech Telecommunication Office, 2018

Figure A7 SIM cards used in the Czech Republic in M2M network



Source: Czech Telecommunication Office, 2018

- When mobile networks were at their beginnings, and when active SIM cards appeared practically solely in mobile telephones, and only a minimum people had several mobile telephones, the number of active SIM cards truly corresponded to the number of customers or mobile telephone users. Nevertheless, this assumption no longer applies. Despite the fact that at the end of 2016 the number of active SIM cards reached 135 pieces per 100 inhabitants, mobile telephones were used by 98% of inhabitants of the Czech Republic over the age of 16.
- The primary phase of mobile telephones spreading within GSM networks in the Czech Republic was connected mainly with **pre-paid** SIM cards. These cards are topped up with *credit* that the customer uses up in compliance with the operator's tariff of offered services. The alternative is **post-paid** cards, acquired

⁶ Number of mobile telephone subscriptions is measured as a number of SIM cards. Both post-paid and active prepaid SIM cards that have been used during the last three months are included.

⁷ The SIM card is a subscriber card that identifies a participant on a public mobile telephone network. SIM cards include both prepaid cards, when the customer does not enter into a contract with the provider, only prepares a certain amount from which the provider subtracts the payments for the services provided, as well as the tariff (post-paid) cards where the customers have a contract with the operator under which they pay for monthly billing services.

by customers by concluding a contract with the operator where the services are paid for at the end of an agreed period (typically a month). As late as in 2002, the number of active pre-paid cards was nearly twice as high as that of the tariff ones. Nevertheless, since 2008 they have been decreasing. As opposed to that, the number of mobile telephone users using post-paid tariffs, and the spreading of so called unlimited (flat) tariffs has been increasing.

- For the first time, in 2009 more than a half (54%) of all active SIM cards operated based on a monthly tariff. More and more customers now prefer concluding contracts, and these currently clearly prevail over pre-paid cards – at the end of 2016 their number increased to precisely two thirds.
- In 2016, two thirds (9.2 million) of the aforementioned 14.3 million actively used SIM cards were used by individuals and the remaining third (5.1 million) was used by legal entities and self-employed individuals – mainly enterprises.
- Mobile operator services are more frequently used for routine data communication between devices without a person's direct interference, for which **M2M SIM cards**⁸ are used. In 2016, the Czech Republic recorded 838 thousand cards of this type compared to 179 thousand in 2010. In connection with the development of Internet of Things (IoT)⁹, an increasing number of SIM cards used for M2M services is expected.
- According to the OECD data, the highest number of M2M SIM cards per 100 inhabitants in **EU countries** in 2017 was recorded in Scandinavian states, as well as in the Netherlands, France, and Estonia. Data on machine-to-machine (M2M) communications, such as for Internet-connected vehicles, show that Sweden remains the leader in the number of M2M SIM cards in use per 100 people, with the caveat that data is not yet fully comparable for all countries. Sweden counts 114 M2M SIM cards per 100 inhabitants in 2017 – a much higher level than most EU countries that provided this data. Overall, M2M/embedded mobile cellular subscriptions grew in all countries in the last year where the data was available.

Telephone traffic in fixed and mobile telephone networks

Another interesting point of view for the analysis of the telecommunication infrastructure is the development in these networks, which may be characterised by the number of realised calls and called minutes. The development in voice services provided within fixed networks in the Czech Republic is still being influenced by the development of mobile voice services, in particular. Further convergence is also a characteristic issue. In particular, this is evident by the offer of various forms of so called communication packages where within the scope of one package a user can operate a mobile telephone line as well as a fixed line together with fixed connection to the internet and the internet TV.

- The decrease in the number of traditional fixed-telephone voice subscribers using **PSTN** lines was in the Czech Republic characterized also by the decrease in **called minutes**¹⁰ from these networks. Even in 2005 the number of called minutes from the PSTN stations reached 7.2 billion, i.e. approximately the equivalent to the called minutes from mobile telephones, ten years later it was only 1 billion minutes. Further 590 million called minutes within fixed network were conducted by using **VoIP** which have also been on the decrease in this respect since 2014.
- Whereas in 2006 there were on the average called **1 959 minutes** from one traditional fixed telephone line (PSTN) in the Czech Republic, ten years later it was approximately 40% less, i.e. 1 215 minutes. With respect to calls realised via VoIP technology, the average of 644 minutes was called by one user of this technology, which is 300 minutes less than five years ago.
- On the other hand, the voice operation within the **mobile network** has been very popular. In recent years, the number of calls has increased, as well as the number of called minutes, whose increase is

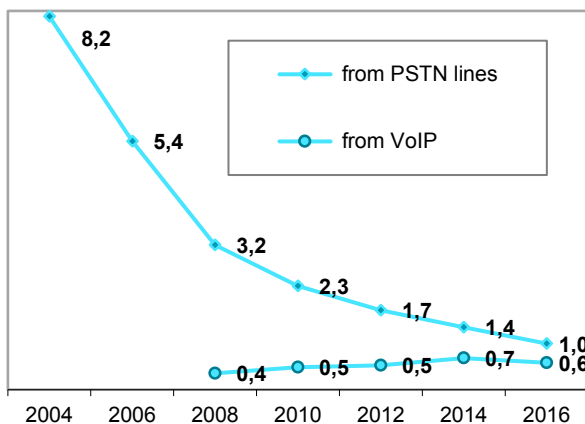
⁸ M2M (Machine-to-machine) – SIM cards designed exclusively for wireless communication between machines, devices and IS without human intervention.

⁹ The Internet of Things (IoT) covers devices (vehicles, home appliances and other devices) equipped with electronic, software, sensors, moving parts and network connectivity that allow them to connect and exchange data and be manageable even remotely, especially through wireless data and internet technologies, e.g. through a mobile phone.

¹⁰ The telephone traffic originated in fixed or mobile telephone networks is measured by means of the number of actually called minutes (real minutes of calling) during the reference year, not the invoiced ones.

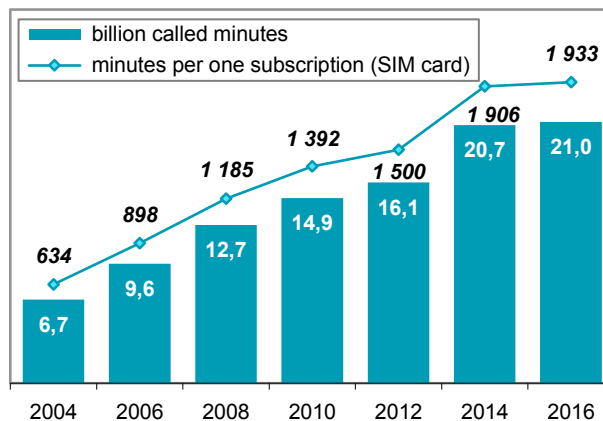
even more significant with respect to the number of calls. In 2016, a total of 20.9 billion minutes were called from the public mobile telephone network, i.e. twice more than ten years ago.

Figure A8 Total fixed telephone traffic in the Czech Republic (billion called minutes)



Source: Czech Telecommunication Office, 2018

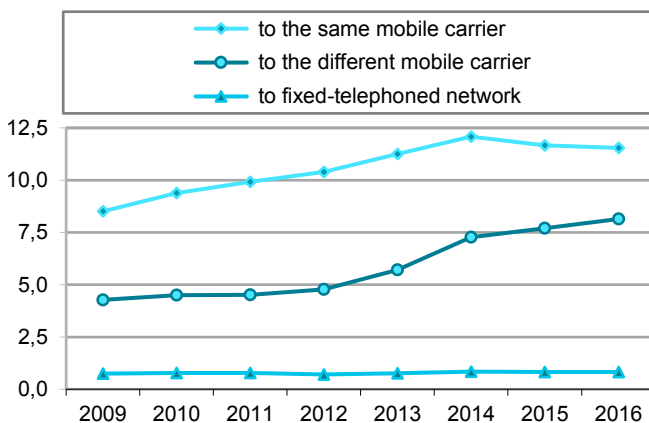
Figure A9 Mobile telephone traffic in the Czech Republic



Source: Czech Telecommunication Office, 2018

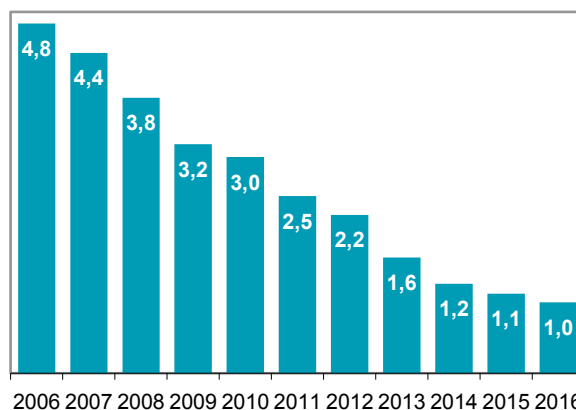
- In 2016, 55% (11.6 billion minutes) of called minutes from mobile telephones was due to calls made by **individuals** (citizens) as mobile-telephone subscribers compare to 9.4 billion called minutes (45%) by enterprises.
- **Outgoing calls** from mobile phones within the national network in 2016 were most frequently made to **their own mobile network** (11.5 billion minutes; 56%), fewer calls were made **to another operator's mobile networks** (8.1 billion minutes; 40%). Compared to this, the total length of outgoing calls from mobile telephones to fixed lines is at its minimum (826 billion minutes; 4%).
- A factor contributing to the increasingly common usage of mobile operator services is price lowering. In the past ten years, the average retail **price per called minute** decreased five times, i.e. from 4.84 CZK in 2006 to 0.98 CZK in 2016. However, when reading the results, it is necessary to consider that end customers also include enterprises with individual (usually more advantageous) tariffs.

Figure A10 Telephone traffic from mobile network in the Czech Republic (billion called minutes)



Source: Czech Telecommunication Office, 2018

Figure A11 The average retail price for one outgoing called minute in the mobile network in CZK



Source: Czech Telecommunication Office, 2018

- The downward trend of **the average price per minute** involves the decreasing average price for individual (resident) subscriptions as well as the decreasing average price for business subscriptions. According to the 2017 Annual Report of the Czech Telecommunication Office, the average aggregated consumer price in the mid-2017 concerning three mobile operators was 63.5% higher than the price for businesses –1.21 CZK per minute for individuals/non-entrepreneurs compared to 0.74 CZK per minute for entrepreneurs.



A.2 Internet infrastructure

Internet, as well as electricity, water or transport routes, is regarded as one of the basic infrastructure necessary for the full operation of the society in 21st century. The internet has become a critical infrastructure, supporting businesses, consumers/users and the public sector, and continues to experience remarkable growth. Therefore, it makes sense to statistically monitor its spreading within the society, despite the fact that, due to the dynamic development of this technology, it may not always be easy.

Broadband and the services provided over them support existing economic and social activities and hold potential for tremendous innovation. Access to broadband measured by number of broadband subscriptions¹¹, as a result, has become a more fundamental indicator of ICT performance and potential than access to voice telephony and other basic services. Broadband diffusion remains uneven across EU economies but continues to increase everywhere. Progress has been particularly swift in mobile broadband take-up.

Fixed broadband penetration – Subscriptions by technology and speed

The gradual development of internet contents requires a gradually faster connection that is reflected by the offer of individual technologies. According to ITU, the number of worldwide fixed broadband subscriptions doubled within just eight years – from 526 million in 2010 to 1 075 million in 2018. On a global scale, the dominant position of wireless connection used for internet access in the Czech Republic, from a fixed place, may be deemed as unique.

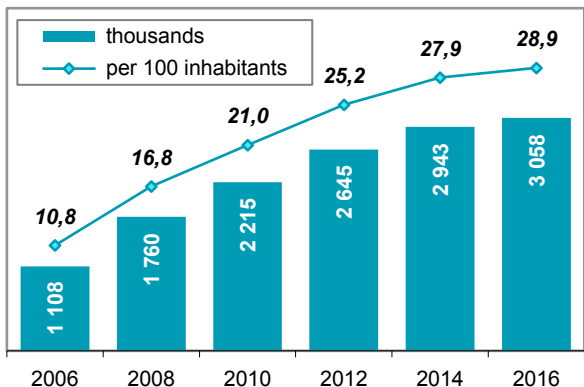
- For the first time in 2016, the total number of **fixed broadband subscriptions (connections)**¹² exceeded in the Czech Republic three million. At the end of 2016, there were 3.1 million subscribers to the fixed broadband internet access – including ones realised by means of fixed wireless connections and Wi-Fi technology¹³, i.e. 2 million more than ten years ago and approximately a half a million more than five years ago. Despite this significant increase, it must be emphasized that in the past 3 years, the approximate number of fixed broadband subscribers has not changed much in the Czech Republic.

¹¹ Broadband subscriptions data are typically supplied to the EC, OECD and ITU by communications regulators that collect them directly from network operators according to common definitions. It is not currently possible for majority of countries – the Czech Republic being exception – to delineate business and consumer subscriptions and so both are counted; the data are presented in relation to the population of individuals.

¹² The number of fixed internet access subscriptions is measured based on the number of so-called access points (active connections) that provide a service for one of the below technologies employed for the internet access. In majority of cases the number corresponds to the number of agreements concluded for the services providing in the retail segment. Fixed broadband refers to the number of subscriptions to services with 256 kbps advertised speed or greater, provided using DSL, cable, fibre-to-the-home (FTTH), fibre-to-the-building (FTTB), satellite, terrestrial fixed wireless, or other fixed-wired technologies.

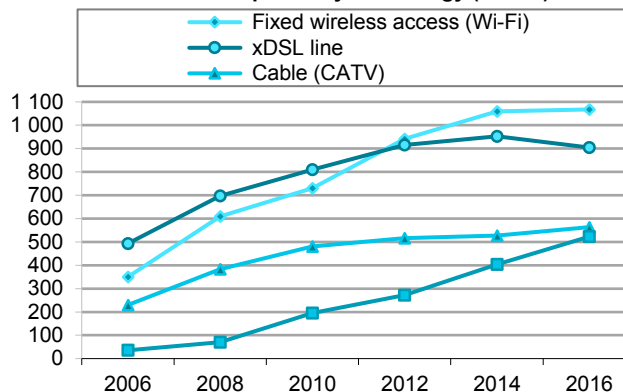
¹³ Fixed wireless access (FWA) is the terrestrial internet connection by means of a radio system including non-licensed frequency (Wi-Fi). It is characteristic by placing of the end point device on a fixed location (house, apartment) – the so-called WLL (Wireless Local Loop).

Figure A12 Fixed broadband internet subscriptions in the Czech Republic



Source: Czech Telecommunication Office, 2018

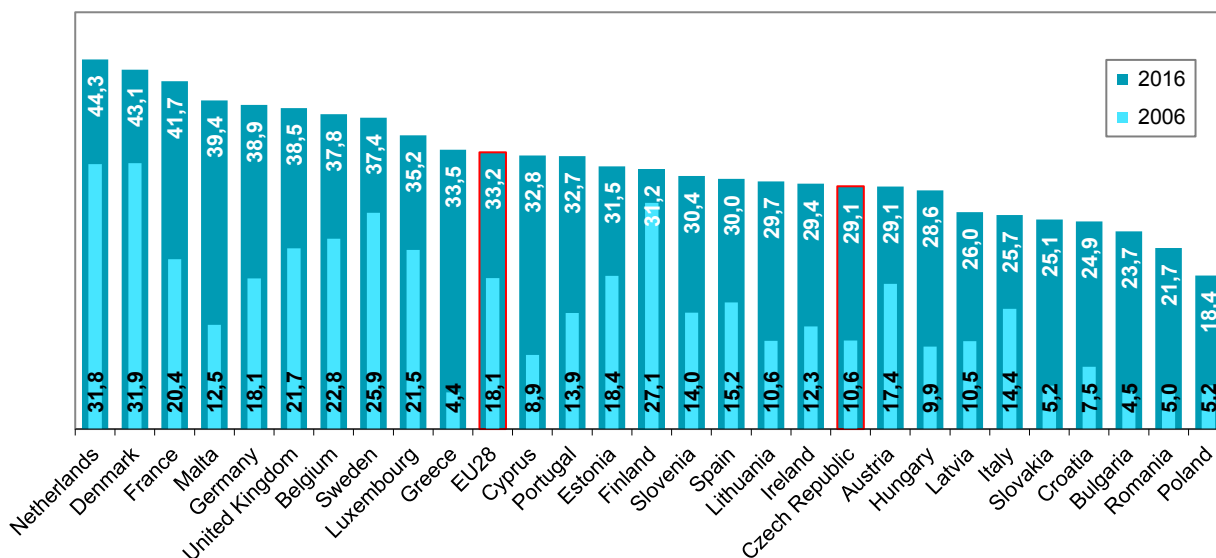
Figure A13 Fixed broadband internet subscriptions in the Czech Republic by technology (thous.)



Source: Czech Telecommunication Office, 2018

- At the end of 2016, there were in **EU countries** 170 million fixed high-speed internet connections (subscriptions) in total, i.e. approximately twice as many as ten years ago. Therefore, compared to 18 fixed broadband subscribers ten years ago, in 2016 there were 33 high-speed fixed internet subscribers per 100 EU inhabitants.
- Broadband **fixed penetration indicator** comprises the number of subscriptions to fixed wired or wireless broadband services, divided by the number of residents in each country. This fixed broadband penetration rate reached over 40% in France, Denmark and the Netherlands in 2016. The Czech Republic had 29 fixed broadband connections per 100 inhabitants compare to above mentioned number 33 for EU average. The Netherlands and Denmark have been the two countries with the highest number of broadband connections for some time. Take-up for fixed broadband has increased at a slower pace than for mobile, and in some countries this latter has been substituting fixed broadband rather than complementing it. The general trend, however, indicates significant improvement in available technologies.

Figure A14 Fixed broadband subscriptions per 100 inhabitants in EU countries



Source: CZSO calculations based on European Commission data, 2018

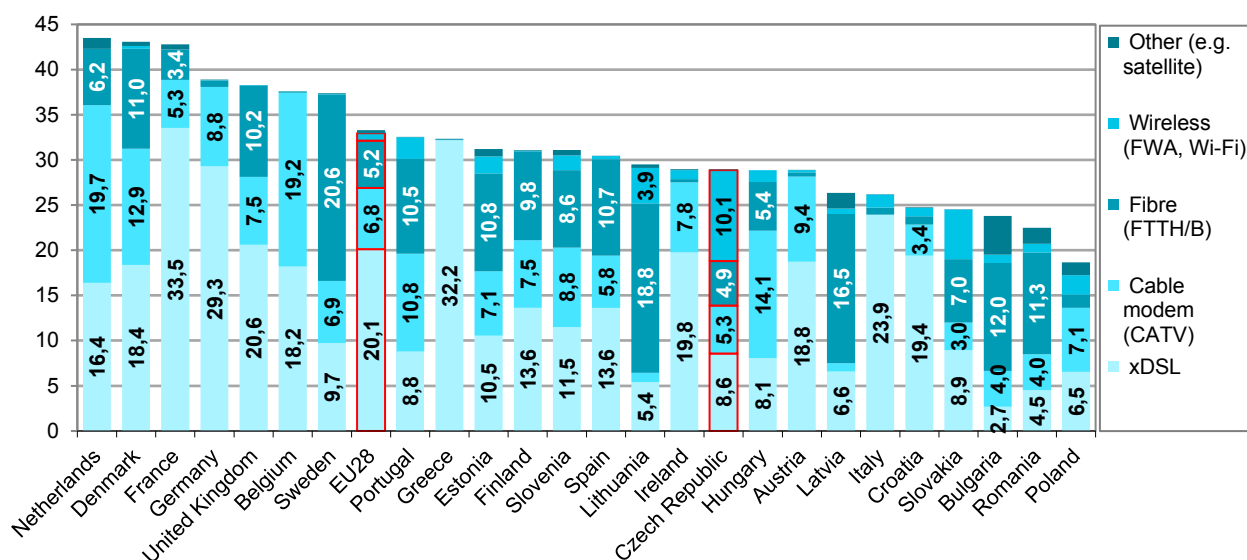
- On a long-term basis, the most popular fixed internet subscription in the Czech Republic is by means of above described **fixed terrestrial wireless access using Wi-Fi technology**. The share of this technology, with respect to the total number of subscribers (connectors/connections), to “fixed” internet is



around one third¹⁴. In 2016, this technology connected 1.07 million subscribers to the internet, with the majority being individual/consumer subscriptions (85% precisely) compare to 15% of business subscriptions. At the end of 2016, however, only a quarter of internet connections, by means of Wi-Fi networks, offered the maximum (advertised) speed of 30 Mb/s and higher.

- The share of **xDSL** technology in fixed high-speed internet has been gradually decreasing. In spite of this, it is the second most common means of fixed internet connection used in the Czech Republic, with its 904 thousand subscribers at the end of 2016, 72% of whom were individuals¹⁵.
- Internet connection via telephone cables by means of xDSL technology represents the most popular means of fixed internet connection in half of EU countries. It is represented significantly in Greece, France, Italy, and Germany. In the Czech Republic, the share of this technology in fixed internet, decreased from 44% in 2006 – at that time it was the most frequent means of internet access – to 30% in 2016.
- Up until the year 2014, the majority of these connections in our country was realised via **ADSL lines**; since 2015, the more modern **VDSL lines** prevail. In 2016, there were 54 thousand active VDSL connections in the Czech Republic as opposed to 350 thousand realised by means of ADSL.

Figure A15 Fixed broadband subscriptions per 100 inhabitants in EU countries by technology; 2016



Source: CZSO calculations based on International Telecommunication Union data, 2018

- Internet access via **cable** (CATV) has recorded a slight increase in the Czech Republic. At the end of 2016 this means of internet access was used by 563 thousand subscribers; 95% of which were **individuals**. Out of **EU countries**, this technology is the most frequently used one in Belgium, the Netherlands, and Hungary where it represents nearly a 50% share of retail market of fixed internet access. Furthermore, Belgium and the Netherlands came close to 20 subscribers per 100 inhabitants in 2016.
- Within the individual technologies of fixed internet access, since 2009 the connection via **fibre broadband (FTTH/B)**¹⁶ has recorded the greatest increase (fivefold) on the Czech market. At the end of 2016, this means of connection was used by 523 thousand subscribers, 91% of whom were

¹⁴ Thanks to this technology, which is used as an alternative to other (traditional) means of internet connections (xDSL, connection via cable TV mains, etc.), the Czech Republic keeps a specific position among the EU countries on the market of fixed internet infrastructure. A significant factor in the use of high-speed services via Wi-Fi networks is, above all, a lower price while maintaining sufficient user quality of these services as well as their availability practically throughout the whole territory of the Czech Republic.

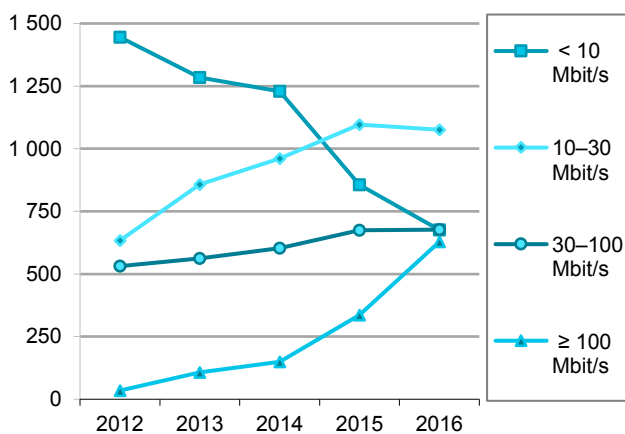
¹⁵ In the past, this situation was primarily caused by the price, offered quality, and generally worse availability of ADSL technology in the Czech Republic as opposed to the majority of EU countries where ADSL technology most frequently belonged among the first affordable quality technology used for high-speed internet access.

¹⁶ Fibre broadband refers to subscriptions using FTTH or FTTB where fibre reaches the subscriber's premises or terminates no more than 2 metres from an external wall. Excludes fibre-to-the-node/cabinet.

individuals. However, the development of FTTx access in the Czech Republic is still being realised mainly by local providers. **In international comparison**, optical networks are the most commonly used means of connection in the following EU countries – calculated by the number of subscribers per 100 inhabitants – Sweden, Latvia, and Lithuania.

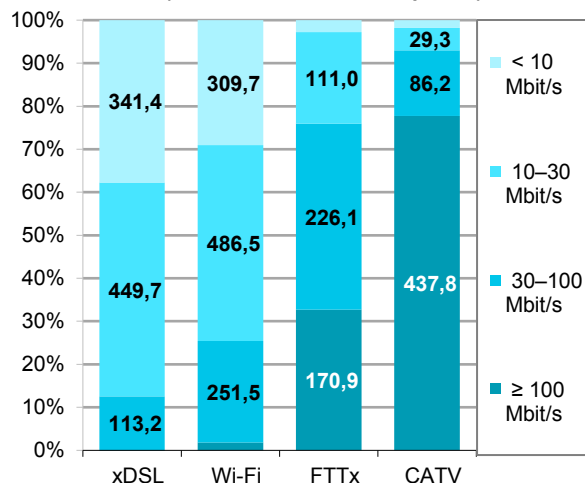
- Deploying fibre closer to the home has been an on-going process in most EU countries for many years. More recently, network operators have started to evaluate whether to bring fibre directly to a premise or to a nearby point and use existing or upgraded DSL and cable infrastructure. However, the majority of fixed broadband connections are in EU countries currently provided still mainly over DSL and cable modem technologies.
- Adequate network access speed¹⁷ is essential to fully exploit existing services over the internet and to foster the diffusion of new ones. Czech broadband network is becoming increasingly faster. At the end of 2016, over 44% of subscribers in the Czech Republic accessed the internet via fixed network, by means of technology with **advertised speed over 30 Mb/s**, which is a significant increase compared to 21% in 2012. In the year 2016, 680 thousand citizens and enterprises (subscribers) could use the internet access within the fixed network, enabling the speed of 100 Mbit data per second, compared to 40 thousand in 2012.

Figure A16 Fixed broadband internet in the Czech Republic by speed (thous. of subscriptions)



Source: Czech Telecommunication Office, 2018

Figure A17 Fixed broadband internet connection in the Czech Republic by speed and used technology; 2016 (% and thous. of subscriptions)



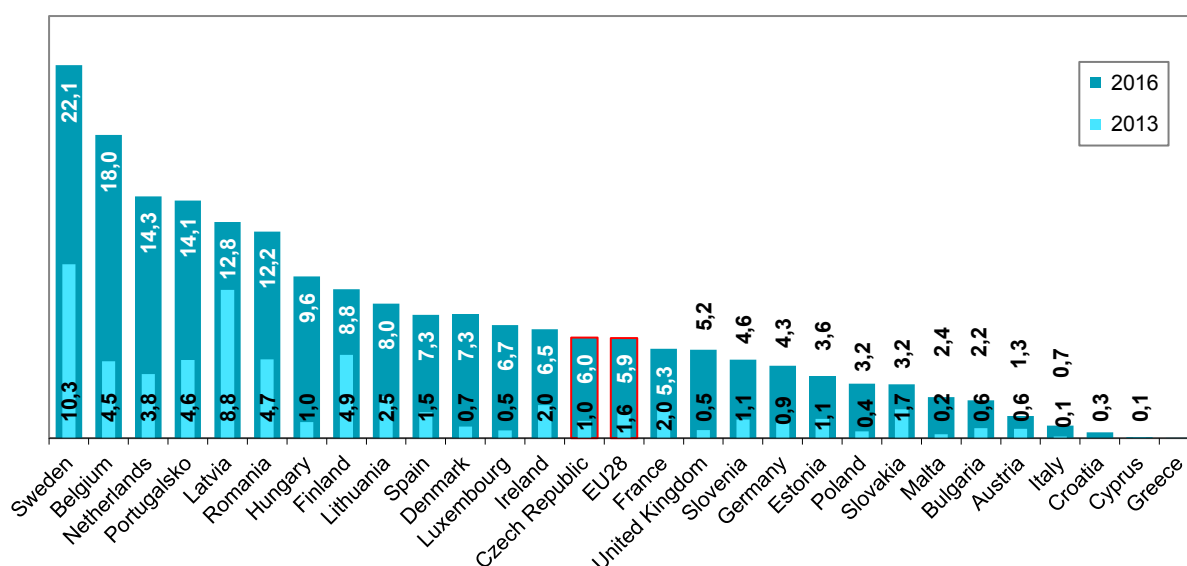
Source: Czech Telecommunication Office, 2018

¹⁷ Internet speed is measured by the amount of data that can pass through the connection in a given amount of time. The most fundamental unit of digital data is the “bit” – which comprises a 0 or 1 in binary code. 1 000 bits is a kilobit, 1 000 kilobits is a megabit, and 1 000 megabits is a gigabit. Network speed is expressed in terms of how many of these are flowing through the connection each second to give – kilobits per second (Kbps), megabits per second (Mbps), and gigabits per second (Gbps). These data focus on download speed (i.e. the speed of data flowing from the internet to the user’s device); nevertheless, the speed at which data moves in the opposite direction (upload speed) is also an important aspect of overall connection quality (as well as reliability). Measurement of broadband performance is affected by the potential gap between advertised and “actual” speeds delivered to customers.



- Distribution of fixed broadband subscriptions across speed tiers varies significantly across countries, due to a variety of factors (e.g. level of competition, population density in the market addressed, availability of back-haul, type of technology most widespread, etc.).
- When comparing the number of subscribers to fixed high-speed internet **with advertised speed of at least 100 Mb/s** per 100 inhabitants in EU countries between the years 2013 and 2016, a great increase in values is evident – whereas in 2013 the EU average amounted to 1.6 subscribers per 100 inhabitants, in 2016 the number was already 5.9 subscribers (i.e. a fourfold increase). Since 2015, the Czech Republic has recorded a significant increase in values; by the end of 2016 it exceeded the EU average with its 6 subscribers per 100 inhabitants. The best values have been recorded in Sweden, where there are 22.1 fixed broadband subscribers per 100 inhabitants with advertised speed of at least 100 Mb/s.

Figure A18 Fixed broadband subscriptions with advertised maximum download speed 100 Mbit/s and more per 100 inhabitants in EU countries



Source: CZSO calculations based on European Commission data, 2018

Mobile broadband penetration – Subscriptions by type of mobile connection

The function of the mobile phone has changed significantly. Up until a few years ago, the telephone was primarily used as a device for making telephone calls and sending/receiving text messages. Since the appearance of the smartphone many people use the telephone primarily for accessing the internet. As a result, mobile connections are now processing far more data traffic.

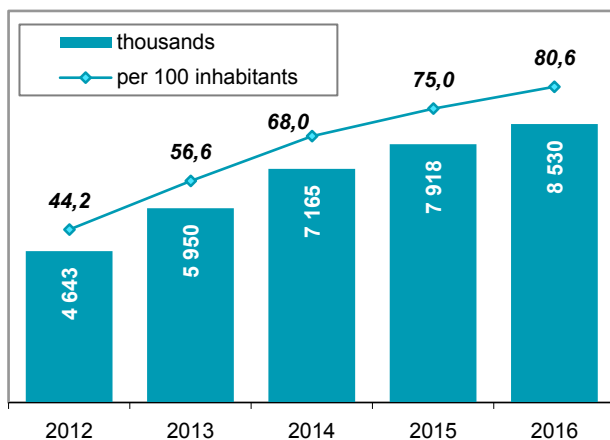
According to ITU, at the end of 2017, there were, throughout the world, approximately four times more active mobile broadband subscriptions than fixed broadband subscriptions. Growth in mobile broadband subscriptions has far outstripped fixed broadband growth since 2010, with worldwide subscriptions increasing from 825 million in 2010 to 4.6 billion in 2017 and representing 82% of all broadband access paths in the world, making mobile broadband the most dynamic broadband market.

Mobile operators in the Czech Republic offered three basic types of internet access services i) “Internet on a Mobile Telephone” (used in mobile phones and smart phones), ii) “Mobile Internet”, which is intended for portable devices (tablets, notebooks) with the use of a separate data SIM card, iii) and also services of high-speed internet access at a fixed location which are provided via SIM cards in mobile networks.

- The most frequent means of high-speed internet connection, in the Czech Republic, is nowadays via mobile networks – mobile broadband. At the end of 2016, there were recorded 8.5 million SIM or data cards serving for high-speed **mobile internet access** – in 2012 it was 4.6 million. As opposed to this, in 2016 the aforementioned 3 million subscriptions were used for fixed broadband connection.
- Up until the year 2011, the access to **mobile internet** in the Czech Republic was mainly realised as **temporary “ad-hoc” access** within the standard voice and data services. Since 2012, the prevailing

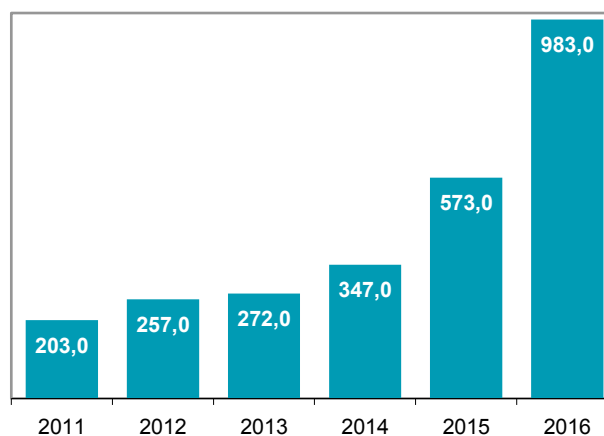
access provided within monthly tariffs has been the **permanent access**. In 2016 this option was used by 6.6 million subscribers as opposed to 1.9 million those using the ad-hoc access.

Figure A19 Mobile broadband subscriptions in the Czech Republic



Source: Czech Telecommunication Office, 2018

Figure A20 Average mobile data consumption per one active SIM card in the Czech Republic (in MB)

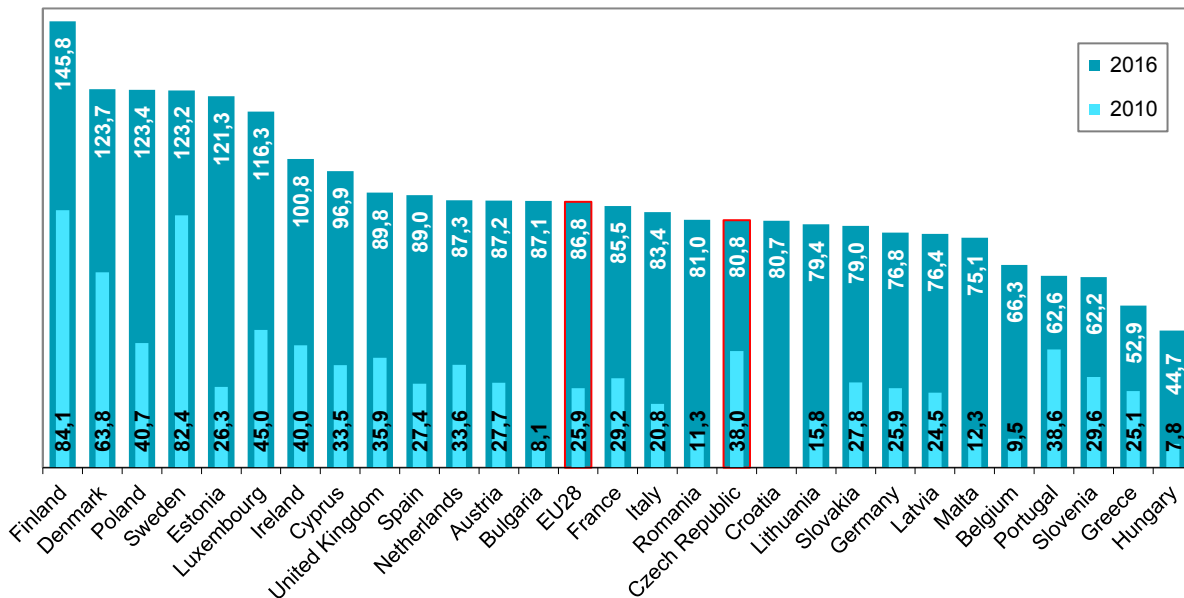


Source: Czech Telecommunication Office, 2018

- Mobile broadband is often combined with a mobile telephony subscription. Such “**standard**” **mobile subscriptions** (data and voice) are very well suited for smartphones. In 2016 it was used by 7.5 million subscribers in the Czech Republic of which 6.6 million were using permanent access. The number of subscribers (SIM cards) using internet in their mobile phones is growing gradually in the Czech Republic. This growth – by 250 per cent since 2010 – is attributable mainly to the expansion of LTE networks in the recent period as well as to the emergence of more attractive mobile data plans which took place (in particular within offers of network operators) recently.
- In addition, there are **dedicated mobile data connections**: mobile broadband (data only) subscriptions that do not comprise mobile telephony. These connections are well suited for *Mobile Internet*, for example on a laptop or tablet. In 2016, 11 percent (976 thousand) of the mobile broadband connections in the Czech Republic were a dedicated mobile data subscription using a stand-alone service and USB data cards/keys/modems integrated usually into portable computers or tablets.
- A growing trend can be observed in the number of dedicated data subscribers using the services of *Mobile Internet*. In comparison with the service of Internet on a Mobile Phone, however, a year-on-year growth is slower – from 542 thousand subscriptions in 2010 to above mentioned 976 thousand in 2016 (by 180 per cent).
- In most EU countries, mobile connectivity is undergoing major advancements through the deployment of Long Term Evolution (LTE) networks. Mobile broadband providers are advertising download speeds at levels increasingly closer to those of some fixed broadband offers. As a consequence, mobile connections are now processing far more data traffic.
- In the Czech Republic in 2016, the average mobile data traffic per one active SIM card was 983 megabytes compare to 203 megabytes five years ago. However, the volume of mobile data is still only a fraction of the volume that is routed exclusively across fixed connections. The mobile internet figures do not include data traffic routed via Wi-Fi. After all, Wi-Fi does not make use of the network for mobile data traffic.
- Relative to population, mobile broadband take-up appears to be much higher than for fixed broadband. In 2016, there were 80.6 mobile broadband connections (subscriptions) per 100 inhabitants in the Czech Republic, whereas the EU average in the same year was 86.8 subscriptions. In Finland this number was 146. This is the highest number among EU countries. Estonia, Denmark and Sweden also have a high mobile broadband penetration rates.
- In all countries, a majority of subscriptions are packages including both calls and data but data-only subscriptions have considerable market share in Finland and Estonia. Even if data for mobile broadband subscriptions have improved greatly in recent years, especially with regard to measurement of data only

and data and voice mobile data subscriptions, the international comparability of mobile communications statistics is still limited by the fact that not all countries are able to comply fully with the same definitions.

Figure A21 Mobile broadband subscriptions per 100 inhabitants in EU countries



Source: CZSO calculations based on European Commission data, 2018

- SIM cards for machine-to-machine (M2M) usage account for a growing segment of mobile data subscriptions. These are dedicated exclusively to communication between equipment at a distance and are not intended for interpersonal communications. Some of the functionality of M2M communications is built into navigation services for automobiles, access to the internet and emergency communications, among others. These devices connect millions of sensors and actuators, providing ever-greater amounts of “big data” to facilitate the monitoring of machines, environments and people’s health. However, there is not yet an official methodology to define the limits of M2M SIM cards. National telecom regulators in some EU countries have begun to release M2M SIM cards figures along with mobile and wireless broadband subscriptions. However, M2M use may still be mixed in with other subscriptions.