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Forecast of VHCN network coverage in the Czech Republic in relation to the roll-out of 5G networks

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Contents

List of key abbreviations

4G	4th generation mobile communications IMT
5G	5th generation of IMT mobile communications
5G-NSA	5G Non-standalone – non-standalone mode
5G-SA	5G standalone – standalone mode
ADSL	Asymmetric Digital Subscriber Line
AP	Access Point
BEREC	Body of European Regulators for Electronic Communications – Association of European Regulators for Electronic Communications
ČTÚ	Czech Telecommunications Office
DOCSIS	Data Over Cable Service Interface Specification – an international standard enabling data transmission over cable television networks (coaxial cables).
EECC	European Electronic Communications Code
eMBB	Enhanced Mobile Broadband – enhanced broadband and high-speed communication
DESI	Digital Economy and Society Index – an index of the digital economy and society, tracking Europe’s overall digital performance and the progress of EU countries in terms of their digital competitiveness
EU	European Union
FTTH	Fibre To The Home – fibre-optic connection to the home
FTTP	Fibre To The Premises – fibre to the building (which may be either a residential or commercial building)
FTTx	x denotes the specific point to which the optical fibre is connected. This designation is used for various connection types depending on how far the optical fibre extends.
FWA	Fixed Wireless Access – fixed wireless access
GIA	Gigabit Infrastructure Act, Regulation (EU) 2024/1309 of the European Parliament and of the Council of 29 April 2024 on measures to reduce the costs of deploying gigabit electronic communications networks, amending Regulation (EU) 2015/2120 and repealing Directive 2014/61/EU (the Gigabit Infrastructure)
IoT	Internet of Things
ITU	International Telecommunication Union
MIMO	Massive Multiple-Input Multiple-Output, a technology used in modern wireless communication systems (particularly in 5G networks). MIMO enables simultaneous communication between multiple devices via multiple antennas, which significantly increases network capacity and performance. "Massive" refers to the deployment of a large number of antennas.
NGA	Next Generation Access – next-generation access networks
NPO	National Recovery Plan
PIK	Operational Programme Enterprise and Innovation for Competitiveness
PPP	Public-Private Partnership
TAK	Operational Programme: Technologies and Applications for Competitiveness
VDSL	Very High Speed DSL
VHCN	Very High Capacity Networks – very high capacity networks

Executive Summary

In the Czech Republic, the development of very high capacity networks (VHCN), which primarily comprise optical networks, has accelerated thanks to a combination of private and public investment. Coverage by optical networks, which enable speeds of up to 1 Gbps, currently stands at around 53% of households, which is, however, significantly below the EU average of 78.8%. The European Union has set several ambitious targets as part of the 'Digital Decade' by 2030. In addition to VHCN coverage for all households (via fibre-optic or equivalent technologies), the main targets include the roll-out of fully developed 5G networks in all urbanised areas. In this respect, however, the Czech Republic is well above the EU average.

More significant progress in the roll-out of VHCN networks is evident in cities, whilst rural areas are lagging behind. The Czech Republic faces many challenges, including geographical diversity, which makes it difficult to install fibre-optic networks in remote areas, and the relatively high costs of expanding these technologies. Furthermore, problems with fragmented infrastructure and difficult coordination between different market players remain.

When estimating the development of VHCN network coverage, we work with a short-term/medium-term three-year horizon and a long-term six-year horizon. In the first case, this covers the period from the end of 2024 to 2027, when the timeframe of the National VHCN Network Development Plan ends. The longer-term horizon is extended by a three-year period to 2030, in line with the objectives of the European strategic document, the Digital Agenda.

In the medium term, up to the end of 2027, higher growth rates can be expected than in the subsequent period. The growth in the number of VHCN connections in the Czech Republic up to 2027 will be driven primarily by the development of FTTP optical connections, which will remain the dominant technology thanks to support from the private sector and public subsidy programmes. Growth in the number of FTTP connections during this period will initially hover around 8%, later falling to 6%. DOCSIS 3.1 and, later, DOCSIS 4.0 technology will complement fibre in urban areas with existing cable networks, whilst FWA may offer a solution in sparsely populated regions. According to the BEREC definition and after taking into account connections built through subsidy schemes, household coverage should reach approximately 69.5% of households by the end of 2027. In this case, growth is expected to be higher (partly due to the inclusion of FWA connections qualifying as VHCN, particularly in rural areas) than under organic growth, initially amounting to approximately 5 %, and 4% thereafter.

For the period 2028–2030, we can also expect further growth in VHCN network coverage of households, based on current trends, technological developments and planned investments, particularly in fibre-optic networks and, to a very limited extent, in the modernisation of cable networks. At the same time, there is significant potential to cover these areas – the most financially demanding (highest investment costs per household) – using wireless broadband technologies such as FWA or others, such as modern satellite solutions. However, it is expected that the pace of growth will not be as rapid as in the previous period of 2024–2027. The growth rate of VHCN gigabit network coverage for households in the 2028–2030 period will be slower than in 2024–2027, for the following reasons:

- Slowing investment rates due to the nature of the location: Most urban areas where it is economically viable to build gigabit networks will already be covered by 2027. Further growth will mainly concern rural and other areas that are less profitable from an investment perspective, where construction is more challenging and costly.

- Support through grant schemes: Although public subsidy programmes (e.g. from European funds) will continue to support deployment in remote areas, deployment in these areas is more time-consuming and, as summarised in previous MIT reports, there are locations where even a 100% subsidy will not be sufficient to ensure that service revenues cover at least the operating costs.

We anticipate that by the end of 2030, organic growth (excluding subsidy schemes) will achieve approximately 75% coverage of households by VHCN networks and approximately 77% coverage when VHCN connections built using subsidy schemes are included. The average annual increase in household coverage during this period is expected to be between 2–3%.

Management summary

1 Introduction

Very high-capacity networks (VHCN) represent the cornerstone of modern digital infrastructure, enabling the fast and reliable data transfers necessary for advanced technological applications and services. In the Czech Republic, the development of VHCN is becoming a key priority for strengthening competitiveness, supporting innovation and improving the quality of life for residents. Alongside the growing need for high-capacity connectivity, 5G technologies are also developing, offering sufficient speed and flexibility for data transmission, thereby contributing significantly to the building of a robust digital economy. The development of 5G networks, which has been underway for several years, promises a significant improvement in coverage and connection capacity, thereby bringing new opportunities for industry, public services and consumers.

VHCN networks have the potential to positively influence the Czech Republic's economic growth and contribute to increasing the competitiveness and sustainability of Czech businesses. High-quality and reliable electronic communications networks are also essential for managing emergencies and crises, whether local, regional or national.

Predicting the development of VHCN (and consequently 5G) network coverage in the coming years is a complex task involving technical, economic and regulatory factors. With the gradual expansion of 5G network coverage and the integration of these technologies with VHCN, it will be possible to achieve a high level of connectivity that will support digital transformation across sectors and contribute to sustainable economic growth.

The necessary prerequisites for the development and facilitation of investment in the construction of VHCN were defined in the 2021 National Plan for the Development of Very High Capacity Networks. This strategy, which is valid until the end of 2027, sets out the Czech Republic's approach to the construction of these networks and further defines the state's role in achieving VHCN coverage, particularly with regard to securing support from public funds.

This study first defines the term VHCN in legislative and strategic documents, both at national and European level. These include, in particular, the European Electronic Communications Code, the Electronic Communications Act, and the BEREC (Body of European Regulators for Electronic Communications) guidelines for VHCN networks. The section on terminology is followed by a short chapter on the potential of 5G and FWA technologies as VHCN networks, their advantages and limitations. Indeed, the development of 5G and FWA networks has been tracked for several years by the CTU's visualisation portal, from which we present maps of VHCN network coverage as at 31 December 2023, as well as a breakdown by speed. At the same time, a separate study, prepared as part of the National Recovery Plan, is also dedicated to the topic of 5G and FWA.

The following two chapters define the strategic objectives for VHCN development. At EU level, the Digital Decade 2030 initiative is particularly key, as it defines the strategic objectives for building a digital (including gigabit) society by the end of that year. Thanks to the DESI indicators, it is possible to effectively monitor the Czech Republic's progress in relation to other Member States and the EU average. At the Czech Republic level, the National Plan for the Development of VHCN Networks is key in this area; it builds on the policy documents National Recovery Plan and Digital Czech Republic and is closely linked to EU grant programmes. A separate study for the Ministry of Industry and Trade (MPO) addresses the definition of the investment gap in VHCN network construction in relation to the development of 5G networks.

The study also contains a description of the key factors influencing investors' decisions to build VHCN networks, including competitive conditions. These factors, as well as risks and uncertainties, are taken into account in the final chapter, which provides a forecast of VHCN network coverage for Czech households. This forecast is linked to the objectives and methodology of the Digital Decade 2030 and to the BEREC methodology. In accordance with the terms of reference, the forecast is divided into a medium-term and a longer-term outlook. The short-term forecast covers the years 2024 to 2027, when the timeframe of the current national VHCN development plan ends. The longer-term forecast extends to 2030, which defines the timeframe of the Digital Decade. As the presented forecast indicates, the ambitious target of achieving 95% coverage of households by VHCN networks will most likely not be met.

2 Definition of VHCN in EU and Czech legislation and strategic documents

2.1 Definition and parameters

To properly understand the issue of VHCN networks, it is important to define them, as this definition underpins not only the regulatory approach but also the direction of support, monitoring and reporting activities. Key documents in this regard are the European Electronic Communications Code, its transposition into Czech legislation in the form of the Electronic Communications Act, and the updated BEREC guidelines on criteria for VHCN networks.

2.1.1 European Electronic Communications Code (EECC)

The term 'very high capacity networks' (VHCN) is defined in the European Electronic Communications Code (EECC), which is enshrined in Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018. Specifically, the term VHCN is defined in Article 2, paragraph 2, point 2:

'Very high capacity network' means either an electronic communications network that consists entirely of optical elements at least up to the distribution point at the service location, or an electronic communications network that is capable, under normal conditions at peak times, of achieving similar performance in terms of available downlink and uplink bandwidth, resilience, parameters relating to error rates and latency, and its fluctuations. Network performance may be considered similar regardless of whether the end-user's perception differs due to different characteristics arising from the nature of the medium through which the network is ultimately connected to the network termination point.

The following Article 3 of the EECC specifies general objectives, foremost among which is 'to promote the connection and access of all citizens and businesses in the Union to very high-capacity networks, including fixed, mobile and wireless networks, and their use'.

The concept of VHCN is also part of a number of other provisions of the EECC, such as:

- The conditions under which national regulatory authorities shall not impose certain obligations on undertakings operating exclusively on the wholesale market depend on access to very high capacity networks (Article 61(3) in conjunction with Article 80);
- Geographical mapping of network deployment may also include a forecast regarding the coverage of very high capacity networks (Article 22(1));

2.1.2 The Electronic Communications Act

The EECC was transposed into Czech law by Act No. 127/2005 Coll. on Electronic Communications and on Amendments to Certain Related Acts (the Electronic Communications Act), as amended. A specific definition of VHCNs is contained in Section 2(g), which differs from the above-mentioned definition in the EECC only in formal details:

> An electronic communications network consisting entirely of optical elements at least up to the distribution point at the service location, or an electronic communications network capable, under normal conditions at peak times, of achieving similar performance in terms of available transmission speeds for downloading and uploading data, resilience, parameters relating to error rates and latency, and their fluctuations; network performance may be considered similar regardless of whether the end-user's perception differs due to different characteristics resulting from the nature of the medium through which the network is ultimately connected to the network termination point.

In addition to the definition of VHCNs, other provisions of the EECC relating to these networks have also been transposed into the Electronic Communications Act. This includes regulation (including price regulation), the geographical mapping of VHCN coverage, and the publication of information.

2.1.3 BEREC Guidelines on Very High Capacity Networks

In parallel with the EECC, Regulation (EU) 2018/1971 of the European Parliament and of the Council of 11 December 2018 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Agency supporting BEREC (BEREC Office), amending Regulation (EU) 2015/2120 and repealing Regulation (EC) No 1211/2009. Pursuant to Article 82 of the EECC, BEREC has drawn up guidelines for national regulatory authorities on VHCNs 'concerning the criteria a network must meet to be considered a very high capacity network, in particular as regards available downlink and uplink bandwidth, resilience, parameters relating to bit error rate and latency, and their variation'.[1] These guidelines are intended to contribute to the harmonisation of the definition of 'very high capacity network' across the EU.

The four criteria, which BEREC developed in 2020 and updated in 2023[2] in light of developments in the roll-out of 5G networks, are based on the EECC definition (criteria 1 and 2) and utilise data obtained from network operators (criteria 3 and 4).

Criterion 1	Any network providing a fixed connection with optical fibre deployed at least as far as a multi-dwelling building.
Criterion 2	Any network providing a wireless connection with optical fibre extended at least as far as the base station.
Criterion 3	Any network providing a fixed connection that is capable, under normal conditions during peak hours, of providing end-users with services of the following quality of service (performance thresholds 1): **a) Data transfer rate (downlink) ≥ 1000 Mb/s** b) Data transfer rate (uplink) ≥ 200 Mb/s c) IP packet loss rate (Y.1540) ≤ 0.05% d) IP packet loss rate (Y.1540) ≤ 0.0025% e) Bidirectional IP packet delay (RFC 2681) ≤ 10 ms f) IP packet delay variation (RFC 3393) ≤ 2 ms g) IP service availability (Y.1540) ≥ 99.9% per year
Criterion 4	Any network providing wireless connectivity that is capable, under normal conditions during peak traffic periods, of providing end-users with services of the following quality of service (performance thresholds 2): a) **Data transfer rate (downlink) ≥ 350 Mb/s** b) Data transfer rate (uplink) ≥ 50 Mb/s c) IP packet loss rate (Y.1540) ≤ 0.01% d) IP packet loss rate (Y.1540) ≤ 0.01% e) Bidirectional IP packet delay (RFC 2681) ≤ 18 ms f) IP packet delay variation (RFC 3393) ≤ 5 ms g) IP service availability (Y.1540) ≥ 99.9% per year

By definition, both fixed and wireless networks must be considered as VHCN networks (i.e. wireless networks cannot be excluded). If a network is not fully optical to the service point, it is always necessary to assess both connection speeds and other quality criteria in accordance with the aforementioned document in order to classify it as a VHCN. BEREC has defined two criteria for fixed networks and two criteria for wireless networks; meeting at least one of these criteria qualifies such networks for the VHCN category.

Also important are the BEREC guidelines on geographical mapping of network deployment from 2020[3] and the related procedural guidelines from 2021[4] and the guidelines on verifying the information obtained from the same year[5] . In accordance with the EECC, these guidelines are intended to contribute to the uniform application of geographical mapping and forecasts.

[1]https://www.berec.europa.eu/sites/default/files/files/document_register_store/2020/10/BoR_%2820%29_165_BEREC_Guidelines_VHCN.pdf

[2]https://www.berec.europa.eu/system/files/2023-10/BoR%20%2823%29%20164%20FNE%20WG_Draft%20BEREC%20Guidelines%20on%20VHCNs.pdf

[3]https://www.berec.europa.eu/sites/default/files/files/document_register_store/2020/3/BoR_%2820%29_42_Guidelines_BBgeoSurveys.pdf

[4]https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/3/BoR_%2821%29_32_BEREC_GL_Art22%282%2C3%2C4%29_clean.pdf

[5]https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/6/BoR_%2821%29_82_BEREC_Guidelines_on_Verification_P2_2021_clean.pdf

3 The potential of 5G and FWA networks as VHCN

3.1 5G

The potential of 5G networks in fulfilling the strategic objectives of VHCN in the Czech Republic is considerable in terms of meeting the requirements of documents such as the 5G Action Plan for Europe, the Digital Decade and the national Digital Czech Republic strategy, or the National Plan for the Development of VHCN Networks. This assertion takes on greater significance in the context of the development of fibre-optic networks on the one hand and 5G networks on the other. Whilst in the former case the Czech Republic is still a long way from meeting the objectives of the Digital Decade (or the national Digital Czech Republic strategy), in the case of 5G network roll-out (population coverage) it is, conversely, above the EU average, with the prospect of smoothly achieving the target of 100% household coverage by 2030. 5G networks enable the development of Industry 4.0, including manufacturing automation, robotics and the Internet of Things, which can significantly contribute to increased productivity and the revitalisation of Czech industry.

With their parameters (in 5G-SA mode), 5G networks meet the criteria for VHCN set out in the BEREC guidelines. 5G networks are designed to offer substantially higher transmission speeds with lower latency and higher capacity than previous generations, including 4G/LTE.

- The high transmission speeds of 5G networks can reach the order of gigabits per second, comparable to fibre-optic networks.
- The IP packet loss rate, which indicates the proportion of packets damaged during transmission over the network, is around one such packet in a million for 5G, significantly below the 0.01% level specified in the BEREC guidelines.
- The IP packet loss rate, defined as the proportion of lost packets (those that never reach their destination) out of the total number of packets, regardless of whether they were damaged during transmission or not, typically hovers around 0.01% for 5G networks (for eMBB mobile broadband connections).
- The round-trip delay of IP packets, measured as the time taken for a packet to travel from the sender to the destination and back, is approximately 10–20 ms in 5G networks for eMBB.
- The availability of IP services for 5G networks is high, typically exceeding 99.9%. This level of availability is in line with the requirements for high quality and reliability of services expected from very high-capacity networks, as set out in BEREC guidelines. These figures reflect the robustness and advanced technology implemented in modern 5G networks.

5G-SA (Stand Alone) represents a fully independent 5G network architecture, unlike 5G-NSA (Non-Standalone), which still relies partially on 4G infrastructure. The introduction of 5G-SA enables full utilisation of 5G features, including ultra-low latency, high capacity and massive IoT device connectivity.

VHCN networks are largely based on optical technologies such as FTTH (Fibre to the Home). The roll-out of optical networks is therefore essential to provide the backhaul infrastructure that is critical for 5G. Optical networks are essential for interconnecting base stations and central network nodes. The synergy between these technologies means that the development of optical infrastructure supports faster 5G deployment, whilst the development of 5G in turn positively influences the need for optical network construction.

3.2 FWA

In connection with the development of 5G networks, the potential for Fixed Wireless Access (FWA) technology has also grown, particularly with regard to the construction of VHCN networks. FWA technology, particularly when utilising 5G networks, has the potential to meet the requirements placed on VHCN. In this way, it can offer speeds in the order of several gigabits per second, particularly when using the millimetre wave band.

Table 1: Comparison of broadband internet speeds

Technology		Download speed (average)
DSL	ADSL/ADSL2+	24 Mbit/s
	FTTC/VDSL2	200 Mbit/s

	G.Fast	100 Mbit/s – Gbit/s
Fibre optics	FTTP/H	2.4 – 40 Gbit/s
Cable networks	DOCSIS 3.1	10 Gbit/s
Satellite	LEO (low-earth-orbit) satellite connection	50–500 Mbit/s
FWA	LTE (4G)	Up to 100 Mbit/s
	5G	**1–10 Gbit/s**

Source: 5G fixed wireless. A renewed playbook (GSMA Intelligence, 2021)

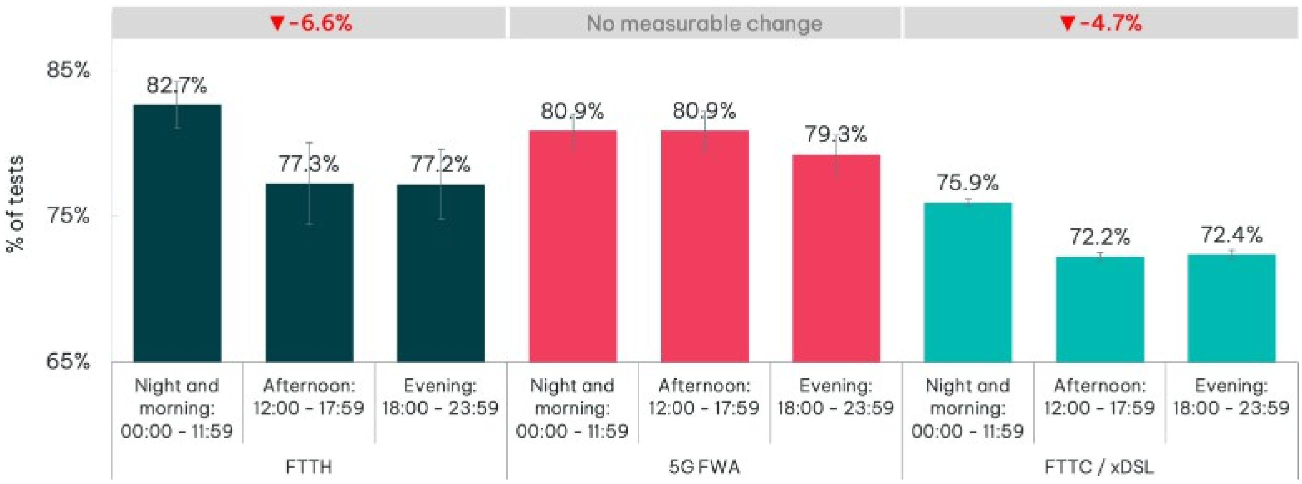
FWA can therefore be a suitable solution for connectivity in areas where laying fibre optic cables is costly or impractical. The initial deployment costs are lower than for fibre optics. To date, FWA technology has found limited application within 4G and LTE networks, particularly in rural areas that lack fixed broadband connectivity or where only lower speeds are available. As shown in the table above, 5G offers ten times faster speeds for FWA, significantly increasing its appeal. Advances in massive MIMO and beamforming technology, combined with the use of higher frequency bands, contribute to the provision of reliable, high-capacity connectivity.

This technology has support at European level. Representatives of the European Commission, telecommunications associations and other stakeholders have repeatedly highlighted the benefits of deploying 5G FWA in helping to achieve connectivity targets. For example, at the Forum Europe event titled "Releasing the Potential of FWA in Europe", aimed at regulatory authorities, Franco Accordino, Head of the EC's High-Capacity Networks Investment Unit, stated unequivocally:

"The combination of FWA with 5G technology has the potential to contribute significantly to achieving Europe's connectivity targets set for the end of the decade. If properly designed and deployed, it can certainly support the gigabit targets we have set."[6]

An example of this is the situation in Italy, where the transition from 4G to 5G in the case of FWA led to a significant increase in both speed and service quality for end-users.[7] It may, however, come as something of a surprise that, unlike other technologies, 5G FWA maintains consistent connection quality throughout the day, including during peak times. This implies that the upgraded 5G FWA infrastructure is capable of accommodating significantly more users before any observable deterioration in connection quality occurs.

Figure 1: Measurements of degradation in FWA, FTTH and FTTC/xDSL connection quality at different times of day in Italy



Source: Opensignal

In the relevant measurement, carried out over a ninety-day period between 8 December 2023 and 6 March 2024, approximately 80% of tests showed no deterioration in quality for 5G FWA. In contrast, FTTH and FTTC/xDSL technologies showed a decline in quality

[6] https://www.eureporter.co/business/digital-society/2022/05/19/eu-and-national-regulators-to-scale-up-investment-in-5g-fwa-to-achieve-ecs-5g-mbb-universal-coverage-targets-and-support-ec-green-and-digitalization-agenda/

[7] https://www.opensignal.com/2024/05/16/5g-fwa-is-a-game-changer-for-broadband-services-in-italy

service availability for users in the evening, which stood at 6.6% for FTTH and nearly 5% for FTTC/xDSL.[8] In terms of speeds, at 56.6 Mbit/s, 5G FWA technology did not reach the levels of FTTH, but it slightly exceeded (with an average of 56.3 Mbit/s) the speeds measured for FTTC/xDSL for downloads, and significantly so for uploads. The table below compares the download and upload speeds of individual Italian 5G FWA providers with the average speeds of xDSL/FTTC and FTTH technologies. Italy's high-speed connectivity strategy towards a gigabit society has set an ambitious target of offering download speeds of 1 Gbit/s and upload speeds of up to 200 Mbit/s to one-third of households by the end of 2026.

In its latest study, Ericsson assesses the significant potential of 5G FWA to complement fibre networks in providing high-speed connectivity to households.[9] This was based on research conducted on a sample of 23,700 households in 19 countries (with varying degrees of FWA development) worldwide, including the Czech Republic. The study shows (among other things) that 5G FWA has the potential to become the preferred method of connectivity. Among 5G FWA users, the number of those who have adopted this technology as their primary means of internet access is growing. Whilst two years ago (2022) this figure stood at 46%, this year it has already reached 69%. 5G FWA does not replace a specific type of connectivity, but rather replaces and complements all types of connectivity prevalent in the relevant markets. As with other types of connectivity, speed, reliability and price were key factors in the decision-making process for households that have acquired FWA connectivity. However, the most significant advantage of FWA over other technologies for households that have or plan to acquire FWA is user convenience.

For the future development of FWA, this study identifies six types of users who could drive significant growth in the technology and business opportunities for operators. These characteristics are as follows:

- **Price considerations:** Generally, these are mainly households of older people or those located in urban or suburban areas.
- **Mobile 'champions'**: This refers to households that prefer to obtain all their services from a single provider. These households are most often nuclear families with younger members, as well as households in smaller towns.
- **Enhanced connectivity**: Households that require reliable and stable connectivity and high speeds. Reliability is cited as the most important need by households in rural areas and those living in rented accommodation.
- **Increased capacity:** Globally, these are mostly multi-generational families who require higher speeds and capacity due to household members using the internet for various purposes, either simultaneously or individually.
- **Service package preferences**: As with 'mobile champions', this primarily concerns nuclear families, but also single-person households. Geographically, this mainly applies to households in large urban centres.
- **User convenience requirements:** As mentioned above, user convenience and flexibility are considered the most significant advantages of FWA. This applies across all types of households, from single-person households to multi-generational families.

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[8] The consistent quality indicator used in this study measures how often user experiences were sufficient to support common application requirements. Consistent broadband quality utilises six key performance indicators, including download and upload speeds, latency, jitter (variation in transmission quality), packet loss and time to first byte. The indicators are presented as the percentage of user tests that met the minimum recommended performance thresholds for watching HD-quality video, completing group video conference calls and playing games. Consistent quality is measured for all users at all times of the day.

[9] https://www.ericsson.com/en/reports-and-papers/consumerlab/reports/fixed-wireless-access-for-household

3.3 Comparison of the costs and benefits of fibre networks, 5G/FWA

The following table summarises the advantages and disadvantages of optical networks versus 5G/FWA.

Table 2: Overview of the advantages and disadvantages of fibre-optic, 5G and FWA technologies

	Fibre optics (FTTx)	5G/FWA
Advantages	• High-speed connectivity (clearly the best performance for bandwidth-intensive applications such as streaming, gaming and video conferencing) • Reliability (less susceptibility to interference and signal degradation) • Future-proof solution (FTTx infrastructure is designed to support future technological advancements)	• Flexibility (deployment and implementation; a suitable choice for rural and remote areas where laying cables is difficult) • Cost-effectiveness (no need for costly infrastructure) • Rapid deployment (enables service providers to offer internet connectivity in a much shorter timeframe)
Disadvantages (limitations)	• High acquisition costs (requires significant investment in infrastructure) • Limited availability (minimal coverage in rural regions)	• Signal interference: affected by natural factors such as weather, physical obstacles or electromagnetic interference • Lower bandwidth (affecting data-intensive applications)

Speed and performance parameters: In this case, fibre-optic solutions have clear advantages, offering much higher speeds.

Coverage and availability: FWA is well-suited to covering rural and other previously unserved areas. In contrast, FTTx is primarily widespread in densely populated areas where its deployment is cost-effective.

Cost considerations: FWA is much less costly in terms of deployment and maintenance, making this technology attractive to users who are primarily price-conscious. In contrast, fibre-optic technology provides long-term value due to its high performance and reliability, which offset the initial high capital costs.

Environmental impact: FWA has a much lower environmental impact as it has minimal infrastructure requirements. In contrast, FTTx involves extensive construction work with high material consumption.

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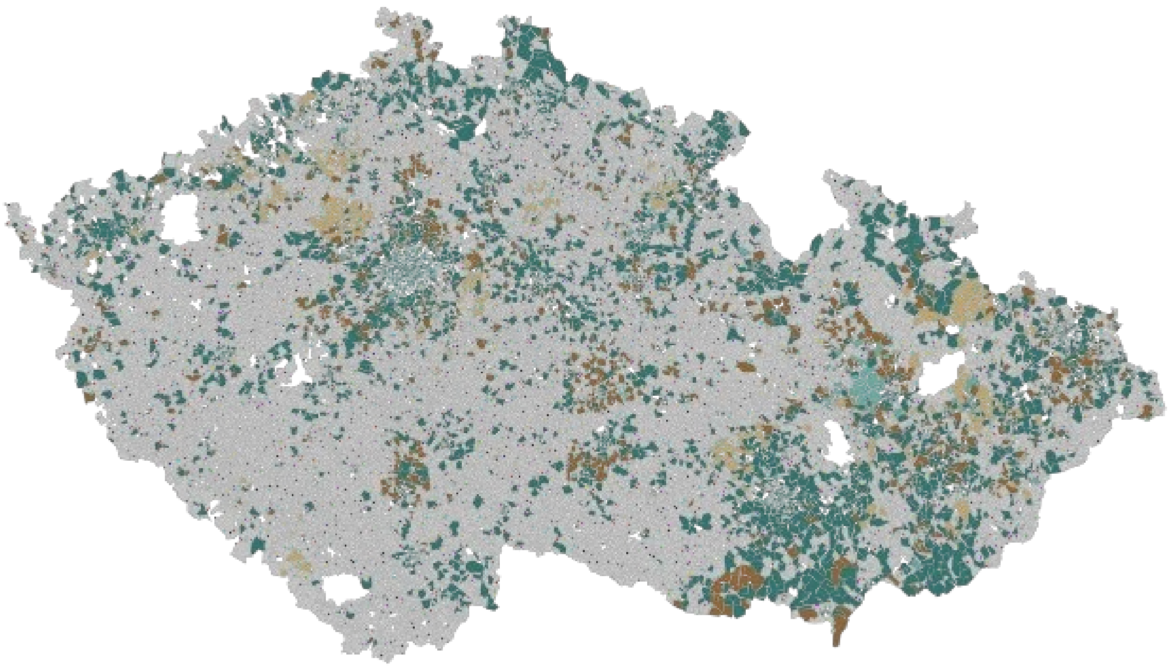
4 Current status of VHCN network coverage

The current status of VHCN network coverage in the Czech Republic shows significant progress in the transparency and availability of data on telecommunications infrastructure, primarily thanks to the features of the CTU Visualisation Portal (VPortal). This was launched in December 2021. It is a comprehensive visualisation tool that helps users compare the quality of telecommunications services in the Czech Republic. With the new version available from December 2023, the modules have been expanded to include the
“Fixed Services”. It displays available connections enabling the provision of internet access services at a fixed location. In addition, it displays the results of user-measured internet speeds using the NetTest tool. VPortal currently offers five modules – Mobile Services, Fixed Services, Radio Services, Television Services and Development Criteria. Users can also download selected available data in their chosen format and coordinate system. The maps below show the status of VHCN network coverage in the Czech Republic at the level of basic settlement units (BSUs) and municipalities as of 31 December 2023, ranging from no coverage to the roll-out of a fully optical network to a specific address (dark green).

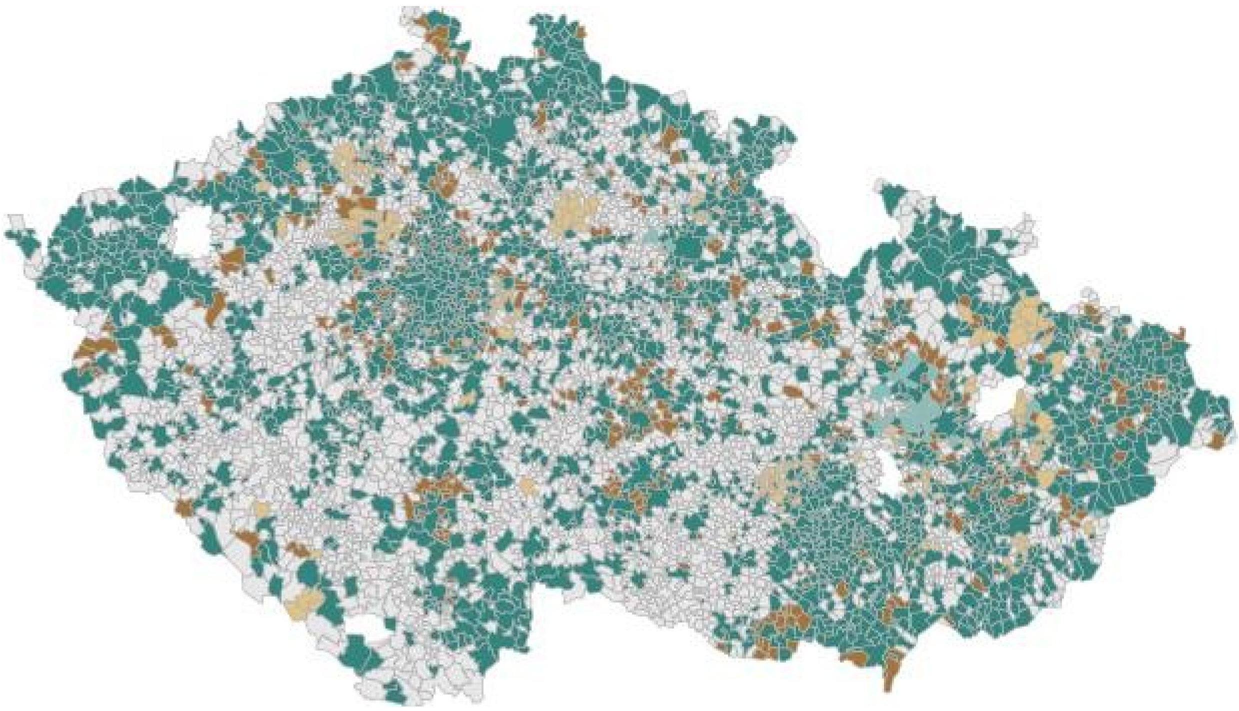
Figure 2: Geographical coverage of VHCN networks in the Czech Republic as at 31 December 2023 at the ZSJ level



Source: VPortal ČTÚ

0. = not covered by the VHCN network
1. = deployment of a fully optical network to the address
2. = deployment of a fully optical network to a base station or similar AP (relevant for wireless networks)
3. = no optical network is installed at the designated location, but all performance thresholds are met 1
4. = no optical network is connected to the base station or equivalent AP, but all performance thresholds 2 are met (relevant for wireless networks)

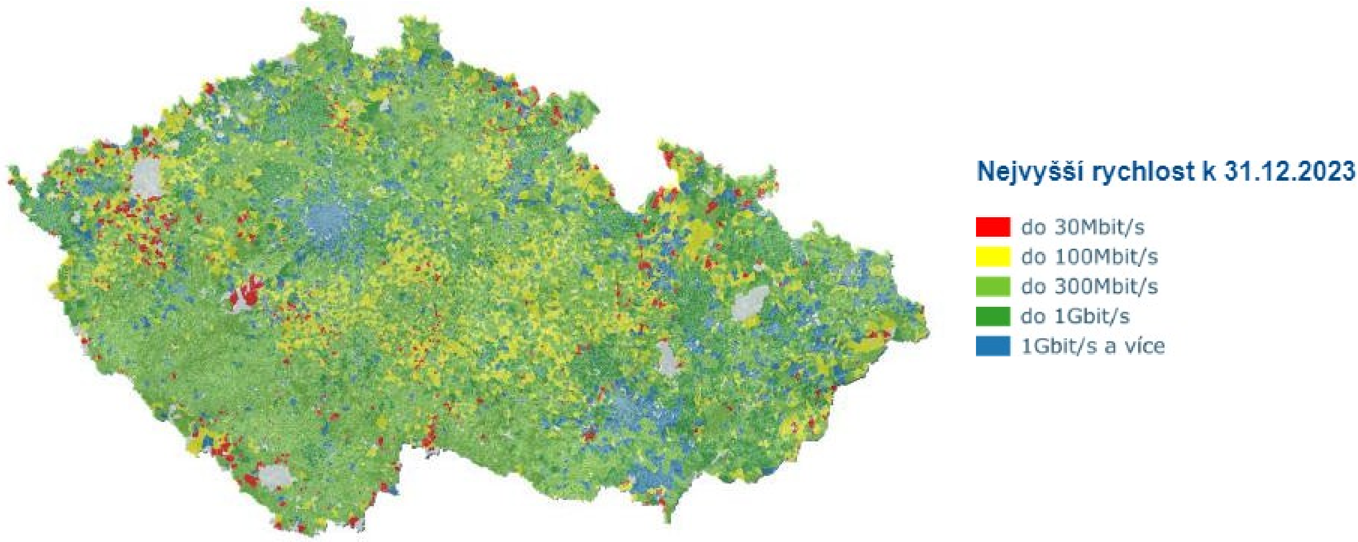
Figure 3: Geographical coverage of VHCN networks in the Czech Republic as at 31 December 2023 at municipal level



Source: VPortál ČTÚ

The available information and data on achieved speeds, both maximum and effective, are presented below.

Figure 4: Coverage of the Czech Republic by electronic communications networks enabling access at a fixed location as at 31 December 2023 – according to declared speeds

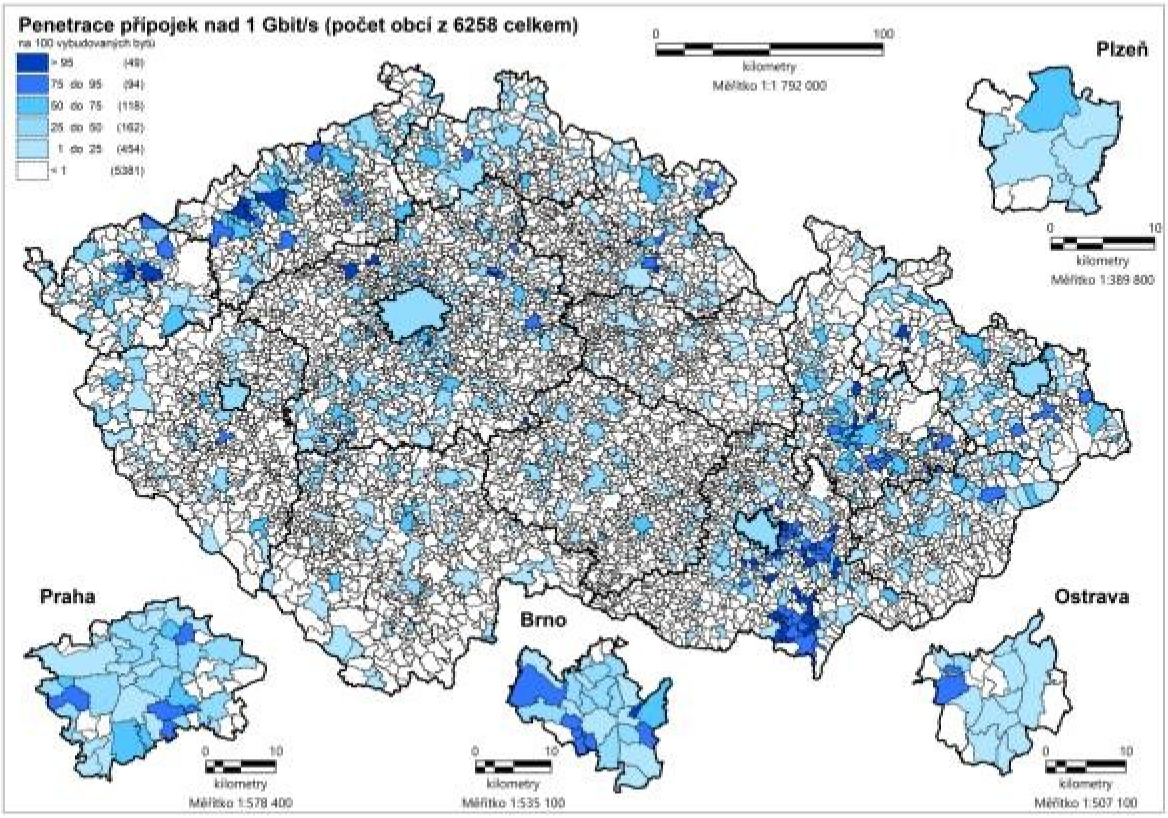


Source: CTU VPortál

As stated in the ČTÚ Report on the Development of the Electronic Communications Market with a Focus on 2023[10] , the construction of new optical networks in recent years has been clearly dominated by CETIN a.s. and T-Mobile Czech Republic a.s., with these companies also collaborating and coordinating the roll-out of optical networks. T-Mobile Czech Republic a.s. also cooperates with Vodafone Czech Republic a.s. on the development of optical networks, and smaller local and regional providers are also involved in the construction of optical networks in the Czech Republic. Construction is typically concentrated in more densely populated areas (which were already partially covered by fibre-optic networks). These are mainly areas within larger cities, where population density is higher. In 2023, the cities of Prague, Kolín and Ústí nad Labem reported the largest increase in available fibre-optic connections compared to 2022.

Networks with an effective achievable download speed of ≥ 1 Gbit/s achieved a penetration rate of at least 50% in a total of 261 municipalities in the Czech Republic in 2023, compared to 144 municipalities in the previous year.

Figure 5: Penetration of connections above 1 Gbit/s



Source: Report on the development of the electronic communications market with a focus on 2023

[10]https://ctu.gov.cz/sites/default/files/obsah/stranky/472017/soubory/zovt_2023.pdf

5 EU strategic objectives regarding VHCN

5.1 The Digital Decade and the Digital Compass

The Digital Decade is a 2021 European Union initiative that builds on previous strategic plans, such as the Digital Agenda for Europe, and aims to further accelerate Europe's digital transformation by 2030. The main objective of this initiative is to strengthen Europe's digital sovereignty and ensure that the EU is a global leader in digital technologies. The Digital Decade is part of a broader framework that includes the Digital Compass 2030 strategy.

The Digital Compass is a concrete implementation plan within the Digital Decade. It serves as a detailed guide and tool for achieving the objectives set out in the Digital Decade. It contains specific targets, indicators and timetables for EU Member States to follow. The Digital Compass comprises four main strands, corresponding to the key areas set out in the Digital Decade:

- **Skills:** Ensuring that 80% of adults have basic digital skills and that the EU has 20 million ICT specialists;
- **Infrastructure:** Access to gigabit internet for all households and 5G network coverage for all populated areas;
- **Businesses:** Digitising 75% of European businesses and increasing the number of start-ups;
- **Public services:** Digitising all key public services and widespread use of digital identity.

Member States' progress in meeting these targets is monitored annually. The latest assessment in the 'country reports' was published on 2 July 2024.[11] In the case of the Czech Republic and VHCN networks, the report notes that the development of VHCN remains a major challenge, particularly in rural areas. According to this assessment, the Czech Republic has made significant progress in terms of mobile connectivity, but the roll-out of fibre-optic networks and the upgrading of cable networks are not proceeding at a sufficient pace to meet the 2030 targets. There is therefore considerable room for improvement in terms of household coverage by fixed VHCN networks, which stands at 'only' 50.5%. This is due to the slow roll-out of fibre-optic networks, for example because of the complex building permit process and the protracted upgrading of cable networks to DOCSIS 3.1 technology.

At 36.1%, the Czech Republic's coverage of households with fibre-to-the-premises (FTTP) networks is significantly below the EU average of 64%. The situation is even worse for subscriptions to speeds exceeding 1 Gbps, with only 2.95% of households subscribing to such services, compared to the EU average of 18.52%.

As part of its implementation plan (see the 'Digital Czech Republic' document), the Czech Republic has set a target of 95% coverage of households with gigabit connectivity by 2030. This is a less ambitious target than that set by the EU, yet even this target appears difficult to achieve according to the assessment.

[11] https://digital-strategy.ec.europa.eu/en/library/digital-decade-2024-country-reports

Figure 6: Gigabit infrastructure penetration in the Czech Republic

Note: The source of national forecast values is the 2023 country roadmap

Source: Digital Decade Country Report 2024 – Czechia

In contrast, positive progress can be reported regarding 5G network coverage, which reached 95% of populated areas in 2023 (compared to 83% in 2022), whilst the EU average stood at 89.3%. In this case, 100% coverage is expected to be achieved smoothly by 2030 (a year earlier than previously projected). However, 5G coverage in the 3.4–3.8 GHz band is considered problematic, as it stood at 39.3% of Czech households, significantly below the EU average of 50.6%.

According to estimates, achieving the Digital Decade targets in EU countries will require investments of €148 billion by 2030, of which €114 billion is for full fibre-optic network coverage and the remaining €33.5 billion for full 5G SA network coverage.[12] Public funding should account for approximately €42.7 billion of the total amount. Both the total amount and the level of public support could be lower if a) the roll-out of fixed and mobile connections were combined, or b) 5G FWA connections were rolled out in most rural areas instead of fibre-optic lines.

Table 3: Estimated investment in EU countries to meet the Digital Decade targets

	Technology	Total investment (private and public) in billions of euros	Public support (as a proportion of total investment) in billion euros
Fixed gigabit connectivity	Fibre-to-the-Premise (FTTP)	114	40
	5G FWA in areas with fewer than 30 inhabitants per km^2	108	29
5G connectivity	5G NSA	11.5	"minimum"
	5G SA	33.5	2.7
Fixed and wireless connectivity	Joint deployment of FTTP and 5G SA	120	33

Source: A future-proof network for the EU: Full fibre and 5G

[12] https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762298/EPRS_BRI(2024)762298_EN.pdf

In the European Commission's updated analysis of national broadband development plans, the likelihood of individual countries achieving the Gigabit Society 2025 and Digital Decade 2030 targets is assessed.[13] The 2016 Gigabit Society package of measures is the predecessor to the Digital Decade. The main targets for 2025 are 100 Mbps networks for all households, gigabit connectivity for key businesses and institutions, continuous 5G coverage in all urban areas and along major transport routes, and access to mobile data everywhere.[14]

Table 4: Estimated probability of achieving connectivity targets in EU countries

EU Member State	GS 2025: Access to 1 Gbps for key economic actors	GS 2025: Universal access to download speeds of 100 Mbps–1 Gbps	SDG 2025: Seamless 5G coverage for urban areas and major roads and railways	Digital Decade
	probability	probability	probability	probability
Belgium	low	low	low	low
Bulgaria	high	medium-low	high	high
Czech Republic	medium	low	high	medium-low
Denmark	high	high	high	high
Estonia	high	medium	medium-high	high
Finland	high	low	high	medium
France	high	medium	high	high
Croatia	medium	low	high	medium
Ireland	high	medium	high	high
Italy	high	low	high	medium-high
Cyprus	high	low	high	medium
Lithuania	high	medium	high	High
Latvia	high	high	high	high
Luxembourg	high	high	high	high
Hungary	high	high	high	high
Malta	targets already achieved	targets already achieved	targets already achieved	high
Germany	low	low	high	medium
Netherlands	high	medium	tall	high
Poland	high	low	medium	medium
Portugal	high	high	high	high
Austria	low	low	high	medium
Romania	high	high	medium	High
Greece	low	low	high	low
Slovakia	high	medium	high	medium-high
Spain	high	medium	high	high
Sweden	high	medium	high	High

Source: Study on National Broadband Plans in the EU-27

Within the EU, the roll-out of fibre-optic networks is proceeding as expected, with the Digital Agenda targets set to be achieved through ambitious private and public investment. For most EU countries, the Digital Agenda targets for gigabit connectivity are expected to be met with a high or medium probability. The Czech Republic has the third-worst outlook for achieving the targets, with a medium-low probability; only Belgium and Greece fare worse in this respect.

[13]https://digital-strategy.ec.europa.eu/en/library/updated-study-national-broadband-plans-eu27

[14]https://digital-strategy.ec.europa.eu/en/library/updated-study-national-broadband-plans-eu27

5.2 Gigabit Infrastructure Regulation

Regulation (EU) 2024/1309 of the European Parliament and of the Council (Gigabit Infrastructure Regulation)[15] was adopted with the aim of facilitating support for and the financing of the development of gigabit infrastructure in EU Member States. The Regulation responds to the growing need for faster, reliable and high-capacity connectivity and replaces the 2014 Directive on reducing the cost of high-speed networks. This regulation, which will be fully applicable from 12 November 2025, is key to achieving the Digital Decade 2030 target on connectivity: ensuring access to fast gigabit connectivity and fast mobile data across the EU by 2030.

The GIA introduces several measures aimed at simplifying the deployment of VHCN networks:

- **Infrastructure sharing:** Encouraging the sharing of ducts and poles for the deployment of VHCNs to optimise resources and reduce costs.
- **Coordination of construction works:** Enabling telecoms operators to collaborate with public works projects on the simultaneous installation of fibre-optic cables, thereby reducing constraints caused by repeated excavation and construction activities and accelerating the roll-out of high-speed internet.
- **Simplification of administrative procedures**: Simplifying administrative procedures related to network deployment across the EU to reduce bureaucratic barriers and improve efficiency.
- **Equipping buildings with infrastructure ready for high-speed connectivity:** All newly constructed buildings and buildings undergoing major renovation, including co-owned elements, for which a building permit application was submitted after 12 February 2026, must be equipped with in-building physical infrastructure ready for fibre optics and in-building fibre distribution, including connections, up to the physical point where the end-user connects to the public network.

This Regulation also aims to reduce the environmental impact of electronic communications networks by promoting the deployment of greener technologies, such as fibre optics and 5G.

Operators' reactions regarding the Regulation's contribution to administrative simplification are rather sceptical. Major telecoms operators' associations, including ETNO and GSMA, have issued a joint statement describing it as "a measure that penalises telecoms operators without delivering any real benefits in terms of administrative simplification."[16] Another issue is the fact that the regulation will not come into force until 12 November 2025, which does not provide enough time to contribute to achieving the ambitious connectivity targets by 2030 through VHCN coverage. According to estimates, achieving these targets, including coverage of transport routes, will cost operators a total of 200 billion euros.[17]

In the Czech Republic, the original 2014 Directive was transposed into national law by Act No. 194/2017 Coll. on measures to reduce the costs of deploying high-speed electronic communications networks and amending certain related acts. In connection with the GIA Regulation, there are two options for approaching Act No. 194/2017 Coll.[(18)] .

- Updating the Act: Act No. 194/2017 Coll. will be updated in the context of the GIA. However, it is necessary to ensure that there is no "duplication" between the Act and the GIA.
- Repeal and replacement: Act No. 194/2017 Coll. will be repealed and replaced by a new Act, which will supplement the GIA where it states that Member States may decide or lay down rules for the interconnection with national legislation. The question remains as to whether it would be better to lay down certain measures in a subordinate regulation in order to respond more effectively to the current state of processes, whilst always ensuring the predictability of the law.

The Ministry of Industry and Trade is responsible for creating a suitable legal environment for the GIA.

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[15] Full title: Regulation (EU) 2024/1309 of the European Parliament and of the Council (EU) 2024/1309 of 29 April 2024 on measures to reduce the costs of deploying gigabit electronic communications networks, amending Regulation (EU) 2015/2120 and repealing Directive 2014/61/EU (Gigabit Infrastructure Regulation)

[16]https://etno.eu//downloads/news/joint_telecom_industry_statement_gia.pdf

[17]https://digital-strategy.ec.europa.eu/en/library/white-paper-how-master-europes-digital-infrastructure-needs

[18]https://www.casopisstavebnictvi.cz/clanky-gia-v-procesu-planovani-projektovani-a-povolovani-siti-vhcn.html

6 National programmes to support the development of VHCN networks

6.1 National Recovery Plan

The National Recovery Plan was established in 2021[19] , as in other EU countries, in response to the Covid-19 pandemic with the aim of supporting the recovery of the national economy. The NRP contains specific reforms and investments focused on key areas such as digital transformation, environmental sustainability, education, healthcare and infrastructure. It also includes Component **1.3: Digital High-Capacity Networks.** The main objective of the component is to ensure, through VHCN, the widest possible access to high-quality internet connectivity for residents, businesses, public administration and socio-economic actors, particularly in rural areas, and to achieve a situation where the potential of technological development and digitalisation can be utilised virtually without restriction throughout the country. At the same time, conditions should be created to support the development of 5G networks and services, particularly in areas that complement the development criteria set by the spectrum auction.

Component 1.3 supports the European flagship initiative 'CONNECT' **by improving access to very high-capacity networks**, and the proposed investments are **explicitly aimed at increasing private investment in very high-capacity network infrastructure**. The estimated cost of the measures under this component is CZK 5.787 billion, and in addition to construction, they include investments in the following areas:

- Deployment of high-capacity connectivity;
- Coverage of corridors with 5G networks and support for the development of 5G networks;
- Support for the development of 5G mobile network infrastructure in investment-intensive rural 'white spots';
- Research and development activities related to the development of 5G networks and services.

The accelerated roll-out of very high-capacity networks in urban and rural areas will generate significant synergies across society and the economy and provide the necessary infrastructure to handle emerging and future processes and applications. It will provide new opportunities for industry, increase the attractiveness of rural areas for businesses and the younger generation, and enhance Europe's digital strategic autonomy. At the same time, it will create job opportunities and opportunities for upskilling in the relevant construction and building works sector.

The investment objective 'Building high-capacity connectivity' includes the key criterion T1:

- T1) Increasing the number of addressable locations with access to VHCN by 23,000 by the end of Q1 2026[20].

The NPO states in its exact wording:

The aim of this measure is to support the construction of very high capacity network (VHCN) connections, with a particular focus on rural areas where market-based solutions are not viable and there is little commercial incentive for their deployment. These areas of intervention will be identified in accordance with the applicable state aid rules and submitted for public consultation.
At least one call for proposals for the deployment of very high capacity connections will be published under this measure, and its outcome must be published by 31 December 2024. Upon implementation of the selected projects, the number of subscriber locations connected to the VHCN network, as defined in the BEREC guidelines on very high capacity networks (connections of at least 1 Gb/s), will increase by at least 23,000 units. The investment will be completed by 31 March 2026.

[19] On 26 September 2023, the European Commission approved the updated version.

[20] In terms of timing, the national recovery plan was published in September 2021

6.2 Digital Czechia

The Digital Czechia document (The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030) represents the national implementation plan (including the roadmap) for the EU Digital Decade. This document was drawn up in connection with Decision (EU) 2022/24811 of the European Parliament and of the Council with the aim of mapping how the Czech Republic, within the framework of its current strategies, is fulfilling the set objectives in the areas of: digital skills, digital infrastructure, digital transformation of businesses and the digitisation of public services. For Digital Objective 2a) Gigabit network coverage and coverage of all populated areas with high-speed networks equivalent to 5G, the strategy sets out the following measures with corresponding timetables:

Timetable for measures contributing to the achievement of Digital Objective 2a)	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Measure 2.1 – Improving digital connectivity	■	■	■	■	■	■	■	■
Measure 2.2 – Broadband Competence Office Czech Republic project	■	■	■	■	■	■	■	
Measure 2.3 – Support for the development of very high-capacity networks	■	■	■	■	■	■	■	
Measure 2.4 – Support for the development of 5G mobile networks	■	■	■					
Measure 2.5 – Non-grant support for the development of electronic communications networks	■	■	■	■	■	■	■	
Measure 2.6 – Research and development activities related to the development of 5G networks and services	■	■	■					
Measure 2.7 – Fulfilment of obligations arising from the allocation of radio frequencies for 5G networks	■	■	■	■				

The budget for all measures attributable to this objective amounts to CZK 13.597 billion from public sources:

- Domestic resources: CZK 7.843 billion from the National Operational Programme (NOP);
- EU funds of CZK 5.754 billion through the TAK and PIK operational programmes.

The largest share of public funding under this objective goes to Measure 2.3 Support for the development of high-capacity networks – CZK 9.7 billion from the TAK OP, PIK OP and NPO. The aim of the measure is the implementation and planning of calls for proposals in the field of network development. Specifically, the calls concern the following areas: high-speed internet, the roll-out of high-capacity connections, the measurement of the quality of electronic communications networks, the development of digital technical maps, the recording of planned infrastructure projects, and the deployment of VHCN fixed networks.

6.3 National Plan for the Development of Very High Capacity Networks

The National Plan for the Development of Very High Capacity Networks is a sectoral strategy focused on the specific area of building and developing infrastructure for high-speed electronic communications services. It forms part of the Digital Czech Republic concept and the Innovation Strategy of the Czech Republic 2019–2030. This document is directly linked to the National Investment Plan. It is valid until 31 December 2027, unless amended by a government resolution.

> The National Plan is a strategic document that sets out procedures and tools, the implementation of which will, in the long term, create the conditions for the development of high-speed internet connectivity for citizens, businesses and public institutions, with a quality and reliability meeting the parameters defined in the EU regulatory framework for very high-capacity networks.

The aim of the National Plan is to outline the necessary prerequisites for facilitating investment in VHCNs, to define the Czech Republic's strategic approach to the construction of these networks, and to determine the necessary role of the state in achieving VHCN coverage, particularly in securing support from public funds whilst minimising interference with competition. The National Plan also addresses the relationship between public and non-public communications networks and the possibilities for sharing them.

> **Page 26 of the National Plan: Connecting addressable locations to VHCN networks**
> Calculations of the investment gap for the deployment of high-capacity, available connections across the Czech Republic indicate that, under commercial conditions, 470,000 connections would not be deployed or upgraded by the end of the 2021–2027 programming period

flats.[21] With an average investment of CZK 30,000 per available high-capacity connection, the investment gap for covering the aforementioned 470,000 connections in the Czech Republic with VHCN networks amounts to approximately CZK 14.1 billion. This amount will need to be reduced by approximately CZK 2.6 billion (expert estimate), taking into account the fact that in investment-intensive locations where it is impossible to cover operating costs from revenues, it will never be possible to build VHCN networks with fixed customer connections. It will therefore likely be useful to prepare a more in-depth analysis that would recommend certain thresholds beyond which (probably for small municipalities with a small population) it will no longer be cost-effective to subsidise the construction of a VHCN cable network. The estimated actual investment gap for covering all addressable locations thus amounts to CZK 11.5 billion.

The conclusion of the National Plan states: “To ensure that the Czech Republic does not lag behind in the development of its digital infrastructure, it is necessary to focus on supporting the roll-out of electronic communications networks with speeds of 1 Gbit/s and above.” This objective is taken from the objectives at EU level.

26. On 2 June 2024, the Minister for Industry and Trade submitted **a Report on the Implementation of Action Plan 2.0 for the implementation of non-grant measures to support the planning and construction of electronic communications networks and on activities aimed at fulfilling the National Plan for the Development of Very High Capacity Networks.**[22] In accordance with the National Plan for the Development of VHCN, public funding is directed primarily to areas and locations where existing commercial models for network deployment fail without such support.

The report provides summary information on the fulfilment of the National Plan’s objectives through relevant public support calls up to mid-2024:

- Operational Programme Enterprise and Innovation for Competitiveness (OP PIK)
- National Recovery Plan (NRP)
- Operational Programme Technologies and Applications for Competitiveness (OP TAK)

Programme	Call and objective	Funding	Completion
Operational Programme Enterprise and Innovation for Competitiveness	II and IV expansion of modern network infrastructure of the new and reliable provision of high-speed electronic communications.	A decision to award a grant was issued for 52 projects with a total value of CZK 1.1 billion.	45 projects were successfully completed and connections were established for 18,119 address points, i.e. almost 22,000 household connections.
	Call III reducing the costs of implementation high-speed networks by sharing existing physical infrastructure and improved coordination of construction works and, at the same time, the creation digital technical maps of regions	CZK 3.5 billion	By 31 December 2023, the projects had digitised a total of 557,000 ha of land and 99,000 km of transport and technical infrastructure.
National Recovery Plan Calls for Component 1.3. Digital High-Capacity Networks	I Support for connecting premises to very high-capacity networks	CZK 2.85 billion	Projects must be completed by the end of 2025.
	II Network quality measurement electronic communications	CZK 170 million	Projects must be completed by 31 October 2025.

[21] Based on the Analysis of the State of NGA Network Development in the Czech Republic to ensure access to high-speed internet available at a fixed location: https://www.mpo.gov.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/2020/2/Zaverecna-zprava_GTA_12_12_2019.pdf

[22]https://www.mpo.gov.cz/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/report-on-the-implementation-of-action-plan-2.0-and-the-national-plan-for-the-development-of-very-high-capacity-networks--282096/

Programme	Call and objective	Funding	Completion
	III Development of 5G mobile network infrastructure in investment-intensive rural areas	CZK 300 million	Projects must be completed by 31 March 2026.
	IV Coverage of selected railway corridors with higher-level 5G signal	Ministry of Industry and Trade: CZK 584 million (support for structures outside the railway track) in 2023. An for the Railway Administration. CTU: CZK 300 million (technical equipment for 5G in railway carriages)	All projects must be completed by 30 June 2026. Projects must be completed by 31 December 2025.
	V. Development of digital technical maps	CZK 1.4 billion	Projects must be completed by 31 December 2025.
	VII. Register of planned infrastructure projects	CZK 20 million	Projects must be completed by 31 December 2025.
	IX. Installation and testing of a Cooperative Intelligent Transport System (C-ITS)	CZK 50 million	Projects must be completed by 31 December 2025.
Operational Programme[23] Technologies and Applications for Competitiveness	I. High-speed internet Activity 1: Deployment of optical backhaul networks in municipalities Activity 2: Deployment of VHCN access networks	CZK 4 billion (In the event of a significant surplus of high-quality projects , the OP TAK Managing Authority may increase the allocation for this Call accordingly.)	Projects must be completed by 30 June 2029.

[23] For further details, see 7.1.2

7 Factors influencing the development of VHCN in the Czech Republic

7.1 Favourable factors

7.1.1 Regulatory and political factors

The regulatory approach is one of the key prerequisites for the development of VHCN networks in the Czech Republic, including investors' decisions to build these networks. These include, in particular, EU-level regulations and strategies such as the EECC, the Digital Decade, the Digital Compass and BEREC guidelines for VHCN networks, which are transposed into Czech law through the Electronic Communications Act and several interlinked strategic documents. These measures contribute to the development, availability and deployment of VHCN networks. The main benefits of these measures are the political declaration that investment in VHCNs should be supported by the European Commission and national regulators, and that conditions should be harmonised on the basis of BEREC guidelines. Political stability is also absolutely crucial, as it boosts investor confidence, whereas an unstable political environment can deter major investment. From this perspective, the political environment in the Czech Republic can be assessed as stable, as both the government and the main opposition groups support the objectives of the Digital Agenda, including the roll-out of high-speed networks

7.1.2 Public support and subsidy programmes

Public support and subsidy programmes are crucial for the development of VHCN networks. They reduce investment costs for investors, contribute to the stability of the regulatory environment and facilitate cooperation between the public and private sectors.

An important instrument for supporting VHCN at European level is the Connecting Europe Facility (CEF2 Digital). This instrument provides financial support primarily for cross-border high-speed connectivity projects across Europe. The CEF, which covers not only digital technologies but also transport and energy, is open to applicants from both the public and private sectors. By utilising these resources for the development of digital infrastructure, it is possible to significantly reduce the financial burden on operators and investors in VHCN networks.

In the 2021–2027 programming period, projects aimed at improving digital connectivity are supported through the European Regional Development Fund and other European programmes. Specifically, this concerns the Operational Programme Technology and Applications for Competitiveness (OP TAK), which follows on from the Operational Programme Enterprise and Innovation for Competitiveness (OP PIK) from the previous 2014–2020 programming period.

A call for proposals is currently open under OP TAK[24] (with a deadline for applications of 31 December 2024), the aim of which is to roll out public broadband electronic communications networks that will enable fast and reliable access to electronic communications services and the internet on VHCN networks for households, businesses, schools, public authorities and other stakeholders. Support is available for two types of activities:

- Deployment of fibre-optic backhaul networks in municipalities;
- The deployment of VHCN access networks.

[24] https://www.agentura-api.org/cs/podporovane-aktivity-optak/vysokorychlostni-internet-optak/vysokorychlostni-internet-vyzva-i/

The minimum requirements for VHCN are set out as follows:

Threshold speed (existing networks)	In the area	Min. target service speed
< 30 Mbps	Category A (white at 30 Mb/s)	150 / 50 Mbps
< 100 Mbps	Category B (white at 100 Mbps)	1 Gbps / 200 Mbps
< 300 Mb/s	Category C (grey at 100–300 Mbps)	1 Gbps / 200 Mbps

Total eligible expenditure for the project must be at least CZK 1 million and up to a maximum of CZK 268 million for projects implemented in so-called less developed regions[25] and at least CZK 1.25 million and up to a maximum of CZK 325 million for projects implemented in so-called transition regions.[26] The aid intensity is 85% for less developed regions and 70% for transition regions.

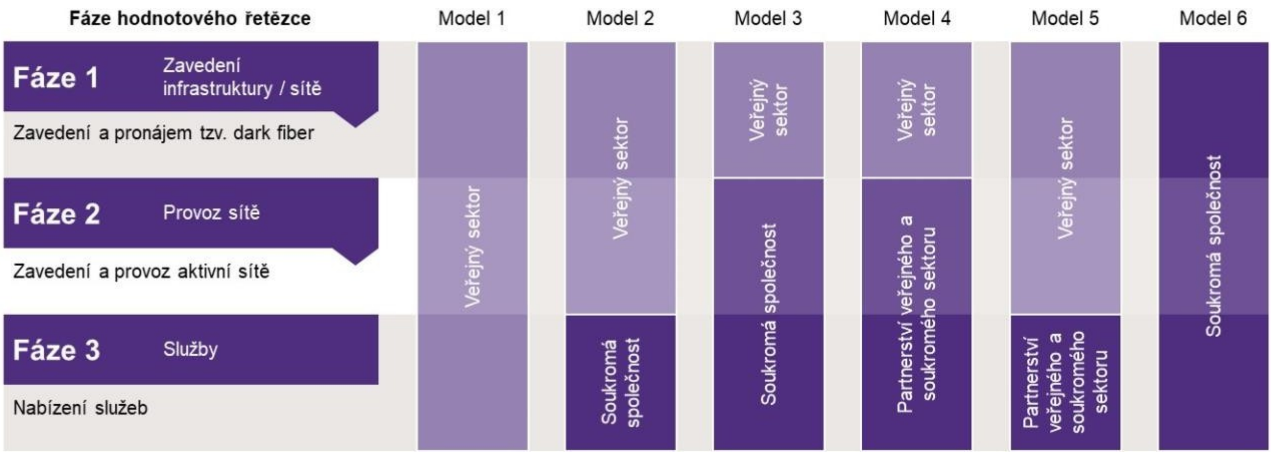
7.1.3 Competitive pressures

The competitive environment has a positive impact on the broadband market. The technologies through which alternative operators are putting pressure on incumbent operators are varied, leading to dynamic market development among cable operators, FWA technology providers, as well as fibre-optic and metallic networks.

In all these cases, alternative players significantly stimulate the market environment, as they force incumbent operators to invest in their networks to maintain their market share. The actual organisational structure of a competitor is irrelevant for determining its impact on the dominant operator.

The European Commission's study on national broadband development plans contains a diagram of organisational models for investment in VHCN infrastructure, and more generally in NGA (see below).[27] These models cover different levels of the digital infrastructure value chain, such as passive infrastructure and services. Although vertically integrated companies remain the main source of connectivity and investment, several other types are emerging. For example, in Germany, Lithuania and Austria, there are several public special-purpose associations that deploy passive infrastructure, whilst private companies operate the active elements and offer services (model No. 3 in the diagram). For countries in our region of Central and Eastern Europe, the study presents a typical public-private partnership (PPP) model (Model 4). In England and Ireland, vertically integrated private companies predominate (Model 6). An interesting aspect of these models is the growing number of cross-sector collaborations. In Sweden, Denmark and Finland, there is increased activity among public service providers (utilities) who are investing across all levels of the value chain.

Figure 7: Organisational models of NGA/VHCN infrastructure investors



Source: Study on National Broadband Plans in the EU-27

[25] North-West – Ústí and Karlovy Vary regions, North-East – Pardubice, Liberec and Hradec Králové regions, Moravia-Silesia – Moravia-Silesia region, Central Moravia – Olomouc and Zlín regions

[26] Central Bohemia – Central Bohemian Region, South-West – Plzeň and South Bohemian Regions, South-East – South Moravian Region, Vysočina Region

[27] https://digital-strategy.ec.europa.eu/en/library/updated-study-national-broadband-plans-eu27

7.1.4 Economic factors

The main economic factors influencing investment decisions regarding the construction of VHCN networks are the digital transformation of businesses and government and public administration (so-called eGovernment) and the growing demand for digital services such as video streaming, remote working, e-learning and the Internet of Things (IoT).[28] All these factors are creating pressure to improve network transmission capacity. Progress in digital transformation is assessed annually in a pan-European comparison by the aforementioned Country Report on the implementation of the Digital Decade. According to the report, however, the Czech Republic's potential in this area remains largely untapped. Although the number of technology-intensive firms in the fields of microelectronics, quantum computing and artificial intelligence start-ups is growing in the country, only 49.3% of small and medium-sized enterprises reached the basic level of digital intensity in 2023.[29] The EU average last year stood at 57.7%. The Czech Republic has set a target of 80%, which, given its low starting point, is 10% lower than the target set for the EU in the Digital Agenda.

The country report for the Czech Republic cites the following aspects as the main reasons for the reluctance of small and medium-sized enterprises to embrace digitalisation more fully, with reference to the Strategy for the Support of Small and Medium-sized Enterprises in the Czech Republic for the period 2021–2027[30] :

- uncertainty regarding the return on investment;
- lack of information on the benefits of digitalisation;
- high acquisition costs;
- insufficient skills for implementation.

Although the Czech population is very well digitally educated compared to the European average (69% have basic digital literacy compared to the EU average of 55.6%), employees in small and medium-sized enterprises lack the specific skills necessary to master information technology tools, and businesses generally face a shortage of ICT experts.

When it comes to the use of at least one of the technologies—cloud services, big data and artificial intelligence—in business, the Czech Republic lags significantly behind the EU average (43.1% vs 54.6%).

7.1.5 Technological factors

VHCN network technologies require compatibility with existing infrastructure, which involves support for the relevant protocols and standards. Fibre-optic networks are less susceptible to external influences and interference than traditional metallic cables and thus offer benefits in the area of cybersecurity. These networks are also characterised by easy scalability without the need for significant infrastructure changes. Using technologies such as DWDM (Dense Wavelength Division Multiplexing), it is possible to increase capacity without having to replace the original infrastructure. From the perspective of integrating environmental considerations into all policies at European and national level, it is also important that fibre-optic networks consume less energy per unit of data transmitted than metallic cables.

The roll-out of VHCN networks is crucial for supporting the development of 5G networks, which require a dense network of small cells and high-speed backhaul internet connections. Optical networks are therefore essential for the deployment of technologies and applications such as the IoT. The 'Digital Czech Republic' strategy document contains a binding timetable for the coverage of the Czech Republic's population and territory by 5G networks for holders of radio frequency allocations for the relevant bands. The adoption of coverage commitments is based on the terms of the radio frequency auction.

7.1.6 Social factors

Social factors include the level of digital literacy among the population (see the assessment in the country report on the implementation of the Digital Decade above) and its readiness to use (high-speed) internet, as well as the penetration of devices such as laptops, tablets, smartphones, etc. Data on the use of information and communication technologies at the level of individuals, households, businesses and public administration is published annually by the Czech Statistical Office in cooperation with Eurostat. A pan-European comparison shows that, for example, internet usage in households in the Czech Republic stands at 93%, which is in line with the EU average.

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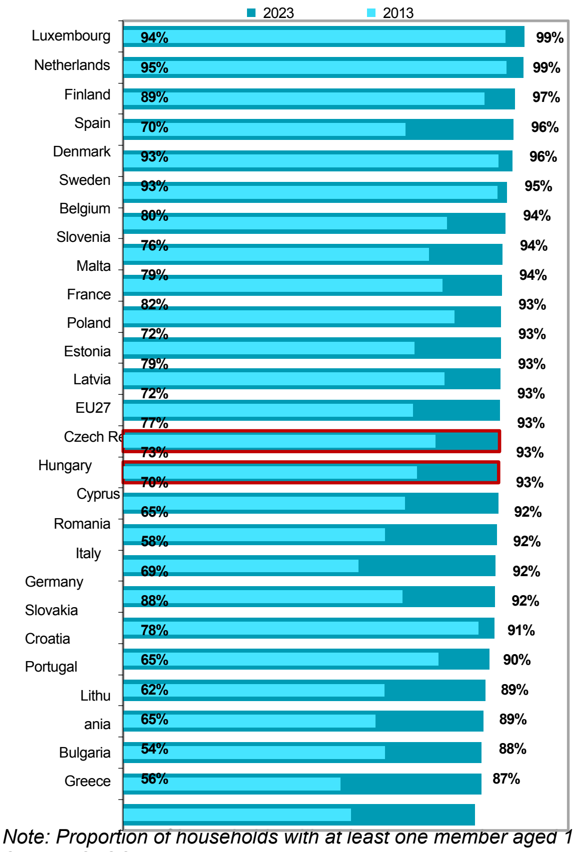
[28] On the other hand, many customers are satisfied with internet connections offering lower speeds, even though high-speed connections are available at their address. As stated in the VHCN Network Development Strategy, this situation can be addressed to a limited extent through marketing and advertising tools. However, a more effective solution would be an expanded portfolio of useful digital services with higher demands on speed and transmission quality, provided this is economically viable for these customers.

[29] The indicator 'Small and medium-sized enterprises with at least a basic level of digital intensity' is assessed on the basis of the use of at least 4 out of 12 selected technologies.

[30] https://www.mpo.gov.cz/assets/cz/podnikani/male-a-stredni-podnikani/studie-a-strategicke-dokumenty/2021/3/Strategie-podpory-MSP-v-CR-pro-obdobi-2021-2027.pdf

Figure 8: Households in EU countries with internet access

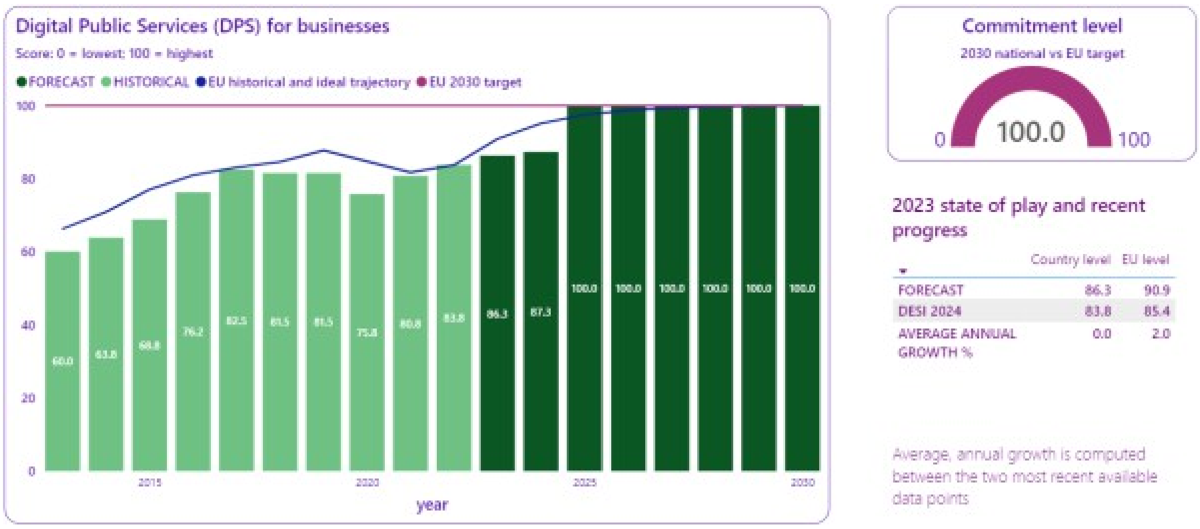


Note: Proportion of households with at least one member aged 16–74 in the given country
Source: CZSO, Eurostat

The growing proportion of citizens and households using information and communication technology tools and services provides investors with an incentive to build robust VHCN infrastructure. The same applies to the digitisation of public administration services (eGovernment).

Between 2021 and 2023, the Czech Republic showed positive growth momentum in terms of the digitisation of public services for businesses, but limited progress in the digitisation of services for citizens.

Figure 9: Digital public administration services for businesses



Source: Digital Decade Country Report 2024 – Czechia

Other social factors include urbanisation and regional development, as a higher concentration of the population in urban agglomerations creates a potential market for high-speed internet providers due to the expected higher rate of return on investment. Conversely, a higher level of public support is essential to increase investment in the roll-out of VHCN networks.

As regards demographic aspects, it is of course true that the younger generation are among the main users of digital technologies and the internet, and thus generate demand for high-speed connectivity, which is reflected in investment in VHCN. However, the older generation, whose share of the population is increasing, can also generate demand for specific services. These include, in particular, e-health services, which require a reliable connection to high-speed internet.

7.2 Negative factors

7.2.1 Regulatory and bureaucratic factors

Whilst the previous chapter outlined the positive benefits in the area of policy and regulation, particularly in the form of strategic documents and public support for the construction of VHCN networks, state regulation can also be a major obstacle. This applies in particular to the complex processes involved in obtaining planning permission. It is precisely these lengthy and complicated processes of constructing and developing VHCN networks. The Czech legal system contains a number of laws and decrees in the field of construction law, which, in the area of VHCN network construction, generally transpose the relevant EU regulations.

The most recent development is an amendment to the law concerning the digitisation of building permit procedures, which comes into force on 1 July 2024. From this date, under the amendment to the Building Act, it will be possible to submit an application electronically, including via a tablet or mobile phone. In practice, however, the system is far from functioning smoothly. This concerns in particular[31] :

- Lack of essential functionalities: For example, there is no functional link with financial systems or local filing services.
- Legal issues: Many parts of the digital building permit process have legal shortcomings that may lead to legal disputes and complications in court proceedings. For example, it is possible to overwrite the plans of another building authority.
- Practical shortcomings: It is not possible to search by land registry, street, house number, etc. It is necessary to enter personal data even after logging in using a citizen's identity.

Another problem is the lack of coordination of construction with local authorities and infrastructure managers, such as those responsible for roads and utility networks. This includes, for example, cases where it is necessary to ensure that construction work related to infrastructure proceeds in sync (e.g. during road reconstruction), which requires effective planning and communication. Obtaining consent from property owners or local authorities for the laying of fibre-optic cables or the installation of new masts is often complicated, particularly if owners object to the construction on aesthetic or safety grounds. This is also linked to strict environmental protection rules or heritage zone regulations, which apply, for example, to construction in historic city centres or protected areas. Alternative solutions in such cases are costly and time-consuming.

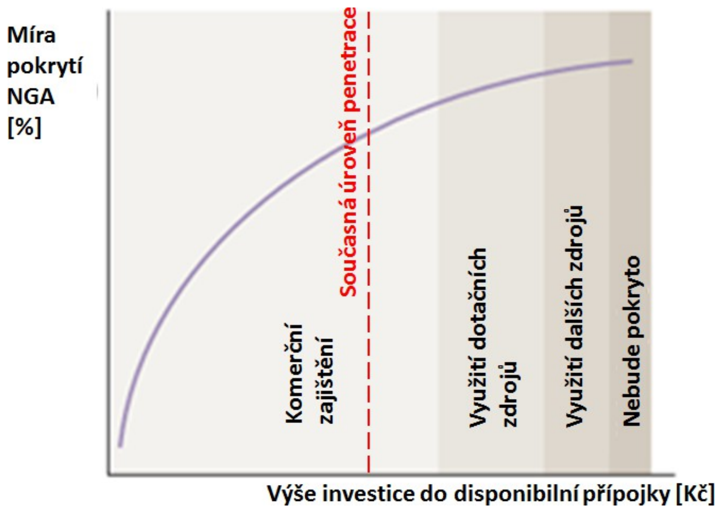
7.2.2 Economic factors

Investments in VHCN networks are capital-intensive. Particularly in remote areas, high construction, installation and operational costs can deter investors precisely because of the significant financial risks associated with the long payback period. Given that the construction of optical or other cable-based electronic communications networks in small towns is costly (with an extremely long payback period), investors in these locations prefer to build wireless networks, which do not require such high investment.

For this reason, networks meeting VHCN parameters are built in locations that are lucrative in terms of return on investment, i.e. where a return is expected within 10–15 years in densely populated urban areas. Outside these areas, it is necessary to utilise subsidies from public funds or synergies when building alongside linear networks, or a combination of both. The following diagram illustrates the relationship between the level of investment in an available connection (i.e. return on investment) and the degree of overall coverage. The diagram shows that for a large number of remote locations, it will be necessary to allocate additional resources in the form of special European funds for cross-border construction or national grant schemes for rural development, including municipal funds.

[31]https://m.praha8.cz/Vyjadreni-MC-Praha-8-k-zavedeni-novely-stavebniho-zakona-do-praxe-a-nabehu-digitalizace-stavebniho-rizeni.html

Figure 10: Coverage rate versus investment level

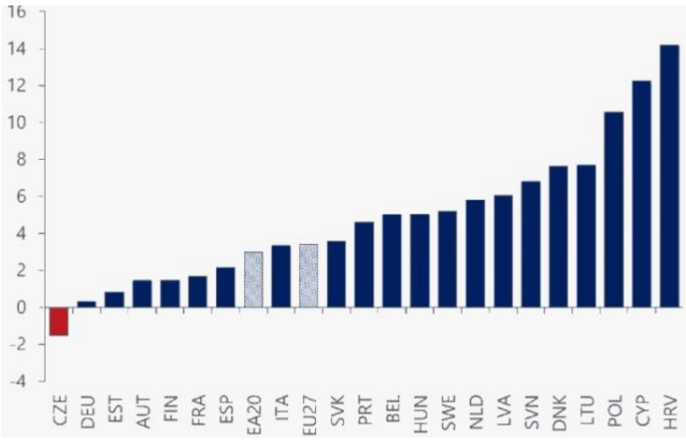


Source: National VHCN Development Plan

From an investor's perspective, the large number of small settlements scattered across the country is problematic, as it complicates the construction of linear infrastructure and, consequently, VHCN networks. More than half of all Czech municipalities (approximately 6,300) have a population of no more than 500. The VHCN network development strategy further states that, in the case of a few municipalities, even with 100% coverage of network construction funded from public sources, operations would never cover the associated costs. A special regime for these municipalities may consist of a fixed wireless connection or another type of wireless connection, provided that it is capable of providing services to end-users under normal conditions during peak times at a quality of service corresponding to the performance thresholds of VHCN networks.

The construction of VHCN networks may be adversely affected by the unfavourable economic situation. The Czech Republic is the only EU country that has not returned to its pre-Covid-19 pandemic performance level by the end of 2023. This means that GDP at constant prices has not yet reached the level of the fourth quarter of 2019. According to estimates, the Czech economy is expected to return to the level seen at the end of 2019 around the turn of 2024 and 2025.

Figure 11: GDP in the third quarter of 2023 relative to the fourth quarter of 2019 at constant prices



Source: Oxford Economics/Haver Analytics

A similarly negative situation applies to real wages (which reflect the purchasing power of the population), where, according to OECD data, the Czech Republic has some of the worst figures in the EU. Since 2019, real wages have fallen by 7.5%, whilst in Hungary, a country of comparable size, an increase of 13.5% was recorded.

8 Defining VHCN network coverage targets

The setting of coverage targets for VHCN networks must be based on relevant EU and Czech documents. In this context, these are primarily the Digital Decade 2030 and its Czech transposition in the form of the document Digital Czech Republic, or *The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030*. In the case of gigabit networks (VHCN coverage), this sets a target for covering end-users with a gigabit network right up to the end point.

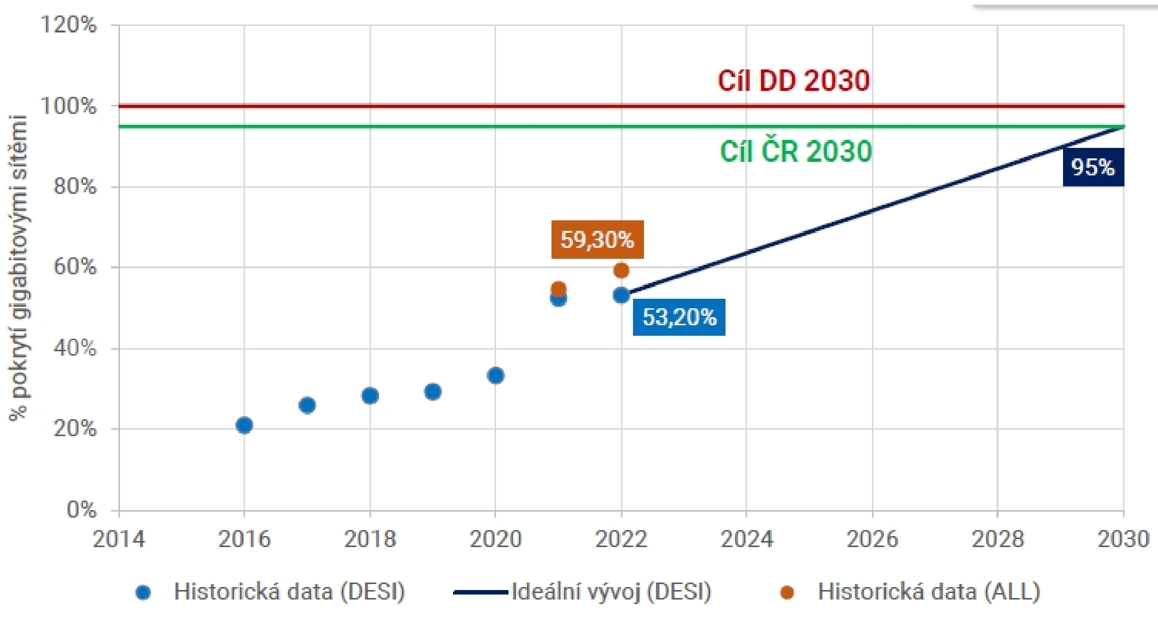
The main indicator, gigabit connectivity, is to be measured as the percentage of households covered by VHCN fixed networks. This includes technologies that are currently capable of providing gigabit connectivity, namely:

- **fibre to the premises (FTTP);**
- **DOCSIS cable technology.**

The DESI methodology used to assess progress towards the Digital Decade targets includes FTTP (FTTH), fibre to the premises, and FTTB, fibre to the building, as well as DOCSIS 3.1 cable technology among high-capacity network technologies. The number of these connections is expressed as a percentage of the total number of households.

Whilst the EU has set a target of 100% coverage by 2030, the Czech Republic has set itself a more modest target of 95%. However, even this target appears to be overly ambitious at present, according to the report on the implementation of the Digital Decade (see Chapter 5.1). The Digital Czech Republic document also includes a graph illustrating the trajectory towards achieving the set target.

Figure 12: Projected VHCN coverage in the Czech Republic



Source: Digital Czech Republic – The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030

However, as the Digital Czech Republic strategy itself, or rather The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030, mentions, the DESI index does not provide a fully reliable basis for assessing the situation in the Czech Republic. The reason is that it conflicts with the technology-neutral definition in the EECC (and the Electronic Communications Act) as well as with BEREC's clarifying criteria. This document further states that, given the nature of the landscape and built environment in the Czech Republic, achieving the Digital Agenda targets using only FTTx and DOCSIS 3.1 technologies would be unrealistic, and therefore a compromise target of 95% was set.

Consequently, the Digital Czech Republic document also states, and the graph above indicates, that according to the strict DESI definition, VHCN network coverage in the Czech Republic would be approximately 53% in 2022, whilst coverage by all VHCN networks under the principle of technology neutrality would be approximately 59%. The document anticipates the possibility of meeting the target values by utilising other technologies that have not yet fallen within the definition of the DESI indicator.

However, 5G networks also have the potential to meet the VHCN requirements set out in the EECC and BEREC guidelines. As mentioned above, VHCN must, among other things, provide high speeds and low latency in the order of milliseconds and ensure consistently high quality of service. 5G networks can offer download speeds in the order of several gigabits per second (more than 10 Gbit/s under ideal conditions), thereby significantly exceeding the capabilities of the previous 4G generation as well as the criteria set out in the BEREC guidelines. Similarly, 5G technology enables very low latency, often below 1 millisecond. The 5G technological infrastructure, in conjunction with optical fibres, can therefore be considered a key technology for future VHCNs.

In line with the Digital Decade, the **5G coverage** indicator should be measured as **the percentage of populated areas covered by at least one 5G network, regardless of the frequency band used**. In the case of this indicator, the Czech Republic is, on the contrary, well on the way to achieving 100% coverage by 2030, in line with the targets for the EU as a whole.

8.1 Methodology for predicting VHCN network coverage

When predicting the development of the number of VHCN connections in the Czech Republic by 2030, the following aspects were taken into account, some of which have already been mentioned in relation to the factors influencing VHCN development.

- **Regulation and state support:** This refers to the strategic framework and rules for the deployment of VHCN networks, including European legislation such as the Gigabit Infrastructure Regulation. In the Czech context, the National Plan for the Development of VHCN Networks is decisive; it envisages support through grant schemes, particularly in underserved rural areas. This plan covers the period up to 2027, and it can be assumed that it will be followed by an updated version focused on achieving or coming as close as possible to the Digital Decade targets. The Gigabit Infrastructure Act (GIA) should contribute to the effective fulfilment of the objectives of the Directive on reducing the cost of broadband access. The GIA supports coordination in the construction of broadband networks, optimises the use of existing infrastructure and reduces administrative barriers.
- **Technological innovations:** Within optical networks, we can expect the expansion of XGS-PON and NG-PON2 technologies, which enable symmetrical speeds of up to 10 Gbps and beyond. These technologies will significantly improve the capacity and speed of optical networks, which will be crucial for both households and businesses. Greater use of artificial intelligence in network optimisation and traffic management will lead to more efficient capacity utilisation, as well as the automation of repairs and updates. For cable networks, which already offer gigabit connectivity with DOCSIS 3.1, the upgrade to version 4.0 will bring better symmetry between download and upload speeds, as well as speeds of up to 10 Gbps. DOCSIS 4.0 includes the Full Duplex DOCSIS (FDX) innovation: this innovation will enable high-capacity bidirectional communication on the same frequency, contributing to higher data transfer speeds in cable networks. Similarly, FWA technology combined with 5G will enable gigabit speeds and access to high-speed internet even in hard-to-reach locations. In this regard, the use of 5G in millimetre-wave bands such as 26 GHz (for high speeds over short distances) and in the sub-6 GHz band (for better coverage and signal penetration) will be key. Last but not least, in the context of technological innovations, it should be noted that new methods of cable installation and the modernisation of existing infrastructure can significantly reduce costs and shorten the time required to build VHCN networks.
- **Demographic and geographical factors:** Larger cities are likely to be prioritised for VHCN expansion due to higher demand and population density, even though public support programmes exist to mitigate these disparities. Similarly, growth in the number of households and businesses will have an impact. In the case of the number of households, we anticipate an average CAGR of 0.25% for the period up to 2030.
- **Demand for high-speed internet:** As the use of data-intensive services such as streaming services, online gaming and remote working grows, demand for fast internet will increase. Similarly, digitalisation in many areas, particularly in e-government, education and healthcare, will contribute to increased demand for reliable high-speed internet connectivity, as demonstrated, for example, by the COVID-19 pandemic.
- **Competitive environment:** Operators and internet providers will have to compete not only on price, but also on the quality and speed of connections, which may accelerate investment in network development. Market dynamics and the pace of VHCN roll-out may also be influenced by mergers and acquisitions within the telecommunications sector. For example, the merger of Vodafone and a cable provider

completed in 2019, has significantly influenced the telecommunications market, including the roll-out of VHCN networks. This acquisition combined the network capacities and services of both companies, thereby creating one of the key players in the market for both fixed and mobile connections.

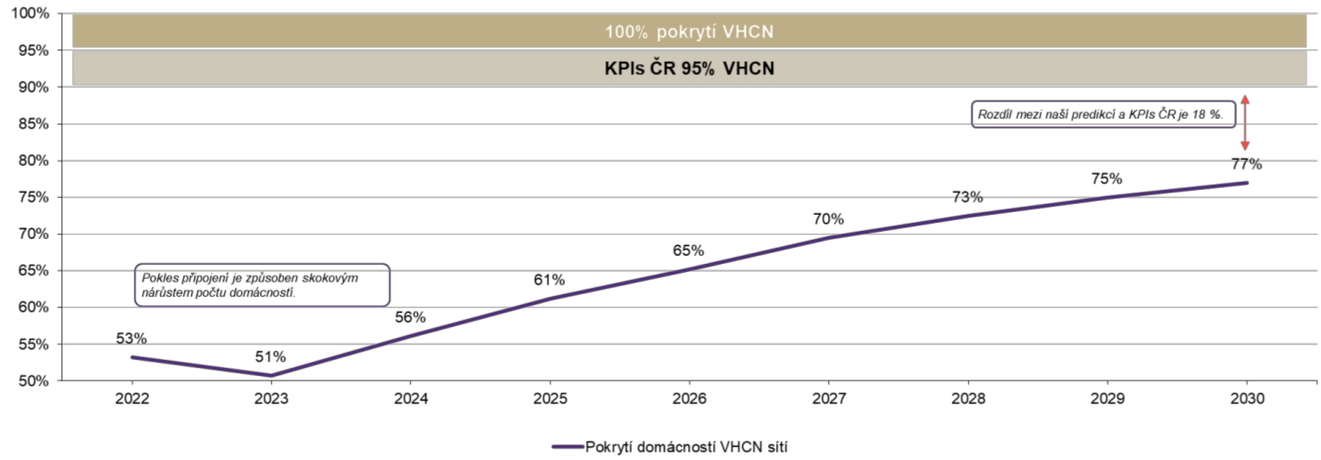
- **International commitments and cooperation:** In addition to its commitments under the Digital Agenda 2030 and other EU initiatives, the Czech Republic utilises EU support programmes, which are translated at national level into the aforementioned operational programmes. Thanks to international cooperation within standardisation bodies (ITU, ETSI or IEEE), the Czech Republic adopts the latest technological standards for VHCN, which facilitates interoperability and accelerates the deployment of modern technologies (e.g. 5G, XGS-PON, DOCSIS 3.1). The Czech Republic has access to international forums and groups for sharing experience and best practice in the construction of VHCN networks.
- **Prediction of subsidy support:** The forecast for the development of VHCN network coverage also includes an estimate of the number of connections created under the subsidy scheme. This was calculated as the total subsidy allocation of the current Operational Programme Technology and Applications for Competitiveness (OP TAK) divided by the historical cost per connection from previous subsidy programmes (plus inflation).

Note: In view of the last point mentioned, it is also necessary to address the issue of reporting and comparison within the EU (benchmarking). In the case of the latest reports for 2023, for example, the number of households in the Czech Republic for 2023 (see Chapter 8.3) relates to the corresponding CSO figure for 2021, which stood at 4,813,103. In our forecast, we therefore use updated data on the number of households, comparable to the number of so-called OBAM/flat – residential building address points – which is more than 300,000 higher than the figure mentioned above. Similarly, we use data on the number of registered VHCN connections for 2023, which were requested from the Czech Telecommunications Office (ČTÚ) for this purpose, as the basis for the forecast. On this basis, the indicator of VHCN network coverage of households for 2024, the base year of the forecast, is essentially identical to that of the previous year, despite a more than 5% increase in the number of all VHCN connections (according to the extended BEREC definition).

8.2 Forecast of VHCN network coverage

When looking at the forecast for VHCN network coverage as a whole, a decline is visible in 2023. This drop is caused by a significantly different reference value for the total number of households. See the note above. The resulting forecast up to the end of 2030 is therefore as follows: **VHCN coverage is expected to reach 77% of households by 2030**, even after taking into account subsidies from support programmes, reflecting growth in urban and surrounding areas. In contrast, rural areas will remain largely uncovered by VHCN networks. This will mean a lack of access for approximately 18% of households compared to the relevant target of the Digital Agenda for the Czech Republic. This deficit may lead to a further widening of the digital divide between urban and rural areas, and thus to unequal opportunities in terms of access to education, healthcare and employment, which today often depend on high-quality internet connectivity.

Figure 13: Forecast of VHCN network coverage of households in the Czech Republic by 2030



When estimating the development of VHCN network coverage, we work with a short-term/medium-term three-year horizon and a long-term six-year horizon. In the first case, this refers to the period between the end of 2024 and 2027, when the timeframe of the National VHCN Network Development Plan ends. The longer-term horizon is extended by a three-year period to 2030 in line with the objectives of the European strategic document, the Digital Agenda.

8.2.1 Medium-term horizon to 2027

In the medium-term horizon up to the end of 2027, higher growth dynamics can be expected than in the subsequent period. The growth in the number of VHCN connections in the Czech Republic up to 2027 will be driven primarily by the development of FTTP optical connections, which will remain the dominant technology thanks to support from the private sector and public subsidy programmes.[32] Growth in the number of FTTP connections during this period will initially be around 8%, later falling to 6%. DOCSIS 3.1 and later DOCSIS 4.0 technology will complement fibre in urban areas with existing cable networks, whilst FWA will offer a solution in sparsely populated regions. In the case of cable networks, this will involve an upgrade from versions 3.0 and 3.1; however, the potential for further growth is rather limited. Cable networks cannot offer the same quality and speed of connection as fibre-optic networks. DOCSIS 3.1 technology may play a role in areas where cable infrastructure is already in place and where upgrading to fibre is not cost-effective. Some cable companies may favour this technology to increase speeds without the need for a complete network overhaul. Although a certain increase in the share of DOCSIS 3.1 can theoretically be expected, its growth will not be as dynamic as that of fibre-optic solutions.

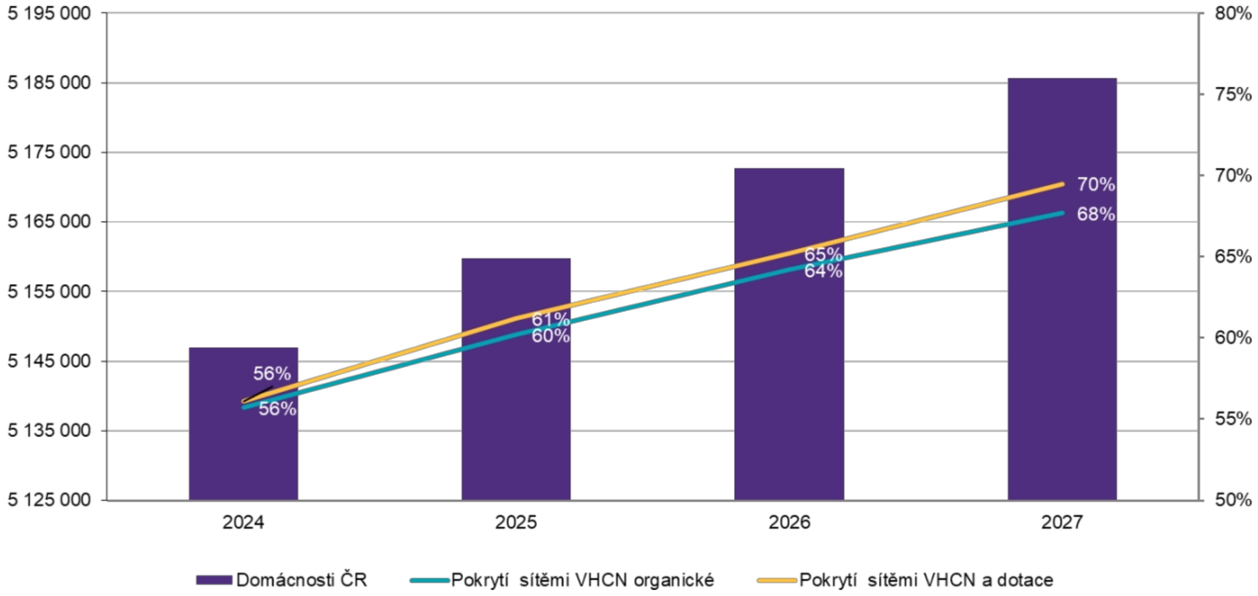
Coverage by fixed networks (FTTP and DOCSIS) according to the original VHCN definition is expected to reach just under 63% of households by the end of 2027, assuming organic growth (i.e. excluding connections built through subsidy schemes). This corresponds to an average growth rate of 3%. Under BEREC's broader definition, and after including connections built through subsidy schemes, household coverage is expected to reach approximately 69.5% of households by the end of 2027. In this case, growth is expected to be higher (partly due to the inclusion of FWA connections qualifying as VHCN, particularly in rural areas) and amount to approximately 5% initially, and 4%
%. Given the parameters of the OP TAK, connections built under the first phase of the programme are also included in the medium-term outlook (in 2027). We assume that a subsidy programme on a similar basis will also be established in the next programming period. However, given the absence of its parameters, the forecast beyond 2027 does not account for further households connected via subsidy schemes.

[32] We examine the role of public support in more detail in a separate study entitled 'Definition of the investment gap in VHCN network construction in relation to 5G network development'.

Table 5: Forecast of VHCN coverage development in the medium term 2024–2027

Indicator	2024	2025	2026	2027
Households in the Czech Republic	5,146,935	5,159,802	5,172,702	5,185,634
Number of VHCN network connections as defined by BEREC	2,886,795	3,158,826	3,373,503	3,604,826
Household coverage by VHCN networks as defined by BEREC	56.1%	61.2%	65.2%	69.5%
Of which VHCN connections built using grant funding	18,408	51,077	51,077	92,592
VHCN connections built from grant schemes in the given year	0	32,669	0	41,515

Figure 14: Forecast of the development of the number of VHCN connections in the Czech Republic by 2027



8.2.2 Long-term outlook to 2030

For the period 2028–2030, we can also estimate further growth in VHCN network coverage of households based on current trends, technological developments and planned investments (see above), particularly in relation to fibre-optic networks and the modernisation of cable networks. However, it is likely that the rate of growth will not be as high as in the previous period of 2024–2027. The rate of growth in VHCN gigabit network coverage of households in the 2028–2030 period is predicted to be slower than in 2024–2027, for the following reasons:

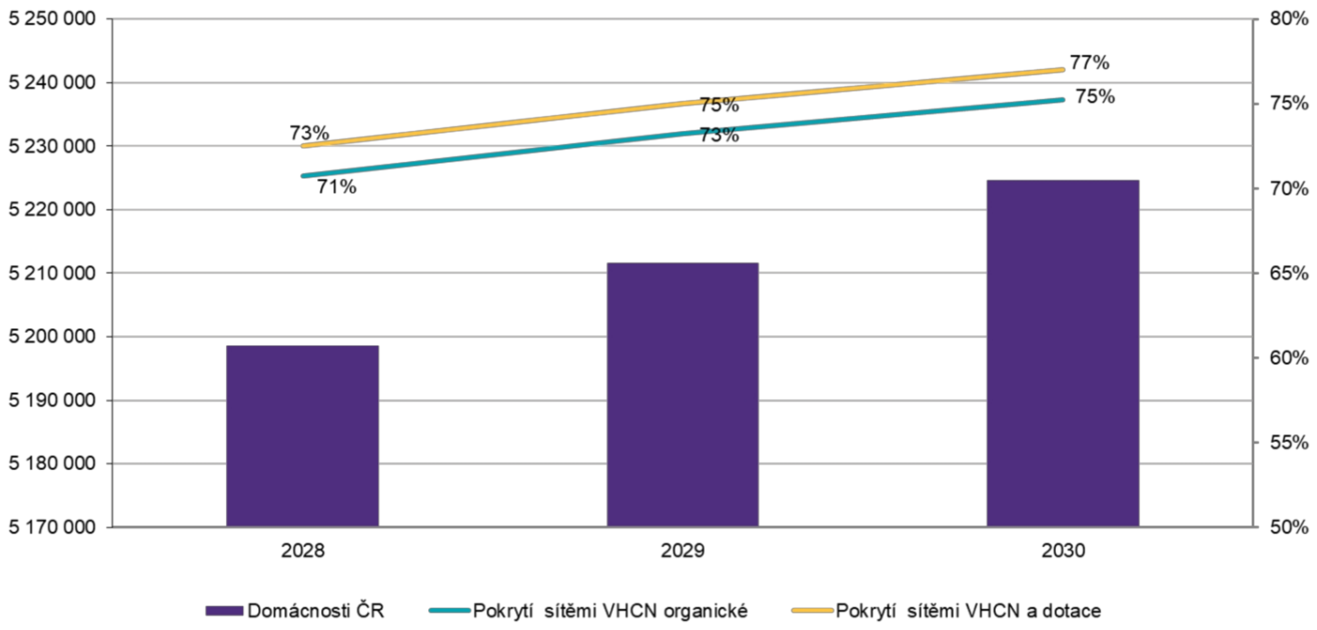
- Slowing coverage in densely populated areas: Most urban areas where it is economically viable to build gigabit networks will already be covered by 2027. Further growth will take place in rural and other areas less lucrative for investment, where construction is more challenging and costly.
- A gradually saturated market: Once a critical coverage threshold has been reached in urban areas, demand for new connections – particularly in rural areas – will be lower, thereby slowing investment growth given the longer payback period.
- Support through grant schemes: Although public grant programmes (e.g. from European funds) will continue to support construction in remote areas, construction in these areas is more time-consuming and the current forecast does not assume the existence of any further grant schemes (beyond those already known), even for the purpose of identifying further specific needs.

We anticipate that by the end of 2030, organic growth (excluding subsidy schemes) will achieve approximately 75% coverage by VHCN networks and 77% according to the extended BEREC definition, after accounting for VHCN connections built using subsidy schemes. The average annual increase in household coverage during this period is expected to be between 2% and 3%.

Figure 15: Forecast of VHCN coverage for the period 2028–2030

	2028	2029	2030
Households in the Czech Republic	5,198,598	5,211,594	5,224,623
Number of VHCN network connections as defined by BEREC	3,769,560	3,909,042	4,023,076
Household coverage by VHCN networks as defined by BEREC	72.5%	75.0%	77.0
Of which connections built under subsidy schemes[33]	92,592	92,592	92,592
Connections built under grant schemes in the given year[34]	0	0	0

Figure 16: Forecast of the development of the number of VHCN connections in the Czech Republic in 2028–2030



8.3 Specification of progress assessment indicators

Indicators for measuring progress in the development of VHCN networks must correspond to the key indicators from the DESI methodology measuring progress towards the Digital Decade targets, including the studies ‘Broadband coverage in Europe’:

- **Gigabit connectivity:** Percentage of households covered by fixed VHCN networks. This indicator includes technologies currently capable of providing gigabit connectivity, namely:
  - fibre to the premises (FTTP);
  - DOCSIS cable technology.

In addition, it is important to monitor other indicators which, like the two mentioned above, are based on the ‘Broadband coverage in Europe’ studies prepared annually for the European Commission by Omdia and Point Topic, or for which the EC collaborates with Eurostat to obtain the data. Within the DESI framework, these indicators include, in particular:

[33] Support through grant schemes is currently envisaged, although, understandably, no details are known as yet.

[34] Ibid.

VHCN connectivity according to the (extended) BEREC definition:

- **VHCN coverage according to BEREC criteria:** Percentage of households covered

This indicator, which was also used as the main one for our prediction, is crucial in this regard. It assumes that at least one BEREC criterion for fixed or wireless networks is met. This is particularly significant for the situation in the Czech Republic, where 5G/FWA technology has great potential to fulfil the Digital Agenda targets, or at least to bring the country closer to them.

Fixed broadband connections:

- **Fibre-to-the-premises (FTTP) coverage:** Percentage of households covered
- **Fixed broadband connections (subscribers) >= 100 Mbit/s[35] :** Percentage of households (subscribers) with this connection, calculated as the total proportion of fixed broadband connections multiplied by the percentage of connections faster than 100 Mbit/s
- **Fixed broadband connections >= 1 Gbps[36] :** Percentage of households (subscribers) with this connection, calculated as the total number of fixed broadband connections multiplied by the percentage of connections faster than 1 Gbps.

Mobile broadband:

- **5G coverage in the 3.4–3.8 GHz band:** The percentage of populated areas with 5G coverage, measured as the proportion of households using 5G services in the 3.4–3.8 GHz band
- **5G SIM cards:** The number of SIM cards that have generated data activity on the national 5G network in the last three months (90 days), measured as a proportion of the total population.

The latest report, “Broadband Coverage in Europe 2023”(37), provides an overview of the development of indicators across the EU as a whole and for individual Member States, including the Czech Republic. For the Czech Republic, this year’s report uses a population figure of 10.828 million, an average of 2.2 persons per household, and a rural population share(38) of 19.5%.

35 Fixed broadband connections include all major fixed access technologies, excluding satellite connections. These are DSL variants (including VDSL and VDSL2), DOCSIS 3.0 and 3.1 cable connections, and FTTP fibre-optic connections.

36 See above.

37 https://digital-strategy.ec.europa.eu/en/library/digital-decade-2024-broadband-coverage-europe-2023

38 Areas with a population density of less than 100 inhabitants per square kilometre are considered to be rural.

Table 6: Broadband connectivity KPIs in the Czech Republic and the EU average

	Czech Republic 2023		Czech Republic 2022		Czech Republic 2021		EU27 2023	
Technology	**Total**	**Rural**	**Total**	**Countryside**	**Total**	**Countryside**	**Total**	**Rural**
FTTP	36.0%	7.2%	37.4%	8.1%	35.8%	6.9%	64.0%	52.8%
DOCSIS 3.0 cable modem	38.5%	2.0%	42.1%	3.8%	41.9%	3.6%	41.1%	9.5%
DOCSIS 3.1 cable modem	32.2%	0.0%	34.9%	0.0%	33.3%	0.1%	33.6%	5.3%
FWA	80.5%	85.4%	85.1%	85.4%	81.4%	85.3%	68.5%	59.6%
5G	94.6%	72.7%	82.6%	78.0%	49.4%	43.3%	89.3%	73.7%
5G in the 3.4–3.8 GHz band	39.3%	32.3%	42.3%	32.0%	-	-	50.6%	15.2%
Fixed broadband total	99.6%	98.7%	99.9%	99.8%	99.9%	99.6%	97.7%	92.2%
Fixed VHCN (FTTP and DOCSIS 3.1)	50.5%	7.2%	53.2%	8.2%	52.5%	7.0%	78.8%	55.7%
VHCN as defined by BEREC	55.6%	14.8%	-	-	-	-	88.1%	70.0%
Broadband connections with speeds of at least 30 Mbit/s	98.2%	-	98.3%	-	98.1%	-	93.3%	-
Broadband connections with speeds of at least 100 Mbit/s	91.1%	-	90.2%	-	89.2%	-	89.0%	-
Broadband connections with speeds of at least 1 Gbit/s	40.3%	-	42.5%	-	38.1%	-	75.6%	-

Source: Broadband coverage in Europe 2023

Note: Data on user coverage (excluding 5G technology) reflect the situation as at 31 December 2022. The Czech Telecommunications Office (ČTÚ) noted that although there was an increase in the absolute coverage figures for individual technologies compared with the data presented in the BCE 2022 report, due to the significant increase in the number of households in municipalities across the Czech Republic, as recorded in the 2021 census conducted by the Czech Statistical Office (an increase of 437,993 households in total and 67,183 in the case of rural households), there has generally been a decline or stagnation in the percentage share of covered households compared to the BCE 2022 report.

The broadband market in the Czech Republic is distinctive within the EU due to the large number of smaller FWA providers, which is reflected in the high coverage of this type of connection (80.5% of Czech households compared to the EU27 average of 68.5%), corresponding to approximately a one-third market share. This also points to the potential of FWA, provided that one of the BEREC criteria is met, in achieving strategic objectives, including in the area of VHCN coverage.

As mentioned above, the Czech Republic lags significantly behind the European average in terms of coverage by fixed VHCN networks capable of speeds of 1 Gbit/s (50.5% versus 78.8%), even under the extended BEREC definition (55.6% versus 88.1%). In rural areas, only 7.2% of households are covered by fixed VHCN networks; under BEREC's extended definition, which also includes mobile networks, the figure is 14.2%.

Cable operators in the Czech Republic traditionally serve large cities, and household coverage is concentrated almost exclusively in these areas. The roll-out of DOCSIS 3.1 technology began in the second half of 2020, and within three years, almost a third of households had gained access to this service.

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