UNOFFICIAL MACHINE TRANSLATION

NPO summary study on the development of the 5G ecosystem and VHCN networks

Prepared for the Ministry of Industry and Trade

[September 2025]

UNOFFICIAL MACHINE TRANSLATION

Contents

Appendices

List of terms and abbreviations

Term, abbreviation	Description
3GPP	Third Generation Partnership Project – International consortium of telecommunications standardisation organisations
5G	Fifth generation of mobile networks
6G	Sixth generation of mobile networks
AI Act	Artificial Intelligence Act
APMS	Association of Mobile Network Operators
AR	Augmented Reality
BCO	Broadband Competence Office
BEREC	Body of European Regulators for Electronic Communications
BTS	Base Transceiver Station – Base station (e.g. mobile networks)
CAPEX	Capital Expenditures
C-ITS	Cooperative Intelligent Transport Systems
CEF Digital	Connecting Europe Facility – Digital – The part of the CEF programme focused on the Digital Decade
CEPT	European Conference of Postal and Telecommunications Administrations
CMS	Central Service Point
ČTÚ	Czech Telecommunications Office
Cybersecurity Act	Cybersecurity Regulation
CZQCI	Czech Quantum Communication Infrastructure
Data Act	European Data Regulation
DESI	Digital Economy and Society Index
DESÚ	Transport and Energy Construction Authority
DIA	Digital and Information Agency
Digital Networks Act (DNA)	New legislative framework for the functioning of the electronic communications market in the EU
DOCSIS	Data Over Cable Service Interface Specification – A telecommunications standard for high-speed data transmission over coaxial cable networks
DSS	Dynamic Spectrum Sharing
DTM	Digital technical maps
DTT	Digital Terrestrial Television
DVB-T2	Digital Video Broadcasting – Second Generation Terrestrial
eMBB	Enhanced Mobile Broadband – High-capacity service within 5G
eMTC	Enhanced Machine-Type Communications – LTE-M technology for the Internet of Things (IoT)
ECC	European Electronic Communications Committee
EECC	European Electronic Communications Code
ERDF	European Regional Development Fund
EC	European Commission
EN	Edge Node – A border or peripheral (computing) node located close to end users
ERA	European Union Agency for Railways

Term, abbreviation	Description
ERJU	European Rail Joint Undertaking
ESIM	Earth Stations in Motion – Mobile ground stations (platforms)
ETCS	European Train Control System – Single European Train Control System
FeMBMS	Further evolved Multimedia Broadcast Multicast Service
FDD	Frequency Division Duplex – Frequency duplex (a method of communication in wireless networks)
FRMCS	Future Railway Mobile Communication System – International standard for wireless communication in rail transport
FWA	Fixed Wireless Access
GIA	Gigabit Infrastructure Act
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite System
GSD	Geographical Survey Data
GSM-R	Global System for Mobile Communications – Railway
HAPS	High-Altitude Platform Stations
HRC	High Reliability Communications
Fire and Rescue Service	Fire and Rescue Service
IIoT	Industrial Internet of Things
IMT	International Mobile Telecommunications
IMT-2020	International Mobile Telecommunications-2020 (5G standard)
IoT	Internet of Things
IROP	Integrated Regional Operational Programme
IRU	Indefeasible Rights of Use
ITU	International Telecommunication Union
IZS	Integrated Rescue System
JIM	Single Information Point
JVDKM	Unified Public Documentation and Communication Centre
KPI	Key Performance Indicators
LSA	Licensed Shared Access
LTE	Long-Term Evolution – Fourth-generation mobile networks
M2M	Machine-to-Machine – Communication between devices
MEC	Multi-access Edge Computing – Distributed computing environment located close to end users
MFCN	Mobile/Fixed Communications Networks – Mobile/Fixed communications networks
MIMO	Multiple-Input Multiple-Output – Wireless communication technology for increasing data transmission capacity
MMR	Ministry for Regional Development
MPO	Ministry of Industry and Trade
MPSV	Ministry of Labour and Social Affairs
SMEs	Small and medium-sized enterprises
MSS	Mobile Satellite Service
MoI	Ministry of the Interior
MoE	Ministry of the Environment
NAKIT	National Agency for Cyber and Information Security and Information Technology
NDT	Network Digital Twin

Term, abbreviation	Description
NIS2	Network and Information Security Directive 2
NPO	National Recovery Plan
NPÚ	National Heritage Institute
NR	New Radio – Radio Interface (4G LTE evolution)
NRA	National Regulatory Authorities
NTN	Non-terrestrial Networks
NÚKIB	National Cyber and Information Security Agency
OPEX	Operational Expenditures
OP PIK	Operational Programme Enterprise and Innovation for Competitiveness
OP TAK	Operational Programme Technology and Applications for Competitiveness
PQC	Post-quantum Cryptography
PPDR	Public Protection and Disaster Relief
PPP	Public-Private Partnership
PUE	Power Usage Effectiveness – Data centre energy efficiency indicator
PVRS	Radio Spectrum Utilisation Plan
QC	Quantum Computing – Quantum computations (applications of quantum mechanics)
QKD	Quantum Key Distribution
RIPE NCC	Réseaux IP Européens Network Coordination Centre – Regional Internet Registry (for IP address management)
RRF	Recovery and Resilience Facility
RSRP	Reference Signal Received Power – Average radio signal power
RSPG	Radio Spectrum Policy Group
SoC	System-on-Chip – An integrated circuit that combines all the key components of a computer or electronic system on a single chip
SŽ	Railway Administration
TDD	Time Division Duplex – Time division duplex (a method of communication in wireless networks)
TEN-T	Trans-European Transport Network
TN	Terrestrial Networks
TR	Technical Report
UHF	Ultra High Frequency – Frequencies from 300 MHz to 3 GHz
UIC	International Union of Railways
UNIFE	Union of the European Railway Industry
URS	User Requirements Specification
VHCN	Very High-Capacity Networks
VR	Virtual Reality
WRC	World Radiocommunication Conference
WRC-23	World Radiocommunication Conference 2023
WRC-27	World Radiocommunication Conference 2027
WRC-31	World Radiocommunication Conference 2031
ZSJ	Basic Settlement Units

Executive Summary

The aim of the study prepared for the Ministry of Industry and Trade is to support the state's strategic decision-making regarding the development of digital infrastructure in the Czech Republic, particularly in the area of very high-capacity networks (VHCN), including 5th generation (5G) mobile networks, with a view to 6G technologies. The study builds on national and European strategic documents and emphasises the creation of a clear framework of measures that can be implemented through specific projects. The study focuses on ensuring a technologically competitive environment, increasing the availability of modern digital services, and supporting innovation in public administration, business and infrastructure.

The Czech Republic is bound by a number of European strategic and legislative frameworks, including in particular the EU Digital Decade, the Gigabit Infrastructure Act (GIA), the outcomes of the World Radiocommunication Conference (WRC-23) and the recommendations of the Radio Spectrum Policy Group (RSPG). At national level, the key documents are the National Plan for the Development of Very High Capacity Networks, the Strategy for the Development of 5G Networks in the Czech Republic and the related action plans. These documents often contain binding measures or specific targets for individual state authorities or administrative bodies. The study therefore proposes a framework for aligning these strategic objectives, eliminating duplication, and prioritising and harmonising implementation activities.

Based on a commission from the Ministry of Industry and Trade, 27 expert studies focusing on key areas of digital infrastructure were produced between 2024 and 2025. The studies cover four main thematic areas:

- **Radio spectrum management** – analysis and proposal for frequency spectrum management, spectrum sharing (including 26 GHz), use of high-frequency bands (42+ GHz, 6G).
- **VHCN deployment** – identification of investment gaps, support in rural areas, coverage mapping, subsidy models.
- **5G applications and digitalisation** – IoT, 5G FWA, 5G Broadcast, digital twins, industrial applications, PPDR (emergency services).
- **Public safety and cybersecurity** – risk assessment (including Open RAN, quantum communications), security requirements for private networks.

The outputs of these studies provide recommendations for network development in various types of locations, for coverage of major transport hubs, Smart Cities and rural areas, including proposals for the use of public funds and investment incentives.

This study subsequently systematises all these findings into a comprehensive reference table, which summarises the required measures and action steps from strategic documents and individual studies. This matrix is designed as a clear tool for policy administrators (Ministry of Industry and Trade, Czech Telecommunications Office, DIA, NAKIT, etc.) and serves to provide better guidance on legislative and practical tasks. Based on the data synthesised in this way, a proposal for specific framework projects covering the aforementioned thematic areas of digitalisation was subsequently developed. Each step (measure) was analysed according to four parameters: stage of development, implementation complexity, relevance and time urgency. These values were converted into a quantitative model that allows for the comparison and subsequent prioritisation of projects. The output also includes a timeline for the implementation of these project proposals.

The study proposes a total of **31 specific framework projects** for the effective use of public resources and the achievement of European and national objectives in the field of digitalisation and connectivity, thereby providing a comprehensive basis for the strategic management of digital infrastructure development in the Czech Republic. As part of the study, **guidelines on the sharing of communications infrastructure** were also drawn up, providing practical guidance for operators of electronic communications networks within the framework of existing legislation and with a view to expected changes in the applicable legal standards.

Executive Summary

The objective of this study, prepared for the Ministry of Industry and Trade, is to support strategic state-level decision-making in the development of digital infrastructure in the Czech Republic – particularly regarding very high-capacity networks (VHCN), including fifth-generation (5G) mobile networks, with consideration for future 6G technologies. The study builds upon national and European strategic documents and emphasises the creation of
a clear framework of measures that can be implemented through specific projects. It focuses on ensuring a technologically competitive environment, increasing the availability of modern digital services, and fostering innovation in public administration, business, and infrastructure.

The Czech Republic is bound by several European strategic and legislative frameworks, notably the EU Digital Decade, the Gigabit Infrastructure Act (GIA), the outcomes of the World Radiocommunication Conference WRC-23, and recommendations by the Radio Spectrum Policy Group (RSPG). At the national level, key documents include the National Plan for the Development of Very High-Capacity Networks, the 5G Strategy of the Czech Republic, and related action plans. These documents often contain binding measures or specific goals for government authorities and programme administrators. The study therefore proposes a framework to align these strategic objectives, eliminate duplication, and prioritise and harmonise implementation activities.

Based on the Ministry's mandate, 27 expert studies were developed between 2024 and 2025, focusing on key areas of digital infrastructure. These studies cover four main thematic areas:

- **Radio Spectrum Management** – analysis and proposals for frequency spectrum management, band sharing (including 26 GHz), and the use of high-frequency bands (42+ GHz, 6G).
- **VHCN Deployment** – identification of investment gaps, support for rural areas, coverage mapping, and subsidy models.
- **5G Applications and Digitalisation** – IoT, 5G FWA, 5G Broadcast, digital twins, industrial applications, and PPDR (public protection and disaster relief).
- **Public Protection and Cybersecurity** – risk assessments (including Open RAN and quantum communication), and security requirements for private networks.

The outputs of these studies offer recommendations for the development of networks in various types of locations, including major transport hubs, Smart Cities, and rural areas. They also include proposals for the use of public funds and investment incentives.

This study then systematises all the gathered findings into a comprehensive reference table that summarises required measures and action steps from both strategic documents and the individual studies. The matrix is designed as a clear tool for agenda administrators (e.g., MPO, CTU, DIA, NAKIT) to better navigate legislative and practical responsibilities. Based on this synthesised data, a proposal for concrete framework projects has been created to cover the aforementioned thematic areas of digitalisation. Each step (measure) has been analysed across four parameters: degree of elaboration, implementation difficulty, relevance, and time urgency. These values have been converted into a quantitative model that enables comparison and subsequent prioritisation of projects. The result also includes a timeline for the implementation of these project proposals.

In total, the study proposes **31 specific framework projects** aimed at the effective use of public resources and the achievement of both European and national objectives in the field of digitalisation and connectivity. It thus provides a comprehensive foundation for the strategic management of digital infrastructure development in the Czech Republic. As part of the study, **guidelines for the sharing of communication infrastructure** have also been developed. These guidelines provide a practical manual for electronic communications network operators, within the framework of current legislation and taking into account expected changes in applicable legal norms.

1 Introduction

The development of electronic communications is a key prerequisite for the digital transformation of the Czech Republic. Very high-capacity network (VHCN) infrastructure, including next-generation mobile networks (5G and future 6G), forms the basis for modern services, a competitive business environment and efficient public administration. Given rapid technological developments and the growing demands of society and industry, it is essential to ensure that the development of these networks proceeds in a coordinated and efficient manner, in line with both national and European objectives.

At the European Union level, strategic and legislative frameworks are being established that commit Member States to developing national strategies. These frameworks include, for example, the EU Digital Decade, the Gigabit Infrastructure Regulation, the outputs of the RSPG and ETSI, and the results of the World Radiocommunication Conferences (WRC). The Czech Republic responds to these initiatives through its own strategic documents – in particular the National Plan for the Development of VHCN Networks and the Strategy for the Implementation and Development of 5G Networks in the Czech Republic. Both documents were created as fundamental tools for achieving the country's digital readiness and also reflect the priorities of the National Recovery Plan (NRP), including components dedicated to digitalisation and infrastructure.

Based on a commission from the Ministry of Industry and Trade, 27 thematically focused studies were produced, aimed at analysing key areas related to the construction, operation and use of VHCNs, including 5G networks. These studies, covering four main thematic areas (radio spectrum management, VHCN network deployment, the use of 5G applications, and security and cybersecurity), addressed, among other things, the development of territorial coverage, conditions for infrastructure sharing—including the effective use of state support for network deployment in remote areas—the use of 'new' bands for 5G (e.g. the 26 and 42 GHz bands), the development of new technologies (e.g. 6G, 5G Broadcast, network slicing, digital twin, satellite communications), cybersecurity, including the impact of quantum computing on the security of communication networks, and the use of 5G applications in industry and public administration. The relevant recommendations emphasised the link to the fulfilment of national and European strategic objectives, often very specific KPIs, particularly within the framework of the EU's Digital Decade policy.

This document focuses on synthesising these findings, categorising them clearly and transforming them into specific strategic measures (action steps), from which the content of the relevant implementation projects can subsequently be developed. The key benefit of this document is thus the compilation and prioritisation of all strategic, mandatory and non-mandatory action steps into a common reference framework, from which inputs can be drawn for the commissioning (or implementation) of the relevant steps by their project managers. The aim is to provide managers with a guide so that, in their own project plans, they can more easily and as required select and address the objectives contained in various documents, overlapping recommendations and strategies at different levels and in different areas (national, EU, by focus), or to enable individual plans to be compared, their completeness assessed, scaled, etc. Last but not least, an overview created in this way can be more easily updated on an ongoing basis in light of technological progress and changing socio-economic conditions.

The document also includes practical information, such as supplementary details on the development and monitoring of edge nodes and practical guidelines on infrastructure sharing during the construction of communication networks.

The study is structured so that the first part provides an overview of currently valid strategic documents and their milestones, followed by a summary of findings from studies conducted for the National Recovery Plan, and subsequently presents a synthesis of these documents and a reference summary of all action steps, including proposals for project plans for the development of digital infrastructure in the Czech Republic.

Structure of the document:

1. Introduction
2. Presentation of currently valid strategic documents and international harmonisation documents. This section provides an overview of the key documents on which the study is based. These include, in particular:
    a. Global and European frameworks: Important initiatives such as the GIA, the Digital Decade, or guidelines arising from ITU conferences and European strategies.

   b. Czech strategic documents: National Plan for the Development of Very High Capacity Networks, Implementation and Development of 5G Networks in the Czech Republic.

3. Overview of studies and recommendations:
   a. **Study on 5G network coverage and radio spectrum management** (with an analysis of technological trends, such as bands above 100 GHz for 6G or the use of the 42 GHz band)
   b. **Enterprise digitalisation and digital infrastructure development** (IoT, enterprise digitalisation, network slicing, etc.)
   c. **Security and cybersecurity** (cybersecurity, quantum communication, PPDR)
   d. Achievement of KPIs in the area of connectivity and **VHCN network coverage**, including infrastructure studies/analyses such as (FRMCS, 5G Broadcasting, 5G FWA, infrastructure sharing)

4. Synthesis of study outputs regarding strategic objectives
   a. Grouping strategic objectives into thematic blocks: Grouping issues to be addressed that have synergistic effects or interdependencies to improve the clarity and organisation of the study synthesis.
   b. Reflecting on the outputs of previous studies and their impact on specific objectives and implementation activities set out in the Czech Republic's strategic documents

5. Creation of a reference matrix of measures and recommendations, including project proposals and prioritisation
   a. Explanation of the synthesis methodology and the logic behind the creation of the comprehensive study
      i. Summarising all measures (tasks) required in the strategic documents and findings from the studies into an overview reference document (matrix).
      ii. Consolidation of all recommendations (sub-action steps) contained in the individual studies, including updated information, into comprehensive action steps – framework projects
      iii. Evaluation of further parameters (urgency, relevance, implementation barriers) based on analyses already carried out.
      iv. Proposal of priorities based on a combination of evaluation parameters.
      v. Proposal of a timeline for the implementation of the proposed summary projects, taking into account the estimated timeframe required to achieve the proposed objectives.

6. Summary and conclusion
   a. Recap of key findings and proposals.
   b. Guide to the output tables and other graphical materials
   c. Top 5 high-priority projects

2 Strategic documents

2.1 Brief overview of relevant strategic documents

The development of VHCN (Very High Capacity Networks) and gigabit infrastructure represents a key priority for the Czech Republic in the field of digital infrastructure, the implementation of which is essential for ensuring the competitiveness of the economy, the availability of modern services and support for the digitalisation of society. The Ministry of Industry and Trade (MPO), as the main guarantor of these activities, in close cooperation with the Czech Telecommunications Office (ČTÚ), plays a key role in fulfilling national and European objectives in the field of supporting the digital society.

The strategic framework for this area is defined by documents such as **the National Plan for the Development of Ultra-High-Capacity Networks** and other materials falling under the **Digital Czech Republic** concept and **the Innovation Strategy of the Czech Republic 2019–2030**. These documents are based on the European Electronic Communications Code (EU Directive 2018/1972) and reflect European priorities such as the Gigabit Society and the 5G Action Plan for Europe. The common goal of these initiatives is, in particular, to establish widespread high-speed connectivity that will ensure access to broadband for households, businesses and public institutions. However, given the dynamic nature of developments, the specific objectives of these strategic documents are being updated to reflect market trends; this is also why the main European Digital Economy and Society Index (DESI) has been incorporated into a new initiative based on it, known as **the Digital Decade.** In place of the outdated Directive 2014/61/EU (the Gigabit Infrastructure Regulation), a new **Regulation on measures to reduce the costs of deploying gigabit networks (GIA)** – with the adopted changes aimed at accelerating and reducing the cost of building gigabit networks in the EU, in particular by reducing administrative costs and facilitating the shared use of existing physical infrastructure.

Another key aspect for the development of VHCN and the digital society in general is the ability to manage scarce resources efficiently; in this context, this refers to the optimal use of the radio spectrum. This issue is addressed by **the RSPG Report on Spectrum Sharing**, which emphasises the need for and methods of sharing individual frequency bands between telecommunications operators and technologies. The conclusions from this initiative will be reflected in the forthcoming ITU **WRC-27**, which will build on the currently valid spectrum harmonisation from **WRC-23**.

In the Czech Republic, there are therefore five key strategic documents aimed at developing telecommunications infrastructure and removing barriers to digital connectivity for the population. However, the objectives and visions set out in these strategic documents reflect the time of their creation. For this reason, it is essential not only to update them regularly but also to conduct a comprehensive assessment and evaluation of the achievement of individual objectives. Many of the objectives were defined without specific milestones or measurable performance indicators (KPIs), which in practice complicates their precise evaluation. In the subsequent sections of the study, therefore, it either evaluates the established KPIs (particularly in the context of infrastructure development) or attempts to establish and evaluate them ex ante, so that the document’s outputs can be fulfilled, enabling the strategic documents to be updated and the progress achieved and the benefits of individual measures to be objectively assessed in the coming years. This practice could thus further support the effective use of both public and private resources, as well as improve planning processes, minimise legislative barriers and adapt the strategy to new technological trends. It is also essential to involve all relevant stakeholders – from public administration through the business sector to local authorities and the professional community – in creating an environment that will support investment and ensure the fulfilment of digital connectivity objectives. Through this approach, the Czech Republic is moving towards the implementation of digital infrastructure meeting the highest standards of technological progress, which will form the basis for innovation, competitiveness and an improved quality of life for citizens.

Strategic documents of the Czech Republic

- Czech Republic Innovation Strategy 2019–2030 – Digitalisation Pillar [1]
- Digital Czech Republic – Concept for the Development of eGovernment[2]
- National Plan for the Development of Very High Capacity Networks[3]
- Implementation and Development of 5G Networks in the Czech Republic[4]
- The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030[5]

These strategic documents are supplemented by an implementing document, **the** so-called **Action Plan for the Implementation of Non-Grant Measures to Support the Planning and Construction of Electronic Communications Networks**. In particular, Action Plan 3.0, approved in the summer of 2025, and to some extent Action Plan 2.0, where most of the measures in Action Plan 2.0 have been fulfilled, some continue into Action Plan 3.0, or are no longer relevant.

Overview of relevant legislation

- Directive (EU) 2018/1972 of the European Parliament and of the Council
- European Electronic Communications Code. Transposed into Act No. 127/2005 Coll., on Electronic Communications[6].
- Regulation of the European Parliament and of the Council on measures to reduce the cost of deploying gigabit electronic communications networks and repealing Directive 2014/61/EU (GIA)[7]
- Commission Communication COM (2016) 587 final – Connectivity for a competitive Digital Single Market – Towards a European Gigabit Society[8].
- Commission Communication COM(2016) 588 final – 5G Action Plan for Europe[9]
- Commission Recommendation (EU) 2020/1307 – A common set of Union tools to reduce the costs of deploying VHCN networks and ensure timely access to 5G radio spectrum[10].
- Regulation (EU) No 1303/2013 of the European Parliament and of the Council – General Regulation on the ESI Funds, Annex XI.
- Resolution of the Government of the Czech Republic No 629 of 3 October 2018 – Adoption of the strategic document 'Digital Economy and Society'.
- Resolution of the Government of the Czech Republic No 885 of 5 October 2016 – Support for the roll-out of high-speed networks.

All the above-mentioned documents contain time-bound measures (tasks) formulated in the form of development objectives, action plans or directly binding regulations, which the relevant state authorities must undertake and adopt at national level so that these measures are put into practice. These documents are discussed in greater detail in the following separate chapters, including a list of all such requirements for the implementation of measures by the state administration. These measures are subsequently clearly summarised and categorised in Chapter 6, Outputs, where, based on the studies conducted and the resulting recommendations, a prioritisation and further implementation procedure are proposed so as to maximise the benefits of the implementation steps over time. At the same time, attention is paid to the relevance of specific measures and, where necessary, amendments to the relevant documents are proposed.

---

[1] https://vyzkum.gov.cz/FrontClanek.aspx?idsekce=866015

[2] https://digitalnicesko.gov.cz/

[3] https://mpo.gov.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/2021/3/149908-21_III_mat_VHCN.pdf

[4] https://mpo.gov.cz/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/implementace-a-rozvoj-siti-5g-v-ceske-republice-_-cesta-k-digitalni-ekonomice--252026/

[5] https://digitalnicesko.gov.cz/media/files/The_Road_to_the_European_Digital_Decade_Strategic_Plan_for_Digitalisation_in_the_Czech_Republic_by_2030_2icFk2m.pdf

[6] https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:32018L1972&from=EN

[7] https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=OJ:L_202401309

[8] https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:52016DC0587&from=en

[9] https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:52016DC0588&from=cs

[10] https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:32020H1307&from=CS

2.2 Digital Decade

The EU's policy programme entitled **'Digital Decade 2030'**[(11)] is key to achieving the above objectives, aiming to bring about Europe's digital transformation by 2030. This strategy focuses on four key areas – the so-called 'digital goals':

- **A digitally skilled population**: The aim is for at least 80% of the EU population to have basic digital skills and for at least 20 million specialists in the field of information and communication technologies (ICT) to be working in the EU, with a balanced representation of men and women.

The Czech Republic performs slightly below average in terms of both basic and advanced digital skills compared to the EU average. Increased investment in ICT education and cooperation between educational institutions and the private sector are considered key to improving this area. The proportion of the population with at least basic digital skills stands at 60%, which is approximately 6 percentage points above the EU average. However, the proportion of ICT specialists in the workforce is 0.1 percentage points below the EU average.

- **Secure, resilient, high-performance and sustainable digital infrastructure**: The aim is to provide all end-users in fixed locations with gigabit connectivity and all populated areas with wireless VHCN networks of at least 5G standard (i.e. 100% coverage for both), furthermore, to produce at least 20% of global production of cutting-edge semiconductors within the EU, to deploy at least 10,000 climate-neutral, highly secure edge nodes, and to have the first quantum-accelerated computer by 2025.

In the context of developing coverage with gigabit connectivity and/or 5G networks, a modified target of 95% has currently been agreed for the Czech Republic, provided that satellite network coverage is also available. This allows construction to be concentrated where it offers greater efficiency, rather than in completely remote or hard-to-reach areas. The roll-out of very high-capacity networks (VHCN) is continuing, but coverage remains insufficient in some rural areas. A key objective is to expand 5G network coverage and further modernise the infrastructure. Financial support from EU funds is considered essential for rapid implementation. Fibre-optic network coverage of households stands at 36%, the third lowest figure in the EU. Fixed very high capacity network (VHCN) coverage of households stands at 53%, which is approximately 20 percentage points below the EU average.

- **Digital transformation of businesses:** At least 75% of companies in the EU will use technologies such as cloud computing, artificial intelligence or big data; more than 90% of small and medium-sized enterprises will achieve at least a basic level of digital intensity; and the number of so-called 'unicorns' (start-ups valued at over USD 1 billion) thanks to easier growth and better access to finance.

The level of digital technology integration in companies remains below the EU average. Small and medium-sized enterprises (SMEs) in particular face challenges in implementing advanced digital tools, such as ERP or CRM systems, primarily due to a shortage of skilled staff and limited financial resources. Supporting SMEs and simplifying access to funding for digitalisation are recommended measures. Only 9% of businesses in the Czech Republic use big data analytics, which is below the EU average (14%). Only 12% of businesses use electronic invoicing, compared to the EU average of 32%. On the other hand, the Czech Republic ranks third in the EU for the share of turnover from e-commerce among SMEs, specifically 17.2%.

- **Digitalisation of public services:** By 2030, all key public services should be available online and (where relevant) citizens and businesses should be able to communicate online with public authorities; all EU citizens should have access to their electronic health records and a digital identity recognised throughout the EU.

The Czech Republic has responded to these objectives by drafting the strategic document *'The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030*', which aims to assess the current state of digital transformation in the Czech Republic, set out national trajectories and identify specific measures leading to the fulfilment of European objectives. It sets out 58 measures across 15 thematic areas, including support for connectivity, increasing the number of ICT specialists, the digitalisation of SMEs, the development of eGovernment and cybersecurity. Each of the 58 measures has an assigned lead agency (e.g. MPO, DIA,

[11] Formerly known as DESI

NAKIT, ČTÚ, MPSV, etc.), who is responsible for its implementation. Budget estimates are also provided (total budget of approximately EUR 1.77 billion, i.e. 0.6% of GDP), including the use of RRF and cohesion policy funds. Monitoring of implementation is carried out by the MIT in cooperation with national partners; the outputs form part of the so-called Digital Decade Scoreboard.

The Czech Republic is making progress in the area of eGovernment, particularly in the availability of digital services for citizens and businesses. However, there is room for improvement in terms of user-friendliness and the interconnectivity of systems. Emphasis is placed on interoperability and ensuring cybersecurity. In the area of e-government, the proportion of citizens who have used online interactions with public authorities in the last 12 months is lower than the EU average. For example, in the area of e-health, the Czech Republic achieves a significantly lower score than the EU average, which is considered a key area for improvement.

To achieve the Digital Decade's objectives, it is essential that EU Member States adapt their national strategies and set specific targets in line with this European vision. In 2024, the European Commission, in its report on the state of the Digital Decade, called on Member States to review and amend their national plans to align them with the ambitions of the Digital Decade policy agenda. Member States were thus required to submit updated national plans by 2 December 2024, reflecting European objectives.

In the case of the Czech Republic, this means that the Ministry of Industry and Trade, in cooperation with other relevant institutions, has drawn up an updated National Action Plan for Smart Grids 2025–2030, which covers not only technical aspects but also the development of the population's digital skills, support for the digitalisation of businesses and ensuring the availability of digital public services.

2.3 GIA

Regulation (EU) 2024/1309 of the European Parliament and of the Council, known as **the 'Gigabit Infrastructure** Regulation' – GIA – represents a key step in strengthening digital connectivity in the European Union. This Regulation, adopted on 29 April 2024, focuses on reducing the costs of building gigabit electronic communications networks and amends or repeals certain previous measures, namely Directive 2014/61/EU. Member States must adopt the necessary national measures to implement the Regulation within 12 months of its entry into force. Coordination with the European Commission is also required, as the Commission will monitor whether the measures adopted are being effectively implemented. The implementation of the measures may be supported by EU funds, such as the Recovery and Resilience Facility (RRF) or the Structural Funds.

The Directive introduces an obligation to grant telecommunications operators access to existing physical infrastructure for the purpose of deploying VHCN network elements, particularly in rural areas. In line with this, it promotes transparency regarding physical infrastructure by providing for the provision of information upon request by operators (this includes georeferenced location and route, type and current use of the infrastructure, and a point of contact). It also specifies the procedure for coordinating construction works in connection with the deployment of VHCN, the procedure for granting authorisations and access to third-party property rights, automatic authorisation, and mandatory infrastructure within buildings (applicable to all buildings for which a building permit application was submitted after 12 February 2026). To coordinate these activities, Member States should establish single digital national points of contact.

Key aspects of the Regulation intended to reduce investment costs and accelerate the roll-out of gigabit networks:

Table 1: Key aspects of the GIA Regulation

Aspects of the Regulation GIA	Name of sub-aspect	Description
Reducing infrastructure construction costs	Infrastructure sharing	Mandatory access to existing physical infrastructure (e.g. pipelines, masts, buildings), where technically feasible, under fair and non-discriminatory conditions. This also includes networks used by other sectors, such as energy or transport.
	Coordination of construction works	Ensuring effective coordination between network operators and other entities when planning and carrying out construction works. This approach minimises duplication and reduces construction costs.
	Centralised information systems	Creating online information systems that will give operators access to data on existing infrastructure and planned works.
	Simplified procedures	Introduction of a unified permitting procedure for VHCN construction. Deadlines for issuing permits are limited to 4 months.

Acceleration of permitting processes	The 'Tacit Consent' rule	If the competent authority does not make a decision within the specified time limit, the application is deemed to have been approved.
	Digitisation of procedures	Mandatory introduction of electronic tools for submitting applications and for communication between operators and authorities.
Support for construction VHCN in areas with insufficient coverage	Definition of 'white' and 'grey' areas	Mandatory mapping of areas with insufficient or no access to VHCN networks. This data will be public and kept up to date.
	Targeted support	Focusing investment (both public and private) on these areas. Member States may provide grants or other incentives for construction.
Strengthening user rights and transparency	Simplifying user connectivity	Network operators will be required to provide access to their networks upon request, including transparent pricing information.
	Standardisation of building connections	Newly constructed or renovated buildings will have to be equipped with high-capacity infrastructure ready for gigabit networks.
Monitoring and evaluating progress	Regular reporting	Member States will be required to report to the European Commission on the results achieved, progress in network deployment and their impact on the digital transformation.
	Cooperation with EU bodies	The European Commission will regularly assess the effectiveness of the regulation and, where necessary, propose amendments to the legislation

2.4 Outputs from global World Conference WRC-23

In the context of national and supranational policies, the World Radiocommunication Conference (WRC), held every four years and organised by the International Telecommunication Union (ITU), plays a key role. The WRC addresses the most efficient use of the radio spectrum and the functioning of the telecommunications market. The main outcomes of WRC-23 are as follows:

1. Strengthening global spectrum coordination: The conference confirmed the strategic importance of harmonising frequency bands across continents and regions.

2. Expansion of spectrum for mobile communications: WRC-23 identified and harmonised new frequency bands for mobile communications within the IMT (International Mobile Telecommunications) system. These decisions will enable the further development of 5G networks and pave the way for the advent of 6G networks. The identified bands include, for example:
   - 6 425–7 125 MHz – potentially usable for higher-capacity mobile services,
   - Frequency bands above 40 GHz and above 100 GHz – with a view to ultra-high-capacity networks and very low latency in the future (e.g. 6G)

3. Support for the development of satellite services and systems: New resolutions and amendments to existing rules have been adopted to ensure the more efficient operation of satellite networks, particularly in the following areas:
   - Non-geostationary systems (non-GSO) – new procedures for registration, spectrum protection and sharing,
   - Earth stations in motion (ESIM) – enabling connectivity in aviation, maritime transport and other mobile applications,
   - Use of the 51.4–52.4 GHz band and others for so-called gateway stations connecting satellite systems with terrestrial networks.

4. Defining conditions for next-generation services
   - Use of high-frequency bands (e.g. above 100 GHz) for new applications, including future wireless access networks (e.g. 6G radio access networks),
   - Use of so-called High-Altitude Platform Stations (HAPS) – airborne systems providing communication services from high altitudes,
   - Extension of the GMDSS (Global Maritime Distress and Safety System) to include new

A number of topics addressed in the studies (use of millimetre bands, 6G, etc.) will be key points at the next WRC to be held in 2027. The outputs of this study should support strategic decision-making for the Czech Republic's agenda at the next world conference.

2.5 RSPG Report on Spectrum Sharing

The Radio Spectrum Policy Group (RSPG) is an expert advisory body to the European Commission on radio spectrum policy. It was established by a Commission decision of 11 June 2019, and its mandate was extended following the adoption of the European Electronic Communications Code in 2018. Members are representatives of the Member States and an official representative of the European Commission. The Chair of the RSPG is a member elected by the Group for a term of two years. The Commission, or the Group with the Commission's consent, may set up working groups to carry out specific tasks. The Commission convenes meetings of the Group through the Secretariat, in agreement with the Chair. Representatives of the European Economic Area, EU candidate countries, the European Parliament, CEPT and ETSI are invited to RSPG plenary meetings as observers.

At the request of the EC or on its own initiative, the Group may adopt opinions and reports. These are based on consensus or, where this is not possible, on a simple majority (members voting against have the option of attaching a minority opinion stating the reasons for their disagreement). To address specific issues, the EC may set up a sub-group, which is dissolved once its task has been completed. In the initial phase, consultations are held with stakeholders affected by the decision. The result is therefore an expert recommendation which the EC incorporates into directives, binding decisions or proposals and, among other things, defines the conditions for harmonisation, spectrum sharing or long-term licences.

The 2021 **RSPG Report on Spectrum Sharing** is a significant document for the purposes of this study, as it provides the technical and regulatory context for spectrum sharing, which enables the simultaneous use of the same frequency band by multiple entities. This leads to maximised spectrum efficiency and greater innovation in the telecommunications sector. The document examines spectrum sharing within the context of EU law, various sharing models, and the technologies used to implement it (including 5G technologies).

Among other things, the report focuses on spectrum sharing using 5G technologies, particularly network slicing. It sees potential for this concept in the 26 GHz band. It identifies further aspects of 5G networks in the combination of licensed and unlicensed spectrum usage, Licensed Assisted Access and Coordinated Multipoint for interference mitigation. The RSPG states that radio technologies enable a wide range of spectrum sharing models, with regulatory and standardisation bodies (ETSI, CEPT, 3GPP) having already developed or exploring technological solutions for specific frequency bands. Research and international cooperation between regulators, industry sectors and academia also play a key role. Programmes such as Horizon Europe (2021–2027), technical cooperation platforms at BEREC and CEPT level, and open-source software licences (e.g. the European Union Public Licence) were also intended to contribute to innovative solutions and facilitate development.

Annex 5 of the document traces the history of spectrum sharing in the Czech Republic up to 2021, from the initial trials in the 5.8 GHz band to the experimental use of 5G technologies in the 26 GHz band. Particular attention is paid to the 57–66 GHz (60 GHz) band, which has been designated for MGWS/WiGig services and fixed high-speed links, both in the legal framework and through the management of this part of the band. Spectrum regulation should therefore be based on the principles of general authorisation, which allow for innovative approaches to spectrum management based on transparency, technological neutrality and proportionality, combining in some cases self-regulation with traditional regulatory oversight, with the regulator intervening only where necessary to eliminate interference. Below is an overview of the parts of the spectrum associated with sharing issues:

- 6 GHz
- Satellites 30 MHz 1970–2000 – 2100 – 2130
- 26 GHz
- 60 GHz
- 600 MHz
- 3.7 GHz?[12]

Band sharing is encouraged in the 3.7 GHz band, where spectrum is currently allocated to the fixed, satellite fixed and mobile services in accordance with the radio spectrum utilisation plan.

[12]https://ctu.gov.cz/sites/default/files/obsah/ctu/sdeleni-o-vydani-opatreni-obecne-povahy-casti-planu-vyuziti-radioveho-spektra-c.pv-p/7/02.2022-3-for-the-2700-4200-mhz-frequency-band/images/pvrs7p.pdf

When describing spectrum sharing, it is important to note that there are five levels of band usage, each with its own specific characteristics:

- Exclusive use
- Static sharing
- Managed shared access (further divided into managed shared access and government-administered access)
- Dynamic spectrum sharing (further divided into priority access and non-priority access)
- Pure spectrum sharing (further divided into 'light' licensing and unlicensed access)

The CTO is exploring options for more flexible licensing models; in the case of DSA, it is basing its approach on the RSPG proposals drawn up in the first half of 2021[13]. In the Czech Republic, it is anticipated that work will commence on developing a suitable solution for the dynamic allocation of rights to use frequencies in the 26 GHz band, which is designated for 5G NR and forms part of the National Recovery Plan. Abroad, we can find examples of the application of this principle, for instance in the UK, where shared access licences are available in four frequency bands (1800 MHz, 2300 MHz, 3800–4200 MHz and 24.25–26.5 GHz – though here only for low-power licences intended for indoor use).

The term Licensed Shared Access (LSA), in turn, refers to a regulated approach to radio spectrum management that allows frequencies to be shared between the primary licence holder and secondary users under pre-defined conditions. LSA is often used in situations where spectrum is allocated for a long period but is not used continuously. For example, spectrum allocated for military or government purposes may be shared with commercial users when it is not actively in use. The LSA concept has been tested in several countries as a means of efficient spectrum utilisation, particularly with regard to 5G technologies. Examples include Finland and its trials in the 2.3 GHz band[14] or Germany in the 3.7–3.8 GHz band.

Effective spectrum management is also set to be ensured in the future by the implementation of artificial intelligence and machine learning in ITU documents; however, this is currently limited to use in cognitive radios[15]. The European Union is also investigating the use of AI in this context for cognitive radios. Artificial intelligence could be utilised in the management of dynamic access or in the field of monitoring to achieve the maximum level of spectral efficiency.

- Act No. 194/2017 Coll. on measures to reduce the costs of deploying high-speed electronic communications networks.
- Regulation (EU) No 2019/881 of the European Parliament and of the Council – Cybersecurity Act.

2.5.1 Summary of implementation steps

The allocation of frequencies for 5G in the Czech Republic differs from previous technologies in its broader use of radio bands. The ITU World Radiocommunication Conference in 2015 identified suitable bands for IMT-2020 (5G) systems, with the 700 MHz, 3.4–3.8 GHz and 26 GHz bands being harmonised in Europe as priorities for 5G deployment. The EU further identified the 66–71 GHz and 40–43 GHz bands for 5G requirements and gradually amended the technical conditions for the previously harmonised bands to enable the operation of 5G networks. The Czech Telecommunications Office implemented the harmonisation documents through the radio spectrum utilisation plan and general measures. A tender in the form of an auction for the allocation of frequencies in the 700 MHz and 3400–3600 MHz bands took place in 2020, with the auction conditions including development criteria for the coverage of key transport infrastructure, in particular the TEN-T rail and road networks. In 2023, the World Radiocommunication Conference (WRC-23) took place, confirming and further expanding the framework for spectrum use for International Mobile Telecommunications (IMT). The conference identified the 6425–7125 MHz band as potentially usable for IMT/5G in Europe, although its implementation remains the responsibility of individual states. Another key change for the European context was the confirmation of long-term protection of the 470–694 MHz band for digital terrestrial television (DTT) broadcasting, whilst the 614–694 MHz band may also be used for public mobile networks in some non-European countries. These decisions will have an impact on the revision of national spectrum strategies, including the Czech Republic's Radio Spectrum Management Strategy.

[13] https://radio-spectrum-policy-group.ec.europa.eu/document/download/00cfd520-efa9-48a1-bfec-d2980f511c3c_en?filename=RSPG21-033final-RSPG_Opinion_on_RSPP.pdf

[14] https://docdb.cept.org/download/94, Annex 2

[15] https://www.itu.int/en/action/ai/emerging-radio-technologies/Pages/default.aspx

The following prerequisites (implementation activities) have been defined to ensure the implementation of 5G networks in the Czech Republic:

Table 2: Prerequisites for the implementation and development of 5G networks

Prerequisites for the implementation of 5G networks	Name
Prerequisite 1	Support for the rapid development of 5G networks in a competitive environment and the implementation of the measures set out in Action Plan 2.0 to implement non-subsidy measures to support the planning and construction of electronic communications networks.
Prerequisite 2	Facilitating the interconnection of base stations via optical cables or other very high-capacity networks.
Prerequisite 3	Create conditions for cooperation between electronic communications network service providers and the owners or operators of buildings, street lighting and transport infrastructure for the purpose of co-locating 5G network technology elements.
Prerequisite 4	Supporting opportunities for the shared use of passive infrastructure (colocation) for the development of 5G cells.
Prerequisite 5	Support the roll-out of networks whilst maintaining control over public health protection, i.e. prepare the infrastructure and authorisation processes for the development and roll-out of 5G networks.
Prerequisite 6	Support for the harmonisation of 5G spectrum at global and European level.
Prerequisite 7	Enabling the use of radio frequencies by 5G mobile networks in all harmonised frequency bands below 6 GHz.
Prerequisite 8	Making the 26 GHz frequency band available.
Prerequisite 9	Strengthening cooperation with heritage authorities to facilitate the roll-out of 5G networks.
Prerequisite 10	Strengthening the legislative and non-legislative framework to enable the cost-effective use of radio spectrum for trial operations under real market conditions.
Prerequisite 11	Promoting and supporting cooperation between the electronic communications sector, the user industry, and the academic and research communities.
Prerequisite 12	It is of fundamental importance to create a space for dialogue and cooperation in the form of a Forum or alliance for the development and implementation of 5G networks (alliance participants – telecommunications operators, the business sector, government and representatives of the academic community). In addition to exchanging experiences and formulating views on the development of 5G networks, this will help identify opportunities for utilising 5G networks and the creation of joint projects, and will provide an opportunity to formulate requirements for legislative, executive, standardisation and harmonisation processes.
Assumption 13	It is crucial that all affected sectors identify their potential and specify their requirements for the development and use of 5G networks.
Prerequisite 14	To make every effort to support or initiate activities aimed at implementing projects utilising 5G networks in towns and villages – ‘Smart City / Smart Village’ – with an emphasis on the development, testing and implementation of specific applications to improve citizens’ quality of life.
Assumption 15	Given the industrial nature of the Czech Republic, prioritise the use of 5G networks within the development of Industry 4.0, together with artificial intelligence applications.
Prerequisite 16	Conduct assessments of exposure to electromagnetic radiation in accordance with health standards; when introducing new antenna system configurations, assess the impact of variable radiation characteristics in particular.
Assumption 17	Given the enormous number of devices connected primarily to the IoT and the exhaustion of the IPv4 address space, it is essential that 5G access network operators implement and 5G service providers actively offer all services with access to the IPv6 Internet, whilst maintaining access to the IPv4 Internet via transition mechanisms (e.g. 464XLAT, NAT64/DNS64, Dual-Stack).
Assumption 18	Ensuring a consistently high level of cybersecurity for the 5G networks being built and fulfilling the Prague Proposals.

Support for Smart Cities solutions is divided, depending on the size of the city in question, into large cities (100,000 inhabitants and above), medium-sized cities (from 10,000 to 100,000 inhabitants) and smaller municipalities and remote areas. The individual solutions were as follows:

- In large cities, the gradual roll-out of 5G networks meeting all global standard parameters, utilising all the types of services listed above. Investors from the private sector, whether financial or specialist firms, will not have to rely on state support – with the exception of the removal of legislative and formal barriers.
- For medium-sized towns, the full roll-out of 5G networks tailored to local conditions (depending on the type of industrial or agricultural production in the area). Here, the use of various financial instruments, including public support, is appropriate.
- For areas with smaller municipalities and for remote areas, sustainable solutions that simultaneously meet the needs of residents and visitors. Taking into account the requirements that tourism and travel will place on new technologies and services, with the possibility of providing public support without using higher frequency bands and with varying base station densities.

In the case of coverage of major transport hubs and corridors, it is crucial to cover the rail and road infrastructure falling within the TEN-T network with 5G networks and services of an appropriate standard, using various forms of investment aid from public sources, whether through the use of the EU's European Structural and Investment Funds or the Integrated Regional Operational Programme administered by the Ministry of Regional Development.

The state plays a key role in the roll-out of 5G networks in the areas of regulation, strategy, security and support, with its main objective being to remove barriers hindering network development, ensure competition and create non-discriminatory conditions for safe operation. Strategic measures include supporting digitalisation as a prerequisite for economic development, whilst the security focus concerns the protection of critical infrastructure and cybersecurity. The supportive role involves communication with stakeholders and the funding of research. The state also ensures that 5G networks are available to the widest possible range of users and flexibly adopts legislative and executive measures to promote competition. The emphasis is on building networks along transport infrastructure and in the energy sector, whilst in areas where commercial network operation is not economically viable, the state seeks solutions that satisfy both end-users and service providers.

2.6 National Plan for the Development of Very High Capacity Networks

The National Plan for the Development of Very High Capacity Networks (VHCN) is a strategic document of the Ministry of Industry and Trade of the Czech Republic, the aim of which is: *"…define the Czech Republic's strategic approach to the roll-out and use of 5G networks, support new opportunities for Czech industry, engage the professional community, local authorities and the academic sector, and elevate the concepts of Smart Cities and Smart Regions to a higher level of quality, all whilst promoting a high level of competition in the market for services provided via these networks, which will enable the best conditions for end-users to be achieved.16"*

The strategic document was drawn up in 2021 for the Ministry of Industry and Trade (MIT) and reflected the main needs for the development of high-speed internet access in the 2021–2027 programming period. The MIT is responsible for implementing the plan in cooperation with the Czech Telecommunications Office (CTO). The strategy was based on the Analysis of Demand for High-Speed Services in the Czech Republic.

Table 3: Main objectives of the strategy

Main objectives of VHCN network development	**Name**
Main objective 1	Ensuring nationwide VHCN coverage: To achieve availability of very high capacity networks for all residents of the Czech Republic, including rural and remote areas.
Main objective 2	Supporting investment in digital infrastructure: To create conditions for effective investment in the construction and modernisation of electronic communications networks.
Main objective 3	Increasing the Czech Republic's competitiveness: Strengthening the digital economy and ensuring the Czech Republic's competitiveness on a European and global scale.

[16] https://mpo.gov.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/2021/3/149908-21_III_mat_VHCN.pdf

The document further focuses on the definition of VHCN networks and the analysis of demand for high-speed services, in order to effectively develop strategic objectives and priorities for the development of VHCN networks. The starting points for this approach are as follows:

- Definition of VHCN networks and coverage analysis, in particular mapping coverage and identifying so-called 'white spots'. This includes the need for a detailed analysis of areas without adequate VHCN coverage and the prioritisation of their development.
- Analyses of demand for high-speed services in the Czech Republic show growing interest among households, socio-economic actors and businesses in high-quality internet connectivity. Whilst central and regional institutions generally have sufficient connectivity, remote areas and educational establishments still lack gigabit connectivity and adequate ICT equipment. Key stakeholders, including public administration, schools and hospitals, face challenges in financing operational costs, which the IRU (Indefeasible Rights of Use) model aims to address.

The main objectives can be summarised as improving the availability of high-speed internet across the Czech Republic, supporting the digitalisation of key sectors such as education, healthcare and transport, and creating sustainable financial models to cover costs. The implementation of projects under the "Digital Czech Republic" programme is intended to help extend gigabit connectivity to remote areas and support innovations such as artificial intelligence and new technologies, which will contribute to the competitiveness of the Czech economy.

Table 4: Strategic objectives and priorities for the development of VHCN networks

Strategic objectives for VHCN network development	**Name**
Strategic Objective 1	Deployment of VHCN networks: To create a robust and reliable very high-capacity network infrastructure, primarily in key locations for social and economic development and in areas lacking existing infrastructure.
Strategic Objective 2	Ensuring internet access: To support the availability of VHCN networks in both urban and rural areas: • For households, with speeds of at least 100 Mbit/s and the potential for speeds of up to 1 Gbit/s. • For businesses, public administration and socio-economic entities with speeds of at least 1 Gbit/s symmetrically.
Strategic Objective 3	Support for private networks: Conditions for the deployment of private networks in the public interest in accordance with national strategic objectives.
Strategic Objective 4	Connecting rural areas: Support for access in remote locations where operating revenues do not cover providers' costs.
Strategic Objective 5	Municipal infrastructure: Support for connecting municipalities via access or distribution networks.
Strategic Objective 6	Development of 5G networks: Ensuring optimal conditions for the development of 5G in cities, rural areas and transport corridors.
Strategic Objective 7	Mobile services in remote areas: Providing mobile service coverage in rural areas.
Strategic Objective 8	Coverage of rail corridors: Ensuring mobile signal coverage, including in tunnels along rail corridors.
Strategic Objective 9	Funding schemes: Providing support for the roll-out of VHCN networks in areas beyond the reach of market mechanisms under commercial conditions.
Strategic Objective 10	Coverage of operating costs: Addressing the financing of operating costs, particularly for socio-economic entities.

2.6.1 Grant measures and support

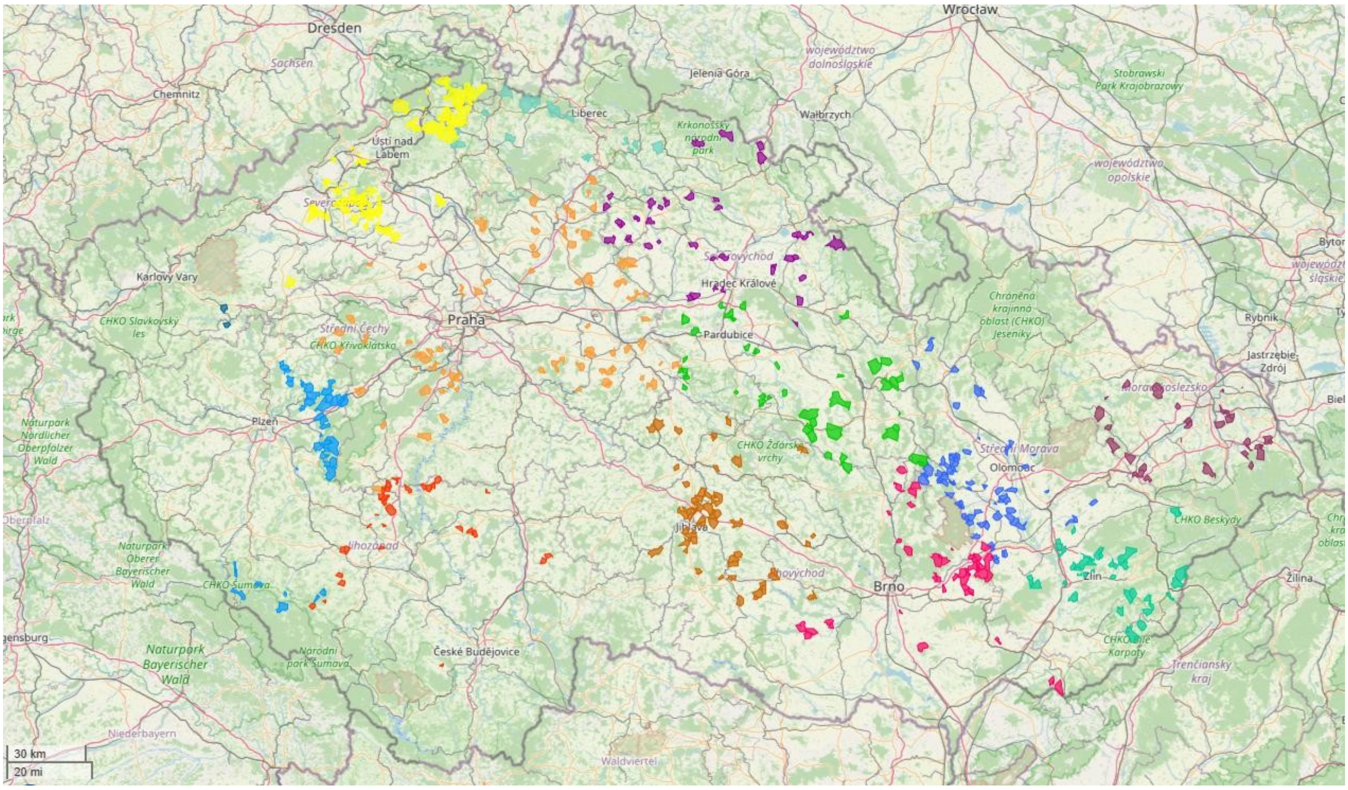
Grant support is not merely a tool for overcoming investment barriers, but also becomes an integral part of the implementation framework for digital strategies. It is not a standalone strategic document in itself, yet it represents a key means by which national regulatory authorities (NRAs) can actively influence the fulfilment of the objectives of strategic documents and digitalisation strategies. At the same time, it serves as a significant source of information on the functioning of the entire public support system, its effectiveness, the rate of absorption and the development of digital infrastructure, and helps to overcome investment barriers, particularly in less lucrative regions where market mechanisms alone are insufficient.

The results of implemented grant programmes and the development of their parameters thus provide important feedback for assessing progress in fulfilling the National Plan for the Development of Very High Capacity Networks, the Digital Czech Republic Action Plan or the objectives set out under the Digital Decade. In this sense, grant support represents a key output of the state's regulatory and implementation activities. Therefore, its evaluation, including historical development and outcomes to date, is an important part of this summary study, the aim of which is to propose the updating and prioritisation of digitisation projects in relation to the strategic objectives of the Czech Republic and the European Union.

The aim of the National Plan is therefore to identify the necessary conditions for facilitating investment in very high-capacity networks, to define the Czech Republic's strategic approach to the construction of these networks, and at the same time to direct support from public funds whilst minimising interference with competition. Support from these public funds is primarily directed towards areas where commercial models fail without such support. This subsidy policy was funded through: the Operational Programme Enterprise and Innovation for Competitiveness (OP PIK), and currently through the National Recovery Plan and the Operational Programme Technologies and Applications for Competitiveness (OP TAK).

Three calls were implemented under **OP PIK**: Call II, Call III and Call IV. These calls focused on expanding infrastructure enabling high-speed internet access (next-generation access networks). Call III specialises in the creation and development of digital technical maps by public-sector entities and regions. A total of CZK 3,463.5 million[17] was allocated to this call, and the projects collectively digitised 557,000 ha of territory and 99,000 km of transport and technical infrastructure. The aim of Call II and Call IV was to expand modern next-generation network infrastructure and ensure the reliable provision of high-speed electronic communications services (in so-called 'white spots'). A total of 86 applications for support were submitted; grant decisions were issued for 52 projects with a total value of CZK 1.1 billion, and 45 projects were successfully completed. As a result, connections were established for 18,119 address points (almost 22,000 household connections).

Figure 1: Map of OP PIK and National Recovery Plan projects



Source: Broadband Competence Office Czech Republic

[17] https://apiagentura.gov.cz/cs/programy-podpory/vysokorychlostni-internet/vysokorychlostni-internet-vyzva-iii-vznik-a-rozvoj-digitalnich-technickych-map-verejnopravnich-subjektu-dtm-vps/, https://apiagentura.gov.cz/cs/programy-podpory/vysokorychlostni-internet/vysokorychlostni-internet-vyzva-iii-vznik-a-rozvoj-digitalnich-technickych-map-kraju-dtm/

The National Recovery Plan, specifically its Component 1.3: Digital High-Capacity Networks and, to some extent, Component 1.4: Digital Economy and Society, Innovative Start-ups and New Technologies, is another tool for accelerating the digitalisation and development of the Czech economy. Component 1.3 aims to ensure, through VHCN networks, the widest possible access to data services, particularly in rural areas. The investments therefore related to the roll-out of high-capacity connectivity, the extension of 5G coverage to corridors, support for the development of 5G networks, support for the development of 5G mobile infrastructure in white spots, and scientific research activities related to the development of 5G networks and services. In total, CZK 6,815 million was allocated to the following calls:

Table 5: Overview of individual calls and funding amounts

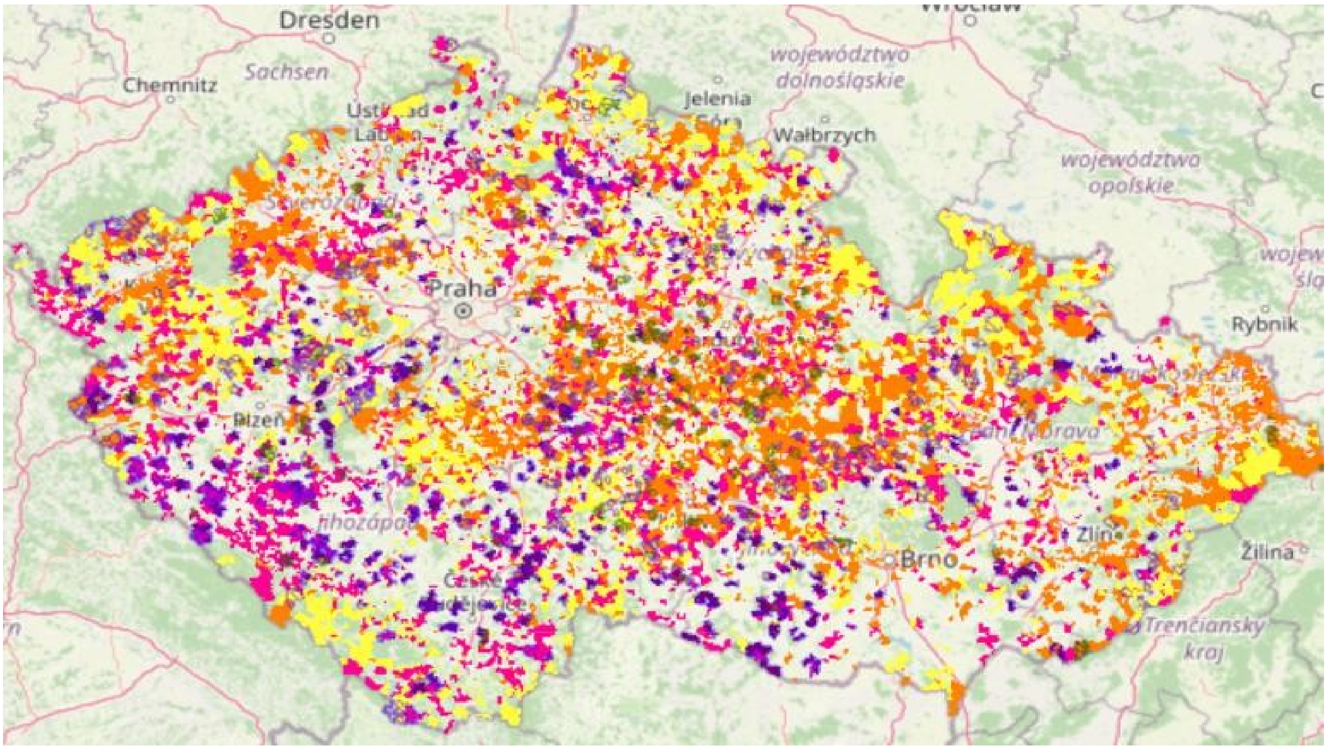
Calls under Component 1.3. Digital High-Capacity Networks	Allocated funds
Call I – Support for connecting locations to very high-capacity networks	CZK 3,466 million
Call II – Measurement of the quality of electronic communications networks	CZK 170 million
Call III – Development of 5G mobile network infrastructure in investment-intensive rural areas	CZK 300 million
Call IV – Coverage of selected railway corridors with higher-level 5G signal	CZK 224 million
Technical equipment for 5G in railway carriages	CZK 300 million
Call V – Development of digital technical maps	CZK 1,684 million
Call VII – Register of planned infrastructure projects	CZK 20 million
Call VIII – Development of digital technical maps – regional components of the register of planned infrastructure projects	CZK 28 million
Call IX – Installation and testing of a Cooperative Intelligent Transport System (C-ITS)	CZK 50 million
Digital high-capacity networks and related investments “Research and development activities related to the development of 5G networks and services (part of the TREND programme)	CZK 325 million

Component 1.4 Digital Economy and Society, Innovative Start-ups and New Technologies is relevant in many cases to the development of digital infrastructure, although its main focus is on supporting entrepreneurship, innovative companies and the introduction of modern digital technologies. The direct link to the area of VHCN and 5G networks is rather limited and takes the form of ‘enabling’ measures that create an environment for their effective use. These include, for example, the establishment of digital regulatory sandboxes for testing innovative solutions or demonstration projects utilising 5G network applications in cities and industrial areas. The component also includes investments in research and experimental development (e.g. quantum communication infrastructure, the European Blockchain Infrastructure (EBSI) or the Czech Rise-Up programme), which may support the usability of modern networks in the longer term. For the VHCN and 5G sectors, component 1.4 is therefore not the main source of funding, but a supplementary framework supporting innovation, testing and technology pilots, which may subsequently contribute to the wider adoption and practical use of the infrastructure built.

Calls under Component 1.4. Digital Economy and Society, Innovative Start-ups and New Technologies	Allocated funds
Call I – Support for entrepreneurship, business and innovative companies	CZK 110 million
Call II – Activity: Support for entrepreneurship, business and innovative companies	CZK 91.6 million
Call III – Support for entrepreneurship, business and innovative companies	CZK 20 million
Call IV – Demonstration projects for the development of applications for industrial sectors using 5G networks	CZK 88 million
Call V – Demonstration projects for the development of applications for industrial sectors using 5G networks	CZK 48 million
Call VII – Demonstration projects for the development of applications for cities and industrial areas (e.g. 5G)	CZK 375 million

Call I **of the OP TAK** focuses on the roll-out of fibre-optic connection networks in municipalities (Activity I) and the roll-out of VHCN access networks (Activity II). CZK 4 billion has been earmarked for this call; should there be a sufficient number of high-quality projects, the Ministry of Industry and Trade is prepared to increase the call's financial allocation (according to the Report on the Implementation of the Action Plan, the Ministry of Industry and Trade has a total of CZK 5 billion from European funds earmarked for this call18).

Figure 2: Map of OP TAK projects (categories A–D)



Source: OP TAK Overview

Under OP TAK, the connection of approximately 8,000 households has already been supported; nevertheless, at the current rate of construction and in combination with the commercial sector, which is estimated to connect roughly a further 100,000 households annually, it would not be possible to achieve the Digital Decade (applicable to the Czech Republic) – to ensure widespread (95%) coverage of households by VHCN networks by 2030 – would not be possible. This situation underscores the necessity of expanding support measures and seeking new mechanisms to accelerate construction and enable the fulfilment of the set targets. Therefore, even after four years of implementing subsidies and measures on both the demand and supply sides, subsidy support remains essential for achieving strategic objectives. It is therefore appropriate, in order to maintain the necessary pace of investment and strengthen the competitiveness of the infrastructure, to introduce even more active and targeted measures that would better motivate investors and strengthen synergies between the public and private sectors.

2.6.1.1 Identification of market failures and sub-optimal investment situations

The strategy in this chapter highlights that there are significant market failures in the development of VHCN networks (also referred to in the documents by the older and broader term 'NGA' – Next Generation Access networks). These include insufficient investment by the private sector, stemming mainly from uncertainty regarding return on investment, limited access to sufficient capital, and the high costs associated with infrastructure deployment. These factors mean that the market is unable to ensure sufficient network coverage and quality on its own, which negatively affects the availability and competitiveness of modern telecommunications services. Without public sector intervention, investment in infrastructure becomes sub-optimal – failing to reach the necessary scale or quality. This manifests itself primarily in regional inequalities, where areas that are less lucrative from an economic perspective suffer from a lack of investment, which hinders the development of the digital economy and widens the digital divide. For

---

18 https://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/

Overcoming these barriers requires active state support, which could include targeted incentives, improvements to the legislative and regulatory framework, and support for cooperation between the public and private sectors.

2.6.1.2 Supply-side measures

A key point is supply-side incentives. Here, the need to amend the legislative and regulatory framework is emphasised, with the aim of removing barriers to infrastructure investment. Recommended measures include simplifying administrative procedures and reducing the bureaucratic burden, which should encourage the entry of new operators and boost the confidence of existing investors. Specific financial instruments are proposed to support investment – subsidies, grants or other forms of incentives designed to encourage private investors to commit funds to network modernisation. These measures also aim to balance regional disparities in investment activity and support the nationwide development of digital infrastructure.

Supply-side measures are also supported by the findings of this study, which recommend active support for the implementation of modern technologies and uniform technical standards, which should contribute to more efficient and flexible network development. Such an approach is also relevant for the coming period, which both the newly launched GIA and Action Plan 3.0 seek to target.

2.6.2 Support for the development of a 5G-based ecosystem

Support for the development of a 5G-based ecosystem is to be provided by a common platform for 5G networks, support for testing and pilot projects for experimental development, the development of the Smart Cities concept within 5G networks, the ‘5G-ready municipality’ initiative, support for industrial applications, cyber security, education and the development of digital literacy, and the use of European and national projects.

The joint platform for 5G networks, led by the Ministry of Industry and Trade, should coordinate relevant stakeholders, such as government bodies, operators, academia, industry, cities developing the Smart Cities concept, and developers of applications for 5G networks, with the aim of harmonising the development of fixed and mobile networks. Support for testing and pilot projects through regulatory sandboxes, as well as the removal of legislative or technical barriers, is also essential. In the context of Smart City development, the Ministry of Industry and Trade, in cooperation with the Ministry of Regional Development, supports cities integrating 5G technologies into their infrastructure. The ‘5G-ready Municipality’ initiative aims to accelerate the roll-out of electronic communications networks by simplifying administrative procedures and standardising access to easements, thereby contributing to the digital transformation of regions. Support for industrial research and applications is key, particularly in the context of Industry 4.0, where cooperation between industry and operators is expected. The cybersecurity of 5G networks is being addressed at European level based on the recommendations of the European Commission and the 2019 Prague Proposals. Another significant aspect is the development of digital literacy and the integration of 5G technologies into educational programmes, which supports the reskilling of workers and safe behaviour in cyberspace.

Specific options for financial support from public sources vary (or varied) depending on the specific focus. For trans-European networks, the Connecting Europe Facility was available; calls prepared by the Ministry of Industry and Trade (MPO) or the Horizon Europe and Digital Europe programmes were used to fund projects for the construction of 5G networks and high-speed electronic communications networks in general; the TREND and The Country for the Future programmes were available to support industrial research and experimental development, and sector-specific research was supported by programmes such as the Ministry of Transport’s DOPRAVA 2020+. Last but not least, the method of investment support has changed following a comprehensive amendment to the Investment Incentives Act and the preparation of the Smart Parks for Future programme.

2.6.2.1 Implementation milestones

The document concludes by summarising the timeline of key milestones in the implementation of 5G networks, identifying the following projects as key milestones of national and international significance: **the Smart Cities project in 5 selected test cities in 2020, coverage of major transport corridors and 95% of the cadastral area of every city with over 50,000 inhabitants by 2025. It should be noted that many relevant topics are also addressed in other strategic documents (Digital Czech Republic, Action Plan 2.0 and others).** The following timetable provides only an overview of some of the main activities that the Ministry of Industry and Trade, government agencies and other institutions were to carry out in cooperation with the private sector in connection with the implementation of 5G networks:

Figure 3: Activities carried out in connection with the implementation of 5G networks

2020	I. kvartál	• Výběr pěti testovacích Smart Cities v kontextu rozvoje sítí 5G. • Realizace aukce kmitočtů pásma 700 MHz a pásma 3400–3600 MHz. • Spolupráce na přípravě OP PIK – zaměření na budování infrastruktury pro vysokorychlostní komunikaci.
	II. kvartál	• Uvolnění pásma 700 MHz podle nařízení vlády č. 199/2018 Sb., o Technickém plánu přechodu zemského digitálního televizního vysílání ze standardu DVB-T na standard DVB-T2, a jeho autorizace pro využití v rámci budoucích 5G sítí. • Dokončení změny Plánu využití rádiového spektra pro kmitočty 26 GHz.
	III. kvartál	• Dokončení Národního plánu rozvoje sítí elektronických komunikací s velmi vysokou kapacitou v souvislosti s přípravou nového programovacího období 2021-2027.
2021		• Aktualizace Národní kmitočtové tabulky podle Radiokomunikačního řádu Mezinárodní telekomunikační unie (v návaznosti na dokumenty ITU).
2023		• Pokrytí 95 % obyvatel vybraných obcí zvlášť uvedených v podmínkách aukce kmitočtů pásma 700 MHz podle podmínek aukce kmitočtů pásma 700 MHz.
2025		• Pokrytí 100 % rozsahu úseků železničních a silničních koridorů spadajících do celoevropské sítě TENT v kategoriích „Core Network" a „Comprehensive Network" podle podmínek aukce kmitočtů pásma 700 MHz. • Pokrytí 95 % katastrálního území každého města nad 50 000 obyvatel podle podmínek aukce kmitočtů pásma 700 MHz. • Pokrytí 70 % obyvatel České republiky podle podmínek aukce kmitočtů pásma 700 MHz.
2027		• Pokrytí 90 % obyvatel každého okresu České republiky a 70 % území každého okresu České republiky podle podmínek aukce kmitočtů pásma 700 MHz.
2030		• Pokrytí 99 % obyvatel každého okresu České republiky a 90 % území každého okresu České republiky podle podmínek aukce kmitočtů pásma 700 MHz.

Source: Implementation and development of 5G networks in the Czech Republic

2.6.3 Further measures to achieve the objectives of the National Plan – Action Plan 3.0

The supporting document for achieving the objectives under the National Plan for the Development of VHCN Networks is Action Plan 3.0 (Action Plan [2019] until 2025). This was approved by Resolution of the Government of the Czech Republic No. 543 of 16 July 2025. *Action Plan 3.0 for the implementation of certain measures to support the planning and construction of electronic communications networks* directly follows on from the previous version of the Action Plan, and the implementation of individual measures will be assessed on an ongoing (annual) basis in the Report on the Implementation of Action Plan 3.0 (as was the case with Action Plan 2.0). In terms of content, it is also closely aligned with the obligations arising from the GIA, and its action steps reflect the need to implement the measures described in the GIA. The measures of Action Plan 2.0 have been fulfilled; see *the Report on the Implementation of Action Plan 2.*[020] published on 4 July 2025.

Action Plan 3.0 addresses key issues and barriers in the planning, construction and operation of electronic communications networks that restrict investment, and proposes the necessary steps to remove these barriers in accordance with state aid rules, including a timetable. The document is based on consultations with the Czech Telecommunications Office (ČTÚ), relevant state administration bodies and professional associations, or umbrella organisations representing businesses in the electronic communications sector, and builds on the Programme Statement of the Government of the Czech Republic, as well as the follow-up documents Digital Czech Republic and Innovation Strategy 2030 – Czech Republic – The Country for the Future.

Action Plan 3.0 comprises a set of nine measures aimed at creating an environment that enables faster and cheaper deployment of electronic communications networks through non-grant instruments, the removal of barriers associated with network deployment, the promotion of effective coordination, and the creation of a predictable legal framework for both investors and public administration. The plan focuses on removing administrative and legislative barriers, standardising building permit procedures, and ensuring access to third-party infrastructure, including setting minimum conditions for infrastructure sharing and addressing easements. An important element is support for the creation of a unified

[19] This study was prepared during the first half of 2025, when Action Plan 3.0 was only a draft, and therefore also refers to Action Plan 2.0

[20] https://mpo.gov.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/narodni-plan-rozvoje-siti-nga/2025/7/Report-on-the-Implementation-of-Action-Plan-2.0-and-the-National-Development-Plan-for-VHCN.pdf

a digital contact point to speed up communication between investors and public institutions, and methodological support, including the development of a database of investment projects, which will enable better coordination of construction works. The Action Plan also provides for the updating of technical standards, an analysis of fees for the use of radio frequencies, and the systematic assessment of construction barriers to facilitate the roll-out of very high-capacity networks (VHCN). Through these steps, the Ministry of Industry and Trade is enhancing the predictability and transparency of the network-building process and creating a stable environment that supports investment in high-speed connectivity. The specific timetable is divided between ongoing tasks and specific deadlines in 2026 and 2027, with the deadline for some measures (particularly No. 4) being directly linked to the legislative process at EU level (GIA Regulation):

Given the dynamic developments in the field of high-speed connectivity and the constantly updated methodologies and indicators, it is advisable to optimise the action steps in light of market developments and current requirements. In this section, we will present the key points of this strategy so that the subsequent part of the study can synthesise the adjustments to the action steps resulting from studies within the 2024 National Recovery Plan and reflecting market developments.

Table 6: Measures of Action Plan 3.0

Measures of Action Plan 3.0
Measure 1 – Raising awareness of the obligations and opportunities arising in particular from the GIA Regulation The aim is to raise awareness among all relevant parties (both obligated and authorised) of the rules and opportunities arising from the European GIA Regulation, in order to avoid delays in network construction.
Measure 2 – Methodological support and support for the development of a database of construction projects This measure focuses on improving the coordination of infrastructure projects through a database of investment plans and methodological materials. Its aim is to strengthen synergies in joint construction, thereby reducing costs and accelerating the roll-out of high-capacity networks.
Measure 3 – Harmonisation of conditions for access to third-party resources and infrastructure necessary for network construction, including related easements Currently, there is a fragmented approach to to infrastructure and the setting of prices for easements. This measure aims to introduce uniform rules and tools that will simplify processes, make pricing more transparent and reduce the costs of both project preparation and construction, thereby accelerating network roll-out.
Measure 4 – Establishment and definition of the operating conditions, coordination and cooperation of the 'Single National Digital Contact Point', other single information points and other relevant entities In accordance with the European Regulation, a single point of contact is to be established in the Czech Republic to provide easy and rapid access to the information necessary for construction permits and the coordination of construction works. The aim is to reduce the time required to obtain opinions and permits, thereby accelerating construction.
Measure 5 – Establishment of a working group to coordinate activities related to the updating of relevant standards and technical specifications concerning the construction and maintenance of passive infrastructure (for the purposes of constructing VHCN networks or relevant infrastructure) The fragmentation of technical standards and specifications complicates network construction. This measure aims to establish a specialist working group to prepare updates to standards and new rules, thereby ensuring greater consistency, reducing costs and promoting the sharing of passive infrastructure.
Measure 6 – Impact analysis of a possible revision of certain fees for the use of radio frequencies The aim is to examine whether adjusting fees, particularly for mobile networks and microwave links, could support network development in less attractive areas, such as rural areas. The analysis is intended to assess the impacts of such changes and, where appropriate, propose amendments to legislation.
Measure 7 – Analysis of barriers to the construction of VHCN networks Construction is often complicated by administrative and legislative barriers, such as the failure to grant necessary permits, nature conservation, landscape character or landowners' requirements. The aim of this measure is to identify the main obstacles and propose solutions that will enable smoother and faster implementation of construction.
Measure 8 – Harmonisation of building authorities' permitting practices The inconsistent approach of building authorities causes delays and uncertainty in the permitting process. The measure aims to analyse options for standardising practices and to introduce a methodology that will ensure more predictable and efficient procedures in accordance with building legislation and European regulations.
Measure 9 – Establishment of a permanent working group to evaluate and propose changes to individual measures to facilitate the construction of electronic communications networks based on feedback during their implementation Individual measures may become outdated over time or fail to deliver the expected results. Therefore, a permanent working group is to be established to continuously evaluate the measures and propose updates based on feedback from practice.

An important step, building on the activities of Action Plan 2.0, was the establishment of organisations to support the development of broadband networks; this led to the creation of the Broadband Competence Office (BCO) and the 5G Alliance, which play an important role in both the preparation and execution of Action Plan 3.0:

- The BCO was established by the Ministry of Industry and Trade of the Czech Republic on 10 February 2020, and its main remit is to provide support to municipalities and regions in the planning and construction of VHCN networks, offer expert advice, organise training courses and seminars, and cooperate with regional coordinators.
- The 5G Alliance was established in 2020 as a joint platform to support 5th generation mobile networks and services . The Alliance coordinates cooperation between the state administration, the commercial sector, cities, municipalities, regions and the academic sector for the development of 5G networks, identifies obstacles and issues limiting the roll-out and use of 5G networks, and proposes measures to eliminate negative factors hindering the development of 5G networks and the services and applications built upon them.

A further step taken on the basis of the action plan was the establishment of a working group under the Ministry of Industry and Trade, tasked with preparing the implementation of measures for the sharing of internal communication lines in multi-apartment residential buildings. The working group provides methodological guidance and ensures the practical implementation of GIA obligations relating to internal building distribution systems, including the drafting of legislative, technical and organisational measures.

2.7 Implementation and Development of 5G Networks in the Czech Republic

Implementation and development of 5G networks in the Czech Republic – The Path to the Digital Economy [21] is a sub-strategy focused on the specific area of building and developing infrastructure for high-speed communications. This document was drawn up as a strategic vision by the Ministry of Industry and Trade and approved at a government meeting in 2020. It also forms part of the Digital Czech Republic concept (which includes the strategic document 'Digital Economy and Society') and the Innovation Strategy of the Czech Republic 2019–2030: Pillar IV – Digitalisation, as well as the Digital Czech Republic strategy with its second pillar
'Digital Economy and Society' and its objective No. 04 'Support for connectivity and infrastructure of the digital economy and society', specifically the first point 4.01 Building electronic communications networks.

In connection with the development of the digital economy under the Digital Czech Republic concept, the document focuses on the necessity of high-speed networks (or very high-capacity networks, including fifth-generation networks), the use of analytical tools for working with large volumes of data, elements of artificial intelligence and Internet of Things technologies, whilst ensuring the cyber security of the entire system. The Ministry of Industry and Trade therefore targeted activities designed to facilitate, simplify and accelerate the construction of high-speed networks from an organisational, legislative and financial perspective, thereby meeting the growing demands on these networks.

The aim of this document is to define the Czech Republic's strategic approach to the roll-out and use of 5G networks, to support new opportunities for Czech industry, to engage the professional community, local authorities and the academic sector, and to elevate the concepts of Smart Cities and Smart Regions to a higher level of quality, all whilst promoting a high level of competition in the market for services provided via these networks, which will enable the best conditions for end-users to be achieved. The document also presents a vision and sets out procedures that specify the management of the radio spectrum and the conditions for its use for 5G networks, with a link to research and development of the necessary applications and services. It further focuses on the necessary prerequisites for the roll-out of 5G networks, funding opportunities for certain activities, support for the testing of new technologies, and the cyber security of 5G networks.

The document 'Implementation and Development of 5G Networks in the Czech Republic' focuses on the key characteristics of 5G networks, the services offered, potential risks, and their positioning within the international, European and national contexts. The document includes a summary of implementation steps, which comprised:

- Frequency allocation in the Czech Republic and assumptions regarding their use
- Basic prerequisites for the implementation of 5G networks in the Czech Republic
- Support for 'Smart Cities' solutions

[21] https://tacr.gov.cz/wp-content/uploads/documents/2020/04/28/1588084690_Implementation%20and%20development%20of%205G%20networks%20in%20the%20Czech%20Republic.pdf

- Coverage of major transport hubs and corridors
- The role of governments in building 5G networks

This summary will be examined in greater detail in the following sections of this document, as will the implementation milestones for the development of 5G network infrastructure.

The document further explains how fifth-generation networks bring about fundamental changes compared to previous generations through the use of a wide spectrum of radio frequencies and advanced technologies, such as beamforming, enabling more efficient coverage and data transmission. These networks enable very high transmission speeds, low latency and the connection of a vast number of devices, which is crucial for areas such as Industry 4.0, intelligent transport systems and the development of the Smart Cities concept.

Compared to their predecessors, 5G networks open up new possibilities for service provision, including telemedicine, smart agriculture, emergency communications and e-learning, whilst enabling rapid real-time data processing and supporting innovation in areas such as augmented and virtual reality. However, with these growing possibilities come security challenges. Risks include cyber threats from both state and non-state actors, vulnerabilities in the supply chain, and potential attacks via less secure IoT devices. The Czech Republic participates in EU security activities and supports the safeguarding of network integrity through recommendations (such as the 2019 Prague Proposals).

In an international context, the development of 5G is supported by EU strategies, which include the harmonisation of frequency bands and common security measures. According to this document, the Czech Republic’s key activities are the Innovation Strategy of the Czech Republic 2019–2030, the National Artificial Intelligence Strategy of the Czech Republic, Digital Czech Republic, Action Plan 3.0, the Action Plan for the Memorandum on the Future of the Automotive Industry in the Czech Republic, the aforementioned National Plan for the Development of Very High Capacity Networks, the document on 5th Generation Wireless Terrestrial Systems, and the Mobile Communications Strategy for Security and Rescue Services. Nevertheless, it is essential not to overlook the continuous identification of key factors related to the development of future mobile systems (e.g. 6G).

2.8 Expected developments in the EU regulatory framework and policies

New strategic proposals and initiatives are currently emerging within the European regulatory framework, which will have a significant impact on the further development and deployment of telecommunications infrastructure in Member States. Although most of these proposals are at the drafting or consultation stage, it is already possible, based on the available documents, to identify the direction of future developments and the preliminary implications for national policies, regulation and the market environment.

Given the date of this study (summer 2025), the specific impacts of these initiatives remain at the level of assumptions. Nevertheless, it is useful to outline their basic content and intended objectives, whilst also highlighting the likely links with the development of VHCN networks, radio spectrum management and the coordination of public and private investment in digital infrastructure. These initiatives are, in particular, the following three:

- Digital Networks Act[22]
- European Defence and the ReArm Europe Plan – Readiness 2030[23]
- Connecting Europe Facility – CEF Digital[24]

2.8.1 Digital Networks Act

The European Commission is preparing a new legislative framework, **the Digital Networks Act (DNA)**, in 2025, which is set to fundamentally redefine the functioning of the electronic communications market in the EU; its adoption is expected by the end of

---

[22]https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2025)772864

[23]https://defence-industry-space.ec.europa.eu/eu-defence-industry/introducing-white-paper-european-defence-and-rearm-europe-plan-readiness-2030_en

[24]https://digital-strategy.ec.europa.eu/en/activities/cef-digital

2025. The proposal builds on the existing European Electronic Communications Code (EECC) and reflects the information summarised in the EC's February 2024 White Paper *'How to master Europe's digital infrastructure* *needs'*[25] , in particular the need for deeper integration and more effective regulation across Member States. The aim of the DNA is to create a sustainable investment framework for building gigabit connectivity, to support the coordination of spectrum management, to accelerate the upgrade of fixed networks, and at the same time to ensure the cybersecurity and resilience of Europe's digital infrastructure. The DNA aims to address the structural challenges of the European telecommunications market – regulatory fragmentation, low returns on investment, and the need for new models of cooperation between market players and public institutions.

Following on from the proposed DNA framework, several specific implications for the development of digital infrastructure in the Czech Republic can be identified, which are also directly linked to the objectives of national strategies (e.g. Digital Czech Republic) and to the indicators and targets of the European Digital Decade:

- **Accelerating the roll-out of gigabit networks** The DNA supports setting deadlines for the phasing out of copper networks (e.g. 80% of users by 2028), which provides a significant impetus for migration to FTTH/FWA technologies. This is in line with the Digital Decade's objective of ensuring 100% coverage of households by VHCN networks by 2030 and may accelerate the implementation of target KPIs in the Czech Republic.
- **Harmonisation and more efficient management of the radio spectrum:** the DNA proposes closer coordination of auctions, the extension of licences, and the possibility of establishing a single European regime for certain types of spectrum (e.g. for satellite communications). This reinforces the findings of studies (e.g. S26) on the development of 5G and 6G, and is also linked to the objectives of the revised Action Plan 3.0.
- **Cybersecurity and resilience**: The DNA envisages a ban or restriction on 'high-risk' suppliers (e.g. Huawei, ZTE), whilst seeking to introduce stricter equipment certification. In the Czech Republic, this is reflected in the national cybersecurity strategy and reinforces the emphasis on security aspects in network deployment, including private 5G networks.
- **Joint management of submarine and backbone infrastructure**: The DNA includes a proposal for the creation of a European framework for the management and financing of strategic projects (e.g. so-called Cable Projects of European Interest), which may in future also influence the Czech Republic's approach to connecting to European backbone infrastructure.
- **Possibilities for a new 'soft regulation' model and support for market consolidation**: The DNA also discusses the issue of possible consolidation or a re-evaluation of the current model of strong ex-ante regulation. This is particularly relevant for the Czech Republic, where the market shows relatively high fragmentation and a low level of network sharing. If, at the European level, ex-ante regulation were to be significantly scaled back in favour of 'softer' forms of regulation (so-called 'regulatory frameworks for investment'), this could lead to a deterioration in the position of local ISPs, for example due to more complex wholesale access and, consequently, an acceleration of market consolidation.
- **Network costs and 'fair share' mechanisms:** The current DNA proposal does not favour direct payments from large content providers (e.g. Netflix, Meta), but considers the possibility of resolving any disputes through NRAs or BEREC. For the Czech Republic, this means the need to prepare for possible changes in the area of net neutrality and economic relations.

2.8.2 European Defence and the ReArm Europe Plan

The ReArm Europe Plan, presented in the *White Paper for European Defence – Readiness* *2030*[26], is the European Union's strategic plan to restore defence readiness and technological sovereignty in response to a destabilising security environment, particularly in the context of the war in Ukraine and growing threats of a hybrid nature (sabotage, cyberattacks). One of the key elements of the ReArm Europe strategy is the emphasis on dual-use infrastructure – that is, the ability of telecommunications, transport, energy and other networks to serve both civilian and military purposes. This principle is gaining in importance in the context of the growing emphasis on resilience, interoperability and the ability to rapidly mobilise resources in the event of crises and armed conflicts. In the field of digital infrastructure, this primarily concerns communication networks (FTTH, 5G/6G, backbone fibre optics, edge/cloud infrastructure) and long-distance data transmission (including satellite connectivity and GNSS services).

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

[26] https://commission.europa.eu/document/download/e6d5db69-e0ab-4bec-9dc0-3867b4373019_en?filename=White%20paper%20for%20European%20defence%20%E2%80%93%20Readiness%202030.pdf

The implications of this initiative may therefore be as follows:

- **5G and private networks for critical communications (PPDR**): The infrastructure built for 5G can also be used for private networks for security and emergency services. ReArm Europe anticipates the need to extend these networks to areas of strategic importance, including cross-border sections, railways, military mobility and energy infrastructure.
- **Optical backbone networks (backhaul) with priority mode**: Backbone networks built as part of VHCN can be designed to support priority data transmission for crisis management, security services or defence systems (e.g. quantum communication, unmanned aerial vehicle control). This means that security requirements must be taken into account as early as the design, sizing and construction phases.
- **Use of European satellite systems for crisis and defence purposes**: ReArm Europe emphasises the need to utilise EU satellite services (Galileo, Copernicus, IRIS) for military purposes as well, and plans to involve Ukraine in these services. This has implications for the requirements regarding the integration of these systems with national networks and the readiness to provide services with high availability and security.
- **Dual use of edge/cloud capacities for civil and defence applications**: The emergence of distributed edge and cloud capacities, which will form part of the backbone infrastructure for public services (e.g. healthcare, transport), can also be utilised for rapid defence response, sensor data processing, or the operation of military applications. In terms of standardisation and operational modes, a higher degree of interoperability and security certification will be required.
- **Support for military mobility through digital management of transport and logistics chains**: Digital infrastructure will also be used to support the movement of military units and logistics when required. This includes access to data networks, spatial information, AI and remote monitoring, which implies a need for high-capacity and secure transmission networks.

In the context of the Czech Republic, the Digital Czech Republic strategy already provides, in its infrastructure section, for support for private 5G networks, the construction of backbone optical networks and the development of edge/cloud capacities. The adoption of the dual-use principle will lead to the need to:

- adjust planning and investment methodologies (e.g. in funds such as CEF Digital, NPO, SF),
- introduce new security and interoperability standards for network construction,
- strengthen coordination between the Ministry of Industry and Trade, the Czech Telecommunications Office, the armed forces and the Defence Intelligence Agency in infrastructure development,
- and to enable national funding for infrastructure with military-civilian dual-use applications.

Expenditure on dual-use infrastructure, telecommunications networks or innovative technologies can, according to the COFOG and ReArm Europe methodologies, be recognised as defence expenditure if they have military or security applications. Member States may include them in their defence budgets, both vis-à-vis the EU and (to a more limited extent) vis-à-vis NATO. Last but not least, this also opens up opportunities for private-sector participation in projects of direct security significance and strengthens the role of domestic technology firms in new defence-industrial supply chains.

2.8.3 Connecting Europe Facility – CEF Digital

CEF Digital is a key European instrument for supporting the construction and modernisation of infrastructure for high-speed connectivity. Within the 2021–2027 programming period, its aim is to support backbone and cross-border networks, high-performance edge/cloud capacities and 5G networks for public services and communities. The programme is closely linked to the objectives of the Digital Decade and reflects the need to build resilient, interoperable and gigabit infrastructure as the foundation of European digital sovereignty. Projects supported by this programme have the potential to significantly boost connectivity and contribute to achieving the Digital Decade's objectives; it is therefore in the Ministry of Industry and Trade's best interests to encourage both the public and private sectors to participate in CEF Digital, where opportunities lie primarily within the two components: 5G Smart Communities and 5G Cross-Border Corridors.

Under the *5G for Smart Communities* component, it supports the roll-out **of 5G networks for public services** – primarily in healthcare, transport and education. The main focus is on **areas with market failure**, where commercial investment in modern networks is insufficient. Supported projects should be carried out in cooperation with local public authorities, universities, hospitals or transport companies.

Key implications for the Czech Republic:

- **The development of private 5G networks in public institutions** (e.g. university campuses, hospitals, transport hubs), which will enable the testing and roll-out of new services (e.g. telemedicine, autonomous mobility).
- **Link to the 5G Action Plan and the national VHCN plan**, where the Czech Republic has already declared its support for public administration projects using 5G for internal processes or communication with citizens.
- **Possibility of combined funding** – CEF Digital can complement national resources or NPOs where a project has a clearly defined European dimension or innovative character.

This component provides an opportunity to demonstrate the use of 5G for the digitalisation of public services outside major cities, including rural or cross-border areas. Projects can also serve as reference models for wider deployment.

CEF Digital also funds the roll-out **of 5G networks along European transport corridors**, known as *cross-border corridors*, which facilitate the development of **smart mobility and autonomous transport**. These corridors support the seamless operation of connected vehicles and digital logistics.

The following are particularly suitable for the Czech Republic:

- the Baltic Sea – Black Sea – Adriatic Sea corridor (Via Carpatia),
- the TEN-T corridor connecting Prague, Brno and Vienna,
- cross-border sections leading to Germany and Slovakia.

Key benefits and links to national strategies:

- The possibility of using 5G along railway lines or motorways for autonomous driving, safety monitoring or traffic management (e.g. integration with C-ITS systems).
- Achieving the Digital Decade target of covering major transport corridors with 5G signal by 2030.
- Strategic synergy with dual use: the infrastructure can also be used for military mobility (see ReArm Europe), creating opportunities for joint funding and strategic planning with defence forces.
- ReArm Europe as a new impetus for policy integration: this initiative brings a fundamental requirement for a higher level of coordination between defence, digital and infrastructure strategies at national level. Its implementation will require coordination or even integration with other key agendas, such as the Digital Networks Act, CEF Digital or national VHCN development plans, in order to make effective use of available investment instruments whilst ensuring the coherence of public policies.

Participation in the CEF Digital programme, and in particular its 5G Smart Communities and cross-border corridors components, presents the Czech Republic with a whole range of opportunities to accelerate the roll-out of 5G networks and link digital objectives with the areas of transport, defence and regional development. However, successful participation in these calls requires significant coordination between the Ministry of Industry and Trade (MPO), the Ministry of Transport (MD), the Czech Telecommunications Office (ČTÚ), regional authorities, technical universities and private investors.

3 Studies

3.1 Overview of studies

The studies were divided into four packages, which were drawn up during 2024. Each package focused on specific aspects of the use of 5G technologies and their benefits for various sectors. **A number of leading institutions across the market contributed to the studies,** including the Czech Telecommunications Office (CTO), the Czech Technical University (CTU), the 5G Alliance, the National Cyber and Information Security Agency (NÚKIB) and the Ministry of Industry and Trade (MIT).

The studies generally focused on the transformative potential of 5G technologies and related topics. They addressed broader topics, such as the effective use of spectrum and technological potential, as well as specific areas, such as the use of 5G for public protection and disaster relief (PPDR), the FRMCS system, network coverage mapping, and the analysis of the investment gap for building very high-capacity networks (VHCN).

These activities formed part of the National Recovery Plan, specifically its Component 1.3, which focuses on supporting digital infrastructure and creating the conditions for its effective development.

The studies themselves can be divided into four thematic areas according to their focus (see Chapter 5.1): Construction and development of very high-capacity networks (VHCN), Radio spectrum management (particularly for 5G), 5G applications and industrial use, and Protection of the population (security) and cybersecurity. A detailed breakdown of the individual studies is shown in the table below.

Table 7 – Overview of studies

Study number	Study title	Thematic block	Links (link to PDF file)
Study 1	Analysis of current and future use of the 600 MHz band, including the Czech Republic's position on the use of the band for DVB-T or IMT	Radio Spectrum Management Spectrum	Link to Study 1
Study 2	Analysis of current and future use of the 4 GHz band	Radio Spectrum	Link to Study 2
Study 3	Analysis of current and future use of the 42 GHz band	Radio Spectrum	Link to Study 3
Study 4	Use of key bands for the development of 5G and other key radiocommunication services	Radio spectrum spectrum	Link to Study 4
Study 5	Analysis and proposal for the process of frequency use and allocation in the 26 GHz band	Radio Spectrum	Link to Study 5
Study 6	Preparation of analytical background material for the spectrum management strategy	Radio Spectrum	Link to Study 6
Study 7	Concept and application of a digital twin for 5G network infrastructure	Industrial applications and applications of 5G	Link to Study 7
Study 8	The use of 5G network slicing for public and private networks	Industrial applications and applications of 5G	Link to Study 8
Study 9	Integration of Internet of Things (IoT) and 5G network elements	Industrial use and applications	Link to Study 9
Study 10	Use of 5G networks for fixed wireless high-speed point-to-multipoint (FWA) access	Building very high-capacity networks (VHCN)	Link to study 10
Study 11	Analysis of the 400 MHz band with regard to future use in the mobile radio service	Radio spectrum management Spectrum	Reference to Study 11
Study 12	5G Broadcast	Radio Spectrum	Link to Study 12

UNOFFICIAL MACHINE TRANSLATION

Study 13	The use of 5G and other electronic communications networks for business digitalisation, including the use of modern information systems	Industrial use and applications of 5G	Link to Study 13
Study 14	KPI for 5G mobile networks, 5G indicators and link to DESI	Building very high-capacity networks (VHCN)	Link to study 14
Study 15	Analysis of cyber risks associated with the operation of 5G networks for private (closed) networks and the provision of public services, including the impact of Open RAN and Open Core approaches on the security of 5G networks	Protection of the population and cybersecurity	Link to Study 15
Study 16	Analysis of approaches to spectrum usage fee policies across the EU, identification of general principles and recommendations for possible changes for the Czech Republic, inter alia in connection with the development of 5G networks	Industrial use and applications	Link to Study 16
Study 17	Use of FRMCS systems in rail transport, including dedicated channels in the 900 MHz and 1900 MHz bands	Radio spectrum spectrum	Reference to Study 17
Study 18	Study of methods and techniques for determining and verifying coverage by radiocommunication services	Building very high-capacity networks (VHCN)	Link to Study 18
Study 19	Development of 6G networks in bands above 100 GHz	Radio spectrum management spectrum	Link to Study 19
Study 20	Drafting of guidelines for the sharing of passive and active network infrastructure, optimisation of the use of public funds earmarked for supporting network deployment in selected areas	Deployment of very high-capacity networks (VHCN)	Link to Study 20
Study 21	Methods for mapping the coverage of fixed and mobile electronic communications networks	Deployment of very high-capacity networks (VHCN)	Link to Study 21
Study 22	Research into solutions for ensuring secure state communications for emergency services within the European Union, with regard to 5G and PPDR technologies	Civil protection and cybersecurity	Link to study 22
Study 23	Radio coverage plan for the Czech Republic with 5G and higher-generation networks	Radio spectrum management Spectrum	Link to Study 23
Study 24	Prediction of VHCN network coverage development in the Czech Republic in relation to the development of 5G networks	Deployment of Very High Capacity Networks (VHCN)	Link to study 24
Study 25	Definition of the investment gap in VHCN network deployment in relation to the development of 5G networks	Deployment of very high capacity networks (VHCN)	Link to study 25
Study 26	The use of satellite communications for 5G	Radio spectrum management spectrum	Link to study 26
Study 27	Quantum technologies and communications	Civil Protection and Cybersecurity	Link to study 27

3.2 Specific study

The structure of this chapter provides a detailed overview of the topics addressed in the study and briefly summarises the main action steps, together with a framework timetable, arising from the study. The summary is supplemented by a link to the study published on the MIT website.

3.2.1 Study 1: Analysis of the current and future use of the 600 MHz band

3.2.1.1 Summary

The UHF band, including the 600 MHz band, has historically been allocated in ITU Region 1 primarily for terrestrial television broadcasting and secondarily for terrestrial mobile services (PMSE), whilst the technological transition to DVB-T2 in 2020 enabled more efficient use of the spectrum and the release of the 700 MHz band for 5G services. Four nationwide and several regional multiplexes in the Czech Republic continue to operate in the UHF band (frequencies allocated until the end of 2030), whilst also providing public service broadcasting, namely the broadcasts of Czech Television, which must provide accessible, diverse content and impartial and independent news coverage.

Technological developments include the possibility of using 5G Broadcast as a complement to DTT in the 600 MHz band. However, existing mobile networks do not provide sufficient coverage for adequate mobile reception of 5G Broadcast. At present, it is difficult to predict the potential benefits of 5G compared to DVB-T2, as this standard is still in the testing phase. The regulatory framework was established at a global level at the WRC-23 conference, which confirmed the priority of television broadcasting in the 470–694 MHz band. The RSPG has supported the use of this spectrum for emergency communications and national defence in the event of a decline in the need for DTT. At the same time, together with the ECC, it emphasises the importance of preserving spectrum for PMSE, whilst the GSMA supports the implementation of 5G in the 600 MHz band due to better coverage of rural areas and lower operating costs.

An analysis of possible scenarios for the Czech Republic includes maintaining the status quo with full DTT coverage, which would allow free-to-air broadcasting to continue, or allocating part of the 600 MHz band to IMT, which could improve mobile network coverage at a lower cost. Signal interference between DTT and IMT remains a significant problem, with minimum separation distances between transmitters reaching 200 to 300 km. Economically, operating 5G networks in the 600 MHz band could generate higher revenues compared to DTT, but relevant studies on the broader societal impacts for all stakeholders are currently lacking.

3.2.1.2 Recommendations of the study

Two possible development scenarios therefore emerge for the 600 MHz band: (1) Maintaining the current allocation of the UHF band for DTT and (2) Allocating part of the UHF band (the 600 MHz band) to IMT. Specific recommendations depend on the preference for the service in question. In both cases, international coordination is also necessary, given the characteristics of both services.

Maintaining the status quo may have a positive impact on network operators' business cases through a slower decline in viewership, regionalisation of broadcasting, ensuring competition on the platform, and the possibility of free-to-air programmes continuing to exist even with a continuing decline in viewers. Any need for additional IMT capacity (particularly for rural areas) will depend on network densification or the use of a different frequency band; this may entail higher costs, which could result in a potential decline in service quality or a slowdown in the innovation cycle for mobile service users. Among other things, there may be significant impacts on the quality of both services given the separation distance if the IMT service is launched earlier abroad.

The second option is to allocate part of the spectrum to IMT, which may entail lower costs compared to network densification and the use of a different frequency band. Additional spectrum can be used for innovative services for users, thereby supporting the development of innovative functionalities (e.g. network slicing). An increase in spectrum allocation may also potentially lead to increased competition. Conversely, a reduction in programming could impact the popularity of DTT, accelerate the decline in viewing figures and increase pressure to restrict FTA broadcasting by commercial stations. This would lead to a reduction in regional coverage and the potential closure of one national network. However, increasing the spectrum for IMT could potentially lead to the development of 5G broadcasting as a form of innovation. If a decision to implement this scenario is taken earlier (before 2030), additional costs may arise, particularly due to the need to optimise the network and replace and write off transmitters and, where applicable, antennas. At the same time, consideration should be given to the potential need for compensation for lost revenue from regional broadcasting.

Study recommendations	Thematic block
Preparation of an analysis of the effectiveness and significance of the 600 MHz band for the Czech Republic, comprising a description and prediction of (viewership) of DTT and other platforms in the Czech Republic, a forecast of tax revenues from IMT services, and a comparison of the benefits with revenues from TV licence fees and taxes generated by content production for free-to-air broadcasting in the 600 MHz band.	Radio spectrum management
Strategic decisions on the future direction of development in the Czech Republic and active participation in working groups at EU (ITU) level	
Implementation of follow-up decisions at the supranational level	

3.2.2 Study 2: Analysis of current and future use of the 4 GHz band

3.2.2.1 Summary

The aim of this study was to assess the current use of the 4 GHz frequency band (3800–4200 MHz), identify opportunities for its more efficient use, and propose solutions supporting the development of 5G mobile networks and other technologies. The analysis focused on both the technical and economic aspects of spectrum utilisation, including the potential for band defragmentation, the development of MFCN networks, and support for new applications such as industrial automation and the IoT. It also included a mapping of current operators and their use of the band.

The study drew inspiration from examples of good practice in the US (FCC) and Canada (ISED) and included scenarios for spectrum optimisation that reflect both technological and economic benefits. Key issues included ensuring fair access to frequencies, coordination between different services, and the security of new networks. The study also proposed measures to support standardisation, consideration of environmental impacts and energy efficiency. The results serve as a basis for strategic planning in the field of spectrum management and support for the sustainable development of telecommunications infrastructure in the Czech Republic.

3.2.2.2 Recommendations of the study

Based on the study of the current and future use of the 4 GHz band, it is recommended that the following action steps be taken to ensure the effective use and future development of this band in the Czech Republic:

- **Public consultation with key stakeholders**: The Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should jointly launch a public consultation with relevant stakeholders from among operators, industrial enterprises, public administration and the academic sector, in order to clearly identify the requirements for the use of the 4 GHz band and the specific technical and operational needs of individual users.

- **Support for flexible licensing:** The CTO should consider introducing a simplified licensing regime to allow for more flexible access to the 4 GHz band. This approach should facilitate the deployment of both mobile networks (IMT) and fixed wireless access (FWA) systems, including private networks.

- **Implementation of ECC and CEPT recommendations**: The Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should monitor and implement the recommendations and harmonised technical standards issued by the European Committee for Electronic Communications (ECC) and the European Conference of Postal and Telecommunications Administrations (CEPT) to ensure interoperability and protect existing services from interference.

- **Coordination with neighbouring countries**: Active cooperation with neighbouring states is required to coordinate the use of the band, ensuring optimal spectrum utilisation without cross-border interference. The Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should engage in dialogue and conclude coordination agreements at both bilateral and multilateral levels.

- **Monitoring and analysis of spectrum usage**: The CTO should introduce continuous monitoring of the 4 GHz band to assess the efficiency of spectrum usage on an ongoing basis, identify any unused portions, and prepare for future spectrum reallocation in favour of promising technologies and applications.

- **Support for pilot projects and innovation**: The Ministry of Industry and Trade (MPO) should support and co-fund pilot projects for the use of networks in the 4 GHz band, particularly for industrial applications, smart cities and other innovative uses that can contribute to the digital transformation of the Czech economy and society.

- **Awareness-raising and communication:** The MIT and the CTO should run information campaigns and workshops to present the potential uses of the 4 GHz band to industrial enterprises, public institutions and other potential users, thereby increasing awareness and demand for modern communication services.

UNOFFICIAL MACHINE TRANSLATION

Recommendations of the study	Thematic section
Analysis of potential demand for specific services and use of the band for 5G and other technologies (local or national networks)	Radio spectrum management
Definition of specific conditions for the use of the band for individual services	
Implementation of the follow-up decision, including ensuring the authorisation process	
Regular monitoring and review of policy	
Active involvement in international and European processes	

3.2.3 Study 3: Analysis of current and future use of the 42 GHz band

3.2.3.1 Summary

5G NR (New Radio) technology is key to increasing the capacity of mobile networks, particularly in areas with high population density. Furthermore, it is suitable for high-speed communication with line-of-sight to specific locations. In the Czech Republic, the 42 GHz band (40.5–43.5 GHz) is currently used for point-to-point fixed-service links with gigabit transmission speeds. However, the popularity of this band is lower compared to the unlicensed 80 GHz band, which offers higher capacity and flexibility with minimal risk of interference. Globally, however, the 42 GHz band is expected to be used for mobile telecommunications (MFCN) in the future. To minimise collisions with other services, geographical separation and advanced antenna technologies are essential. Authorisation of the band requires individual licences or registration with different specifications for hotspots. The use of active sector antennas, which enable precise signal steering, is recommended.

Ongoing research at Brno University of Technology focuses on the characteristics of signal propagation in the 42 GHz band, which should contribute to improving the practical implementation of these solutions. Key elements of 5G NR standardisation in this band are flexible spectrum (meaning the ability to use multiple frequency bands and different channel widths), advanced modulation technologies, massive MIMO and beamforming, which enable efficient spectrum utilisation and higher data rates. The 42 GHz band is ideal for short distances and dense urban or suburban hotspots, where active antenna systems with high gain, i.e. high directivity in the direction of user terminal traffic, are employed. However, it is not suitable for nationwide mobile network coverage due to its limited range. Buildings and other obstacles pose a significant challenge to signal propagation in urban areas, which can be addressed through the appropriate placement of access points and intelligent distributed antenna systems (DAS).

The development and implementation of 5G technologies in the 42 GHz band are driven by industry trends and global demand for higher transmission capacities. Millimetre-wave technologies, such as 80 GHz (E-band) and 60 GHz (V-band), have already proven their viability and inspired the use of similar bands in 5G networks. Standardisation and preparation of the 42 GHz band for commercial use are still ongoing. ETSI and 3GPP are currently focusing on developing standards that are key to technological development in this band. Documents such as ETSI TS 138 104 and 3GPP specifications provide the technical conditions for the effective use of the 42 GHz band for 5G NR, including channel n259, which supports wideband transmissions in time division duplex (TDD).

The European Commission’s strategy ‘Connectivity for a European Gigabit Society’ sets out the objectives for building a gigabit society by 2030. The telecommunications sector is expected to demand high-capacity technologies for 5G networks, including FWA solutions based on 5G NR. The 42 GHz band has the potential to become a key element in meeting the needs of Industry 4.0 and the future development of mobile and fixed communication networks. Developments in the market environment have led to the creation of specialised devices with reduced capabilities (SoCs) that do not require all the functions of 5G networks. So-called RedCap devices can be used, for example, as fixed or campus network equipment.

In summary, it can be said that, as yet, there are no feasible and realistic regulatory and user models for the 42 GHz band in the European context. However, there is sufficient supporting documentation and pre-specifications from ETSI and 3GPP to ensure the establishment of an appropriate regulatory framework and to adequately define the potential benefits of the band, the use of which is anticipated and studied at a global level.

UNOFFICIAL MACHINE TRANSLATION

3.2.3.2 Study recommendations

Analysis of potential demand for specific services and use of the band for 5G and other technologies (local or national networks): To plan the use of the band effectively, it is necessary to know the actual market demand. This analysis will help identify potential use cases (e.g. campus networks, FWA, hotspots) and prevent inefficient spectrum allocation.

Definition of specific conditions for spectrum use for individual services: Clear and technically feasible rules for spectrum use must be established for both mobile and fixed services. The aim is to ensure technological neutrality, minimise interference between services and optimise spectrum use.

Implementation of the follow-up decision, including the authorisation process: Once the conditions have been established, a clear and transparent process for granting authorisation to use the band must be created. This will enable the rapid deployment of new services and the efficient management of the radio spectrum.

Development of a methodology for authorisation and shared use of the band between IMT/FWA and fixed services: Band sharing is key to maximising the use of available frequencies. The methodology should establish rules for service coordination, protection of existing systems and support for the development of new technologies.

Active participation in international working groups at ETSI and 3GPP level with a view to harmonising technical conditions: The involvement of the Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) in European and global standardisation activities is essential if the Czech Republic is to influence future conditions for the use of the spectrum and ensure that domestic regulation is in line with global trends.

Recommendations of the study	Thematic block
Analysis of potential demand for specific services and spectrum usage for 5G and other technologies (local or national networks)	Radio spectrum management
Definition of specific conditions for spectrum use for individual services	
Implementation of the follow-up decision, including ensuring the authorisation process	
Development of a methodology for authorisation and shared use of spectrum between IMT/FWA and fixed services	
Active participation in international working groups at ETSI and 3GPP level to harmonise technical conditions	

3.2.4 Study 4: Utilisation of key bands for the development of 5G and other key radiocommunication services

3.2.4.1 Summary

Compared to previous generations of mobile networks (particularly 4G LTE), 5G technology brings significant advances, primarily due to higher transmission speeds, lower latency and greater network capacity. A significant benefit is the ability to connect a large number of devices to a single base station, which is key for applications such as the Internet of Things (IoT), augmented reality (AR), virtual reality (VR) and autonomous vehicles. These innovations require a stable and reliable connection, which 5G technology can provide.

The frequency bands for 5G in the Czech Republic are allocated in accordance with European regulations (RSPG, CEPT) and global ITU standards. Key pioneering bands for 5G include 700 MHz (low band suitable for wide coverage), 3.6 GHz (mid-band for balanced coverage and capacity) and 26 GHz (high band suitable for high-speed transmissions in cities). In the Czech Republic, a spectrum auction for the 700 MHz and 3.6 GHz bands has already taken place, with the spectrum being transferred to the three existing mobile operators following its purchase from new entrants. The 26 GHz band is currently being used on an experimental basis. For 5G services, the 800, 900, 1800, 2100 and 2600 MHz bands are available in the Czech Republic. For other bands (e.g. 6 GHz or 37 GHz), their release for 5G services is not currently anticipated, partly due to other services utilising these bands.

Each band has its own specific advantages: low bands (below 1 GHz) are suitable for covering rural areas due to better signal penetration, mid-bands (1–6 GHz) provide a balanced ratio between coverage and capacity, whilst high-bands (above 24 GHz) offer extremely high transmission speeds, albeit with limited range, making them particularly suitable for densely populated urban areas.

To ensure the efficient management and use of frequencies, 5G networks employ a combination of several technologies and strategies:

- **Carrier Aggregation** (combining multiple bands to increase capacity and speed),
- **Dynamic Spectrum Sharing (DSS)** (simultaneous use of bands for 4G and 5G),
- **Spectral refarming** (reallocation of older bands for 5G),
- **Massive MIMO and Beamforming** (multiple antennas to increase capacity and improve signal directionality).

5G radio spectrum management must be carefully planned to ensure sustainable and widely available high speeds. This means, for example, preventing the haphazard allocation of frequencies, which would hinder the creation of a wide-channel block within the same band. Innovative solutions, such as self-driving vehicles and the massive expansion of the IoT, require constant monitoring of developments and adaptation of spectrum options so that they support technological progress without restricting the market and do not stifle the innovative environment.

3.2.4.2 Study recommendations

The approach to regulation and frequency allocation for 5G services is based on a pan-European procedure defined by the European Commission, the RSPG and the CEPT, which takes into account the ITU and the WRC respectively through the Radio Regulations. A combination of low, mid and high bands is required for the effective use of 5G networks. For 5G, and in view of these facts, the pioneering bands (in particular) 700 MHz, 3.6 GHz and 26 GHz have been defined, although the latter is used only for experimental purposes. In the Czech Republic, the 800, 900, 1800, 2100 and 2600 MHz bands are available for 5G services. Other bands will not be released for 5G services in the foreseeable future, although their potential is considerable (e.g. the 6 GHz and 37 GHz bands). Furthermore, the use of technologies and strategies such as Carrier Aggregation, Massive MIMO, Dynamic Band Sharing, Spectrum Refarming and the use of artificial intelligence is required.

Therefore, the management and allocation of spectrum for 5G must be carefully planned to eliminate the haphazard allocation of smaller blocks. It is also necessary to monitor the development of 5G applications well in advance and adapt proactively to the market.

Study recommendations	Thematic block
Monitoring regulatory developments	Radio spectrum management
Czech Republic’s position on spectrum harmonisation for 5G (spectrum licensing)	
Use of modern technologies for spectrum sharing and management	
Implementation of international decisions	
Updating the PVRS	
Preparation of the auction format (e.g. definition of development criteria)	

3.2.5 Study 5: Analysis and proposal for the process of using and allocating frequencies in the 26 GHz band

3.2.5.1 Summary

The 24.25–27.5 GHz frequency band falls within the group of millimetre-wave bands suitable for providing ultra-high-capacity connectivity. This band, together with the 3.4–3.8 GHz, 40.5–43.5 GHz and 66–71 GHz, identified as one of the bands for meeting the objectives of the 5G Action Plan by 2020, with the aim of ensuring increased coordinated availability of radio spectrum for the development of very high-speed fixed and wireless networks.

Frequency bands in the millimetre-wave range are characterised by very limited coverage range due to the predominant nature of line-of-sight propagation, compared to lower frequency bands where more favourable conditions for signal propagation apply. However, the limited coverage range often means that base stations can be deployed inside buildings, and their physical size (smaller antenna arrays compared to lower bands) facilitates their installation. These bands also have limited potential for indoor coverage from outdoor base stations due to signal losses when passing through windows and building walls. This characteristic, on the other hand, represents a strength in terms of their potential for indoor use.

In the Czech Republic, the technical parameters and conditions for the use of the radio spectrum in the 24.25 GHz to 27.5 GHz frequency band are set out in Radio Spectrum Utilisation Plan No. PV-P/2/10.2020-10. According to PV-P/2/10.2020-10, the 26.5–27.5 GHz band is designated for mobile service applications for the provision of wireless broadband electronic communications services (IMT). Five adjacent blocks, each 200 MHz wide, are defined in this section, with the upper edge frequency of the last block being 27.5 GHz. Operation is via time-division duplex (TDD). Further conditions necessary for the practical use of this band will be set out by the CTO in the relevant section of the spectrum utilisation plan at a later date. The use of frequencies by base stations and terminals is envisaged on the basis of individual authorisations for the use of radio frequencies (currently permitted only for experimental purposes).

The CTO’s objective is to make frequencies in the 1000 MHz range available for the provision of wireless broadband electronic communications services. The basic technical conditions for the use of the 26 GHz band are determined both by the Commission’s implementing decisions and by recommendations and other documents issued by the Electronic Communications Committee (ECC). At national level, however, specific conditions may be set in accordance with national needs.

For the purpose of identifying good practice, this study analysed the use of the 26 GHz band in 12 EU countries, the UK and the US (28 GHz band). The aim of the analysis was to identify approaches in individual countries regarding the method and conditions of allocation, including pricing; the definition of entities authorised to use the frequencies; conditions for frequency use, including development criteria; and conditions for frequency sharing in order to increase the efficiency of their use. The overview of spectrum use includes an overview of the practical use of frequencies.

In order to determine the most appropriate approach to frequency allocation in the 26 GHz band, the advantages and disadvantages of various framework scenarios for regulatory conditions governing the use of the frequency spectrum were assessed, which influence the efficiency of frequency use, specifically: a) Which part of the frequency band should be allocated or made available?, b) How can frequencies be allocated, or under what conditions can they be made available?, c) What might be the geographical coverage of the allocated frequencies?

Based on an assessment of the advantages and disadvantages of the individual scenarios, the CTO will adopt a decision on the appropriate approach to the allocation of frequencies in the 26 GHz band. In doing so, the CTO will also take into account the prospects for the future use of the remaining part of the 26 GHz band, i.e. 24.25–26.5 GHz.

3.2.5.2 Recommendations of the study

In connection with the Czech Telecommunications Office’s (ČTÚ) plan to make the 1000 MHz band available for the provision of wireless broadband electronic communications services, it is necessary to define individual authorisations, as this band is currently used solely for experimental purposes. This step should be taken in line with the overall harmonisation at European level, as set out in the RSPG’s opinions. In the long term, it would be advisable to adopt a coordinated approach when deciding on the 26 GHz band regarding how, for what geographical scope and how much of the band to allocate, so as to create the conditions for effective spectrum management with the support of various users.

UNOFFICIAL MACHINE TRANSLATION

Recommendations of the study	Thematic block
Harmonisation of the use of the 26 GHz band based on ECC decisions (e.g. ECC Decision (18)06) and CEPT recommendations	Radio spectrum management
Implementation of a national plan for spectrum sharing between existing and future services, including protection of the fixed satellite service	
Introduction of monitoring mechanisms to control usage and eliminate interference with other services	
Support for testing 5G technologies in the 26 GHz band for new applications, including autonomous systems and IoT	

3.2.6 Study 6: Preparation of analytical background material for the spectrum management strategy

3.2.6.1 Summary

Strategic spectrum management focuses on the efficient allocation and use of spectrum with the aim of supporting technological progress and economic development. It involves meeting the current needs of various sectors in the short term and long-term planning for sustainable development. A key aspect is the flexibility of the strategy, which allows for adaptation to changing technological and market conditions. The strategic process is divided into three phases: formulation of objectives and vision, implementation of operational steps, and evaluation of results, with an emphasis on measurable performance indicators.

Modern spectrum management strategies focus on striking a balance between flexibility, innovation and long-term planning to reflect the growing demand for wireless connectivity. Cooperation between government, industry and international organisations is key to ensuring access to spectrum for future technologies. International cooperation involves the harmonisation of standards and regulations, enabling a more effective response to technological change. Strategies include stakeholder engagement, the use of data for analysis, and the development of technical expertise.

However, spectrum management faces conflicts between the interests of various stakeholders and tensions arising from the conflict between international harmonisation and national flexibility, current market needs and support for innovation, short-term tactical goals and long-term sustainability, and flexible licensing models versus the risk of interference. The modern spectrum strategy, which also forms the basis of this study, is divided into three main areas: (1) making frequencies available to ensure the development of services, (2) establishing legislative requirements, and (3) implementing processes, approaches and tools to ensure the efficient use of frequencies, whilst taking into account the tensions described above.

3.2.6.2 Recommendations of the study

When developing a modern spectrum management strategy, several tensions arise that must be addressed. Given the potential divergence of individual states' needs in contrast to national interests, the Czech Republic should effectively 'lobby' for specific Czech interests whilst remaining open to compromises that ensure global spectrum harmonisation. Active communication between all stakeholders should ensure a balance between current market demands and the creation of space to support innovation. This can be achieved by establishing working groups to regularly analyse these demands. Evaluating these demands will reduce the risks of signal quality degradation and interference. Such evaluation should therefore be used to seek suitable solutions and alternatives to ensure a balance between the need for flexibility and the protection of the quality of currently provided services. Communication with stakeholders (particularly political ones) is also key to balancing short-term and long-term objectives. Educating political stakeholders will ensure that policy decisions are grounded in realistic technical and market requirements, thereby preventing inappropriate interventions that could undermine the future sustainability of the spectrum.

3.2.7 Study 7: Concept and application of a digital twin of 5G network infrastructure

3.2.7.1 Summary

A digital twin is a virtual replica of physical entities or processes that enables two-way data transfer and the ability to model scenarios. The market for digital twins is growing rapidly and is expected to increase tenfold by 2025. This concept has transformative potential for various sectors thanks to autonomous decision-making and the optimisation of physical entities. However, most current digital twins are still at a low level of maturity; they are often digital representations of reality capable of supporting certain analyses, but lack the ability to recommend optimal solutions and directly influence the physical entity.

With growing technological capabilities, digital twins can bring a range of benefits to businesses and other users. Data and its real-time transmission are key elements for the implementation of digital twins, making 5G technology the ideal tool for their realisation. However, the benefits of 5G also bring complications in the form of greater complexity of the network infrastructure, and demands on network design, operation and optimisation. Network Digital Twins (NDT) play a particularly significant role in 5G networks, enabling the simulation of the physical network, the optimisation of its performance and the resolution of faults in a controlled environment.

The development of 5G network digital twins will be accompanied by integration and interconnection with traditional tools such as network inventory, monitoring systems and testbeds, enabling more comprehensive network management. With the transition to 5G Advanced and future 6G standards, further improvements in the replication of physical environments are expected thanks to low latency and an improved uplink. NDTs are also significant in discussions regarding new 6G standards, which could enhance their role through new functionalities such as network sensing or ubiquitous communication.

3.2.7.2 Study recommendations

To achieve maximum efficiency, it would be advisable to standardise terminology based on the phase in which the digital twin is located, as is the case, for example, with autonomous vehicles. Currently, no uniform classification exists. Digital twins can also assist in network performance simulation and prediction, virtual testing, improving decision-making, and accelerating the deployment of new 5G applications.

The implementation of digital twins is associated with certain challenges and risks: cybersecurity risks, interoperability and compatibility risks, high complexity and resource costs, uncertainty regarding return on investment, the risk of incomplete or inaccurate replication, and dependence on evolving standards. Mitigation measures therefore include the development of a comprehensive cybersecurity strategy, a standards-based interoperability framework, and the use of agile development.

In the case of the public sector, it is advisable to consider making it mandatory to include digital twins in strategic plans for crisis management (e.g. in the areas of crisis communication, energy infrastructure, transport or healthcare). This would strengthen the state's ability to prevent crises and effectively manage the response to emergencies through simulations and predictive models.

The successful implementation of a digital twin requires a modular and scalable technology stack. The process itself is highly demanding, and an iterative approach is recommended, starting with a proof-of-concept to verify the feasibility and impact of the digital twin, followed by the creation of a minimum viable product and its connection to real-time data sources.

With the advent of 6G networks, digital twins will gain new capabilities such as network sensing, ubiquitous communication and autonomous network control, which will significantly enhance their ability to optimise and manage infrastructure in real time. For the Ministry of Industry and Trade, this means preparing strategies in good time to integrate these functions into existing digital twins, actively participating in international projects such as Hexa-X, and ensuring support for research and development focused on cybersecurity and the interoperability of new 6G systems.

UNOFFICIAL MACHINE TRANSLATION

Study recommendations	Thematic block
Standardisation of terminology and categorisation of development phases	Industrial use and applications of 5G
Cybersecurity – recommendations/standards for digital twins	
Incorporating the digital twin concept into public sector strategic plans for crisis management	
Preparation for application in 6G	

3.2.8 Study 8: Use of 5G network slicing for public and private networks

3.2.8.1 Summary

Network slicing (NS) has the potential to transform the current state of service provision towards a model that enables the delivery of services with guaranteed parameters, tailored to meet diverse requirements. This brings greater value to the customer and new revenue streams for communications service providers. Unlike previous generations, which were primarily characterised by increased transmission speeds, 5G brings fundamental changes in architecture and support for virtualisation and software-defined networks, which enable innovations such as 5G network slicing and MEC/edge computing.

There are several types of network slicing, including NS as a virtual private network on a public network for smaller businesses, NS for a wide area with guaranteed services, and NS on private 5G networks for large enterprises. This technology is suitable for a wide range of applications, from B2B through B2G to B2C, particularly where mobile or flexible connectivity is required outside a limited perimeter with guaranteed parameters. Key sectors for the use of NS include healthcare, energy, transport, agriculture and the entertainment industry, as well as services for smart cities and public protection and disaster relief (PPDR).

However, the successful implementation of network slicing requires not only technological readiness but also suitable business models. Identifying and implementing a viable business model will be one of the main challenges for the successful deployment of network slicing technology. Further challenges may lie in the areas of operational management, regulation and cybersecurity. In-depth interviews were required for the analysis of network slicing, which point to a general consensus regarding the potential of this technology. This study therefore presents the benefits of network slicing and possible ways of utilising it to potential customers, particularly businesses and institutions, to aid their understanding of this issue.

3.2.8.2 Study recommendations

Balancing the requirements for public network operators, net neutrality and network slicing technology presents a regulatory challenge, requiring policy decisions that support innovation, protect consumer rights and ensure fair competition. The ideal solution lies in the development of network slicing-based services that deliver high value to both users and providers without adversely affecting access to the open internet or distorting competition. Service providers play a key role here; they should plan network capacity so that prioritisation based on network slicing is non-discriminatory and accessible to all users on equal terms, whilst being based on general categories of traffic and not favouring specific applications or providers.

Similarly, the successful roll-out of network slicing is linked to successfully addressing the many security and privacy challenges that this technology brings.

A possible solution to the operational management challenge is to implement network slicing in incremental steps, gain experience, develop business models, and only gradually move on to complex dynamic scenarios. In practice, this means starting with static slicing, progressing to dynamic slicing, and subsequently to slicing open to third parties. In more detail, this gradual process of deploying network slicing is divided into three phases: from launching the basic functionality of network slicing, through end-to-end automation of slicing and scaling, to the creation of advanced business models.

Successful implementation of network slicing requires the parallel implementation of multiple business models, their ongoing evaluation and flexible adaptation, much like in product prototyping. It is recommended to choose simple

UNOFFICIAL MACHINE TRANSLATION

models in the early stages and gradually develop them according to current needs. It is crucial to understand the specific needs of segments and verticals, with service providers needing to move beyond a ‘one-size-fits-all’ approach. Emphasis should be placed on building an ecosystem and collaborating with partners to create a range of specialised services.

As in any commercial sector, the pace of progress here will depend not only on technological development but also on demand for advanced services. It is therefore essential to raise awareness of the possibilities and benefits of network slicing among its potential users in the corporate and institutional sectors.

Recommendations of the study	Thematic block
Creation of a regulatory framework for the use of network slicing	Industrial use and applications of 5G
Cybersecurity – recommendations/standards for network slicing	
Promotion of network slicing to potential users	
Creation of a roadmap	

3.2.9 Study 9: Interconnection of Internet of Things (IoT) and 5G network elements

3.2.9.1 Summary

The Internet of Things (IoT) is part of a vast array of applications across various sectors, ranging from business digitalisation and increased production efficiency to improved healthcare standards and accessibility. The significance of IoT is also reflected in the size and growth of the market, which is predicted (global enterprise IoT market size) to more than double by 2030. This study therefore provides a comprehensive overview, examining how its layers and components function, its areas of application, the challenges it faces, and its future.

There are different variants of 5G technologies for IoT. The NB-IoT and Cat-M technologies were adopted and developed from the original 4G ecosystem. The current 5G NR is not a technology designed specifically for IoT due to its high cost and poor energy efficiency from the perspective of end devices. High expectations are associated with NR-light (RedCap) and Passive IoT technologies. The study divides IoT systems into three categories – critical, massive and medium IoT – which differ in terms of performance, reliability and energy consumption requirements.

The study also highlights the challenges associated with IoT, such as cybersecurity, limited interoperability and high fragmentation of protocols and technologies. It identifies key trends for the future in new communication technologies (particularly RedCap and Passive IoT) for the implementation of new business models and the wider deployment of IoT, the use of AI/ML for advanced data analysis for predictive maintenance or anomaly detection, and cloud-based IoT products that will enable the rapid deployment of IoT systems.

3.2.9.2 Recommendations of the study

Given the significant economic benefits of IoT applications, particularly with the use of 5G technologies, it is essential that the public sector (Ministry of Industry and Trade) actively stimulates their development and presents new use cases to potential users. The public sector should support awareness-raising initiatives and provide examples of successful IoT applications, thereby increasing awareness and adoption of these technologies.

In the area of IoT system cybersecurity, it is essential that the Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) introduce ‘Security by Design’ recommendations or standards, and support the use of encryption protocols and regular software updates. Public sector experts should provide consultancy and methodological support in the field of cybersecurity so that this responsibility is not shifted exclusively to general system designers. To address interoperability and fragmentation issues, the Ministry of Industry and Trade and the Czech Telecommunications Office should promote open standards, support investment in middleware solutions and organise cooperation with industry stakeholders. Furthermore, they should initiate pilot operations in multi-vendor environments, create platforms for the integration of protocols and devices, and enable the practical testing of IoT solutions.

Regarding the selection of suitable transmission technology, we recommend that guidelines be defined for various technologies based on typical use cases and their specific requirements. Public sector support for IoT adoption should require transparency from providers regarding long-term support for selected technologies and effective support for the academic sector in verifying technology characteristics through Proof of Concept projects.

These recommendations can be effectively supported, in particular, by improving the awareness of potential users on the part of the public sector.

Study recommendations	Thematic block
Definition of a strategy and options for using IoT for government purposes	Industrial use and applications of 5G
Promoting the use of 5G in IoT applications to potential users	
Support in the area of cyber security for IoT systems	
Creation of an environment stimulating the application of IoT solutions	

3.2.10 Study 10: Use of 5G networks for fixed wireless high-speed point-to-multipoint (FWA) access

3.2.10.1 Summary

From a global, European and Czech perspective, Fixed Wireless Access (FWA) networks are an integral part of the technological environment of the access layer for the provision of electronic communications services. Modern wireless access technologies for electronic communications networks represent the final link in the chain, with the assumption that the higher layers of the network – the access and backbone layers – are implemented using high-speed data transmission technologies, most commonly optical fibre.

The aim of this study is to analyse the potential and development of the wireless access layer, whether based on 5G technologies or on technologies with similar or higher performance based on licensed or unlicensed bands. To achieve the study's objectives, it is necessary to quantify the current and future requirements of households and businesses regarding connection capacity and reliability. A secondary objective of the study is to analyse the usability of FWA networks for content distribution via specialised protocols, such as 5G Broadcasting.

3.2.10.2 Study recommendations

Fixed Wireless Access (FWA) technologies offer significant potential for achieving the goals of the Digital Decade and meeting the requirements of the Gigabit Infrastructure Act, particularly in areas where traditional optical infrastructure is challenging or economically unviable. The following action steps arise from the study and aim to effectively utilise the opportunities offered by FWA technology and ensure its successful implementation.

Action steps arising from the study on the use of FWA (Fixed Wireless Access):

Support for the development of FWA networks:

- The Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should actively support the deployment of FWA technologies, particularly in areas where the construction of optical networks is economically or technically challenging.

Securing spectrum resources:

- The ČTÚ should optimise access to the frequency spectrum suitable for FWA, particularly in the 26 GHz band, and support flexible licensing models enabling the economically sustainable development of networks in less densely populated areas.

Information and awareness-raising activities:

- The Ministry of Industry and Trade should promote FWA as a fully-fledged alternative to fibre-optic connections within the framework of the gigabit connectivity targets, highlight successful implementations, and disseminate information to municipalities and local authorities.

Increasing network capacity and availability:

- The public sector should support investment in infrastructure densification, including strengthening connection capacities, which is essential for maintaining service quality and the long-term competitiveness of FWA solutions.

Utilisation of European funds and national resources:

- The Ministry of Industry and Trade should systematically utilise available European funds (e.g. Digital Decade, Recovery Fund) to finance FWA pilot projects in areas with high barriers to optical infrastructure.

Support for interoperability and cybersecurity:

- The Czech Telecommunications Office (ČTÚ) and the Ministry of Industry and Trade (MPO) should ensure that the FWA technologies being deployed meet cybersecurity and interoperability standards, which will contribute to their wider acceptance and long-term sustainability.

Recommendations of the study	Thematic block
Selection of a suitable frequency band for FWA	Building VHCN
Monitoring network infrastructure requirements	
Analysis of FWA usage within the MFCN, for use in the 3800–4200 MHz band	
Establishment of an appropriate regulatory framework with regard to international harmonisation	

3.2.11 Study 11: Analysis of the 400 MHz band with a view to future use in the mobile radio service

3.2.11.1 Summary

The aim was to map the use of the 410–430 MHz and 450–470 MHz bands and the trend in the deployment of broadband networks in these bands, and to describe scenarios for the possible future use of these bands in the Czech Republic. The study serves as a basis for strategic decision-making on the future use of the 400 MHz band.

The 400 MHz band is widely used due to its characteristics, and so the nature of this usage varies across EU countries; however, the use of broadband technologies is very low. The growing demand for mission-critical M2M communications is driving a trend towards the deployment of broadband networks in this band (an overview of available technologies is also provided in this study).

The analysis confirms the importance of the 400 MHz band as a strategic resource for current and future needs in the field of critical communications, particularly in narrowband PMR/PAMR systems. At the same time, however, a significant portion of the band, reserved for broadband technologies, remains unused due to minimal demand, which opens up scope for consideration of its future use.

3.2.11.2 Study recommendations

The analysis of the 400 MHz band has confirmed its key importance for the future of critical communications networks and its use within private networks in the Czech Republic. In order to ensure the effective use of this strategic spectrum and to create optimal conditions for its future development, the following action steps must be taken:

- **Public consultation:** The Ministry of Industry and Trade, in cooperation with the Czech Telecommunications Office, should launch a broad public consultation with key users of the band, particularly from the energy, utilities, public administration and other critical infrastructure sectors. The aim consultation is to identify the actual market requirements for the use of the 400 MHz band and to assess the current and future needs of individual users.

- **Decision on spectrum allocation:** Based on the consultation outcomes, the CTO should review the radio spectrum utilisation plan and, where appropriate, release the 410 MHz band segment for narrowband systems, thereby effectively addressing the shortage of available channels in critical areas such as Prague and its surroundings.
- **Support for pilot projects:** The Ministry of Industry and Trade (MPO) should actively support and initiate pilot projects for broadband networks in the 450 MHz band, particularly for use in critical infrastructure and mission-critical communications. Pilot projects will enable practical verification of the benefits of LTE technology in the 400 MHz band and provide important data for future decisions.
- **Coordination with neighbouring countries:** The Czech Telecommunications Office (CTO) should cooperate closely with neighbouring countries to coordinate the use of the band, in order to ensure optimal use of the spectrum without cross-border interference, particularly in view of the planned use of broadband technologies in neighbouring countries.
- **Legislative amendments:** The Ministry of Industry and Trade should consider legislative changes that will enable more efficient and flexible use of the spectrum for non-public broadband networks (e.g. mission-critical LTE), which may require amendments to the Electronic Communications Act or sector-specific legislation.
- **Strategic decision on the 410 MHz band:** Given the current underutilisation of the 410 MHz broadband segment, the Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should decide on the possible release of this band for narrowband systems, which would ensure the necessary capacity for existing PMR systems and prevent the long-term blocking of spectrum resources without any real use.

Recommendations of the study	Thematic block
Conducting a strategic review of the 410 MHz band	Radio spectrum management
Public consultation with existing and potential users of the band	

3.2.12 Study 12: 5G Broadcast

3.2.12.1 Summary

This study focuses on analysing FeMBMS (Further evolved Multimedia Broadcast Multicast Service) technology in current 5G networks and its potential use in the Czech Republic. FeMBMS offers the possibility of more efficient transmission of audiovisual data and mass communications with high efficiency, both for commercial use and for public services, including emergency communications. The study assesses the current state of the technology's implementation, analyses its compatibility with existing systems, and explores possible future applications.

3.2.12.2 Study recommendations

For the successful introduction of FeMBMS technology, it is first advisable to focus on establishing methodological and regulatory frameworks. One step towards achieving this is to develop a methodology for the use of FeMBMS, including the establishment of conditions for spectrum sharing between broadcast and mobile services. The subsequent implementation of pilot projects should involve stakeholders, including industry partners and the academic sector, in key locations across the Czech Republic, thereby ensuring support for the entire ecosystem and industrial development. In the long term, systems must then be introduced to monitor the effectiveness of FeMBMS implementation, including the collection and analysis of data on spectrum usage and service quality.

Study recommendations	Thematic block
Development of a methodology for the use of FeMBMS	Industrial use and applications of 5G
Implementation of FeMBMS pilot projects	
Support for the ecosystem and industrial development	
Monitoring the effectiveness of FeMBMS implementation	

UNOFFICIAL MACHINE TRANSLATION

3.2.13 Study 13: The use of 5G and other electronic communications networks for the digitalisation of businesses, including the use of modern information systems

3.2.13.1 Summary

Although the digitalisation of businesses using 5G in the Czech Republic is proceeding at a pace comparable to that in other European countries, it still lags behind the expectations of the professional community associated with the 5G spectrum auction. This comparison is based on projects involving private 5G networks due to the absence of network slicing and, consequently, the limited options available to businesses on public 5G networks. The state of digitalisation is examined from the perspective of the regulatory environment, the state of research and development, the availability of support programmes, and projects implemented to date.

The study proposes improvements to the regulatory environment, ranging from the necessary interpretation of the existing spectrum band through the use of other potential bands to the use of unlicensed bands for 5G technologies. Businesses have the option of utilising functional testbeds, and it is therefore important to promote these solutions to encourage greater business participation. For further digitalisation, it is desirable to maintain (or repeat) support programmes and to raise greater awareness among companies regarding the use of these resources at both national and European levels. Projects implemented to date are included in the appendix to this document in the form of case studies.

According to stakeholders, the main barriers to faster digitalisation of businesses using 5G are regulatory conditions, costs, a lack of expertise and a limited ecosystem. The study therefore proposes measures to remove or mitigate these barriers, as well as further steps to support 5G-enabled digitalisation in the areas of education, financial incentives and further improvements to the regulatory environment. For companies, as well as other stakeholders, who have plans and ambitions in the field of digitalisation and have use cases that require data connectivity, this study provides information to help them navigate the entire issue.

3.2.13.2 Study recommendations

Although the regulatory environment in the Czech Republic allows for the establishment of private 5G networks, it still contains certain restrictions that affect both the low utilisation of potentially available spectrum for private 5G networks and the high costs of private 5G networks. The high costs are partly addressed by support programmes in the field of 5G network research and development at both national and European level, which are underutilised. It is desirable to maintain these programmes in the future and to inform industrial verticals about the possibilities for their use. Testbeds in Prague and Brno also suffer from a lack of awareness, so it is appropriate to promote these opportunities in order to increase the number of companies using them.

Study recommendations	Thematic block
Promotion of testbeds and their cooperation with the private sector	Industrial use and applications of 5G
Improving the regulatory environment for private 5G networks	
Improving awareness among potential users	
Further implementation of support programmes	

3.2.14 Study 14: KPIs for mobile 5G networks, 5G indicators and links to DESI

3.2.14.1 Summary

Within the European Union, Member States are compared year-on-year using the so-called DESI index, which assesses the digital economy and society. This tool identifies areas requiring improvement and determines differences between Member States across four dimensions (digital skills, digital infrastructure, digital transformation of businesses, and digitisation of public services), which aids in the development of policies aimed at improving digital infrastructure and skills and setting digital transformation targets.

The document compares the Czech Republic’s position in specific metrics, such as the availability of 5G networks in the Czech Republic and Germany. The key barriers and limitations to the development of 5G networks in the Czech Republic stem from the conclusions outlined above. The main constraints on the development of 5G networks in the Czech Republic are linked to the insufficient use of higher frequency bands (expanding the use of the 3.4–3.6 GHz band) and the need for investment in standalone technology. Although 5G signal coverage of the population stands at 96.8%, which is above the EU average, further increases in coverage may entail disproportionately high investment costs when calculated per capita of the newly covered population. In the context of the DESI index, the Czech Republic lags behind primarily in the area of gigabit connectivity, mainly due to the indicator for the development of optical networks. Partly for this reason, the Czech Republic's relative position will continue to deteriorate, also in view of the lack of anticipated increases in infrastructure investment in the foreseeable future, assuming the same DESI indicator methodology.

Due to the lack of robust data, it is necessary to base the assessment on partial sources, which have certain limitations. This assessment shows higher download speeds and lower latency for the operator O2 compared to the other two operators, which, however, have better coverage. Furthermore, a significant difference can be observed between results in urban and rural areas, as well as between 5G and older technologies (particularly in high-traffic situations). The decline in 5G network quality beyond a certain threshold of connected users is addressed by deploying mobile base stations or strengthening the infrastructure using standalone technology.

According to several studies, 5G networks bring significant economic benefits and create new jobs. 5G networks also offer increased data transmission efficiency; on the other hand, the need for a dense network of base stations may increase the network's energy consumption. Further environmental costs are associated with the manufacture and installation of new equipment, which may lead to higher CO2 emissions and the generation of electronic waste.

3.2.14.2 Study recommendations

The study on 5G mobile network KPIs and their links to DESI identified several key areas that must be addressed for the further development of 5G networks in the Czech Republic and to maintain competitiveness within the EU. To achieve an optimal state of digital connectivity, the following action steps must be implemented:

Support for the transition to Standalone (SA) 5G technology: The Ministry of Industry and Trade (MPO) should actively encourage operators to transition more quickly to SA technology, which enables the full potential of 5G networks to be realised, such as network slicing and higher connection quality. The MIT could consider grant schemes or other forms of support for operators implementing SA technology.

Expanding the use of the 3.4–3.8 GHz band: The Czech Telecommunications Office (ČTÚ) should closely monitor and support operators' investments in expanding 5G networks in higher frequency bands, which offer greater capacity and speeds. At the same time, the CTO should provide regular updates on the development of coverage and connection quality in this band to increase transparency and motivate operators to make further investments.

Awareness and information campaign on the benefits of 5G: The Ministry of Industry and Trade should initiate communication and awareness-raising activities targeting businesses and the public, highlighting the benefits of 5G networks not only in terms of speed but also in terms of economic benefits and new applications in industry and services. The aim is to increase demand for advanced services and encourage wider adoption of new technologies.

Improving regional availability of 5G networks: The Czech Telecommunications Office (ČTÚ) should, in cooperation with operators, implement projects aimed at increasing the availability of high-quality 5G connectivity in rural and less densely populated areas. The Ministry of Industry and Trade should make use of European funds (e.g. the Recovery Fund, Digital Decade) to finance network development in regions where economic viability for operators is lower.

Support for **cooperation between operators:** The Ministry of Industry and Trade (MPO) and the Czech Telecommunications Office (ČTÚ) should create conditions for cooperation between operators in the construction and sharing of 5G infrastructure, particularly in areas where there might otherwise be duplicate investment or low efficiency. Such cooperation can significantly accelerate network development and improve their availability and quality.

UNOFFICIAL MACHINE TRANSLATION

Recommendations of the study	Thematic block
Supporting an increase in the share of standalone networks and expanding the use of the 3.4–3.6 GHz band	Building VHCN
Increasing the proportion of households connected via VHCN networks	
Improving the methodology for analysing qualitative parameters	
Achieving DESI sub-objectives (supporting the digital transformation of businesses, digital skills of the population, and the digitisation of public services)	

3.2.15 Study 15: Analysis of cyber risks associated with the operation of 5G networks for private (closed) networks and the provision of public services, including the impact of Open RAN and Open Core approaches on the security of 5G networks

3.2.15.1 Summary

5G technology represents a revolutionary leap in the telecommunications industry, bringing significant improvements in speed and reliability, as well as new possibilities for industrial applications and public services. This technology is a key factor in the realisation of the ‘Internet of Things’ (IoT) concept, which enables the interconnection of millions of devices, from smart homes to autonomous vehicles and smart infrastructure. The main benefits of 5G include higher data transfer speeds, lower latency—crucial for real-time applications—and support for a large number of devices per unit area, which is essential for the development of smart cities and IoT applications. Despite these advantages, however, 5G networks face new cyber threats and security challenges. The complex architecture of 5G networks, which involves a large number of different devices and systems, potentially increases the scope of an attack and broadens the range of vulnerabilities.

Cyber threats associated with 5G include greater network complexity, a distributed network architecture, dependence on various software and hardware suppliers, an increased risk of privacy breaches and leaks of sensitive information, and signal interference. Open RAN and Open Core technologies improve network flexibility and interoperability; Open Core technology also enables faster and more efficient deployment of new services. However, due to their nature, there is an increased risk of cyberattacks and greater vulnerability. Therefore, certain security measures must be applied for these approaches, which are further described in the study’s recommendations.

3.2.15.2 Study recommendations

To mitigate cyber risks, certain security measures must be applied, including strengthening security standards and controls, implementing systems for monitoring and detecting anomalies, introducing security audits of suppliers, deploying strong encryption mechanisms, establishing data protection rules, and training staff. Strengthening security standards and controls can be achieved by introducing robust security measures and standards for all parts of the 5G network. Thorough vetting and auditing of all suppliers involved in the construction and operation of 5G networks will, in turn, reduce dependence on various suppliers of hardware and software components and increase control over the entire supply chain. Data protection and privacy will be ensured by the deployment of strong encryption mechanisms and strict data protection rules. The human factor also plays a significant role in enhancing the security of 5G networks; staff must be regularly trained and informed about cyber risks in order to mitigate them. Cooperation and the sharing of know-how at an international level can also serve this purpose, as they improve the ability to respond quickly to security incidents.

UNOFFICIAL MACHINE TRANSLATION

Recommendations of the study	Thematic section
Strengthening safety standards and controls	Radio spectrum management
Implementation of systems for monitoring and detecting anomalies	
Introduction of supplier security audits	
Deployment of strong encryption mechanisms	
Introduction of data protection policies	
Staff training	
Participation in international programmes	

3.2.16 Study 16: Analysis of approaches to spectrum usage fee policy across the EU, identification of general principles and recommendations for possible changes for the Czech Republic, inter alia in connection the development of 5G networks

3.2.16.1 Summary

This study was conducted to provide a comprehensive overview of approaches to the collection of fees for the use of radio frequencies across the EU and to compare these with fees in the Czech Republic based on Government Regulation No. 154/2005 Coll. on the determination of the amount and method of calculation of fees for the use of radio frequencies and numbers. The main objective was to identify potential areas for review of fee collection in the Czech Republic based on a comparison and in-depth analysis of the CTU's fee policy.

The first part of the study describes the regulatory framework for the collection of fees under European Union legislation. It further defines the reasons for collecting fees for the use of frequencies, citing more efficient spectrum management, the coverage of regulatory costs by the CTU, and the promotion of the public interest and competition as the main ones. The chapter also addresses trends and challenges in this sector, highlighting the role of 5G networks as the main current and future driver of the telecommunications sector.

Part of the document focuses on the main principles of setting fees for the use of frequencies. Various charging models are compared in relation to the type of service or application definition. Different approaches to the financing of national telecommunications regulators are also mentioned and compared, including the role of fees in this area. There is also a discussion on methods for updating fees over time.

An important part of the report is an extensive benchmark of fee policies across thirteen European countries. The benchmark examines the general approach of the selected countries to the collection of fees for the use of frequencies, then analyses the method of calculating fees for key services, such as fixed, terrestrial mobile and satellite services, and finally, in the appendices, provides a detailed analysis of further information on the collection of fees in accordance with the legislation of the relevant country. The benchmark was carried out for twelve selected EU countries and the United Kingdom.

The core chapter of the study focuses on specific areas that have been identified as important for the further development of the telecommunications sector, or which, based on an international benchmark or an analysis of fees in the Czech Republic, have been identified as suitable for more detailed examination with the potential for future adjustments. The main focus was on the following topics:

- a change in the structure of fees for authorisations for experimental use of frequencies, with the aim of simplifying calculations and providing better coverage of short-term experiments and demonstration events;
- adjustment of coefficients in the calculation of fees for fixed and land mobile services to more accurately reflect market realities and increase the efficiency of spectrum allocation;
- options for setting the method of collecting fees for private networks (5G and TETRA networks/business radio);
- a potential review of the method of charging for satellite services to ensure appropriate fee collection in light of the sharp increase in the use of this type of service.

Based on a more detailed examination of these areas, possible adjustments to the current approach to the collection of fees for the use of frequencies have been proposed, which the CTO should address in the near future. These include, for example, dividing experiments into two categories according to the duration of the authorisation, namely short-term and long-term; removing the unused table for calculating the fee for point-to-multipoint services; or increasing the granularity of the intervals for determining the calculation coefficients for certain types of fixed and land mobile services.

3.2.16.2 Recommendations of the study

Removal of the table for fixed point-to-multipoint services from Regulation 154/2005 Coll.: This table is obsolete, as the actual use of this service is practically non-existent today. Its removal will simplify the legal framework and reduce unnecessary administrative burdens.

Adjustment of bandwidth intervals for the calculation of the S4 coefficient for other PPS radio networks: Refining the intervals will enable a more accurate and fairer calculation of fees, reflecting the actual market value of the spectrum used.

Scaling of K9 coefficient intervals for the calculation of the fixed service (PS) fee: As with S4, the aim is to better differentiate fee levels according to bandwidth and to promote more efficient use of radio frequencies.

Removal of point A2.1 due to obsolescence and non-existent use cases: This point no longer reflects current technological and market conditions; its removal will improve the clarity of the fee rules.

Adjustment of fees for experimental and short-term use of frequencies (amendment to the Government Regulation): The aim is to encourage greater use of the spectrum for innovation, for example in the field of 5G/6G technology research and development, by reducing and simplifying fees for short-term projects.

Definition of the charging method for private 5G networks: Emerging private networks (e.g. in industry and logistics) require clear rules and predictable fees to ensure their reasonable economic accessibility and rapid development.

Revision of the satellite service fee model: With the sharp rise in demand for satellite services (internet, IoT), it is necessary to revise the fee model so that it reflects the current economic value of these services whilst supporting the development of new satellite technologies.

Revision of fees for experimental and short-term use of frequencies (amendment to the Act): In addition to changes to the Government Regulation, the legal framework must also be amended to enable the full implementation of new, more flexible fee models for short-term use of frequencies.

Recommendations of the study	Thematic block
Removal of the table for fixed point-to-multipoint services from Regulation 154/2005 Coll.	Radio spectrum management
Adjustment of bandwidth intervals for calculating the S4 coefficient for other PPS radio networks	
Scaling of K9 coefficient intervals for the calculation of PS fees	
Removal of point A2.1 due to obsolescence and non-existent use cases	
Adjustment of fees for experimental and short-term use of frequencies (amendment to the Government Regulation)	
Definition of the method of charging for private 5G networks	
Adjustment of the satellite service fee model	
Adjustment of fees for experimental and short-term use of frequencies (amendment to the Act)	

UNOFFICIAL MACHINE TRANSLATION

3.2.17 Study 17: Use of FRMCS systems in rail transport, including dedicated channels in the 900 MHz and 1900 MHz bands

3.2.17.1 Summary

The study addresses the specific conditions for implementing the FRMCS system in the Czech Republic, particularly on the network of the majority railway infrastructure manager Správa železnic s.o., taking into account existing strategic plans for the development of rail transport in the Czech Republic, as well as the technical and economic conditions for the construction of the GSM-R system. In addition to written and online sources, the study incorporated the views of members of a working group comprising representatives of the contractor, freight and passenger transport operators associated with ŽESNAD and SVOD Bohemia, Správa železnic s.o., the Ministry of Transport, the Ministry of Industry and Trade, and Czech delegates to the international organisations ERJU and UNIFE.

A list of applications defined in the FRMCS User Requirements Specification (FRMCS URS), drawn up by the UIC and forming the basis for FRMCS standardisation, was adopted as a representative sample of current and future applications used to support railway operations. The user requirements also classify these applications in terms of criticality. For the purposes of the study, a separate translation of the relevant parts of the FRMCS URS was prepared, taking into account established Czech railway terminology and the specific characteristics of Czech railway operations, as presented to the working group by representatives of the Ministry of Transport and the SVOD/ŽESNAD association. The translation itself, together with an updated glossary of relevant terms and definitions, forms part of the annexes to this study. The annex will be submitted to the EC Translation Service in Luxembourg, where it will serve to refine the translation of EC regulations on railway matters into the national language version. Based on the list of applications, a questionnaire was drawn up to map their prospects and significance for the railway sector in the Czech Republic. The methodology used for the questionnaire is taken from an earlier study prepared for the ERA in 2016, so its findings allow for a comparison of the views of representatives of the Czech railway sector with the European context.

The document also addresses the potential coverage of the railway network by the FRMCS system, as well as individual RMR bands, MNO bands and other radio access options, summarising the technical conditions for their use, the basic characteristics of signal propagation and their relationships with other bands, taking into account potential mutual interference. Specifically for the 900 MHz band, coexistence with GSM-R is discussed, and for the 1900 MHz band, the specifics of using TDD bands, the limitations and benefits of its potential use are discussed. The main conclusion of the analysis is that densification of the FRMCS base station (gNB) network is necessary for the deployment of the 1900 MHz band, but will not reach the commonly considered 100%; and, given the longer-term prospects for FRMCS use, the use of this band should not be excluded from planned procedures.

The communication requirements, specifically the throughput of the radio access network, were taken from UIC and ERA working documents and technical reports and compared with the results of NR RAN simulations reported in the technical report ETSI TR 103 554-2. The results of this comparison show that none of the RMR bands will be sufficient on its own to support the full range of critical applications, and it will be necessary to gradually expand the FRMCS system to cover both bands, or to transfer part of the communications to bands operated by MNOs. It will be advantageous to take this target state into account for the optimisation of costs and logistics during the initial migration steps.

The next section of this study is devoted to the evaluation of the migration scenarios under consideration. The evaluation proceeds from theoretical scenarios, taken from an earlier study prepared for the ERA in 2016, to sub-variants reflecting the specific characteristics of the current situation in the Czech Republic. The individual variants cover the sequence of infrastructure and rolling stock migration, the transition to bands outside the 900 MHz range, and the impact of incompatibilities within FRMCS or in relation to ETCS, assessed for a single network, as well as the sequence of migration in relation to a neighbouring larger railway network, taking into account cross-border operation conditions. The main conclusion of the comparison is that, whilst the scenario involving dual FRMCS/GSM-R terminals installed on vehicles is more favourable to operators in terms of investment and more resilient to external influences, it is unfeasible due to a lack of time reserves for piloting and approving on-board equipment. The evaluation of the scenarios includes a discussion of the motivations of individual participants based on their responses to the questionnaire and a comparison of these results with a survey from an earlier study conducted for the ERA among Western European railway administrations and operators.

The evaluation of the options and the content of the discussion within the working group preparing the study suggest, among other things, proposals for changes to the legislative framework, primarily concerning the stabilisation of the technical regulations environment, vehicle certification and the conditions for public financial support for migration. The aim of these proposed measures is to prevent the negative impacts of previous migration campaigns – specifically the introduction of exclusive ETCS operation, which had significant impacts on the profitability of migration for operators and are one of the reasons for the minimal motivation among entities in the Czech railway sector to switch to FRMCS.

3.2.17.2 Study recommendations

For the effective implementation of FRMCS, it is essential to take several key measures. Updating strategic plans involves revising the National ERTMS Implementation Plan and supplementing the strategy for the implementation of FRMCS with an emphasis on priority applications (ETCS and ATO). Furthermore, spectrum harmonisation (particularly the 900 MHz and 1900 MHz bands) must be ensured, and the PVRS updated with regard to sharing with GSM-R. Support for migration includes ensuring a dual-mode operation of GSM-R and FRMCS during the transition period and creating the conditions for the gradual phasing out of GSM-R technology.

The implementation will include FRMCS pilot tests to verify coverage, capacity and interoperability, with a focus on cross-border transport. To ensure a smooth transition, legislative amendments are crucial, including changes to the legal framework and financial incentives for both carrier migration and the construction of new infrastructure. It is also important to strengthen international cooperation through participation in European working groups focused on standardisation and the sharing of knowledge with other EU Member States. Last but not least, it is essential to establish monitoring and evaluation of FRMCS implementation, which includes ongoing progress monitoring and regular updates to strategic plans based on the data obtained.

Recommendations of the study	Thematic block
Updating strategic plans	Radio spectrum management
Spectrum harmonisation for FRMCS systems + updating the PVRS with regard to GSM-R sharing	
Creating conditions for the phasing out of GSM-R	
Ensuring dual mode operation of FRMCA and GSM-R	
Conducting FRMCS pilot tests	
Amendment of legislative frameworks	
Financial incentives for carrier migration and infrastructure development	
Active international cooperation	
Introduction of monitoring and evaluation of FRMCS implementation	

3.2.18 Study 18: Study of methods and techniques for determining and verifying coverage by radiocommunication services

3.2.18.1 Summary

The study focuses on modern methods for determining and verifying radio signal coverage, which include the use of satellites, drones, software tools and the processing of large volumes of data. It concentrates in particular on mobile service coverage, especially 5G, and examines the possibilities for establishing the interdependence of monitored parameters for the evaluation of services provided according to new criteria. Monitoring is carried out primarily by measuring signal levels at various locations using portable measuring devices, by measurements using vehicles equipped with specialised measuring technology, by evaluation using software tools and mathematical models in the form of coverage level prediction, and also by monitoring the status and performance of the network in real time.

In the context of hardware monitoring, satellites appear to be practically unusable for technical and economic reasons; however, with the growing focus on the use of space, there are also demands for the development of space-based telecommunications and their monitoring. Drones appear to be an alternative option in specific situations where standard drive and walk tests are not possible. Suitable measuring instruments and methodologies currently exist, but current legislation lacks exemptions for selected state authorities and institutions; an example is the Czech Telecommunications Office (ČTÚ), which does not have an exemption to conduct measurement flights. With regard to software tools, there are discrepancies between simulation results and measured values. Due to differing methodologies and input parameters for calculations, there are variations in outputs among individual operators and in relation to the CTO. It would therefore be beneficial to harmonise the legislation and, in cooperation with the Czech Office for Surveying, Mapping and Cadastre (ČÚZK), create a ‘reference’ terrain model

. Another part of the study focuses on the use of more advanced technologies and software tools in testing voice communication. Voice transmission quality testing is based on the same methodologies, and solutions for monitoring communication networks differ only minimally among multinational manufacturers.

The document also examines ways of linking existing monitoring methodologies with new service evaluation criteria that better reflect end-users' needs. The analysis showed that simultaneous and correlated parameter verification is possible, but requires the processing of large amounts of data. Data averaging plays a major role in drive-by measurements. Measuring radio signal coverage of a geographical area, continuous monitoring and evaluation of service parameters are essential tasks for ensuring the operation of wireless networks and the efficient use of spectrum. The study recommends focusing specifically on analysing the need for measurement and testing in the area of fixed LTE and 5G (including VHCN), analysing the need for measurement and testing in the area of private 5G networks (including in the context of 26 GHz band usage), striving to expand the usability of drones (including by introducing exemptions in current legislation for conducting measurement flights), initiate a more detailed analysis of simulation and measurement tools and their results with the aim of standardising the baseline conditions of methodology and criteria, analyse in greater detail and on an ongoing basis the relationships between radio parameters and quality of service parameters leading to validation, and address the topic of radio spectrum management in space telecommunications and the development of satellite technologies.

3.2.18.2 Recommendations of the study

Measuring the coverage of a geographical area by radio signals, and the continuous monitoring and evaluation of service parameters, are key activities for ensuring the operation of wireless electronic communications networks, the efficient use of spectrum, and consumer protection. In this context, it is essential to focus on several specific action steps. The growing importance of fixed LTE and fixed 5G requires an analysis of measurement and testing needs in this area, particularly in the context of VHCN networks and conditions. Similarly, there is a need to analyse the measurement and testing requirements for private 5G networks, particularly in industrial applications, with regard to the expected use of the 26 GHz band. Furthermore, it is advisable to expand the use of drones for measurement flights, for example by introducing exemptions in the current legislation. A key initiative is also a more detailed analysis of simulation and measurement tools and their results at operators and the CTO, with a view to harmonising baseline conditions, methodologies and criteria. It is also essential to continuously analyse the relationships between radio parameters and quality of service parameters, which will enable the validation and possible adjustment of coverage limits, and to optimise the methodology for measuring data transmission parameters. Last but not least, it is important to address radio spectrum management in space telecommunications in the context of the development of satellite technologies, taking into account the outcomes of the WRC-27 and WRC-31 radio communication conferences, and their applications in science, research, industry and services.

Recommendations of the study	Thematic block
Analysis of measurement and testing needs in the field of fixed LTE and fixed 5G (including in the context of VHCN)	Radio spectrum management
Analysis of measurement and testing requirements in the field of private 5G networks (including in the context of the 26 GHz band)	
Expanding the use of drones for measurement	
Introduction of exemptions in current legislation for conducting measurement flights	
Analysis of simulation and measurement tools with a view to standardisation	
Analysis of the relationships between radio parameters and quality of service parameters leading to the validation (revision) of coverage limits	
Optimisation of the methodology for measuring data transmission parameters	
Analysis of spectrum management in space telecommunications	
Development of satellite technologies + support for their applications	

3.2.19 Study 19: Development of 6G networks in bands above 100 GHz Summary

The study analyses the current state and prospects for the standardisation of 6G networks and summarises the current state of knowledge regarding bands above 100 GHz under consideration for mobile networks. It is divided into three parts: an examination of 6G network issues, an analysis of the potential use of frequency bands above 100 GHz, and a forecast of the potential use of frequency bands above 100 GHz. The 5G-Advanced specification is expected to be finalised in the near future, bringing a range of new features that already point towards the next generation, 6G. A fully-fledged 6G network is likely to be standardised by 2028, and practical deployment and use in a number of countries, including in Europe, is expected around 2030.

The 100 GHz to 1 THz frequency bands are suitable for transmission at ultra-high speeds and have also been identified as one of the bands for the development of 6G networks after 2030. According to the approved resolutions, all preparatory work should be completed in time for WRC-31, which will be crucial for their commercial opening. Millimetre-wave frequency bands are characterised by very limited range due to the predominant nature of line-of-sight propagation and high environmental attenuation. This fact, combined with the expected small size of antenna arrays, will lead to their use primarily for indoor coverage and relatively small, confined areas (stadiums, squares, etc.) and direct communication between devices (D2D, V2V). On the other hand, it will enable far more precise localisation and detection of objects as secondary functions.

In the context of evolving requirements, technological challenges and expected investments, expansion into bands above 100 GHz does not appear particularly pressing and is likely to be necessary only in the long term. That is, only after the 26 GHz band has been utilised and fully exploited, or other bands under consideration that are internationally coordinated for mobile communications. The following are envisaged as possible basic licensing regimes: licence-exempt operation for applications with low radiated power
and advanced active antenna systems, and the possibility of granting individual licences for specific applications where the risk of mutual interference between stations would be unacceptable to users.

In conclusion, it is recommended to closely monitor developments in the field and actively participate in forums on the use and licensing of bands for 6G networks; to adopt a position and formulate a strategy for the introduction of 6G in the Czech Republic in a timely manner; monitoring the use of current bands, the evolution of customer requirements and the development of services, and, on this basis, updating the need to utilise bands above 100 GHz and supporting research and further specialist studies in this area through appropriate calls for proposals and funding mechanisms (initially focused on theoretical and experimental work and subsequently on applied research).

3.2.19.1 Study recommendations

In the context of this topic, it is recommended to closely monitor developments in the field of 6G networks and to actively contribute to discussions in international forums on the use and licensing of spectrum bands for these networks. At the same time, it is important to adopt positions in good time and formulate a strategy for the roll-out of 6G networks in the Czech Republic, with 2025 and 2026 appearing to be a suitable timeframe for its formulation. Based on monitoring the use of current bands, the evolution of customer requirements and the development of services, it is necessary to continuously update the requirements for the use of bands above 100 GHz, particularly in view of expected investments and their realistic return on investment.

Equally important is the support of research and further specialist studies in the field of 6G through appropriate calls for proposals and funding mechanisms. In the first phase (approximately 2025 to 2027), funding should be directed towards theoretical and experimental work carried out by the academic sector and research organisations. The subsequent phase (approx. 2028 to 2030 and beyond) should support applied research and collaboration between research organisations and industrial enterprises, focusing on specific use cases, the development and testing of specific products and solutions.

Recommendations of the study	Thematic block
Monitoring developments in the field of 6G networks in bands above 100 GHz	Radio spectrum management
Active participation in international forums	
Formulation of a strategy for the roll-out of 6G networks in the Czech Republic	
Monitoring of current bands, evolving customer requirements and service development	
Updating requirements for the use of the band above 100 GHz	
Support for theoretical and experimental research in the field of 6G networks in bands above 100 GHz	
Support for applied research in the field of 6G networks in bands above 100 GHz	
Monitoring and measuring the effects of EM radiation on the human body	

3.2.20 Study 20: Drafting guidelines for the sharing of passive and active network infrastructure, optimisation of the use of public funds earmarked for supporting network deployment in selected areas

3.2.20.1 Summary

This study focused on analysing the possibilities for the effective use of public funds for the development of high-capacity fixed and mobile networks in the Czech Republic. The study provided comprehensive proposals for improving the efficiency of public resource utilisation, including infrastructure sharing models, cost optimisation and transparent project evaluation. These proposals form a key basis for decision-making by regulators and public institutions in achieving the goals of a gigabit society in the Czech Republic.

Key areas of analysis:

• Models for evaluating publicly funded projects: Proposal of criteria for project evaluation, including economic efficiency, quality of technical solutions, coverage rates and incentives for small and medium-sized enterprises (SMEs). The study also analysed methods used in previous calls for proposals and in other countries.

• Infrastructure sharing: Analysis of infrastructure sharing options on fixed and mobile networks, including models such as joint ventures, access to existing infrastructure or coordinated construction. The study included examples of good practice from Portugal, Poland and Ireland.

• Optimisation of infrastructure sharing costs: Proposal for a methodology for cost allocation in shared projects, including criteria such as the form of sharing, the existence of infrastructure, the cost-sharing ratio, and the reasonableness and causality of costs.

• Grant environment and transparency: Proposal for measures to improve the transparency of the project evaluation process, including adjustments to evaluation criteria and formulas, objectification of the process, and balancing the weighting of criteria across different intervention areas.

3.2.20.2 Study recommendations

To increase efficiency and optimise the use of public funds, steps are required which have been divided into three main parts: (1) an analysis of options for setting up an evaluation model for projects competing for public funding and a proposal for measures to increase the transparency and fairness of the evaluation process,
(2) the issue of infrastructure sharing, including a description of international experience and options for the Czech Republic,
(3) an analysis of infrastructure sharing in the grant environment, including cost sharing and the eligibility of costs.

Within these sections, the following solutions are recommended: (1) adjustments to evaluation criteria and the introduction of objective scoring tables for a more precise allocation of public support, (2) support for sharing models that increase the efficiency of resource use, including legislative amendments and a methodology for cost-sharing, (3) the introduction of mechanisms to coordinate the development of fixed and mobile networks, particularly in white areas, to prevent duplicate funding, and (4) the introduction of incentives and other motivational measures to encourage the involvement of small and medium-sized enterprises in the development of telecommunications infrastructure.

Recommendations of the study	Thematic block
Development of a methodology for sharing passive and active infrastructure	Radio spectrum management
Optimisation of public funds allocated for network construction	
Ensuring transparency in the project evaluation model	

3.2.21 Study 21: Methods for mapping coverage by fixed and mobile electronic communications networks

3.2.21.1 Summary

BEREC guidelines and the requirements of the European Electronic Communications Code (EECC) stipulate an obligation to conduct a geographical survey of broadband network coverage every three years, a requirement which is being met in the Czech Republic. Nevertheless, there is room for improvement, particularly in supporting the development of connectivity, where the Czech Republic lags behind the EU average. Opportunities for improvement exist within the verification process, which enables regulators to forecast network development based on data from operators. To increase the transparency and efficiency of geographical data collection (GSD), more detailed mapping of networks at the backhaul infrastructure level and the introduction of standardised network codification are recommended.

More effective use of data collected by the CTO via the electronic data collection system can contribute to better planning and resource allocation. Currently, data is collected at the level of address points and is used, for example, to identify intervention areas for subsidy support from the Ministry of Industry and Trade. Expanding analytical procedures and incorporating comprehensive network topology—from access to backbone networks—could enable more precise identification of areas requiring support. Inspiration may be drawn from certain European models, such as those from Lithuania or Austria, which feature detailed network codification and take into account the affordability of transitioning to VHCN networks.

Mapping FWA networks faces the problem that reported parameters do not always correspond to the actual quality of the connection. This can lead to situations where a network is designated as VHCN even though it does not meet gigabit standards, which subsequently limits grant support for the construction of fixed networks. Taking into account the technical parameters of backhaul networks and introducing transparent reporting of the actual capabilities of the infrastructure could improve the accuracy of mapping and planning for the development of electronic communications. The introduction of a uniform nomenclature for network technologies and the use of APIs for automated data collection would contribute to more accurate mapping and reduced administrative burden.

The GSD must reflect not only the needs of the Ministry of Industry and Trade, but also those of the national statistical service and international reporting. At the international level, it is important to monitor the actions of BEREC, which published a study in 2024 on the implementation of Article 22 of the EECC in Member States. The updating of guidelines and harmonisation of data collection should be implemented in 2025, which would contribute to the creation of a uniform methodology for data reporting and support for digital transformation across the EU.

3.2.21.2 Recommendations of the study

To improve geographical data collection and the effective development of high-capacity networks in the Czech Republic, it is necessary to focus on several measures based on the study. Improving the use of processes within the verification process will enable the regulator to better forecast network development and generally analyse the achievement of set targets. Increasing the accuracy of the datasets collected by the CTO via the electronic collection system is essential for the effective planning of connectivity development and will enable a more detailed identification of areas with insufficient coverage. Establishing mechanisms for greater infrastructure transparency, particularly in the area of mapping technologies and capacities at the backhaul network level, will help to better reflect actual connectivity options and ensure a fairer allocation of support within the market environment. The implementation of tools for improved data collection (e.g. APIs for questionnaire-based data collection or adjustments to the criteria for identifying intervention areas) will lead to improved availability and quality of connectivity and to a stronger competitive environment. Last but not least, it is important to monitor BEREC's actions, such as the adoption of updated guidelines and consideration of the implementation report.

UNOFFICIAL MACHINE TRANSLATION

Recommendations of the study	Thematic block
Improving the use of processes within the verification process	Radio spectrum management
Improve the use and increase the accuracy of data sets	
Establishing mechanisms for greater infrastructure transparency (mapping of technology and capacity at the backhaul network level)	
Implementation of tools for better data collection (e.g. APIs, adjustment of intervention area criteria)	
Updating guidelines based on international provisions	

3.2.22 Study 22: Research into solutions for ensuring secure state communications for emergency services within the European Union with regard to 5G and PPDR technological solutions

3.2.22.1 Summary

This research examines aspects of secure and reliable communication for Integrated Rescue System (IRS) units in European Union countries, with an emphasis on the use of modern technologies such as 5G networks and PPDR (Public Protection and Disaster Relief) systems. Emergency communications are a key element in the state's effective response to emergencies and crisis situations. They ensure the smooth and reliable exchange of information between emergency and security services, such as the Czech Police, the Fire and Rescue Service and the Emergency Medical Service.

Given growing challenges such as more frequent natural disasters, terrorist threats and technological accidents, it is essential that communication systems are not only secure and resilient, but also flexible and capable of responding rapidly to new threats and needs. The research therefore focuses on analysing the current state of technology, specific international implementations, and identifying technologies and approaches that could be effectively utilised in the Czech Republic.

Examples of communication system implementations in Finland and Germany demonstrate how modern technologies enhance the security and reliability of crisis communication. These findings may inspire and lead to the introduction of similar systems in the Czech context.

3.2.22.2 Recommendations of the study

Based on international experience, the following objectives can be set for the communication networks of the Integrated Rescue System (IRS) in the Czech Republic, which should enhance efficiency, security and preparedness for crisis situations:

- **Development of in-house communication networks:** Modernising communication technologies through the implementation of 5G and PPDR technologies will ensure fast and reliable communication, including backup solutions using a secure private communication network.

- **Interoperability:** It is necessary to ensure compatibility with international systems and standards for effective cooperation in crisis situations at a global level.

- **Security and encryption:** The introduction of advanced encryption standards and other security measures is essential for protecting sensitive data and ensuring the security of communication systems.

- **Research and development:** Increasing investment in research and development in the field of secure communications is key to supporting innovation and the long-term improvement of the communication infrastructure of the Integrated Rescue System (IRS).

Recommendations of the study	Thematic block
Modernisation of communication technologies through the implementation of 5G and PPDR technologies	Radio spectrum management
Ensuring compatibility with international systems and standards	
Introduction of advanced encryption standards and other security measures	
Increasing investment in research and development in the field of secure communications	

3.2.23 Study 23: Radio coverage plan for the Czech Republic with 5G and next-generation networks

3.2.23.1 Summary

The study focused on analysing current approaches to 5G signal coverage and proposing a modernised radio plan that reflects the changing needs of the electronic communications sector in the era of gigabit communications. The study took into account the shortcomings of existing methods for defining coverage, which are often based on percentage targets. Based on the analysis carried out, the main output was a proposal for a modernised concept of a radio plan for 5G and future-generation mobile network coverage in the Czech Republic, providing specific recommendations for improving the quality and accuracy of coverage data.

3.2.23.2 Recommendations of the study

It identifies three main ways to reduce the discrepancies between available sources of information on mobile network coverage: expanding and standardising coverage definition parameters, expanding the CTU's prediction tool, and creating and operating an independent prediction tool. The fundamental step towards these approaches is a decision to adjust coverage definition parameters (e.g. transmitter type or definition of available services). Spectrum auctions should also undergo adjustments to quality parameters and tender procedures; in the narrower sense, this refers to the integration of control mechanisms to verify operators' compliance with their obligations. Last but not least, the study recommends the creation of ad hoc models that can be used to measure coverage in transport or during crises and emergencies.

Recommendations of the study	Thematic block
Revision of the coverage assessment methodology	Radio spectrum management
Decision on parameter adjustments	
Creation of ad hoc models	
Adjustment of tender processes and spectrum auction quality parameters	

3.2.24 Study 24: Predicting the development of VHCN network coverage in the Czech Republic in relation to the roll-out of 5G networks

3.2.24.1 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 optical 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 deployment 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 rolling out these technologies. Furthermore, problems persist with fragmented infrastructure and difficult coordination between different market players.

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. The first covers the period between 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.

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 later 4%.

Further growth in VHCN network coverage of households can also be expected for the period 2028–2030, 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.

The study assumes 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 after accounting for VHCN connections built using subsidy schemes. The average annual increase in household coverage during this period is expected to be between 2–3%.

3.2.24.2 Recommendations of the study

One possible recommendation is to support coordination between public and private investors, leading to increased construction efficiency. Furthermore, the document calls for the introduction of targeted support for rural areas and the use of modern technologies, such as FWA or modern satellite solutions, to cover hard-to-reach areas. Ensuring transparent monitoring and reporting of coverage and the effective use of grant schemes should also not be overlooked.

Recommendations of the study	Thematic block
Revision of coverage targets with specific metrics	Building the VHCN
Revision of set coverage targets with specific metrics	
Preparation of a study on 5G FWA	
Supporting coordination between the private and public sectors	
Introducing targeted support for rural areas	
Ensuring transparent monitoring	
Reporting on grant schemes	

3.2.25 Study 25: Defining the investment gap in VHCN network deployment in relation to 5G network development

3.2.25.1 Summary

The study focused on analysing current approaches to 5G signal coverage and proposing a modernised radio plan that reflects the changing needs of the electronic communications sector in the era of gigabit communications. The study took into account the shortcomings of existing methods for defining coverage, which are often based on percentage targets. Based on the analysis carried out, the main output was a proposal for a modernised concept of a radio plan for 5G and future generations of mobile networks in the Czech Republic, providing specific recommendations for improving the quality and accuracy of coverage data.

Key outputs and recommendations include a new definition of coverage, consideration of interference, transparency of the data presented, and optimisation of the coverage map.

3.2.25.2 Recommendations of the study

The scope of this study did not include a clear action plan; rather, it focused on defining the investment gap based on the current state of coverage. Nevertheless, there are a few indirect steps that can be considered in light of the study's findings.

Study recommendations	Thematic block
Review of the identification of priority areas for investment based on socio-economic criteria.	Building the VHCN
Preparation of documentation for securing funding for connectivity development.	
Supporting the development of public-private sector cooperation in the construction of linear infrastructure and property development.	

3.2.26 Study 26: Use of satellite communications for 5G

3.2.26.1 Summary

The combination of satellite (NTN) and terrestrial (TN) networks represents a strategic solution for expanding high-quality internet coverage, particularly in remote areas without available infrastructure. The study examines the technological and legislative aspects of integrating NTN with 5G, identifies key barriers and proposes ways to overcome them, with an emphasis on spectrum harmonisation, economic feasibility and compliance with European regulatory frameworks, whilst also taking into account conditions in the Czech Republic. The effective coexistence of satellite and terrestrial networks requires the development of hybrid architectures and appropriate spectrum planning, with the development of 5G-NTN dependent on technological progress and standardisation (3GPP, ETSI, ITU-R). Technological capabilities determine use cases ranging from enhanced mobile broadband (eMBB) and high-capacity IoT (eMTC) to high-reliability communication (HRC), particularly for white spots, mobile platforms, emergency and defence applications, or the control of autonomous systems. The introduction of 5G satellite connectivity is economically justified in areas where otherwise expensive or inefficient solutions would be required. For national use, it is essential to transpose the new standards into the Czech Republic's regulatory framework, particularly regarding spectrum and access rules, as set out in ITU-R recommendations and RSPG decisions. Although it may seem that NTN does not play a significant role in the Czech Republic, there are practical scenarios for its deployment: (1) emergency communications, (2) supplementing TN during outages, (3) navigation, (4) drone control, or (5) communications in agriculture and forestry. However, development is contingent upon resolving technical challenges such as latency, integration into 5/6G, routing, prioritisation, handover between networks, and the availability of suitable end-user devices, whilst mass deployment can be expected in the medium term, approximately five years from now.

3.2.26.2 Study recommendations

Study recommendations	Thematic block
Exploring the potential benefits of TN–NTN collaboration scenarios suitable for local conditions	Industrial use and applications of 5G
Supporting development in other sectors requiring high-speed data communication between dispersed and mobile devices in areas with insufficient TN coverage (e.g. agriculture or forestry)	
MSS frequency band allocation solution (2 GHz)	Radio spectrum management

3.2.27 Study 27: Quantum technologies and communications

3.2.27.1 Summary

Quantum computing (QC) represents one of the most significant applications of quantum mechanics, the current development of which is referred to as the 'second quantum revolution'. It enables not only the observation but also the manipulation of individual particles, thereby paving the way for practical applications in the fields of quantum sensing, communications and computing. QC is based on principles that defy classical physics (superposition, entanglement, measurement uncertainty and the impossibility of copying quantum information) and offers a new computational model with the potential to drastically accelerate specific tasks such as factorisation, materials simulation or optimisation. The basic unit of a QC is the qubit, which can be physically realised using various technologies (e.g. superconducting circuits, ion traps). A key challenge for the practical application of QCs is mastering the implementation of quantum error correction and scaling up to hundreds or thousands of logical qubits. Although leading global companies are making progress, development remains at an experimental stage and requires significant investment. At present, the performance of quantum computers does not exceed that of standard systems; however, they are capable of solving specific sub-tasks that are unsolvable for standard systems within a reasonable timeframe. A key risk associated with QCs is the threat of current cryptographic algorithms (particularly RSA and ECC) being broken, which jeopardises the security of digital communications. Furthermore, Grover's algorithm also poses a risk to symmetric encryption. It is therefore essential to transition in good time to post-quantum cryptography (PQC), which offers robust algorithms without the need for new physical infrastructure, despite higher computational demands. Quantum key distribution (QKD) represents another security approach, based on quantum phenomena, which enables the secure distribution of encryption keys and the detection of eavesdropping, and promises long-term protection against quantum attacks, albeit with limited scope and high infrastructure costs at present. The development of QC remains technologically and financially demanding, and alongside the activities of large companies, state entities are also becoming involved. In the EU, initiatives such as the Quantum Flagship, the EuroHPC Joint Undertaking and the EuroQCI are underway. In the Czech Republic, a national quantum testing infrastructure (CZQCI) is also being built, educational and research activities are being developed across universities, a national quantum strategy is being prepared, and cooperation within the European framework is being developed.

3.2.27.2 Recommendations of the study

The study sets out the following recommendations for government institutions and regulators:

Study recommendations	Thematic block
Formulation of minimum methodological rules for operators to ensure cybersecurity	Protection of the public and cybersecurity
Creation of a reference register of PQC-compatible devices	
Establishment of minimum interoperability requirements between classical and QKD cryptography	

3.2.28 Additional information – Edge Nodes

3.2.28.1 Introduction

The inclusion of this supplementary information in this study stems from the contracting authority's current need to respond to the ongoing requirements of European institutions, which are based on adopted strategic documents, in this case the Digital Decade programme. The purpose of this supplementary information is to provide the contracting authority, beyond the scope of the individual studies, with a brief, comprehensive overview to facilitate understanding of the technical and regulatory issues relating to edge nodes.

3.2.28.2 Definition of an edge node[27]

An **edge node (EN)** is a device or server located at the edge of a network – close to end users or devices (e.g. IoT sensors, robots, cameras, etc.). It is used for pre-processing, storing or routing data before it is sent to a central data centre or the cloud (so-called pre-computing). Its main features are as follows:

- **Proximity to data sources** – it processes data where it is generated, thereby reducing latency (response time) and the load on the network.
- **Localised decision-making** – it can perform analysis, filtering, anomaly detection or real-time responses without the need to communicate with a remote cloud.
- **Increased efficiency** – it reduces the amount of data transferred to the central infrastructure and speeds up system response times, saving overall system capacity.

The need for edge nodes stems from the requirements of modern industry and the challenges associated with its implementation in the economies of European countries. It also has geopolitical implications. Some of the main requirements include the following:

- EN as a foundation for autonomous systems, robotics, IoT, the digital industry, healthcare, and energy,
- a response to the need for data processing closer to users (e.g. due to latency, data protection),
- an element of European digital sovereignty and security, i.e. less dependence on American or Asian clouds.

An edge node is a computing device located as close as possible to the data source (e.g. a sensor, camera, terminal), which enables data to be processed locally, i.e. without the need to send everything to the cloud or a data centre. It may be a server, a high-performance router, an industrial computer, a network box, or in certain cases even a smartphone, provided it fulfils the required function. To transfer data processed in the EN (to/from the EN), fibre-optic cables, mobile connections, Wi-Fi, LoRa, Ethernet or even Bluetooth (e.g. for IoT sensors) can be used.

Examples of edge node technology applications vary. In industry, an edge node can process data from machines and react immediately to errors or deviations. In autonomous vehicles or robots, it can be used for local processing of video and sensor data. In telecommunications, the edge node will likely form part of the 5G network and provide services close to the customer (e.g. streaming, security analytics, IoT services).

3.2.28.3 Legislation

The development of edge computing at European Union level is enshrined in legislation, notably in Decision (EU) 2022/2481 of the European Parliament and of the Council establishing the Digital Decade policy programme until 2030, which sets out key objectives for digital transformation, including the creation of at least 10,000 climate-neutral and secure edge nodes across the EU. This objective is part of a broader effort to ensure digital sovereignty, reduce dependence on global hyperscalers and provide low-latency infrastructure for advanced services such as autonomous systems, the Industrial Internet of Things (IIoT), healthcare and energy. The document also sets out the obligations of Member States

[27] https://ec.europa.eu/newsroom/dae/redirection/document/100202

to draw up national strategic plans to help achieve these objectives, and introduces tools for monitoring them, such as the 'Edge Observatory'.[28]

In addition to the Digital Decade, other legislative frameworks also influence the development of edge infrastructure. The European Data Act supports localised and secure processing of industrial data, which edge computing naturally enables. The Cybersecurity Act and the proposed Artificial Intelligence Act (AI Act) emphasise the need to operate systems with a high level of trust and security, which are often run precisely on edge nodes close to the point of use. These documents do not explicitly mention edge computing objectives, but the desired end state presented in these strategic documents is directly related to EN issues.

There is currently no specific legislation within the Czech legal framework focused exclusively on edge computing, but emerging strategies for the digital economy, energy and telecommunications infrastructure (e.g. plans relating to 5G or Industry 4.0) should begin to take edge computing into account in the near future. To meet European targets, it will be crucial for edge computing to be incorporated into national strategic documents, grant schemes and, where appropriate, national legislation as a separate area of digital infrastructure.

3.2.28.4 Current status and development

To date, there is no officially published national target for the number of edge nodes set by the government or a regulator (e.g. the Ministry of Industry and Trade, the Czech Telecommunications Office). However, in response to the obligation to develop a strategy for meeting European KPIs based on the Digital Decade, the Office of the Government of the Czech Republic has prepared the document "The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030".[29] This document mentions the European target of building 10,000 climate-neutral edge nodes by 2030. However, given the absence of a national legally binding target, it does not contain any direct steps by the Czech Republic towards this goal. The document refers to missing information that is expected to emerge in the near future within the framework of the Edge Observatory, which is tasked with monitoring and setting specific measures in this area. The setting of specific EN development targets for individual member states is more likely to follow subsequently.

The aforementioned common European KPIs will be monitored regularly. Data will likely be collected in various forms. These are likely to include:

- selected reports from network and cloud infrastructure operators (e.g. telecoms operators, hyperscalers such as AWS and Microsoft, and edge cloud platforms),
- questionnaire surveys or data collection via national regulators and agencies,
- expert estimates and coverage modelling, as is common, for example, in measuring 5G coverage or data centres.

Within the Edge Observatory, initial analyses and questionnaire surveys have already been produced, reporting on the state of development (EN) in member states[30], including the Czech Republic[31].

There are likely to be a larger number of ENs in Europe at present, primarily within private 5G networks, industrial IoT installations and data centres, which have been extended towards end devices (the so-called 'distributed cloud') and smart cities (smart city platforms). At the same time, it can be assumed that many existing devices may not meet some of the technical KPI requirements (or possess the relevant information), for example regarding climate neutrality.

In the Czech Republic, their exact number is unknown; at the same time, it is currently impossible to determine precisely how many meet the parameters defined in the KPIs. These parameters are as follows:

[28] https://digital-strategy.ec.europa.eu/en/policies/edge-observatory

[29] https://digitalnicesko.gov.cz/media/files/Cesta_k_Evropsk%C3%A9_digit%C3%A1ln%C3%AD_dek%C3%A1d%C4%9B_strategick%C3%BD_digitalisation_plan_for_the_Czech_Republic_by_2030_2icFk2m.pdf

[30] https://ec.europa.eu/newsroom/dae/redirection/document/109620

[31] https://ec.europa.eu/newsroom/dae/redirection/document/104535

- Latency < 20 ms
- Operations as part of edge infrastructure (e.g. in an edge data centre, not a cloud/data centre in the hyperscaler sense)
- Physical proximity to users (as opposed to a central cloud)
- Energy efficiency and climate neutrality (e.g. low PUE, renewable sources, CO_2 offsetting)
- High level of physical and cyber security

The typology of devices is also key. According to the taxonomy published by the Edge Observatory, several different types of EN are distinguished, of which only some will be included in the KPIs.[32] This distinction can be seen in the table below:

Type	Example	Included in the KPI?	Explanation
On-premise edge	Edge servers in the company	Yes	Close to the user, small data node, often in a factory, with low latency
Far edge	Edge nodes at BTS, substations	Yes	Up to 100 km from the user, latency 2–5 ms, greater IT capacity
Near edge	Regional mini-data centres	Yes	Up to 1000 km, latency 10–20 ms, greater capacity, still relevant
Cloud or hyperscaler	AWS data centre	No	Too far away, higher latency, not included
On-device edge	Smartphone, sensor	No	Does not have its own infrastructure to ensure secure operation and management

3.2.28.5 Proposed action steps

The following action steps are a prerequisite for the successful development of EN technology in the Czech Republic.

a. Defining a national roadmap for edge computing

Creating a strategic document will help align the activities of the state, businesses and the academic sector with the European Digital Decade objectives. The roadmap will set out the objectives, priorities, responsibilities and timetable for the development of edge infrastructure. The result will be more coordinated development with a clear direction and better guidance for investors and businesses.

b. Introduction of financial support instruments

Support in the form of grants or incentives is key to motivating companies, particularly small and medium-sized enterprises, to invest in edge technologies, where the return on investment is not always immediate. This will result in faster adoption of edge technologies and a reduction in entry barriers for businesses.

c. Support for education in IT and other relevant fields

A shortage of experts in networking, cybersecurity, IoT and edge computing is hindering the wider adoption of these solutions. The aim is to create new educational programmes, courses and training schemes that will prepare qualified personnel for this field and strengthen digital skills across the economy.

d. Create a national catalogue of recommended architectures and open-source solutions for edge computing

Technology fragmentation and closed proprietary solutions hinder the scalability and interoperability of edge infrastructure. A catalogue of recommended solutions will guide companies in their choice of technologies and promote the use of open, scalable and European-compatible platforms.

e. Ensuring connectivity and energy availability – development of private 5G networks in industry

[32] https://ec.europa.eu/newsroom/dae/redirection/document/100202

Edge infrastructure requires stable, fast and low-latency connectivity, which is limited in some regions or industrial sites. Supporting the development of private 5G networks will ensure sufficient connectivity for the practical deployment of edge solutions, particularly in industry, transport and logistics.

f. Create a platform for discussion and cooperation between key stakeholders

Bringing together government institutions, the business sector, research organisations and technology providers will enable the sharing of know-how and experience, as well as the coordination of actions. Such a platform will facilitate the identification of obstacles, the search for synergies and the creation of joint projects.

g. Support the launch of pilot projects

Pilot deployments of edge solutions in various sectors (e.g. industry, healthcare, transport, energy) serve as proof of concept, inspiration for other organisations and a source of practical insights. These projects will demonstrate the economic and social benefits of edge computing and can form the basis for wider adoption.

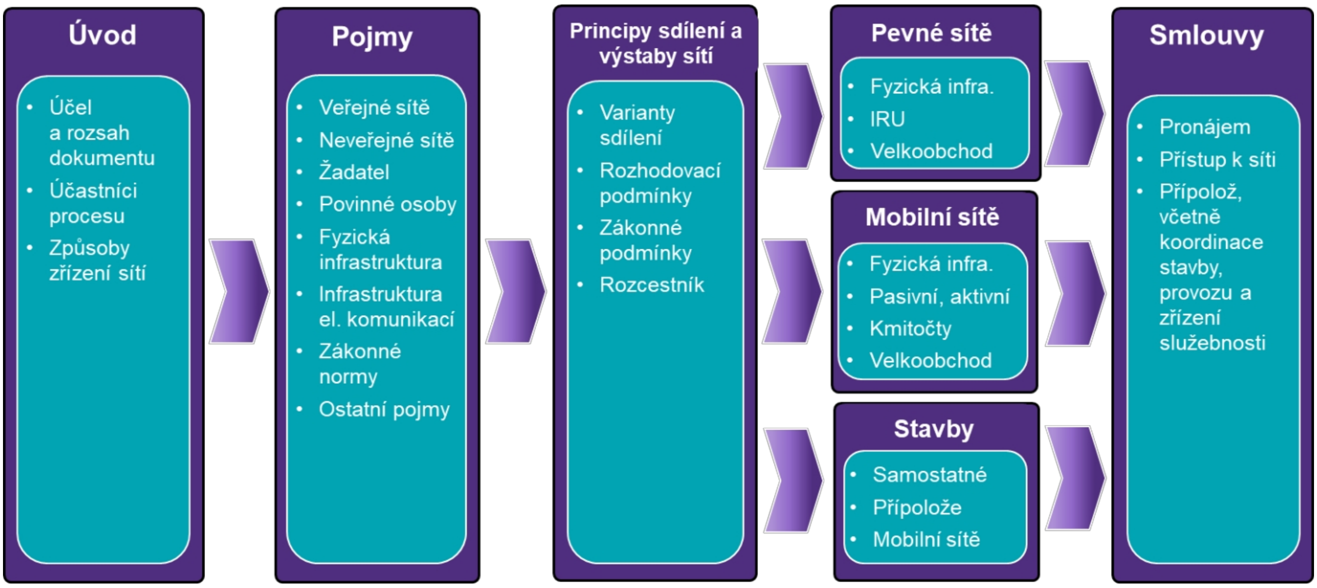
h. Mapping the deployment of new edge nodes and reporting to European institutions

The European Commission requires monitoring of the fulfilment of the target of 10,000 edge nodes as part of the Digital Decade. Regular mapping of deployed edge devices in the Czech Republic, their parameters and operational characteristics will enable the fulfilment of reporting obligations and, at the same time, provide data for better decision-making and infrastructure development planning.

3.2.29 Guidelines on the sharing of communications infrastructure

Guidelines on the sharing of passive and active infrastructure have been drawn up as a separate document and as part of this final study, with the aim of facilitating the roll-out of 5G networks in accordance with the Union's common set of tools to support connectivity. The guidelines provide practical guidance for operators of all types of public electronic communications networks, focusing on facilitating the preparatory phase of establishing a new network or part thereof, and recommend appropriate procedures for operators within the framework of existing legislation and with a view to expected changes in applicable legal standards (in particular the application of the GIA).

Figure 4: Structure and content of the guidelines on the sharing of communications infrastructure



4 Summary of study findings on strategic objectives

National strategic documents were drawn up in 2020 and 2021 respectively and reflected the requirements at that time for the development of 5G networks and VHCN infrastructure in the form of necessary measures. However, given the dynamic nature of the telecommunications sector, it is necessary to assess the progress made in fulfilling these objectives and the relevance of individual implementation measures in light of current needs. The aim of this chapter is to reflect on the findings of previous studies and use them to comment on the objectives and implementation activities set out in the Czech Republic's strategic documents. For clarity, comments on the current status of the fulfilment of these objectives and implementation activities are divided into thematic blocks, which group individual tasks into logical units, offering a critical view of their fulfilment and proposing possible updates based on the latest analytical findings and recommendations.

When updating, it is also necessary to take into account measures proposed subsequently and their structure within the framework of updating and refining strategic plans, in particular the document of the Office of the Government of the Czech Republic of 15 November 2023 responding to Decision (EU) 2022/2481 of the European Parliament and of the Council (EU) 2022/2481 of 14 December 2022 (Digital Decade 2030 programme), entitled 'The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030'. Among other things, this document contains a number of measures proposed for implementation in great detail, including an elaboration of budgetary resources, implementation steps and their impact on individual strategic objectives. This comprehensive study records and takes into account all measures already identified by the state, but its focus is not to create a further strategic or implementation document. The aim of the study is to help grasp the identified action steps in their mutual context and to present the possibility of their joint implementation. Together with the recommendations presented in the individual studies mentioned in the previous chapter, all the identified implementation measures form a set of steps for achieving the aforementioned strategic objectives, which should be presented in a structured form within logical programme units (framework projects), which we elaborate on further in Chapter 6 and present as a proposal and the output of this study.

4.1 Thematic blocks

These are blocks in which interrelated issues addressed in strategic documents are grouped together, which can be addressed jointly or in interdependence. Individual sub-studies were also presented within the blocks described below.

i. **Radio spectrum management**

ii. **Building very high-capacity networks (VHCN)**

iii. **Industrial use and applications of 5G**

iv. **Public safety and cybersecurity**

The definition of thematic blocks is an organisational element of this synthesis. The blocks reflect the affinity of objectives contained in different, independent strategic documents or parts thereof. Based on this relationship, the individual action steps recommended in the sub-studies – which were otherwise focused on narrower topics – can be viewed in a broader context; these action steps can then be assessed collectively and generalised into joint framework projects, so that synergies can be exploited during their implementation.

4.1.1 Thematic block: Radio spectrum management

4.1.1.1 5G network development implementation activity No. 6: Supporting the harmonisation of 5G spectrum at global and European level.

Supporting the harmonisation of 5G spectrum at global and European level remains a key strategic objective, the importance of which continues to be emphasised in the context of ongoing developments in the field of radio spectrum management. Based on the outcomes of WRC-23 and the ongoing preparations for WRC-27, it is clear that the Czech Republic should continue to actively promote its priorities in the area of frequency band harmonisation, with an emphasis on the efficient use of already allocated frequencies and their maximum contribution to the development of 5G networks and the digital economy. This approach will not only enable the optimisation of spectrum use but will also ensure that the Czech Republic remains competitive in a European and global context.

As part of the updated strategic documents, it is essential to focus on specific frequency bands and models for their use. In already harmonised bands such as 700 MHz, 800 MHz, 900 MHz, 3.5 GHz and 26 GHz, the focus should be on the efficiency of their use, and increased attention should be paid to newly identified opportunities, particularly in the 400 MHz, 600 MHz, 4.4–4.8 GHz and 6 GHz bands, which are coming to the forefront of regulatory authorities' interest both in Europe and beyond. The Czech Republic should actively cooperate within the CEPT and the EU to shape the technical and regulatory conditions that will enable their effective use for mobile services, with the issue of shared access and technological neutrality also playing a key role here.

Maintaining this focus in strategic documents remains essential; however, in view of future developments, it is crucial to define it as precisely as possible so that it includes specific steps and milestones for the next five years. The update should reflect not only changes in the field of spectrum management, but also the need for a systematic approach to optimising the use of individual bands. The starting point is the formulation of a national radio spectrum management strategy, which will ensure a unified framework for the coordinated and consistent representation of Czech interests at international level.

S1 Analýza současného a budoucího využití pásma 600 MHz

S4 Využívání klíčových pásem pro rozvoj 5G a dalších klíčových radiokomunikačních služeb

S6 Strategie správy spektra

4.1.1.2 Implementation activity for 5G network development No. 7: Enabling the use of radio frequencies by 5G mobile networks in all harmonised frequency bands below 6 GHz.

From the perspective of spectrum management and the harmonisation of radio frequencies for 5G mobile networks in frequency bands below
6 GHz, it is crucial to follow the outcomes of the World Radiocommunication Conference (WRC) and the strategic documents of CEPT/ECC and the European Commission. As part of the harmonisation of 5G bands in Europe, the 700 MHz, 3.4–3.8 GHz and 26 GHz bands have been defined as priorities. The technical conditions for their use have been harmonised at EU level and are being implemented by national regulatory authorities, including the Czech Telecommunications Office (ČTÚ). For IMT services, the 6 425–7 125 MHz band was newly identified at WRC-23, opening up scope for further harmonisation and the development of next-generation mobile networks. The 2.1 GHz (FDD and TDD), 2.3 GHz (TDD) and 2.6 GHz (FDD and TDD) bands are already partially harmonised and used for mobile communications; however, in some countries (e.g. Austria, Belgium, Slovenia), their full allocation for IMT is still under discussion. The 3.5 GHz band (3 400–3 800 MHz) has already been standardised for IMT use, with an auction having taken place in the Czech Republic and the allocations subsequently redistributed (resold) among the three main operators. Emerging opportunities for harmonising spectrum below 6 GHz currently include the 600 MHz and 4 GHz bands; in this context, it is necessary to monitor the efficiency of these bands' use by current technologies and their relevance for IMT applications.

In this context, it is appropriate to illustrate the RSPG's work on the 600 MHz band. The European Commission requested the RSPG to draw up an opinion pursuant to Article 7 of Decision (EU) 2017/899 to provide a strategic vision for the use of the 470–694 MHz band after 2030. To this end, a working sub-group was established to analyse the previous RSPG opinion 15-595, the EU legal framework, technological developments and possible scenarios beyond 2030. Subsequently, the RSPG plenary voted on the proposal, which, following consultations with stakeholders, was submitted to the European Commission in the form of document RSPG23-021 FINAL and contained recommendations for further development in the band in question.

UNOFFICIAL MACHINE TRANSLATION

The WRC-27 conference will address the possible allocation of further bands for IMT services, particularly in the 4 400–4 800 MHz and 7 125–8 400 MHz ranges. This process will require detailed studies of compatibility with existing services and an assessment of potential interference. From the Czech Republic's perspective, it is important to continuously monitor and evaluate demand for spectrum and its efficient use. Subsequently, a national working group should be established to prepare spectrum harmonisation for WRC-27, which will actively promote the efficient allocation of rights to new frequencies, monitor technological developments and, based on all the preceding points, revise the PVRS.

In the context of frequency bands below 6 GHz, it is also appropriate to focus on the allocation of the 2 GHz MSS band following the expiry of current licences for satellite networks and to assess suitable scenarios in line with the RSPG's alternative proposals. Satellite networks could be used as a complementary service to existing broadband services, for example in ensuring emergency communications for government and the Integrated Rescue System, ensuring air traffic control and navigation, monitoring linear infrastructure, and in a number of other sectors.

S1 Analýza současného a budoucího využití pásma 600 MHz

S2 Analýza současného a budoucího využití pásma 4 GHz

S4 Využívání klíčových pásem pro rozvoj 5G a dalších klíčových radiokomunikačních služeb

4.1.1.3 5G network development implementation activity No. 8: Making the 26 GHz frequency band available.

To make the most of 5G capabilities, a combination of three frequency bands (below 1 GHz, below 6 GHz and above 6 GHz) is required to balance coverage and high capacity. It is precisely the frequency bands above 6 GHz – typically in the millimetre wave bands – that are used to provide ultra-high capacity. On the other hand, they provide limited coverage range compared to lower frequency bands, where more favourable conditions for signal propagation apply. At European level, the RSPG has identified the 24.25–27.5 GHz band (referred to as the 26 GHz band) as one of the bands for the development of very high-speed fixed and wireless networks. Currently, parts of the 26 GHz frequency band are used in EU Member States for terrestrial fixed wireless links, short-range vehicle radars, transport and traffic telematics equipment (particularly for vehicle radars), radio positioning equipment, and space and satellite services.

Decision 2019/784 harmonised the conditions for the availability and efficient use of this frequency band for the provision of wireless broadband electronic communications services, so as to ensure the proper coexistence of terrestrial systems providing these services with other services in the band. At the same time, the maximum size of this 200 MHz block in time-division duplex (TDD) was determined. The basic technical conditions are thus defined by Commission implementing decisions and recommendations and other documents of the Electronic Communications Committee (ECC); however, at national level, specific conditions may be established in accordance with national needs. In the Czech Republic, according to PV-P/2/10.2020-10, the 26.5–27.5 GHz band is allocated to IMT in five defined adjacent blocks, each 200 MHz wide, and the 24.25–27.5 GHz band is used by the fixed radiocommunication service. The use of frequencies by base stations and terminals is currently only possible on the basis of an individual licence to use radio frequencies for experimental purposes. Two individual licences for experimental purposes are currently valid in the band for the Prague area:

- O2 – 800 MHz, 3 stations + ML – experimental 5G network,
- ČRa – 100 MHz 1 x point-to-multipoint – testing the characteristics of a radio network for the provision of wireless broadband electronic communications services in the 26 GHz frequency band.

On 29 February 2024, the individual authorisation for experimental purposes held by VanCo for the 200 MHz 1x point-to-multipoint channel expired; the purpose of this authorisation was to test fixed access technology designed to coexist with 3GPP standards, whilst not requiring a complex and costly network core.

Procedure for spectrum coordination and sharing in the 26 GHz band

In order to make frequencies in the 26 GHz band available to potential interested parties, four scenarios described in Study 5 can be used for the purpose of granting rights:

- allocation of frequencies for a specific base station,
- allocation of frequencies for a defined operational area (together with an interference area), for multiple base stations and terminals,
- allocation of a specific frequency block (i.e. frequency allocation),
- allocation exclusively for indoor use.

Given the spectrum manager's role in creating, amongst other things, conditions for the efficient use of radio frequencies, it is necessary to create the conditions in the 26 GHz band for the emergence and development of a market for services and technologies in the foreseeable future, whilst supporting various spectrum users, including public networks and private and industrial networks. This raises the following questions: (1) what part of the frequency band will be made available, (2) under what conditions may the frequencies be made available, and (3) what might be the geographical scope of the allocated frequencies.

Study 5 therefore proposes three scenarios for opening up the 26 GHz band: (1) opening up the currently unoccupied 26.5–27.5 GHz band, (2) opening up the entire 24.25–27.5 GHz band whilst retaining existing usage in the 24.5 – 26.5 GHz, and (3) opening up the entire 24.25 – 27.5 GHz band whilst releasing the 24.25 – 26.5 GHz segment from existing services. Furthermore, methods of frequency allocation are assessed based on
(1) a general authorisation, (2) an individual authorisation or (3) a tender procedure. Last but not least, it is necessary to decide whether the authorisation to use the designated band will be national or local. To guide the CTO's next steps, this study evaluated the advantages and disadvantages of each of these scenarios, which should facilitate the authority's decision-making.

The results of the study indicated that the most advantageous option appears to be making the currently unallocated 26.5–27.5 GHz band available through a tender process with a licence valid at the national level. It must be emphasised, however, that the resulting ranking of the individual options is also sensitive to the weighting of the evaluation criteria used.

In the period following the publication of the study focusing on the use of 5G in the 26 GHz frequency band, tests have been (and are still being) conducted. For example, in April 2025, an operator published a test in which it achieved a downlink speed of 11.5 Gb/s and an uplink speed of 4 Gb/s. Successful tests should therefore enable the CTO to propose specific conditions for the allocation of this band during 2025. These conditions should continue to reflect the national strategy, with an emphasis on the efficient use of spectrum and a focus on stimulating and supporting new industrial applications.

For future development, the following remains important within the scope of this task:

- Harmonise the use of the 26 GHz band based on ECC decisions and CEPT recommendations
- Implement a national plan for spectrum sharing between existing and future services, including protection of the fixed satellite service
- Implement monitoring mechanisms to control usage and eliminate interference with other services
- To continue supporting the testing of 5G technologies in the 26 GHz band for new applications, including autonomous systems and IoT
- Test new licensing concepts and rules for spectrum sharing

S4 Využívání klíčových pásem pro rozvoj 5G a dalších klíčových radiokomunikačních služeb

S5 Analýza a návrh procesu využívání a přidělování kmitočtů v pásmu 26 GHz

S6 Strategie správy spektra

4.1.1.4 5G network development implementation activity No. 10: Strengthening the legislative and non-legislative framework enabling the economically viable use of radio spectrum for testing under real market conditions

The development of a testing environment for new wireless technologies in the Czech Republic is in line with European policy, which emphasises support for the experimental use of spectrum and the introduction of innovative approaches to its management. Measures taken to date have primarily involved piecemeal legislative and non-legislative adjustments, which, however, do not adequately reflect rapid technological progress and the growing need for testing under real market conditions. Particularly in relation to millimetre-wave bands and the future development of 6G networks, it is clear that the current legal framework does not allow for sufficiently flexible spectrum allocation for testing purposes, which represents an obstacle to technological innovation and investment in research and development.

To ensure the effective continuation of implementation activities in the field of testing new technologies, it is essential to refine the legislative framework for the use of radio spectrum in experimental mode. To achieve this, the CTO must draw up and publish a methodology for granting authorisations for test operations, including a clearly defined procedure, timetable and evaluation criteria. At the same time, it is recommended to introduce the possibility of granting individual authorisations for longer periods (e.g. 12–24 months), particularly for entities operating in the field of research and development. For smaller or public-benefit entities, it is appropriate to simplify the process for granting individual authorisations.

Furthermore, it is desirable to introduce an incentive-based fee model that would reduce or fully waive administrative fees for entities conducting testing as part of research or development activities. To promote transparency and enhance regulatory predictability, the CTO should regularly publish aggregated testing results and their benefits for further decision-making. It is also recommended to allow the use of shared spectrum under a time- or geographically-limited regime for testing purposes without the need for a traditional auction. In this way, it would be possible to create an innovation-friendly environment that also reflects the recommendations of European institutions and the conclusions of international conferences.

S4 Využívání klíčových pásem pro rozvoj 5G a dalších klíčových radiokomunikačních služeb

S5 Analýza a návrh procesu využívání a přidělování kmitočtů v pásmu 26 GHz

S19 Vývoj 6G sítí v pásmech nad 100 GHz

4.1.2 Thematic block: Building VHCN networks

The individual sub-activities within this thematic block also reflect the impact of VHCN network deployment and the Strategy for the Digitalisation of the Czech Republic on the activities and tasks of the public administration – this primarily concerns the digitalisation of public services and the financing of new tasks for public institutions related to digitalisation. In the subsequent summary of activities and draft project proposals, we have classified this type of activity under a common sub-area entitled ‘Modernisation of the State Administration’.

4.1.2.1 Implementation activity for the development of 5G networks No. 1: Support for the rapid development of 5G networks in a competitive environment and the implementation of measures set out in Action Plan 2.0 to carry out non-grant measures to support the planning and construction of electronic communications networks.

In 2019, Action Plan 2.0 was approved, aimed at supporting the planning and construction of electronic communications networks in the Czech Republic, most of which have already been fulfilled. Given the dynamic developments in this area and the approval of the GIA, it is necessary to respond to these developments. During the preparation of this study, Action Plan 3.0 had already been drafted for comments and input from all stakeholders, and is due to be approved. Action Plan 3.0 is closely linked to the measures arising from the GIA and its transposition into Czech law[33]. The implementation of individual measures is to be evaluated annually in the Report on the Implementation of Action Plan 3.0 and should also reflect the following documents:

- Regulation (EU) (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)

[33] Act No 194/2017 Coll., on measures to reduce the costs of deploying high-speed electronic communications networks and amending certain related acts.

- Act No. 194/2017 Coll., on the coordination of infrastructure construction and measures to reduce the costs of deploying high-speed electronic communications networks, and amending certain related acts
- “Common Union TOOLBOX for Connectivity” prepared by the EU in 2023
- Commission Communication Guidelines on State Aid for Broadband Networks 2023/C 36/014
- The objectives of the Digital Decade 2030 and the Digital Compass 2030 and the measures arising therefrom
- Czech Republic’s vision “Digital Czech Republic”
- Czech Republic strategic document “The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic by 2030”
- Commission Recommendation (EU) 2024/539 of 6 February 2024 on regulatory support for gigabit connectivity
- National Plan for the Development of Very High Capacity Networks

4.1.2.2 Implementation activity for 5G network development No. 2: Facilitating the interconnection of base stations via optical cables or other very high-capacity networks.

One of the fundamental prerequisites for the development of very high-capacity networks (VHCN) is to facilitate the interconnection of base stations via optical cables or other high-capacity networks in order to ensure sufficient transmission network capacity when gigabit services are rolled out to end-users. This implementation activity is all the more significant in the Czech Republic, given that the proportion of households connected via FWA is significantly above the European average. **An effective solution for interconnecting base stations via optical infrastructure remains relevant for the next five years** and is necessary not only to achieve gigabit speeds but also to eliminate bottlenecks in the transmission infrastructure.

One of the main recommendations arising from the studies is to further strengthen coordination between central government, operators and local authorities when planning the construction of optical infrastructure. It is necessary to make effective use of existing public and private resources and ensure that investment in optical networks is in line with the state’s strategic objectives. The use of a single information hub for sharing data on infrastructure availability and deployment should significantly speed up and streamline the construction process. Such an approach would also help to optimise investment decisions and minimise unnecessary duplication of infrastructure. Another key element is support for investment in fibre-optic routes, particularly in rural and less populated areas. As indicated by the coverage map and the intervention areas under the grant programmes (OP TAK), the gap in fibre-optic infrastructure coverage between the periphery and the centre remains a significant problem; it is therefore necessary to create appropriate grant mechanisms specifically aimed at improving connectivity in these regions. The National Plan for the Development of VHCN Networks provides a basic framework for the development of high-capacity networks, but it is essential to supplement this framework with concrete measures that will facilitate the deployment of optical routes for mobile networks, for example through investment incentives or targeted financial support. It also appears essential to set timeframes for operators’ transition to optical links between base stations.

In addition to direct investment, it is also necessary to make effective use of infrastructure sharing opportunities. The existing regulation on gigabit infrastructure facilitates access to both public and private communications networks as well as to non-telecommunications infrastructure, which can reduce the costs of building new optical routes. Furthermore, cooperation between operators should be encouraged, as this could lead to more efficient use of existing routes and capacity. Sharing passive infrastructure, such as ducts or masts, can significantly reduce construction times and lower the financial costs of projects. To ensure sufficient transmission infrastructure capacity, it is also advisable to improve digital mapping of fibre-optic network coverage and to forecast the development of VHCN coverage. Accurate and up-to-date information on existing infrastructure at the backhaul network level will enable more efficient construction planning and targeted interventions in areas where infrastructure is insufficient. It is therefore important to introduce standardised data collection methods and create a system that would regularly update this information, which appears to be another potential use for a single information hub.

In addition to optical infrastructure, the use of alternative technologies such as fixed wireless access (FWA) should be considered, as this may in some cases serve as a suitable complement to optical networks. However, it is essential to establish clear criteria for assessing the quality and capacity of these networks and to ensure that they are capable of providing stable, high-speed connectivity comparable to optical technologies. Hybrid base station interconnection models combining optical and wireless technologies could be an effective solution, particularly in areas where the roll-out of optical networks is economically or technically challenging.

It is necessary to continue reducing the administrative barriers hindering the faster roll-out of optical infrastructure. Simplifying permitting processes and improving coordination between individual authorities could significantly speed up the entire process of building VHCN networks. Current legislation already contains certain tools for reducing the administrative burden,

UNOFFICIAL MACHINE TRANSLATION

but it is necessary to ensure their effective implementation in practice and, where necessary, to amend the rules so that they reflect current market needs.

The recommendation for this implementation activity is therefore to define, in the strategy update, the specific steps and tools to be implemented to achieve the objective, in particular:

- Establish specific targets for the development of optical backhaul as part of the update to the National VHCN Network Development Plan, including indicators for the coverage of base stations by optical routes.
- Establish and describe a coordination mechanism between the Ministry of Industry and Trade (MPO), the Czech Telecommunications Office (ČTÚ), operators and local authorities for joint route planning, data sharing and infrastructure sharing.
- Make public subsidy schemes conditional on the requirement for optical connections to base stations, or set minimum technical parameters for hybrid models.
- Refine the methodology for digital mapping and monitoring of backhaul infrastructure, including regular data collection and updates on capacity and utilisation.
- Support the use of a single information hub for sharing infrastructure data in accordance with the principles of the Gigabit Infrastructure Act (GIA), including passive infrastructure.
- Introduce methodological guidelines for the sharing of passive infrastructure (ducts, masts, rights-of-way), including the standardisation of contractual relationships and cost-sharing.
- Support cooperation models between operators (joint ventures, access sharing), particularly in areas with low return on investment.
- Simplify administrative processes for the construction of backhaul networks, e.g. by amending building regulations, speeding up procedures and introducing a ‘one-stop shop’ principle for processing permits.
- Ensure that support for backhaul deployment becomes a cross-cutting priority for all measures in the area of 5G and VHCN development – without a robust transmission network, the potential of the radio part of access networks cannot be fully utilised.

S10 Využití 5G sítí pro pevný bezdrátový vysokorychlostní FWA

S18 Studie metod a technik zjišťování a ověřování pokrytí radiokomunikačními službami

S21 Metody mapování pokrytí sítěmi elektronických komunikací pevných a mobilních sítí

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

4.1.2.3 5G Network Development Implementation Activity No. 3: Create conditions for cooperation between electronic communications network service providers and the owners or operators of buildings, street lamps and transport infrastructure for the purpose of co-locating 5G network technology elements

Given the progress achieved under Action Plan 2.0, particularly through the introduction of a unified information portal and new legislation imposing obligations regarding network expansion and the co-location of 5G technological elements within linear infrastructure, it is now necessary to shift the strategy from creating the basic conditions to the actual optimisation and development of cooperation, the procedures and direction of which are further elaborated within the GIA and the new Action Plan 3.0. The main objective should be to achieve maximum synergy in reducing the costs of building 5G and VHCN networks, which requires systematic coordination between individual stakeholders and further simplification of processes related to the implementation of new infrastructure.

One of the key steps should be to accelerate the roll-out of both 5G technology and FTTP connectivity. This can be achieved not only through investment incentives, but also by better aligning the construction of 5G and optical networks, particularly within existing construction projects. It is necessary to ensure that, in every new construction or renovation of linear structures, the possibility of installing infrastructure for optical networks and 5G is automatically taken into account, thereby significantly reducing additional costs whilst accelerating the penetration of gigabit networks. This area is the focus of a newly established working group at the Ministry of Industry and Trade (MPO) tasked with preparing the implementation of GIA obligations regarding the sharing of internal communication lines in multi-apartment residential buildings.

Another key area is raising awareness of the benefits of gigabit networks not only among the professional community, but also among building owners, local authorities and developers. It is necessary to actively communicate the economic and technological benefits arising from the presence of high-speed connectivity, for example through awareness-raising, training and support for pilot projects in various regions. This aspect is particularly important in the case of private property owners, who may still lack sufficient motivation to invest in preparing buildings for fibre-optic connections. Simplifying the permitting processes for network roll-out also remains a key factor. Although new legislation has brought significant steps forward, administrative delays still occur in practice, slowing down infrastructure development. It would therefore be advisable to further streamline approval processes, for example by digitising administrative procedures or setting binding deadlines for the approval of applications. In addition, it is advisable to consider regulatory incentives for infrastructure owners who allow the co-location of 5G elements or access to optical networks. The negative attitude of some local authorities towards the construction of telecommunications infrastructure remains a problem, which could also be addressed as part of the simplification of permitting processes.

Overall, it is therefore recommended to shift the strategy from the phase of creating conditions to specific measures leading to the maximum utilisation of existing legislation and infrastructure. The key to success will be the active development of cooperation between all stakeholders, the effective use of synergies, and the removal of remaining administrative barriers that could slow down the pace of 5G and VHCN network development.

S20 Sdílení infrastruktury

S5 Analýza a návrh procesu využívání a přidělování kmitočtů v pásmu 26 GHz

4.1.2.4 Implementation activity for 5G network development No. 4: Supporting opportunities for the shared use of passive infrastructure (colocation) for the development of 5G cells

Support for the shared use of passive infrastructure for 5G development has so far focused primarily on creating the conditions for sharing infrastructure elements, eliminating duplicate investment and optimising network development costs. However, in the context of developments to date, it is necessary to shift the strategy towards actively expanding and deepening cooperation between operators and infrastructure owners with the aim of maximising the use of existing capacity. This also involves preparing for the new challenges that technological developments will bring, in particular the transition to 6G and the associated higher demands on network density and the efficient use of passive infrastructure.

Experience to date shows that passive infrastructure, such as masts, street lighting columns, street furniture or transport infrastructure assets, can play a key role in the further development of 5G. To this end, however, it is necessary to strengthen coordination between the various stakeholders and establish standardised procedures for infrastructure sharing. It is desirable to introduce mechanisms that will enable faster access to public and private sites suitable for the deployment of 5G elements, including a transparent model for cost-sharing between operators and infrastructure owners. Experience from abroad confirms that sharing passive infrastructure can significantly reduce network deployment costs, with a predictable and effective regulatory framework playing a key role. This includes, for example, the development of new models of cooperation between operators and local authorities, support for the multi-purpose use of passive infrastructure, or the introduction of advanced methods for the management and allocation of shared capacity.

Furthermore, processes relating to the authorisation of shared infrastructure installations need to be simplified, particularly in urban areas where the greatest increase in network density is expected. The digitisation of processes and clearly defined deadlines for approving applications could significantly accelerate the development of 5G and future 6G networks. It is also advisable to expand support mechanisms for investment in shared infrastructure, for example through tax incentives or grant schemes promoting innovative approaches to the shared use of infrastructure. The revised strategy should therefore shift from creating conditions to the actual optimisation of shared infrastructure, with an emphasis on the efficient use of existing resources and preparation for future technological trends.

As with other activities, this involves specifying conditions and developing methodological recommendations, as well as facilitating cooperation across all stakeholders, specifically:

- Establish a central digital register of passive infrastructure, e.g. as part of Digital Technical Maps.
- Standardise contracts and pricing models for access to infrastructure
- Support ‘neutral host’ pilot projects (a single infrastructure for multiple operators) in urban environments.
- Introduce grant and tax incentives for multifunctional shared infrastructure (e.g. public lighting poles with 5G antennas).
- Simplify and digitise permitting processes and introduce maximum time limits.
- Incorporate sharing into 6G planning, e.g. density predictions, usage scenarios for urban facilities.
- Prepare model contracts and methodologies for local authorities, including training and support via the BCO and the 5G Alliance.

S20 Infrastructure Sharing

UNOFFICIAL MACHINE TRANSLATION

4.1.2.5 5G Network Development Implementation Activity No. 5: Supporting network deployment whilst maintaining control over public health protection, i.e. preparing infrastructure and permitting processes for the development and deployment of 5G networks

The issue of infrastructure preparation and the simplification of permitting processes for 5G network deployment has been significantly reflected in the implementation of reforms under the National Recovery Plan, specifically in the Digital Transformation pillar, section 1.3 Digital High-Capacity Networks. As part of these activities, initiatives were developed such as the creation and development of digital technical maps, which provide more accurate information on the infrastructure environment and contribute to greater transparency for the planning of electronic communications network construction. In parallel with this, a review of the legislative framework was carried out, particularly following the adoption of the European Gigabit Infrastructure Act (GIA). Despite these partial advances, permitting processes remain one of the most significant constraints on the development of 5G infrastructure in the Czech Republic. In practice, the main barriers are lengthy and administratively burdensome planning procedures, issues of coordination with property owners, and specific restrictions in protected landscape areas and conservation areas. This problem persists despite certain amendments to the rules for linear infrastructure and the introduction of some simplifications in the valuation of easements.

In the area of health risks associated with the operation of 5G networks, no major public controversy has been identified in the Czech Republic, and the issue of public health protection in relation to electromagnetic radiation is not currently a pressing topic of public debate. Public discussion on this matter has been rather limited in the past and has not become a significant obstacle to infrastructure development.

Given the legal nature of this implementation activity, its execution is contingent upon legislative and methodological measures, which have already been partially incorporated into the amendment to the Building Act and the Electronic Communications Act. However, practical implementation in the form of an effective and predictable permit-issuing process at the local level remains inadequate, particularly in the context of the construction of small antenna systems and micro-infrastructure in urban agglomerations.

S20 Sdílení infrastruktury

S23 Radiový plán pokrytí České republiky sítěmi 5G

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

4.1.2.6 5G Network Development Implementation Activity No. 9: Intensifying cooperation with heritage conservation authorities to facilitate the roll-out of 5G networks

The exercise of state heritage conservation in the Czech Republic is defined by Act No. 20/1987 Coll. and Act No. 114/1992 Coll. on the protection of nature and the landscape. Within this framework, key roles are played by the Ministry of Culture and the Ministry of the Environment, regional authorities and municipal authorities of municipalities with extended powers. An important expert partner to these administrative bodies is the National Heritage Institute, which provides expert opinions, consultations and methodological support in the assessment of construction projects in heritage-protected areas.

A significant step towards strengthening cooperation between the Ministry of Industry and Trade and heritage conservation authorities was the preparation and approval of the amendment to Act No. 416/2009 Coll., which contributes to the regulation of procedures for the preparation and authorisation of infrastructure projects, including high-speed networks. Practical support for implementation is also provided by the Broadband Competence Office (BCO), which acts as a mediator between the parties involved and assists in resolving disputes, providing methodological materials and training, and raising awareness of the importance of VHCNs, including 5G networks.

As is also evident from the conclusions of Study 24, one of the main limiting factors in the development of 5G networks remains the administrative and technical-organisational barriers associated with the construction authorisation process in heritage-protected areas. These barriers are further exacerbated by the growing need for network densification, which leads to a more frequent need to install smaller transmitters and antenna systems in prominent urban locations and historic centres.

The main barriers to implementation are, in particular:

- Strict cultural heritage protection rules, which limit the options for siting antenna systems.
- The high cost of alternative technical solutions designed to minimise visual impact (integrated solutions on street furniture, buildings, etc.).

UNOFFICIAL MACHINE TRANSLATION

- The need for individual assessment of each project, which prolongs the permitting process and increases investment uncertainty for operators.
- Given the ongoing technological developments in the field of 5G networks, particularly with regard to the future use of higher microwave bands and the need for high-density access points, further development of cooperation with heritage conservation authorities remains a key prerequisite for the sustainable roll-out of 5G networks.

Given the ongoing technological developments in the field of 5G networks, particularly with regard to the future use of higher microwave bands and the need for high-density access points, further development of cooperation with heritage authorities remains a key prerequisite for the sustainable roll-out of 5G networks. This concerns the following points in particular:

- Integration of 5G technologies into existing infrastructure (e.g. street lighting or building roofs), which minimises the visual impact on protected areas.
- Amending legislation and establishing rules for the siting of electronic communications network structures in heritage-protected areas, taking into account the priority of digitalisation and the temporary nature of these structures – incorporate the Heritage Institute’s opinion as a recommendation.
- Another option is to collaborate with heritage conservation authorities on the individual assessment of projects to strike a balance between technological development and the protection of cultural heritage.

S6 Strategie správy spektra

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

4.1.2.7 Implementation activity for 5G network development No. 16: Carry out assessments of exposure to electromagnetic radiation in accordance with health standards; when introducing new antenna system configurations, assess the impact of variable radiation characteristics in particular

A study entitled *‘Risks of human exposure to electromagnetic fields from 5G network transmitters’*[34] was already produced in 2020; whilst interest in this issue has waned over time, none of the studies produced has addressed this issue in greater detail, given the technical nature of this activity and the volume of specialist literature on the subject. Nevertheless, it should go without saying that even with the advent of new technologies, such as 6G, relevant information will be available to enable a swift response to any queries from the public. However, given the current level of 5G implementation, this issue should not be regarded as an obstacle to the further development of these networks. It does, however, appear appropriate to increase the level of communication with the public on this issue.

4.1.2.8 Strategic Objective No. 1 of the National VHCN Development Plan: To build VHCN network infrastructure in key locations and unconnected areas

At the time the National VHCN Development Plan was drawn up, the key issue was the highly uneven coverage of very high-capacity networks, with the Czech Republic lagging behind the European Union average in terms of fixed gigabit connectivity. DESI index data showed that the proportion of households covered by fixed VHCN networks in the Czech Republic was significantly lower than in most developed European countries, mainly due to the insufficient development of fibre-optic networks. Conversely, FWA and 5G penetration in the Czech Republic was above average, although this did not always correspond to gigabit connection parameters. At that time, it was clear that market mechanisms alone were not sufficiently effective to ensure the development of fibre-optic networks in all necessary locations, which led to the need to involve public funds through the National Recovery Plan and the OP PIK, and subsequently the OP TAK.

When updating the VHCN infrastructure development plans in 2020 (updated 2023) BEREC Guidelines for VHCN Networks BoR (20) 165, which defined specific VHCN parameters and their categorisation; furthermore, the DESI indicator was updated to the new framework for Europe’s digital transformation, the so-called Digital Decade, with specific tasks and targets for the period up to 2030. There are inconsistencies regarding the definition of VHCNs within the BEREC guidelines on VHCNs and the Digital Decade monitoring report when it comes to implementing VHCN development and reporting on them in the BCE country report, the main difference being the inclusion of FWA connections as VHCNs.

[34] https://mpo.gov.cz/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepce-a-strategie/rizika-expozice-cloveka-elektromagnetickemu-poli-vysilacu-siti-5g--252602/

UNOFFICIAL MACHINE TRANSLATION

In assessing the strategic objective and its update, it is important to emphasise that, as part of the Digital Decade, the mandatory VHCN coverage target for the Czech Republic has been extended to 95% of all households; this therefore involves not only building infrastructure in key locations, but in almost all locations across the country. As noted in the S24 study 'Prediction of VHCN Network Coverage Development in the Czech Republic in Relation to 5G Network Development', it is unlikely that this target will be met.

To achieve higher VHCN network coverage and meet the targets, we recommend continuing with the strategic objective, which should be further developed and appropriately combined with other objectives focused on building VHCN connectivity and public communication, addressing both infrastructure development (the supply side) and the stimulation of demand for high-speed connectivity. The recommended steps are based on analyses contained in studies concerning infrastructure sharing, coverage mapping methods, investment gaps and the strategic development of digital connectivity.

Supply-side support – infrastructure development

Within the framework of grant schemes, it is crucial to ensure that investments are effectively targeted at areas where market mechanisms do not provide sufficient coverage. Current grant instruments, such as the OP TAK and interventions under the National Recovery Plan, should be optimised to support not only the construction of fibre-optic networks but also other hybrid approaches (e.g. Fixed Wireless Access – FWA) in less economically attractive areas. It is important to simplify the processes for drawing down subsidies, particularly through the digitisation of administration and the standardisation of approval processes. Another key step is to promote the sharing of passive infrastructure, which would lead to significant savings in network construction. This includes maximising the use of existing fibre-optic routes in the energy, transport and public administration sectors, as well as extending access rights to public and private buildings suitable for the installation of active VHCN elements. It is also advisable to strengthen developers' obligations so that new construction automatically accounts for preparation for fibre-optic connectivity. From a legislative perspective, it is necessary to further simplify the permitting process for the construction of fibre-optic networks, both for new routes and for the refurbishment of existing infrastructure. Speeding up and streamlining the building permit process would significantly boost the pace of network roll-out.

Support on the demand side – stimulating the adoption of VHCN

Higher fibre-optic network penetration does not in itself guarantee widespread use. Motivating households to switch to higher speeds is essential for creating the economic conditions that will encourage operators to make further investments. One effective measure could be targeted financial support for households to switch to gigabit connections, for example in the form of discount vouchers for activating fibre-optic connections. In addition to financial support, it is important to raise awareness of the benefits of high-speed internet, particularly in relation to new digital services such as remote working, e-health or smart homes. Awareness of the advantages of gigabit networks should be promoted not only through marketing campaigns, but also through the involvement of local authorities and community projects. Another significant factor is supporting the digital transformation of businesses and public administration. If businesses, schools and public institutions begin to make widespread use of gigabit connections, pressure on households to connect to these networks will also increase.

S10 Využití 5G sítí pro FWA

S20 Sdílení infrastruktury

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

S26 Využití satelitní komunikace pro 5G

4.1.2.9 Strategic objective of the National VHCN Development Plan No. 2: Ensure internet availability: 100 Mbit/s+ for households, 1 Gbit/s symmetrical for businesses and institutions

Ensuring the availability of high-speed internet, i.e. connections of at least 100 Mbit/s for households and 1 Gbit/s symmetrical for businesses and institutions, should continue to be one of the key objectives of the Czech digital strategy in line with the ambitions of the Digital Decade 2030. Although the Czech Republic performs well in terms of basic connectivity rates, with 92.8% of households having internet access, the reality regarding connection quality and speed remains problematic.

UNOFFICIAL MACHINE TRANSLATION

According to the latest available data from 2023, 50.54%[35] of households were covered by VHCN networks, whilst only 36.1% of households were covered by FTTP[36] technology. This is well below the EU average and clearly highlights the need for intensive infrastructure support. 5G networks fare better, with coverage reaching 94.6%. In this context, FWA technology is important, as it is regarded as a means of covering areas where the roll-out of fibre-optic networks is difficult or uneconomical.

In terms of actual high-speed internet usage, 40.38% of households had a fixed connection with a speed of at least 100 Mbit/s in 2023; however, only 2.95% of users had a connection with a speed of 1 Gbit/s or more, which is a key limiting factor for the development of the gigabit economy and higher-level digital services. The low proportion of such high-speed connections is linked not only to supply but also to demand, which is limited in some regions due to price or insufficient awareness of the benefits.

Currently, approximately 1,206 local areas remain without any connection to the backbone network, representing around 80,500 households that have no access to any form of high-speed connection. To improve the situation, it would therefore be advisable to focus public support primarily on remote regions and utilise a combination of FTTx and FWA. At the same time, it is important to raise awareness among households and businesses of the benefits of gigabit connectivity and to remove the legislative and administrative barriers that are slowing down the roll-out of the necessary infrastructure. Without these measures, the Czech Republic cannot be expected to meet the Digital Decade targets for connectivity.

The key recommendations for achieving this objective are as follows:

- Introduce an accelerated digital construction process in accordance with EU Regulation 2024/1309, including a unified online system for submitting applications and issuing decisions within 4 months.
- Establish a separate grant programme, ‘Gigabit Network for Rural Areas’, aimed at supporting the construction of FTTH in rural areas with low population density and high connection costs.
- Launch a nationwide communication campaign to promote the use of gigabit internet, targeting households utilising remote working, multimedia services and e-learning.
- Establish a voucher scheme for end-users in rural areas where infrastructure has already been built but there is insufficient demand – e.g. CZK 3,000 for activation or a tariff.
- Introduce mandatory coordination of fibre-optic network construction with investments in transport and technical infrastructure at the municipal and regional levels, including preliminary engineering.
- Make it a condition for drawing on public funds that all schools, hospitals and public institutions are connected via a gigabit symmetrical connection by the end of 2027.
- Introduce a mechanism for the centralised procurement of connectivity for public institutions in individual regions under the leadership of the Ministry of Industry and Trade (MPO) or ICT alliances of regional authorities, with the aim of achieving lower prices and guaranteed service quality.

S10 Využití 5G sítí pro FWA

S20 Sdílení infrastruktury

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

S26 Využití satelitní komunikace pro 5G

4.1.2.10 Strategic Objective No. 4 of the National VHCN Development Plan: Expand connectivity in rural areas where investment is not commercially viable

This activity is assessed on the basis of its characteristics as part of Chapter 5.1.2.8, and all recommendations are therefore the same for both activities.

---

[35] According to the BEREC definition, the VHCN covers 55.6% of households in the Czech Republic.

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

UNOFFICIAL MACHINE TRANSLATION

4.1.2.11 Strategic Objective No. 5 of the National VHCN Development Plan: To ensure the connection of municipalities via access and distribution networks

The strategic objective of ensuring connectivity for local authorities via access and distribution networks was a key element of the National Broadband Development Plan in its early stages, when it was necessary to address major infrastructure gaps and support the development of fibre-optic networks, particularly in smaller settlements. However, data from the 2023 mapping exercise show that this objective has been largely achieved. Approximately 95% of basic settlement units (BSUs) are already connected via optical infrastructure, with coverage at the municipal level being even higher. These results confirm that most municipalities will have a connection to the optical backhaul and backbone network by 2025, and where this is not yet the case, these areas are eligible for grant support under the intervention areas of the National Recovery Plan or the Operational Programme Technologies and Applications for Competitiveness (OP TAK).

In view of this, a logical strategic realignment is warranted. Instead of maintaining a separate objective focused exclusively on connecting municipalities, this point should be merged with the broader strategic objective of building VHCN network infrastructure. This step would enable more efficient use of resources and reflect the current phase of digital connectivity development in the Czech Republic. The focus should shift from simply providing basic infrastructure towards higher levels of connectivity, with an emphasis on connection quality, the elimination of remaining gaps, and the achievement of the Digital Decade targets, namely covering 95% of all households with VHCN networks by 2030. The practical implementation of this change should include continued support for the expansion of optical infrastructure in line with specific regional and local needs, with greater emphasis on technological neutrality and the use of various connection models, such as Fixed Wireless Access (FWA) in areas where full optical coverage would be uneconomical. There should also be an expansion of investment incentives to ensure the availability of gigabit speeds, not only within newly built networks but also in the form of modernising existing infrastructure where optical coverage is present but the network has not been upgraded to DOCSIS 3.1 technology, and the network may not meet VHCN requirements.

Another important aspect remains the further digitisation of construction and permitting processes with the aim of accelerating the construction and expansion of VHCN networks. Simplifying the legislative framework and administrative processes related to the construction of new infrastructure could significantly contribute to achieving the Digital Decade targets within the prescribed timeframe. Overall, therefore, the strategic objective of connecting municipalities should be transformed to reflect the current phase of digital infrastructure development and be linked to the broader goals of gigabit connectivity by 2030.

S20 Sdílení infrastruktury

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

4.1.2.12 Strategic Objective No. 7 of the National VHCN Development Plan: Extend mobile services to rural areas

Coverage of rural areas with mobile services in the Czech Republic remains a challenge despite the declared 94.6% 5G coverage. In reality, many rural areas suffer from poor signal quality, particularly inside buildings, where up to 80% of mobile communication takes place and where there is significant signal attenuation of up to 20 dB. In contrast, the declared coverage is often based on an ideal situation in open spaces and may therefore not be functionally usable.

Study 23 also points out that current 5G networks in the Czech Republic operate in NSA mode, essentially as an extension of the 4G infrastructure. In rural areas, 5G coverage is therefore mostly formal rather than actually usable. At the same time, it is clear that for rural areas it is not realistic to rely solely on the roll-out of fibre-optic networks, but rather on a combination of technologies; in particular, FWA represents an effective solution. FWA is currently used by over 38% of households and has the potential to provide high-speed internet even where fibre-optic infrastructure is economically unviable, with the use of public support.

Nevertheless, 4G services are available in almost 100% of rural areas, and according to data from 2023, 72.7% of these areas were covered by 5G connectivity. The strategic objective can be considered achieved. Should the strategic objective be updated, it would be advisable to focus on higher connectivity standards, whether this involves 5G coverage in the 3.6 GHz band or the incorporation of this strategic objective into one of the connectivity targets arising from the Digital Decade.

S10 Využití 5G sítí pro FWA

S20 Sdílení infrastruktury

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

S26 Využití satelitní komunikace pro 5G

4.1.2.13 Strategic objective No. 8 of the National VHCN Development Plan: To ensure coverage of railway corridors, including tunnels

As part of the National Recovery Plan, several calls for proposals have been issued for the provision of 5G coverage along selected railway corridors. The aim of this call is to build passive infrastructure for 5G base stations, or 5G + GSM-R and FRMCS, to modernise existing infrastructure and subsequently provide 5G coverage of a higher level (RSRP = -83dBm) on selected TEN-T corridors to ensure the reliable provision of mobile services on these routes. This signal level exceeds the requirements set out in the terms of the 5G spectrum auction (document: Announcement of a tender for the granting of rights to use radio frequencies for the provision of electronic communications networks in the 700 MHz and 3400–3600 MHz frequency bands)[37].

At the turn of 2023 and 2024, the CTO, in conjunction with the Railway Administration (SŽ), carried out measurements of the quality and availability of coverage of the main railway corridors and other lines in the TEN-T network by mobile radio communication services. Measurements of service availability for the three main operators (O2, T-Mobile, Vodafone) showed that, in terms of 5G signal coverage outside railway carriages (outdoor), the figure for all operators ranges between 99 and 100%. Conversely, for coverage inside railway carriages (indoor), the coverage quality level ranges from just 65 to 82%[38]. Signal quality and availability inside the carriage depend on a number of factors, such as the type of carriage itself (material, construction type), or even the carriage's position relative to the direction of the mobile network base station, as the signal can be significantly attenuated when passing through obstacles such as walls and the internal structure of trains, and its quality may therefore fluctuate whilst the train is in motion[39]. To improve the signal inside train sets, 5G repeaters can be installed on trains to amplify the received signal, or more transparent windows can be fitted in České dráhy's ComfortJet carriages. In 2024, České dráhy issued a public tender for the supply of 5G repeaters with an estimated value of up to CZK 132 million[40]. Coverage of railway tunnels will be provided using radiating cables positioned along the tunnel walls at a pre-specified height relative to the trains. The specifications also include a requirement to ensure that these cable solutions do not interfere with the provision of other radio technologies. The delivery of these installations is carried out on the basis of contracts with operators/suppliers, e.g. the contract between Správa železnic and Vodafone for coverage of several locations[41].

The results of coverage measurements on railway corridors to date, including pilot projects carried out in cooperation with mobile operators, the Railway Administration and other entities, show that signal quality, particularly in tunnels and on sections that are difficult to cover, often fails to meet the required parameters for both connection capacity and stability. Given the gradual development of high-capacity networks, the increase in demand for data transmission on trains and, at the same time, the as yet limited actual scope of implementation of certain projects, this objective remains fully relevant within the VHCN priorities, where the update of strategic objectives is intended to recommend specific solutions that combine both technical feasibility and economic efficiency. This includes:

- Defining the targeting of support by type of location and service (road/rail corridors, tunnels, trainsets).
- Defining the appropriate technical solution (measures to boost signal strength, increase throughput or reduce interference).
- For financing, consider using funds from existing sources, e.g. the radio communications account.

S4 Sdílení infrastruktury

S14 KPI mobilních 5G sítí, indikátory 5G a vazba na DESI

S23 Radiový plán pokrytí České republiky sítěmi 5G

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

[37] https://mpo.gov.cz/cz/podnikani/narodni-plan-obnovy/vyzvy/vyhlaseni-ix--vyzvy---dokryti-vybranych-zeleznicnich-koridoru-signalem-5g-vyssi-levels-of-components-1-3-digital-high-capacity-network--investment-c--2--275766/

[38] https://ctu.gov.cz/mereni-pokryti-

zeleznice[39] https://ctu.gov.cz/sites/default/files/obsah/stranky/91655/soubory/Zpr%C3%A1va%20o%20v%C3%BDsledc%C3%ADch%20m%C4%9B%C5%99en%C3%AD%20pokryt%C3%AD%20%C5%Railway%20corridors%20of%20TEN-T%20signalled%20by%20mobile%20radio%20communication%20networks.pdf

[40] https://www.ceskedrahy.cz/tiskove-centrum/tiskove-zpravy/lepsi-mobilni-signal-ve-vlacich-ceske-drahy-vypsaly-zakazku-na

[41] https://smlouvy.gov.cz/smlouva/soubor/33474231/Smlouva%20S%C5%BD%20a%20Vodafone%20-%205G%20corridors%20grants_signed_redacted.pdf

UNOFFICIAL MACHINE TRANSLATION

4.1.2.14 Strategic objective No. 9 of the National VHCN Development Plan: Grant support for the construction of networks beyond the reach of market mechanisms

There are already grant schemes in place that focus on developing VHCN in areas beyond the reach of market mechanisms. One such example is Call I – High-Speed Internet from the Ministry of Industry and Trade (MPO) under the OP TAK programme, for which CZK 4 billion has been allocated.

As also mentioned in Study 14, 5G networks are available to almost 97% of the population; however, there are differences in coverage between individual operators, with the highest coverage at Vodafone (around 93%) and the lowest at O2 (around 84%). On the other hand, it is important to note that most of this coverage is in the 700 MHz frequency band. Conversely, the availability of 5G connectivity in the 3.4–3.8 GHz band is not yet sufficiently developed, despite the fact that this band was originally acquired by five operators (now reallocated through sale among the three main operators). Here too, there are differences between individual operators, with O2 making this band available to almost a fifth of the population, compared to 1.3% in the case of Vodafone.

Given that the Czech Republic lags behind other EU Member States in terms of the availability of fibre-optic network connectivity (the EU average is 64%, compared to just 36% in the Czech Republic), it is important to continue these initiatives in the coming years, to provide incentives for projects in rural or less attractive areas, and to prioritise infrastructure sharing. The specific refinement of the strategic objective should therefore consist of the following tasks:

- Adjust the evaluation model for grant calls with an emphasis on covering genuinely unserved areas and the efficient use of funds.
- Refine the evaluation criteria for grant calls – Infrastructure sharing as a condition for the award of a grant.
- Introduce a cost-sharing methodology for infrastructure sharing.
- Introduce mechanisms to prevent project overlap – Preventing double funding of fixed and mobile infrastructure.
- Introduce the possibility of pre-financing smaller projects or advance payments to kick-start construction.
- Introduce incentives for projects targeting rural or less attractive areas.

S20 Sdílení infrastruktury

S21 Metody mapování pokrytí sítěmi elektronických komunikací

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

4.1.2.15 Strategic Objective No. 10 of the National VHCN Development Plan: Form of financing operating costs for key institutions

Ensuring stable and sustainable funding of operating costs (OPEX) for key public and strategic digital and communications infrastructure currently represents a fundamental weakness in the overall architecture of VHCN development in the Czech Republic. Most public and critical digital infrastructures are established with the support of investment grant instruments (CAPEX), but the subsequent financing of their operation is left to an ad hoc approach by individual ministries, local authorities or project budgets. This approach lacks long-term stability, predictability and systematic coordination.

An analysis of the current situation identifies several key barriers:

- The lack of a centralised model for financing operating costs for state and public digital infrastructure.
- Insufficient long-term planning of OPEX expenditure, absence of forecasts and provisions in the budgetary frameworks of ministries.
- Fragmentation of competences and responsibilities among individual administrators, sectors and levels of government.
- Limited experience with alternative operational models, including PPPs, concessions or community-based forms of infrastructure management.
- Low motivation to share operating costs between the state, local authorities, operators and other users of public infrastructure.

In this context, it is desirable to retain this objective within the National VHCN Development Plan; however, its further elaboration should aim to create a systematic and coordinated framework that will enable stable and long-term sustainable financing of the operation of these networks even after the investment phase has ended.

S12 5G Broadcast

S13 Digitalizace podniku

S22 PPDR

S25 Definice investiční mezery výstavby sítí VHCN ve vazbě na rozvoj sítí 5G

4.1.3 Thematic block: Industrial use and applications of 5G

4.1.3.1 5G network development implementation activity No. 12: Creating a space for dialogue and cooperation in the form of a Forum or alliance for the development and implementation of 5G networks (alliance participants – telecommunications operators, the business sector, government and representatives of the academic community). In addition to exchanging experiences and formulating views on the development of 5G networks, this will help identify opportunities for the use of 5G networks and the creation of joint projects, and will provide an opportunity to formulate requirements for legislative, executive, standardisation and harmonisation processes.

In the Czech Republic, the 5G Alliance was established in 2020 as a platform to support the development and implementation of . Its aim is to create a space for dialogue and cooperation between telecommunications operators, the business sector, government and the academic community. The Alliance focuses on exchanging experiences, identifying opportunities for the use of 5G technologies, initiating joint projects and formulating requirements for legislative, executive, standardisation and harmonisation processes. The 5G Alliance Steering Committee meets four times a year and addresses current issues on an ongoing basis through five specialised working groups focusing on industry, smart cities, cyber security, disinformation and education, and transport corridors. It comprises representatives from the Ministry of Industry and Trade (MPO), the Ministry of Regional Development (MMR), the Ministry of the Interior (MV ČR), the Czech Telecommunications Office (ČTÚ), the Association of Mobile Network Operators (APMS), the electronic communications industry, the academic sector, the National Cyber Security Authority (NÚKIB), the Chamber of Commerce, the Confederation of Industry and Transport, the Union of Towns and Municipalities, and the Association of Small and Medium-sized Enterprises.

For the effective use of 5G networks, the interests of all stakeholder groups must be continuously taken into account, including their concerns and comments regarding the future development of 5G technologies. Similarly, communication among all participants is important for a modern spectrum strategy, as outlined in Study 6. In the coming years, therefore, dialogue must continue, and an environment for such discussions and the exchange of experiences among all stakeholders in mobile network development must be fostered. Given that a platform in the form of the 5G Alliance has already been established in the Czech Republic and is operating successfully, it is appropriate to further develop this objective not by creating a new structure, but by supporting and transforming this existing platform so that it reflects new technological challenges, particularly with regard to the upcoming development of 6G networks. In this context, the Alliance should expand its activities to include the systematic sharing of knowledge, research outputs and standardisation recommendations, which will enable the preparation of a domestic environment for an effective transition to the new generation of networks and the active involvement of Czech stakeholders in international discussions and projects in the field of 6G.

S6 Strategie správy spektra

4.1.3.2 5G Network Development Implementation Activity No. 11: Promotion and support of cooperation between the electronic communications sector, the user industry sector, and the academic and research sectors.

Support for interdisciplinary cooperation between the electronic communications sector, industrial users, the research community and public administration represents one of the key prerequisites not only for the effective development of VHCNs, including 5G networks, but also for preparing the conditions for the advent of 6G networks and other advanced digital technologies.

In the Czech Republic, a number of functional platforms have already been established in this area, which put this activity into practice. In addition to the aforementioned 5G Alliance, which serves as a strategic platform for dialogue between the state, industry, operators and the academic sector, the BCO has also been established. This office, in addition to its supporting role in the planning and construction of high-capacity networks, is also actively involved in promoting the technological capabilities of 5G networks, education, methodological advice and facilitating communication between public administration, industry, research and operators.

Both platforms are thus already effectively fulfilling substantial parts of the objective of this implementation activity. As part of the amendments and updates to strategic documents in the field of VHCN network development, including 5G and the forthcoming 6G technologies, the following should be:

- The functioning of these existing platforms (the 5G Alliance and BCO) should be taken into account and recognised as the main tools for fulfilling this implementation activity.
- Their role as coordination centres for interdisciplinary cooperation should be formally enshrined in national strategic documents.
- In cooperation with these entities, further development of activities focused on the promotion, popularisation, education and support of the interdisciplinary use of 5G/6G technologies should subsequently be specified.
- Expand the remit and objectives of the National Centre for Industry 4.0, which should have clearly defined rules for supporting projects across various sectors and an overview of specific calls for project development and supporting infrastructure.

4.1.3.3 Implementation activity for the development of 5G networks No. 13: It is crucial that all affected sectors identify their potential and specify their requirements for the development and use of 5G networks.

This activity is assessed on the basis of its characteristics as part of section 5.1.3.1/2, and all recommendations are therefore the same for both activities.

4.1.3.4 5G Network Development Implementation Activity No. 14: To make every effort to support or initiate activities aimed at implementing projects utilising 5G networks in towns and villages – "Smart City / Smart Village", with an emphasis on the development, testing and implementation of specific applications to improve citizens' quality of life.

The Smart City / Smart Village concept is a gradual process aimed at improving citizens' quality of life whilst reducing costs associated primarily with the operation of urban infrastructure, through the application of information and communication technologies. These technologies can be utilised across a wide range of areas, from public transport and street lighting to waste management. To stimulate new solutions, it is necessary to initiate activities aimed at this concept. The original document envisages development primarily in the form of test cities within 5G networks, in line with the objectives of Digital Czech Republic. The Ministry of Regional Development and the Ministry of Industry and Trade therefore launched the '5G for 5 Cities' competition in 2019. The winning cities in this competition focused their projects on developing the Smart Cities concept through technologies based on the use of 5G networks, and their projects were completed in 2023 under the National Recovery Plan.

The detailed Implementation Plan for the Smart Cities Concept up to 2030, approved in 2022, was updated by a government resolution in early 2025[42] and falls under the remit of the Ministry of Regional Development. This plan sets out in detail the necessary measures in the field of Smart Cities, which are intended to support the development of the innovative potential of cities and regions and which fulfil the sectoral strategies of ministries, such as the Digital Czech Republic strategy. For the purposes of this document, measure ZPO1.g Implementation of 5G demonstration projects is key; its aim is to utilise the findings of previous projects in the further expansion of the Smart Cities concept to other municipalities to ensure a sufficient volume of information and the subsequent creation of a methodology for widespread use. Another measure is ZPO4.b: Support for cooperation between municipalities, cities and regions with universities and other research organisations, which, as the name suggests, promotes the sharing of best practice between municipalities and research organisations in applied research. It is precisely the lack of a national framework for supporting and coordinating projects, which would facilitate the sharing of know-how, that is arguably the most pressing problem in the implementation of Smart projects.

As described in Study 8, network slicing can also contribute to making the application of the concept more effective, although its full potential has not yet been fully realised. Next year should see the initial implementation of static slicing, and only then should advanced dynamic and open models be addressed. Currently, the main challenges of this

[42] UPDATE TO THE IMPLEMENTATION PLAN – Smart Cities Concept – List of specification measure cards.

technology are the identification of a functional business model, operational management and cyber security. From the MIT's perspective, the regulatory framework and efforts to change the mindset of communications service providers are important.

In the coming years, it is therefore advisable to continue with these initiatives as has been the case to date. This is also anticipated in the 2nd call from the Ministry of Regional Development (MMR)[43], which focuses on demonstrative applications of the 5G network ecosystem for smart cities, municipalities and regions; this call forms part of the National Recovery Plan (sub-components 1.4 and 1.6), and approximately CZK 600 million has been allocated to its projects. By 2030, as mentioned above, a methodology and information materials for widespread use by other municipalities should be developed. At present, however, the replicability of successful implementations in other municipalities and towns is not systematically ensured, and attention should therefore be paid to this issue in order to better evaluate the public funds invested (utilising synergies).

S7 Digitální dvojče | S9 5G IoT | S13 Digitalizace podniku

4.1.3.5 5G network development implementation activity No. 15: Given the industrial nature of the Czech Republic, prioritise the use of 5G networks within the development of Industry 4.0 alongside artificial intelligence applications.

Unlike their predecessors, 5G technologies represent a new stage of development characterised by higher capacity, reliability and lower latency, which should enable new ways of connecting, communicating and managing business operations across a range of verticals and, more generally, their digital transformation. A key aspect of this transformation is private 5G networks, which offer businesses tailored connectivity solutions that meet their specific requirements for security, capacity and speed. For the Czech Republic, harnessing the potential of 5G to support digital transformation is not merely a matter of economic competitiveness, but a strategic necessity. Although the digitalisation of businesses using 5G technologies is progressing and is comparable to that in other European countries, the Czech Republic still lags behind leading nations (e.g. Germany), as well as behind public expectations associated with the 5G spectrum auction.

This activity should remain a focus in the coming years; however, Industry 4.0 is such a complex topic that it is recommended to divide it into three sub-components in line with the studies conducted. These are network slicing, IoT and digital twins. For all these components, systemic support from the state is important for the smooth digital transformation of businesses; however, the specific measures differ for each area.

From the perspective of network slicing, this involves creating a regulatory framework for its use, together with information materials and further promotion to potential users. Slicing services also bring new requirements for cybersecurity standards and the creation of a roadmap for their implementation.

The advent of IoT requires the definition of a strategy, the interoperability of diverse systems and potential applications for government purposes, alongside active promotion to potential users. In the case of IoT, too, consideration must be given to cybersecurity requirements, the creation of an environment that stimulates its deployment, and the development of specific technologies, namely RedCap and Passive IoT. Last but not least, it is important to support research into modern approaches to connectivity, particularly in remote areas, including the use of satellite communications.

Effective use of the digital twin concept requires the standardisation of terminology and the categorisation of development phases, the definition of cybersecurity recommendations and standards, and the creation of information materials describing the benefits of its use.

S7 Digital Twin | S8 Network Slicing | S9 5G IoT

S13 Enterprise Digitalisation | S19 Development of 6G networks in bands above 100 GHz

[43] https://mmr.gov.cz/getattachment/0b40779d-492b-4b85-a3ba-11aa0c0ee956/Seznam-projektu-schvalenych-a-neschvalenych-k-financovani-1-4-1-6-V2.pdf.aspx?lang=cs-CZ&ext=.pdf

4.1.3.6 5G Network Development Implementation Activity No. 17: Given the enormous number of devices connected primarily to the IoT and the exhaustion of the IPv4 address space, it is essential that 5G access network operators implement and 5G service providers actively offer all services with access to the IPv6 Internet, whilst maintaining access to the IPv4 Internet using transition mechanisms (e.g. 464XLAT, NAT64/DNS64, Dual-Stack).

In June 2023, RIPE NCC (the organisation managing the IP address registry for Europe and the Middle East) published a study[44] focusing on the adoption of the IPv6 protocol in the Czech Republic, Poland, Hungary and Slovakia. This study found that the rate of IPv6 deployment remains low, despite the limited supply of IPv4 addresses and growing consumption. According to the organisation, only around 20% of the network was IPv6-capable, which is significantly below the average for the countries surveyed, which stands at between 35–39%, despite successful deployment a decade ago. The study also emphasises that, in addition to regulatory measures, a bottom-up approach is important when introducing IPv6. In conclusion, it highlights the need for further support for IPv6, leading to long-term growth and new technologies such as 5G, IoT or Smart Cities.

This is also recognised by the Ministry of Industry and Trade (MPO), which in 2024 presented a joint declaration on cooperation and support for the expansion of the IPv6 protocol[45] (the signatories to this declaration are the MPO, the Czech Telecommunications Office (ČTÚ), the Digital and Information Agency, the Ministry of the Interior, the CZ.NIC, NIX.CZ and CESNET associations, the Independent ICT Industry Committee and APMS). The aim of this declaration is to fulfil Czech Government Resolution No. 49 of 17 January 2024[46] on restarting the roll-out of DNSSEC technology and the IPv6 protocol in the public administration, and to provide overall support for the promotion and implementation of IPv6 in the Czech Republic. These activities also include a regular annual review and update of their activities.

Subsequently, on 22 July 2025, the Ministry of Industry and Trade published a Report on the Support of the IPv6 Protocol and DNSSEC Technology in the Czech Republic's Public Administration. This report follows on from Government Resolution No. 49 of 17 January 2024 on the relaunch of the implementation of DNSSEC technology and the IPv6 protocol in the public administration and sets out the current status, outlook and recommendations for the deployment of the protocol. Technical and security reasons are identified as key factors for the full transition of the public administration to these technologies by 6 June 2032.

IPv6 brings with it a host of benefits in the form of (1) an expansion of the address space, (2) a reduction in entry barriers for potential new market participants, (3) improved security, (4) better support for mobile devices, (5) improved international interoperability, and (6) support for the roll-out of the IoT. In view of these facts, it is essential to continue activities to support the IPv6 protocol among both 5G access network operators and 5G service providers.

When updating and revising national strategies in the field of VHCN and digital infrastructure, it is important to recognise that the transition to IPv6 can no longer be viewed merely as a technological option, but as an essential prerequisite for the long-term stability of the Czech internet environment and its ability to accommodate growing data and IoT demands in both 5G and future 6G networks. It is necessary to shift the strategy from general declarations towards the implementation of specific measures that will overcome the current regulatory inaction, economic inertia and lack of motivation among small and medium-sized players. At the same time, it is crucial to link measures to support IPv6 with VHCN development grant schemes and to actively utilise the regulatory and development powers of the CTO within the scope of its supervisory function. Key activities therefore include, for example:

- Defining the role of the CTO in overseeing the transition to IPv6 within the scope of its regulatory powers.
- Set a binding deadline for the transition of public networks and government services to IPv6.
- Introduce an IPv6 capability requirement as a condition for participation in public procurement and grant schemes in the field of networks.
- Making the allocation of new access rights and licences conditional on infrastructure IPv6 compatibility.
- Create an incentive scheme for small and medium-sized ISPs (e.g. bonus points, direct financial support, technical assistance).
- Provide training and advisory services to enhance operators' technical capacity in the area of IPv6 deployment
- Propose minimum standards for IPv6 support in network equipment and services.
- Introduce regular assessments of the status of IPv6 deployment, with monitoring at the level of both providers and public institutions.

[44] https://labs.ripe.net/media/documents/RIPE_NCC_Internet_Country_Report_Central_Europe_June_2023_1.pdf

[45] https://mpo.gov.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/2024/9/Spolecna-deklarace-k-IPv6.pdf

[46] https://konecipv4.cz/media/filer_public/98/d0/98d083ca-a089-460e-a378-601ac25d0d31/usneseni_2024_49.pdf

UNOFFICIAL MACHINE TRANSLATION

- Define the role of the CTO in overseeing the transition to IPv6 within the scope of its regulatory powers.
- Coordinate the transition with international initiatives and standardisation bodies (RIPE NCC, European Commission).

S9 5G IoT

S14 KPIs for 5G mobile networks, 5G indicators and link to DESI

4.1.3.7 Strategic Objective No. 6 of the National VHCN Development Plan: To support the development of 5G networks in cities, rural areas and transport corridors.

The development of 5G networks in cities, rural areas and transport corridors, including railways and tunnels, represents one of the key prerequisites for achieving the Czech Republic's digital transformation goals. This topic repeatedly emerges across specialist studies as a strategic priority and, at the same time, as a cross-cutting area whose successful implementation depends on progress in other related areas.

The development of 5G cannot therefore be viewed in isolation; this objective is closely linked to the roll-out of high-capacity networks, the planning and allocation of radio spectrum, the strengthening of the optical backbone infrastructure, and the establishment of an effective system of public support. It is precisely the coordination of these elements that is essential to ensure that 5G networks are available not only in cities but also in less populated areas and within transport infrastructure. Support for the development of 5G networks thus naturally overlaps with other areas of digital policy, and the strengthening of this infrastructure will also be the result of the successful implementation of the state's broader digital development strategy.

When updating the National VHCN Development Plan, it is advisable to further elaborate on this objective, taking into account the identified barriers that significantly affect the dynamics of 5G network development in various types of locations. A key limitation remains the underutilisation of the mid-band spectrum (from 1 GHz to 6 GHz), which is crucial for achieving the full capacity and speeds of 5G, particularly in urban areas. At the same time, it is necessary to address the low economic return on investment in networks in remote and sparsely populated areas, where commercial development remains limited without targeted public support. In the specific category of transport corridors and railway lines, in addition to general coverage, it is necessary to systematically address the ageing of the rolling stock and the lack of on-board infrastructure in trains, which hinder the effective use of 5G inside carriages.

Recommended adjustments to the objective should focus on:

- Earmarking targeted financial instruments to support rural areas and transport corridors, including the possibility of multi-source funding via the NPO, OP TAK and, where appropriate, a new investment framework.
- Refining the targeting of construction according to the typology of locations and services, taking into account population density, economic potential and public service coverage.
- Launching specialised calls for proposals to support the installation of 5G repeaters in railway corridors and tunnels, including support for the modernisation of rolling stock interior infrastructure.
- Coordination of the construction of 5G access points with the development of backbone optical infrastructure, which is essential for the stable operation of high-capacity 5G networks.
- Regular evaluation of 5G coverage and service quality in line with DESI indicators, enabling ongoing adjustment of support measures.

S4 Využívání klíčových pásem pro rozvoj 5G a dalších klíčových radiokomunikačních služeb

S14 KPI mobilních 5G sítí, indikátory 5G a vazba na DESI

S23 Radiový plán pokrytí České republiky sítěmi 5G

S24 Predikce vývoje pokrytí sítěmi VHCN v České republice ve vazbě na rozvoj sítí 5G

UNOFFICIAL MACHINE TRANSLATION

4.1.4 Thematic block: Civil protection and cybersecurity

4.1.4.1 Strategic Objective No. 3 of the National VHCN Development Plan: To support private networks for public and strategic purposes.

Non-public networks used for public and strategic purposes can be divided into various categories. The first category of non-public networks comprises critical infrastructure networks, which include the Integrated Rescue System (IRS), the Police of the Czech Republic and regional state administration bodies under the name of the Ministry of the Interior's Integrated Telecommunications Network. These are subject to Act No. 181/2014 Coll., on cyber security, which regulates the scope of activity and powers of public authorities in the field of cyber security, ensuring the security of electronic communications networks and information systems.

The second category comprises non-public networks for public administration. In the Czech Republic, four out of thirteen regions operate this type of network as regional data networks, predominantly in larger municipalities. The main service is the provision of access to the Central Service Point (CMS). The regional data network also connects, for example, schools, hospitals, social care facilities, museums, as well as components of the integrated rescue system[47].

The development of public administration's technological infrastructure is currently a fundamental prerequisite for meeting the digitalisation demands brought about by next-generation networks, new types of customer services, and applications that are demanding in terms of bandwidth and transmission capacity. It is anticipated that, as a result of the digitalisation of public administration, the volume of data transmitted will increase many-fold in the coming years compared to 2020, particularly in central nodes and backbone sections of networks[48]. This requires a fundamental modernisation of network infrastructure at both regional and national levels, ensuring it is ready to support services with high demands on connectivity and security.

A large part of the funding for public administration development projects is linked to the Integrated Regional Operational Programme (IROP), which acts as an intermediary in the Czech Republic for the redistribution of funds from the European Regional Development Fund (ERDF). This programme focuses primarily on supporting digital transformation in line with EU objectives. As regards the objective of the digitalisation of public authorities and cybersecurity, a sum of CZK 12.4 billion has been allocated to projects falling under this objective, of which CZK 6.4 billion goes directly to related eGovernment projects. At present, nearly CZK 2.98 billion of this amount is available for drawdown under the open calls (Nos. 45, 46 and 47). The deadline for submitting applications for funding in this category was set for 30 April 2025, and at the time of writing this study, the registered applications comprise projects worth a mere CZK 276 million (9% of the total funds)[49]. Such a small proportion of the total grants drawn down points to insufficient utilisation of the ERDF's potential for the rapid and high-quality modernisation of public administration.

As regards the components of the Integrated Rescue System (IRS), a total of CZK 9.3 billion has also been allocated to them under the IROP, of which approximately CZK 2 billion is earmarked for project categories that include, for example, increasing the capacity of ICT systems. However, given the relatively broad scope of this category and the fact that the call for project proposals remains open, it is currently unclear what proportion of the investment will be allocated to projects specifically related to the VHCN and the modernisation of network solutions for strategic purposes[50].

A recent development in the field of the Integrated Rescue System (IRS) was the resolution of the Czech Government dated 21 May 2025, by which the Government approved a project to modernise the public warning system and establish a Cell Broadcast system, which will enable an unlimited number of mobile phone users to be informed of an imminent danger within a short time. The Cell Broadcast system will complement and gradually replace existing sirens (rotary, electronic) and text SMS messages, and will eliminate their weaknesses (e.g. limited information regarding the nature and location of the threat). It will also enable integration with other modern warning tools, such as mobile applications, information boards, crisis management systems, social media, and, in the future, DAB (digital audio broadcasting) systems.

However, in light of the identified barriers, when updating the national strategy and amending the relevant objective within the National VHCN Development Plan, it is necessary to shift away from the current predominantly declarative approach to building critical

[47] https://irop.gov.cz/getmedia/a90a60a4-ed32-410d-aea7-0eebef40dda4/Prezentace_RO-45-46-47v-neverejne-site-050923.pdf.aspx?ext=.pdf

[48] https://mv.gov.cz/npo/clanek/1-2-digitalni-systemy-verejne-spravy.aspx?q=Y2hudW09Mw%3d%3d

[49] https://irop.gov.cz/cs/irop-2021-2027/temata/egovernment-a-kyberbezpecnost

[50] https://irop.gov.cz/cs/irop-2021-2027/temata/integrovany-zachranny-system

UNOFFICIAL MACHINE TRANSLATION

infrastructure towards a systematic definition of a national strategy for the development of private 5G networks for PPDR and other critical infrastructure. This strategy should primarily include:

- A clear definition and allocation of spectrum for private networks.
- A definition of communication interoperability between current voice emergency services systems and IP infrastructure.
- Proposals for operational and financial models that will enable the long-term sustainable operation of these networks.
- The introduction of binding timelines for the modernisation of technologies within the Ministry of the Interior and security services.
- Active involvement in international standardisation, adoption of advanced security and encryption standards.
- Creation of a framework for testing hybrid public and non-public models.
- Increasing investment in research and development of secure communication technologies.

S13 Digitalizace podniku

S22 Rešerše řešení zajištění bezpečné komunikace státu s ohledem na technologická řešení 5G a PPDR

4.1.4.2 Strategic Objective No. 18 of the National VHCN Development Plan: Ensuring a consistently high level of cybersecurity for the 5G networks being built and implementing the Prague Proposals[51] .

Ensuring a high level of cybersecurity in connection with the deployment of 5G networks is a long-term priority for the Czech Republic and the EU as a whole, and builds on the framework set out in the 2019 Prague Proposals. These proposals constitute an international set of recommendations for increasing the resilience of 5G infrastructure against security threats, in particular through thorough assessment of supplier trustworthiness, technical independence and transparency in the field of cybersecurity. The Czech Republic is implementing these recommendations through its national cybersecurity strategy and relevant IROP calls for proposals, as well as through technical documents issued by NÚKIB (e.g. the 2022 Recommendations for Assessing the Trustworthiness of Suppliers of Technologies for 5G Networks).

European legislation also plays a key role in this area, particularly the NIS2 Directive (2022/2555)[52], which requires Member States to introduce national cybersecurity strategies and strengthen capabilities in the areas of risk management and supply chain security. Given the sensitivity of 5G networks as a backbone communication infrastructure, it is essential that their security framework reflects not only current threats but also future ones, including the advent of quantum technologies.

Quantum computers pose a threat to current cryptography, including the security of 5G networks. Algorithms such as RSA and ECC are predicted to be breakable within 10 to 20 years, a fact that attackers are already taking into account today through ‘harvest now, decrypt later’ attacks. The quantum threat is therefore not merely hypothetical but already a reality, and requires a timely response from both the state and critical infrastructure operators. Furthermore, the scale of this risk doubles every five years, which further emphasises the need for a swift response to these developments.

This objective should therefore be supplemented by measures that take into account newly emerging threats, primarily in the form of quantum computers. These include:

- Formulating a minimum methodological framework for operators to ensure the cybersecurity of 5G and other communication networks in connection with the advent of quantum computing.
- Creating a reference register of PQC-compatible devices.
- Establishing minimum requirements for interoperability between classical and QKD cryptography.
- Ensuring the sustainability of the chosen security technology, with an emphasis on security agencies.

S8 Network Slicing 5G

S13 Využívání 5G a jiných sítí elektronických komunikací pro potřeby digitalizace podniků

S15 Kyberbezpečnost 5G sítí

S22 Rešerše řešení zajištění bezpečné komunikace státu s ohledem na technologická řešení 5G a PPDR

S27 4.2.27 Studie 27: Quantum Computing

[51]https://nukib.gov.cz/download/5G_site/Prague_Proposals_CZE.pdf

[52]https://digital-strategy.ec.europa.eu/cs/policies/nis2-directive

5 Methodology for synthesising information and defining projects

To ensure the applicability of this study's outputs, we have adopted a structured approach to synthesising information from individual sub-studies. This is based on a clear method of evaluating individual recommendations against specific tasks from individual strategic documents, eliminating duplication, and carefully assessing criteria for determining priorities and further recommended procedures, so as to optimise the implementation timeframe and the benefits of individual action steps.

Procedure

i. **Summary of all measures** (tasks) required in strategic documents (national, international, binding and advisory) and findings from the studies **into a comprehensive reference document (matrix)**, which will enable further analytical work with the findings and simultaneously serve as a guide when it is necessary to trace back to the primary information.

ii. **Consolidation of all recommendations** (sub-action steps) contained in the individual studies, including updated information, into comprehensive, unique action steps. This is a key point of synthesis, in which the content of each such action step is designed to represent a substantive proposal **for a framework project to achieve the given objective and to include sub-project plans** suitable for creating specific terms of reference for actual implementation activities/stand-alone projects. All such sub-project plans together then constitute the maximum ambition for achieving the framework project's objective. This makes the framework project scalable, and the actual scope of implementation can then be chosen to be narrower, depending on the decision and needs of the client (project manager).

iii. **Evaluation of parameters**: based on the established parameters and analyses carried out, each framework project is evaluated according to – (a) **an analysis of the progress of individual action steps,** which assesses the current state of implementation (AS-IS) against the target state (TO-BE) defined by the relevant strategic document (b) **the severity of the identified barriers** to further implementation progress; and (c) **the urgency/relevance** of the step in question, combining aspects arising from legislative obligations and the timeliness of the task.

iv. Based on a combination of evaluation parameters (stage of implementation, difficulty of implementation, and urgency/relevance), a proposed priority order for the individual summary action steps was established, which determines their recommended sequence for achieving the strategic objectives and tasks.

v. **A proposed timeline for the implementation of the summary action steps (potential framework projects)**, taking into account the estimated timeframe required to achieve the proposed objectives. It should be noted that this is only a rough estimate of the time required, assuming that the necessary capacity exists on the part of the contracting authority and collaborating entities to devote themselves fully to the given topic. The authors are not aware of these available capacities, nor of other circumstances (of an organisational, technical or other nature) on the part of the contracting authority that could influence the overall timing or the chosen scope of such a project.

Below is a diagram (Figure 5) created to illustrate the logic of this study. The diagram illustrates the link between European legislation and the strategic documents of the EU and the Czech Republic, which form the basis for the planning and implementation of telecommunications policy in the Czech Republic. This comprehensive study was commissioned by the Ministry of Industry and Trade (MIT) and links the outputs of 27 individual studies, providing an overview of the key steps required to successfully achieve the objectives in the field of VHCN, including 5G. The study defines the main tasks, synthesises individual findings, sets priorities and proposes a timeline for project implementation. It serves as a guide for the MIT on how to coordinate national actions with European requirements and meet the set milestones.

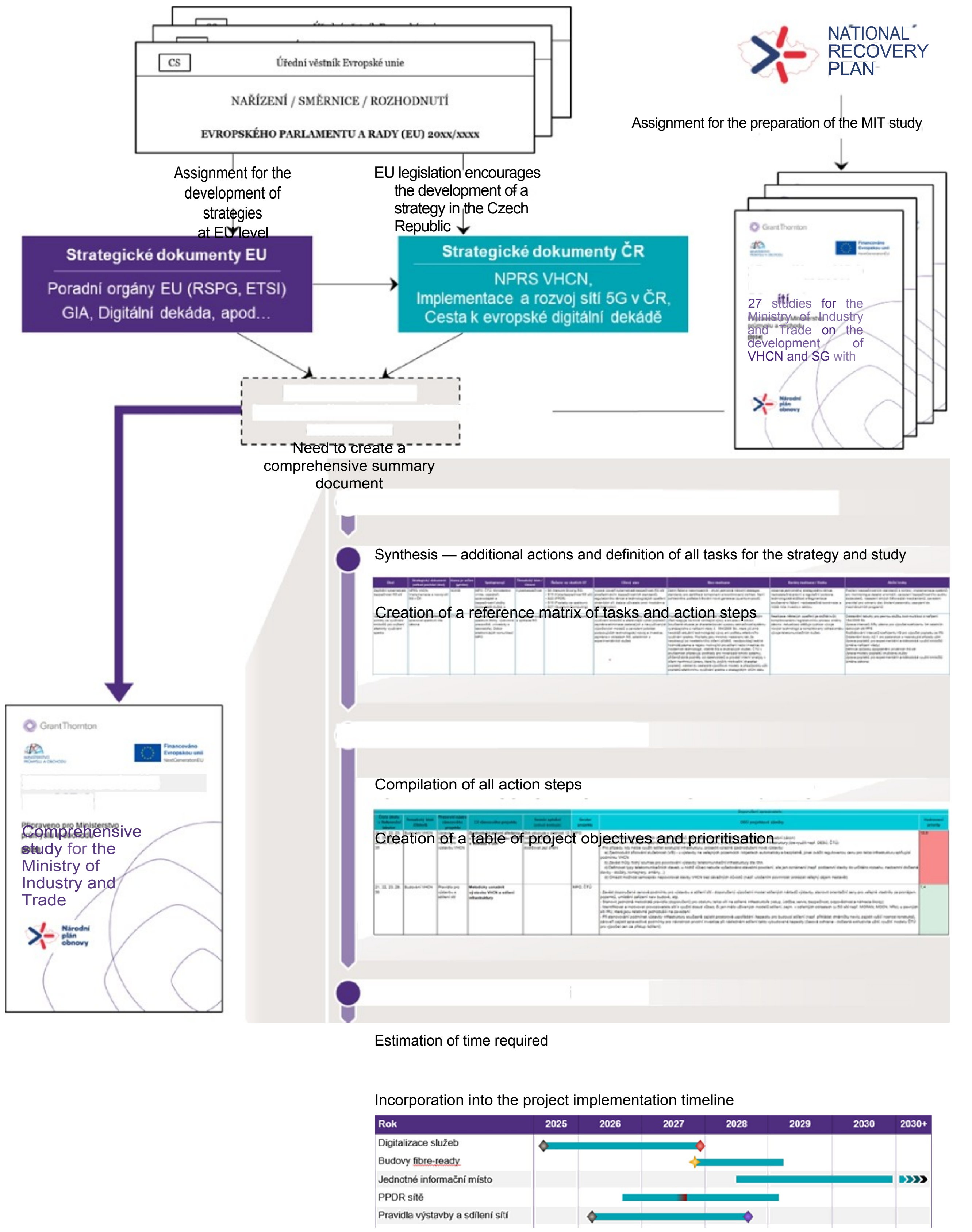


Figure 5: Structure of the final study document on VHCN development

5.1 Methodology for prioritisation and timeline design

To determine the priorities of individual summary action steps, an evaluation of the individual parameters of each measure was used in the form of coefficients. It should be borne in mind that evaluation using a quantitative coefficient is always, to some extent, a subjective/simplified view of individual issues; nevertheless, the aim was to capture the actual state of affairs as accurately as possible and to base this evaluation on the findings contained in the sub-studies.

5.1.1 Status of implementation/progress of a sub-task (GAP coefficient):

This metric expresses the current stage of completion of each sub-task or action step in relation to its target state as set out in national and European strategic documents, in particular *'The Path to the European Digital Decade: Strategic Plan for the Digitalisation of the Czech Republic*'. The assessment is carried out using a GAP coefficient on a scale of 0–4, where a higher number indicates a greater deviation from the target state.

Table 8: Scale for the GAP coefficient

Value	Status name	Description
0	Completed	The task/project has been fully implemented and meets the objectives set out in the strategy.
1	In progress	Active implementation is underway (e.g. network construction, system roll-out, implementation of measures).
2	Launched	The project is in the start-up phase – planning, preliminary analyses, drafting of concepts.
3	Preparatory phase	The project is at a stage where specific proposals for solutions already exist, a responsible manager has been appointed, and the first preparatory steps have begun (for example, drafting legislation, launching a public consultation, preparing the project framework).
4	Not yet started	The project has not yet started; no preparations or analyses have taken place.

Example of application of Metrics 1. GAP coefficient: Status of implementation of a sub-task for a specific action step

Action step: "Legislatively ensure standards for connecting buildings and individual users to optical infrastructure in accordance with the GIA."

Identification of the current status of task fulfilment: Regulation (EU) 2024/1309 of the European Parliament and of the Council on Gigabit Infrastructure (hereinafter "GIA") was adopted at European Union level in 2024. The Czech Republic has not yet fully transposed this Regulation into its national legal system. Partial steps towards implementing the GIA requirements have been initiated, such as the preparation of amendments to the Electronic Communications Act and related decrees, as well as work on methodologies for connecting buildings. Nevertheless, the final legislative amendments have not been approved, nor have they been effectively put into practice.

Analysis of actual progress: Based on the findings, it can be stated that the measure is not in the initial preparation phase (commenced), but at the same time, it cannot be said that the legislative process has been completed or that widespread implementation has begun. Active substantive preparation of legislative and technical documentation is underway, but the target state defined by strategic documents has not been achieved. There is no finally adopted legislative framework that would fully cover all requirements for 'fibre-ready' buildings, as set out in the GIA.

Determination of the stage of progress: According to the defined scale for Metric 1 (implementation status), this status corresponds to the value "1–In progress". This value characterises a situation where active implementation of an action step is underway (e.g. preparation of legislation, technical standards, draft procedures), but the measure has not yet been finalised. The results at this stage have no direct impact on the target state and cannot be considered partially complete from the perspective of implementation results.

Summary of the assessment: Based on the above facts, the action step "Legislatively ensure standards for connecting buildings and individual users to the optical infrastructure in accordance with GIA" was assessed as "1–In progress". The assessment reflects the status of active work on the preparation of legislative amendments and methodologies without reaching a stage where the measure has been functionally implemented or can be considered almost complete.

5.1.2 Difficulty of implementation

This metric assesses the extent of the barriers to putting a given action step into practice. It tracks the extent of complications associated with implementing the task, taking into account legislative, technological, market, historical and other relevant factors. This metric helps identify the effort likely to be required to successfully complete the action step. It allows measures to be prioritised not only according to their benefits, but also according to the difficulty of their implementation.

Assessment scale

Table 9: Scale for the difficulty of implementation

Value	Status name	Description
0	No barriers	Implementation is easy, quick and requires no special effort. There are no legal, technical or organisational obstacles.
1	Very low complexity	There are only minimal obstacles, which can be quickly and easily overcome using standard resources.
2	Low complexity	There are some minor complications, but these do not prevent implementation and are easily resolved.
3	Medium difficulty	Implementation requires some effort; there are identified barriers, but these can be managed using standard organisational and technical measures.
4	High difficulty	Implementation faces significant barriers. Successful completion of the task requires thorough preparation, comprehensive problem-solving and often fundamental changes (e.g. legislative amendments, overcoming market resistance).

Example of application of Metric 2: Implementation difficulty: Status of implementation of a sub-task for a specific action step

Action step: In accordance with the GIA, significantly simplify the rules and legislation for the construction of VHCN and infrastructure sharing.

Identification of the main characteristics of the action step: The action step involves extensive legislative changes, relating in particular to the amendment of Act No. 194/2017 Coll. on measures to reduce the costs of deploying high-speed networks and the Building Act No. 283/2021 Coll. It also calls for the establishment of a specialised body for the construction of telecommunications infrastructure, the introduction of simplified procedures for building permits, the establishment of automatic or regulated conditions for easements on public land, and the introduction of recommended pricing models. The measures also include the establishment of uniform rules for infrastructure sharing and incentives for operators to use less common sharing models. This is a systemic change requiring comprehensive coordination between public administration (ministries, building authorities, municipalities), private entities (mobile operators, internet providers) and the regulator (CTU).

Analysis of implementation difficulty: The implementation of this action step is associated with significant barriers:

- Legislative complexity: the need to amend two key laws and related implementing regulations, including procedural changes at building authorities.
- Organisational complexity: the need to establish and staff a specialised office or department.
- Political and institutional risks: the high degree of independence of local authorities, which may hinder the implementation of simplified permitting procedures.
- Market pressure: expected strong interest from mobile operators and ISPs, which will require repeated iterations of proposals and consultation.
- Linking legislation to practice: the need to translate legislative changes into the day-to-day operations of building authorities, which is a time-consuming and organisationally demanding process.

Taking all the above factors into account, it is clear that the implementation of this action step will require not only extensive preparatory work but also thorough and long-term implementation, including training, methodological support and monitoring of the application of the new legislation in practice.

Determination of the degree of difficulty of implementation: Based on the above factors, the situation corresponds to the highest degree of difficulty according to the defined scale. The action step was therefore rated 4 – High difficulty. This rating reflects significant legislative, organisational and practical barriers and the need to expend a considerable amount of coordinated effort in both the preparation and implementation of the changes.

Summary of the assessment: The action step "In line with the GIA, significantly simplify the rules and legislation for the construction of VHCN and infrastructure sharing" was assessed as having a difficulty level of 4 – High difficulty. The assessment is based on the scope of legislative changes, organisational complexity, the degree of coordination required, and the expected pressure from stakeholders throughout the implementation process.

5.1.3 Urgency/relevance

The metric assesses a combination of two aspects:

- Urgency – whether there is a fixed deadline for completing the task and whether the risk of it being compromised is relevant to the fulfilment of national or European commitments,
- Relevance – whether the task remains topical and/or significant in the context of technological and market developments in the Czech Republic.

The metric enables action steps to be prioritised according to the urgency of their completion and their long-term significance. It ensures that tasks essential for regulatory compliance, international commitments or key strategic objectives are ranked higher than measures whose significance may have diminished over time or ceased entirely.

Table 10: Scale for urgency/relevance

Value	Status name	Description
1	Lowest urgency and relevance	The project is not linked to a legislative obligation, a European commitment or the implementation of other key objectives. It can only be implemented on an optional basis, depending on available capacity and budgetary constraints. Its implementation is linked to the results of long-term activities that as yet have no specific time frame (research/development /harmonisation within the EU, etc.). The project has lost its justification as a result of technological or market changes.
2	Medium urgency and relevance	The project is relevant but is not directly linked to binding legislative, regulatory or other key objectives; alternatively, the deadline for achieving such objectives lies in the medium to long term. Its benefits depend on market conditions or technological developments. Postponing implementation will not jeopardise the fulfilment of other mandatory objectives, but may reduce the effectiveness or benefits of the measure.
3	Highest urgency and relevance	The project is legally or regulatory binding (arising, for example, from European legislation, national legislation, international agreements or strategic plans). Postponing implementation would directly jeopardise the fulfilment of mandatory objectives (e.g. indicators of the National Recovery Plan, Digital Decade targets, GIA requirements). The project is fully relevant and its significance will endure for at least five years, regardless of changes in the market and technology.

Example of the application of Metric No. 3: Urgency/relevance

Action step: "In line with the GIA, significantly simplify the rules and legislation for the construction of VHCNs and infrastructure sharing."

Identification of the relevance and urgency of the action step: The action step concerns the simplification of the legislative and administrative framework for the construction of very high-capacity networks (VHCNs) in the Czech Republic, in accordance with the requirements of Regulation (EU) 2024/1309 of the European Parliament and of the Council on Gigabit Infrastructure (GIA). This action step directly supports the achievement of key digital transformation objectives set out in documents such as the Digital Decade Policy Programme (the target of 100% gigabit connectivity for households by 2030) and the National Plan for the Development of VHCN Networks. The significance of this measure is also supported by current data, which shows that the Czech Republic is lagging significantly behind in the pace of VHCN network coverage of households compared to the trajectories required to meet European and national KPIs. Without a fundamental simplification of the processes for permitting and developing infrastructure, it is unrealistic to expect the connectivity targets to be achieved within the required timeframe. Furthermore, the significance of legislative and organisational changes is expected to increase over the next five years, driven by growing demand for gigabit services and the transition to new technological standards (e.g. 5G-Advanced, 6G, edge computing). Taking action is therefore not only timely, but its necessity will only grow more pressing as time goes on.

Assessment and justification of the evaluation: In terms of urgency, it can be stated that failure to implement the measures in a timely manner would directly jeopardise the fulfilment of mandatory European and national targets (e.g. the Digital Decade, GIA commitments). The action is therefore legally binding and highly urgent. In terms of relevance, the measure is fully in line with the medium- and long-term strategic priorities of the Czech Republic and the European Union in the field of digital infrastructure. Given technological developments and market trends, it cannot be assumed that its significance will diminish in the foreseeable future.

Based on the above facts, the action step was rated 3 – Highest urgency and relevance.

Summary of the assessment: The action step “In accordance with the GIA, significantly simplify the rules and legislation for the construction of VHCN and infrastructure sharing” was rated 3 under the Urgency/Relevance metric. The assessment reflects the legislative binding nature of the task, its key importance for the fulfilment of the strategic objectives of the Czech Republic and the European Union, and its long-term relevance in the context of technological and market developments.

5.1.4 Priority

The Priority metric is a synthesis of the previous three sub-metrics for evaluating action steps, namely:

- **Implementation Status (GAP coefficient),**
- **Difficulty of implementation,**
- **Urgency / Relevance.**

The aim of the Priority metric is to determine the overall ranking of summary action steps according to their importance and the recommended order of completion within the implementation plan.

Calculation methodology:

The priority value is calculated as the simple sum of the values of all three basic metrics, with the Urgency / Relevance metric weighted twice, i.e. its value is multiplied by a factor of 2 before being added to the total.

The formula for calculating priority is therefore: **Priority = (Implementation status) + (Implementation difficulty) + (2 × Urgency/Relevance)**

- The lower the resulting priority value, the higher the recommended priority for implementing the action step.
- Action steps with the lowest total are considered the most relevant, the most urgent and, at the same time, the best prepared for immediate implementation.
- Conversely, action steps with a higher total indicate lower urgency or greater complexity of implementation and may be carried out in later phases.

Taking time requirements into account:

Each action step is also accompanied by an estimate of the time required for its implementation, expressed in years. This estimate does not increase the priority score, but is essential for proper planning of implementation over time.

In the case of action steps with a clearly defined binding deadline (for example, by 2030 according to the Digital Decade targets), the timeframe is a key guide. If the time required for an action step exceeds the time remaining until the binding deadline, it is essential to commence its implementation immediately and manage it with the utmost effort to ensure that the set objectives are met on time.

The resulting order of action steps is shown in the prioritisation schedule to ensure:

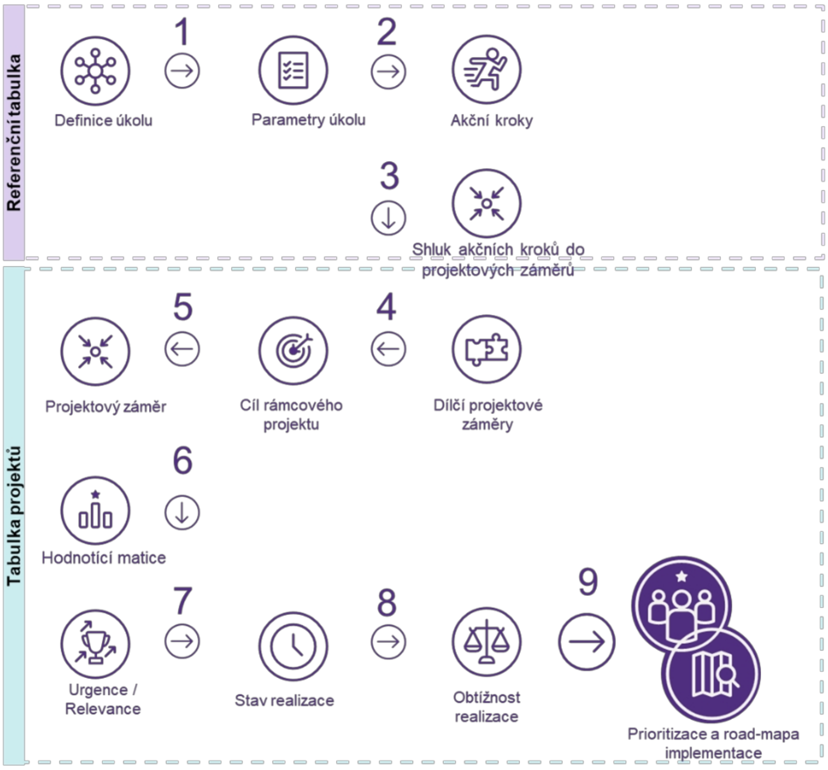
- The timely implementation of the most urgent and relevant actions,
- The fulfilment of strategic and legislative objectives by the required deadlines.

6 Outputs – overviews, priorities and timing of action steps

Introduction

Using the procedure described in the previous chapter, we have gained an insight into the appropriate phasing of the implementation of individual strategic measures over time, including the specific action steps associated with them. The analysis carried out enables us to present the following overviews, the purpose of which is to facilitate navigation through what is, overall, a very extensive issue and to provide guidance for the client's decision-making process. Figure 6 provides a simplified overview of the process of working with the individual tables and the transformation of tasks into action steps, project objectives, and their evaluation and prioritisation.

Figure 6: Workflow within this study



In simplified terms**, the figure illustrates the 9 steps through which we proceed from the general to the specific** and back to the definition of general project objectives. We begin with strategic documents, where tasks are defined (steps 1–2) and developed into specific action steps (step 3). These action steps are then grouped into project objectives (steps 4–5), whilst maintaining an emphasis on specificity and clarity in accordance with the SMART principles (specific, measurable, achievable, realistic, time-bound). This is followed by a certain degree of generalisation – the projects are evaluated according to a uniform methodology (steps 6–8), which takes into account their urgency, readiness and difficulty of implementation. This creates a prioritisation framework (step 9), i.e. an overview of which projects should be implemented first and how they can build on one another.

Scheduling the implementation of tasks within a specific timeframe according to the established priority – which combines the urgency of the task, the existence of barriers to implementation and the stage of its development – will enable the contracting authority to plan and manage its own resources more effectively and also to limit any undesirable fragmentation of activities. By prioritising the completion of tasks identified as high priority, the contracting authority will be able, on the one hand, to demonstrate tangible progress in fulfilling strategic objectives and harmonisation obligations, and, on the other hand, to utilise the subsequently freed-up capacity to tackle the subsequent, more difficult steps, which involve the time-consuming process of overcoming technical, legislative and other challenges to their completion.

Another key aspect of the approach presented below is the scalability of tasks, or sub-projects. This is achieved by setting out the maximum ambition for individual projects, going beyond the recommendations of the individual sub-studies, so that the highest desirable benefit of the measures is visible, whilst at the same time the possibility of partial fulfilment of the ambition is clear, depending on capacity, time and other external circumstances related to implementation.

6.1 Reference table – overview of tasks from strategic documents

The compiled task matrix (reference table) provides, in a single place, an overview of all identified strategic tasks, their substantive content and all relevant recommendations provided for them within the sub-studies[53]. It also includes items important for general orientation, such as the identification of the source strategic document, the identification of the primary recipient of the task (the anticipated lead agency) and the anticipated collaborating entities, the thematic block, and references to all sub-studies where the task is discussed (even if only in part). It further summarises the essence of the task (the expected target state), the status of its implementation according to available findings, and the barriers and other constraints to its implementation, as highlighted by the individual sub-studies. The final category included in the table is a summary of the necessary action steps, listed in bullet points, for the fulfilment of each task.

The reference table, which we have created as the main output of this study, serves as a central matrix of all identified tasks arising from both strategic documents and sub-studies. It enables the client to maintain an overall overview of all topics being addressed, to have basic factual information immediately at hand, and subsequently to cross-reference detailed information in strategic documents and individual sub-studies.

First, we extracted key development objectives and binding tasks from the core strategies – Digital Decade, GIA, Action Plan 2.0, National VHCN Network Development Plan and others – as well as from specific analyses (e.g. of the 600 MHz, 4 GHz and 26 GHz bands, or cyber risk analyses). We assigned a set of parameters to each task identified in this way:

- **Source strategic document** – the document from which the task derives (NPRS VHCN, GIA, etc.),
- **Responsible body** – the primary responsible authority or institution (MPO, ČTÚ, NÚKIB, etc.),
- **Cooperating entities** – other ministries, local authorities or professional associations,
- **Thematic area** – e.g. radio spectrum management, VHCN development, civil protection and cybersecurity, 5G applications,
- **Primary studies** – a list of sub-studies that address the task (even partially),
- **Expected target state** – a description of the quality or scope to be achieved,
- **Implementation status** – a verbal description of the AS-IS status based on the findings of the studies,
- **Barriers and constraints** – key obstacles identified in the individual studies (legal, financial, technical).

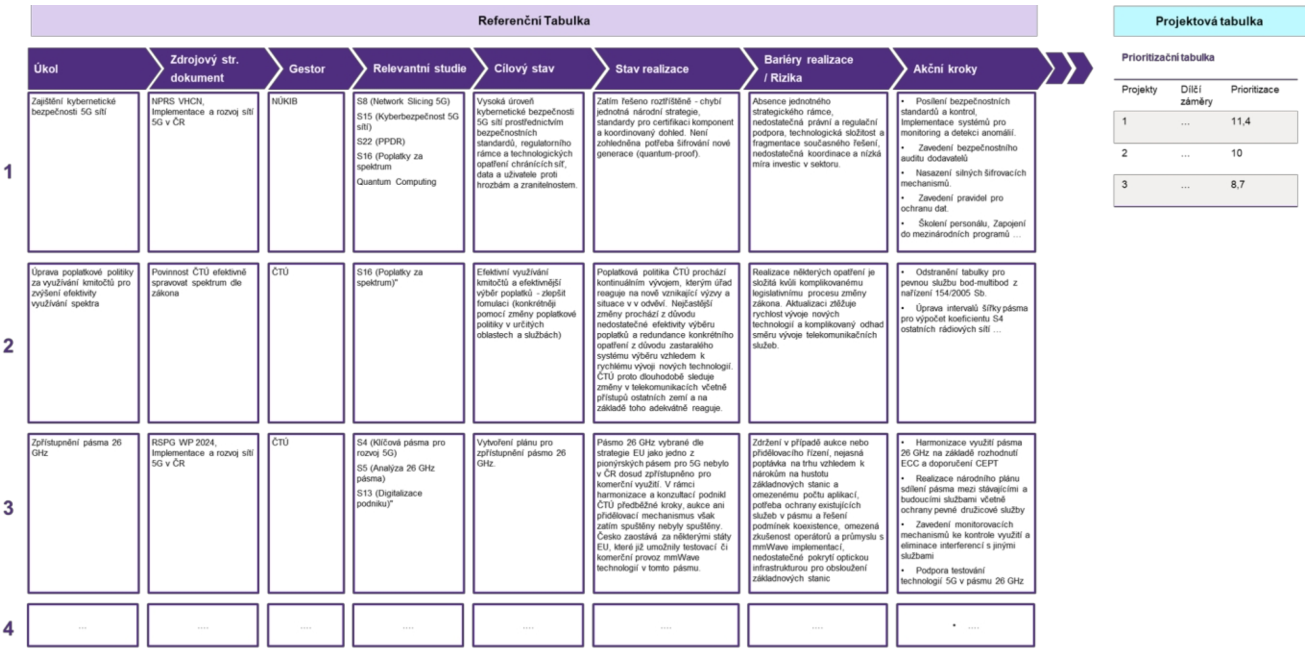
[53] Given the complexity of the table and its limited relevance to the presentation of results, only a simplified version is used in the main body of the document (Figure 7). The complete table is included in Annex 1.

The matrix presented in this way provides the client with a unified, comprehensive overview of all tasks, their interconnections and current progress. **In the final category of the table, a specific set of action steps is defined for each task; these have been derived from the recommendations of the studies and form the basis for the digitisation projects**. These action steps are further evaluated and ranked in a prioritisation table according to their impact, implementation complexity and the current readiness of the responsible party.

The entire process is iterative: first, a general strategic task is identified; this is then broken down into specific action steps with clear milestones and responsibilities; and finally, thanks to interdependencies and time overlaps, they are grouped into new clusters of projects, which form the starting point for the prioritisation table. The result is a subset of sub-project proposals, which are then worked on further and assessed for priority, etc.

The table's content and the procedure for working with it are illustrated below, showing the progression from a general task to a specific set of action steps. The actual reference table is attached as Appendix 1 to this document. Within the Reference Table, 37 tasks have been elaborated in this way, arising from strategic and legislative documents. The 'Action Steps' column in the table then serves as a repository of possible activities (action steps) that can be created to fulfil the objectives.

Figure 7: Example of a reference table



Referenční Tabulka

	Úkol	Zdrojový str. dokument	Gestor	Relevantní studie	Cílový stav	Stav realizace	Bariéry realizace / Rizika	Akční kroky
1	Zajištění kybernetické bezpečnosti 5G sítí	NPRS VHCN, Implementace a rozvoj sítí 5G v ČR	NÚKIB	S8 (Network Slicing 5G) S15 (Kyberbezpečnost 5G sítí) S22 (PPDR) S16 (Poplatky za spektrum Quantum Computing	Vysoká úroveň kybernetické bezpečnosti 5G sítí prostřednictvím bezpečnostních standardů, regulatorního rámce a technologických opatření chránících síť, data a uživatele proti hrozbám a zranitelnostem.	Zatím řešeno roztříštěně - chybí jednotná národní strategie, standardy pro certifikaci komponent a koordinovaný dohled. Není zohledněna potřeba šifrování nové generace (quantum-proof).	Absence jednotného strategického rámce, nedostatečná právní a regulační podpora, technologická složitost a fragmentace současného řešení, nedostatečná koordinace a nízká míra investic v sektoru.	• Posílení bezpečnostních standardů a kontrol, Implementace systémů pro monitoring a detekci anomálií. • Zavedení bezpečnostního auditu dodavatelů • Nasazení silných šifrovacích mechanismů. • Zavedení pravidel pro ochranu dat. • Školení personálu, Zapojení do mezinárodních programů …
2	Úprava poplatkové politiky za využívání kmitočtů pro zvýšení efektivity využívání spektra	Povinnost ČTÚ efektivně spravovat spektrum dle zákona	ČTÚ	S16 (Poplatky za spektrum)"	Efektivní využívání kmitočtů a efektivnější výběr poplatků - zlepšit fomulaci (konkrétněji pomocí změny poplatkové politiky v určitých oblastech a službách)	Poplatková politika ČTÚ prochází kontinuálním vývojem, kterým úřad reaguje na nově vznikající výzvy a situace v v odvěví. Nejčastější změny prochází z důvodu nedostatečné efektivity výběru poplatků a redundance konkrétního opatření z důvodu zastaralého systému výběru vzhledem k rychlému vývoji nových technologií. ČTÚ proto dlouhodobě sleduje změny v telekomunikacích včetně přístupů ostatních zemí a na základě toho adekvátně reaguje.	Realizace některých opatření je složitá kvůli komplikovanému legislativnímu procesu změny zákona. Aktualizaci ztěžuje rychlost vývoje nových technologií a komplikovaný odhad směru vývoje telekomunikačních služeb.	• Odstranění tabulky pro pevnou službu bod-multibod z nařízení 154/2005 Sb. • Úprava intervalů šířky pásma pro výpočet koeficientu S4 ostatních rádiových sítí …
3	Zpřístupnění pásma 26 GHz	RSPG WP 2024, Implementace a rozvoj sítí 5G v ČR	ČTÚ	S4 (Klíčová pásma pro rozvoj 5G) S5 (Analýza 26 GHz pásma) S13 (Digitalizace podniku)"	Vytvoření plánu pro zpřístupnění pásmo 26 GHz.	Pásmo 26 GHz vybrané dle strategie EU jako jedno z pionýrských pásem pro 5G nebylo v ČR dosud zpřístupněno pro komerční využití. V rámci harmonizace a konzultací podnikl ČTÚ předběžné kroky, aukce ani přidělovací mechanismus však zatím spuštěny nebyly spuštěny. Česko zaostává za některými státy EU, které již umožnily testovací či komerční provoz mmWave technologií v tomto pásmu.	Zdržení v případě aukce nebo přidělovacího řízení, nejasná poptávka na trhu vzhledem k nárokům na hustotu základnových stanic a omezenému počtu aplikací, potřeba ochrany existujících služeb v pásmu a řešení podmínek koexistence, omezená zkušenost operátorů a průmyslu s mmWave implementací, nedostatečné pokrytí optickou infrastrukturou pro obsloužení základnových stanic	• Harmonizace využití pásma 26 GHz na základě rozhodnutí ECC a doporučení CEPT • Realizace národního plánu sdílení pásma mezi stávajícími a budoucími službami včetně ochrany pevné družicové služby • Zavedení monitorovacích mechanismů ke kontrole využití a eliminace interferencí s jinými službami • Podpora testování technologií 5G v pásmu 26 GHz
4	…	….	….	….	….	….	….	• ….

Projektová tabulka

Prioritizační tabulka

Projekty	Dílčí záměry	Prioritizace
1	…	11,4
2	…	10
3	…	8,7

This baseline (reference) table provides users with a comprehensive overview of all action steps organised by main tasks, including assigned coordinators and collaborating entities, so that they can quickly ascertain in which strategic or study document the task was addressed, who is responsible for individual points, and where to find detailed supporting documents; thanks to clearly structured links to primary studies and strategic plans, they can easily find further details, check the current status of implementation, and focus on priorities for the next project phases of digitisation or telecommunications infrastructure development.

6.2 Project table – draft project plans

This involves an in-depth elaboration of the main matrix of strategic tasks (reference table), in which a large amount of information from the overall overview was processed into a form of summary action steps – comprehensive project objectives. The aim of this step was to eliminate overlaps between individual strategic requirements as far as possible and to redefine and consolidate the individual action steps from the studies so that they could be addressed collectively, in the form of a targeted, tangible (SMART) project, should the client so decide. A typical example is the consolidation of several recurring recommendations on strengthening cross-sectoral cooperation in various areas of societal digitalisation and the development of new technologies into a single task, the benefit of which, if implemented, will be, in particular, avoiding the fragmentation of the limited pool of specialist expertise on the Czech market. This overview of summary action steps (projects) also includes cross-references so that the origin of the recommendations can be identified via the main matrix of strategic tasks. The priority, also included in the table, is discussed separately below. For greater clarity, the individual action steps are divided into four categories corresponding to the described thematic blocks (Radio Spectrum Management, VHCN Development, Industrial Use and 5G Applications, and Civil Protection and Cybersecurity). The prioritisation table thus consists of 31 project proposals, which also include points from the most recent documents on quantum computing and satellite communications. As with the reference table, only an excerpt from the full table—which forms part of Annex 1 to this study—is shown here in the body of the document. In this case too, it is advisable to treat it as a comprehensive whole.

As already mentioned, the aim of the project table (Figure 8) was to transform tasks and action steps into project proposals so that they could be evaluated. This involves two main operations: combining and transforming action steps into a project proposal, and evaluating the parameters of urgency/relevance, difficulty of implementation and implementation status (see Chapter 5):

- **Task identification and thematic classification**
  - The **Task** column contains reference numbers to the original reference matrix – these can be used to trace back the exact description of the strategic assignment.
  - **The Thematic Block / Area** allows projects to be grouped into four main categories (Radio Spectrum Management, VHCN, 5G Applications, Civil Protection and Cybersecurity); we recommend using a filter or bulk selection to select only projects from a given area.
- **Overview of the framework project and its objectives**
  - **The Framework Project Title** and **Framework Project Objective** briefly summarise the content and purpose – this heading serves as a quick guide and groups together project objectives.
  - **The Project Manager** column shows who is the main responsible entity; where multiple institutions are involved, it is advisable to also assign a list of key collaborating partners to each row.
- **Time planning**
  - **The completion date** (if applicable) indicates the recommended or legally stipulated deadline – projects with the nearest deadline, and therefore a necessary condition, are reflected in the roadmap.
- **Detailed breakdown**
  - **The 'Sub-project objectives' column** lists the main sub-tasks or milestones to which it is appropriate to assign separate projects or sub-teams.
- **Priority assessment**
  - **Sub-parameters:** the Priority value of a given project is calculated from each of the parameters Urgency/Relevance, Difficulty of Implementation and Status of Implementation (see Chapter 5)
  - **Average prioritisation assessment**: this is a quantification of individual parameters and a tool used to assess individual project proposals for prioritisation purposes.
  - **Average duration** (in years): approximately how long its implementation will take. Sorting by these parameters will enable the creation of an order in which the authority will address individual projects.

The resulting summary of action steps essentially constitute recommendations for commissioning the relevant projects, with the highest ambition being the full achievement of the strategic objective and the long-term sustainability of the solution. **It is legitimate that this high ambition may not always be the contracting authority's intention, and it is clear that, in practice, individual parts of the projects proposed in this way can also be utilised separately.**

Figure 8: Example of a project table

Projektová Tabulka						
Odkaz na úkoly referenční tabulky	**Rámcový projekt**	**Cíl**	**Termín**	**Gestor**	**Dílčí projektové záměry**	**Prioritizace**
20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 33, 34, 35	Úprava zákonných norem pro výstavbu VHCN	Zjednodušit právní předpisy s vazbou na výstavbu VHCN v souladu s GIA	12. listopadu 2025 - od té doby bude nutné dodržovat její znění	MPO	- Zajistit novelizaci relevantních právních předpisů (zejm. zákona 194/2017 Sb. a 283/2021 Sb. - stavební zákon), zejm.: - Prosadit jeden specializovaný úřad /odbor pro výstavbu telco. infrastruktury (lze využít ČTÚ + doplnit stavebními specialisty) - Pro případy, kdy nelze využít /sdílet existující infrastrukturu, prosadit výrazné zjednodušení nové výstavby: A) Zjednodušit zřizování služebnosti (VB) B) Zavést lhůty /tichý souhlas pro povolování výstavby telekomunikační infrastruktury dle GIA….	10,9
21, 25, 29, 32, 33, 35	Kolokace 5G	Usnadnit kolokaci pro všechny prvky 5G sítě ve veřejném prostoru	NA	MPO	- Vymezit prioritní oblasti pro kolokaci 5G (např. města, dopravní uzly, veřejná prostranství) a vhodné typy infrastruktury pro zpřístupnění (např. lampy, budovy, zastávky). - Zavést metodiku a (další) vzorové smlouvy dle zákona č. 194/2017 Sb. pro subjekty působící ve veřejném prostoru dle jejich typu a specifik - Zavést datový standard pro evidenci kolokačně vhodné infrastruktury - např. integrovat do JIM…..	10,2
…..	….	…	…	…	….	…

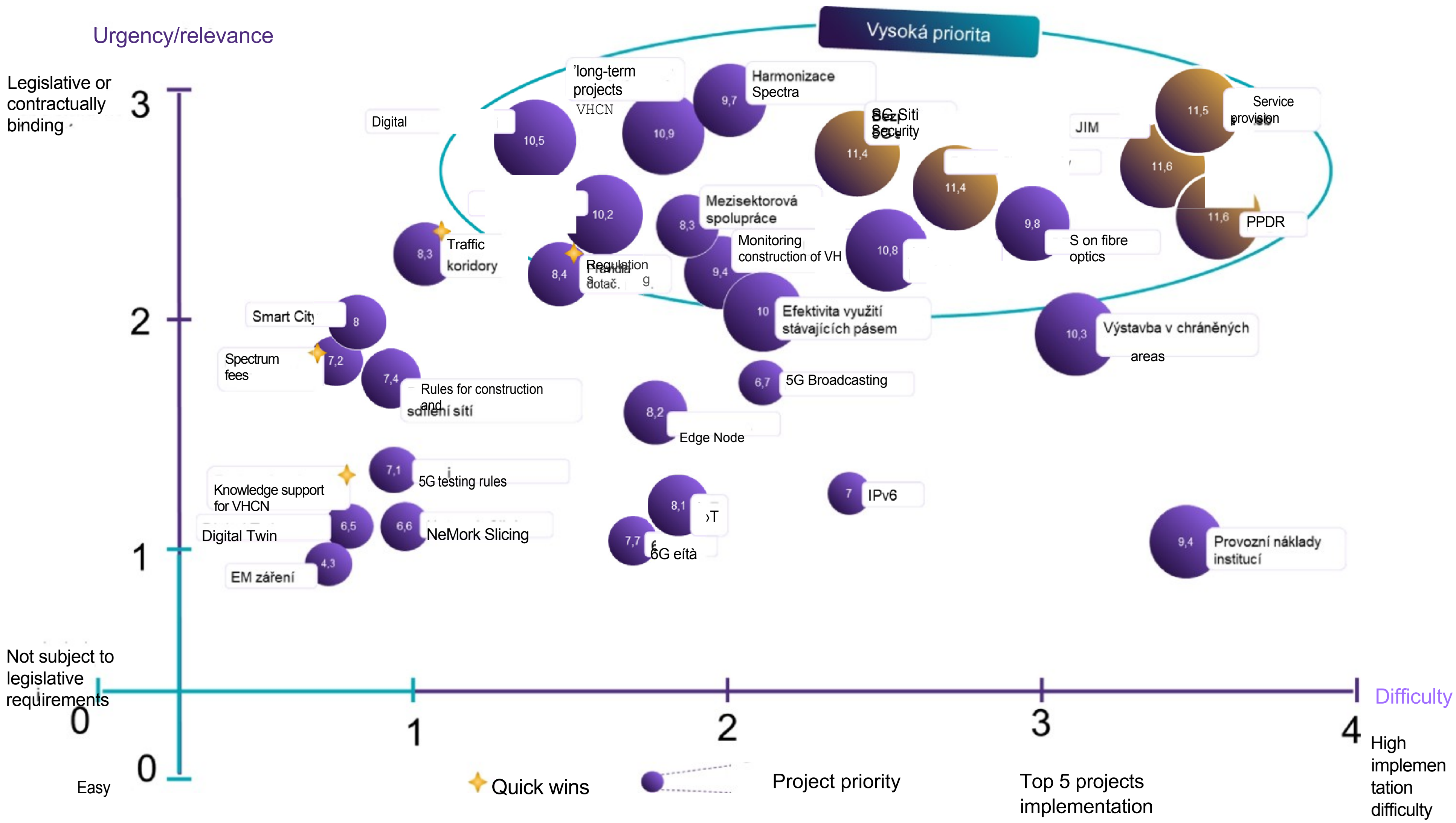
6.2.1 Prioritisation of project proposals and timeline

Priorities were assigned to individual summary action steps in accordance with the procedure described in the previous chapter. This procedure involved an assessment of the task's implementation status (progress), difficulty and urgency/relevance. Here we present a visualisation of individual project proposals in terms of their specific parameters. Using an analytical bubble chart, **the horizontal axis** shows **the difficulty of project implementation and the vertical axis its urgency/relevance**. The third dimension in the chart, represented by the size of the bubbles, is the calculated priority of the project in question.

This allows us to visually 'categorise' projects so that we can identify top-priority tasks (in the top-right section of the chart), or, for example, so-called 'quick-wins' – that is, projects that are relatively straightforward, already well underway (lower implementation status and lower difficulty level) and can be completed quickly. Conversely, those tasks that were marked as already completed in the reference table do not appear in this chart, as they were not carried over to the prioritisation table.

UNOFFICIAL MACHINE TRANSLATION

Figure 1: Visualisation of the prioritisation of action steps



Based on their position in the chart, the individual framework projects can be ranked according to their resulting priority as follows:

Table 11: Classification of summary action steps by priority

High priority	Medium priority	Low priority
Amendment of legal standards for the construction of VHCN	5G co-location	Knowledge support for VHCN
Single point of contact	Rules for grant projects	6G networks
Fibre-ready buildings	Monitoring of VHCN construction	EM radiation
BTS on fibre	Construction in protected areas	5G broadcasting
Digitisation of services	Transport corridors	Smart City / Village
Digital skills	IPv6	Slicing
5G network security	New bands, spectrum harmonisation	Digital Twin
PPDR networks	Cross-sector cooperation	Fees for existing spectrum
Auctions and fees	Efficiency of existing spectrum usage	Rules for 5G testing
	IoT	Rules for network deployment and sharing
	Edge nodes	
	Operating costs for institutions	

However, it is necessary to bear in mind not only the priority but also the overall time required for implementation if any of the projects is to be completed within a defined timeframe. For this reason, we (following a time estimate for the project's implementation at its most ambitious level – see above) have arranged the individual projects on a timeline so that priority projects are given precedence, whilst also taking into account the 'feasibility' of time-consuming activities.

We then considered the overlap of implementation in time separately, i.e. so that the number of activities running in parallel is as balanced as possible within the monitored timeframe up to 2030. A related aspect is the rescheduling of relatively straightforward activities to times when they place the least burden on other projects, whilst at the same time, once completed, the need to reserve capacity for them is eliminated (freeing up capacity at the end of the period under review for the completion of delayed activities).

For greater clarity, a roadmap-style diagram (Figure 9) has been created, visualising the timeline of 31 key projects based on a synthesis of 27 sub-studies. It shows the expected start dates, durations and key milestones of individual activities in the field of digital infrastructure, including projects related to the digitisation of services, the roll-out of fibre-ready buildings, the construction of PPDR networks, and the establishment of rules for network construction and sharing.

The graphic legend distinguishes between projects requiring immediate commencement to meet deadlines, legally and strategically set deadlines, quick-win projects, and other important information necessary for the successful development of telecommunications in the Czech Republic. The roadmap thus serves as a practical tool for managing, allocating resources and coordinating the activities of the Ministry of Industry and Trade in line with European and national objectives in the field of digital transformation and network development.

The red diamonds indicate projects that must be launched immediately, as failure to do so would risk falling short of strategic objectives or failing to meet legislative requirements. Yellow stars represent so-called 'quick win' activities – that is, those that can deliver rapid and tangible results and strengthen confidence in the state's ability to manage the digital transformation. Purple diamonds indicate fixed deadlines, often based on European frameworks, such as the Digital Decade, which stipulates that all key services must be available online by 2030. The double arrows at the end of some time segments indicate that the project extends beyond the 2030 horizon and its significance will continue into the next decade. The blue time segments themselves represent the period of active project implementation, during which a specialist team is working on it systematically. The short reddish-brown segments then indicate preparatory steps, typically legislative changes or organisational preparations, which precede the actual implementation.

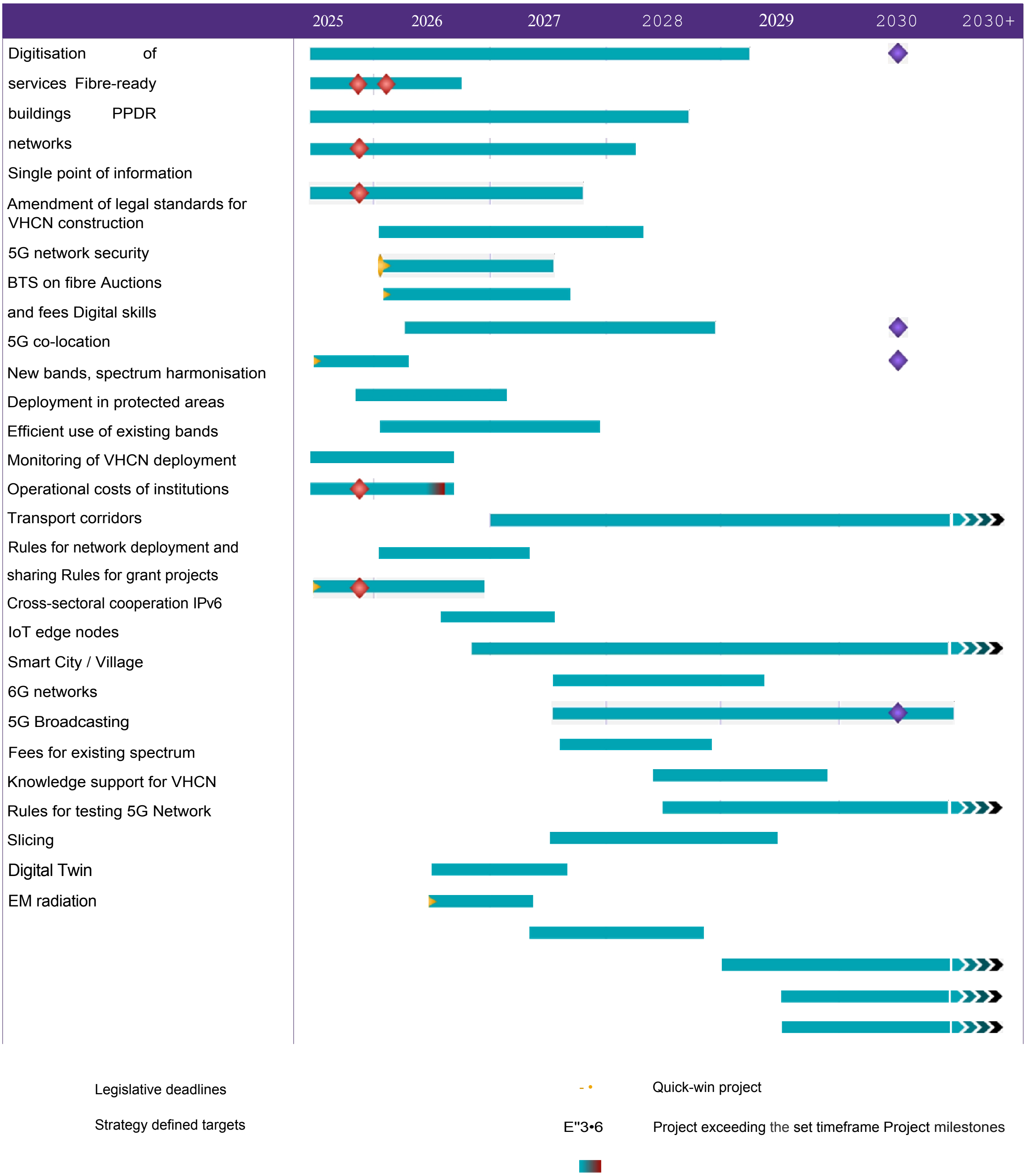
We illustrate how to interpret this logic here using the Service Digitalisation project as an example. This begins as early as 2025, which reflects its high priority. The Digitisation of Services is, in fact, one of the main pillars of the Digital Czech Republic strategy and also fulfils the European Digital Decade objective, according to which citizens are to have access to all essential public administration services in digital form by 2030. The timeline for this project extends to 2029, a period during which it is necessary to systematically build infrastructure, digitise administrative processes and integrate data platforms. A purple milestone is then set for 2030 – a fixed deadline that serves as a reminder of the commitment that the objectives must be

. In practice, this means that by the end of the decade, for example, a universal digital identity, electronic health records and full online availability of key government services must be in place.

It is important to emphasise that the estimated duration, and thus the timeline, reflects the active phase of the project – the period during which a team of several experts on the project manager's side can devote themselves to the project. This does not mean that the active phase of the project is not preceded by any other preparatory activities at the political, inter-ministerial or organisational level (e.g. the approval process for the scope of the project, or funding, etc.). Projects whose active implementation phase is proposed here for a later period do not therefore represent postponed activities, but rather those that are expected to require the greatest targeted effort only in this later period.

UNOFFICIAL MACHINE TRANSLATION

Figure 9: Roadmap for the implementation of project plans



UNOFFICIAL MACHINE TRANSLATION

6.2.2 TOP 5 priority framework projects

To provide a concrete illustration of the work on strategic objectives, the resulting tasks and their transformation into project plans, this section describes five project plans (a comprehensive overview is included in Appendix 1: Project Table) as we assessed their evaluation and prioritisation. These are the following projects:

1 Jednotné informační místo

Cíl projektu: Výrazně rozšířit použití a význam JIM jako centrální databáze (aplikace) o komunikační infrastruktuře

Gestor: MPO

Odhad trvání projektu: Projekt nemá legislativně stanovený termín naplnění, **odborný odhad doby trvání projektu jsou 4 roky.**

Projektový záměr je navázán na tyto úkoly vyplývající ze strategických dokumentů (viz referenční tabulka):

N. Úkolu	Úkol v referenční tabulce
20	Usnadnění propojení základnových stanic optickými kabely
22	Příprava infrastruktury a povolovacích procesů na výstavbu sítí a společného využívání pasivní infrastruktury
25	Digitální infrastruktura – zajistit dostupnost internetu: 100 Mbit/s+ pro domácnosti, 1 Gbit/s symetricky pro firmy a instituce.
32	Snížení nákladů na výstavbu infrastruktury
35	Monitorování a vyhodnocování pokroku výstavby VHCN

V rámci naplnění daného úkolu byly definovány následující dílčí projektové záměry:

- Zahrnout do Jednotného informačního místa (JIM) všechny provozovatele liniové infrastruktury, TowerCos a veřejné subjekty
- Využít JIM pro referenční účely při výstavbě VHCN, sdílení infrastruktury, kolokaci 5G sítí, případně i využívání spektra a pro další potřeby shromažďování informací v souvislosti s výstavbou komunikačních sítí a digitalizací
- Uložit povinným subjektům automatizovat sběr klíčových dat do JIM
- Propojit databázi JIM s dalšími veřejnými registry (např. KN, stavební úřady, mapové podklady)
- Oznamovat/stahovat do JIM informace o zahajovaných stavbách, výkopových pracích, změnách veřejné infrastruktury apod.
- Zavést závazné lhůty pro zápis údajů do JIM

Tento projekt a jeho dílčí projektové záměry byly hodnoceny následně:

Parametr	Průměrné hodnocení	Popis hodnocení
Urgence/relevance	2,6	Projekt nemá stanovený pevný legislativní termín plnění, nicméně jeho relevance pro naplňování národních i evropských strategických cílů je velmi vysoká. Rozšíření a konsolidace Jednotného informačního místa je zásadní pro usnadnění výstavby sítí VHCN, sdílení pasivní infrastruktury a efektivní plánování investic do digitální infrastruktury. Projekt přímo podporuje realizaci indikátorů Digitální dekády (zejména v oblasti gigabitové konektivity a plánování výstavby) a vychází z požadavků GIA i národních plánovacích dokumentů.
Stav realizace	3	Projekt byl zahájen na úrovni strategického rámce a existuje základní vize jeho funkčního rozšíření. Dílčí aktivity, jako je začlenění vybraných provozovatelů či příprava koncepce budoucích funkcionalit JIM, byly diskutovány na meziresortní úrovni. Zatím však nedošlo k přijetí legislativních ani technických kroků k zásadnímu rozšíření systému, nebyly určeny povinnosti ani závazné datové formáty a chybí propojení na další registry.
Obtížnost realizace	3,4	Implementace projektu JIM je organizačně a technicky velmi náročná. Projekt vyžaduje: • koordinaci mezi různými kategoriemi subjektů (provozovatelé sítí, veřejné instituce, obce), • řešení otázky ochrany dat, právní závaznosti a interoperability systémů, • napojení na další existující databáze (např. katastr, stavební řízení), • úpravy legislativy k zavedení povinnosti vkládat a sdílet data. Z hlediska systémového řízení digitální infrastruktury jde o jeden z nejkomplexnějších projektů. Náročnost není dána technologickou nemožností, ale institucionální komplexitou, množstvím aktérů a vysokými nároky na standardizaci a zabezpečení.
Výsledná priorita	**11,6**	

2 PPDR sítě

Project objective: To modernise the communications infrastructure of the security services

Responsible body: Ministry of Industry and Trade

Estimated project duration: The project does not have a legally prescribed completion date; **the expert estimate of the project duration** is 5 years.

The project proposal is linked to the following tasks arising from strategic documents (see reference table):

Main task	**Task** in **the reference table**
1	Ensuring the cyber security of 5G networks
26	Supporting secure networks for public and strategic purposes, including PPDR.

The following sub-project objectives were defined as part of fulfilling this task:

- In accordance with the NPRS, draw up an implementation timetable and commit the manager of the security forces' communications infrastructure to replacing existing networks with 5G/PPDR technologies in a public or hybrid model,
- Ensure their compatibility with international standards and the transition to certified security technologies
- Increase investment in research and development in the field of secure

communications This project and its sub-project objectives were assessed as follows:

Parameter	Average Evaluation	Description of evaluation
Urgency/relevance	2.6	The project is of high strategic importance in the field of security policy and the state's digital sovereignty. The measure is mentioned in strategic documents concerning the support of private networks for security and crisis management purposes. Although there is no firm legislative deadline for implementation, the project is relevant in terms of meeting EU security standards, European coordination of PPDR networks, strengthening the Czech Republic's ability to respond to emergencies, and protecting critical communications infrastructure. However, there is currently no clear regulatory commitment to implementation, which reduces the enforceability and pace of preparations.
State of implementation	3	The project has been discussed within strategic frameworks and there are general plans for the future transformation of the security services' communications infrastructure, particularly towards hybrid or fully public 5G/PPDR networks. However, no timetable has yet been adopted, nor have specific lines of responsibility or technological standards been defined.
Difficulty of implementation	3,4	The project faces exceptional institutional, organisational and technological challenges. A key obstacle is the fact that responsibility for the existing communications infrastructure of the security services lies outside the Ministry of Industry and Trade — specifically with the Ministry of the Interior, the Police of the Czech Republic, the Fire and Rescue Service and other agencies. The project therefore requires the transfer or sharing of competences, in an area highly sensitive to security, trust and legal liability Other challenges include: • the need to align with international security standards, • ensuring cyber certification of technologies, • high financial costs (research, development, testing, operation of hybrid systems), • the need for an inter-ministerial agreement on the structure of the process and the allocation of responsibilities.
Resulting priority	11.6	

3 Digitalizace služeb

Project objective: To digitise all key public services

Lead agency: Ministry of the Interior and DIA

Estimated project duration: The project has no legally stipulated completion date; the expert estimate of the project duration is 5 years.

The project proposal is linked to the following tasks arising from strategic documents (see reference table):

No. of Task	Task in the **reference** table
3	Digitisation of public services
22	Preparation of infrastructure and permitting processes for the construction of networks and the shared use of passive infrastructure

As part of fulfilling this task, the following sub-project objectives were defined:

- Interconnect the databases of individual authorities, ensure the interoperability of public service systems (in particular, ensure automated data sharing and pre-filling of data, and avoid duplication of administrative tasks).
- Introduce a single sign-on point, standardise the front-end environments of systems, websites and forms for greater clarity and user-friendliness for end users.
- Establish a single owner of digital public service administration systems (e.g. DIA) in the role of developer, operator and coordinator for individual public institutions—the custodian of administrative processes and data.
- Prioritise the creation of key digital services that are currently lacking (e.g. building permits, judicial services, healthcare services) This project and its sub-project proposals were evaluated as follows:

Parameter	Average **Evaluation**	Description of evaluation
Urgency/relevance	3	The digitisation of key public services is one of the main pillars of both European and national digital transformation strategies. The project is directly linked to the objectives of the Digital Decade 2030, under which all key public services are to be available online, and at the same time aligns with the objectives of strategic documents such as the 'Czech Republic in the Digital Age' programme Digital Decade or the Digital Czechia Action Plan. The high score for the urgency/relevance metric (3) is justified not only by the strategic importance of the project, but also by the fact that insufficient progress in this area directly jeopardises the fulfilment of commitments to the European Commission within the framework of reporting on the Digital Decade. Although the project does not have a fixed legislative deadline, it is one of the key expectations by 2030.
Implementation status	2	The "Digitisation of Services" project is in the active implementation phase. Framework strategic documents are in place, and several key sub-activities have been launched (e.g. the Unified Digital Environment, data sharing between administrative information systems, and the design of the eDocuments platform). In a number of areas (particularly within public administration services), concrete implementation is already taking place. However, key services such as building permits, the judiciary and healthcare remain at various stages of preparation, and most projects have not yet been systematically integrated or standardised within a unified interface.
Difficulty of implementation	3.5	The implementation of this project is exceptionally demanding, both organisationally and technologically. It requires: • extensive changes in public administration management, • institutional centralisation of system administration under a single coordinator (e.g. DIA), • a high degree of inter-ministerial cooperation, • legislative amendments to a number of sectoral laws, • technical assurance of interoperability, cybersecurity, data integration and a uniform user environment across government. The degree of dependence on political consensus, public trust and the availability of highly qualified experts in the field of digital technologies increases the complexity of implementation.
Final priority	11.5	

4 Budovy fibre-ready

Project objective: To establish the regulatory and methodological framework for connecting buildings and individual users to the optical infrastructure in accordance with the GIA.

Responsible body: Ministry of Industry and Trade

Estimated project duration: From the EU regulation and the entry into force of the GIA in the Czech Republic, transposed by Act No. 194/2017 Coll., on measures to reduce the costs of deploying high-speed electronic communications networks and amending certain related acts.Two implementation deadlines have been set:

- By 12 November 2025, technical standards and specifications for fibre optics in buildings must be adopted.
- From 12 February 2026, all new and renovated buildings must be prepared for fibre optics.

The project proposal is linked to the following tasks arising from strategic documents (see reference table):

No. Task	Task in the reference table
20	Facilitating the interconnection of base stations via optical cables
22	Preparing infrastructure and permitting processes for network deployment and the shared use of passive infrastructure
23	Strengthening cooperation with heritage conservation bodies
24	Building VHCN network infrastructure in key locations and unserved rural areas
25	Digital infrastructure—ensuring internet availability: 100 Mbit/s+ for households, 1 Gbit/s symmetrical for businesses and institutions
27	Ensure connectivity for municipalities via access and distribution networks
28	Support the development of 5G networks in towns, rural areas and transport corridors, including railways and tunnels
30	Grant support for the construction of networks beyond the reach of market mechanisms
32	Reduction in infrastructure construction costs
33	Simplification of user connections
34	Standardisation of building connections
35	Monitoring and evaluating progress in VHCN construction

As part of fulfilling this task, the following sub-project objectives were defined:

Ensure that all new and significantly renovated buildings (subject to technical feasibility and reasonable costs) are equipped with physical infrastructure ready for optical fibres, with optical cabling extending to the point where the end user connects to the public network, and that more residential buildings include an access point.

Specify specific technical standards for the compatibility of buildings with optical infrastructure (so-called ‘fibre-ready’), including, for example, the specification and location of access points, cables, sockets, micro-cables, protection against interference with electrical wiring, minimum bending radius and cabling specifications.

For multi-user buildings (e.g. apartment blocks), allow each public network provider to install its own network at its own expense up to the building’s access point.

Draw up guidelines for cases where it is not technically or economically viable to build a new network, on the basis of which the provider may exercise the right to use the existing physical infrastructure within the building and the owner of that infrastructure shall grant access to it on fair, reasonable and non-discriminatory terms (consider setting a maximum price).

This project and its sub-project proposals were subsequently assessed as follows:

Parameter	Average Evaluation	Description of evaluation
Urgency/relevance	2.7	The urgency/relevance metric value reflects the exceptionally high importance of the measure in the context of national and European strategic objectives, high long-term relevance, as well as the fact that this is a legally binding task.
Implementation status	3.2	The project is in the early stages of preparation. The analysis shows that although the task has been identified and there is an obligation to implement it, the draft technical specifications have not yet been finalised, no specific standard has been adopted, nor have any implementing methodological guidelines been issued. In some areas (e.g. defining responsibility for access to existing infrastructure), the preparation process is only just beginning.
Difficulty of implementation	2.8	From an organisational and legislative perspective, the implementation of the project is relatively straightforward. Most steps fall under the remit of the Ministry of Industry and Trade (MPO) or the Czech Telecommunications Office (ČTÚ), and the proposed amendments (e.g. methodologies, standards) do not require fundamental changes to existing legislation, but merely its supplementation or clarification.
Overall priority	**11.4**	

5 Bezpečnost 5G sítí

Project objective: To ensure the security of 5G

networks Project manager: NÚKIB

Estimated project duration: The project has no legally stipulated completion date; the expert estimate of the project duration is 3 years.

The project proposal is linked to the following tasks arising from strategic documents (see reference table):

Task No.	Task in the reference table
1	Ensuring the cyber security of 5G networks
26	Supporting reliable networks for public and strategic purposes, including PPDR

The following sub-project objectives were defined as part of fulfilling this task:

In accordance with critical infrastructure requirements, formulate minimum (binding) rules/conditions for ensuring the cybersecurity of 5G networks, particularly in connection with the advent of quantum computers:

a) The timeline and method (roadmap) for the introduction of advanced encryption standards (prepared for future quantum decryption),
b) Minimum technical requirements for audit/detection/monitoring systems,
c) A standardised procedure for security audits of supplier systems,
d) Rules for the protection of internal data and (security) requirements for staff
e) Creation of a register of devices compatible with or suitable for the deployment of PQC (post-quantum cryptography)
f) Establishment of minimum requirements for interoperability between classical and QKD (Quantum Key Distribution) cryptography

This project and its sub-project proposals were subsequently evaluated as follows:

Parameter	Average Assessment	Description of the assessment
Urgency/relevance	2.8	The project is of high strategic importance in terms of protecting critical communications infrastructure and meeting the security requirements of the European framework for 5G networks. It reflects European commitments regarding the security certification of suppliers and the protection of critical technologies, including the expected requirements of GIA and NIS2. Although the project is not bound by a fixed legislative deadline, its implementation is crucial for meeting the quality objectives of the Digital Decade, such as network reliability and resilience to security threats. It is anticipated that the rules defined within the project will influence the development of both public and private 5G networks in the coming years.
Implementation status	3.4	The project is in the early preparatory phase. Expert discussions are underway; risk analyses have been carried out and proposals for certain principles of security measures have been drawn up, primarily in the form of methodological or advisory documents. However, no specific binding rules have yet been published, no timetable for their implementation has been prepared, nor has a legal or institutional framework for their application been established.
Difficulty of implementation	2.4	The implementation of the project is technically demanding but institutionally manageable. NÚKIB is responsible for defining security standards and possesses the necessary technical capacity in this area. The project does not require fundamental legislative changes or changes to competences — the results are intended to be of a recommendatory or methodological nature. The complexity lies in the need for technological neutrality, coordination with operators, alignment with European security standards, and the practical applicability of the measures in a hybrid environment (public vs. private networks). However, compared to other projects with high institutional fragmentation, however, the level of external barriers is lower.
Resulting priority	11.4	

7 Conclusion

This summary study was produced in response to dynamic developments in the field of digital infrastructure and electronic communications, which are influenced both by newly adopted European legislation (e.g. GIA, Digital Decade) and by ongoing national activities under the Action Plan and Strategies for the Development of VHCN Networks, including 5G. Over the past year, a total of 25 studies were produced, plus two follow-up studies (Quantum Technologies and Satellite Communications), as part of Component 1.3 of the National Recovery Plan, focused on the development of digital infrastructure, which provide a comprehensive set of technical, economic and legislative insights. The proposed structure of tasks, prioritisation of projects and proposed timeline for their implementation provide a logically organised framework that facilitates navigation of the complex issues and supports effective implementation planning.

The study consists of four outputs:

1. **Overview of studies** – the first part provides a structured list and description of key studies prepared as part of the national component for the development of 5G, VHCN and digital transformation. These comprise 27 individual studies addressing specific aspects (e.g. network deployment, radio spectrum management, digitalisation of public administration, the use of IoT and 5G in industry, etc.); the overview provides a brief summary of the specific studies and, where relevant, proposes action steps.

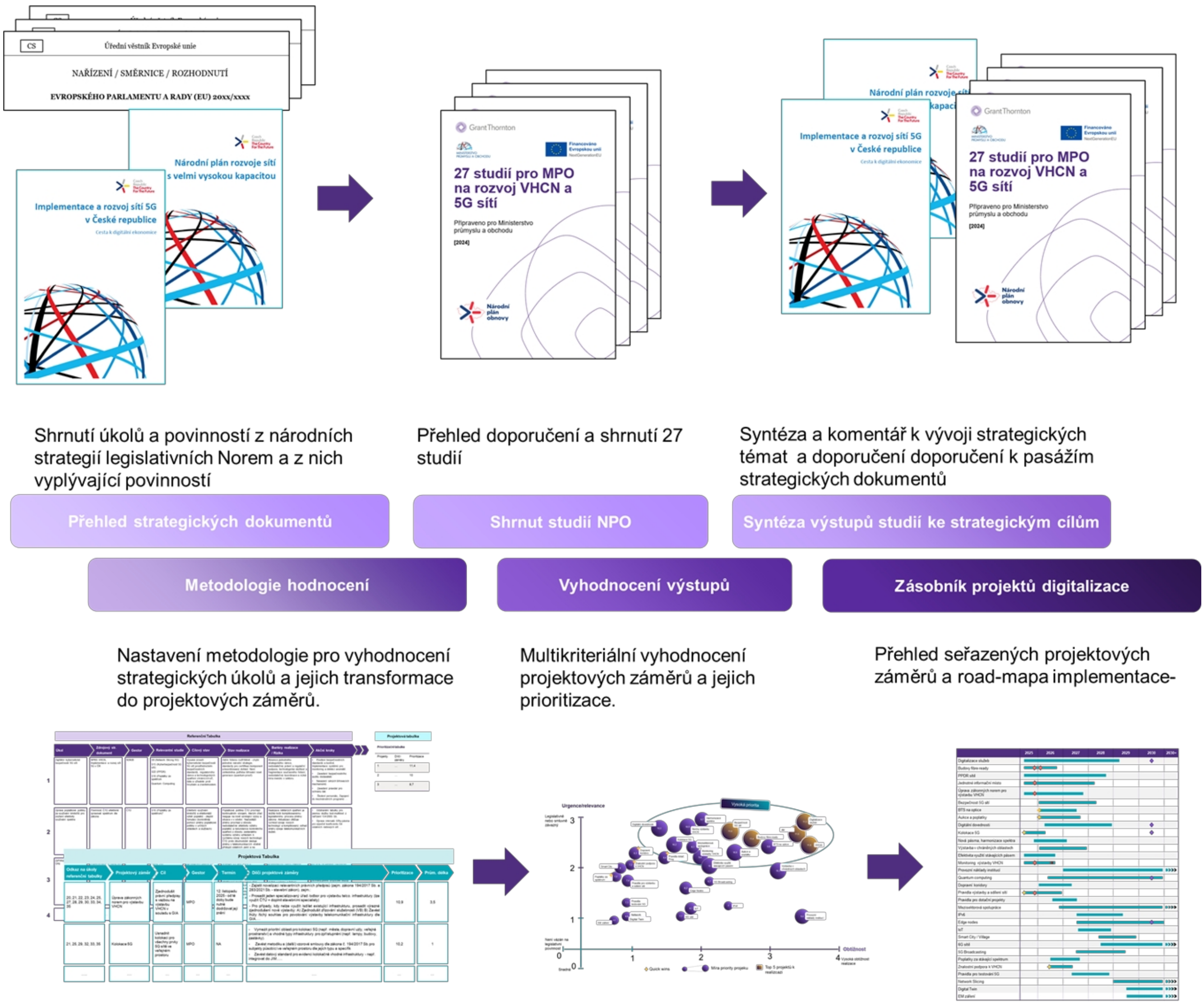
2. **Synthesis of studies and strategic documents** – this section links the findings from the above-mentioned studies with national strategic documents and comments on the implementation activities of the strategic documents in the context of the outputs of the completed studies. The chapter is divided into four thematic blocks, which group together interrelated issues addressed in the strategic documents that can be addressed jointly or in an interdependent manner. Based on the outputs, it was possible to identify several key thematic areas.

3. **Methodology and evaluation** – the third part serves as a commentary and description of the methodological approach (described in Chapter 6 of this study), which is based on the systematic processing and synthesis of the outputs from more than 27 studies prepared as part of the National Recovery Plan and strategic documents focused on digital infrastructure and digitisation. The procedure involved identifying specific tasks and their action steps, from which separate project proposals were subsequently derived. Each project was evaluated according to three key criteria:
   - Status of implementation of the sub-task;
   - Difficulty of implementation;
   - Urgency/relevance;

   The evaluation also included an expert prediction of the expected duration of the project. The aim of this methodology was to provide the client with a comprehensive basis not only for navigating the vast amount of input documents, but above all for updating national strategic plans and actively managing digitisation and infrastructure initiatives in line with current legislative and technological challenges.

4. **Project prioritisation** – The main output of this summary report is a table of project proposals derived from the tasks outlined in the national strategies, supplemented with information on the current status of implementation and specific action steps proposed for their fulfilment. Based on a multi-criteria analysis of the projects, an implementation roadmap was subsequently drawn up, defining the order of implementation of individual measures with regard to their impact, feasibility and timeframe. This roadmap is visualised in the attached figure and serves as a basis for strategic decision-making on the future direction of digital infrastructure policy in the Czech Republic.

Figure 10 Overview of the individual steps of the final study on the development of the VHCN



The outputs of this summary study represent a practical tool for the Ministry of Industry and Trade and other interested institutions (managing bodies), which can be used for the systematic management and updating of the agenda in the field of digital infrastructure and digitisation policies. **Based on an internal capacity analysis and expert validation of priorities, the prepared overview of tasks and description of their action steps can be utilised directly, including their transformation into specific project proposals, as set out in the attached Excel document.** This tool enables flexible work with individual inputs, their reassessment, the assignment of responsibilities, and alignment with existing strategic and implementation documents. In this way, the aim is to add a dynamic element to the agenda of activities of the Ministry of Industry and Trade and other relevant organisations focused on achieving the objectives set out in the Digital Decade, the National Plan for the Development of VHCN Networks or the Digital Czech Republic Strategy. The proposed implementation timeline and clearly structured prioritisation of projects also make it possible to identify measures that can be launched immediately and to lay the groundwork for the active phase of implementing key initiatives/projects. Overall, the output of this study thus provides a framework for a coordinated approach towards the digital transformation of the Czech Republic and the achievement of European objectives in the areas of connectivity, the digitalisation of businesses and public services, and the strengthening of the population’s digital skills.

This document is of a recommendatory nature. It is based on the analytical outputs of the studies conducted and serves as a guide for the contracting authority's future decision-making, particularly with regard to the timing of steps based on internal priorities and the management of the contracting authority's capacities, as well as the coordination of individual projects over time with other relevant institutions.

© 2025 Grant Thornton Advisory k.s. All rights reserved.

Grant Thornton Advisory k.s. is a member firm of Grant Thornton International Ltd. (Grant Thornton International). References to Grant Thornton refer to Grant Thornton International or to member firms. Grant Thornton International and the member firms are not an international partnership. Services are provided independently by individual member firms.

www.grantthornton.cz