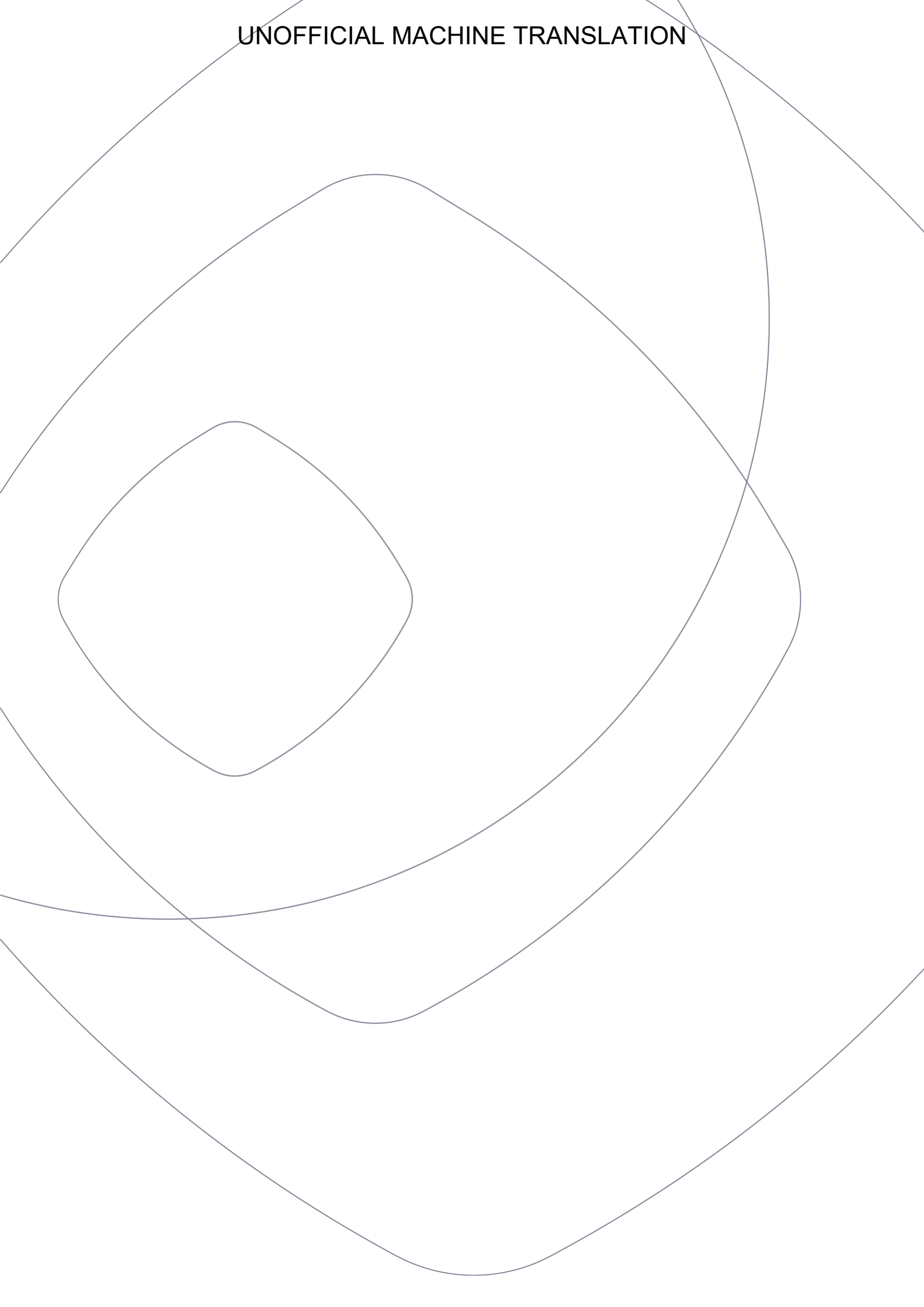


Preparation of analytical background material for the spectrum management strategy

Prepared for the Ministry of Industry
and Trade

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1 Management Summary

Strategic spectrum management is a key process focused on the efficient allocation and use of spectrum with the aim of supporting technological progress and economic development. This process involves meeting the current needs of various sectors in the short term and long-term planning for the sustainable development of spectrum. Given the dynamic nature of technological development, it is important for the strategy to be flexible and resilient to change, enabling rapid adaptation to market needs. Strategic management consists of three main phases: formulation, implementation and evaluation. Formulation focuses on defining strategic objectives and a long-term vision; implementation involves operational steps to achieve these; and evaluation focuses on assessing results and adapting the strategy in line with developments. Tactical objectives, which are operational and have a shorter time horizon, support the realisation of the long-term vision and adapt to current challenges. Emphasis is placed on measurable performance indicators and a thorough analysis of needs, which must be regularly reassessed in line with changing technological and market conditions.

A new trend in national spectrum management strategies is the emphasis on striking a balance between flexibility, innovation and long-term planning in order to meet the growing demand for wireless connectivity. These strategies are being developed with the aim of supporting both current and future technologies, with a focus on the efficient use of spectrum for both the public and private sectors. Equally important is long-term planning based on cooperation between government, industry and international organisations to ensure that future technologies have access to spectrum. The strategies focus on both short-term and long-term objectives, which are regularly assessed and adapted in line with developments, so that spectrum is not used inefficiently but is flexibly reallocated according to actual demand.

These trends in national spectrum management strategies demonstrate a consensus on the importance of supporting innovation, the efficient use of spectrum and long-term planning to ensure access to spectrum for both the public and private sectors. International cooperation, particularly the harmonisation of standards and regulatory flexibility, is key to responding to rapid technological change. The main principles for developing new strategies include discussions with stakeholders, the use of data for analysis, the development of expertise and international cooperation. Stakeholders are involved in the decision-making process through consultations and workshops, ensuring dynamic spectrum management. Data plays a key role in optimising spectrum use, automating processes and strategic planning. Ongoing training of experts and the development of know-how are essential for effective management, whilst international cooperation focuses on harmonising rules and addressing cross-border interference.

On the other hand, strategic spectrum management often gives rise to conflicts between the various interests of stakeholders, which require dialogue and compromise. Among the main tensions is the conflict between international harmonisation and national flexibility, where global standards must be aligned with national needs, requiring active international cooperation and participation in forums. Further friction arises between current market demands and the need to support innovation, where spectrum managers must balance short-term gains with long-term support for new technologies. There is also tension between short-term tactical objectives and long-term sustainability, which requires the involvement of political stakeholders in long-term planning and their education to understand market needs. The final tension lies in the conflict between flexible licensing models and the risk of interference, which must be resolved by directly identifying needs, assessing them and seeking appropriate solutions to ensure the efficient use of spectrum without compromising service quality.

The starting point of the study is the development of a modern spectrum strategy which, as mentioned above, combines both long-term planning and the short-term fulfilment of current requirements. The strategy is structured around 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. All these areas are complemented by specific objectives designed to contribute to their fulfilment, so as to meet current market demands whilst also stimulating innovation.

2 -management summary

Strategic spectrum management is a key process focused on the efficient allocation and use of spectrum in order to promote technological progress and economic development. This process involves meeting the current needs of various sectors in the short term and planning for the sustainable development of spectrum in the long term. Given the dynamic nature of technological development, it is important that the strategy is flexible and resilient to change, allowing for rapid adaptation to market needs. Strategic management consists of three main phases: formulation, implementation and evaluation. Formulation focuses on defining strategic goals and a long-term vision; implementation involves operational steps to achieve these; and evaluation focuses on assessing results and adapting the strategy as development progresses. Tactical goals, which are operational and shorter-term in nature, support the implementation of the long-term vision and adapt to current challenges. The focus is on measurable performance indicators and a thorough analysis of needs, which must be regularly reassessed in line with changing technological and market conditions.

A new trend in national spectrum management strategies is to emphasise the balance between flexibility, innovation and long-term planning in order to address the growing demand for wireless connectivity. These strategies are being developed to support both current and future technologies, with an emphasis on the efficient use of spectrum for both the public and private sectors. Equally important is long-term planning based on cooperation between government, business and international organisations to ensure that future technologies have access to spectrum. The strategies focus on short- and long-term objectives, which are regularly evaluated and adapted in line with developments, so that spectrum is not used inefficiently but is flexibly reallocated according to actual demand.

These trends in national spectrum management strategies reflect a consensus on the importance of fostering innovation, the efficient use of spectrum, and long-term planning to ensure access to spectrum for both the public and private sectors. Cooperation at the international level – in particular the harmonisation of standards and flexibility in regulation – is key to responding to rapid technological change. The main principles for developing new strategies include consultations with stakeholders, the use of data for analysis, the development of expertise and international cooperation. Stakeholders are involved in the decision-making process through consultations and workshops, ensuring dynamic spectrum management. Data plays a key role in spectrum optimisation, process automation and strategic planning. Continuous training of professionals and the development of expertise are essential for effective governance, whilst international cooperation focuses on harmonising rules and tackling cross-border interference.

On the other hand, in strategic spectrum management, conflicts often arise between the differing interests of stakeholders, requiring dialogue and compromise. The main tensions include the conflict between international harmonisation and national flexibility, where global standards must be aligned with national needs, which requires active international cooperation and participation in forums. There is further friction between current market requirements and the need to foster innovation, where spectrum managers must balance short-term gains with long-term support for new technologies. There is also a tension between short-term tactical goals and long-term sustainability, which requires the involvement of political stakeholders in long-term planning and their education to understand market needs. The final point of friction lies in the conflict between flexible licensing models and the risk of interference, which must be resolved by directly identifying needs, assessing them and finding appropriate solutions to ensure the efficient use of spectrum without compromising the quality of service.

The starting point of the study is the creation of a modern spectrum strategy, which, as mentioned above, combines both long-term planning and the short-term fulfilment of current requirements. The strategy is structured around 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. All these areas are complemented by sub-objectives designed to contribute to their fulfilment, thereby meeting current market requirements whilst simultaneously stimulating innovation.

3 Introduction to the ‘ ’ strategy

ITU-R Recommendation SM.1047 – National Spectrum Management, adopted in 2012, recommends that the development of national spectrum management programmes should address spectrum planning. Furthermore, administrations are guided by the relevant sections of ITU-R Recommendations, Reports and Manuals.

The Handbook on National Spectrum Management, adopted in 2015, sets out the rules relating to spectrum planning in Chapter 2 ‘Spectrum Planning’¹.

The text of the following chapters in this section of the document is based on the 2015 ITU Handbook on National Spectrum Management.

3.1 Planning in the field of radio spectrum management

Planning aimed at achieving national objectives and goals is an essential prerequisite for the effective management and use of the radio spectrum.

Radio spectrum planning involves identifying future spectrum management objectives and establishing procedures to achieve these objectives. Planning thus creates an environment in which the radio spectrum is available to meet the constantly evolving needs and demand for radio spectrum. Planning facilitates decision-making by providing a basis for assessing and evaluating the future actions of entities using, or planning to use, the radio spectrum. Spectrum planning must support and monitor the main trends and needs of current and future radio spectrum usage.

The role of planning in the field of radio spectrum management is to optimise the fulfilment of the needs of radio spectrum users through:

- the effective organisation of radio spectrum management;
- the development and implementation of policies, rules and regulations relating to the radio spectrum;
- creating the conditions for the efficient and effective use of the radio spectrum;
- allocating spectrum to radiocommunication services and applications; and
- the organisation and authorisation of specific radiocommunication systems or services.

Spectrum planning encompasses processes, activities or decisions relating to radio spectrum management that directly influence how the spectrum will be used. This includes allocation², policies, rules and standards. Each of these areas influences the use of radio frequencies, the introduction of radiocommunication services and, in some cases, the technologies employed.

Planning for the use of the radio spectrum should take into account changes in spectrum usage, new technologies, new services not included in the current national frequency table, the plans of existing spectrum users regarding changes to their usage, potential congestion in specific bands or locations, and, last but not least, potential changes to frequency allocations resulting from the World Radiocommunication Conference (hereinafter ‘WRC’).

¹ [R-HDB-21-2015-PDF-E.pdf \(itu.int\)](#)

² In radio spectrum management, the terms ‘allocation’ (the assignment of a frequency or frequency band to services), ‘group allocation’ (the assignment of a frequency or frequency band to regions or countries) and ‘assignment’ (the assignment of a frequency or frequency band to stations) are used. These terms are based on the terminology used in connection with radio spectrum management within the International Telecommunication Union. – Source: Decree No. 467/2021 Coll., amending Decree No. 105/2010 Coll., on the frequency band allocation plan (national frequency table),

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as amended by Decree No. 423/2017 Coll.

The scope of a spectrum utilisation plan may be limited by the planning period, the frequency range, the services covered, or a specific issue. Long-term plans cover a wider range of thematic areas and take into account, for example, the results of the WRC.

The information that needs to be taken into account in spectrum utilisation planning includes data on current usage, allocations, technologies, future usage requirements and available spectrum. A meaningful analysis of spectrum utilisation requirements must take economic and political factors into account. Where technical solutions allow for the relevant economic and political factors to be taken into account, plans can be drawn up easily. More often, however, the planning process requires finding compromise solutions that take into account political, legal, economic, social, environmental and technical factors.

The planning process consists of the following elements:

1. setting objectives – when identifying and setting spectrum planning objectives, it is necessary to consider how to optimise the use of the radio spectrum. This consideration includes potential growth in demand for spectrum use by existing services, as well as the introduction and growth in demand from new services and applications. In addition, changes in spectrum usage by industry sectors, businesses, government bodies and the general public must be taken into account.
2. Factors to be taken into account – spectrum planning can establish future, broadly defined national spectrum requirements based on technological, legal, social, environmental, political and economic factors that influence spectrum use. In order to meet the demand for spectrum use, it is necessary to identify current and future requirements and the available spectrum. Future requirements must be identified in good time to ensure the necessary reallocation of spectrum. For effective spectrum management, it is necessary to have a list of spectrum users and to identify available spectrum. Spectrum availability depends on:
 - the number of spectrum users (i.e. the number of allocated frequencies together with the number of stations);
 - the relevant characteristics of the stations;
 - the geographical distribution of stations with a uniform degree of accuracy;
 - the potential mutual interference between stations.

Information on current and future spectrum usage requirements can be obtained from: the national frequency table, spectrum usage monitoring, information provided by other administrations, consultations, assumptions regarding future spectrum usage, international trends, and forecasts focusing on spectrum usage.

3. information on spectrum availability – spectrum availability must be analysed across all domestic services in order to meet the identified spectrum requirements. Inputs primarily come from the spectrum manager itself, but may also come from the International Telecommunication Union's (hereinafter 'ITU') international frequency list, ITU plans and any existing studies relating to spectrum planning in the relevant region³.
4. Planning options – it is necessary to define appropriate spectrum planning options with a view to meeting spectrum requirements based on data on spectrum availability. The analysis of planning options must take into account technical, legal, social, environmental, political and economic factors. The analysis shall also assess the various options for services given the existing and planned radio communications environment and/or allocations. Recommendations concerning requirements that cannot be met within the framework of current national allocations will be based on this analysis and any available spectrum monitoring results. Allocation options will be identified and the relative costs of any reallocation and/or relocation of existing spectrum users will be assessed.
5. Implementation of the process – the introduction of various spectrum planning strategies is an ongoing process. The introduction of new services may require changes to national frequency tables and a review of national regulations and ITU regulations. Reviews of international regulations will be carried out at regular World Radiocommunication Conferences.

³ For the purpose of frequency allocation, the world is divided into three regions; Source: Decree No. 467/2021 Coll., amending Decree No. 105/2010 Coll., on the plan for the allocation of frequency bands (national frequency table), as amended by Decree No. 423/2017 Coll., Section I. Regions and Bands

6. Iterative process – previous decisions may be periodically reviewed or triggered by specific events and, where necessary, adjusted on the basis of updated information. The planning process therefore constitutes a continuous process of data analysis and processing. It is advisable to record all changes so that the history of developments can be tracked for the purposes of long-term planning.
7. Support for spectrum planning – to support spectrum planning, it is advisable to develop tools for monitoring its actual usage. This monitoring may be carried out on an ongoing basis or at specified intervals (on an annual or longer-term basis). These tools serve as a source of feedback for the planning process.

Planning for spectrum use or the development of a spectrum management system's infrastructure can be carried out on a short-term, long-term or strategic basis. Each of these approaches requires a commitment to regular and, in some cases, scheduled activities.

The first step towards successful planning is to establish a process for updating plans. This process should include specific mechanisms for short-term, long-term and strategic planning.

Short-term and strategic planning address specific issues and therefore do not follow prescribed outlines or formulas. However, they should always define requirements, resource availability, decisions and implementation.

On the other hand, a long-term plan will generally follow a standardised template.

The spectrum administrator must consider the impact of the plans on its own departments, neighbouring administrations, equipment manufacturers, service providers and spectrum users.

Decisions regarding spectrum utilisation planning must take into account political, legal, economic, social, environmental and technical factors, and must be taken on the basis of national priorities.

3.2 Strategic planning

The development of a radio spectrum management strategy is one of the most important processes in the field of radio spectrum management. A well-drafted strategy and its implementation are the result of a set of key strategic decisions aimed at allocating spectrum efficiently and ensuring its optimal use for technological progress and economic development. The chosen spectrum management strategy is then reflected in:

- (1) the **short-term** fulfilment of requirements regarding spectrum availability and usability, which contributes to the current needs not only of the electronic communications sector but also of other sectors,
- (2) as well as in **long-term planning**, which is geared towards its sustainable development.

Given the dynamic development of technologies and growing demands on the spectrum, the current period is characterised by numerous risks and uncertainties, which increase the complexity of its management. It is therefore important not only that the strategy is prepared for and resilient to these changes, but also that it is flexible, enabling rapid and effective adaptation of policies and plans in line with technological developments and market needs.

Strategic management of the radio spectrum encompasses a set of guidelines, decisions, activities and human capital that are essential for achieving the objectives of efficient and equitable spectrum allocation and its sustainable use. The strategy is therefore an integral part of governance and management processes, which begin with the formulation of the organisation's mission (in this case, that of the national regulatory authority as the administrator of the scarce resource that is the radio spectrum) and culminate in the required outcomes in the form of the fulfilment of the set objectives (meeting market needs, ensuring balance and the effective management of the spectrum).

Strategic planning is a form of long-term planning which simplifies or reduces the demands of ongoing planning by identifying a small number of key areas or themes that need to be taken into account during planning, whilst assuming that most activities in the field of radio spectrum management can continue without significant change. In this case, an important aspect that distinguishes it from long-term planning is the need to define the process for identifying key areas. Where radio spectrum management falls within the remit of multiple bodies, it is necessary to

ensure that all relevant bodies are involved in identifying the key areas and that the final identification of these areas is accepted by them.

The advantage of strategic planning is that it reduces the need for continuous, broad-based planning activities and focuses on a limited set of topics. This reduces the workload involved in the planning process, both by reducing the number of stakeholders and by shortening the time that would otherwise be required if topics of no strategic importance were included in the planning. Generally speaking, from a strategic planning perspective, it is important at any given time to focus only on a few key areas that require planning and resolution. Frequent updates to a comprehensive, long-term plan are therefore often unnecessary. Instead, it is more appropriate to focus on a limited number of topics in the strategic planning process.

Given the growing demand for the use of radio spectrum across various sectors of the economy, and in view of the complexity of radio spectrum management, it is important that as many relevant stakeholders as possible – including regulatory authorities, operators, manufacturers and consumers – are able to participate in strategic planning.

Strategic planning must take into account the following principles, which lead to a more efficient use of the radio spectrum:

- allocation of radio spectrum based on market demand
- promotion of competition;
- adapting to anticipated and unanticipated technological progress;
- requirements arising from international harmonisation and cooperation.

Strategic management is generally divided into three phases, namely: (1) formulation, (2) implementation and (3) evaluation of the strategy's fulfilment. With the impact of globalisation, and consequently more frequent technological changes, there is a growing need to ensure greater flexibility. Above all, this involves a shift from defining long-term objectives and priorities to achieving them through short-term activities.

Formulation involves developing strategic objectives at the end of the planning horizon and the anticipated procedures for achieving them; implementation is carried out using operational management tools; and evaluation focuses on assessing the fulfilment of the strategy and strategic objectives.

Precisely because of the sector's dynamic nature, fluctuating demand and, on the other hand, the need to provide certainty for market participants and to fulfil the Czech Republic's long-term objectives towards its citizens, it is appropriate to formulate both a long-term vision – that is, the fundamental pillars of the spectrum management strategy – and specific short-term objectives that will help to realise these pillars.

3.3 Long-term planning

The long-term vision is a fundamental planning document that contains a precise and structured description of the state of affairs within a specific future timeframe. It should be formulated precisely, with its constituent parts consistent with one another so that it retains its meaning as a whole. The vision comprises elements that enable the setting of strategic objectives and the identification of the means to achieve these objectives. The vision must also incorporate an innovative dimension, i.e. how the situation in the target year will differ from the current situation. Although it is an initial formulation, the vision must have the necessary depth and breadth to serve as a tool for deriving long-term objectives, whilst respecting the requirements and positions of all stakeholders.

If the radio spectrum is to support national objectives and aims appropriately, long-term planning is essential. It can provide the basis for effective spectrum management, ensuring that spectrum is allocated in a way that adapts to the constantly evolving spectrum requirements of new systems and their applications. It also facilitates decision-making by providing a basis for the practical identification, assessment and evaluation of alternative approaches.

Long-term planning involves making decisions today on spectrum planning strategies with a view to their future implications, identifying the impact of past decisions on the future, and regularly adapting these decisions to changing conditions. The plan should be sufficiently comprehensive to take into account both current and anticipated national requirements for the use of radio spectrum within a specified time frame. This process also leads to the revision of the frequency band allocation plan (national frequency table), the formulation of national positions on

areas of harmonisation, cooperation or international coordination, and the revision of regulations, policies and standards relating to the management and use of the radio spectrum.

Long-term planning and updates to the existing plan must take all possible scenarios into account. The plan must be regularly reviewed in the light of political and legal factors, economic factors, social and environmental factors, and technical factors.

When undertaking long-term planning for the use of the radio spectrum, it is necessary to take into account current, future and anticipated uses across the entire radio spectrum, as it may be necessary to migrate certain uses from one band to another. Long-term costs, national priorities, developments in neighbouring countries, technological developments and, last but not least, the state of harmonisation at international level must be taken into account.

The primary tool for long-term planning is the frequency band allocation plan, which serves as a guide for the introduction of radiocommunication services.

The ITU divides the national long-term planning process into five steps⁴: (1) Defining spectrum requirements involves identifying future national needs for all radio services, taking into account technological, political and economic factors. (2) These requirements are established on the basis of an assessment of scenarios, traditionally through consultation with stakeholders, but now also using analytical models. (3) Subsequently, spectrum availability must be assessed and plans drawn up that take into account technical, political and economic aspects. (4) Spectrum planning should also include options for reallocating frequencies, whilst taking into account the costs and impacts on existing users. (5) The implementation of these strategies requires ongoing updates to national and international regulations, with the process being continuous and subject to periodic review.

3.4 Short-term planning

In contrast, tactical objectives are more immediate and operational in nature, focused on supporting strategic objectives through short-term measures. They address specific tasks, resource allocation and day-to-day operations with the aim of effectively implementing the established strategies. The main difference from strategic objectives lies in their scope and time horizon. Whilst strategic objectives determine the long-term trajectory of a given strategy, tactical objectives ensure their realisation in the short term.

From the perspective of radio spectrum management, short-term planning is seen as a consequence of the limited time available for planning purposes. Short-term planning is an action that is necessary in order to respond rapidly to a situation that has arisen. The outcome of short-term planning is a specific type of decision-making document that sets out the chosen course of action and the milestones required to achieve the objective or to resolve the situation at hand. From a short-term perspective, an inflexible environment becomes the primary consideration. A short-term plan must therefore set out a process for adapting to the existing environment. The consequences of short-term planning are, in most cases, long-term, as a new use of spectrum or a new approach to spectrum management will remain in place for a long time.

The short-term plan should be sufficiently comprehensive to be consistent with the national spectrum requirements of existing and anticipated radio communication systems. A short-term plan may influence the revision of the frequency table, the formulation of national positions on harmonisation, cooperation or international coordination, and the revision of regulations, policies and standards relating to the management and use of the radio spectrum.

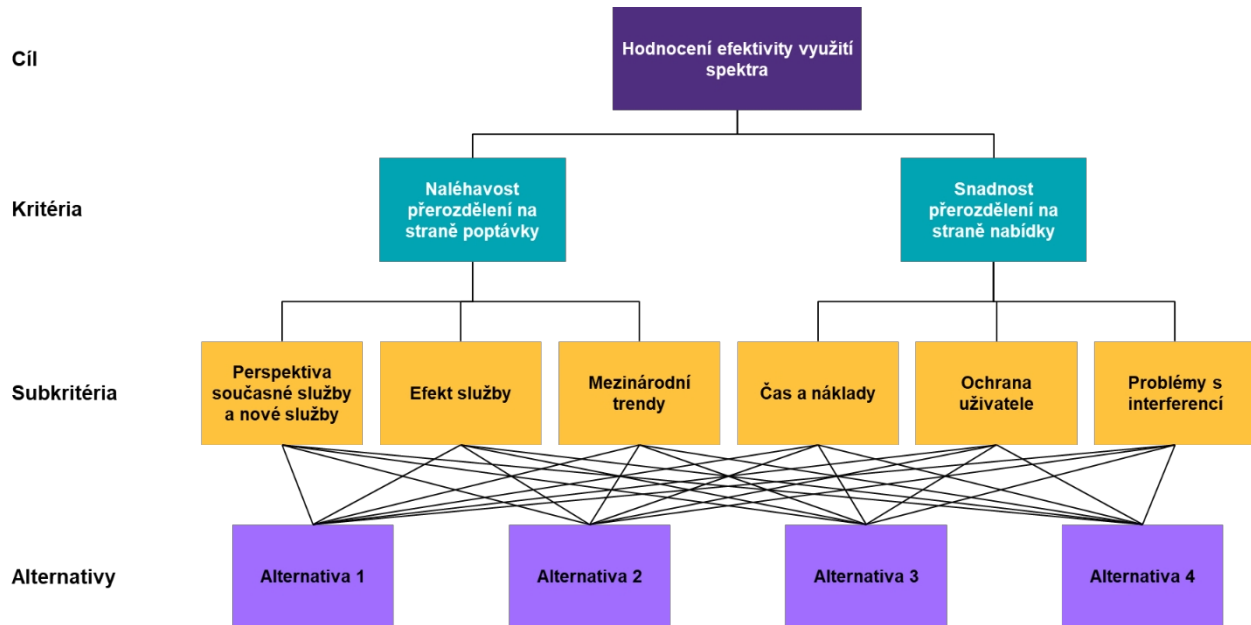
3.4.1 Adapting to a dynamic environment

The development and evaluation of alternative scenarios serve to adapt to new challenges. One example is the AHP (Analytic Hierarchy Process) method, which was implemented by the Republic of Korea in 2019 and is used precisely to select alternative solutions. This method structures decision-making problems, quantifies elements and evaluates alternative solutions on the basis of defined objectives. AHP is used to prioritise different frequency bands and to

⁴ ITU-R Report SM.2015-2. ITU-R: Methods for determining national long-term strategies for spectrum utilisation

optimising their use, taking into account various aspects such as technological developments, social benefits or the costs of technology migration.

Figure 1: Analytic Hierarchy Process (AHP)



Source: Own work, based on the ITU document

4 Trends

A new trend in the development of national spectrum management strategies emphasises a balance between flexibility, innovation and long-term planning, with the aim of addressing the growing demand for wireless connectivity. With technological progress and the emergence of new applications, spectrum management strategies are evolving to support both existing services and future innovations.

The central theme of these strategies is the efficient use of spectrum. This involves ensuring the optimisation of spectrum resources for both the public and private sectors and addressing competing demands for this limited natural resource. Individual strategies are increasingly focusing on dynamic spectrum sharing and market-based mechanisms that enable more efficient allocation whilst fostering innovation in wireless technologies. This approach involves reallocating under-utilised spectrum bands, enabling spectrum trading (through the establishment of secondary markets) and utilising advanced technologies to minimise interference.

Another key trend is the need for collaborative, long-term planning. Spectrum strategies emphasise coordination between government agencies, private sector entities and international organisations with the aim of aligning spectrum management with future technological needs. This includes proactive measures such as creating a 'spectrum pipeline' for future technologies and ensuring that emerging sectors, such as satellite communications and autonomous systems, have access to the spectrum they require.

Strategies are designed to set a long-term direction, to which short- to medium-term objectives are aligned, the very purpose of which is to verify the validity of the vision. These strategies therefore aim to enable the long-term plan to be reviewed at regular intervals (e.g. through studies conducted every two years), ensuring that the spectrum is not 'locked in' for an extended period for a purpose that may subsequently prove to be a dead end, and that it will only be released in the event of genuine demand for that band.

4.1 Benchmark

To compare the various spectrum management strategies, documentation from the USA and the United Kingdom relating to this issue was used. Each of these documents contains key areas, which are further broken down into specific objectives:

4.1.1 United Kingdom

The document 'Supporting the UK's wireless future' sets out the United Kingdom's spectrum management strategy for the 2020s, aimed at supporting the future of wireless communications across various sectors. This strategic plan is divided into four sections, which in turn briefly (1) outline the significance and role of spectrum in the United Kingdom; (2) set out Ofcom's role as regulator and explain the need for spectrum regulation; (3) define the objectives of spectrum management and areas of particular focus; and (4) finally, outline the consultation topics, a summary of individual responses to these consultations, the legal framework and a glossary of terms. The strategy highlights the growing role of wireless technologies in everyday life and emphasises the importance of the efficient management of the radio spectrum, which is a limited resource. Ofcom aims to ensure that spectrum use supports innovation, growth and productivity, whilst enabling both existing and new users to access this resource. The document itself sets out a clearly defined vision focused on the continuous improvement of wireless communications, making suitable frequency bands available to businesses, the public sector and all organisations with specific requirements, increasing the flexibility of the spectrum to support innovation, and the sustainable development of its efficient use. It aims to achieve this vision through three main strategic areas, which include:

1. **Supporting wireless innovation:** Ofcom plans to release more spectrum for innovative uses, support new wireless technologies and influence international standards to promote flexibility and enable the emergence of new applications.
2. **Licensing of local and national services:** Given the diverse needs of users, Ofcom is focusing on a localised approach to spectrum allocation for specialised services, such as factories and farms, whilst ensuring widespread coverage for public mobile services.
3. **Promoting spectrum sharing:** The strategy promotes the efficient use of spectrum through better data analysis and by ensuring that wireless systems can coexist without harmful interference. This includes enhancing resistance to interference and providing balanced protection for existing users whilst ensuring flexibility for new entrants.

These areas are further broken down into specific objectives designed to achieve the goals set out in these areas. The regulatory authority is addressing all these areas equally, taking into account the comments made by stakeholders during the consultations. Support for wireless innovation is to be ensured by (1) making spectrum available for innovation before its long-term future use is certain, (2) reducing barriers for wireless innovators, and (3) engaging all spectrum users through an information programme. The second area focuses on promoting the diversity of wireless services by considering the possibility of localised access for specialised services in combination with licences covering larger areas. To promote spectrum sharing, the strategy aims to: (1) utilise better data and sophisticated analysis of sharing conditions; (2) increase the resilience of wireless systems to interference; and (3) strike a balance between protecting one system from interference and ensuring flexibility for others.

The strategy also highlights Ofcom's ongoing responsibilities, including enforcing regulations and representing the UK's interests at international level. The document emphasises a long-term and flexible approach to spectrum management that is capable of responding to new technologies and market demands.

4.1.2 USA

The 2023 National Spectrum Management Strategy sets out a comprehensive plan to modernise spectrum management policy in the United States with the aim of securing the country's leadership in advanced wireless technologies. The strategy is divided into four main pillars, with three sub-strategic objectives defined for each pillar, to which the document devotes equal attention:

1. **Sufficient spectrum to secure the US's leading position in advanced and new technologies:** This pillar focuses on ensuring access to spectrum for new technologies in both the public and private sectors. The aim is to reallocate existing spectrum bands to meet growing demand and support innovation in areas such as 5G, satellite services and autonomous systems. The strategic objectives are therefore to ensure sufficient access to spectrum to support (1) the missions of federal agencies, (2) private-sector innovation, and (3) the availability of sufficient spectrum by applying principles and procedures to identify additional bands for study.

2. **Collaboration on long-term planning to meet the ongoing demand for spectrum:** This pillar emphasises the need for coordinated collaboration between government agencies, industry and other stakeholders. The strategy calls for the creation of a new framework for transparent and consistent decision-making that will ensure access to spectrum for all sectors, including public safety and scientific research. In other words, the strategic objectives focus on (1) establishing a continuous process of strategic spectrum planning using the best available scientific practices and data, (2) developing and documenting a national methodology for spectrum decision-making, and (3) defining requirements and creating the conditions for the collection of relevant data and information on spectrum usage.
3. **Unprecedented integration of technological development into innovation in spectrum access and management:** The third pillar supports the development of new technologies that will improve access to spectrum, such as dynamic spectrum sharing. The strategy calls for investment in research and development to increase the efficiency of spectrum use and maintain American standards in global competition. This involves (1) improving spectrum efficiency and enhancing coexistence by facilitating investment in new and emerging technologies, (2) committing to improving our collective understanding of the spectrum through coordinated, targeted and sophisticated research and development; and (3) implementing a spectrum policy that maximises flexible use, adapts to new and innovative technologies, and identifies opportunities to expand access to the spectrum.
4. **Developing expertise in spectrum management and utilisation and raising national awareness:** The final pillar focuses on strengthening expertise in spectrum management and raising public awareness of the importance of spectrum in everyday life. Emphasis is placed on training future professionals in this field and ensuring that key decision-makers have sufficient knowledge of the complexities of spectrum policy. The three strategic objectives are divided into (1) increasing the number of experts, (2) raising awareness of the spectrum, and (3) improving the public's understanding of the spectrum and raising awareness of its role in everyday life.

The aim of the strategy as a whole is to balance current needs with long-term planning, ensure the efficient use of the spectrum, promote innovation and maintain the US's leading position in wireless technologies. A key component is cooperation between the public and private sectors, which is necessary to achieve these objectives.

5 nd Trends Conclusions

National strategies agree on several areas, including:

- the importance of supporting innovation in wireless technologies,
- maximising (efficient) use of the spectrum,
- long-term planning to ensure sufficient access to spectrum for both the public and private sectors,
- an emphasis on international cooperation, particularly in the area of standard harmonisation, and the need for flexibility in spectrum regulation to enable a response to rapid changes in technological requirements and market conditions.

At the same time, key principles can be derived from these findings which should be taken into account when developing a new spectrum management strategy, namely:

- Consultation with the market and other stakeholders
- Use of data and analysis
- Building expertise
- International cooperation and active participation

5.1 Consultation with the market and stakeholders

Within the framework of spectrum management, cooperation with stakeholders plays a key role in the effective management and development of telecommunications infrastructure, in terms of understanding their demands and needs. Stakeholders, including the government, the private sector, academic institutions and the general public, are actively involved through dialogue or direct participation in the entire process, from planning through to the implementation of strategic and tactical objectives. This approach is important because spectrum management must be dynamic and responsive to a rapidly changing technological environment, where each of these stakeholders has specific needs and contributes to the common goal, often in conflicting ways, given their respective needs and the limited nature of the spectrum.

The first step is to establish a consultation framework that ensures all relevant parties can share their views and needs. This involves organising public consultations, workshops and discussion forums where individual stakeholders can present their perspectives on anticipated spectrum usage requirements. For example, businesses in the electronic communications sector may emphasise the need for greater bandwidth for new technologies, whilst government agencies may focus on securing spectrum for critical infrastructure services. It is precisely the establishment of working groups and ongoing discussions that create a platform for presenting needs and for mutual interaction between the parties.

It is also important to involve stakeholders in the decision-making process. Stakeholders have the opportunity to influence key decisions regarding spectrum allocation and the rules governing its use. This is a two-way process – stakeholders provide information on current needs and challenges, whilst at the same time learning about the technical constraints or legal conditions that must be taken into account in spectrum management. Dialogue between the government and industry is key to reaching a consensus, particularly when addressing complex issues such as spectrum overcrowding in densely populated areas or the roll-out of new technologies that may cause interference.

Engaging with stakeholders in the field of spectrum management involves creating a comprehensive and participatory process, where every voice is heard and where the needs of different sectors are taken into account when deciding on the future use of the spectrum. In this way, it is possible to respond effectively to the challenges posed by rapid technological progress and the growing demand for wireless connectivity.

5.2 Data utilisation and the creation of analysis

Data analysis has become a vital part of modern spectrum management, particularly with the growing demand for wireless technologies and services. Given the technological advances that bring ever-changing spectrum requirements, it is essential that data is used to inform better decision-making on spectrum allocation. This data helps to monitor spectrum usage in real time and adapt its management to current needs.

Analytical tools enable a comprehensive assessment of spectrum usage. These tools include advanced methods of data collection and processing, which provide a detailed overview of how different parts of the spectrum are being used (or can be expected to be used). This not only facilitates allocation decisions but also allows for continuous monitoring of traffic and the rapid identification of potential problems or areas where utilisation is insufficient. This makes it possible to automate licensing and allocation tools, which is essential for speeding up access to the required frequencies and reducing the administrative burden. Data-driven automated tools can simplify the allocation process, leading to optimisation in terms of both time and spectrum utilisation. This process also enables a faster response to changing industry conditions and technological innovations.

Furthermore, regular data analyses provide key insights for developing long-term strategies. These analyses focus on identifying trends in spectrum usage and predicting future requirements across various sectors, thereby facilitating strategic planning at both national and international levels. Data-driven planning helps spectrum managers prepare for the development of new technologies and innovative applications, thereby ensuring that sufficient resources are available to meet future demand.

Data plays a key role in monitoring existing strategies and regulations. Based on the information gathered, spectrum allocation can be adjusted to respond to the changing needs of both commercial and public sector entities. This ensures that the spectrum is managed not only efficiently but also sustainably, with future societal needs in mind.

In the broader context, comprehensive data analysis helps to maintain flexibility and oversight of compliance with spectrum strategies, enabling decisions to be based on data and the indisputable conclusions of studies carried out. Regulatory authorities are thus able to respond to market developments and technological progress, whilst ensuring that a key resource such as spectrum is managed with maximum efficiency. This process leads to the continuous improvement of the rules, standards and technologies necessary to maintain a competitive advantage and drive innovation in the field of wireless services.

5.3 Building know-how

Ongoing training and the development of professional competence within the human capital involved in spectrum management are key to ensuring that regulatory authorities, technology firms and other stakeholders are able to respond effectively to the growing technological demands and challenges associated with spectrum management. Given the technological evolution of this dynamic environment, it is essential that experts in this field are equipped with the latest technical and scientific knowledge.

Government agencies and regulatory bodies often collaborate with academic institutions and research centres to support training programmes aimed at developing the skills required in the field of spectrum management. This approach encompasses a range of activities, such as workshops, specialist courses, exchange programmes and seminars, which contribute to building professional capacity at both national and international levels. The aim of these training initiatives is not only to enhance the technical competence of current experts, but also to nurture a new generation of professionals capable of managing the complexities of modern spectrum management and utilisation.

These programmes also include collaboration on research projects, where academic institutions work alongside regulatory bodies and private sector organisations. Joint research focuses on technical solutions that can improve spectrum utilisation, for example by identifying tools to minimise harmful interference between users. This collaboration helps to ensure that spectrum management remains flexible and open to innovation, which is essential in an era of rapidly changing technological conditions.

Among other things, education plays an important role in improving regulatory tools and frameworks. The development of experts and regulatory staff in this field enables the drafting of legal and technical standards capable of responding to new market demands. This includes training on how to effectively roll out new technologies or how to tackle challenging issues of spectrum congestion in large urban areas.

Promoting international cooperation among experts is another key element of capacity building. Exchange programmes and international conferences, where spectrum experts meet and share their knowledge, contribute to the creation of a globally connected community of professionals who work together to develop new approaches to spectrum use. Such cooperation is particularly important in the development of international technical standards and the harmonisation of regulations across different countries, ensuring the smooth deployment of technologies and seamless communication across borders.

5.4 International cooperation and active participation

Active participation and cooperation at the international level logically builds on the aforementioned discussions with stakeholders, data analysis and the know-how that has been developed. In order to meet the requirements of stakeholders, it is necessary to ensure effective engagement in existing platforms, such as the International Telecommunication Union (ITU), the European Conference of Postal and Telecommunications Administrations (CEPT) and the Radio Spectrum Policy Group (RSPG). Harmonisation of rules is essential to support technological development and to ensure that spectrum-dependent services can operate seamlessly across borders.

A key element of international cooperation is participation in spectrum harmonisation processes. This process involves the harmonisation of frequency bands for various services, enabling technologies such as mobile networks or satellite communication systems to operate seamlessly across different countries. Harmonisation reduces the complexity and costs associated with deploying new technologies and ensures that technological progress can be effectively shared across both European and global markets.

Another important issue in the field of international cooperation is addressing cross-border interference. As radio waves can travel across national borders, it is essential that countries have clear processes and agreements in place to resolve such issues. Cooperation at regional level is key to minimising interference between neighbouring countries and to ensuring the smooth operation of key services, such as mobile networks or satellite communication systems. Coordination mechanisms enable countries to resolve interference issues quickly and effectively, thereby minimising the impact on everyday services. Active cooperation can help establish cross-border agreements that benefit both parties, based on joint testing or impact assessments.

Technological innovation also requires ever-closer coordination between countries. As new innovations emerge, they present fresh challenges that necessitate the sharing of technology and expertise between countries. The joint development of technologies and approaches to their regulation helps to ensure that the roll-out of new technologies proceeds smoothly and that the spectrum is utilised optimally and without hindrance. States, or their regulatory authorities, are therefore increasingly engaging in international research projects and sharing their knowledge to ensure that they are able to respond to new market demands.

In the context of the above, international cooperation should focus on harmonising rules, addressing cross-border issues and developing technologies, thereby enabling spectrum-dependent technologies to operate efficiently and without hindrance throughout the European region and beyond.

6 Research Questions

As part of the study, several sub-questions were defined which, precisely because of their interrelated nature, have been partially addressed above in the section identifying the main trends:

- How can the radio spectrum be effectively allocated and managed, taking into account the current and future needs of various telecommunications and wireless services?
- How can a spectrum management strategy be developed that supports the effective deployment of 5G and other new technologies in line with national objectives and requirements?
- How can coordination between different service providers be ensured when using the radio spectrum?
- How can interference between services and different technologies be minimised?
- How can transparency be ensured in the spectrum management process?
- How can the public be effectively involved in the decision-making process through public consultations?
- How can we assess and propose changes to the legal and regulatory framework that could support innovation and optimise the use of the radio spectrum?
- How can we achieve international frequency harmonisation with minimal costs and resources?
- How does this process affect the strategy for spectrum management at national level?
- How should criteria for prioritising services be established when allocating frequencies?
- How can we ensure that the spectrum is used as efficiently as possible?
- How can long-term sustainability be taken into account in the spectrum management process, given technological changes, growing demand and environmental impacts?
- How can we promote the use of the radio spectrum for industrial applications, including the Internet of Things (IoT) and industrial automation?
- How can we ensure effective cooperation with the Czech Telecommunications Office in implementing the spectrum management strategy?

Given the significance of these questions, this study seeks to provide comprehensive answers by identifying the tensions outlined below. These factors were also taken into account during the actual development of the strategy, which is intended to be the key output.

When considering international trends and strategic management in general, conflicts regularly arise between the interests of individual stakeholders; as a rule, there is no single correct solution to these, but rather there is scope for dialogue and the search for compromises. The same applies to the development of a spectrum strategy, where we can identify the following tensions.

Figure 2: The most significant tensions



6.1 International harmonisation v nd flexibility

International and national spectrum management strategies may find themselves in a paradoxical situation arising from the effort to reconcile global coordination and cooperation with individual national needs and priorities. Whilst international strategies, such as those developed by the ITU, emphasise global harmonisation of spectrum use, a regional approach and negotiations between different countries, national strategies must take into account the specific needs of their own economic sectors, industrial requirements, technological visions and national interests.

National strategies focus on ensuring technological competitiveness, security and economic prosperity by optimising spectrum use across various sectors, including public services and defence. This approach can often lead to the reallocation of bands or innovative models that reflect a country's specific needs, such as securing spectrum for the development of 5G mobile networks, new technologies or industrial applications; however, these may differ from the needs of neighbouring states.

Conversely, international spectrum management is influenced by the need to ensure that spectrum is used fairly and efficiently at a global level, which requires strict coordination between countries. International standards developed in forums and at international conferences may impose constraints on national strategies by focusing solely on harmonisation, whilst not always taking full account of specific national needs or the historical context of individual countries.

This dilemma between national flexibility and international harmonisation is one of the difficult choices involved in formulating a spectrum management strategy, which requires striking a balance between global commitments and local innovation, and between the need to share spectrum and ensuring national security and growth.

The solution lies in active international cooperation and regular participation in conferences, such as ITU forums, where the Czech Republic should not only promote its national interests but also proactively seek joint solutions that take into account the needs and priorities of other states. The Czech delegation should effectively 'lobby' for specific Czech interests whilst remaining open to compromises that will ensure global spectrum harmonisation. This balanced approach will enable both the promotion of national security and growth, and a contribution to effective global coordination.

6.2 Current market demands versus support for innovation

An analysis of strategic documents relating to spectrum management reveals a clear tension between market demands for the frequency spectrum and the need to support innovation. On the one hand, the market requires spectrum allocation that takes into account the immediate and specific needs of end-users, particularly in sectors with high demand for current technologies. On the other hand, there is pressure to stimulate innovation, which requires a flexible approach to spectrum management; this often leads to the need to experiment with new ways of sharing and reallocating spectrum for future applications that may have enormous potential but are not yet fully developed in the market.

This paradox is evident in the effort to strike a balance between short-term profit maximisation through market mechanisms, such as spectrum auctions, and long-term investment in innovation, which can bring significant benefits to society but, in the short term, requires a certain degree of uncertainty and flexibility. Market demands often focus on a rapid return on investment and the optimisation of existing services, whilst innovation requires a more flexible approach, experimentation with technology and the creation of new models.

One consequence of these conflicting objectives is that spectrum managers must strike a balance between market pressure to maintain competitive advantages and the need to ensure that new technological solutions have sufficient access to spectrum for testing and subsequent implementation. All of this can lead to a conflict between market players, who wish to maximise their profits from the immediate use of spectrum, and innovators, who demand unrestricted access for the development of future technologies.

A solution to this friction could lie in active communication between all stakeholders through a dialogue that brings together market players, innovators, the regulatory authority and other interested parties. The establishment of specialised working groups to regularly analyse market needs and innovation requirements could ensure a balanced reallocation of spectrum. A public consultation could also contribute to this by, for example, opening up

a discussion on spectrum sharing. This process would foster mutual understanding of the priorities and interests of all parties and help to find a compromise that would maximise market efficiency whilst simultaneously stimulating the development of innovation.

6.3 Long-term sustainability versus political vision

Across national spectrum strategies, a tension can be identified between long-term (strategic) and short-term (tactical) objectives. This tension arises from differing priorities and approaches, with short-term tactical objectives responding to current needs and challenges, whilst long-term strategic objectives aim for the sustainable and innovative use of spectrum in the future and focus more on formulating a vision, as mentioned in the previous section.

Short-term objectives focus on the rapid and efficient allocation of spectrum to support current technologies and services. This includes immediate measures, such as spectrum reallocation or the conduct of auctions, which enable a flexible response to rising demand and the need to ensure spectrum availability for new services. Tactical objectives often address urgent needs that require operational decisions to ensure the seamless functioning of the spectrum at any given moment.

Long-term objectives, by contrast, focus on a broader strategic framework that encompasses forecasting future spectrum requirements and the development of new technologies that will utilise the available spectrum more efficiently. These objectives involve long-term planning and regular assessment of trends, technological innovations and global standards. The aim is to develop strategies that will enable not only current but also future optimal and long-term sustainable use of spectrum across various sectors, including industry, public services and the commercial market.

This distinction between short-term and long-term approaches requires a constant balance between an immediate response to market needs and long-term planning that takes into account future spectrum requirements. Spectrum managers must therefore effectively manage current needs whilst also paving the way for future technological changes and innovations, without one area undermining the other.

To balance short-term and long-term objectives within national spectrum strategies, it is crucial to involve political stakeholders in discussions and enhance their understanding of market dynamics and technological trends. This process should include regular consultations with spectrum experts, industry representatives and the regulatory authority, so that policymakers can better understand why certain measures cannot be implemented immediately and why it is important to plan with future technological developments in mind. Educating political stakeholders about the complexities of spectrum management and the need for a balanced approach between immediate needs and long-term investment in innovation will ensure that political decisions are grounded in realistic technical and market requirements, thereby preventing inappropriate interventions that could undermine the future sustainability of the spectrum.

6.4 Licensing models versus ‘ ’ interference

On the one hand, flexible licensing models that allow for dynamic spectrum allocation and sharing amongst different users are essential for fostering innovation and maximising the use of limited spectrum capacity. These models offer benefits in the form of more efficient resource allocation and enable the faster deployment of new technologies, which often require immediate access to available spectrum. For example, spectrum sharing through dynamic licensing models, which allow multiple users to access the same spectrum under specific conditions, is becoming increasingly common to ensure the optimal and rapid distribution of available spectrum.

On the other hand, however, these flexible licensing models increase the risk of interference, particularly if coordination between different users is not adequately ensured, and not all users prefer flexible licensing models due to their specific needs. Interference can lead to a reduction in the quality of services provided, which negatively affects both public and commercial use of the spectrum. Interference is a key issue, particularly for technologies that require stable and uninterrupted data transmission, such as wireless networks for critical infrastructure or long-distance communications.

The conflict of interest therefore lies in the fact that, whilst flexible licensing models are necessary for the efficient use of spectrum and to support innovation, they simultaneously present a challenge in terms of managing and minimising interference. This conflict

The tension between the need for open access and signal quality management requires sophisticated technical analysis and regulation in order to strike a balance between these two conflicting requirements.

The starting point for resolving the conflict between flexible licensing models and the minimisation of interference lies in a direct understanding of the needs of users who require efficient and rapid access to the spectrum. It is essential to assess these needs carefully, particularly in terms of their impact on signal quality and the potential risk of interference. Based on this assessment, suitable solutions or alternatives must be sought, for example by amending the rules for access to the spectrum so that the conditions for its use and coordination between users are clearly defined. This will help to ensure a balance between the requirement for flexibility and the protection of the quality of the services provided.

7 Annex – Draft ‘ ’ spectrum management strategy for the Czech Republic

(Draft)

Radio Spectrum Management Strategy

Prague, *month/year*

A) *Note: This document is intended for an informal public consultation primarily with the electronic communications sector and the relevant professional community, outside the scope of Section 130 of the Act on Electronic Communications. Following this informal public consultation, the Office also reserves the right to make changes to both the content and the structure of the document.*



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B) Executive summary

The Czech Telecommunications Office (hereinafter referred to as 'CTO'), as the central public administration body responsible for ensuring the management and efficient use of radio frequencies, has drawn up and is submitting to the Government a new National Radio Spectrum Management Strategy (hereinafter referred to as the 'Strategy'). The Strategy defines the ČTÚ's short- and medium-term⁵ objectives and implementation measures, in response to studies carried out, international developments, current trends and the needs of industry, network operators and service providers, taking into account the irreplaceable role of the radio spectrum in the future development of society.

The purpose of the Strategy is to create the conditions for achieving the set objectives regarding the efficient use of radio frequencies, **for the development of public networks, private networks and industrial applications utilising radio frequencies** across a wide range of economic sectors, and, last but not least, for the use of radio frequencies in the fields of research, civil protection, or for the benefit of businesses and citizens. The measures implemented are also intended to contribute to the development of economic competition.

With regard to **the future use of the UHF band**, which also includes the 600 MHz band, the Strategy continues **to prioritise the sustainability of terrestrial digital TV broadcasting (DTT)** for the period beyond 2030. At the same time, the Strategy sets out the Czech Telecommunications Office's (ČTÚ) intention to continuously monitor the state of utilisation of alternative TV broadcasting distribution platforms and to prepare proposals or recommendations for EU legislative acts on DTT. The Strategy also proposes, for a transitional period (until 2030), the possibility of time-limited access to the internationally coordinated frequencies of broadcasting networks Nos. 25 and 26 in order to improve the quality and availability of DTT.

The Strategy's proposed measures to **support 5G** and future-generation **mobile networks** also take into account **the promotion of their use in industrial applications**. This intention builds on both the existing obligations of radio spectrum allocation holders in certain 4G and 5G bands and the established practice of parties interested in using spectrum to reach agreements on the use of spectrum for non-public purposes, even beyond the obligations imposed in mobile operators' radio spectrum allocations (i.e. licences). The 4G/5G bands, including the 3.4–3.8 GHz band and the 26 GHz band, may be included amongst the bands of interest for industrial and non-public applications, alongside bands suitable for the development of the operation and communication of unmanned aerial vehicles.

At the same time, the Czech Telecommunications Office (ČTÚ) is defining **measures for further frequency bands, aimed at enabling the continued development of services based on new, modern technologies**, and at supporting high-quality connectivity for future use by modern devices, particularly within buildings, buildings and industrial halls, so that their capabilities for interoperability with modern transmission systems for public or industrial applications based on 5G and future technologies can be fully utilised.

Last but not least, the CTU aims, in cooperation with other state bodies, to systematically act as **a responsible** and modern **spectrum manager** which, with the assistance of external experts, possesses sufficient technical capacity to meet society's needs. A key aspect of ensuring the effective management of the spectrum therefore remains the provision of transparent information to the professional community and radio spectrum users on matters that are significant for its use, not only within the Czech Republic but also in a European and, more broadly, international context.

The proposed measures set out in the Strategy will be implemented through amendments to the conditions for the use of frequencies and related areas by means of measures of a general nature (in particular the radio spectrum utilisation plan and general authorisations for the use of radio frequencies); furthermore, use will be made of the options for establishing the necessary

⁵ Individual strategic measures are defined for short-term (2 years), medium-term (2–5 years) and long-term (10 years) or permanent timeframes.

conditions in radio frequency allocations; new solutions will be developed via web applications and further refined; and legislative proposals or recommendations will be put forward, including proposals for European and international negotiations as part of cooperation on harmonised solutions. To this end, the CTU will continue to engage in consultations with industry representatives, expert and academic groups, public debates and other procedures.

As an integral part of the proposed measures, the Strategy also includes the CTO's intention to prepare a proposal to amend the levels of fees for the use of the radio spectrum (and the principles for setting them) for selected categories of radiocommunication services. The aim of such an adjustment is, in particular, to promote the efficient use of the radio spectrum by removing barriers to its use, deploying new technological solutions, and developing the range and provision of modern and ancillary electronic communications services.

1. The purpose of this document and its link to the existing 'strategy'

This document is based on the role of the Czech Telecommunications Office (ČTÚ) and its objectives in the field of radio spectrum management. It carries out this role on the basis of the powers conferred by Act No. 127/2005 Coll., on electronic communications and amending certain related acts (the Electronic Communications Act), as amended (hereinafter also referred to as the 'ECA'), and takes into account the CTU's close cooperation with other state bodies, including local authorities, representatives of spectrum users, providers of electronic communications services, representatives of the academic community and other experts.

The Strategy focuses in particular **on addressing the needs arising in relation to spectrum management which are not specifically set out in the existing legal and regulatory framework**, i.e. the Electronic Communications Act (ZEK) and related regulations under the remit of the CTU, in particular measures of a general nature (PVRS, VO-R).⁶ These needs must be consistent with the principles defined by the existing legal framework, which include, in particular, the promotion of the efficient and effective use of the radio spectrum, the promotion of shared use of the radio spectrum, measures to facilitate the rapid development of new wireless communications, and the promotion of long-term investment. Interactive communication and cooperation with relevant stakeholders and experts, the incorporation of innovation – for example, through software tools, the automation of certain tasks and the sharing of information relating to spectrum management – as well as publishing and awareness-raising activities, the use of modern communication tools when communicating with the public, and other procedures are key to achieving effective radio spectrum management.

This Strategy builds on the Radio Spectrum Management Strategy adopted by Government Resolution No. 421 of 3 June 2015, subsequently updated by the first Progress Report on the Implementation of Measures under the Strategy (discussed by the Government on 16 May 2018) and the second Progress Report, discussed by the CTU Council in August 2022.⁷ During the period from 2015 onwards, 40 specific measures⁸ were proposed, of which 35 were implemented in accordance with the original framework assumptions. These include, for example, the reorganisation of the TV spectrum and the digitisation of TV broadcasting, the allocation of the 700 MHz and 2.6 GHz bands (unallocated portions) to mobile operators for the purposes of public 5G networks, together with the gradual allocation of the 3.4–3.8 GHz band for 4G and 5G networks, making the 60 GHz band available for licence-exempt use with the innovative incorporation of coordination algorithms to support self-regulation; making further bands available for Wi-Fi at 5.2 GHz and 5.8 GHz beyond the scope of European harmonisation; introducing conditions for wide radio channels in microwave links to support high-speed communications; launching a range of information websites and databases for users and businesses; conducting a spectrum auction for commercial DAB digital radio networks; the ongoing optimisation of fee schedules for the use of radio frequencies with the aim of stimulating the efficient use of spectrum and investment; and other measures. The 2015 strategy also defined the main long-term and ongoing objectives, which are based on the Radio Spectrum Act and remain valid for achieving the goal of ensuring the efficient use of the radio spectrum: making frequency bands available

² <https://ctu.gov.cz/vydana-opatreni>

⁷ The Government did not discuss this report.

⁸ The summary reports are set out in the Progress Reports on the Strategy from 2018 and 2022, <https://ctu.gov.cz/strategie-spravy-radioveho-spektra>.

for utilisation, predictability, transparency and communication with the public, harmonised use of the radio spectrum, and its flexible and shared use, which is becoming an increasingly urgent task for **modern and sustainable spectrum management**.

2. Pillars of long-term sustainable spectrum management

Spectrum management will continue to build on existing best practice (broad consultation, involvement of experts, cooperation with international partners, duly justified regulatory measures and so on), whilst simultaneously developing new procedures. At the same time, spectrum management measures support the development of competition between network operators and, subsequently, between service providers. Spectrum management is based on four key pillars.

2.1. First pillar: Making frequencies available for the development of services and applications

Technological developments create the conditions for new uses of frequencies, thereby creating pressure to make frequencies available for new services or applications. Conversely, there may be services or applications using frequencies whose significance or use is declining or has ceased altogether.

In the interests of the efficient use of spectrum, activities in this area should focus on identifying users, services or applications for which spectrum availability needs to be ensured, as well as on identifying spectrum suitable for meeting the needs of users or services. This area is influenced to a certain extent by harmonisation measures at international level.

Spectrum management for this pillar will

- continue to create **the conditions for the availability of spectrum and its efficient use** by both the private and public sectors, including industrial applications,
- and will continue to identify frequencies for potential users.

2.2. Second pillar: Creating the legislative framework and conditions for effective spectrum management

Spectrum management, in the interests of the efficient use of frequencies, requires the establishment of clear, comprehensible and enforceable rules.

In this area, the CTU focuses on identifying, preparing and proposing measures and rules relating in particular to the technical, organisational and economic aspects of spectrum management, thereby contributing to the creation of the conditions for the efficient use of frequencies.

Under this pillar, spectrum management will

- to continue to involve experts in the discussion of proposed measures and rules,
- take into account expectations regarding a predictable and fair charging policy,
- and actively and clearly describe and explain the specific rules and principles governing the use of spectrum.

2.3. Third pillar: Implementation of processes, approaches and tools for the efficient use of spectrum

Effective spectrum management should be based, amongst other things, on relevant information regarding the current use of frequencies and supported by optimised approaches and effective tools, for example through the use of innovative technologies.

To support the efficient use of spectrum, the CTU ensures, amongst other things, the collection, analysis and verification of available and relevant information, and monitors compliance with the conditions for spectrum use. It also implements procedures

and tools that can be used to adapt the rules governing the use of spectrum to real-world operational conditions (for example, by setting parameters for the operation of equipment to prevent harmful interference, or by taking measures to minimise the impact of harmful interference on operations on the part of both the interfering and the affected parties), as well as the practical and effective implementation of tools for the efficient use of spectrum (such as spectrum sharing), taking into account, amongst other things, the possibilities for automation.

Under this pillar, the CTU will

- continue to improve the system for collecting relevant information on spectrum usage for the purposes of effective spectrum management,
- deploy modern and effective tools for spectrum management,
- utilise the results of research and real-world testing to determine the optimal operating parameters for radio stations whilst minimising the risk of harmful interference.

2.4. Fourth pillar: Developing expertise and awareness in the field of radio spectrum management and use

For sustainable spectrum management, it is necessary, through cooperation between relevant bodies, to create the conditions for the involvement of a sufficient number of experts with the necessary knowledge, not only at the level of central government but also in other sectors. An important role in raising awareness is played, for example, by the dissemination of clear information on the importance of radio frequency use for innovation, the development of new services and, more generally, for the functioning of modern society.

The CTU will therefore, together with other stakeholders, focus on creating sustainable conditions for training experts in the field of spectrum management and utilisation, for their active involvement in professional practice at both national and international levels, and on disseminating information on the importance of radio frequencies in a form that is appropriate and comprehensible to specific target groups. The CTO's measures will focus on engaging specific experts in spectrum management, particularly on motivating them and subsequently retaining them within the spectrum management sector.

3. Vision for spectrum management

The long-term vision of this Strategy is to promote the benefits to society as a whole of radio spectrum use. These include, in particular, high-quality and nationwide modern public mobile networks, local or regional access networks, broadcasting networks for the distribution of radio and television programmes, the development of access to electronic communications networks, and the availability of radio frequencies for various users and applications, ranging from licence-exempt use⁹, including consumer electronics, through to private and industrial networks. The proposed measures are also intended to support the fulfilment of society's growing needs, such as the development of services requiring low latency, high data throughput, reliability and secure connectivity. Examples of such services include industrial and gaming applications, advanced cloud applications, remote learning and working, augmented reality utilising elements of artificial intelligence (AI), and many others. Newly emerging services will continue to be taken into account both at the level of national spectrum management and in the international harmonisation of conditions for the use of radio frequencies. For these new or emerging services, it will be necessary **to make suitable portions of the radio spectrum available** and to introduce new approaches to spectrum management, for example in the area of shared use of frequencies.

⁹ Operation under a general authorisation for the use of radio spectrum.

Vision for responsible spectrum management:

Ensuring society-wide benefits from the efficient use of the radio spectrum.

4. Prerequisites for further development and strategic priorities for spectrum management

Our lives are increasingly taking place online. People and businesses are relying more and more on online services, such as financial services, video on demand, communication with public authorities, distance learning or remote working, and many other areas. Communication via the internet is, above all, an integral part of our lives, with communication networks becoming ever more important for the functioning of the economy and for personal and business use. New consumer experiences are developing alongside traditional forms of communication. Significant investment is being channelled into the online world and into virtual worlds, such as the metaverse and **augmented reality**. The Internet of Things (IoT, M2M) will continue to develop, as will the associated technical and operational support for these applications via electronic communications networks. The social and economic importance of communications networks will continue to grow, and ever-greater demands will be placed on them in terms of speed, reliability and security, particularly with the development of cloud services. They will also require the development and deployment of energy-efficient technologies.

In line with the expectations of the general public, the availability of internet access and coverage by high-speed networks – both fixed and wireless – will continue to expand, whilst **further development** will **focus on the quality of existing** services and the support of new ones, a good user experience, and the reliability of networks and services, including a further increase in their availability. The future world of wireless communications will require not only higher data throughput for certain applications, but also **low connection latency** and high security, initially particularly in professional or local applications. Even in the distant future, however, we expect today's operational and user models to remain in use.

The growing importance of the spectrum in modernising and improving the efficiency of industrial processes, the smooth flow and safety of transport, the protection of health and property, as well as in research, meteorology and environmental protection, places increased demands on the efficient use of the spectrum, including **making frequencies available to new services and applications**. This also creates scope for the development of competition in the fields of services, networks and technologies.

Previous experience shows that, in order to set the right regulatory course, it is essential to balance the interests of the national market, spectrum users and end-users with the availability of suitable technologies or applications. This objective can be achieved through **broad discussion and cooperation with the electronic communications sector**, experts and other stakeholders, with the aim of reaching consensus on the proposed steps and measures. It is also a means of incorporating insights from international institutions.

International cooperation in the field of spectrum management and harmonised conditions takes place at a global level within the International Telecommunication Union (hereinafter also 'ITU') and is driven both by the study groups of the Radiocommunication Sector (ITU-R) in study groups, and by the programme of World Radiocommunication Conferences (WRCs) (currently WRC-27 and WRC-31), the purpose of which is to review and update the International Radio Regulations.¹⁰ WRC conferences also set global strategic directions. For the period following WRC-23, the main areas of focus include, in particular, satellite communications, including the study of conditions for the direct connection of user terminals to satellites

¹⁰ A brief summary of the WRC-23 conclusions is set out in the press release of 15 December 2023 (<https://ctu.gov.cz/tiskova-zprava:-prvni-zavery-radiokomunikacni-konference-wrc-23:-frequencies-for-terrestrial-tv-guaranteed>) and in greater detail in Monitoring Report No. 1/2024 (<https://ctu.gov.cz/monitorovaci-zprava-c.-12024>).

networks in low (LEO) and medium (MEO) Earth orbits, as well as points relating to scientific applications and, for example, the search for additional spectrum bands for IMT mobile networks (i.e. 5G and its technological successors).

In the field of international cooperation, the Czech Republic is represented on the CEPT Electronic Communications Committee (**ECC**), which, through extensive cooperation amongst 46 European member countries, discusses specific issues relating to spectrum harmonisation, technology standardisation, the coordination of spectrum policies and procedures, and the resolution of international issues. CEPT/ECC plays a key role in creating a unified and coordinated environment for electronic communications in the European region and provides the technical basis for forthcoming EU measures.

National measures should be implemented in line with and in accordance with European strategies such as the EU Digital Decade¹¹ and the EU Digital Compass, although we recognise that some of the targets may be somewhat ambitious. The work of EU bodies, such as the RSPG,¹² will play a significant role in further developments.

Experts and institutions should actively **engage in research projects** in the field of spectrum management, related regulation and the development of innovative solutions. For example, the growing demand for available spectrum, coupled with the exhaustion of its extensive use, will require increasingly complex approaches to the coexistence of various radio equipment, technologies and radiocommunication services. Science, research and innovation will play a key role in supporting innovative potential and delivering benefits for citizens and businesses alike. Examples include testing technologies in the UHF band or seeking solutions for the 6 GHz and 4 GHz bands (see section 5.2.3.), proposals for specifications for 6G applications, and global issues discussed within the International Telecommunication Union.¹³

With the growing importance of spectrum use across various sectors, it is essential **to foster a sufficient number of experts with the necessary knowledge** who will actively engage in spectrum management practices. This can be achieved by raising awareness of the importance of radio frequencies for innovation and the development of modern society; by collaborating with universities and involving experts in national and international projects; by promoting attractive working conditions and training staff in spectrum management; and by raising awareness of the importance of radio frequencies amongst both the professional community and the wider public.

Where possible and appropriate, consideration should be given to a transition to **modern regulation with a reduced role for the state, and to transferring responsibility to those interested in using frequencies and to existing frequency users**. The desired outcome should be the development of conditions for a flexible regulatory system which, through risk assessment, experience and the application of corrective mechanisms, responds to new challenges and changes in the environment in which regulation operates. This should also be facilitated by increasing **the automation of certain spectrum management processes, thereby enabling greater involvement of prospective spectrum users in the process of mutual coordination of spectrum use, particularly in cases where the benefits of such coordination have an equally positive impact on all participating entities (prospective spectrum users)**.

¹¹ Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the 'Digital Decade 2030' policy agenda.

¹² Work Work RSPG for the years 2024–2025 was consulted in in 2023:
https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-10/RSPG23-045final-Draft_RSPG_WP24_and_beyond_proposal.pdf.

¹³ An example is the agenda of the WRC-27 conference, which includes, for example, spectrum studies for mobile or satellite networks and links, scientific applications and procedures for the efficient sharing of spectrum.

Strategic long-term priorities for spectrum management:

1. Quality of service, service development and promotion of competition
2. Availability of spectrum
3. A greater role for spectrum users
4. Cooperation with experts and the sector
5. International cooperation
6. Development of expertise in spectrum management
7. Research projects, including experimental operations

c)

5. Tools for delivering strategic priorities

Spectrum management will continue to build on existing best practice (broad consultation, involvement of experts, cooperation with international partners, duly justified regulatory measures and so on), whilst developing new procedures. Measures planned or already underway to fulfil strategic priorities also include specific steps for individual frequency bands, services and applications.

5.1. Measures across spectrum management

The following long-term general principles and approaches represent important tools for achieving objectives in individual areas:

- (1) **Availability of spectrum and its efficient use:** Technological developments create the conditions for new uses of spectrum and exert pressure to make spectrum available for new services or applications. Conversely, there may be services or applications using spectrum whose significance or use is declining or has ceased altogether. The CTU will identify users, services or applications for which it is necessary to ensure the availability of frequencies. This area is influenced to a certain extent by harmonisation measures adopted at international level.
- (2) **Effective use of harmonisation:** The Czech Republic has traditionally been an active participant in the preparation of strategic documents and decisions at EU level, as well as in global negotiations on the harmonisation of conditions for the use of the radio spectrum. In the context of **international cooperation**, the Czech Republic will continue to support the identification and adoption of uniform procedures where possible and appropriate, as well as harmonisation and the creation of scope for innovation; however, particularly with regard to proposals for measures at EU level, the Czech Republic will also take into account **the principles of subsidiarity and proportionality**, which afford EU Member States a certain degree of freedom in deciding on certain conditions for the use of frequencies. Examples of valid reasons for national decision-making include the use of spectrum by non-public networks, short-term applications or industrial use, or taking into account the national context regarding the use of certain bands, such as the UHF band (470–694 MHz).
- (3) **Innovation, technology and new algorithms in spectrum management:** The Czech Telecommunications Office (ČTÚ) will continue to support the experimental use of radio frequencies and will analyse in greater detail the findings obtained from such experimental use. When seeking solutions for shared use of frequencies, the potential for incorporating algorithms and automated procedures in general will be utilised where deemed appropriate.
- (4) **Promoting competition:** Given the significant role played by small and medium-sized enterprises in the Czech Republic's electronic communications market in providing electronic communications networks and services using radio frequencies, the CTO will continue to take steps to foster competition, for example by creating conditions to make spectrum available to **smaller spectrum users**.
- (5) **Local use of frequencies:** The CTU will examine the possibilities and conditions for the local use of spectrum that reflects local market needs or other local requirements (for example, for industry or local authorities). However,

where harmonised solutions, or solutions that can also be applied in other countries, represent a better option due to the development of broader commercial and business opportunities, and in the interests of end-users, the CTU will support the implementation of harmonised solutions.

- (6) **Licence-exempt spectrum use** and the development of new technologies and advanced usage models in connection with the virtualisation of the world (VR, AR, XR): The development of virtual reality applications in education, medicine, schooling, telepresence, computer games and, more generally, in human-computer interaction or next-generation systems requires sufficient spectrum capacity. Although these applications are not yet widely used in their early stages, they are expected to become increasingly widespread in certain areas of modern society. Further expansion of the possibilities **for licence-exempt spectrum use**, in synergy **with the development of** optical and **mobile networks** and applications, will contribute to supporting the development of such applications. In view of the development of the European and global markets for consumer electronics utilising the radio spectrum, the harmonisation of conditions for the use of frequencies for applications that will contribute to the development of wireless platforms will continue to be supported, with a view to meeting society's new needs. An example of a promising frequency band for licence-exempt use is the 6 GHz band.
- (7) New **spectrum-sharing** models: A number of new demands for spectrum use, including private mobile networks and industrial networks, are directed towards bands used in the Czech Republic for fixed microwave links (for example, in the 3.8–4.2 GHz, 6 GHz or 40 GHz), or those used in Europe by satellite systems or for communications relating to national security (the 7 to 24 GHz bands); consequently, these bands cannot be made available without further measures. When seeking new frequencies to meet new demands for spectrum use, it is therefore advisable to look for spectrum-sharing **models** which, within the framework of available modern technologies, **will not be restrictive for existing users**, or which will offer existing users adequate alternatives. Proposals for sharing conditions will be **based on** quantitative **analyses** of interactions between services, which are **fact- and evidence-based** and are sufficiently robust, transparent and reproducible.
- (8) Participatory decision-making and strengthening **the public's role** in spectrum management: **Deepening expert discussion**, sharing information, actively involving experts – including representatives from academia – continuing to develop websites providing information on spectrum use, and other elements of broad cooperation are key tools of modern spectrum management. The existing expert platform of the Spectrum Working Group¹⁴ has proved its worth, and the ČTÚ will further expand its use for communication with the sector. The CTU intends to continue its cooperation with external specialist organisations, both in the engineering and technical fields and in the development of related IT systems for spectrum management, as well as in the **development of modern legal, regulatory and international principles of spectrum management**. For example, the development of corrective mechanisms to enable the review, amendment or correction of existing conditions in the event that regulation or self-regulation fails or does not achieve its intended objectives. Spectrum management will further develop the principles **of open public administration**, which involve the use of procedures to increase transparency, efficiency and interaction between the state and citizens, businesses and other entities (transparency, participation, digitalisation, efficiency and other areas).
- (9) **Publicly accessible tools and information**: In order to implement the measures set out in points (1), (3), (7) and (8) concerning the availability of frequencies, spectrum sharing, innovation and public engagement, the conditions for the feasible and successful implementation of strategic priorities include **the need for access to data on spectrum usage** and tools for **shared frequency usage procedures**.¹⁵ Where possible, modern tools and procedures will be developed, such as

¹⁴ An inter-ministerial group comprising over 50 experts, coordinated by the Czech Telecommunications Office (ČTÚ) in cooperation with the Ministry of Industry and Trade (MPO).

¹⁵ The Czech Telecommunications Office (ČTÚ) has developed and operates a range of applications that make spectrum information available, such as a portal on mobile network and TV signal coverage, the NetTest connection measurement tool and a visualisation tool (<https://vportal.ctu.gov.cz>), a portal for coordination in the 60 GHz band (<https://rlan.ctu.gov.cz>) and the <https://spektrum.ctu.gov.cz> portal with information on the conditions for spectrum use.

the gradual release of information on the use of the radio spectrum¹⁶, whilst respecting the need to ensure national security and the protection of critical electronic communications network infrastructure. Making data on spectrum use available may, for example, contribute to the feasible implementation of opening up the 4 GHz, 6 GHz or 26 GHz bands for local use or fixed wireless access; see, for example, Chapter 5.2.3, points (a), (d) and (e).

(10) Greater involvement of the professional community, in the form of expanding **the existing expert platform** to include representatives from the sector, as well as making significantly greater use of its potential, is an important prerequisite for the development of modern spectrum management. As part of its cooperation with other administrations in the field of spectrum management, in the context of the European Union's common objectives, the CTU will create the best possible conditions for the involvement of experts, both in matters relating to wireless communications and international cooperation on spectrum harmonisation and European policies, and in matters concerning the development of new technologies and the sharing of outcomes with other administrations.

(11) **Setting of fees** for the use of frequencies and the value of spectrum: The schedule of fees for the use of radio frequencies is laid down by the relevant government regulation.¹⁷ Adjustments made in previous periods have included, for example, the optimisation of rates in connection with technological developments and the introduction of wider radio channels in the fixed radio communications service, in mobile networks and in satellite communications. During discussions on the appropriate setting of fees, societal objectives relating to the introduction and development of new services, the efficient use of spectrum and consideration of competitive aspects are usually balanced against the economic interests of spectrum users, which aim to minimise operating costs and stimulate investment.

D) The Czech Telecommunications Office (ČTÚ) will launch further discussions on the fee policy for the use of radio frequencies with the aim of promoting the efficient use of frequencies and creating opportunities for the further development of existing and new services, including support for their maximum possible availability and for innovative approaches to the use of radio frequencies, whilst taking into account best practice in fee policy. Options for supporting investment in the development of electronic communications networks will be analysed, as will discussions on stimulating investment in areas with insufficient coverage by mobile and fixed-line networks, including, for example, through the use of selected spectrum usage fees. The possibility of introducing special coefficients when calculating fees for the use of frequencies in areas of interest will be assessed.

E) The primary objective of the revision of the fee policy is not to maximise revenue from the collection of fees, but to take account of new technological solutions in the use of radio frequencies, to ensure the efficient use of the spectrum, to support demand for modern services, and to take into account the economic impact of the fee policy on spectrum users.

(12) **International cooperation**: During Europe's preparations for the WRC-23 conference, the Czech Republic contributed to the drafting of proposals on several items, covering both procedural and strategic matters as well as substantive issues. Examples include a proposal for studies in the Upper 6 GHz band regarding conditions for RLANs, and a proposal for the **shared** use of this band by both IMT and RLAN applications whilst ensuring coexistence with existing users of the band. Representatives of the Czech Republic will **continue to participate**, within the framework of international cooperation, both **in technical matters relating to wireless telecommunications** and innovations in this field, and **in shaping Europe's strategic direction** regarding spectrum harmonisation and the roll-out of new services. Examples include the Czech Republic's involvement in the work of CEPT/ECC and its active participation in EU committees and groups, in particular the RSPG and RSC.

(13) **Developing expertise and awareness in the field of radio spectrum management and use**: With **the growing importance** of radio frequencies for network deployment, industry and everyday life, it is essential to ensure there are sufficient experts in

¹⁶ In accordance with Section 15 of the ZEK.

¹⁷ 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, as amended.

this field. The CTU, in cooperation with relevant bodies, will create the conditions for attracting and retaining qualified specialists with a focus on equipment manufacturing, station operation, research, public administration and other related sectors. The aim is also to disseminate clear information on the importance of radio frequencies for innovation and the functioning of modern society. This can be achieved, for example, through collaboration with universities, the provision of work placements, publications and participation in national and international projects. The CTU will focus on collaboration with the academic sector. Creating attractive working conditions in spectrum management within state institutions and enhancing the expertise of existing staff. Outreach activities aimed at raising awareness of the importance and potential of radio frequencies amongst both the professional community and the wider public. These steps will ensure the long-term development of the professional workforce and support the efficient use of the radio spectrum.

F)

Measures across spectrum management to fulfil strategic priorities:

- The CTU will continue **discussions with user representatives and the sector** on establishing optimal conditions for the efficient use of frequencies.
- The CTU will continue **to develop modern approaches to spectrum management**, such as promoting competition, advanced spectrum sharing, developing support tools for spectrum management, local and licence-exempt spectrum use, adapting regulatory conditions based on practical experience, introducing innovative solutions, engaging experts and deepening international cooperation.
- During 2025, the CTU will draw up **a proposal** for the Ministry of Industry and Trade **to update 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.¹³

G)

5.2. Measures for individual frequency bands, services and applications

Certain frequency bands are, or will be, the subject of negotiations on **the conditions for new** or emerging **services or applications**. The following sections summarise the areas in which the CTO, together with other stakeholders, is analysing or preparing appropriate solutions to meet such needs.

5.2.1. UHF as a band of great value to society as a whole

The UHF band must be viewed from a comprehensive perspective, taking into account both current needs and future opportunities, which should lead to the development of modern platforms for the provision of electronic communications services and support the long-term prosperity of the Czech Republic.

5.2.1.1. Current use of the UHF band in the Czech Republic and development trends

The 470–962 MHz band was originally used almost exclusively for terrestrial TV broadcasting. The advent of DVB-T/T2 digital television broadcasting marked a fundamental shift in the quality of TV reception, enabled a significant increase in the efficiency of spectrum utilisation, and led to such an increase in transmission capacity that it was possible, in two stages, to narrow the band for terrestrial TV broadcasting to the 470–694 MHz and to make the freed-up spectrum available for the development of public mobile networks (first the 800 MHz band, then the 700 MHz band). In Europe, these steps were the result of joint action and harmonised conditions which, as binding on Member States, contributed to the coordination of processes and the roll-out of new technologies. The band also permits the operation of wireless microphones and PMSE (Professional Mobile Satellite Earth) applications.

Following the release of the 700 MHz band, the Czech Republic transitioned from DVB-T technology to the more advanced DVB-T2, enabling a further increase in capacity (resulting, for example, in an increase in the number of TV channels and more intensive use of HbbTV services), without restricting the scope of existing TV broadcasting in terms of geographical coverage or the range of

TV programmes. At the same time, 5G mobile networks have been introduced, and the geographical coverage of mobile services, including internet access, has been further expanded.

Currently, four nationwide DVB-T2 multiplexes and other regional and local DVB-T/T2 networks are operated in the 470–694 MHz band in the Czech Republic. Rights to use radio frequencies are granted to holders of nationwide radio frequency allocations until 31 December 2030; in the case of regional and local networks, individual authorisations are granted with a maximum validity period of five years.

The release of the 800 MHz band was crucial to the rapid roll-out of 4G/LTE mobile networks and the successful, widespread adoption of mobile internet.

Decisions on future steps in Europe, and the framework conditions, will **be taken jointly and in a coordinated manner** based on an analysis of development trends and needs. These currently indicate a general trend towards an increase in the share of internet-based TV broadcasting platforms at the expense of terrestrial and satellite broadcasting. However, this trend is not uniform across all European countries. There are countries where the share of terrestrial broadcasting is already minimal – in one case, it has already been phased out – but there are also countries that are only just completing plans for its more advanced digitisation. The results of EU studies¹⁸ show that, given the significant differences in the role of terrestrial TV broadcasting across Member States, there is no justification for introducing further harmonisation measures to reorganise the spectrum; rather, it is appropriate to maintain the guarantees set out in the Commission Decision¹⁹ regarding the use of the spectrum for terrestrial TV broadcasting and not to alter them. **Flexible use of the band** for other purposes is possible provided that there is no interference with the frequencies used for television broadcasting. Tests of 5G Broadcast technology have also been carried out in the Czech Republic, which, amongst other things, verified the capabilities of the technology used and assessed reception on mobile devices in practice.²⁰

The conditions for applying flexibility in the use of the UHF band and potential alternatives for the future use of the band are addressed in the RSPG's position paper²¹ from 2023. The RSPG's consultation on the UHF band from October 2024²² will contribute to the drafting of appropriate framework conditions for the flexible use of the band in the EU.

5.2.1.2. Broadcasting Networks Nos. 25 and 26

As part of the preparations for the transition to the DVB-T2 standard, the Strategy for the Development of Terrestrial Digital Television Broadcasting (hereinafter the 'DTT Strategy')²³ proposed two nationwide networks, designated as Network No. 25 and Network No. 26, intended to serve as compensatory networks. In this context, Network No. 25 was considered as a potential development network to compensate for the loss of frequencies in DVB-T Networks Nos. 2 and 3 (České Radiokomunikace a.s. and Czech Digital Group a.s.), whilst Network No. 26 was intended to enable the expansion of Czech Television's regional broadcasting. The proposed allocation of these networks for the aforementioned purposes was conditional upon compliance with competition rules at both national and European level, and the adoption of appropriate legislative measures. In the case of Network No. 26, the DTT Strategy stated that, should the legislative measures be delayed (amongst other possible reasons), the frequencies would be used on the basis of individual licences

¹⁸ Study on the use of the sub-700 MHz band (470–694 MHz): <https://op.europa.eu/en/publication-detail/-/publication/8c6755a1-4f55-11ed-92ed-01aa75ed71a1/language-en/format-PDF/source-search>

¹⁹ Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 2017 on the use of the 470–790 MHz frequency band in the Union: <https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:32017D0899>

²⁰ Annex III to the RSPG Opinion of October 2023: https://radio-spectrum-policy-group.ec.europa.eu/document/download/6cb17632-9aba-4a15-ae9-28b9d272d9ed_en?filename=RSPG23-035final-RSPG_Opinion_on_UHF_beyond_2030.pdf

²¹ https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-10/RSPG23-040final-RSPG_Opinion_on_5G_developments_and_6G_spectrum_needs.pdf

²² https://radio-spectrum-policy-group.ec.europa.eu/consultations-0_en

²³ <https://www.mpo.gov.cz/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepcie-a-strategie/strategie-rozvoje-zemskeho-digitalniho-televizniho-vysilani/strategie-rozvoje-zemskeho-digitalniho-televizniho-vysilani-247262/>

without the need for a tender procedure. Given the close connection, it is appropriate to apply this expectation to the case of Network No. 25 frequencies as well.

Given that the relevant legislation has not yet been adopted, nor is it currently being drafted or submitted to the legislative process, it is appropriate, in the interests of ensuring the efficient use of radio frequencies (Section 5(2)(b) of the Electronic Communications Act), to permit at least the time-limited use of the radio frequencies of networks Nos. 25 and 26. To this end, the Czech Telecommunications Office (ČTÚ) will amend the relevant section of the Radio Spectrum Utilisation Plan to allow the use of the radio frequencies in question on the basis of individual authorisations valid until 31 December 2030.

5.2.1.3. The UHF band in an international context

The propagation of radio waves in the 470–694 MHz band requires mutual coordination between states regarding its use. The conditions set out in the Geneva Agreement of 2006 are decisive; this agreement allocated frequencies to states for use in broadcasting (meaning radio and television broadcasting), subject to compliance with defined spectral emission masks and other conditions.

In light of the evolving needs of modern society and the successful development of nationwide mobile networks designed to provide publicly available electronic communications services, **there has been an ongoing debate** at both international and national levels **regarding further opportunities** for utilising **the UHF band**, particularly with regard to the potential for future use of the band by cellular nationwide networks, for which this band is optimal for technical and economic reasons, especially in terms of providing continuous signal coverage of the territory.

Following the extension of the UHF band – which has hitherto been prioritised for broadcasting – to include new co-primary²⁴ allocation of the 800 MHz band (WRC-07) and the 700 MHz band (WRC-12, with conditions added at WRC-15) for mobile networks intended for IMT (public cellular networks), the WRC-15 conference decided²⁵ that the WRC-23 conference would discuss further steps. European countries, given the importance of terrestrial TV broadcasting in a significant proportion of European states, pushed through a proposal at WRC-23 to **maintain the conditions for broadcasting**, on the understanding that the possibility of a primary allocation of the band, or part thereof, to mobile services for the European region would not be discussed until WRC-31.²⁶ At the same time, **the WRC-23 conference** took into account the requests of several countries outside Europe regarding the possibility of using the 614–694 MHz band for public IMT mobile networks (within the territories of those countries). The next revision of the conditions set out in the Radio Regulations for the 614–694 MHz band will therefore be carried out²⁷ at the WRC-31 conference. These conditions are particularly significant for certain countries bordering regions outside Europe; **for the Czech Republic, the EU regulatory framework** is of particular importance, which is currently based on the Opinion on the strategy for the future use of the 470–694 MHz frequency band after 2030 in the EU²⁸. This approach creates the conditions for decision-making on the UHF band at EU and Member State level. In particular, the Opinion emphasises **the importance of a flexible approach** at national level²⁹, consisting mainly of taking national needs into account, with countries cooperating with one another at bilateral and multilateral levels. This, for example, allows countries where terrestrial TV broadcasting has been reduced or discontinued to roll out advanced mobile communications.

²⁴ Co-primary allocation means that the radio communication service in question is listed alongside other services as having priority.

²⁵ Resolution 235 (WRC-15): https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000C0036PDFE.pdf

²⁶ Europe's proposal was supported by the common position of the EU Member States, which set out their position for the WRC-23 conference in the Council Decision of 15 September 2023 on the position to be taken on behalf of the EU at the World Radiocommunication Conference of the International Telecommunication Union in 2023 (WRC-23).

²⁷ The task was only assigned through revised Resolution 235 (rev. WRC-23).

²⁸ https://radio-spectrum-policy-group.ec.europa.eu/system/files/2023-10/RSPG23-035final-RSPG_Opinion_on_UHF_beyond_2030.pdf

²⁹ Article 4 of Decision (EU) 899/2017.

When revising regulatory documents – in this case, in particular, the anticipated future revision of Decision (EU) 2017/899 – the European Commission takes into account the recommendations of the RSPG as well as national experience with the use of the UHF band and opportunities for potential new applications or services within the band.

5.2.1.4. National measures relating to the UHF band

At present, there is not yet a sufficient amount of conclusive data and reliable assumptions available to estimate the long-term needs of Czech society beyond 2030. For this reason, the Czech Telecommunications Office (ČTÚ) will cooperate with individual ministries and stakeholders to produce a continuously updated forecast of the needs of society and state bodies in terms of frequencies and services that will be or could be provided in the UHF band, taking into account technological developments, the plans of neighbouring countries regarding the UHF band, opportunities to support and develop the market and competition, and the state's interest in creating **conditions** that will lead **to the long-term social and economic prosperity of the Czech Republic**.

In doing so, account will be taken of investments already made in DTT networks, the public interest in the long-term operation of the DTT platform – particularly for the distribution of public service linear broadcasting content – and, at the same time, the maintenance of conditions for private broadcasting in line with the principle of duality in television broadcasting. Another important aspect is the maintenance of a sufficient level of competition in the provision of communication networks for DTT transmission, even in the period after 2030, regardless of any changes in the use of the UHF band. At present, it is not possible to make responsible predictions in advance regarding the specific ways in which frequencies in the UHF band will be used in the future; however, it is desirable to consider possible solutions by **developing potential scenarios**, assessing their impact on end-users, existing and planned investments, and other factors. These scenarios, including the assumptions, estimates and trends used – which will be progressively refined in collaboration with stakeholders – should also include any proposals for amending the existing legal framework, should this be necessary for their implementation.

The RSPG²¹ opinion sets out possible scenarios for the period after 2030, ranging from the predominant operation of terrestrial TV broadcasting, through partial use by other applications (such as SDL unidirectional mobile networks), to the option of introducing a duplex frequency plan for mobile services.

In the Czech Republic, **the conditions for the long-term operation of DTT** have been and will continue **to be maintained even after 2030**, at least in part of the UHF band below 614 MHz.

The Czech Telecommunications Office (ČTÚ) anticipates that discussions on proposals for specific conditions will

commence in the second half of 2028. TV transmitter operators in the Czech Republic have repeatedly expressed an

interest in **continuing the operation of TV transmitters** beyond 2030.

At the same time, interest has been expressed both publicly and within the ČTÚ/MPO working group in exploring options for the future use of the band (after 2030) by mobile networks, with the aim of developing coverage by 5G networks and their next-generation successors (5G-Advanced). From a technical and economic perspective, the UHF band is optimal for ensuring coverage of the territory with mobile services.

In the coming period, national measures in the UHF band will focus on monitoring developments in terms of the availability of electronic communications services, the provision of content-viewing services and interactive services, with the aim of maintaining suitable platforms for content distribution.

From 2025 onwards, the Czech Telecommunications Office (ČTÚ), in cooperation with the Ministry of Industry and Trade, the Ministry of Culture, the Council for Radio and Television Broadcasting (RRTV) and other experts, will draw up an analysis of possible scenarios. This will require **the conduct of studies** covering, in broad terms, the following areas or parts thereof:

- H) Service requirements: Monitoring of indicators of developments in the provision of publicly available services via terrestrial radio and television broadcasting networks and other electronic communications networks; see **Annex A: UHF band – service requirements**.
- I) Study of options for the reorganisation of the UHF band (after 2030); see **Annex B: Possible focus of the study of options for the reorganisation of the UHF band (after 2030)**.
- J)

5.2.1.5. Strategy for the UHF band

With regard to the future use of the UHF band, individual steps and measures will be based on the preference **the sustainability of terrestrial digital TV broadcasting (DTT)** even for the period after 2030.

Medium-term outlook up to 2030

Radio spectrum management will be based on the premise that there is objective demand in the Czech Republic for TV reception services via the terrestrial broadcasting platform, and that its share in the Czech Republic will remain significant. Therefore:

- **Frequencies will continue** to be made available to public service broadcasters and private terrestrial **TV broadcasters** for the operation of their networks **until at least 2030**, in accordance with the conditions attached to radio frequency allocations already issued.
- The Czech Telecommunications Office (ČTÚ) will prepare a proposal for **the possible time-limited use of radio frequencies from networks 25 and 26**, which were created as part of the transition to the DVB-T2 standard, for the period up to 31 December 2030. Available frequencies that do not cause interference with frequencies allocated for TV broadcasting or mobile networks in the 700 MHz band may continue to be used for experimental testing of alternative broadcasting technologies, such as 5G Broadcasting, or for testing the operation of unidirectional SDL transmitters intended to increase download (downlink) in mobile networks, or to improve the quality and availability of DTT (coverage), or for the purposes of regional broadcasting.

K)

Long-term outlook (post-2030)

The conditions for the use of the UHF band will be based on the EU and Czech regulatory frameworks, unless affected by significant changes initiated at national level as a result of technical progress or changes in the consumption of audiovisual content. **The guiding principle** governing the conditions for the use of the band from the perspective of international coordination **is Article 4 of EU Decision ¹⁹on flexible conditions within the band**, which allows states to introduce services and applications on their territory based on national needs, provided that this does not restrict the use of frequencies – in particular for broadcasting – at national level or in neighbouring states. From the perspective of the EU's approach and the interests of the Czech Republic, international cooperation is therefore essential with a view to reaching agreements in cases where the use of UHF frequencies in these countries would not be compatible with the terms of the 2006 Geneva Agreement.

- In accordance with its obligations, the public service broadcaster will continue to have access to the UHF band under the current legal framework of the Czech Republic, even after 2030.
- Nationwide private broadcasters will continue to have access to the UHF band after 2030, provided they consider this to remain relevant to their business plans. The extent to which access will be provided will also depend on the studies and analyses carried out on future usage and needs (see also Chapter 7, Annexes A and B), and taking into account other existing platforms for the distribution of TV broadcasting.

- It is not currently possible to specify the availability of frequencies for regional or local broadcasters; however, this will be based on the priority need to secure frequencies for nationwide networks.

L)

M)

Short-term measures concerning the UHF band:

- With a view to ensuring the effective management and efficient use of available frequencies, in 2025 the Czech Telecommunications Office (ČTÚ) will amend the conditions of the radio spectrum utilisation plan to allow for **the time-limited use (until 2030) of frequencies from two as yet unused nationwide networks, Nos. 25 and 26**, under the allocation regime for internet access and high-speed network coverage.

Medium-term measures for the UHF band:

- **The wide-ranging discussion** with experts will continue, with the aim **of identifying the key principles and factors** that may be decisive for developments in the UHF band, and these will be given due consideration. Rather than the state making ex-ante decisions on the specific use of the UHF band or on timeframes, an ongoing dialogue will continue, drawing on a range of views. The key outcomes of these consultations are being, and will continue to be, shared on an ongoing basis within expert groups or published.
- The Czech Telecommunications Office (ČTÚ), in cooperation with other state authorities, will ensure ongoing **monitoring of developments** in terms of service requirements and available technologies, alongside monitoring indicators of developments in the provision of publicly available services via terrestrial radio and television broadcasting networks and other/ alternative distribution platforms.
- For the purposes of future alternative proposals for conditions in the UHF band, **a study** will be drawn up setting out options for **the possible reorganisation of the UHF band** (with implementation possibly taking place after 2030).

All considerations will be guided by the aim of minimising negative impacts on consumers, whilst also taking into account the creation of opportunities for the development of society as a whole and the prosperity of the Czech Republic.

5.2.2. Bands for terrestrial public mobile networks

Bands for nationwide 2G and 4G/5G networks: For nationwide coverage with full user mobility, the primary bands are the 700 MHz (5G), 800 MHz and 900 MHz (4G, 5G) bands, with the 1.8 GHz, 2.1 GHz and 2.6 GHz bands playing a supplementary role, intended primarily to boost capacity. To ensure high-speed connectivity, for example in more densely populated areas or for fixed wireless access, higher frequency bands are primarily used, including 3.4–3.8 GHz, where network operators are gradually rolling out 4G and 5G transmitters in line with market demand, their investment strategies and other parameters.

The CTU continues to verify compliance with the development conditions imposed in mobile operators' spectrum allocations, based on a combination of coverage simulations and calculations, as well as field measurements, including along transport routes. The aim is to continue, in future periods, to cooperate with government departments, mobile operators and infrastructure operators in efforts to improve territorial mobile signal coverage, particularly in sparsely populated areas – **so-called 'white spots'** – as well as along major rail corridors. To this end, the CTU will continue to utilise development criteria and other conditions imposed in radio frequency allocations.

Coverage of certain 'white spots' that do not fall under the original development criteria from the 4G and 5G auctions, or where coverage is not addressed through grant schemes (under the National Recovery Plan), will primarily be addressed through conditions set out in new allocations in the 900 and 1800 MHz bands.

When constructing base stations, mobile operators encounter a number of obstacles in many locations during complex administrative processes, particularly when obtaining consent from landscape conservation authorities, which restricts construction in protected areas or limits the height of telecommunications structures, thereby affecting the scope and effective possibilities

coverage or extension. Municipal zoning plans and restrictions relating to air traffic also impose limitations. Difficulties also arise in obtaining consent from landowners in connection with the planned construction of the necessary infrastructure. Another problem is posed by grant schemes that do not allow the use of ongoing construction work for mobile network infrastructure. The CTU will therefore, together with other ministries, advocate for **the removal of administrative barriers** in connection with the preparation of construction projects (the planning permission process). At the same time, the CTO will examine the possibility of establishing instruments (both regulatory and financial) to support the construction of fixed repeaters designed for 4G/5G signal transmission, which would ensure improved coverage in under-served settlements that, taken together, do not meet the definition of a 'white spot'.

As regards long-term trends, investment is expected to be channelled into the development of access networks and related infrastructure, with the primary aim **of improving coverage**. From the perspective of technological development and its impact on end-users, a gradual phase-out of GSM services and the progressive expansion of promising VoLTE voice services are anticipated. Further considerations regarding the smooth transition during the phase-out of 2G/GSM are set out, for example, in the conclusions of the review of the 900/1800 MHz bands.³⁰ Questions to be examined further:

- a) **Coverage gaps:** *How could coverage of these gaps be improved?* As part of the review to determine whether the reasons for limiting the number of rights to use radio frequencies in the 900 and 1800 MHz bands still apply,³⁰ The CTU has set out specific development criteria in the new terms and conditions for radio frequency allocations to support coverage of white spots, including rail and road corridors, consisting, amongst other things, of promoting cooperation between mobile operators, sharing passive infrastructure, the transition to new services in connection with the phase-out of 2G/GSM, and other conditions. The search for further and alternative coverage solutions will continue in the coming period, for example through continued support for the sharing of passive infrastructure or by exploring investment opportunities. With a view to the further development and availability of mobile services, work is also continuing to refine the appropriate definition of a 'white spot' so that it meets the needs and expectations of users and investors (for example, time-based prioritisation).
- b) **5G signal measurement methodology:** *What is the best way to assess the connection quality of user terminals (smartphones) in 5G networks?* The metrics currently used by the Czech Telecommunications Office (ČTÚ) to measure signal quality are based primarily on procedures for LTE/4G technology. When measuring compliance with the conditions arising from international obligations in cross-border coordination, the procedures set out in the HCM Agreement and the agreements on mutual coordination of radio frequencies between the Czech Republic and neighbouring countries are followed.³¹ The CTU will examine supplementary methods for verifying and monitoring 5G NR signal levels in the context of the Authority's practical operations.³²

³⁰<https://ctu.gov.cz/zavery-prezkoumani-2023>

³¹ Specific procedures for 4G and 5G are set out, for example, in ECC Recommendation (15)01, '<https://docdb.cept.org/document/515>'.

³² Some additional options are summarised, for example, in ECC Report 341: Report on coverage availability and performance aspects for 5G NR (2022).

N)

Medium-term measures in spectrum management in the bands for terrestrial public mobile networks:

- In cooperation with state bodies (e.g. ministries and the BCO), it will support the amendment of legislative conditions with the aim of removing, in particular, administrative barriers hindering the improvement of mobile signal **coverage in white spots**.

5.2.3. Other terrestrial communications bands

Spectrum management is currently also addressing issues relating to support for the development of FWA networks, which play a significant role in terms of connectivity to electronic communications services, and the drafting of conditions for bands that have not yet been utilised or bands no longer used by their original services. The CTU is also analysing bands that may be used for new services or applications, such as drones. The main areas include the following:

- Upper 6 GHz band:** The 6425–7125 MHz band was allocated by the WRC-23 conference to IMT (5G, 6G) and RLAN (including Wi-Fi) applications, though without specifying the conditions for spectrum use. In Europe, the band is being analysed in terms of conditions for licence-exempt, low-power RLAN applications to supplement the gigabit connectivity available via optical networks. At the same time, conditions for future use by IMT networks based on spectrum sharing between the two technologies are being investigated. The results of studies on shared RLAN and IMT operations are expected to be available in 2025. The potential deployment of cellular IMT mobile networks is not realistic in Europe before 2030. This will therefore be the 6G generation (IMT-2030). The Czech Republic is participating at international level in the search for a harmonised solution whilst safeguarding the services that currently use the band.
- Lower 6 GHz band:** The 5945–6425 MHz band is intended for low-power RLAN stations designed primarily for indoor use by portable consumer electronics, including Wi-Fi 6A. The band may also offer opportunities for the operation of outdoor FWA networks, provided that the operation of existing fixed links is not disrupted. The CTU will therefore continue to collaborate on international **studies into the conditions for the use of the lower part of the 6 GHz band** by fixed RLAN applications with higher radiated power than permitted under the current harmonised conditions.³³ Following on from European discussions, the ČTÚ will continue discussions with potential stakeholders regarding the use of this band at national level. See also the 3.8–4.2 GHz band, which will be harmonised for local networks across Europe.
- Wi-Fi and unlicensed FWA bands:** These bands are of exceptional importance in the Czech Republic and their use is continuing to develop. In the 5.2 GHz, 5.8 GHz and 60 GHz bands, which are subject to a notification requirement via the RLAN registration portal, the intention is to continue developing tools for self-regulation, whilst placing an emphasis on spectrum sharing under licence-exempt access conditions. In light of comments and proposals from the sector, **discussions are underway regarding appropriate amendments to the conditions** in the general authorisation bands VO-R/12³⁴ and the establishment of conditions for the long-term sustainable use of frequencies under the so-called 'light licensing' regime, along with related adjustments to the RLAN registration portal. One suitable solution, in terms of ensuring the sustainability of regulatory conditions whilst preserving the benefits for spectrum users, could be, for example, to clarify the principles of shared spectrum use, explain the associated opportunities and limitations, and clarify the expectations of radio users

³³<https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:32021D1067>

³⁴https://ctu.gov.cz/sites/default/files/obsah/vo-r_12-112021-11.pdf

and, last but not least, defining the role of the Czech Telecommunications Office (ČTÚ) in terms of regulation. The discussion is therefore being conducted in collaboration with the sector and spectrum users.

- d) **26 GHz, the band for 5G and FWA:** The 24.25–27.5 GHz band is harmonised for IMT/5G applications and networks. In 2020, the ČTÚ set out the basic conditions for the use of the 26.5–27.5 GHz band for the experimental operation of 5G applications and others that meet the technical requirements (the technology-neutral designation is MFCN).³⁵ Given the limited availability of technologies for comprehensive solutions, both in terms of equipment for service providers and terminals for customers, the ČTÚ has deferred opening the band pending practical experience from experiments and indications of possible user and operational models. To date, successful tests of the band's use have been presented, for example indoors³⁶ indicating the potential for indoor use of the frequencies, or in outdoor environments,³⁷ where experimental operations have also verified fixed wireless access.

O) The CTU has therefore begun preparing the conditions for opening up the 26.5–27.5 GHz band, with a view to opening the band in 2025. In its proposal, the CTU will take into account the conclusions of the national study with the aim of proposing specific conditions for the allocation of this band for the commercial provision of services. The ČTÚ's preferred option is authorisation based on the granting of individual licences with no limit on the number of licences. The issue of fees in the 26 GHz band is discussed in Section 4, point 10. Subsequently, based on experience with the 26.5–27.5 GHz band, and in line with demand for spectrum, the possibilities for making the adjacent 24.25–26.5 GHz band available in the long term (approximately 5 years or more) will be examined, with a spectrum-sharing model that respects existing users of the band in the fixed radio communication service being tentatively envisaged.

- e) **The 3.8–4.2 GHz band** (conditions in the Czech Republic for local MFCN): An EC Mandate for CEPT³⁸ has been issued for this band to study harmonised conditions for MFCN networks with local transmitters of low and medium power. In the Czech Republic, the band is used by the fixed service. The national objective is not to discontinue the existing operation of the fixed service or its further development, but to seek conditions for sharing the band with potential new users, i.e. local MFCN networks (both public and non-public). From a business perspective, the band may also be of interest for specific networks and wireless telecommunications in industry. CEPT is expected to draw up a proposal for technical conditions during 2024. In the subsequent period from 2025, the Czech Telecommunications Office (ČTÚ) will analyse possible procedures and tools for the future coordination of the band in the event of user interest in operating local transmitters in the mobile service, on the assumption that such operation would be subject to individual authorisations.
- f) **Study of the 4.4 GHz, 7/8 GHz and 15 GHz bands for IMT:** During the study period of the WRC-27 conference, the 4.4–4.8 GHz, 7.125–7.25 GHz, 7.75–8.4 GHz and 14.8–15.35 GHz are being examined at international level (ITU) with regard to the region covering Europe, with a view to their possible future use by terrestrial nationwide IMT networks.³⁹ However, all the proposed bands are currently used by a range of services; for example, in NATO countries, the bands are also allocated for non-civil communications.⁴⁰ Part of the 15 GHz band is also used by the fixed radiocommunication service. For none of the bands currently (October 2024) proposed for IMT is it yet possible to formulate an assumption regarding the feasibility of establishing conditions; however, at least the 7 GHz band follows on from a band already designated for IMT by the WRC-23 conference and, according to some preliminary views, may offer some

³⁵ Further details are set out in the 2022 Situation Report, Chapter 4.1.4.

³⁶ Experimental operations were, for example, introduced by O2 in collaboration with CETIN.

³⁷ <https://www.lupa.cz/galerie/wia-a-vanco-testovani-mmwave-na-26-ghz-cambium-networks/0/>

³⁸ <https://ec.europa.eu/newsroom/dae/redirection/document/82230>

⁽³⁹⁾ These bands were not proposed by Europe, but are the result of a compromise that takes particular account of the requirements of other regions.

⁴⁰ In NATO countries, the 4.4 GHz and 15 GHz bands are used, amongst other things, for non-civil mobile communications; the 7/8 GHz band is designated in certain sections for, amongst other things, satellite communications.

prospects for these communications. Given the importance of these bands for existing users and the potential impact on spectrum usage conditions in the Czech Republic, the Czech Telecommunications Office (ČTÚ) is participating in discussions on the proposed conditions for the use of these bands.

- g) **The 1.4 GHz band** has been harmonised for use **by high-speed mobile** electronic communications **networks** (MFCN).⁴¹ The use of the band by potential MFCN networks involves a specific operating mode of unidirectional data transmission from base stations, to support data throughput towards users (terminals) of IMT mobile networks (including 4G and 5G). Although some countries have already allocated the band to mobile operators, no demand has yet been identified in the Czech Republic to suggest possible business models suitable for the roll-out of MFCNs in the aforementioned band in the short term. It is therefore possible to confirm the current position, namely that **once there is confirmed interest** in utilising frequencies from the 1.4 GHz band, **the necessary steps** will be taken **to grant future rights to use these frequencies**.
- h) **The 410/420 MHz and 450/460 MHz bands**, originally used in part by nationwide mobile networks, are no longer utilised by these networks, and the question of the further use of these frequencies therefore remains open.⁴² However, the number of rights to use radio frequencies in these bands is currently still limited; it is therefore not possible to issue individual authorisations to applicants for these frequencies in parts of these bands. The band may be of potential significance for new users of the band and new services, for example in the network sectors,⁴³ in industry or for the purposes of the Ministry of the Interior. The Czech Telecommunications Office (ČTÚ) will therefore, in cooperation with other ministries and stakeholders, and taking into account international experience, carry out an analysis of the possible conditions for using the band, including authorisation methods, whilst taking into account the needs of potential users of the band. Following the conclusions of the analysis, the ČTÚ will propose amendments to the conditions for the use of these bands.
- i) **Unmanned aerial vehicles:** For new projects in the field of professional unmanned aerial vehicles, both civil (U-space,⁴⁴ UAS corridors) and non-civil, suitable frequency bands are still being studied; in some cases, technical studies have already been carried out, but comprehensive harmonisation, including safety and operational issues, has not yet been achieved. Some internationally developed proposals or conditions that have already been adopted do not yet align with technological supply or demand at national levels; an example is the 1880–1900 MHz and 1910–1920 MHz bands, where the CEPT is finalising harmonised conditions for the use of frequencies by drones⁴⁵ on the assumption that DECT technology will be used, or the ITU-R (WRC-23) proposals for new frequency allocations in the aeronautical mobile service intended for UAS in the 15.41–15.7 GHz and 22–22.2 GHz bands.⁴⁶ Promising bands for drone communications via mobile networks are the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2 GHz and 2.6 GHz bands,⁴⁷ where detailed studies on spectrum sharing have already been carried out.⁴⁸ With a view to future binding harmonisation within the EU, in autumn 2023 the RSC Committee adopted the European Commission's mandate to CEPT to study the conditions for drone communications using mobile network bands. Should there be interest in the use of the aforementioned bands by unmanned aerial vehicles, the CTU will initiate discussions with mobile operators regarding the facilitation of such operations and will assess whether there are any objective procedural, regulatory or other obstacles preventing such use of the frequencies.

⁴¹ For further details, see Chapter 4.1.5 of the Second Status Report.

⁴² A more detailed overview is provided in Chapter 4.1.7 of the Second Situation Report.

⁴³ The band is used for these purposes in 10 European countries; one country has launched a consultation on the band.

⁴⁴ <https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/u-space>

⁴⁵ Governmental drones: ECC Report 332 on Technical compatibility studies related to UAS (Unmanned Aircraft System) in the 1880–1920 MHz band.

⁴⁶ Subject to further conditions.

⁴⁷ Decision ECC/DEC(22)07.

⁴⁸ However, the studies do not cover, for example, the issue of the impact on the potential operational load on mobile networks.

Priorities of the radio spectrum management strategy in terrestrial communications bands, short-term measures:

- In 2025, the CTU will draw up a proposal for the conditions governing **the opening up of the 26.5–27.5 GHz** band for FWA, 5G and other applications and services.
- In the 5.2 GHz, 5.8 GHz and 60 GHz bands, which are used on a licence-exempt basis by Wi-Fi and other applications, the ČTÚ will propose **appropriate amendments to the regulatory conditions** in 2025.
- In 2025, a discussion draft of new conditions for the efficient use of the 410/420 MHz and 450/460 MHz bands will be prepared.

Long-term measure:

- The possibility of amending **the conditions for the use of frequencies** will be analysed in cooperation with mobile operators regarding communication with **drones** in selected mobile network bands.
- Upper 6 GHz band: Through the Czech Telecommunications Office (ČTÚ), the Czech Republic will continue to participate in the development of a harmonised European solution, with an emphasis on examining the possibilities for coexistence of future use within the IMT framework and solutions for high-capacity indoor RLAN connections for terminals and devices.

5.2.4. Satellite bands

Satellite communications are developing very rapidly thanks to technological advances, demand for new services and investment interest. A number of new projects require ubiquitous broadband connectivity with minimal latency, a requirement that can only be met through non-geostationary systems in low and medium Earth orbits (LEO, MEO). New active ground station antennas, including those in ordinary consumers' installations, enable flexibility in coverage and the use of radio frequencies thanks to beam steering. For example, direct communication between mobile terminals (smartphones) and satellites (D2D) is in its early stages of development. Satellite systems are thus becoming part of the 5G ecosystem.

As the majority of the conditions for satellite communications result from regional or global harmonisation, **there is currently no identified need for immediate measures at national level** to ensure benefits for society as a whole. Nevertheless, the CTU is encountering specific requirements, for example for IoT communications, signalling, goods tracking, etc., which respond to specific demand or plans for the development of non-personal communications. These requirements relate, for example, to enabling the operation of satellite network terminals under a general authorisation in harmonised bands. When applying such requirements, the CTU will proceed both in accordance with its delegated powers and with due regard to the long-term priorities of spectrum management (see Chapter 4).

From the perspective of the Czech Republic's strategic interests, investment opportunities and innovation, the EU space programme – in which the Czech Republic actively participates under the coordination of the Ministry of Transport – is of key importance. As part of spectrum management, state bodies will continue to contribute their resources to the elimination of GNSS (Galileo) interference and will continue to support and participate **in a coordinated approach to the implementation of the IRIS² project** and other projects.⁴⁹

In the case of shared use of radio frequencies, certain bands allocated to satellite services may allow for local and time-limited use of frequencies in cases where it is technically possible to use such a frequency

⁴⁹ The EU programme aims to deploy a European satellite constellation called IRIS², which stands for Infrastructure for Resilience, Interconnectivity and Security via Satellite. It will provide a European satellite communications infrastructure for government purposes and will integrate and complement existing and future national and European capabilities as part of the GOVSATCOM component of the EU Space Programme: <https://eur-lex.europa.eu/eli/reg/2023/588/oj>

coordinated with a view to avoiding interference. An example is the 1980–2010 MHz and 2170–2200 MHz bands allocated to operators providing pan-European electronic communications services. An operator utilises a 2×15 MHz segment of this band to provide mobile connectivity on board aircraft (EAN) via a combined connection using a satellite network and complementary ground-based systems (CGC). The CTU will therefore assess **the possibility of making the band used by CGC, or part thereof, available on a shared basis for other potential uses at national level**, such as PMSE or short-term applications. The ČTÚ will take into account the conditions for such further use in light of the fact that the validity of the rights granted for the 1980–2010 MHz and 2170–2200 MHz bands is due to expire and changes will be made to the harmonised conditions of use. Possible alternatives for the future European use of the band have been drawn up by the RSPG⁵⁰group.

At European level, discussions are taking place on **the protection of global navigation satellite systems (GNSS)**, including the European **Galileo** navigation system, against deliberate harmful interference, including spoofing. The interference is caused predominantly by illegally operated signal jammers, ranging from short-range devices installed, for example, on vehicles, to long-range jamming associated with military conflicts outside the Czech Republic, yet with serious impacts on radio navigation applications, particularly in air transport. The Ministry of Transport, the Ministry of Industry, the Ministry of Defence, NÚKIB, the GNSS Centre of Excellence, the Czech Telecommunications Office (ČTÚ) and other stakeholders are involved both in identifying the problem and in seeking suitable solutions to minimise its impact.

Priorities of the radio spectrum management strategy in satellite bands:

1. At national level, the Czech Republic continues to participate in **the coordinated approach to the implementation of the IRIS² project**.
2. The Czech Telecommunications Office (ČTÚ) will continue to cooperate with other state bodies and stakeholders, including through international cooperation, to **protect the Galileo system against deliberate jamming**.
3. The possibility of **sharing the 2 GHz band** used by EAN systems **with other applications** at national level will be assessed.

6. Conclusion

This Radio Spectrum Management Strategy for the period after 2024 builds on the strategic documents from 2015, 2018 and 2022 and incorporates existing experience, as well as anticipated major or general trends and assumptions, into the requirements of modern spectrum management. It emphasises a future based on best practice and more enduring general principles of responsible spectrum management and broad cooperation. It outlines the areas with which spectrum management is currently engaged or intends to engage; however, this does not preclude other tasks arising from current needs.

The aim of the general principles set out in this Strategy is to contribute to the creation **of an environment that will promote the prosperity of the Czech Republic** through the development of services and communications utilising radio frequencies. The proposed measures are intended to promote **the benefits to society as a whole arising from the use of the radio spectrum**.

In spectrum management, emphasis will be placed on responding to market needs. Where there is demand for spectrum, solutions will also be sought that promote competition at the technological level under conditions of technological neutrality.

⁵⁰ Draft Opinion on the assessment of different possible scenarios for the use of the 1980–2010 MHz and 2170–2200 MHz frequency bands by Mobile Satellite Services beyond 2027.

Where possible and appropriate, ways will be sought to utilise automation or algorithms to efficiently address certain tasks in spectrum management.

Although the Electronic Communications Act **entrusts** the **Czech Telecommunications Office (ČTÚ)** with **the primary responsibility** for the civil management of the radio spectrum, decisions and regulations will, where possible, be adopted following consultation or **in cooperation with the relevant ministries, frequency users, experts and the public**, so that the needs and interests of all stakeholders are taken into account and balanced as effectively as possible. This Strategy is intended to contribute to ensuring that radio spectrum management is effective, transparent, sustainable and prepared for the challenges and opportunities of the future.

7. Annexes

7.1. Annex A: UHF band – service requirements

Monitoring of indicators relating to the development of publicly available services provided by terrestrial radio and television broadcasting networks and other electronic communications networks

Technological developments have contributed significantly to the expansion and qualitative changes in both terrestrial television broadcasting and platforms for access to electronic communications services, including mobile networks. The trend towards the roll-out of high-speed communications networks, particularly fibre-optic networks, and the growing proportion of households with high-speed internet connections also means a significant increase in the consumption of television (linear) content via this channel. This offers the option of watching a chosen programme either live or as a recorded programme at a time of the viewer's choosing, or with the option to limit or skip adverts. As audiovisual content is also consumed from other sources, **the boundary between linear and non-linear content consumption** (the boundary between traditional and new media) **is gradually blurring**. Although this is a general and irreversible trend towards digitalisation, the pace of change varies from country to country depending on actual conditions – the status of household connections to telecommunications networks, the coverage of the territory by terrestrial and satellite TV networks, their programme offerings, and the affordability of services for users. **Changes** to regulatory conditions, including those governing the use of the UHF band, **must be based on monitoring trends** so that market and technological developments can be taken into account and combined with social responsibility – primarily through measures to ensure that a significant proportion of the population, for whom switching to another distribution platform is financially unfeasible, is not excluded from access to radio and TV broadcasting. **Indicators tracking trends** and leading to predictions, including the identification of risks, are intended to serve this purpose. In the context of the Czech Republic, the following factors apply:

- The importance of terrestrial TV broadcasting: Among the various distribution networks – terrestrial television, cable television, television via fixed and mobile internet, and satellite television – terrestrial TV reception accounts for the most significant, albeit not exclusive, share in households. It is broadcast unencrypted, i.e. without a reception fee; it has high coverage; and the range of programmes is broad and stable, albeit with significant differences in programme viewing figures. It is also included in pay-TV platforms alongside premium packages and other services.
- The broadcasting operators' market:
 - The public service broadcaster fulfils a social mandate set out in the legislation governing the operation of Czech Television, and its funding is secured primarily through revenue from television licence fees.
 - For private broadcasters, the source of funding for broadcasting is revenue from broadcast advertising.⁵¹ Regional TV broadcasters use the spectrum at their own discretion and may only utilise that part of the available spectrum which is not required by the public service broadcaster.

The indicators monitored for future developments will include statistical data (e.g. the number of households, the availability of consumer electronics intended for the use of electronic communications services), the scope and reach of the programme offering (e.g. the number of programmes broadcast, viewing figures), user metrics (e.g. average time spent viewing content via individual platforms, the share of VOD services, data consumption requirements) and others. Another important parameter will be the scope of the free-to-air (FTA) programme offering and a comparison with the scope and prices of paid programme packages or SVOD services.

⁵¹ TV NOVA and PRIMA hold a significant share of the market.

7.2. **Annex B:** Possible focus of the study on options for the reorganisation of the UHF band (post-2030)

The aim is to analyse (for the period after 2030) the potential for reorganising the UHF band with a view to creating opportunities for the roll-out of nationwide mobile networks in this paired frequency arrangement in accordance with the 3GPP specification: downlink 617–652 MHz and uplink 663–698 MHz. In such a case, the band would be divided into a section for broadcasting (470–614 MHz, TV channels 21 to 38) and a section (617–694 MHz) for mobile networks and other services, such as PMSE in the 652–663 MHz duplex section. In this scenario, the spectrum allocated to DTT would be reduced by 80 MHz, i.e. 10 TV channels.

Such a study should respond to developments in the debate on the possible harmonised allocation of a further part of the UHF band for IMT within the framework of the national flexible approach, taking into account the needs identified at national level.

The study should take into account the possibility of utilising already coordinated frequencies, the uninterrupted operation of nationwide DTT networks, the maintenance of the current level of competition in the relevant market, opportunities for international coordination and other conditions, including the impact that a reduction in the UHF band would have on existing DTT broadcasters. The study will therefore examine solutions to minimise the negative impacts on current users of the UHF band. In view of developments in the electronic communications services market, demand for spectrum, the development of technologies for the UHF band, the prospects for spectrum use in neighbouring countries and the associated possibilities for a coordinated approach to spectrum use, a more detailed study is not expected to be carried out until after 2025. This study should include a comprehensive assessment of spectrum utilisation by individual radiocommunication services using the UHF band and an evaluation of the impact of individual options on terrestrial TV broadcasting, including an analysis of the feasibility of reorganising the UHF band in terms of its benefits to society as a whole in the Czech Republic.

None of the above-mentioned studies or envisaged scenarios **should prejudge future conditions** in the UHF band.

7.3. Appendix C: List of abbreviations

AR, VR, XR	Terms relating to virtualisation – Augmented Reality, Virtual Reality, Extended Reality
3GPP	Organisation defining mobile communications standards, the 3rd Generation Partnership Project 4G, 5G 4th and 5th generations of IMT mobile communications
BEREC	Body of European Regulators for Electronic Communications
CEPT, ECC	An umbrella organisation for technical and regulatory cooperation amongst European countries; the European Conference of Postal and Telecommunications Administrations (originally in French: Conférence Européenne des Administrations des Postes et des Télécommunications); the ECC is its Electronic Communications Committee,
CGC	Complementary Ground Components of a satellite mobile system, Complementary Ground Components
BCO	Broadband Competence Office of the
Czech Republic (ČTÚ)	Czech Telecommunications Office
D2D	Direct-to-device communication, Direct-to-device DAB Digital radio, Digital Audio Broadcasting
DTT	Digital Terrestrial Television
DVB-T	Digital terrestrial television broadcasting system, Digital Video Broadcasting – Terrestrial EU, EC European Union, European Commission
EAN	European Aviation Network, European system for data links with aircraft FWA Fixed Wireless Access
IMT	International Mobile Telecommunications family of systems IoT
Things	Internet of
ISP	Internet Service Providers, Internet Service Providers ITU-R Radiocommunication Sector of the International Telecommunication Union
LTE	Fourth-generation mobile network technology, Long Term Evolution of the 3GPP radio technology
M2M	Machine-to-Machine communication
MFCN	Mobile/Fixed Communications Networks. This is a technology-neutral term for access networks (and therefore does not refer solely to IMT technology).
RRTV	Council for Radio and Television
Broadcasting MPO	Ministry of Industry and Trade
ODVL	Military Aviation Supervision Department
PMSE	Programme and Special Events Services (musical performances, public gatherings), Programme Making and Special Events services
PPDR	Public Protection and Disaster Relief PVRs
RLAN	Radio Local Area Network. This is a technology-neutral term that most commonly refers to Wi-Fi technology.
RSC	Radio Spectrum Committee: an EC body responsible for preparing documents harmonising the use of the radio spectrum within the EU
RSPG	Radio Spectrum Policy Group, an advisory body to the European Commission on strategic issues relating to the use of the radio spectrum
RSPP	Radio Spectrum Policy Programme, a strategic EU document. UAS
	Unmanned Aircraft Systems

UNOFFICIAL MACHINE TRANSLATION

UHF	Ultra-High Frequency, covering the 470–960 MHz bands
VO-R	General licence – for radiocommunications; documents are available at https://ctu.gov.cz/vseobecna-opravneni
WRC	World Radiocommunication Conference of the International Telecommunication Union, World Radiocommunication Conference ITU
ZEK	Act No. 127/2005 on electronic communications and amending certain related acts (the Electronic Communications Act), as amended



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