

Radio Spectrum Management Strategy

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Information contained in this document does not give rise to any legal claim whatsoever and is not a part of the procedures laid down by the legislation of the Czech Republic and the European Union.

1. PURPOSE OF THE DOCUMENT

1.1. Introduction

The use of radio spectrum (hereinafter also referred to as “spectrum”) is relevant across a number of industries and sectors and has direct or indirect impact on the economic development of every country.

Without radio spectrum there would be no such phenomenon as mobile communications which have become a part of our everyday lives. The start of widespread use of smart phones was an early signal of the requirements for development of high-speed networks through which new services could be provided.

Digitalisation and the use of the Internet platform¹ brings along fundamental changes in the sector of electronic communications. Connection to a single network can fulfill all needs of the users, from voice communication through access to radio, television, musical recordings, movies, various information, communication on social networks, electronic mail, electronic shopping, etc.

The new industrial applications are developing in similar manner, and the spectrum plays an important role also in the field of science, research and innovation.

Broad availability of services of high-speed Internet access for commercial users as well as the general public is a prerequisite for continued competitiveness of the country, its economic, cultural and social development. Thanks to the multiplication effect, the development of modern electronic communications stimulates the growth of other industries.

The Ministry of Industry and Trade is responsible for national policy in the area of all-society objectives of utilisation of the frequency spectrum, in particular development of high-speed Internet access, spectrum utilisation in public interest (national security), policy of charging for radio frequencies, national allocation to radiocommunication services, and other activities associated with the support of businesses, consumer protection, development of electronic communications and other related activities.

The body responsible for the regulation activities and for radio spectrum management² is the national regulator – Czech Telecommunication Office (hereinafter referred to as “the Office”). The powers and responsibilities of the Office are defined by Act No. 127/2005 Sb. (Collection of Laws), on electronic communications, as amended (hereinafter referred to as “the Act”)³. The role of the Office as the national manager of the spectrum also includes coordination of the satisfaction of the needs of the state, commercial and non-commercial sector, in accordance with the national commitments which follow from the membership of the Czech Republic in international organisations (European Union, ITU⁴, NATO, CEPT) and from international treaties.

¹ The platforms, i.e., methods of distribution of the services of electronic communications, include cable networks, wireless networks of mobile and fixed Internet connection, satellite and terrestrial television and radio networks.

² The phrase “spectrum management” in this document has a general meaning of approach to the use of radio frequencies in the context of the national policy, strategy, concept, granting of rights, international cooperation, radio monitoring, etc.

³ In particular Section 4, Sections 5 and 6 of the Act. Extract from Section 4: “Regulation is implemented in order to substitute the missing effects of competition, create conditions for proper functioning of competition and for the protection of the users and other market participants until the fully competitive environment has been achieved.”

⁴ International Telecommunication Union.

1.2. Main foundations of spectrum management in the Czech Republic

Spectrum management is a set of activities which include policy, regulation and administration including planning and coordination of joint utilisation of the spectrum, which aims at ensuring optimal utilisation thereof by radio stations under defined conditions, without harmful interference⁵.

The spectrum management strategy is based on two basic foundations:

- System changes of the spectrum management directed at the development of competition in electronic communications,
- National objectives set in the State Policy in Electronic Communications - Digital Czech Republic[1].

1.2.1. Spectrum management for the benefit of economic competition

European countries are about to complete the process of migration to market mechanisms in electronic communications as well as in the area of spectrum utilisation.

The basis of this process is the set-up of the mechanisms in the spectrum management in such manner as to gradually apply in the management

- economic competition without government intervention or, if applicable, to apply regulation intervention only in situations where competition is not sufficiently developed or where the radio spectrum is used non non-commercial basis,
- competition of platforms, technologies and market players.

These market mechanisms in the spectrum management applied in a harmonised manner are in particular:

a) application of the socially economic value of the spectrum and the use thereof in decision-making processes (in particular in the initial process of granting authorisations for the use of the spectrum),

b) flexible approach to the spectrum and to the treatment of the authorisations for the use thereof – priority of utilisation of the spectrum under a general authorisation for the use of radio products of mass consumption, market principle of the approach to the spectrum – by means of lease or transfer of rights to the use thereof, (i.e., secondary trading of the rights),

c) liberal conditions of the use of the spectrum – minimum limitation of the technical parameters under the conditions of utilisation of the spectrum, making it possible for businesses to introduce technical innovations without a change to the rights for the utilisation thereof.

The harmonisation of the conditions of the use of frequency bands, technical harmonisation of products, uniform rules for regulatory interventions and regulatory procedures are helpful in achieving the maximum economic effects and ensuring functionality of the described mechanisms.

⁵ The attribute "harmful" means that such interference materially impairs the quality, repeatedly interrupts or prevents operation of the radiocommunication service working in accordance with the internationally adopted Radio Regulations of ITU-R.

1.2.2. Objectives of the state policy

The state policy in the field of electronic communications is defined in the documents entitled “State Policy in Electronic Communications – Digital Czech Republic” and “Digital Czech Republic v. 2.0 – The Way to Digital Economy” [1].

The policy includes a requirement for the preparation of the Spectrum Management Strategy.

Among the main objectives of the government for the period until 2020, which are defined by the state policy Digital Czech Republic v.2.0 – with respect to the formulation of the spectrum management strategy – the following ones are most critical:

- Support of development of high-speed Internet access networks enabling transmission speeds in accordance with the objectives of the Digital Agenda,
- Effective utilisation of radio spectrum for the benefit of the end users,
- Improvement of availability of ICT for all, regardless of the location, etc.,
- Guarantee of free reception of the programs of public service media through terrestrial broadcasting and broad availability of the current scope of television broadcasting and its development.

With regard to the above-mentioned foundations, in accordance with the requirements for the focus of the spectrum management strategy according to measure No. 4 of the state policy “Digital Czech Republic v. 2.0 The Way to Digital Economy” (hereinafter referred to as Digital Czech Republic), in *the Spectrum Management Strategy*, the Office describes to the extent necessary the factual relations of the proposed measures and procedures both in terms of the ongoing changes in the spectrum management and in the fulfillment of the objectives of the national policy in the area of wireless communications, in particular for the medium-term horizon⁶ of the period 2014 - 2017.

Although the changes in the spectrum management and the fulfillment of the objectives of the state policy overlap, the structure of the Spectrum Management Strategy document takes account of both.

In the first case, Article 2 of this Strategy lays down the national strategic measures according to the individual frequency bands; Article 3 lays down the national strategic measures for achievement of the effective utilisation of the spectrum and for the development of competition.

In the second case, Article 4 lays down specific procedures for the fulfillment of the objectives specified in the Digital Czech Republic.

Article 5 summarizes the fulfillment of the spectrum management strategy including the characteristics of the priority tasks requiring cooperation with other public authorities.

The factual relations justifying the measures and procedures proposed in the previous articles are included in the analytical section of this Spectrum Management Strategy (Article 6).

⁶ Short term (2 years) to medium term (2 to 5 years), with a hint at development in the long term (10 years).

2. NATIONAL STRATEGIC MEASURES FOR INDIVIDUAL FREQUENCY BANDS

The objectives and the proposed strategic measures described in this chapter *pertain to the Czech Republic* and are based on the main objectives of the state policy (Article 1.2) and are directly related to the utilisation of the spectrum and the methods of authorisation of the use of the frequencies. *The permanent objective is effective utilisation of radio frequencies* (hereinafter also referred to as “frequencies”) and the related process of continuous harmonisation with the conditions of the use thereof in the European Union. The Office is responsible for the fulfillment of the tasks and the objectives specified in this chapter, unless the text clearly implies powers and responsibilities of a different public body.

One of the main goals in accordance with the European harmonisation is directed in particular at the long-term strategic objective: release of additional frequencies for mobile high-speed access networks⁷. The national objectives include implementation of the adequate conditions for the development of additional services, in particular one-way broadcasting television and radio terrestrial digital networks.

2.1. Access cellular mobile and fixed networks, IMT networks

2.1.1. Current situation (development trends – see Article 6.4.1)

Each one of the frequency bands (hereinafter referred to as “bands”) intended for mobile and fixed access⁵⁸ networks is harmonised on international or European level. The phenomenon of the growth of data traffic is indicated also in the Czech Republic – the number of subscribers using broadband mobile IMT services in the Czech Republic reached 4.85 million⁸ in 2013 and keeps growing.

Development of 4G networks is one of the main objectives of the Czech Republic in the area of implementation of higher-quality and more advanced services of electronic communications than those offered by the existing mobile national 2G and 3G networks. Migration to voice services based on the transitional CSFB technology (see Article 6.4.1) or the fully packet-based VoLTE technology is therefore conditional particularly upon development of 4G networks in the frequency band of 800 MHz where the obligatory coverage conditions⁹ are aimed for the period after 2019. The band which is more suitable for the initial steps in the area of technological innovation and the related reorganisation of the band from today’s perspective is the band of 1800 MHz, in which the operation of LTE started. Under the condition of reorganisation of the frequency configuration (so-called rearming¹⁰), the band of 900 MHz, in which the operation of LTE started also in 2014, is also important for the development of 4G networks.

The aggregate volume of frequencies harmonised on European level available for use by access networks intended for provision of publicly available services of electronic communications in the Czech Republic is currently 990 MHz.

⁷ The Decision of the European Parliament and of the Council [11] set the objective to define at least 1200 MHz by 2015 designated for high-speed networks based on the inventory of the spectrum. In 2014 the Commission will issue a report on utilisation of the spectrum and on demand for different services and applications in the frequency bands of 400 MHz – 6 GHz, also with respect to the need to harmonize additional frequency bands for high-speed networks. Achievement of this objective means expansion of the harmonized bands by the candidate bands identified in the [RSPG report](#) by frequency bands 700 MHz, 1.5 GHz and 2.3 GHz. The EU objectives from the point of view of global harmonisation are provided e.g., by [RSPG Interim Opinion on Common Policy Objectives for WRC-15](#).

⁸ Downstream speed at least 256 kbit/s; information dated 04/2014 for ITU Indicators Short Questionnaire 2014.

⁹ http://www.ctu.cz/cs/download/vyberova_rizeni/vyhlaseni_vyberoveho_rizeni_15_08_2013.pdf

¹⁰ Reorganisation of the use of the spectrum in order to create homogeneous sections allowing for the implementation of broadband technologies.

Regarding each frequency band in greater detail:

410 MHz and 450 MHz

Definition of the sections: 410–413 / 420–423 MHz and 451.3–455.74 / 461.3–465.74 MHz

Current use¹¹: CDMA, data and voice services

These bands are suitable for provision of nationwide services of electronic communications in the areas with lower population density. The bands are not harmonised by a binding European decision.

Another potential future use of this band can be successful harmonisation in the use for applications of non-personal communication (M2M) or PPDR.

700 MHz

Definition of the section: 694–790 MHz

Current use: Television broadcasting

Implementation of IMT networks is anticipated in the future, but it is also necessary to take into account the existing rights for utilisation of the spectrum. The Office does not intend to set in the Strategy a date of the release of the band from television broadcasting prior to the expiry of the allocations issued. A decision on the use of the frequency band of 700 MHz harmonised on European level has not been made. Digital Czech Republic 2.0, in connection with the savings of the spectrum in the frequency band of 700 MHz and its utilisation for IMT, envisages ensuring nationwide continuity of availability of the existing scope of television broadcasting and its development. The change of the use of the frequency band of 700 MHz for the provision of mobile services can be supported by migration to the DVB-T2 standard.

800 MHz

Definition of the section: 791–821 / 832–862 MHz

Current use: Allocations of frequencies for the operators of nationwide IMT networks were granted in this band.

The extraordinary value of the band of 800 MHz for the deployment of 4G networks is due to the harmonised pan-European conditions, optimal physical characteristics, increasing potential for innovation in the area of technologies and services, and other factors. The band is designed for operation of access IMT networks by the holders of the allocations who have taken over the commitments implied by the conditions of the competitive bidding procedure; the commitments include, but are not limited to, compliance with the schedule of coverage through the frequencies acquired within the competitive bidding procedure.

900 and 1800 MHz

Definition of the sections: 880–915 / 925–960 MHz and 1710–1785/1805–1880 MHz.

Current use of the bands: GSM and LTE. The band is liberalised for IMT.

Liberalisation of these frequency bands creates conditions for the use thereof by any technology and for provision of any publicly available service of electronic communications.

In particular 2G networks are currently operated in the band of 900 MHz, and with respect to the homogenous coverage of the territory they are of key importance in particular for voice services. The optimal utilisation of the bands of 900 MHz and 1800 MHz by 4G

¹¹ Use in priority radiocommunication service

networks is conditional upon refarming leading to the creation of continuous sections for every operator.

A part of the band of 1800 MHz, in which the authorisations for the use of frequencies have not been granted yet, will be the subject of another competitive bidding procedure expected to be announced no later than the 1st half of 2015, in connection with the modification of the fee policy (see Article 3.7).

Band L

Definition of the section: 1452–1492 MHz

Current use: In section 1452–1479.5 MHz digital radio broadcasting.

The entire band L is allocated, among others, to the terrestrial and satellite component of radio broadcasting, i.e., services which transmit signal on one-way basis. The current legislation allows the use of the frequency band of 1452–1479.5 MHz by terrestrial mobile multimedia one-way applications in the radio service.

This frequency band is partially utilised by T-DAB networks. In the CEPT countries, terrestrial services were given priority in 2013, and a concept was adopted of use of the frequency band for the so-called supporting downlink in mobile and fixed access networks based on the principles of minimally limiting technical parameters (block edge masks)¹².

The decision on whether and under what conditions the frequency band will be designated for IMT will be made by the WRC-15 conference. The Office does not intend to set a date of the release of the band from radio broadcasting prior to the expiry of the allocations issued.

TDD 2 GHz (unpaired bands)

Definition of the section: 1900–1920 MHz and 2010–2025 MHz

Current use: The bands are not utilised. One 5MHz block in the frequency band of 1900 MHz is allocated to a holder of frequency allocations.

The original use of the part of the band for operation of 3G UMTS TDD systems was terminated in 2012. The conditions are currently being reconsidered on European level toward alternative use of the bands of 1900–1920 MHz and 2010–2025 MHz.

The considered use includes applications of non-personal communication (M2M), low-output use of IMT-A, SRD, DECT, PPDR, PMSE; utilisation for direct ground-aircraft communication (BDA2GC) for high-speed communication for passengers onboard aircraft is currently being thoroughly studied. In September 2012 the European Commission issued a mandate to CEPT to prepare harmonised conditions of the use in the bands IMT 1900–1920 MHz and 2010–2025 MHz, the timing of the proposal of the technical conditions being in 2015.

FDD 2.1 GHz (paired bands FDD)

Definition of the section: 1920–1980/2110–2170 MHz

Current use: IMT/3G in the entire band.

This frequency band was originally intended for use by mobile 3G systems (UMTS). Three allocations of frequencies are granted in this band for that purpose. The band is liberalised for IMT by the Commission Implementing Decision of 5 November 2012 on the harmonisation of the frequency bands FDD 2 GHz No. 2012/688/EU which liberalizes the conditions of the use of the FDD sections in the frequency band of 2 GHz by introducing a block edge mask and modifying the frequency raster. The change ultimately provides the

¹² From the long-term perspective, the entire band will be designated for use in the mobile service (8 blocks of 5 MHz).

holders of the allocations, among other things, with the possibility to trade parts of the allocation¹³.

2.3 GHz

Definition of the section: 2300–2400 MHz

Current use: The band is partially used by telemetry and outside broadcasting links.

Harmonised conditions of the use of this prospective frequency band by IMT systems are being prepared on European level. The scope of the harmonisation will depend on the results of the studies of compatibility of IMT systems with aviation telemetry and other systems. The proposal of the harmonised concept of LSA is being prepared by CEPT in cooperation with ETSI (see also Article 6.3.3.2).

2.6 GHz

Definition of the section: Paired bands FDD 2500–2570/2620–2690 MHz, unpaired band TDD 2570–2620 MHz

Current use: In a part of the band FDD 2500–2560/2620–2680 MHz allocations of frequencies were granted for the operators of nationwide IMT networks.

This frequency band will be used for IMT networks. The parts of the band which have not been allocated to mobile network operators will be the subject of a competitive bidding procedure the announcement of which is expected by the Office no later than in the 1st half of 2015, in connection with the modification of the fee policy (see Article 3.7).

3.5 GHz and 3.7 GHz

Definition of the section in the frequency band of 3.5 GHz: Paired sections 3410–3500/3510–3600 MHz

Definition of the section in the frequency band of 3.7 GHz: 3600–3800 MHz

Current use: Fixed access networks in the frequency band of 3.5 GHz

These frequency bands are prospective in terms of implementation of high-speed access networks, including IMT-A. Upon suggestion of the European Commission (the Commission) the operating conditions were prepared for systems enabling the utilisation of aggregated channels with bandwidths of up to 40 MHz, and the operation mode TDD supporting the trend of asymmetric operation¹⁴ was prepared. The decision on whether both bands (3.5 GHz and 3.7 GHz) will be globally designated for IMT will be made by the conference WRC-15. The Office is monitoring the businesses' interest and intends to lay down the optimal conditions of utilisation of these bands in 2014, and to perform a competitive bidding procedure in 2015.

2.1.2. Objectives and strategies

The objectives in the area of the spectrum for access mobile and fixed networks, including IMT networks, are based on the main political objectives described in general terms in Article 1.2 and in more detail in Article 4.1. There are also factors and trends described in Articles 6.4.1, 6.4.2 and 6.4.3 and the principles of modern spectrum management described in Article 6.3 which include effectiveness of utilisation of the spectrum, *making another*

¹³ By decision ECC DEC(06)01 the frequency band is divided into 12 paired blocks with width 4.8 to 5 MHz.

¹⁴ More detailed context is provided by the [Information and discussion document on frequency band 3.4–3.8 GHz](#).

spectrum available for high-speed access networks¹⁵ while ensuring mutual compatibility of the stations, role of the Office in the refarming process, and implementation of the results of joint European harmonisation plans.

Long-term strategic objectives common for all bands of the access networks including IMT¹⁶:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Release additional up to 400 MHz of the spectrum for high-speed access networks during the next decade in accordance with European harmonisation, market requirements and taking into account the existing authorisations, according to the actual development of the market. If other bands in Europe are made available (i.e., 700 MHz, 1.4 GHz, 2.3 GHz, see also Article 6.4.1.3) the total amount of the spectrum should be at least 1200 MHz. • Participation of the Office in the optimisation of the coexistence of IMT networks with other utilisation of the spectrum, including the compatibility with television digital broadcasting in the UHF frequency band. 	<ul style="list-style-type: none"> • Implement harmonisation measures for the respective bands after adopted, by applying the standard legal procedures (issuance of updated measures of general nature Radio Spectrum Utilisation Plan, general authorisation).
Strategic objectives by individual frequency bands:	
<p><u>400 MHz</u></p> <ul style="list-style-type: none"> • In bands 410 MHz and 450 MHz, used by nationwide CDMA networks prepare conditions for future liberalisation of these bands and implementation of technological neutrality. 	<ul style="list-style-type: none"> • Prepare ahead of the expiry of the allocations (by 2015) proposals for liberalisation of these frequency bands in terms of prospective technologies which can use the band. • Implementation of the conditions for applications of non-personal communication (M2M) according to harmonisation documents or according to the market requirements (continuously).
<p><u>700 MHz</u></p> <ul style="list-style-type: none"> • The band is allocated co-primarily to the mobile service (IMT) (i.e., equally with the existing radio service), coming to effect after the end of the conference WRC-15¹⁷. Studies are performed on European level regarding further possibilities of utilisation of the band in the EU¹⁸ with respect to the needs of terrestrial TV broadcasting and the possibility to use the frequency band for IMT networks. 	<ul style="list-style-type: none"> • Allocation of the band to the mobile service with the status of co-primary service by means of modification of NFT in 2016. • The decision on further utilisation of the band of 700 MHz in the conditions of the Czech Republic will be made by the government based on the conclusions of the working committee of the Ministry of Industry and Trade.

¹⁵ The State Policy in Electronic Communications lays down the strategic plan to achieve in Internet connection the availability of transmission speed of 30 Mbit/s by 2020 for the entire population and 100 Mbit/s at least for half of the households.

¹⁶ Currently in particular bands 0.4 to 6 GHz.

¹⁷ [Resolution 232 \(WRC-12\)](#).

¹⁸ Strategic proposals and recommendations for the European Commission from the High Level Group consisting of the representatives of leading broadcasting and telecommunication companies were [presented in the report of Pascal Lamy in September 2014](#).

<p><u>800 MHz</u></p> <ul style="list-style-type: none"> • Development of LTE networks, compliance with the development criteria and other adopted commitments of the operators of mobile access networks. 	<ul style="list-style-type: none"> • The Office will monitor the compliance with the development criteria and other commitments taken over by the holders of the allocations for the use of frequencies by mobile access networks (continuously).
<p><u>900 and 1800 MHz</u></p> <ul style="list-style-type: none"> • Refarming of the frequency band of 900 MHz to enable utilisation of homogenous sections of the spectrum for operation of 4G technologies. • Granting of allocations for the use of the remaining frequencies of the band of 1800 MHz. • Ensuring continuity of the services provided based on the allocations issued in the frequency band of 900 and 1800 MHz. 	<ul style="list-style-type: none"> • The Office expects a joint proposal of the users of the band of 900 MHz and will reflect the changes of the allocated frequencies in the allocations based on the operators' requests (according to the date of the request). The role of the Office is that of an initiator or, as the case may be, coordinator. • Preparation and commencement of the competitive bidding procedure no later than the 1st half of 2015, immediately after the modification of the fees for the terrestrial mobile service. • In accordance with the applicable legislation start procedural steps toward renewal/prolongation of validity of the authorisations for the utilisation of the spectrum (allocations whose validity expires in 2016).
<p><u>1452–1492 MHz (band L)</u></p> <ul style="list-style-type: none"> • Giving priority to the use of the frequency band by terrestrial services. • In medium term, after the release of the band of 1452–1479.5 MHz from radio broadcasting, allow interim utilisation by PMSE applications until the start of utilisation thereof by mobile networks. 	<ul style="list-style-type: none"> • Giving priority to terrestrial services in the frequency band of 1479.5–1492 MHz in the radio spectrum utilisation plan after adoption of the harmonisation documents of CEPT ECC (estimated in 2015). • Project the conclusions of WRC-15 into the proposal of NFT and subsequently modify the relevant parts of the plan of utilisation of radio spectrum (estimated in 2016).
<p><u>TDD 2 GHz</u></p> <ul style="list-style-type: none"> • Adoption of the Commission's harmonisation documents is expected after completion of the European preparation of utilisation of frequencies in the unpaired bands of 2 GHz. The implementation of the new utilisation conditions on national level is expected to take place some time in 2015. 	<ul style="list-style-type: none"> • According to the results of the studies, analyze the modification of the Radio Spectrum Utilisation Plan taking into account the existing authorisations in the frequency band of 1900–1920 MHz (in 2015). • Implementation of conditions for the utilisation according to the harmonisation documents or according to market requirements (in 2015).
<p><u>FDD 2.1 GHz</u></p> <ul style="list-style-type: none"> • Liberalisation of the conditions of utilisation of the frequency band in accordance with the Commission's decision on harmonisation of bands FDD 2 GHz No. 2012/688/EU. 	<ul style="list-style-type: none"> • Projecting the liberalisation into Radio Spectrum Utilisation Plan for the frequency band of 2.1 GHz together with modifications which result from the previous point.
<p><u>2.3 GHz</u></p>	<ul style="list-style-type: none"> • Making the band available for IMT systems according to the prepared harmonised

<ul style="list-style-type: none"> • A long-term goal is to make the band or a part thereof available for IMT systems. 	<p>conditions which will, among other things, modify the coexistence with the existing use (estimated in 2017).</p>
<p><u>2.6 GHz</u></p> <ul style="list-style-type: none"> • Granting authorisations for the use of the non-allocated frequencies from the band of 2.6 GHz to be used by high-speed access networks. 	<ul style="list-style-type: none"> • Preparation and commencement of the competitive bidding procedure after the modification of the fees for the terrestrial mobile service (1st half of 2015).
<p><u>3.5 GHz and 3.7 GHz</u></p> <ul style="list-style-type: none"> • Creation of conditions for the implementation of prospective technologies which will enable establishment of high-/ultra-high-speed access networks¹⁹. • Implementation of an updated harmonisation decisions of the Commission 	<ul style="list-style-type: none"> • Preparation for the commencement of the competitive bidding procedure (frequency band of 3.7 GHz) (1st half of 2015, based on the modification of the fees – see Article 3.7). • According to the adopted operating conditions harmonised on European level, the conditions of utilisation of the spectrum in Radio Spectrum Utilisation Plan and general authorisation will be modified to allow implementation of prospective high-speed systems TDD in both frequency bands (2014–2015). • Change of priority of the satellite fixed service in the frequency band of 3.4–3.6 GHz and downgrading to secondary service status by means of a revision of NFT (in 2016).

2.2. License-free utilisation by access networks FWA/BWA including WiFi

2.2.1. Current situation (development trends – see Article 6.4.4)

Bands designed for the operation of wireless high-speed access (WiFi, RLAN, BWA/FWA) networks are harmonised internationally and are used both for the provision of publicly available services of electronic communications and in private, community or home networks.

Band	Aggregate of frequencies [GHz]	Note on the use
2.4 GHz	0.0835	
5 GHz – aggregate	0.455	For outdoor installations only 0.255 GHz.
57–66 GHz	9 GHz	For indoor use only. For example, technology IEEE 802.11ad (WiGig).

Table No. 1: Frequency bands for fixed wireless access networks FWA/BWA – license-free operation

0.54 GHz of the spectrum is available aggregately in the bands up to 6 GHz in the frequency bands designed for the use of frequencies under a general authorisation (i.e., hereinafter also referred to as so-called license-free use of radio frequencies) by fixed high-speed wireless Internet access networks. (Note: Sections from the bands 10 GHz and 17 GHz intended for the license-free use by fixed microwave connections are described in Article 2.5).

¹⁹ Category “Super-high multimedia” with speeds over 30 Mbit/s according to the recommendations of ITU-R <http://www.itu.int/rec/R-REC-M.1768/en>

When using frequencies out of the band 5 GHz by WiFi stations in some cases and at some locations there is interference with meteorological radars in the frequency band 5.65 GHz (see Article 3.6). The most frequently discovered cause is violation of the conditions of the use of radio spectrum when operating RLAN stations and using equipment which does not comply with applicable technical standards. A campaign is currently underway on both national and international level directed at ensuring compatibility of operation in this frequency band. The feasibility of national extension of the usable frequencies for WiFi networks in the frequency band of 5 GHz is of long-term nature and depends on the international harmonisation process, adoption of operating and technical standards (IEEE), performance of sharing studies, and must be considered on national level in cooperation with other ministries (e.g., Ministry of Transport).

2.2.2. Objectives and strategies

Long-term strategic objective:	Implementation of the strategic measures:
<ul style="list-style-type: none"> Achievement of mutual compatibility of the stations and elimination of the interference with meteorological radars. 	<ul style="list-style-type: none"> Procedure for the achievement of discipline in the area of suppression of undesirable interference is described in Article 3.6 (continuously).
<ul style="list-style-type: none"> Possible expansion of bands in 5 GHz for the WiFi access networks. 	<ul style="list-style-type: none"> Ensuring cooperation in the projection of the strategy of the Ministry of Transport on the plan of development of the electronic tolling system for the Czech Republic (topology of road toll system) in terms of the use of the frequency band of 5.8 GHz (continuously). In accordance with the results of Commission's mandate on frequency band of 5 GHz and the international harmonisation, preparing the procedure for the addition of additional sections for the access networks (BWA/WiFi). Estimated in 2016.
<ul style="list-style-type: none"> Support of development of the cells of the access networks whose operating and technical conditions enable license-free utilisation of the radio spectrum (femtocells). 	<ul style="list-style-type: none"> Modification of the Radio Spectrum Utilisation Plan, general authorisation and, as the case may be, the fee policy based on the adoption of the harmonisation documents (see also Article 3.7).

2.3. One-way networks of terrestrial television and radio broadcasting

One of the main changes of the last decade in the terrestrial broadcasting is the arrival of digital technologies enabling more effective utilisation of frequencies. While the migration to digital television broadcasting, which was a coordinated European process directed at more effective utilisation of the spectrum with the related key strategic objective to release frequencies for mobile access networks (so-called digital dividend resulting from the release of the band of 800 MHz), was successfully completed the implementation of digital radio broadcasting has no defined single European process and the technological innovation is conditional upon the market's interest.

2.3.1. Television broadcasting

2.3.1.1. Current situation (development trends – see Article 6.4.2)

In the UHF band (470–790 MHz, channels 21 through 60) there is one network of public DVB-T broadcasting operated on the basis of an allocation of radio frequencies which expires in 2023, and three nationwide commercial digital broadcasting DVB-T networks based on allocations of radio frequencies which expire in 2021, 2022 and 2024. The conditions enable the holders of the allocations in the UHF frequency band to use the radio frequencies technologically neutrally. Holder of the allocation for public broadcasting has a technologically neutral allocation allowing for future implementation of 2nd generation broadcasting technologies²⁰. At the time of preparation of this document fifteen other regional networks were operated under individual authorisations with expiry date on 31 December 2017. Reception of terrestrial broadcasting is the most significant platform in comparison with the other methods of distribution of the television signal which include cable TV (distribution of television program by means of fixed optical fiber or coaxial cables), IPTV (signal distribution using an IP protocol through high-speed connection), and satellite TV.

Platform	Satellite TV	Cable TV	IPTV	Terrestrial TV
Usage in households	23 % *)	26 % *)	2 % *)	52 % *)

Source: * [Eurobarometer 414](#) dated 01/2014.

Table No. 2: Overview of the modes of reception of television broadcasting

2.3.1.2. Objectives and strategies

In terms of the medium-term development, it is necessary, in accordance with the Digital Czech Republic²¹ policy, to ensure continuity of terrestrial broadcasting in the scope in which digital terrestrial broadcasting was implemented²², i.e., with a guarantee of the validity period of the allocations. The Digital Czech Republic policy foresees using optimisation of the use of the spectrum in the frequency band of 470–790 MHz to achieve savings of the spectrum in order to use it further for access networks (band 700 MHz) under the condition of ensuring the opportunities for the development of terrestrial television broadcasting. The release, if any, of the band of 700 MHz in favor of the access networks, however, means reduction of the available scope of frequencies in the UHF band for further development of terrestrial digital television broadcasting.

Dates of release of the band of 700 MHz should be determined on the basis of a political decision that will reflect the fact that this decision will affect the future development of terrestrial television broadcasting in the Czech Republic.

The fulfillment of the objective of long-term development of terrestrial broadcasting can be ensured only by transition to the second generation of broadcasting technologies – migration to the DVB-T2 standard. The migration together with the deployment of more effective compression technologies will increase the transmission capacity of the networks allowing to increase the number of channels transmitted in a single multiplex and to improve the quality by transmitting channels in HD or UHDTV resolution. The important factor is involvement of the Czech Television as the public media. The prerequisite of a successful migration to DVB-T2, in addition to the optimal set-up of the technical (frequency) conditions, is also the resolution of the other related aspects (funding, minimisation of impact on the audience, equipment of the market with DVB-T2 receivers, etc.) as well as the finding of a suitable economic model for all stakeholders.

²⁰ In Europe DVB-T2.

²¹ Measure No. 5.

²² Government Regulation No. 161/2008 Sb. (Collection of Laws), on the technical plan of migration, defined the scope of the nationwide broadcasting for 4 networks.

To fulfil the long-term objective of the development of terrestrial TV broadcasting is desirable to further guarantee the future use of the remaining UHF band (470-694 MHz) for television broadcasting until at least 2030. At the latest before this date must be done an analysis of frequency requirements for terrestrial television broadcasting. Dates of release of the band of 700 MHz, means of migration to DVB-T2, including all related aspects, and guaranteed future use of the remaining UHF band until at least 2030 should be determined on the basis of a political decision.

Long-term strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Optimisation of the use of the UHF frequency band. 	<ul style="list-style-type: none"> • Application of European harmonisation plans for the sharing of the UHF band with other systems (cognitive technologies and applications using the white spaces within the spectrum, non-personal communication (M2M), PMSE applications). • After the adoption of the harmonisation documents with the methodologies of utilisation of the white spaces, prepare an analysis of white spaces in the UHF frequency band.
<ul style="list-style-type: none"> • Elimination of the unfounded differences in the approach to the spectrum when comparing the methods of authorisation – i.e., form of competitive bidding procedure as opposed to a direct allocation of individual authorisation based on application. 	<ul style="list-style-type: none"> • Prepare a proposal for introduction of a transparent system of granting authorisations for all frequencies intended for greater coverage than what corresponds with local²³ coverage (in 2016).
Specific strategic objectives:	
<ul style="list-style-type: none"> • Enable technological innovation of television broadcasting for the users of the UHF band while respecting the projection of the available range of radio frequencies, based on other documents adopted by the government. 	<ul style="list-style-type: none"> • Acceptance of the requests for enabling technological neutrality for all operators in the radiocommunication service in the UHF frequency band (started in 2013). • Cooperate with the competent public authorities²⁴ on preparation of the concept of migration from DVB-T to DVB-T2 after presentation to the government, so that process would respect <ul style="list-style-type: none"> ➤ the existing authorisations and European plans for the harmonised utilisation of the bands of 700 MHz, ➤ time limitation of the validity period of the individual authorisations which are not issued on the basis of nationwide allocations of radio frequencies by 31 December 2017, ➤ involvement of the public operator in the migration process²⁵ and further

²³ Section 2, (e) of the Act 231/2001 Sb. (Collection of Laws), on radio and TV broadcasting.

²⁴ The issue of the future migration to the new digital standard DVB-T2 [is dealt with by the Ministry of Industry and Trade within its scope of responsibility.](#)

²⁵ Pursuant to the amendment of Act No. 483/1991 Sb. (Collection of Laws), on Czech Television, as amended.

	development of its terrestrial broadcasting.
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2.3.2. Radio broadcasting

This chapter proposes measures related to broadcasting the content of which is primarily audio broadcasting.

2.3.2.1. Current situation (development trends – see Article 6.4.3)

In terms of terrestrial radio broadcasting, analog broadcasting is operated in the bands of long waves (LW), medium waves (MW) and very high frequency (VHF), and digital broadcasting in the television UHF band (470–790 MHz, DVB multiplexes), in the frequency band of L (1452–1479,5 MHz, T-DAB), and authorisations have been granted also for individual T-DAB transmitters in band III (174–230 MHz). Terrestrial analog FM radio broadcasting on very high frequency (87.5–108 MHz) is currently the most important platform for the provision of radio services, among other reasons due to the nationwide coverage, operation of regional stations, easy availability of the receivers, sufficient quality of broadcasting and reception, and also due to the possibility of mobile reception.

Band	Number of transmitters / networks ^{*)}	Service provided	Analog. / digit. broadcasting
LW	1 transmitter ^{**)}	public broadcasting	A
MW	13 transmitters	public and commercial broadcasting	A
VHF	705 transmitters	public and commercial broadcasting	A
Band III	11 transmitters	public and commercial broadcasting	D
UHF (DVB multiplexes)	2 networks	public broadcasting, commercial broadcasting	D
Band L	9 transmitters	public and commercial broadcasting	D

^{*)} Valid as of 29 September 2014. ^{**)} Estimated termination by the operator in 2017.

Table No. 3: Utilisation of bands by terrestrial analog and digital radio broadcasting in the Czech Republic

Implementation of digital radio broadcasting is not a substitute to the existing analog radio broadcasting both methods of broadcasting will be used concurrently in the long run. The following chapter includes a general overview of the steps toward the digitalisation of radio broadcasting, which will also create room for the introduction of new types of services. The current legislation also motivates operators of FM broadcasting to support the migration to digital broadcasting *with the aim to achieve a significant degree of digitalisation of radio broadcasting by 2025*. An important factor is the time required for the technological replacement of consumers' receivers.

2.3.2.2. Objectives and implementation of the strategy – band III, digital broadcasting

Band III (VHF) is designated for the implementation and development of digital radio and multimedia one-way broadcasting for mobile users. Taking into account the facts provided

in this document, the Office intends to make band III accessible²⁶ for digital radio broadcasting while using the conclusions from the consultation on utilisation of band III which has published by the Office on its website²⁷ in August 2013. The International agreement Geneva, 2006 [17] allocates blocks for digital broadcasting to the Czech Republic within geographically defined areas (group allocations) under the condition of complying with the agreed-upon signal levels on the borders of these areas.

Strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Create conditions for nationwide coverage with digital radio broadcasting. 	<ul style="list-style-type: none"> • Prepare the conditions of the competitive bidding procedures for the allocations of radio frequencies (estimated in 2015). • Technical support for MC when preparing the Strategy of digitalisation of radio broadcasting including the rights and obligations of the operator of public broadcasting. • Carry out competitive bidding procedures for the allocations of radio frequencies (subsequently, according to the preparation). • In specified allocations, holders of the allocations of authorisations for the use of frequencies will take over the commitment to reserve a part of the capacity of the multiplex for a law-defined number of programs of the operator of public broadcasting which are currently disseminated as analog. • Grant allocation for the dissemination of public radio multiplex in line with the prepared strategy and the amendment of Act No. 484/1991 Sb. (Collection of Laws), on Czech Radio Service, or after adoption of the factual intent of the act which is to reserve the necessary radio frequencies to Czech (public) Radio Service (“Český rozhlas”). • Holders of the allocations of authorisations for the use of frequencies will take over the commitments to cover with broadcasting, in the first phase of building of the networks, at least the cities of Plzeň, Prague, Brno, Ostrava and the line of motorway networks connecting these cities.

2.3.2.3. Objectives and implementation of the strategy – band L, digital broadcasting

Band L (1452–1479.5 MHz) whose future utilisation in Europe tends toward the support of high-speed access networks (downlink), namely in the mobile service in the entire band of 1452–1492 MHz, can be used by the holders of the allocations in the radio service throughout their validity period. Allocations were removed from the holders who have not started using band L in the radio service. Utilisation of band L by T-DAB transmitters is currently decreasing in favor of the use of band III.

Operation of supporting mobile networks is envisaged in this frequency band in the long run (see Article 6.4.1.3). The migration of radio broadcasting from band L to band III is voluntary and is not subject of this national strategy. After the release of this frequency band, one of the considered alternatives is to use this frequency band in interim basis for PMSE

²⁶ Technical conditions of the use of frequency band III in the Czech Republic are described in a part of the radio spectrum utilisation plan No. [PV-P/21/11.2013-6](#) for frequency band 174–280 MHz.

²⁷ <http://www.ctu.cz/aktuality/aktualni-informacion.html?action=detail&ArticleId=10600>

applications (see Article 2.7). The long-term objective is to use this frequency band for mobile networks (see Article 6.4.1.3).

2.3.2.4. Objectives and implementation of the strategy – analog radio broadcasting

Development of analog radio broadcasting is limited to the facilitation of conditions for the operation of the existing transmitters in the bands MW and VHF FM which include, but are not limited to, compliance with the frequency excursion, the total multiplex output, and compliance with the protective parameters against radio systems in the aviation radio navigation service.

Strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> Ensuring standardised operating parameters of all FM transmitters in order to minimize the risk of interference with other radiocommunication services, including but not limited to air radio navigation. 	<ul style="list-style-type: none"> In the frequency band of VHF 87.5–108 MHz continue monitoring the operating conditions of the use of frequencies by the operators of FM transmitters (continuously).
<ul style="list-style-type: none"> Validity of the new and existing individual authorisations for the use of frequencies for the purpose of disseminating radio audio broadcasting will be extended to 10 October 2025 as a maximum. 	<ul style="list-style-type: none"> The Office will make a decision on further development in the FM frequency band based on a more detailed specification of the future development²⁸ of DAB broadcasting in accordance with the law [13], in particular Section 5 and Section 12 (validity periods of the licenses for the operation of broadcasting), and with the government document which will be adopted for the development of terrestrial digital broadcasting of the Czech Radio Service.

2.4. Short-range devices (SRD)

2.4.1. Current situation (development trends – see Articles 6.4.4.2 and 6.4.4.3)

All bands harmonised on the level of the European Union and membership of European countries in CEPT are made available for the purpose of operation of short-range devices (SRD). On European scale²⁹ the Czech Republic has achieved a high degree of harmonisation, and the current conditions of the use of the spectrum in the Czech Republic do not prevent development of SRD using the harmonised sections of the spectrum. The Office continuously reviews the conditions of utilisation of the spectrum through general authorisation in accordance with the harmonisation documents issued, in particular Commission Decision 2006/771/EC on short-range devices, as amended.

The frequency band of 870 MHz (870–875.8/915–920.8 MHz), which is currently designated for PMR/PAMR stations and networks (see Articles 2.6.1 and 6.4.4.2), is important for potential development of SRD; the original use by broadband access networks has been terminated. On the level of CEPT, the expansion of the sections for SRD into the band of 870 MHz is considered.

Development of non-personal communication (M2M) takes place both in the area of SRD-category applications (e.g., development of energy meters with wireless reading in households) and also through the terminals of the cellular networks described in Article 6.4.1³⁰.

²⁸ Degree of coverage of the Czech Republic with the signal and scope of services – number of programs.

²⁹ Study by Analys Mason: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=1357

³⁰ 0.6 million M2M devices were registered in mobile networks in the Czech Republic in 2013.

2.4.2. Objectives and implementation of the strategy

Strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> In the event of demand by the markets and if not inconsistent with international harmonisation make the newly harmonised and other frequency bands available for SRD. 	<ul style="list-style-type: none"> The Office will present a discussion material on the suggestions with a proposal for making the identified bands available in order to check the users' interest (by 2016). If users are interested and in accordance with the harmonisation make in particular the band of 870 MHz available for SRD – see Article 2.6.1
<ul style="list-style-type: none"> Reserve specific sections in the frequency band of 400 MHz for the operation of data stations for the non-personal communication (M2M). 	<ul style="list-style-type: none"> The Office will present a discussion material on the suggestions with a proposal for making the frequencies available in order to check the users' interest (by 2016). If users are interested <ul style="list-style-type: none"> ➤ in the frequency band of 160 MHz make additional frequencies available for the license-free utilisation by data stations (including M2M) by means of modification of the Radio Spectrum Utilisation Plan and/or general authorisation (continuously), ➤ define channels in the section of 442.5–443.6 MHz – see Article 2.6.2

2.5. Fixed microwave links

2.5.1. Current situation (development trends – see Article 6.4.5)

The typical utilisation in fixed radio communication service is microwave links designed for directional links (point-to-point) or for sector coverage (point-to-multipoint). The prevailing use is operation of networks for backbone networks (connection between base stations and the core of the networks), for transmission of traffic in telephone and Internet networks (connectivity), including connection of customers at places where there is no available connection with copper or optical fiber cable, and it is also significantly used by private networks. As a supplement, the fixed service is also of importance for PMSE outside broadcasting links described in Article 2.7.

Frequency bands up to 59 GHz are currently made available for use under an individual authorisation, and the conditions of the use thereof are harmonised with the current documents of the EU, ITU-R and CEPT. There are also bands available for use under a general authorisation. The list of frequencies available for use by microwave links under individual and general authorisations is summed up in the following tables.

Band ³¹ [GHz]	Sum of frequencies [MHz]	Note on use	Band [GHz]	Sum of frequencies [MHz]	Note on use
1.88 – 1.90	20	DECT	24 – 25	1,344	
3.8 – 4.2	400		31 – 33	1,900	
6 – 7	1,800		37 – 39	2,170	
10.7 – 11.7	1,000		40 – 44	3,000	
12 – 14.5	500		48 – 50	1,700	
14.5 – 15	240		51 – 52	1,200	

³¹ Exact definition is provided by the Radio spectrum utilisation plan [4].

17 – 20	2,050		57 – 59	3,020	
22 – 24	1,200		<i>Over 59 GHz – see the note</i>		

Table No. 4: Frequency bands up to 59 GHz available for point-to-point microwave links, individual authorisation.

Note: Individual authorisation for a fixed link can be issued also in other designated bands over 59 GHz; because the common conditions of the use of frequencies in these bands have not been laid down the Office proceeds individually when issuing authorisations.

In frequency bands up to 59 GHz a total of 21.5 GHz of the radio spectrum is available for use by point-to-point fixed microwave links operated under individual authorisations.

Frequency band ³¹ [GHz]	Sum of frequencies [MHz]
24 – 26	336
27.8 – 28	112
28 – 29	560

Table No. 5: Frequency bands for fixed wireless access networks FWA/BWA (point-to-multipoint) – individual authorisations, operation of the terminals is under a general authorisation.

A total of 1 GHz of the spectrum is available in the frequency bands of fixed wireless access FWA/BWA used under an individual authorisation for point-to-multipoint links.

Band ³¹ [GHz]	Sum of frequencies	Note
10 GHz	0.23 GHz	Supporting band for WiFi networks.
17 GHz	0.2 GHz	
71–76 /81–86 GHz	10 GHz	

Table No. 6: Frequency bands up to 90 GHz used by point-to-point fixed high-speed links, license-free utilisation

A total of 10.4 GHz of the spectrum is available in the frequency bands up to 90 GHz designated for license-free use by point-to-point microwave links, including high-speed data transmissions.

2.5.2. Objectives and implementation of the strategy

Objectives in the area of the spectrum for fixed microwave links are based on the main objectives specified in Article 1.2, factors and trends described in Articles 6.3 and 6.4.5 and included, but are not limited to, effectiveness of utilisation of the spectrum, technological neutrality, support of mutual compatibility of the stations, development of high-speed links, trend of license-free utilisation of the spectrum in suitable frequency bands, and general support of the development of the network infrastructure. Specifically, the objectives and strategies are as follows:

Long-term and common strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> Development of backbone networks and infrastructure connections³² of the access points (high-speed Internet access). 	<ul style="list-style-type: none"> Gradual opening of additional sections of the radio spectrum for infrastructure links (continuously).
Specific strategic objectives for selected frequency bands:	

³² Fixed links other than access networks.

<ul style="list-style-type: none"> In the frequency bands up to 6 GHz, use by radio access and communication networks (IMT, MFCN, FWA, BWA, PMR/PAMR) is gradually preferred in the terrestrial radio communication services. 	<ul style="list-style-type: none"> For fixed infrastructure links³² (other than access networks) operated under individual authorisation no further sections will be made available in the bands up to 6 GHz (continuously). The priority is use by access networks.
<ul style="list-style-type: none"> Release of additional duplex frequencies (individual authorisation) in the frequency band of 7 GHz³³ for commercial use in the event of indication of the users' interest. This frequency band is attractive in particular for the implementation of point-to-point links at long distances (typically 30 to 50 km). 	<ul style="list-style-type: none"> The Office will submit for commenting a discussion material with the proposal to make the duplex channels available in order to verify the users' interest (by 2015). The conditions of use of the band will be modified in the relevant part of the Radio Spectrum Utilisation Plan in the event of the users' interest (continuously).
<ul style="list-style-type: none"> Technological neutrality will be introduced in the duplex sections 28.2205 –28.4445 GHz and 29.2285 – 29.4525 GHz, which were so far designated for use by fixed links of the infrastructure of UMTS networks. 	<ul style="list-style-type: none"> Review of the relevant part of the Radio Spectrum Utilisation Plan (in 2014).
<ul style="list-style-type: none"> Enable operation of high-capacity links using broad channels in the frequency bands over 40.5 GHz suitable for the implementation of short-distance microwave links. 	<ul style="list-style-type: none"> Modification of the Radio Spectrum Utilisation Plan according to the nature of the current utilisation of the bands and according to the market requirements (continuously).
<ul style="list-style-type: none"> In the frequency bands over 57 GHz the methods of authorisation will be reconsidered in order to increase the number of these frequency bands available under general authorisation. 	<ul style="list-style-type: none"> According to the market requirements in the medium term Review of the relevant part of the Radio Spectrum Utilisation Plan a general authorisation.

2.6. Mobile private networks PMR

2.6.1. Current situation (development trends – see Article 6.4.6)

Sections from the bands of 140–174 MHz (frequency band of 160 MHz), 406–468 MHz (frequency band of 400 MHz) and 870–925 MHz (frequency band of 800 MHz) are designated for the operation of the mobile stations of the private networks PMR/PAMR (other than IRS networks).

- In the frequency band of 160 MHz a total of 23.55 MHz of the spectrum is available for duplex networks, a total of 1.77 MHz for simplex networks. Interest in utilisation of frequencies by simplex mobile networks is indicated in this frequency band.
- In the frequency band of 400 MHz a total of 18.6 MHz of the spectrum is available for duplex networks, a total of 7.1 MHz for simplex networks. Interest in utilisation of frequencies by simplex mobile networks is indicated in this frequency band.
- A total of 14 MHz of the radio spectrum in the bands 150 MHz, 460/470 MHz and 880/925 MHz is used for communication in railway transport.

The completed release of the frequency band 870 –875.8 / 915 – 920.8 MHz, which was used in the past by digital access broadband networks PAMR, is important in terms of the future objectives. The decision on the future use of the frequency band will be made in

³³ 6425–7125 GHz

accordance with the European harmonisation which is currently directed toward extension of the bottom-adjacent frequency band used intensively for the operation of short-range devices SRD (see Article 2.4). The potential use is for non-personal communication (M2M). As no conflict with such plans is indicated, further utilisation of this frequency band will take into account the above-mentioned intentions of the license-free use.

Further changes can result from the gradual abandonment of the band by the technologies which are obsolete from today’s perspective – e.g., the concept of collective analog radio networks (HRS) in the frequency band of 455.74 – 457.38 / 465.74 – 467.38 MHz adjacent to the frequency bands used by the nationwide CDMA network. The release of this frequency band could contribute to the future expansion of frequencies which are still used by nationwide networks to a volume which allows for placement of the 5MHz block suitable for the implementation of more modern access networks.

2.6.2. Objectives and implementation of the strategy

Strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> With respect to the demand for the operation of broadband applications including data stations of non-personal communication (M2M), a specific section will be dedicated for use under individual authorisation (license-free use see Article 2.4.2.) 	<ul style="list-style-type: none"> The Office will submit for commenting a discussion material with the proposal for designation of the section 442.5 - 443.6 MHz for suitable use, e.g., by non-personal communications (M2M), under individual authorisation (by 2016). Designation of the section 442.5 – 443.6 MHz for simplex channels with 200kHz width, according to the market requirements, by modification of the Radio Spectrum Utilisation Plan and/or general authorisation.
<ul style="list-style-type: none"> Making the frequencies in the section of 440 MHz released by non-civil use available for use by simplex narrow-band PMR stations with channel width 12.5 kHz. 	<ul style="list-style-type: none"> Modification/update of the Radio Spectrum Utilisation Plan (2015).
<ul style="list-style-type: none"> Frequency band of 870 – 875.8 / 915 – 920.8 MHz will no longer be designated for PMR/PAMR. 	<ul style="list-style-type: none"> In accordance with international harmonisation and use abroad, utilisation by SRD stations is envisaged (medium-term objective).

2.7. Outside broadcasting links, PMSE

2.7.1. Current situation (development trends – see Article 6.4.6)

Harmonised frequency bands listed in table No. 7 are designated for PMSE devices designated for outside broadcasting links in the mobile service, for the support of radio and television broadcasting and for wireless microphones. Frequencies up to 1.8 GHz are used primarily by wireless microphones under license-free operation; higher frequency bands are suitable for applications and video transmissions using greater channel width (e.g., 10 MHz). SNG applications use license-free as well as licensed satellite gigahertz bands. Due to the changes of utilisation of the spectrum in the bands VHF and UHF, which had and will have impact on the operation of PMSE, we provide a summary table of the current use of frequencies for PMSE in the Czech Republic:

Frequency band ³¹	Authorisation	Note on the use
36.4–38.5 MHz	general authorisation	Microphones

band 169.5 MHz	general authorisation	Microphones
173.3 MHz	general authorisation	Microphones
174 MHz	general authorisation	Microphones
174–216 MHz	general authorisation	Microphones; restriction on the local or regional use of discrete channels due to the operation of DAB.
470–789 MHz	general authorisation	Microphones
470–790 MHz	individual authorisation	PMSE in radio and TV broadcasting.
823–832 MHz	general authorisation	
863–865 MHz	general authorisation	Microphones
1785–1800 MHz	general authorisation / individual authorisation	Microphones
2025–2110 MHz	individual authorisation	
2300–2412 MHz	individual authorisation	
3400–3600 MHz	individual authorisation	
4.4–5 GHz	individual authorisation	
10.42–10.476 GHz and 10.588–10.644 GHz	individual authorisation	
22,592–22,704 GHz	individual authorisation	
24,25–24.5 GHz	individual authorisation	

Table No. 7: List of frequency bands for PMSE

2.7.2. Objectives and implementation of the strategy

Currently there are no specific requirements for the extension of bands for PMSE or modification of the conditions of utilisation of the frequencies. With respect to the plan to release the bands of 700 MHz, a European-harmonised basic set of frequencies is reserved for PMSE, and the frequencies for PMSE will be expanded by the band of 1800–1805 MHz. Within the set period the harmonisation document will be implemented using the standard method of updating the Radio Spectrum Utilisation Plan or the general authorisation.

2.8. Other services and use

2.8.1. Aviation services (development trends – see Article 6.4.10)

In the aviation mobile service, the significant change is the next phase of migration of the voice communication from channel width 25 kHz to frequency division in the raster of 8.33 kHz for the entire airspace of the Czech Republic (communication using channels of the width 8.33 kHz is already used in air elevations over 5000 m).

These changes toward more effective use of the radio spectrum are a result of the intensification of air traffic and the increasing requirements for spectrum for the communication in air traffic in Europe. The changes in the use of the frequencies impact users in aviation

mobile service, and coordination of these actions in the European Union is regulated by an implementing regulation of the Commission³⁴.

Strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> In the period until 31 December 2018 ensure national coordinated transition to the use of channel spacing 8.33 kHz in air voice communication. After this date only channel spacing 8.33 kHz will be used. 	<ul style="list-style-type: none"> The process starts with the modification of the Radio Spectrum Utilisation Plan and takes place in cooperation with the Ministry of Transport which provides organisation for the process.

2.8.2. Satellite services (development trends – see Article 6.4.9)

A high degree of harmonisation of the conditions of the use of satellite bands was achieved in the Czech Republic. The bands designated for the satellite *interactive communication* are primarily the internationally used bands in particular from the area of frequencies 1.5 GHz to 30 GHz.

Terminals are operated mostly under a general authorisation, either as non-mobile terminals, or as mobile (portable) terminals. Thanks to the high degree of coverage with the single of terrestrial mobile communication networks, the application of satellite broadband interactive communication in the Czech Republic is secondary, and the estimated number of users of satellite broadband access networks in the Czech Republic gradually decreases – from 1200 users in 2012 to 800 in 2013³⁵. Satellite interactive services are used also by *outside broadcasting links* in the frequency bands of 11 GHz and 14 GHz.

The most important use of satellite in terms of the interests of the society is one-way digital television *broadcasting* in the frequency band of 12 GHz. Satellite reception is used by 26% households in the Czech Republic (see also Article 2.3.1.1), and it is almost always DVB-S. Currently there are no needs for substantial regulatory modifications in the area of spectrum management beyond the standard procedures.

2.8.3. Communication of security and rescue services of the PPDR (development trends – see Article 6.4.7)

In order to ensure a functional system of rescue and security services of PPDR³⁶, coverage of the tasks of national defense and obligations of the Czech Republic to the NATO, and activities of other armed forces and security services of the Czech Republic it is necessary to provide these services with adequate access to the spectrum.

The section 2 x 5 MHz in the frequency band of 380–385/390–395 MHz are designated for the operation of all services of the single Integrate Rescue System (IRS) in all of Europe, and this frequency band is fully used by professional units of the IRS. The system in the Czech Republic is based on Tetrapol technology and its further development, if any, is limited by circumstances including but not limited to the following:

- The above-mentioned frequency section is a part of the frequency band of 225 – 400 MHz which is designated, in accordance with the harmonised table of NATO, for military use and does not allow for extension of frequency allocation above 385/395 MHz without a radical reorganisation of the band of 225 – 400 MHz,
- The limited bandwidth makes it possible to use this band only for the operation of voice services and narrowband (low-speed) data transmission,
- The currently used technology and the limited bandwidth does not make it possible to fulfill the requirements for broadband communication (BB PPDR),

³⁴ COMMISSION IMPLEMENTING REGULATION (EU) No 1079/2012 of 16 November 2012 laying down requirements for voice channels spacing for the single European sky.

³⁵ OECD Broadband Subscription Data, June 2013.

³⁶ PPDR – Public Protection and Disaster Relief.

- Long-term parallel use of frequencies by broadband and narrowband PPDR systems (operation of two systems) is not realistic and technical and economic terms,
- Different technologies and different frequency bands are currently used for the communication of the rescue and security services; the objective of implementation of the Tetrapol technology that all units will be equipped with this system and the radio spectrum in the other frequency bands will be released, was not fulfilled.

2.8.3.1. Objectives and implementation of the strategy

The basic objective is to create conditions for the implementation of broadband communication for PPDR applications. The Office will build upon the European or, as the case may be, regional harmonisation of the radio spectrum for BB PPDR applications which foresees uniform utilisation of the spectrum throughout Europe in order to ensure interoperability and cross-border cooperation of the rescue and security services. The subject of the studies ordered from CEPT by the Commission is the use of a part of the band of 700 MHz for these purposes.

Long-term strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Create conditions for the implementation of broadband communication for PPDR applications. 	<ul style="list-style-type: none"> • The Office will initiate preparation of a communication strategy of the security and rescue services (in 2014). • Conditions of development of PPDR will respect the national communication strategy of the security and rescue services prepared by the Ministry of the Interior (estimated by 2017) and also the European harmonisation of the spectrum and the principles of cooperation of the security and rescue services with the neighboring states. • Designation of the spectrum for BB PPDR applications based on adoption of a national strategy (as per the previous paragraph). • Participation of the representatives of the Czech Republic in the working bodies of the EU in the preparation of a single technical solution of high-speed communications of the security and rescue services (2014–2015).

Access to the spectrum for other armed services and security services is ensured by the standard procedure in accordance with the law, and the current situation does not show any major problems. The Office also has not registered new user needs which would lead to a significant increase of the need for spectrum from civil sections and other security services.

2.8.4. Meteorological and scientific services, Earth exploration satellite service (trends – see Article 6.4.11)

On European level there are currently no known requirements for additional spectrum for the *meteorological service* or other related regulatory changes. The operating and technical conditions in this service will be modified in particular to improve the compatibility with the other use of the spectrum (see also 3.6).

In the *Earth exploration satellite service*, possible future allocation of additional spectrum 7190 – 7235 MHz for use by the new systems in the area of navigation, control and telemetry of these satellite systems will be discussed based on the positions of European scientific organisations. Scientific contribution in the area of environmental protection and climate changes is expected also from new-generation high-resolution satellite radars operated in the Earth exploration satellite service (active).

The needs for using radio frequencies for scientific, research and innovation purposes are fulfilled in particular by procedures which include utilisation of frequencies for experimental use³⁷. Fulfillment of other objectives in the area of utilisation of frequencies using the operational programs is also possible in the form of shared use of frequencies (see Article 3.5) under an agreement with the authorised users of the respective parts of the radio spectrum or, more precisely, the individual radio frequencies.

The conditions of use *in other scientific services* do not require adoption of specific national measures.

2.9. Non-civil utilisation of the radio spectrum

2.9.1. Current situation (development trends – see Article 6.4.8)

The Ministry of Defense, which is the second largest user of the radio spectrum in terms of the volume of the dedicated spectrum, is in a specific position. The frequency bands dedicated for military use are specified in NFT and are based on the needs to ensure national defense and the needs of the NATO according to the NATO frequency table (NJFA – NATO Joint Frequency Agreement). Specific technical parameters for individual radio devices are not set for the Ministry of Defense because, in accordance with the law, the Office does not issue individual authorisation for the use of the radio spectrum for military purpose to the Ministry of Defense. In specific cases the use of some sections of the radio spectrum is regulated by the agreement between the Ministry of Defense and the Office. The use of frequency bands according to this agreement is updated on regular basis within periodical meetings with the Office.

2.9.2. Objectives and implementation of the strategy

The main objective is to provide access for the Ministry of Defense to the spectrum in the scope which will enable fulfillment of the national defense tasks and obligations to NATO represented in the harmonised frequency table of NATO (NJFA).

Long-term strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • provide access for the Ministry of Defense to the spectrum in the scope which will enable fulfillment of the national defense tasks and obligations to NATO. 	<ul style="list-style-type: none"> • Review the utilisation of the spectrum by the Ministry of Defense and its justified needs in terms of the amount and status of the spectrum allocated, effectiveness and efficiency of the use by the Armed Forces of the Czech Republic (geographic utilisation, time utilisation, life cycle of the current technology, planned needs) (in 2016). • Cooperate with national administrations and NATO bodies on the review (updates of the harmonised table of NJFA) focusing on future requirements for the spectrum to be used for military purposes (continuously). • Subsequently prepare resources for proposals of the changes to the law and NFT (2016).
<ul style="list-style-type: none"> • Based on the review, initiate implementation of a single strategic management within the scope of responsibility of the Office and creation of the conditions for effective 	<ul style="list-style-type: none"> • Start a discussion (in 2016) on implementation of the regulatory and motivation tools which will lead to improvement of the effectiveness and efficient use of the spectrum by the Ministry of Defense (including the analysis of the reasons for the implementation, if any, of the fee duty, including the scope thereof) in order to

³⁷ Section 19a of the Act.

<p>use of the spectrum dedicated to the Ministry of Defense in order to expand the possibility of commercial use while covering the specific needs of the Ministry of Defense.</p>	<ul style="list-style-type: none"> ➤ verify, on cyclic basis, the requirements for the use of the spectrum in peace conditions, ➤ optimize the method of sharing of the spectrum between the Ministry of Defense and the civil use of the frequencies. • Analysis of the possibilities of application of the methods of sharing of the spectrum (e.g., LSA, WSD) in the frequency bands used by the Ministry of Defense (see Article 3.5) and presentation of this analysis for commenting (by 2016).
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3. COMMON MEASURES for effective utilisation of the spectrum, for development of competition

3.1. Main principles and measures of spectrum management

Spectrum is a national and public economic source which, in different bands, at different times and different places, has different potential uses, different functional, social and economic value. Some frequency bands have a higher value for a certain type of use, and this value can even be increased by the location of the potential use. The general principles mentioned in Articles 6.2 and 1.2 – *Mission of the Office in the area of spectrum management* – will continue being decisive in the spectrum management, and in the long run the direction will be toward development and optimisation of market mechanism, in particular in the following directions:

Common objectives:	Implementation of the measures:
<ul style="list-style-type: none"> Effectiveness 	<ul style="list-style-type: none"> In the spectrum management the decisive factor will be the aspects of effective use thereof defined in Article 6.3.2. Calculation of the fees for the use of the spectrum will continue to support achievement of equal use by all users.
<ul style="list-style-type: none"> Making frequency bands available to the users 	<ul style="list-style-type: none"> The releases of the spectrum for the users will create conditions for the implementation of new applications and services and the support of competitive environment. Based on the adoption of the European harmonised documents, frequency bands will be continuously made available for commercial use.
<ul style="list-style-type: none"> Predictability, transparency and communication 	<ul style="list-style-type: none"> Development of the basic general principles specified in Articles 6.2 and 1.2 will continue, and emphasis will be put on publication of information and consultation documents, on the availability of relevant information for businesses. Development of the national information portal related to the utilisation of the radio spectrum will continue. The frequency bands of interest are in particular radio frequencies in the range 0.4 – 6 GHz. In the preparation or modifications of the substantial regulatory measures the Office will organize public consultations and work meetings with the users.
<ul style="list-style-type: none"> Harmonisation 	<ul style="list-style-type: none"> The Office will proceed in accordance with the international harmonisation of the use of radio spectrum as a means of innovation, achievement of interoperability, effective use of frequencies, and international coordination.
<ul style="list-style-type: none"> Radio spectrum utilisation analysis 	<ul style="list-style-type: none"> The Office will continuously evaluate the utilisation of radio spectrum <ul style="list-style-type: none"> ➤ within the state inspection of electronic communications (monitoring of the spectrum),

	<ul style="list-style-type: none"> ➤ public consultations on the plans regarding the potential utilisation.
<ul style="list-style-type: none"> • Flexibility and shared use of the radio spectrum 	<ul style="list-style-type: none"> • The Office will create conditions for the application of <ul style="list-style-type: none"> ➤ market principles of the access to the spectrum (trading the authorisations, transfer and lease of authorisations, simplification of the process of authorisation including the methods of approvals of the amateur service, license-free use of frequencies), ➤ sharing of the spectrum by civil and non-civil users, including the expansion of the possibilities of mutual sharing of the spectrum not used by both sectors, ➤ only the necessary limiting technical conditions of the use of radio spectrum.

3.2. Principles of development of broadband services and effective utilisation of frequencies

The principles require:

- Wherever possible, making it possible to use the stations, networks and services using the principle of technological neutrality and neutrality in terms of services. In the case of frequency bands designated for use by publicly available services of electronic communications the concept of wireless access to the services of electronic communications is adopted (WAPECS⁹⁵; see Article 6.3.4).
- Application of the market principles of authorisation utilisation of the spectrum which include
 - announcement of a competitive bidding procedure in the case of reduction of the number of authorisations for utilisation of the spectrum in accordance with the law³⁸. The preferred method of granting of exclusive rights to use frequencies is auction;
 - transfer of the rights resulting from the allocations (tradability, secondary trading of the rights) and the change of the holder of the individual authorisation (6.2.1.5);
 - lease of the rights resulting from the authorisation to use radio frequencies³⁹.
- Authorisation of stations in the form of license-free operation is introduced in a situation where no harmful interference occurs and where no obstacles are indicated.
- The priority is use of frequency bands by the services which have greater benefits for the entire society, which cannot be provided by means of other alternative platforms (e.g., other types of radio networks⁴⁰, fixed transmission media⁴¹).
- Allocations to radiocommunication services⁴² and the conditions of the use of the spectrum are continuously updated in accordance with national interests, European and global development.

³⁸ Section 21 of the Act

³⁹ Section 19a of the Act

⁴⁰ E.g., satellite networks.

⁴¹ Cable copper and optical fiber networks.

⁴² Allocation to radio communication services is the list of type of use (services) for each frequency band.

3.3. Radio spectrum register

A register of the existing use of the radio spectrum (review of the use⁴³) is being prepared in the European Union, focusing on identification of frequencies in the range of 400 MHz to 6 GHz which are suitable for the operation of networks for mobile and nomadic subscribers. More detailed specification of the procedures toward achievement of elected objectives of the European policy in the area of frequencies was adopted by the Commission by its implementing decision [19]. The purpose is to get a detailed overview of the use of radio spectrum in EU Member States and subsequently determine suitable bands for harmonisation and for the achievement of the European objective of provision at least a total of 1200 MHz for high-speed access networks. The Office will ensure, within the cooperation in this project:

Common strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Provision of information to the register of the use of radio spectrum of the Commission. • Keeping the data in the information system of the radio spectrum of European Communication Office (EFIS) up to date. 	<ul style="list-style-type: none"> • Provision of data from the national database for the European register of radio spectrum in accordance with the decision [19], period 2013 to 2015. • Continuous updating of the information (at least twice a year) on the EFIS portal pursuant to the Commission decision [18] and CEPT⁴⁴ reports focusing on information on the rights to use the spectrum.

3.4. Flexibility in the use of the radio spectrum, access to the spectrum

Decision of the European Parliament and of the Council [11] focuses on the improvement of flexibility in the utilisation of the spectrum – possibility to use new technologies and access to the spectrum by means of trading of the rights to use radio spectrum (transfer and lease of the rights to use the radio spectrum). This also relates to the need to analyze the development trends, make frequency planning more effective, provide information on the authorisations for the use of the spectrum granted and on the holders of these authorisations, and use of these records for the purposes of the related economic tasks. In order to cover the needs for the provision of these activities the Office will proceed to modernize its internal database and the SPECTRA planning software.

Common strategic objective:	Implementation of the strategy:
<ul style="list-style-type: none"> • Facilitation of the access to the spectrum and flexibility of the handling of the radio spectrum. 	<ul style="list-style-type: none"> • Alterations of the information systems of the Office available through the Internet. Providing access in the "open data" mode to the information on the authorisations granted on the level of the individual authorisation for the use of radio frequencies⁴⁵ to support tradability and lease of the rights (by 2015). • In order to ensure feasibility of Section 19a of the Act⁴⁶ and provision of information on the contents and holders of individual authorisations prepare a

⁴³ Pursuant to Article 9 of the Regulation of the European Parliament and of the Council [11].

⁴⁴ [CEPT report No. 46 and No. 47](#) to the European Commission of March 2013 regarding the mandate for expansion of information on the rights for all users in the frequency band of 400 MHz to 6 GHz.

⁴⁵ Depending on the nature of the service, in particular frequency, validity period, radiocommunication service, location, holder, technical parameters.

⁴⁶ Change of the holder of the authorisation and lease of the right resulting from the authorisation for the use of radio frequencies.

	<p>proposal of legislative amendments of the Act and the related regulations⁴⁷ (2015).</p> <ul style="list-style-type: none"> • Ensure gradual updating of the SPECTRA system (starting in 2015). • In justified cases add authorisation with registration in selected frequency bands to the authorisation mode of general authorisation (starting in 2016).
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3.5. Sharing of the spectrum

Sharing of the spectrum by applications and services is one of the most important procedures toward improved effectiveness of utilisation of the spectrum.

From the *operating and technical* point of view, the possibilities of sharing of the spectrum are described in Article 6.3.3 and the measures resulting from the strengthening of the sharing are reflected in the objectives in Article 2. The concept of license-free use of the spectrum (CUS) by applications SRD, WiFi, microwave links in selected frequency bands and other technologies is broadly applied in the Czech Republic and will be further developed, e.g., in the bands of microwave links (Article 2.5.2). Looking forward, the Office expects the implementation of the LSA concept (see Article 6.3.3.2).

From the *legislative and administrative* point of view, there is a difference between the use of the spectrum by commercial⁴⁸ (private) users and public (non-commercial) sector. The main use by the *public* sector in the Czech Republic is as follows:

- The Ministry of Defense which is also the greatest user of the spectrum in the public sector. Part of the spectrum administered by this ministry can be potentially used for commercial use, e.g., based on the sharing principle.

Other users within the public sector include:

- Air services (communication, radio navigation and other systems),
- Applications in transport – ITS systems, collection of toll, including information and communication systems. The spectrum is used for the operation of transport telematics in road and railway transport,
- The Ministry of the Interior operating in particular the integrated rescue system IRS,
- Meteorological service (radiolocation systems for weather forecast).

Common strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> • Objectives of license-free use of the spectrum and sharing of the spectrum will be taken into account in the proposal of the conditions of use of the spectrum. 	<ul style="list-style-type: none"> • Continuous review of the Radio Spectrum Utilisation Plan in particular based on the adoption of the harmonisation documents.
<ul style="list-style-type: none"> • Make available for shared use <ul style="list-style-type: none"> ➤ Band of 5.8 GHz, ➤ bands UHF and VHF. 	<ul style="list-style-type: none"> • Frequency band of 5.8 GHz for FWA – see Article 2.2.2. • Frequency bands VHF and UHF for the use of white spaces – see Article 2.3.1.2.

⁴⁷ Elimination of obstacles implied by the interpretation of Section 15 (5) of the Act or, as the case may be, Section 38 of the Code of Administrative Procedure and the related documents in the sense of access to the contact information necessary for the introduction of flexibility pursuant to Section 19a of the Act.

⁴⁸ Such use the primary purpose of which his not generation of profit and which is not solely owned by private entities.

<ul style="list-style-type: none"> Modification of the regulatory framework allowing for the implementation of the concept of LSA and cognitive technologies. 	<ul style="list-style-type: none"> Start discussion on LSA, based on the legal-procedural analysis, including the analysis of the related effects, propose amendments of the relevant legislation after the issue of the technical-regulatory documents from the level of the Commission, CEPT and ITU (2015). In the long run proceed toward the implementation of the concept of LSA in the frequency band of 2.3–2.4 GHz.
<ul style="list-style-type: none"> Mutual sharing of frequencies by civil and non-civil users. 	<ul style="list-style-type: none"> Based on the activities of the Office and the Ministry of Defense – see Article 2.9.2.

3.6. Prevention and elimination of interference (*Interference management*)

The main task of spectrum management is *ensuring compatibility* of the use of frequencies, i.e., interference-free mutual operation of the stations in the individual radio communication services. The tools for achievement of such state, in addition to the procedures described in Article 6.2.1.1, include planning, coordination, implementation of advance techniques of mutual coexistence of the stations, and inspection of the use of the radio spectrum. With respect to the increasing intensity of the use of the spectrum the issue of compatibility becomes more and more significant.

From the point of view of the providers and users of publicly available services of electronic communications, it is particularly the issues of interference with television reception and wireless Internet connection that are most important.

The procedures for investigating *interference with the reception of terrestrial television broadcasting* caused by the operation of LTE networks in the frequency band of 800 MHz are regulated by the already published methodology⁴⁹ which will be amended based on the current knowledge and experience of the operators of LTE, television networks, the Office, and using international experience.

In the case of operation of networks designated for *wireless Internet connection* in the frequency band of 5.60 – 5.65 GHz there is harmful interference with meteorological radars caused by the operation of WiFi stations (RLAN) due to the violation of the set conditions⁵⁰.

In addition to the application of the standard procedures implied by the national legislation, the following measures are proposed:

Strategic objective:	Implementation of the strategic measures:
<ul style="list-style-type: none"> The long-term objective is <ul style="list-style-type: none"> ➤ To prevent interference and determine the causes of interference, ➤ Prevention and elimination of interference in the frequency band of 5 GHz (5.60–5.65 GHz) and interference with TV single reception by the operation of mobile networks in the frequency band of 800 MHz (and potentially 700 MHz). 	<ul style="list-style-type: none"> Information campaigns focusing on the operators of WiFi/FWA networks in the frequency band of 5 GHz to promote compliance with the set conditions (continuously). Modification of the methodology of the procedure of investigation of mutual interference of stations of mobile networks (LTE) and the broadcasting of television networks (DVB) (continuously).

⁴⁹ [Procedure in the investigation of interference](#) with radio reception by the operation of LTE

⁵⁰ VO-R/12/09.2010-12, as amended, and Commission Decision No. 2005/513/ES, amended by Commission Decision No. 2007/90/ES, on the use of frequency band 5 GHz.

3.7. Fee policy and price of the spectrum

Fee policy is one of the important tools of the active approach to the spectrum management in order to ensure balanced access to the spectrum and development of competition in the area of electronic communications.

The change of the rates by government regulation [6] newly defined the fees in the fixed service and decreased their amount in two steps in 2013 and 2014 with the aim of creating more favorable conditions of operation of fixed links whose importance is expected to increase in connection with the development of high-speed communication networks (Article 2.5).

With respect to the expected development of high-speed mobile communications, application of new technologies, the intensifying convergence of services and application of the principles of sharing of the spectrum, the Office foresees a need for evaluation of the impact of the currently set payments for the use of the spectrum and, if necessary, for proposing a revision thereof.

In addition to the fee policy, it is also necessary to take into account the market price of the spectrum which should reflect its useful value and should therefore be respected also in the price of access to the spectrum, i.e., for example, in the determination of the lowest bid within the competitive bidding procedures⁵¹.

The prices will gradually approximate the objective (i.e., market) value of the spectrum in connection with the use of trading of the rights for the use of the spectrum.

The objective will be elimination of the disproportion in the costs of access to the spectrum in the cases where the rights for the use of the radio spectrum (comparable in terms of the scope and possibilities of the use of the spectrum) are granted both by the competitive bidding procedure in the form of allocations (with the payment of the price resulting from the competitive bidding procedure), and by authorisation outside competitive bidding procedures (i.e., only for an administrative fee assessed upon issuing the individual authorisation).

⁵¹ Based on e.g., price comparison of the results of the competitive bidding procedures in other countries.

Long-term common strategic objectives:	Implementation of the strategic measures:
<ul style="list-style-type: none"> Equalisation of the conditions of free competition, taking into account the convergence of fixed, mobile and radio services. 	<ul style="list-style-type: none"> Analyze the unification of the fee policy with respect to the convergence of the radio communication services (continuously).
Medium-term common strategic objectives:	
<ul style="list-style-type: none"> Set up optimal payments for the use of frequencies in the fixed service. 	<ul style="list-style-type: none"> Evaluate the impact of the changes of the fee policy and impact on the growth of high-speed communications in fixed links after the change of the rate in 2013 and in 2014 and assess the need for additional measures (in 2016).
<ul style="list-style-type: none"> Taking into account the market value of the spectrum when setting the fees for the use of frequencies by nationwide mobile networks. 	<ul style="list-style-type: none"> Perform an analysis of the fee policy and categorisation of the fees in groups according to the frequency bands by introducing additional spectrum coefficients (2014) using digression.
<ul style="list-style-type: none"> Introduction of the mechanisms eliminating unjustified differences in the costs of the access to the spectrum when granting the rights for the use based on application directly (individual authorisation without allocation) and in the form of a competitive bidding procedure (allocation). 	<p>Prepare a proposal of the procedure to ensure access to the spectrum which will take into account the price of the spectrum in the application of different forms of authorisation. If necessary, propose amendment of the government regulation [6], or, as the case may be, the Act (2016).</p>

3.8. Support of the competition in the long term

The migration to market mechanisms of handling the rights for the use of the radio spectrum significantly strengthens the role of the spectrum in economic competition. A flexible, speedy access to the spectrum prevents its blocking by a limited number of users. Flexible conditions of the use of the spectrum enable technological innovation without the need for prior administrative acts. This creates conditions for businesses and users supporting the competition of platforms and new services, competition of technologies, and ultimately competitive environment in the market. To this end, the Office will proceed with respect to:

- application of technological neutrality⁵² including LRTC,
- application of suitable method of authorisation and competitive bidding procedure,
- flexible utilisation of the spectrum,
- transparency, and
- elimination of obstacles in the access to the spectrum which are described in the previous chapters.

The long-term deliverable is a situation where the spectrum designated for commercial use (harmonised frequency bands) is allocated, is used without administrative interference by the government, and changes in the holders of the rights for the use of the spectrum occur in the form of trading of the rights⁵³.

⁵² Technological neutrality creates conditions for competition of technologies.

⁵³ The trading of the rights should be brokered by entities such as "spectrum brokers".

4. FULFILLMENT OF THE SPECIFIC OBJECTIVES OF THE STATE POLICY

4.1. Assignment of the Digital Czech Republic policy

The document entitled Spectrum Management Strategy was prepared with the intention to provide a comprehensive overview of the system of spectrum management, the implementation of market mechanisms in spectrum management, the current situation and development trends of the use of the spectrum including provision of factual context with the use of the spectrum on international level.

Digital Czech Republic v. 2.0 – The Way to Digital Economy provides a *list of the main parts of the strategy*⁵⁴ for preparation of the national spectrum management strategy for the purpose of more effective use of the radio spectrum for the benefit of the end users. The main parts are as follows:

- 1) survey of the current utilisation of the spectrum and adoption of such follow-up measures including the refarming⁵⁵ of frequency bands that will lead to the release of sufficient amount of the spectrum for high-speed Internet access,
- 2) optimisation of the use of the spectrum for public security and rescue services in order to quantify and streamline the utilisation of the spectrum in public interest,
- 3) method of authorisation of the users of the spectrum and support of flexible approach to the allocation of the radio spectrum,
- 4) further implementation and support of networks for high-speed Internet access, along with the development of competitive environment in the market,
- 5) implementation of resources for non-personal communication (e.g., machine to machine – M2M) in order to encourage the use of new technologies and innovative services,
- 6) shared use of the spectrum in order to streamline and maximize the use of each frequency band, including those which are currently designated for military use,
- 7) principles of tradability of the rights for the use of the spectrum in order to support secondary tradability of the greatest possible amount of the spectrum,
- 8) conditions for further technological development of terrestrial digital television and radio broadcasting,
- 9) suitable method of charging for the use of radio frequencies with respect to the fulfillment of the objectives of this policy.

4.2. Proposed measures for the fulfillment of the Digital Czech Republic policy

The above-listed points determining the long-term objectives of the document are and will be fulfilled by the implementation of the measures specified in chapters 2 and 3 and in accordance with the implementation of the Decision No. 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy program as follows:

⁵⁴ Page 18 of Digital Czech Republic v. 2.0

⁵⁵ Reorganisation of the use of the spectrum in order to create continuous blocks allowing for implementation of broadband technologies.

Re 1) By ensuring availability of harmonised radio spectrum for high-speed Internet access in total scope of at least 1200 MHz

- a) By authorisation of the harmonised band of 3.7 GHz – preparation starting in 2014,
- b) By ensuring preparation of the spectrum register from which the proposals for harmonisation of new bands for high-speed access will arise – continuously in the period 2014 – 2015,
- c) By implementation of the harmonisation decisions on the new frequency bands – in the dates set by these decisions – continuously,
- d) By accepting the joint proposal of the operators for refarming in the harmonised band of 900 MHz – subsequently after receipt of the proposal.

(for more details see Article 2.1.2, 3.3)

Re 2) By preparing the conditions for the provision of high-speed communications for the use by the security and rescue services

- a) By continued participation in the EU work bodies preparing the single technical solution for high-speed communications of the security and rescue services in the period 2014–2016,
- b) By initiating the national communication strategy of the security and rescue services by the Ministry of the Interior – in 2016,
- c) According to the adopted national strategy (see b) within the scope of responsibilities of the Office by the implementation thereof – after b).

(for more details see Article 2.2.2, 2.8.3.1)

Re 3) By facilitation and flexibility of the access to the spectrum

- a) Making selected bands (in particular above 43.5 GHz) available for license-free use (general authorisation) or, as the case may be, license-free use complemented with registration of the users (stations) – in 2016,
- b) By the use of electronic applications for the individual authorisations to use radio frequencies – in 2016.

(for more details see Article 2.6.2, 2.5.2, 3.4)

Re 4) By adopting measures for expansion of high-speed networks, nationwide availability of Internet access by ensuring conditions for the development of backbone networks, infrastructure of the interconnection between the access points

- a) By means of preparation and implementation of the project of direct support for construction of the infrastructure of the networks in cooperation with the Ministry of Industry and Trade in the period 2014 - 2020,
- c) By covering the requirements for construction of wireless infrastructure of high-speed networks, for connection and linking of the access points, including the modification of the conditions of the use of radio spectrum by fixed links, under equal conditions for the network operators – continuously.

(for more details see Article 2.5.2)

Re 5) By ensuring access to the spectrum of M2M resources for non-personal communication by incorporating the conditions of the use of the radio spectrum by these resources in

- a) the radio spectrum utilisation plan, and

b) The general authorisation

in accordance with the contents and dates of the harmonisation documents which will be adopted for the resources of non-personal communication.

(for more details see Article 2.1.2, 2.5.2, 2.6.2)

Re 6) By making the use of the radio spectrum more effective by means of

- a) proposal for making the frequency band of 5.8 GHz available for shared use by RLAN systems in geographically defined areas up to 1 year after the receipt of the future topology of the road tolling system in accordance with the intentions of development of the ITS systems,
- b) proposal for introduction of the possibility of authorised sharing of the spectrum (LSA) by preparing a proposal of the relevant amendments of the legislation – based on the preparation of the uniform procedures in the EU, estimated in 2015,
- c) cooperation with the Ministry of Defense on development of the concept of use and sharing of the spectrum and update of the definition of the spectrum for civil and non-civil use – continuously until 2016.

(for more details see Article 2.2.2, 2.9.2, 3.5)

Re 7) By gradual implementation of the secondary trading of the rights for the use, supported by

- a) maintenance of the current state of information in the European information system EFIS and the information systems of the Office on the granted authorisations for the use of the spectrum – continuously, at least twice a year,
- b) update and modification of the information systems of the Office accessible through the website of the Office and providing information on the granted authorisations for the use, including addition of the information whether a particular right is tradable – in 2016.

(for more details see Article 3.3, 3.4)

Re 8) In the area of television broadcasting, by preparation of the technical scenarios of migration from DVB-T to DVB-T2 standard for technological innovation of television broadcasting (within the working group of the Ministry of Industry and Trade)

- a) While respecting the needs of the operators of the broadcasting networks and operators of broadcasting within the scope of the available frequencies, with respect to the objectives of Digital Czech Republic v. 2.0,
- b) With the deadlines in accordance with the proposal of further development of terrestrial television broadcasting presented to the government by the Ministry of Industry and Trade.

In the area of radio broadcasting, preparation of conditions for nationwide digital radio broadcasting

- c) by preparing conditions for competitive bidding procedure for the granting of the allocations of radio frequencies in the frequency band of 174–230 MHz – in 2015.

(for more details see Article 2.3.1.2, 2.3.2.2)

Re 9) By reflecting the knowledge following from the implementation of the new technologies and services, from the effects of the convergence of radio communication services, establishment of local access points, etc. by means of

- a) Proposal for amendment of the government regulation on fees [6], and, to the necessary extent, amendment of the Act – in 2015,
- b) Also continuously based on the facts discovered.

(for more details see Article 3.7)

5. RECAPITULATION, NATIONAL PRIORITIES AND COOPERATION OF THE MINISTRIES

Preparation of the Strategy is the fulfillment of the assignment of the state policy Digital Czech Republic adopted by a government resolution [1]. The state policy emphasizes the role of the spectrum for economic and social development of the Czech Republic, requiring a well-planned and effective management of the radio spectrum.

The strategy provides an overview of the requirements for the current management of the spectrum in connection with the fast global technological development and the obligations of the Czech Republic resulting from the European Union membership. It lays down the objectives and measures for fulfilling them primarily in the short and medium term⁶ and thus contributes to transparency of the regulatory environment and fulfillment of the plans of the state policy.

The substantial scope of the measures is the responsibility of the manager of radio spectrum, and therefore the measures are within the scope of responsibilities and powers of the Office and will be implemented by the Office in the working order. Proposal of the steps beyond the scope of responsibilities and powers of the Office is incorporated in the proposal of the government resolution presented to the government together with the text of the Strategy.

These steps are determined by the priorities of the state policy and in the area of the radio spectrum they include:

1. *Development of mobile high-speed communications plus release of the spectrum in total amount of 1200 MHz, including the preparation for the future release of the band of 700 MHz for high-speed communications depending on the adoption of the European harmonisation decision;*
2. *Creation of the conditions for technological development of television broadcasting in the terrestrial platform, i.e., migration to the technologically more advanced standard of DVB-T2, taking into account the conclusions of the meeting of the working group of the Ministry of Industry and Trade;*
3. *Facilitation of development of the platform of terrestrial digital radio broadcasting;*
4. *Creation of the conditions for technological innovation of broadband communication of rescue and security services (PPDR);*
5. *Preparation of the mechanism of optimisation of the use of the spectrum designated for the defense purposes.*

Basic characteristics of the tasks and factual relations are summarised in the following table No. 8.

The Spectrum Management Strategy must be updated as necessary with respect to the dynamics of the development of the industry, so that it reflect the changes in the market of electronic communications, identification and coverage of national specific needs, the European harmonisation process, technological development, and new requirements for the spectrum.

The Office will therefore present to the government by the end of 2017 a situation report on the development in the fulfillment of this Spectrum Management Strategy in the Czech Republic in terms of the objectives of the state policy entitled Digital Czech Republic (see 4.2) with proposals for further actions and proposals of measures on the

government level if required by the circumstances for the achievement of these objectives.

Table No. 8: National priority tasks with cooperation of other public administration bodies

Priority task	Description in Article:	Context and risks of the implementation	Cooperation		
			Reason	Subject	Ministry
1. Development of wireless high-speed communication plus release of radio spectrum in total amount of at least 1200 MHz including the release of the band of 700 MHz.	2.1.2	It is a basic strategic objective shared with European countries, binding, and with direct economic and social impact. In terms of assessment of risks or obstacles, the following aspects are generally important <ul style="list-style-type: none"> • Time aspects (e.g., use by obsolete technologies hinders innovation), • Commercial aspects (e.g., absence of demand, development of use abroad is not sufficient or prospective), • Administrative aspects (e.g., absence of LSA sharing principles), • Technical aspects (e.g., unavailability of technologies, compatibility with other users – e.g., making the frequency band of 5.8 GHz available for FWA), • and combination of the above (including the expected release of the band from use in a different service – e.g., from TV broadcasting in the band of 700 MHz). 	Need of government decision on the procedure of the release of the band of 700 MHz and the nature of utilisation thereof.	Material government discussion with a decision proposal.	MIT The Office
			Possible expansion of the band of 5.8 GHz for FWA/WiFi access networks.	Plan of the Ministry of Transport for development of the electronic road tolling system for the Czech Republic (topology of the road tolling system) in terms of use of the frequency band of 5.8 GHz.	MT
2. Facilitation of technological development of television broadcasting in the terrestrial platform	2.3.1.2	The objective is to help increase the transmission capacity of the distribution networks and thus dissemination of higher number of TV channels and/or dissemination thereof in high or, if applicable, ultrahigh resolution (see Article 6.4.2). This is related to the choice of the scenario b) and mitigation of the adverse impact of the expected future release of the band of 700 MHz for terrestrial television broadcasting. To make the migration easier, operation of parallel broadcasting in both standards, at least to a certain extent (number of programs) and for a certain period, is envisaged as a priority. Migration to the higher standard must be based on the strategy of development of the domestic platform of television broadcasting in the Czech Republic discussed by the government. Since the migration is conditional upon a number of partial measures which are the responsibility of several ministries and have socioeconomic impact including impact on the general public it is necessary that these measures be initiated by the government, including the charging the relevant ministries with the individual assignments. The material	Need of specification/definition of further development of television broadcasting Tool: a) Definition of the plan of further development of terrestrial television broadcasting, taking into account	Proposal of further development of terrestrial television broadcasting, including the proposal of the process of migration to the technologically higher standard DVB-T2, taking into account the issues of further use of the frequencies in the	MIT, in cooperation with MC, the Office, RRTV

		<p>approved by the government must cover in particular legislative, legal and technical aspects, economic impact, including ensuring the availability of the corresponding receivers on the market while respecting the current state of Europe's process of release of the band of 700 MHz for harmonised use.</p> <ul style="list-style-type: none"> • Migration of programs of the operators of broadcasting under the license depends on their willingness to migrate and bear certain costs associated with the migration. • Delay of the preparation and implementation of the entire process increases the risk of insufficient amount of the necessary radio spectrum for migration with impact on the possibility of parallel broadcasting. 	<p>the future conditions of the use of the band of 700 MHz.</p> <p>b) Definition of the process of migration to DVB-T2</p>	<p>frequency band of 700 MHz.</p>	
3. Facilitation of development of the terrestrial platform of digital radio broadcasting.	2.3.2.2	<p>In the future, operation of terrestrial digital broadcasting in band III should complement/replace the current analog broadcasting in the frequency band of VHF (see Articles 6.4.3.2 and 6.4.3.3). There are risks of</p> <ul style="list-style-type: none"> • Low availability of digital broadcasting receivers in the population, competition of other platforms of radio broadcasting, • According to the law, conditions of digital broadcasting must be laid down for the operators of the broadcasting by amendment of the Act. 	<p>Definition of the plan of further development of terrestrial radio broadcasting of the public radio service.</p>	<p>Proposal of development of terrestrial digital broadcasting of the Czech Radio Service, including proposals of the measures.</p>	<p>MC in cooperation with MIT, the Office, RRTV</p>
4. Preparation of technological innovation of emergency and security communications (PPDR) regarding the implementation of high-speed radio communications.	2.8.3.1	<p>It is a preparation of a prospective solution of radio communication of the security and rescue services (see Article 6.4.7). The main risk is</p> <ul style="list-style-type: none"> • Effectiveness of the costs spent on provision of high-speed communications with respect to the high investment needs, requirements for the use of a harmonised solution in order to achieve economies of scale and cross-border compatibility, low operating costs and interconnection with other systems. 	<p>Material for a political decision on designation of frequencies for PPDR networks.</p>	<p>Preparation of a strategy of facilitation and development of mobile communications of the security and rescue services.</p>	<p>MI</p>
5. Preparation of the mechanism of optimisation of the use of the radio spectrum designated for defense purposes.	2.9.2	<p>It is a preparation of a mechanism which would cover the needs of the spectrum for defense purposes in the long term while enabling more flexible handling of the spectrum and its sharing for non-civil as well as civil use. The scope of the dedicated spectrum remains on the same level in the long term in spite of the limited use (see Article 6.4.8). The risks and obstacles generally include</p> <ul style="list-style-type: none"> • Necessary legislative changes, • Need for gradual implementation with a transition period, • Absence of specified requirements for the spectrum on the level of the Czech Republic, EU and NATO. 	<p>Material for a political decision on the increase of the volume of the spectrum for commercial use while covering the needs of the Ministry of Defense.</p>	<p>Analysis of the necessary spectrum for the Ministry of Defense. Modification of the NFT.</p>	<p>MD MIT</p>
Supplementary assignment with need for cooperation with other ministries					

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Introduction of market principles to the handling of the radio spectrum.	3.4	Ensuring open access to information on the granted rights for the use of the radio spectrum as a prerequisite for trading.	Making the information on the rights granted available.	Legislative amendment of the Act in order to provide access to the information on the rights granted and on the use of the radio spectrum.	MIT
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6. ANALYTICAL PART OF THE STRATEGY

For the specification of the strategic measures in Articles 2 and 3, the Office analyzed, to the extent necessary, the relevant context provided in the following chapters which justifies the proposed measures.

6.1. Importance of the spectrum and regulation of the use thereof

6.1.1. Benefits of the use of radio spectrum

Radio spectrum is a natural and public economic⁵⁶ resource which supports economic, social and communication activities and has *irreplaceable* significance for a group of services which cannot be substituted by a different platform (different media) for technical reasons (independence of a fixed connection) or for economic reasons. Such services are, for example, coverage of large geographical areas with satellite broadcasting, emergency and security mobile communication, and in everyday life mainly mobile access to the services of electronic communications.

The importance of radio spectrum for the population, businesses and the state is assessed comprehensively taking into account social, functional, technical and economic aspects. These aspects form the fundamental pillars of assessment of effective use of the spectrum (see Article 6.3.2) and are based on the global principles of the use of the spectrum⁵⁷, EU legislation [11, 19], and the comprehensive evaluation thereof is determinant for the spectrum management and the national and international policy in the area of utilisation of frequencies. In terms of the use of the spectrum, mobile service (mobile access⁵⁸ networks) and radio service (one-way networks of radio and television broadcasting) are the major contributors to the socioeconomic benefits. The importance of electronic communications is documented by the following selected economic data:

- Summary overview of the significance of the growth of broadband connection to the growth of GDP is provided e.g., by ITU in its 2012 report⁵⁹ – in OECD countries the 10% growth of penetration of broadband connection stimulated GDP growth of 0.25% – 1.5%, depending on the initial penetration.

Economic benefits of electronic communications in the Czech Republic are partially documented by the following data⁶⁰:

- It is estimated that the Internet has approximately 3% impact on GDP of the Czech Republic. The entire sector of the Internet economy contributes to other sectors of the economy by 9%, according to the estimates.
- In 2013 the overall revenues from the services of electronic communications exceeded CZK 106 billion⁶¹.
- At the end of 2013 the revenues for retail services provided in mobile networks reached almost CZK 53 billion and in fixed networks (including cable networks) CZK 28 billion. Retail services of dissemination of radio and television broadcasting contributed CZK 3.6 billion to the total revenues

⁵⁶ In terms of the economic theory, spectrum can be treated in similar manner as some other national resources – e.g., energy resources, raw materials, land: use the source for business or satisfaction of national needs, grant rights to the use thereof, regulate its use, trade the rights to the use thereof, etc.

⁵⁷ For example, Report of ITU-R SM.2012-2 (economic aspects of spectrum management) and Recommendation ITU-R SM.1046-2 (effectiveness of the use of the spectrum).

⁵⁸ Access networks – in the legislation of the Czech Republic networks designated for provision of publicly available services of electronic communications.

⁵⁹ [The impact of Broadband on the Economy](#): Research to Date and Policy Issues, ITU, 04/2012.

⁶⁰ Report of the Office on market development in 2013 and [Study of SPIR](#), February 2014.

⁶¹ Exclusive of VAT.

- Retail revenues from services provided in mobile networks constituted 90% of the total revenues in mobile networks in 2013, in the fixed networks this share was 67%, and in the dissemination of radio and television broadcasting it was 73%.
- Total investments in the networks and services of electronic communications in the Czech Republic in 2013 increased by 4.7% on year-on-year basis to CZK 14.2 billion⁶¹.

6.1.2. Spectrum management on global scale

The entity responsible for the development of conditions for the use of radio spectrum on *worldwide level* is the Radio communication sector of the International Telecommunication Union (ITU-R). Its task is to lay down basic technical and regulatory conditions of the use of radio frequencies and satellite orbits and to facilitate procedurally effective use of the radio spectrum in global scale in order to eliminate or, more precisely, *minimize the risk of mutual interference* of the stations operated in individual radio communication services and in different countries. Spectrum management on the international level is based on the procedures of mutual frequency coordination, notification and registration. The basic document which lays down internationally the rules, procedures and processes in the use of radio spectrum is the Radio Regulations [12] which, from the point of view of the Czech legislation, has the status of an international presidential treaty.

6.1.3. European radio spectrum policy and the harmonisation process

Mutual coordination of the use of radio spectrum was a natural need for *European countries*, which are concentrated in a relatively limited area, and they responded by establishing CEPT⁶². It has become a professional technical and regulatory base which adopts harmonisation documents in the form of reports, recommendations and decisions.

Harmonisation measures for the use of radio spectrum in EU Member States are adopted by the European Commission. The Radio Spectrum Policy Group (RSPG) lays down recommendations for the main directions of the actions of the European Commission and the Radio Spectrum Committee (RSC) participates in the preparation of the harmonisation measures. The harmonisation documents are based mainly on technical studies performed by CEPT under the mandates issued by the European Commission and are binding upon the Member States. Development of the technical standards is ordered from standardisation institutions ETSI, CEN and CENELEC (see Article 6) in a similar form.

The legislative basis is the telecommunication regulatory framework consisting of a group of directives [7, 8, 9] adopted in 2002. Effective implementation of the harmonisation measures, situation on the common European market, growth of requirements for high-speed Internet access, changes in the requirements of the individual sectors of the economy and other factors have induced a requirement for creation of a multiannual radio spectrum policy program [11]. This program includes a requirement for detailed analysis of the current utilisation of radio spectrum in the frequency band of 400 MHz – 6 GHz (spectrum inventory). The main purpose of the spectrum register is, based on the current use of the radio spectrum, identification of frequency bands suitable for harmonisation and, as the case may be, identification of frequency bands which could be used more effectively and determination at least 1200 MHz for the harmonised use of the spectrum by high-speed access networks by 2015.

⁶² The European Conference of Postal and Telecommunications Administrations was established on 26 June 1959.

6.2. System of management of the frequency spectrum in the Czech Republic

6.2.1. General principles

The system of management of the frequency spectrum in the Czech Republic is based on general principles which are identical with the principles applied in the other EU countries and is reflected in the *mission of the Office* in the area of spectrum management:

- Manage the use of the spectrum in a way that leads to optimal utilisation of the radio spectrum and increase of benefits for the society.
- Use the spectrum in nondiscriminatory manner and under transparent conditions.
- Support competition and prevent competition deformations by setting the appropriate conditions of the use of the spectrum.
- Use the spectrum in such manner as to minimize harmful interference⁵.
- Lay down the conditions of the use of the spectrum with the aim that they are not restrictive for services or applications for which the radio frequencies are necessary.
- Enable innovation and development of technologies and services by setting the conditions for flexible use of the spectrum.
- Fulfill predictability by publishing the estimates of the future development for every radiocommunication service and in every frequency band.

6.2.1.1. Specific procedures of spectrum management

To fulfill its mission and legislative obligations, the Office proceeds according to the Act, the Code of Administrative Procedure⁶³ and other regulations in the management of the spectrum. With respect to the fact that in terms of utilisation of the spectrum the significant factors are the conditions of the use of frequencies, degree of harmonisation thereof, method or procedures of authorisation of the use of the spectrum and the method of handling the rights in terms of their transferability, Article 3.2 only provides a brief overview focusing on the above-mentioned areas without analyses of the internal procedures⁶⁴ associated with the spectrum management.

6.2.1.2. Documents laying down conditions of the use of radio spectrum

The basic document based on the Radio Regulations is the *plan of allocation of frequency bands* (national frequency table [3]) which transposes the general conditions of the use of the spectrum specified in the Radio Regulations into Czech legislation. Particular conditions of the use of the spectrum across all frequency bands and by radiocommunication services, including the method of authorisation of the use of the spectrum, are provided in the individual parts of *the radio spectrum utilisation plan* [4].

⁶³ Act No. 500/2004 Sb. (Collection of Laws), Code of administrative Procedure, as amended.

⁶⁴ E.g., cooperation with other ministries/agencies in the Czech Republic, national and international coordination, participation in the international process of harmonisation of the conditions of use of the spectrum, cooperation with the European Commission and other activities.

6.2.1.3. Authorisation of the use of frequencies in the Czech Republic

Any active⁶⁵ utilisation of the spectrum, in addition to the frequency bands allocated by NFT for military purposes, is only possible under an *authorisation*⁶⁶, i.e., acquisition of the rights *for the use of radio frequencies*:

- a) *General authorisation*, which is not associated with a specific user of the spectrum, is used in situations where the probability of mutual interference does not jeopardize the operation of any radiocommunication service. It is used for mass products and in Europe is typically called license-free operation⁶⁷. The use of the spectrum under a general authorisation is free of charge. Note: If users mutually coordinate the operation of the stations using a common database of stations⁶⁸, it is the so-called *light licensing* based on registration of the stations.
- b) *Individual authorisation* for the use of radio frequencies⁶⁹ by transmitting radio equipment is granted to specific users and guarantees a reasonable degree of protection against interference. The conditions of the use of the spectrum in this case are based on the radio spectrum utilisation plan and the coordination made. The use of radio frequencies is associated with an obligation to pay a fee for the use of radio spectrum⁷⁰ (see Article 6.3.5).

Note: A specific form of right to acquire individual authorisation(s) for the use of radio spectrum is allocation of radio frequencies⁷¹.

Allocation can be used only in a situation where the number of rights in the frequency band in question is limited⁷² by the radio spectrum utilisation plan. Acquisition of the allocation does not give rise to the possibility to the use radio spectrum; it only guarantees the acquiring party exclusivity (entitlement) to the individual authorisation for the use of frequencies within a defined geographical area. Granting of the allocation grants the holder of the allocation specific operating or development conditions⁷³.

A special case where only a designated entity can be authorised to use the frequencies applies if the frequency band is reserved for a specific purpose⁷⁴.

6.2.1.4. Duration of the rights for the use of radio frequencies

Individual authorisations for the use of radio frequencies are granted for a maximum period of five years⁷⁵. Prior to the expiry of the period the validity of the authorisation can be extended upon the applicant's request, unless there are obstacles specified by the law. In the case of granting of individual authorisations based on the rights implied by the allocation of radio frequencies pursuant to Section 22 of the Act, the validity period authorisation for the use

⁶⁵ Active use of the spectrum is broadcasting of radio waves or generation of alternating magnetic field. Passive use is based on reception of radio waves of natural origin, e.g., in radio astronomy.

⁶⁶ Provision of Article 18.1 of the Radio Regulations regarding the obligation to set up and operate stations only under a license issued in accordance with the Radio Regulations. In the Czech Republic this article is implemented in Section 17 (1) of the Act.

⁶⁷ "Unlicensed"; the exact term according to the Act is "use under the general authorisation". It is an example of the so-called product (non-addressed) regulation where the conditions of the use of the spectrum are related mainly to the products (devices, transmitting stations).

⁶⁸ Registration of the users; the current example is registration of the stations of wireless local system or microwave links in the frequency band of 71–76 GHz and 81–86 GHz.

⁶⁹ Section 17 and Section 18 of the Act; in English terminology "Licence".

⁷⁰ Except the users specified in Section 24 (3) of the Act.

⁷¹ Section 22 of the Act; English terminology: "block license", block assignment".

⁷² Section 20 of the Act.

⁷³ E.g., coverage of an area or coverage of a percentage of the population.

⁷⁴ E.g., only a railway operator can be authorized for the use of the spectrum for GSM-R networks or PMR networks in the bands of 140 MHz, 460 MHz and 880/925 MHz (see Article 6.4.6, 2.6).

⁷⁵ Section 18 (3) of the Act.

of radio frequencies can be set as longer, but it may not exceed the validity period of the allocation of radio frequencies.

The validity period of *the allocation of radio frequencies* is defined by the law in general, it must be, among other things, proportional to the respective service of electronic communications, is a part of the conditions associated with the competitive bidding procedure for the granting of the allocation, and is always subject to public consultation. Determination of the validity period currently respects technical and economic aspects which include, for example, time of return on the investment in the construction of the networks. Prior to the expiry of the validity period the Office proceeds pursuant to Section 20 subsections 4 and 5 of the Act and reviews whether the reasons for the limitation of the number of rights for the use of radio frequencies still remain. In the case of an affirmative outcome of the review the Office may issue, under the conditions specified in Section 20 of the Act, to the current holder a new allocation and thus enable prolongation of the exclusive utilisation of frequencies.

6.2.1.5. Market principles of handling of the individual rights for the utilisation of the spectrum

In order to ensure access to the spectrum using standard market principles the use of sale and lease of the rights, so-called *secondary trading* has been introduced – see Article 6.3.3.1. The law allows for trading of the rights by means of the change of the holder of the individual authorisation including lease of the right resulting from the authorisation (Section 19a) and transfer of the allocation of the radio frequencies or any part thereof (Section 23). Due to the assessment of the impact on the competition, transfer in the case of allocation is only possible with the consent of the Office. With the exception of specific cases of a need to ensure competition and protection against accumulation of the spectrum, the rights to transferability are typically not restricted when granting allocations of radio frequencies, and the conditions are governed by Section 23 of the Act.

6.3. Factors and trends determining the spectrum management globally and a in the Czech Republic

In the medium term the Office expects significant changes in the use of radio spectrum. The main changes include implementation of 4G networks in the bands of 800 MHz, 900 MHz, 1800 MHz, 2.6 GHz, opening of frequency bands of 3.4–3.6 GHz and 3.6–3.8 GHz for high-speed communication, development of digital radio terrestrial broadcasting, new services in air communications and navigation, meteorology and satellite communications. Changes can be anticipated also in the security communications where the need for broadband communication is indicated.

In the short and medium term it is also possible to expect trends toward transformation of the user environment, increase of requirements for broadband communication and changes in the radio service. In the long term it is possible to expect requirements for further release of the frequency spectrum, in particular in frequency bands below 6 GHz, and expansion of shared utilisation of the spectrum. In the European level studies are underway on the issue of further use of the UHF band (470–790 MHz) with respect to the needs of terrestrial digital TV broadcasting and the possibility of using a part of the band (700 MHz) for IMT networks; a report for the European commission was compiled on this issue¹⁸.

The original historical division of telecommunication services into voice – data – television and radio is gradually transforming into a model where one network will enable transmission of any telecommunication service through fixed cable and wireless or mobile packet networks; such concept in its advanced form is identified with the acronym NGN⁷⁶.

⁷⁶ <http://www.itu.int/en/ITU-T/qs/ingn/Pages/definition.aspx>

6.3.1. Predictable and transparent spectrum management

Radio spectrum management, the mode of use thereof, impact of the user and technological trends, and fulfillment of the strategic plans require predictable⁷⁷ regulatory environment.

Predictable management of the spectrum in the Czech Republic is fulfilled by standard processes of publication of legislation in the Collection of Laws, in the Telecommunication Bulletin and on the website of the Ministry of Industry and Trade and of the Office (electronic official notice board). These documents provide information on the prepared changes, periods for the implementation of the changes, and information on the possible future development.

Transparent management of the spectrum is one of the tools of strengthening of credibility of state administration and is included in the requirements for market-oriented regulatory environment. Within the fulfillment of the principle of transparency, the Office is obliged to provide businesses providing publicly available services of electronic communications and the users with all information necessary for their activities, unless the provision thereof is prevented by the provisions of separate laws or regulations⁷⁸.

6.3.2. Effective utilisation of the spectrum

The term of effective⁷⁹ use of frequencies is introduced in the Electronic Communications Act, and in the most general terms it is fulfillment of Article 7 of the Constitution of the Czech Republic ("the state cares about efficient use of natural resources"), because radio spectrum is a natural and public economic⁵⁶ resource.

The principles of effective use of frequencies are based on the benefits from the use of radio spectrum described in Article 6.1.1. The general definition of effective and efficient use of radio frequencies (hereinafter referred to as "effective use") complies with the legislation of the European Union [19], documents of ITU⁵⁷), general approaches applied in the telecommunication practice and economics, and supports the objectives of the state policy in the area of electronic communications [1].

Effective use of radio frequencies is categorised using the following aspects:

- a) *Technical aspects* are, for example, transmission properties of the networks in terms of transmission capacity related to unit of the frequency spectrum⁸⁰ or area, possibility of repeated use of the frequency, resilience of the network or link in the case of coexistence with other broadcasting radio equipment, possibility of allocation of frequencies in the harmonised or standardised channel configuration, etc.
- b) *Functional aspects* include quality parameters of the service provided, and an example is access to the services of electronic communications, speed and mobility of the connection, degree or homogeneity of the coverage, substitutability of the transmission of the service with a different media or platform.
- c) *Economic aspects* take into account the contribution to the support of competition and growth of national economy and usually are evaluated from the point of view of the consumer (willingness to pay for the service), service provider or network operator (costs, profit) and external benefits (positive impact on GDP, revenues of the state budget – tax revenues, revenues from the fees for the use of the spectrum, revenues from the auctions, etc.).
- d) *Social aspects* are identified as an inseparable factor, albeit difficult to quantify, which takes into account the broader questions of the importance of the spectrum and the

⁷⁷ Section 5 of the Act.

⁷⁸ In particular privacy policy, protection of trade secrets and classified information.

⁷⁹ For the purpose of this document, "effective" use of the spectrum is associated with the efficient use thereof.

⁸⁰ kb/s/MHz.

services provided in the social, cultural, scientific-research, security, political context or in the context of general concept of national or European politics⁸¹.

The principal task of the current spectrum management is optimal balancing of all factors of effectiveness of use of the spectrum.

6.3.3. Flexible and shared use of radio spectrum

Based on the requirement for development of competitive and innovative environment, the European regulatory framework introduced market mechanisms into spectrum management. It includes flexible use of the spectrum, flexible handling of the rights to the use thereof and utilisation of sharing⁸² of the spectrum. The purpose is to provide manufacturers and other businesses in electronic communications quick access to the spectrum and quick implementation of innovations.

6.3.3.1. Flexible use of the spectrum

Flexibility of handling of the rights: The current legislation includes the basic elements of the flexibility described in Article 6.2.1.5. Tradability of the rights to the use of frequencies requires access to the information databases containing information on the rights granted with contact information on the users of particular frequencies⁸³ and development of a supporting mechanism for the brokerage of the demand and supply and the sale⁸⁴.

Flexibility from technological point of view: The basis of this flexibility in the use of the spectrum is application of technological neutrality with minimally restricting technical parameters in the conditions of use of radio spectrum. At the moment of termination of use of the frequency band by a specific technology the conditions of use of the frequencies should allow for use by a more advanced technology⁸⁵. Along with the technological development, innovation should be enabled without the need for administrative changes to the granted rights to the use (see also chapter 6.3.4).

6.3.3.2. Shared use of the spectrum

Shared use of the spectrum is a way to significantly improve the effectiveness of the use of frequencies. Two principles are applied:

CUS⁸⁶ is a well-established (standard) model of collective (i.e., license-free) use of the spectrum which is based in particular on the use of standardised technical algorithms of sharing of the spectrum in the devices used. Operation of the devices does not require coordination or technical knowledge of the operators and is widely used today (e.g., WiFi; see Article 6.4.4).

⁸¹ Examples of the social importance of the spectrum include support of social cohesion and improvement of the quality of life in particular thanks to widely available mobile communication services, emergency service calls, effective distribution of information to the public by networks of radio and television broadcasting, availability of services for handicapped persons, scientific use (radio astronomy, Earth Exploration Satellite Service), requirements for access to the spectrum for defense purposes in accordance with the NATO commitments of the Czech Republic, etc.

⁸² [COM\(2012\) 478 final](#): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - promoting the shared use of radio spectrum resources in the internal market.

⁸³ An example of specific implementation is the [database of British regulator Ofcom](#) including the [database of trading with the rights](#) or [database of the use of frequencies in Denmark](#) or database of the Polish regulator UKE <http://www.uke.gov.pl/pozwolenia-radiowe-dla-stacji-gsm-umts-lte-oraz-cdma-4145>.

⁸⁴ The target situation is application of the brokered services by independent entities having the nature of so-called spectrum brokers.

⁸⁵ An example is frequency band 3.4–3.6 GHz which is used in Europe and in the Czech Republic for fixed wireless networks and which is harmonized by the implementing decision of the European Commission C(2014)2798final (amendment of Decision NO. 2008/411/EC) for high-speed access networks using the single channel raster of 5 MHz enabling the operation of 4G technologies. Some new concepts of use of the spectrum also abandon the principle of individual authorisation of the use of the spectrum and head toward the use of the spectrum on license-free basis, for example by M2M equipment (see Article 6.4.4.3) or femtocells of the access networks (see Article 6.4.1.1).

⁸⁶ RSPG11-392 Final: [Report on Collective Use of Spectrum](#) (CUS) and other spectrum sharing approaches, 11/2011.

*LSA/ASA*⁸⁷: LSA/ASA principles are being prepared on international level and is based on the use of the frequency band which had been authorize for another entity usually in priority radiocommunication service⁸⁸. Based on an agreement with this entity, additional users may be authorised to use the band. Such shared use typically provides a higher degree of protection against interference than CUS sharing, and thus also possibility of guaranteed quality of service (QoS). The frequency band can be shared using the principle of division of the operating time, definition of different locations, etc. Both stations of higher output (macro cells⁸⁹) and the model of smaller cells will be applied in the sharing, including use for internal coverage (see Article 6.4.1). Authorisation of the use of the spectrum using the LSA principle is administered by the spectrum manager (regulator) who is also responsible for the management of interference. Implementation of LSA is currently envisaged in Europe in the frequency band of 2.3–2.4 GHz⁹⁰.

6.3.3.3. Dynamic access to the spectrum

Dynamic access to the spectrum in based on identification of access to the spectrum at a time, place or in the frequency section and its use according to the current need. The principle is based on the existing procedures of ensuring mutual coexistence of the stations⁹¹; the newly prepared concepts of dynamic access to the spectrum using the principle of utilisation of *white spaces* (so-called *cognitive technology*, see also Article 6.4.4.4) envisage utilisation of the common database of available frequencies in geographically defined locations. The prospective frequency band for such use is the UHF band. Dynamic use of the spectrum significantly contributes to the effectiveness of the use of radio spectrum⁹².

6.3.3.4. Benefits of flexible and shared use of the spectrum

The benefits of the flexibility of use, sharing and dynamic access to the spectrum include:

- Support of utilisation of the spectrum sections which were used minimally or not at all,
- Substantial increase of the capacity of the spectrum⁹³,
- Opportunity for innovation and development of competition,
- Quick response to the current demand,
- Applicability in the bands where individual rights are granted as well as in the bands for license-free use.

Transparency and comprehensiveness of information is essential for the support of flexible use of the spectrum in terms of tradability and lease of the rights (see Article 3.3, 3.4).

⁸⁷ Draft Report ECC 205 on LSA: <http://www.cept.org/ecc/tools-and-services/ecc-public-consultation>. Published document ETSI on LSA – [TR 103 113](#); standard prepared on frequency band 2.3 GHz – TR 103 154.

⁸⁸ The main user of the spectrum (incumbent) is usually the current holder of the rights to use the spectrum.

⁸⁹ Range of macrocells is usually units of km.

⁹⁰ In April 2014 the Commission granted a [mandate to CEPT](#) to propose technical conditions of the use of frequency band of 2.3 GHz. The draft version of the first report was published before the consultation in 07/2014 (Report A, [draft Report of CEPT No. 55](#)).

⁹¹ An example of the use is the coexistence of the stations using techniques such as LBT, SON, dynamically allocate channel and power to the terminals of mobile networks, algorithms of coexistence of WiFi networks, etc.

⁹² See, for example, the analysis [Rule based dynamic spectrum access](#), Richard Thanki 2013.

⁹³ [Report of the Board of Advisors PCAST of the President of USA](#) of July 2012 estimates that implementation of new approaches in the spectrum management can increase the effective capacity of the spectrum more than 1000 times and states, among other things, that the possibilities of radio communications are not limited by the lack of the spectrum but rather by the approaches in the management thereof.

6.3.4. Technological neutrality and neutrality with respect to services, convergence

Application of neutrality with respect to the services provided, technological neutrality and convergence of services are anchored in the European regulatory framework [8, 9] and in the law.

Technological neutrality makes it possible to use any type of technology subject to fulfillment of certain minimum technical conditions for the use of the spectrum and consistent application of the principle of technologically neutral regulation will allow users of the spectrum to choose the most suitable technologies and services for individual frequency bands. The term used in Europe for technological neutrality in the harmonised frequency bands designated for the operation of publicly available services of electronic communications is LRTC⁹⁴, meaning minimally restricting technical conditions of operation.

One of the most important steps of the European Union toward implementation of technological neutrality and flexible use of the spectrum is the liberalisation of virtually all bands from 790 MHz to 3800 MHz which were designated for operation of networks providing terrestrial publicly available services of electronic communications using the concept of WAPECS⁹⁵.

Technological neutrality is applied in the bands authorised individually and also in the bands for license-free operation.

In exceptional cases it is possible to limit the principle of technological neutrality. Such limitation, however, must be always reasonable and justified - only by the need to prevent harmful interference (for example, by specifying spectrum masks and output levels) or the need to ensure proper functioning of services (e.g., by specifying the relevant level of technical quality of the services).

The trend of *convergence* of radio communication services usually means introduction of identical conditions for fixed and mobile radiocommunication service⁹⁶. Determination of such bands is identified as MFCN⁹⁷.

6.3.5. Fee policy and price of the spectrum

The significance of attributing an adequate economic value to the radio spectrum⁹⁸ and the fee policy as a form of regulation of the use of the spectrum has substantially increased after the liberalisation of national telecommunication environments because the conditions of access to the spectrum and the conditions of use of the spectrum substantially affect free competition of the entities active in electronic communications.

6.3.5.1. Economic value of the spectrum and price of the spectrum

The term economic value of the spectrum represents the fact that the commercial use of the spectrum generates revenues of businesses. The costs which the commercial entity must spend to acquire exclusive rights to the use of the spectrum are typically called *price of the spectrum*.

According to the analysis⁹⁹, the value of the spectrum is the highest in the bands allocated to the mobile service (mobile networks), followed by frequency bands designated for

⁹⁴ Least Restrictive Technical Conditions.

⁹⁵ The abbreviation means Wireless Access Policy for Electronic Communications Services whose objectives are achievement of technical and economic effectiveness of the use of the spectrum.

⁹⁶ E.g., frequency bands 3.4–3.8 GHz where the same conditions of use of the spectrum are used in the fixed and mobile service.

⁹⁷ Mobile Fixed Communication Networks, i.e., networks in the mobile and fixed (radiocommunication) service.

⁹⁸ The spectrum is generally used to cover the needs of the society. The fact that there are areas where the priority is given to other needs than economic effects of the use of the spectrum is the reason why the spectrum is attributed a socioeconomic value and the regulation of the use of the spectrum takes it into account.

⁹⁹ According to the [Analysis Mason analysis](#), the contribution to the total value of the radio spectrum in UK consisted of mobile service (60%) and frequency bands designated for television and radio broadcasting (20%); the rest was contribution of other services.

television and radio broadcasting, and others. A similar conclusion, although with larger share of the fixed service, can be expected also in the Czech Republic.

Access to the spectrum in a liberalised environment should be provided based on market principles (Article 6.2.1.5), and its objective price can be realistically identified upon acquisition of the rights (authorisation described in Article 6.2.1.3) to the use of the spectrum on the market. The first granting of the still free (non-allocated) part of the spectrum in the form of issuance of an allocation uses the procedure of one of the forms of competitive bidding procedure. Winners of the rights are therefore naturally mostly the entities which manage to use the spectrum to achieve the highest economic effect.

When granting the rights for the use of the spectrum by means of individual authorisation for the use of radio frequencies¹⁰⁰, i.e., use of the frequency by a station, the market price of the spectrum is not taken into account; the authorisation is associated with the payment of a one-off fee for the administrative act¹⁰¹. This right to the use of the spectrum, too, is normally tradable and can be leased using the demand and supply principle (see Article 6.2.1.5).

6.3.5.2. Fees for the use of the spectrum

Fees for the utilisation of the spectrum in the Czech Republic are related to the use of frequencies based on the rights to the use of the spectrum in the form of individual authorisation for the use of radio frequencies⁷⁰. They are a tool of the regulatory policy which is used to stimulate effective use of the spectrum and eliminate non-use of the allocated radio frequencies including accumulation of the rights for the use of the spectrum for competitive reasons. The fact that in the bands near 1 GHz the unit market value of the spectrum is the highest and decreases with the increasing frequency should be taken into account also in the amount of the fees for the use of the spectrum.

6.4. Global development trends of the use of spectrum

In order to lay down the objectives and strategies it is necessary to analyze the current situation and the estimated development, from different viewpoints – operational, technological, market, economic and other. This annex suggests some *trends* which are expected to shape the changes in the area of use of frequencies *on global and European level*.

6.4.1. Mobile cellular networks, IMT

The sector of mobile cellular networks and IMT¹⁰² represents the greatest economic potential in the area of radio communication services. The key factor of development of mobile networks is stable (still exponential) growth of traffic and the inseparable innovation factor in the area of technologies and services. Until the end of the last century the prevailing traffic in mobile networks was voice traffic for which symmetry is typical – uplink¹⁰³ used the same range of frequencies as downlink¹⁰⁴. In the last decade, with the development of data packet networks, however, data asymmetric traffic starts prevailing in mobile communication, and according to the estimates, such traffic in mobile access networks will continue increasing. The technological development of IMT systems which represent an advanced communication between mobile phones, smart phones, wireless modems and other mobile or fixed devices jointly identified as “terminal” responds to the capacity requirements and development of services. Development of mobile communications leads to requirements for additional

¹⁰⁰ Sections 17 and 18 of the Act.

¹⁰¹ Act No. 634/2004 Sb. (Collection of Laws), on administrative fees.

¹⁰² International Mobile Telecommunications includes 3G technologies as well as 4G technologies.

¹⁰³ Data stream from the user or, in other words, link toward the base station.

¹⁰⁴ Data stream to the user or, in other words, link toward the terminal

spectrum which include, for example, the prepared international allocation of the band of 700 MHz to the mobile radiocommunication service.

Definition of mobile networks: Mobile communication allows the users to connect to the network or communication service through the terminals while in motion or when changing locations without interruption of the service. With respect to the trend of use of IMT technology also for higher frequency bands, which limit fully mobile connection for technical reasons, this chapter describes in general the trends for the networks combining mobile and fixed communication networks, abbreviated as MFCN⁹⁷.

6.4.1.1. Technological trends

Technological advancement seeks to achieve a number of objectives – from functional benefits (e.g., achievable data speed), to procedures suppressing the effects or risk of interference (mitigation techniques), to optimisation of effective use of radio spectrum. An example is communication technologies in the mobile service: while the second generation of mobile communications (GSM) uses a different frequency in order to minimize interference in the adjacent cells, the third generation IMT (UMTS, HSPA) uses the same frequency in all cells, thanks to which it also achieves higher spectrum effectiveness¹⁰⁵. Even higher spectrum effectiveness is achieved by 4th generation technologies (E-UTRA, i.e., LTE-A) whose theoretical possibilities have practically nearly reached the physical limits¹⁰⁶. The currently operated LTE systems have approximately ten times higher spectrum effectiveness than 2G systems in real operation. Further increase of the aggregate capacity transmittable in the given radio channel in the given area is achieved by the implementation of base stations with low effective radiated power – *concentration of networks* where the capacity of the radio channel is used repeatedly using the concept of *heterogeneous networks*, i.e., networks using smaller cells (e.g., microcells, femtocells¹⁰⁷) to satisfy local demand for high-speed services. Other techniques of providing capacity are techniques of *channel aggregation* (e.g., LTE-A can systematically aggregate up to five channels with width 20 MHz), *sharing of the spectrum* and development of *diversity reception* (e.g., MIMO¹⁰⁸). The availability of broadband connection is also achieved thanks to the use of technologies such as WiFi, Bluetooth or Zigbee which relieve data traffic (data off-loading¹⁰⁹) in the base stations of mobile networks¹¹⁰. The above-mentioned procedures bring operational and economic benefits.

From the point of view of the network layer of telecommunication networks, migration of mobile services will continue in the next decade toward fully *packet traffic*, which will affect also mobile voice services which are still primarily provided by 2G networks. The target technology for voice communication in the LTE networks is the standardised packet technology VoLTE providing voice transmission in guaranteed quality. The arrival of VoLTE will be one of the most important contributions to functional effectiveness of the use of the spectrum¹¹¹. During the phase of construction of LTE, however, it is still possible to implement transitional solutions (e.g., CSFB technology which uses the already built infrastructure of 2G/3G networks).

Mobile 4G networks are also an area which will contribute both to *convergence* of radio communication of mobile, fixed and radio services, and to convergence of telecommunication services and to development of the concept of next generation networks, NGN, which combines fixed cable, fixed wireless and mobile networks. The advanced architecture of 4G

¹⁰⁵ bit/s/MHz; representation of the amount of information which can be transmitted by a communication channel with a given bandwidth.

¹⁰⁶ Shannon-Hartley theorem of channel capacity.

¹⁰⁷ Cells installed according to the local need which are not an integral part of the mobile networks and radiate usually lower power than 2 W e.r.p. Unlike the large “traditional” macrocells they do not require ex ante coordination.

¹⁰⁸ Technology using multiple antennas for transmission or reception.

¹⁰⁹ Offloading of the terminals of 3G/4G networks via smaller public, private or home networks of fixed wireless access (FWA), using femtocells of mobile technologies or, in particular, WiFi connection.

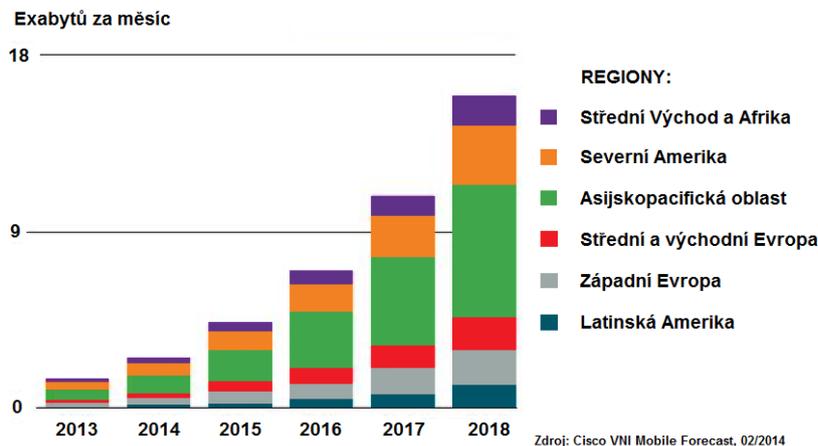
¹¹⁰ According to the current estimates, five to six users watching video in excellent quality at the same time will exhaust the capacity of one cell of the base station of UMTS–HSPA mobile networks.

¹¹¹ [Verizon estimates](#) that communication using solely VoLTE will not be widespread on the market before 2016.

networks¹¹² is proposed also for the converged services which will be provided in foreseeable future – they include the possibility of transmission of radio broadcasting services to a defined area¹¹³ including unauthorised reception for users who are not registered for services in the network, and also use of 4G technologies for security communication PPDR whose future capacity and functional demands cannot be covered by the existing narrowband networks¹¹⁴ (for more details on PPDR see Article 6.4.7). Studies of convergence of radio and mobile service and further development of the use of frequencies in the UHF frequency band have been ordered by the European Commission from its own advisory body (RSPG)¹¹⁵ and also from another independent¹⁸ and third-party contractor¹¹⁶.

6.4.1.2. Traffic growth factor

The consequence and also reason of the technological advancement and implementation of new services is the increase of traffic in the access telecommunication networks¹¹⁷. A major contribution to the overall traffic is multimedia services such as TV and video streaming, games, social networks, use of navigation services, etc. provided particularly through smart phones and tablet PCs. *Data services* will generate *the largest share* in the traffic. According to the periodically published report of Cisco¹¹⁸, the estimated total year-on-year increase of traffic in mobile networks derived from the CAGR factor is approximately 68 % for Central Europe (i.e., annual growth approximately 1.68x; see figure No. 1):



Key:

Czech original	English translation
Exabytů za měsíc	Exabytes per month
Regiony	Regions
Střední Východ a Afrika	Middle East and Africa
Severní Amerika	North America
Asijskopacifická oblast	Asia-Pacific
Střední a východní Evropa	Central and eastern Europe
Západní Evropa	Western Europe
Latinská Amerika	Latin America
Zdroj	Source

Figure No. 1: Estimated increase of traffic in mobile networks until 2018

Other estimates assess the increase of traffic separately for mobile networks and for fixed wireless networks in order to apply the preference of data traffic through routing of the traffic outside mobile networks (data off-loading, WiFi off-load). For example, estimates of

¹¹² The core of the eMBMS platform LTE-Broadcast.

¹¹³ Minimum size of the area according to today's specifications is 0.5 to 1.5 km.

¹¹⁴ Integrated rescue system networks.

¹¹⁵ [Requirement for preparation](#) of a long-term strategy of the future use of the UHF band in the EU with the date of adoption 02/2015 (after public consultation) in the form of RSPG opinion.

¹¹⁶ Preliminary results of the [study on convergence in the UHF band](#) were presented in 07/2014 (Plum Consulting).

¹¹⁷ Traffic in terms of the volume of data transmitted.

¹¹⁸ http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

Analysys Mason¹¹⁹ predict the increase of CAGR total wireless traffic in the access mobile networks to be approximately 44%, provided that the share of traffic in fixed wireless networks (WiFi, data off-loading) in total traffic will be approximately 84%. *According to today's estimates, the traffic in wireless networks will increase in the next five years four to thirteen times.* Increase of the traffic is the main reason for investments in the 4G networks, expansion of UMTS/HSPA+ networks and investments in the acquisition of the rights to use frequencies from the newly opened bands.

The increase of data traffic and the resulting increased demand for spectrum in Europe have led to the preparation of the RSPG Opinion¹²⁰ which deals with the description of the situation, development trends (e.g., increase of traffic, consequences of the convergence) and measures for coverage of the needs of wireless communications which include the current study of harmonisation of additional bands for IMT (700 MHz, 1452–1492 MHz, 2.3 GHz) as well as re-evaluation of the current use for alternative services of IMT (e.g., frequency band of 1.9 GHz).

6.4.1.3. Requirements of IMT for additional spectrum, allocation of the band of 700 MHz to the mobile service

The demand for the use of radio spectrum has increased substantially in the last two decades, in particular in connection with the development of mobile cellular networks. The optimal physical properties have directed commercial interest in the use of frequencies to the area below 6 GHz, and the main commercial utilisation by cellular networks is in bands below 2.2 GHz which are suitable for the provision of services with high degree of mobility. In terms of the access networks, also bands above this limit are attractive because they enable operation of networks designated for satisfaction of the growing demand for high-speed connection (so-called capacity bands).

The current requirements for provision of frequencies for cellular IMT networks which use 3G or 4G technologies are globally concentrated into bands of 790 – 960 MHz, 1710 – 2025 MHz, 2110 – 2200 MHz, 2300 – 2400 MHz and 2500 – 2690 MHz. Frequency band 3400 – 3600 MHz is designated for IMT regionally, i.e., in countries of ITU Region 1 including mainly Europe. Although the adjacent frequency band of 3600 – 3800 MHz is currently not designated as IMT band all technical studies including requirements for spectrum and compatibility studies tend toward use for MFCN systems which include a set of IMT technologies (including but not limited to LTE/LTE-A). Requirements for spectrum are increasingly concentrated in the area of low-power internal use (offices, homes). Operation of 4G networks in Europe and in the Czech Republic is currently performed in the bands of 900 and 1800 MHz as well as in the newly opened bands of 800 MHz and 2.6 GHz. European region¹²¹ responds to the increasing demand for spectrum with joint efforts to determine additional bands for the IMT networks. The individual bands considered for IMT are more fully described in Article 2.1.1.

Another important frequency band designated for the operation of 4G networks, i.e., IMT networks with full mobility of users, is *band 700 MHz* (694 – 790 MHz, sometimes also called digital dividend II) the future allocation of which to mobile service in Region 1¹²¹, which includes Europe, was decided by the International Telecommunication Union at the World Radiocommunication Conference WRC in 2012. Specific regulatory and technical conditions of the use of the band of 700 MHz will be laid down by the next WRC in 2015 based on studies of coexistence of mobile applications¹²² with other users of the band, in particular terrestrial

¹¹⁹ Wireless network traffic worldwide: Forecasts and analysis 2013-2018, October 2013.

¹²⁰ [RSPG opinion](#) "on strategic challenges facing Europe in addressing the growing spectrum demand for wireless broadband".

¹²¹ Europe together with Africa and part of Asia forms the so-called radiocommunication Region 1.

¹²² [Mandate for the studies of future use of the frequency band of 700 MHz](#) was granted by the European Commission to CEPT in February 2013. The Electronic Communications Committee of CEPT/ECC established a [temporary technical group TG6](#) whose task was to analyze the harmonized use of the UHF band focusing on 470–694 MHz including the

digital television broadcasting, DVB-T, which currently uses this frequency band quite intensively. Allocation of the band of 700 MHz will result in harmonisation of the European region with other radiocommunication regions of the world in terms of allocation to the radiocommunication services. The European Commission ordered preparation of the technical configuration of the band 700 MHz for use by services other than television broadcasting by the Commission mandate; the result is the CEPT Report¹²³.

The future requirements for the spectrum for mobile networks are based on the increasing share of data services in the total traffic. The consequence of such trend is the requirement for asymmetric traffic which respect higher volume of data transmitted to the user (terminal) than from the user. The asymmetric traffic leads to efforts to release additional unpaired bands for IMT access networks, and the most likely future technology for independent traffic is TDD-LTE¹²⁴. In addition to independent networks, testing is underway of supplemental auxiliary SDL systems which are linked with the main bands of IMT networks, allowing for strengthening of the data stream to the user in mobile networks; an example is SDL technology designated for the band of 1452 – 1492 MHz¹²⁵ and in the future also for the band of 738 – 758 MHz. IMT applications also include the considered use of the bands 1900 – 1920 MHz and 2010 – 2025 MHz for direct communication from aircraft (DA2GC) with two optional solutions – either FDD (uplink 1900 – 1910 MHz, downlink 2010 – 2020 MHz), or TDD (1900 – 1920 MHz¹²⁶). The requirements for the spectrum for IMT networks are supported also by the analysis of ITU-R mentioned in ITU-R Report M.2290. Proposals for determination of additional bands for IMT mobile systems are currently being prepared in Europe, and on global level the proposals will be discussed at WRC in 2015. The current proposals of other sources of spectrum for IMT systems in the bands over 1 GHz envisage operation of IMT allowing for optimisation of the ratio of the asymmetric data traffic. The current options of resolving the synchronisation in IMT TDD radio networks with asymmetric traffic are summarised by the CEPT report¹²⁷.

6.4.2. Television terrestrial broadcasting (one-way networks)

One-way broadcasting networks are designed for mass provision of the service to a large number of users (viewers). Open¹²⁸ terrestrial television broadcasting has undergone the process of digitalisation by migration to the DVB-T standard. Potential innovation in the area of television broadcasting is directed toward implementation of more advanced broadcasting standards than DVB-T which allow more effective use of the spectrum, better resistance to interference, more flexible utilisation in terms of the range of operating modes (e.g., mobile reception of one of the programs of the digital broadcasting network – multiplex) and provision of higher quality services (in particular distribution of the content in HDTV resolution). On the other hand, further development of television broadcasting is affected by the user trends – although in a number of countries the equipment of households with terrestrial television broadcasting receivers is relatively high, usually such reception is not the only platform for watching television programs. With the development of HDTV connection, there is growing interest in the world in broader programming available within the broadcasting distributed via

option of the future co-primary allocation of this frequency band to the mobile service; the result is now the [draft Report of ECC](#) on long-term vision for the UHF band.

¹²³ [Draft Report of CEPT No. 53](#) on the mandate of the European Commission to determine harmonized technical conditions in the frequency band of 694–790 MHz in the EU for the purpose of provision of wireless broadband and other services, support of strategic objectives of the EU in the area of the spectrum. The proposed configuration of the band of 700 MHz enables compatible use with the regions of Asia, Australia and South America.

¹²⁴ [GSA on the boom of TDD](#) states that the share of LTE smart phones equipped with TDD increased from 5% to 35% in the period 2013–14.

¹²⁵ Information on the practical operation test of SDL was provided in the [Monitoring Report of the Office for June 2013](#). The study prepared under the mandate of the European Commission in the form of [draft Report of CEPT No. 54](#) represents the proposal of the harmonized use of the band L by IMT/SDL systems.

¹²⁶ Optimal operation of TDD requires continuous 20 MHz. [see also](#) ECC Report No. 209, draft reports of ECC No. 214 and 220 and draft report of ECC No. 52.

¹²⁷ [ECC Report No. 216](#) on the practical procedures of synchronisation of TDD networks.

¹²⁸ i.e., free-of-charge broadcasting (Free-to-air)

satellite, cable and the Internet (IPTV), which is used by an increasing number of users¹²⁹. Development of terrestrial television broadcasting in Europe during the next decade will have impact on the changes of allocation of the band of 700 MHz which allows it to be used by mobile IMT networks.

6.4.2.1. Consumer trends

The decisive factors of the changes in the area of television broadcasting is a combination of the role of public broadcasting, plans of private broadcasters, offering of the content and services (i.e., television programs), development in the area of the media and, in particular, *behavior of consumers* (viewers, customers) which is based mainly on the experience that terrestrial television broadcasting

- offers almost universal signal coverage,
- enables offering also regional and local content,
- consumers expect free content, and that
- there is a broad supply of TV receivers on the market.

Qualitative consumer trends are associated with the format of HDTV which has become the standard in consumer electronics and is a major factor determining the main platform of television reception in households. The question is how important the factor will be for the prevalent percentage of the users and their willingness for innovation.

The increasing number of viewers use, in addition to the traditional way of watching broadcasting in real time (linear broadcasting), possibilities of *watching nonlinear content* – demand video¹³⁰. Supply of modern TV sets which are increasingly equipped with Internet connection responds to this trend. Another trend is the increasing popularity of *watching TV and videos on mobile terminals* – 3G networks as well as 4G networks will participate in the distribution of television content. These factors, combined with the parallel distribution of content in packet-based two-way networks (i.e., over the Internet), transfer the investment and consumer interest to development of the platforms which are not limited to one-way transmission of multimedia information, i.e., to cable networks, satellite, Internet in general, and in particular mobile networks.

Television *reception through Internet access networks* for on-line TV and demand video is also gradually starting to be used. An example of a current innovative distribution of broadcasting is hybrid television broadcasting (HbbTV) which combines the advantages of traditional terrestrial broadcasting and high-speed Internet and which is available also in the Czech Republic¹³¹.

Consumer trends can be affected by the concept of television broadcasting called Tower Overlay¹³² which foresees dissemination of TV content partially or fully by 4G networks, and the released spectrum is available for mobile networks or for use in the so-called secondary service by cognitive technologies.

In terms of development of digital of terrestrial television broadcasting, another factor will be the *scope of the programming distributed*, and thus the number of multiplexes for the distribution of terrestrial television broadcasting depending on the availability of the frequency spectrum. Digitalisation of terrestrial television broadcasting in the period 2008–2012 resulted in the expansion of the program offering in a number European countries including the Czech

¹²⁹ In the Czech Republic, according to Digital Agenda Scoreboard (EC), the number of IPTV users increased in the period 2011–2013 by 32%.

¹³⁰ According to the long-term estimates, e.g., based on the data of [EBU and IHS](#), the total time of watching television and video will increase, and the share of consumption of non-linear content will increase.

¹³¹ <http://www.ceskatelevize.cz/hbbtv/>

¹³² [A study of future spectrum requirements for terrestrial TV and mobile services](#) and other radio applications in the 470-790 MHz frequency band, including an evaluation of the options for sharing frequency use from a number of socioeconomic and frequency technology perspectives, particularly in the 694-790 MHz frequency sub-band, TU Braunschweig, January 2013.

Republic. According to some estimates¹³³, no potential is seen for increase of program offering in the long term in open terrestrial television broadcasting. When proposing regulatory measures, the important factor is consumer behavior and willingness of the consumer to participate in technological migration. Implementation of second generation digital broadcasting (source encoding DVB-T2) will require replacement of a large number of terminal devices – the proposals of the migration scenarios will have to take into account consumers' interests.

The main circumstances which have had or may have impact on operational and consumer trends of terrestrial television broadcasting can be summarised as follows:

- The advantage of easy solution of reception of terrestrial television will continue to be a significant driver of continuation of development of terrestrial broadcasting during the next decade. The second (and other) television receiver in a household often uses the terrestrial platform.
- Qualitative and quantitative innovation shift the consumers' attention to cable and satellite platform. In the Czech Republic the number of IPTV connections has been slightly growing in the recent years.
- Another innovation is brought by the possibility of mobile reception which is currently dependent primarily on the 3G HSPA+ access networks, partially also on LTE, or nomadic reception¹³⁴ in WiFi networks.
- There is growing interest in non-linear distribution of the content, watching more advanced picture formats than the standard SDTV resolution, and interest in interactive watching of multimedia content.
- The driver of the development of television broadcasting across the platforms has always been the growing supply of the content (programs).
- The limiting factor for migration to the second generation technology of digital television broadcasting is the innovation cycle of the consumers' terminals and the willingness of consumers to use paid broadcasting.
- Excessively long operation of the DVB-T technology without technological innovation reduces the potential of development of terrestrial television broadcasting.

6.4.2.2. Technological innovation in TV broadcasting

Terrestrial digital television broadcasting is heading toward implementation of HDTV and more advanced compression methods of the source encoding (H.264/AVC MPEG-4, H.265/HEVC). The requirements of HDTV for capacity of the data stream are approximately 2.5 times higher than the SDTV transport stream when using the same compression format.

More advanced technologies of digital broadcasting of the second generation (DVB-T2) contribute to spectrum effectiveness by using MPEG-4 or higher standard (potentially HEVC) of compression allowing for distribution of higher number of programs or qualitative innovation, contribute to better coverage, are more resistant in terms of coexistence with the networks in neighboring regions, and allow for enlargement of the geographical areas usable for single-frequency networks (SFN). The technology of DVB-T2/MPLP makes it possible to allocate to individual channels out of the multiplex a different degree of robustness of the signal depending on whether the priority is speed of the data stream or mobility of reception. DVB-T2 was tested in the Czech Republic and the results are published in the website of the Office¹³⁵.

3DTV broadcasting passed the phase of development and search for customers, but today it is not promising in normal broadcasting.

The critical factors of technological innovation of digital television broadcasting include

¹³³ [European Audiovisual Observatory \(EAO\)](#), Euromonitor

¹³⁴ Nomadic terminal in the mobile service can be used at several places, but it is stationary during the operation.

¹³⁵ <http://www.ctu.cz/pusobnost-ctu/experimentalni-vysilani/test-dvb-t2.html>

- The existing rights of the operators of networks of terrestrial television broadcasting,
- Statutory role of the public broadcasting,
- Penetration of receivers supporting the DVB-T2 format and the related question whether users will not opt for a different reception platform upon migration to HDTV (cable, satellite TV, IPTV),
- Scope of the available spectrum (see the following chapter).

6.4.2.3. Consequences of allocation of the band of 700 MHz to the mobile service

As the operation of transmitters and networks which are characterised by high effective radiated powers from high antennas where the signal crosses state border to relatively great distance is subject to the conditions of the international agreement [17], the range of such usable frequencies is conditional upon successful international coordination. The original plan of utilisation of television bands adopted in Europe at a conference in Geneva in 2006 guaranteed to every country the use of six layers in the UHF frequency band (i.e., operation of six nationwide multiplexes). The number of usable layers was reduced after the European decision on the use of the frequency band of 800 MHz solely for mobile access networks. In addition, conference WRC-12 decided on co-primary allocation of the frequency band of 694 – 790 MHz¹³⁶ to the mobile service (see also Article 6.4.1.3). Technical conditions of use of the frequency band for IMT systems are laid down by the next conference WRC-15. In the frequency band of 700 MHz there are 12 television channels (channels 49 to 60), i.e., 30% of resources still dedicated to television broadcasting. If a binding harmonisation decision of the EU changing the existing use of the band is made it would mean reduction of the volume of radio spectrum for the existing terrestrial digital television broadcasting. The decision whether to proceed with technological innovation (DVB-T2 H.264 / H.265-HEVC) will be critical for the future of terrestrial digital broadcasting.

This technological innovation of the television broadcasting would result in availability of greater capacity of the multiplexes which could be used for distribution of a larger number of SDTV programs within one multiplex, or for qualitative innovation (introduction of HDTV). The expected trend of the further development is the implementation of ultrahigh resolution (4K). With respect to a number of factors, which include also the trends described in Article 6.4.1, the requirements for national use of the layers are different; in some countries¹³⁷ the current popularity of terrestrial TV broadcasting is relatively high; in other countries it is not significant¹³⁸, and some countries have proceeded to preference of future use of the band of 700 MHz for mobile networks¹³⁹, provided that the role of terrestrial wireless broadcasting of multimedia services can be supported e.g., to a limited extent by 4G networks LTE-A subject to implementation of the multimedia core¹⁴⁰ of the networks. The different situation in the popularity of terrestrial broadcasting and development of alternative platforms are the main reasons why a new regional or European planning conference of frequencies for television broadcasting is not anticipated. Studies on the long-term use of the UHF band were also ordered by the European Commission¹²². Therefore it will be necessary to proceed, when planning television broadcasting, based on bilateral and multilateral negotiations within micro-regional groups which can capture the national requirements and objectives in greater detail.

¹³⁶ The lower limit can be specified by WRC-15.

¹³⁷ E.g., UK, Spain, Italy and also the Czech Republic.

¹³⁸ E.g., Germany, Belgium or northern European countries.

¹³⁹ Examples: Britain's House of Lords presented in 2012 an ambitious proposal for the development of broadband connection [Broadband for all - an alternative vision](#) and transfer of terrestrial TV services to other platforms. Consultation of British regulator Ofcom on the [plans in UHF](#) took place, including the proposal for future use of the band of 700 MHz for networks for the provision of broadband services. German regulator published a [study of utilisation of the entire UHF band by mobile networks](#) (01/2013). In June 2013 French government adopted a [plan to allocated the band of 700 MHz to operators of mobile networks](#). In 02/2014 Swedish government adopted a [decision on the release of the band of 700 MHz](#) as of 1 April 2017.

¹⁴⁰ eMBMS – Evolved Multimedia Broadcast Multicast Service. The implementation of eMBMS typically takes place in the phase of the advanced stage of development of LTE networks. The first [test of broadcasting through LTE-A eMBMS](#) took place in Germany in 07/2014.

6.4.2.4. Scenarios of development of terrestrial television broadcasting in the UHF frequency band

Currently (2014) it is not possible to establish in the medium long term a clear development of television broadcasting by means of terrestrial platform in the UHF frequency band in Europe or in the Czech Republic, except for the generally accepted fact that the operation of DVB-T technology without technological innovation is not commercially promising in the long run. The method of use of the UHF frequency band in more distant future is currently being examined.

Continuation of the technological development of television broadcasting using the terrestrial platform in the UHF frequency band can be expected, of course, if a part of the 700MHz band is not released on national level in the future for use in the mobile service and the entire band will be continue to be used only for dissemination of television broadcasting. Technological innovation today can mean migration to the DVB-T2 technology enabling distribution in an effective format and is heading either toward distribution of larger number of programs within the multiplex, or distribution in the HDTV format. Preparation of the concept of development of television broadcasting using the terrestrial platform in the UHF frequency band, however, must take into account the development of technologies which will probably offer more advanced formats in the future.

Nevertheless, if the possibility of release of a part of this frequency band for use in the mobile service is considered in the future, there are potential solutions whose feasibility will depend on the situation in the area of the media, availability of frequencies for the so-called transitional periods, national political decisions on development of television broadcasting, and on other related factors.

- The first possible development after the release of the band of 700 MHz is preservation of the current scope of broadcasting, abandoning the technological development of terrestrial television broadcasting. If the national study confirms that the existing scope of DVB-T broadcasting can be consolidated in channels 21 to 48, channels 50 to 60 can be released for use in the mobile service (channel 49 will probably become a part of the protective band¹⁴¹). The consequence of such conservative solution can be a situation where viewers no longer accept the current SDTV format and gradually migrate to one of promising platforms of distribution of television broadcasting which now already distribute television content in more advanced formats in terms of quality.
- Another possibility is migration to DVB-T2 technology enabling distribution in the effective format of H.264/MPEG-4 or H.265/HEVC. This solution is heading either to distribution of larger number of programs within the multiplex (quantitative benefits), or to distribution in HDTV format (qualitative benefits), but only in the scope of the available the spectrum. Migration to DVB-T2 foresees (in particular in the case of public broadcasting) parallel DVB-T and DVB-T2 broadcasting, which will require frequencies for the transitional networks.
- Another option is, however, gradual phase-out of terrestrial television broadcasting. In some countries (e.g., Switzerland), for economic reasons, they also consider phasing out the terrestrial television broadcasting. One of the reasons is the broad availability of alternative platforms and demand for radio spectrum in the UHF frequency band.

The decisions on national level on the release of the band of 700 MHz from television broadcasting must be therefore based on specific conditions in the country in question.

¹⁴¹ The current results of the studies of the working groups of ITU-R JTG and CEPT ECC PT1.

6.4.3. Radio broadcasting (one-way networks)

Reception of radio broadcasting was, still is and will be a very popular form of dissemination of information, entertainment, culture and education for general public. An important factor for the development of this broadcasting in Europe is technological innovation, development of the offering of services and content, interoperability, interactivity and convergence together with other platforms. The key technology for the development of digital radio broadcasting is DAB-series systems, and in the long term also access high-speed mobile and fixed networks. Technological innovation in the area of radio broadcasting is not digitalisation in the genuine sense of the word but rather innovation and implementation of new platforms enabling expansion of the program offering and generally offering of services because modern systems enable generally transmission of multimedia content – audio, video and data.

Whereas the digitalisation of terrestrial television broadcasting in Europe was coordinated in order to release a large amount of frequencies for mobile access networks, there is no such need in radio broadcasting; common European objectives are not being prepared and innovation is left up to national decisions. So it is not “migration” in the sense of DTT¹⁴² because frequencies are not blocked for a more progressive use but rather technological innovation and expansion of the program offering. In terms of technological innovation, the available technologies are hybrid (i.e., “improvement” of the analog broadcasting with a digital channel – e.g., HD radio), which have not been implemented to a significant extent, and fully digital, which can be used in Europe.

6.4.3.1. Analog broadcasting

In the frequency band of *long waves* (LW; 148.5 – 283.5 kHz) the main advantage of radio broadcasting is long-distance reception. In the frequency bands of *medium waves* (MW; 526.5 – 1606.5 kHz) the reception of programs is important primarily as substitution in locations with difficult reception. The demand for LW and MW broadcasting, however, significantly decreased, and in the European region no massive digitalisation of broadcasting is expected. The *frequency band of VHF* (87.5 – 108 MHz) is intensively used; the potential of utilisation during the next decade is high, but in a number of locations it is currently not possible to meet the requirements for authorisation of frequencies due to the occupancy of the bands. For successful international coordination of frequencies it is also important to comply with all international commitments which include also adherence to the operating parameters of the broadcasting. In the recent years there has been an intensive campaign to achieve compliance of the operating parameters with the prescribed parameters. A single date of termination of analog broadcasting in the frequency band of VHF¹⁴³ is not planned on European level or global level.

Utilisation of LW, MW and VHF bands by analog narrowband broadcasting (i.e., broadcasting using relatively narrow radio channels) is not considered non-optimal in terms of effectiveness of the use of the spectrum because the frequencies in these bands cannot be used for the operation of broadband networks or other applications whose benefits for the society would be greater.

The high popularity of radio broadcasting is the reason that this broadcasting is an integral part of European and Czech economy and culture. Radio broadcasting is the least expensive and most effective method of transmission of up-to-date and important information, and it brings culture and knowledge to millions of listeners every day. The fact that most mobile phones, MP3 players and other portable devices are equipped with an FM receiver also contributes to the popularity of FM broadcasting. Thanks to the penetration of these devices the traditional FM broadcasting is becoming even more widely available. *With respect to the limited amount of usable radio spectrum and the high demand for radio services, further*

¹⁴² Digital TV Transition – migration of terrestrial analog to terrestrial digital broadcasting.

¹⁴³ Some countries consider future termination of FM broadcasting – e.g., Norway, Denmark or UK.

development of radio service is basically exhausted in terms of the increase of the offering of programs on this traditional platform. Further development of radio services is only possible with gradual digitalisation of the terrestrial platforms, similarly to the situation of the satellite and cable platform whose digitalisation has taken place together with TV digitalisation. Similarly to the terrestrial television platform, also the terrestrial radio platform is irreplaceable due to its unique characteristics:

- Almost universal signal coverage,
- Can be used in emergency situations to inform the public,
- Can be received with a fixed antenna as well as mobile reception,
- Possibility of offering regional and local content,
- Large supply of receivers,
- Free available content,
- Technical and economic affordability for listeners,
- Support from the broadcasting operators,
- Successful acceptance by the listeners.

6.4.3.2. Technology of digital broadcasting

The most widely used technologies of terrestrial digital radio broadcasting currently include DAB/DAB+, which enable transmission of audio content and concurrent transmission of text, graphics, images and data (multimedia). In the case of addition of image encoder to the DMB specification it is possible to use these systems also for distribution of video. In general, DAB/DAB+/DMB systems (collectively “DAB”) are designed for dissemination of multimedia. DAB technology is standardised for the transmission of audio in the format of MPEG layer II, DAB+ technology uses the codec MPEG-4 HE-AAC v2 which significantly increases spectrum effectiveness. DAB technologies are designated for broadcasting in band III (174 – 230 MHz) which is the most promising for the development of digital radio broadcasting, or in the frequency band of L (1452 – 1479.5 MHz). Since band L in Europe is designated for future use by one-way networks of mobile and fixed access networks (see Article 2.1), the objectives of this strategy in radio digital broadcasting are directed at band III. For Europe, DAB technology is a promising solution and a number of manufacturers of receivers (desktop, portable and car radios) have responded to this trend. DAB systems offer *quantitative improvement* of radio audio broadcasting (possibility to distribute up to 20 programs in each frequency block – multiplex) as well as *qualitative improvement* (high quality of sound, in certain conditions also better quality of the reception; supplemental services – e.g., information on traffic situation). The coverage with DAB signal may be implemented usually locally, regionally or nationwide. Technological expansion of the DAB-IP platform enables distribution of the content also in mobile networks, together with the possibility of multimedia distribution of the content (including television).

DRM technologies are standardised for digitalisation of narrowband broadcasting in the bands of SW, MW and VHF (and newly also band III); these technologies are used abroad in particular in countries with the need to cover large areas. In the FM frequency band, stations of DRM/DRM+ can be operated parallel with analog FM transmitters. Because DRM has not significantly developed in the world the potential of deployment of DRM in the bands up to 108 MHz in the Czech Republic is minimal in the medium term.

In addition to the above-described technologies for radio broadcasting, which are sized for distribution in high audio quality in mobile reception, other methods of digital distribution of radio programs can be used, in addition to the Dab systems – the already provided Internet broadcasting by means of the Internet access networks and application of the potential possibilities of the implemented 4G networks which – after the complete multimedia core has been built – can match or even exceed the properties and possibilities¹³² of the DAB/DAB+ systems. The Europe-wide platform which is being considered can be broadcasting within the

terrestrial component of the mobile satellite service in the frequency band of 2 GHz where Europe-wide allocations are granted for this purpose (see also Article 6.4.9).

6.4.3.3. Trends in radio broadcasting

Natural development of the digital terrestrial radio platform is conditional upon significant *increase of abundance of the services provided* which include derived and minority programs, data and supplemental services (e.g., sophisticated traffic information systems) and in particular the increasingly dominating interactive broadcasting systems combining the benefits of radio broadcasting networks and high-speed Internet connection. The major driver of the development of radio broadcasting is the non-linear model of consumption of the broadcasting content at the time (i.e., moment) which suits the listeners, and not at a time when the program is broadcast. A major motivating factor is also improvement of the listening quality of the services provided.

Convergence and interactivity: Attractive content and services will be offered in interoperable and homogeneous environment which will be created by the interconnection between the broadcasting and Internet networks. Also in the area of digital radio broadcasting the boundaries between modern digital devices are slowly disappearing; digital services are approximating and will become generally accessible on any device, may it be a smart phone, tablet PC, computer, digital radio at home or in a vehicle. Radio broadcasting of the future will therefore be digital, multiplatform and hybrid. Listeners will listen to radio on different receivers which will also display additional information and multimedia content. To achieve this objective the hybrid radio service will be disseminated by broadcasting radio networks and by the Internet – two platforms which will complement each other.

In order to become a full-fledged platform (complementing FM broadcasting or, as the case may, MW broadcasting), digital radio broadcasting must meet the criterion of identical coverage as the one offered by the existing analog networks (nationwide, local).

6.4.4. License-free use of the spectrum including WiFi, SRD and M2M

A broad group of applications using the spectrum under the general authorisation is short-range devices (SRD) and WiFi access networks. In the case of higher requirements for data throughput or connection stability these stations are equipped with technologies of mutual automatic coordination including automatic suppression of mutual interference which show further technological and user direction of the license-free utilisation of frequencies. Although the license-free utilisation of frequencies does not guarantee such a high degree of exclusivity of the use of frequencies as the use under the individual authorisation it is use which significantly contributes to the effectiveness of the use of radio spectrum. The example of the most successful technology of license-free use of the spectrum by WiFi networks leads to considerations about designation of additional frequency bands for license-free use by WiFi/BWA access networks. SRDs represent a broad range of applications (e.g., RFID, M2M, UWB, ITS, medical applications, contactless bank cards) which use low effective radiated power for their operation (usually up to 500 mW of equivalent isotropically radiated power which corresponds to the range of approximately 500 m) or magnetic field. A special category of SRD is devices designed for control of models in the bands of 27 – 41 MHz.

6.4.4.1. WiFi radio access networks

From economic point of view, the use of WiFi technology is among the most important ones. WiFi technology is used for wireless access networks as well as for offloading of 3G/4G data traffic terminals (data off-loading¹⁰⁹). Bands 2400 – 2483.5 MHz (frequency band 2.4 GHz) and 5150 – 5350 MHz and 5470 – 5725 MHz (frequency band of 5 GHz) are

harmonised in Europe for WiFi technology¹⁴⁴ and are used by computers, tablet PCs, smart phones and other devices designed for connection to public and private networks. It is estimated¹⁴⁵ that WiFi connection is used by 75 % of the users of smart phones. In most regions of the world WiFi is understood as a key component of development of Internet connection. Standard IEEE 802.11n practically enables speed over 100 Mbit/s and 802.11ac gigabit speed. The related standard IEEE 802.11ad (WiGig), approved in 2013, will enable gigabit communication at short distance in the bands 57 – 66 GHz. The potential of WiFi is based on the possibility of license-free operation and on continuous innovation – relative to the first specification of devices with speed 11 Mbit/s today's standards have exceeded the achievable speed almost by two orders.

Popularity and development of WiFi will be also supported by the development of 4G networks which, in a certain phase of development, envisage offloading of the traffic by means of WiFi. WiFi networks could become an integral part of mobile communication networks (e.g., by means of the WiFi hotspots). The decision on the expansion, if any, of additional frequencies for mobile access networks in the frequency band of 5 GHz will be made by the international conference WRC-15. In this context, the European Commission issued mandate to CEPT in 2013 to prepare a *study of utilisation of the sections 5350 – 5470 MHz and 5725 – 5925 MHz by FWA networks* designated for provision of broadband services of electronic communications¹⁴⁶.



Key:

Czech original	English translation
WiFi v současnosti	WiFi today
Analyzované rozšíření WiFi	Analyzed expansion of WiFi

Figure No. 3 – Current and possible future configuration of the band of 5 GHz for FWA/WiFi

The expansion of bands pro FWA is conditional upon compatibility with other civil and non-civil use of the bands, in particular the radiolocation service, scientific services¹⁴⁷ and intelligent transport systems ITS¹⁴⁸ which are or will be important for ensuring security, fluency and economy of road traffic. The expansion of the bands would enable homogenous use of the spectrum by BWA/FWA/WiFi systems using channel width up to 160 MHz which enable gigabit data throughput. In some countries, the frequency band 5.725 – 5.825 GHz is now used¹⁴⁹ under the so-called light license usually in rural areas for wireless access. The preliminary internal analysis of the Office prepared according to the measurement results suggests compatibility of the existing ITS systems with BWA/FWA/WiFi systems. In the frequency band of 5350 – 5470 MHz the facilitation of mutual coexistence is significantly more complicated and it would require sophisticated procedures preventing mutual interference (e.g., geo-location databases).

Consequences of utilisation of the spectrum by WiFi networks: In both frequency bands of 2.4 GHz and 5 GHz designated for the operation of WiFi networks there have been cases of mutual local interference of the networks and other signs indicating quite high load on the band. In a part of the 5GHz band designated for the operation of outdoor networks there are instances of interference with meteorological radars due to WiFi operators' failure to comply with the operating conditions. Since this phenomenon has very adverse implications for the

¹⁴⁴ WiFi means belonging to a group of standard developed by IEEE.

¹⁴⁵ Source: [Analysys Mason](#) and Arbitron Mobile, 2012.

¹⁴⁶ Mandate to CEPT to study and identify harmonised compatibility and sharing conditions form wireless access systems including RLAN in the bands 5350-5470 MHz and 5725-5925 MHz for the provision of wireless broadband services. Estimated date of completion of the studies is 2016.

¹⁴⁷ Earth Exploration Satellite Service and cosmic research.

¹⁴⁸ Commission Decision NO. 2008/671/EC.

¹⁴⁹ Frequency band C, used e.g., in the UK or USA.

quality of the services using the information from the meteorological radars the problem is dealt with both on international level and on national level (see Article 3.6).

6.4.4.2. Short-range devices (SRD)

SRDs use frequencies from units of kHz up to tens of GHz for their operations, and important bands for their operation from the end users' point of view are particularly bands 433 MHz, 863–870 MHz, 2.4 GHz and 5 GHz. Development of short-range devices pertains to all areas of life, starting with home applications and alarms, RFID identification of goods and individuals, extensive use in ICT and automotive industry (e.g., pro so-called anti-collision radars¹⁵⁰) up to medical applications. According to European analyses¹⁵¹, for example the volume of the fire alarm market grows by 3.3% every year, market of surveillance equipment (alarms) by 10 %. The number of SRDs for control of household systems recently grew by 15% to 50% on year-on-year basis. The considered obligatory equipment of new vehicles with anti-collision radars and other features of ITS will substantially support the development of SRDs. The coexistence of the devices is ensured by the application of a number of algorithms which reduce the risk of mutual interference – e.g., relatively short operating intervals (duty cycle – time of keying), technique of broadcasting with distributed spectrum and other procedures (LBT, DFS). Support of the development of the use of the spectrum by SRD stations is a subject of continuous cooperation on the level of CEPT, ITU, European Commission, and consists not only of the modifications of the operational and technical conditions of use of the spectrum but also addition of more sections –for example, expansion of the sections for SRDs above the band of 870 MHz (e.g., standard EN 303 204), which is currently designated for PMR applications (see Articles 2.6.1 and 6.4.4) is currently analyzed. Applications using the ultra-wideband technology (UWB) met the expectations only to a very limited extent and tend to be used in industrial applications (cable detection, identification of vehicles and surveillance applications, support of safety in industry, etc.)

6.4.4.3. M2M devices, Internet of Things

M2M (Machine-to-machine communication) is a diverse set of data stations which transmit information to one another via relatively low transmission speed between devices or machines, e.g., to the central database, or it is communication between a device and man. M2M is used by a range of applications, from individual household control, to sensors, surveillance camera systems, security systems all the way to systems participating in the billing of the supplies in energy networks and distributed control thereof (decentralisation of energy generation, intelligent networks). M2M devices respond to certain changes in real time; an example is energy meters and systems of automation of distribution networks (Smart Grid), consumption, temperature, road traffic applications, commercial applications of modern medical applications MBAN providing diagnoses of patients (e-Health).

Other examples of M2M communication include telemetric communication in industry, metropolitan networks used to control street lights, parking meters, air quality monitoring, applications in the automotive industry, safety communication between vehicles, etc. With respect to the fact that some devices foresee communication for a distance up to tens of meters the key condition of effective use is the appropriate set-up of the operating conditions for use. The volume of the transmitted information is usually small, and the connection lasts only a short time. The M2M concept is also called *Internet of Things*, and great development of this concept is expected depending on the technological maturity of the society; the development is currently partially coordinated also by European legislation – an example is the European objectives of equipment with intelligent energy meters in households (in some EU countries the goal is to equip 80% households¹⁵² by 2020 with these applications). The M2M concept

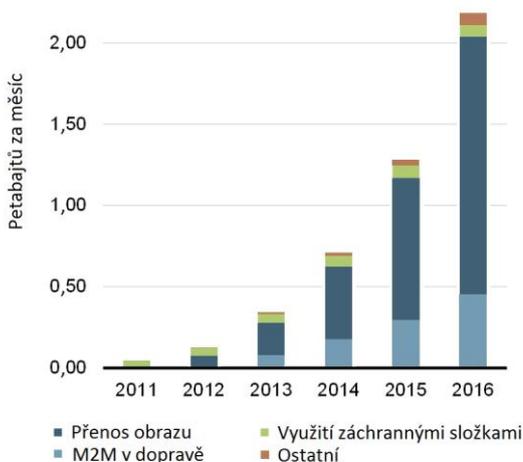
¹⁵⁰ Implementation of anti-collision radars in accordance with the EU policy for improvement of the safety of road traffic is directed at bands 76–81 GHz. Use of these radars also for aeronautical applications is currently discussed.

¹⁵¹ Source: Aegis Systems Ltd. and Analysys Mason.

¹⁵² Directive 2009/72/ES concerning common rules for the internal market in electricity.

represents large room for innovation, also because of the possibility of M2M traffic transmission through cellular networks – the simplest example is household control or consumption monitoring by means of text messages (SMS).

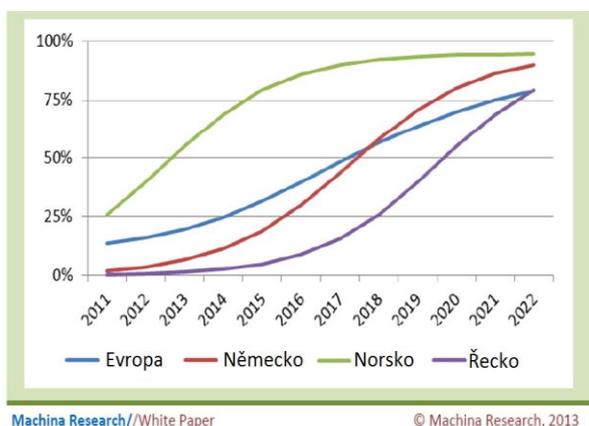
Communication standards of the M2M equipment include SRD protocols as well as wireless and fixed access networks, including cable networks, and are continuously expanded – an example is the new standard IEEE 802.15.4(g)¹⁵³ designed also for Smart Grid networks. The operation of M2M is directed also to the bands of the so-called white spaces (see 6.4.4.4) and an example is new specification of the IEEE 802.11ah standard for the UHF band, derived from the WiFi standard, suitable in Europe for the operation of M2M equipment using IP address-based identification. M2M equipment represents great potential – it is estimated¹⁵⁴ that the number of M2M devices will increase globally from 124 million in 2012 to 2.1 billion in 2021. Development of M2M is assessed in terms of the volume of transmitted data (figure No. 3) or in terms of the number of stations (figure No. 4).



Key:

Czech original	English translation
Petabajťů za měsíc	Petabytes per month
Pěenos obrazu	Transmission of images
Využitě záchranněmi sloŹkami	Use by rescue services
M2M v dopravě	M2M in road traffic
Ostatně	Other

Figure No. 3: Estimated monthly traffic of the most widely used types of M2M through the terminals of cellular networks (source: Analysys Mason, 2012)



¹⁵³ In Europe under the name ETSI TS 102 887 (Smart Metering).

¹⁵⁴ Analysys Mason, 2012

Key:

Czech original	English translation
Evropa	Europe
Německo	Germany
Norsko	Norway
Řecko	Greece

Figure No. 4: Estimates of development of the use of M2M (number of stations; source: Machina Research, 2013)

6.4.4.4. White spaces within the spectrum

The new trends in the use of the spectrum include the so-called *white spaces* - frequencies and geographically defined areas¹⁵⁵ which are located outside the operational area of coverage (where, for example, the distributed TV signal does not reach the required level and is not usable for TV reception) and which are usually used for frequency or geographic separation of transmitters and cannot be used for the broadcasting. Preparation of the new technologies and standards¹⁵⁶ (including the dynamic access to the spectrum) is headed toward the use of the white spaces, and the first generations of communication systems, so-called *cognitive technologies*, which are capable of evaluation of the optimal operating conditions prior to the broadcasting are tested¹⁵⁷. The basic operating condition is elimination of interference with the main use of the band, currently usually television reception, using e.g., the geo-location database with the information on the suitable frequencies or maximum allowed power. The database makes it possible to change the operating parameters should interference occur. Examples are networks based on the IEEE 802.22 WRAN standard enabling approximately ten times greater coverage with broadband access in UHF bands than the coverage offered by WiFi networks. UHF bands are exceptionally promising for WSD applications.

6.4.5. Fixed microwave links

Fixed links will continue to be used for the operation or support of wireless networks, access networks, private networks and other needs. With respect to the gradual development of optical fiber networks, the importance of these links will grow upon the implementation of high-capacity links at shorter distance. The growing need of implementation of gigabit links will support the importance of the use of the highest frequency bands enabling implementation of wide radio channels, including the license-free bands of 70 / 80 GHz.

Fixed microwave links are used in the so-called fixed radiocommunication service for various purposes, in broad range of bands from units of gigahertz up to tens of gigahertz, and for longer-distance as well as short-distance links. They are an alternative to copper and optical fiber links and often represent an economical, fastest or the only option of connection to the backbone networks. The continuous exponential growth of traffic in *all* telecommunication networks will affect also the traffic in the fixed wireless networks. With the gradual development of the use of backbone optical fiber networks and the need of implementation of high-capacity links the importance of the lower frequency bands (approximately below the limit of 7 GHz) used for longer-distance links is gradually decreasing. In the frequency bands up to 6 GHz, described in Article 2.1 and 2.3, there is a trend of convergence of services (Article 6.3.4). The use of fixed networks is closely related to the operation and development of 2G / 3G / 4G mobile access networks for which microwave links provide backbone connection of the base

¹⁵⁵ E.g., in the bands of digital television broadcasting.

¹⁵⁶ ETSI is preparing, under the [mandate of the European Commission](#), a set of standards for the architecture, operating and system requirements. An example is ETSI EN 301 598 on WSD (02/2014) and the procedures of identification of a free channel in the UHF band.

¹⁵⁷ Finland was the first country in Europe to [announce](#) in August 2012 operation of such technologies; in 2013 British regulator Ofcom [initiated cooperation](#) of 20 organisations in the test of the WSD technology.

stations to the core of the networks or between each other in particular in situations where connection using an optical fiber network is not available. With respect to the dynamic development of 3G and 4G mobile networks it is possible to expect continued interest in the operation of microwave links, in particular in areas outside the more densely populated agglomerations or, as the case may be, as backup links installed parallel with the high-capacity optical fiber connection. With respect to the growing requirements for high-capacity links, slightly increased interest in high-capacity links using greater channel widths in the bands which are not yet significantly exposed is expected in the short term. A continued technological trend is the use of more advanced encoding procedures and adaptive modulation patterns making it possible to maximize the transmitted information in the allocated radio channel. The current edition of the Government Regulation No. 154/2005 Sb. (Collection of Laws), on determination of the amount and method of calculation of the fees for the use of radio frequencies and numbers, laid down reasonable conditions of the fee policy in the Czech Republic which stimulates interest in the use of frequencies in the fixed service under an individual authorisation. Nevertheless, in terms of the procedures of authorisation of the use of the spectrum, the highest frequency bands in the fixed service in some other countries are gradually opened for use under the general authorisation or, as the case may be, complemented with some form of station registration (light licensing) for the sake of optimisation of the use of the spectrum. The reason for the trend toward license-free use of the centimeter waves is, among other things, the short range of the radio equipment, narrow radiated beam, and lower operating costs. In terms of the future potential, application of these frequency bands is also expected for connectivity of small local networks.

6.4.6. Mobile private networks PMR and operation of PMSE

Another significant utilisation of the mobile radiocommunication service, in addition to the access networks described in Article 6.4.1, are PMR/PAMR stations and networks and PMSE applications. The abbreviations PMR and PMSE refer to communication between individuals, stations or within networks which are not a part of the publicly available access networks. Terminals of PMR/PAMR networks are sometimes also called "radio stations".

PMR/PAMR stations are typically used in the mobile service in non-public networks in the commercial sector starting with taxi service, company networks in industry and energy sector, to communication in airports up to transport services. They are used by the integrated rescue system (IRS) services i.e., by ambulance and firefighters including the police in the harmonised frequency bands (380–385/390–395 MHz, technology TETRA/TETRAPOL) as well as in the other bands of VHF and UHF. In terms of development of IRS networks, the decisive factor is the issue of PPDR described in the following Article 6.4.7. PMR/PAMR communication is prevalent in railway transport which uses, to ensure operability and safety of traffic, frequency bands 140–160 MHz and 460 MHz as well as the more advanced interoperable transport and communication system ERTMS which is currently based on communication through GSM-R in the frequency band of 880 MHz. The use of frequency bands designated for GSM-R in Europe is relatively low¹⁵⁸, although more effective (i.e., more intensive) use of these frequency bands is partially limited by the need for ensuring the capacity and operating reliability of the networks. Technological innovation of the ERTMS system, based on the technology of switched circuits GSM-R, will result from the considered migration to packet-based traffic – the suitable candidate is LTE technology. Implementation of the system is expected to take place after 2020.

PMSE stations are a group of applications which are involved in the production of television or radio program, i.e., broadcasting from social, sports or cultural events (hereinafter referred to as events). An example is cameras, studio listening (intercom) or microphones which are used for example at conferences, on stage or during sports activities. A number of bands are designated for the operation of PMSE, starting with 40 MHz up to microwave gigahertz bands (up to 50 GHz). PMSE stations and other supporting systems (e.g., telemetry)

¹⁵⁸ According to the European Railway Agency, the use is 10 – 20%.

use the spectrum on secondary basis, i.e., they must not interfere with other services or applications which use the spectrum in priority services (e.g., a concert microphone must not interfere with the reception of television broadcasting). Since the usual channel width for voice communication of professional PMSE stations, save for exceptions, is 200 kHz, these devices can use lower frequency bands unlike video broadcasting sessions requiring greater channel widths which are available in microwave bands. With the development of HDTV and 3DTV and reduction of the usable frequencies after the granting of the rights to the operators of mobile networks (bands 800 MHz and 2.6 GHz) there is an increasing pressure on determination of additional harmonised bands, preferably in the bands below 3 GHz.

Some trends of the development and use of PMSE:

- Thanks to the strict requirement for the speed of response (minimum delay) the digitalisation and implementation of compression of the signal in PMSE equipment is very slow.
- Development of microphones is expected in particular in UHF bands, whereas the bands which are more suitable for wireless cameras which have higher requirements for channel width are the bands over 3 GHz.
- Lower frequency bands are usually operated in license-free mode; the higher bands are operated under individual authorisation.
- Requirements for the spectrum are conditional upon the number of events transmitted, the scope thereof, requirement for quantitative and qualitative requirements for outside broadcasting applications.
- Development of cognitive technologies for PMSE takes place in Europe¹⁵⁹.
- Future implementation of mobile services in the frequency band of 700 MHz will result in redistribution or restriction of the spectrum available for PMSE in the UHF frequency band. CEPT received mandate for an analysis of utilisation of the sections in UHF band by PMSE applications¹⁶⁰ after the adoption of the changes in the frequency band of 700 MHz (see Article 6.4.1). An alternative solution of the use of the section 733–758 MHz is provided by the CEPT study regarding the compatibility of PMSE and IMT¹⁶¹.

6.4.7. Communication of the security and rescue services and PPDR

The trends having impact on the future use of the radio spectrum for the purpose of security communications (PPDR) can be divided into global, regional and national trends.

The main current trend is harmonisation of the spectrum. Harmonised spectrum for security communication is a guarantee of interoperability of the technical resources, makes it possible to deploy the rescue and security services wherever necessary globally or regionally, and creates conditions for mass production of the devices. Another significant trend is the substantial changes in the operational requirements. The future operational requirements, in particular those for *broadband applications* (video, quick access to databases, specific requirements for robustness of the links, requirements for confidentiality of channels, etc.), greatly exceed the capabilities of the current narrowband technologies and generate requirement for additional spectrum for broadband PPDR (BB PPDR). This determines another significant trend, which is *change of the technological base*. It appears that the defined future operational requirements for BB PPDR can be fulfilled also using the LTE technology. In terms of the economy of operation and the construction of BB PPDR, some trends go toward the use of the capacities of commercial networks which will be built on the same technological base by a combined use of commercial networks also for BB PPDR networks. There is also

¹⁵⁹ E.g., in Germany.

¹⁶⁰ Mandate of the European Commission for technical conditions of harmonisation of the spectrum for PMSE (Brussels, October 2012) and Mandate of the European Commission for the proposal of the harmonized technical conditions of the use of the band 694–790 MHz, including PMSE applications, Brussels, March 2013.

¹⁶¹ [Draft of report of ECC No. 221](#) on compatibility of MFCN and PMSE in the frequency band of 700 MHz (07/2014).

great pressure on building independent, physically separated BB PPDR networks. Such concept means significant costs.

The issues of BB PPDR are dealt with on global level (ITU) as well as in Europe on the level of CEPT and the European Commission. Frequency requirements were currently defined based on the operational needs, calculated for the LTE technology in the minimum scope of 2 x 10 MHz, provided that in the event of extensive disasters or accidents the communication will use also radio resources based on different technologies (in the Czech Republic for example resources of the Czech Army, voluntary rescue services). Related requirements are additional frequencies for communication between terminals and communication with aviation resources (AGA). In Europe, frequency sections from the bands 400–470 MHz or 694–790 MHz are considered for BB PPDR. The prerequisite of the implementation thereof is a single European solution. The mandate of the European Commission regarding PPDR¹⁶² foresees European harmonisation and interoperability of the security and rescue services.

6.4.8. Non-civil use of frequencies

Trends which affect the future use of the radio spectrum for non-civil cannot be clearly categorised. In general, it is possible to conclude that the current use of the spectrum for military purposes and the range of bands used for national purposes and NATO purposes is based on outdated concepts of NATO operations originating in the 1990s. Since then, major global changes in the political, economic and security situation have occurred. As a result, the military forces were significantly reduced, the original NATO concepts for operations have been reconsidered, and brand new technologies have appeared. The new conditions require quick response to the changes in the security situation anywhere in the world, deployment of smaller units with modern equipment at several places which are capable of fulfilling tasks independently until the deployment of the main forces, the corresponding logistical supplies and support of air, navy and other forces. Such changes require adequate access to the spectrum for military use.

Just like in security applications, there are growing *requirements for high-speed communication* (video, telemetry, satellite communication). Specific requirements are designated for radiolocation, radio navigation, telemetric applications providing information advantage in the conflict, if any. The specificity of the use of the spectrum for military purposes is the fact that the access to the spectrum is required not only at the time of a conflict but also for training of the staff and troops in peace periods. The total volume of the spectrum for non-civil use must be sufficient, depending on the equipment of the Armed Forces of the Czech Republic, to ensure protection of the Czech Republic.

Another trend is also based on the above-mentioned developments in the security situation. *Most of the time the spectrum for military purposes is used during peace periods.* In combination with the economic factors, it leads to more and more frequent *requirements for the use of commercially manufactured devices* which meet the military requirements for use at the time of peace and often are much less expensive than specially developed military systems.

The current absence of uniform strategic spectrum management complicates effective use of the spectrum in the acquisitions of military radio equipment.

A negative trend in terms of the effective and efficient use of the spectrum is also the current situation where there is no economic positive or negative motivation. It means that the unused spectrum cannot be provided by the Office for civil purposes for a fee and, on the other hand, the absence of motivation tools where, for example, one of them could be obligation to pay for the use of the spectrum, does not lead to the need for reduction thereof to the optimal scope.

¹⁶² [Mandate of the European Commission for band 700 MHz](#) and PPDR foresees European harmonized solution and interoperability of the security and rescue services

6.4.9. Satellite services and satellite broadcasting

The main trend in satellite communication is provision of new services in the area of high-speed communications, television broadcasting, navigation, meteorology, and Earth exploration satellite service. The promising bands 11.7–12.5 GHz are designated for the development of digital satellite TV broadcasting. Higher bands (e.g., 22 GHz) are reserved, looking forward, for distribution of television signal with high requirements for capacity of the channel – e.g., UHDTV or 3DTV. From the navigation point of view, operation of the satellite-based GPS navigation system and the newly built Galileo system are of great importance. In terms of the aggregate allocation of the spectrum, satellite services are among the most important users of the spectrum.

A significant commercial use is television broadcasting in the radio service which in Europe is concentrated in the frequency band of 11.7–12.5 GHz. Analog broadcasting has been basically terminated and digital broadcasting gradually migrates¹⁶³ from SDTV to HDTV.

Mobile interactive communication terminals use the spectrum under the general authorisation. Satellite two-way communication is of irreplaceable significance in particular in sparsely populated or remote areas of the Earth (e.g., maritime communication) or for communication from aircraft. Although the satellite platform, as a tool for personal communication and as access networks, is available also in the Czech Republic, due to the relatively high price for a unit for information transmitted, limited speed of data connection and the great delay (latency) it will not be significantly involved in the achievement of the objectives related to the penetration of broadband networks laid down by the state policy in electronic communications [1]. Nevertheless, satellite communication networks will participate in the support of communication networks on secondary basis (e.g., voice and data communication onboard aircraft). Application of interactive satellite communication in mobile communications in terms of the number of users in the Czech Republic will be limited, although irreplaceable. According to some estimates¹⁶⁴, both traffic and the number of users will slightly grow in the interactive communication networks.

In the frequency bands of 2 GHz (1980–2010 MHz and 2170–2200 MHz), preparation is underway of a concept of mobile satellite communications (MSS) based on systems which will combine wireless transmitters on the Earth (terrestrial) and the satellite. Such networks where the individual components complement each other are called CGC (Complementary Ground Component), and the foundations of the single use in Europe were administratively initiated by the European Commission. With respect to the fact that the status of the implementation of networks in the bands of the satellite service 2 GHz has not reached an important phase in Europe (the satellite operators' failure to meet the conditions of the competitive bidding procedure), an alternative use e.g., by broadband networks in terrestrial mobile service is considered.

In some frequency bands up to 6 GHz, which are shared by satellite services and terrestrial services of electronic communications, terrestrial use is given priority; an example is the frequency band 3.4–3.8 GHz designated for the development of access networks or frequency band 1479.5–1492 MHz released in Europe from satellite radio broadcasting in favor of mobile one-way multimedia networks (SDL, see Article 6.4.1).

In the satellite communications, there will be continued trend of using higher frequency bands driven by the lack of the spectrum in the lower frequency bands and the need of using wider communication channels.

In terms of the operation of satellite navigation systems, it is possible to expect in the next decade the launch of full operation of the European civil navigation system Galileo. Since 2009 the supporting system EGNOS has been providing corrections to the US GPS system; in the near future we can also expect increased use of the global systems GLONASS

¹⁶³ E.g., German stations ARD and ZDF announced termination of broadcasting of SDTV by the end of 2019.

¹⁶⁴ Source: Inmarsat.

and Compass. The systems can be complemented with stations¹⁶⁵ enabling improvement of coverage in the problematic locations on the Earth (e.g., cities).

6.4.10. Aviation services

Aviation services include a broad range of applications associated with the safety and fluency of traffic, navigation (landing systems, secondary radars), operation of altitude gauges, voice and data communication between stations on the ground and airborne stations. The operation uses frequency bands starting with MW, to SW, VHF, UHF up to microwave bands. With respect to the nature of the service where e.g., the operation of an airborne radio station (during flight) has a dramatically greater reach than operation on the ground, and therefore the area necessary for coordination of the frequency increases, and the opposite requirement for absolute reliability of all radio communication systems, the use of the frequencies is coordinated internationally by ICAO and Eurocontrol, an organisation which coordinates the common European initiative SES (Single European Sky) in order to unify the air traffic system across Europe and optimize its operation.

Although analog communication is still prevalent in air communication, transition to more effective method of use of the spectrum is underway. Due to the absolutely necessary reliability of the communication systems, the migration to the more effective use of the spectrum is relatively slow – an example is the implementation of voice communication using narrower channel width (8.33 kHz instead of the original 25 kHz), which will take place in the European airspace until 2018. With respect to the requirement for full equipment of all aircraft with the respective stations and the scope of the technological renewal given the system integration, digitalisation of voice communication in the air mobile service is not envisaged in the medium term.

The spectrum for the terrestrial component of the control and command of the UAS system was harmonised for unmanned aerial systems (UAS). Conference WRC-15 should decide on the satellite component designated for the command and control. The ongoing studies focus on provision of communication lines for UAS in the fixed satellite service.

Technological innovation also leads to the deployment of radio resources (in particular character of the sensors, regulation elements) in the aircraft as a part of the measures to increase flight safety, reduce aircraft weight, and protect the environment.

6.4.11. Meteorological and scientific services, Earth exploration satellite service

Meteorological, scientific services and the Earth exploration satellite service use for their operation a number of frequency bands for weather forecasts, monitoring of the climate, measurement of the speed of wind, and exploration of the Earth. Scientific services include radio astronomy which is based on passive reception of waves of cosmic origin and is one of the fields whose benefits are in the area of knowledge and technological innovation. It depends on the discipline of use in the other services or frequency bands. Although in the Czech Republic the use is concentrated primarily into the higher frequency bands between 0.8 GHz and 4.5 GHz the condition of protection of radio astronomy from undesirable interference also pertains to the use outside the Czech Republic.

¹⁶⁵ In English: "pseudolite".

6.5. Annex 1 – Instruments for the enforcement of the national strategy

The effects of the individual measures proposed in Articles 2 and 3 are achieved in particular by means of the following legislative, procedural and information instruments:

- [1] Government resolution No. 203 of 20 March 2013 on the updated State policy in electronic communications Digital Czech Republic v. 2.0 – The Way to Digital Economy
- [2] Act No. 127/2005 Sb. (Collection of Laws) of 22 February 2005, on electronic communications and on amendment of some related acts (Electronic Communications Act)
- [3] Decree No. 105/2010 Sb. (Collection of Laws) of 2 April 2010, on the plan of allocation of frequency bands (national frequency table)
- [4] Measure of general nature – plan of use of radio spectrum (Radio Spectrum Utilisation Plan)
- [5] Measure of general nature – general authorisation for the use of radio frequencies
- [6] Government Regulation No. 154/2005 Sb. (Collection of Laws), on determination of the amount and the method of calculation of the fees for the use of radio frequencies and numbers
- [7] Directive 2002/19/EC of the European Parliament and of the Council (access directive), as amended
- [8] Directive 2002/20/EC of the European Parliament and of the Council (authorisation directive), as amended
- [9] Directive 2002/21/EC of the European Parliament and of the Council (framework directive), as amended
- [10] Decision 676/2002/EC of the European Parliament and of the Council on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision))
- [11] Decision 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme (RSPP).
- [12] Radio Regulations, International Telecommunication Union, Geneva, 2012
- [13] Act No. 231/2001 Sb. (Collection of Laws) of 17 May 2001 on operation of radio and television broadcasting and on amendment of other acts
- [14] Information of the Office published on the website of the Office (e.g., Monthly Monitoring Reports, search database on the use of frequencies)
- [15] Public consultations of the Office either pursuant to Section 130 of Act No. 127/2005 Sb. (Collection of Laws), on electronic communications, or outside Section 130 (informal consultation).
- [16] Frequency Information System of the European Communications Office (www.efis.dk)
- [17] Agreement Geneva, 2006 – international agreement signed at the conference of ITU-R in 2006. The agreement regulates the coordination of radio services in the frequency range 174 – 230 MHz and 470 – 862 MHz among the signatories.
- [18] Commission Decision No. 344/2007/EC on harmonised availability of information o utilisation of the spectrum in the European Union.
- [19] Commission implementing Decision of 23 April 2013 defining the practical arrangements, uniform formats and a methodology in relation to the radio spectrum inventory established by Decision No 243/2012/EU of the European Parliament and of the Council establishing a multiannual radio spectrum policy programme.
- [20] Telecommunication bulletin (<http://www.ctu.cz/aktuality/telekomunikacni-vestnik/obecne-information.html>).
- [21] Website of the Office (www.ctu.cz).

6.6. Annex 2 – List of Abbreviations

3DTV	Television with three-dimensional picture delivery	ETSI	European Telecommunications Standards Institute
2G	2 nd generation of mobile communications (GSM, GPRS)	Eurocontrol	European Organisation for the Safety of Air Navigation
3G, HSPA+	Third generation of wireless mobile cellular technology IMT (UMTS, CDMA)	E-UTRA	Radio part of LTE-A networks
4G	fourth generation of wireless cellular (mobile) technologies fulfilling the specification IMT-Advanced (today especially technology LTE-A)	FDD	Frequency Division Duplex
7FP-ICT	7 th framework programme	FM	Frequency modulation
ACR	Armed Forces of the Czech Republic	FWA	Fixed Wireless Access
AIC	Aeronautical Information Circulars	FWA/BWA	Broadband FWA
ATPC	Automatic transmit power control	GSM	Communication system of the 2 nd generation
BB PPDR	Broadband PPDR	GSM-R	Railway communication (R = railway)
BDA2GC	Broadband Direct Air-to-ground Communication	H264/AVC, H265/HEVC	Video compression codecs MPEG
BWA	Broadband Wireless System	HbbTV	Hybrid Broadcast Broadband TV
CAGR	Compound Annual Growth Rate	HD, HDTV	High Definition (TV)
CDMA	Code division multiple access	GDP	Gross domestic product
CEN, CENELEC	Comité Européen de Normalisation	HRS	Trunk radio networks
CEPT	Commission Européenne des Postes et Télécommunications	HSPA	see 3G
CGC	Complementary Ground Component	ICAO	International Civil Aviation Organisation
CSFB	Circuit Switched Fallback	ICT	Information and Communication Technologies
CUS	Collective use of spectrum	IEEE	Institute of Electrical and Electronics Engineers
CR	Czech Republic	IMT, IMT-A	International Mobile Telecommunications (IMT-Advanced); see also 3G, 4G
Office	Czech Telecommunication Office	IA	Individual Authorisation
DAB+/DMB	Technologies of digital audio and multimedia broadcasting	IPTV	Internet TV
DECT	Cordless handset technology	ITS	Intelligent Transport Systems
DFS	Dynamic Frequency Selection	ITU	International Telecommunications Union
DL	Downlink (BS to MS transmission direction)	ITU-R	ITU – Radiocommunication sector
DMO	Direct Mode	IRS	Integrated rescue system
DRM/DRM+	Technologies of digital of narrowband of radio broadcasting	JTG	Group of ITU-R established regarding the issue of the band 700 MHz
LW	Long waves	SW	Short waves
DVB-H/S/T/T2	Technologies of digital television broadcasting: H – handheld, S – satellite, T / T2 – terrestrial	LBT	Listen Before Talk
ECC	Electronic Communications Committee of the CEPT	LSA/ASA	Licensed/Authorised Shared Access
EFIS	ECO Frequency Information System	LTE, LTE-A	Long Term Evolution
EIRP	Effective Isotropic Radiated Power	M2M	Machine-to-machine communication
EC, EP	European Commission, European Parliament	MBAN	Medical Body Area Network System
ERTMS	European Rail Traffic Management System	MCA	Mobile Communications on board Aircraft
EC, EU	European Community, European Union	MFCN	Mobile and Fixed Communication Networks
		MT	Ministry of transport
		MD	Ministry of defense
		MIT	Ministry of Industry and Trade
		MSS	Mobile satellite service
		MPEG	Methods of compression and storage of audio and video data
		MPLP	Multiple Physical Layer Pipes
		MI	Ministry of the interior

Annex 2 – List of Abbreviations

NATO	North Atlantic Treaty Organisation	TDD	Time Division Duplex
NGN	Next Generation Networks	UHDTV	Ultra High Definition TV
NJFA	NATO Joint Frequency Agreement	UHF	Band IV and V
NFT	National frequency table	UL	Uplink (MS to BS transmission direction)
P(A)MR	Public (Access) Mobile Radio	UMTS	Universal Mobile Telecommunication Service
PMSE	Program Making Special Events	UWB	Ultra-wideband Technology
PPDR	Public Protection Disaster Relief	VHF	Band III
RSUP	Radio Spectrum Utilisation Plan	VHF	Very high frequency
QoS	Quality of Service	GA	General authorisation for the use of radio frequencies
RFID	Radio Frequency Identification Device	VoLTE	Voice Over LTE, technology of packet-based transmission of voice services in LTE networks
RLAN	Radio Local Area Networks	WAPECS	Wireless Access Policy for Electronic Communications Services ⁹⁵
RSC	Radio Spectrum Committee	WRC	World Radiocommunication Conference reviews the Radiocommunication regulations in regular intervals
RSPG	Radio Spectrum Police Group	WSD	White Space Devices, equipment using white spaces within the spectrum
RSPP	Radio Spectrum Policy Program		
SDL	Supplemental Downlink; supporting data stream in IMT networks		
SDTV	Standard Definition Television, resolution 720x576 pixels		
SES	Single European Sky		
SFN	Single Frequency Network		
SNG	Satellite News Gathering		
SON	Self Organizing Networks		
SRD	Short Range Device		
MW	Medium waves		
T-DAB	see DAB		
TV	Television		