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Analysis of the 400 MHz band with a view to its future use in the mobile radio communication service

Prepared for the Ministry of Industry and Trade

15 November 2024

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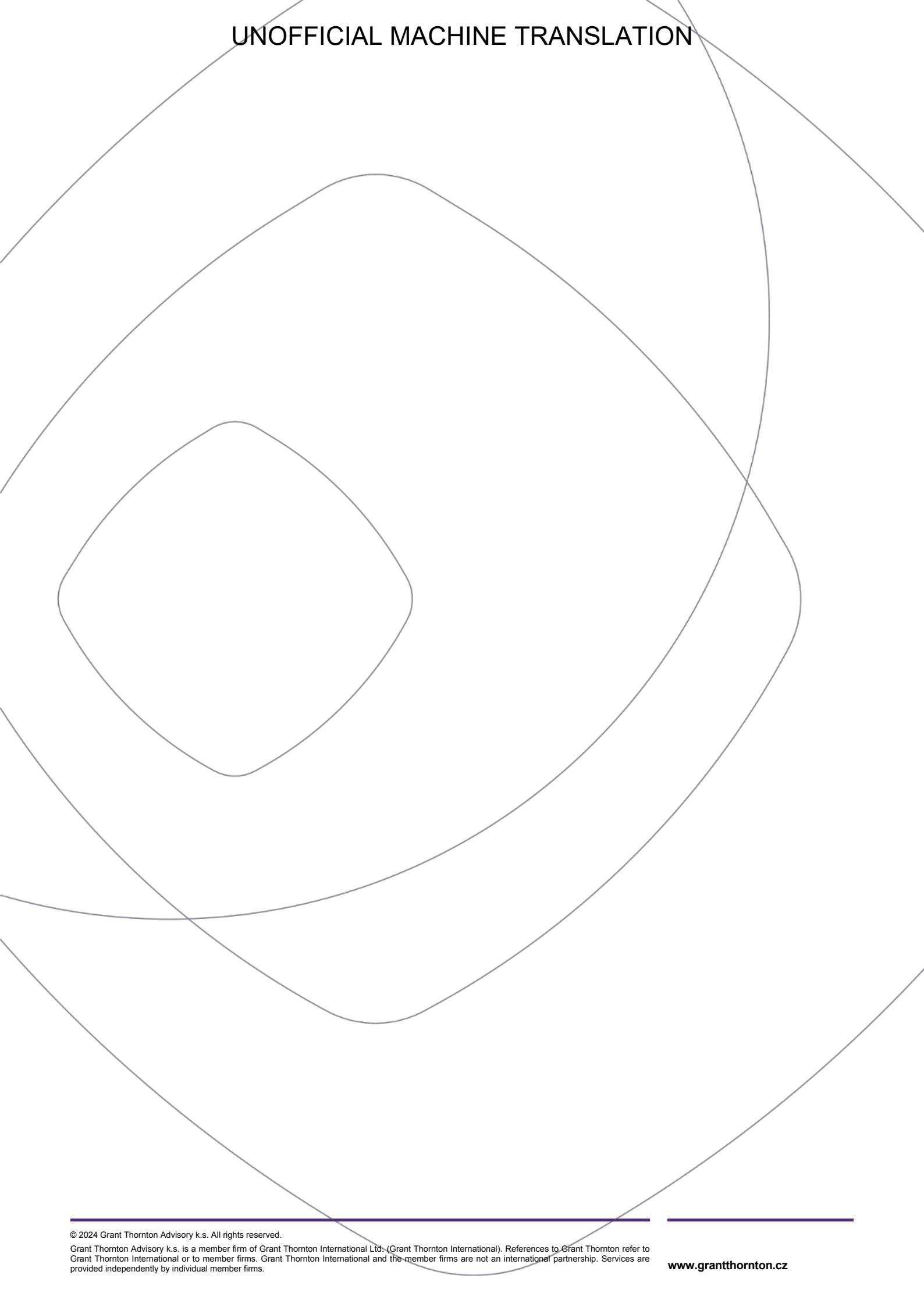

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Contents

Definitions of terms and abbreviations

The definition of key terms is an important starting point for the subsequent sections of the study and for its practical implications.[1]

List of definitions

IoT (Internet of Things): The Internet of Things is a system of uniquely identified devices that collect data, which is then transmitted via the internet, analysed and evaluated, and on the basis of which actions can be carried out within or outside the system. This system has a clearly defined purpose, which is typically to increase process efficiency, performance, awareness, etc.

Mission-critical communication: Communication systems whose failure would have serious implications for the security or operations of an organisation

400 MHz band: The part of the band comprising both the 410–430 MHz and 450–470 MHz sub-bands

410 MHz band: The 410–430 MHz section of the band

450 MHz band: The 450–470 MHz section of the band

Smart Grids: Intelligent electricity networks enabling efficient electricity distribution and the integration of renewable energy sources

Smart Metering: Technology enabling remote, real-time energy consumption readings

Broadband networks: Systems providing greater bandwidth than narrowband systems, including technologies such as CDMA and LTE

Narrowband networks: Communication systems typically using a channel bandwidth of up to 25 kHz, for example dPMR, TETRA, DMR

[1] Note: Czech vs. English terms. As in many specialist fields, there are a number of terms in the areas of PMR, IoT, 4G/5G networks and related solutions for which no suitable Czech equivalent has been established. As a matter of principle, new terms will also be in English. This is the case with most specialist literature. It is therefore sometimes necessary to use the original English term, or to use both the English and Czech equivalents. Another reason for using English terms is to enable users to search for further information on the subject. This is straightforward when using the original

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English term; using an unestablished Czech equivalent could prove problematic.

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List of abbreviations

3GPP – 3rd Generation Partnership Project (standardisation organisation for mobile technologies)

4G – Fourth generation of mobile networks – the LTE mobile communication technology standard, part of the IMT family of technologies

5G – Fifth generation of mobile networks, successor to LTE, focused on faster data transfers, low latency and massive device connectivity

5G NR – 5G New Radio (standard for fifth-generation mobile networks, including new frequency bands and technological improvements)

AMM – Advanced Metering Management (advanced energy consumption measurement and control systems)

BB-PPDR – Broadband Public Protection and Disaster Relief (broadband communications for security and emergency services)

CDMA – Code Division Multiple Access (now obsolete mobile communication technology, being replaced by the LTE standard)

CEPT – European Conference of Postal and Telecommunications Administrations

DMO – Direct Mode Operation

DMR – Digital Mobile Radio (narrowband digital mobile radio technology)

ECC – Electronic Communications Committee (CEPT)

EUTC – European Utility Telecom Council (an organisation representing the interests of utilities in the telecommunications sector) **IMT** – International Mobile Telecommunications (ITU standard for mobile systems – includes 4G and 5G) **ITU** – International Telecommunication Union

LTE – Long Term Evolution (technology for fourth-generation mobile networks).

LTE-M – Long Term Evolution for Machines (LTE technology adapted for IoT and M2M applications)

M2M – Machine-to-Machine (automatic communication between devices without human intervention)

NB-IoT – Narrowband Internet of Things (a technological standard designed for IoT communication)

NMT – Nordic Mobile Telephony (a first-generation mobile standard)

PAMR – Public Access Mobile Radio (a mobile radio system analogous to PMR, but services are provided to users by the PAMR network operator)

PMR – Private Mobile Radio (a system for private mobile radio communication, typically owned and operated by the user, used for example in industry or transport)

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PPDR – Public Protection and Disaster Relief (communications for security and emergency services)

PVRS – Radio Spectrum Utilisation Plan

SCADA – Supervision, Control, and Data Acquisition

TEDS – TETRA Enhanced Data Services (an extension of the TETRA standard enabling higher data transfer speeds)

TETRA – Terrestrial Trunked Radio (narrowband digital mobile radio technology)

ZoEK – Electronic Communications Act

Executive Summary

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

The radio spectrum in the 400 MHz band is used intensively due to its propagation characteristics and the availability of technologies; however, the nature of this use is not uniform across European Union countries. Sections of the 400 MHz band are intensively used by narrowband PMR/PAMR networks; however, in some countries, broadband technologies (CDMA or LTE) have been and are being deployed in the 410–430 MHz and 450–470 MHz bands. Monitoring of foreign signals has revealed that the actual use of broadband technologies is very low; in some neighbouring countries, none has been detected.

The trend towards launching broadband networks in the 400 MHz band is driven by the rapid deployment of information and communication technologies across all sectors of the economy (e.g. Smart Grids, Smart Metering, Industry 4.0), which is increasing demand for mission-critical M2M (Machine-to-Machine) communication.

The study provides an overview of the technologies available for the 400 MHz band. These include narrowband technologies for traditional narrowband systems such as TETRA, DMR or dPMR. In some cases, however, private 4G broadband networks are also being deployed.

However, the ongoing, ubiquitous roll-out of ICT is fundamentally changing the PMR/PAMR market. In the energy sector in particular, there is high demand for M2M applications, mainly due to the ongoing decentralisation of the energy grid, the integration of renewable energy sources into distribution networks, and regulatory requirements regarding smart grids and metering. In addition to high reliability and low latency, the energy sector has also seen a rise in demand for connectivity to a large number of devices. Standardised IMT technologies adapted to the needs of PMR/PAMR can respond to this evolving demand, particularly for robust Machine-to-Machine (M2M) and IoT communication. Broadband communication is already in common use (WiFi, LTE and, more recently, 5G) in the harmonised 700 MHz and higher bands. Within the 3GPP, 4G standardisation has taken place for both the 410 MHz band and the 450 MHz band. At the same time, standardisation for 5G is underway, which will ensure the long-term viability of investments in 4G networks and the possibility of their future upgrade to 5G. Harmonisation has also taken place at CEPT level. However, there has been no harmonisation of spectrum use at EU level, which would be analogous to the harmonisation of higher bands. According to the EU–RSC report dated 3 July 2024, such harmonisation is not even expected.

The study also mapped the use of the 400 MHz band across 28 European countries. Unsurprisingly, across Europe, the band is used to operate traditional PMR/PAMR networks. However, in 22 countries, a portion of the band has already been allocated for the operation of broadband networks; in most of these, the allocation is technology-neutral with the option to deploy IMT technology, whilst in some, usage remains limited to the previously used CDMA networks. CDMA was a third-generation technology (operation of this generation of technology ceased in the Czech Republic long ago).

In a number of countries, LTE networks have already been launched or are under construction following licences granted in recent years. In Scandinavia, LTE networks are still used for internet access in remote areas, but in the rest of Europe there is a clear trend towards using these networks for utility purposes or BB-PPDR (Public Protection and Disaster Relief) communications. As regards networks for the energy and utilities sectors, licences for this purpose have recently been granted in Ireland, Germany and the Netherlands, where

private LTE networks for mission-critical communications are being launched and built. The BB-PPDR band is reserved, for example, in Slovenia and Spain.

In the Czech Republic, the 400 MHz band was used by both narrowband and broadband mobile networks. However, broadband public networks using the CDMA standard, which provided fixed and mobile internet access, ceased operations due to a lack of customer interest in a service that was not competitive with 4G mobile networks in terms of either cost-effectiveness or quality and coverage. Operators were unable to find a viable business model for operating LTE broadband technology and therefore returned their spectrum allocations and licences. The sections in the 410 MHz and 450 MHz bands, designated for the operation of broadband networks, have been unused since 2021. In contrast, in some areas the CTO faces a shortage of frequencies for narrowband networks (e.g. for TETRA standard radio networks in the Prague area).

An analysis of the 400 MHz band confirms its importance as a strategic resource for current and future needs in the field of critical communications. There is still a clear market trend towards narrowband digital systems (particularly DMR and TETRA), which were designed for this purpose and whose networks are still being built and expanded.

Given the current intensity of PMR channel usage and the clear global trend towards a transition to broadband IMT networks (particularly in the 450 MHz band), focused primarily on mission-critical applications in the energy sector and industry, the main focus of the strategic review will likely be the 410 MHz band. In the case of vertical sectors – the energy sector – the transition to broadband systems has already taken place in the Czech Republic. Modern electricity meters are routinely fitted with an LTE module utilising the services of mobile operators in bands above 700 MHz, whilst no interest has been shown in lower bands.

Competition for broadband networks in the 400 MHz band comes from other broadband technologies (particularly public mobile networks). Broadband services in the 400 MHz band, due to the lower available bandwidth, will achieve lower performance parameters (particularly in terms of speed), will be operated over a smaller area (poorer coverage, uncovered national borders), and have a limited range of available equipment. Their deployment is also economically demanding. The range of frequencies in the 400 MHz band available for use by broadband technologies is very limited and cannot be further expanded, which restricts both the number of customers and the quality of the service provided.

Before a fundamental decision is taken on the future use of the 400 MHz band, a broad public consultation should therefore be held with both existing and potential users of the band, particularly from the utilities, transport, public administration and other sectors.

Management summary

The study aims to show the current use of the 410–430 MHz and 450–470 MHz frequency bands and the trend of broadband network deployment in these bands, particularly in the European context. It also describes possible scenarios for the future use of these bands in the Czech Republic. The study is intended to serve as a basis for strategic decision-making regarding the future use of the 400 MHz band in the country.

The 400 MHz band is used extensively due to its propagation characteristics and the availability of suitable technologies. Specific usage patterns of this band vary between EU Member States. Parts of the 400 MHz band are heavily used by narrowband PMR/PAMR networks. However, broadband technologies such as CDMA or LTE have been or are being deployed in the 410–430 MHz and 450–470 MHz bands in some countries. Monitoring of cross-border signals has revealed that the actual use of broadband technologies is very low, with no detections in some neighbouring countries.

The trend towards the deployment of broadband networks in the 400 MHz band is driven by the rapid adoption of information and communication technologies (ICT) across all sectors of the economy (e.g. smart grids, smart metering, Industry 4.0), leading to increased demand for mission-critical machine-to-machine (M2M) communications.

The study provides an overview of the technologies available for the 400 MHz band, including narrowband solutions such as TETRA, DMR and dPMR, which are widely used in traditional PMR/PAMR systems. However, private broadband 4G networks are also being deployed.

The widespread introduction of ICT is transforming the PMR/PAMR market. This shift is particularly evident in the energy sector, where the increasing decentralisation of the power grid, the integration of renewable energy sources and regulatory requirements for smart grids and metering have created a strong demand for M2M applications. In addition to reliability and low latency, there is a need to connect a large number of devices. Standardised IMT technologies tailored to PMR/PAMR requirements are well suited to meet this evolving demand, especially for robust M2M and IoT communications. Broadband communication is already being widely used (WiFi, LTE, 5G) in harmonised bands (700 MHz and above).

The 3GPP standardisation body has standardised 4G technologies for both the 410 MHz and 450 MHz bands, and ongoing 5G standardisation ensures the long-term viability of investments in 4G networks, with the option of future upgrades to 5G. The use of the 400 MHz band by broadband systems has been harmonised at CEPT level. However, harmonisation of spectrum usage at EU level, comparable to the harmonisation of higher bands, is not anticipated. According to the EU–RSC report dated 3 July 2024, such harmonisation is not expected.

The study also examines the use of the 400 MHz band in 28 European countries. Unsurprisingly, the band is widely used for traditional PMR/PAMR networks. However, parts of the band have been allocated for broadband networks in 22 countries, mostly in a technology-neutral manner that allows for IMT deployment. In some cases, these allocations only permit legacy CDMA networks (no longer in use in the Czech Republic) to operate.

Broadband LTE networks have been launched or are being deployed in many countries following recent spectrum licence awards. In Scandinavia, LTE networks in this band continue to provide internet access in remote areas, whilst elsewhere in Europe there is a clear trend towards using these networks for utility

or BB-PPDR (Broadband Public Protection and Disaster Relief) communications. Recent licence awards in Ireland, Germany and the Netherlands highlight the use of this band for private LTE networks dedicated to mission-critical communications in the energy and utility sectors. Meanwhile, countries such as Slovenia and Spain have reserved spectrum for BB-PPDR use.

In the Czech Republic, the 400 MHz band has historically been used for both narrowband and broadband mobile networks. However, public CDMA broadband networks which provided fixed and mobile internet access ceased to operate due to a lack of customer interest in a service that was neither economically viable nor competitive with 4G mobile networks in terms of quality and coverage. Operators were unable to establish a sustainable economic model for operating broadband LTE technology and thus returned their allocations and licences. The 410 MHz and 450 MHz bands allocated for broadband use have been unused since 2021. In contrast, the Czech Telecommunications Office (ČTÚ) faces a shortage of spectrum in some areas for narrowband networks, such as TETRA radio systems in Prague.

The analysis confirms the strategic importance of the 400 MHz band for current and future critical communications needs. Spectrum users continue to favour narrowband digital systems (primarily DMR and TETRA), which are specifically designed for such purposes, and their networks are still being newly developed and expanded.

Given the intensity of PMR channel usage and the global trend towards broadband IMT networks (particularly in the 450 MHz band) tailored for mission-critical applications in energy and industry, the 410 MHz band is likely to become the focus of the strategic review. In sectors such as energy, a transition to broadband systems has already taken place in the Czech Republic in some cases. Modern electricity meters are commonly equipped with LTE modules utilising mobile operators' services in bands above 700 MHz, with no interest shown in the lower bands.

Broadband networks in the 400 MHz band face competition from other broadband technologies, particularly public mobile networks. Broadband services in the 400 MHz band, due to the limited available bandwidth, will exhibit inferior performance (notably lower data speeds), operate over smaller areas (poorer coverage and uncovered border areas), have a limited range of available devices, and are economically challenging to deploy. The frequency range in the 400 MHz band available for broadband technologies is very limited, with no possibility of further expansion, which restricts both the number of customers and the quality of services provided.

A broad public consultation should take place before any major decisions are taken on the future use of the 400 MHz band. This process should involve current and potential users of the band, in particular in sectors such as utilities, transport, public administration and other key industries.

1 Introduction

1.1 Objectives of the study

The radio spectrum in the 400 MHz band is used intensively due to its propagation characteristics and the availability of technologies; however, the nature of this use is not uniform across the countries of the European Union. Sections of the 400 MHz band are heavily utilised by narrowband PMR/PAMR networks; however, in some countries, broadband technologies (CDMA or LTE) have been and are being deployed in the 410–430 MHz and 450–470 MHz bands.

The trend towards launching broadband PMR networks is driven by the rapid deployment of information and communication technologies across all sectors of the economy (e.g. Smart Grids, Smart Metering, Industry 4.0), which is increasing demand for mission-critical M2M communication. However, the roll-out of broadband services is focused primarily (and in some countries, including the Czech Republic, exclusively) on the use of mobile operators' services in harmonised bands above 700 MHz.

In the Czech Republic, the 400 MHz band was used by both narrowband and broadband mobile networks. However, the sections in the 410 MHz and 450 MHz bands, designated for the operation of broadband networks, are currently unused. They have been left idle by former operators who lost interest in them. In contrast, in some areas the CTO faces a shortage of frequencies for narrowband networks (e.g. for TETRA standard radio networks in the Prague area).

The aim of the study is to map, particularly in a European context, the current use of the 410–430 MHz and 450–470 MHz bands and the trend in the deployment of both narrowband and broadband networks in these bands, and to describe scenarios for the possible future use of these bands in the Czech Republic. The study should serve as a basis for strategic decision-making on the future use of the 400 MHz band in the Czech Republic.

1.2 History of the use of the 400 MHz band

1.2.1 History of use in the Czech Republic

Historically, the 400 MHz band was used by narrowband mobile networks and fixed links. The 450 MHz band has been used since the early 1990s for the operation of an analogue mobile network in the NMT standard by Eurotel. With the advent of GSM networks in the second half of the 1990s, the operation of the NMT network became obsolete. In 2004, Eurotel launched a network based on CDMA technology and designed to provide internet access services on the frequencies originally allocated for the NMT network. At the time, this was a competitive alternative to other methods of internet access. The company used frequencies in the 451.3–455.74 MHz band to operate the network.

In 2007, Mobilkom also launched its own CDMA network. It used frequencies in the 410 MHz band and gradually expanded its licence to use radio frequencies, which was based on an allocation of 0.5 MHz, to the 410–414.25 MHz range. The company provided both mobile and fixed voice and data services and, at the time of launching its services, presented itself on the market as the fourth mobile operator. This project was not particularly successful. It ended with MobilKom being declared bankrupt on 15 December 2011 and subsequently changed hands twice.

With the development of other fixed and mobile technologies, services provided on CDMA networks began to reach the limits of their competitiveness (achievable transmission speeds, the need for special end-user devices for the CDMA standard, etc.). Both companies (by then known as O2 and Nordic Telecom) therefore declared their interest in transitioning to LTE technology and focusing on mission-critical sectors such as utilities, security and the like.

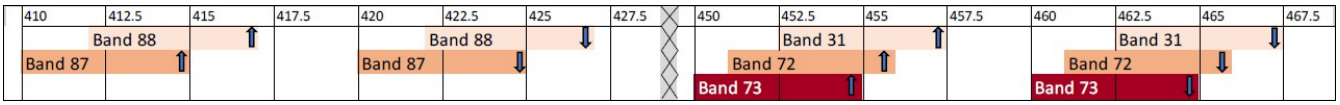
In 2016, a change to the PVRS led to the technological neutralisation of the 410 and 450 MHz bands, thereby enabling the deployment of LTE technology. However, the operation of LTE networks did not go beyond the scope of testing and pilot operations, and in 2021 both companies relinquished their rights to use frequencies in the 410 and 450 MHz bands. Since then, the sections of the 400 MHz band intended for use by nationwide broadband mobile networks have remained unused.

1.2.2 History of use worldwide

The 400 MHz band is widely used by narrowband PMR/PAMR systems. In the 450 MHz band, following the previous allocation for NMT mobile networks, broadband networks using the CDMA standard were launched in some countries. In the 2000s, CDMA networks were also launched in some countries in the 410 MHz band (e.g. the Czech Republic, Poland, Serbia). However, only in the Czech Republic were networks launched in both bands.

With the advent of LTE technology, interest also arose in its use in the 450 MHz band. The first country to issue a licence for LTE networks in the 450 MHz band was Brazil in 2012, even before the completion of LTE standardisation for this band. However, the first LTE450 network was launched in 2014 by the Finnish operator Ukkoverkot. Given the growing interest in the potential deployment of broadband networks for critical communications (utilities, PPDR, etc.), the
In many countries, the 450 MHz band is heavily utilised by narrowband PMR/PAMR systems, and releasing it for broadband networks is not feasible in the medium or long term. Efforts to standardise LTE in the 410 MHz band then culminated in 2019 with European harmonisation at CEPT level and subsequent standardisation at 3GPP level.

The status of standardisation is illustrated in the following table:



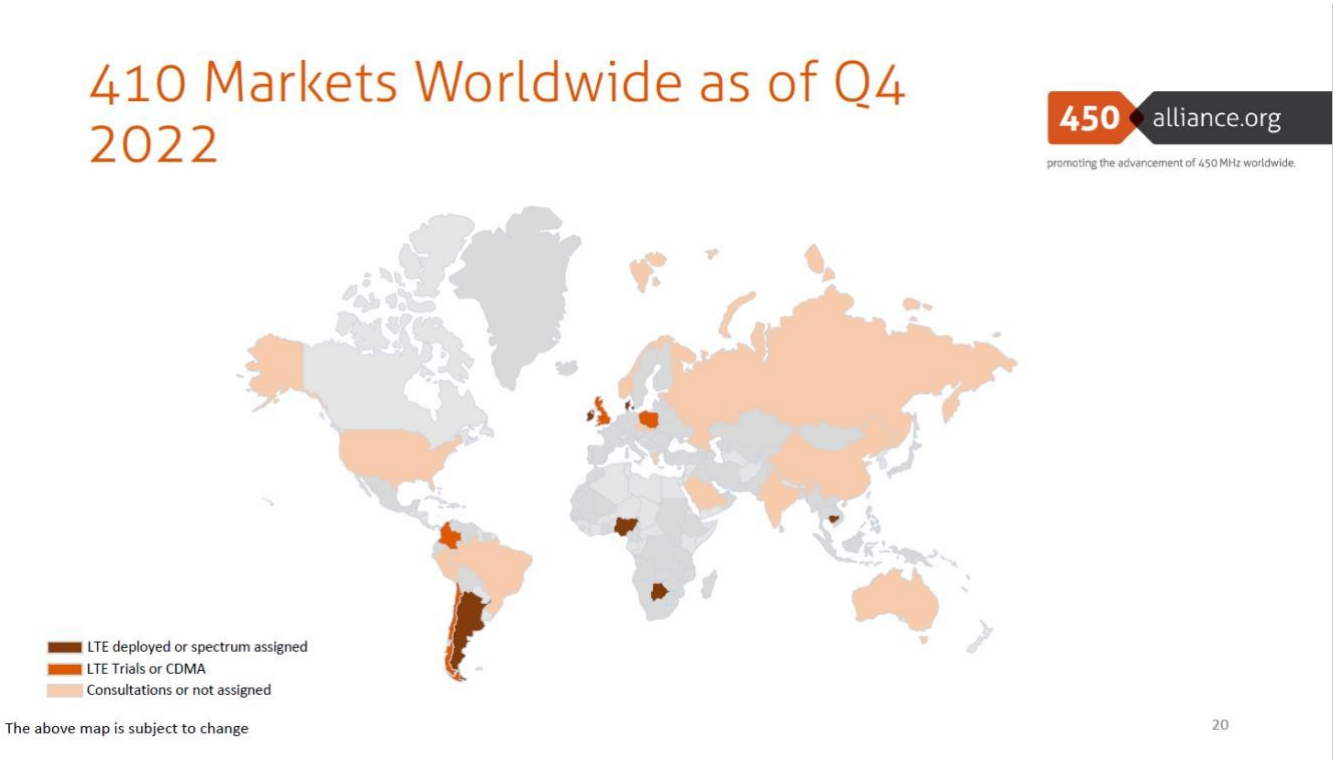
It is worth noting that efforts to standardise 4G/5G in the 380 MHz band are already underway.

According to the latest data available from the 450 Alliance[2], CDMA technology continues to dominate broadband technologies in the 410 and 450 MHz bands. The 450 Alliance has recorded 26 LTE networks in commercial operation and four trial projects. In recent years, a number of licences have been issued in Europe for the operation of LTE networks in the 450 and 410 MHz bands. The main users are network operators from the utilities sector (energy); in some countries, the band is designated for PPDR. We examine the situation in Europe in detail in the following chapters. In a number of countries, outdated 3rd generation technologies (CDMA) are still in use, whilst in others, more modern technologies from the IMT family are being deployed.

Network development in the 410 MHz band is significantly less significant than in the 450 MHz band. This is partly due to the history of NMT networks in the 450 MHz band and the relatively widespread migration to CDMA technology, to which

[2] https://450alliance.org/wp-content/uploads/2024/01/450Alliance-Annual-Global-Update-2023-ver-P.pdf

in the 410 MHz band. Furthermore, the several-year delay in standardisation for 4G technologies plays a role. The difference is evident from the following overview maps from the 450 Alliance:



2 Harmonisation, technology, applications

2.1 Overview of harmonisation documents

ITU

The fundamental harmonisation document is **the ITU Radio Regulations.** For the Czech Republic, this results in the allocation of frequencies in the 410–430 MHz and 450–470 MHz bands for the following services:

410–430 MHz

- FIXED
- MOBILE except aeronautical mobile
- SPACE RESEARCH (410–420)
- Radar (420–430)

450–470 MHz

- FIXED
- MOBILE
- Satellite meteorological (460–470)

Note 5.286AA of the Radio Regulations is important, as it anticipates the implementation of IMT (International Mobile Telecommunications) technologies in the 450–470 MHz band.

The provisions of the Radio Regulations are duly reflected in the national frequency table[3] and the frequency spectrum utilisation plan (PVRS).

CEPT

At European level, the key harmonisation documents have been prepared within the framework of the European Conference of Postal and Telecommunications Administrations (CEPT):

- **ECC Decision (16)02** – Harmonised technical conditions and frequency bands for the implementation of Broadband Public Protection and Disaster Relief (BB-PPDR)

[3] Decree No. 105/2010 Coll.

- **ECC Decision (19)02** – Land mobile systems in the frequency ranges 68–87.5 MHz, 146–174 MHz, 406.1–410 MHz, 410–430 MHz, 440–450 MHz and 450–470 MHz
- **Recommendation T/R 25-08** – Planning criteria and cross-border coordination of frequencies for land mobile systems in the range 29.7–470 MHz

ECC Decision (19)02 sets out technical requirements for narrowband systems using a bandwidth of 6.25 kHz to 25 kHz, as well as for systems with an effective bandwidth of 50 kHz to 200 kHz, and also for wideband systems with bandwidths of 1.25 MHz (corresponding to CDMA technology) and 1.4 MHz, 3 MHz and 5 MHz (corresponding to LTE). ECC Decision 19(02) first defined three possible 2x5 MHz frequency ranges for broadband systems in the 410 MHz band. A standardised band within 3GPP was adopted for two of these (see below).

ECC Decision 16(02) was amended in 2019 in connection with the adoption of ECC Decision 19(02) and, in line with it, sets out the recommended spectral ranges for BB-PPDR networks in the 400 MHz band.

Recommendation T/R 25-08 sets out rules for cross-border frequency coordination in the 400 MHz band.

3GPP

From the perspective of deploying IMT technologies (4G and 5G) in the 400 MHz band, standardisation of the technology for this band is crucial.

The 3GPP standard defines the following bands for LTE in the 400 MHz band:

Band	Uplink	Downlink
31	452.5–457.5 MHz	462.5–467.5 MHz
72	451–456 MHz	461–466 MHz
73 (not in use)	450–455 MHz	460–465 MHz
87	410–415 MHz	420–425 MHz
88	412–417 MHz	422–427 MHz

The corresponding 5G bands n31 and n72 are standardised within 3GPP Release 18, and work is underway on standardising bands n87 and n88, which are expected to be part of Release 19.

2.2 Technology in the 400 MHz band

2.2.1 Narrowband technologies

This category primarily includes communication systems with a channel bandwidth of up to 25 kHz. The channel bandwidths used are 6.25 kHz, 12.5 kHz or 25 kHz.

These systems include analogue and digital systems such as TETRA, DMR or dPMR and are widely used for PMR.

They support voice services, including group communication and 'push-to-talk' (PTT), and, to a limited extent, data services (e.g. text messages, SDS – short data service, or IP data transmissions).

DMO (direct mode operation) is also often supported, which allows user stations to communicate with each other, for example when they are out of range of the base station.

Modern digital PMR systems also support mission-critical M2M (Machine-to-Machine) services, such as SCADA (Supervision, Control, and Data Acquisition) systems, smart distribution networks (e.g. for electricity, gas and water), data transmission from sensors and smart meters, etc.

Among digital systems in the Czech Republic, TETRA[4]systems, which use a 25 kHz channel, and DMR[(5) systems], which use a 12.5 kHz channel, predominate.

In addition to narrowband systems, wideband systems with a channel bandwidth of up to 150 kHz have been developed and standardised. Of particular note is the TETRA TEDS (TETRA Enhanced Data Service) system.

TETRA TEDS uses channels with a bandwidth of 25, 50, 100 or 150 kHz. Depending on the channel bandwidth used and propagation conditions, data rates in the range of **10–500 kbit/s** are reported.

2.2.2 Broadband technologies

CDMA

CDMA technology utilised a channel bandwidth of 1.25 MHz. Today, it can be considered obsolete. The ETSI standard is no longer being developed, and existing networks are gradually migrating to technologies from the IMT family.

[4]https://tcca.info/tetra/home/

[5]https://www.dmrassociation.org/dmr-standards.html

LTE

LTE technology was standardised at the 3GPP and ETSI levels in the 400 MHz band for both the 410 MHz and 450 MHz bands. Networks based on LTE technology are also referred to as 4G networks. They belong to the IMT family of technologies[6] .

Broadband LTE systems for PMR/PAMR are flexible in their application. They can provide voice and data services, low-latency applications, a high level of security, prioritisation and quality of service (QoS), or transmission speeds in the order of megabits per second. They are also suitable for massive M2M and IoT communication, with the capacity to connect hundreds of thousands to millions of devices. The 4G standard also includes a range of functionalities for mission-critical communication.

LTE systems in the 400 MHz band can be used with bandwidths of 1.4 MHz, 3 MHz and 5 MHz.

Maximum data rates [7] :

1.4 MHz	9 Mbit/s
3 MHz	22 Mbit/s
5 MHz	37 Mbit/s

The difference in the capacities of individual carrier frequencies is also illustrated by the following table from the UK regulator Ofcom[8] :

Table A7.4: Number of video streams that could be supported by a base station sector

Capacity scenario for concurrent video streams	Lower service data rate requirement assumptions for each bandwidth scenario			Higher service data rate requirement assumptions for each bandwidth scenario		
	1.4 MHz	3 MHz	5 MHz	1.4 MHz	3 MHz	5 MHz
Uplink capacity (*Mbps*)	**4.7**	**10.1**	**16.8**	**4.7**	**10.1**	**16.8**
High capacity areas *No. concurrent video streams*	11	25	42	4	10	16
Central case results *No. concurrent video streams*	1	3	5	0	1	2

[6] IMT – International Mobile Telecommunications – is a set of requirements (standard) developed by the ITU, comprising the IMT-2000, IMT-Advanced (4G) and IMT-2020 (5G) systems.

[7] 64QAM, 2x2 MIMO

[8] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/263558-call-for-input-potential-spectrum-bands-to-support-utilities-sector-transformation/associated-documents/utilities-cfi-june-2023.pdf?v=329843

For the ‘Lower service’ scenario, Ofcom assumed a data rate of 400 kbit/s; for the ‘Higher service’ scenario, a data rate of 1 Mbit/s.

The “Central case results” row then illustrates a scenario with a device at the cell edge (i.e. with very poor radio conditions), for which Ofcom uses a very conservative assumption of spectral efficiency of 0.4 bps/Hz.

The LTE standard also includes technologies specifically aimed at M2M and IoT communication.

NB-IoT (Narrowband IoT)

NB-IoT is a technology for low-power broadband networks standardised by 3GPP in Release 13. It was designed specifically for IoT applications. It operates within the existing LTE spectrum.

NB-IoT uses a **200 kHz** channel bandwidth**,** with data rates **of up to 250 kbit/s.** The technology focuses on low power consumption, enabling IoT devices to operate for long periods (up to 10 years) on a single battery.

LTE-M (Long Term Evolution for Machines)

LTE-M is a technology developed within the 3GPP specifically for M2M/IoT applications that require greater bandwidth and mobility than NB-IoT. It utilises a **1.4 MHz** channel bandwidth**,** supports higher data rates (up to **1 Mbps**), mobility and handover between cells.

5G

At the 3GPP level, the 5G bands n31 and n72 were standardised as part of Release 18. A standard was also adopted for a 3 MHz-wide 5G NR[9]channel[10](previously, the 5G NR standard had assumed a minimum channel width of 5 MHz).

This will enable the future deployment of 5G technologies even in situations where the full 2x5 MHz section is not available in the 400 MHz band. The existence of the 5G standard also gives operators and users of LTE networks the assurance of their long-term viability and the possibility of upgrading from 4G to 5G in the future.

2.3 What is the 400 MHz band used for?

2.3.1 PMR/PAMR networks

The 400 MHz band is absolutely essential for the operation of PMR (Private Mobile Radio) and PAMR (Public Access Mobile Radio).

[9] 5th Generation New Radio

[10] https://www.ericsson.com/en/blog/2024/2/narrowband-spectrum-for-mission-critical-networks

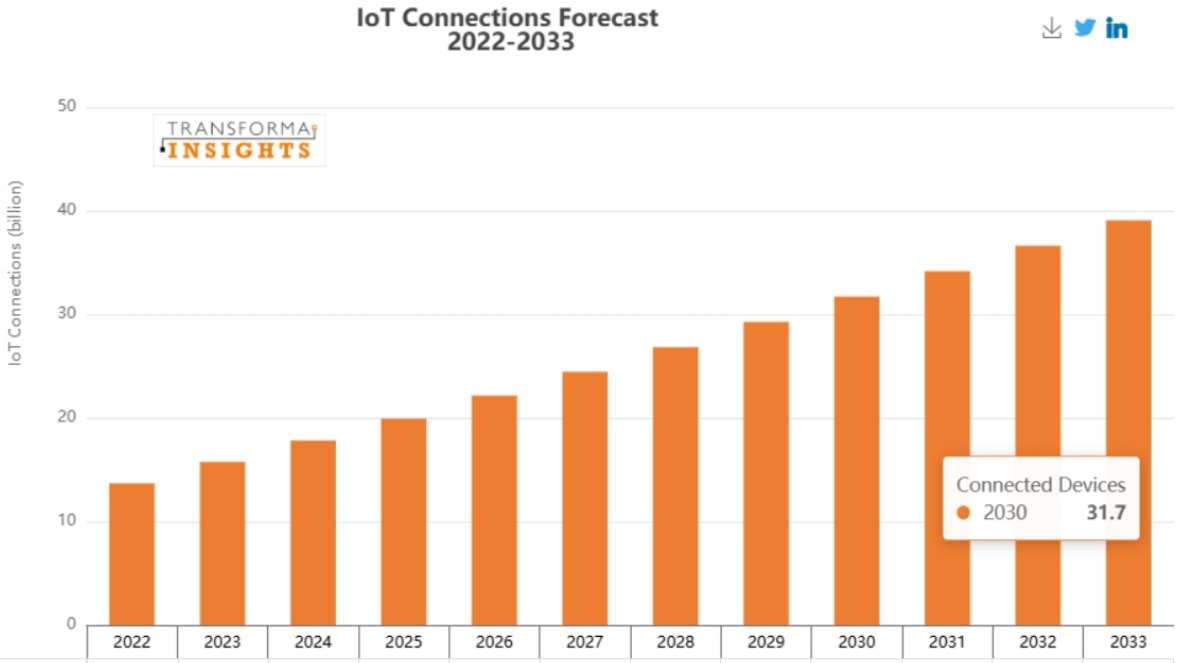
PMR networks are private networks used for professional, mission-critical and business-critical communications, as well as group communications; they are typically tailored to the user's specific needs. PMR networks may be owned and operated by the users themselves. The purpose of a PMR network is to facilitate communication and support the activities of the network operator/user.

PAMR networks – publicly accessible mobile radio – are a type of service offered by an operator to groups of business users via an extensive network. These networks are operated for the purpose of providing professional or mission-critical communication services comparable to PMR networks. PAMR operators provide such services on a commercial basis for professional use. These networks can benefit from economies of scale.

The PMR/PAMR market is characterised by services with channel bandwidths of 6.25/12.5/25 kHz (critical voice applications), and the associated technologies are still in demand and widely used.

A second trend in PMR/PAMR usage involves systems with channel widths of 200 kHz, 1.4 MHz, 3 MHz and 5 MHz. Millions of devices are expected to be deployed. This trend is linked to the introduction of information and communication technologies (ICT) into many sectors that require data-oriented PMR/PAMR services. However, given the economics of operation and the technological complexity involved, mobile operators' networks are primarily used for these services.

The number of IoT devices is growing rapidly. According to a forecast by Transforma Insights, the global number of IoT devices will rise to more than 39 billion by 2033[11] .

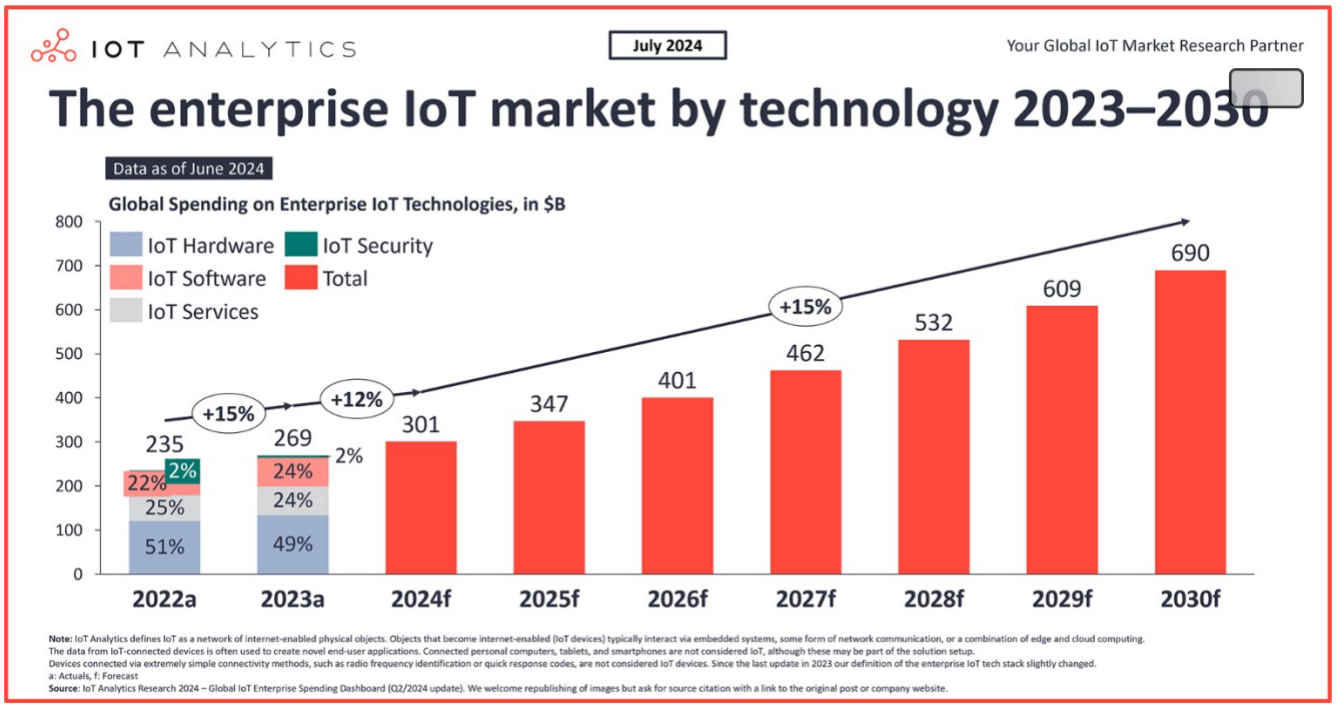


	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
IoT Connections	13.7	15.7	17.8	19.9	22.2	24.4	26.8	29.3	31.7	34.2	36.6	39.1

Source: Transforma Insights

[11] https://transformainsights.com/research/forecast/highlights

IoT Analytics, meanwhile, forecasts 15% year-on-year growth in the enterprise IoT market by 2030[12] .



Source: IoT Analytics

2.3.2 Mission-critical communications

PMR and **PAMR** systems are required for users who demand high availability and resilience of systems for operational and other critical communications. Depending on the criticality of the communication, the categories of mission-critical and business-critical communications are often used, which can be defined as follows:

- **Mission-critical**: One or more communication systems whose failure would have a very serious impact on the overall operation or efficiency of the organisation.
- **Business-critical**: Communications that are frequently required and that support operations or other value-added activities which have a significant positive impact on the entire organisation.

Requirements for mission-critical PMR/PAMR networks[13] :

- Very high coverage availability within a defined service area, in some cases even in remote and uninhabited areas;

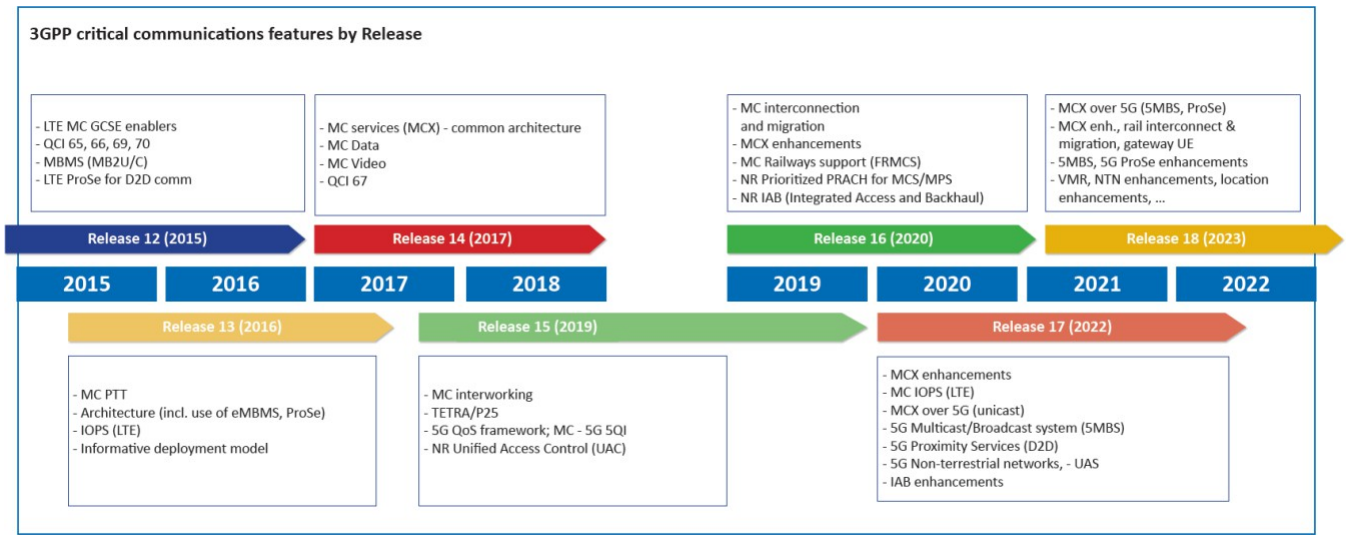
[12]https://iot-analytics.com/iot-market-size/

[13] ECC Report 292

- It is often designed to meet precise technical requirements, rather than for economic gain;
- Resilient M2M (RM2M) capability;
- Immediate and guaranteed access to the channel;
- Up to 99.999% (e.g. transmission line protection and SCADA) connection availability and connection redundancy. In the event of a primary route failure, it is essential that the redundant route functions immediately and correctly;
- The system and transmitted data have a high level of security and network integrity, including: no connection to external and/or public communication systems, such as public mobile networks and the public internet;
- The network is secured to ensure reliable operation in harsh environmental conditions, including electromagnetic interference;
- Up to 96 hours of backup power;
- The possibility of very low latency between end stations, e.g. 10 ms for extremely high-voltage protection circuits;
- High requirements regarding latency variation and synchronisation;
- Long service life and support, e.g. 10 to 20 years.

Mission-critical and business-critical applications in PMR/PAMR systems typically require higher availability and reliability than standard PMR/PAMR communications.

Mission-critical PMR/PAMR networks typically feature functionalities not available in public mobile networks (PTT, group communication, communication prioritisation, etc.). Based on the requirements of users of mission-critical communications (particularly the TCCA organisation), mission-critical functionalities are being developed and standardised within 3GPP, enabling the use of IMT networks in a manner analogous to traditional narrowband PMR systems.



Source: TCCA

2.3.3 Sectors using PMR/PAMR in the 400 MHz band

PMR/PAMR networks are used by a wide range of users. Typical users include:

- **The industrial sector**
- **Transport sector** (including airports and railways)
- **Government sector** (security services, embassies)
- **Emergency services** (ambulances, emergency response)
- **Energy and utilities** (voice communication between staff, remote metering and control)
- **Financial sector** (voice communication for security personnel during cash transport)
- **Agriculture and forestry** (narrowband dGPS signal)
- **Retail sector** (voice communication for security staff in shopping centres)

The digitalisation of the economy is increasing the need for M2M and IoT communication, with this trend affecting different sectors at varying speeds. In Europe and globally, the utilities sector and, in particular, the energy sector are at the forefront of interest in the deployment of broadband PMR/PAMR. These sectors require a high-capacity and scalable wireless network for their communication needs, such as the control and monitoring of smart grids. Less critical services (such as Smart Metering) typically utilise unlicensed WiFi, whilst more demanding services rely on mobile operators.

Requirements of the energy sector

There is high demand for M2M applications in the energy sector, particularly due to:

- The restructuring of the energy sector from centralised power stations to decentralised solutions
- Integration of renewable energy sources into distribution networks
- Obligations regarding smart grids and metering

Basic requirements for communication systems:

- Very high reliability and low latency
- Connection to a large number of devices

In addition to voice communication, which is important, data requirements imposed by various applications—both existing and future—are also crucial for utility communication systems, and these differ significantly from the typical model of public mobile networks:

- Typical transmission speeds are much lower than those for consumer internet, ranging from 2.4 kbps to 10 Mbps
- Increased resilience, enabling telecommunications networks to operate for longer periods even without power from the mains

- Geographical coverage that includes less densely populated areas, where utility infrastructure is typically located
- Stringent requirements for availability, latency, jitter and synchronisation
- High (above-standard) level of security
- A long-term solution and product profile that aligns with the longer investment cycles required by companies (and regulators) in this sector

Typical communication needs of energy companies:

Teleprotection Systems – used to isolate parts of the network upon fault detection to prevent the fault from spreading to other consumers connected to the interconnected system.

SCADA Systems (Supervision Control and Data Acquisition) – used to monitor and collect data for the visualisation and control of a given process. They provide a high level of information for the system operator, delivering real-time updates on all important events in the intelligent electronic devices (IEDs) deployed across the network.

Remote Smart Metering – is implemented at consumption points, substations and the edges of the electricity network. Smart meters provide electrical measurements (energy consumption, voltage, power, etc.) at regular intervals for monitoring consumption, the quality of the electricity supply and demand management.

Distribution automation – remote control of power grid equipment using built-in monitoring and control functions. It is used for automatic grid reconfiguration without operator intervention, and for reporting automated actions to the control centre.

Dynamic asset management – continuous monitoring of the status and load of equipment to optimise capacity and eliminate the need for grid reinforcement. Real-time measurement can actively prevent faults and interruptions to customer supply.

Mobile voice communication – communication between the control centre and field staff. It is used for routine activities as well as for safety and system restoration during emergencies.

Video monitoring – used to secure remote sites and monitor equipment. It is used in substations, control centres and other strategic locations. It ensures system security and operational protection of network assets. Video recordings can be stored locally and can be automatically transmitted to the control centre in the event of technical incidents at substations or when vandalism is detected.

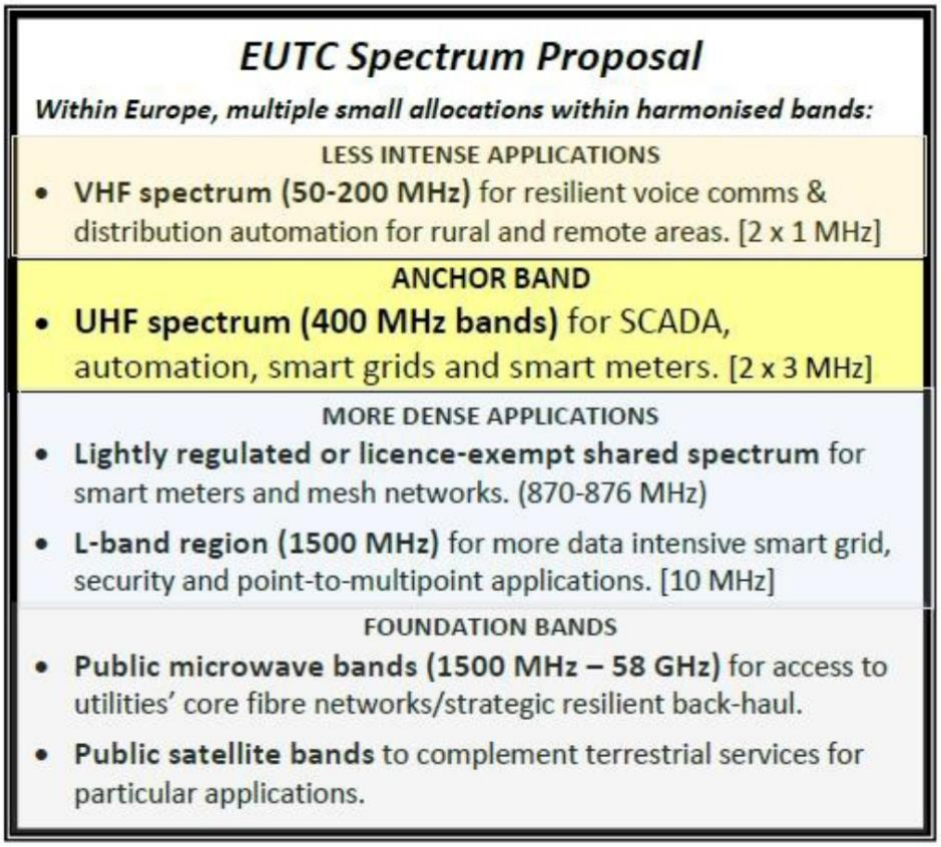
The requirements for frequency resources for the utilities sector (energy) have been defined by the European Utility Telecom Council (EUTC)[14] .

The EUTC proposes the allocation of a frequency band of at least 2x3 MHz in the 400 MHz band for utilities[15] . The 400 MHz band is particularly suitable due to the optimal geographical coverage achieved in this

[14] https://eutc.org/

[15] https://eutc.org/media/2021/07/EUTC-Spectrum-Position-Paper.pdf

band and support from standardised technologies. The EUTC designates the 400 MHz band as the so-called ‘anchor band’ and also proposes the allocation of further supplementary bands for utilities.



Source: EUTC[16]

2.3.4 Advantages and disadvantages of the 400 MHz band

As the EUTC also notes, the main advantages of the 400 MHz band for the utilities sector and other users of mission-critical communications are the availability of standardised technologies and the signal propagation characteristics in this band (extensive signal coverage).

Lower frequencies result in greater coverage and thus a reduction in the number of BTSs. This offers a significant advantage for mission-critical networks, which have higher requirements for resilience and reliability (backup power, redundant backbone connections, etc.), whilst on the other hand they anticipate a limited number of users/subscribers. The use of a lower frequency therefore leads to a reduction in the costs required to build and operate the network.

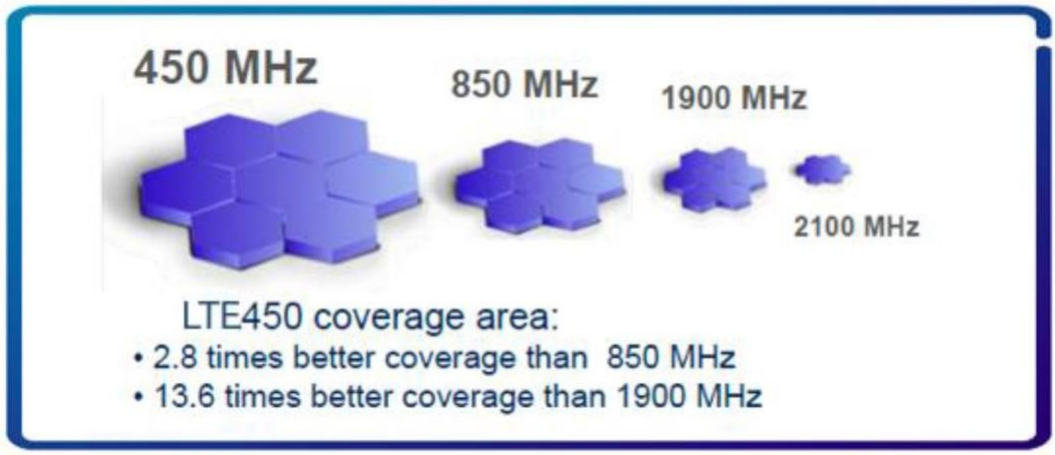
However, reducing the number of BTSs automatically leads to significantly greater variations in coverage quality (shading in rugged terrain). ‘Dead spots’ appear in the coverage, where the service is either completely unavailable or only very

[16] https://eutc.org/media/2021/07/2021-03-EUTC-Response-to-Draft-RSPG-Opinion-on-a-Additional-Spectrum-Needs.pdf

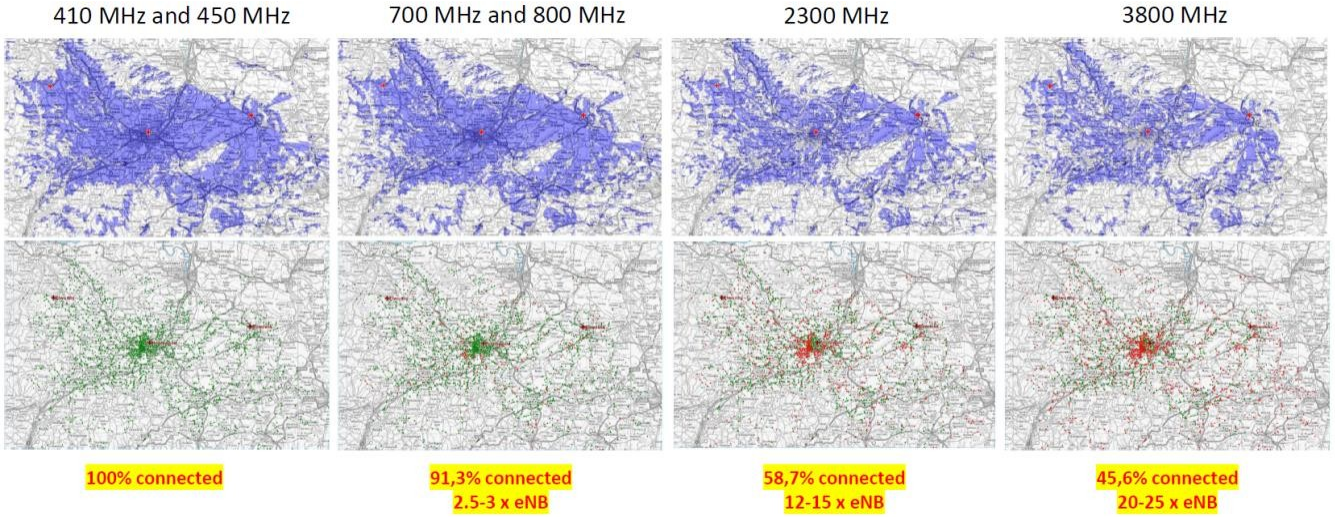
poor. The necessary installation of repeaters and the use of alternative solutions increases the cost of the network, and the resulting cost-saving effect may be precisely the opposite.

Another significant shortcoming is the inability to provide 400 MHz services across the entire country, as, according to the Czech Telecommunications Office (ČTÚ), international frequency agreements prevent the signal from covering areas near the state border and prohibit the operation of terminals in the vicinity of the border.

Better signal coverage and propagation is also advantageous because staff of critical infrastructure operators or security services often operate in remote areas. In the case of M2M applications, better signal penetration inside buildings is an advantage. Some devices (typically smart meters) are often located, for example, in basement areas, where a signal at higher frequencies would not reach. However, the placement of radio terminals in underground areas is generally considered poor technical practice and is undesirable. Modern meters (e.g. PV power meters) are always installed with access from a public road (e.g. on a post by the roadside). For mission-critical networks, placement below ground level or even low above ground is risky, as evidenced, for example, by the impact of the recent floods that affected the Czech Republic.



Differences in coverage across different frequency bands. *Source: 450 Alliance*



Comparison of coverage and number of base stations. *Source: Western Power Distribution UK (NGED)*

2.4 Availability of equipment

As regards narrowband systems, the PMR/PAMR sector is competitive**, with more than 20 global suppliers** primarily providing standardised yet customised solutions to meet the diverse requirements of PMR users.[17]

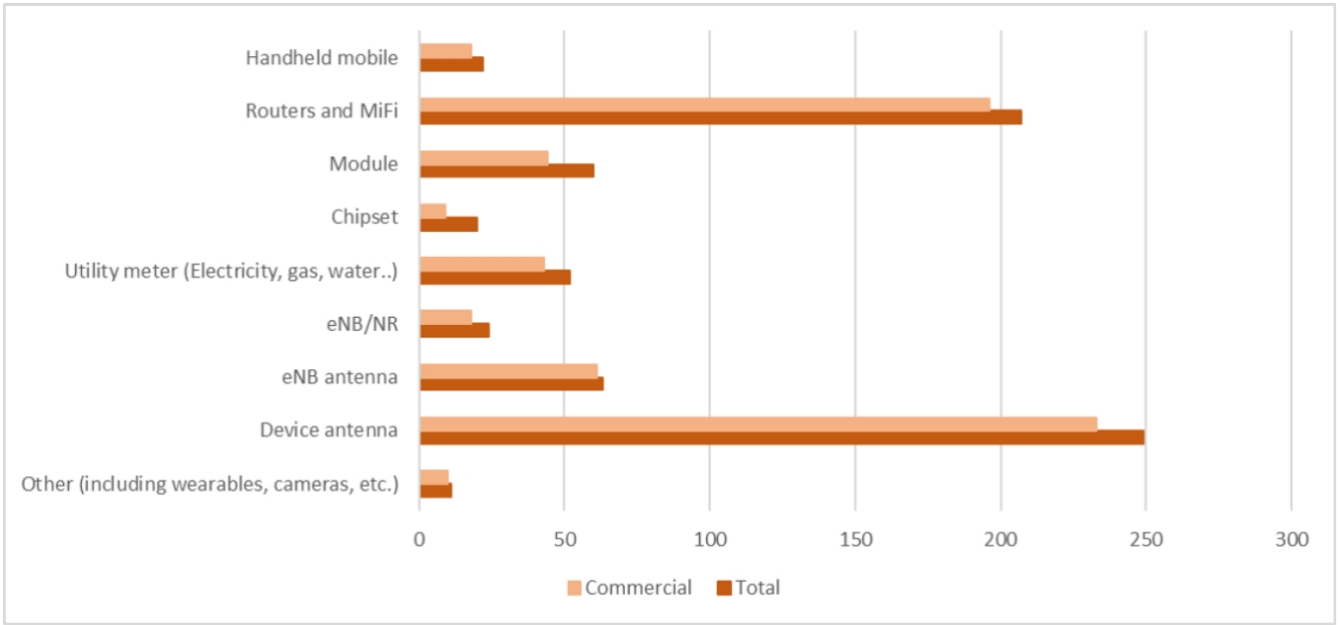
As regards equipment for LTE networks in the 400 MHz band, following 3GPP standardisation and the gradual roll-out of LTE networks over the last decade, the ecosystem of manufacturers and devices is gradually developing. However, compared to the 700 MHz band and higher, which are commonly used by public mobile networks, the availability of devices is limited (450 MHz band) or very limited (410 MHz band).

According to data from the 450 Alliance(18), the most active suppliers in the end-device segment are Advantech, Andra, Baeris, Cavli Wireless, Cisco, Cybertel, Cyrus, Digi, Etic Telecom, Garderos, GE, Hitachi Energy, Huawei, INSYS, Intelliport, Meazon, Nokia, Quectel, Robustel, RugGear, Sierra Wireless, SIMCOM, Telit, Unitac, Westermo, WMsystems and ZTE.

In the field of chipsets, major global players Qualcomm and GCT are active. In September, Qualcomm announced the first device supporting the 5G standard in the 450 MHz band.

In the field of network elements, Airbus, Anktion, Airspan, Ericsson, Huawei, Nokia and ZTE (maco eNBs), Anktion and Ubiik (small cells) and Ericsson, Huawei, Nokia, ZTE and Druid Software (core) are active.

The number of devices available for the LTE band in the 400 MHz band is shown in the table below. According to data from the 450 Alliance, all devices support the 450 MHz band and approximately 25% support both the 410 and 450 MHz bands.



Available LTE devices in the 400 MHz band. *Source: 450 Alliance*

[17] ECC Report 292

[18] https://450alliance.org/wp-content/uploads/2024/08/450Alliance-annual-equipment-update-2024-P-rev.pdf

3 Overview of the use of the 400 MHz band

In cooperation with the Czech Telecommunications Office (ČTÚ), we requested information from European regulatory authorities regarding the use of the 400 MHz band in European countries. We received responses of varying levels of detail from 17 countries. We summarise the information obtained, along with further information from open sources, in this chapter, focusing on the situation in Europe and also on certain other countries where relevant developments have taken place in relation to the focus of this study.

In general, it can be said that the 410 and 450 MHz bands – where not allocated for use by broadband systems – are typically used in Europe by narrowband systems with channel bandwidths of 6.25 kHz, 12.5 kHz and 25 kHz. The same applies to parts of the band that are not reserved for broadband systems in countries where such reservation has taken place. A portion of the band has been reserved for broadband systems in most of the countries examined.

3.1 Overview of spectrum usage in selected European countries

Germany

410–430 MHz band: According to the frequency plan, the 410–430 MHz band is primarily designated for private mobile radio (PMR) and private trunked mobile radio (PTMR) services. PTMR is a mobile radio service in a cellular system for voice or data communication.

The following spectrum segments within this band are also designated for:

- 410–411 MHz and 420–421 MHz: also designated for single-channel fixed links;
- 419–420 MHz and 429–430 MHz: partly designated for public rail transport and other users;
- 410–420 MHz: used for military radar applications;
- 419.99375 MHz and 420.0000 MHz: for direct mode operation (DMO) in PMR/PTMR networks.

The spectrum for PTMR is allocated on the basis of applications for specific locations and with specific radio parameters. An individual licence is required for each station. Individual licences are granted for each PTMR frequency to ensure efficient use of the spectrum and to minimise radio interference. Licence applicants must demonstrate the necessary expertise, financial resources and reliability.

PTMR applications in the 410–430 MHz band are used for corporate communications and for managing operational processes, with an emphasis on high availability and security. Users are primarily from the energy, chemical and industrial sectors (as well as airports, ports, transport companies, etc.).

BNetzA anticipates the continued use of the band for narrowband PMR/PTMR systems.

450–470 MHz band: According to the frequency plan, the 450–455.74 MHz and 460–465.74 MHz bands are designated for broadband networks ('MFCN 450 MHz').

In 2021, the spectrum in the 451–455.74 MHz / 461–465.75 MHz bands was allocated to 450connect GmbH. The allocation is valid until 31 December 2040 and is primarily intended for critical infrastructure applications. The aim of MFCN 450 MHz is to establish resilient communications for critical infrastructure. BNetzA has thus responded to the energy transition, which is accompanied by a process of increasing decentralisation and digitalisation of electricity distribution. It is also anticipated that the spectrum will be used in the gas, water and public transport sectors, which also rely on resilient voice and data communications.

Furthermore, the sub-bands 450–451 MHz and 460–461 MHz and the spectrum above MFCN 450 MHz are primarily intended for local PMR applications, and three frequencies (465.96–465.98 MHz, 466.0625–466.0875 MHz and 466.22–466.24 MHz) are allocated at national level for paging services (POGSAG technology for one-way communication from base stations to receivers, using 20 kHz and 25 kHz channel bandwidths). The spectrum is also used for railway applications, maritime mobile services and PMR alarms.

Austria

410–430 MHz band: The band is used for fixed and mobile services. Fixed links use a channel bandwidth of 12.5 kHz or 25 kHz. No new allocations are permitted for fixed links; only the extension of existing networks is allowed. The mobile service uses narrowband systems with a channel bandwidth of 6.25 kHz (only in the 414–416 / 424–426 MHz sub-band), 12.5 kHz and 25 kHz.

450–470 MHz band: The 451.3–455.74 / 461.3–455.74 MHz band segment (2×4.44 MHz) is designated for use by broadband networks. The band was originally allocated in 2006 to T-Mobile (2×1.6 MHz) and Green Networks (2×2.84 MHz).

Currently, ArgoNET GmbH holds the licence for the entire section; the company operates regional LTE networks serving customers in the energy sector (e.g. Energie Steiermark), utilities, industry and local authorities.

In adjacent bands, the use of narrowband fixed links and mobile systems is permitted. However, no new allocations are possible in the 450–457.5 / 460–467.5 MHz band, and existing licences may be extended until the end of 2026 at the latest.

Poland

410–430 MHz band: The 410.0–412.0 / 420.0–422.0 MHz (2×2 MHz) sub-band is reserved for state purposes. In the sub-bands 412.0–412.5 / 422.0–422.5 MHz (2×0.5 MHz), a guard band is established to protect radio communication systems operating in the 410.0–412.0 / 420.0–422.0 MHz bands.

The 412.5–415.0 / 422.5–425.0 MHz band (2×2.5 MHz) is reserved for broadband digital systems with channel widths of 200 kHz, 1.25 MHz or 1.4 MHz. The licence holder – Polkomtel – is required to provide coverage to at least 95% of Poland's territory and to offer voice services, including dispatch services, closed user groups, dynamic group formation, call prioritisation, data transmission, etc. The licence is valid until the end of 2035.

The 415.0–420.0 / 425.0–430.0 MHz band (2×5 MHz) is reserved for narrowband radio systems with channel bandwidths of 12.5 kHz and 25 kHz. Systems using 12.5 kHz channels may only be used in the 416.2–420 / 426.2–430 MHz band.

Of the narrowband systems, analogue systems, TETRA and DMF (Tier II) are predominantly used. TETRA standard networks are intended for the energy sector. Narrowband systems are also used by private businesses, local authorities and public transport.

Polkomtel uses both CDMA and LTE technology. CDMA systems are used for mobile dispatching and telemetry. 4G (LTE) technology is predominantly used for wireless internet access in rural (remote) areas with poorer mobile network coverage.

450–470 MHz band: The 450.0–452.5 / 460.0–462.5 MHz sub-band (2×2.5 MHz) is reserved for government use.

The **452.5–457.5 / 462.5–467.5 MHz band (2×5 MHz) is reserved for broadband digital systems with channel bandwidths of 200 kHz, 1.25 MHz, 1.4 MHz, 3 MHz or 5 MHz.** The licence holder is obliged to use the frequencies exclusively for the provision of voice and data communication services for the management of networks for the transmission or distribution of gaseous or liquid fuel or electricity.

The licence has been held by PGE Systemy (an ICT subsidiary of the Polska Grupa Energetyczna group) since 2018. PGE Systemy announced that it would build a private LTE-450 network for the energy industry. In December 2023, PGE Systemy signed a contract with Nokia for the supply of network components.[19]

The 457.5–460.0 / 467.5–470.0 MHz band (2×2.5 MHz) is reserved for narrowband radio systems with 12.5 kHz channel spacing. Analogue and DMR systems predominate.

Of the narrowband systems, analogue systems and DMF (Tier II) are predominantly used, and they are utilised in the same way as in the 410–430 MHz band. PGE Systemy's LTE network will be intended solely for the energy sector.

Given the intensive use of both bands, the Polish regulator does not plan to make any changes to the allocation of frequency bands. The Polish regulator has also expressed an interest in signing a new agreement concerning the use of terrestrial electronic communications systems in the 450 MHz frequency band in border areas.

Slovakia

410–430 MHz band: The band is designated for the civil mobile service (excluding the aeronautical mobile service). Narrowband systems with bandwidths of 12.5 kHz and 25 kHz are permitted. Channels may be combined. The band is predominantly used for PMR networks operating under the TETRA standard.

450–470 MHz band: This band is designated for the civil mobile service – PMR.

[19] https://www.nokia.com/customer-success/pge-choses-nokia-to-deploy-a-country-wide-critical-backhaul-network-by-utilizing-ipmpls-technology-for-power-grid-companies/

The 451–456 / 461–466 MHz band (2×5 MHz) is designated in the frequency plan for broadband systems with channel bandwidths of 1.4 MHz, 3 MHz and 5 MHz. The Slovak regulator plans to allocate the band to an LTE network in the future. Users of narrowband systems are currently being migrated from this band.

The remaining bands are designated for narrowband systems with a channel bandwidth of 12.5 kHz. In the 455.75–457.37 / 465.75–467.37 MHz band, systems with a channel bandwidth of 20 kHz are permitted. In the 457.39–458.47 / 467.39–468.47 MHz band, systems with a channel bandwidth of 25 kHz are permitted.

Belgium

Both bands are used for narrowband PMR networks—

410–430 MHz band: channel bandwidth 6.25 kHz, 12.5 kHz, 25 kHz. Tetra, DMR and NXDN technologies predominate. The band is mainly used for large networks (operators, large enterprises, public transport).

450–470 MHz band: 6.25 kHz, 12.5 kHz. DMR, NXDN and analogue systems predominate. It is mainly used for smaller private networks, public transport and short-term applications (sporting and cultural events, construction – tower cranes, etc.).

Bulgaria

Most of the spectrum in both the 410–430 MHz and 450–470 MHz bands is allocated to narrowband PMR/PAMR networks with a channel bandwidth of 12.5 kHz or 25 kHz.

The 417.45–417.85 MHz / 427.45–427.85 MHz band is reserved for PMR/PAMR networks with channel bandwidths of 50 kHz, 100 kHz, 150 kHz and 200 kHz

The 411–414 MHz / 421–424 MHz and 452.7–457.4 MHz / 462.7–467.4 MHz bands are designated for wideband PMR/PAMR networks and CDMA technology

The main users are commercial organisations, transport, security and emergency services, etc.

Denmark

The 453–457.5 / 463–467.5 MHz band is designated for a broadband network. The licence is held by Cibicom Mobility, which provides LTE services under this licence.

Croatia

PMR applications with bandwidths of 12.5 kHz and 25 kHz are used in both parts of the band. Analogue

systems, TETRA and DMR predominate. The main users are the utilities and transport sectors.

The 450 MHz band is heavily utilised. Nevertheless, the regulator plans to refarm the band and release a section for broadband systems.

Finland

410–430 MHz band: The band is used by narrowband PMR networks and fixed links. Channel bandwidths range from 6.25 kHz to 200 kHz. The detailed allocation of individual segments is evident from the frequency plan

450–470 MHz band: The **452.425–456.925 / 462.425–466.925 MHz** sub-band **is reserved for broadband networks.** In mainland Finland, the licence is held by Digiset – a subsidiary of the operator Elisa. In the Åland Islands, the licence is held by Ålands Telekommunikation. Finland is evaluating the possibility of extending the sub-band to 2x5 MHz; currently, a 1.4 MHz + 3 MHz carrier is in use. For other sub-bands, the situation in the 410 MHz band applies analogously.

The use of digital PMR systems – DMR, dPMR, TETRA – predominates. The main users are commercial entities.

Italy

410–430 MHz band: administered by the Ministry of Defence and designated for PPDR.

450–470 MHz band: is intended for civil use**.** It is used by narrowband PMR networks with a channel bandwidth of 6.25–150 kHz.

Ireland

410–430 MHz band: The 410–414 / 420–424 MHz sub-bands are designated for broadband systems. The licence has been held since 2019 by the Irish electricity distribution network operator ESB Networks. The LTE network currently under construction will serve the needs of the smart grid. The remainder of the band is used by narrowband analogue systems.

450–470 MHz band**:** The band is used by narrowband systems with channel bandwidths of 12.5 kHz and 25 kHz.

Among narrowband technologies, analogue systems, TETRA and DMR predominate.

The Irish regulator is considering[21] [the]possibility of releasing the 414–417 / 424–427 MHz segment for BB-PPDR

It is worth noting that in Ireland, as in the UK, ‘reverse channelisation’ is used in the 450-470 MHz band compared to continental Europe, i.e. the 450-460 MHz segment is used for the downlink and the 460-470 MHz segment for the uplink. Consequently, the deployment of IMT systems in this band is problematic, and the 410 MHz band is the preferred choice for Ireland in terms of broadband system deployment.

[20] https://www.traficom.fi/sites/default/files/media/file/Radio_Frequency_Regulation_4AE2024M.pdf

[21] https://www.comreg.ie/media/2020/10/ComReg-2098.pdf

Hungary

410–430 MHz band: The 410–417 / 420–427 MHz sub-band is reserved for non-civilian use. **The 410–415 / 420–425 MHz sub-band (Band 87) is reserved for BB-PPDR.**

450–470 MHz band: The 451–457.38 / 461–467.38 MHz sub-band is designated for broadband systems. There is a nationwide LTE network (5 MHz) in Hungary. It was primarily designed to support government objectives (e.g. eGovernment, public services). The licence expired on 30 April 2024. The previous licence holder, MVM Net, withdrew its application for licence renewal for commercial reasons.

According to a government decision from January 2024, the LTE450 network will be used primarily for military purposes from 1 May 2024, whilst temporarily serving certain government purposes.

Other sections of the 410 and 450 MHz bands are used by a large number of narrowband local and regional PMR/PAMR networks. Use by public services, industry, public transport, etc. predominates. The Hungarian regulator expects continued high demand for narrowband systems.

Malta

410–430 MHz band: This is primarily intended for PMR systems with channel bandwidths of 12.5 kHz and 25 kHz.

450–470 MHz band: Primarily intended for PMR systems with a channel bandwidth of 12.5 kHz. The **452.5–457.5 / 462.5–467.5 MHz** sub-band **is reserved for BB-PPDR.**

Among narrowband systems, analogue systems and DMR predominate. The main users are businesses and security and emergency services.

Market interest in traditional PMR applications is declining, which can be attributed to users utilising services provided by MFCN (Mobile/Fixed Communications Networks) operators, who offer nationwide 4G and 5G network coverage. The Maltese regulator has not recorded any interest in the use of radio spectrum for private 4G/5G networks. Should there be interest, it is prepared to support the transition to 4G/5G.

Netherlands

The 451.76875–453.26875 / 461.76875–463.26875 MHz band (2x3 MHz) is designated for a broadband network for utility purposes. The licence is held by Utility Connect until 2050. Until then, it will use CDMA and LTE in parallel; from 2035, the entire band is scheduled to be converted to an LTE network.

Norway

Both bands are used by narrowband systems with a channel bandwidth of up to 25 kHz. The predominant use is for PMR and PPDR networks.

The **452.5–457.5 / 462.5–467.5 MHz band is reserved for a broadband network.** The licence holder is the operator ICE Communication Norge, which operates a public LTE communications network on the allocated frequencies. The licence is valid until the end of 2039.

The Norwegian regulator is not currently considering any changes to the allocation of frequency bands.

Portugal

410–430 MHz band: Part of this band is reserved for military purposes, whilst another part is used by fixed links and PMR networks with channel bandwidths of 12.5 and 25 kHz. Analogue systems and TETRA predominate. The band is primarily used by emergency services and energy companies.

450–470 MHz band: Part of this band is reserved for military purposes, whilst the remainder is used by fixed links, PMR networks and SRD. PMR networks operate with a channel bandwidth of 12.5 kHz. Analogue DMR and dPMR systems predominate. Experimental CDMA operations took place in the 453–457 / 463–467 MHz bands, but have since been discontinued.

In line with the trend towards the roll-out of private 4G/5G networks in the 400 MHz band, the Portuguese regulator is considering options for the future use of this band. However, consultations with stakeholders have yet to take place.

Greece

In 2022, a licence for 2x2 MHz in the 413.75–415.75 / 423.75–425.75 MHz band was granted to the operator Cosmote (OTE Group). Cosmote plans to launch an LTE network focused on IoT for businesses.

Slovenia

In both bands, 2x5 MHz of spectrum has been reserved for broadband networks (Band 87 and Band 72). Allocation of the band to users is expected in 2025–2026. Slovenia plans to use Band 87 for "business-critical" communications (i.e. utilities) and Band 72 for "mission-critical" communications (i.e. BB-PPDR).

Narrowband systems are being migrated to the 417–420 / 427–430 MHz and 457.5–460 / 467.5–470 MHz bands.

Serbia

410–430 MHz band: A CDMA network for the provision of universal service is currently still in operation in the 411.875–418.125 / 421.875–428.125 MHz sub-bands.

450–470 MHz band: The band is used by PMR systems with a bandwidth of 25 kHz (analogue systems) and 12.5 kHz (digital systems). PMR systems are predominantly used by taxi services, security services, the energy and utilities sector, industry, rail transport, etc.

The sections of the band corresponding to LTE bands 87, 88, 72 and 31 are reserved in the frequency plan[22]for priority use by BB-PPDR. The specific form of the BB-PPDR network is likely yet to be decided.

[22] https://www.ratel.rs/uploads/documents/empire_plugin/Uredba%20o%20utvrdjivanju%20Plana%20namene%20radiofrekvencijskih%20opsega.pdf

Spain

410–430 MHz band: The band is designated for fixed links and PMR. The 410–415.3 / 420–425.3 MHz segment is designated for digital trunking systems (TETRA, etc.) with a channel bandwidth of 25 kHz.

The remainder of the band is designated for systems with a bandwidth of 12.5 kHz (exceptionally 25 kHz).

450–470 MHz band: The 452–457.5 / 462–467.5 MHz sub-band is reserved for BB-PPRD. The remainder of the band is intended for narrowband systems with a channel bandwidth of 12.5 kHz.

Sweden

The 452.5–457.5 / 462.5–467.5 MHz band is reserved for broadband services. The licence, valid until 2044, is held by the operator Net1 (Teracom Mobil), which offers LTE services under it.

Switzerland

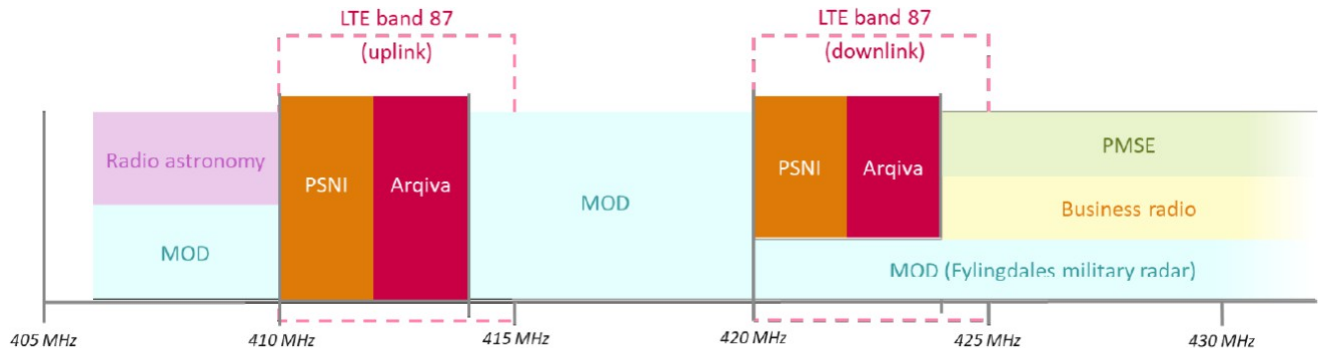
410–430 MHz band: The 410–418 / 420–428 MHz band is reserved for narrowband PMR systems with channel bandwidths of 12.5 kHz and 25 kHz. 2 x 2 MHz is reserved for non-civilian applications. Use is predominantly for PPDR, transport and military purposes.

450–470 MHz band: This is intended for digital and analogue local and regional PMR networks with a channel bandwidth of 12.5 kHz. It is predominantly used for PPDR, critical infrastructure operators, emergency services, transport, energy, public services, temporary use, etc.

The 400 MHz band is used extensively by many organisations in Switzerland. For this reason, the Swiss regulator is not considering any changes to the allocation of frequency bands.

United Kingdom

410–430 MHz band: The band is used by analogue and digital (TETRA, DMR) narrowband systems. Part of the band is reserved for the Ministry of Defence. Main uses: defence, civil PMR, PMSE.



Use of the 410 MHz band in the UK. *Source: Ofcom*

450–470 MHz band: Used by narrowband analogue and digital (TETRA, DMR) systems. Predominant uses: civil PMR, telemetry, SRD, emergency services, etc.

The situation in the 450 MHz band in the UK is specific due to 'reverse channelisation' (see Ireland), which makes releasing the band for a broadband network highly problematic. According to ECC Report 292, the 450 MHz band in the UK is the busiest in Europe.

In 2023, Ofcom conducted a public consultation entitled "Call for Input: Potential spectrum bands to support utilities sector transformation[23]", which also addressed the 410 and 450 MHz bands. According to Ofcom's statement, respondents favoured the 410 and 700 MHz bands in Northern Ireland and the 700 MHz band in Great Britain (where, however, the 410 MHz band was not the subject of the consultation).

Other countries

The 400 MHz band is also allocated for broadband networks in Romania (Band 31, BB-PPDR), Lithuania (Band 31), Latvia (Band 31), Estonia (Band 31) and Moldova (Band 72+31). Probably also in Russia.

3.2 Other regions

Globally, in the 410 and 450 MHz bands, according to data from the 450 Alliance from June 2024, there are 75 broadband networks, 26 of which use the LTE standard. Most networks are still operated using the CDMA standard, and Europe is leading the way in terms of technological neutralisation of licences and the transition from CDMA to LTE.

Region	CDMA+LTE	Of which LTE	Consultation	Unused
Africa	22	5	3	1
America	9	3	2	1
Asia and Oceania	18	3	6	4
Europe	26	15	4	9
Total	75	26	15	15

Source: 450 Alliance

However, developments are also taking place in regions outside Europe – a modest expansion of the LTE ecosystem in the 400 MHz band.

[23] https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/potential-spectrum-bands-to-support-utilities/

3.2.1 America

Brazil

In Brazil, LTE technology can be deployed in both the 450 MHz band (Band 31) and the 410 MHz band (Band 87).

Brazil was the first country to grant licences for LTE 450 networks to four operators in 2012 for the purpose of providing internet access in remote areas. Following these allocations, LTE Band 31 was standardised. However, the operators Vivo (Telefónica), Oi and TIM Brasil lost their licences in 2022 due to insufficient use of the frequencies. There is significant interest in this band from utilities, as well as in the 410 MHz band. For example, the energy company Neoenergia was granted a 15-year licence for private LTE 450[24]

In February 2024, the Brazilian frequency plan was amended to stipulate that the 410–415 / 420–425 MHz band (Band 87) is primarily intended for use by companies providing electricity, gas and water services (in effect, it has been reserved for utilities). In this band, a number of companies from this sector are conducting tests with the aim of obtaining dedicated licences.

Argentina

In Argentina, both Band 31 and Band 87 are designated for LTE. Historically, both bands were used for CDMA networks. The operator Alvis is the first to switch to LTE.

Other countries

- **USA:** Energy companies are seeking opportunities to acquire their own spectrum so as to be independent of third parties and have control over connectivity. Options in the 410 MHz and 380 MHz bands are being evaluated.
- **Mexico:** Telmex holds a licence for the 450 MHz band, which is currently operated on CDMA, and is considering a switch to LTE.Asia
- **Suriname:** A network for IoT services is deployed in the 450 MHz band.

3.2.2 Asia

Saudi Arabia

In June 2024, Aramco Digital was awarded a licence for 2x5 MHz (Band 72). This represents the biggest boost to the further development of the IMT ecosystem in the 400 MHz band this year. Aramco Digital is set to build a nationwide industrial network and also plans to deploy 5G technology. In response, the major chipset manufacturer Qualcomm has already announced the first processors supporting 5G in the 450 MHz band[25]

The Saudi regulator (CST) also intends to refarm the 410 MHz band in the future and allocate it in a similar manner to the 450 MHz band. CST hopes and expects that the launch of a broadband network in the 450 MHz band

[24]https://www.neoenergia.com/en/w/neoenergia-frequencia-mhz-brasil

[25]https://www.qualcomm.com/news/releases/2024/09/qualcomm-and-aramco-digital-announce-world-s-first-processors-wi

in many cases will lead to the gradual migration of users from their own systems in the 410 MHz band to the network in the 450 MHz band.

Other countries

- Bahrain has granted a licence for LTE Band 87 to EWA specifically for utility applications. A licence for Band 87 has also been granted by Cambodia.
- Licences in the 450 MHz band have been granted in China, Indonesia, Malaysia, Singapore, Armenia, the Philippines, Sri Lanka and others.

3.2.3 Africa

- **Botswana:** A licence has been granted for Band 87
- A number of countries are in the process of transitioning to LTE in the 450 MHz band (Angola, Nigeria, Namibia, etc.)
- South Africa plans to grant a licence for Band 31[26] .

[26] https://www.icasa.org.za/uploads/files/Notice-regarding-the-Final-Radio-Frequency-Assignment-Plan-for-the-IMT450.pdf

4 Case studies

4.1 Germany – 450 Connect

450connect is a company owned by more than 70 energy and water utilities. Major shareholders include Alliander, E.ON, 450
MHz Beteiligung GmbH (a consortium of regional energy companies) and Versorger-Allianz 450 (which includes many municipal utilities, energy suppliers, water management companies and EnBW's subsidiary Netze BW).

History

2013: Energy industry companies and associations expressed the need to utilise the 450 MHz band and, in collaboration with the then licence holder, tested technologies in this band.

2016: Alliander AG acquired the licence holder, renamed it 450connect and began collaborating with regional energy companies to build regional 450 MHz networks using the CDMA standard.

2020: The 450connect joint venture was established with equal shares held by Alliander, E.ON, regional energy companies and Versorger-Allianz 450.

2021: In July 2021, it obtained a nationwide licence for 2x4.74 MHz, valid until 2040.

2025: Planned completion of the nationwide LTE-450 network.

450connect shareholders

Alliander: Provider of digital solutions for mission-critical communications. It provides services in the areas of planning, installation and management of infrastructure in the energy sector, transport, for local authorities, etc.

E.ON: An international energy company.

450 MHz Beteiligung GmbH: A consortium of regional energy companies which, in collaboration with 450connect, has been building and operating regional 450 MHz networks since 2016.

Versorger-Allianz 450: Versorger-Allianz 450 Beteiligungs GmbH & Co. KG was founded in 2020 as the successor to the Versorger Allianz 450 association, which brought together more than 200 national companies in the energy, water and waste management sectors. It primarily represents the interests of local authorities.

LTE network in the 450 MHz band

The network is designed for operators of critical infrastructure, particularly in the energy and water sectors. Thanks to its physical propagation characteristics, the 450 MHz band enables cost-effective coverage of large areas using a relatively small number of base stations.

450connect lists the following advantages of LTE 450 technology:

- Excellent coverage of both areas and buildings
- High system availability thanks to backup power
- Application prioritisation
- Standardised mobile technology and long-term availability of the technology
- High level of security thanks to dedicated network infrastructure

The network uses a combination of 1.4 MHz and 3 MHz carrier frequencies. It is also possible to deploy a 5 MHz carrier with restrictions on certain resource blocks.

Network resilience is important for users, with a 72-hour backup required in the event of a blackout.

Use case

The network is intended for operators of transmission and distribution systems in the energy sector and users in other industries.

In the energy sector, it is used both for M2M communication (ranging from network monitoring and control, through the connection of generation and consumer equipment, to readings from smart metering systems) and for voice communication for maintenance teams, both during normal operations and in emergency situations, such as large-scale power outages.

With the growing number of generation facilities, such as photovoltaic power stations, and the growing number of consumer devices, such as charging infrastructure and heat pumps in the low-voltage grid, the monitoring and control of distribution stations is becoming increasingly important (e.g. remotely readable short-circuit indicators for rapid fault localisation and restoration of supply, or remote switching of circuit breakers and fuses).

As regards smart metering and the control of consumer devices, smart metering systems are mandatory in Germany for consumers with an annual consumption of 6,000–100,000 kWh. Similarly, controllable consumer devices and generation equipment (7–100 kW) must be equipped with smart metering systems and controlled via control boxes. Smart metering systems are often installed in basements or hard-to-reach locations – in this case, the 450 MHz band is advantageous due to better propagation inside buildings and overall coverage in the field. Furthermore, the 450connect system enables the prioritisation of critical switching commands, which facilitates the control

the growing number of production facilities and the reliable regulation of the output of appliances such as heat pumps and charging stations.

Voice services are designed for both routine and emergency communication. The advantage of a dedicated mission-critical network in emergency situations is the availability of voice communication even when public communication networks are unavailable. Field teams can communicate not only with each other, but also with the control centre, the network operator, other critical infrastructure operators or crisis management teams. The 450connect network supports:

- Telephony
- Communication within closed user groups, including between organisations
- Prioritisation of voice communication
- Push-To-Talk (PTT) group communication
- Chat with photo-sharing capability
- Dispatch functions
- Integration with branch PBX systems

In the field of water management, the network is used for both water supply control and water quality monitoring. This includes, for example, digitally controlled devices that enable real-time intervention in water management and the reading of meters.

For infrastructure such as water tanks, pumping stations and valves, or measuring devices and sensors, which are often located in remote areas, the excellent signal propagation in the 450 MHz band is again a major advantage.

4.2 Netherlands – Utility Connect

Utility Connect operates a CDMA network in the 450 MHz band for the energy sector. In April 2024, it was granted a licence for 2x3 MHz, valid until 2050.

In the part of the band where the CDMA network is operated, it is obliged to continue operating CDMA technology until 2035, after which a transition to LTE technology will be possible. In the second (newly allocated) part of the band, LTE technology with a 1.4 MHz carrier will be deployed.

Shareholders

The shareholders are the Alliander Group, which includes the distribution system operator Liander, and the distribution system operator Stedin. Liander and Stedin are also the main users of the network.

Network usage

The network is intended for network management and smart metering. Currently, more than 3 million smart meters are connected to the CDMA network. This is also the reason for continuing the operation of the CDMA network until 2035. The plan is to connect up to ten million smart meters.

Unlike Germany, which requires a 72-hour energy backup and independence from energy supplies, the Utility Connect network has an energy backup for only 8 hours (though this is still a higher figure than is common in public mobile networks).

The network is designed for smart metering, control and monitoring of the energy grid (Smart Grid) and, to a limited extent, for voice services.

The network is used by two of the three main distribution system operators (DSOs) – Liander and Stedin. The third major player – Enexis – has not yet expressed an interest in joining the project or using the network. The network is also used by the small DSO Westland Infra.

The network is not intended to be reserved solely for the needs of the energy sector. The Ministry of Infrastructure and Water Management has expressed interest in using it for applications in the North Sea, traffic management and the water supply sector.

It is also possible that the Dutch transmission system operator (TSO) TenneT will join the project.

4.3 Ireland – ESB Networks

ESB Networks Ltd (ESBN), a regulated subsidiary within the ESB Group, is a licensed electricity distribution network operator in the Republic of Ireland. ESBN is responsible for the construction, operation, maintenance and development of the electricity network and for serving all customers connected to the electricity network in Ireland.

ESBN was awarded a licence for 2x4 MHz in the 410 MHz band in 2019 for a period of 15 years.

The process leading to the allocation of the band

The allocation of the band was preceded by a consultation process led by the Irish regulator ComReg, launched in 2017[27] , in which ComReg examined possible uses of the 400 MHz band and methods for its allocation. To this end, ComReg commissioned an analysis from DotEcon and Plum Consulting with the aim of identifying potential uses, estimating the amount of spectrum required and assessing the technical requirements.

Plum Consulting analysed[28] four main categories of potential uses for the 400 MHz band:

- Private mobile radio (PMR).
- Public Protection and Disaster Relief (PPDR).
- Smart meters.
- Smart grids.

For each application, Plum assessed:

- Available technologies and their future potential.
- Minimum requirements for spectrum blocks.
- Availability of alternative frequency bands or solutions.

Plum Consulting identified the following technical requirements:

- Low to medium data rates, typically 9.6 kbit/s to approximately 64 kbit/s, with the potential to reach several Mbit/s where video is required for monitoring key elements.

[27] https://www.comreg.ie/industry/radio-spectrum/spectrum-awards/400mhz-band-spectrum/

[28] https://www.comreg.ie/media/dlm_uploads/2018/10/ComReg-1892b.pdf

- Networks are planned for deployment over a significantly long period (e.g. 10 to 20 years).
- Low jitter (latency variation) and synchronisation requirements.
- Increased resilience – for example, a requirement for battery backup power that significantly exceeds the capabilities provided by public mobile networks.
- Immediate and guaranteed access to the channel.
- Extensive geographical coverage (including less populated areas to ensure 100% utility network coverage).
- Strict latency requirements.
- High level of security.

ComReg examined two alternatives for meeting the Smart Grid requirements identified above:

- existing telemetry systems, or
- existing mobile networks.

ComReg assessed each of these alternatives and rejected both options for the following reasons:

The number of remote rural connections is predicted to increase ten- to twelve-fold, and existing telemetry systems are unlikely to have sufficient capacity to support such a significant increase.

Although certain aspects of the Smart Grid could be supported via a public mobile network, ComReg has identified strong reasons for building a dedicated network:

- Mobile networks may not be able to meet availability and reliability requirements – they may fail when the mains power supply fails, which is precisely when smart grids are most needed.
- Mobile networks may not have coverage in areas where smart grid elements are located, such as remote substations or wind farms, and operators may have little incentive to provide such coverage.
- Despite new concepts such as network slicing, mobile networks may lack sufficient capacity or may not have a clear business model that would allow for adequate prioritisation of smart grid communications.
- The benefits of using commercial networks are less pronounced for smart grids than for PPDR, as smart grids do not require equipment that benefits from significant economies of scale in commercial markets.

Plum found that alternative frequency bands are available for PMR that could meet these needs. In contrast, no suitable bands below 1 GHz were available for the Smart Grid, which is considered essential for connecting to substations, renewable energy sources, etc., and for achieving the necessary coverage in remote rural areas.

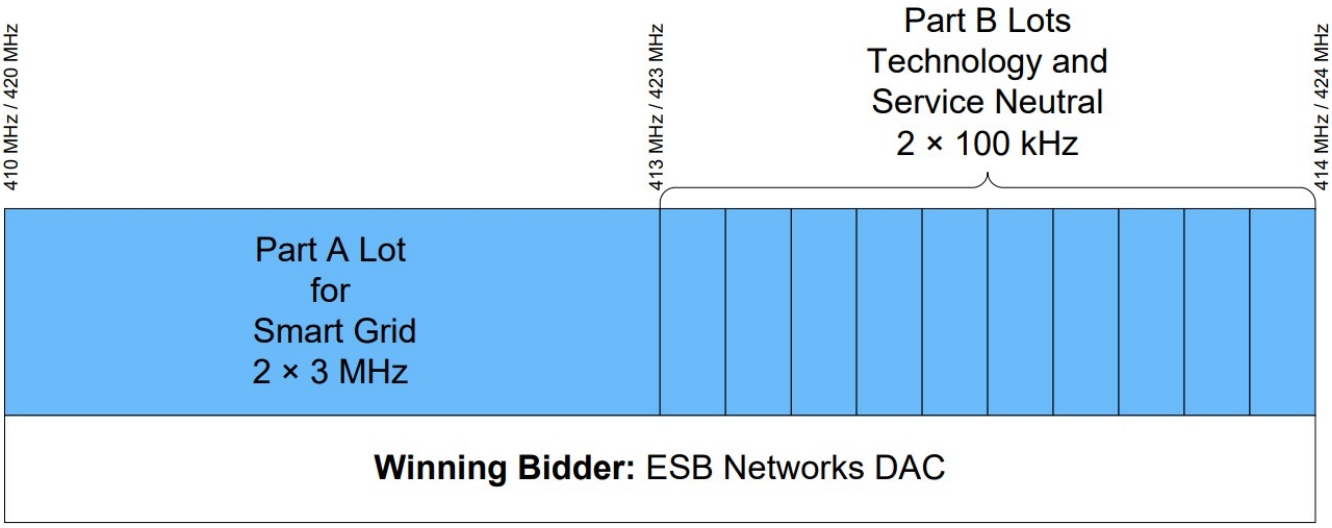
ComReg concluded that no suitable alternative spectrum for Smart Grids is available and also took the view that smart grids are a key part of the government's efforts to reduce emissions and ensure the security and sustainability of the energy system.

Options for using the band

ComReg considered three regulatory options:

- To grant all rights to use the 400 MHz band on a technology- and application-neutral basis.
- Restrict all rights to use the spectrum for Smart Grid purposes.
- Restrict part of the rights to use the band for Smart Grids and allocate the remainder on a technology- and application-neutral basis.

ComReg opted for the latter option, which involved allocating 2x3 MHz of spectrum to Smart Grids and the remainder of the spectrum (2x1 MHz) on a neutral basis (including, for example, PMR). The division into auction blocks is shown in the following diagram:



Source: Comreg[29]

Use of the ESBN network

The ESBN electricity distribution network comprises all distribution stations, overhead lines, poles and underground cables that supply electricity to more than 2 million households, commercial and industrial customers across the country.

In 2023, ESBN announced[30] a partnership with Sigma Wireless Communications and Nokia to build its LTE network. ESBN plans to complete the network build-out in 2026.

The network will be used to control and monitor the smart distribution network. The deployment of smart grid control is expected at medium and low voltage levels. It will also be used for smart metering in the commercial sector, with plans for future deployment for smart metering in households.

4.4 Saudi Arabia – Aramco Digital

In June 2024, a licence for 2x5 MHz of spectrum (Band 72) in the 450 MHz band was granted to Aramco Digital. The planned network is aimed much more broadly at use across various industrial sectors than just utilities or critical infrastructure operators.

[29] https://www.comreg.ie/publication/results-of-the-400-mhz-band-spectrum-award

[30] https://esb.ie/media-centre-news/press-releases/article/2023/05/19/esb-networks-completes-process-for-development-of-private-mobile-network

The aim of the regulator (CST) in granting the licence[31] is to support the digital transformation of industrial users in Saudi Arabia and to enable these users, in addition to mission-critical communications, to utilise advanced Industrial Internet of Things (IIoT) applications. CST aims to create a nationwide, highly resilient and secure specialised network for applications related to Industry 4.0, energy, utilities and other critical infrastructure.

The main objectives of the frequency allocation were:

- To allocate a licence for the 450 MHz band for the deployment of a nationwide network that will provide the above-mentioned services.
- To enable the deployment of national shared PMR networks (business radio), which will bring improved technologies and services to a wide range of users.
- To reduce or eliminate congestion in the 400 MHz band through more efficient shared systems.
- To meet the communication needs of all users, from critical national users such as oil and mining companies to smaller local users.
- Ensure reasonable prices for the services provided.

Following the allocation of frequencies for IMT networks in the 450 MHz band, CST further anticipates:

- Sufficient and acceptable coverage and services for large user groups, including oil companies, manufacturing enterprises and other nationally significant organisations that previously operated their own private networks.
- Adequate provision of services for smaller user groups, who individually represent only a small proportion of revenue compared to larger users.
- The provision of services to both large and small users at reasonable costs that will not hinder their digital transformation.

It is clear that this is a major state-led project with great potential to further support the development of the IMT ecosystem in the 400 MHz band. In September of that year, a collaboration between Aramco Digital and Qualcomm was announced (see section 3.2.2).

Aramco Digital's vision for the planned network and services is evident from the following figures:

[31] https://www.cst.gov.sa/ar/services/spectrum/Documents/450MHZradio.pdf

Regulation Directive for Industrial Network on 450Mhz

هيئة الاتصالات والفضاء والتقنية
Communications, Space & Technology Commission

Nation-Wide Industrial 450MHz Network

Basic Services (Mandated by CST)

Push-to-Talk (Radio)

- Single Site (60 min package)
- Roaming (120 min package)

Industrial IoT Connectivity

- 200 kbps
- 1 Mbps

Advanced Services (Future offerings)

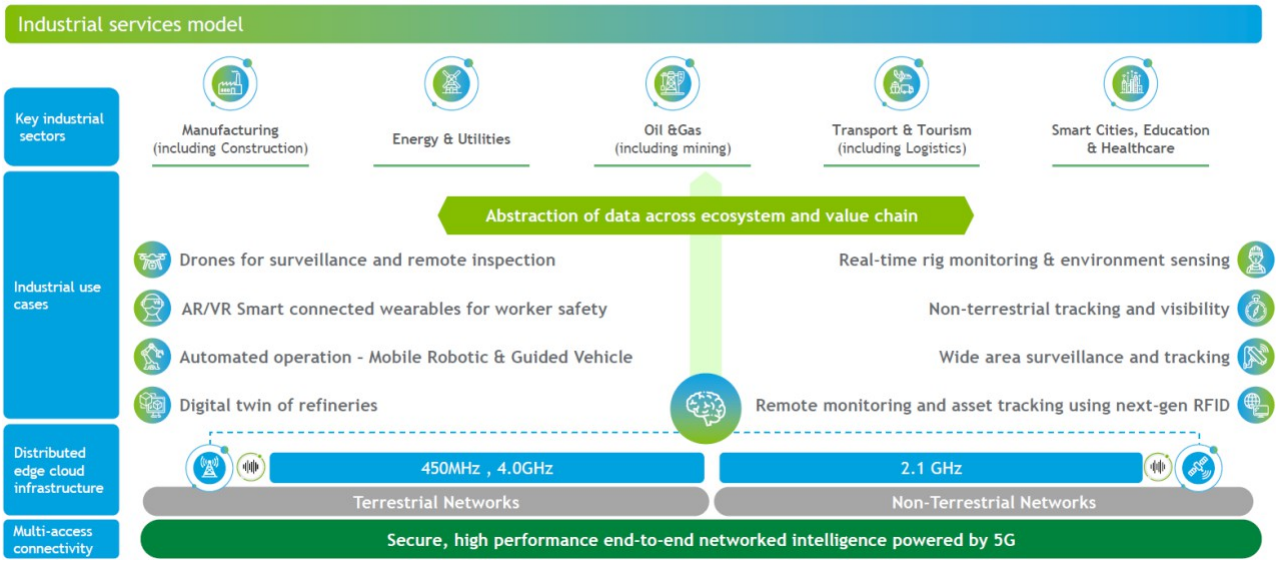
Solutions as a Service

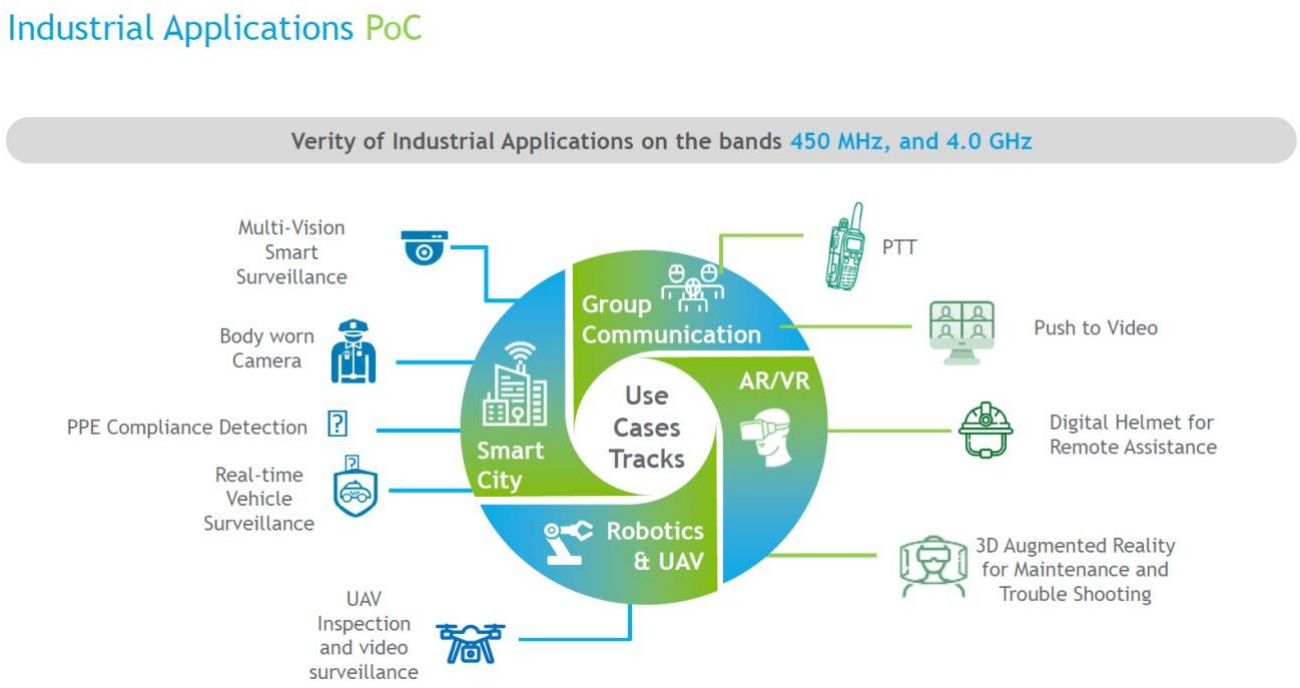
Application + Sensor

Industrial Use cases

- Drones for surveillance & remote inspection
- AR/VR Smart connected wearables
- Automated operation - Mobile Robotic
- Digital twin of refineries

Strategic Plan for Industrial Network





Source: Aramco Digital

4.5 Findings on actual use of systems in Austria, Germany, Poland and Slovakia

In September 2024, the Czech Telecommunications Office carried out radio spectrum monitoring with the aim of verifying the actual use of the 400 MHz band in neighbouring countries.

Following an analysis of the findings, it concluded that in the frequency bands of interest (420–424.25 MHz and 461.3–465.74 MHz), broadband systems are used only in Poland and Germany, specifically a nationwide LTE-M system operating at 423.7 MHz with a bandwidth of approximately 1.1 MHz in Poland, and in Germany, two unspecified broadband services with a bandwidth of 1.1 MHz at the frequencies 461.7 MHz and 463.35 MHz.

Apart from Poland and Germany, no broadband operations in the relevant bands were recorded in neighbouring countries (Slovakia and Austria) or in the Czech Republic itself.

The potential for using WB systems is also complicated by the fact that the available spectrum segments in the 450 MHz band, which were originally used for NMT technology, vary in width and location across different countries, which makes the coordination necessary to ensure coverage in border areas practically impossible.

5 The potential of the 400 MHz band in the Czech Republic

5.1 Use of the band

The 410–430 MHz and 450–470 MHz bands are currently used in the Czech Republic for the operation of narrowband systems, very intensively in some areas, and the development of modern digital narrowband technologies is limited by a shortage of frequencies in certain parts of the Czech Republic. The sections of the band designated for broadband networks are currently unused.

The band reserved for narrowband systems is practically exhausted in Prague, where, according to the CTO, the development of TETRA radio networks is currently completely blocked. The CTO is currently in a situation where it cannot comply with the applications received for the allocation of new radio frequencies in the 410–430 MHz band within Prague and the surrounding area. This also affects the radio networks of certain major users.

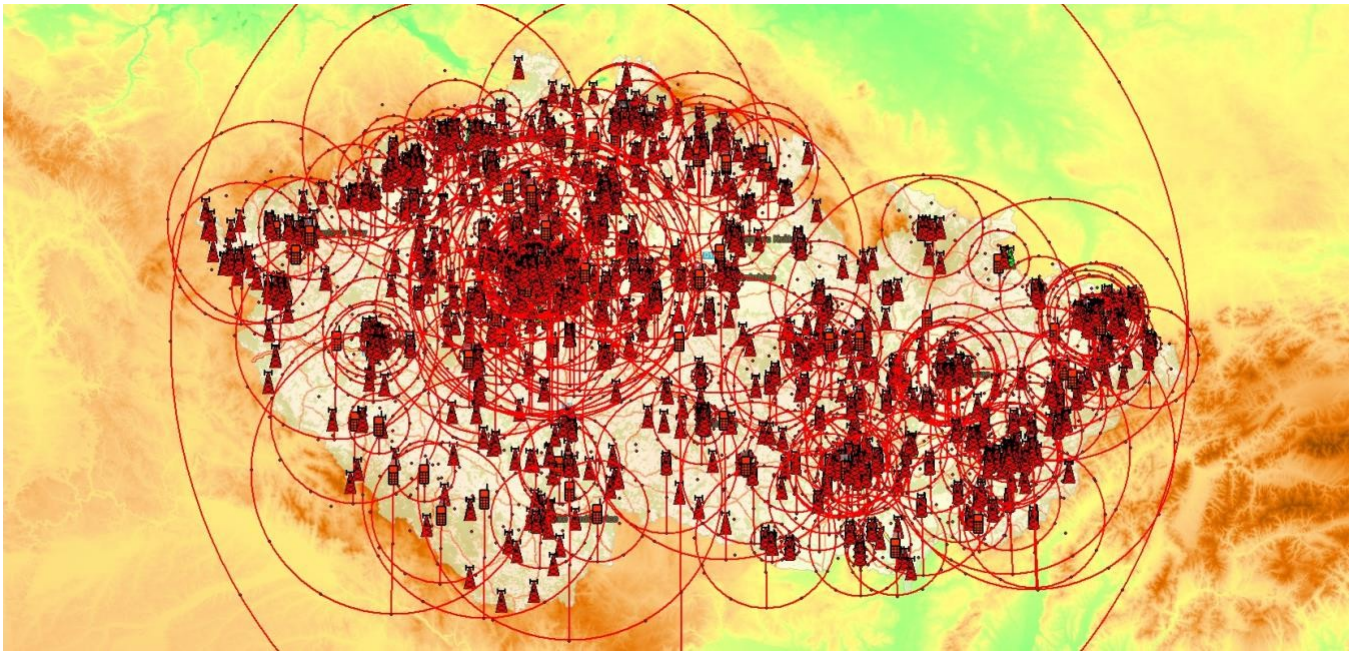
Analogue systems remain the predominant technologies, but there is a clear trend towards users switching to digital technologies, most notably DMR (in the Czech Republic, the MOTORBO variant from Motorola predominates). Of the digital technologies, TETRA and DMR are the most widely used.

Use of the 400 MHz band in the Czech

Republic Regional use of 410–430 MHz

Source: ČTÚ

Regional use of 450–470 MHz



Source: ČTÚ

Particularly in Prague, the available channels for narrowband systems in the band are practically exhausted. In the 410 MHz band, more channels are effectively allocated than stipulated by the PVRS; TETRA systems cannot be migrated to another band. In the 450 MHz band, 129 of the 165 available channels are in use. However, it is necessary to take into account requests for short-term authorisations (at least 16 channels for a single large-scale event). According to the ČTÚ,
unused frequencies designated by the PVRS for broadband networks are also being used on a short-term 'emergency' basis.

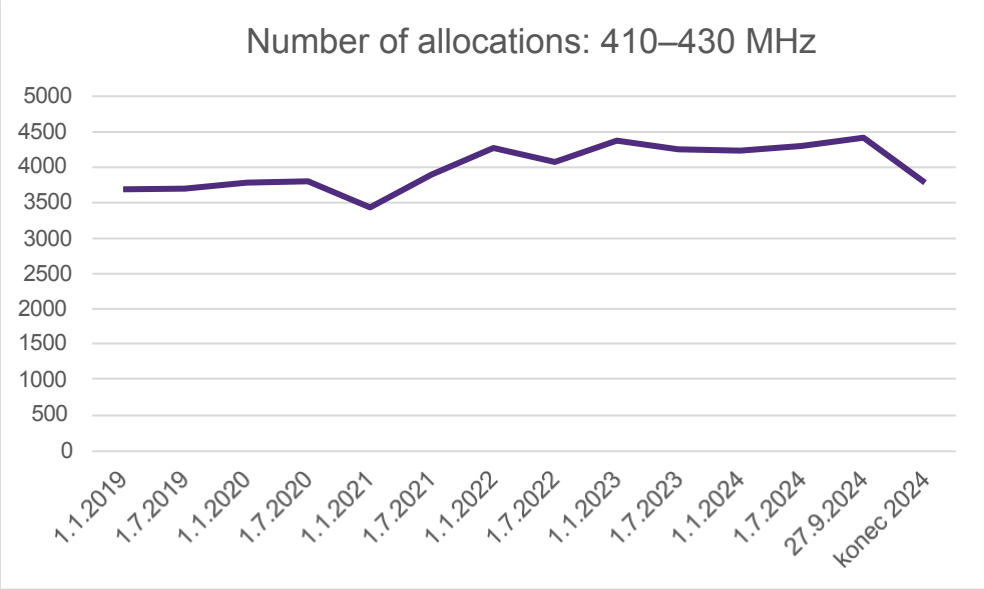
Other areas with intensive use of both bands include the Brno and Ostrava regions. According to the CTO, the situation in these areas is currently manageable.

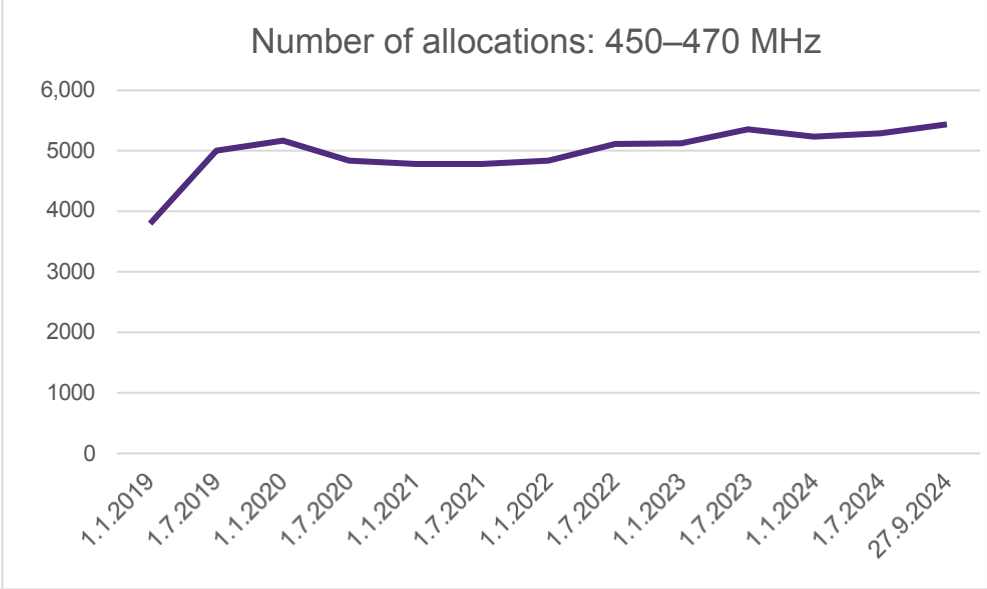
Trends in the number of licences for narrowband systems in the 400 MHz band

In terms of the development of licences over time, there is a clear steady, slight increase in the number of licences for narrowband systems. In the Czech Republic, there is no sign of a trend towards declining interest in the use of narrowband PMR in the 400 MHz band (e.g. due to the transition to MFCN networks), as reported by some foreign regulators. The slight decrease in the 410 MHz band is due to the expiry of the licence of one major user; however, as can be seen from the tables below, this has virtually no impact in Prague and Brno.

UNOFFICIAL MACHINE TRANSLATION

Total number of allocations for narrowband systems in the 410–430 and 450–470 MHz bands





Source: ČTÚ (excluding short-term licences and obvious duplicates)

UNOFFICIAL MACHINE TRANSLATION

Number of allocations in the 410–430 MHz band

data as of	Prague city		Prague and surrounding area		Prague + Central Bohemia		Sokolov region + KV		Most region		Liberec region		Brno		Ostrava city		Ostrava + Northern Moravia		**Czech Republic**	
	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA	Total	TETRA		DMR
1 January 2019	790	676	907	706	966	706	41	0	183	34	50	6	308	134	99	0	495	16	**3690**	**53**
1 July 2019	794	680	909	710	968	710	39	0	183	34	50	6	308	134	95	0	507	16	**3698**	**57**
1 January 2020	898	788	1017	822	1076	822	39	0	183	42	40	0	308	134	89	0	499	16	**3782**	**57**
1 July 2020	912	796	1011	830	1096	830	39	0	199	24	40	0	308	134	89	0	499	16	**3,798**	**57**
1 January 2021	920	796	1027	830	1066	830	39	0	137	44	40	0	174	134	85	0	461	16	**3435**	**69**
1 July 2021	924	800	1089	866	1172	886	39	0	155	44	40	0	174	134	85	0	497	16	**3,897**	**73**
1 January 2022	924	800	1085	866	1188	906	47	8	173	72	56	16	168	134	83	8	583	126	**4271**	**89**
1 July 2022	796	672	987	768	1094	812	47	8	173	72	56	16	168	134	70	8	566	126	**4076**	**79**
1 January 2023	850	722	1041	818	1148	862	47	8	189	88	52	16	175	134	70	8	564	126	**4,377**	**274**
1 July 2023	812	684	993	780	1099	824	47	8	189	88	52	16	179	134	76	8	572	126	**4255**	**225**
1 January 2024	812	684	990	780	1088	824	47	8	183	88	52	16	175	134	76	8	572	126	**4,230**	**270**
1 July 2024	812	684	990	780	1103	824	47	8	165	88	52	16	175	134	76	8	571	126	**4301**	**297**
27 September 2024	836	708	1016	804	1129	848	47	8	165	88	52	16	187	134	76	8	573	126	**4415**	**311**
end of 2024*	832	704	980	768	1053	772	39	0	137	60	46	0	187	134	68	0	471	24	**3,785**	**311**

Source: CTU (adjusted for short-term licences and obvious duplicates)
** Outlook*

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Number of allocations in the 450–470 MHz band

data as of	Prague city	Prague and surrounding area	Prague + Central Bohemia	Sokolov region + KV	Most region	Liberec region	Brno	Ostrava city	Ostrava + Northern Moravia	**Total Czech Republic**	
											DMR
1 January 2019	507	677	825	37	175	132	303	167	360	3,799	**624**
1 July 2019	689	965	1144	37	300	139	389	185	387	5001	**855**
1 January 2020	683	963	1142	37	300	139	389	255	546	5166	**1094**
1 July 2020	729	1015	1196	36	289	139	182	185	402	4836	**1029**
1 January 2021	697	983	1162	30	297	152	172	161	374	4,787	**1078**
1 July 2021	711	997	1175	30	289	140	178	161	386	4786	**1109**
1 January 2022	734	1029	1207	30	279	148	178	160	385	4842	**1140**
1 July 2022	745	1051	1229	28	267	142	178	160	390	5111	**1453**
1 January 2023	735	1041	1221	39	328	142	182	156	396	5128	**1526**
1 July 2023	809	1155	1336	39	308	147	178	150	203	5,360	**1780**
1 January 2024	743	1039	1220	39	328	147	156	150	390	5239	**1812**
1 July 2024	731	1079	1289	43	298	143	156	150	390	5,290	**1806**
27 September 2024	751	1099	1309	43	298	147	146	150	386	5437	**1924**

Source: ČTÚ (adjusted for short-term licences and obvious duplicates)

5.2 Demand for frequency spectrum

Narrowband systems

As can be seen from the trend in the number of licences for PMR systems in the 400 MHz band in recent years, demand for the use of these communication systems is stable with a slight increase.

In the 410 MHz band, typical users include local authorities, transport companies, security agencies, operators, energy companies, utilities (water supply, sewerage, heating plants), the Mountain Rescue Service and large industrial enterprises. The total number of licence holders is 142.

In the 450 MHz band, typical users include local authorities (municipal police), government agencies, transport companies, security agencies, warehouses, shopping centres, industry, energy companies, etc. The total number of licence holders is 263.

Of the users approached from the critical infrastructure and security sectors, some declared an interest in the long-term continued use of narrowband PMR networks in both bands for a period of at least 10 years or more. Some have declared plans to further expand the number of base stations in their networks in the coming years. One major user has expressed an interest in the long-term use of the 400 MHz band, although they are currently unable to estimate how long this operation will continue.

Broadband systems

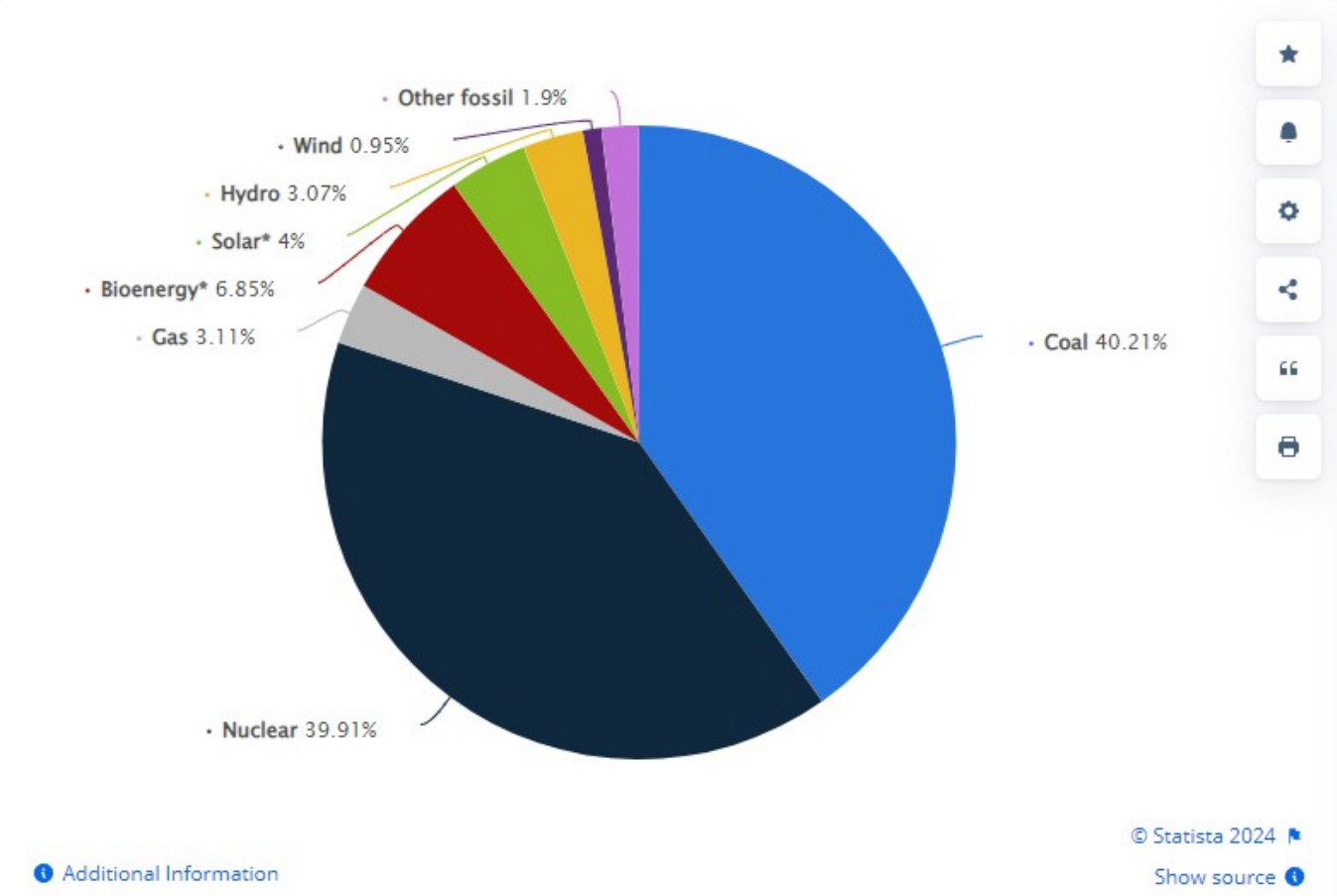
The sections of the 410 MHz and 450 MHz bands, designated under the PVRS for the operation of broadband networks, have been unused since 2021. According to a statement from the Czech Telecommunications Office (ČTÚ), the authority has not since been approached by any party interested in deploying and utilising broadband technology in these bands.

We contacted representatives from the energy sector and critical state communications, who had previously shown an interest in the band. At present, they have not declared any immediate or short-term need (or interest) in utilising these bands for broadband services; however, they have not ruled out an interest in the 400 MHz band in the medium to long term.

As regards the state's security services, there remains an interest in securing broadband data communications, and the possibility of a dedicated BB-PPDR network – for example, as part of a hybrid communication solution combining private and public networks – may be an interesting alternative in the future. A key factor is the widespread availability of user devices. Given the limited number of users, nationwide coverage and the immediate need for significant operational/required capacity (which depends on the number of PPDR response units), a dedicated PPDR network is, however, always time-limited and a very costly solution.

From the perspective of electricity distribution, the emphasis in the Czech Republic is on fibre-optic connections. The company in question has all its high-voltage substations and a number of other elements in the distribution network connected via fibre optics. At present, it is considering radio communication only as a backup M2M communication channel and for voice communication. As regards M2M communication within the network, it focuses on the EHV and HV levels. For AMM (Advanced Metering Management), a public mobile network is envisaged.

This stands in relative contrast to the position of distribution system operators in other countries, though this may be due to the nature of the energy mix in the Czech Republic, where large-scale sources still dominate.



Energy mix in the Czech Republic. *Source: Statista*

In contrast, in countries with a significant share of renewable sources and a higher degree of decentralisation of the energy grid, the use of wireless technology is a necessity from a cost perspective, and this results in pressure from the energy sector for the allocation of a dedicated band for a mission-critical IMT network. For example, in Germany, generation from renewable sources accounted for almost 60% in 2023.

6 Scenarios for the future use of the 400 MHz band

6.1 Summary of the starting points

To define possible scenarios for future use of the band, we can briefly summarise the previous chapters into the following starting points:

- The Czech Republic has a dense and high-quality network of mobile phone operators. This is due to the relatively high and even population density, which requires coverage with sufficient transmission capacity to ensure service availability for all subscribers.
- Modern technologies are used; in this respect, the Czech Republic is ahead of many Western countries, which in some cases still operate outdated third-generation networks (CDMA, UMTS) that have already been decommissioned in the Czech Republic.
- The Czech Republic probably has the most experience in Europe with operating broadband systems in the 400 MHz band, as publicly available networks were actually operated in both bands here.
- The communication needs of utilities are largely met by fibre-optic cable.
- There is no sufficiently significant entity in the Czech Republic that would make intensive use of a broadband system across the entire country (e.g. electricity distribution is provided by ČEZ, EG.D and PRE, each within their own territory).
- According to the CTO, existing narrowband PMR networks will be sufficient in the future for the communication needs of many critical infrastructure operators or for mission-critical and business-critical M2M/IoT. This applies in particular to the energy and utilities sector. Broadband communication takes place via optical fibre and through mobile operators' networks.
- There is a clear trend towards reserving a section of the 400 MHz band for IMT networks and building BB-PPDR networks using the LTE standard for the needs of utilities, PPDR or industry.
- In many countries, the 400 MHz band is used very intensively, and these countries are therefore not releasing the band for broadband networks.
- In the Czech Republic, sufficiently wide sections are available and can be allocated without complex and costly prior refarming.
- The sections of the band reserved for narrowband networks are used intensively, particularly in urban and industrial areas. In Prague and the surrounding area, the available frequency band is congested.
- The use of narrowband PMR networks is stable over time, with a slight increase, and user interest in their use can be expected to continue for at least the next decade.
- Since 2021, we have not registered any specific parties interested in deploying and operating a 4G/5G network in the 400 MHz band.

It must be borne in mind that any cancellation of the reservation of any of the segments for a nationwide broadband network and the allocation of the band to narrowband PMR networks is an irreversible step for the long term, as it would entail the subsequent need to refarm the band and re-release frequencies already occupied by narrowband PMR at that time.

If a 4G/5G broadband network were to be launched in the 400 MHz band, it cannot be automatically assumed that there would be a significant migration of PMR users to these networks and thus a reduction in demand for narrowband channels, as those interested in broadband services have long been using them and currently operate narrowband PMR/PAMR networks precisely because broadband systems are not suitable for this type of communication

Before taking any further decision on the use of the 400 MHz band, we recommend that the CTO conduct a broad public consultation with both current and potential users of the band, particularly with regard to operators of critical infrastructure in the energy sector and other network industries.

Narrowband and broadband technologies do not target the same users, nor do they offer the same service. They are therefore not competitors, but complementary technologies. Indirectly, potential broadband networks in the 400 MHz band would not only compete with narrowband networks, but also with broadband communications in general (Wi-Fi, XDSL, fibre optics, LTE and 5G, satellite). The direct competitors are LTE/5G systems in the 700 MHz and 800 MHz bands, for which very similar wave propagation conditions apply.

	400 MHz	700 MHz	800 MHz
available channel bandwidth	3 MHz	10 MHz / operator	10 MHz / operator
number of stations (for 400 MHz in the past, 700 & 800 MHz as of 31 October 2024)	approx. 400 (approx. 1,200 sectors) / network	13,210 in total	18,072 in total
5G	yes	Yes	LTE (future transition)
Coverage near the national border	no	yes	yes
Communication range	comparable (only slightly better for 400 MHz), in reality roughly a town the size of Kladno	comparable (only slightly worse for 700 MHz), in reality roughly the size of Kladno	comparable (only slightly worse for 800 MHz), in reality roughly the size of Kladno
device availability (particularly terminals)	limited in the 450 MHz band, very limited in the 420 MHz band	excellent, worldwide supported technology	Excellent, globally supported technology
network cost sharing within the operator / network operator (fibre optics, microwave links, electricity, technicians, marketing...)	is not (in the case of an independent user)	full (operators)	full (operators)
cost sharing customers	limited, most likely one or a few	millions of customers	millions of customers
data speed	lower (narrow channel bandwidth)	higher (full 2 blocks)	higher (full 2 blocks)

signal coverage	lower (slightly greater range cannot compensate for network density in the 700 & 800 MHz bands)	very good (auction commitments)	very good (auction commitments)
available capacity	limited – only 1 base station in a significant part of the territory	substantial – availability of multiple base stations in areas with heavy traffic	considerable – availability of multiple base stations in areas with heavy traffic
commissioning	?	yes	yes
PPDR	?	Yes – must, auction commitment	yes – may, auction commitment

6.2 Scenarios for future use of frequencies

6.2.1 Maintaining the status quo

This scenario assumes the maintenance of the status quo in terms of reserving sections of the 410 and 450 MHz bands for nationwide broadband networks.

The advantage of this scenario is that it preserves the possibility of future deployment of modern 4G/5G networks in both bands, i.e. for example, one network intended for BB-PPDR and the other for mission-critical communications in network sectors, as planned by Slovenia, for instance.

The disadvantage is, on the one hand, the limited ability to address spectrum congestion in narrowband segments and the practical lack of a solution in the short term. This is also linked to the long-term inability to expand broadband segments to 2x5 MHz and the necessity of deploying narrower carrier bandwidths such as 1.4 MHz and 3 MHz.

6.2.2 Release of the 410 MHz band for narrowband systems

This scenario assumes the removal of the allocation reserved for the broadband network and a change in the PVRS within the band, designating it for narrowband systems.

The advantage of this solution is the rapid availability of free channels for narrowband systems. It would also create sufficient space for refarming the 450 MHz band and expanding the allocated band for the LTE450 broadband network to 2x5 MHz, which would enable the deployment of a 5 MHz carrier and the full utilisation of 4G/5G technology in this band.

The disadvantage is that the number of broadband networks in the 400 MHz band would be limited to one for a long period. Should the need arise in the future to meet mission-critical communication requirements, for example of the state or operators of critical infrastructure, an alternative solution would have to be sought in other (higher) bands. Given that the obligations arising from the spectrum auction include a commitment to operate PPDR by public radio network operators, a solution exists and is binding on operators.

6.2.3 Narrowing of the 410 MHz band section reserved for the broadband network

This scenario envisages narrowing the section reserved for the broadband network to 2x3 MHz and designating the remainder of the reserved band for narrowband systems. In practice, this would mean releasing 2x1.25 MHz in the 410-414.25 / 420-424.25 MHz bands and lifting the restrictions on issuing new licences in the 414.25-415.3 / 424.25-425.3 MHz bands. However, this change would in reality be merely cosmetic, as the aforementioned bands will not actually be released, given that they are heavily utilised. It would rather be an acknowledgement of the actual situation. Any release of 1.25 MHz would also be reduced by the need to establish a guard band.

Hypothetically, a narrowing to 2x1.4 MHz could be considered if a realistic scenario for deploying an LTE-M network (e.g. for mission-critical massive IoT) were to emerge during consultations; however, we do not anticipate such an alternative, as this bandwidth is insufficient for typical users of BB-PMR or BB-PPDR networks.

The advantage of this scenario is that it preserves the option of deploying two 4G/5G networks in the 400 MHz band in the future, albeit one with only the option of deploying a 3 MHz carrier. In Europe, however, we see a number of cases where a narrower band than 2x5 MHz has been allocated and 4G networks for utilities are being built on it.

At the same time, narrowband channels would be freed up, which would create some manoeuvring room both for allocating new channels in congested areas and for the potential migration of users from the 450 MHz band and the expansion of the reserved section for 4G/5G networks to 2x5 MHz. In the long term, it is unlikely that the band will be freed up due to users migrating to other technologies, and thus the section for 4G/5G networks in the 410 MHz band will not be expanded.

A disadvantage of this scenario is the potential reduction in the attractiveness of such a narrowed reserved segment for potential interested parties.

6.2.4 Cancellation or narrowing of the reserved section for the broadband network in the 450 MHz band

We present this scenario for the sake of completeness and it includes all combinations with possible variants of access to the 410 MHz band (retention, narrowing, or cancellation of the allocation for the broadband network).

It is clear that the 450 MHz band is more advantageous in terms of allocation for broadband networks (support from manufacturers, allocation in neighbouring countries, and the prevalence of regulatory bodies that have allocated the 450 MHz band compared to the 410 MHz band). Therefore, if we are considering the cancellation or restriction of the allocation of a band for broadband networks in one of the two bands, the 410 MHz band is the clear candidate for such a change.

We currently consider the removal of the allocation in both bands and the designation of the band for narrowband PMR networks to be an inappropriate scenario. This would effectively more than double the number of available narrowband channels. At the same time, the Czech Republic would close the door on the possibility of deploying a broadband 4G/5G network for mission-critical communications, should such a demand arise in the future.

6.3 Cross-border coordination and implications for individual scenarios

The key document for cross-border coordination is the international agreement known as the HCM Agreement (currently in force in the 2022 Berlin version).

To assess the impact of cross-border coordination on individual scenarios, it is necessary to consider the coordination mechanism for three possible variants:

a) Coordination of narrowband systems on both sides of the border
b) Coordination of broadband systems on both sides of the border.
c) Coordination of narrowband systems on one side of the border and broadband systems on the other side of the border.

In the case of (a), the procedure is based on agreements on preferred channels.

Preferred frequencies (channels) have been agreed between the relevant authorities of neighbouring countries. Preferred frequencies may be used under specified conditions without coordination with the neighbouring country. This means that the signal level at the border, as specified for non-preferred frequencies, need not be observed, and systems operating on non-preferred frequencies must tolerate interference from services in the neighbouring country that use preferred frequencies.

In the case of (b), the procedure is governed by the HCM Agreement, which sets the maximum signal level at the border. Networks on both sides of the border must therefore be designed to ensure that these signal levels are complied with.

However, it is possible to deviate from the recommendations and conclude a bilateral agreement. Neighbouring operators may, for example, agree to increase the signal level at the border and subsequently ask their telecommunications authorities to conclude the relevant coordination agreement. This occurs, for instance, in the case of public LTE networks, where an improvement in network availability near the border is achieved at the cost of some degradation in service quality.

It is also the case for this option that reaching and concluding an agreement is much more likely than with the other options.

In the case of **option c)**, narrowband systems may use radio frequencies in accordance with applicable agreements and the results of frequency coordination. However, broadband systems must not exceed the electromagnetic field strength at the national border, which is at noise level and does not allow for communication to be established near the national border. Any deviations from the principle set out in the HCM Agreement are possible only on the basis of bilateral and multilateral international agreements.

The impact of the coordination schemes described above on the scenarios in Chapter 6.2 therefore depends on the allocation and use of the band in neighbouring countries.

The relationship between the current allocation of the 410 and 450 MHz frequency bands in the Czech Republic and neighbouring countries is as follows:

	Czech Republic	Germany	Austria	Poland	Slovakia
410 MHz	B87	NB	NB	B87/NB	NB
450 MHz	B72	B72	B72	B31	B72

Allocation of frequency bands for broadband networks (NB – narrowband systems, Bxx – LTE band)

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It is therefore clear that, depending on the intensity of narrowband system usage in neighbouring countries, the situation for a broadband network operator in the 410 MHz band will be worse compared to the 450 MHz band. If part or all of the section reserved in the 410 MHz band for the broadband network were to be reallocated, the situation of users of these released channels would be comparable to that of other users of narrowband systems in the 400 MHz band.

7 Regulatory aspects of the future use of the 400 MHz band

7.1 Current regulatory framework

The legal framework for the use of the radio spectrum is set out in the Electronic Communications Act[32] (ZoEK), the National Frequency Table[33] and the Radio Spectrum Utilisation Plan[34] .

The current version of the PVRS stipulates that the 410-415.3 / 420-425.3 MHz and 450.7-456.3 / 460.7-466.3 MHz bands are designated for the provision of publicly available electronic communications services. This corresponds to LTE bands 87 and 72, taking into account the 300 kHz guard band that the PVRS establishes in the bands adjacent to these LTE bands.

Currently, according to the PVRS, in the 410–410.5 / 420–420.5 MHz and 451.3–455.74 / 461.3–465.74 MHz bands, the number of rights to use frequencies is limited to one. In 2020, the Office conducted a review of the restriction on the number of rights in the 410 MHz band, concluding that *"the restriction on the number of rights in the 410-410.5 / 420–420.5 MHz, refrain from issuing new radio frequency allocations in this segment, and thus allow for the continued use of the radio frequencies in question without administrative restrictions in the form of a limit on the number of rights."* This will therefore need to be taken into account in future amendments to the PVRS.

The remaining sections of the 410–430 MHz and 450–470 MHz bands are designated for the operation of duplex and simplex narrowband systems.

7.2 Need for legislative amendments

Currently, frequencies in the 410 and 450 MHz bands are designated for the operation of a network intended to provide publicly available electronic communications services, and CDMA networks operating on these frequencies have been used accordingly.

According to Section 2(3)(e) of the Electronic Communications Act, a publicly available electronic communications service means an electronic communications service from which no one is excluded in advance.

[32] Act No. 127/2005 Coll., the Act on Electronic Communications and on Amendments to Certain Related Acts (the Electronic Communications Act)

[33] Decree No. 105/2010 Coll., Decree on the Frequency Band Allocation Plan (National Frequency Table)

[34] https://ctu.gov.cz/plan-vyuziti-radioveho-spektra

It is quite clear that any future 4G/5G networks in the 400 MHz band will not be used to provide publicly available mobile voice and data services, as they would be completely uncompetitive with the public mobile networks of existing mobile operators.

If a broadband network were to be rolled out, it would most likely be a private BB-PMR or BB-PPDR network, or networks. Even if a scenario similar to that in Germany (a broad consortium of utilities and municipalities) or Saudi Arabia (a mission-critical IMT network for industrial use) were to be implemented in the Czech Republic, despite the plurality of users, there would likely be a risk of conflict with the legal definition of a publicly available service and network (for example, due to the high requirements for the resilience and security of such a network).

However, Section 22(7) of the ZoEK explicitly stipulates that an allocation may only be granted to an undertaking providing a public communications network or a publicly available electronic communications service, unless otherwise provided for by a specific legal regulation.

Some form of restriction on access to these frequencies would, however, be desirable. Leaving the frequencies solely under the general regime of individual authorisations could lead to a (albeit unlikely) scenario in which a user might apply for a very regionally limited individual authorisation, thereby completely blocking the roll-out of a nationwide network, with the associated negative impacts on the efficient use of frequencies. Although the CTO could require nationwide use of frequencies in the PVRS, the existence of a legal basis for such a procedure is doubtful. Similarly, the CTU would be venturing onto interpretatively uncertain ground in relation to Section 16a of the Electronic Communications Act, which generally establishes the principle of technological neutrality and service neutrality, if it were to specify in the PVRS a particular category of users (e.g. licence holders under the Energy Act) or the purpose of network use (e.g. Smart Grid control or PPDR).

For the reasons set out above, we consider it desirable that, well in advance of any amendment to the PVRS and as soon as it becomes clear how a potential broadband network is to be used, such use should be defined by the relevant sector-specific legislation. Alternatively, consideration could be given to amending the ZoEK to allow for a cap on the number of rights and the allocation of spectrum to non-public networks as well; however, the legislative feasibility of such a proposal is likely to be more problematic than in the previous option and represents a relatively long-term solution.

8 Conclusion

The analysis of the 400 MHz band confirms its importance as a strategic resource for current and future needs in the field of critical communications and non-public networks. The 400 MHz band is currently crucial for narrowband PMR/PAMR systems, which are used in many sectors of the economy and for government purposes. At the same time, a significant portion of the band, reserved for broadband technologies, remains unused, which opens up scope for consideration of its future use.

Given the current intensity of PMR channel usage and the clear global trend towards deploying broadband IMT networks focused primarily on mission-critical applications in the energy sector and industry, the 410 MHz band is likely to be the main focus of the strategic review.

In the Czech Republic, the opportunity to implement a broadband network has existed for more than 20 years. However, since 2021, there has been no operator on the market offering such a network service, nor has any demand for these services been identified at present.

Before a fundamental decision is taken on the future use of the 400 MHz band, a broad public consultation should therefore be held with existing and potential users of the band, particularly from the utilities, transport, public administration and other sectors.