**MINISTRY OF TRANSPORT**

**OF THE SLOVAK REPUBLIC**

# NATIONAL POLICY FOR ELECTRONIC COMMUNICATIONS TO 2030

**APPROVED BY THE GOVERNMENT OF THE SLOVAK REPUBLIC**

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# 1 INTRODUCTION

Digitisation generally means the conversion of various forms of information into their digital electronic form. Digital form greatly facilitates and speeds up the processing, transmission and storage of information, contributing to greater process efficiency and the development of innovation.

For the further growth of Slovakia and increasing its competitiveness on a global scale while maintaining sustainable development, progress in the digitisation of the economy and society is an essential condition with a high priority.

Building a modern Slovakia as part of the EU therefore requires intensive implementation of digital transformation in the coming years. This transformation is a means to achieve smart, sustainable and inclusive growth, in line with the European vision of universal, non-discriminatory access to secure, trustworthy and environmentally friendly digital services, with sufficient universal digital knowledge and skills for citizens to use them.

The digitisation of industry and the modernisation of sectors such as transport, energy, healthcare and public administration depend on universal access to efficient, reliable, secure and affordable digital infrastructure. The digital communications infrastructure, made up of electronic communications networks and services, is a crucial part of the digital infrastructure that ensures the transmission of digitised information by optical, metallic or radio means, irrespective of the type and content of the information to be transmitted.

The crisis caused by the COVID-19 pandemic has shown the vital role of digital infrastructure for healthcare, education and the functioning of the economy. Electronic communications service providers have played a key role during the current health pandemic, especially when the Slovak government declared a state of emergency from 12 March 2020. They have become the target of demand for different types of data from the public administration, local governments or the private sector, while at the same time providing connectivity services to support the continuity of economic and social activities, despite challenging circumstances.

Similarly, the providers of electronic communications services responded to the humanitarian crisis associated with the military conflict in Ukraine on the basis of a request from the Government of the Slovak Republic. They took a range of actions to facilitate communication and support people in need. They provided free distribution of SIM cards to refugees, free WiFi in refugee assistance sites (asylum camps), free roaming calls to Ukraine, etc. Here, too, access to communication has proven to be paramount in times of crisis.

Based on the above facts, it is clear that a prerequisite for the digital transformation and building of the information society is the existence of a sufficiently robust, secure and functional high-speed communications infrastructure (mobile and fixed networks of new generations), which will enable permanent connectivity of all systems, their mutual communication and, of course, their effective management and supervision. At the same time, however, it should be noted that no funds have been allocated for building the latest 5G technologies and fibre-optic networks in the approved Recovery and Resilience Plan of the Slovak Republic.

The presented document determines the future direction of Slovakia in the field of development of electronic communications. It focuses on technological trends and market development tendencies in the provision of electronic communications networks and services and the identification of the possibilities of influencing them by means of instruments of state intervention.

It is based on the following national documents:

- National Policy for Electronic Communications to 2020,
- Digital Transformation Strategy of Slovakia 2030,
- Support for the Development of 5G Networks in Slovakia for 2020 - 2025,

- Strategy for the Introduction of Digital Terrestrial Radio Broadcasting in the Slovak Republic.

At the same time, it takes into account the objectives and principles of communications infrastructure development from European documents, in particular:

- 2030 Digital Compass,
- 2030 Path to the Digital Decade,
- European Electronic Communications Code,
- Union Space Programme.

The document does not address the issues of building very high capacity electronic communications networks for the purpose of deploying ultra-fast broadband (UFB) to meet the EU's gigabit society objectives. This area is the subject of the "National Broadband Plan" and its follow-up Feasibility Study, which is under preparation and will set out, in particular, the criteria and models for prioritisation of investments, the required more detailed rules, parameters and requirements for the state aid scheme. The implementation of both these documents is the responsibility of the Ministry of Investments, Regional Development and Informatization of the Slovak Republic.

The vision and objectives of the present National Policy for Electronic Communications to 2030 are as follows:

1. In terms of supporting the deployment and use of new technologies, 5G and prospective 6G mobile network infrastructure, harmonisation and efficient use of spectrum, it is the identification and use of potential frequency bands linked to the timely harmonisation of spectrum, taking into account the conclusions of the World Radiocommunication Conference (WRC), the decisions and recommendations of the EU and the CEPT.
2. In the field of digital terrestrial television broadcasting or future fixed and mobile communication services, ensuring optimisation of the use of the 470-694 MHz frequency band for its future use.
3. In the field of digital terrestrial radio broadcasting, complete the planning process of the VHF band (174 - 230 MHz) for T-DAB+ broadcasting to ensure the possibility of successful regular T-DAB+ broadcasting throughout the territory of the Slovak Republic and at the same time prepare an update of the T-DAB+ strategy.
4. In the field of global navigation satellite systems and space activities, the priority objectives are to ensure the legislative and technical conditions for their use by public authorities and commercial entities.

Act No. 200/2022 Coll. on spatial planning and Act No. 201/2022 Coll. on construction, which should improve the regulation and supervision of infrastructure construction, will also play an important role in achieving and implementing the above objectives. At the same time, these acts provide for an information system to which individual operators should provide information about their technical infrastructure. The creation of a relevant source of information on the existence and planning of transport and technical infrastructure will require close cooperation between the operators of electronic communications networks, the Regulatory Authority for Electronic Communications and Postal Services, which performs the role of the Single Information Point, and the Authority for Spatial Planning and Construction, which will create a basic information system for spatial planning and construction from 1 April 2024. At the same time, the physical infrastructure mapping functionality will be supported by the implemented information system Monitoring System for Regulation and State Supervision, which is under the responsibility of the Regulatory Authority for Electronic Communications and Postal Services.

The national policy should contribute to the creation of a favourable business environment in Slovakia, supporting key technologies for the development of electronic communications, in coordination with EU procedures.

# 2 DIGITAL COMMUNICATIONS INFRASTRUCTURE

In 2016, the Communication "Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society"[1] set out strategic objectives for the transition to a gigabit society by 2025, underpinned, inter alia, by regulatory 5G policy initiatives in Europe.

This policy initiative has been updated with the publication of the Commission's Communication "2030 Digital Compass: the European way for the Digital Decade"[2]. The main objectives set out in this policy initiative include the widespread deployment of very high capacity networks, including radio networks.

The requirements regarding the parameters of electronic communications networks are constantly increasing. While in the recent past the focus has mainly been on increasing broadband speed, other performance parameters such as latency, availability and reliability are increasingly important now and in the near future. To meet these increased demands on network capabilities, it is most appropriate to build networks on the optical physical layer and bring optical fibre as close as possible to users or to base stations in the case of mobile networks. For the forthcoming high-performance electronic communications networks, the concept of "very high capacity networks" has therefore been introduced at European level, whose performance parameters are equivalent to those that a fibre-based network can provide at least up to the distribution point at the service point of the network.

Very High Capacity Network (VHCN) means an electronic communications network that consists exclusively of fibre optic elements at least up to the distribution point at the point of service, or a network that is capable of providing, under usual peak-time conditions, a performance similar to that of a fibre optic network in terms of available bandwidth in both downlink and uplink directions, resilience, error, latency and its variation. The performance of the network can be considered similar regardless of whether the end user perceives differences due to different characteristics inherent in the medium that ultimately connects the network to the network termination point.

In accordance with the document BEREC BoR (20) 165[3] a very high capacity network is a Fibre to the Premises (FTTP) network and any fixed network that provides a quality of service to the end-user similar to that of a FTTP network under usual peak-time conditions, or a wireless network with optical fibre installation up to the base station and any wireless network that provides the end-user with a quality of service similar to a wireless network with optical fibre installation up to the base station under usual peak-time conditions.

The National Broadband Plan, which was approved on 17 March 2021 by Government Resolution of the Slovak Republic No. 151/2021, is a strategic document for the area of connectivity, the issuance of which was a prerequisite for the future use of European Structural and Investment Funds. The main purpose of this plan is to ensure the availability of sufficiently powerful and high quality communications infrastructure for the use of modern electronic communications services in a gigabit society for all inhabitants of Slovakia, enterprises and public institutions regardless of their current place of residence or location. Fixed electronic communications networks with very high connectivity capacity are also necessary for the development of next-generation mobile networks.

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[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society, COM(2016) 587 final of 14.9.2016.

[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – 2030 Digital Compass: the European way for the Digital Decade, COM (2021) 118 final of 9.3.2021.

[3] BEREC BoR (20) 165 BEREC Guidelines on Very High Capacity Networks, BEREC, October 2020.

To ensure Slovakia's connectivity goals by 2030, where:

- all households, whether rural or urban, will have access to an internet connection with a minimum speed of 100 Mbit/s, with the option to upgrade to gigabit speeds, and
- all major entities of socio-economic interaction, such as schools, transport hubs and major public service providers, as well as enterprises using digital services, will have access to gigabit connectivity, on the passive part of the infrastructure, which will not require replacement in the future due to increasing capacity or other quality and technological requirements,

the plan provides that in the medium and long term, it is necessary to invest in the construction of ubiquitous fibre optic infrastructure in Slovakia based on fibre access networks FTTH or FTTB (FTTP), which is the only currently available technology that will not require replacement in the future due to increasing capacity or other quality and technological requirements. Fibre optic networks are also the most advantageous alternative in terms of environmental impact in all phases of their life cycle and a necessary prerequisite for ensuring sufficient transmission capacity for 5G networks and thus supporting quality coverage by these networks.

Considering locations that are not commercially interesting and are geographically complicated, the plan recommends market intervention in areas of market failure to ensure equal access to modern infrastructure and digital services for all. The resources for financing interventions by the state will be proposed in the form of a grant and should come from the state budget or EU funds. The allocation of funds is recommended through calls for proposals announced in the intervention areas. Not only network operators, but also local governments can be subsidised. State authorities will play the role of regulator and coordinator of these demand projects.

Currently, in the sense of this plan, the Ministry of Investments, Regional Development and Informatization of the Slovak Republic has created a project called "Feasibility Study for the National Broadband Plan", and within the given project, a study will be prepared by an external contractor, which will establish the criteria and models for prioritising investments, the required more detailed rules, parameters and requirements for the state aid scheme, calls and the implementation of the communications infrastructure. This study will be the starting point for the implementation of investments in building ultra-fast broadband through individual projects in the form of calls for proposals. Following the Digital Compass and other policy initiatives, on 15 September 2021, the EC presented a proposal for a Decision of the European Parliament and of the Council establishing the 2030 Policy Programme "Path to the Digital Decade"[4]. In particular, it sets policy objectives regarding digital infrastructures that coincide with the objectives of the European Green Deal. In line with the 2030 Digital Compass, it aims in particular for all European households to be covered by a gigabit network connection in 2030 and for all populated areas to have an available 5G network. The policy goals of the Digital Compass increase the parameters of the national plan targets from 100 Mbit/s to gigabit speeds.

For the safe and efficient operation of digital infrastructure and electronic communications services, it is also important to define the dimension of cyber security. This will be addressed through the transposition of Directive of the European Parliament and of the Council on measures for a high common level of cybersecurity across the Union, repealing Directive (EU) 2016/1148 (NIS 2 Directive)[5] into national legislation and in accordance with the European Electronic Communications Code[6]. The cyber security of electronic communications will be handled by the National Security Authority, as the competent authority in this area.

[4] https://eur-lex.europa.eu/legal-content/SK/TXT/?uri=CELEX:52021PC0574

[5] https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:52020PC0823&from=EN

[6] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code

The development of digitisation is conditioned by the large-scale construction and modernisation of the digital communications infrastructure. However, the construction of electronic communications networks is economically demanding, therefore, in an effort to speed it up, the EC approved a directive on reducing costs of deploying high-speed electronic communications networks already in 2014[7]. The problems brought about by the transposition and application of this directive in practice, its diverse interpretation as well as other issues, are to be solved by the "Proposal for a Regulation of the European Parliament and of the Council on measures to reduce the cost of deploying gigabit electronic communications networks and repealing Directive 2014/61/EU"[8], which was published in early 2023. The subsequent early implementation of the entire legislative process can significantly help the development of infrastructure.

Given the fact that one of the important tools for reducing costs is also enabling access to the transport infrastructure (road and railway), the owner of which is the state, it is inevitable to improve the dialogue and the influence of the state on the persons operating the transport infrastructure. In this way, the need for regulatory intervention in the construction of infrastructure could be reduced.

The deployment of digital communications infrastructures is also supported by the EU with funds under the "Connecting Europe Facility 2.0"[9] (CEF Digital) in the form of co-financing of up to 50% for studies, 30% for the implementation of national projects and 50% for the implementation of projects of cross-border importance (international corridors).

Such projects are e.g., 5G coverage along cross-border transport corridors, 5G connectivity for smart communities, deployment or modernisation of backbone networks within the state or between EU states, etc. Supporting entities that would be interested in participating in these projects in the form of co-financing from public sources would significantly help in meeting the goals of the National Policy for Electronic Communications to 2030 and EU political goals related to digital infrastructures.

In the field of mobile communication systems, the 4G system based on LTE technologies is currently the worldwide standard. This system provides users with a transmission speed of around 100 Mbit/s, in the case of using the Carrier Aggregation functionality, by a suitable combination of frequency channels from different frequency bands, antenna systems (4x4 MIMO) and modulation (256 QAM) up to 1 Gbit/s. Already during the full deployment of 4G systems in the world, the development of 5G systems was fully underway, as 4G systems will not be able to meet the technical requirements of applications in the future, such as - augmented and virtual reality, Intelligent Transport Systems (ITS), cloud computing, real-time applications and others. For their proper functioning, these applications need a 5G network that will be able to serve an area with a very high density of devices, with very low latency and with a very high transmission speed of 1 Gbit/s. 5G networks are currently being widely deployed around the world. The leaders in deploying 5G networks are Asian countries, e.g. South Korea, China and Japan, followed by the US and Europe, where the speed of 5G deployment varies between Member States. Currently, work is already underway on the development of 6G networks, which should once again continue the trend of improving technical parameters for applications that should provide data throughput at the level of 10 Gbit/s download and 1 Gbit/s upload and real-time transfers. The European Commission draws attention to the importance of the rapid deployment of 5G networks in the EU if Europe wants to keep up with technological progress in the world, and therefore it is also important for Slovakia to keep up with the speed of deployment of new mobile communication systems.

The development of digital infrastructure for 5G networks and, prospectively, 5.5G (5G advanced) and 6G is mainly driven by the technological demands of applications, which for

[7] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks

[8] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0094

[9] https://eur-lex.europa.eu/legal-content/SK/TXT/?uri=CELEX:32021R1153

their proper functionality need constantly better and faster networks in terms of technical parameters, such as transmission speed, latency, density of connected points per $km^2$, reliability and, last but not least, network security. Applications that work in real time are especially sensitive to these parameters. Among the most important applications that will definitely need 5G and 6G networks for their operation are mainly:

- Internet of Things (IoT),
- Applications working in real time,
- Industry 4.0,
- Intelligent Transport Systems,
- e-Health,
- Smart Cities,
- Augmented and virtual reality.

It can be assumed that in the future 4G networks should be used mainly for interpersonal communication and thus will serve to connect people in the form of voice, text and image communication. 5G networks will serve for human-machine communication in the form of the Internet of Things based on the collection of data from various sensors. 6G networks represent the further development of the 5G network and will be intended for machine-to-machine (M2M) communication.

Although the commercial launch of 6G is not expected until around 2030, standardisation work is expected to start from 2025. Many development activities are taking place in Europe as well as in other parts of the world. Technical developments are expected to bring new possibilities extending the scope of wireless broadband to various areas, including mitigating the negative impact on the environment and climate change, as well as meeting new operational needs and new services addressed to consumers. Some research initiatives are starting to consider the use of the frequency spectrum in the sub-THz band, but also in the frequency bands intended for 5G, including low and medium bands.

Future 6G networks will be used by both people and machines, which, however, are already widely used for 2M type communication nowadays. On the contrary, immersive[10] XR (extended reality) applications, mobile holograms and digital replicas – of people and the environment (see Fig. 1[11]) should be an innovation.

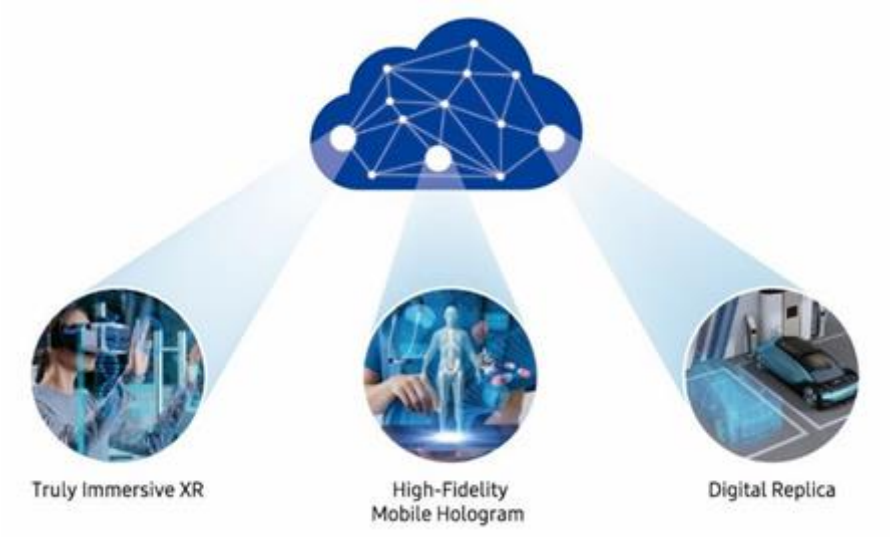


Fig. 1 – Three key applications of 6G

[10] Applications that create a virtual environment around the user and draw them directly into the created environment

[11] https://cdn.codeground.org/nsr/downloads/researchareas/20201201_6G_Vision_web.pdf

The final 6G technology is expected to deliver a peak data rate of 1 000 Gbit/s, which is 50 times faster than 5G, with a latency of under 100 µs, which is one tenth of that of 5G (within 1 ms). It is also reported that 6G networks will enable up to 10 times more connected devices per square kilometre (i.e. up to 10 million) compared to 5G networks, suggesting that this is mainly for the Internet of Things.

The future of 6G networks will see the use of frequency bandwidth in the terahertz scope (up to 3 THz), new antenna solutions, advanced duplexing technologies, better network topology and the use of artificial intelligence in wireless communications.

The users of 6G networks will mostly be machines and devices, including autonomous cars requiring huge data flows. For example, next-generation extended reality (XR) will require an individual data rate of 0.44 Gbit/s to feed 16 million retinal pixels. This will be even more significant for holograms, i.e. mobile and larger displays will start displaying true spatial holograms, which require a “minimum data rate” of 580 Gbit/s for a 6.7-inch phone display, and “human” holograms at several terabits per second (Tbit/s). Key applications of 6G are to include “digital twins” or “digital replicas”, i.e. people, objects and places will be fully digitally replicated in the future, allowing reality to be explored and monitored in a virtual world without constraints in space and time. However, duplicating an area of 1 $m^2$ in real time will reportedly require a data throughput of 800 Gbit/s, which is again well beyond the capabilities of 5G networks.

Table 1 - Comparison of technical parameters of 4G, 5G and 6G systems

| | ***System*** | | |
|---|---|---|---|
| *Parameter* | 4G | 5G | 6G |
| ***Peak Data Rate*** | 100 Mbit/s | 20 Gbit/s | ≥1 Tbit/s |
| ***Experienced Data Rate*** | 10 Mbit/s | 0.1 Gbit/s | 1 Gbit/s |
| ***Spectrum efficiency*** | 1x | 3 times more efficient than 4G | 5 – 10 times more efficient than 5G |
| ***Network Energy Efficiency*** | 1x | 10 – 100 times more efficient than 4G | 10 – 100 times more efficient than 5G |
| ***Area Traffic Capacity*** | 0.1 Mbit/s/$m^2$ | 10 Mbit/s/$m^2$ | 1 Gbit/s/$m^2$ |
| ***Connectivity Density*** | $10^5$ devices/$km^2$ | $10^6$ devices/$km^2$ | $10^7$ devices/$km^2$ |
| ***Latency*** | 10 ms | 1 ms | 10 - 100 μs |
| ***Mobility*** | 350 km/h | 500 km/h | ≥1000 km/h |
| ***Service Objects*** | People | People and things (link) | People and the world (interaction) |
| ***Applications*** | HD videos<br>Voice<br>Mobile TV<br>Mobile internet<br>Mobile payments<br>IoT | Virtual reality (VR)/<br>Augmented reality (AR)/ 360° videos<br>UHD videos<br>V2X<br>IoT<br>Smart cities/ factories/ households<br>Telemedicine<br>Wearable devices | Holographic verticals and society<br>Tactile/Haptic Internet<br>Full-Sensory digital sensing and reality<br>Fully automatic driving<br>Industrial internet<br>Space travel<br>Deep-see sightseeing<br>Internet of bio-nano-things |
| ***Technologies*** | OFDM<br>MIMO<br>Turbo codes<br>Carrier aggregation<br>Hetnet<br>ICIC<br>D2D communication<br>Unlicensed spectrum | Millimetre wave communication<br>Massive MIMO<br>LDPC and Polar Codes<br>Flexible frame structure<br>Ultra-dense networks<br>NOMA<br>Cloud/Fog/Edge computing<br>SDN/NFV/Network slicing | Terahertz band communications<br>SM-MIMO<br>LIS and HBF<br>OAM multiplexing<br>Lasers and VLC<br>Blockchain based spectrum sharing<br>Quantum communication and computing<br>Artificial intelligence (AI)/ Machine learning |

# 3 SPECTRUM FOR BUILDING 5G AND 6G NETWORKS

## 3.1 HARMONISATION AND USE OF SPECTRUM

The frequency spectrum is used for a wide range of applications in all sectors of the economy. It is used for applications that support a well-functioning supply chain and support international trade, such as logistics and aviation services (e.g. global navigation systems, radars, etc.). It is a critical asset for public services including education, healthcare, digital government, law enforcement, emergency communications, and public security and military applications. Spectrum is also needed for communication-based services, including the production and distribution of content, such as television and radio broadcasting, which promote cultural diversity and a functioning democracy. It is used to monitor our natural environment (e.g. through Earth observation satellites and water level monitoring) and is needed to facilitate weather forecasting and assess the impacts of climate change. In addition, the development and proliferation of Internet of Things (IoT) devices also requires spectrum-enabled connectivity to support a variety of applications that can not only help reduce our carbon footprint but that enable the digital transformation of our industries. In a world where communications services and connectivity are more important than ever, reaping the benefits of the digital transformation requires policy makers to manage spectrum in the most efficient way for the benefit of all in society.

Looking to the future, providers of electronic communications networks and services, large technology companies and industry players in other sectors will rely on the use of spectrum for a huge amount of innovation. Many artificial intelligence (AI) systems as well as virtual and augmented reality applications will depend on the quality of connectivity, which is proportionally dependent on the amount of spectrum available. The use of non-geostationary-satellite orbit (NGSO) constellations, which have important potential to bridge the rural connectivity gap, will continue to rely on spectrum. There will also be a need to ensure that there is sufficient spectrum available for drones or agricultural field monitoring applications. Connected and automated vehicles will rely on a range of connectivity solutions, including mobile and wireless local area networks (WLANs), also known as radio local area networks (RLANs) which will also be able to communicate with their surroundings and other vehicles only through frequencies.

Harmonisation of different parts of spectrum refers to the coordinated allocation or identification of individual frequency bands across regions for a specific category of networks, such as mobile, fixed, satellite, radio and TV, etc. Harmonisation takes place at international, regional as well as national level. Harmonisation of individual spectrum bands has important economic implications for policy makers.

International spectrum harmonisation is coordinated by the ITU. In accordance with the Radio Regulations, which are revised at the World Radiocommunication Conferences, frequencies are used in a harmonised way in different regions of the world. The role of the ITU Radiocommunications Sector (ITU-R) is to ensure the rational, equitable, efficient and economical use of spectrum worldwide by enhancing international cooperation between ITU member countries. Regional harmonisation is taking place in regional organisations such as the Asia Pacific Telecommunity (APT), the Inter-American Telecommunication Commission (CITEL) and the European Conference of Postal and Telecommunications Administrations (CEPT). Within the EU, this coordination is carried out through the Radio Spectrum Policy Group (RSPG), a political advisory group, and the Radio Spectrum Committee (RSC), a comitology committee.

## 3.2 SPECTRUM FOR 5G

The propagation of radio waves varies from frequency to frequency, so it is important to ensure that the coverage and capacity requirements of 5G networks are met by appropriate combinations of the frequency bands used. The low (up to 1 GHz) and medium (1 - 10 GHz) frequency bands have the potential to provide wide area coverage in terms of propagation, while the high frequency bands (above 10 GHz) are suitable for ensuring high transmission capacity of networks.

Bands below 1 GHz are particularly suitable due to their favourable propagation characteristics to cover more remote areas where longer range or building penetration is required. Mid-bands are a compromise between coverage and transmission capacity, with mid-band spectrum allowing significant data volumes (up to 2 Gbit/s) to be transmitted over a considerable distance (with a radius of several km). High frequency bands provide high transmission capacity (up to 20 Gbit/s) but the disadvantage is reduced range (less than 2 km). They have the advantage of being able to achieve high data rates using antenna beamforming techniques, but are more sensitive to interference.

Sufficient spectrum is needed to ensure that 5G and, in the future, 6G systems work properly and are fully operational.

At EU level, the 700 MHz (694 - 790 MHz), 3.6 GHz (3400 - 3800 MHz) and 26 GHz (24.25 - 27.5 GHz) pioneer frequency bands are harmonised for 5G networks in the first phase of deployment. Current developments in the world of electronic communications already make it clear that additional frequency bands with sufficient bandwidth will need to be allocated for a fully functional 5G network. Otherwise, 5G mobile communications networks will not be able to deliver the data rates and connection quality that new applications such as cloud applications, augmented and virtual reality, 3D video and real-time applications need to function properly. The use of frequency bands up to 100 GHz is therefore also being considered for the further development of 5G networks.

By 31 January 2023, EU Member States have allocated about 68% of all available pioneer bands:

- the 700 MHz band has been allocated in 24 Member States,
- the 3.6 GHz band has been allocated in 25 Member States (including Member States that have allocated it for temporary use or have allocated only part of the frequency band),
- the 26 GHz band has been allocated in 9 Member States (including Member States that have allocated it for individual applications for temporary use or have allocated only part of the frequency band).

The delay in the allocation of the 26 GHz band is mainly due to weak demand from mobile network operators. However, the deployment of 5G in this band has been slow, even in the Member States that have allocated the band.

Issues of cross-border coordination with non-EU countries on the EU's eastern borders are also contributing to delays in spectrum allocation for 5G deployment. In addition, auctions of spectrum harmonised for 5G networks were postponed in some EU Member States during the COVID-19 pandemic. Other reasons for delays in the allocation of pioneer bands are Member States' differing approaches to 5G network security, delays in the adoption of their 5G network security laws leading to uncertainty among enterprises, as well as differing timetables for the granting of individual authorisations.

Table 2 – Allocation of individual frequency bands in EU countries as of 31 January 2023

| Member State | 700 MHz | 3.6 GHz | 26 GHz |
|---|---|---|---|
| Belgium | ✓ | ✓ | timetable unknown |
| Bulgaria | expected in 2023 | ✓ | timetable unknown |
| Cyprus | ✓ | ✓ | timetable unknown |
| Czech Republic | ✓ | ✓ | timetable unknown |
| Denmark | ✓ | ✓ | ✓ |
| Estonia | ✓ | ✓ | expected in 2023 |
| Finland | ✓ | ✓ | ✓ |
| France | ✓ | ✓ | timetable unknown |
| Greece | ✓ | ✓ | ✓ |
| the Netherlands | ✓ | expected in 2023 | timetable unknown |
| Croatia | ✓ | ✓ | ✓ |
| Ireland | ✓ | ✓ | timetable unknown |
| Latvia | ✓ | ✓ | timetable unknown |
| Lithuania | ✓ | ✓ | timetable unknown |
| Luxembourg | ✓ | ✓ | timetable unknown |
| Hungary | ✓ | ✓ | deadline unknown |
| Malta | timetable unknown | ✓ * | deadline unknown |
| Germany | ✓ | ✓ | ✓ ** |
| Poland | expected in 2024 | expected in 2023 | timetable unknown |
| Portugal | ✓ | ✓ | timetable unknown |
| Austria | ✓ | ✓ | timetable in 2023 |
| Romania | ✓ | ✓ | timetable unknown |
| Slovakia | ✓ | ✓ | timetable unknown |
| Slovenia | ✓ | ✓ | ✓ |
| Spain | ✓ | ✓ * | ✓ |
| Sweden | ✓ | ✓ | ✓ * |
| Italy | ✓ | ✓ | ✓ |

* Allocated only part of the frequency band or only for temporary use
** Frequencies allocated only for individual applications with time limitation

The identification of other possible frequency bands for the deployment of 5G networks will need to be based mainly on the conclusions of the World Radiocommunication Conference to be held in 2023 (WRC-23), EC strategy documents and BEREC strategy documents.

### 3.2.1 Frequency bands for 5G in the Slovak Republic

#### 3.2.1.1 700 MHz frequency band

To support the deployment of 5G networks, a Decision of the European Parliament and of the Council on the use of the 470 - 790 MHz frequency band was adopted in May 2017[12], related to the coordinated release of the 700 MHz frequency band to ensure the provision and development of new innovative digital services in both urban and rural or remote areas. That Decision required Member States to allow the use of the 694 - 790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services by 30 June 2020, with the 470 - 694 MHz frequency band to be available for terrestrial TV broadcasting services until at least 2030.

The 700 MHz frequency band provides good coverage, but due to its bandwidth it provides lower bit rates than the 3.6 GHz and 26 GHz bands.

On 10 December 2020, on the basis of a selection procedure in the form of an electronic auction, the Regulatory Authority for Electronic Communications and Postal Services allocated frequencies from the 700 MHz frequency band to the mobile operators Slovak Telekom, Orange Slovensko and O2 Slovakia with validity until 31 December 2040.

#### 3.2.1.2 3.6 GHz frequency band

Frequencies from the 3.3 - 4.2 GHz band are used as the basis for the implementation of 5G networks. The frequency band's characteristics represent an ideal compromise between a combination of suitable signal coverage and transmission capacity, making it ideal for creating the initial connectivity for 5G.

The 3.6 GHz frequency band is the primary band for the implementation of 5G networks in the EU. The initial deployment of 5G technologies in this band benefits from the reuse of 4G network architectures with Non-Stand-Alone deployments. Mobile network operators are also obliged to build 5G Stand-Alone networks in this band.

Harmonisation of the 3.6 GHz frequency band (3400 - 3800 MHz) at European level is specified in the Commission Decision of 2008[13], which has been progressively updated by Commission Implementing Decisions in 2014[14] and 2019[15].

The European Electronic Communications Code[6] requires Member States to allow the use of the 3.6 GHz band, or a large part of it, for terrestrial systems capable of providing next-generation (5G) wireless broadband electronic communications services by 31 December 2020.

Individual authorisations allocating frequencies in the 3400 - 3600 MHz frequency band will expire on 31 August 2025 and in the 3600 - 3800 MHz frequency band will expire on 31 December 2024. In order to support new 5G technologies and to reallocate frequencies well in advance of the expiry of the current individual authorisations, on 5 May 2022, the Regulatory Authority for Electronic Communications and Postal Services closed the electronic

[12] Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 2017 on the use of the 470-790 MHz frequency band in the Union

[13] Commission Decision of 21 May 2008 on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community

[14] Commission Implementing Decision 2014/276/EU of 2 May 2014 on amending Decision 2008/411/EC on the harmonisation of the 3400 - 3800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community.

[15] Commission Implementing Decision (EU) 2019/235 of 24 January 2019 on amending Decision 2008/411/EC as regards an update of relevant technical conditions applicable to the 3400-3800 MHz frequency band

auction selection procedure for the granting of individual authorisations for the use of frequencies from the 3.6 GHz frequency band. The frequencies from the 3.6 GHz frequency band will be available for use by the successful selection procedure participants - Slovak Telekom, Orange Slovensko, O2 Slovakia and SWAN from 1 September 2025. Individual authorisations have been granted with a validity until 31 December 2045.

However, at the ITU level (Region 1, which includes the Slovak Republic), only the 200 MHz block in the 3.4 - 3.6 GHz band is harmonised.

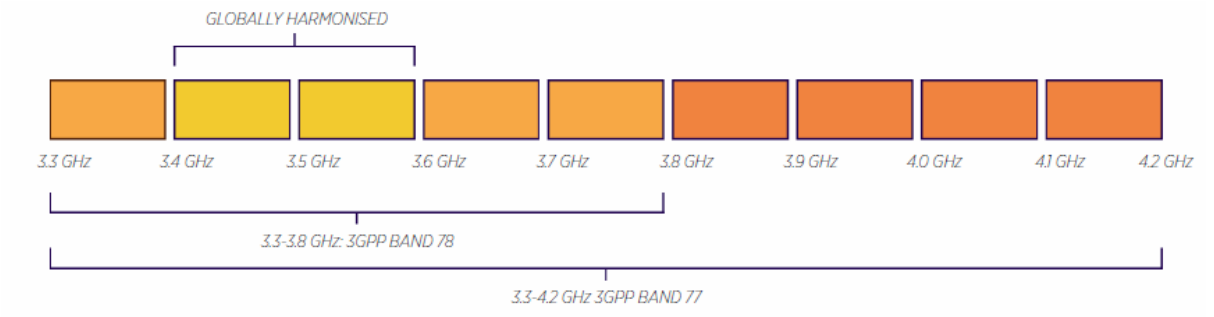


Fig. 2 - Current state of harmonisation of the 3.3 - 4.2 GHz band in the world[16]

The frequency bands 3.3 - 3.4 GHz (Region 2 only) and 3.6 - 3.8 GHz will be on the agenda of WRC-23, and it is foreseeable that these frequency bands will be allocated for the development of 5G (IMT) networks as a primary mobile service, which will facilitate global harmonisation and allow the 3.3 - 3.8 GHz band to be used as a contiguous frequency block. Harmonisation of the 3.4 - 3.8 GHz band is foreseen for Region 1.

#### 3.2.1.3 26 GHz frequency band

As for the 3.6 GHz band, the European Electronic Communications Code has set a deadline of 31 December 2020 for Member States to allow the use of at least 1 GHz of the 24.25 - 27.5 GHz band (provided there is market demand and there are no significant barriers).

The 26 GHz frequency band makes it possible to address very high-capacity use cases in dense areas, bringing opportunities for new types of networks and new services, as well as options for service providers, users and business models. At the same time, this band does not provide good coverage due to its different propagation characteristics compared to other frequency bands that have been used since the launch of mobile technology.

Currently, the 26 GHz frequency band is partially allocated for defence purposes, with a contiguous frequency block for 5G available in the 600 MHz range (26.5 - 27.1 GHz). It will therefore be necessary to continue negotiations with representatives of the armed forces to release also the remaining part of 27.1 - 27.5 GHz (400 MHz) and to identify adequate spectrum for military purposes.

[16] https://www.gsma.com/spectrum/wp-content/uploads/2021/04/3.5-GHz-for-5G.pdf

### 3.2.2 Future use of the 6 GHz frequency band (6425 - 7125 MHz)

The 6 GHz band, like the 3.6 GHz band, represents an ideal compromise between a combination of adequate signal coverage and high transmission capacity, making it a perfect candidate for use in 5G networks. Expanding the transmission bands for 5G by harmonising the 6 GHz band will give the 5G network greater bandwidth and improve overall network performance. The wide contiguous frequency blocks offered by this band will reduce the need for network densification and make next-generation connectivity available to the general public and enterprises.

For Industry 4.0, medical applications, intelligent transport systems, virtual and augmented reality, and all applications that need high transmission capacity, the 6 GHz band will be a key source of spectrum for the 5G network. The 6 GHz band will also be used for fixed wireless access (FWA) via 5G in areas where fibre connectivity is not provided and in areas where it is too costly to build fibre broadband access. Such “fibre-like” connectivity will help people and enterprises access broadband in a much more affordable way than fibre[17]. For the future of the 6 GHz band and its future use for 5G purposes, the conclusions of WRC-23, where worldwide harmonisation of this band for IMT is expected, will be particularly important. One possible scenario is to split the band into a lower unlicensed and an upper licensed part of the band.

## 3.3 SPECTRUM FOR 6G

6G networks are currently in the development and design phase of their technical requirements, which should be defined in IMT-2030. In the course of defining the requirements for a 6G system, several white papers[18] have been issued in which states and working groups involved in the development of 6G systems define the relevance, vision, concept and preliminary timetable for the deployment and support of the development of standards for 6G.

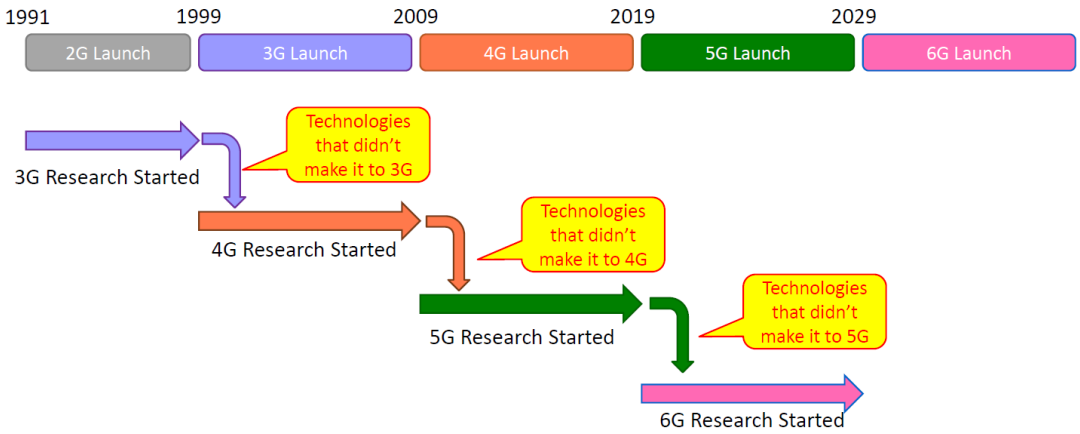


Fig. 3 - 6G standardisation timetable[19]

With commercial 5G networks deployed worldwide and their further expansion, the research and development of 6G is also gaining momentum. Typically, it takes around ten years from early research to commercialisation of new generation cellular systems. So it is expected that by 2030the first 6G networks will be deployed. At this stage, 5G and its advanced

[17] https://www.gsma.com/spectrum/wp-content/uploads/2021/05/6-GHz-Capacity-to-Power-Innovation.pdf

[18] https://www.6gchannel.com/6g-white-papers/

[19] https://www.free6gtraining.com/

technologies will already serve as a communications and information backbone that can support the daily needs of humans, enterprises and smart machines. The 6G vision is manifesting itself through a number of envisioned use cases, and many more are yet to emerge.

By 2030, sufficient spectrum is expected to be allocated or auctioned to achieve the full potential of 5G/5G-Advanced. These frequencies will play a role as part of the broader 6G spectrum context:

- Spectrum in frequency bands below 1 GHz, such as the 600 MHz or 700 MHz bands, will remain the basic coverage layer and will continue to help bridge the digital divide.
- Spectrum in the millimetre wave (high frequency) range, such as 26/28 GHz or 40 GHz, will continue to provide the high capacity as well as the low latency and high reliability required by enterprises.
- Spectrum in the mid-band range, including 3.6 GHz, 4.5 GHz and 6 GHz, will continue to address wide-area use cases that require capacity.

In terms of spectrum, there is currently no frequency band allocated in the ITU Radio Regulations for the deployment of 6G networks. 6G networks are expected to use the expanded frequency bands of 5G networks. The development of IMT-2020 systems and their successors is being addressed by the ITU Working Party 5D[20]. The ITU is currently studying the use of bands above 100 GHz, which should be able to meet the very high data rate requirements of the applications that 6G networks will bring.

## 3.4 PROPOSED ACTIONS

From the point of view of the development of 5G networks, the most important frequency bands that have been included in the WRC-23 draft agenda as Agenda Items 1.2 (Resolution 245)[21] and 1.3 (Resolution 246)[22] are the 3300 - 3400 MHz (Region 2 only), 3600 - 3800 MHz, 6425 - 7025 MHz, 7025 - 7125 MHz and 10.0-10.5 GHz (Region 2 only) frequency bands. The RSPG has prepared a document entitled Opinion on WRC-23, which identifies them as future bands for the development of 5G networks in the EU, describing 5G as one of the “most critical building blocks” of the European digital economy and society in the next decade.

In the area of frequency management, from the point of view of the development of the digital infrastructure of the Slovak Republic, it is mainly necessary to make available a sufficient amount of frequency spectrum for wireless electronic communications services (IMT). To ensure this objective, it is necessary to monitor developments in the field of frequency management, in particular changes in the ITU Radio Regulations, WRC conclusions, EC and ECC decisions and to ensure their timely implementation in national regulatory documents (in particular in the NTFA and the Spectrum Utilisation Plan), as well as to ensure the timely availability of allocated frequency blocks for providers of electronic communications services in the form of an electronic auction.

In terms of harmonisation and efficient use of spectrum, there is a need to focus mainly on the following areas:

- inventory of the spectrum in the Slovak Republic in internationally coordinated bands for the deployment of 5G networks and subsequent elaboration of long-term plans - strategy for its use, including identification of potential frequency bands, e.g. for the purposes of broadband wireless access networks, digital broadcasting,
- ensuring timely harmonisation of spectrum taking into account WRC conclusions, EU and CEPT decisions and recommendations through implementation in the ongoing update of

[20] https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/Pages/default.aspx

[21] https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000D0002PDFE.pdf

[22] https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000D0003PDFE.pdf

the NTFA and the Spectrum Utilisation Plan, also taking into account national defence and security needs,

- publishing information on spectrum use in the Slovak Republic and updating relevant data in the EFIS system in accordance with Commission Decision 2007/344/EC of 16 May 2007 on harmonised availability of information regarding spectrum use within the Community,
- re-conduct a public discussion on the future use of the 26 GHz band in the course of 2024 in order to gauge the interest of providers of electronic communications services in using frequencies in this band.

# 4 DIGITAL TERRESTRIAL TV BROADCASTING

## 4.1 CURRENT STATE

In June 2018, the Ministry of Transport and Construction of the Slovak Republic approved the document “Plan for the use of the 470 - 790 MHz frequency band in the Slovak Republic”. This document was prepared according to Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 2017 on the use of the 470 - 790 MHz frequency band in the Union (hereinafter referred to as the “Decision”), effective from 17 May 2017. In accordance with Article 5 of that Decision, Member States were required to adopt national roadmaps by 30 June 2018 to release the 700 MHz frequency band (694-790 MHz) for wireless broadband electronic communications services by 30 June 2020 at the latest.

The 700 MHz frequency band was originally used mainly for digital terrestrial television broadcasting. Digital terrestrial television broadcasting has moved to the band below 700 MHz, i.e. 470-694 MHz. In the Slovak Republic, in addition to changes directly related to the release of the 700 MHz band, changes not directly related to the release of the 700 MHz band had to be made in order to ensure the continuity of digital terrestrial television broadcasting.

At the same time, Article 4 of that Decision provided that “the Member States shall ensure availability at least until 2030 of the 470 - 694 MHz (‘sub-700 MHz’) frequency band for the terrestrial provision of broadcasting services, including free television, and for use by wireless audio PMSE on the basis of national needs, while taking into account the principle of technological neutrality. Member States shall ensure that any other use of the sub-700 MHz frequency band on their territory is compatible with the national broadcasting needs in the relevant Member State and does not cause harmful interference to, or claim protection from, the terrestrial provision of broadcasting services in a neighbouring Member State ...”

These issues are dealt with in detail in the “Study on the use of the sub-700 MHz UHF band (470 - 694 MHz)”[23], which was worked out for the EC in 2022. This study assesses the current status and future trends of the use of the 470 - 694 MHz band within the EU and third countries worldwide. In particular, the study examines:

- technological developments and future trends in the digital terrestrial television broadcasting and programme making and special events (PMSE) sectors;
- the evolution of consumer behaviour towards audio-visual consumption;
- public service media mission requirements; and
- current and future use of the sub-700 MHz band in third countries.

The study also forecasts trends for 2025 and 2030 using different prediction models. Following the consumer analysis, the study presents an analysis public broadcasting services mission requirements. The study considers the extent to which Member States are making use of the most resent digital terrestrial TV broadcasting and PMSE technologies and the degree to which there remains room for further improvement. It also documents Member States’ opinions on the future use of the band and the anticipated implications for the ability of digital terrestrial television broadcasting and PMSE to continue operating satisfactorily in the event of any significant changes.

WRC-23 will also consider possible regulatory measures in the 470 - 694 MHz band in Region 1 (which includes the SR), based on a review of spectrum use and spectrum needs of existing services in the 470 - 960 MHz band.

In preparation for WRC-23, this frequency band was also considered by the RSPG, which recommended that the EC propose to the Council an EU position for WRC-23 to ensure

[23] https://digital-strategy.ec.europa.eu/en/library/study-use-sub-700-mhz-uhf-band-tv-broadcasting-and-event

that the WRC-23 decision on this agenda item is consistent with the Decision prioritising digital terrestrial television broadcasting and the use of PMSE until at least the end of 2030.

The RSPG discussed various possible ways to achieve this EU objective, noting that many Member States do not currently see the need for regulatory action (no change at WRC-23, with a possible agenda item for WRC-27 or WRC-31) and several other Member States see the need for regulatory action (co-primary allocation of a mobile service, which could come into effect at a later stage (e.g. 31 December 2030)). A compromise solution would be a secondary allocation of a mobile service, which would be the subject of the WRC-31 agenda.

## 4.2 PROPOSED ACTIONS

Pursuant to Article 4 of the Decision, it will be necessary to decide, in accordance with the adopted conclusions of WRC-23, on the possibilities of using the 470 - 694 MHz band after 2030, i.e. whether it will continue to be used for digital terrestrial television broadcasting or PMSE, or whether it will be reserved e.g. for wireless broadband electronic communications services.

The RSPG's opinion on a strategy for the future use of the 470 - 694 MHz band beyond 2030 in the EU, expected in autumn 2023, will also be an important document for the adoption of the action.

Optimising the use of the 470 - 694 MHz band is a significant challenge for its future use. This concerns in particular the assessment of the possibility of releasing its 596 - 694 MHz frequency block (600 MHz frequency band) for future fixed and mobile communications services or the assessment of the possibility of mutual coexistence of digital terrestrial television broadcasting and future fixed and mobile communications services in this frequency band, taking into account the current state of its use.

These decisions should be made on the basis of analyses, including as regards service options, new business models and, in particular, should contribute to facilitating the shared and efficient use of spectrum. In addition, social, economic and cultural aspects related to the use of the sub-700 MHz band should be taken into account, as well as developments in consumer behaviour.

# 5 DIGITAL TERRESTRIAL RADIO BROADCASTING

## 5.1 CURRENT STATE

Government Resolution of the Slovak Republic No. 26 of 11 January 2017 approved the *Strategy for the Introduction of Terrestrial Digital Radio Broadcasting in the Slovak Republic* (hereinafter referred to as the "Strategy"). The approved Strategy gave the Ministry of Transport of the Slovak Republic the task of ensuring that a baseline representative survey was carried out and that surveys were subsequently carried out within the framework of the individual phases of the transition to digital broadcasting. The need to monitor the progress of digitisation and to modify the set procedures if necessary also emerged.

In line with the Strategy, the Ministry of Transport of the Slovak Republic carried out a baseline representative survey of radio broadcasting in Slovakia in 2017. Subsequently, during July-November 2022, the Ministry of Transport of the Slovak Republic proceeded to conduct the survey again, while the same parameters were set for the sake of comparability of the results of both surveys, i.e. the survey was conducted through a network of interviewers using the method of personal interview recorded in a questionnaire on a representative sample of approximately 1,000 respondents.

The aim of these surveys was to obtain information from listeners, in particular on radio listenership, radio reception patterns, awareness of digital terrestrial radio broadcasting, including the current trial in Slovakia, expectations of the benefits of digital radio broadcasting, and the consumer behaviour of radio listeners.

In addition to the listener surveys, the Ministry of Transport of the Slovak Republic also carried out a survey of broadcasters of radio programme services and holders of individual authorisations to operate radio broadcasting. The aim of this survey was to obtain information in particular on the interest in broadcasting in the T-DAB+ standard, the date and conditions for the termination (switch-off) of analogue broadcasting in the VHF band, the number of full-screen multiplexes needed for broadcasting in the T-DAB+ standard as well as the obligations that should be imposed on the holder of an individual licence for the operation of T-DAB+ broadcasting.

Given that Slovakia is not bound by international obligations concerning the termination of analogue terrestrial radio broadcasting, the development of digital terrestrial radio broadcasting is not currently conditional on the switch-off of analogue radio broadcasting in the VHF band. The Ministry of Transport of the Slovak Republic will continue to monitor the gradual introduction of digital radio broadcasting and subsequently optimise its further progress also on the basis of the results of the surveys carried out.

## 5.2 PROPOSED ACTIONS

In the area of digital terrestrial radio broadcasting, it will be necessary to focus in particular on the following areas:

- completion of the re-planning process of the VHF band (174 - 230 MHz) for T-DAB+ broadcasting (assuming that this band will not be shared with DVB-T broadcasting),
- develop the structure of T-DAB+ full-area frequency allocations (allotments) to ensure the possibility of successful regular T-DAB+ broadcasting throughout the territory of the Slovak Republic and at the same time prepare the conditions for the launch of local and regional broadcasting in individual areas of the Slovak Republic,
- prepare an update of the digital terrestrial radio strategy by the end of 2024.

# 6 USING THE UNION SPACE PROGRAMME IN THE FRAMEWORK OF DIGITAL INFRASTRUCTURE DEVELOPMENT

Satellite navigation and Earth observation systems are increasingly used in a growing number of key sectors of the economy, in particular transport, electronic communications, agriculture and energy. The Union Space Programme[24] should exploit synergies between these sectors, taking into account the benefits of space technologies for these sectors, support the development of compatible equipment and promote the development of relevant standards and certifications. Synergies between space activities and those related to the security and defence of the EU and its Member States are also increasing.

The Union Space Programme consists of the following components: Galileo, EGNOS, Copernicus, SSA (space situational awareness), GOVSATCOM, which aim to provide high quality, up-to-date and, where appropriate, secure data, information and services at a global level and is managed by the European Union Agency for the Space Programme (EUSPA).

The individual components of the Union Space Programme are under the responsibility of several ministries. The Galileo and EGNOS programmes are under the responsibility of the Ministry of Transport of the Slovak Republic.

## 6.1 GALILEO PROGRAMME

Galileo is an autonomous civil global navigation satellite system (hereinafter referred to as “GNSS”) consisting of a constellation of satellites, centres and a global network of stations on the ground, offering positioning, navigation and timing services and integrating the needs and requirements of security.

The services provided by the Galileo system include:

Galileo Open Service (GOS) – an open service that provides positioning and synchronisation information mainly for high-volume satellite navigation applications for use by consumers.

High Accuracy Service (HAS) – a high-accuracy service that provides, through additional data disseminated in a supplementary frequency band, high-accuracy positioning and synchronisation information intended mainly for applications for professional or commercial use.

Signal Authentication Service (SAS) – a signal authentication service based on the codes contained in signals, intended mainly for satellite navigation applications for professional or commercial use.

Public Regulated Service (PRS) – a public regulated service designed for government-authorised users for sensitive applications that require effective access control and a high degree of continuity of service, including, but not limited to, security and defence.

Emergency Service (ES) – a rescue service that broadcasts, through emitting signals, warnings regarding natural disasters or other emergencies in particular areas; where appropriate, it is provided in cooperation with Member States national civil protection authorities.

Timing Service (TS) - a timing service that is free of charge to users and provides an accurate and robust reference time as well as the realisation of the coordinated universal time,

[24] Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme

facilitating the development of timing applications based on Galileo and the use in critical applications.

The positioning and timing signals provided by satellite navigation systems are used in many areas of the economy, including synchronisation of the electricity transmission system, e-commerce and mobile electronic communications networks, efficient management of road, maritime and air traffic, automotive navigation, search and rescue services.

## 6.2 EGNOS PROGRAMME

EGNOS (European Geostationary Navigation Overlay Service) is a civil regional satellite navigation system under civil control which consists of centres and stations on the ground and several transponders installed on geosynchronous satellites and which augments and corrects the open signals emitted by Galileo and other GNSSs, inter alia for air-traffic management, for air navigation services and for other transport systems.

EGNOS aims to improve the quality of the open signals transmitted by existing global satellite navigation systems, in particular those transmitted by Galileo.

The services provided by the EGNOS system include:

EGNOS Open Service (EOS) – an open service that provides positioning and synchronisation information intended mainly for high-volume satellite navigation applications for use by consumers,

EGNOS Data Access Service (EDAS) – a service that provides positioning and synchronisation information intended mainly for satellite navigation applications for professional or commercial use, offering improved performance and data with greater added value than those obtained through the EOS,

Safety-of-life (SoL) – a life protection service that provides positioning and time synchronisation information with a high level of continuity, availability and accuracy, including an integrity message alerting users to any failure in, or out-of-tolerance signals emitted by, Galileo and other GNSSs which EGNOS augments in the coverage area, intended mainly for users for whom safety is essential, in particular in the sector of civil aviation for the purpose of air navigation services, in accordance with ICAO standards, or other transport sectors.

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## 6.3 SYNERGIES BETWEEN UNION SPACE PROGRAMMES

Examples of synergies between space technologies and space applications are the EU flagship programmes Galileo, EGNOS and Copernicus, which can become major contributors to the achievement of the Sustainable Development Goals not only in the EU but also in the world.

Synergies between the transport, space and digital sectors need to be used to promote wider use of new technologies such as eCall, the digital tachograph, traffic surveillance and management, autonomous and unmanned vehicles and aircraft, and to respond to the need for safe and seamless connectivity, reliable positioning, intermodality and interoperability.

The use of Galileo and Copernicus data is also emerging in other sectors such as environmental management and monitoring, border surveillance, maritime security, transport, emergency/crisis management and many other areas.

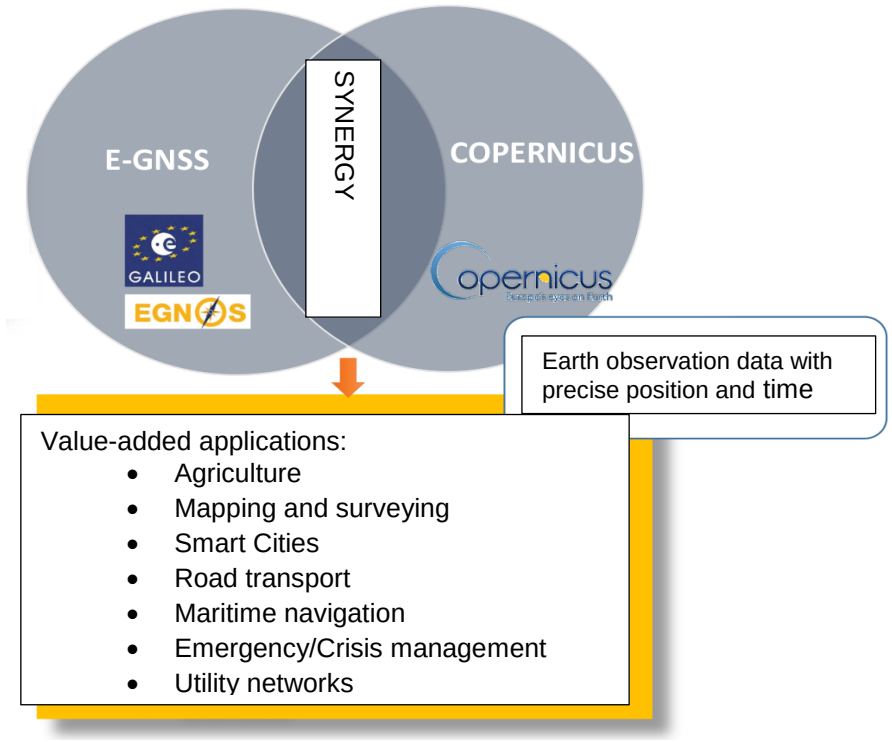


Fig. 4 - Galileo, EGNOS and Copernicus synergy

For the 2030 Agenda for Sustainable Development to succeed, the use of space services must become commonplace, as the use of GNSS services, and in particular the combination of data from these systems, helps to develop new products, services and contributes to the development of the digital economy.

## 6.4 PROPOSED ACTIONS

It is Slovakia's intention to continue its cooperation with the European Space Agency as an Associate Member. Slovakia has also been a member of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) since 2001 and participates in its sessions. The Ministry of Transport of the Slovak Republic has established a working group on GNSS, composed of experts in this field and dealing with issues in the field of space technologies. It is therefore appropriate to update and effectively direct its activities in the field according to the needs and state of play in the different segments of the space programmes creating synergies with the Galileo programme.

A legal framework is an essential part of supporting and strengthening research, development and deployment of space programmes in all segments (space, ground, applications). The preparation of a draft law on the conduct of space activities (in particular, issues related to the supervision and competence of central government authorities, authorisation, termination or modification of space activities, space debris, national register of space objects, liability for damage and sanctions) is also a result of UN agreements and conventions related to space activities, to which the Slovak Republic is a signatory. The successful completion of the legislation will require the coordinated activities of several central government authorities.

The priority objectives of the Ministry of Transport of the Slovak Republic in the field of global navigation satellite systems and space activities (also in the framework of cooperation with the European Space Agency) are:

- the preparation of a draft law on the conduct of space activities and subsequently the establishment of a register of space objects,
- the use of the Galileo Public Regulated Service by government and state authorities to ensure national defence and security, critical infrastructure and the protection of citizens' health and property,
- apply in practice the conclusions from meetings of the Space Programme Committee - Galileo EGNOS Configuration (SPC-GEC), the AB EUSPA Administrative Board and other committees and working groups of the Union Space Programme in cooperation with other ministries,
- increasing the general awareness of the European satellite navigation programme Galileo and its support by state authorities with the possibility of Slovak entities joining the programme for the development and production of systems, equipment and applications using Galileo/EGNOS services.

# 7 CONCLUSION AND ACTIONS

The basic objective in the field of electronic communications is the effective deployment of an accessible, reliable, efficient and secure communications infrastructure that will meet the demanding requirements of modern digital services and applications. For all future digital services, new technologies (5G, 6G) in synergy with the different components of the Union Space Programme are an important tool. Next-generation communications networks will not only form the backbone of a wide range of services essential for the functioning of the internal market, but will also be essential for the operation of vital societal and economic functions such as energy, transport, banking and healthcare systems, as well as industrial control systems.

The presented National Policy for Electronic Communications to 2030 is the basis for determining the future direction of Slovakia in the field of development of electronic communications. It focuses on technological trends and market development tendencies in the provision of electronic communications networks and services and the identification of the possibilities of influencing them by means of instruments of state intervention.

To meet these objectives, the following actions are proposed:

1. In terms of supporting the development of electronic communications networks and the use of new technologies, it is necessary to ensure:

   - Improving dialogue and state action on those operating the transport infrastructure (road and rail) to enable access to this infrastructure, thereby ensuring that the cost of building electronic communications networks is reduced.

     Deadline: ongoing
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

   - Inventory of the spectrum in the Slovak Republic in internationally coordinated bands for the deployment of 5G and prospectively 6G networks and subsequent elaboration of long-term plans - strategy for its use, including identification of potential frequency bands, e.g. for the purposes of broadband wireless access networks, digital broadcasting.

     Deadline: ongoing
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

   - Timely harmonisation of spectrum taking into account WRC conclusions, EU and CEPT decisions and recommendations through implementation in the ongoing update of the NTFA and the Spectrum Utilisation Plan, also taking into account national defence and security needs.

     Deadline: ongoing
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

   - Publishing information on spectrum use in the Slovak Republic and updating relevant data in the EFIS system in accordance with Commission Decision 2007/344/EC of 16 May 2007 on harmonised availability of information regarding spectrum use within the Community.

     Deadline: every year after the publication of the Government Order of the Slovak Republic establishing the National Table for Frequency Allocation
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

- Conduct a public discussion on the future use of the 26 GHz band in order to obtain the interest of providers of electronic communications services in using frequencies in this band.

  Deadline: 1st half of 2024
  Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

2. In the area of digital terrestrial television broadcasting, a decision will have to be taken on the possibilities of using the 470 - 694 MHz band after 2030. Optimising the use of the 470 - 694 MHz band is a significant challenge for its future use. This concerns in particular the assessment of the possibility of releasing its 596 - 694 MHz frequency block (600 MHz frequency band) for future fixed and mobile communications services or the assessment of the possibility of mutual coexistence of digital terrestrial television broadcasting and future fixed and mobile communications services in this frequency band, taking into account the current state of its use.

   These decisions should be made on the basis of analyses, including as regards service options, new business models and, in particular, should contribute to facilitating the shared and efficient use of spectrum. In addition, social, economic and cultural aspects related to the use of the sub-700 MHz band should be taken into account, as well as developments in consumer behaviour.

   Deadline: in accordance with the adopted conclusions of WRC-23 and subsequent implementing decisions of the European Commission
   Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

3. In the area of digital terrestrial radio broadcasting, it will be necessary to focus in particular on the following areas:

   - Completion of the planning process of the VHF band (174 - 230 MHz) for T-DAB+ broadcasting (assuming that this band will not be shared with DVB-T broadcasting).

     Deadline: 1st quarter of 2024
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

   - Develop the structure of T-DAB+ full-area frequency allocations (allotments) to ensure the possibility of successful regular T-DAB+ broadcasting throughout the territory of the Slovak Republic and at the same time prepare the conditions for the launch of local and regional broadcasting in individual areas of the Slovak Republic.

     Deadline: 2nd quarter of 2024
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

   - Prepare an update of the digital terrestrial radio strategy.

     Deadline: by the end of 2024
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Regulatory Authority for Electronic Communications and Postal Services

4. The priority objectives in the field of global navigation satellite systems and space activities (also in the framework of cooperation with the European Space Agency) are:

   - The preparation of a draft law on the conduct of space activities and subsequently the establishment of a register of space objects.

     Deadline: by the end of 2024
     Responsible: Ministry of Transport of the Slovak Republic

   - The use of the Galileo Public Regulated Service by government and state authorities to ensure national defence and security, critical infrastructure and the protection of citizens' health and property.

     Deadline: by the end of 2024
     Responsible: Ministry of Transport of the Slovak Republic

   - Apply in practice the conclusions from meetings of the Space Programme Committee - Galileo EGNOS Configuration (SPC-GEC), the AB EUSPA Administrative Board and other committees and working groups of the Union Space Programme in cooperation with other ministries.

     Deadline: ongoing
     Responsible: Ministry of Transport of the Slovak Republic

   - Increasing the general awareness of the European satellite navigation programme Galileo and its support by the state with the possibility of Slovak entities joining the programme for the development and production of systems, equipment and applications using Galileo/EGNOS services.

     Deadline: ongoing
     Responsible: Ministry of Transport of the Slovak Republic in cooperation with the Ministry of Education, Science, Research and Sport of the Slovak Republic

In order to meet these ambitions, close cooperation between state authorities, including regulators, operators and providers of electronic communications networks and services, all sectors of the national economy, investors and research and academic institutions is necessary.

The deadlines for meeting the objectives of the National Policy for Electronic Communications to 2030 will also be affected by the adopted WRC conclusions, EU and CEPT legislation, as well as the launch of the PRS service in full operation.

# LIST OF ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| AB EUSPA | Administrative Board of the European Union Agency for the Space Programme |
| APT | Asia Pacific Telecommunity |
| AR | Augmented Reality |
| BEREC | European Regulators for Electronic Communications |
| BTS | Base Transceiver Station |
| CATV | Cable Television Service |
| CEPT | European Conference of Postal and Telecommunications Administrations |
| CITEL | Inter-American Telecommunication Commission |
| COVID-19 | Coronavirus Disease 2019 |
| COPUOS | Committee on the Peaceful Uses of Outer Space |
| DOCSIS | Data over Cable Service Interface Specification |
| DVB-T | Digital Video Broadcasting-Terrestrial |
| ECC | Electronic Communications Committee |
| EDAS | EGNOS Data Access Service |
| EDIC | European Digital Infrastructure Consortium |
| EFIS | ECO Frequency Information System |
| EGNOS | European Geostationary Navigation Overlay Service |
| EC | European Commission |
| EOS | EGNOS Open Service |
| ES | Emergency Service |
| EUSPA | European Union Agency for the Space Programme |
| EU | European Union |
| FTTB | Fiber-to-the-building |
| FTTH | Fiber-to-the-home |
| FTTP | Fiber-to-the premises |
| FTTx | Fiber to the x |
| FWA | Fixed Wireless Access |
| GSM | Global System for Mobile Communications |
| GNSS | Global Navigation Satellite System |
| GOS | Galileo Open Service |
| GOVSATCOM | Governmental Satellite Communication |
| HAS | High Accuracy Service |

| | |
|---|---|
| IoT | Internet of Things |
| ISDN | Integrated Services Digital Network |
| ITM | International Mobile Telecommunications-Advanced |
| ITS | Intelligent Transport System |
| ITU | International Telecommunication Union |
| ITU-R | International Telecommunication Union - Radiocommunications |
| LTE | Long Term Evolution |
| M2M | Machine to Machine |
| MFCN | Mobile/Fixed Communications Networks |
| MIMO | Multiple-input Multiple-output |
| NGSO | Non-Geostationary-Satellite Orbit |
| NTFA | National Table for Frequency Allocation |
| OFDM | Orthogonal Frequency-Division Multiplexing |
| PMSE | Programme Making and Special Events |
| PRS | Public Regulated Service |
| QAM | Quadrature Amplitude Modulation |
| RLAN | Radio Local Area Network |
| RSC | Radio Spectrum Committee |
| RSPG | Radio Spectrum Policy Group |
| SAS | Signal Authentication Service |
| SoL | Safety-of-Life |
| SPC - GEC | Space Programme Committee – Galileo EGNOS Configuration |
| SSA | Space Situational Awareness |
| T-DAB | Terrestrial-Digital Audio Broadcast |
| TS | Timing Service |
| UFB | Ultra-Fast Broadband |
| VDSL | Very High Data Rate Digital Subscriber Line |
| VHCN | Very High Capacity Network |
| VHF | Very High Frequency |
| VoIP | Voice over Internet Protocol |
| VHF | Very High Frequency |
| VR | Virtual Reality |
| WLAN | Wireless Local Area Network |
| WRC | World Radiocommunication Conference |
| xDSL | Generic Digital Subscriber Line |
| XR | Extended Reality |