

**Roadmap for the
470 – 790 MHz
frequency band
in the Slovak Republic**

Approved by the Minister of Transport and Construction of the Slovak Republic

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1 Analysis of the current state of the 470 – 790 MHz frequency band

1.1 Introduction

In the past, the frequency band 470-862 MHz (TV Band IV and V) in the UHF frequency band was assigned for terrestrial television.

The first release of a frequency band (Digital Dividend I) for terrestrial television took place in 2012 when the 790-862 MHz frequency band (about 20% of the UHF TV band) was reallocated for other radio communication services. Decision 2017/899 of the European Parliament and of the Council on the use of the 470-790 MHz frequency band in the Union (hereinafter referred to as "the Decision") calls for another release of frequencies (Digital Dividend II) in the 694-790 MHz band (freeing up a further 30% of the remaining UHF TV band) for reallocation to wireless broadband electronic communications services.

The 470-790 MHz band is currently shared between digital terrestrial television services (nationwide and local multiplexes) and partially wireless microphones for program-making and special events (PMSE).

Currently in the Slovak Republic (hereinafter referred to as "Slovakia"), digital terrestrial television is transmitted using the DVB-T and DVB-T2 (DVB-T/T2) standards with MPEG-2 and MPEG-4 coding.

1.2 Definition of Terms

Multiplex provider means a natural person or legal entity that, on its own account and under its own responsibility, provides or is entitled to provide a multiplex signal intended for reception by the public into an uninterrupted chain of communication managed from a multiplexer to a user's terminal equipment or communication network termination point.

Allotment area means a territory defined by a border, where the choice of its size depends on the standard used (DVB-T/T2), its configuration parameters, distance, the parameters of the transmitters covering this territory and the nature of the territory itself (e.g. the hills and valleys within it).

Allotment is the reservation of digital frequencies (TV channel frequency bands) coordinated internationally for relevant territory (allotment area), to which Slovakia is bound by the results. Allotment is the base unit for a frequency layer.

TV channel is a defined part of the UHF frequency band (8 MHz bandwidth) from the total band allocated for digital terrestrial TV service (470-790 MHz), identified by a number.

Single frequency network (hereinafter referred to as "**SFN**") is a grouping of two or more transmitters synchronised in terms of frequency (they are broadcasting on the same frequency), timing (transmission is triggered at a specified time), and data (the same content and data sharing has to be transmitted). An SFN may also be comprised of multiple allotments.

DVB-T/T2 standards use OFDM multiplexing, allowing digital terrestrial TV signals to be transmitted from multiple transmitters at the same frequency (SFN) hence saving spectrum. However, this feature can only be used to a limited extent (e.g. within the limited size of the allotment area) and also causes technical complications in synchronisation of the SFNs.

1.3 Current use of the 470- 790 MHz frequency band in Slovakia

Allotment area boundaries in the 470-790 MHz band are defined in GE06 Plan (Regional Agreement, Geneva 2006) and they divide Slovakia into a number of areas.

The GE06 allotment area boundaries within Slovakia with their names are graphically displayed in Fig. 1.

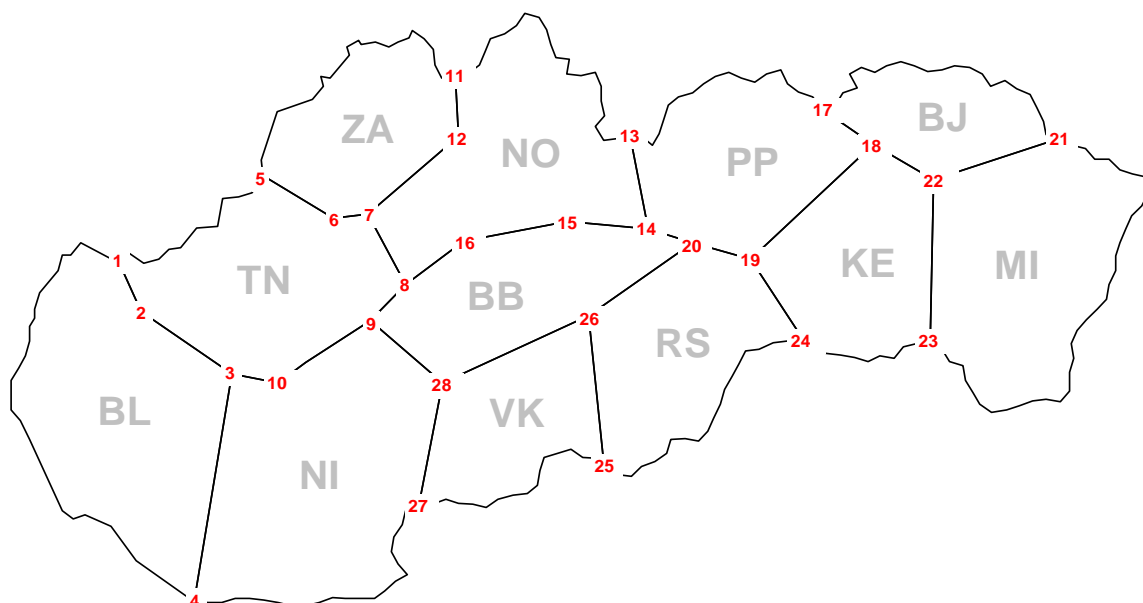


Fig. 1: Graphical presentation of GE06 allotment area boundaries

In Slovakia, the 470-790 MHz frequency band is currently used by digital terrestrial TV at the nationwide and local multiplex levels and partly also by radio microphones. Nationwide multiplexes are operated using GE06 Plan frequencies, while local multiplexes and radio microphones are operated at individually coordinated frequencies¹⁾ beyond the scope of GE06 Plan in the 470-790 MHz frequency band.

There are currently four nationwide multiplexes, 83 local multiplexes, and a number of radio microphones in operation.

Three nationwide digital terrestrial TV multiplexes use the DVB-T standard (two multiplexes provide Free-to-Air (FTA) services only and one multiplex provides both FTA and Pay TV services). One nationwide multiplex uses the DVB-T2 standard, disseminating only Pay TV services. There are a total of 32 program services (21 Pay TV, 11 FTA), of which 27 transmit in standard definition (SD format) and the remaining five broadcast in high definition (HD format). There are also two programs simultaneously broadcasting in SD and HD formats. For FTA SD programs, the MPEG-2-MP@ML standard is used for source coding, while the MPEG 4 AVC standard is used for all remaining programs.

Nationwide multiplexes are now broadcast using allotments of GE06 Plan (see Table 1).

Local digital terrestrial TV transmitters predominantly broadcast using the DVB-T standard with MPEG-2 coding. In Slovakia, program services are predominantly transmitted in SD format through local digital terrestrial TV multiplexes.

¹Space for coordinating individual frequencies has been significantly reduced by Digital Dividends I and II.

After releasing the 700 MHz frequency band, networks operating nationwide across Slovakia will lose 20 allotments out of a total 48. Some of the affected allotments may be replaced by the unused allotments from GE06 Plan, although this will enable to create only two nationwide multiplexes.

Table 1: Frequency plans for digital terrestrial TV broadcasting by GE06

Planning Area	MUX 1	MUX 2	VP MUX	MUX 4	MUX 5	MUX 6
BL	44	56	27	39	37	54
NI	50	21	48	31	28	45
TN	55/53	52/56	57	23	38/43	
ZA	35	52	32	39	30	
NO	44	59	26	46	47	29
BB	49	51	33	40	30	
VK	49	60	33	32		
RS	57	27	54	22	47	52
PP	41	55	24	39	38	42
BJ	49	40	54	46	47	37
KE	50	59	25	21	23	37
MI	57	59	25	22	23	30

Table shows the number of GE06 allotments (in both the 470-694 MHz and 694-790 MHz bands, along with the number of frequencies missing for the launch of a nationwide multiplex) and the number of TV programs currently transmitted in nationwide multiplexes. Allotments in the 694-790 MHz band need to be reallocated for wireless broadband electronic communications services.

Table 2: Number of allotments in the 470-694 MHz band (K21-K48) and in the 694-790 MHz band (K49-K60)

GE06 division into multiplexes	Number of allotments in the 470-694 MHz band	Number of allotments in the 694-790 MHz band	Number of allotments missing for full nationwide multiplex	Current number of programs transmitted
MUX 1 DVB-T	4	8	-	1 HD/5 SD 2 FTA/4 Pay TV
MUX 2 DVB-T	3	9	-	0 HD/5 SD 5 FTA/0 Pay TV
VP MUX DVB-T	9	3	-	2 HD/2 SD 4 FTA/0 Pay TV
MUX 4 DVB-T2	12	0	-	2 HD/15 SD 0 FTA/17 Pay TV
MUX 5	11	0	1	0
MUX 6	6	2	4	0
Total	45	22	5	5 HD/27 SD 11 FTA/21 Pay TV

The number of transmitters currently operating in Slovakia in the 470-694 MHz band (K21-K48) and in the 694-790 MHz band (K49-K60) is shown in Table 3.

Table 3: Number of transmitters currently operating in the 470-694 MHz band (K21-K48) and at the 694-790 MHz band (K49-K60)

GE06 division into multiplexes	Number of transmitters in the 470-694 MHz band	Number of transmitters in the 694-790 MHz band	Total number of transmitters in multiplex
MUX 1 DVB-T	9	15	24
MUX 2 DVB-T	17	46	63
VP MUX DVB-T	54	14	68
MUX 4 DVB-T2	14	0	14
Total	94	75	169
Local MUX valid after 30.6.2020	31	4	35

1.3.1 Individual authorisations granted for the use frequencies from the 700 MHz band

The expiry dates of current individual authorisations for the use of frequencies from the 694-790 MHz band, granted for nationwide multiplexes to Towercom, a.s. are as follows:

- MUX 1 (8 allotments), expires 31 May 2021
- MUX 2 (9 allotments), expires 9 September 2029
- VP MUX (3 allotments), expires 9 September 2029
- MUX 4 (0 allotments), expires 9 September 2029

Expirations dates for the different individual authorisations covering the use by local multiplexes of frequencies in the 700 MHz band vary, with the latest date being 28 February 2022. 43 of all currently valid local individual authorisations for the use of the frequencies (out of a total of 78) will expire before 30 June 2020 or not later than 2020. Out of the individual authorisations granted for frequencies used in local broadcasting that expire after 30 June 2020, 4 are from the 700 MHz band.

In addition to the 20 allotments reserved for nationwide multiplexes and 4 frequencies for local multiplex broadcasting in the 700 MHz band, a number of additional changes can be expected (retuning, frequency inverting between multiplexes, etc.) at existing multiplexes. These additional changes do not directly result from the need to release of the 700 MHz band, but rather they will need to be done to ensure its seamless repurposing.

Current individual authorisations for PMSE wireless microphone services are granted over the entire 470-790 MHz frequency band, with the final expiring date on 31 December 2020.

2 Cross-border frequency coordination agreements concluded with neighbouring countries for the 470-694 MHz band

By 31 December 2017, Slovakia had concluded all the necessary cross-border frequency-coordination agreements with neighbouring countries (the Czech Republic, Austria, Poland, Hungary and Ukraine) in accordance with Article 1 paragraph 2 of the Decision. Signing these agreements led to re-planning of nationwide digital terrestrial television layers.

Table 4 shows the nationwide layers for Slovakia, composed of frequency plans for digital terrestrial TV broadcasting after the releasing the 700 MHz band, resulting from the required cross-border frequency coordination agreements (hereinafter referred to as "frequency plans resulting from cross-border coordination agreements"²⁾).

Table 4: Frequency plans for digital terrestrial TV broadcasting to cover the releasing the 700 MHz band

Allotment Area ³⁾	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
BL	44	27	45	39	28	37
NI	21	31	45	48	28	37
TN	21	27	32/45	39	28	23
ZA	30	38	32	47	35	46
NO	30	44	26	47	29	46
BB	30	27	33	47	40	37
VK	21	27	33	47	32	37
RS	21	27	25	47	22	42
PP	41	38	24	39	40	42
BJ	46	30	25	47	40	37
KE	21	30	25	23	22	37
MI	21	30	25	23	22	37

²⁾ The frequency plans for DVB-T2 standard illustrated in Table 4 can be used even for the DVB-T standard if the required SFN size is met. It is possible to exploit them advantageously at the start of the process of releasing the 700 MHz band whenever there is insufficient penetration of DVB-T2 TV receivers.

³⁾ Detailed specification of allotment areas can be found in Chapter 1.3.

3 Manner and timeframe for releasing the 700 MHz frequency band (694-790 MHz) for wireless broadband electronic communications services

The deadline for making the 700 MHz band available for wireless broadband electronic communications services is 30 June 2020, although a number of changes still have to be put in place, not just in nationwide and local digital terrestrial TV service multiplexes, but also in wireless microphones.

There are individual licenses covering the use of frequencies for nationwide digital terrestrial TV service multiplexes that expire after the 30 June 2020 deadline for releasing the 700 MHz band. Similar cases exist for local digital terrestrial TV multiplex and PMSE allocations.

In addition to changes directly related to the release of the 700 MHz band, Slovakia will need to put in place changes that are not directly related to the releasing the 700 MHz band in order to ensure continuous broadcasting of terrestrial digital TV.

Changes directly related to the release of the 700 MHz band are implied in current use of the 700 MHz digital terrestrial TV band. This includes frequency swap in the 700 MHz band with frequencies below 700 MHz that cover 20 allotments for nationwide multiplexes (75 transmitters) and also substitution 4 local multiplex frequencies.

Changes not directly related to the release of the 700 MHz band (among other things, frequency swap between nationwide multiplexes and retuning frequencies outside the 700 MHz band) will come with the technical roadmap for releasing the 700 MHz.

The timetable and method for releasing the 700 MHz frequency band has to be aligned in order for the latest changes directly relating to the release of the 700 MHz band to be in place by the 30 June 2020 deadline. To release of the 700 MHz band, cooperation between the multiplex providers and the Regulatory Authority for Electronic Communications and Postal Services (hereinafter referred to as "Regulatory Authority") will be crucial.

It is envisaged that frequencies will be retuned in Slovakia to make way for the repurposing of allotments in the 700 MHz band between 1 July 2019 and 30 June 2020.

3.1 Time and technical conditions for the transition of terrestrial digital television broadcasting from the DVB-T to DVB-T2

Out of the four nationwide digital terrestrial TV multiplexes currently operating in Slovakia, one has been using the DVB T2 standard since 2016, while the other three follow the DVB-T standard.

The releasing the 700 MHz band can be joined with the transition from DVB-T to DVB-T2, although this is not a prerequisite.

Neither the start nor the end of the transition from DVB-T to DVB-T2 has been stipulated in any legislation. However, in terms of maintaining the current digital terrestrial TV broadcasting status while releasing the 700 MHz band, it should be contingent on at least a partial transition from DVB-T to DVB-T2.

In Slovakia, therefore, DVB-T will have been partially transitioned to DVB-T2 during the releasing the 700 MHz frequency band.

For nationwide broadcasting in Slovakia, the final transition of digital terrestrial TV from DVB-T to DVB-T2 is envisaged for 30 June 2022, with this period to be used in Slovakia to equip households with the appropriate TV receivers. The transition to DVB-T2 will also depend on DVB-T2/HEVC receiver household survey results.

4 Envisaged use of the 700 MHz band in Slovakia after 30 June 2020

The envisaged use in Slovakia of the 700 MHz frequency band is displayed in Figure 2. The 703-733 MHz and 758-788 MHz frequency ranges are currently reserved for mobile broadband electronic communications services.

Slovakia intends to use the 700 MHz band in compliance with the international harmonisation of MFCN, PMSE, PPDR, M2M and IoT.

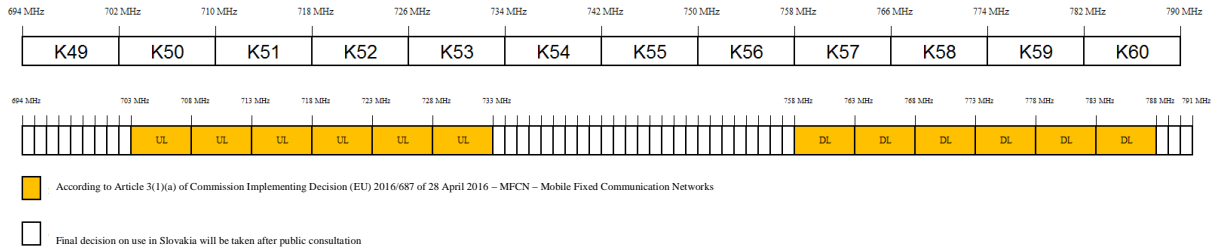


Figure 2: Envisaged use of the 700 MHz band in Slovakia after 30 June 2020

4.1 Enabling frequencies to be used for PMSE, PPDR, M2M and IoT

At present, the purpose of the remaining 694-703 MHz, 733-758 MHz and 788-791 MHz frequency ranges has not yet been definitively established. However, their use in Slovakia will be in line with international harmonisation for some of the following services: MFCN (SDL), PMSE, PPDR, M2M and IoT. Taking into account the current situation in Slovakia, it seems as if the most suitable use would be for PPDR, M2M and IoT services.

As this is a relatively broad issue with wide-ranging impact on several entities in Slovakia, a final decision will be made after public consultation, which will be handled by the Regulatory Authority.

4.2 Envisaged allocation of frequencies from the 700 MHz band

In order to achieve the maximum degree of transparency, it is envisaged that frequencies from the 700 MHz band will be allocated by means of electronic auction.

The date of the tender to allocate the frequencies from the 700 MHz band in Slovakia has yet to be fixed. However, the Regulatory Authority is anticipating that it will take place during the second half of 2019.

5 Measures envisaged to limit the negative impact of transition in Slovakia

5.1 Entities in Slovakia affected by the releasing the 700 MHz band

The need to release of the 700 MHz band and subsequent transition of a large part of digital terrestrial TV broadcasting to the band below 700 MHz will have a direct impact in Slovakia on TV multiplex providers, operators of systems of common reception of TV signals and viewers.

5.1.1 TV multiplex providers

Transmitter technology is one of the main components of TV multiplex providers that will be impacted by the transition of broadcasting to the band below 700 MHz. When releasing the 700 MHz band by the frequency swap that will be required to retune the transmitters (including repeaters), diplexers and filters. In some cases antenna systems would probably need to be either modified or even fully replaced (due to the change of antenna patterns).

When transmitter parameters are changed, the area to be covered by completing nationwide multiplexes has to be likewise figured out, with a subsequent assessment of coverage.

Nationwide multiplex provider would be among the most affected by Slovakia's releasing the 700 MHz band. Costs incurred for retuning the transmitters, in connection with the replacement of frequencies in Slovakia, would be covered by the providers themselves.

5.1.2 Operators of systems of common reception and distribution of TV signals

Based on the experience of Slovakia's switch off from analogue to digital broadcasting, it can be assumed that CATV, MMDS, MVDS and satellite system operators will not face major problems.

The situation may be different for Master Antenna Television (MATV) operators that had invested several years ago into new technology for common reception in the DVB-T standard.

5.1.3 End users

End-users – viewers using individual or common reception with their own or shared DVB-T/T2 reception will be the group in Slovakia most affected by the release of the 700 MHz band. However, households connected to MATV and households using DVB-T/T2 reception on second or third-party receivers should also be included into this group.

Retuning and transitioning TV broadcasts to the band below the 700 MHz may bring additional costs for end-users, especially for purchasing the appropriate TV receiver (set-top box).

5.2 Measures envisaged to limit the negative impact of transition on viewers in Slovakia

5.2.1 DVB-T/T2 receivers

The compatibility of DVB-T/T2 receivers with broadcasting parameters is a basic prerequisite for end-user satisfaction. This consideration was what drove the July 2015 issue in Slovakia of TNI 36 7554 "Technical Specification of DVB-T/-T2 Receivers Intended for the Slovak Market", a standard containing requirements for minimal and recommended features of digital TV receiving equipment such as receivers, set-top boxes and PC modules. From the point of view of source coding, TNI specifies that receivers should be also able to decode HEVC coding for HD format.

Sales statistics for DVB-T2/HEVC TV receivers have been favourable. It is likely that most outdated DVB-T receivers will have been upgraded to DVB-T2/HEVC receivers by the end of 2022.

5.2.2 Providing information about market availability in Slovakia of suitable DVB-T/T2 television receivers

Public awareness of the transition process is an absolute necessity. It is important to avoid as much as possible a situation where, following the transition, part of the population would be unable to receive terrestrial television broadcasts. The objective behind providing information to the public in Slovakia about the transition would be to raise awareness, minimising the negative impact of the transition to new broadcasting frequencies and the new DVB-T2/HEVC broadcasting platform on households.

The loss of TV signal reception would be particularly sensitive for socially weaker viewers and households reliant on TV broadcasts received from terrestrial transmitters, whether directly or through MATV. The information campaign should provide users with technical information and time horizons associated with the transition to new broadcasting frequencies and the DVB-T2/HEVC platform.

Due to the amount of technical details specified in TNI 36 7554, people in Slovakia with neither technical education nor background may experience problems orientating on the market and purchasing a suitable TV receiver. Warranties should be judged according to TNI 36 7554 and then marked with the "Suitable for Slovak DVB-T/-T2" logo.



Preparatory activities need to include the provision of information about the following:

- Releasing the 700 MHz frequency in Slovakia
- Upcoming transition to the new DVB-T2/HEVC broadcasting standard, its advantages and benefits it brings with high-definition broadcasts.
- What immediate impact this change will have on people receiving TV signals with individual antennas or through MATV.
- Transition timetable, new broadcast frequencies and TV programs.
- Technical details and timing of the entire transition process (specialised websites containing information about the transition, including terrestrial coverage maps and household information).

6 Summary

By 31 December 2017, Slovakia had concluded all the necessary cross-border frequency-coordination agreements with neighbouring countries (Czech Republic, Austria, Poland, Hungary and Ukraine) in accordance with Article 1 and paragraph 2 of the Decision. Signing these agreements led to preplanning of nationwide digital terrestrial television layers.

It is envisaged that frequencies will be retuned in Slovakia to make way for the releasing the allotments in the 700 MHz band between 1 July 2019 and 30 June 2020.

However, in order to successfully release of the 700 MHz band and maintain the existing state of digital terrestrial broadcasting in Slovakia, a relatively large number of changes in existing digital terrestrial television networks would need to be carried out.

The envisaged releasing the 700 MHz band in Slovakia would be time-consuming, economically difficult and technically challenging. Rolling it out in Slovakia will depend on cooperation between relevant players.

In Slovakia, digital terrestrial TV would be partially transitioned from DVB-T to DVB-T2 while the 700 MHz frequency band is released. It is envisaged that the final transition of digital terrestrial TV from DVB-T to DVB-T2 would take place before 30 June 2022, with the period to be used for equipping households in Slovakia with the appropriate TV receivers. The transition to the DVB-T2 platform would also depend on DVB-T2/HEVC receivers household survey results.

The 703-733 MHz and 758-788 MHz frequency ranges in the 700 MHz band are currently reserved for mobile broadband electronic communications services. There will be a final decision taken after public consultation on the use of the remaining 694-703 MHz, 733-758 MHz and 788-791 MHz frequency ranges from the 700 MHz band.

The date of the tender to allocate the 700 MHz band in Slovakia has yet to be fixed. The anticipated date for the electronic auction is during the second half of 2019.

The release of the 700 MHz frequency band can be expected in Slovakia to be accompanied by exposure to risk and the loss of digital terrestrial TV viewers, high costs to rebuild the broadcasting infrastructure, SFN operation exceeding the guard bands, limited frequency sources for local digital terrestrial TV and unavoidable higher costs for end-users.

End-users - viewers using individual or common reception in DVB-T/T2 standard will be the largest group affected by the releasing the 700 MHz band. Retuning and the transition of TV broadcasting below the 700 MHz band may bring additional costs for end-users, especially for purchasing the appropriate TV receiver (set-top box).

Forthcoming activities will need to include providing information to population in Slovakia about the 700 MHz band release, the upcoming transition to the new DVB-T2/HEVC broadcasting platform, the technical details and timing of the entire transition process and the placement of suitable DVB-T/T2 television reception devices on the market in Slovakia.

The objective behind providing information to the public in Slovakia about the transition would be to raise awareness, minimising the negative impact on households of the transition to new broadcasting frequencies and the new DVB-T2/HEVC broadcasting platform.

The process of releasing and repurposing the 470-790 MHz frequency band is summarised in Table 5.

Table 5: Envisaged releasing and repurposing the 470-790 frequency band after 1 July 2018

Date	Process
1.	Releasing and repurposing the 470-790 MHz frequency band
from 1. 7. 2019 to 30. 6. 2020	Releasing and making the 700 MHz frequency band available
2019	Public consultation on use of the remaining 694-703 MHz, 733-758 MHz and 788-791 MHz frequency ranges
2 nd half of 2019	Electronic auction to allocate frequencies from the 700 MHz band
2.	Transition to DVB-T2 broadcasting
from 1. 7. 2019 to 30. 6. 2020	Partial transition of digital terrestrial TV from DVB-T to DVB-T2
at the earliest after 30. 6. 2022	Final transition from DVB-T to DVB-T2
3.	Information campaign – retuning frequencies and transitioning to DVB-T2 broadcasting
from 1. 7. 2018	Preparing an information campaign
1 st quarter of 2019	Approving the information campaign
from 2 nd half of 2019	Running the information campaign