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THE TRANSITION OF THE REPUBLIC OF MOLDOVA TO DIGITAL TERRESTRIAL TELEVISION

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ПЕРЕХІД РЕСПУБЛІКИ МОЛДОВА ДО ЦИФРОВОГО НАЗЕМНОГО ТЕЛЕБАЧЕННЯ

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Abstract. *The paper contains the description of the current situation in the Republic of Moldova and the necessary conditions for the transition to digital terrestrial television. It explained the division of the territory of the Republic of Moldova in 6 different geographical zones and the distribution of the digital television channels in each area. Is indicated the signal coverage of different emission stations. Is indicated the selected technology for designed network of digital terrestrial television.*

Key words: *Digital terrestrial television, DVB, DVB-T2, SFN), multiplexing, modulation, MPEG, H.264, H265, Digital Dividend.*

Анотація. *У статті міститься опис поточної ситуації в Республіці Молдова стосовно переходу на цифрове наземне телебачення. Показано поділ території Республіки Молдова на 6 національних зон цифрового наземного телевізійного мовлення. Показано площі покриття сигналом, що їх забезпечують передавальні станції. Вказано обрані технології для проектованої мережі цифрового наземного телебачення.*

Ключові слова: *модуляція, мультиплексування, цифрове наземне телебачення, цифровий дивіденд, DVB, DVB-T2, H.264, H265, MPEG, SFN.*

Аннотация. *В статье содержится описание текущей ситуации в Республике Молдова касающейся перехода на цифровое наземное телевидение. Показано разделение территории Республики Молдова на 6 национальных зон цифрового наземного телевизионного вещания. Показаны площади покрытия сигналом, обеспечиваемые передающими станциями. Указываются выбранные технологии для проектируемой сети цифрового наземного телевидения.*

Ключевые слова: *Цифровое наземное телевидение, DVB, DVB-T2, SFN, мультиплексирование, модуляция, MPEG, H.264, H265, Цифровой Дивиденд.*

INTRODUCTION

The contemporary period is characterized by the advanced development of digital signal processing technologies, integration with communications and multimedia technologies. Over the past decades, It held an advanced process of transition from analogue to digital television - systems that have some undeniable advantages based partly on implementing intelligent signal processing

methods and elsewhere on implementing unification processes interfaces that have a point of connection between different systems and allow the use of these systems at large.

The advantages of digital television to analogue are: the multitude of images, including the high resolution HD image; much more effectively is managed radio spectrum; the digital image is better quality than the analog image - it is clearer, it contains more detail because it is resistant to interference and noise; the viewer can receive additional information - such as the Electronic Program Guide (EPG) table; there is an opportunity to receive additional facilities - multilingual support, titles in different languages; a five-channel sound can be transmitted to the digital channel; and so on.

Several digital television systems are currently use in the world, such as the Advanced Television Systems Committee (ATSC) - implemented in the United States, Canada, Mexico, Argentina, Taiwan and South Korea; ISDB (Integrated Services Digital Broadcasting) - implemented in Japan, South America and other countries of the world; DMB (Digital Multimedia Broadcasting) - implemented in China, Cuba, Hong Kong and other countries.

DVB (Digital Video Broadcasting) - is a series of standards in the DTV field, developed by an international consortium working as DVB Project today, consisting about 300 companies in 35 countries. These DVB standards are successfully used in the countries of the European Union, Russia, Australia, Ukraine, the Republic of Moldova, in most African countries and many other countries in the world. The digital television standards developed by the DVB Project consortium are known under the following names: DVB-T, DVB-T2 - terrestrial broadcasting; DVB-H, DVB-SH, DVB-H2 - for portable devices; DVB-S, DVB-S2, DVB-S2X - satellite broadcasting; DVB-C, DVB-C2 – cable.

DVB-T, DVB-T2 (Digital Video Broadcasting – Terrestrial) are systems that use coding of Moving Pictures Experts Group (MPEG) and provide solutions for various digital terrestrial television applications. According to the statistical data from 2013 on the distribution of digital standards, DVB-T/T2 standard prevails in the world, (see Figure 1).

Figure 1 – The distribution of digital standards in the world.

So, at the global level, the end of the past millennium was marked by the beginning of the transition to digital broadcasting with the adoption of a string of standards for different TV transmission systems. It is worth mentioning that the implementation of these digital technologies, with the use of the Moving Pictures Experts Group (MPEG), is a set of standards that describe the compression algorithms for digital video and audio signals.

Due to the geographic location of the Republic of Moldova in Europe, DVB-T and DVB-T2 digital terrestrial television standards are currently being used. In the near future, we will rely on only DVB-T2.

1 SIGNALS CODING MULTIPLEXES CREATING

Implementation of digital television systems is possible, only in conjunction with the use of coding/compression systems for digital signals. This need can be explained by the following arguments, having as example the analog video signal at the encoder MPEG:

1. For the digitization of analog signals are used two technical procedures - meshing and analogue quantization;

2. The video signal in the MPEG compression encoder is divided into three components - the luminance signal Y and two difference signals in the CB and CR colors, each component patch is coded separately;

3. For the SD system with standard image resolution, the Y signal can be discretized at 13.5 MHz, but the C_B and C_R signals at 6.75 MHz. If we quantify the analog signal in 256 levels, which corresponds to an 8-bit digital signal, we obtain the following data stream speed - (13.5 MHz x 8 bits + 2 x 6.75 MHz x 8 bits) = 216 Mbit/s;

4. In the Republic of Moldova the bandwidth of a terrestrial television channel is 8 MHz. To transmit digital stream at a speed of 216 Mb/s, it is necessary to expand the bandwidth of approx. 10 times. Only to match analogue television is necessary to compress the digital stream in a proportion of 10: 1. But for economic attractiveness of new systems it is necessary much higher compression ratios.

Currently in the world are used two standards of copying digital video: H.262/MPEG-2 and H.264 AVC/MPEG-4. Recently, the H.265 HEVC/MPEG-H standard has been developed that contains some undeniable advantages in terms of system capacity. This standard is already being implemented in many countries around the world.

It is worth mentioning that the Audio signal in DVB-T, DVB-T2 systems is coded according to the algorithm MPEG-1 Audio Layer II.

The main purpose of the DVB-T, DVB-T2 digital television system is to transmit several services (TV programs, RD programs, teletext, EPG table, etc.) to the terrestrial television channel in the frequency band. In order to achieve this goal, it is necessary to perform the procedure of multiplexing the coded signals. There are two levels of multiplexing. At the first level, the parts of a service are multiplexed. The second multiplexing layer involves multiplexing of components that refer to different services, (see Figure 2).

This coding and multiplexing station is defined by the name "Head End" and is the central part of any digital television system. At the exit of the Head End we get the packed digital stream which is then transmitted according to the system specifications to the transmitter input.

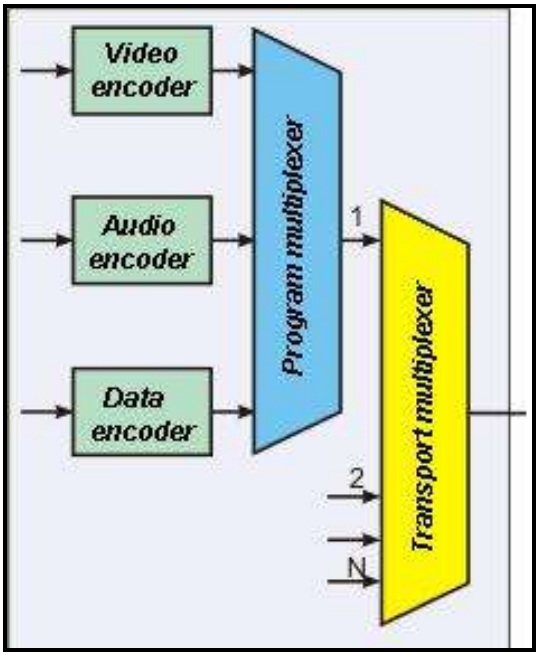

Figure 2 – Composition of the signal coding "Head End" and multiplexing station.

In 2003, SE. "Radiocommunications" launched the first station "Head End" H.262 that together with the DVB-T system has provided digital terrestrial television services in the Chisinau area. At the beginning of 2011, the H.264 coders, which are currently operating, have been put into operation, providing with the signal of Chisinau municipality and the first national digital multiplex.

In 2017, the company's specialists began the technical testing of H.265 encoders for the purpose of applying this modern technology to the formation of national digital TV multiplexes. The real tests that were carried out in Chisinau on Channel 58, demonstrated the efficiency of the new compression technology.

Based on the arguments presented to the Ministry of Information Technology and Communications, by Government Decision no.52 of 01.02.2017 H.264 and H.265 technologies have been approved in accordance with national compression standards. Dealing with the fact that the transition to digital terrestrial television is slow, technologically and legislatively, Moldova is aligned with the latest standards alongside Germany, Croatia, etc., and even more advanced than neighboring countries. The capabilities of coding systems in the years 2016-2017, obtained from tests conducted by SE "Radiocommunications" specialists, are presented in (Figure 3).

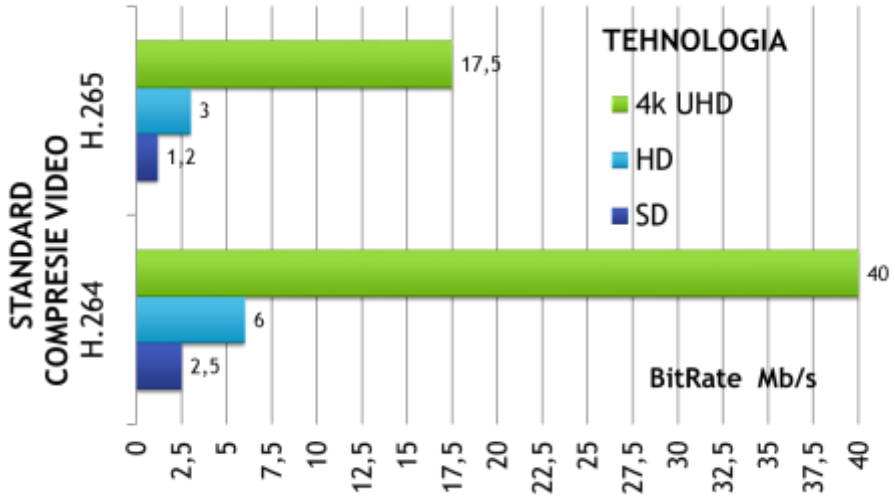

Figure 3 – The coding capabilities of H.264 and H.265 systems.

2 DVB-T & DVB-T2 SYSTEMS

The digital terrestrial television system is defined as a functional unit of equipment, which ensures the adaptation of digital TV signals, coded according to MPEG algorithms and to the technical characteristics of the terrestrial emission standards. DVB-T and DVB-T2 use the principle of OFDM division (Orthogonal Freguency Division Multiplexing), which divides the flow of data across multiple slow streams. These obtained streams modulate subparts. For DVB-T, DVB-T2 is allocated channels previously intended for analogue terrestrial television, with bandwidth of 8 MHz, 7 MHz or 6 MHz. For example, in the DVB-T standard, a single Orthogonal Frequency Division Multiplexing (OFDM) symbol may contain 1705 or 6817 orthogonal carriers named "2k" or "8k".

DVB-T and DVB-T2 systems can operate in single frequency (SFN) and multifrequency networks (MFN).

The DVB-T2 standard is the next generation of the DVB-T digital standard. It was created to increase the capacity of television networks by approx. 30% compared to DVB-T. In the DVB-T2 standard, has been increased the number of carrier frequencies up to "32k" and has been introduced 256 QAM modulation. As a result, the system capacity increase of approx. 50%. Therefore we have

the possibility to increase the number of TV stations or their definition. The maximum signal speed in the DVB-T2 system can reach 50.3 Mbit/s. The capacity of the DVB-T2 format depends on the settings made on the broadcast equipment. The settings in turn are quite flexible.

DVB-T2 technology is based on two types of modulation. The first is called "Mode A". All the signals (or TV programs) are also processed at the "HeadEnd" base station and then emitted by the digital emitter. As a result, we have the same modulation and coverage for all TV programs, see (Figure 4).

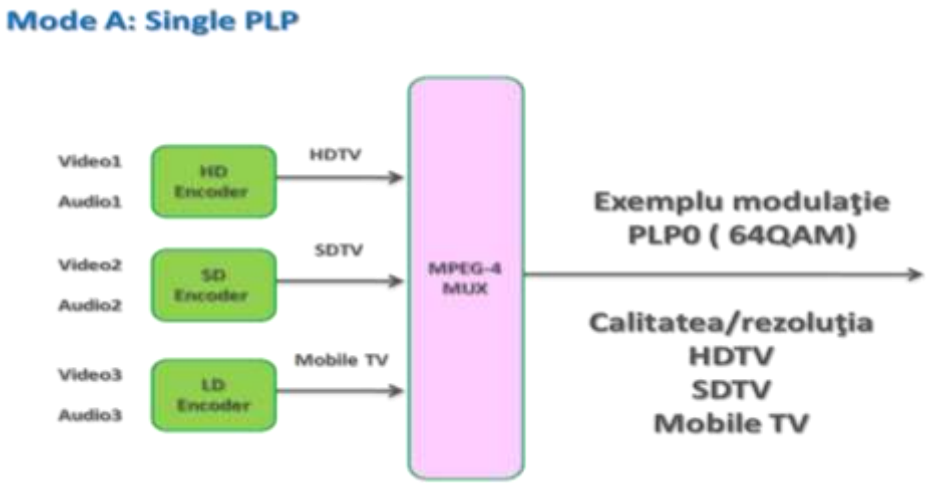

Figure 4 – Modulation "Mode A".

The second type of modulation in DVB-T2 called "Mode B" (see Figure 5). This mode allows to process a different program or group of programs differently. As an example, we can modulate carrier frequencies by 256-QAM ("fast" flow, the smallest coverage area) or QPSK ("slow" flow, the largest coverage). This multiple modulation mechanism is also called Physical Layer Pipe (PLP) and can be translated as the physical channel layer. At the same time, Mode B allows the construction of SFN networks.

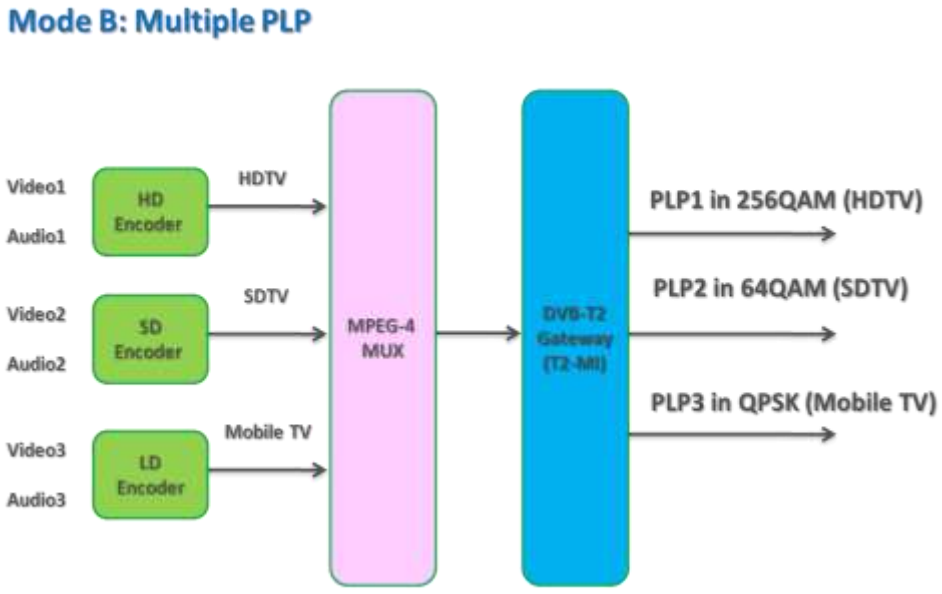

Figure 5 – Modulation "Mode B"

The DVB-T2 standard was chosen in the Republic of Moldova for the implementation of the national digital terrestrial television multiplexs. In 2015 SE. Radiocommunications has built the first MUX-A national multiplex, which was later put into operation in 2016, based on the H.264 AVC/MPEG-4 encoding system. This multiswitch provides with the DVB-T2 signal 6 coverage areas all over the country. The transmitters of each zone functioned with a single frequency (Single Frequency Network (SFN), modulation mode „Mode B" Single PLP.

In 2016 SE. "Radiocommunications" has built the second MUX-B national multiplex that is ready to be put into operation after stop the broadcast of the national analogue terrestrial television. Is expected migration from the H.264 to H.265 coding system.

3 DISTRIBUTION OF THE RADIO SPECTRUM

In accordance with the provisions of the Regional Agreement on Terrestrial Digital Broadcasting Service Planning, signed at the Regional Radiocommunications ITU (Geneva) Conference in 2006 (RRC-06) and ratified by Law no. 69-XVI of March 27, 2008 (Official journal of the Republic of Moldova, 2008, No. 74-75, art. 247), starting with June 17, 2015, the Republic of Moldova assumed the responsibility to complete the digitization of the terrestrial broadcasting.

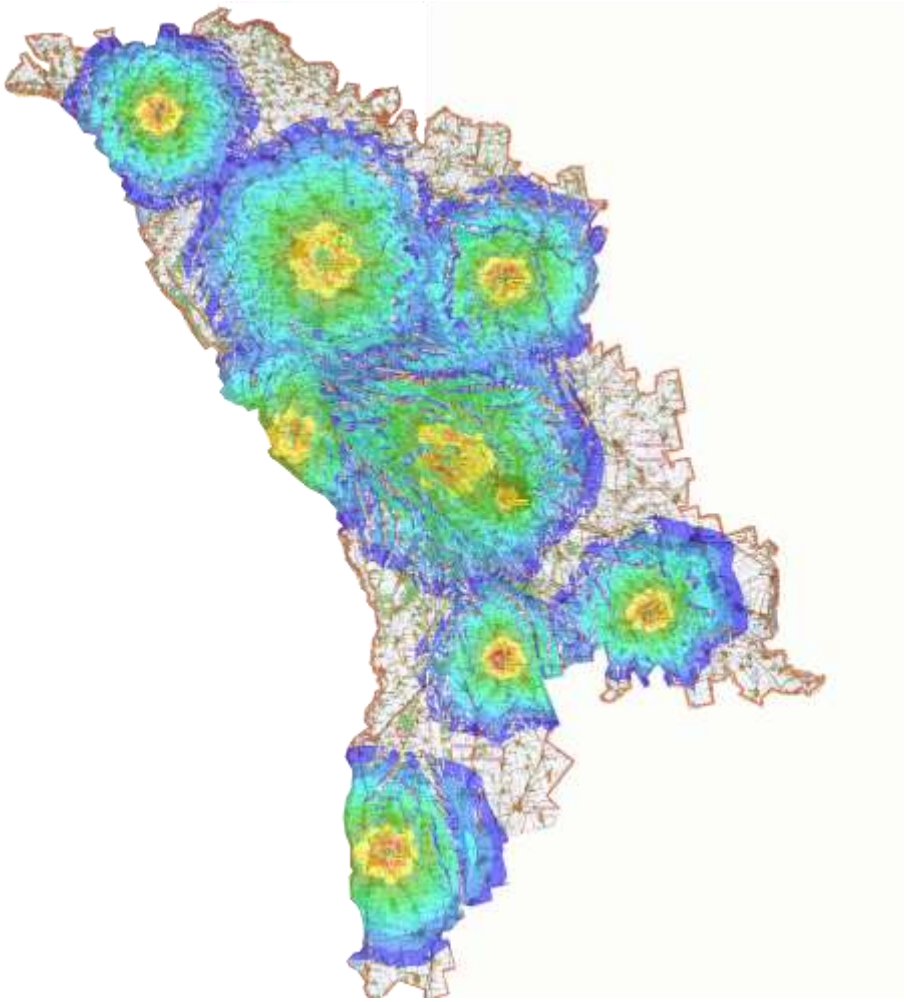

Figure 6 – Coverage of the MUX-A signal on the territory of the Republic of Moldova

At that conference, a new frequency plan (replacing the frequency plan for analogue TV transmissions) defining the use of transmission bands III (VHF - 174-230 MHz) and bands IV/V (UHF - 470-862 MHz) for digital terrestrial transmission. According to this plan, 62 TV channels were allocated to the Republic of Moldova.

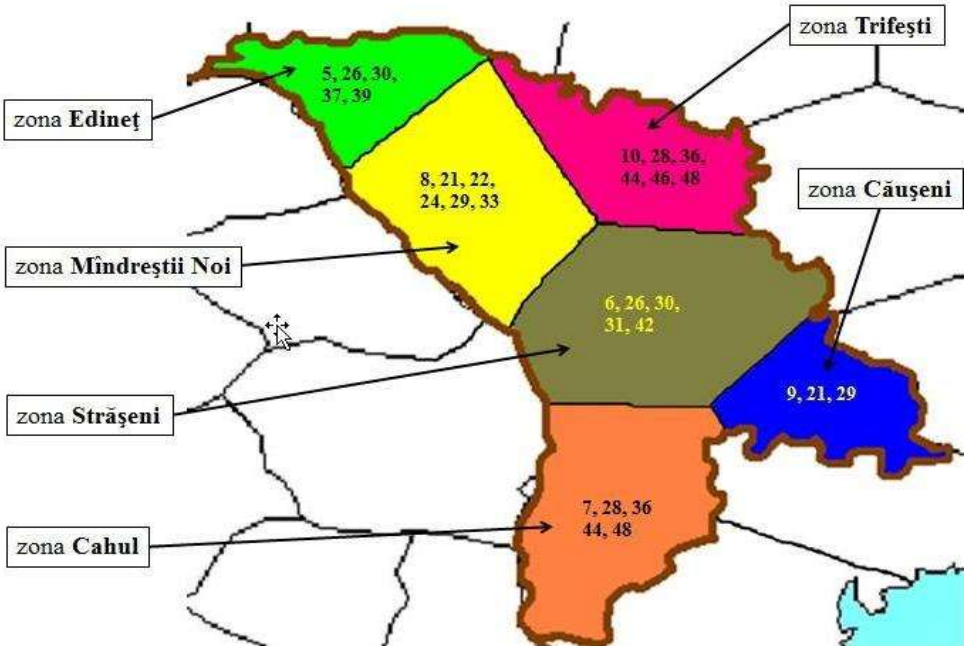

Figure 7. Distribution of digital television channels for national areas.

According to the final documents RRC-06, the territory of the Republic of Moldova is divided into 6 zones to which the following resources have been allocated for the implementation of digital terrestrial television: 6 TV channels were allocated for each area, with a total of 36 zonal channels. Using 6 TV channels we have the possibility to build a multiplex with national coverage. Also, the territory of the Republic of Moldova has been divided into 12 regions to which 26 channels have been allocated for the implementation of digital terrestrial television.

By the Government Decision of the Republic of Moldova no. 116 of February 11, 2013, the 790-862 MHz spectrum (channels 61-69), also called the "Digital-1 Dividend", was transmitted to mobile telephony operators. The recent World Radiocommunication Conference (RRC-12, Regional Radiocomunication Conference), held in Geneva from January 23 to February 17, 2012, recommended the use of the 694-790 MHz band (also known as the "Digital Dividend- 2 ") for mobile electronic communications services. The results of the analysis will be presented and discussed at the next World Radio Conferences. In case of approval, the possibilities of deploying digital terrestrial television in the UHF band will be constrained. So, the national digital plan could be reduced, de facto, and with the TV channel 49-60.

In the Republic of Moldova, can be constructed 3 digital multiplexes with national coverage (2 UHF multiplexes and 1 multiplex in the VHF band), as well as 21 regional digital multiplexes. The distribution of channels for digital terrestrial television in Moldova is shown in (Figure 7) and (Figure 8).

At present, the Republic of Moldova is going through a transition period in which coexist analogue TV networks and broadcast digital signals.

As of June 17, 2015, analogue TV channels do not benefit from protection in case of disturbances caused by digital television channels, and in case of disturbances from analogue TV channels to digital television channels, broadcasting on these analogue channels will be closed.

Figure 8. Distribution of digital television channels for regional areas.

4 RECEPTION OF DVB-T, DVB-T2 SIGNALS

In order to receive the TV signal, the viewer has two options: using modern TV sets equipped with built-in digital receivers or older set-top boxes requires the use of external digital receivers (so-called set-top boxes). Set-top box connects to the TV as a video cassette or DVD player. In both cases, the receiving antenna is an ordinary antenna that has previously been used to receive analog signals in the UHF band.

5 CONCLUSIONS

1. The process of extending coverage areas with the DVB-T2 signal in the Republic of Moldova can be implemented only gradually and simultaneously with the gradual decrease of the coverage areas of the analogue terrestrial television networks.

2. Implementation of the H.265 HEVC/MPEG-H encoding system will enhance the process of reducing the number of carriers incurred by operators in order to transmit a service within national multiplexes.

3. Implementation of digital terrestrial television in the Republic of Moldova is a big advantage because will be an increase of access of the population to information and elsewhere it will significantly improve the quality of the image.

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