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XII Халықаралық ғылыми конференциясының
БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ
XII Международной научной конференции
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«НАУКА И ОБРАЗОВАНИЕ – 2017»

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«SCIENCE AND EDUCATION - 2017»

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RESEARCH COVERAGE AREA OF BY USING TELEVISION (TV) TRANSMITTER DVB-T2 STANDARD

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The basic principle of DVB standards family is that they should be consistent with each other. That is, the signal conversion should be as simple as possible while it's transferring from one format to another (e.g., from DVB-S2 format in DVB-T2). In addition, when developing new DVB standards should be used the same mechanisms as in the existing standards of this family.

DVB-T2 format is improved and functionally advanced successor of DVB-T format. Comparative characteristics of the two systems, taken from the relevant standards are listed in Table. 1.

Table 1

Comparative characteristics of DVB-T and DVB-T2 formats

Name of parameter	**DVB-T format**	**DVB-T2 format**
Number of carrier frequencies	2000, 4000, 8000	2000, 4000, 8000, 32 000
Noiseless coding, code rate	½, 2/3, ¾, 5/6, 7/8	½, 3/5, 2/3, ¾, 4/5, 5/6
Modulation of the carrier frequencies in the frequency block OFDM-modulation	QPSK, 16-QAM, 64-QAM	QPSK, 16-QAM, 64-QAM, 256-QAM
Dimension of FFT (K=1024)	2K, 8K	1K, 2K, 4K, 8K, 16K, 32K
The value of protective interval of OFDM-symbol	¼, 1/8, 1/16, 1/,32	¼, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Share of distributed pilot-signals from the number of carrier frequencies	8% from the total amount of carrier frequencies	1, 2, 4, 8%
Proportion of fixed pilot signals from the total number of carrier frequencies	2,0%	0,4-2,4% (0,4-0,8% when 8K-24K)
Radio channel frequency band	6, 7, 8	1,7; 5, 6, 7, 8, 10
Bit rate, Mbit/s	24	40
The maximum bit rate (with relation signal / noise ratio of 20 dB)	31,7 (radio frequency band at a 8 MHz)	45,5
Frame header	1%	0,7%
Rotation of signal constellation	No	Yes
ratio signal/noise with bit rate 24 Mbit/s, db	16,7	10,8
Modulator interface	MPEG-2 TS ASI IP	T2-MI ASI IP

In DVB-T2 [1] the basic ideas of the digital signal processing implemented in the DVB-T are saved. They are scrambling, interleaving, noiseless coding, modulation type, but every type of data processing is improved and extended.

Two key DVB-T2 technologies borrowed from the standard DVB-S2 [2] namely:

- System Architecture of transport streams, primarily the encapsulation of digital data in the low-frequency baseband-frames (BB);

- Using a Noise code with a low density parity check (LDPC).

In DVB-T2 the header of BB-frame (see Fig. 1) contains information about the nature of the data. Then there are the actual figures BB-frame, followed by the check bits of error-correcting coding LDPC (low density parity check codes). To eliminate errors remaining after LDPC-decoding the digital data information additionally protected by short-BCH-code (code Bose - Chaudhuri - Hocquenghem).

Commercial requirements to the dvb-t2 standard include providing of different levels of immunity for different types of services (blocks of digital data)

The total length of the frame with the bits of FEC (forward error correction) is 64 800 bits. The share of the forward error correction bits can vary from 15 to 50% of their total number in the FEC-frame. And also allowed a shorter version of FEC-frame of 16 200 bits long. It can be used to reduce delays when receiving services. The data transmitted within the BB frame usually represent a sequence of transport packets MPEG-2 standard. At the same time, fields of signaling in the header of BB-frame are fully compatible with the encapsulation system of IP-packets over DVB-protocol called Generic-stream encapsulation (GSE).

The test simulation of error-correcting coding work based on the control bits of LDPC showed a significant increase in noise immunity than to the protection of digital data, used in DVB-T, i.e. compared to the high-precision coding (SC). The dependences of bit error rate (BER) of the ratio of "signal / noise" are shown in Fig. 2. Here are the comparative figures for both cases.

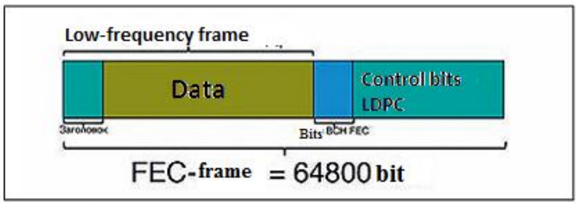

Figure 1. Frame structure

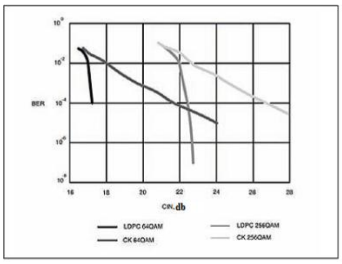

Figure 2. Comparing LDPC and CK

It can be seen that the LDPC and BCH codes provide higher noise immunity than the RS and SC codes, which allows to transfer more information in the channel. In the DVB-T2 additionally incorporated relative coding rate 3/5 and 4/5. The winning is approximately 5 dB in respect the "signal / noise" due to the use of new methods of error-correcting coding for the DVB-T2 standard with identical BER value.

Besides the error-correcting coding in DVB-T2 system also three stages of interleaving are used. This virtually guarantees that the distorted elements, including the burst errors, after deinterleaving procedure performed in the decoder will be scattered on the FEC-frame. This should allow the LDPC decoder to recover the original data without distortion. Here are the stages of interleaving:

- Bit interleaving carries out this procedure within each FEC-block;
- Temporary interleaving produces process of FEC-frame interleaving by using modulation symbols which increases resistance of signal to impulse noises and to changes in the characteristics of radio channel;
- The frequency interleaving redistributes the digital data by different carrier frequencies of OFDM-symbol in order to weaken the influence of selective frequency fading in the radio channel.

A number of options such as new dimensions of FFT, values of guard interval, as well as new types of arrangement of the pilot signals, is inserted for better optimization of radio channel parameters depending on his changing characteristics.

The more dense arrangement of pilot signals in OFDM-symbol can be used to reduce required for normal operation of the receiver with the ratio "signal to noise" or to improve synchronization

In DVB-T2 [3] encapsulation of data may be performed not only in the transport stream of MPEG-TS, but also in a general purpose transport stream GSE (generic stream encapsulation), which allows to reduce the amount of transmitted information and to make adaptation of the traffic flow to a network more flexible. Compared with DVB-T in the DVB-T2 binding to a data structure on the transport level does not exist.

In DVB-T all frequency band of radio channel is used to transmit one traffic stream. (single mode). In contrast to this, in DVB-T2 is used the concept of physical level pipes (plp) - it means there can be transferring in one channel several logical channels. There are two modes in DVB-T2: with transferring single PLP - mode A, with transferring multi PLP - mode B. In mode B a few traffic stream passed at the same time, and each of them is placed in its own channel of physical level PLP. It allows to ensure the coexistence of services (data) in one radio channel which were transmitted with varying degree of noise immunity at the expense of choice in them different modes of modulation and noise immunity coding (Fig. 3). In other words, the operator can choose a different transfer speed of digital data, different noise immunity and respectively different volume of digital data (information) which were transmitted in each plp.

Receiver decodes only selected PLP and is turned off at the time when transferring other PLP that are not interested in subscriber that provides energy savings.

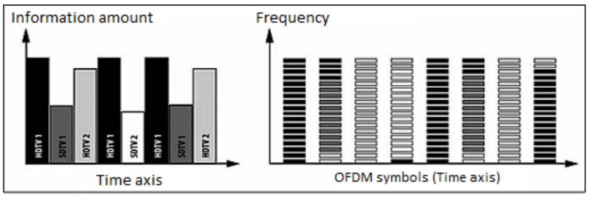

Figure 3. Sample of using PLP

In single frequency networks of DVB-T2 can be supported MISO technology (multiple input - single output) using coding Alamouti. In this case, the data of the same program is distributed over a plurality of carrier frequencies. The DVB-T2 format also includes the ability to receive signals separately from two transmitters. In those cases, where the receiver is able to receive a signal from two transmitters, for example, when receiving on a non-directional antenna in a small single-frequency network, this can significantly improve the operation of the system: the possibility to split and separately decode the signals which were received from two different broadcast transmitters without loss. Preliminary calculations showed that this technique allows to increase coverage zone of small single-frequency networks to 30%.

In the DVB-T2 system, the OFDM modulation with guard intervals (GI-OFDM) is selected, which is also used in the DVB-T system. In GI-OFDM, each digital data block is transmitted on a large number of orthogonal carrier frequencies, modulated simultaneously in phase and amplitude (OFDM / QAM modulation). In this case, DVB-T format provides only two modes of modulator operation - 2K and 8K (K = 1024). These numbers reflect the dimension of the inverse fast Fourier transform (IFFT) used to generate a signal with a plurality of orthogonal carrier frequencies. However, the actual number of carrier frequencies used to transmit digital data is somewhat smaller. To protect modulated carrier signals (I.e., each carrier frequency used to transmit the symbol) from possible distortions under multipath conditions, a duplication of the end of each OFDM symbol in the guard interval is introduced, as shown in Fig. 4.

Format DVB-T2 also includes opportunity to receive separately signals from two transmitters. The length of the OFDM symbol guard interval is selected depending on the length of the radio channel and other parameters of the transmission network. Longer guard intervals are required in single frequency broadcasting networks, where signals from neighboring transmitters can arrive at a reception point with a significant delay relative to the main signal. The protective interval is a superstructure that consumes a share of the transport resource. In DVB-T, this superstructure may take up to 1/4 of the total amount of transmitted data. To extend the guard interval without increasing its share in the total data volume, two additional operating modes were introduced in DVB-T2 during the formation of the OFDM symbol. These modes are 16K and 32K (to increase the number of orthogonal carrier frequencies). Fig. 5 illustrates the transition to a mode with a large number of carrier frequencies in the OFDM symbol. Moreover, what is important, the length of the guard interval OFDM symbol remains the same, but its share in the total duration OFDM symbol is reduced.

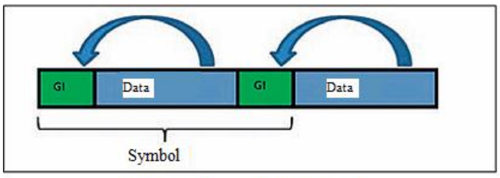

Figure 4. Using of guard intervals

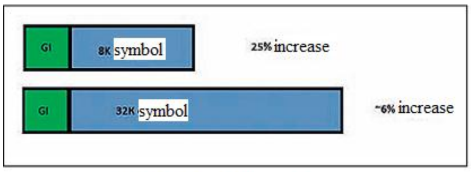

Figure 5. Using of longer intervals

The maximum guard interval length in DVB-T2 system takes place in the 32K mode, when a ratio of a guard interval GI and the entire symbol length equal to 19/128. In this case, the duration of the protective GI interval greater than 500 ms, which is sufficient for the construction of a large single frequency network. Thus, DVB-T2 format offers a wide range of FFT dimensions and guard interval:

• FFT Dimensions: 1K, 2K, 4K, 8K, 16K, 32K, where K = 1024;
• Relative duration of guard intervals: 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4.

As noted above, each OFDM symbol carrier frequency is modulated in phase and amplitude. In the DVB-T system, each modulation symbol contains six bits when modulating OFDM / 64-QAM, In contrast, in DVB-T2, the largest length of the modulation symbol is eight bits (OFDM / 256-QAM modulation). Despite the fact that this type of modulation is more sensitive to errors, due to channel noise, The test tests showed that the use of noise-immune encoding LDPC in the FEC frame provides a 30% increase in channel efficiency compared to DVB-T.

So, as a result of the foregoing, it can be concluded that in the Kazakhstan the implementation of DVB-T2 standard which has significantly better parameters in comparison with the DVB-T is justified.

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ПРОЕКТИРОВАНИЕ РАДИОПРИЕМНОГО УСТРОЙСТВА ЗВУКОВОГО СОПРОВОЖДЕНИЯ TV – ПРОГРАММ

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Как известно, более 80 процентов информации человек получает через зрение. Вместе с тем нельзя не отметить, что в условиях избыточности визуальной информации основным ее