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CHOOSING A COMPRESSION STANDARD FOR TRANSMITTING A TELEVISION IMAGE

Abstract. With the advent of the MPEG-4 Visual and H.264 compression standards, the role of the MPEG-2 compression standard has not diminished at the present time, since these standards are largely compatible, especially for information highways. Today, in a number of countries, the MPEG-2 compression standard is actually the main one for broadcasting, the functioning of which is based on the operation of DVB-T terrestrial digital television systems.

Due to the fact that the majority of the currently used STBs support the MPEG-2 standard, it will remain widespread for at least the next few years.

The ITU-T H.264 /MPEG-4 Part 10 AVC standard (abbreviated as H.264/AVC) is a promising new technology for encoding and compressing audiovisual information. The compression efficiency of the H.264/AVC standard is higher than the MPEG-2 standard with equal visual perception. The H.264/AVC standard was developed independent of the transport layer of the transmission systems used. Therefore, information delivery in the H.264/AVC standard can be carried out using any existing transmission and broadcasting systems, including: systems with IP protocols (including streaming delivery), transport streams of broadcasting systems in the MPEG-2 standard, as well as specific formats H.264 / AVC files for storage and processing on servers.

Keywords: standard, digital TV broadcasting, codec, signal, IP protocol.

The ITU-T H.264/MPEG-4 Part 10 AVC standard (abbreviated as H.264/AVC) is a promising new technology for encoding and compressing audiovisual information. The compression efficiency of the H.264/AVC standard is higher than the MPEG-2 standard with equal visual perception. The H.264/AVC standard was developed independent of the transport layer of the transmission systems used. Therefore, the delivery of information in the H.264/AVC standard can be carried out on any existing systems transmission and broadcasting, including: systems with IP protocols (including streaming delivery), transport streams of broadcasting systems in the MPEG-2 standard, as well as specific H.264/AVC file formats for their storage and processing on servers.

Thus, existing MPEG-2 digital TV broadcasting networks are directly suitable for transmitting to users H.264/AVC programs, the number of which in the multiplex will be greater.

To switch to broadcasting in the H.264/AVC standard, international standardization of terminal equipment is required: digital studios and subscriber receiver decoders. For transmission paths of transport streams, specific support of the H.264/AVC standard by statistical multiplexers, in which operations of decoding and compressing program information are performed, will be required. Advantages of the H.264/AVC standard. With the same image quality, the H.264/AVC standard requires approximately half the digital bit rate than MPEG-2. This allows you to either increase the number of standard definition television (SDTV) programs or transmit HDTV programs.

Unlike MPEG-2, the H.264/AVC standard allows you to transfer images with a lower resolution (1/16 standard resolution) at very low digital bit rates. This allows you to organize the transfer of low-definition TV programs to mobile phones, PDAs, TV receivers in cars, etc. The capabilities of the H.264/AVC standard for compressing images of various quality are shown in table 1.1.

Table 1.1 - H.264 / AVC Image Compression Capabilities

Application scenario	Resolution and frame rate	Transmission speed, kbps
Mobile content	176x144, 10-15 frame/s	50-60
Internet / Standard Definition	640x480, 24 frame /s	1000-2000
High definition	1280x720, 24p	5000-6000
Full high definition	1920x1080, 24p	7000-8000

In a number of European countries, a large number of transmission networks based on MPEG2 technology are currently deployed and operate. In such publicly accessible digital TV broadcasting networks with the set-top boxes and MPEG-2 decoders already installed, the transition to the H.264/AVC standard will be difficult for many years, while the existing MPEG-2 set-top boxes are actively used.

In addition, this will also impede the implementation of HDTV in the H.264/AVC standard. Possible alternatives: reloading new H.264/AVC decoding software, installing additional modules (decoding or converting standards) in the set-top boxes. The mildest alternative to replacing the MPEG-2 set-top boxes is the duplication of digital TV broadcasting in the MPEG-2 and H.264/AVC standards, but this is only possible if there are free radio frequencies released as the analog broadcast is turned off.

In paid digital TV broadcast networks, the situation is very different. In this case, broadcasters can coordinate the updating of decoders of their subscribers. But for financial reasons, this transfer can only begin after depreciation of the initial paid equipment, i.e. a few years after putting it into operation.

In all cases, users should be given full clarity regarding the prospects of the development of digital broadcasting and the possibilities of using the equipment.

Therefore, in order to minimize the cost of viewers during the first few years, without slowing down the implementation of HDTV, the digital set-top boxes offered to the population should have the options necessary to receive both current and future services, i.e., first of all, they must support the H.264/AVC standard, for standard definition television (HDTV) and high definition (HDTV).

The use of H.264 / AVC encoders in window devices currently requires the use of digital TV program transmission systems (SDTV and HDTV) in the ADSL standard with a bandwidth of 4 ... 6 Mbit / s.

It is believed that modern ADSL modems-decoders should support decoding in MPEG-2 and H.264/AVC standards using the same software, which will eliminate the complexity of the transition from MPEG-2 to H.264/AVC.

It should be borne in mind that when deploying mobile television networks of the DVB-H standard, all ongoing development and experiments are based on the H.264/AVC standard, as a more effective one.

Principles of building digital terrestrial television broadcasting systems in the H.264/MPEG-4 AVC standard.

Currently, there is an increased interest in encoding and digital broadcasting of TV programs in the H.264/MPEG-4 AVC standard in the world.

It is known that in the world there are also a number of proposals and experiments conducted on the use of the H.264/MPEG-4 standard instead of the MPEG-2 standard for encoding standard definition TV images.

In this regard, digital TV broadcasting systems that use the H.264/MPEG-4 AVC compression algorithm have certain development prospects. In such systems, the transmission of high-definition TV programs (HDTV) and an increased number of standard-definition programs is possible, which allows the audience to provide new services and make better use of the frequency resource. When switching to digital TV broadcasting, it is necessary to take into account all aspects of digital broadcasting of TV programs in the H.264/MPEG-4 AVC standard as an alternative to the MPEG-2 standard.

The transition to digital TV broadcasting is preferably carried out at the level of individual regions as they become available. You can, as an example, propose a distribution and broadcasting scheme for digital TV programs for a single region with a family number of about 300-350 thousand. The general idea is that the central program block is distributed via satellite channels in MPEG-2 format (which is most often the case at present).

But in the regional center these programs are converted to MPEG-4 format and multiplexed with other regional programs (both high and standard definition), originally encoded in MPEG-4 format. In principle, depending on the available resources, several digital multiplexes in MPEG-4 may be formed in the region, including high-definition and standard-definition programs. Then these multiplexes should be

distributed to the population on digital terrestrial and cable TV broadcasting networks. The transmitters of the regional single-frequency network of digital TV broadcasting can be downloaded via satellite channels (as shown in the diagram) or via fiber optic cables.

At the same time, it should be noted that in order to improve the quality of the final image received by the consumer, it is advisable to avoid re-compression of previously compressed digital signals, or, if possible, reduce the number of nodes in the distribution network of programs in which such compression occurs.

Under these conditions, it is advisable, given the technical ability, to build the entire program delivery network based on H.264/MPEG-4 AVC. In the absence of such a possibility, an alternative may be the use of optimized encoders that re-compress MPEG2-MPEG4 with minimal loss of image quality [1].

When using any compression methods for TV programs, quality is an important issue. Both MPEG2 and H.264/MPEG-4 are lossy compression technologies. This means that once lost due to compression, the image details cannot be restored. Modern compression technologies make it possible to achieve very high rates of decreasing the speed of the digital stream, but at the same time you can get an image that is significantly inferior in quality to the image of an analog TV under good reception conditions, especially for dynamic scenes.

Therefore, it is important to standardize the minimum bit rate for transmitting a standard quality program (SDTV) in both MPEG2 and MPEG4 standards. Practical experiments with the currently available encoder models show that to ensure high-quality broadcasting of one TV program in SDTV in the H.264/MPEG-4 standard, at least 2.5 Mbit/s is required, and in the MPEG2 standard - 4.5 Mbit/s. Using statistical multiplexing with a variable signal coding rate (VBR) allows this value to be slightly reduced without loss of quality, but only with careful equipment setup [2].

Thus, the introduction of H.264/MPEG-4 compression technology will increase the number of transmitted programs within a single multiplex (with a fixed reception of 64 QAM, 24 Mbps) from 4-5 to 9-10 programs of standard quality. Currently, in most cities the number of received analog TV programs does not exceed 10.

Thus, the use of modern equipment and technologies based on MPEG4 will make it possible to duplicate all programs accepted by the population using one multiplex, which will not only save the frequency resource, but also open the way to a two-step transition model from analog to digital broadcasting. At the same time, the first step within the region ensures the broadcasting of all TV programs in digital format, and the second step (after the distribution of digital set-top boxes among the population).

Switching to HDTV is facilitated if the receivers support all H.264/MPEG-4 profiles up to 1920×1080, 24/25p. In order to ensure the transition to HDTV, it is advisable to distribute only TV set-top boxes in the regions that allow receiving HDTV in the MPEG4 standard. In this case, it will be possible to transmit up to 3 HDTV programs in one multiplexed channel, and with the development of compression technologies, possibly more.

Recommendations for using the MPEG-4 compression standard may be as follows:

a) the use of a more advanced compression standard H.264/MPEG-4 can significantly increase the efficiency of use of the radio frequency resource and facilitate the transition to digital broadcasting;

b) when using equipment that supports H.264/MPEG-4, a painless transition from standard definition television to high-definition television can be made without the need for additional costs from the user;

c) the transition to the technology of effective video compression is an objective necessity and is inevitable in the future, even if it is postponed at present. It is advisable for RCC countries that do not have a large fleet of MPEG2 receiving equipment use MPEG4 when introducing NCTV.

From the above we can see the superiority of the digital standard DVB-T over ATSC. Due to the fact that each of the sub-channels is narrow-band in COFDM modulation, the influence of reflected signals during multi-path reception is reduced. Which can not be said about the modulation of 8VSB standard ATSC [3. 4].

Table 1.2 shows the main technological capabilities of the two compression standards described above.

Table 1.2 - Comparison of MPEG2 and MPEG4 Standards

Parameters	MPEG-2	MPEG-4
Mode of operation	8K 64 QAM 5/6 1/8 27,65 Mbp/s	8K 64 QAM 5/6 1/8 27,65 Mbp/s
Mode of transmission	without statistical multiplexing	without statistical multiplexing
Information speed on 1 TV channel	5 Mbp/s	2 Mbp/s
Number of channels in one package	5	13
Number of channels in three packages	15	39
Mode of transmission	with statistical multiplexing	with statistical multiplexing
Information speed on 1 TV channel	3,5 Mbp/s	1,8 Mbp/s
Number of channels in one package	7	15
Number of channels in three packages	21	45

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ТЕЛЕВИЗИЯЛЫҚ КЕСКІН БЕРУ ҮШІН СЫҒЫМДАУ СТАНДАРТЫН ТАҢДАУ

Аннотация. MPEG-4 Visual және H.264 сығымдау стандарттары пайда болғандықтан, қазіргі уақытта MPEG-2 сығымдау стандартының рөлі төмендей қойған жоқ, өйткені бұл стандарттар, әсіресе, ақпараттық магистральдармен үйлесе түседі. Бүгінде бірқатар елдерде MPV-2 сығымдау стандарты эфирлік сандық теледидар жүйесінің DVB-T жұмысына негізделген, хабар таратуда басты орын алады.

Қазіргі уақытта қолданыстағы абоненттік тіркемелердің көпшілігі (STB) көпшілігі MPEG-2 стандартын қолдайтындықтан, бірнеше жыл бойы кең таралып келді.

ITU-T H.264/MPEG-4 AVC 10-бөлігі (H.264/AVC қысқа) – аудиовизуалды ақпаратты кодтау мен сығымдаудың жаңа технологиясы. H.264/AVC стандартының сығылу тиімділігі бірдей көру қабілетке ие MPEG-2 стандартынан жоғары. H.264/AVC стандарты тарату жүйелерінің көлік қабатынан бөлек жасалған. Сондықтан H.264/AVC стандартындағы ақпаратты жеткізу кез-келген қолданыстағы тарату жүйелерін, соның ішінде, IP протоколы бар жүйелерді (ағын беруді қоса), MPEG-2 стандартындағы хабар тарату жүйелерінің көлік ағынын, сондай-ақ нақты форматтарды пайдалану арқылы жүзеге асырылуы мүмкін. H.264 / AVC файлдары серверде сақтауға және өңдеуге арналған.

Осылайша қолданыстағы MPEG-2 сандық телехабар тарату желілері H.264/AVC бағдарламаларын пайдаланушыларға тікелей таратуға жарамды әрі саны мультиплекста көбірек болады. H.264/AVC стандартында хабар таратуға ауысу үшін сандық студиялар мен абоненттік қабылдағыш декодері сынды терминалды жабдықты халықаралық стандарттау қажет. Көлік ағынының өткізу жолдарына бағдарламалық ақпараттарды декодтау және сығымдау операциялары орындалатын статистикалық мультиплексорларлы H.264/AVC стандартына қолдау көрсету керек. H.264/AVC стандартының артықшылығы, сурет сапасы бірдей болса, H.264/AVC стандарты MPEG-2-ге қарағанда сандық бит жылдамдығының жартысын қажет етеді. Бұл стандартты теледидар бағдарламаларының (SDTV) санын көбейтуге немесе HDTV бағдарламаларын таратуға мүмкіндік береді.

Түйін сөздер: стандартты, теледидарлық сандық хабар тарату, кодек, сигнал, IP протокол.

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ВЫБОР СТАНДАРТА КОМПРЕССИИ ПРИ ПЕРЕДАЧЕ ТЕЛЕВИЗИОННОГО ИЗОБРАЖЕНИЯ

Аннотация. С появлением стандартов сжатия MPEG-4 Visual и H.264 роль стандарта компрессии MPEG-2 в настоящее время не уменьшилась, так как данные стандарты во многом совместимы, особенно это относится к информационным магистралям. На сегодня в ряде стран стандарт сжатия MPEG-2 является для вещания фактически основным, на функционировании которого основаны работа наземных систем цифрового телевидения DVB-T.

Вследствие того, что большинство используемых ныне абонентских приставок (STB) поддерживают стандарт MPEG-2, он, по крайней мере, в течение нескольких последующих лет останется широко распространенным.

Стандарт ITU-T H.264/MPEG-4 Part 10 AVC (сокращенно – H.264/AVC) является новой перспективной технологией кодирования и сжатия аудиовизуальной информации. Эффективность сжатия стандарта H.264/AVC выше, чем стандарта MPEG-2 при равном визуальном восприятии. Стандарт H.264/AVC был разработан как независимый от транспортного уровня используемых систем передачи. Поэтому доставка информации в стандарте H.264/AVC может осуществляться по любым действующим системам передачи и вещания, включая системы с IP-протоколами (в том числе для потоковой доставки), транспортные потоки систем вещания в стандарте MPEG-2, а также специфические форматы файлов H.264/AVC для их хранения и обработки на серверах.

Таким образом, существующие сети цифрового ТВ-вещания стандарта MPEG-2 напрямую подходят для передачи пользователям программ в стандарте H.264/AVC, число которых в мультиплексе будет больше.

Для перехода на вещание в стандарте H.264/AVC требуется стандартизация на международном уровне оконечного оборудования: цифровых студий и декодеров абонентских приемников. Для трактов передачи транспортных потоков потребуется специфическая поддержка стандарта H.264/AVC статистическими мультиплексорами, в которых производятся операции декодирования и сжатия информации программ. Преимущества стандарта H.264/AVC. При одинаковом качестве изображения стандарт H.264/AVC требует примерно вдвое меньшей скорости цифрового потока, чем MPEG-2. Это позволяет либо увеличить число ТВ программ стандартной четкости (SDTV), либо осуществлять передачу программ ТВЧ (HDTV).

Ключевые слова: стандарт, цифровое ТВ-вещание, кодек, сигнал, IP-протокол.

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