Usage of MPEG-2 to AVS Transcoder in IPTV System

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Abstract. AVS Standard is the abbreviation of Advanced Audio Video Coding Standard made by China with the main purpose to efficiently compress digital audio and video data. The standard may be applied in the field of information industry, such as high-resolution digital broadcast, high-density laser-digital storage media, wireless broadband multimedia communication and broadband stream media. MPEG-2 is the most popular international video compression standard, and has existed in different systems and networks for a long time. At present, most of video programs are made in MPEG-2 format. AVS is expected to become popular in the coming decade. There is a requirement to convert the MPEG-2 programs into AVS ones. This paper presents the usage of MPEG-2 to AVS transcoders in IPTV systems.

Keywords: MPEG-2, AVS, Transcode, IPTV.

1 Introduction

At present, the popular source code standard is MPEG-2, which is generally adopted in digital television and other domain broadcast programs, DVD/HD-DVD, IPTV and personal video recorder (PVR), through satellites, cable and terrestrial channel. But MPEG-2 is a standard that was established 10 years ago. Its establishment was based on the compression technology level and the integrated circuit (IC) technology level at that time. Today, a lot of breakthroughs have been achieved in the field of the audio and video compression technology. The compression efficiency has at least been doubled by these technologies.

In recent years, a number of new digital audio and video coding standards have been established, including international standards such as MPEG-4 and AVC/H.264, while China has also independently developed the AVS standard, in which the majority of the intellectual property rights are China's own patents. In addition, since AVS has established One-Stop Licensing and a new Patent Pool Management Strategy, the patent issues of AVS have been better resolved. Furthermore, AVS has obvious performance advantages compared with MPEG-4 and MPEG-2. The compression efficiency of AVS has increased 2-3 times of MPEG-2, and is equivalent to that of H.264, but AVS has lower implementation complexity than H.264.

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The diversification of coding standards makes transcoding more and more important, especially from MPEG-2 to AVS for us. In order to promote the industrialization of AVS standard, we have devoted a lot of effort on the transcoding from MPEG-2 to AVS, and achieved a complete real-time transcoding device at the server platform, which not only realizes transcoding from the MPEG-2 video data to AVS ones, but also the multiplex and de-multiplex of video stream and MPEG Audio stream or AC-3 audio stream as well. The device can be widely used in various broadcasting and streaming media business. This paper introduces that the transcoder from MPEG-2 to AVS is applied in IPTV system.

2 Introduction of MPEG2-to-AVS Transcoding Technologies and Products

Video transcoding technology provides an end-to-end process for video compression, that is, the data flow of input and output in the device are both compressed. The compressed bit stream by transcoding can adapt to the requirements of transmission bandwidth and the receiver. There are two kinds of transcoding: one is for similar standards and the other is for heterogeneous standards. According to the principal of transcoding for similar standards, the decoder and the encoder can be designed together to simplify transcoding, for instance MPEG-2 to MPEG-2, H.263 to H.263, etc.. There are two ways to translate heterogeneous standards: one is the direct mapping of the bit stream, for instance the translation between MPEG-4 and H.263, which requires that the two standards are reasonably similar; the other is to make a grammatical change, for which the process of decoding and re-coding becomes necessary, such as MPEG2-to-AVS. [1]

In response to the different types of conversion, there are two main methods to realize the transcoding. The most straightforward method is to decode the stream fully at first into the pixel domain, then re-encode the picture, which is called Cascade Pixel Domain Transcoding (CPDT). Since this method needs to re-calculate the motion vectors of the code-block data and re-calculate the coding mode in the process of recoding, the quality of the output images can be very high. However, the implementation of CPDT is rather inefficient, which cannot meet the requirements of real-time broadcasting.

Another way is called Compressed Domain Transcoding (CDT), the basic idea of which is to take the advantage of information in the compressed stream from the input code as much as possible, such as the information of video sequence header, macroblock coding mode, motion vectors, quantized DCT coefficient, etc., to generate the translated code stream directly. The method is more intricate, but it can be used to greatly reduce computation of the conversion process, which is now widely used in such fields as non-linear editing, etc. The algorithm at the present condition can be realized by software, and the efficiency of transcoding is very high with low delay. This method of translation can be used only when the video processing algorithms are similar. [2]

This paper will give an enhanced solution, which combines CPDT and CDT to produce an optimum way of transcoding: At first, the input bit stream is decoded completely, and is then re-coded. However, in the encoding process, the input bitstream of the information of the video sequence header, macroblock coding mode and motion vector encoding from the input bitstream is used as much as possible to speed up the coding, which as shown in Figure-1. In this way, the transcoding will be guaranteed to realize by high speed.

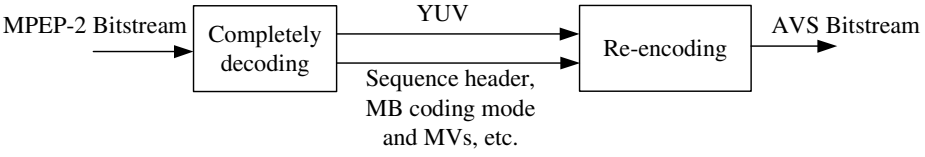


Fig. 1. Enhanced Pixel Domain Transcoding

Currently, SVA is providing an AVS Real-time transcoder for business applications. The main functions and features are shown as in Table1.

Table 1. Features of AVS Real-time Transcoder

Video	Coding Standard for Input Stream	ISO/IEC13818 (MPEG-2) (MPEG-2 Class MP@ML Grade); ISO/IEC11172 (MPEG-1)
	Coding Standard for Output Stream	GB/T 20090.2 JZ profile @ level 4.0
	Video Format	QVGA,CIF,SIF@30fps,SDTV,ITU-R601,ITU-R 656
	Input Interface	ASI(Asynchronous Serial Interface)、RJ-45 Ethernet interfaces, etc..
	Output Interface	ASI(Asynchronous Serial Interface)、RJ-45 Ethernet interfaces, etc..
	Pretreatment	Adaptive de-interlacing filter
	Mode of Bitrate	CBR(Constant BitRate)and VBR(Variable Bitrate)
	Bitrate	200kbps–1.5Mbps（CIF/SIF/ QVGA）, 800kbps-4Mbps(SDTV) (The fluctuation should range from -3% to 3%, at CBR mode.)
	GOP Structure	Adjustable or the same as the input
	Configurability	Configuration for the length of GOP, number of BP、Elementary Stream PID, etc..
Audio	Coding Standard	MPEG-1 Layer Ⅰ、Ⅱand Ⅲ, AC3、AVS Part3
	Coding Bitrate	32Kbps – 384Kbps
	Audio Mode	Stereo or double track
Output format	Encapsulation Format	TS、PS、ISMA and TS over UDP/IP
Delay	Delay Time	Not more than two seconds

It can be seen from the above table that the device can be used to achieve real-time transcoding between MPEG-2 and AVS for SD TV programs, working at a stable bitrate, which supports the mainstream audio standards. The output bit stream can be multiplexed into TS, PS or RTP format and transmitted through ASI and IP ports which can be widely used in digital television broadcasting and streaming media, such as IPTV. The applications of MPEG2-to-AVS transcoder in IPTV system will be introduced in the next section.

3 IPTV System Based on MPEG-2-to-AVS Transcoder

Most of contents of IPTV system are from DVD films, VCD films, and live broadcasting that is telecasted by satellite broadcast or by cable television. The data of these programs are mainly compressed by MPEG-2 standard. Therefore, the transcoding from MPEG-2 to AVS in AVS IPTV system is an efficient way to enrich the supply of AVS programs, which are relatively scarce at present. So it is important to redesign the structure of IPTV system and integrate AVS transcoders with the existing IPTV system, which is shown in Figure-2.

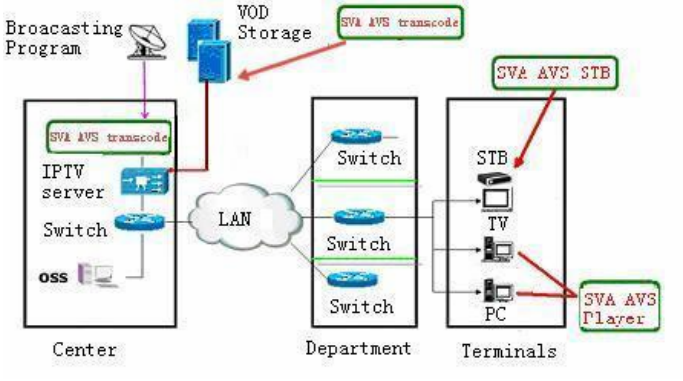
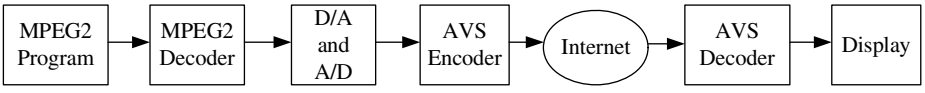


Fig. 2. IPTV System Based on MPEG-to-AVS Transcoder

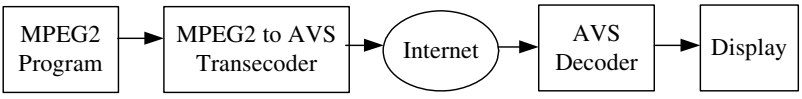
In Figure-2, the MPEG-to-AVS transcoder plays two roles: one is used as broadcasting server, another is used as the codec for storage server. As broadcast server, the transcoder supports IP outport and can provide multicast. As a codec for the storage server, it can store the converted AVS bit stream into the VOD storage server to be accessed by the streaming media server. In addition, two terminal access modes are provided: IPTV STB and media player, which can meet the requirements of different users.

4 Advantages of the Application of MPEG-to-AVS Transcoder in IPTV System

There are two methods to achieve AVS end-to-end transmission system of the existing television system: encoder and transcoder, as shown in figure 3.



(a) End-to-End Transmission System: by Encoder



(b) End-to-End Transmission System: by Transcoder

Fig. 3. AVS end-to-end Transmission System

Actually, there are two ways to use an AVS codec as the front-end device: One is direct to upgrade the entire front-end system, by which the former MPEG-2 modules are replaced by AVS modules. Since coding efficiency of AVS is quite high, this AVS system can save a lot of transmission bandwidths. But the shortcoming of the solution is obvious: on the one hand, all the MPEG-2 equipment will be eliminated, which means a waste for the operators; on the other hand, the cost of replacement for AVS programs is rather high, especially the cost of programming is very expensive, which brings the producer a great pressure. Another way is to decode the stream at the first step, and then encode to AVS flows, the structure of which is depicted in Fig-3(a). However, the method involves the conversion of D/A and A/D, which would decrease the quality of image significantly.

To solve these problems, the third method comes, which is designed on the basis of the MPEG-2- to-AVS transcoders, as shown in Figure-3(b). The solution, which can be implemented easily, avoids the loss of conversion of D/A and A/D. In addition, the transcoder will be compatible with the terminal equipment, that is, the former MPEG-2 equipments will still be made use of in this low-delay solution. Compared with the system shown in Figure-3(a) the system of the third method can save 0.5 second delay; which enables the former MPEG-2 equipments to continue to function, for example the MPEG-2 encoder, multiplexer, user management system, charge system and CA system, etc..

From the above, we can conclude that it is wiser to choose MPEG2-to-AVS transcoder to solve the problem of the shortage of AVS programs under current conditions, and this scheme can save the cost for upgrading of MPEG-2 equipments as well, which is more significant.

References

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