(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 May 2008 (02.05.2008)

PCT

(10) International Publication Number
WO 2008/049271 A1

(51) International Patent Classification:
H04N 7/26 (2006.01)

(21) International Application Number:
PCT/CN2006/002848

(22) International Filing Date: 25 October 2006 (25.10.2006)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **THOMSON BROADBAND R & D (BEIJING) CO., LTD.** [CN/CN]; 8th Floor, Building A, Technology Fortune Center, No.8 Xueqing Road, Haidian District, Beijing 100085 (CN).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **GAO, Yongying** [CN/CN]; 8th Floor, Building A, Technology Fortune Center, No.8 Xueqing Road, Haidian District, Beijing 100085 (CN). **WU, Yuwen** [CN/CN]; 8th Floor, Building A, Technology Fortune Center, No.8 Xueqing Road, Haidian District, Beijing 100085 (CN).

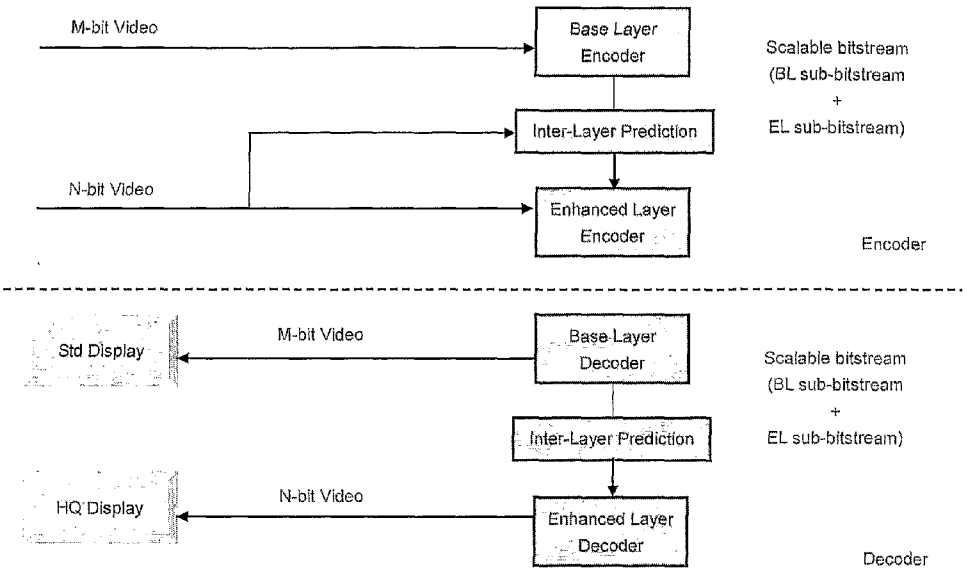
(74) Agent: **YU, Gang**; Kangxin & Partners, P.C., Floor 16, Tower A, InDo Building, A48 Zhichun Road, Haidian District, Beijing 100098 (CN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(54) **Title:** NEW SYNTAX ELEMENTS TO SVC TO SUPPORT COLOR BIT DEPTH SCALABILITY



(57) **Abstract:** This invention presents a scalable solution to encode the whole 12-bit raw video once to generate one bitstream that contains an H.264/AVC compatible base layer and a scalable enhancement layer. If an H.264/AVC decoder is available at the client end, only the base layer sub- bitstream is decoded and the decoded 8-bit video can be viewed on a conventional 8-bit display device; if the color bit depth scalable decoder is available at the client end, both the base layer and the enhancement layer sub-bitstreams will be decoded to obtain the 12-bit video and it can be viewed on a high quality display device that supports more than eight bit.

WO 2008/049271 A1

New Syntax Elements to SVC to Support Color Bit Depth Scalability

Field of this Invention

This invention relates to the technical field of digital video coding. It presents a technical solution for a novel type of scalability: color bit depth scalability. Two new syntax elements are presented to be added to SVC.

Background of the Invention

In recent years, higher bit color depth rather than the conventional eight bit color depth is more and more desirable in many fields, such as scientific imaging, digital cinema, high-quality-video-enabled computer games, and professional studio and home theatre related applications. Accordingly, the state-of-the-art video coding standard - H.264/AVC - has already included Fidelity Range Extensions, which support up to 14 bits per sample and up to 4:4:4 chroma sampling.

However, none of the existing high bit coding solutions supports color bit depth scalability. Assume that we have a scenario with 2 different decoders (or clients with different requests for the color bit depth, e.g. 12 bit) for the same raw video. The existing H.264/AVC solution is to encoder the 12-bit raw video to generate bitstream no. 1 and then convert the 12-bit raw video to an 8-bit raw video and encode the 8-bit counterpart to generate bitstream no. 2. If we want to deliver the video to different clients that request different bit depths, we

have to deliver it twice, or put the 2 bitstreams in one disk together. It is of low efficiency regarding both the compression ratio and the operational complexity.

Summary of the Invention

This invention presents a scalable solution to encode the whole 12-bit raw video once to generate one bitstream that contains an H.264/AVC compatible base layer and a scalable enhancement layer. If an H.264/AVC decoder is available at the client end, only the base layer sub-bitstream is decoded and the decoded 8-bit video can be viewed on a conventional 8-bit display device; if the color bit depth scalable decoder is available at the client end, both the base layer and the enhancement layer sub-bitstreams will be decoded to obtain the 12-bit video and it can be viewed on a high quality display device that supports more than eight bit.

Brief description of the drawings

Figure 1 illustrates a framework of color bit depth scalable coding

Detailed description of the preferred embodiment

The framework of the presented color bit depth scalable coding is shown in Figure 1. In Figure 1, two videos will be used as an input to the video codec: N-bit raw video and M-bit (usually 8-bit) video (N>M). The M-bit video can be either converted from the N-bit raw video or given by other ways.

The M-bit video is encoded as the base layer using the inside H.264/AVC encoder. The N-bit video is encoded as the enhancement layer using the scalable encoder. The coding efficiency of the enhancement layer can be significantly improved by utilizing the information of the base layer. We call the utilization of the base layer information in encoding the enhancement layer *inter-layer prediction*. Each picture — a group of Macroblocks (MBs) — will have two access units, one for the base layer and the other one for the enhancement layer. The coded bitstreams will be multiplexed to form a scalable bitstream.

During the decoding process, base layer decoder will use only the base layer sub-bitstream which is extracted from the whole bitstream, to provide a M-bit reconstructed video. By decoding the whole bitstream, N-bit video can be reconstructed.

In this part, we present the technical solution to color bit depth scalability. Two new syntax elements are added to SVC SPS in SVC extension (seq_parameter_set_svc_extension( )) to support color bit depth scalability: bit_depth_scalability_flag and bit_depth_pred_idc, as highlighted.

seq_parameter_set_svc_extension( ) {	C	Descriptor
extended_spatial_scalability	0	u(2)
if (chroma_format_idc > 0) {		
chroma_phase_x_plus1	0	u(2)
chroma_phase_y_plus1	0	u(2)
}		
if(extended_spatial_scalability = = 1) {		
scaled_base_left_offset	0	se(v)
scaled_base_top_offset	0	se(v)
scaled_base_right_offset	0	se(v)
scaled_base_bottom_offset	0	se(v)
}		
bit_depth_scalability_flag	0	u(1)
if (bit_depth_scalability_flag) {		
bit_depth_pred_idc	0	ue(v)
}		
fgs_coding_mode	2	u(1)
if(fgs_coding_mode = = 0) {		
groupingSizeMinus1	2	ue(v)
} else {		
numPosVector = 0		
do {		
if(numPosVector = = 0) {		
scanIndex0	2	ue(v)
}		

else {		
deltaScanIndexMinus1[numPosVector]	2	ue(v)
}		
numPosVector ++		
} while(scanPosVectLuma[numPosVector - 1] < 15)		
}		
}		

bit_depth_scalability_flag equal to 1 specifies that process of color bit depth prediction shall be invoked in the inter-layer prediction.. Otherwise (equal to 0) specified that no process of color bit depth prediction shall be invoked (default).

bit_depth_pred_idc equal to 0 specifies that the operation of bit-shift is utilized as the color bit depth inter-layer prediction (default). Otherwise is reserved for advanced color bit depth prediction.

Claims

1. A method to provide a technical solution to H.264/AVC scalable extension (SVC) to support color bit depth scalability.

2. The method as claimed in claim1, wherein two news syntax elements are added to SVC SPS syntax – seq_parameter_set_svc_extension( ):

- **bit_depth_scalability_flag** to signal the process of color bit depth scalability. It is equal to 1 to specify that process of color bit depth prediction shall be invoked in the inter-layer prediction. Otherwise (equal to 0) specified that no process of color bit depth prediction shall be invoked (default);

- **bit_depth_pred_idc** to specify the approach for color bit depth inter-layer prediction. It is equal to 0 to specify that the operation of bit-shift is utilized as the color bit depth inter-layer prediction (default). Otherwise is reserved for advanced color bit depth prediction.

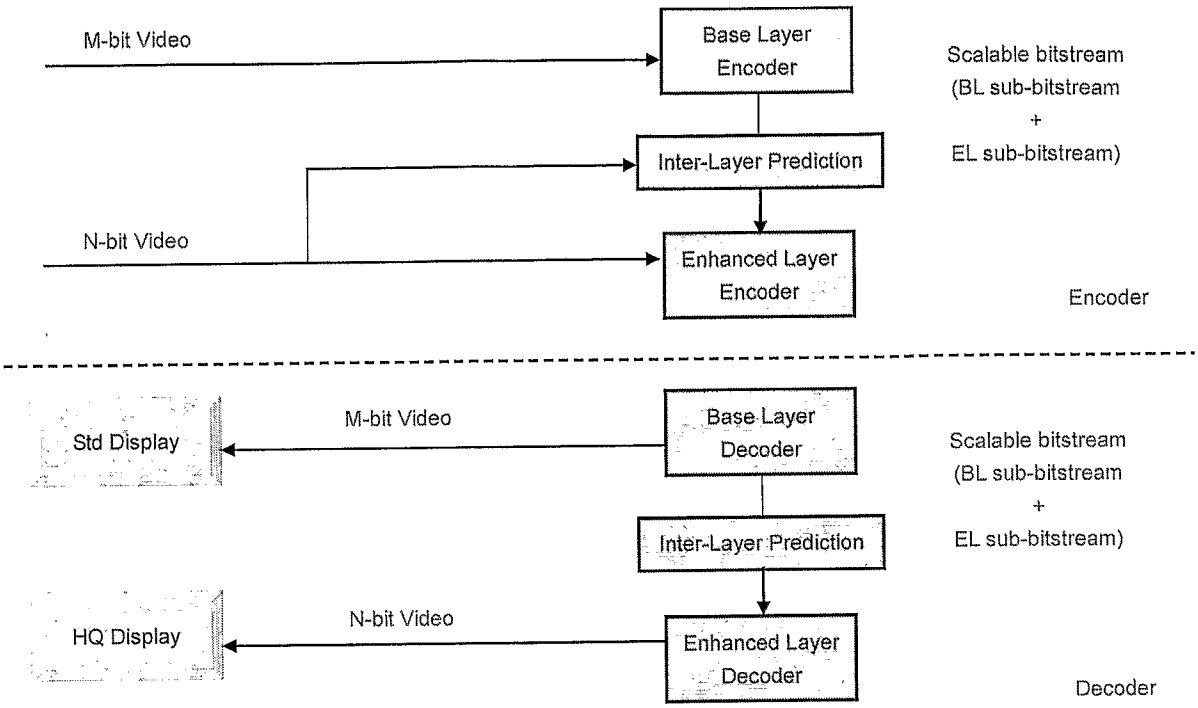

M-bit Video
Base Layer Encoder
Scalable bitstream (BL sub-bitstream + EL sub-bitstream)
Inter-Layer Prediction
N-bit Video
Enhanced Layer Encoder
Encoder
Std Display
M-bit Video
Base Layer Decoder
Scalable bitstream (BL sub-bitstream + EL sub-bitstream)
Inter-Layer Prediction
HQ Display
N-bit Video
Enhanced Layer Decoder
Decoder

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2006/002848

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/26 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:H04N7/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI,EPODOC,PAJ,CNPAT,CNKI: video, decod+, scalable, scabl+, depth, color, colour

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US2005259729 A1 ((SUNS-I) SUN S -) 24 Nov.2005 (24.11.2005) the whole document	1
A		2
A	WO03036980 A1 (KONINK PHILIPS ELECTRONICS NV) 01. May 2003 (01.05.2003) the whole document	1-2

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 Jul. 2007 (19.07.2007)	02. AUG. 2007 (02. 08. 2007)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LI, Jing Telephone No. (86-10)62084665

Form PCT/ISA /210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2006/002848

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US2005259729 A1	24.11.2005	NONE	
WO03036980 A1	01.05.2003	EP1442603 A1	04.08.2004
		AU2002341297 A1	06.05.2003
		KR20040054748 A	25.06.2004
		JP2005507586T T	17.03.2005
		CN1575601 A	02.02.2005
		US2005105814 A1	19.05.2005
		WO03036981A	01.05.2003
		WO03036982 A	01.05.2003
		WO03036983A	01.05.2003
		WO03036984 A	01.05.2003
		CN1575605A	02.02.2005
		CN1254978C C	03.05.2006
		CN1575604 A	02.02.2005
		CN1253008C C	19.04.2006
		CN1611077 A	27.04.2005
		JP2005507587T	17.03.2005
		JP2005507588T	17.03.2005
		JP2005507589T	17.03.2005
		JP2005507590T	17.03.2005