

A Study of MXF Extension of Mapping HEVC Stream for UHD Broadcasting Contents Production

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Abstract—Terrestrial UHD broadcasting will be started from February in 2017. Therefore, it is obvious that UHD contents production in broadcasting studio will be rapidly increasing. MXF (Material exchange format) is a standard for interchanging contents among devices in broadcasting production workflow. However, HEVC stream is not supported in the current MXF standards. Thus, we propose a mapping method of HEVC stream into MXF. Fortunately, HEVC is a successor of H.264 and also mapping of H.264 stream into MXF generic container exists in current MXF standards, ST 381-3. Thus, we propose a mapping method of HEVC stream into MXF generic container based on ST 381-3. However, there are some differences between HEVC and H.264, especially random access point pictures and leading pictures. Therefore we also proposed how to handle those pictures in the mapping of HEVC stream into MXF. From the experimental results, we could confirm that the proposed method is working properly. We plan to submit the proposed method as a new standard to SMPTE.

Keywords— MXF, HEVC, UHD, RAP, Broadcasting contents

I. INTRODUCTION

Terrestrial UHD broadcasting service in Korea will be started from February in 2017 and it is obvious that the UHD content production will be rapidly increasing for the broadcasting service. In the UHD broadcasting standards [1, 2], HEVC (High Efficiency Video Coding) had been adopted as a video coding standard. HEVC is the state of the art video coding standard and it has four times coding performance than MPEG-2 video coding standard which has been adopted in HDTV broadcasting.

In the BCPW (broadcasting content production workflow), MXF (Material exchange format) is a standard format for exchanging contents among the devices. MXF is a container format and supports many video and audio coding standards such as AVC (Advanced Video Coding) and MPEG-2 video/audio. Although MXF has not yet supported HEVC, it must support HEVC in the near future because the explosive increasing data amount in the UHD BCPW than the data amount of HD BCPW. AVC is supported in MXF standard [3], therefore it is a major coding standard in HD BCPW.

Fortunately, HEVC is a successor of AVC. There are many similar things between HEVC and AVC. Thus, we can make easily a mapping method of HEVC stream into MXF GC (generic container) based on the AVC stream mapping into MXF GC. However, there are some differences between

HEVC and H.264, especially RAP (random access point) pictures and LP (leading picture). In this paper, we propose how to handle those differences in the new mapping of HEVC stream into MXF GC.

II. BACK GROUND

In this section, we briefly explain the standard of AVC stream mapping into MXF GC and the main difference between HEVC and AVC when mapping into MXF GC.

A. AVC stream mapping into MXF generic container

MXF is a wrapper format which contains audio and video essence data and metadata. MXF file consists of header, body and footer. Essence, audio or video, data is contained in MXF GC in the file body.

The MXF Generic Container is a streamable data container, meaning it was designed to allow the audio-visual material to be continuously decoded, which is achieved by interleaving the data streams, typically over a 1-frame duration [4].

There are two wrapping method in MXF GC. One is clip-based wrapping and the other is frame-based wrapping. In this paper, we consider frame-based wrapping only. Because the clip-based wrapping is not suitable streaming and random access, most MXF file uses frame-based wrapping.

ST 381-3 defines how to mapping AVC stream into MXF generic container such as wrapping methods, Key-Length-Value coding, Label values, essence descriptor and index table for AVC mapping. Index table is used when random access is required as show in the figure 1.

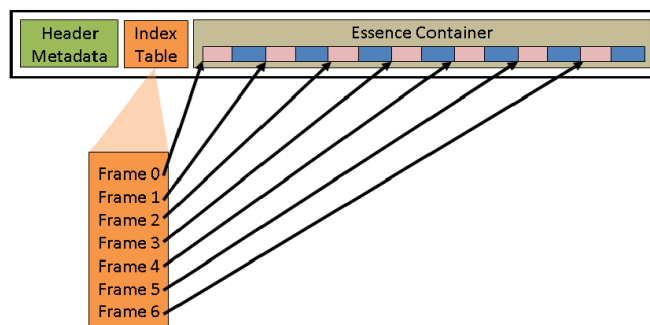


Figure 1. Index Table in MXF [4]

B. RAP OF HEVC

There are some differences between AVC and HEVC. Especially, RAP and LP are most important in the view point of mapping HEVC stream into MXF GC.

In ST 381-3, all GOP (Group of Pictures) having random access point is assumed as closed-GOP.

However, HEVC define three RAP such as IDR (Instantaneous Decoding Refresh) picture for Close-GOP, CRA (clean random access point) picture for open-GOP. BLA (Broken Link Access) picture for indicating a concatenation of two sequences at this point [5].

CRA and BLA may have LP that precedes the associated RAP in output order but follows it in coding order. There are two type of LP.

One is RADL (Random Access Decodable Leading) picture which can be correctly decoded if decoding of the video sequences starts at the associated RAP (CRA or BLA) picture. A RADL picture contains no references to pictures prior to the RAP picture in decoding order [5].

The other is RASL (Random Access Skipped Leading) picture which refers some pictures preceding RAP picture in coding order. Thus, RASL is not correctly decodable if decoding of the video sequences starts at the associated CRA picture and also RASL is not correctly decodable if the associated RAP is BLA.

Therefore, we can intuitively know that RASL picture may be a problem when random access is used. Figure 2 show an example of RASL problem when use random access in MXF GC. Above part shows in coding order and below part shows in output order.

The requested random access interval is from 4th frame to 80th frame and the 4th frame is RASL picture. In MXF GC, if the start frame of the request random access interval is not RAP, then the start frame is changed as the associated RAP, 5th frame in Figure 5. However, the RASL picture 4 is not decodable because it requires preceding picture than 5th picture in coding order.

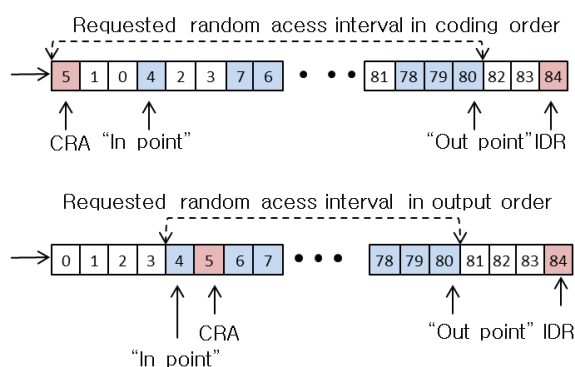


Figure 2. Example of RASL Picture Problem in MXF GC

III. PROPOSED METHOD

In this section, we describe the proposed method to solve the two problem cases, CRA with RDSL picture and BLA with RDSL picture, respectively.

A. Handling CRA with RDSL

RASL picture associated CRA picture is not decodable when the RASL is included in the request random access interval but the reference picture of the RASL is not included in the interval. To make RASL picture is decodable, the start point picture change mechanism should change as the table I.

Also we propose the index table entry properties as the table II.

Table I. START POINT PICTURE CHANGE MECHANISM

Picture type of requested Start point	Changed start point to decoding
RAP	No change
not RDSL picture	Associated RAP
RDSL picture	Preceding RAP than associated RAP

Table II. PROPOSED INDEX TABLE ENTRY PROPERTIES FOR HEVC

Parameter	Type	Meaning
Temporal Offset	Int8	Offset in Edit Units from Display Order to Coded Order (see SMPTE ST 377-1 for usage)
Key Frame Offset	Int8	Offset in Edit Units to previous Key Picture. The value is zero if this is a Key Picture.
Flags	EditUnitFlag	Flags for this Edit Unit Bit 7: Random Access Bit 6: Video Parameter Set or Sequence Parameter Set Bits 5,4: Forward/backwards prediction flag Bit 3: Offsets out of range Bit 2: Supplementary Picture type flag Bits 1,0: HEVC picture type (00: I picture, 01: P picture, 11: B picture, 01: RASL picture)

B. Handling BLA with RDSL

RASL picture associated BLA picture is not decodable after concatenation. When the frame-based wrapping is used in MXF GC, each picture item has only one frame of video data. It means RASL picture cannot be included in the picture item

contained other video frame. To avoid this problem is simple, the RASL picture associated BLA discard when apply the frame-based wrapping into MXF GC. However, it may occur other issue that is difference between video sequences before wrapping and after wrapping.

IV. EXPERIMENTS

To verify our proposed method, we implemented software for mapping HEVC stream into MXF generic container and then conducted experiments of cut editing and playing of the editing result. From the experimental results, we could confirm that the proposed method is working properly.

V. CONCLUSIONS

In this paper, we propose a mapping method for HEVC stream into MXF GC. The proposed method is based on ST 381-3 and we proposed handling method of RAP and RASL picture in the mapping. Also, we plan to submit the proposed method as a new standard to SMPTE (Society of Motion Picture and Television Engineers) which is the standard body of MXF.

ACKNOWLEDGMENT

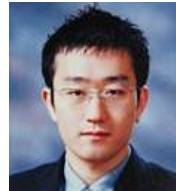
This work was supported by Institute for Information & communications Technology Promotion (IITP) grant funded by the Korea government (MSIP) (R0166-16-1013, Development of Standards for UHD TV Broadcasting Technology and Its Transmission-Reception)

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