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TECHNICAL REPORT

Professional tape-less camera recorder

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TECHNICAL
REPORT

Professional tape-less camera recorder

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PROFESSIONAL TAPE-LESS CAMERA RECORDER

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IEC 62712, which is a technical report, has been prepared by technical area 6: Storage media, data structures, equipment and systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
100/1781/DTR	100/1839/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

During the last few years, various types of tape-less camera recorders with different formats have emerged to the broadcast and professional video market. It is desirable to ensure interoperability and to establish its operation. The stage 0 project "Professional tape-less camera recorder" was established to meet these requirements and the purpose of this project was to study the possibility of standardization of this type of products in the current market. The initial step of study was to understand the current status of the products in the market. (Performance comparison is out of the scope of this Technical Report.)

This Technical Report was created as a summary of the project and includes the result of the product survey along with the possibility of standardization. Although the investigation is limited to the products in the market, it does not obstruct or exclude standardization of future products.

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PROFESSIONAL TAPE-LESS CAMERA RECORDER

1 Scope

This Technical Report summarizes the results of the study on products and market status of professional tape-less camera recorders. This report also includes the guideline on the possibilities of standardizations for professional tape-less camera recorders, including the following components:

– codec;

– file format;

– metadata;

– recording media;

– interface.

NOTE 1   Each professional tape-less camera recorder used for the product survey is defined as "PRODUCT".

NOTE 2   Since each PRODUCT is also defined as a "product series" of each manufacturer, PRODUCT may include two or more models with different product specifications.

NOTE 3   Some of the names described in this report represent a trademark or registered trademark of the respective companies. However, symbols such as TM and ® are omitted in this report.

NOTE 4   The interface specifications investigated in this project were limited to a file transfer or compressed bit stream transfer since this report is focusing on a file-based specification.

NOTE 5   The detail specification of each PRODUCT is shown in Annex A.

2 Result of product survey

2.1 General

In this report, eight types of PRODUCTs for investigation are listed, based on the information given by camera recorder manufacturers.

2.2 Codec

2.2.1 Video codec

Each PRODUCT uses efficient video compression formats such as MPEG-2, MPEG-4 AVC/H.264, JPEG2000 and DV. Since these specifications are defined as international standards of ISO/IEC, they can be referred to as a normative reference. The video compression format of PRODUCT-C is defined as SMPTE standard and is also defined as an IEC standard for digital VTR format. It can therefore also be referred to as a normative reference. Since all the compression formats listed in Table 1 are a well-known codec scheme and widely supported in industry, compatibility is ensured with equipment other than camera recorders.

Table 1 – Video codec

	Compression format	Referred standard
PRODUCT-A	MPEG-2 HD	ISO/IEC 13818-2
PRODUCT-B		
PRODUCT-E		
PRODUCT-F		
PRODUCT-G		
PRODUCT-H		
PRODUCT-A	MPEG-2 SD	ISO/IEC 13818-2
PRODUCT-E		
PRODUCT-F		
PRODUCT-C	MPEG-4 AVC / H.264	ISO/IEC 14496-10
PRODUCT-D		
PRODUCT-F	JPEG2000	ISO/IEC 15444-1
PRODUCT-A	DV	IEC 61834-2
PRODUCT-B		
PRODUCT-F		
PRODUCT-G		
PRODUCT-C	DV Based 100Mbps	SMPTE ST 370 (IEC 62447-2)
	DV Based 50Mbps	SMPTE ST 314 (IEC 62071-2)

2.2.2 Audio codec

It is characterized that almost all PRODUCTs listed in Table 2 use uncompressed linear PCM audio for audio codec. Altough a linear PCM specification is not defined in any published standard, linear PCM is also widely supported in many products and compatibility is ensured as well as video codec.

Table 2 – Audio codec

	Compression format	Referred standard
PRODUCT-A	Linear PCM	--
PRODUCT-B		
PRODUCT-C		
PRODUCT-E		
PRODUCT-F		
PRODUCT-G		
PRODUCT-H		

As listed in Table 3, PRODUCT-D uses AC-3 format defined in the ATSC standard which cannot be referred to as a normative reference.

Table 3 – Audio codec for PRODUCT-D

	Compression format	Referred standard
PRODUCT-D	AC-3	ATSC A/52B

2.3   File format

As a file format, MXF (Material eXchange Format) defined as SMPTE standard is adopted in the PRODUCT listed in Table 4. In order to ensure operational compatibility, several kinds of Operational Patterns are defined in the MXF specification. It is characterized that the camera recorders supporting MXF adopt OP-1a (Operational Pattern-1a) or OP-Atom (Operational Pattern-Atom). In case of shooting materials by a camera recorder, since each taken material is wrapped in an individual clip as file, complex operational patterns are not required. OP-1a is used for wrapping video and audio to a single file to facilitate contents exchange. On the other hand, OP-Atom is used for wrapping video and audio in individual files to facilitate contents editing.

NOTE   MXF standards are under revision in SMPTE and, in parallel, also under study for standardization in the IEC TC100/TA6 working group. Since it is confirmed that the MXF specification has been adopted for various types of PRODUCTs, it would be significant to standardize MXF as an IEC standard in order to ensure compatibility among different types of equipment. Therefore, it is desirable to start studying standardization in IEC when primary MXF revision projects in SMPTE finish the revision work.

Table 4 – MXF based PRODUCT list

	File format	Referred standard
PRODUCT-A		SMPTE ST 377-1,
PRODUCT-F	MXF OP-1a	SMPTE ST 378, SMPTE ST 379-2,
PRODUCT-H		SMPTE ST 380, SMPTE ST 381, etc
PRODUCT-C		SMPTE ST 377-1, SMPTE ST 379-2, SMPTE ST 381,
PRODUCT-E	MXF OP-Atom	SMPTE ST 382, SMPTE ST 383, SMPTE ST 390, etc
NOTE SMPTE 377-1/379-2 is a revision of 377M-2004/379-1 that supersedes the previous 377M-2004/379-1. Existing equipment in the market may still reference the older version.		

As listed in Table 5, PRODUCT-B and PRODUCT-G adopt the MP4 file format defined as ISO/IEC standard which can be referred to as a normative reference.

Table 5 – File format of PRODUCT-B and PRODUCT-G

	File format	Referred standard
PRODUCT-B	MP4	ISO/IEC 14496-12
PRODUCT-G		ISO/IEC 14496-14

The file formats listed in Table 6 are not defined in any standards' bodies. PRODUCT-B and PRODUCT-G adopt AVI Type 2 file format and PRODUCT-G adopts QuickTime file format.

Although both specifications are not standardized, they are generally disclosed and support various types of codec and metadata.

These file formats are widely supported in the IT industry and considered to ensure compatibility with this type of equipment. In addition, it is known that QuickTime file format is the basis for the MP4 file format.

Table 6 – File format of PRODUCT-B and PRODUCT-G

	File format	Referred standard
PRODUCT-B	AVI Type2	not standardized
PRODUCT-G		
PRODUCT-G	QuickTime	not standardized

As listed in Table 7, PRODUCT-D adopts MPEG-2 TS (Transport Stream) as a container of contents. Although MPEG-2 TS specification is defined in ISO/IEC 13818-1, actually MPEG-2 TS is not a file wrapper but a stream definition.

Table 7 – File format of PRODUCT-D

	File format	Referred standard
PRODUCT-D	MPEG-2 TS file	ISO/IEC 13818-1

2.4 Metadata

Metadata is classified as technical metadata and descriptive metadata. The technical metadata is essential data in order to play back video and audio essences. The descriptive metadata provides additional information of the shooting contents. There are two types of encoding of metadata, the determined data specification defined in each supported file format and the proprietary data specification depending on each manufacturer's PRODUCT specification. Table 8 shows metadata specification examples of MXF based camera recorder.

The technical metadata is defined in each file format specification such as MXF or MP4. Since each PRODUCT supports technical information (in case of MXF, defined as the MXF Structural metadata) required to play back video and audio essences, subsequent equipment can determine the essence format and codec type properly and play back each content.

On the other hand, in case of descriptive metadata, PRODUCTs A, F and H implement the descriptive metadata defined in the MXF standard and other PRODUCTs define a proprietary descriptive metadata scheme according to each PRODUCT specification. Each specification on the proprietary descriptive metadata scheme is not disclosed and there is no compatibility.

As for encoding format of metadata, the KLV (Key Length Value) encoding defined as SMPTE ST 336 standard is supported in the MXF specification.

The other feature clarified in this survey is that each PRODUCT adopts a separate metadata file aiming at operational conveniences. These metadata files are XML (eXtensible Markup Language) encoded in common and XML is standardized in W3C (World Wide Web Consortium). As mentioned above, since a metadata specification of each PRODUCT depends on each PRODUCT specification, there is no compatibility in metadata elements.

In order to ensure compatibility of metadata, it is required to define a common metadata scheme, description format and precise meaning of each element. However, currently only