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**Information technology — Multimedia  
application format (MPEG-A) —**

**Part 9:  
Digital Multimedia Broadcasting  
application format**

*Technologies de l'information — Format pour application multimédia  
(MPEG-A) —*

*Partie 9: Format pour application de diffusion générale multimédia  
numérique*

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## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 23000-9 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23000 consists of the following parts, under the general title *Information technology — Multimedia application format (MPEG-A)*:

- *Part 1: Purpose for multimedia application formats* [Technical Report]
- *Part 2: MPEG music player application format*
- *Part 3: MPEG photo player application format*
- *Part 4: Musical slide show application format*
- *Part 5: Media streaming application format*
- *Part 7: Open access application format*
- *Part 8: Portable video application format*
- *Part 9: Digital multimedia broadcasting application format*
- *Part 10: Video surveillance application format*

## Introduction

Digital Multimedia Broadcasting (DMB) is the first global mobile TV service based on a digital radio transmission system. DMB provides people with crystal-clear video, theatre-quality audio, and other data services on the move via in-vehicle terminals or hand-held gadgets like mobile phones so that it makes possible the information acquisition and consumption anywhere. DMB contents on air include audio-visual programs, interactive data, web pages, slideshows, TTI (traffic & travel information), etc.

Most users want to store their preferred DMB contents for consuming the contents at their preferred time and on their preferred device. Many of them also want to share the contents with other people. Contents providers also want to serve their DMB contents not only through broadcast but also through communication networks. Thus a standardized format needs to be specified to guarantee the interoperability of the DMB contents across various devices from different vendors.

DMB AF (Application Format) specification defines a file format that pertains to DMB (more specifically T-DMB and S-DMB) contents and services. It specifies how to combine the variety of DMB contents with associated information for a presentation in a well-defined format that facilitates storage, interchange, management, editing, and presentation of the DMB contents in protected, governed, and interoperable ways.

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# Information technology — Multimedia application format (MPEG-A) —

## Part 9: Digital Multimedia Broadcasting application format

### 1 Scope

This part of ISO/IEC 23000 specifies a file format that pertains to both terrestrial digital multimedia broadcasting (T-DMB) and satellite digital multimedia broadcasting (S-DMB) contents and services. It integrates the existing DMB contents with appropriate additional information to facilitate storage, interchange, management, editing, and presentation of the contents in protected, governed, and interoperable ways.

This part of ISO/IEC 23000 is applicable both to storage and playback of DMB contents and to acquisition and consumption through communication networks and removable storages. Application examples of this specification include but are not limited to

- scheduled storage and time-shifted playback of DMB contents,
- file casting through DMB data channel,
- IP media service such as DMB content portal,
- rightful interchange of DMB contents between terminals, and
- user editing or creation from DMB contents.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14496-12, *Information technology — Coding of audio-visual objects (MPEG-4) — Part 12: ISO base media file format*<sup>1)</sup>

ISO/IEC 14496-14, *Information technology — Coding of audio-visual objects (MPEG-4) — Part 14: MP4 file format*

ISO/IEC 14496-15, *Information technology — Coding of audio-visual objects (MPEG-4) — Part 15: Advanced Video Coding (AVC) file format*

ISO/IEC 21000-2, *Information technology — Multimedia framework (MPEG-21) — Part 2: Digital Item Declaration*

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1) Technically identical to ISO/IEC 15444-2.

ISO/IEC 21000-4, *Information technology — Multimedia framework (MPEG-21) — Part 4: Intellectual Property Management and Protection Components*

ISO/IEC 21000-5, *Information technology — Multimedia framework (MPEG-21) — Part 5: Rights Expression Language*

ISO/IEC 21000-9, *Information technology — Multimedia framework (MPEG-21) — Part 9: File Format*

ETSI EN 300 401, *Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers*

ETSI TS 102 428, *Digital Audio Broadcasting (DAB); DMB video service; User Application Specification*

ETSI TS 102 822-3-1 V1.4.1:2007, *Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 1: Phase 1 – Metadata schemas*

ETSI TS 102 822-3-3 V1.2.1:2007, *Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 3: Phase 2 – Extended Metadata Schema*

ETSI TS 102 822-4 V1.3.1:2007, *Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 4: Phase 1 – Content Referencing*

TTAS.KO-07.0027, *Standard for Satellite Digital Multimedia Broadcasting (S-DMB) Transmitter/Receiver Interface*

TTAS.KO-07.0032, *Terrestrial Digital Multimedia Broadcasting; Specification of the MOT Slide show service for Terrestrial Digital Multimedia Broadcasting (DMB) to mobile, portable and fixed receivers*

TTAS.ET\_TS101498-1, *Radio Broadcasting Systems; Specification of the Broadcast Web Site Service for VHF Digital Multimedia Broadcasting (DMB) to Mobile, Portable and Fixed Receivers*

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

##### 3.1.1

##### **DMB**

##### **digital multimedia broadcasting**

collective term representing both terrestrial digital multimedia broadcasting (T-DMB) and satellite digital multimedia broadcasting (S-DMB)

#### 3.2 Abbreviated terms

|        |                                    |
|--------|------------------------------------|
| AAC    | Advanced Audio Coding              |
| AVC    | Advanced Video Coding              |
| AVC-FF | AVC File Format [ISO/IEC 14496-15] |
| BIFS   | Binary Format for Scenes           |
| BWS    | Broadcast Web Site                 |
| CRID   | Content Reference Identifier       |
| CS     | Classification Scheme              |

|           |                                                               |
|-----------|---------------------------------------------------------------|
| DAB       | Digital Audio Broadcasting [ETSI EN 300 401]                  |
| DLS       | Dynamic Label Segment                                         |
| DI        | Digital Item                                                  |
| DID       | Digital Item Declaration                                      |
| DMB-AF    | DMB Application Format [This part of ISO/IEC 23000]           |
| DRM       | Digital Right Management                                      |
| ES        | Elementary Stream                                             |
| GOP       | Group of Pictures                                             |
| GUI       | Graphic User Interface                                        |
| HE-AAC v2 | High Efficiency AAC version 2                                 |
| IPMP      | Intellectual Property Management and Protection               |
| ISO-FF    | ISO Base Media File Format [ISO/IEC 14496-12]                 |
| MATE      | Multimedia Application Terminal Environment                   |
| MIDP      | Mobile Information Device Profile                             |
| MOT       | Multimedia Object Transfer                                    |
| MP4-FF    | MP4 File Format [ISO/IEC 14496-14]                            |
| MP21-FF   | MPEG-21 File Format [ISO/IEC 21000-9]                         |
| MPEG      | Moving Picture Experts Group (ISO/IEC JTC 1/SC 29/WG 11)      |
| NPAD      | Non-PAD                                                       |
| PAD       | Program-Associated Data                                       |
| PMT       | Program Map Table                                             |
| RAI       | Random Access Indicator                                       |
| REL       | Rights Expression Language                                    |
| SBR       | Spectral Band Replication                                     |
| S-DMB     | Satellite Digital Multimedia Broadcasting [TTAS.KO-07.0027]   |
| SL        | Synchronization Layer                                         |
| T-DMB     | Terrestrial Digital Multimedia Broadcasting [ETSI TS 102 428] |
| TPEG      | Transport Protocol Expert Group                               |
| TS        | Transport Stream                                              |
| TTI       | Traffic and Travel Information                                |
| TVA       | TV-Anytime                                                    |

4 Overview of technology

4.1 Components summary

Figure 1 shows a brief summary of the components of DMB-AF which consists of the MPEG Standards and non-MPEG Standards. The components of DMB-AF include native DMB contents which can be broadcasted on air and additional components added by this specification such as file format and metadata.

The native DMB contents include MPEG-4 AVC video, MPEG-1/2/4 audio, interactive video based on MPEG-4 BIFS, and various kind of data such as MOT slide show, Dynamic Label (DLS), Broadcast web site (BWS), Traffic and travel information (TTI) based on TPEG, and Java applications (midlet).

For this specification, ISO Base Media File Format and MP4 File Format are used for base file format structure. MPEG-21 DID is used for organizing and listing content items. TV-Anytime Metadata is used for contents and user description and is encapsulated by MPEG-21 DID. MPEG-21 REL and IPMP Components are used for protection and governance of content resources and descriptive metadata. 3GPP Timed Text Format is used when characters and glyphs rendering in timed manner is required, for example as in karaoke application.

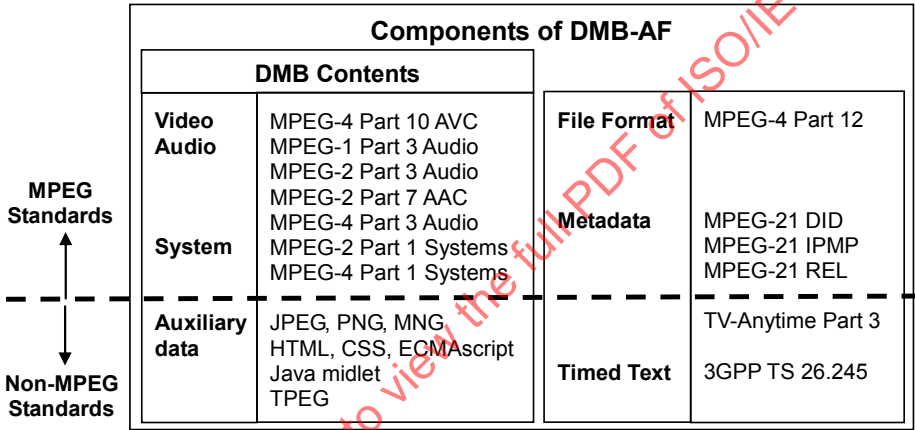


Figure 1 — Components summary for DMB-AF

4.2 File format - ISO base media file format

The ISO base media file format is a flexible, extensible format which contains timed media information in order to facilitate interchange, management, editing, and presentation of the media. The ISO base media file format is a base format for the DMB-AF file structure.

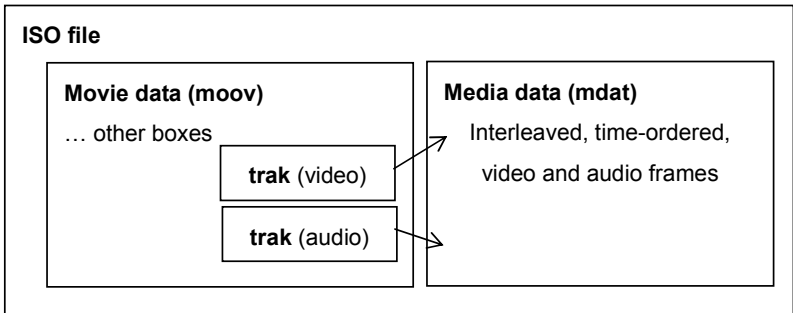


Figure 2 — ISO base media file format example

Figure 3 shows the relations to other file formats; DMB-AF is basically derived from ISO file format and is based on MP4 file format for storing MP4 contents, AVC file format for storing AVC video and parameter sets, and MPEG-21 file format for content packaging, 3GPP timed text format for storing the 3GPP timed text.

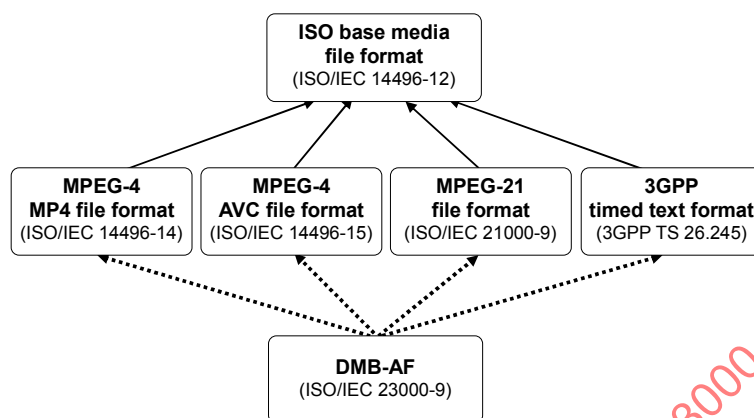


Figure 3 — Relation to other file formats

### 4.3 Organization of contents – MPEG-21 DID

MPEG-21 DID (ISO/IEC 21000-2) describes a set of abstract terms and concepts to form a useful model for defining Digital Items. In the MPEG-21 multimedia framework, the digital item (DI) is a fundamental unit with a standard representation, identification and metadata for the distribution, and transaction. For the declaration of the digital item in flexible and general ways, MPEG-21 DID aims to standardize the description for the definition of the digital item and provides the basic structure for content representation for the DMB content storage and distribution scenario.

### 4.4 Content creation and consumption description – TV Anytime Metadata

TV-Anytime (ETSI TS 102 822-1 to 822-9) is a set of specifications for the controlled delivery of multimedia content to a user's digital video recorder (DVR). It enables applications to exploit local and remote storage in consumer electronics platforms.

The TV-Anytime metadata are sub-divided into two categories: phase 1 metadata (ETSI TS 102 822-3-1) and phase 2 metadata (ETSI TS 102 822-3-3). The phase 1 metadata schema has the root element of TVAMainType and defines mainly about program and user descriptions. The phase 2 metadata schema has the root element of ExtendedTVAMainType and extends the phase 1 schema for including various content types and consumption conditions.

For describing creation and consumption information of DMB contents, DMB-AF uses a restricted subset of the TV-Anytime metadata specification. The restricted subset of TV-Anytime metadata for DMB-AF is defined in subclause 5.3 of this specification.

DMB-AF also adopts CRID (content referencing Identifier) defined in TV-Anytime Part 4 (ETSI TS 102 822-4) for identifying a specific content item independent of its location.

## 4.5 Protection and governance – MPEG-21 IPMP and REL

### 4.5.1 Right management and protection

MPEG-21 IPMP (Intellectual Property Management and Protection) Components standard is a DRM (Digital Right Management) framework developed by MPEG for safe and easy distribution of contents between the different user terminals and the different content providers. The MPEG-21 IPMP Components standard provides the means to represent which parts of Digital Items are protected with what IPMP Tools.

For supporting governed and protected usage of DMB contents, DMB-AF adopts a restricted subset of MPEG-21 IPMP Components. The lists of the functionalities are explained in subclause 5.2 of this specification. Note that unless specifically mentioned in this specification, the requirements of MPEG-21 DID and IPMP (ISO/IEC 21000-2 and ISO/IEC 21000-4) apply for digital item declaration and protection in DMB-AF.

### 4.5.2 Right expression

ISO/IEC 21000-5 defines a right expression language (REL), which is designed to be domain-agnostic and comprehensive, and also very flexible and adaptive to the specific scope and requirements of applications within a particular domain. The language provides extension and profile mechanisms for these purposes.

In DMB-AF, licenses governing the use of content or parts thereof are expressed according to the dissemination and capture DAC profile of the MPEG-21 REL. The REL DAC profile is designed for usage in broadcasting applications, which can handle various use cases for DMB-AF applications. Note that the requirements of the DAC profile of MPEG-21 REL (ISO/IEC 21000-5) apply for right expression in DMB-AF.

## 4.6 Timed text

3GPP Timed Text format describes the normative behavior of text data for rendering. Timed text supports the characters and glyphs rendering, font support such as name, size and style, color support of text and background, text rendering position and composition, etc. By using these functionalities, various applications such as closed captioning, karaoke, dynamic highlighting and other visual annotation can be deployed in the user's terminal.

The synchronized usage of the timed text with other timed media is described in subclause 6.6.

## 5 Components of DMB-AF

### 5.1 Supported components and restrictions

In general, DMB Video Service components include audio and visual objects and associated auxiliary data, which can be carried in MPEG-2 SPTS (Single Program Transport Stream). DMB Audio Service components include audio stream and associated auxiliary data. DMB Data Service components include various kind of NPAD (Non Program-Associated-Data).

In Table 1, all the supported components of DMB-AF, except the file format, are listed with the specification reference of the respective component. Note that DMB-AF does not mandate all the syntax and semantics of the 'Specification' column of Table 1. Instead, it does mandate the component specification with some restrictions on profiles, levels, and usages, which are defined in the specification of 'Restriction' column of the table. In other words, for each component listed in Table 1, the requirements of the corresponding specification in the 'Restriction' column apply. For example, MPEG-4 AVC in T-DMB service is restricted such that Baseline Profile Level 1.3 apply with "num\_ref\_frames = 3" and "pic\_order\_cnt\_type = 2" according to ETSI TS 102 428. Implementers of this specification shall carefully consult to the specifications in the 'Restriction' column for the exact restrictions made on the supported components.

For the file format components, refer to Section 6 of this specification.

Table 1 — Supported Components of DMB-AF

| Type      | Component Name                         | Abbreviation | Specification                                                            | Restriction                                      |
|-----------|----------------------------------------|--------------|--------------------------------------------------------------------------|--------------------------------------------------|
| Audio     | MPEG Audio Layer II                    | MP2          | ISO/IEC 11172-3 and ISO/IEC 13818-3                                      | ETSI EN 300 401                                  |
|           | MPEG-4 Audio ER-BSAC                   | ER-BSAC      | ISO/IEC 14496-3                                                          | ETSI TS 102 428                                  |
|           | MPEG-4 Audio HE-AAC v2                 | HE-AAC2      | ISO/IEC 14496-3                                                          | ETSI TS 102 428                                  |
|           | MPEG-2 AAC LC<br>MPEG-4 Audio SBR      | AAC+SBR      | ISO/IEC 13818-7 and ISO/IEC 14496-3                                      | TTAS.KO-07.0027                                  |
| Visual    | MPEG-4 AVC Baseline                    | AVC          | ISO/IEC 14496-10                                                         | T-DMB: ETSI TS 102 428<br>S-DMB: TTAS.KO-07.0027 |
| Transport | MPEG-2 Systems TS<br>MPEG-4 Systems SL | MP4on<br>MP2 | ISO/IEC 13818-1 and ISO/IEC 14496-1                                      | ETSI TS 102 428                                  |
| Data      | MOT Slide Show                         | MOT-SLIDE    | TTAS.KO-07.0032                                                          | None                                             |
|           | Dynamic Label Segment                  | DLS          | ETSI EN 300 401                                                          | None                                             |
|           | MPEG-4 BIFS                            | BIFS         | ISO/IEC 14496-11                                                         | ETSI TS 102 428                                  |
|           | JPEG Image                             | JPG          | ISO/IEC 10918-1                                                          | TTAS.ET-TS101498-1                               |
|           | PNG Image                              | PNG          | ISO/IEC 15948 PNG Version 1.2                                            | TTAS.ET-TS101498-1                               |
|           | MNG Image                              | MNG          | MNG(Multiple-image Network Graphics), Version 1.0, PNG Development Group | TTAS.ET-TS101498-1                               |
|           | 3GPP Timed Text                        | 3GPP-TT      | 3GPP TS 26.245                                                           | None                                             |
|           | Broadcast Web Site                     | BWS          | TTAS.ET-TS101498-1                                                       | Intermediate Profile                             |
|           | TTI (Traffic and Travel Information)   | TPEG         | ISO/TS 18234 Part 1~6                                                    | None                                             |
|           | Java Application                       | MIDlet       | Java ME MIDP                                                             | None                                             |
| Metadata  | MPEG-21 DID                            | DID          | ISO/IEC 21000-2                                                          | None                                             |
|           | MPEG-21 IPMP Components                | IPMP         | ISO/IEC 21000-4                                                          | This specification (subclause 5.2)               |
|           | MPEG-21 REL                            | REL          | ISO/IEC 21000-5                                                          | DAC Profile                                      |
|           | TV-Anytime Metadata                    | TVA          | ETSI TS 102 822-3 Subpart 1 and 3<br>ETSI TS 102 822-4                   | This specification (subclause 5.3)               |

NOTE 1 MOT-SLIDE and BWS components can contain JPG/PNG/MNG images and that BWS can contain HTML (Hyper Text Markup Language) document, CSS (Cascading Style Sheet), and ECMA Script, etc. Unless specifically mentioned in this specification, the requirements of TTAS.KO-07.0032 apply for the MOT-SLIDE component and the requirements of TTAS.ET-TS101498-1 Intermediate Profile apply for the BWS component.

NOTE 2 JPG, PNG, and MNG images can be used in the contexts of BIFS, MOT-SLIDE, and BWS. In addition, the images can also be used as media titles or thumbnails in TVA or can independently exist as additional resource items for user. In any context, only the requirements of TTAS.ET-TS101498-1 apply for all the image components in DMB-AF.

## 5.2 Restrictions on MPEG-21 IPMP components

### 5.2.1 Introduction

The IPMP tool set for DMB-AF is a subset of MPEG-21 IPMP Components. The selection criterion on this tool set is based on the specific application domain of DMB.

- Most of the target terminals are to be hand-held DMB receivers.
- The selected IPMP tools should be useful and applicable for DMB-AF services on such devices.
- For easy implementation, some ambiguous tool elements, e.g. the elements of “any” type should be specifically defined.

The following subclauses specify the normative set of the required IPMP Components elements for DMB-AF.

### 5.2.2 IPMP DIDL

To maintain the full capability to express the protected Digital Item, the IPMP tool set for DMB-AF shall include all the elements in the IPMP DIDL schema of MPEG-21 IPMP Components.

### 5.2.3 IPMP Information Descriptor

IPMP Information Descriptors in DMB-AF are composed of the subset of IPMP Information Descriptor schema in MPEG-21 IPMP Components standard. The selected elements with restrictions are as follows.

| Element/Child Element           | Restrictions on MPEG-21 IPMP Components                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| ipmpinfo:IPMPInfoDescriptor     | As defined in 7.3 of the standard                                                                                                |
| ipmpinfo:Tool                   | Restricted to include only ToolRef                                                                                               |
| ipmpinfo:RightsDescriptor       | As defined in 7.5 of the standard.                                                                                               |
| dsig:Signature                  | As defined in 7.6 of the standard.                                                                                               |
| ipmpinfo:Tool                   | Restricted to include only a ToolRef, an optional initializationSettings, an optional RightsDescriptor and an optional Signature |
| ipmpinfo:ToolRef                | As defined in 7.4.5 of the standard                                                                                              |
| ipmpinfo:initializationSettings | As defined in 7.5 of the standard.                                                                                               |
| ipmpinfo:RightsDescriptor       | As defined in 7.5 of the standard.                                                                                               |
| dsig:Signature                  | As defined in 7.6 of the standard.                                                                                               |

The ipmpinfo:RightsDescriptor element is used for containing rights information that governs the IPMP information. The ipmpinfo:RightsDescriptor element under the ipmpinfo:Tool element is for each IPMP Tool. The common rights information about all tools in ipmpinfo:IPMPInfoDescriptor can be expressed by the ipmpinfo:RightsDescriptor under the ipmpinfo:IPMPInfoDescriptor.

Regarding encryption of resources, AES-128 CTR [32] is used as a default encryption tool in DMB-AF, meaning that DMB-AF file players compliant to the protection supporting brands of this specification shall be able to decrypt the resources encrypted by the default encryption tool. In addition, the initiation vector (IV) can be used as a value of ipmpinfo:initializationSettingsData for AES-128 CTR method.

### 5.2.4 IPMP General Information Descriptor

IPMP General Information Descriptors in DMB-AF are composed of a subset of MPEG-21 IPMP Information Descriptor schema in MPEG-21 IPMP Components and MPEG-A Media Streaming Player application format [17]. The selected elements with restrictions are tabulated as follows.

| Element/Child Element              |                                | Restrictions on MPEG-21 IPMP Components                                                                                                      |
|------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| ipmpinfo:IPMPGeneralInfoDescriptor |                                | As defined in 8.3.1 of the standard.                                                                                                         |
|                                    | Ipmpinfo:ToolList              | This element is restricted to include one or many ipmpinfo:ToolDescription element(s).                                                       |
|                                    | ipmpinfo:LicenseCollection     | As defined in 8.5 of the standard.                                                                                                           |
|                                    | Dsig:Signature                 | As defined in 8.6 of the standard.                                                                                                           |
| Ipmpinfo:ToolList                  |                                | Restricted to include only ipmpinfo:ToolDescription                                                                                          |
|                                    | ipmpinfo:ToolDescription       |                                                                                                                                              |
| ipmpinfo:ToolDescription           |                                | This element is restricted to include the following child elements only: ipmpinfo:IPMPToolID, an optional ipmpinfo:Inline Or ipmpinfo:Remote |
|                                    | ipmpinfo:IPMPToolID            | As defined in 8.4.4.3 of the standard.                                                                                                       |
|                                    | Ipmpinfo:Inline                | As defined in 8.4.4.5 of the standard.                                                                                                       |
|                                    | Ipmpinfo:Remote                | As defined in 8.4.4.6 of the standard.                                                                                                       |
|                                    | Ipmpinfo:ConfigurationSettings | As defined in 8.4.8.6 of the standard.                                                                                                       |
|                                    | @localID                       | As defined in 8.4.4.1 of the standard.                                                                                                       |
| ipmpinfo:ConfigurationSettings     |                                |                                                                                                                                              |
|                                    | ipmpinfo:Configuration         | Restricted to include a ipmpinfo-msx:ToolBody element [17] in order to indicate IPMP Tool Configuration.                                     |
|                                    | ipmpinfo:Update                | As defined in 7.4.4.7.4 of the standard.                                                                                                     |

## 5.2.5 IPMP Information schema

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
xmlns:ipmpinfo-msx="urn:mpeg:mpeg21:2006:10-IPMPINFO-MSX-NS" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-
NS" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS" xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
targetNamespace="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="0.01">
  <import namespace="http://www.w3.org/2000/09/xmldsig#"
schemaLocation="http://www.w3.org/TR/2002/REC-xmldsig-core-20020212/xmldsig-core-schema.xsd"/>
  <import namespace="urn:mpeg:mpeg21:2003:01-REL-R-NS" schemaLocation="rel-r_IS.xsd"/>
  <import namespace="urn:mpeg:mpeg21:2002:01-DII-NS" schemaLocation="dii.xsd"/>
  <element name="IPMPInfoDescriptor" type="ipmpinfo:IPMPInfoDescriptorType"/>
  <complexType name="IPMPInfoDescriptorType">
    <annotation>
      <documentation>The RightsDescriptor under this element is applied to the associated
asset</documentation>
    </annotation>
    <sequence>
      <element ref="ipmpinfo:Tool" minOccurs="0" maxOccurs="unbounded"/>
      <element ref="ipmpinfo:RightsDescriptor" minOccurs="0" maxOccurs="unbounded"/>
      <element ref="dsig:Signature" minOccurs="0"/>
    </sequence>
  </complexType>
  <element name="Tool" type="ipmpinfo:ToolType"/>
  <complexType name="ToolType">
    <complexContent>
      <restriction base="ipmpinfo:ToolType">
        <sequence>
          <element ref="ipmpinfo:ToolRef"/>
          <element ref="ipmpinfo:InitializationSettings" minOccurs="0"/>
          <element ref="ipmpinfo:RightsDescriptor" minOccurs="0"/>
          <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
        <attribute name="order" type="positiveInteger"/>
      </restriction>
    </complexContent>
  </complexType>
  <element name="ToolRef" type="ipmpinfo:ToolRef"/>
  <complexType name="ToolRef">
```

```

    <attribute name="localidref" type="IDREF" use="required"/>
</complexType>
<element name="IPMPToolID" type="anyURI"/>
<element name="Inline" type="ipmpinfo:InlineType"/>
<complexType name="InlineType">
  <sequence>
    <element ref="ipmpinfo:Binary"/>
    <element ref="dsig:Signature" minOccurs="0"/>
  </sequence>
</complexType>
<element name="Binary" type="base64Binary"/>
<element name="Remote" type="ipmpinfo:RemoteType"/>
<complexType name="RemoteType">
  <sequence>
    <element ref="dsig:Signature" minOccurs="0"/>
  </sequence>
  <attribute name="ref" type="anyURI"/>
</complexType>
<element name="ConfigurationSettings" type="ipmpinfo:ConfigurationSettingsType"/>
<complexType name="ConfigurationSettingsType" mixed="true">
  <sequence>
    <element ref="ipmpinfo:Configuration"/>
    <element ref="ipmpinfo:Update" minOccurs="0"/>
  </sequence>
</complexType>
<element name="Configuration" type="ipmpinfo:ConfigurationType"/>
<complexType name="ConfigurationType" mixed="true">
<complexContent>
  <restriction base="ipmpinfo:ConfigurationType">
    <sequence>
      <element ref="ipmpinfo-msx:ToolBody" minOccurs="0"/>
    </sequence>
  </restriction>
</complexContent>
  <sequence>
    <any namespace="##any" processContents="lax" minOccurs="0"/>
  </sequence>
</complexType>
<element name="Update" type="ipmpinfo:UpdateType"/>
<complexType name="UpdateType">
  <sequence>
    <element ref="ipmpinfo:Location" maxOccurs="unbounded"/>
    <element ref="ipmpinfo:ScheduledUpdateTime" minOccurs="0"/>
    <element ref="ipmpinfo:SupportedPlatform" minOccurs="0" maxOccurs="unbounded"/>
    <element ref="dsig:Signature" minOccurs="0"/>
  </sequence>
</complexType>
<element name="Location" type="ipmpinfo:RemoteType"/>
<element name="ScheduledUpdateTime" type="ipmpinfo:ScheduledUpdateTimeType"/>
<complexType name="ScheduledUpdateTimeType">
  <simpleContent>
    <extension base="dateTime">
      <attribute name="periodic" type="duration" use="optional"/>
    </extension>
  </simpleContent>
</complexType>
<element name="SupportedPlatform" type="ipmpinfo:SupportedPlatformType"/>
<complexType name="SupportedPlatformType">
  <sequence>
    <any namespace="##any" processContents="lax" minOccurs="0"/>
  </sequence>
</complexType>
<element name="RightsDescriptor" type="ipmpinfo:RightsDescriptorType"/>
<complexType name="RightsDescriptorType">
  <sequence>
    <element ref="ipmpinfo:IPMPInfoDescriptor" minOccurs="0"/>
    <choice minOccurs="0">
      <element ref="ipmpinfo:License"/>
      <element ref="ipmpinfo:LicenseReference"/>
      <element ref="ipmpinfo:LicenseService"/>
    </choice>
  </sequence>
</complexType>
<element name="License" type="ipmpinfo:LicenseType"/>
<complexType name="LicenseType" mixed="true">
  <sequence>

```

```

    <any namespace="##any" processContents="lax" minOccurs="0"/>
  </sequence>
</complexType>
<element name="LicenseService" type="ipmpinfo:LicenseServiceType"/>
<complexType name="LicenseServiceType" mixed="true">
  <sequence>
    <any namespace="##any" processContents="lax" minOccurs="0"/>
  </sequence>
</complexType>
<element name="LicenseReference" type="ipmpinfo:LicenseReferenceType"/>
<complexType name="LicenseReferenceType">
  <simpleContent>
    <extension base="anyURI" />
  </simpleContent>
</complexType>
<element name="InitializationSettings" type="ipmpinfo:InitializationSettingsType"/>
<complexType name="InitializationSettingsType" mixed="true">
  <sequence>
    <element ref="ipmpinfo:IPMPInfoDescriptor" minOccurs="0"/>
    <element ref="ipmpinfo:InitializationData"/>
  </sequence>
</complexType>
<element name="InitializationData" type="ipmpinfo:InitializationDataType"/>
<complexType name="InitializationDataType" mixed="true">
  <sequence>
    <any namespace="##any" processContents="lax" minOccurs="0"/>
  </sequence>
</complexType>
<element name="IPMPGeneralInfoDescriptor" type="ipmpinfo:IPMPGeneralInfoDescriptorType"/>
<complexType name="IPMPGeneralInfoDescriptorType">
  <sequence>
    <element ref="ipmpinfo:ToolList" minOccurs="0"/>
    <element ref="ipmpinfo:LicenseCollection" minOccurs="0"/>
    <element ref="dsig:Signature" minOccurs="0"/>
  </sequence>
</complexType>
<element name="ToolList" type="ipmpinfo:ToolListType"/>
<complexType name="ToolListType">
  <complexContent>
    <restriction base="ipmpinfo:ToolListType">
      <sequence>
        <element ref="ipmpinfo:ToolDescription" maxOccurs="unbounded"/>
      </sequence>
    </restriction>
  </complexContent>
</complexType>
<element name="ToolDescription" type="ipmpinfo:ToolDescriptionType"/>
<complexType name="ToolDescriptionType">
  <complexContent>
    <restriction base="ipmpinfo:ToolDescriptionType">
      <sequence>
        <element ref="ipmpinfo:IPMPToolID"/>
        <choice minOccurs="0">
          <element ref="ipmpinfo:Inline"/>
          <element ref="ipmpinfo:Remote"/>
        </choice>
        <element ref="ipmpinfo:ConfigurationSettings" minOccurs="0"/>
        <element ref="ipmpinfo:RightsDescriptor" minOccurs="0"/>
        <element ref="dsig:Signature" minOccurs="0"/>
      </sequence>
      <attribute name="localID" type="ID" use="required"/>
    </restriction>
  </complexContent>
</complexType>
<element name="LicenseCollection" type="ipmpinfo:LicenseCollectionType"/>
<complexType name="LicenseCollectionType" mixed="true">
  <sequence>
    <element ref="ipmpinfo:RightsDescriptor" maxOccurs="unbounded"/>
  </sequence>
</complexType>
</schema>

```

### 5.3 Restrictions on TV-Anytime metadata

#### 5.3.1 Introduction

DMB-AF uses a restricted subset of TV-Anytime Metadata for the rich content description and consumption. The followings are taken into considerations in order to customize the TVA metadata schema for DMB-AF applications.

- There are many elements that can be used to describe the same information. To reduce usage ambiguity of such elements, some redundant elements should be eliminated as much as possible.
- There are recursive elements such as 'item', which can contain 'item's recursively. For a simple description and devices with limited system resources, the level of recursion should be restricted to a certain level.
- Those elements which are not essential for DMB-AF applications should be optimized in regards to the required system resources and possible future usages.

#### 5.3.2 Restricted schema elements

Figure 4 shows a high-level view of the restricted TV-Anytime metadata schema for DMB-AF.

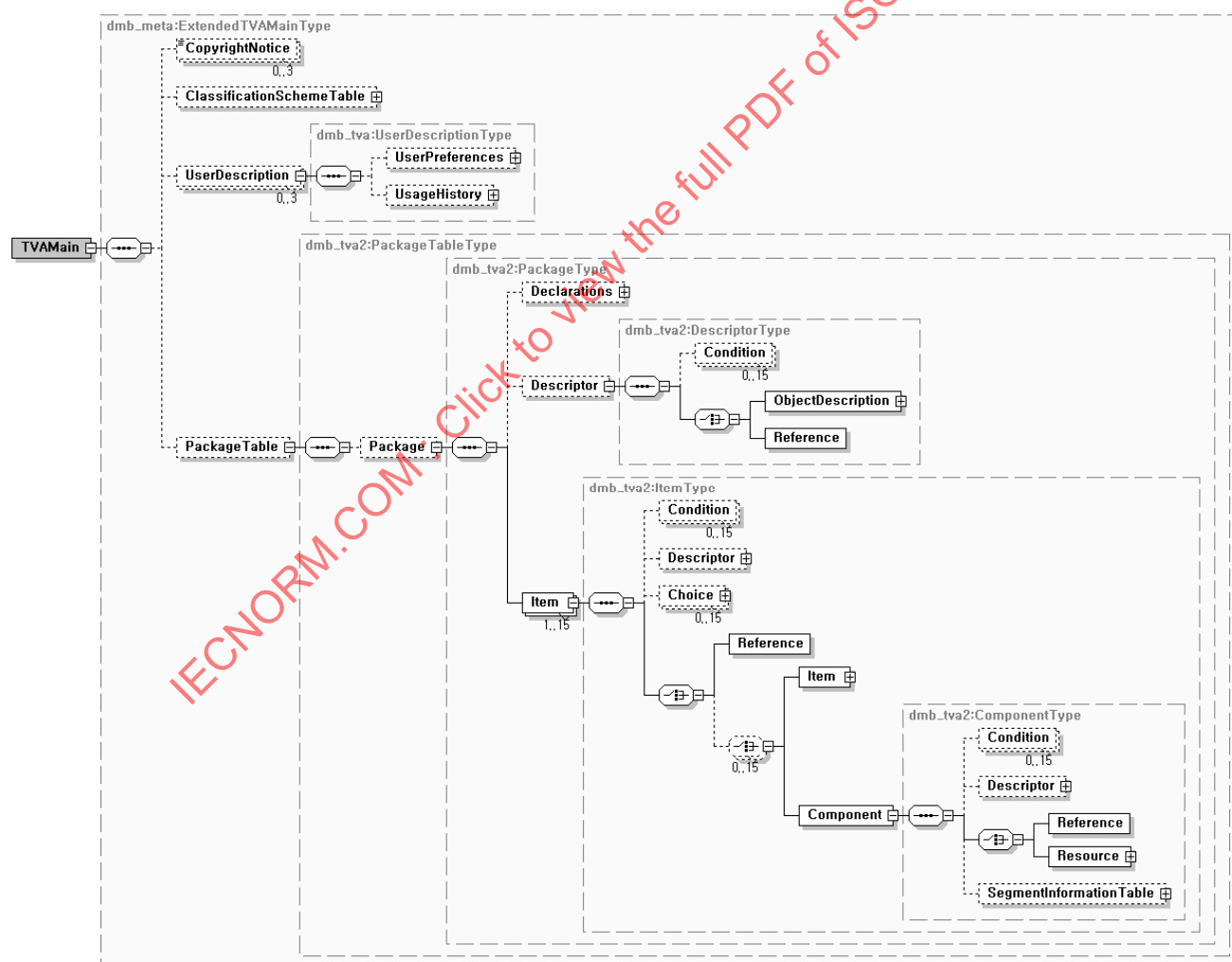


Figure 4 — Overview of the restricted set of TV-Anytime metadata

The top-level schema of the restricted set of TV-Anytime metadata is shown in Figure 5.

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:dmb_meta="urn:mpeg:maf:schema:dmb:metadata:2007"
xmlns:dmb_tva="urn:mpeg:maf:schema:dmb:tva:2007" xmlns:dmb_tva2="urn:mpeg:maf:schema:dmb:tva2:2007"
xmlns:dmb_mpeg7="urn:mpeg:maf:schema:dmb:mpeg7:2007" xmlns="http://www.w3.org/2001/XMLSchema"
targetNamespace="urn:mpeg:maf:schema:dmb:metadata:2007" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <annotation>
    <documentation xml:lang="en">This schema consists of datatypes that are normatively defined in
Updated proposal on TV-Anytime Metadata in ISO/IEC 23000-9 MAF for DMB (2007-10)</documentation>
  </annotation>
  <import namespace="urn:mpeg:maf:schema:dmb:tva:2007" schemaLocation="dmbmaf_tva1_3-1_v141.xsd"/>
  <import namespace="urn:mpeg:maf:schema:dmb:tva2:2007" schemaLocation="dmbmaf_tva2_3-3_v121.xsd"/>
  <import namespace="urn:mpeg:maf:schema:dmb:mpeg7:2007" schemaLocation="dmbmaf_mpeg7.xsd"/>
  <import namespace="http://www.w3.org/XML/1998/namespace" schemaLocation="xml.xsd"/>
  <annotation>
    <documentation xml:lang="en">ISO/IEC 23000-9 MAF for DMB</documentation>
  </annotation>
  <element name="TVAMain" type="dmb_meta:ExtendedTVAMainType"/>
  <complexType name="ExtendedTVAMainType">
    <sequence>
      <element name="CopyrightNotice" type="dmb_mpeg7:TextualType" minOccurs="0" maxOccurs="3"/>
      <element name="ClassificationSchemeTable" type="dmb_tva:ClassificationSchemeTableType"
minOccurs="0"/>
      <element name="UserDescription" type="dmb_tva:UserDescriptionType" minOccurs="0"
maxOccurs="3"/>
      <element name="PackageTable" type="dmb_tva2:PackageTableType" minOccurs="0"/>
    </sequence>
    <attribute ref="xml:lang" use="required"/>
    <attribute name="publisher" type="string" use="optional"/>
    <attribute name="publicationTime" type="dateTime" use="optional"/>
    <attribute name="rightsOwner" type="string" use="optional"/>
    <attribute name="originID" type="dmb_tva:TVAIDType" use="optional"/>
    <attribute name="version" type="unsignedInt" use="required"/>
  </complexType>
</schema>
```

**Figure 5 — Top-level schema of the restricted set of TV-Anytime metadata**

The restricted schema element types are tabulated in Table 2. In the 'Restrictions' column of this table, 'TVA1' and 'TVA2' mean TV-Anytime Phase 1 and Phase 2 Metadata specifications (i.e., ETSI TS 102 822-3-1 V1.4.1 and ETSI TS 102 822-3-3 V1.2.1), respectively.

Table 2 — The restricted schema elements of TV-Anytime metadata

| Index | Element/Child Element         | Restrictions                                                                                                                                                                 |
|-------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | ExtendedTVAMain               | Restricted as only the elements in Index 2~5 of this table are used. In addition, xml:lang and version attributes are used as mandatory.                                     |
| 2     | CopyrightNotice               | As defined in 6.7.2 of TVA1                                                                                                                                                  |
| 3     | ClassificationSchemeTable     | As defined in 6.7.2 of TVA1                                                                                                                                                  |
| 4     | UserDescription               | See Index 6~8                                                                                                                                                                |
| 5     | PackageTable                  | See Index 15~16                                                                                                                                                              |
| 6     | UserDescription               |                                                                                                                                                                              |
| 7     | UserPreferences               | See Index 9                                                                                                                                                                  |
| 8     | UsageHistory                  | See Index 12~14                                                                                                                                                              |
| 9     | UserPreferences               | Restricted as only the elements in index 10~11 of this table are used.                                                                                                       |
| 10    | UserIdentifier                | As defined in 6.5.2 of TVA1                                                                                                                                                  |
| 11    | FilteringAndSearchPreferences | Restricted from 6.5.2 of TVA1; Restricted only to use "CreationPreferences" element. Restricted as this element is used for describing preference for a program.             |
| 12    | UsageHistory                  |                                                                                                                                                                              |
| 13    | UserIdentifier                | As defined in 6.5.2 of TVA1                                                                                                                                                  |
| 14    | UserActionHistory             | Restricted not to use "ObservationPeriod" element                                                                                                                            |
| 15    | PackageTable                  | Restricted from 10.1 of TVA2; Restricted as xml:lang is mandatory, and copyrightNotice is optional                                                                           |
| 16    | Package                       | See Index 17~20                                                                                                                                                              |
| 17    | Package                       |                                                                                                                                                                              |
| 18    | Declarations                  | Restricted from 8.2 of TVA2; Restricted not to use "Anchor".                                                                                                                 |
| 19    | Descriptor                    | See Index 38~44                                                                                                                                                              |
| 20    | Item                          | See Index 21~27                                                                                                                                                              |
| 21    | Item                          | Restricted from 8.4 of TVA2; Restricted not to use "Relation" element and "xml:lang" attribute                                                                               |
| 22    | Condition                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 23    | Descriptor                    | See Index 38~44                                                                                                                                                              |
| 24    | Choice                        | See Index 28~31                                                                                                                                                              |
| 25    | Reference                     | As defined in 8.3 of TVA-2                                                                                                                                                   |
| 26    | Item                          | See Index 21~27                                                                                                                                                              |
| 27    | Component                     | See Index 32~37                                                                                                                                                              |
| 28    | Choice                        | Restricted from 8.4 of TVA2; Restricted as minSelections and maxSelections attribute are not used.                                                                           |
| 29    | Condition                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 30    | Descriptor                    | See Index 38~44                                                                                                                                                              |
| 31    | Selection                     | As defined in 8.4 of TVA2                                                                                                                                                    |
| 32    | Component                     | Restricted from 8.5 of TVA2; Restricted not to use "Relation" element and xml:lang attribute. In addition, "Anchor" element is replaced with "SegmentationInformationTable". |
| 33    | Condition                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 34    | Descriptor                    | See Index 38~44                                                                                                                                                              |
| 35    | Reference                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 36    | Resource                      | See Index 101~102                                                                                                                                                            |
| 37    | SegmentInformationTable       | See Index 105~107                                                                                                                                                            |
| 38    | Descriptor                    | Restricted as xml:lang is not used                                                                                                                                           |
| 39    | Condition                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 40    | ObjectDescription             | See Index 42~44                                                                                                                                                              |
| 41    | Reference                     | As defined in 8.3 of TVA2                                                                                                                                                    |
| 42    | ObjectDescription             | As defined in 8.3 of TVA2                                                                                                                                                    |
| 43    | Description                   | As defined in 8.3 of TVA2                                                                                                                                                    |
| 44    | ContentDescription            | See Index 45~61                                                                                                                                                              |
| 45    | ContentDescription            | Restricted from ExtendedContentDescriptionType of TVA2; Restricted as the only elements in Index 46~61 are used.                                                             |
| 46    | Title                         | Restricted from 6.3.4 of TVA1; Restricted as "type" attributes are not used.                                                                                                 |
| 47    | MediaTitle                    | As defined in 6.3.4 of TVA1                                                                                                                                                  |
| 48    | ShortTitle                    | As defined in 6.3.4 of TVA1                                                                                                                                                  |
| 49    | Synopsis                      | As defined in 6.3.4 of TVA1                                                                                                                                                  |
| 50    | Genre                         | Restricted from 6.3.4 of TVA1; Restricted as only "href" attribute and "Name" element are used.                                                                              |
| 51    | ParentalGuidance              | As defined in 6.3.4 of TVA1; Restricted as only "ParentalRating" and "MinimumAge" elements are used. Restricted not to use "ExplanatoryText" element.                        |

Table 2 (continued)

| Index | Element/Child Element                 | Restrictions                                                                                                                                                                                                                                                                                         |
|-------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 52    | Language                              | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 53    | CaptionLanguage                       | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 54    | SignLanguage                          | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 55    | CreditsList                           | Restricted from that defined in 6.3.4 of TVA1;<br>Restricted as only the "role" attribute, "PersonName" and "Character" elements under "CreditsItem" are used.<br>For both the "PersonName" and "Character" elements, only the "xml:lang" attribute, "GivenName" and "FamilyName" elements are used. |
| 56    | RelatedMaterial                       | Restricted from 6.3.4 of TVA1;<br>Restricted as "HowRelated", "MediaLocator" and "PromotionalText" elements are only used                                                                                                                                                                            |
| 57    | ProductionDate                        | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 58    | ProductionLocation                    | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 59    | Duration                              | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 60    | ContentProperties                     | See Index 62~66                                                                                                                                                                                                                                                                                      |
| 61    | SourceLocation                        | See Index 77~81                                                                                                                                                                                                                                                                                      |
| 62    | ContentProperties                     |                                                                                                                                                                                                                                                                                                      |
| 63    | ContentType                           | As defined in 6.1.3 of TVA2.<br>But the default CS used for this element (i.e., ContentTypeCS) need to be extended to describe DMB contents. Therefore, SlideShow, BWS, TTI, BIFS, Java Midlet, Timed Text are newly added to the ContentTypeCS to make dmbmaf_ContentTypeCS.                        |
| 64    | FileProperties                        | As defined in 6.1.3 of TVA2                                                                                                                                                                                                                                                                          |
| 65    | ContentAttributes                     | See Index 67~70                                                                                                                                                                                                                                                                                      |
| 66    | ContextAttributes                     | See Index 71~76                                                                                                                                                                                                                                                                                      |
| 67    | ContentAttributes                     |                                                                                                                                                                                                                                                                                                      |
| 68    | AudioAttributesType                   | As defined in 6.1.1.1 of TVA2                                                                                                                                                                                                                                                                        |
| 69    | VideoAttributesType                   | As defined in 6.1.1.2 of TVA2                                                                                                                                                                                                                                                                        |
| 70    | StillImageContentAttributesType       | As defined in 6.1.1.3 of TVA2                                                                                                                                                                                                                                                                        |
| 71    | ContextAttributes                     |                                                                                                                                                                                                                                                                                                      |
| 72    | DataBroadcastingContextAttributesType | As defined in 6.1.2.1 of TVA2                                                                                                                                                                                                                                                                        |
| 73    | InterstitialContextAttributesType     | As defined in 6.1.2.2 of TVA2                                                                                                                                                                                                                                                                        |
| 74    | EducationalContextAttributesType      | As defined in 6.1.2.3 of TVA2                                                                                                                                                                                                                                                                        |
| 75    | ApplicationContextAttributesType      | As defined in 6.1.2.4 of TVA2                                                                                                                                                                                                                                                                        |
| 76    | GameContextAttributesType             | As defined in 6.1.2.5 of TVA2                                                                                                                                                                                                                                                                        |
| 77    | SourceLocation                        | As defined in 7.1 of TVA2<br>(Used to describe Program Location information)                                                                                                                                                                                                                         |
| 78    | BroadcastEvent                        | See Index 82~86                                                                                                                                                                                                                                                                                      |
| 79    | OnDemandProgram                       | See Index 96~100                                                                                                                                                                                                                                                                                     |
| 80    | ContentIdRef                          | As defined in 7.1 of TVA2                                                                                                                                                                                                                                                                            |
| 81    | int                                   | As defined in 8.5 of TVA2                                                                                                                                                                                                                                                                            |
| 82    | BroadcastEvent                        | Restricted from 6.4.2 of TVA1;<br>Restricted not to use "ProgramURL" and "InstanceMetadataId" elements under "ProgramLocationType".<br>Restricted as only the "PublishedStartTime" and "PublishedEndTime" elements under "ScheduleEventType" are used.                                               |
| 83    | Program                               | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                                                          |
| 84    | InstanceDescription                   | See Index 87~88                                                                                                                                                                                                                                                                                      |
| 85    | PublishedStartTime                    | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                                                          |
| 86    | PublishedDuration                     | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                                                          |
| 87    | InstanceDescription                   | Restricted as only used "PurchaseList" element                                                                                                                                                                                                                                                       |
| 88    | PurchaseList                          | See Index 89~90                                                                                                                                                                                                                                                                                      |
| 89    | PurchaseList                          | Restricted as only used "PurchaseItem" element                                                                                                                                                                                                                                                       |
| 90    | PurchaseItem                          | See Index 92~95                                                                                                                                                                                                                                                                                      |
| 91    | PurchaseItem                          | Restricted as only use the elements in Index 92~95                                                                                                                                                                                                                                                   |
| 92    | Price                                 | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 93    | PricingServerURL                      | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                                                          |
| 94    | RequiredCoupon                        | Restricted from 6.3 of TVA2<br>Only couponId and requiredNumber attributes are used                                                                                                                                                                                                                  |
| 95    | RewardCoupon                          | Restricted from 6.3 of TVA2;<br>"userConfirmationRequired" and "number" attribute are not used                                                                                                                                                                                                       |

Table 2 (continued)

| Index | Element/Child Element   | Restrictions                                                                                                                                                                                                                                                |
|-------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 96    | OnDemandProgram         | Restricted from 6.4.2 of TVA1;<br>Restricted not to use "PublishedDuration", "FirstAvailability",<br>"LastAvailability" and "ImmediateViewing" elements.<br>Restricted not to "ProgramURL" and "InstanceMetadataId" elements<br>under "ProgramLocationType" |
| 97    | Program                 | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                 |
| 98    | InstanceDescription     | See Index 87~88                                                                                                                                                                                                                                             |
| 99    | StartOfAvailability     | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                 |
| 100   | EndOfAvailability       | As defined in 6.4.2 of TVA1                                                                                                                                                                                                                                 |
| 101   | Resource                | As defined in 8.5 of TVA2                                                                                                                                                                                                                                   |
| 102   | ResourceType            | See Index 103~104                                                                                                                                                                                                                                           |
| 103   | ResourceType            | As defined in 8.5 of TVA2                                                                                                                                                                                                                                   |
| 104   | Name                    | Restricted from 8.5 of TVA2;<br>Preferred attribute is not used.                                                                                                                                                                                            |
| 105   | SegmentInformationTable | Restricted from 6.6.7 of TVA1<br>"metadataOriginIDRef" and "xml:lang" attributes are not used.                                                                                                                                                              |
| 106   | SegmentList             | See Index 108~109                                                                                                                                                                                                                                           |
| 107   | SegmentGroupList        | As defined in 6.6.7 of TVA1                                                                                                                                                                                                                                 |
| 108   | SegmentList             |                                                                                                                                                                                                                                                             |
| 109   | SegmentInformation      | See Index 110~115                                                                                                                                                                                                                                           |
| 110   | SegmentInformation      | Restricted from 6.6.5 of TVA1;<br>"metadataOriginIDRef" and "xml:lang" attributes are not used.                                                                                                                                                             |
| 111   | ProgramRef              | As defined in 6.6.5 of TVA1                                                                                                                                                                                                                                 |
| 112   | TimeBaseReference       | As defined in 6.6.5 of TVA1                                                                                                                                                                                                                                 |
| 113   | Description             | See Index 116~112                                                                                                                                                                                                                                           |
| 114   | SegmentLocator          | As defined in 6.6.5 of TVA1                                                                                                                                                                                                                                 |
| 115   | KeyFrameLocator         | As defined in 6.6.5 of TVA1                                                                                                                                                                                                                                 |
| 116   | Description             |                                                                                                                                                                                                                                                             |
| 117   | Title                   | See Index 46                                                                                                                                                                                                                                                |
| 118   | Synopsis                | As defined in 6.3.4 of TVA1                                                                                                                                                                                                                                 |
| 119   | Genre                   | See Index 50                                                                                                                                                                                                                                                |
| 120   | RelatedMaterial         | See Index 56                                                                                                                                                                                                                                                |
| 121   | CreditsList             | See Index 55                                                                                                                                                                                                                                                |
| 122   | RewardCoupon            | See Index 123~124                                                                                                                                                                                                                                           |
| 123   | RewardCoupon            | Restricted from 6.3 of TVA2; "CouponRef" element,<br>"userConfirmationRequired" and "number" attribute are not used                                                                                                                                         |
| 124   | CouponDescription       | See Index 125~129                                                                                                                                                                                                                                           |
| 125   | CouponDescription       | Restricted from 6.3 of TVA2;<br>Restricted not to use "NonTVACouponRef", "CouponURL",<br>"UserTargetingInformation" and<br>"UserTargetingInformationRef" element.<br>In addition, only couponId and acquisitionMode attributes are used.                    |
| 126   | RequiredCoupon          | Restricted from 6.3 of TVA2;<br>Only couponId and requiredNumber attributes are used.                                                                                                                                                                       |
| 127   | CouponValue             | See Index 130~131                                                                                                                                                                                                                                           |
| 128   | ContentTarget           | See Index 132~133                                                                                                                                                                                                                                           |
| 129   | CouponText              | As defined in 6.3 of TVA2                                                                                                                                                                                                                                   |
| 130   | CouponValue             | Restricted from 6.3 of TVA2; "ReductionAmount" element and<br>"purchaseIDRef" attribute are used only.                                                                                                                                                      |
| 131   | ReductionAmount         | As defined in 6.3 of TVA2                                                                                                                                                                                                                                   |
| 132   | ContentTarget           | Restricted from 6.3 of TVA2; Program CRID is only used.                                                                                                                                                                                                     |
| 133   | Program                 | As defined in 6.3 of TVA2                                                                                                                                                                                                                                   |
| 134   | SegmentGroupList        | As defined in 6.6.7 of TVA1                                                                                                                                                                                                                                 |
| 135   | SegmentGroupInformation | See Index 136~143                                                                                                                                                                                                                                           |
| 136   | SegmentGroupInformation | Restricted from 6.6.6 of TVA1;<br>Restricted not to use "GroupInterval" element.<br>metadataOriginIDRef and xml:lang are not used.<br>Restricted as the number of keyframe equal to 1 and not to use<br>numberOfKeyFrames attribute.                        |
| 137   | ProgramRef              | As defined in 6.6.6 of TVA1                                                                                                                                                                                                                                 |
| 138   | TimeBaseReference       | As defined in 6.6.6 of TVA1                                                                                                                                                                                                                                 |
| 139   | GroupType               | Restricted from 6.6.6 of TVA1;<br>GroupType is listed at SegmentGroupTypeType                                                                                                                                                                               |
| 140   | Description             | Index 116~133 are used                                                                                                                                                                                                                                      |
| 141   | Segments                | As defined in 6.6.6 of TVA1                                                                                                                                                                                                                                 |
| 142   | Groups                  | As defined in 6.6.6 of TVA1                                                                                                                                                                                                                                 |
| 143   | KeyFrameLocator         | As defined in 6.6.6 of TVA1                                                                                                                                                                                                                                 |

In addition to the restrictions in Table 2, the following restrictions on the schema elements apply:

- The recursion level of 'Item' type (index 21 of Table 2) is bounded to 2. Thus a top-level 'Item' can have sub-'Item's but the sub-'Item's shall not have any sub-'Item'. Note that since the DMB-AF file structure also support a movie-level recursion (i.e., multiple movie file structure), it is recommended to use such functionality if 'Item' depth more than 2 is needed.
- The recursion level of segment 'Groups' (index 142) is bounded to 2, meaning that a 'Groups' element can only contain such 'SegmentGroupInformation's that do not have 'Groups' element as a child.
- The recursion level of 'Term' type in 'ClassificationSchemeTable' (index 3) is bounded to 2.
- The maximum occurrence of each element is bounded to some values (1, 3, 15, 255, or 1023). The specific bound values are defined in the restricted schema.
- The maximum length of 'TextualType' string is bounded to 256.

**NOTE** An informative set of Classification Schemes (CSs) has been developed by TVA to provide a universally applicable default set of classification terms. In addition to – or as a total or partial replacement for – this default CSs, implementers may create and make use of other CSs to meet specific regional or other special requirements. For describing the DMB content components, the original 'ContentTypeCS' in TVA is extended for DMB-AF.

The restricted schema of the TV-Anytime metadata and the DMB content type CS are provided with this specification as an electronic attachment. Unless specifically mentioned in this specification, the syntax, semantics, and usage of the schema elements, the CS, and the CRID shall be in accordance with the associated TV-Anytime specifications (ETSI TS 102 822-3-1 V1.4.1, ETSI TS 102-822-3-3 V1.2.1, and ETSI TS 102 822-4 V1.3.1).

## 6 File structures

### 6.1 Table for boxes

The file format of DMB-AF can be represented in two kinds of structures for single movie contents and multiple movie contents. The file format structure of this specification is derived from the ISO base media file format standard.

The boxes used in this specification is based on a restricted set of boxes from the ISO base media file format and the MP4 File Format. Table 3 shows the structure of the employed boxes with their description. The mandatory boxes, which shall be exist in DMB-AF files if the higher level box exist, are marked with an asterisk (\*). Note that support for all the structural boxes in Table 3 is required for all the brands defined in this specification.

Unless specifically mentioned in this specification, the requirements of ISO base media file format (ISO/IEC 14496-12), MP4 file format (ISO/IEC 14496-14), AVC file format (ISO/IEC 14496-15), and MPEG-21 file format (ISO/IEC 21000-9) apply for the listed boxes.

Table 3 — Box types and structure for this specification

|   |      |      |      |      |      |                                                                                                                                                              |
|---|------|------|------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * | ftyp |      |      |      |      | file type and compatibility                                                                                                                                  |
|   | pdin |      |      |      |      | progressive download information                                                                                                                             |
|   | moov |      |      |      |      | container for all the metadata                                                                                                                               |
| * |      | mvhd |      |      |      | movie header, overall declarations                                                                                                                           |
|   |      | iods |      |      |      | object descriptor                                                                                                                                            |
| * |      | trak |      |      |      | container for an individual track or stream                                                                                                                  |
| * |      |      | tkhd |      |      | track header, overall information about the track                                                                                                            |
|   |      |      | tref |      |      | track reference container                                                                                                                                    |
|   |      |      | edts |      |      | edit list container for data                                                                                                                                 |
|   |      |      |      | elst |      | an edit list                                                                                                                                                 |
| * |      |      | mdia |      |      | container for the media information in a track                                                                                                               |
| * |      |      |      | mdhd |      | media header, overall information about the media                                                                                                            |
| * |      |      |      | hdlr |      | handler, declares the media (handler) type<br>"soun" for audio data<br>"vide" for video data<br>"text" for timed text data<br>"hint" for protocol hint track |
| * |      |      |      | minf |      | media information container                                                                                                                                  |
|   |      |      |      |      | vmhd | video media header, overall information (video track only)                                                                                                   |
|   |      |      |      |      | smhd | sound media header, overall information (sound track only)                                                                                                   |
|   |      |      |      |      | hmhd | hint media header, overall information (hint track only)                                                                                                     |
|   |      |      |      |      | nmhd | Null media header, overall information (some tracks only)                                                                                                    |
| * |      |      |      |      | dinf | data information box, container                                                                                                                              |
| * |      |      |      |      | dref | data reference box, declares source(s) of media data in track                                                                                                |
| * |      |      |      |      | stbl | sample table box, container for the time/space map                                                                                                           |
| * |      |      |      |      | stsd | sample descriptions (codec types, initialization etc.)                                                                                                       |
| * |      |      |      |      | stts | (decoding) time-to-sample                                                                                                                                    |
| * |      |      |      |      | stsc | sample-to-chunk, partial data-offset information                                                                                                             |
|   |      |      |      |      | stsz | sample sizes (framing)                                                                                                                                       |
|   |      |      |      |      | stz2 | compact sample sizes (framing)                                                                                                                               |
| * |      |      |      |      | stco | chunk offset, partial data-offset information                                                                                                                |
|   |      |      |      |      | co64 | 64-bit chunk offset.                                                                                                                                         |
|   |      |      |      |      | stss | sync sample table (random access points)                                                                                                                     |
|   |      | udta |      |      |      | user-data                                                                                                                                                    |
|   | mdat |      |      |      |      | media data container                                                                                                                                         |
|   | free |      |      |      |      | free space                                                                                                                                                   |
|   | skip |      |      |      |      | free space                                                                                                                                                   |
|   | meta |      |      |      |      | metadata                                                                                                                                                     |
| * |      | hdlr |      |      |      | handler, declares the metadata (handler) type                                                                                                                |
|   |      | iloc |      |      |      | item location                                                                                                                                                |
|   |      | iinf |      |      |      | item information                                                                                                                                             |
|   |      | crid |      |      |      | mapping table between CRID and item or track (a 'uuid' box)                                                                                                  |
|   |      | xml  |      |      |      | XML container                                                                                                                                                |
|   |      | bxml |      |      |      | binary XML container                                                                                                                                         |

## 6.2 File structure for a single type file

Figure 6 illustrates a single type file structure containing single movie presentation with associated data. This type of file structure mainly consists of `ftyp`, `moov` and `mdat` boxes. The `moov` box describes the presentation of the scene in which more than one `trak` box are contained. The `trak` box contains the description for one media. A media in each `trak` box can be interleaved AV, individual audio and video, BIFS, and other data service contents as shown in Table 1. The `trak` box supports time information (such as `edtl`, `stbl` box) for the synchronization with other media of other `trak` box. The `mdat` box contains the real contents which are described in the `trak` box or the `trak` box may import the content by URL without depositing the content in the `mdat` box.

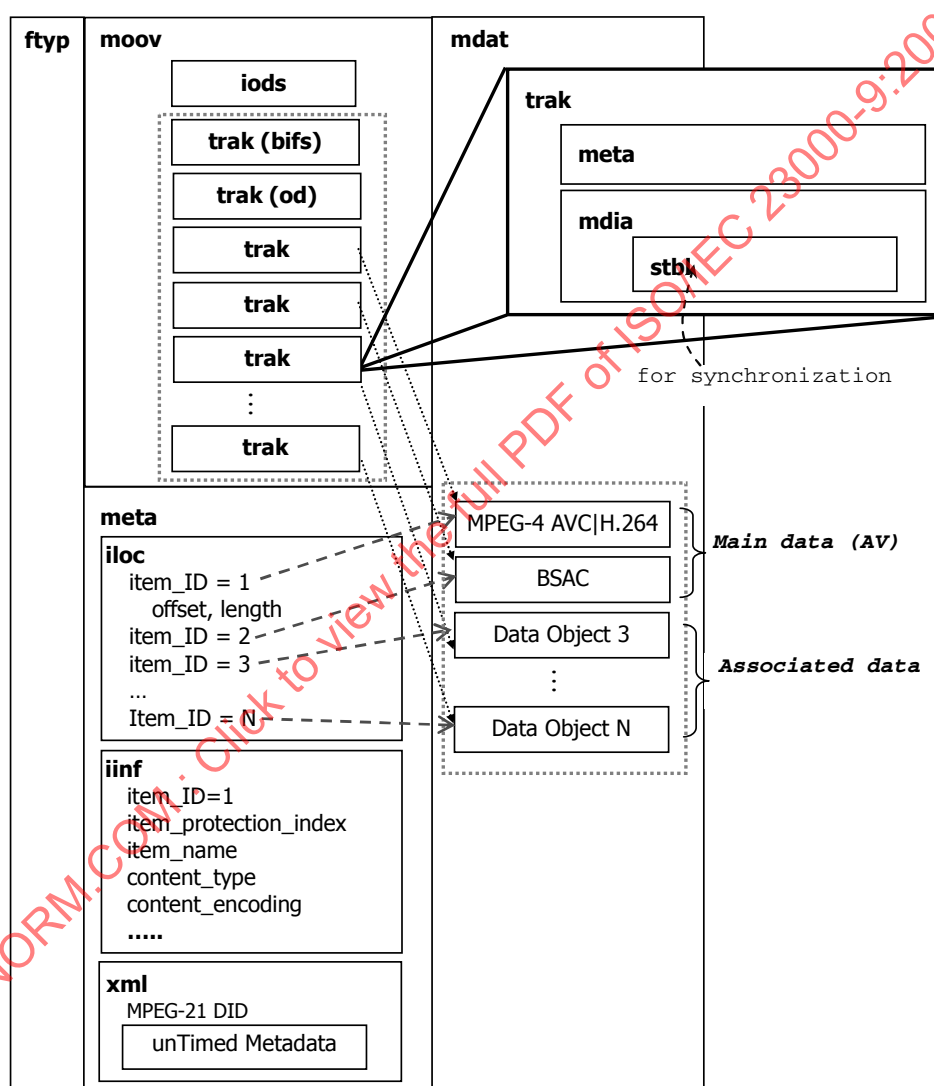


Figure 6 — Single type file structure

- Usages of single type file structure (Informative)

Usage 1

Figure 7 shows a primitive file structure for a single type file, where BIFS and IOD/OD information is not included in the file.

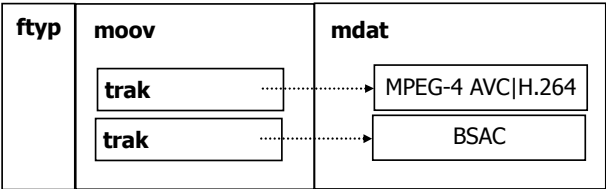


Figure 7 — A primitive file format structure

Usage 2

Figure 8 shows another primitive file structure for a single type file. In this figure, Audio and Visual streams are multiplexed in MPEG-2 TS format.

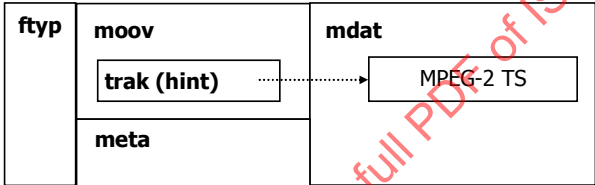


Figure 8 — A primitive file format structure for storing TS

Usage 3

Figure 9 shows another file structure for a single type file. BIFS, IOD and OD information is included with the main AV data.

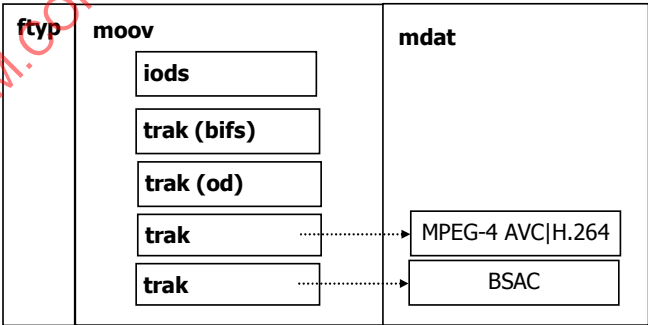


Figure 9 — A file format structure with BIFS and OD information

File format 3 with meta box

Figure 10 shows a file structure for a single type file using the *meta* box. This file contains the BIFS associated non-main data such as caption, images, script, timed metadata, program code and private data. The *meta* box mainly consists of the *iloc*, *iinf*, *ipro*, *xml* boxes and etc. The *iloc* and *iinf* boxes contain the *item\_ID*, *length* and *offset* for locating to an item and information such as *item\_ID*, *item\_protection*, *item\_name*, *content\_type* and *content\_encoding*. The *xml* box can support the untimed text or binary data such as MPEG-21 DID, IPMP, and TV Anytime. MPEG-21 DID can support the description for items.

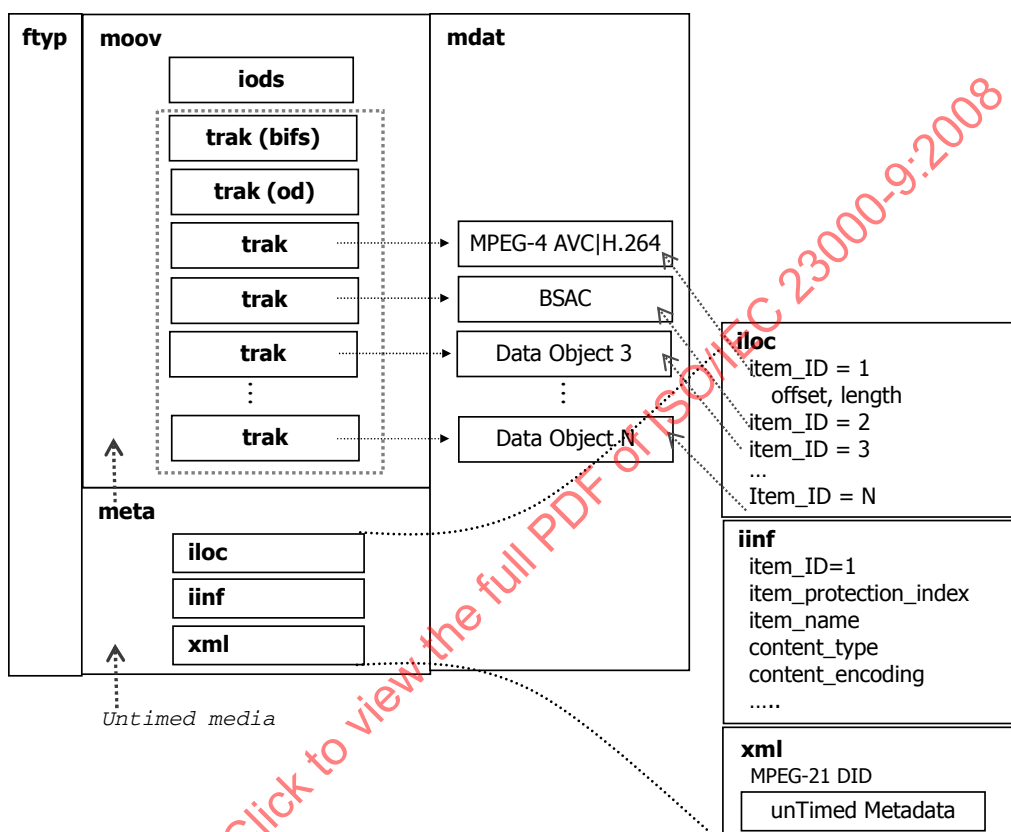


Figure 10 — A single type file structure with *meta* box

The *iloc* and *iinf* boxes describe the location and information of each item in the *mdat* box. However, the structure for items in the *iloc* and *iinf* boxes is flat and has limitation to describe the items in detail. In order to support the flexibility of the file format, MPEG-21 DID can be used to describe the location and information of the items as shown in Figure 10. The MPEG-21 DID metadata can be contained in the *xml* box and can contain the metadata such as IPMP, REL, and TV anytime metadata, the script and the source code in the hierarchical structure. The example of MPEG-21 DID usages can be shown in Annex A.

### 6.3 File structure for a multiple type file

Figure 11 illustrates the multiple type file structure containing multiple movie presentations with associated data. There are two layers: outer file format which consists of the `ftyp`, `meta` and `mdat` boxes and inner one which consists of `moov`, `meta` and `mdat` boxes. The directory and information of the items in the outer and inner file format can be described by the `iloc` and `iinf` boxes and/or MPEG-21 DID metadata in the `meta` box. In the multiple DMB-AF contents, `item_IDs` in the outer and inner `iloc` box are called the global item id and local item id, respectively. The global item id shall indicate the hidden `moov` box and the local item id shall indicate the items in each hidden `moov` box. MPEG-21 DID in the outer `xml` box contains hierarchical item structures of all hidden `moov` boxes.

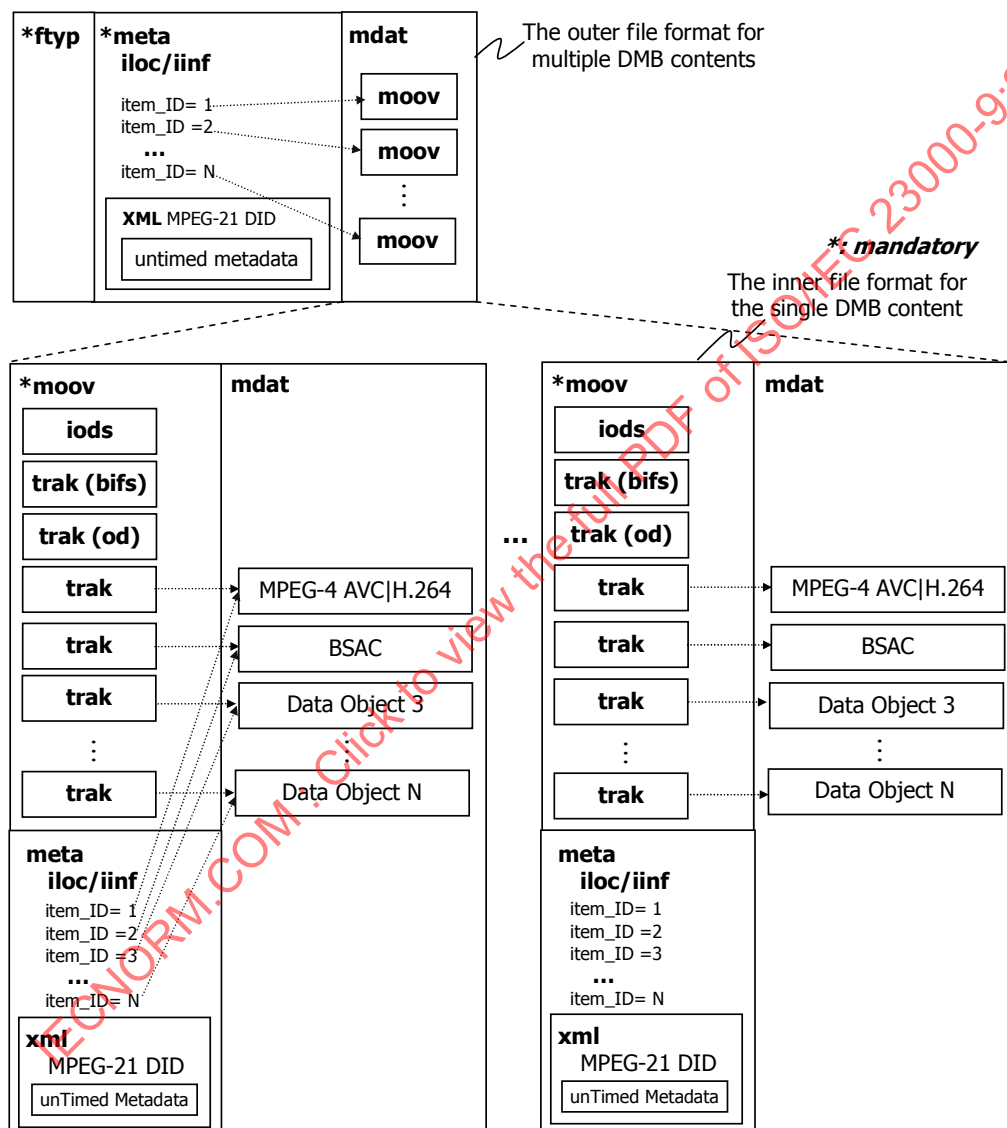


Figure 11 — Multiple type file structure

## 6.4 Protected file structure

### 6.4.1 Signaling protection

In order to signal content protection, sample description of the `trak` box and IPMP DIDL of the `meta` box can be utilized. To indicate whether the resource in the track is protected, sample description of the `trak` box is utilized as in 6.4.1.1, and to indicate the protection mechanism including IPMP tools and Right information, the IPMP information carried in `meta` box is utilized as in 6.4.1.2.

#### 6.4.1.1 Protection indication using sample entry code of the `trak` box

Through the sample description of the `trak` box, DMB Player can notice that the specified resource is protected. The four-character-code of the sample entry is replaced with a four-character-code indicating protection encapsulation: these codes vary only by media-type. For example, 'avc1' video, 'mp4a' audio, 'm2ts' system, and 'tx3g' timed text are replaced with 'encv', 'enca', 'encs', and 'enct', respectively. The entry codes for protected stream are as following:

| Stream (Media) Type | Sample-Entry Code |
|---------------------|-------------------|
| Video               | encv              |
| Audio               | enca              |
| Text                | enct              |
| System              | encs              |

#### 6.4.1.2 Protection signaling using MPEG-21 IPMP Information

Through the IPMP information carried in `meta` box, the protection of the resource can be signaled. The following example is an example of the protected DID expression which can be expressed in the xml box of `meta` box. Using MPEG-21 IPMP DIDL expression, a Digital Item related to a resource track can be noticed as a protected into DMB-AF player.

```
<Item>
<Component>
  <Resource mimeType="application/mp21-ipmp">
    <ipmpdidl:item>
      <ipmpdidl:Identifier>...</ipmpdidl:Identifier>
      <ipmpdidl:Info>
        <ipmpinfo:IPMPInfoDescriptor> ... </ipmpinfo:IPMPInfoDescriptor>
      </ipmpdidl:Info>
      <ipmpdidl:Contents> ref="#mp(/byte(2048, 150000))"/>
    </ipmpdidl:item>
  </Resource>
</Component>
</Item>
```

### 6.4.2 Protection for a Single Type File

Figure 12 shows the single type file structure with the IPMP metadata.

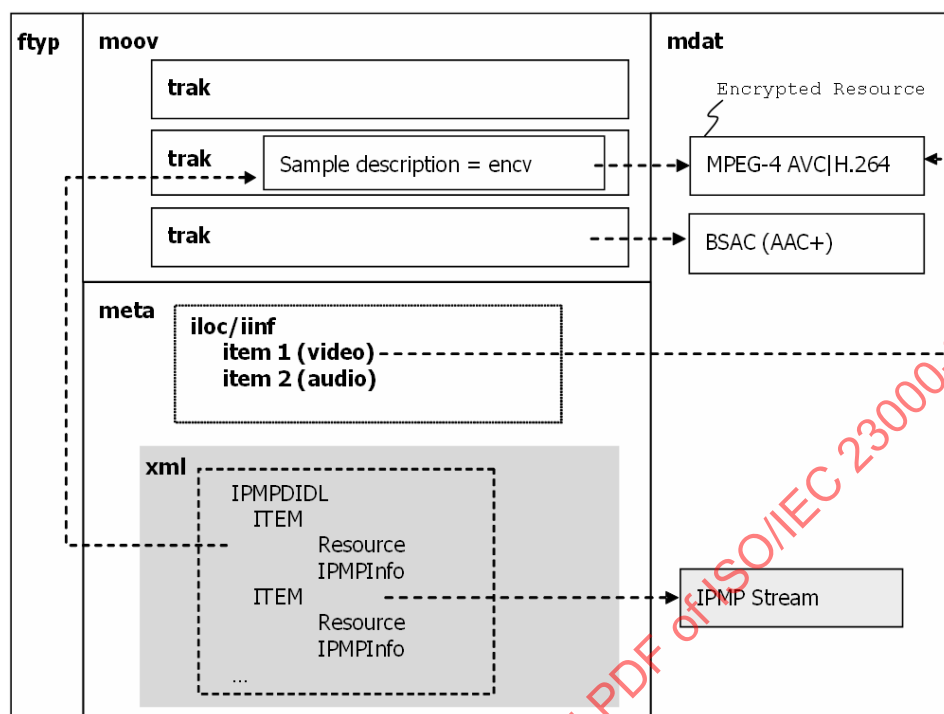


Figure 12 — Single type file structure with IPMP

For signaling to protect a video item, the sample description in the `trak` box can be used. The IPMP information is included in the `xml` box using MPEG-21 IPMP information scheme. The example of MPEG-21 IPMP usage will be shown in Annex A.

### 6.4.3 Protection for a Multiple File Type

Figure 13 shows the multiple type file structure with the IPMP metadata. Based on file structure for multiple type file structure in 6.3, the signaling and governance information is contained in `xml` box within `meta` box.

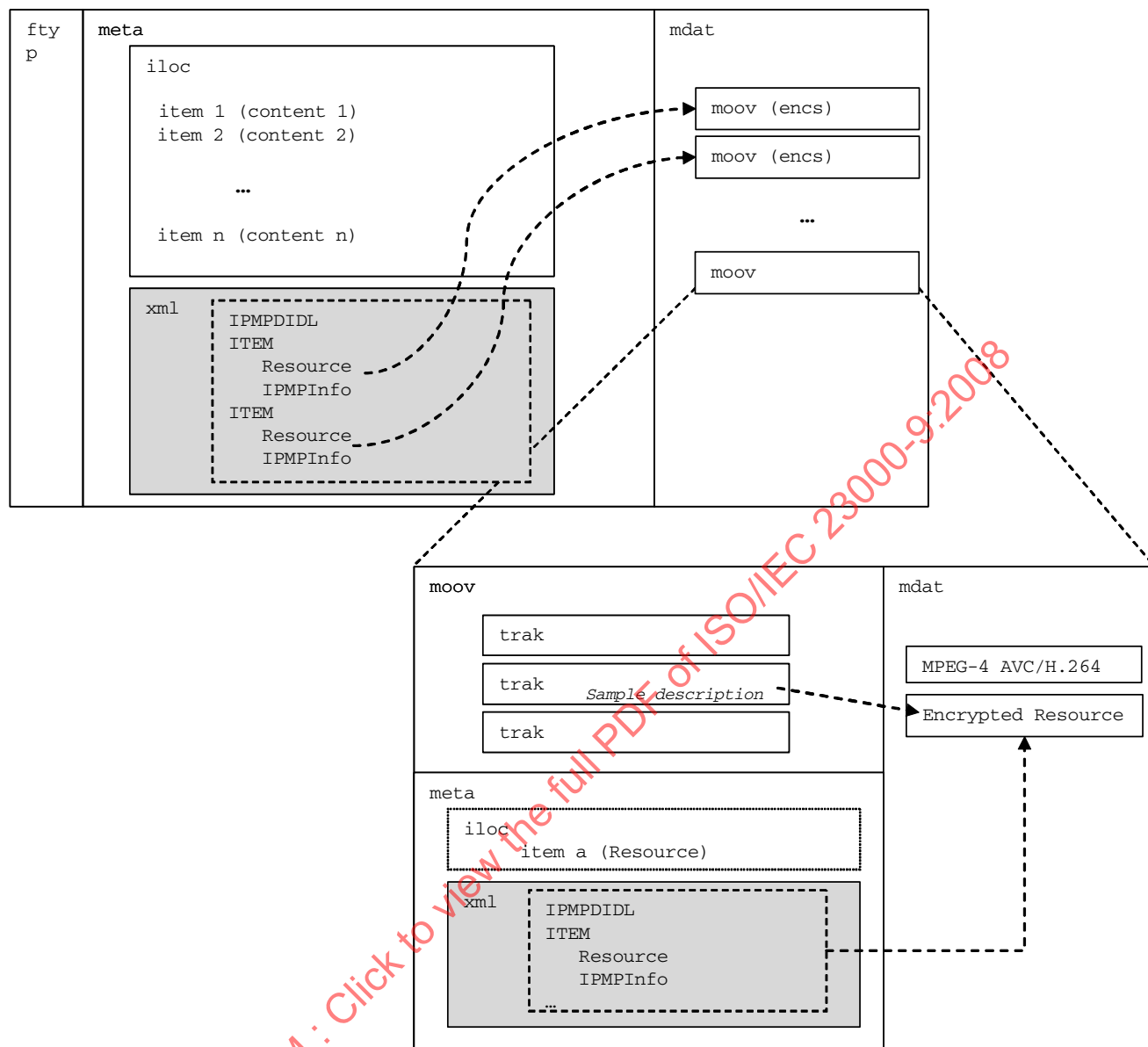


Figure 13 — Multiple type file structure with IPMP

## 6.5 Storage and playback of transport stream

### 6.5.1 Introduction

Since DMB video service contents are delivered in MPEG-2 TS (Transport Stream) format, it is required that the TS should be translated into ESs (Elementary Streams) for being stored in a DMB-AF file. However, most of the DMB receivers are hand held devices and not enough system resources may be available to translate MPEG-2 TS into ESs. For DMB receivers to easily adapt to DMB-AF and to exploit the benefits of DMB-AF, a simple storage and playback method of MPEG-2 TS is defined here.

The design principle is as follows;

- DMB-AF shall be able to store MPEG-2 TS in its natural form, i.e., untouched.
- DMB-AF should be able to support random access and trick mode play on the stored MPEG-2 TS in some degree.
- If possible, no new box should be added on ISO base media file format for above functionalities. It is to make no change in ISO base media file format specification itself.

### 6.5.2 File structure and track type definition

An MPEG-2 TS is stored sequentially (i.e., untouched) as a sample data. A sample can be the whole TS to be stored or a segment of it. All the sample boundaries shall coincide with the TS packet boundaries.

A handler type of 'hint' (hint track) is used for local playback of the stored TS and the matching media information header shall be 'hmhd' (hint media header). The maxPDUsSize and avgPDUsSize fields in the 'hmhd' of the TS hint track shall all be equal to 188 (the TS packet size) in this case.

Normally, hint tracks are used to guide streaming servers to stream the stored media for transport protocols such as RTP and FLUTE. But here, a hint track is used for local playback or preview of already multiplexed transport streams and thus it provides a 'playback hint' for a stored transport stream rather than a 'streaming hint' for an external transport protocol. When the hint track is used for local playback in DMB-AF, the track header flags need not be 0. In addition, the playback hint track may not refer to other media tracks.

### 6.5.3 Sample description

An MPEG-2 TS sample entry is defined as follows. The protocol field for this sample entry shall be 'm2ts' in this case.

#### Syntax

```
// MPEG-2 TS Sample Entry
class M2TSSampleEntry() extends HintSampleEntry ('m2ts') {
    unsigned int(64) transporttime_offset;
    unsigned int(64) record_time;
    unsigned int(16) reserved = 0;
    unsigned int(8) sample_type;    // one-sample TS or not
    unsigned int(8) pmt_type;       // not stored or inlined
    unsigned int(8) od_type;        // not stored or inlined
    if (pmt_type == 1) {            // inline
        unsigned int(16) pmt_size;  // size of PMT in bytes
        byte[pmt_size] pmt_data;   // actual PMT section data
    }
    if (od_type == 1) {             // inline
        unsigned int(16) od_size;   // size of the OD Stream in bytes
        byte[od_size] od_data;     // actual OD Stream data (ES)
    }
}
```

#### Semantics

`transporttime_offset` is an integer that specifies time offset (in the timescale indicated in the 'mdhd' box) between the transport timing and media playback timing for the stored TS. It shall be specified and shall take the PCR value corresponding to the firstly stored TS packet for this sample entry. The value 0 means 'unspecified'.

`record_time` is an integer that specifies the time of recording (in seconds since midnight, Jan. 1, 1904, in UTC time) The value 0 means 'unspecified'.

`sample_type` specifies the way how a sample maps to TS packets. It shall take the value 0 or 1:

0: the whole TS is treated as one sample. Both `pmt_type` and `od_type` shall take the value 0 for this sample type.

1: each sample corresponds to a sequence of TS packets that belong to a GOP (group of pictures). The `pmt_type` shall take the value 1 for this sample type. If the TS to be stored is from T-DMB, `od_type` shall also take the value 1.

`pmt_type` specifies how the PMT is stored in this sample entry. It shall take the value 0 or 1:

- 0: the PMT data is not stored.
- 1: the PMT data is stored in this sample entry.

`pmt_size` gives the size (in bytes) of the PMT data stored in this sample entry.

`pmt_data` is the actual PMT data.

`od_type` specifies how the OD data is stored in this sample entry. It shall take the value 0 or 1:

- 0: the OD data is not stored.
- 1: the OD data is stored in this sample entry.

`od_size` gives the size (in bytes) of the OD data stored in this sample entry.

`od_data` is the actual OD data.

Another `M2TSSampleEntry` shall be instantiated if at least one of the following happens;

- the version number of the PMT changes (i.e., another PMT)
- the version number of ISO/IEC 14496 section containing OD stream changes (i.e., another OD)
- the actual OD data is changed
- a discontinuity in the system time-base happens (Note that when a system time-base discontinuity happens, `transporttime_offset` shall also be changed.)

In case `sample_type` equals to 1, a sample corresponds to TS packets having random accessible group of video or audio frames. More specifically, following rules apply;

If video exist in the TS to be stored, then TS packets corresponding to a GOP (Group of Pictures) are defined as a sample. The `random_access_indicator` inside the `adaptation_field()` of TS packet is used to identify the starting TS packet corresponding to a GOP; that is, a sample starts from a TS packets having `random_access_indicator=1` and ends just before the firstly encountered another TS packet having `random_access_indicator=1`. In users' perspective, random accessibility to each GOP will be enough in most cases since GOP intervals (i.e., IDR picture transmission intervals) do not exceed two seconds in T-DMB and S-DMB.

If video does not exist in the TS to be stored, then TS packets corresponding to an audio frame are defined as a sample.

Note that 'stss' (sync sample table) box is not used for TS hint tracks since all the samples are random-accessible regardless of the value of `sample_type`.

To randomly access and playback an 'm2ts' sample, the PMT (Program Map Table) and OD (Object Descriptor) associated with the TS packets in the sample is needed. The PMT data is accessed by consulting to the corresponding `M2TSSampleEntry` of 'stsd' box.

To randomly access and playback an 'm2ts' sample, the PCR (Program Clock Reference) value corresponding to the first TS packet in the sample is needed to initialize the STC (System Time Clock) of the player. The PCR value for each sample is stored in the 'stts' box, with the value of `transporttime_offset` in the corresponding `M2TSSampleEntry` is subtracted from the original PCR value. Accordingly, the time scale field in 'mdhd' shall take the value equal to the time scale of PCR, making sample times in 'stts' box expressed in this time scale. Note that for this TS hint track, 'stts' maps transport times (with an offset) to sample numbers rather than media decoding times to sample numbers. It is much like the DMB receivers turns on and randomly access to the TS on air.

#### 6.5.4 Remark on chunk definition

In case `sample_type` equals to 0, a chunk shall be equal to a sample, i.e., the TS itself. In this case, the `sample_delta` in 'stts' box for this sample gives the duration of the stored TS unless `sample_delta` equals to 0, which means "unspecified".

In case `sample_type` equals to 1, no constraints are imposed on the chunk definition. One guideline is that it is more efficient to make the number of samples in chunks the same since the size of 'stsc' box can be minimized in this way.

#### 6.5.5 Usage guidelines for random access

Use case 1 (Simplest): `sample_type=0`

In this case, `pmt_type=od_type=0`, and random access to the stream can be achieved as follows:

- First, estimate the TS packet position corresponding to the wanted time point  $T$  (in second) using the following formula:  $estimated\_position = chunk\_offset + avgbitrate \cdot T / 8$ .
- Then, around the *estimated\_position*, search and parse PMT, OD, and random access point of video (or audio if video does not exist). Not that this method needs searching overhead and may result in relatively larger time error between the wanted time point and the actually accessed time point (compared with the following method).

Use case 2: `sample_type=1`

In this case, the `pmt_type=1` and random access to the samples can be achieved as follows:

- First, find out the sample number corresponding to the wanted time point  $T$  by using 'stts' box. (In this case, time scale conversion between  $T$  and the PCR time scale shall be done.)
- Then, follow the normal procedure for accessing the wanted sample (i.e., using the 'stsc', 'stsz/stz2', and 'stco/co64' boxes according to ISO/IEC 14496-12).
- The required PMT can be accessed from `pmt_data` of the sample entry for the wanted sample.
- If `od_type=1`, the required OD can be accessed from `od_data` of the sample entry for the wanted sample.

### 6.6 Storage and playback of 3GPP time text

#### 6.6.1 Introduction

For using the timed text with DMB contents, DMB-AF adopts 3GPP Timed Text format (3GPP TS 26.245). The timed text is stored in 'mdat' box and treated as a track. By using the usual boxes in the sample table box, such as 'stts', 'stsc', 'stsz', and 'stco', the text samples can be synchronized with other timed media.

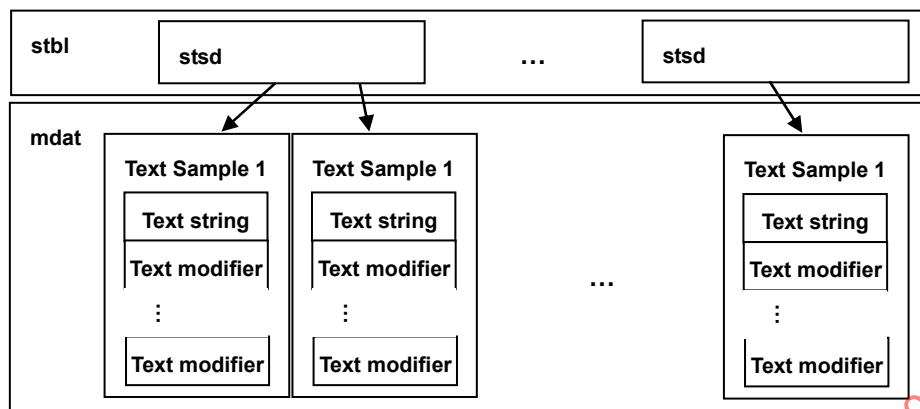


Figure 14 — Storage of timed text in DMB-AF file

### 6.6.2 Sample description

The sample description box ('*stsd*') contains sample descriptions for the text track. TextSampleEntry in 3GPP Timed Text format, which extends SampleEntry with format name of '*tx3g*', is used to describe the information on the format of the timed text to be rendered. The '*tx3g*' sample entry firstly specifies the manner of the text rendering (still, marquee, or scrolled), the horizontal and vertical justification of the sample, and the background color of the sample in RGB color space as well as the alpha (transparency) value. Then it also specifies the style of the text such as the inset of the text within the region of the text, the font color, font style, and font size.

### 6.6.3 Sample format

3GPP Timed Text Format also specifies the manner of storing the text sample inside the media data container box ('*mdat*'). Each sample is composed of a string of text and followed by optional sample modifier box. Text string consists of a list of characters of the text. Text modifiers describe how the text should be rendered using different style than that specified by the sample descriptions. Since the size and location (offset) of the sample is described in the sample size box in the sample table box, the text sample do not need null termination character to signal the end of the sample.

The sample modifier boxes can be recognized by comparing the string length and the sample size. These modifier boxes, if exist, override the style described in sample description. It is possible to combine the sample modifier boxes to compose various rendering style, but two modifier boxes of the same type shall not be applied to the same character in the text sample. The examples of sample modifier boxes include Text StyleBox '*styl*', TextHighlightBox '*hlit*', TextKaraokeBox '*krok*', TextHyperTextBox '*href*', BlinkBox '*blnk*', etc.

### 6.6.4 Usage example

Table 4 shows the use case of using three timed text samples. The first two samples belong to the same sample entry, while the last one is described in the other sample entry. Each text sample is rendered using different rendering mode. The first text sample is rendered in marquee mode, is highlighted with bluish color. The second sample also rendered in marquee mode and is blinking at certain position. The third sample is rendered in still mode and is rendered as hypertext link to certain URL.

Table 4 — Timed text usage example

| sample number | Sync. Time and Offsets (stts, stsz, stco)                               | Sample descriptions (tx3g sample entry)                                                                            | Text sample (mdat)                            |                                                                                                                  |
|---------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|               |                                                                         |                                                                                                                    | Text string                                   | Text modifiers                                                                                                   |
| 1             | stts : Sample delta: 600<br>stsz: Size: 16<br>stco: Chunk offset: 18234 | Rendering: marquee left to right<br>Text style: Arial, 10, bold<br>Text color: red: 0, green: 0, blue: 0, alpha: 0 | "This is a sample"                            | Highlight: from character no. 1 to character no.16<br>Highlight color: red: 64, green: 64, blue: 192, alpha: 128 |
| 2             | stts: Sample delta: 600<br>stsz: Size: 27<br>stco: Chunk offset: 18322  | Rendering: still<br>Text style: Serif, 12<br>Text color: red: 10, green: 10, blue: 10, alpha: 0                    | "This is also a sample"                       | Blink: from character no. 18 to character no. 27                                                                 |
| 3             | stts: Sample delta: 1800<br>stsz: Size: 43<br>stco: Chunk offset: 18361 | Rendering: still<br>Text style: Serif, 12<br>Text color: red: 10, green: 10, blue: 200, alpha: 0                   | "The quick brown fox jumps over the lazy dog" | Href: from character no. 1 to character no. 43<br>URLLength: 20<br>URL: http://www.abcd.com                      |

## 6.7 Relating content ID with item or track

### 6.7.1 Introduction

TV-Anytime standard uses CRID to uniquely identify content independently of its physical location. DMB-AF also adopts the CRID mechanism to author, manage, and provide the content description information independently of the physical location of the associated content. When content resources and the descriptive metadata are stored in the same DMB-AF file, a mechanism to relate the description and the described content inside the file is needed.

In DMB-AF, a kind of mapping table between the CRIDs inside the enclosing xml document and the associated content resources inside the file are stored in 'crid' box. Figure 15 illustrates a content referencing example for DMB-AF.

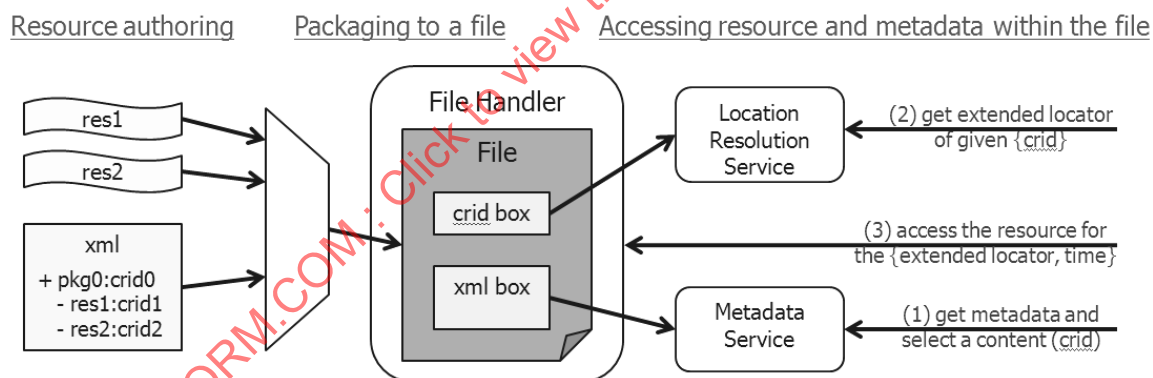


Figure 15 — Content referencing example

### 6.7.2 CRID box

The following is the definition of 'crid' box, which contains mapping information between CRIDs in TVA xml document and the associated 'item\_ID's or 'track\_ID's.

**Box Type:** 'crid'

**Container:** 'meta' box

**Mandatory:** Yes if TV-Anytime metadata is stored in the 'xml' or 'bxml' box

**Quantity:** Exactly one

**Syntax**

```

aligned(8) class CridBox extends Box ('uuid', 'crid') {
    int i;
    unsigned int(16) item_count;
    unsigned int(16) track_count;
    for (i=0; i<item_count; i++) {
        unsigned int(16) item_ID;        // item_ID associated with the CRID
        unsigned int(16) str_len;        // byte length of the CRID string
        byte[str_len] CRID_string;      // CRID string
    }
    for (i=0; i<track_count; i++) {
        unsigned int(32) track_ID;       // track_ID associated with the CRID
        unsigned int(16) str_len;        // byte length of the CRID string
        byte[str_len] CRID_string;      // CRID string
    }
}

```

**Semantics**

`item_count` specifies the number of {CRID : `item_ID`} pairs to be stored.

`track_count` specifies the number of {CRID : `track_ID`} pairs to be stored.

`str_len` specifies the byte length of the CRID string.

`CRID_string` is the actual CRID string to be stored.

`item_ID` is the value of `item_ID` associated to the paired CRID string.

`track_ID` is the value of `track_ID` associated to the paired CRID string.

**6.7.3 Benefits and usage examples**

The followings are some of the benefits in using the 'crid' box;

TVA metadata authoring and file packaging can be separately handled.

Physical location and associated item or track can be independently updated without updating the xml.

If used with the MPEG-21 Fragment Identification schemes [16], the mechanism completes the TV-Anytime content referencing model by specifying how to reference the resources inside ISO media files.

**Usage example 1**

If a user requests to see some descriptive information about the media being played in a DMB-AF player, the player firstly searches the 'crid' box for the CRID associated to the media track (or item). Then the player finds in the TVA metadata and displays the descriptions related to the CRID.

**Usage example 2**

Using the TVA metadata inside a DMB-AF file, the player presents the content descriptions for the included contents to a user. The user browses the metadata on the player's GUI and selects a content that he or she wants to consume. Then the player searches the 'crid' box for the `item_ID` (or `track_ID`) associated to the CRID of the selected content.

## 7 Brands identification

### 7.1 Introduction

In general, a brand identifies a specification or a conformance point in a specification; its presence in a file indicates both:

- that the file conforms to the specification; it includes everything required by, and nothing contrary to the specification (though there may be other material);
- that a player implementing that specification is given permission to read and interpret the file.

These brands are set in the File Type Box (`ftyp` box). In the File Type Box, two kinds of brands can be indicated. One is the `major_brand` that identifies the specification of the best use for the file. Second is the `compatible_brands`, which can identify multiple specifications to which the file complies. If more than one brand is present in the list of the `compatible_brands`, and one or more brands are supported by the player, the player shall play those aspects of the file that comply with those specifications. In this case, the player may not be able to decode unsupported media.

Since DMB-AF files can be used for various purposes, multiple brands are defined in this specification to label DMB-AF files. For instance, T-DMB in Korea uses ER-BSAC for audio coding while T-DMB in Germany uses HE-AAC v2 and S-DMB in Korea uses AAC+SBR.

The following subsections describe the defined brand identifiers for this specification according to application domains.

For the following subsections, the following legend applies;

- R (required): the component data shall exist in the file
- O (optional): the component data may or may not exist in the file
- A brand-conforming player shall support all the components marked as 'R' as well as 'O'.

### 7.2 Audio applications

Table 5 defines brands for audio applications and the corresponding components thereof. Example services of audio brands include but not limited to: audio album with title image (JPG) and lyrics (DLS), audio with slide show (MOT-SLIDE) [22], and audio with Karaoke (3GPP-TT).

Brands starting with 'da0' or 'da2' are basically for supporting DAB audio service contents such as MP2 audio and PAD (MOT-SLIDE and DLS). MOT-SLIDE provides the user with a sequence of slides which carry information in the form of images. If exists, each slide appears on the display of player in synchronization with the associated audio. DLS provides the users with audio related text; the dynamic label may comprise up to 8 segments, each consisting of up to 16 characters and appears on the display of player in synchronization with the associated audio.

Brands starting with 'da1' and 'da3' are basically for supporting audio elementary stream of T-DMB (Korea) and S-DMB (Korea), respectively.

Brands ending with 'b' are basically for supporting content description (TVA) and protection (REL and IPMP).

Note that MP2 and HE-AAC2 audio and the associated MOT-SLIDE and DLS components shall be stored in accordance with DAB audio frame structure (ETSI EN 300 401 and ETSI TS 102 563) for the audio brands.

**Table 5 — Brands for audio applications**

| Compo-<br>nents<br>Brands | Audio |             |             |             | Associated Data |               |     |                     |             | Associated Metadata |     |     |      |
|---------------------------|-------|-------------|-------------|-------------|-----------------|---------------|-----|---------------------|-------------|---------------------|-----|-----|------|
|                           | MP2   | ER-<br>BSAC | HE-<br>AAC2 | AAC+S<br>BR | BIFS            | MOT-<br>SLIDE | DLS | JPG<br>/PNG<br>/MNG | 3GPP-<br>TT | DID                 | TVA | REL | IPMP |
| 'da0a'                    | R     | -           | -           | -           | -               | O             | O   | O                   | -           | -                   | -   | -   | -    |
| 'da0b'                    | R     | -           | -           | -           | -               | O             | O   | O                   | O           | O                   | O   | O   | O    |
| 'da1a'                    | -     | R           | -           | -           | -               | -             | -   | O                   | -           | -                   | -   | -   | -    |
| 'da1b'                    | -     | R           | -           | -           | -               | -             | -   | O                   | O           | O                   | O   | O   | O    |
| 'da2a'                    | -     | -           | R           | -           | -               | O             | O   | O                   | -           | -                   | -   | -   | -    |
| 'da2b'                    | -     | -           | R           | -           | -               | O             | O   | O                   | O           | O                   | O   | O   | O    |
| 'da3a'                    | -     | -           | -           | R           | -               | -             | -   | O                   | -           | -                   | -   | -   | -    |
| 'da3b'                    | -     | -           | -           | R           | O               | -             | -   | O                   | O           | O                   | O   | O   | O    |

### 7.3 Video applications

Table 6 defines brands for video applications and the corresponding components thereof. Example services of video brands include but not limited to: Visual Radio (audio with INTRA-only AVC), audio-visual program with interactivity (BIFS), and audio-visual program with closed-caption (JPG or 3GPP-TT).

Brands starting with 'dv1' and 'dv3' are basically for supporting video service components of T-DMB (Korea) and S-DMB (Korea), respectively. Brands starting with 'dv2' are basically for supporting video service components of T-DMB (Europe).

Brands ending with 'b' are basically for supporting content description (TVA) and protection (REL and IPMP) as is in the audio brands.

Note that unless multiplexed into TS, the Visual and Audio components data are stored in elementary stream form for the video brands.

**Table 6 — Brands for video applications**

| Compo-<br>nents<br>Brands | Visual | Associated Audio |             |             | Associated Data |                     |             | TS           | Associated Metadata |     |     |      |
|---------------------------|--------|------------------|-------------|-------------|-----------------|---------------------|-------------|--------------|---------------------|-----|-----|------|
|                           | AVC    | ER-<br>BSAC      | HE-<br>AAC2 | AAC+S<br>BR | BIFS            | JPG<br>/PNG<br>/MNG | 3GPP-<br>TT | MP4on<br>MP2 | DID                 | TVA | REL | IPMP |
| 'dv1a'                    | R      | R                | -           | -           | O               | O                   | -           | O*           | -                   | -   | -   | -    |
| 'dv1b'                    | R      | R                | -           | -           | O               | O                   | O           | O*           | O                   | O   | O   | O    |
| 'dv2a'                    | R      | -                | R           | -           | O               | O                   | -           | O*           | -                   | -   | -   | -    |
| 'dv2b'                    | R      | -                | R           | -           | O               | O                   | O           | O*           | O                   | O   | O   | O    |
| 'dv3a'                    | R      | -                | -           | R           | O               | O                   | -           | O*           | -                   | -   | -   | -    |
| 'dv3b'                    | R      | -                | -           | R           | O               | O                   | O           | O*           | O                   | O   | O   | O    |

[Remark] The component marked as 'O\*' may or may not be supported by the brand-conforming players according to the following rule; if the player is DMB receivable, it shall support the component, and otherwise, the player may not support the component.

Note that the TS (Transport Stream) can contain all the audio, visual, and data components except 3GPP-TT inside it as a multiplexed form. If TS having audio and visual components exists in a DMB-AF file, the extra audio and visual components are not necessarily required to be exist in the same file.

### 7.4 All-in-one applications

Table 7 defines an all-in-one brand which supports all the components of this specification.

**Table 7 — Brands for all-in-one applications**

| Brands | Components                                                                                                                                                                                   |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'dmb1' | This brand support all the components listed in Table 1 except Transport stream components. For the Transport stream components, the same rule described in the 'Remark' of Table 6 applies. |

## Annex A (informative)

### MPEG-21 DID and TV-Anytime Usage Examples

#### A.1 MPEG-21 DID Description

As described in 6.4.2, this is an example of the MPEG-21 DID description which contains the element information and the location of the resources in a DMB-AF file, IPMP information and their metadata of each or whole resource.

##### Case 1: DIDL expression for a DMB-AF Content

The following example is a DIDL expression for a clear DMB-AF content with a video and audio stream. The video and audio resources refer to the position of the file structure, and the content description can be inserted within Descriptor in Digital item.

```
<?xml version="1.0" encoding="UTF-8"?>
<DIDL xmlns="urn:mpeg:mpeg21:2006:07-DIDL-NS" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS">
<Container>
  <Item id="dmb_sample">
    <Descriptor>
      <Statement mimeType="text/plain">
        <dii:Identifier>1234</dii:Identifier>
      </Statement>
    </Descriptor>
    <Descriptor>
      <Statement mimeType="text/xml">
        <!-- DMB contents description -->
      </Statement>
    </Descriptor>
    <Component id="video01">
      <Resource mimeType="video/avc" ref="#mp(/byte(2048, 150000))"/>
    </Component>
    <Component id="audio01">
      <Resource mimeType="audio/bsac" ref="#mp(/byte(150000, 180000))"/>
    </Component>
  </Item>
</Container>
</DIDL>
```

Remark: For the 'mp()' pointer scheme inside the above xml sample, refer to MPEG-21 Fragment Identification [16].

**Case 2:** DIDL expression for a DMB-AF Content with protection for video stream

The following example is a modified DIDL expression with protection for the Case 1 example. In this example, the video stream is protected using IPMP Tool specified by IPMPInfoDescriptor, and its usage rule can be expressed in license within RightsDescriptor. It shows how to signal that a resource is governed and which IPMP Tool is required in order to access. It also shows how to express IPMP Tool information and its update information

```
<?xml version="1.0" encoding="UTF-8"?>
<DIDL xmlns="urn:mpeg:mpeg21:2006:07-DIDL-NS" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS"
xmlns:ipmpdidl="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-
IPMPINFO-NS" xmlns:ipmpinfo-msx="urn:mpeg:mpeg21:2006:07-IPMPINFOMSX-NS"
xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS" xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
xmlns:dsig="http://www.w3.org/2000/09/xmldsig#" :schemaLocation="urn:mpeg:mpeg21:2002:02-DIDL-NS
didl.xsd">
<Container>
<item id="dmb_sample">
  <Descriptor>
    <Statement mimeType="text/xml">
      <!-- DMB contents description -->
    </Statement>
  </Descriptor>
  <Component id="video01">
    <Resource mimeType="application/mp21-ipmp">
      <ipmpdidl:ProtectedAsset mimeType="video/avc">
        <ipmpdidl:Identifier>
          urn:mpegRA:mpeg21:dii:isan:006A-15FA-002B-C95F-B
        </ipmpdidl:Identifier>
        <ipmpdidl:Info>
          <ipmpinfo:IPMPInfoDescriptor>
            <ipmpinfo:Tool>
              <ipmpinfo:ToolBaseDescription>
                <ipmpinfo:IPMPToolID>urn:mpeg21:IPMPTool:ToolID:ABCDEF9</ipmpinfo:IPMPToolID>
                <ipmpinfo:Remote ref="...">
              <ipmpinfo:ConfigurationSettings>
                <ipmpinfo:Update>
                  <ipmpinfo:Location ref="...">
                <ipmpinfo:ScheduledUpdateTime periodic="P1D">2005-03-07T00:00:00
                  </ipmpinfo:ScheduledUpdateTime>
                </ipmpinfo:Update>
              </ipmpinfo:ConfigurationSettings>
            </ipmpinfo:ToolBaseDescription>
            <ipmpinfo:InitializationSettings>
              <ipmpinfo:InitializationData>... </ipmpinfo:InitializationData>
            </ipmpinfo:InitializationSettings>
            </ipmpinfo:Tool>
            <ipmpinfo:RightsDescriptor>
              <ipmpinfo:License>
                <r:license> ... </r:license>
              </ipmpinfo:License>
            </ipmpinfo:RightsDescriptor>
          </ipmpinfo:IPMPInfoDescriptor>
        </ipmpdidl:Info>
        <ipmpdidl:Contents ref="#mp(/byte(2048, 150000))"/>
      </ipmpdidl:ProtectedAsset>
    </Resource>
  </Component>
  <Component id="audio01">
    <Resource mimeType="audio/bsac" ref="#mp(/byte(150000, 180000))"/>
  </Component>
</item>
</Container>
</DIDL>
```